Aquatic Plant Management Plan Update

Camp and Center Lakes

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Lake and Pond Solutions LLC
E. Faber – Field Biologist, J. Stelzer – Senior Biologist

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INTRODUCTION

This Aquatic Plant Management (APM) Plan update is presented as an addendum to the previous APM Plan for Camp and Center Lakes approved in April of 2017. Its purpose is to report the inventory findings of the aquatic plant communities present, their relative densities and species composition from the summer of 2021. A review of the past and present aquatic plant community information will be used to formulate an aquatic plant management plan to provide a variety of lake uses, while protecting significant aquatic resources. **This plan outlines a strategy to implement an aquatic harvesting and herbicide management program that will provide for recreational lake uses through nuisance and exotic species control. High quality plant communities which help promote water quality and provide fish and wildlife habitat should be protected from unnecessary negative impacts.**

WATER QUALITY

The Camp and Center Lake Rehabilitation District (CCLRD) contracted to collect turnover samples on each lake starting in 2007. Analyses examined 16 different components of water chemistry including pH, conductivity, alkalinity, total hardness, calcium hardness, reactive phosphorus, total phosphorus, ammonia, nitrite+nitrate, total Kjeldahl nitrogen (TKN), chloride, sulfate, sodium, potassium, turbidity, and color (Figures 1 and 2). Samples were collected at a one-foot depth over the deepest portion of each lake during spring and fall turnovers.

Figure 1: Camp Lake Water Quality (2007 - 2021)

Sample Date	pH	Cond (uS/cm)	Alk	T Hard	Ca Hard	React P	Total P	NH3 (N)	NO2 + NO3 (N)	TKN	CL	SO4	Na	K	Turb (NTU)	Color
10/15/2007	8.35	561	176	233	99	0.025	0.027	0.08	0.20	1.02	64.7	36.76	29.8	2.6	3.9	26
5/15/2008	8.11	590	200	252	127	0.024	0.052	0.02	0.70	0.99	54.0	30.43	25.7	2.8	6.0	28
10/22/2008	8.52	500	164	201	84	n/a	0.027	0.02	<0.01	0.90	52.5	23.43	25.3	2.8	5.5	36
4/6/2009	8.22	580	184	216	121	n/a	0.028	<0.01	0.58	0.88	51.2	25.10	25.6	2.8	4.2	25.3
10/15/2009	8.41	437	164	180	82	0.031	0.033	0.03	<0.01	0.95	45.9	17.39	23.5	3.2	3.3	21.8
4/13/2010	8.16	492	204	236	126	0.017	0.026	<0.01	0.10	0.77	47.3	20.60	21.7	3.0	3.6	21
10/19/2010	8.11	505	176	208	91	0.018	0.040	0.08	0.10	1.71	50.9	15.2	24.2	3.6	4.9	20.4
4/14/2011	8.26	545	200	232	119	0.009	0.029	0.06	1.54	0.97	50.1	23.3	26.0	3.2	x	7.8
10/19/2011	8.53	452	160	180.4	72	0.025	0.046	0.09	<0.1	1.21	56.5	16.4	26.0	1.8	5.4	23.6
3/28/2012	8.17	620	190	240	120	<0.019	0.038	0.2	0.048	0.83	57	20.0	29.0	2.2	4.4	30
10/11/2012	8.63	560	140	220	74	<0.010	<0.010	0.12	<0.052	0.77	78	20.0	39.0	1.7	3.3	20
4/22/2013	7.84	563	160	202	107	<0.005	0.027	0.056	1.3	0.69	61	29.0	30.6	2.61	7.7	30
10/17/2013	8.24	560	180	209	88.1	<0.005	0.020	0.040	<0.090	0.85	74	21.0	35.3	2.48	1.3	30
4/25/2014	8.44	600	180	212	106	<0.005	0.016	<0.04	0.12	0.55	67	26.0	33.8	2.54	2.7	20
10/13/2014	8.58	582	160	206	83.4	0.023	0.023	<0.04	0.87	1.1	75	24.0	35.6	1.96	2.3	20
4/10/2015	8.21	639	190	217	99.6	<0.004	<0.006	<0.03	<0.07	0.67	80	25.0	34.6	2.11	1.0	15
10/19/2015	7.88	615	190	231	102	<0.004	0.018	<0.03	<0.07	0.56	73	21.0	37.1	2.41	3.1	30
3/29/2016	8.33	565	240	233	119	<0.004	<0.005	<0.03	0.22	0.74	60	23.0	28.7	2.10	2.5	20
10/14/2016	8.04	616	200	228	83.2	<0.004	<0.005	0.048	<0.045	0.98	72	19.0	32.9	2.35	2.1	20
4/3/2017	7.89	644	210	214	109	<0.004	0.010	<0.040	0.28	1.80	72	25.0	26.3	2.47	6.0	15
10/16/2017	8.48	524	180	169	73.4	<0.004	0.014	0.069	<0.06	0.80	110	16.0	26.1	2.34	3.3	15
4/4/2018	8.12	542	210	200	98.4	<0.004	0.009	<0.04	0.16	0.72	46	16.0	22.2	2.76	4.3	15
10/2/2018	7.28	516	180	188	68.2	0.014	0.021	0.057	<0.057	0.74	55	13.0	28.6	2.22	<1.0	30
4/15/2019	8.13	569	180	207	109	<0.004	0.026	<0.04	0.30	0.44	51	15.0	21.2	1.96	9.0	20
10/16/2019	8.28	472	180	187	92.6	<0.004	<0.031	<0.04	<0.057	<0.53	46	10.0	23.8	2.72	5.9	40
4/6/2020	8.61	594.2	230	242	121	<0.004	0.012	<0.04	<0.057	<0.53	49	15.0	24.4	2.89	4.7	30
10/13/2020	8.81	455.7	150	177	67.7	<0.004	<0.031	<0.04	<0.057	2.60	47	11.0	26.6	1.87	7.1	15
4/15/2021	8.59	585.8	210	214	109	<0.004	0.029	<0.13	<0.12	0.62	46	14.0	26.3	2.73	5.1	20
10/19/2021	8.12	588.6	170	175	60.9	<0.004	<0.02	<0.13	<0.12	1.50	61	13.0	32.4	1.56	2.8	20
AVG	**8.25**	**554.25**	**185**	**211**	**97**	**0.006**	**0.020**	**0.033**	**0.218**	**0.92**	**60**	**20.2**	**28.4**	**2.48**	**4.0**	**23**

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Figure 2: Center Lake Water Quality (2007 - 2021)

