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CRANBERRY LAKE, BAYFIELD COUNTY

2024-2028 Aquatic Plant Management Plan
WDNR WBIC: 2741700

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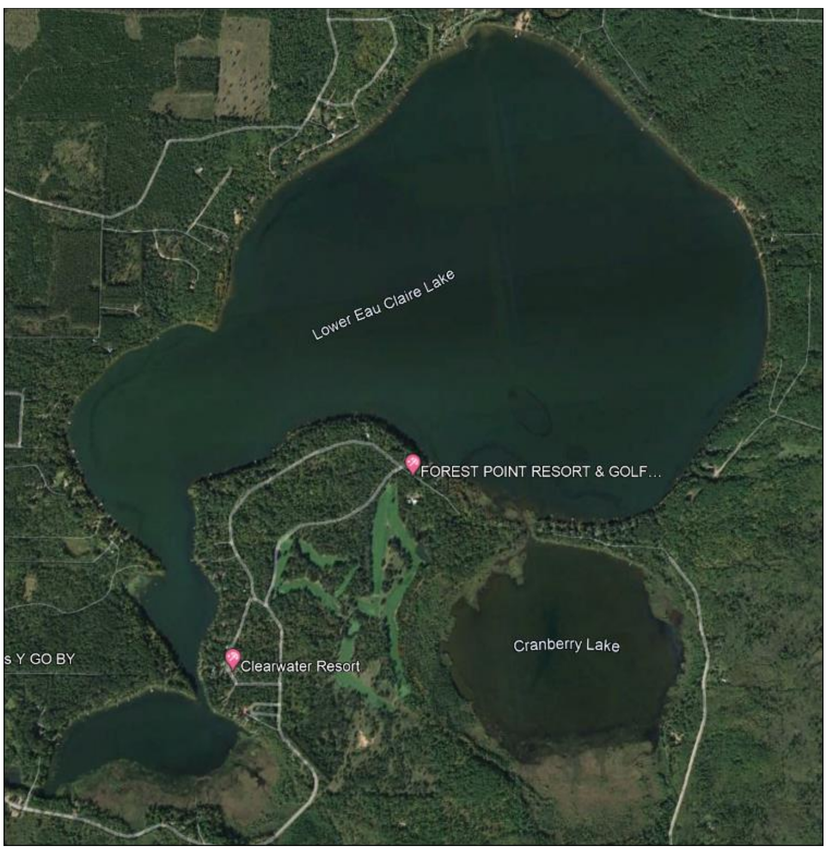
August 2023



Town of Barnes – Addendum 4

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1.0 Lake Characteristics

Cranberry Lake (CL) is a 122-131 acre lake that is connected to Lower Eau Claire Lake (LECL) in the Eau Claire Chain of Lakes in the Towns of Barnes and Gordon in Bayfield and Douglas Counties. CL is considered a drainage, shallow headwater to the Eau Claire Chain that is comprised of the Upper Eau Claire, Middle Eau Claire, and Lower Eau Claire Lakes, as well as seven additional smaller connecting lakes for a total surface water area of 3,488 acres. CL is accessible through LECL which is accessible to the public via Mooney Dam Park and Boat Landing located at the dam on the southeast corner of the lake. Mooney Park also includes a popular public campground (Figure 1).

Fish include musky, panfish, largemouth bass, northern pike and walleye. The lake's water is moderately clear. Cranberry Lake is located in the Upper St. Croix and Eau Claire Rivers watershed which is 277.89 mi². Land use in the watershed is primarily forest (83.90%), wetland (9.50%) and a mix of open (4.30%) and other uses (2.40%). This watershed has 153.93 stream miles, 7,654.41 lake acres and 13,694.48 wetland acres.

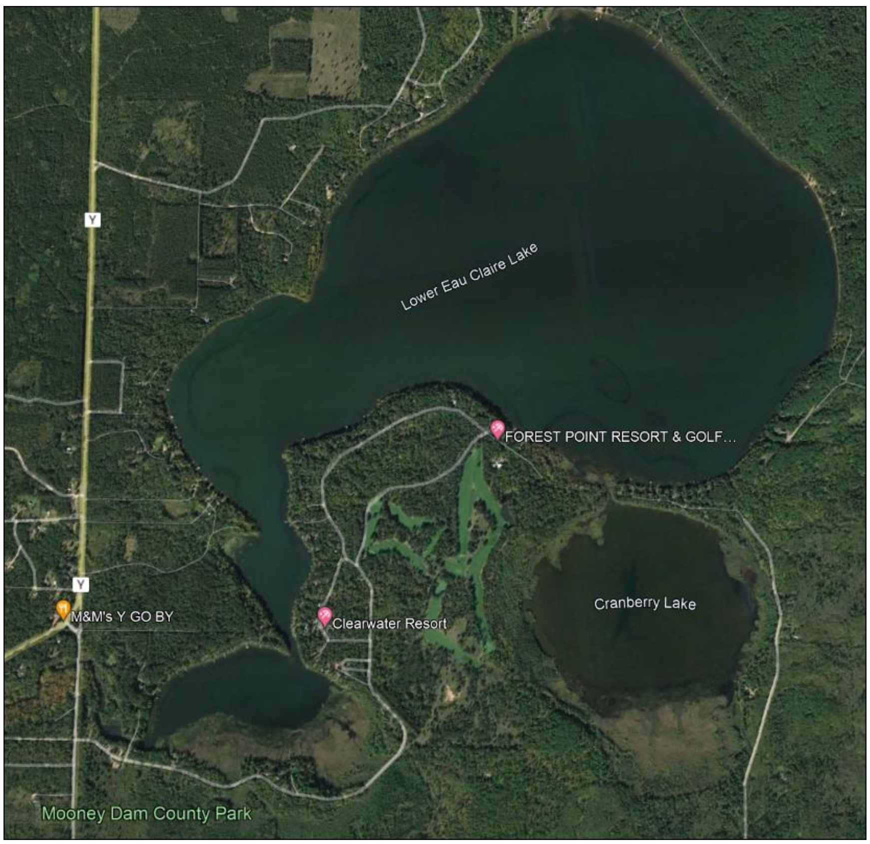

Figure 1: Cranberry Lake aerial photo (Google Earth)

CL has a maximum depth of 10.0ft and an average depth of 2.7ft according to the most recent whole-lake, point-intercept (PI) aquatic plant survey completed in 2022. Depth soundings taken at CL's 284 survey points revealed a wide open basin gradually sloping to deep water mostly in the center of the lake (Figure 2). A narrow channel exits the lake midway on the northern shoreline to LECL.

