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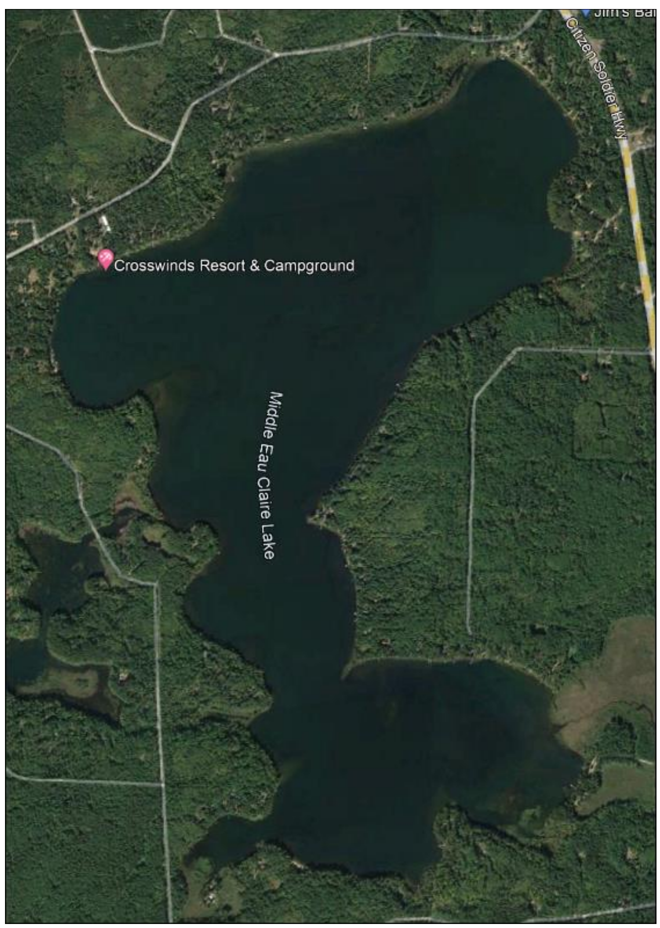
MIDDLE EAUCLAIRE LAKE, BAYFIELD COUNTY

2024-2028 Aquatic Plant Management Plan
WDNR WBIC: 2742100

Prepared by: Dave Blumer, Lake Educator
August 2023



Town of Barnes – Addendum 2

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1.0 Lake Characteristics

Middle Eau Claire Lake (WBIC 2742100) is a 902 acre soft water drainage lake on the Eau Claire Lakes Chain in the southwestern section of Bayfield County. The Eau Claire River runs through the chain from Upper to Middle to Lower Eau Claire Lake. In addition, Bony Lake drains into Middle Eau Claire Lake. The lake has a highly developed shoreline and public access through a boat landing located at the southeast end of the lake (Figure 1).

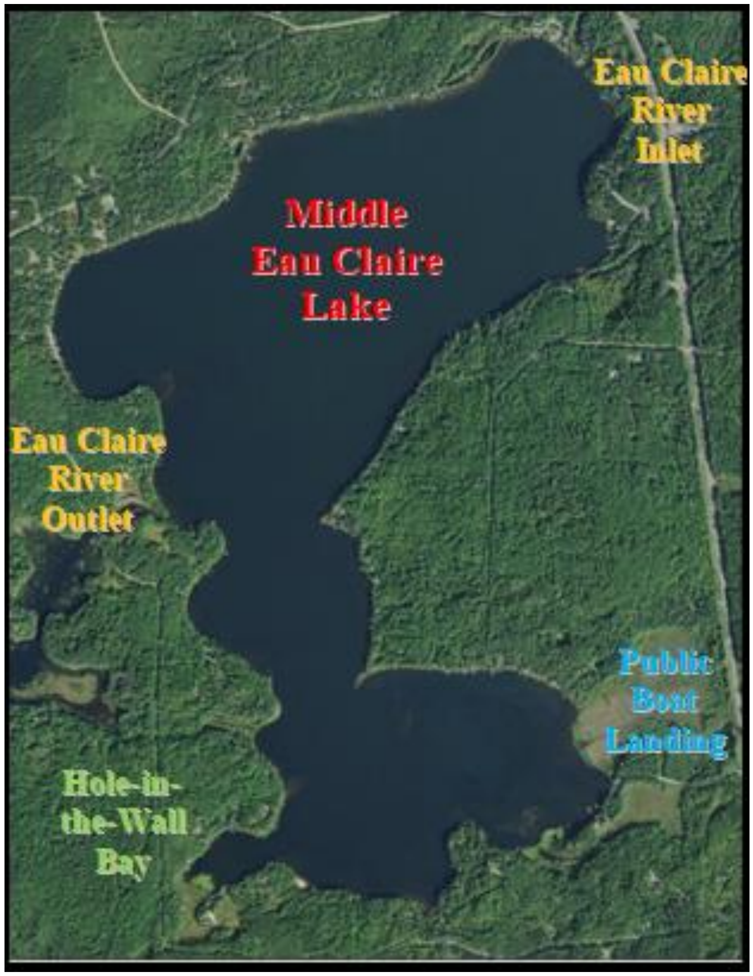


Figure 1: Middle Eau Claire Lake aerial photo and location map

Depth soundings taken at Middle Eau Claire Lake's 791 survey points revealed an extremely varied underwater topography with flats, bars, and sunken islands scattered throughout the lake. While the lake's southern bays tended to sloped gradually to 15ft+, the central neck and northern shorelines tended to drop off sharply into 30ft+ with the deepest areas occurring in the 60ft+ hole on the northeast end (Figure 2).

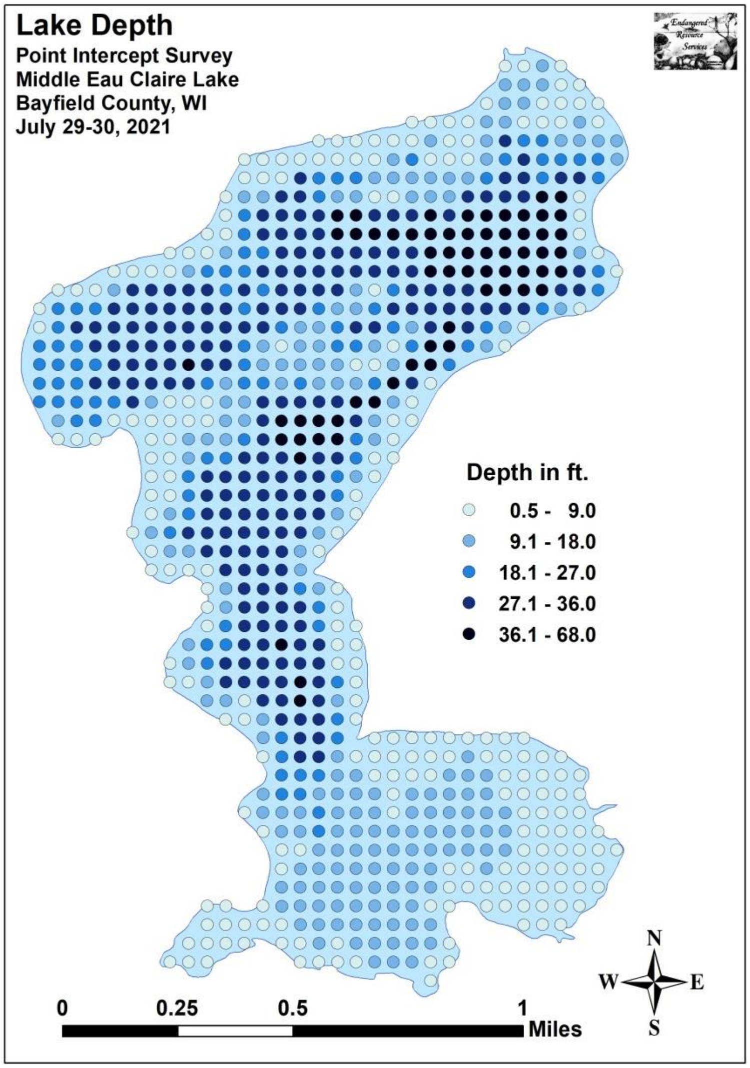


Figure 2: 2021 lake depth

Sand and rock dominated the majority of the nearshore lake bottom as well as around the numerous sunken islands and bars on the northern two-thirds of the lake (Figure 3). Away from the shoreline in the southern third of the lake, the majority of these areas quickly transitioned to a nutrient poor sandy muck with the only organic rich muck occurring in the far northeast bay, the east end of the boat landing bay, and throughout Hole-in-the-Wall Bay. Of the 453 points where the substrate could be determined, it was categorized as 52.3% pure sand, 33.8% as sandy and organic muck, and the remaining 13.9% as rock.

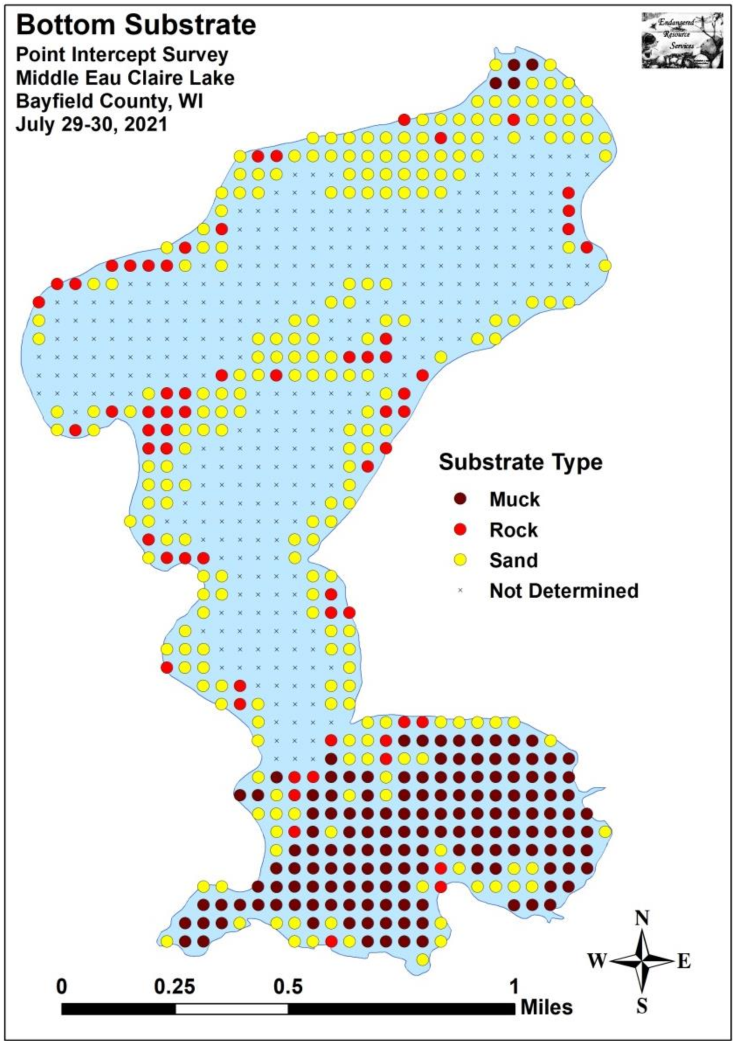


Figure 3: 2021 lake substrate

2.0 Water Quality Data

The natural resources of the Upper, Middle, and Lower Eau Claire Lakes are a defining feature for the Town of Barnes. The Eau Claire Chain is comprised of the Upper Eau Claire, Middle Eau Claire, and Lower Eau Claire Lakes, as well as eight smaller connecting lakes for a total surface area of 3,488 acres of waters. These lakes are the headwaters of the Eau Claire River and are recognized as outstanding resource waters. These clear lakes are connected by streams with the Middle and Lower Lakes connected through a navigable channel controlled by a mechanical small boat lock.

Water quality appears to decline slightly moving downstream in this chain. Upper Eau Claire Lake (UECL) shows signs of oligotrophic characteristics while MECL and Lower Eau Claire Lake (LECL) show signs of increasing levels of fertility. Due to signs of deterioration in water quality, the Upper and Lower Lakes have been regularly monitored since 1986 through the WDNR's long term lake water quality monitoring program. MECL has been monitored by a self-help volunteer program since 1988.

The Citizen Lake Monitoring Network[1] (CLMN) is a water quality monitoring partnership between the WDNR, the Wisconsin Lakes Partnership, and over a 1,000 citizen volunteers statewide. The goals of the CLMN are to collect high quality data, to educate and empower volunteers, and to share this data and knowledge. Volunteers measure water clarity using the Secchi disk, as an indicator of water quality (based on clarity). They also comment on other parameters including lake level, water color, murkiness, and how they perceive the lake on any given monitoring date using a 1 to 5 scale with 1 being "great, fantastic" and 5 being "really bad". Volunteers may also collect chemistry data; collect temperature and dissolved oxygen data; and monitor for the first appearance of aquatic invasive species near boat landings, other access points, or along the shoreline. Volunteers on MECL have been collecting CLMN water quality data since the CLMN program started in 1986. They have not missed any year of Secchi disk data between 1987 and 2022.

2.1 Secchi Readings of Water Clarity

From 1987 to 2022 the average annual Secchi disk reading of water clarity was about 19.4ft. The deepest Secchi disk reading of 48.25ft was taken in early May 2009. The worst or lowest Secchi disk reading of 7.0ft was taken only two years earlier in August 2007. Based on all 413 Secchi disk readings of water clarity included in the WDNR SWIMS database from 1987 to 2022, there is a positive trend of slightly deeper water clarity readings (Figure 4).