Sample Date	pH	Cond (umhos)	Alk	T Hard	Ca Hard	React P	Total P	NH3 (N)	NO2 + NO3 (N)	TKN	Cl	SO4	Na	K	Turb (NTU)	Color
10/15/2007	8.00	566	196	245	121	0.021	0.035	0.30	0.30	1.34	51.8	34.67	24.9	3.7	3.4	36
5/15/2008	8.26	657	224	268	154	n/a	0.031	0.02	1.40	0.92	60.4	33.26	28.7	3.1	5.3	35
10/22/2008	8.00	583	205	238	117	0.038	0.042	0.25	<0.01	1.20	52.3	26.42	26.0	3.7	4.1	33
4/6/2009	8.12	654	208	252	146	0.032	0.045	<0.01	1.24	0.92	57.7	29.21	28.0	3.1	4.5	31.5
10/15/2009	8.00	504	208	216	122	0.037	0.049	0.51	<0.01	1.53	42.9	17.61	22.3	4.1	5.5	30.6
4/13/2010	8.31	586	240	287	160	0.018	0.039	<0.01	0.8	0.95	52.9	24.12	24.3	3.2	5.0	33
10/19/2010	7.90	570	212	240	123	0.028	0.048	0.26	0.02	1.39	49.8	17.9	24.0	3.3	4.0	25.5
4/14/2011	8.43	619	232	260	140	0.022	0.060	0.03	0.76	1.23	57.3	26.0	29.0	3.2	x	20.2
10/19/2011	8.01	577	208	234.5	112.5	0.037	0.057	0.56	<0.1	1.67	60.5	20.1	29.0	2.7	4.8	24.2
3/28/2012	8.22	680	210	270	130	<0.019	0.024	0.20	0.77	1.1	65	24	31.0	2.5	1.6	30
10/11/2012	8.18	590	160	240	89	<0.010	0.034	0.29	<0.052	0.9	75	23	37.0	2.5	3.3	20
4/22/2013	7.83	623	180	221	120	<0.005	0.029	0.07	1.9	0.44	70	39	35.0	2.91	8.4	40
10/17/2013	7.88	611	200	237	115	<0.005	0.018	0.14	0.22	0.75	67	30	35.5	2.95	2.6	30
4/25/2014	8.56	670	200	235	124	<0.005	0.025	<0.04	0.22	0.52	77	38	37.9	2.79	11	40
10/13/2014	8.24	672	200	250	120	<0.004	0.022	0.099	0.51	1.4	82	31	38.2	2.75	3.9	35
4/10/2015	8.18	743	230	266	132	<0.004	0.015	<0.03	0.18	1.1	84	33	39.0	2.78	1.9	30
10/19/2015	7.67	668	210	265	129	<0.004	0.028	<0.03	<0.07	0.73	73	23	36.4	3.19	9.3	30
3/29/2016	8.42	608	270	274	145	<0.004	0.009	<0.03	0.74	0.75	73	27	31.5	2.33	3.4	30
10/14/2016	8.19	680	230	257	102	<0.004	<0.005	0.16	<0.045	0.97	73	23	34.5	2.53	2.5	30
4/3/2017	8.09	738	240	250	129	<0.004	0.017	<0.04	0.56	2.40	85	37	30.1	2.41	9.0	20
10/16/2017	8.14	565	220	205	106	<0.004	0.014	0.36	<0.06	1.10	55	15	24.2	3.39	2.9	20
4/4/2018	8.38	628	240	233	121	<0.004	0.013	<0.04	0.48	0.79	52	20	24.7	3.37	2.3	40
10/2/2018	8.03	606	230	223	95.4	0.011	0.021	0.09	<0.057	0.59	59	16	30.5	3.09	<1.0	30
4/15/2019	8.24	671	220	250	135	<0.004	0.019	<0.04	0.56	0.31	64	20	26.2	1.99	3.2	30
10/16/2019	7.99	513	200	211	115	0.015	0.045	0.22	<0.057	0.66	44	10	22.7	3.29	5.3	50
4/6/2020	8.53	634.5	250	265	136	<0.004	0.018	<0.04	0.15	<0.53	54	17	26.7	2.86	5.4	40
10/13/2020	8.51	556.9	210	220	101	<0.004	<0.031	<0.04	<0.057	0.69	51	12	28.1	3.07	3.2	15
4/15/2021	8.67	653	230	247	129	<0.004	<0.02	<0.13	0.19	0.92	54	17	29.5	3.29	3.0	20
10/19/2021	8.96	529	150	208	82.9	<0.004	0.039	<0.13	<0.12	1.2	60	5.2	31.5	2.54	2.6	10
AVG	**8.21**	**619.2**	**214**	**244**	**122**	**0.009**	**0.027**	**0.12**	**0.369**	**0.98**	**62**	**24**	**29.9**	**2.99**	**4.2**	**30**

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pH

pH is an index of lake water's acid level. A pH of 7 is neutral, below 7 is acidic, and above is considered basic. Moderately low pH levels do not usually harm fish, but some metals can become soluble and release into lake water, potentially harming fish. Lakes dominated with a large quantity of plants or algae can experience large fluctuations in pH levels from day to night. pH is measured logarithmically, meaning a pH of 6 is ten times more acidic than a pH of 7, and one hundred times more acidic than a pH of 8. From 2007 - 2021, Camp Lake had an average pH of 8.25 while Center Lake was 8.21. Both values fall within typical ranges and there were no statistically significant changes in pH over this time.

Conductivity

Conductivity is a measure of water's ability to conduct electrical current. This number is directly related to the total dissolved inorganic chemicals in the water. Values are commonly two times the water hardness unless the water is receiving high concentrations of contaminants introduced by humans. From 2007 - 2021, Camp Lake had an average conductivity of 554.25 uS/cm (2.63 times the hardness) while Center Lake was 624 uS/cm (2.53 times the hardness). There were no statistically significant changes in conductivity over this time.

Alkalinity and Hardness

A lake's alkalinity and hardness are affected by the type of minerals in the soil, watershed bedrock, and by how much the lake water contacts it. Alkalinity is a measure of the concentration of carbonates, bicarbonates, and hydroxide present in water. Low alkalinity (0 – 199 mg/l) is the main indicator of susceptibility to acid rain. Values from 200 – 499 mg/l mean a low impact from acid rain. Increasing alkalinity is often related to increased algae productivity. From 2007 - 2021, Camp Lake had an average alkalinity of 185 mg/l (moderate susceptibility) while Center Lake was 214 mg/l (low susceptibility).