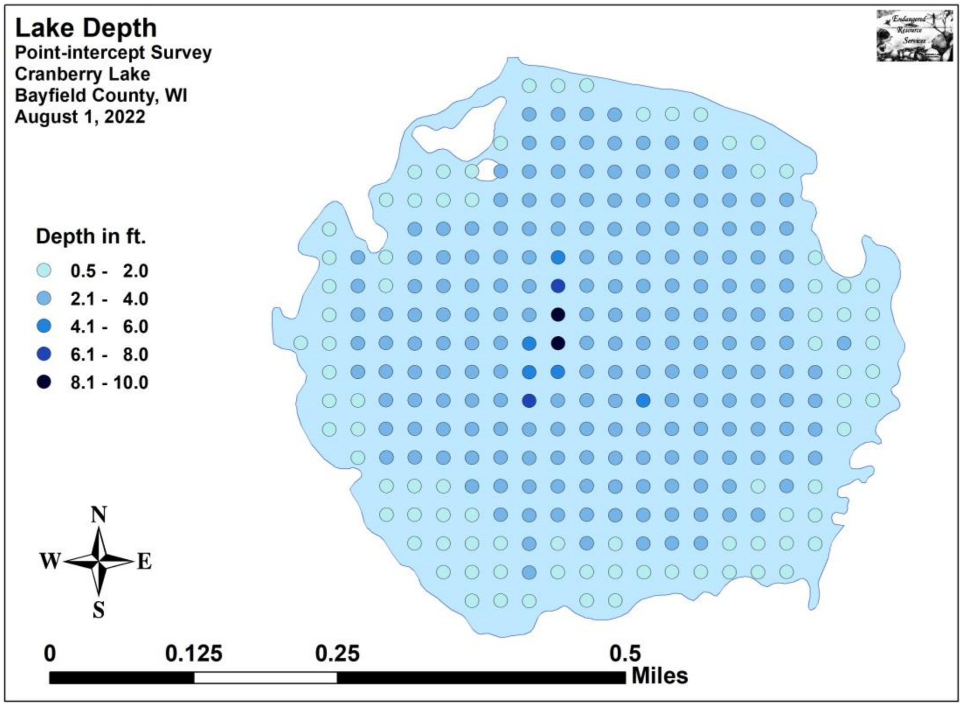

Figure 2: 2022 CL depth

All of the points included in the point-intercept grid created by the WDNR were included in the survey. The bottom of the lake is mostly muck (89.1%) with a small amount of sand (9.1%) (Figure 3).

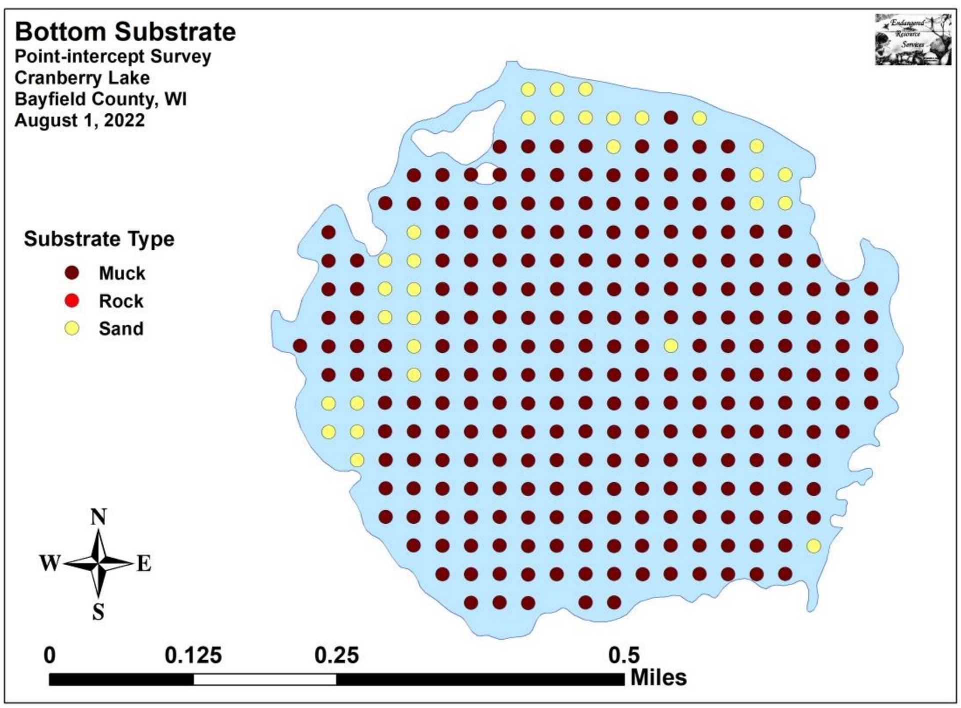

Figure 3: 2022 CL substrate

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 in the connected lakes is not as well studied, however, some data does exist through the Citizen Lake Monitoring Network[1] (CLMN). 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 CL have been collecting CLMN water quality data through the CLMN program since at 2001. During this time, 159 Secchi disk readings of water clarity have been recorded; however 103 of them indicate that when the reading was taken the Secchi disk was seen all the way to the bottom of the lake. These data have been removed from analysis.

2.1 Secchi Readings of Water Clarity

From 2001 to 2022 the average annual Secchi disk reading of water clarity was about 8.1ft. The deepest Secchi disk readings all reached the bottom of the lake at around 10.0ft. The worst or lowest Secchi disk reading taken was 5.5ft. Based on all 56 Secchi disk readings of water clarity included in the WDNR SWIMS database from 2001 to 2022 that did not reach the bottom, there is a trend of better water clarity readings (Figure 4). These data indicate also indicate that the worst month for water clarity in in May, then July. In May, spring runoff likely impacts water clarity. In July, nutrient loading may slightly impact water clarity.

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

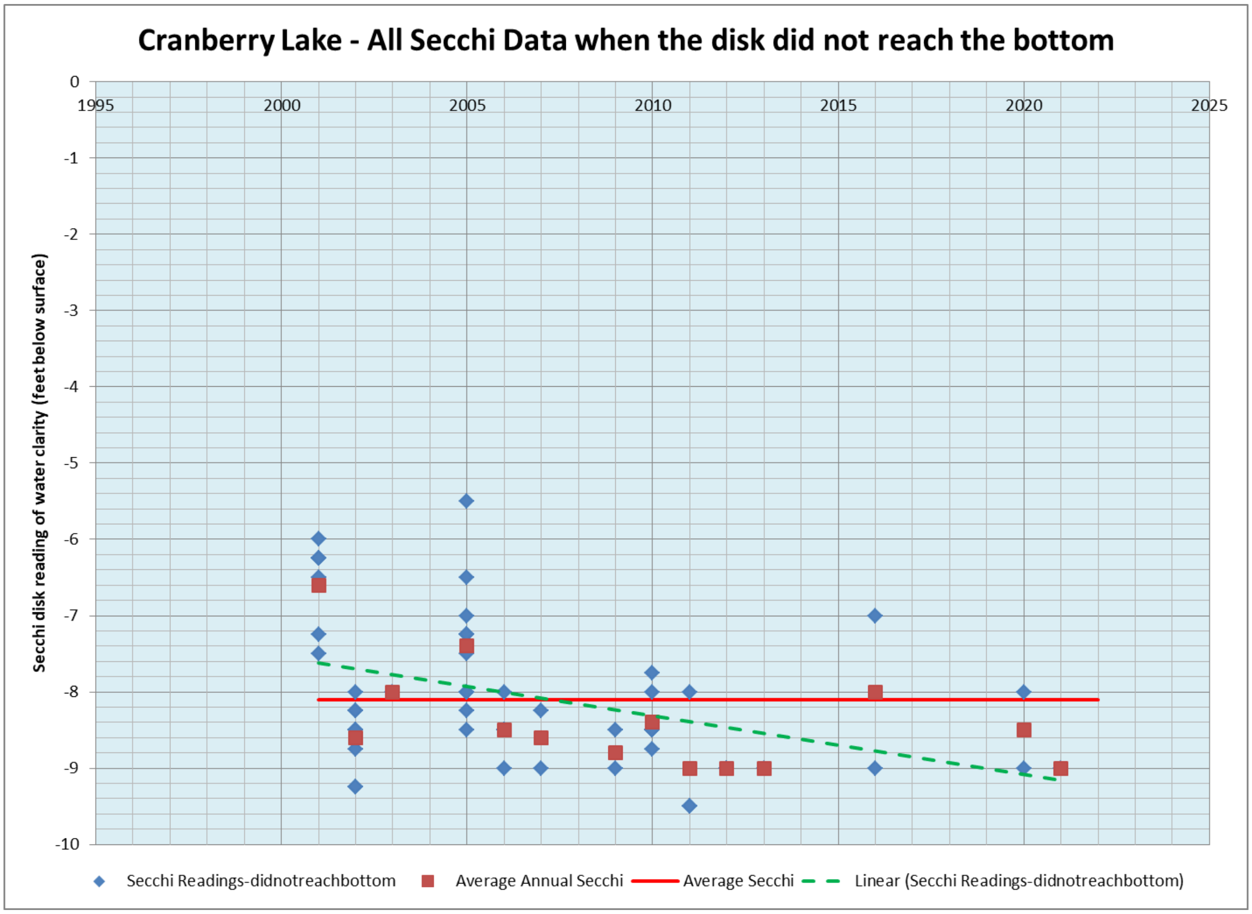

Figure 4: 2001 – 2022 Secchi depth readings that did not reach bottom w/average annual readings, average of all data, and trend line