[1] For more information about the CLMN go to: https://dnr.wisconsin.gov/topic/lakes/clmn

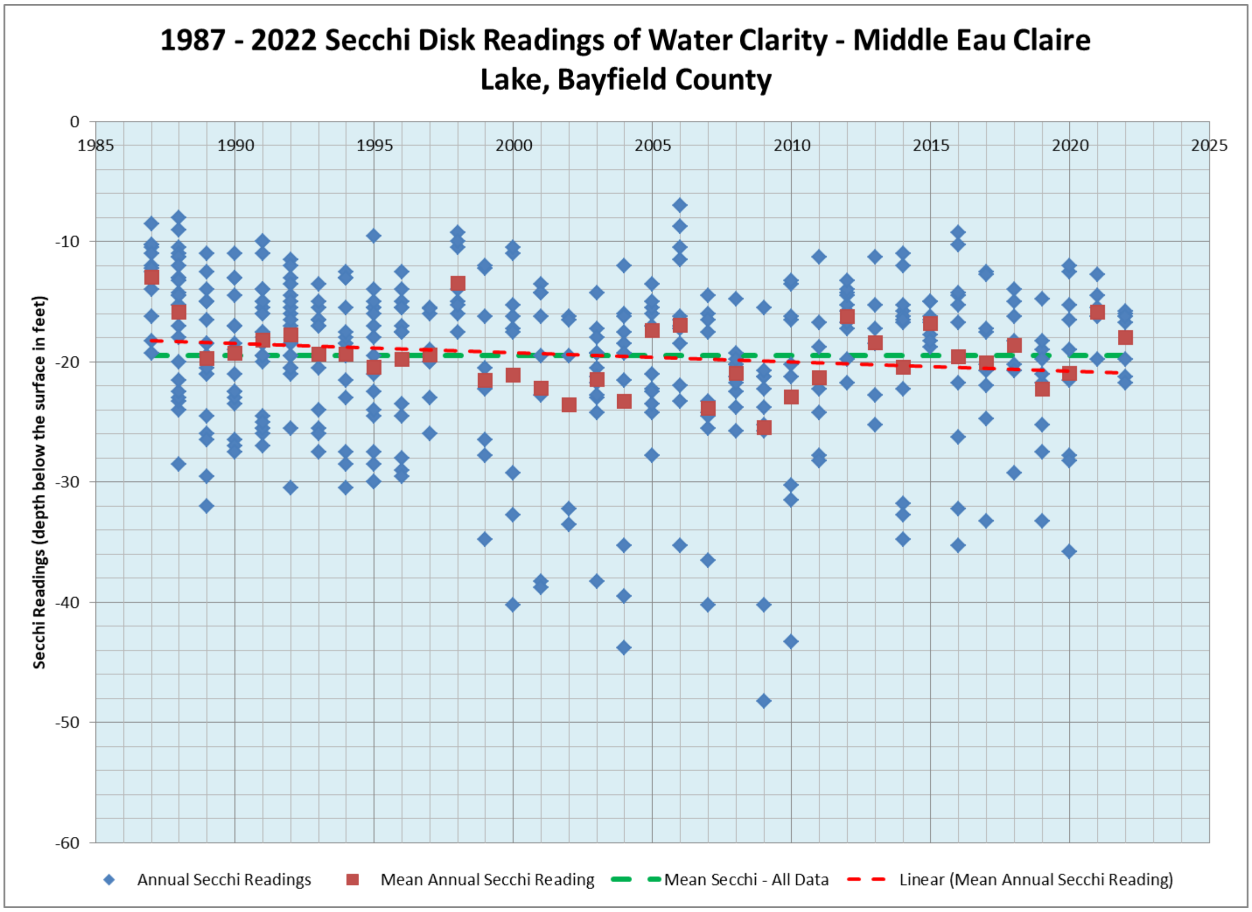


Figure 4: 1987 – 2022 Secchi depth readings, average annual readings, and trend line

Water clarity during the open water season in MECL follows a fairly common pattern. In April, water clarity may be somewhat reduced by ice out and turnover and runoff into the lake during snowmelt. May and June present the best water clarity. Water clarity begins to worsen in July, with August and September being the worst due to warmer water and more available phosphorus supporting the growth of algae. By late October, water clarity begins to improve again as the water cools down again and algae die and sink to the bottom of the lake (Figure 5 - left).

The same pattern is presented with Lower Eau Claire Lake only it is more firmly established. This was not the pattern that presented itself in UECL. In UECL, water clarity is at its worst in the spring and again in the fall likely tied closely to spring and fall turnover, when water temperature is the same from the surface to the bottom of the lake. At this time, water density is also the same causing the entire water column to mix up. From late May through September, the deeper water in UECL keeps water temperatures cooler, the lake stratifies, and there is not as much phosphorus available to growth algae so the result is clear water through most of the summer (Figure 5 – right).

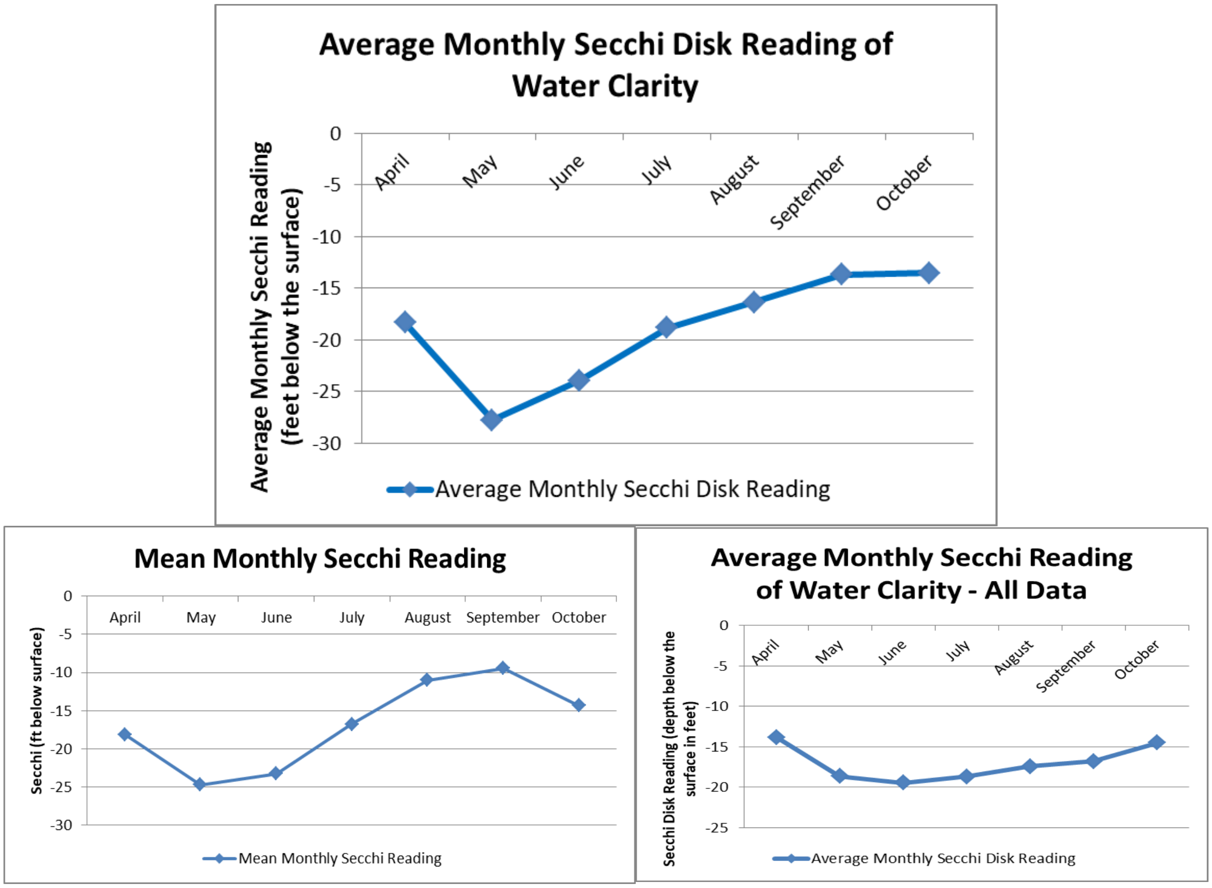


Figure 5: Average monthly Secchi depth readings Middle Eau Claire Lake (top); Lower Eau Claire (left), and Upper Eau Claire Lake (right)

2.2 Water Chemistry – TP and Chla

The "expanded" water quality monitoring level of the CLMN includes volunteers collecting Total Phosphorus (TP) and Chlorophyll-a (Chla) data along with Secchi disk readings of water clarity. TP and Chla have been collected by CLMN volunteers since 2002. CLMN protocol for TP monitoring involves collecting water samples four times during the open water season to determine the amount of phosphorus in the water. Since 2002, three or more surface water samples were collected in each season. Figure 6 reflects the annual summer average of TP in MECL over time. A trend line over the same time period pretty clearly shows a trend toward less phosphorus.

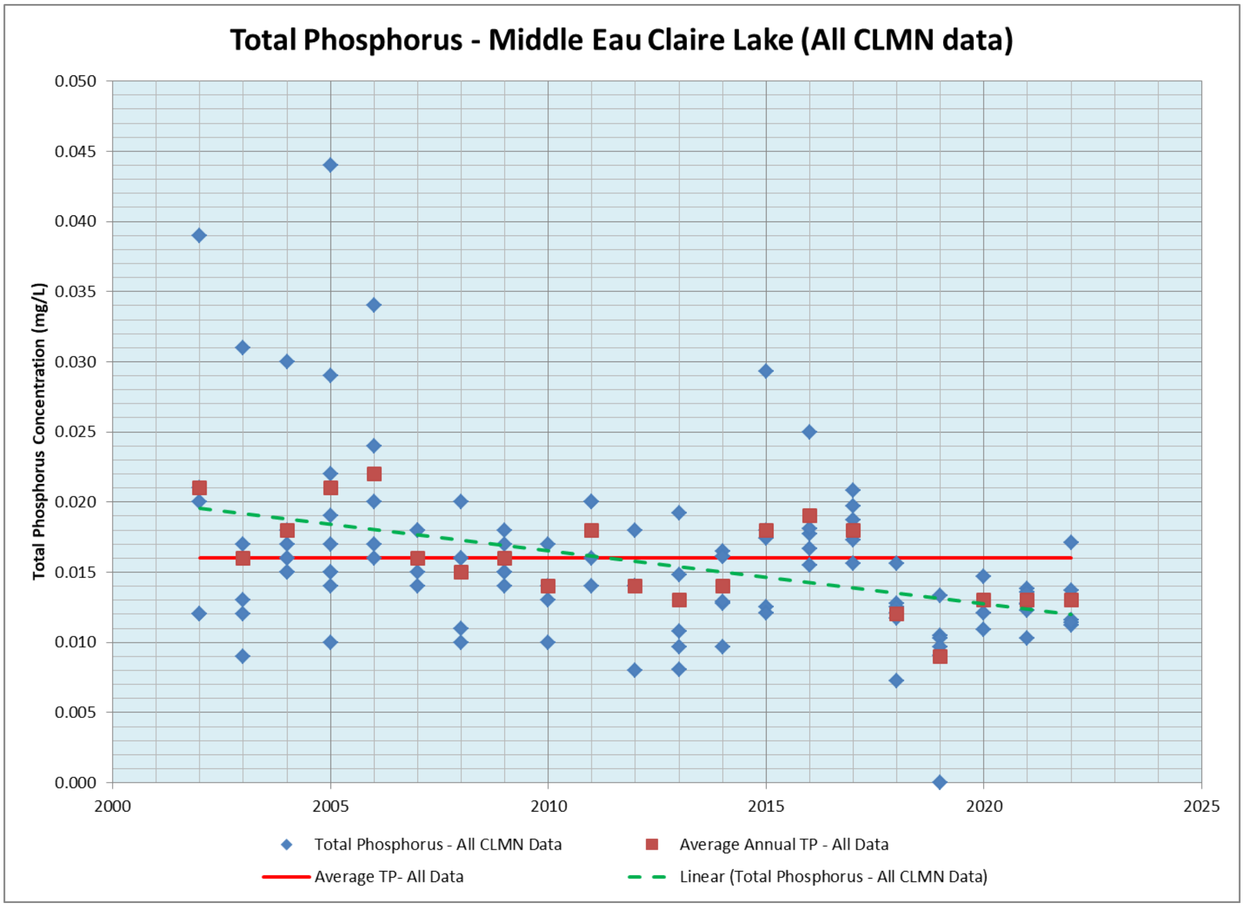


Figure 6: TP concentrations w/average annual TP and trend line

Chlorophyll-a monitoring involves collecting water samples three times during the open water season. Chla is the pigment that makes all plants green. In a lake, Chla is used as a measurement of the amount of algae that is in the water. Chla data was been collected on MECL from 2002 to 2022. In each of those years, at least three Chla samples were collected (Figure 7). A trend line suggests that, like TP, the concentration over time has gone down.

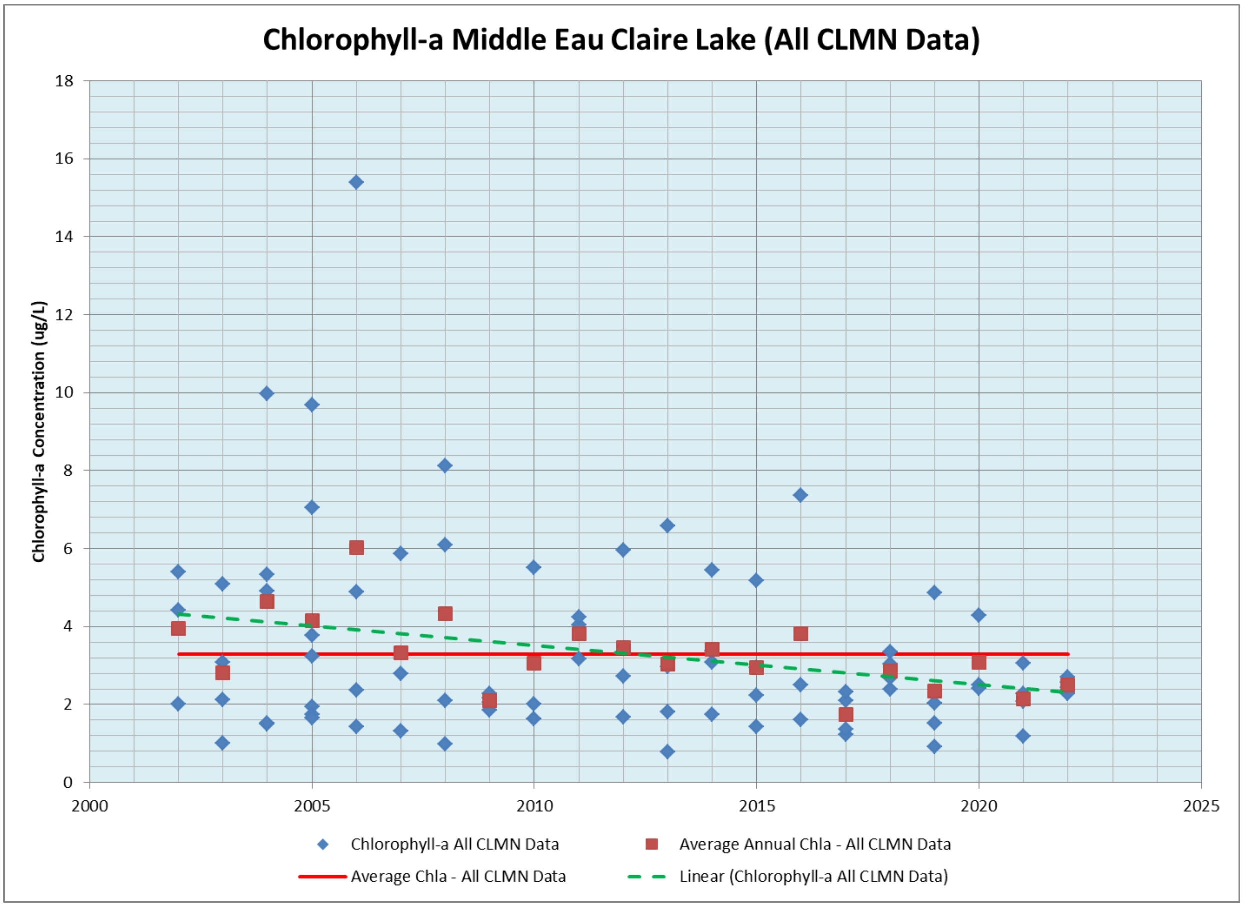


Figure 7: Chla concentrations with average annual Chla and trend line

2.1 Temperature and Dissolved Oxygen

Temperature and dissolved oxygen are important factors that influence aquatic organisms and nutrient availability in lakes. As temperature increases during the summer in deeper lakes, the colder water sinks to the bottom and the lake develops three distinct layers as shown in Figure 8. This process, called stratification, prevents mixing between the layers due to density differences which limits the transport of nutrients and dissolved oxygen between the upper and lower layers. In most lakes in Wisconsin that undergo stratification, the whole lake mixes in the spring and fall when the water temperature is between 53 and 66°F, a process called overturn. Overturn begins when the surface water temperatures become colder and therefore denser causing that water to sink or fall through the water column. Below about 39°F, water becomes less dense and begins to rise through the water column. Water at the freezing point is the least dense which is why ice floats and warmer water is near the bottom (called inverse stratification) throughout the winter.