Total hardness is a measure of the mineral content, typically calcium and magnesium ions. Values over 180 ppm are considered "very hard". From 2007 – 2021, Camp Lake had an average total hardness of 211 ppm while Center Lake was 244 ppm. Very hard water is to be expected in the limestone dominated substrate of Southeast Wisconsin.

Calcium hardness measures the calcium ions in the water. A high value here (related to the total hardness) may indicate groundwater coming from calcite and dolomite. From 2007 – 2021, Camp Lake had an average calcium hardness of 97 ppm while Center Lake was 122 ppm. In this area, it is typical to see calcium hardness comprise about 50% of the total hardness.

Phosphorus

In more than 80% of Wisconsin's lakes, phosphorus is the limiting nutrient affecting the amount of weed and algae growth. The analysis of phosphorus has included soluble reactive phosphorus and total phosphorus. Fertilizers, animal wastes, and septic systems are the main sources of this nutrient. Reactive phosphorus is a measure of readily available phosphorus. This form is in a usable form for aquatic plants and especially algae. Ideally, reactive phosphorus concentrations during the spring should be below 0.020 ppm for natural lakes and 0.030 ppm for impoundments to prevent nuisance algal blooms. From 2007 – 2021, Camp Lake had an average spring reactive phosphorus value of 0.004 ppm while Center Lake was 0.006 ppm (Figure 3). Based on the data, this should result in limited algal growth during the summer. The higher fall reactive phosphorus averages are most likely due to phosphorus recycling from hypolimnetic sediment during fall turnover, as well as aquatic plant mortality.

Figure 3: Average Reactive Phosphorus Concentrations (2007 - 2021)

	Avg. Spring RP (ppm)	Avg. Fall RP (ppm)	Avg. Yearly RP (ppm)
Camp Lake	0.004	0.010	0.010
Center Lake	0.006	0.012	0.013

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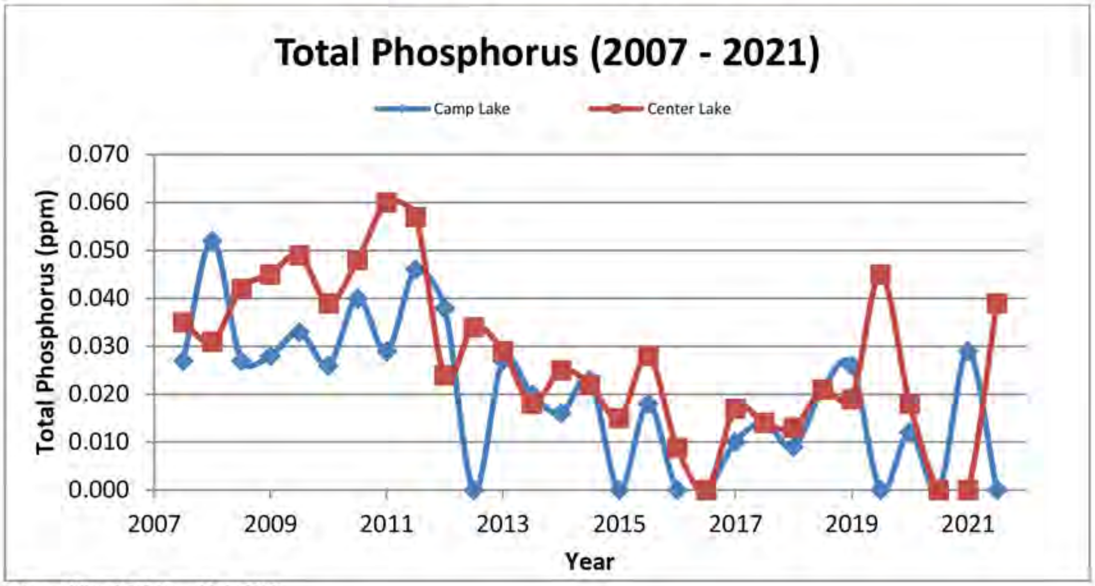
Total phosphorus is usually considered more representative of a lake's nutrient level because it remains more stable than reactive phosphorus. Total phosphorus includes reactive phosphorus plus particulate phosphorus (what is being taken up in growth or contained in suspended sediments). Average concentrations are 0.025 ppm for natural lakes while impoundments may be around 0.065 ppm. From 2007 – 2021, Camp Lake had an average total phosphorus value of 0.020 ppm while Center Lake was 0.027 ppm, both falling within a normal range for many area lakes. From 2007 - 2017, average total phosphorus in both lakes was on a downward trend. Since 2017, total phosphorus on both lakes has shown greater variability with an increasing trend (Figure 4). Total phosphorus values taken during the spring turnover were used to estimate the trophic state of both Camp and Center lakes using the trophic state index (Figure 8). The Town of Salem passed a "No Phosphorus Fertilizer Ordinance" on June 12th, 2006 (Ordinance # 06-06-12B) to reduce phosphorus runoff.

Figure 4: Total Phosphorus Concentrations (2007 – 2021)



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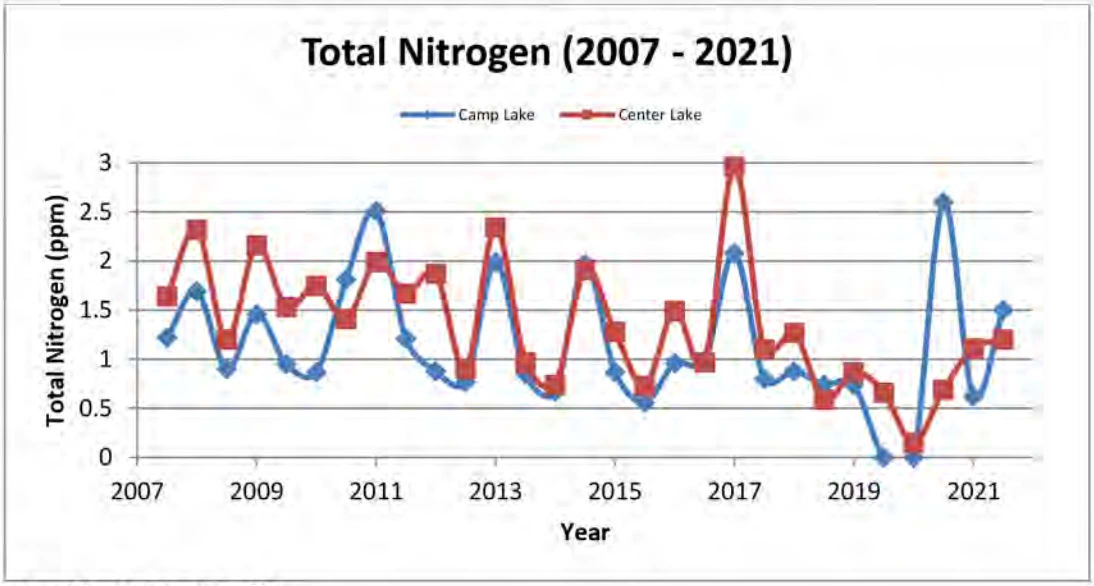
Nitrogen