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 in CL since 2001. The average TP concentration when considering all data is 0.022mg/L (Figure 5). This is slightly higher than the average of all the TP data for LECL – 0.016mg/L. A trend line for all data – 2001-2021 indicates that the concentration of TP has decreased over time (Figure 5).

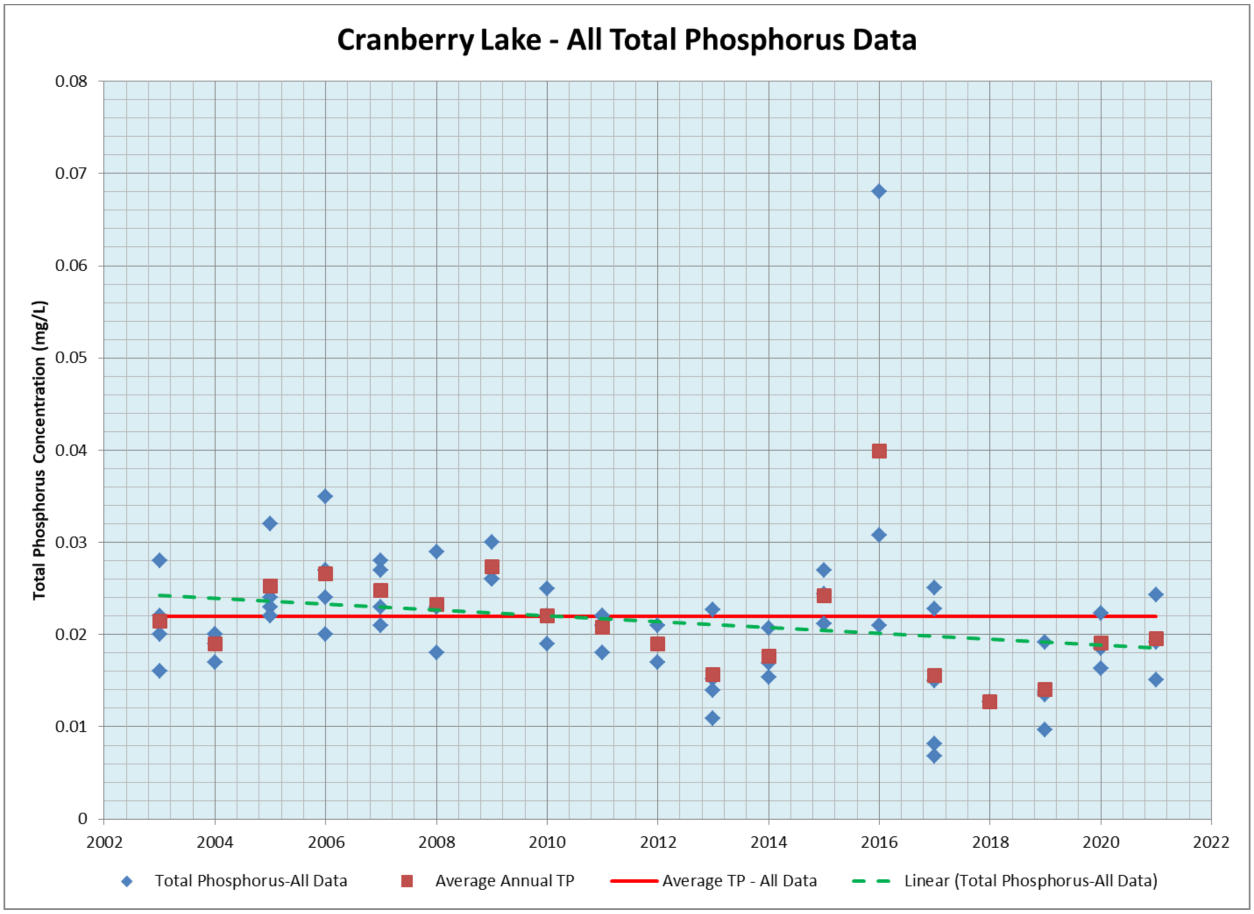

Figure 5: TP concentrations w/average annual TP and trend line

Chlorophyll-a monitoring involves collecting water samples at least 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 collected on CL from 2003 to 2021. Of the 60 samples collected over the time, 19 of them came back from the lab with a “No Detect” (ND). These results are represented by a blue diamond on the “zero” line of the graph (Figure 6). This does not mean the amount of chlorophyll-a was “zero” just that it was below the detection limit of the lab running the analysis. All of the years included in this analysis had at least three samples collected, however in some years all the samples came back as ND, or ND results limited the total results in the given year to only one sample result. These years were not included in the Average Annual Chla concentration represented by the red squares in Figure 6. A trend line suggests that the concentration of Chla has gone up over time, particularly in the late 20-teens and early 2020s (Figure 6).