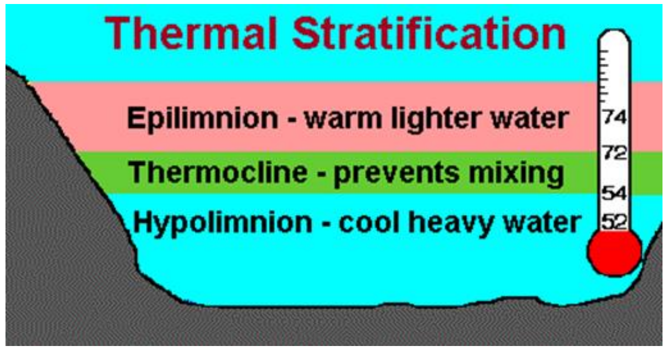


Figure 8: Summer thermal stratification

When a lake stratifies, dissolved oxygen (DO) levels in the bottom or hypolimnion portion of the lake may drop dramatically or disappear altogether. When this happens, nutrients normally trapped in the sediment can be released back into the water increasing the phosphorus available to grow more algae, degrading water quality further. If a deep lake stratifies and DO levels do not drop dramatically, that lake may support a two-story fishery – both cold water fish like cisco, trout and whitefish, as well as warm water fish like bass and walleye. The next section will discuss a two-story fishery in more detail.

Temperature and DO monitoring in the entire water column of MECL is part of the data that is collected annually. At 68ft deep and based on temperature and DO profiles taken in most of the months and years since 2002, MECL stratifies from about middle of June through the mioddle of September. During that time, the thermocline becomes established between 25-35ft, with DO concentrations dropping below 1.0mg/L at around 30ft. Enough DO is present for fish species (around 4.0mg/L) down to about 25ft in most summer sampling profiles.

The results of this data analysis corroborate what was observed in the first paragraph of Section 2.0. "Water quality appears to decline slightly moving downstream in this chain. UECL shows signs of oligotrophic characteristics while the Middle Eau Claire Lake (MECL) and Lower Eau Claire Lake (LECL) show signs of increasing levels of fertility." Hence there is a slight decline in water quality as a whole from Upper to Middle to Lower Eau Claire lakes.

2.2 Trophic State Index – Lake Productivity

Water clarity (based on Secchi disk readings), total phosphorus, and chlorophyll-a are parameters that can be used to determine the productivity or trophic status of a lake. The Carlson trophic state index (TSI) is a frequently used biomass-related index. The trophic state of a lake is defined as the total weight of living biological material (or biomass) in a lake at a specific location and time. Eutrophication is the movement of a lake's trophic state in the direction of more plant biomass. Eutrophic lakes tend to have abundant aquatic plant growth, high nutrient concentrations, and low water clarity due to algae blooms (Figure 9). Oligotrophic lakes, on the other end of the spectrum, are nutrient poor and have little plant and algae growth (Figure 9). Mesotrophic lakes have intermediate nutrient levels and only occasional algae blooms (Figure 9). Based on actual data (Secchi depth in feet and TP and Chla in ug/L), Figure 9 can be used to determine the productivity of a given lake. TP and Chla concentrations put MECL in the mesotrophic range, Secchi depth puts MECL in the oligotrophic range.

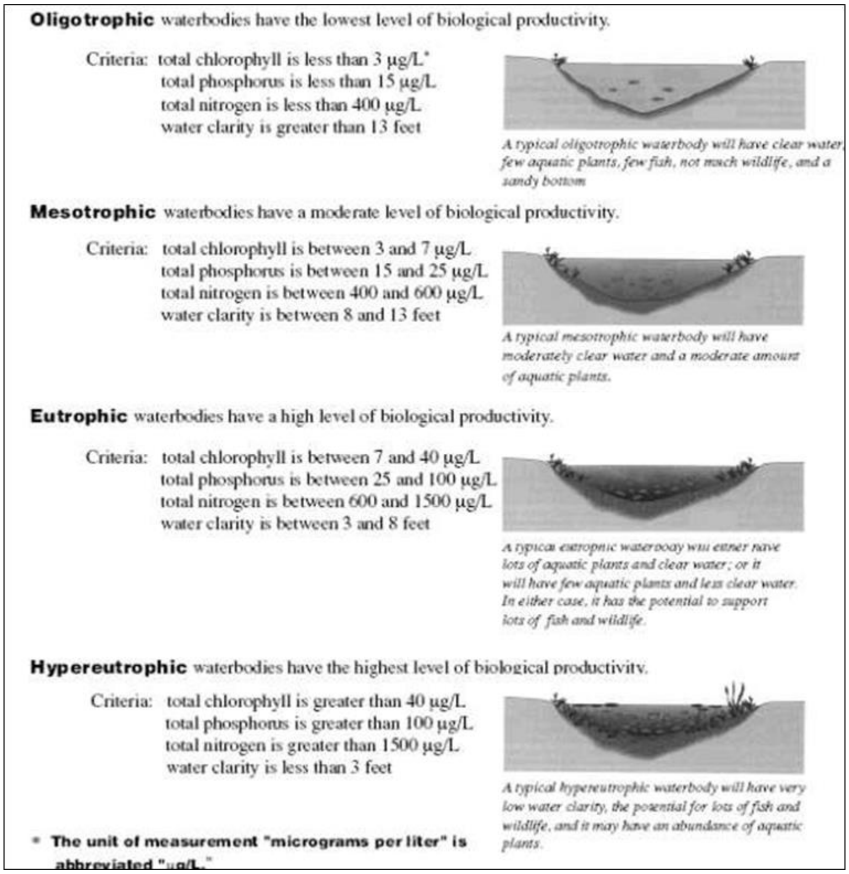


Figure 9: Trophic states in lakes

The TSI scale runs from "0" to "100". Generally, TSI values from 0-40 are considered oligotrophic, 40-50 are mesotrophic, 50-70 are eutrophic, and anything above 70 is considered hypereutrophic (Table 1).

Table 1: TSI Scale (Cedar Corporation, 2006)

Table 3-4: Trophic State Index (TSI)		
TSI Value	**Water Quality Attributes**	**Fisheries, Recreation or Example Lakes**
<30	**Oligotrophic:** Clear water, oxygen through the year in the hypolimnion. Water supply may be suitable unfiltered.	Salmonid fisheries dominate.
30-40	Hypolimnia of shallower lakes may become anoxic during the summer.	Salmonid fisheries in deep lakes only. Example: Lake Superior (WDNR)
40-50	**Mesotrophic:** Water moderately clear but increasing probability of anoxia in hypolimnion during summer. Possible iron, manganese, taste and odor problems may worsen in water supply. Water turbidity requires filtration.	Walleye may predominate and hypolimnetic anoxia results in loss of salimonoids.
50-60	**Eutrophic:** Lower boundary of classic eutrophy. Decreased transparency, anoxic hypolimnion during the summer, macrophyte problems evident, warm water fisheries dominant.	Bass may dominate.
60-70	Dominance of blue-green algae, algal scums probable, extensive macrophyte problems. Possible episodes of severe taste and odor from water supply. Anoxic hypolimnion, water-water fisheries.	Nuisance macrophytes, algal scums and low transparency may discourage swimming and boating.
70-80	**Hypereutrophic:** Light limited productivity, dense algal blooms and macrophyte beds.	Lake Menomin & Tainter Lake, Dunn County, WI (WDNR).
>80	Algal scums, few macrophytes, summer fishery kills.	Dominant rough fish.

The measurements of all three parameters (Secchi - feet, TP & Chla - µg/L) can be converted to values that fit in the TSI range of 0 to 100. By doing so, all three can be compared together to establish trends (Figure 10). The dark blue area of Figure 10 is considered oligotrophic; the light blue mesotrophic; and the green eutrophic. The annual average summer Secchi disk readings (black dots) almost all fall in the oligotrophic area. Chla values (green squares) fall always in the mesotrophic area. TP values fall mostly on the borderline between the mesotrophic and the eutrophic areas, higher than both Chla and Secchi.

TSI data can be used for more than just visualizing trends. Over time, several familiar patterns emerge from the data. Carlson and Havens (2005) discussed the patterns that frequently emerge when looking at long-term trend data and TSI values. Since TP and Chla monitoring began, TP has been consistently higher than Chla, which has been consistently higher than Secchi (Figure 10). This pattern suggests that zooplankton grazing has reduced the number of smaller particles, leaving larger particles. Biomass has been reduced below levels predicted from total phosphorus. From a water quality perspective, this pattern suggests that there might be good potential to control algae blooms (or prevent them from happening) with biomanipulation of the planktonic food web (e.g. increasing the biomass of large zooplankton (Carlson & Havens, 2005).

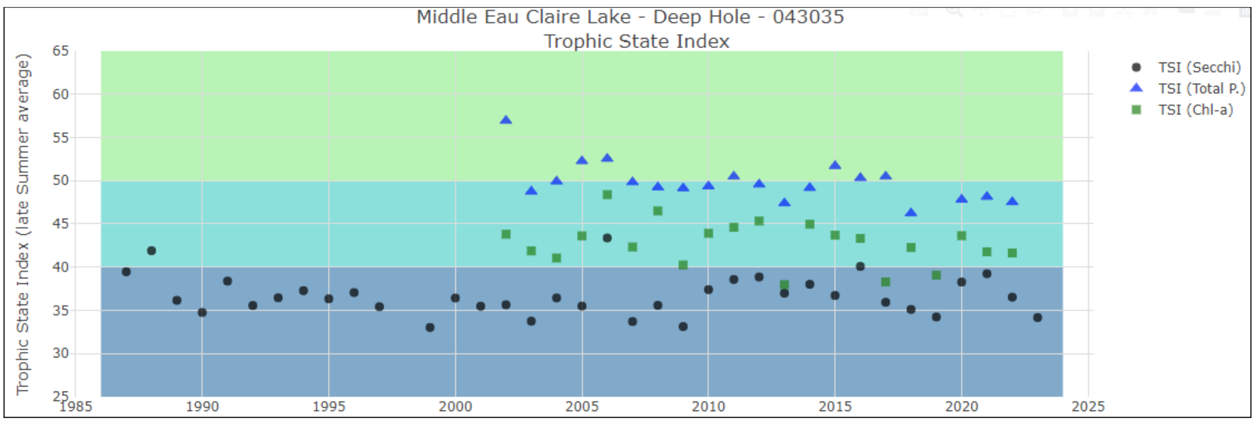


Figure 10: Yearly TSI values for Chla, Secchi (water clarity), and TP (CLMN)

3.0 Fisheries and Wildlife

As previously mentioned, MECL is considered an outstanding resource water by the WDNR. It is also listed as a Priority Navigable Water (PNW) for musky and walleye. Much of the data included in this section is from a comprehensive fishery survey completed by the WDNR on MECL from 2013-2014 (Toshner, 2014). Objectives of the 2013-2014 survey were to determine the status of the walleye, muskellunge, northern pike, largemouth and smallmouth bass populations, along with sport and tribal use of these species. More specifically, the WDNR was interested in determining population abundance, growth, size structure and harvest of walleye, largemouth and smallmouth bass. They also hoped to determine some population parameters of panfish in Middle Eau Claire Lake (Toshner, 2014).

3.1 Fisheries

MECL has a diverse fishery consisting of walleye, muskellunge, northern pike, largemouth bass, smallmouth bass, bluegill, pumpkinseed, warmouth, rock bass, black crappie, yellow perch, white sucker, yellow bullhead, black bullhead, brown bullhead, golden redhorse, logperch, Iowa darter, least darter, brook silverside, bluntnose minnow, common shiner, mimic shiner, blackchin shiner, and spottail shiner.

Past management of Middle Eau Claire Lake includes fishery surveys, stocking, various fishing regulations and large woody habitat restoration projects. Walleye surveys were conducted in 1993, 1998, 2004, 2007 and 2010 utilizing Wisconsin Department of Natural Resources (WDNR) standardized treaty protocols (Hennessey 2002). A walleye survey was also conducted in 1983 by WDNR which attempted to calculate a population estimate using the Chapman modification of the Petersen estimator. However, the recapture rate was low and the Schnabel method needed to be used to estimate the walleye population. Additional walleye surveys were conducted in 1991 and 1996 using a different sampling protocol, i.e. electrofishing to both mark and recapture walleye for a population estimate.

Recent management has focused on muskellunge stocking, regulation changes, public outreach and education and habitat protection/restoration. Rusty crayfish, have been present in Middle Eau Claire Lake since at least the 1980s, however it has not been well documented when they first entered the lake. Rusty crayfish, from anecdotal accounts, have reduced the amount of aquatic vegetation dramatically. In an effort to mimic habit that was once provided by the aquatic plant communities, 84 fish cribs were installed between 1988 and 2002. Large wood, in the form of whole trees, were taken from upland areas and placed along the shoreline in an attempt to mimic natural tree falls and increase the abundance of wood in the littoral zone in 2009 and 2010. One hundred and thirty nine trees were installed along the shoreline during both years combined.

Middle Eau Claire Lake has a long stocking history (Table 2) and has been stocked with a number of fish species, including walleye, muskellunge, largemouth bass and various panfish species, since at least 1933. Only walleye were stocked from 1951 to 1965, and between 1965 and 1982 there was no stocking due to evidence of adequate natural reproduction of all species present (Weiher 1968). Rainbow trout were also stocked in 1985, 1988 and 1991 and discontinued thereafter due to poor returns to creel (Scholl 1994). Walleye fry stocking began again in 1982 and alternated with fingerlings starting in 1987. Walleye stocking in 1987 was initiated because the 1983 population estimate indicated that densities were below the 3 adult/acre statewide management objective. Walleye stocking was discontinued after 1993 due to increased density of adults and adequate natural reproduction (Scholl 1994). In 2013 large fingerling walleye were purchased, stocked and fin clipped by the Eau Claire Lakes Conservation Club after the 2013 population estimate again indicated that densities were below the 3 adult/acre statewide management objective. In 1984 muskellunge stocking began in an attempt to introduce an additional shallow water predator to help control abundant slow growing panfish (Schram 1984). Muskellunge were stocked on an annual basis from 1987 to 1998 with the exception of 1994 and 1995, when no muskellunge were stocked, due to hatchery renovations in Spooner. Since 2000, muskellunge have been stocked on an alternate year basis and since 2004 all stocked muskellunge have been fin clipped or pit tagged in an attempt to ascertain survival and contribution rates (fin clip) and/or long term individual growth (pit tag).