Nitrogen is second only to phosphorus as an important nutrient for aquatic plant and algae growth. In most cases the amount of nitrogen in lake water corresponds to local land use. Sources of nitrogen include agricultural fertilizer, lawn fertilizer, animal wastes and human wastes. Analyses included ammonia (NH3), nitrite (NO2) plus nitrate (NO3), and total Kjeldahl nitrogen (TKN). Ammonia (NH3) is the first form of nitrogen released when organic material decays which then converts to ammonium. Ammonium is also a waste product of fish and aquatic invertebrates. The ammonium converts rapidly to nitrate if oxygen is present. From 2007 – 2021, Camp Lake had an average ammonia of 0.033 ppm while Center Lake was 0.12 ppm, both normal for SE Wisconsin lakes. The higher value for Center Lake may indicate that organic decay and lack of oxygen may be more prominent than in Camp Lake.

Nitrite (NO2) plus nitrate (NO3) nitrogen are the forms important for plant and algae growth. High levels (> 10 ppm) in drinking water are dangerous to infants and expectant mothers. Typically, if the sum of ammonium and nitrite plus nitrate exceeds 0.30 ppm in the spring, there is sufficient nitrogen to support summer algal blooms. From 2007 – 2021, Camp Lake had an average nitrite plus nitrate value of 0.22 ppm while Center Lake was 0.37 ppm. Both levels fall within normal parameters for SE Wisconsin lakes. There were no statistically significant changes over the sampling period.

Total Kjeldahl Nitrogen (TKN) is a measure of the amount of ammonia (NH3), ammonium (NH4), and other organic nitrogen in the water. Typically, the organic-N in TKN is the largest portion and found in proteins, amino acids, urea, living or dead organisms, decaying plant material, and organic based sediments like muck. When TKN is added to nitrite plus nitrate, the resulting value is the total nitrogen of a water body (TN) which can be used to calculate nitrogen to phosphorus ratios. For our area, TKN values range between 0.7 and 1.7 ppm. Although the organic portion is usually not available for growth, plants and algae do convert other forms of nitrogen back to the organic form. Ultimately high TKN values can indicate potential growth impacts, runoff issues or organic sediment accumulation. From 2007 – 2021, Camp Lake had an average TKN of 0.92 ppm while Center Lake was 0.98 ppm, both typical values for southeast Wisconsin lakes.

Figure 5: Total Nitrogen (2007 – 2021)



Lake and Pond Solutions LLC (2022)

N:P Ratio

In most of Wisconsin's lakes, phosphorus is the limiting factor affecting algae growth. Examining the nitrogen to phosphorus (N:P) ratio can highlight which is the limiting nutrient. If the N:P ratio is less than 10:1, nitrogen is the limiting nutrient. If values are between 10:1 and 15:1, the lake is considered transitional. Lakes with values greater than 15:1 are considered phosphorus limited, meaning algae growth is controlled by the amount of phosphorus cycled into the system. From 2007 – 2021, Camp Lake had an average N:P ratio of 39:1 while Center Lake was 51:1. This means that algal growth is limited by phosphorus concentrations in both lakes and small increases in phosphorus can have an impact on growth.

Chloride

The presence of chloride (Cl) where it does not naturally occur can indicate water pollution, commonly from human activity. Septic systems, animal waste, and road salts are major chloride sources. Research shows at levels greater than 230 ppm, aquatic life may be impacted. Typically, an increase in chloride is found during the spring turnover due to runoff from roads that have been salted over the winter. From 2007 – 2021, both Camp Lake and Center Lake had an average chloride concentration of 60 ppm. Normal levels range from 10 – 50 ppm though it is not uncommon to see 100 – 250 ppm in water bodies receiving large amounts of spring runoff. Chloride levels were elevated from 2012 to 2017; however, over time there was no significant change in concentration (Figures 6 and 7).

Sodium

Natural levels of sodium (Na) in soil and water are very low so its presence may indicate pollution caused by human activities. Commonly found in road salt, fertilizers, and animal waste, increasing values over time can mean a long-term effect caused by pollution. Often, sodium when in conjunction with other factors can influence large algal blooms. From 2007 – 2021, Camp Lake had an average sodium concentration of 28.4 ppm while Center Lake was 29 ppm. Normal levels range from 5 – 40 ppm, though it can be common to see up to 150 ppm in water bodies receiving large amounts of spring runoff (usually correlates with chloride). Sodium levels have remained relatively stable over time (Figures 6 and 7).

Figure 6: Camp Lake Sodium and Chloride (2007 – 2021)