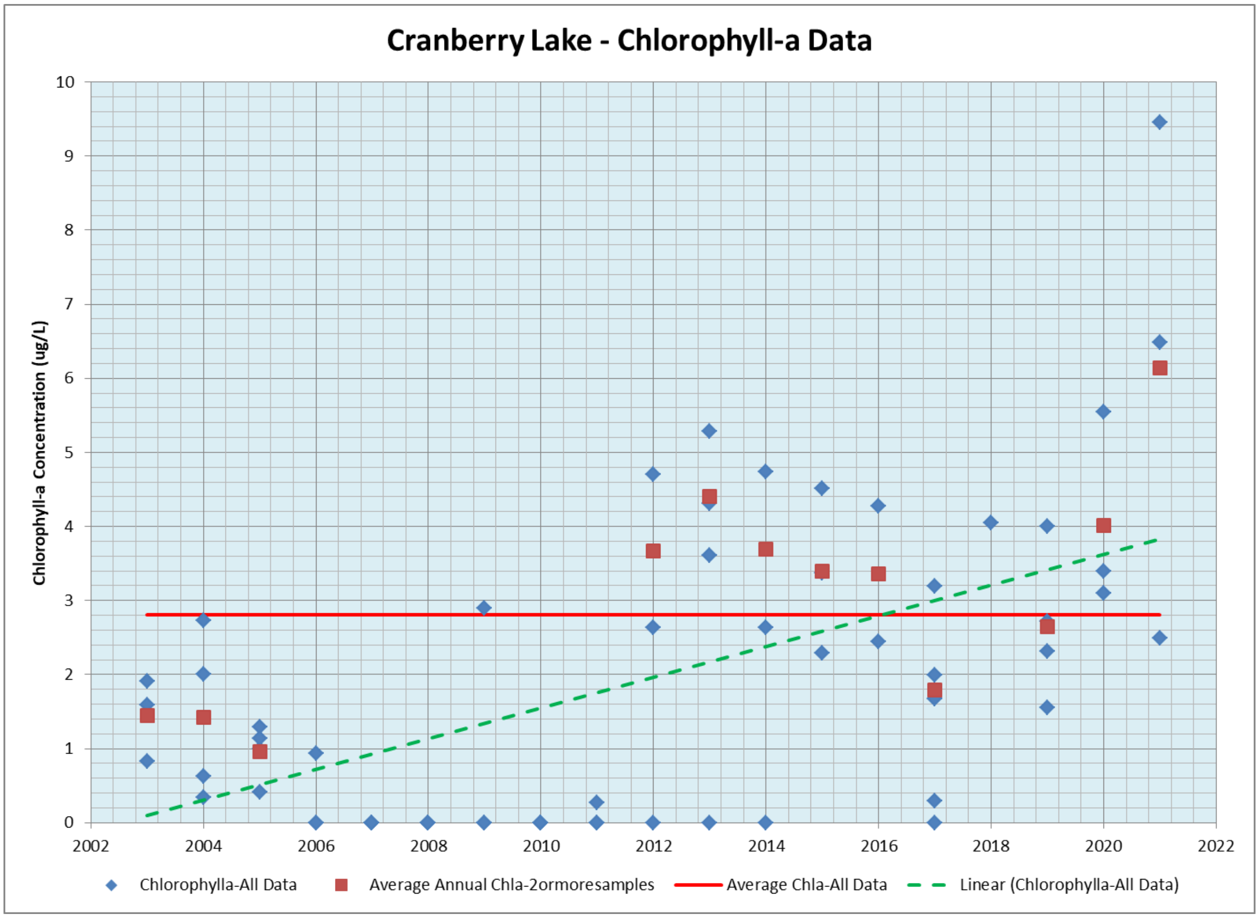

Figure 6: Chla concentrations with average annual Chla and trend line

2.3 Temperature and Dissolved Oxygen

Temperature and dissolved oxygen (DO) 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 7. 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. However, this process only occurs when the water is deep enough and/or the lake sheltered enough to make it possible. CL remains “mixed” with temperature and DO mostly consistent from the surface of the lake to the bottom of the lake during the entire open water season.

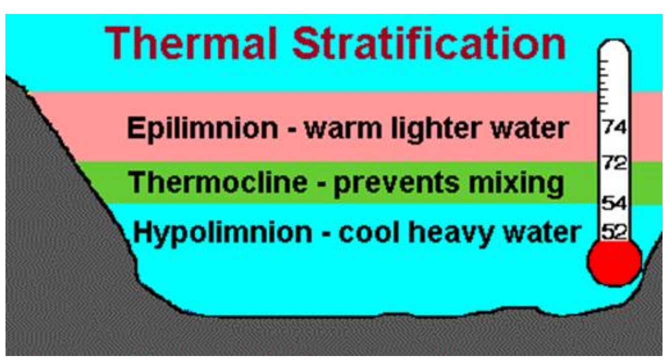

Figure 7: Summer thermal stratification

2.4 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 8). Oligotrophic lakes, on the other end of the spectrum, are nutrient poor and have little plant and algae growth (Figure 8). Mesotrophic lakes have intermediate nutrient levels and only occasional algae blooms (Figure 8). Based on actual data (Secchi depth in feet and TP and Chla in ug/L), Figure 8 can be used to determine the productivity of a given lake. Secchi and TP results put CL in the mesotrophic range, and Chla concentrations put CL in the oligotrophic range.

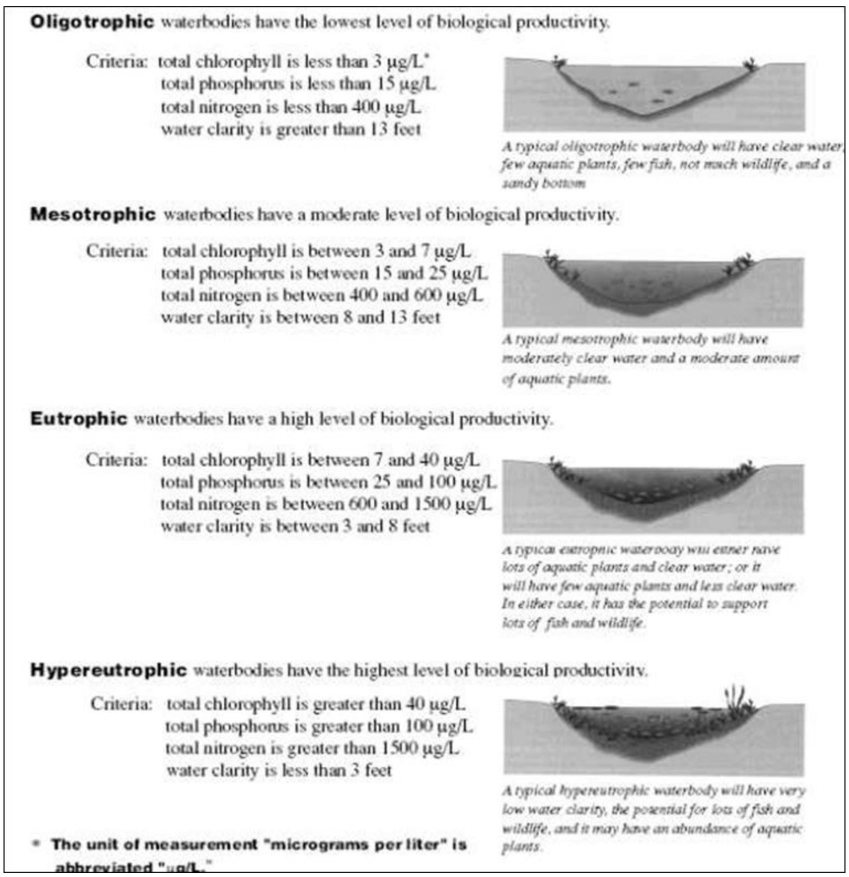

Figure 8: Trophic states in lakes

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 9). The dark blue area of Figure 9 is considered oligotrophic; the light blue mesotrophic; and the green eutrophic. Almost all values for Secchi and chlorophyll-a fall in the mesotrophic range on the chart. Total phosphorus values fall mostly in the eutrophic portion of the chart.

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 for the most part equal to Secchi (Figure 9). This pattern suggests that some factor other than phosphorus (zooplankton grazing, nitrogen, etc.) limits algal biomass. From a water quality perspective, this pattern suggests algal bloom occurrence may not change rapidly in response to P, because P concentrations are in excess of demands by phytoplankton (Carlson & Havens, 2005).