In the 2013/14 Fisheries Report there are many fish management recommendations. The last one, however, is most pertinent to this APM Plan.

"The last recommendation is to work with local residents, the Middle Eau Claire Lake Association, the Eau Claire Lakes Conservation Club and the WDNR lake grants program to create and adopt a lake management plan and aquatic plant management plan including: 1) develop strategies for protecting and restoring sensitive aquatic and shoreline habitats by utilizing critical habitat designation recommendations, 2) continue exotic species survey and control programs targeting satellite infestations, 3) continue educational and participation forum for environmentally sensitive shoreline living, 4) continue water quality monitoring through the citizen lake monitoring program. No amount of regulation or stocking practices will change the need for healthy aquatic environments. Although water quality remains high, habitat loss, declining shoreline aesthetics, and exotic introductions are warning signs of cultural disturbances that are degrading ecosystem health. Currently, rusty crayfish are in decline which has likely had the effect of higher aquatic plant abundance in the littoral zone and curly leaf pondweed which is also an exotic species has been identified in Middle Eau Claire Lake. Attempts to prevent the spread of curly leaf pondweed and the introduction of Eurasian watermilfoil from nearby sources are worthy objectives in preserving the ecosystem as a whole. Shoreline restoration projects in areas that are currently lacking buffers should be explored. Preventing the spread of exotics and enhancing habitat through restoration projects, as well as preserving the existing habitat will be far more beneficial than losing what is currently present and relying on stocking and artificial habitat improvements to maintain the fishery and ecosystem as a whole ."

Table 2: WDNR stocking of musky, walleye, and rainbow trout

Stocking Year	Waterbody	Species	Age Class	# Fish Stocked	Avg Fish Length (IN)
2022	MIDDLE EAU CLAIRE LAKE	WALLEYE	FRY	220	2
2022	MIDDLE EAU CLAIRE LAKE	MUSKELLUNGE	LARGE FINGERLING	484	13.8
2021	MIDDLE EAU CLAIRE LAKE	WALLEYE	LARGE FINGERLING	8792	6.8
2020	MIDDLE EAU CLAIRE LAKE	WALLEYE	LARGE FINGERLING	8542	4.83
2018	MIDDLE EAU CLAIRE LAKE	MUSKELLUNGE	LARGE FINGERLING	503	12.1
2016	MIDDLE EAU CLAIRE LAKE	MUSKELLUNGE	LARGE FINGERLING	326	11.8
2014	MIDDLE EAU CLAIRE LAKE	MUSKELLUNGE	LARGE FINGERLING	451	11
2013	MIDDLE EAU CLAIRE LAKE	WALLEYE	LARGE FINGERLING	7700	5
2012	MIDDLE EAU CLAIRE LAKE	MUSKELLUNGE	LARGE FINGERLING	451	12.7
2010	MIDDLE EAU CLAIRE LAKE	MUSKELLUNGE	LARGE FINGERLING	451	11.7
2008	MIDDLE EAU CLAIRE LAKE	MUSKELLUNGE	LARGE FINGERLING	451	10.85
2006	MIDDLE EAU CLAIRE LAKE	MUSKELLUNGE	LARGE FINGERLING	255	11.4
2004	MIDDLE EAU CLAIRE LAKE	MUSKELLUNGE	LARGE FINGERLING	451	10.8
2002	MIDDLE EAU CLAIRE LAKE	MUSKELLUNGE	LARGE FINGERLING	1804	10.6
2000	MIDDLE EAU CLAIRE LAKE	MUSKELLUNGE	LARGE FINGERLING	900	12.1
1998	MIDDLE EAU CLAIRE LAKE	MUSKELLUNGE	LARGE FINGERLING	800	12.5
1997	MIDDLE EAU CLAIRE LAKE	MUSKELLUNGE	LARGE FINGERLING	450	12.1
1996	MIDDLE EAU CLAIRE LAKE	MUSKELLUNGE	FINGERLING	900	11.6
1993	MIDDLE EAU CLAIRE LAKE	WALLEYE	FINGERLING	45675	2
1993	MIDDLE EAU CLAIRE LAKE	MUSKELLUNGE	FINGERLING	900	11.9
1992	MIDDLE EAU CLAIRE LAKE	MUSKELLUNGE	FINGERLING	900	10
1992	MIDDLE EAU CLAIRE LAKE	WALLEYE	FINGERLING	22550	2
1991	MIDDLE EAU CLAIRE LAKE	MUSKELLUNGE	FINGERLING	900	11
1991	MIDDLE EAU CLAIRE LAKE	RAINBOW TROUT	YEARLING	2700	9
1991	MIDDLE EAU CLAIRE LAKE	WALLEYE	FRY	454000	1
1990	MIDDLE EAU CLAIRE LAKE	MUSKELLUNGE	FINGERLING	450	13
1989	MIDDLE EAU CLAIRE LAKE	MUSKELLUNGE	FINGERLING	900	9
1989	MIDDLE EAU CLAIRE LAKE	WALLEYE	FINGERLING	46044	5
1988	MIDDLE EAU CLAIRE LAKE	MUSKELLUNGE	FINGERLING	1000	11
1988	MIDDLE EAU CLAIRE LAKE	RAINBOW TROUT	YEARLING	2700	9
1987	MIDDLE EAU CLAIRE LAKE	WALLEYE	FINGERLING	118236	3
1987	MIDDLE EAU CLAIRE LAKE	MUSKELLUNGE	FINGERLING	1350	9
1985	MIDDLE EAU CLAIRE LAKE	RAINBOW TROUT	ADULT	33	16
1985	MIDDLE EAU CLAIRE LAKE	RAINBOW TROUT	YEARLING	2700	11
1984	MIDDLE EAU CLAIRE LAKE	MUSKELLUNGE	FINGERLING	900	9
1982	MIDDLE EAU CLAIRE LAKE	WALLEYE	FRY	2000000	

3.1.1 Two-Story Fishery

MECL is considered a “two-story” fishery by the WDNR. A two-story fishery is a lake capable of supporting warm-water species like bass and northern pike in its warm, “top story”, while at the same time, capable of supporting cold-water species like cisco or whitefish in its deeper, colder, well-oxygenated “lower story”. In Wisconsin there are only about 200 of these lakes. Recent WDNR documentation (Minahan, 2017) suggests that cisco need DO levels >6.0mg/L and water temperatures <73°F to survive in a lake. The survival of cold water fish species like cisco depends on conditions in and below the thermocline that allow them to move up in the water column as oxygen levels in the bottom of the lake decline, while at the same time staying in cold enough water to keep them alive (Figure 12).

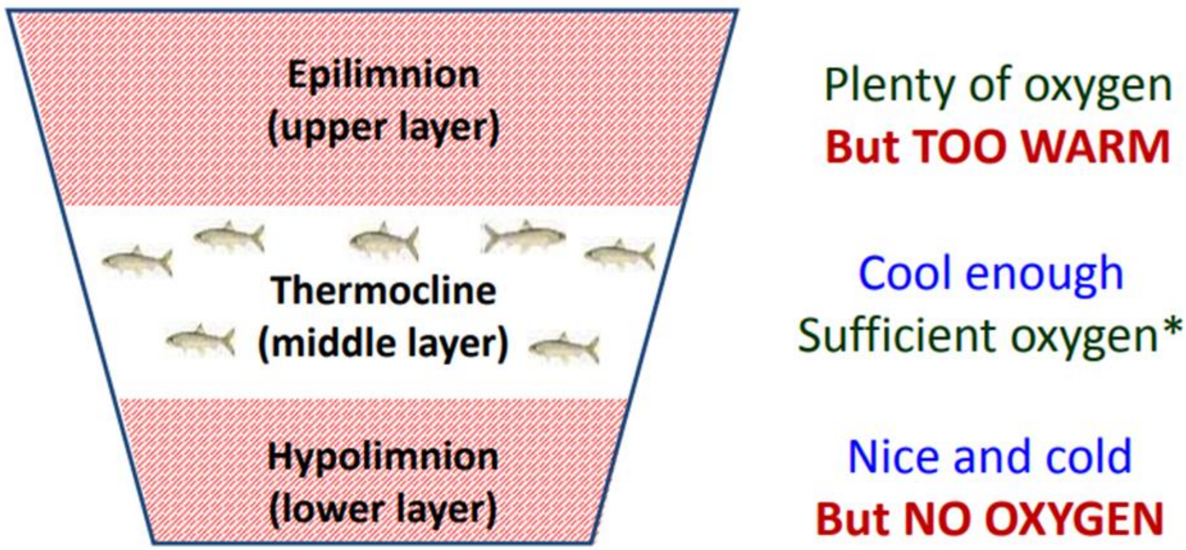


Figure 11: Lake stratification zones necessary to support a two-story fishery (Minahan, 2017)

Cold-water habitat in lakes is by its very nature fragile and imperiled. As organic matter dies and sinks, its decay uses up oxygen in deeper water. The amount of decay and the rate of oxygen loss depend upon how fertile the lake is. Imagine a first floor (lower story) where the floor and ceiling squeeze together for three or four months. Then a “normal” September brings surface cooling. Cisco and whitefish squeezed by low oxygen in the first floor now have an open stairway to the second floor (top story) because surface waters are now cool enough to meet their survival needs. If, however, summer hangs on well into September, a full month of squeeze is added and the proverbial stairs are blocked. The basement is plenty cold, but devoid of oxygen most of the time during the summer. The lower story can become devoid of oxygen as well, and if at the same time, the surface waters remain too warm, there is no escape. Under these conditions, the cold water fishery suffers. Longer summers and warmer temperatures brought on by climate change lead to even greater loss of oxygen in the “basement” and “first floor”.

3.2 Critical Habitat

Every body of water has areas of aquatic vegetation that offers critical or unique fish and wildlife habitat. Such areas can be identified by the WDNR and identified as Sensitive Areas (critical habitat) per Ch. NR 107. A sensitive areas survey was completed on MECL by the WDNR in 2013 Smith et al. (2013). Figure 13 shows the critical habitat areas in MECL identified by the WDNR in 2013. Aquatic habitat areas provide the basic needs (e.g. habitat, food, nesting areas) for waterfowl, fish, and wildlife. Tables 3 and 4 provide greater detail about each of the critical habitat areas identified on the lake. Disturbance to these areas should generally be avoided or minimized and chemical treatment is generally not allowed. Areas of rock and cobble substrate with little or no fine sediment are considered high quality walleye spawning habitat. No dredging, structures, or deposits should occur in these sensitive areas. Further details for each sensitive area can be found in the MECL Critical Habitat Designation Report Smith et al. (2013).

Figure 12: Middle Eau Claire Lake Critical Habitat Map (Smith et al. 2013)

Table 3: Middle Eau Claire Lake Critical Habitat Polygon Justifications

Critical Habitat Polygon ID	Acres	Justification	Justification	Justification	Justification	Justification	Classification
MEC1	3.7	7	11	-	-	-	Public Rights Feature
MEC2	29.2	1	3	6	7	11	Sensitive Area
MEC3	1.1	7	11	-	-	-	Public Rights Feature
MEC4	28.7	1	3	6	7	11	Sensitive Area
MEC5	12.7	3	6	-	-	-	Sensitive Area
MEC6	5.6	2	3	6	-	-	Sensitive Area
MEC7	21.5	2	3	6	-	-	Sensitive Area
MEC8	8.5	4	7	6	-	-	Sensitive Area
MEC9	1.3	4	-	-	-	-	Sensitive Area
MEC10	16.7	8	-	-	-	-	Public Rights Feature
MEC11	9.3	8	-	-	-	-	Public Rights Feature
MEC12	1.6	6	-	-	-	-	Sensitive Area
MEC13	5.9	1	-	-	-	-	Sensitive Area
MEC14	2.1	3	2	7	11	-	Sensitive Area
MEC15	4.2	8	7	9	-	-	Public Rights Feature
MEC16	83.4	2	6	3	-	-	Sensitive Area

Table 4: Critical Habitat Justification Descriptions

Justifications	Justification Feature	Classification
1	Bio-diverse Submerged Aquatic Vegetation (SAV)	Sensitive Area
2	SAV Important to Fish and Wildlife Habitat	Sensitive Area
3	Emergent and Floating Leaf Vegetation	Sensitive Area
4	Rush Beds	Sensitive Area
5	Wild Rice Bed	Sensitive Area
6	Extensive Riparian Wetland	Sensitive Area
7	Woody Habitat	Public Rights Feature
8	Spawning Substrate	Public Rights Feature
9	Water Quality (springs, etc)	Public Rights Feature
10	Natural Scenic Beauty	Public Rights Feature
11	Navigational Thoroughfare	Public Rights Feature

3.2.1 Natural Heritage Inventory

The Natural Heritage Inventory (NHI) database contains recent and historic observations of rare species and plant communities. Each species has a state status including Special Concern (SC), Threatened (THR) or Endangered (END). On the county level (Bayfield County), there are well over 100 communities, birds, plants, insects, fish, mammals, mussels, reptiles, and amphibians included in the NHI list. On a township level, the township and range that MECL is in lists only three – a lake community, a fish species (Least Darter), and the Bald Eagle.

Three invasive species have been officially verified within MECL: curly-leaf pondweed, Chinese mystery snails, and Rusty crayfish. Purple loosestrife and yellow iris may also be present.

4.0 Aquatic Plant Surveys

While there is always some natural variation from year to year in the makeup of the aquatic plant community in a lake, human changes to a lake, including management of an invasive species like CLP, may have a more obvious impact to aquatic plants. Under active management, it is recommended by the WDNR that whole-lake, point-intercept, aquatic plant surveys be completed at least every five years. There have been three such surveys completed in MECL. The first was completed in 2005 by Citizen Scientists, and although the data is interesting it has a lot of issues. The second was completed in 2013 a year after CLP had been identified in the lake for the first time. The 2013 survey was completed by Endangered Resource Services (ERS). The third survey was completed again by ERS in 2021. Only the changes between 2013 and 2022 are covered in this APM Plan.

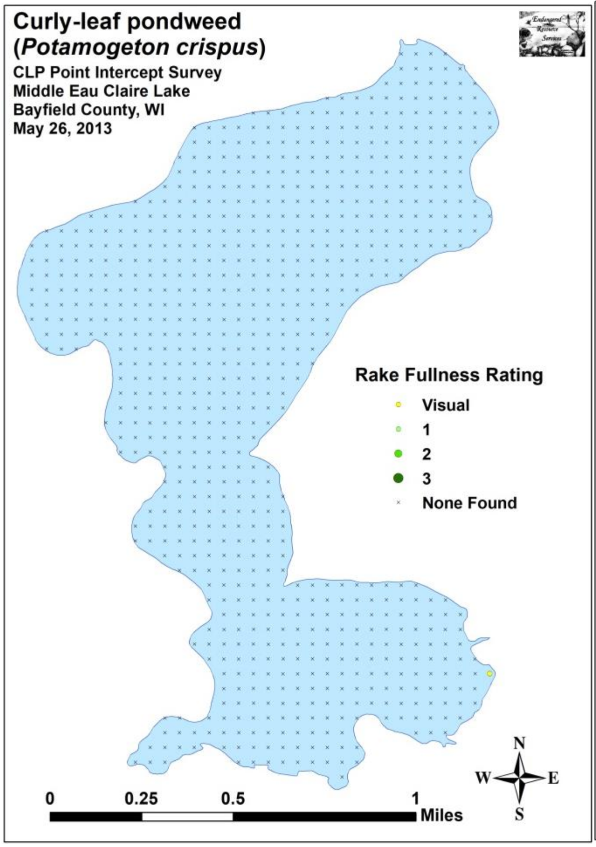
4.1 2013 and 2021 Early Season, Whole-lake, CLP Point-intercept Surveys

Information in the next several sections related to plant survey work completed in the lake, is taken in part from data collected and reports written by ERS but not published yet.