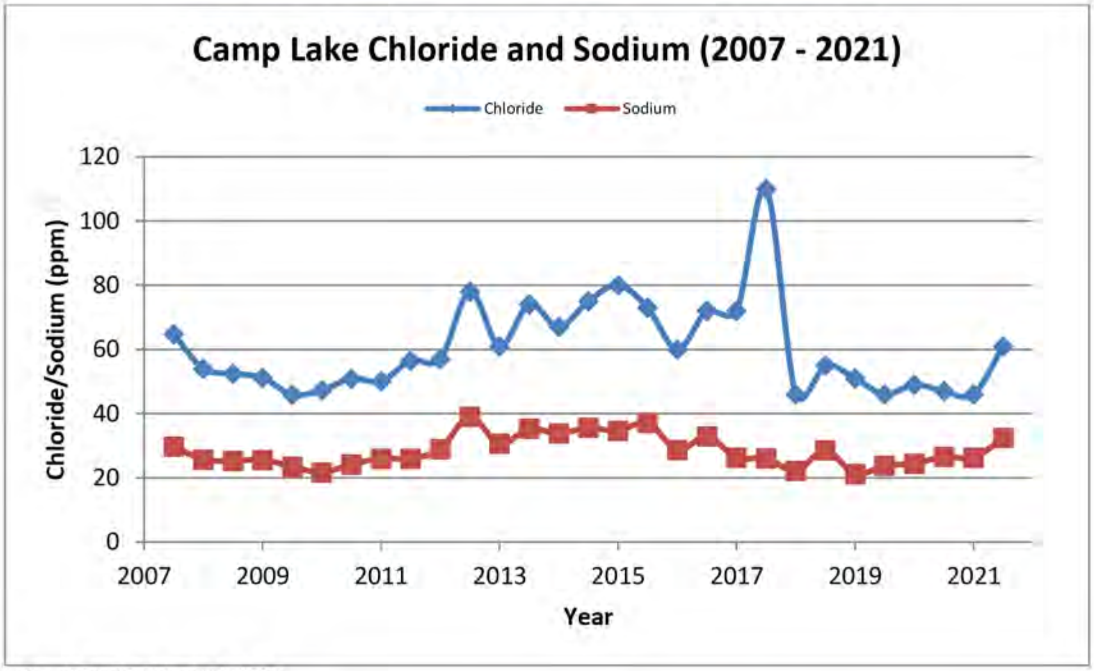


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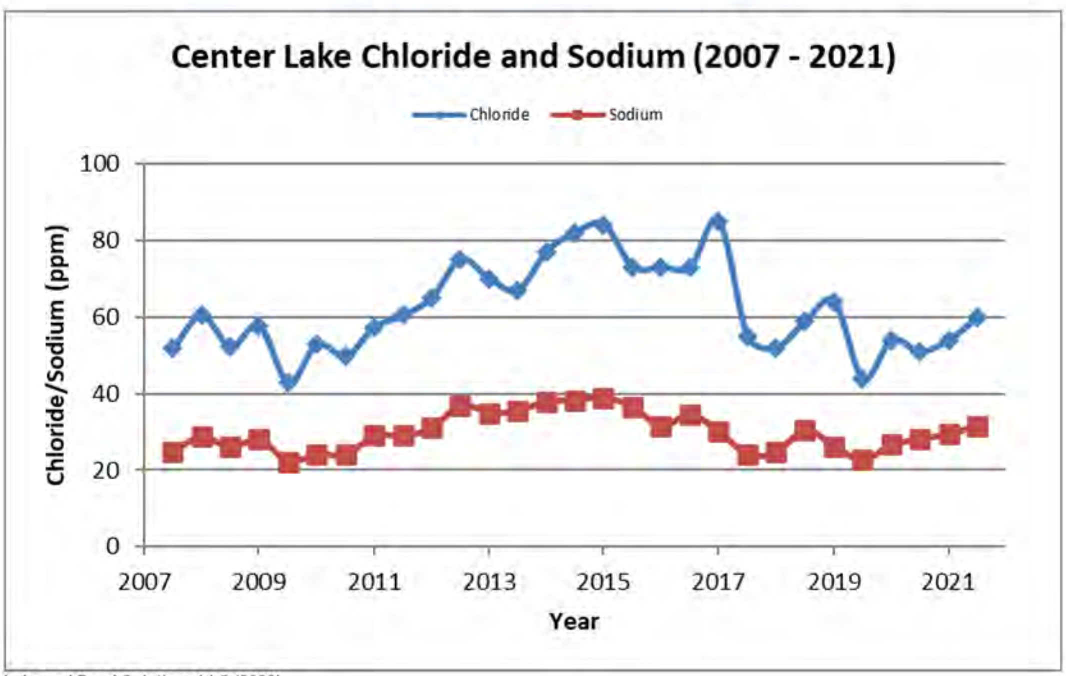
Figure 7: Center Lake Sodium and Chloride (2007 - 2021)



Lake and Pond Solutions LLC (2022)

Sulfate

Sulfate (SO_4) is the most common form of sulfur in natural waters. The amounts relate primarily to soil minerals in the watershed. Sulfate may also be an indicator of acid rain. In water depleted of oxygen, sulfate can be reduced to hydrogen sulfide which smells like rotten eggs and is toxic to aquatic organisms. Commonly, background concentrations in SE Wisconsin are 20 – 40 ppm. From 2007 – 2021, Camp Lake had an average sulfate value of 20.2 ppm while Center Lake was 24 ppm.

Potassium

Like sodium, natural levels of potassium (K) in soil and water are very low so its presence may indicate pollution caused by human activities. It is commonly found in fertilizer and abundant in animal waste. Increasing values over time can mean a long-term effect caused by pollution. High potassium levels have also been associated with large algae populations. From 2007 – 2021, Camp Lake had an average potassium value of 2.48 ppm while Center Lake was 2.99 ppm, both within normal ranges. There were no statistically significant changes over the sampling period.

Turbidity

Turbidity is one component to water clarity. It measures the materials suspended in the water such as algae and silt and ultimately affects the depth at which plants can grow. Suspended particulates are an indicator of overland flow (runoff) and disturbances within the water body itself (bottom-feeding fish, crayfish, muskrat activity, etc.). From 2007 – 2021, Camp Lake had an average turbidity of 4.0 NTU while Center Lakes had an average turbidity of 4.2 NTU. This is a typical value as many area lakes may range from 2 – 10. There were no statistically significant changes over the sampling period.

Color

Color is the other component to water clarity. It measures the materials dissolved in the water. The main significance of this component is aesthetic. High color values may also reduce light penetration, ultimately affecting weed and algae growth. From 2007 – 2021, Camp Lake had an average color of 23 while Center Lake was 30. Typical values are 0 – 40 while higher color values may reach 40 – 100. There were no statistically significant changes over the sampling period.

Trophic State Index

The Carlson trophic state index (TSI) assigns a trophic condition rating based on Secchi disk, total phosphorus, and Chlorophyll-*a* which can be used to summarize the quality of a lake. The trophic state index was developed by Dr. Robert Carlson in 1977 to compare the three water quality values on a scale from 0 to 100. Values from 0 to 40 describe lakes defined as oligotrophic—lakes that are generally clear, deep, and free of rooted aquatic plants and algae blooms. Values above 50 define eutrophic lakes—lakes that are high in nutrients and tend to support large biomass of rooted aquatic plants and algae. Mesotrophic lakes, with values from 40 to 50, lie between oligotrophic and eutrophic lakes. Discretion is advised as the Carlson Trophic State Index was developed for use with lakes that have few rooted aquatic plants and little non-algae related turbidity (EPA, 2010).

There has been a tendency to average the three variables rather than to prioritize their use (Osgood, 1982; Kratzer and Brezonic, 1981). According to Carlson (1982), there is no logic in combining them since chlorophyll *a* is a better predictor. Figure 8 shows the chlorophyll *a* TSI and related classification. Camp

Lake is in a transitional phase between mesotrophic and eutrophic while Center Lake is classified as eutrophic.

Data has not been collected for Chlorophyll-*a* or Secchi Disk measurements since 2016, and the last time either metric was collected prior to this was 2001. Volunteer or contracted data collection for these two metrics could provide useful water quality data. However, the trophic status for both lakes has remained stable over nearly the last 30 years; therefore, these metrics are likely not crucial unless either major watershed land use changes occur, or algae blooms become an issue.