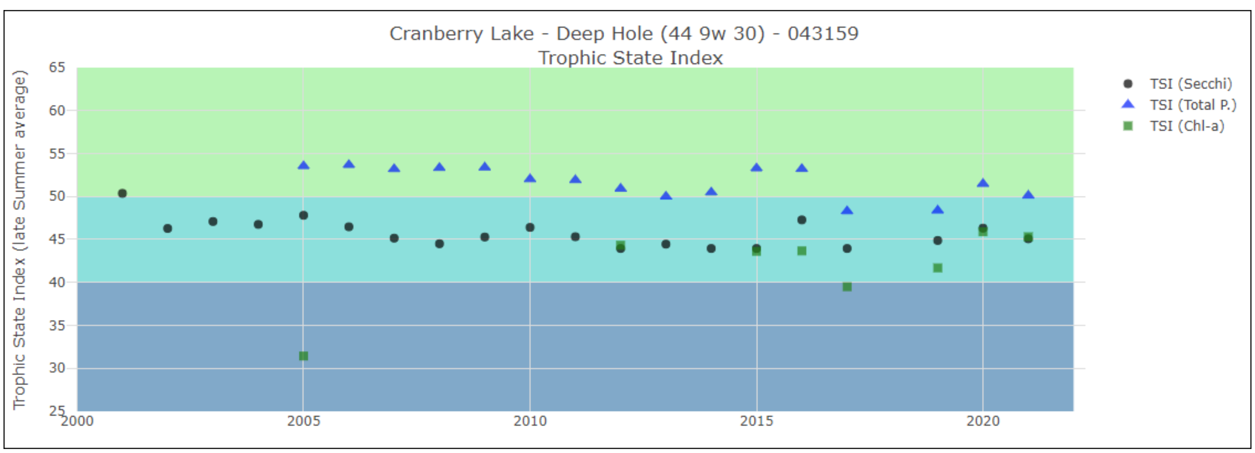

Figure 9: Yearly TSI values for Chla, Secchi (water clarity), and TP (CLMN)

3.0 Fisheries and Wildlife

Since CL is attached to LECL, the fishery is likely best represented by the fishery within LECL. LECL is considered an outstanding resource water by the WDNR. It is also listed as a Priority Navigable Water (PNW) for musky and walleye.

Lower Eau Claire Lake has a diverse fishery consisting of walleye, muskellunge, northern pike, largemouth bass, smallmouth bass, bluegill, pumpkinseed, rock bass, black crappie, yellow perch, warmouth, white sucker, yellow bullhead, creek chub, tadpole madtom, brook stickleback, johnny darter, Iowa darter, brook silverside, bluntnose minnow, common shiner, spottail shiner, mimic shiner, blackchin shiner, and golden shiner. Historic records indicate the presence of lake sturgeon and cisco, however recent surveys have not recorded the presence of these species. Rainbow trout were stocked in the mid-1980s to early 1990s but are no longer expected to be present in Lower Eau Claire Lake.

Lower Eau Claire Lake has a long stocking history and has been stocked with a number of fish species, including walleye, muskellunge, largemouth bass, bluegill and rainbow trout, since at least 1936 (Table 2).

Recent management has focused on fishery surveys and woody habitat restoration. In addition, a critical habitat designation survey was begun in the summer of 2008. The objective of the 2007-2008 survey was to determine the status of the walleye and bass populations, along with sport and tribal use of these species. More specifically, we were interested in determining population abundance, growth, size structure and harvest of walleye and abundance and size structure of panfish.

In the 2007/08 Fisheries Report there are many fish management recommendations. The last one, however, is most pertinent to this APM Plan.

"Protection of inshore habitat is important for long-term health of fisheries. Schram (1984) recognized the importance of monitoring development to ensure that aquatic plants, spawning substrates and water quality were protected. Work with local residents, the Eau Claire Lakes Conservation Club, the Eau Claire Lake Property Owners Association and the WDNR lake grants program to create and adopt a lake management plan and aquatic plant management plan: 1) develop management objectives for fisheries including goals for densities and size structures for the various fish species found in the lake, 2) where the public is willing implement recommendations from the critical habitat designation process, 3) continue restoring woody habitat along conducive shorelines working with willing riparian landowners, 4) formally establish exotic species survey and control programs targeting satellite infestations, 5) provide educational and participation forum for environmentally sensitive shoreline living, 6) identify uses and user groups to facilitate all recreational uses on the lake, 7) continue water quality monitoring through the self help 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. Preserving and enhancing the ecosystem and vigilance for exotic species must continue and 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	Stocked Waterbody Name	Species	Age Class	Number Fish Stocked	Avg Fish Length(IN)
2021	LOWER EAU CLAIRE LAKE	WALLEYE	LARGE FINGERLING	8624	6.7
2019	LOWER EAU CLAIRE LAKE	WALLEYE	LARGE FINGERLING	7844	6.3
2017	LOWER EAU CLAIRE LAKE	WALLEYE	LARGE FINGERLING	7463	6.5
2015	LOWER EAU CLAIRE LAKE	WALLEYE	LARGE FINGERLING	7844	7.4
2010	LOWER EAU CLAIRE LAKE	MUSKELLUNGE	LARGE FINGERLING	176	12.7
2006	LOWER EAU CLAIRE LAKE	MUSKELLUNGE	LARGE FINGERLING	110	12.4
2004	LOWER EAU CLAIRE LAKE	MUSKELLUNGE	LARGE FINGERLING	401	10.8
2002	LOWER EAU CLAIRE LAKE	MUSKELLUNGE	LARGE FINGERLING	401	11.4
2000	LOWER EAU CLAIRE LAKE	MUSKELLUNGE	LARGE FINGERLING	800	12.1
1998	LOWER EAU CLAIRE LAKE	MUSKELLUNGE	LARGE FINGERLING	700	12.5
1997	LOWER EAU CLAIRE LAKE	MUSKELLUNGE	LARGE FINGERLING	400	12.1
1996	LOWER EAU CLAIRE LAKE	MUSKELLUNGE	FINGERLING	800	11.6
1993	LOWER EAU CLAIRE LAKE	MUSKELLUNGE	FINGERLING	800	11.9
1992	LOWER EAU CLAIRE LAKE	MUSKELLUNGE	FINGERLING	800	10
1992	LOWER EAU CLAIRE LAKE	WALLEYE	FINGERLING	11250	3.6
1991	LOWER EAU CLAIRE LAKE	MUSKELLUNGE	FINGERLING	800	10
1991	LOWER EAU CLAIRE LAKE	RAINBOW TROUT	YEARLING	2500	9
1989	LOWER EAU CLAIRE LAKE	MUSKELLUNGE	FINGERLING	400	11
1988	LOWER EAU CLAIRE LAKE	RAINBOW TROUT	YEARLING	2500	9
1985	LOWER EAU CLAIRE LAKE	RAINBOW TROUT	YEARLING	2500	9
1984	LOWER EAU CLAIRE LAKE	MUSKELLUNGE	FINGERLING	800	9.5

3.1 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 CL by the WDNR in 2007 with a report completed in 2013 (Smith et al. (2013). Figure 10 shows the critical habitat areas in LECL 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 CL Critical Habitat Designation Report Smith et al. (2013).

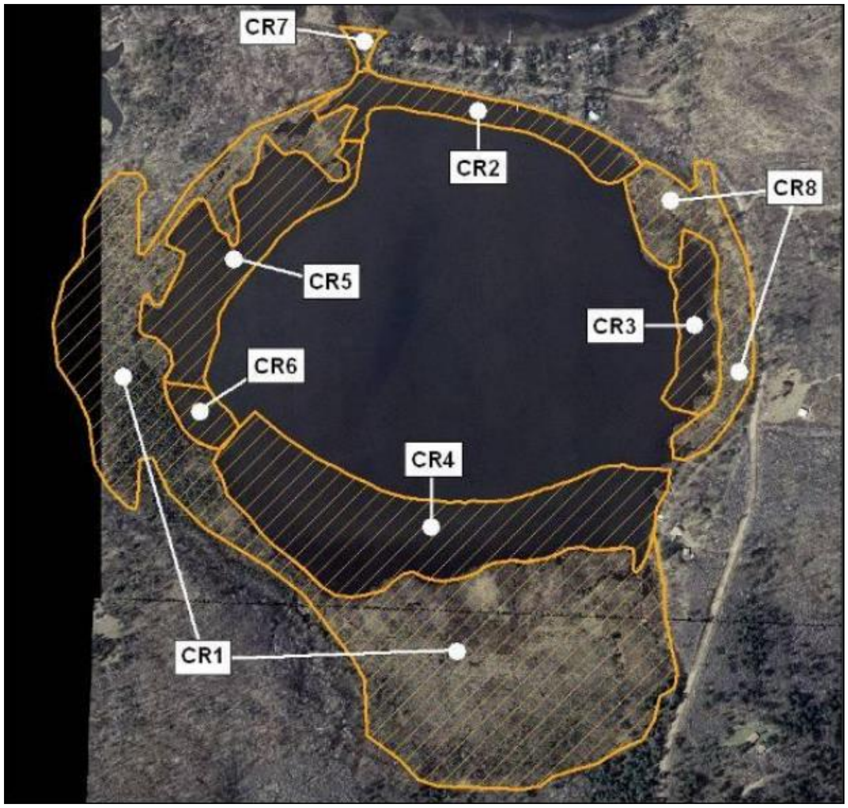

Figure 10: Cranberry Lake Critical Habitat Map (Smith et al. 2013)