Using a standard formula that takes into account the shoreline shape and distance, islands, water clarity, depth, and total acreage, Jennifer Hauxwell (WDNR) generated the original 791-point sampling grid for MECL that has been used for each survey. Using this grid, a density survey where CLP was sampled for at each point in and adjacent to the lake's littoral zone was completed in both 2013 and 2021. Each survey point was located using a handheld mapping GPS unit (Garmin 76CSx) and used a rake to sample an approximately 2.5ft section of the bottom. When found, CLP was assigned a rake fullness value of 1-3 as an estimation of abundance. Visual sightings of CLP within six feet of the sample point were also noted.

Following the establishment of the June 2021 littoral zone at approximately 15.5ft of water, survey results showed CLP was present in the rake at 15 sample points with 3 additional visual sightings. This extrapolated to 2.3% of the entire lake and 4.7% of the 386-point littoral zone having at least some CLP present. All of these points had a density of 2 or less on a 0-3 scale (Figures 13&14).

In 2013, CLP was not present on the rake but documented as a visual at one point (Figure 13&14). Comparing the 2013 and 2021 early-season surveys finds that CLP appeared to be increasing from 2013 to 2021.



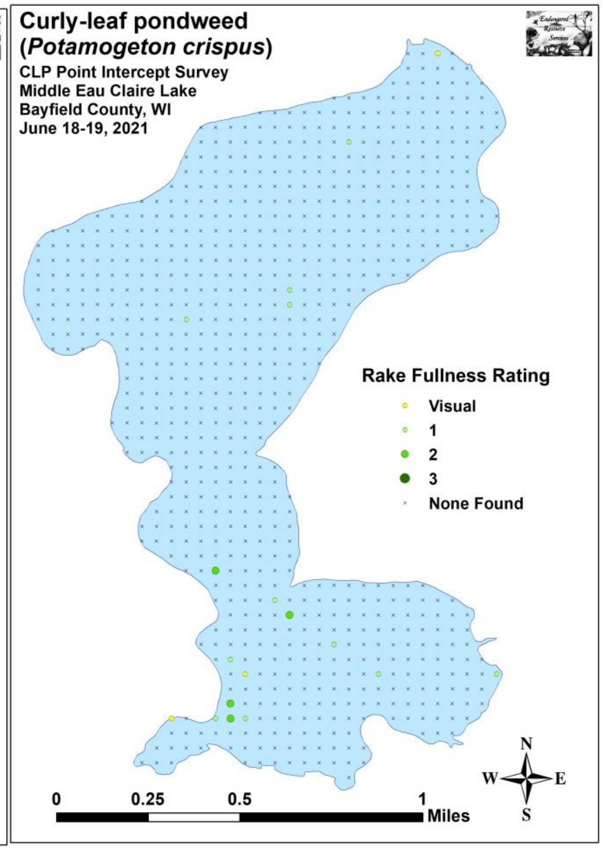


Figure 13: 2013 and 2021 spring CLP density and distribution

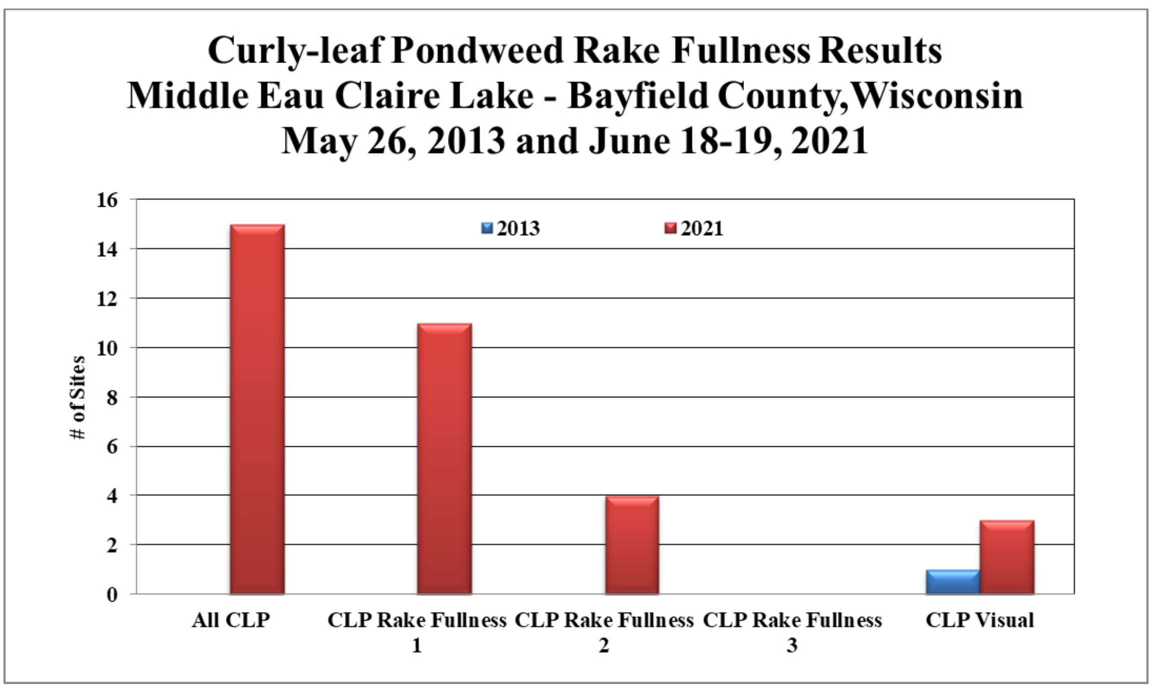


Figure 14: 2013 and 2021 changes in early-season CLP rake fullness

4.2 2021, 2022, and 2023 CLP Bed Mapping

During a bed mapping survey, the lake's entire visible littoral zone is searched. By definition, a "bed" is determined to be any area where CLP was visually estimated to make up >50% of the area's plants, is generally continuous with clearly defined borders, and is canopied, or close enough to being canopied that it would likely interfere with boat traffic. After a bed is located, GPS coordinates are taken at regular intervals while motoring around the perimeter of the area. The GPS points are used to create maps with the acreage of each area. The rake density range and mean rake fullness of each area or bed mapped is also estimated. The maximum depth of the bed, whether it was canopied, and the impact it was likely to have on navigation (none – easily avoidable with a natural channel around or narrow enough to motor through/minor – one prop clear to get through or access open water/moderate – several prop clears needed to navigate through/severe – multiple prop clears and difficult to impossible to row through) is also recorded.

During the 2021 survey, 17 small beds of CLP totaling 0.58 acres were mapped (Figure 15). In 2022, after some removal completed by the BAISS boat, only 3 beds totaling 0.06 acres was mapped (Figure 15). In 2023, only a few isolated and individual CLP plants were found and rake-removed by the surveyor (Figure 16). After completing the 2023 survey, the surveyor suggested that the BAISS boat was not necessary on MECL in 2023.

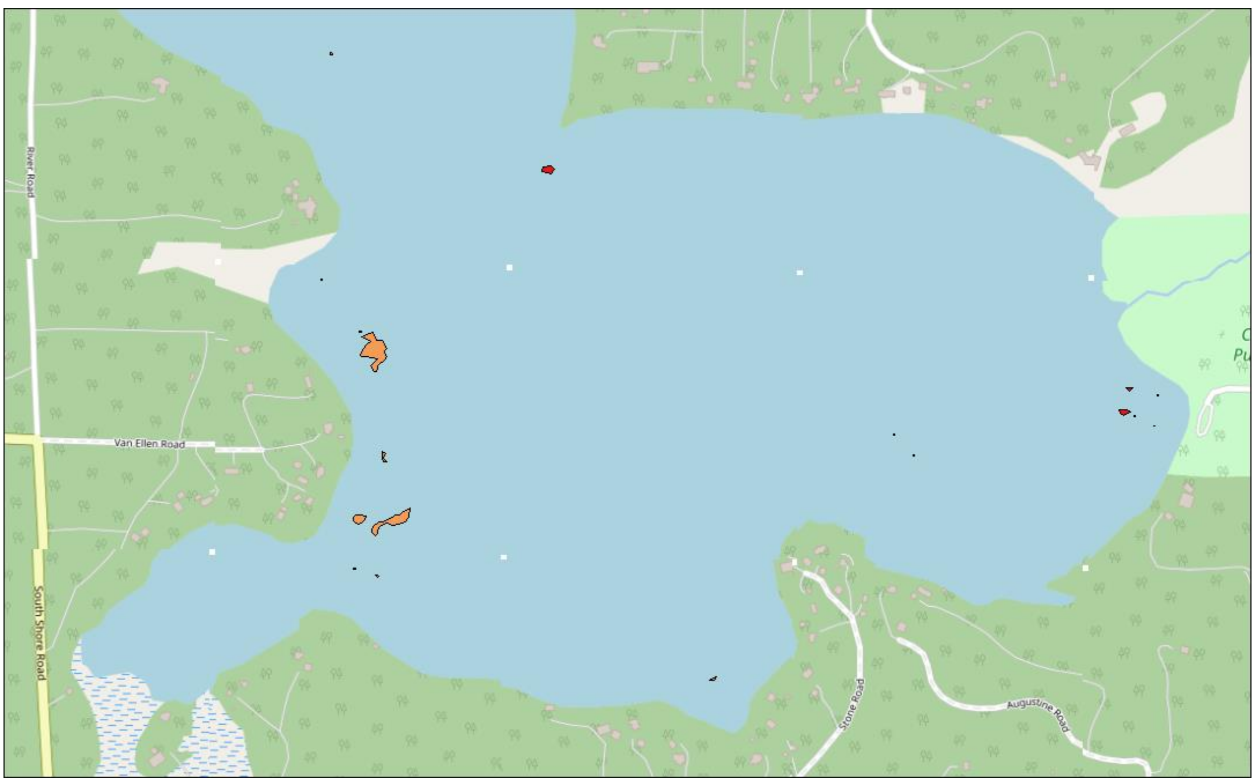


Figure 15: 2021 (orange polygons) and 2022 (red polygons) CLP bed mapping results (ERS)

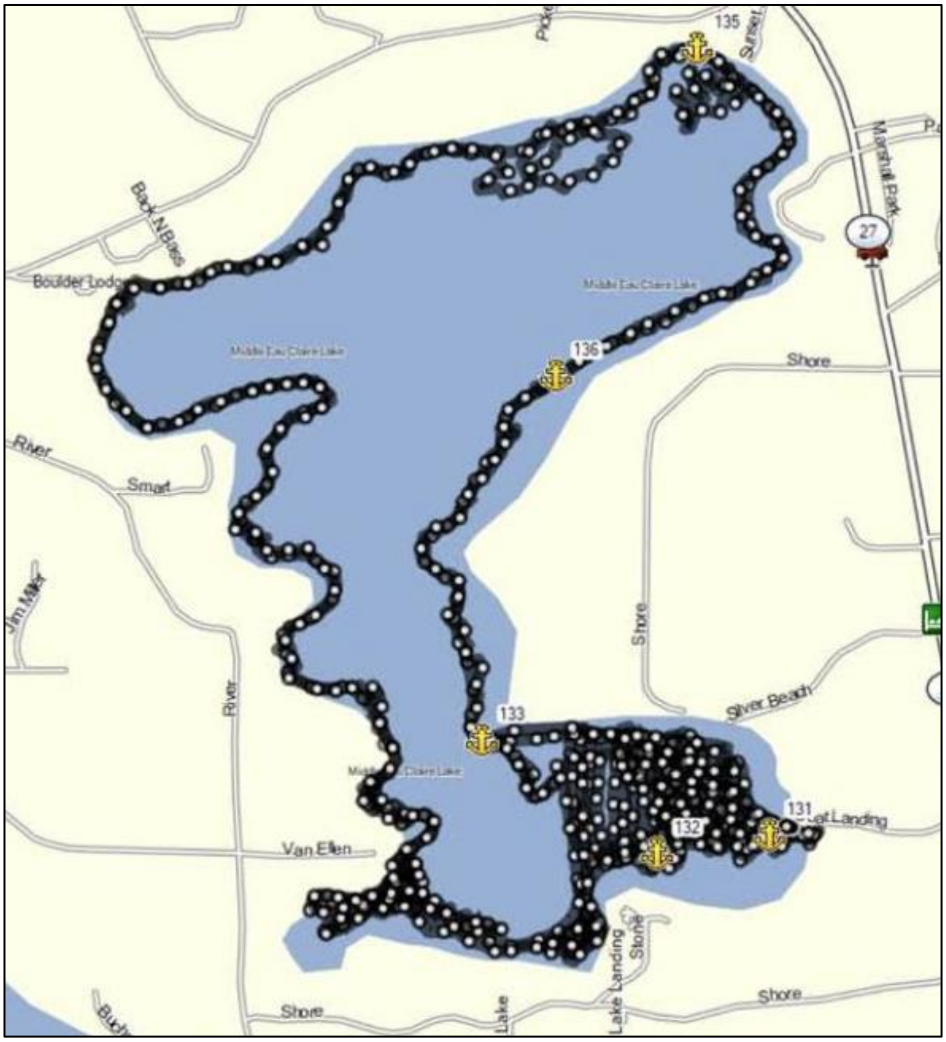


Figure 16: 2023 CLP bed mapping results (anchors represent individual plants rake-removed by the surveyor)

4.3 2013 and 2021 Warm-water Whole-lake, Point-intercept Aquatic Plant Survey

During the July 2021 survey, aquatic plants were found at 391 sites (49.4% of the bottom and 88.7% of the 19.4ft littoral zone) (Table5, Figure 17). In 2013 plants were present at 359 sites (45.4% of the entire lake bottom and in 82.9% of the then 19.0ft littoral zone). Plant growth in 2021 was skewed to deep water as the mean depth of 8.6ft was greater than the median depth of 8.0ft (Table 5). This mean was higher than in 2013 when it was 8.2ft, but the median depth was the same at 8.0ft, making the depth of plant growth less skewed to deeper water.