Figure 8: Trophic Status Based on Chlorophyll *a*

	CAMP LAKE		CENTER LAKE	
YEAR	TSI (CHL)	CLASS	TSI (CHL)	CLASS
1993	54	Eutrophic	64	Eutrophic
1994	52	Eutrophic	52	Eutrophic
1996	57	Eutrophic	57	Eutrophic
1997	50	Mesotrophic	52	Eutrophic
1998	49	Mesotrophic	n/a	n/a
2000	n/a	n/a	n/a	n/a
2001	49	Mesotrophic	51	Eutrophic
2016	47	Mesotrophic	51	Eutrophic

Lake and Pond Solutions LLC / WDNR (2016)

RESULTS OF THE 2021 AQUATIC PLANT SURVEY

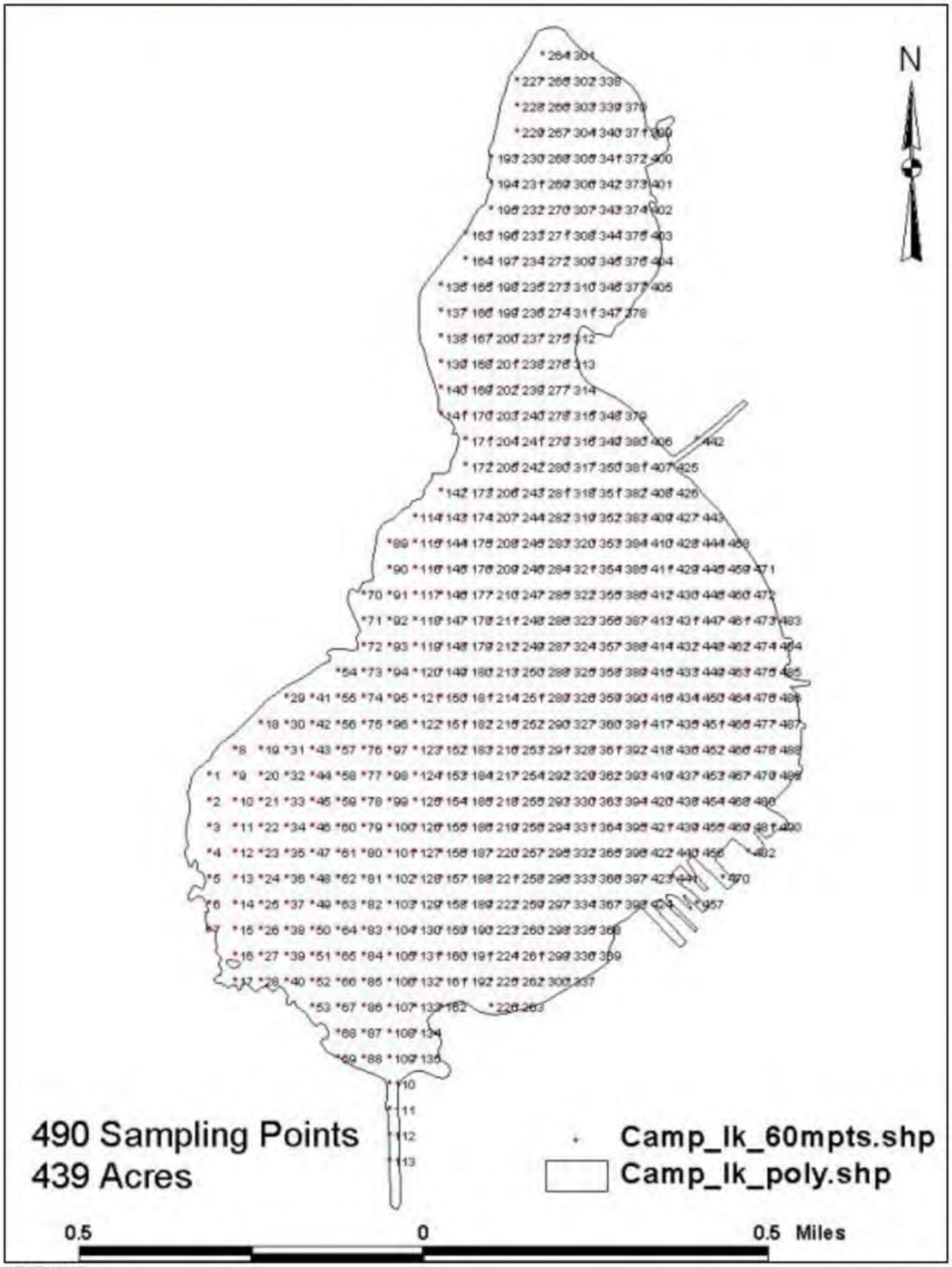
The 2021 aquatic plant survey was conducted using some guidelines adopted by the WDNR for point-intercept survey methods. This method utilizes a grid system that accounts for the size and morphology of the lake. The WDNR established points were transferred to a Garmin GPSMAP 64st GPS unit before sampling. For the 2021 survey, Camp Lake had 490 points and Center Lake had 576 points.

At each established point, a double headed plant sampling rake on a 15' graduated pole was lowered down and rotated twice to gather plants. A double headed throw sampling rake tied to a rope was used for sites with depths greater than 15' and dragged roughly three feet along the substrate to gather plants. Data collection included depth, substrate type (when possible), species present, species density, overall rake density and any visual of species located within the immediate area of the boat. Shoreline vegetation (i.e. cattails, purple loosestrife, phragmites) was listed as a visual for the points nearest shore. Ultimately, data was used to calculate frequency of occurrence, relative frequency of occurrence, average rake density, total sites with vegetation, maximum depth of plants, average native species per site, average of all species per site, species richness, and floristic quality.

Camp Lake

Plants were surveyed on August 16th, 17th, and 18th, 2021 using the 490 pre-determined WDNR points (Figure 9). The thirty-three different species of plants identified on Camp Lake are outlined in Figure 10 from highest to lowest frequency of occurrence. The C-value for each species is also recorded. The C-value is the estimated probability that a plant is likely to occur in a landscape that is believed to be relatively unchanged from before development. The C-value ranges from 0 – 10 with 10 being assigned to species most sensitive to disturbance.