Table 3: Cranberry Critical Habitat Polygon Justifications

Critical Habitat Polygon ID	Acres	Justification	Justification	Justification	Classification
CR1	61.0	6	-	-	Resource Protection Area
CR2	5.6	4	-	-	Sensitive Area
CR3	4.4	3	-	-	Sensitive Area
CR4	22.5	3	-	-	Sensitive Area
CR5	8.8	3	-	-	Sensitive Area
CR6	1.1	7	3	-	Sensitive Area
CR7	0.7	11	3	6	Sensitive Area
CR8	8.4	6	-	-	Resource Protection 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

3.1.1 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/Douglas 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 CL is in lists only three – a lake community, a fish species (Least Darter), and the Bald Eagle.

No aquatic invasive species have been officially recognized in CL. During the whole-lake aquatic plant survey completed in 2022, no non-native aquatic plants were identified. It is possible that CL may have Banded mystery snails, Rusty crayfish, and purple loosestrife because LECL also has these species. 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 has been only one such survey completed in CL, in 2022 by Matt Berg of Endangered Resource Services (ERS). Only data from the 2022 survey is included in this document. There is no comparison of 2022 data to previous data.

Only one year (2022) of CLP survey work has been done.

4.1 2022 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 284-point sampling grid for CL. 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 2022. 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.

No CLP was identified anywhere in the lake.

4.2 2022 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.

No CLP was mapped.

4.3 2022 Warm-water Whole-lake, Point-intercept Aquatic Plant Survey

During the August 2022 whole-lake, point-intercept survey, aquatic plants were found at 254 of the 284 points visited by the surveyor (89.4% of the whole lake and 89.4% of the littoral zone (considered the whole lake)) (Table 5, Figure 11). The mean and median depth of plant growth in 2022 was fairly consistent at 2.65 and 3.0ft (Table 5).

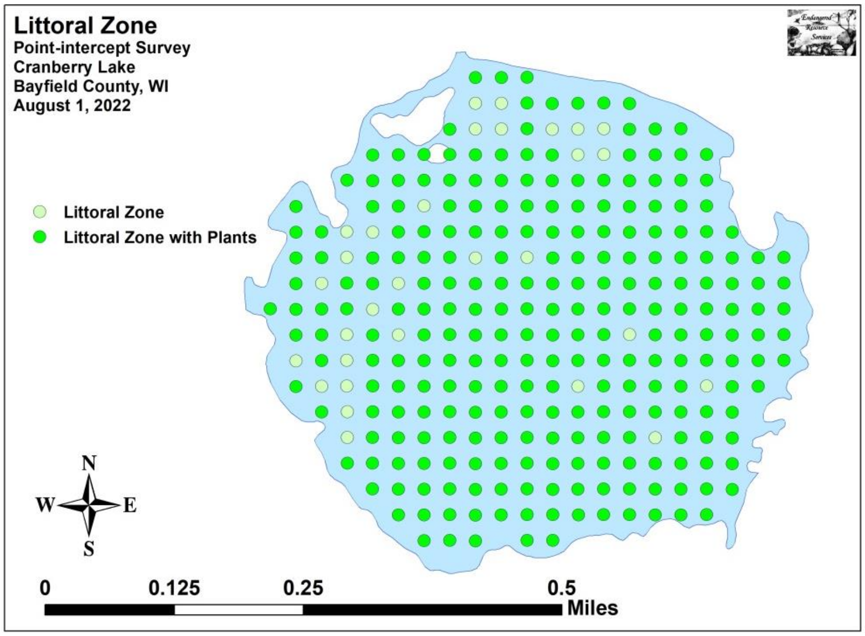

Figure 11: 2022 littoral zone (ERS)

Plant diversity was high in 2022 with a Simpson Index value of 0.84, lower than any of the Eau Claire Lakes (Table 5). Total species richness was high with 60 species (including rake, visuals, and boat survey) found in and immediately adjacent to the lake in 2022. Mean native species richness at sites with native vegetation was 2.2 and density (rake fullness) was 1.78 on a scale from 0-3 (Table 5). The distribution of aquatic plants at each point and the density of vegetation at each point can be seen in Figures 12 & 13.

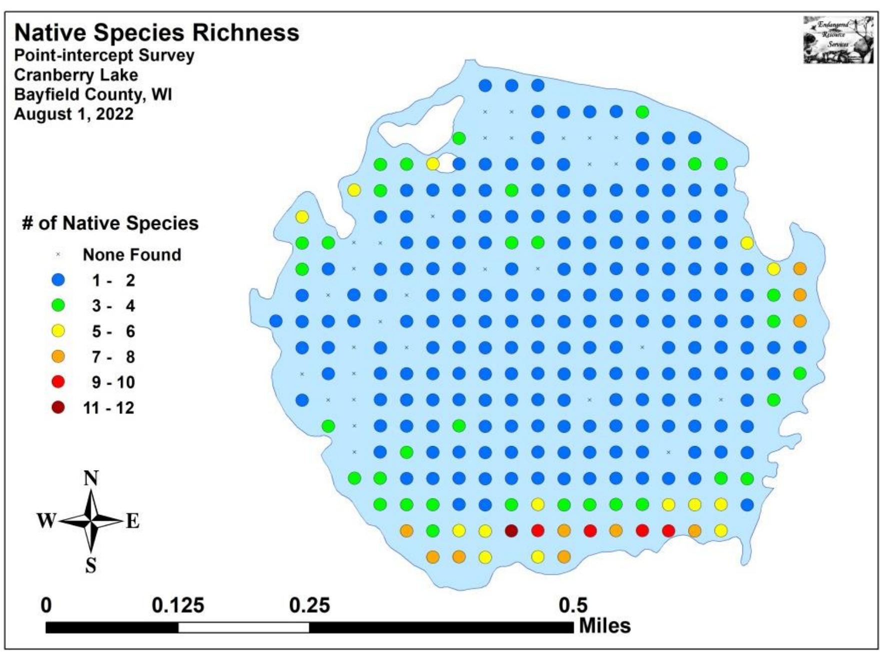

Figure 12: 2022 native species richness (ERS)