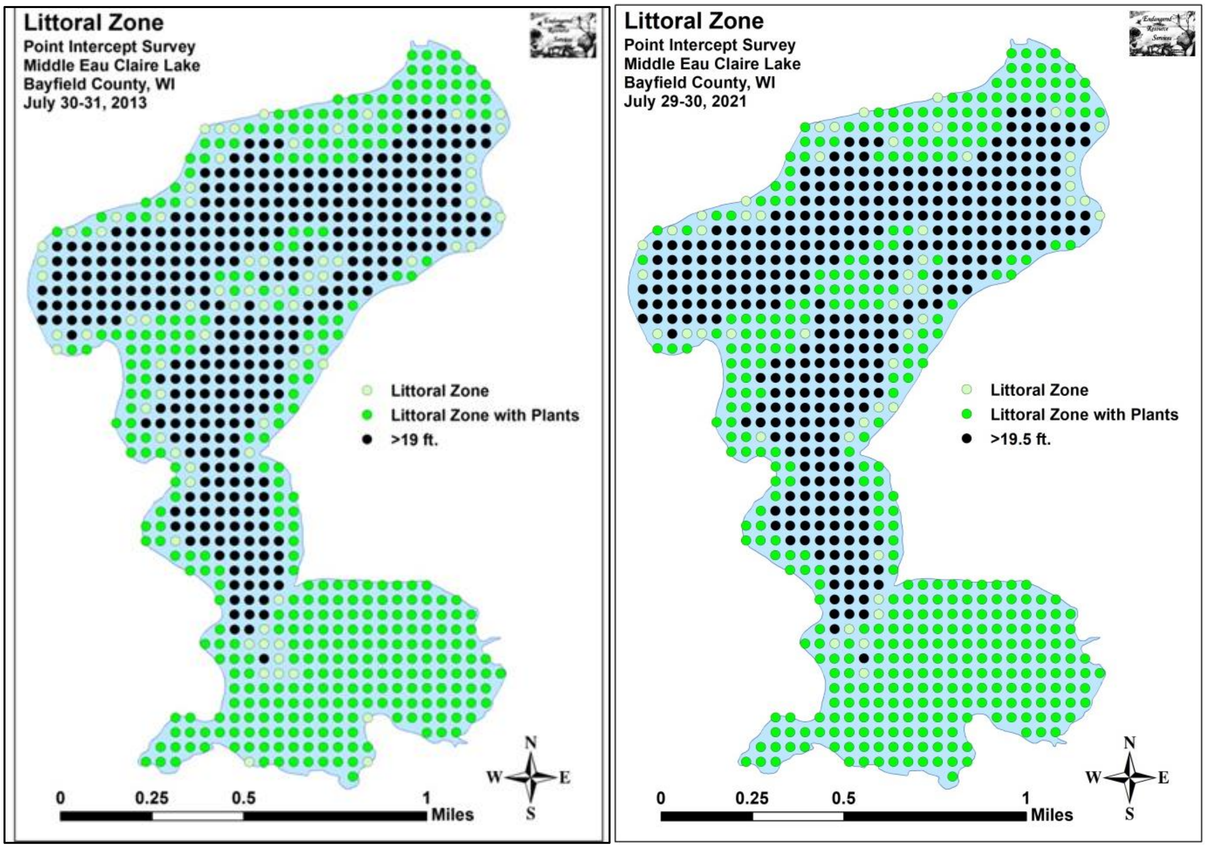


Figure 17: 2013 and 2021 littoral zone

Plant diversity was exceptionally high in 2021 with a Simpson Index value of 0.93 – up slightly from 0.92 in 2013 (Table 5). Total species richness was also high with 64 species (including rake, boat, and visual) found in and immediately adjacent to the lake in 2021 – up from 56 in 2013. From 2013 to 2021, mean native species richness at sites with native vegetation saw an increase from 2.96species/site in 2013 to 3.75 species/site in 2021 (Table 5). Visual analysis of the map showed many changes in localized richness, particularly in the northern most bay and the southern basin (Figure 18).

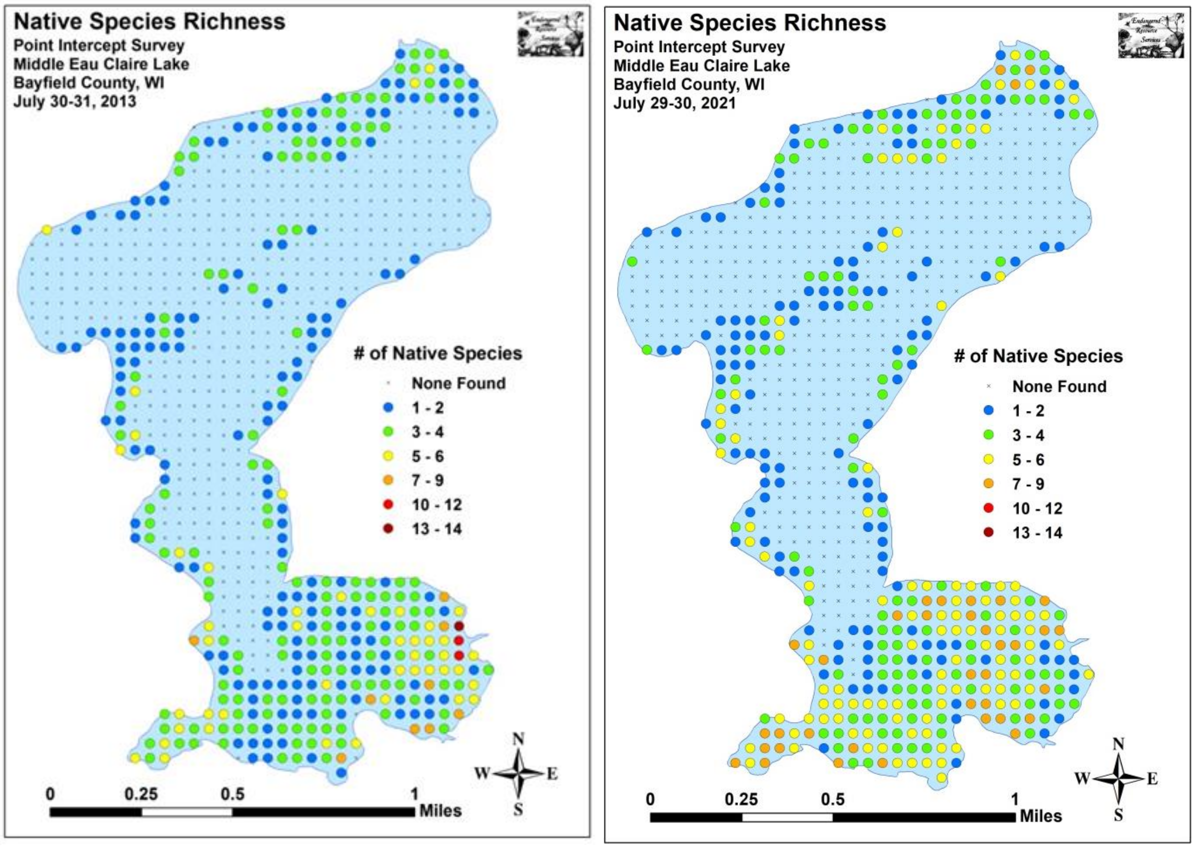


Figure 18: 2013 and 2021 native species richness

Total rake fullness underwent a significant increase from a moderate 1.79 in 2013 to a moderately dense 2.22 in 2021. Visual analysis of the maps showed these increases were mostly in the southern basin (Figure 19).

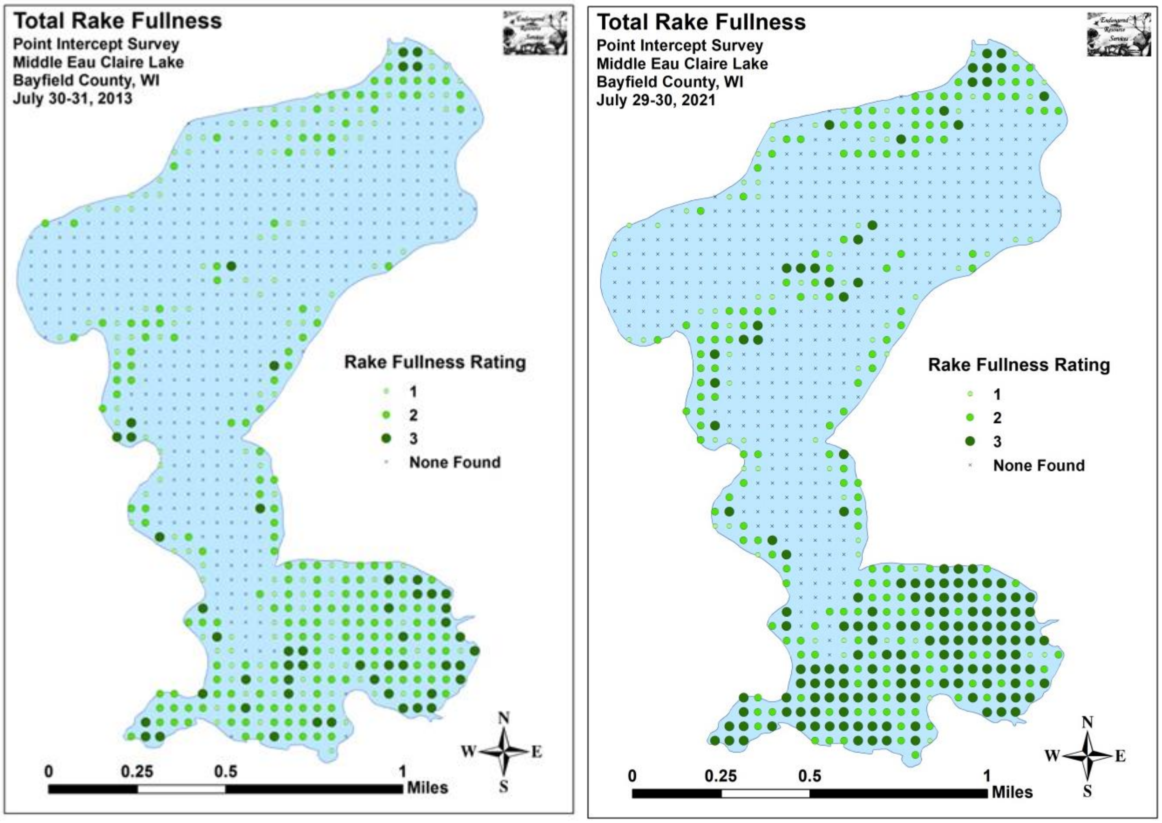


Figure 19: 2013 and 2021 total rake fullness

Table 5: 2013 and 2021 aquatic plant PI survey statistics

SUMMARY STATS: Middle Eau Claire Lake	2013	2021
Total number of sites visited	791	791
Total number of sites with vegetation	359	391
Total number of sites shallower than maximum depth of plants	433	441
Frequency of occurrence at sites shallower than maximum depth of plants	82.91	88.66
Simpson Diversity Index	0.92	0.93
Maximum depth of plants (ft)**	19.00	19.50
Number of sites sampled using rake on Rope (R)	66	19
Number of sites sampled using rake on Pole (P)	375	435
Average number of all species per site (shallower than max depth)	2.45	3.33
Average number of all species per site (veg. sites only)	2.96	3.76
Average number of native species per site (shallower than max depth)	2.45	3.33
Average number of native species per site (veg. sites only)	2.96	3.75
Species Richness	42	48
Species Richness (including visuals)	45	57
Species Richness (including visuals and boat survey)	56	64
Mean depth of plants (ft)	8.15	8.64
Median depth of plants (ft)	8.00	8.00
Mean rake fullness (veg. sites only)	1.79	2.22

4.3.1 Comparison of Floristic Quality Indexes in 2013 and 2021:

The FQI 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. Nichols (1999) identified four eco-regions in Wisconsin: Northern Lakes and Forests, North Central Hardwood Forests, Driftless Area and Southeastern Wisconsin Till Plain. He recommended making comparisons of lakes within ecoregions to determine the target lake's relative diversity and health. Upper Eau Claire Lake is in the Northern Lakes and Forests Ecoregion.

Aquatic plant species are only included in calculating the FQI if they are identified on a rake. Visuals or plants identified during the boat survey are not included in the index and are excluded from FQI analysis. The 2013 point-intercept survey identified a total of 42 native index plants in the rake. They produced a mean Coefficient of Conservatism of 6.8 and a Floristic Quality Index of 43.8. Seven of the species identified were given Cs of 9 or 10 (two species had a C of 10).

The 2021 point-intercept survey found 44 native index plants in the rake. They produced a mean Coefficient of Conservatism of 6.8 and a Floristic Quality Index of 45.4. Nichols (1999) reported an average mean C for the Northern Lakes and Forest Region of 6.7 putting MECL slightly above average for this part of the state. The FQI was nearly double the median FQI of 24.3 for the Northern Lakes and Forest Region. Seven of the species identified were given Cs of 9 or 10 (three species had a C of 10). These values were better than what was recorded in 2013.

Table 6: 2013 FQI calculations – Middle Eau Claire Lake

Species	Common Name	C
Bidens beckii	Water marigold	8
Brasenia schreberi	Watershield	6
Ceratophyllum demersum	Coontail	3
Chara sp.	Muskgrass	7
Elatine minima	Waterwort	9
Eleocharis acicularis	Needle spikerush	5
Elodea canadensis	Common waterweed	3
Heteranthera dubia	Water star-grass	6
Isoetes echinospora	Spiny-spored quillwort	8
Juncus pelocarpus	Brown-fruited rush	8
Lemna trisulca	Forked duckweed	6
Myriophyllum sibiricum	Northern water-milfoil	6
Myriophyllum tenellum	Dwarf water-milfoil	10
Najas flexilis	Slender naiad	6
Nitella sp.	Nitella	7
Nuphar variegata	Spatterdock	6
Nymphaea odorata	White water lily	6
Pontederia cordata	Pickerelweed	8
Potamogeton alpinus	Alpine pondweed	9
Potamogeton amplifolius	Large-leaf pondweed	7
Potamogeton foliosus	Leafy pondweed	6
Potamogeton friesii	Fries' pondweed	8
Potamogeton gramineus	Variable pondweed	7
Potamogeton illinoensis	Illinois pondweed	6
Potamogeton natans	Floating-leaf pondweed	5
Potamogeton praelongus	White-stem pondweed	8
Potamogeton pusillus	Small pondweed	7
Potamogeton richardsonii	Clasping-leaf pondweed	5
Potamogeton robbinsii	Fern pondweed	8
Potamogeton strictifolius	Stiff pondweed	8
Potamogeton zosteriformis	Flat-stem pondweed	6
Ranunculus aquatilis	White water crowfoot	8
Ranunculus flammula	Creeping spearwort	9
Sagittaria cristata	Crested arrowhead	9
Schoenoplectus acutus	Hardstem bulrush	6
Sparganium emersum	Short-stemmed bur-reed	8
Stuckenia pectinata	Sago pondweed	3
Typha latifolia	Broad-leaved cattail	1
Utricularia intermedia	Flat-leaf bladderwort	9
Utricularia minor	Small bladderwort	10
Utricularia vulgaris	Common bladderwort	7
Vallisneria americana	Wild celery	6
N		42
mean C		6.8
FQI		43.8