Figure 9: Overview of 2021 Plant Sampling Points - Camp Lake



WDNR (2007)

Figure 10: 2021 Plant Sampling Species Summary - Camp Lake

Common Name	Scientific Name	Total Number of sites found (includes Visuals)	% Relative Frequency of Occurance* (Includes Visuals)	Average Density Rating	C-value
Eurasian water-milfoil**	***Myriophyllum spicatum***	**368**	**80.3**	**1.37**	**Invasive**
Slender naiad	*Najas flexilis*	293	64.0	1.34	6
Water star-grass	*Heteranthera dubia*	275	60.0	1.16	6
Common waterweed	*Elodea canadensis*	267	58.3	1.37	3
Wild celery	*Vallisneria americana*	267	58.3	1.20	6
Illinois pondweed	*Potamogeton illinoensis*	233	50.9	1.23	6
Long-leaf pondweed	*Potamogeton nodosus*	222	48.5	1.13	7
Sago pondweed	*Stuckenia pectinata*	191	41.7	1.13	3
White water lily	*Nymphaea odorata*	171	37.3	1.17	6
Coontail	*Ceratophyllum demersum*	142	31.0	1.34	3
Muskgrasses	*Chara spp.*	122	26.6	1.61	7
Common watermeal	*Wolffia columbiana*	93	20.3	1.00	5
Variable pondweed	*Potamogeton gramineus*	87	19.0	1.04	7
Purple loosestrife**	***Lythrum salicaria***	**70**	**15.3**	**V**	**Invasive**
Common bladderwort	*Utricularia vulgaris*	67	14.6	1.14	7
Filamentous Algae		58	12.7	1.00	n/a
Cattail	*Typha spp.*	53	11.6	V	1
Floating-leaf pondweed	*Potamogeton natans*	51	11.1	1.06	5
Spatterdock	*Nuphar variegata*	40	8.7	1.17	6
Softstem bulrush*	*Schoenoplectus tabernaemontani*	40	8.7	1.00	4
Orange Jewelweed	*Impatiens capensis*	35	7.6	V	3
Leafy pondweed	*Potamogeton foliosus*	34	7.4	1.12	6
Swamp loosestrife	*Decodon verticillatus*	29	6.3	V	n/a
Ditch grass	*Ruppia cirrhosa*	20	4.4	1.40	8
Starry Stonewort**	***Nitellopsis obtusa***	**12**	**2.6**	**1.22**	**Invasive**
Small duckweed	*Lemna minor*	10	2.2	V	4
Common reed**	***Phragmites australis***	**9**	**2.0**	**V**	**1**
Pickerelweed	*Pontederia cordata*	9	2.0	1.00	8
Small bladderwort	*Utricularia minor*	8	1.7	1.00	10
Curly-leaf pondweed**	***Potamogeton crispus***	**2**	**0.4**	**1.00**	**Invasive**
Forked duckweed	*Lemna trisulca*	2	0.4	V	6
Common bur-reed	*Sparganium eurycarpum*	2	0.4	V	5
Small pondweed	*Potamogeton pusillus*	1	0.2	1.00	7
Arrowhead	*Sagittaria spp.*	1	0.2	1.00	3

Lake and Pond Solutions LLC (2022)

*Relative frequency shown as a percentage of occurrence within vegetated sites including visuals

** **Non-native (exotic) species**

Figure 11: 2021 Plant Sampling Data Summary - Camp Lake

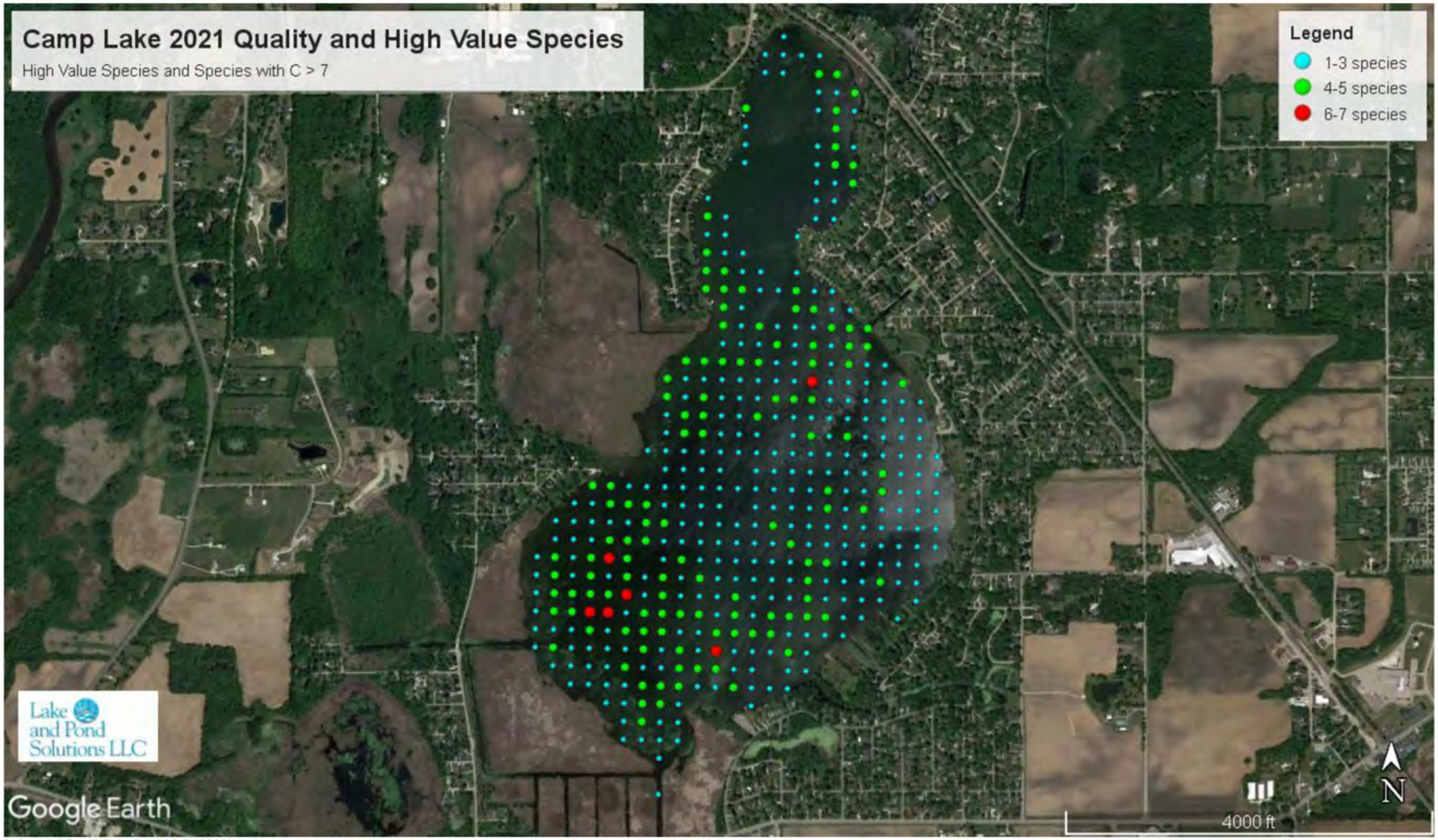
Total number of sites with vegetation	458 / 490 total (93.5%)
Maximum depth of plants	16.0 feet
Species Richness (including visuals)	33
Average number of all species per site (vegetated sites only) incl visuals	7.22
Average number of native species per site (vegetated sites only) incl visuals	6.30