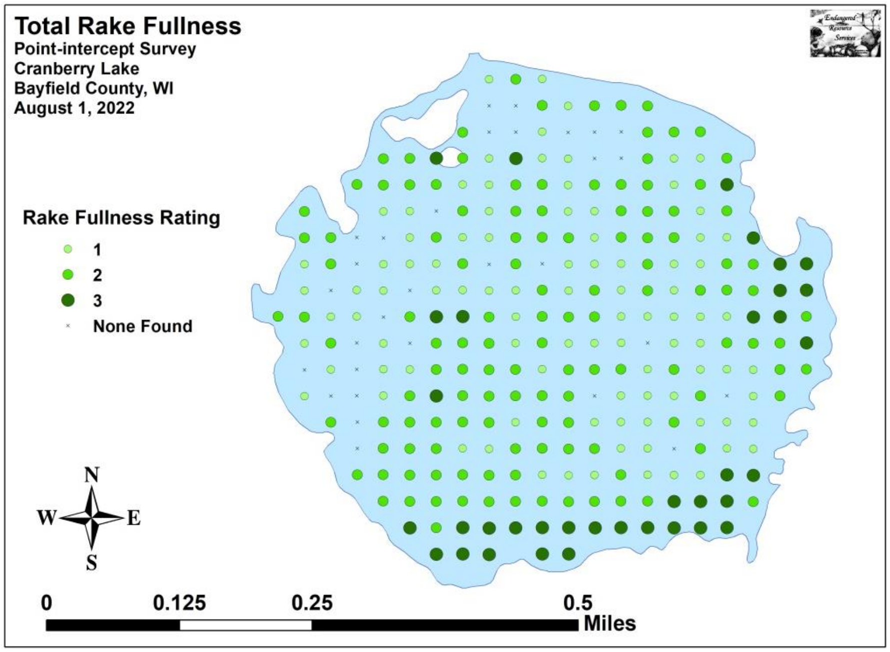

Figure 13: 2022 total rake fullness (ERS)

Table 5: 2022 aquatic plant PI survey statistics

SUMMARY STATS: Cranberry Lake	2022
Total number of sites visited	284
Total number of sites with vegetation	254
Total number of sites shallower than maximum depth of plants	284
Frequency of occurrence at sites shallower than maximum depth of plants	89.44
Simpson Diversity Index	0.84
Maximum depth of plants (ft)**	10.00
Number of sites sampled using rake on Rope (R)	0
Number of sites sampled using rake on Pole (P)	284
Average number of all species per site (shallower than max depth)	1.97
Average number of all species per site (veg. sites only)	2.20
Average number of native species per site (shallower than max depth)	1.97
Average number of native species per site (veg. sites only)	2.20
Species Richness	42
Species Richness (including visuals)	51
Species Richness (including visuals and boat survey)	60
Mean depth of plants (ft)	2.65
Median depth of plants (ft)	3.00
Mean rake fullness (veg. sites only)	1.78

Slender naiad (Figure 14) was by far the most abundant aquatic plant in CL. It was identified at 216 of the 254 points with vegetation during the 2022 survey. The second most abundant plant, Watershield, was only found at 48 points (Figure 14). Along with Slender naiad and Watershield, only six other species were found at more than 20 points each: White waterlily, Large-leaf pondweed, Common bladderwort, Muskgrass, Water bulrush, and Fern-leaf pondweed (Figure 15). White waterlily was only found on the rake at 44 points, but was recorded as a visual on 38 other points making it the second most abundant plant in the lake when involving visuals.

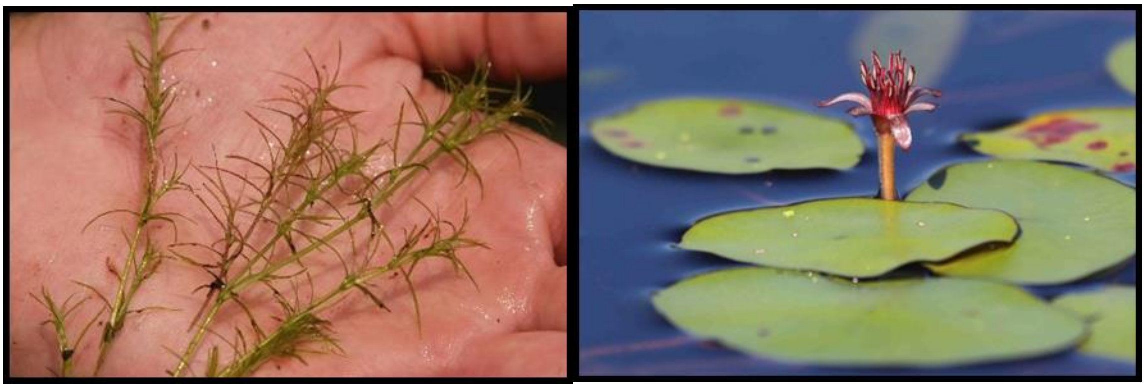

Figure 14: Slender naiad (left) and Watershield (right)

Figure 15: Left to right, top to bottom: White waterlily, Large-leaf pondweed, Common bladderwort, Muskgrass, Water bulrush, and Fern-leaf pondweed

4.3.1 2022 Floristic Quality Index

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 2022 point-intercept survey identified a total of 40 native index plants in the rake. They produced a mean Coefficient of Conservatism of 6.5 and a FQI of 41.3 (Table 6). Seven of the species identified were given Cs of 9 or 10 (one species had a C of 10) (Table 6). Nichols (1999) reported an average mean C for the Northern Lakes and Forest Region of 6.7 putting CL slightly below average for this part of the state. The FQI was higher than the median FQI of 24.3 for the Northern Lakes and Forest Region.

Table 6: 2022 FQI Calculations – Cranberry Lake

Species	Common Name	C
Bidens beckii	Water marigold	8
Brasenia schreberi	Watershield	6
Ceratophyllum demersum	Coontail	3
Chara sp.	Muskgrass	7
Eleocharis acicularis	Needle spikerush	5
Eleocharis erythropoda	Bald spikerush	3
Eleocharis palustris	Creeping spikerush	6
Elodea canadensis	Common waterweed	3
Heteranthera dubia	Water star-grass	6
Myriophyllum sibiricum	Northern water-milfoil	6
Myriophyllum verticillatum	Whorled water-milfoil	8
Najas flexilis	Slender naiad	6
Nuphar variegata	Spatterdock	6
Nymphaea odorata	White water lily	6
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 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
Sagittaria cristata	Crested arrowhead	9
Sagittaria latifolia	Common arrowhead	3
Schoenoplectus acutus	Hardstem bulrush	6
Schoenoplectus subterminalis	Water bulrush	9
Schoenoplectus tabernaemontani	Softstem bulrush	4
Sparganium emersum	Short-stemmed bur-reed	8
Sparganium natans	Small bur-reed	9
Typha latifolia	Broad-leaved cattail	1
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
Zizania palustris	Northern wild rice	8
N		40
mean C		6.5
FQI		41.3

4.3.2 Changes in Native Aquatic Plant Species

Because this is the first whole-lake, point-intercept survey completed by ERS, and the only data set to work with, there is no comparison of changes in native aquatic plant species.

4.4 Other Aquatic Invasive Species in Cranberry Lake

No evidence of EWM or any other AIS was found in CL during the 2022 survey.

4.5 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.

Surprisingly, wild rice was found at several points in Cranberry Lake during the 2022 whole-lake, point-intercept survey (Figure 16).