Table 7: 2021 FQI calculations – Middle Eau Claire Lake

Species	Common Name	C
Bidens beckii	Water marigold	8
Brasenia schreberi	Watershield	6
Ceratophyllum demersum	Coontail	3
Ceratophyllum echinatum	Spiny hornwort	10
Chara sp.	Muskgrass	7
Elatine minima	Waterwort	9
Eleocharis acicularis	Needle spikerush	5
Elodea canadensis	Common waterweed	3
Heteranthera dubia	Water star-grass	6
Juncus pelocarpus f. submersus	Brown-fruited rush	8
Lemna minor	Small duckweed	4
Lemna trisulca	Forked duckweed	6
Myriophyllum sibiricum	Northern water-milfoil	6
Myriophyllum tenellum	Dwarf water-milfoil	10
Myriophyllum verticillatum	Whorled water-milfoil	8
Najas flexilis	Slender naiad	6
Nitella sp.	Nitella	7
Nuphar variegata	Spatterdock	6
Nymphaea odorata	White water lily	6
Pontederia cordata	Pickerelweed	8
Potamogeton alpinus	Alpine pondweed	9
Potamogeton amplifolius	Large-leaf pondweed	7
Potamogeton foliosus	Leafy pondweed	6
Potamogeton friesii	Fries' pondweed	8
Potamogeton gramineus	Variable pondweed	7
Potamogeton illinoensis	Illinois pondweed	6
Potamogeton natans	Floating-leaf pondweed	5
Potamogeton praelongus	White-stem pondweed	8
Potamogeton pusillus	Small pondweed	7
Potamogeton richardsonii	Clasping-leaf pondweed	5
Potamogeton robbinsii	Fern pondweed	8
Potamogeton strictifolius	Stiff pondweed	8
Potamogeton zosteriformis	Flat-stem pondweed	6
Ranunculus aquatilis	White water crowfoot	8
Sagittaria cuneata	Arum-leaved arrowhead	7
Sagittaria graminea	Grass-leaved arrowhead	9
Schoenoplectus acutus	Hardstem bulrush	6
Spirodela polyrhiza	Large duckweed	5
Stuckenia pectinata	Sago pondweed	3
Utricularia gibba	Creeping bladderwort	9
Utricularia intermedia	Flat-leaf bladderwort	9
Utricularia minor	Small bladderwort	10
Utricularia vulgaris	Common bladderwort	7
Vallisneria americana	Wild celery	6
N		44
mean C		6.8
FQI		45.4

4.3.2 Changes in Native Aquatic Plant Species – 2013 to 2021

The 2013 survey documented Slender naiad, Coontail, Flat-stem pondweed, Small pondweed, Muskgrass, Common waterweed, and Northern watermilfoil as the most common species - found at 80 or more points during the survey (Figure 20). In 2021, nine species were found at 80 or more points – all of the same species from the 2013 survey plus two more, Fern-leaf pondweed and Clasping-leaf pondweed (Figure 21). Only one species that held a sizable place in the aquatic plant community in MECL saw a significant decline from 2013 to 2021 – Slender naiad (Figures 22 and 23).

Left to right, top to bottom: Slender naiad, Coontail, Flat-stem pondweed, Small pondweed, Muskgrass, Common waterweed, Northern watermilfoil

Figure 20: 2013 most common aquatic plant species in MECL

Figure 21: Fern-leaf pondweed (left) and Clasping-leaf pondweed (right)

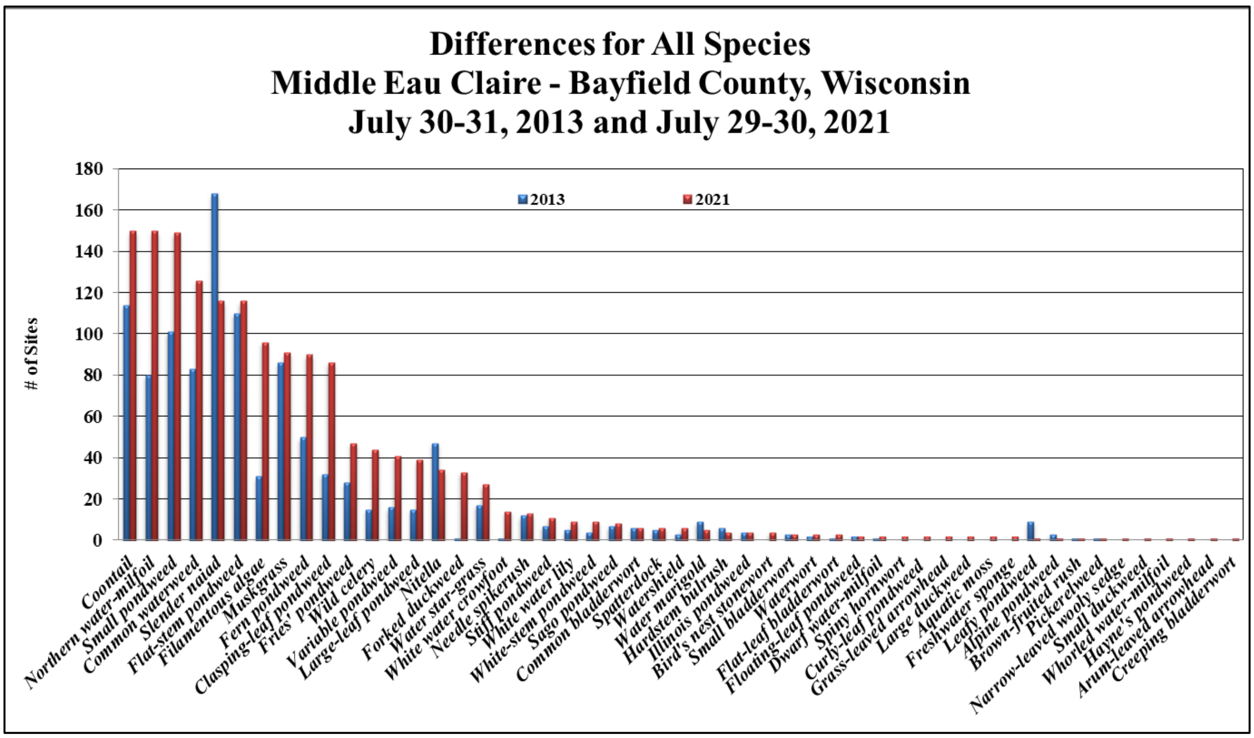


Figure 22: 2013 to 2021 differences for all aquatic plant species (ERS)

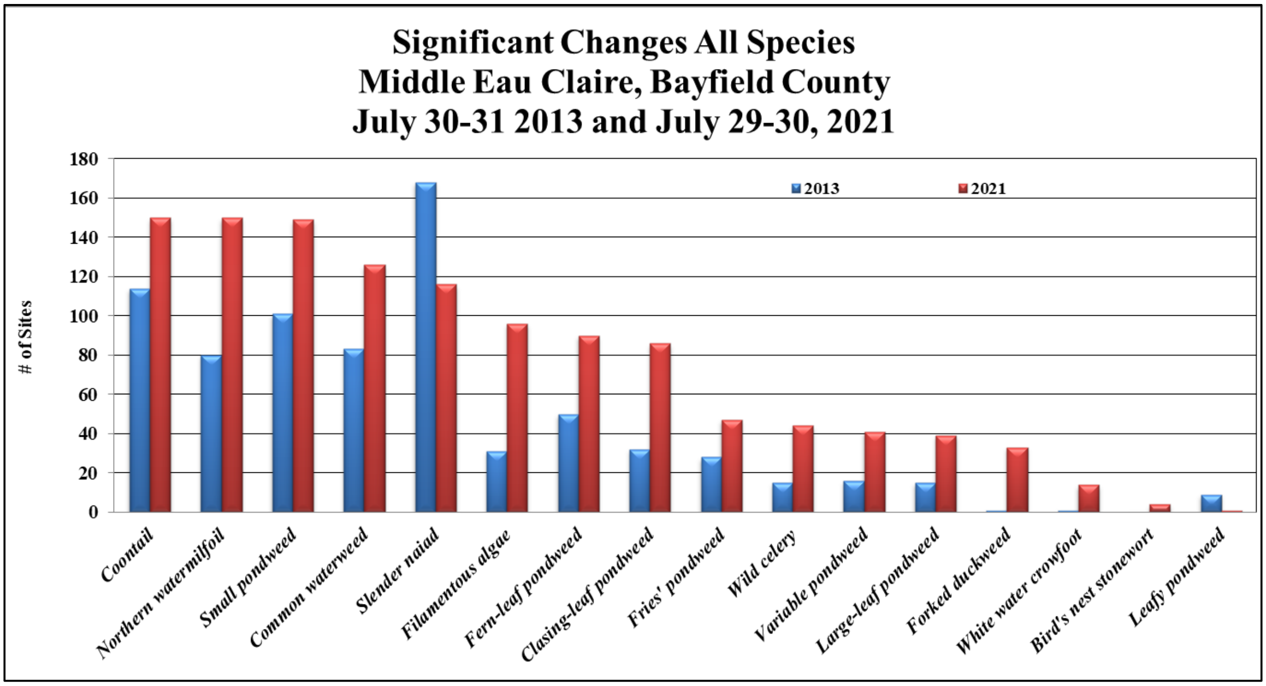


Figure 23: 2013 to 2021 significant differences in aquatic plant species (ERS)

4.4 Filamentous Algae:

In 2013, filamentous algae was located at 31 sites throughout MECL. In 2021 it was present at 96 points, more than 3x what was identified in 2013 (Figure 24). Normally, these algae proliferate in environments where there are excessive nutrients in the water. The surveyor noted that these locations had little to no correlation with residences suggesting these growths may be caused by generalized high nutrient levels rather than point-source or localized nutrient recycling.

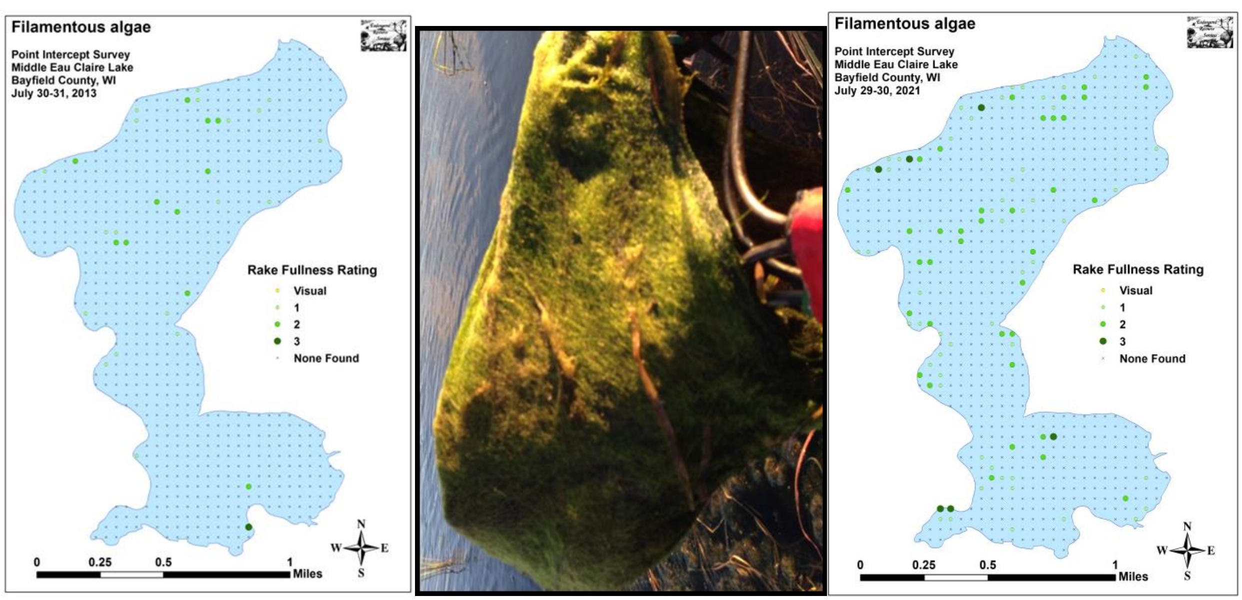


Figure 24: 2013 and 2021 points with filamentous algae (ERS)

4.5 Other Aquatic Invasive Species in Middle Eau Claire Lake

No evidence of EWM was found in MECL during any of the surveys that have been completed through 2022. However, in addition to CLP, Hybrid cattail, Reed canary grass, and Common forget-me-not were identified during the 2021 survey (Figure 25). Purple loosestrife and yellow iris have also been found at various times along the shoreline of MECL.

Figure 25: Forget-me-not, Reed canary grass, and Yellow iris (ERS)

4.6 Wild Rice

Wild rice is an aquatic grass which grows in shallow water in lakes and slow flowing streams. This grass produces a seed which is a nutritious source of food for wildlife and people. The seed matures in August and September with the ripe seed dropping into the sediment, unless harvested by wildlife or people. It is a highly protected and valued natural resource in Wisconsin. Only Wisconsin residents may harvest wild rice in the state. According to the WDNR Surface Water Data Viewer, MECL is not wild rice water.

5.0 2021-2023 Curly-leaf Pondweed Management

In 2015, the Town of Barnes began the discussion of building a DASH (diver-assisted suction harvest) boat for use to remove CLP in the Eau Claire Lakes and EWM in Sand Bar and Tomahawk Lakes. The Barnes AIS Sucker (BAISS) boat was completed in 2016 and used for the first time in 2017. DASH involves scuba divers who swim along the bottom of the lake with a hydraulic suction tube and when an offending plant is found, it is dislodged by the diver and fed into the suction tube. Hydraulic suction brings the removed plant to the surface of the lake and deposits into a bag or bin on the boat (Figure 23).

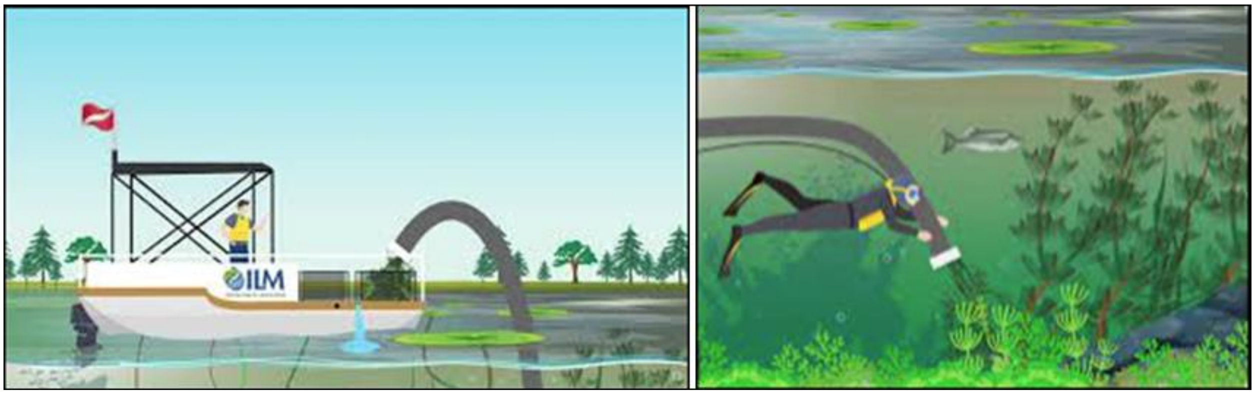


Figure 26: DASH boat and underwater operation (ILM Environments)
https://www.youtube.com/watch?v=YQmLMKzc1UM

While physical removal by volunteers continues in the lake to the current time, the BAISS boat and DASH is the main management action. No herbicide use has been proposed or implemented. Table 8 reflects the results of those management actions based on data mined from the Town of Barnes AIS Committee Minutes since 2014, and some of the volunteers involved in the process. In the Table, the term "bags" refers to the mesh bag or onion bag that is used to catch the aquatic vegetation that is removed from the bottom of the lake and fed into the suction tube.