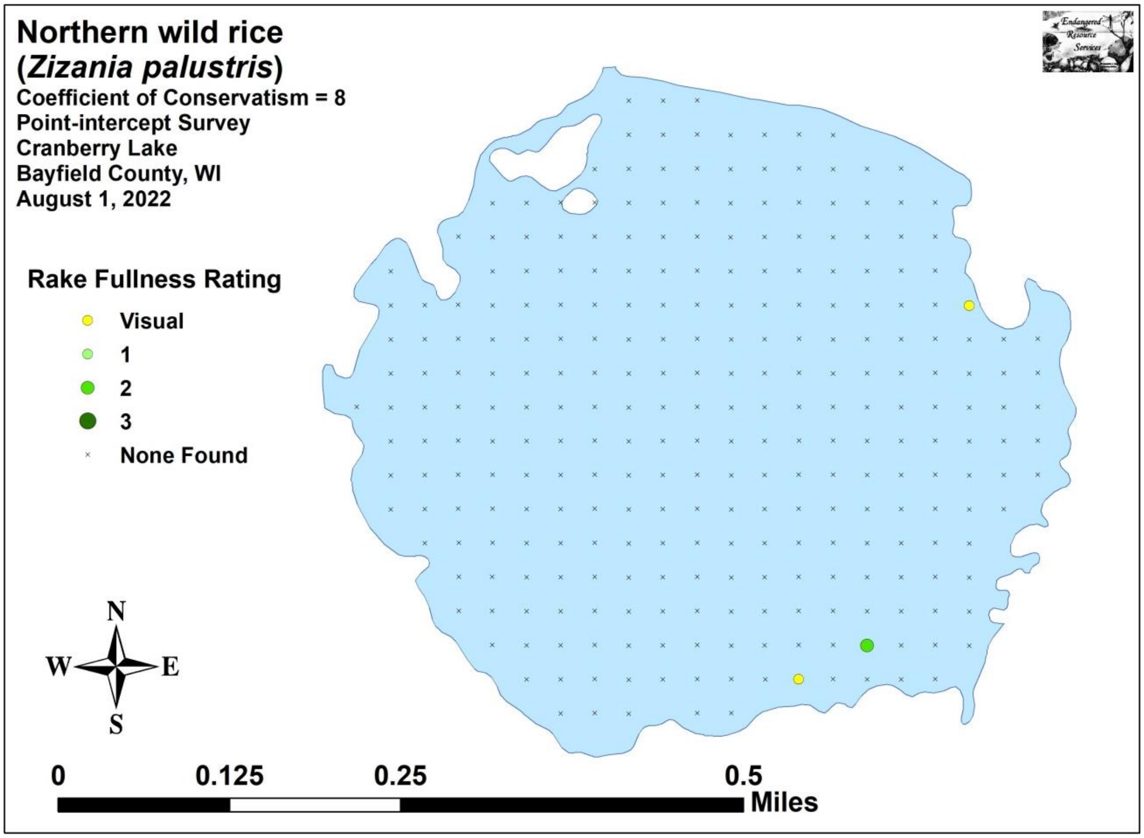

Figure 16: Wild rice in Cranberry Lake during the 2022 survey (ERS)

5.0 Aquatic Invasive Species Management

To date, no AIS management has been done in CL simply because there has been no AIS to manage. Monitoring efforts in CL should continue given that CLP and several other non-native aquatic invasive species are in LECL. If management of CLP (or EWM) is needed in the future, the Barnes BAISS boat will likely be used to remove it with DASH. 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 17).

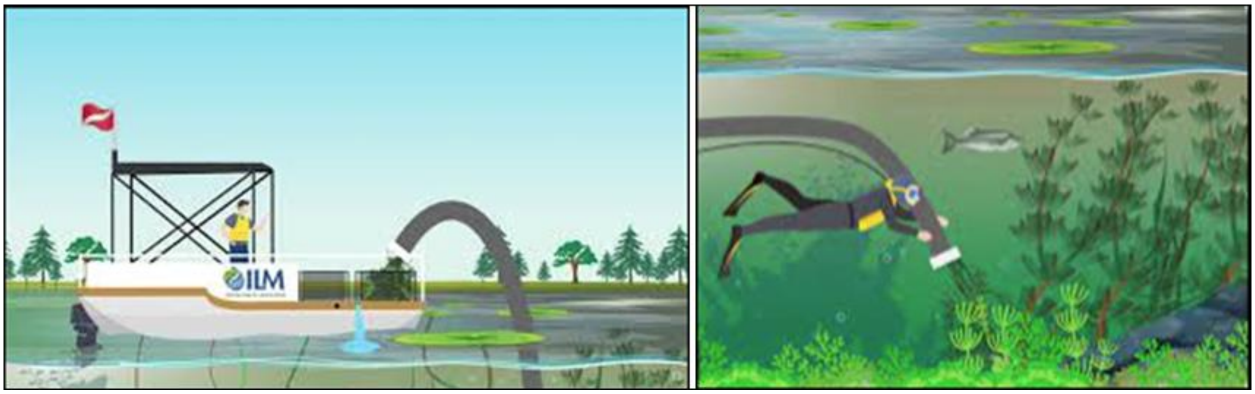

Figure 17: DASH boat and underwater operation (ILM Environments)
https://www.youtube.com/watch?v=YQmLMKzc1UM

Due to the presence of wild rice in CL, the use of aquatic herbicides will likely be limited or not permitted at all.

5.1 CLP or EWM Management

If any management of CLP (or EWM) becomes necessary in CL, a scenario-based approach to management is recommended over the next five years. A scenario-based approach means that any amount of CLP or EWM 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 CL, although the use of aquatic herbicides may be limited or not permitted at all in the lake due to the presence of wild rice. The following monitoring and control activities have been outlined:

1) AIS will be monitored by volunteers and resource professionals every year.
    a. Pre-management surveys will be completed annually as soon as an AIS begins to make an appearance in an effort to judge the severity of seasonal growth.
    b. AIS bedmapping will be completed annually at the appropriate times for the AIS discovered (early to mid-June for CLP, summer or fall for EWM) in an effort to track its expansion or decline.
2) Areas of AIS 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 particular AIS's growing season
    b. Does not require a WDNR permit.

3) Snorkel, rake, and/or scuba diver removal of AIS 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 AIS's 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 CL. 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 and other AIS in other lakes. DASH makes it possible to manage larger areas 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 AIS 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 for CLP at 1-3 ppm
        iii. Liquid 2,4D, triclopyr, or ProcellaCOR is used for EWM at 2-4ppm (2,4D & triclopyr) or 2-5pdus (ProcellaCOR)
        iv. 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
        v. 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
        vi. Requires a WDNR Chemical Application permit
        vii. Herbicides must be applied by a licensed Applicator

As mentioned, many of the management actions outlined for CLP would also be effective for the management of EWM should it be found in CL 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.

5.2 Management of Other AIS

At the present time, there are no other AIS that have been identified in CL. That said, other AIS plants including but not limited to CLP, EWM, purple loosestrife, and 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.

6.0 Aquatic Plant Management Goals

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

1) **AIS Management.** AIS management will only be implemented when something new has been identified in the lake. When it is implemented, it should be done 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.

6.1 Goal 1. AIS Management

AIS management is not the main goal of this APM Plan for CL. However, this goal is included if and when a new AIS is identified in the lake. Any new AIS found will be from increasing its distribution and density in the lake.

6.1.1 AIS Survey Work

Determining when AIS management is needed will be dependent on annual or semi-annual AIS monitoring completed in CL by volunteers or resource professionals. If a new AIS is discovered, discussions pertaining to next season management will begin. Should it be determined that the application of aquatic herbicides or any other management action 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.

6.1.2 Herbicide Concentration Testing

At least in the first year covered in this APM Plan where aquatic herbicides are used in LECL 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.

6.2 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.

6.3 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. CL 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 2027 with an update of this plan completed in 2028.

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.

6.4 Goal 4. Adaptive Management

This APM Plan is a working document guiding management actions on CL 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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