When operating the BAISS boat having a volunteer driver, at least two volunteers to serves as deck hands assisting the divers and at least two paid divers is necessary. Hundreds of hours of volunteer and paid time have been expended by the Town of Barnes since 2017 operating the BAISS boat on Lower, Middle, and Upper Eau Claire Lakes.

CLP mapping of the lakes is a necessary pre-management action as it helps to minimize time wasted traveling around the lakes looking for CLP while on the BAISS boat. Hundreds of additional volunteers hours and paid consultant time has been expended doing mapping from 2014-2023.

In 2020, CLP was found in Shunenberg Lake and physically removed by volunteers. It was rediscovered in 2023.

Table 8: 2014-2023 CLP management actions in Lower, Middle, and Upper Eau Claire Lakes

2014 to 2023 Physical and DASH Removal of Curly-leaf Pondweed from Lower, Middle, and Upper Eau Claire Lakes										
Lake	2014		2015		2016		2017		2018	
	Method	Result	Method	Result	Method	Result	Method	Result	Method	Result
Lower	NA		NA		NA		NA		NA	
Middle	Physical	NR	Physical	NR	Physical	NR	DASH	48cuft	DASH	none
	Diver (ERS)	NR			Diver	NR				
Upper	Physical	NR	Physical	BR	Physical	NR	DASH	NR	DASH	NR

Lake	2019		2020		2021		2022		2023	
	Method	Result	Method	Result	Method	Result	Method	Result	Method	Result
Lower	NA		NA		NA		DASH	2 bags	DASH	?
Middle	DASH	none	DASH	10 bags	DASH	46.5 bags	DASH	25.5 bags	DASH	?
Upper	DASH	2 bags/day	DASH	21 bags	DASH	35.5 bags	DASH	57.25 bags	DASH	?

NA - Not Applicable   NR - No Report

At least in the last three years, the BAISS boat has been used in MECL to remove CLP. This process has been successful at keeping the amount of CLP in the lake to a low frequency. As mentioned, DASH removal with the BAISS was not necessary in 2023 due to past removal efforts by the BAISS boat and the aquatic plant surveyor.

6.0 Management Discussion

In a Technical Review of the literature available discussing CLP, two WDNR researchers identified the following potential lake impacts as it relates to CLP (Mikulyuk & Nault, 2009).

Economic Impact

Monotypic stands of P. crispus can be quite a nuisance, presenting significant navigational difficulties to recreational users. P. crispus can also stimulate algal blooms which can decrease the aesthetic value of a waterbody. These factors have a significant impact on the recreational and real estate value of a waterbody, and may also have an impact on the tourism industry. Impacts are greatest in the species' introduced range, where it is considered a noxious weed.

Social Impact

P. crispus can be a substantial nuisance to recreational users by impeding navigation and tangling fishing line. This species can also reduce swimming access and stimulate unsightly, possibly toxic algal blooms. Its environmental effects can decrease the aesthetic value of a waterbody as well as affect property values and tourism.

Impact on Crops and Other Plants

Given this species' tendency to grow in monocultures with high productivity, it has been reported to cause decreases in biodiversity by outcompeting native plants. However, it should be noted that the impact of this species on the native plant community is disputed, with some authors concluding that the fact that the plant acts like a winter annual removes it from negatively impacting native species. In its native range it can be productive, but is not generally reported as a nuisance.

Impact on Habitat

Massive stands of P. crispus substantially alter a waterbody's internal loading, and can also reduce the fetch of a lake, sometimes inducing stratification in normally unstratified systems. In a comparative study that evaluated four related macrophyte species, P. crispus produced the highest shoot growth rate and biomass. It can grow in dense monotypic stands and affect habitat structure, which may have impacts on commercially and recreationally sought after fish species. P. crispus has been reported to decrease the amount of light reaching the sediment surface. However, the plant may have positive effects in extremely degraded systems. One study reports that planting of P. crispus in enclosures improved water transparency, decreased electric conductivity, increased pH, and was shown to have an inhibitory effect on green algae.

Impact on Biodiversity

Several sources report that P. crispus has a negative effect on macrophyte biodiversity and often outcompetes native plants. P. crispus is found at sites where P. ogdenii, a critically impaired species, exists. P. crispus likely competes with P. ogdenii and may be having a significant impact on it. In studies conducted in its native range of Poland, the variety of fungus species reported growing on dead fragments of P. crispus was greater in relation to other plant species.

6.1 CLP in Middle Eau Claire Lake

Almost all of the CLP found in MECL since 2013 has been in the southern-most basin where a muck bottom exists. There is little habitat for CLP anywhere else in the lake. This area of the lake also has the greatest native aquatic plant diversity. Management actions that continue to control the spread of CLP in the lake and at the same time protects the native aquatic plant diversity should be continued. In MECL and with the Town of Barnes, this means mechanical harvesting (diver removal) using DASH.

The BAISS boat harvesting program appears to be keeping the CLP populations in check in both Middle and Upper Eau Claire lakes and as long the distribution of CLP does not expand rapidly these efforts will likely continue to be successful while simultaneously having minimal impact on all of the lakes rich and diverse native plant community. As long as running the harvester remains a viable management option, it will likely continue to be the most environmentally friendly method of controlling CLP. In the future, if suction harvesting is discontinued or if isn't possible to get to all of the CLP beds with the time available and the Town of Barnes and/or the Friends of the Eau Claire Lakes considers chemical control, it is strongly encouraged that a measured approach that is closely evaluated be taken.

6.2 CLP Management

A scenario-based approach to CLP management is recommended over the next five years. A scenario-based approach means that any amount of CLP may be managed in the lake; however, the management actions implemented will be dictated by the conditions that exist in the lake at any given time. Not all CLP needs to be removed from the lake, but efforts should be made to keep it from gaining more purchase in the lake. To do this, a combination of manual/physical removal, DASH, and chemical control methods are recommended for MECL. As such, the following monitoring and control activities have been outlined:

1) CLP will be monitored by volunteers and resource professionals every year.
    a. Pre-management surveys will be completed annually as soon as CLP begins to make an appearance in an effort to judge the severity of seasonal growth.
    b. Early summer CLP bedmapping will be completed annually in early to mid-June in an effort to track its expansion or decline.
2) Areas of CLP with sparse, isolated plants can and should be hand pulled or raked by volunteers in shallow water (≈ 5 feet) around docks and along shorelines.
    a. Can be completed at any time during the CLP growing season
    b. Does not require a WDNR permit.
3) Snorkel, rake, and/or scuba diver removal of CLP can and should take place in areas with isolated plants, small clumps, or small beds of plants where practical and if resources are available.
    a. Would likely be completed by the Friends of the Eau Claire Lakes and supported by the Town of Barnes
    b. Can be completed at any time during the CLP growing season
    c. Does not require a WDNR permit.
4) Diver-assisted Suction Harvest or DASH will likely be the most used management action in MECL. It has been and will continue to be used in place of or in combination with snorkel, rake, and/or scuba diver removal of CLP allowing larger areas of CLP to be managed without the use of herbicides.
    a. Would likely be completed by the Friends of the Eau Claire Lakes and supported by the Town of Barnes
    b. Can be completed at any time prior to when turions are set
    c. DASH requires a WDNR Mechanical Harvesting permit.
5) Application of aquatic herbicides can be used in any area under the following guidelines
    a. The Town of Barnes or Friends of the Eau Claire Lakes can show that other management methods have been tried.
    b. Conditions exist that are likely to make other management alternatives less effective

i. Bed size and density of CLP in the area
ii. Location of the area in relation to lake access and usability
iii. Bottom substrate, water depth, and/or clarity are prohibitive
iv. Limited or unavailable access to diver, or DASH services
v. Limited financial resources
vi. Less than a majority constituent support for a proposed management action.

c. One-time herbicide application
    i. Proposed chemical treatment areas are at least 5.0 acres in size.
    ii. Liquid endothall (Aquathol K) is used at 1-3 ppm
    iii. Single or combined area treatments >10.0 acres will be considered large-scale
        1. Pre (prior year) and post (year of and/or year after) treatment aquatic plant surveys should be considered.
        2. Herbicide concentration testing should be considered
    iv. Single or combined area treatments >51.0 acres will be considered whole-lake
        1. Whole-lake herbicide concentration should be calculated based on the proposed application rate.
        2. Pre (prior year) and post (year of and/or year after) treatment aquatic plant surveys should be considered.
        3. Herbicide concentration testing should be considered
    v. Requires a WDNR Chemical Application permit
    vi. Herbicides must be applied by a licensed Applicator

Many of the management actions outlined for CLP would also be effective for the management of Eurasian watermilfoil should it be found in MECL over the next five years. A different herbicide would be used; likely ProcellaCOR or a liquid 2,4D-based herbicide. Annual management decisions for CLP (or EWM) will always be based on the level of infestation, current understanding of management alternatives, resources available, what is acceptable to the constituency, and what the WDNR will approve.

6.3 Management of Other AIS

At the present time, CLP is the only AIS plant that is actively managed in MECL. That said, other AIS plants including but not limited to Eurasian watermilfoil, purple loosestrife, yellow iris should be monitored for on a regular basis and management actions taken when found. EWM would be managed similarly to CLP. Purple loosestrife could be physically removed, managed with aquatic herbicides, or in large areas, biological control beetles could be reared and released. Yellow iris would likely be managed with physical removal.

The lake should also be actively monitored for zebra mussels and spiny waterflea.
For more information about these and other AIS review the more inclusive Aquatic Plant Management Plan for the Towns of Barnes, Gordon, and Highland in Bayfield and Douglas Counties of which this document is an addendum.

7.0 Aquatic Plant Management Goals

This Aquatic Plant Management Plan establishes the following goals for aquatic plant management in Middle Eau Claire Lake:

1) **CLP Management.** Maintain CLP at low levels through environmentally responsible management methods that will minimize the potential for negative impacts to the lake and native plant community in the future.

2) **AIS Education and Awareness.** Continue to educate property owners and lake users on aquatic invasive species through public outreach and education programs to help contain existing AIS in and around the lake and new AIS that could get introduced to the lake.

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 modifies the management plan as necessary to meet goals and objectives.

7.1 Goal 1. CLP Management

The main goal of this APM Plan for MECL is to keep CLP from increasing its distribution and density in the lake. While the presence of CLP in the lake is not necessarily an indicator that the health of the lake and its aquatic plant community is deteriorating, in many lakes CLP can cause the following issues identified by the WDNR[2]:

- It can become dominant and invasive due to its tolerance for low light and low water temperatures.
- It may outcompete other underwater plants and become dominant, which causes problems due to the formation of dense mats that interfere with recreational activities.
- It also causes an increase in phosphorus concentrations, causing an increase in algae blooms and a pile-up of dying plants along the shore.

At the present time, CLP is doing none of these things in MECL. The goal is to complete prevention management to keep it from doing so for as long as possible.

7.1.1 CLP Survey Work

Management of CLP will be updated regularly based on pre-management surveys and annual bed mapping surveys completed by either trained volunteers or resource professionals. Pre-management surveys should be completed as soon after ice out as possible to begin getting a perspective on how the given growing season will impact the amount of CLP in the lake. WDNR permitting either needs to wait to be completed until some perspective is gained from these surveys, or have the possibility of managing more CLP then expected built into it. This is easy with a mechanical harvesting permit, more difficult with a chemical application permit. Once pre-management surveys are completed management plans should be reviewed and modified if necessary. Annual CLP bed mapping surveys, completed at the height of CLP growth, will be used to quantify the extent of CLP in the lake in any given year. Generally

[2] https://dnr.wisconsin.gov/topic/Invasives/fact/CurlyLeafPondweed.html

speaking, greater amounts of CLP during a bed mapping survey will lead to more extensive management plans the following year.

Once these surveys are completed discussion pertaining to next season management will begin. Should it be determined that the application of aquatic herbicides will come into play in the following year, additional pre-treatment surveys of aquatic plants may be completed to document the present of native plants. Post-treatment surveys may be included in the year of treatment and/or in the year after treatment. Pre and post treatment surveys are not required by the WDNR unless the chemically treated areas cover 10 or more acres.

7.1.2 Herbicide Concentration Testing

At least in the first year covered in this APM Plan where aquatic herbicides are used in MECL it is highly recommended that herbicide concentration testing be done. Herbicide concentration testing helps determine if the amount of herbicide applied reached the expected concentrations, how fast it dissipates, and if it is transported to other parts of the lake that were not intended for treatment. If a chemical treatment is not very effective, concentration testing can help determine why.

7.2 Goal 2. AIS Education and Awareness

Aquatic invasive species can be transported via a number of vectors, but most invasions are associated with human activity. Maintaining signs and continuing watercraft inspection at the public boat landing should be done to educate lake users about what they can do to prevent the spread of AIS.

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 and eradicated. Once an aquatic invasive species becomes widely established in a lake, complete eradication becomes extremely difficult, 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 Town of Barnes and Friends of the Eau Claire Lakes 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 EWM and other species like purple loosestrife, Japanese knotweed, giant reed grass, and zebra mussels. Free support for this kind of monitoring program is provided as part of the UW-Extension Lakes/WDNR 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 Town of Barnes and Friends of the Eau Claire Lakes 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 Town of Barnes and Friends of the Eau Claire Lakes 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 Town of

Barnes and Friends of the Eau Claire Lakes should distribute, or redistribute 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 Town of Barnes and Friends of the Eau Claire Lakes that is focused on 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.

7.3 Goal 3. Research and Monitoring

Long-term data can be used to identify the factors leading to changes in water quality. Such factors include 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. MECL has been a part of this program for many years and should continue its involvement.

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.

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 APM Plan as needed in response to how the plant community changes as a result of management and natural factors. The next whole-lake point-intercept survey should be planned for 2026 with an update of this plan completed in 2027.

The Town of Barnes and Friends of the Eau Claire Lakes should continue to support efforts to improve/restore native shoreland around the lake that lead to healthier habitat and less polluted runoff from properties immediately adjacent to the lake. These efforts should continue and can be supported by the Wisconsin Healthy Lakes and Rivers Initiative. In addition, the Town of Barnes and Friends of the Eau Claire Lakes should continue to work with the Bayfield County Soil and Water Conservation Department to address runoff concerns in the greater watershed.

7.4 Goal 4. Adaptive Management

This APM Plan is a working document guiding management actions on MECL for the next five years. This plan will follow a scenario-based, 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.

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