Lake and Pond Solutions LLC (2022)

Lake-wide, there was an average of 6.30 native species found per site (up from 3.34 in 2011 and 4.18 in 2016). Non-native plants seem to have resurged, with a higher frequency of EWM than any other year, as well as the documentation of Starry Stonewort, a new invasive plant for Camp Lake. There remains a healthy distribution of native plant species, including four species listed as "high value" by the WDNR NR109.05(3)(g) document. Figure 12 depicts a total of the number of these high value species, as well as species deemed "quality" with a C-Value (Figure 10) greater than or equal to seven at each of the points. The high value species include Illinois Pondweed (*Potamogeton illinoensis)*, Sago Pondweed (*Stuckenia pectinata)*, Wild Celery (*Vallisneria americana)*, and Softstem Bulrush (*Schoenoplectus tabernaemontani*) while the quality species include Muskgrasses (*Chara spp.),* Variable Pondweed (*Potamogeton gramineus)*, Long-leaf Pondweed (*Potamogeton nodosus)*, Small Pondweed (*Potamogeton pusillus)*, Widgeon Grass (*Ruppia cirrhosa)*, Small Bladderwort (*Utricularia minor)*, and Common Bladderwort (*Utricularia vulgaris)*.

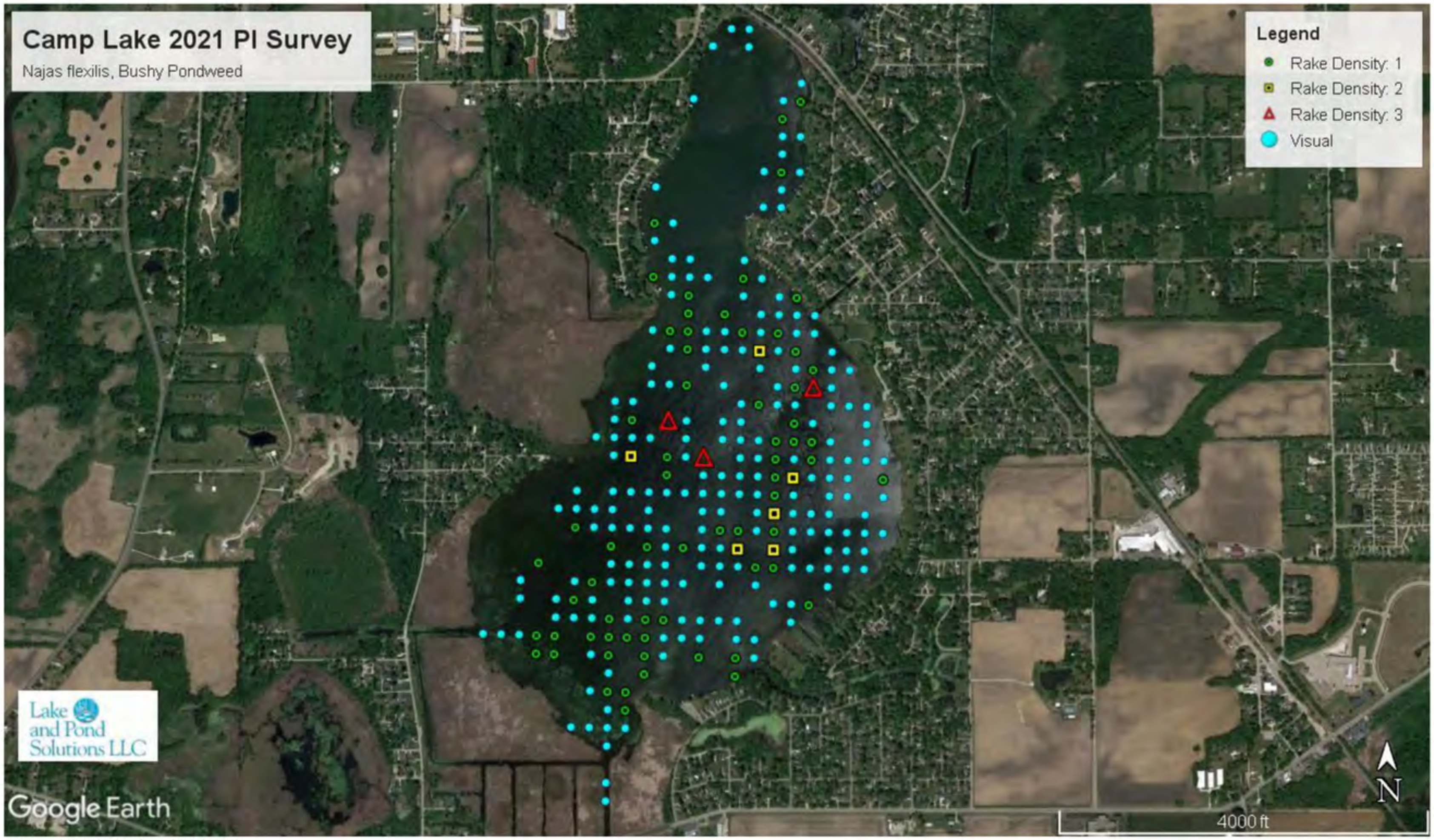
The five most common native aquatic plant species, including visuals, ranked by percent relative frequency of occurrence at all vegetated points surveyed on Camp Lake were Bushy Pondweed (64.0%), Water Stargrass (60.0%), Common Waterweed (58.3%), Wild Celery (58.3%), and Illinois Pondweed (50.9%). Figures 13 through 17 show locations of the top five most common native plants. Non-native aquatic plant species in Camp Lake include Eurasian Milfoil (80.3%), Purple Loosestrife (15.3%), Starry Stonewort (2.6%), Common Reed (2.0%) and Curly-leaf Pondweed (0.4%). Figures 18 through 21 show locations of the non-native plants. Curly-leaf pondweed was not depicted in a map since only two sites were found throughout the lake. Species from the 2021 survey are compared with previous surveys on Camp Lake in Figure 36.

Figure 12: Camp Lake Quality and High Value Species (2021)



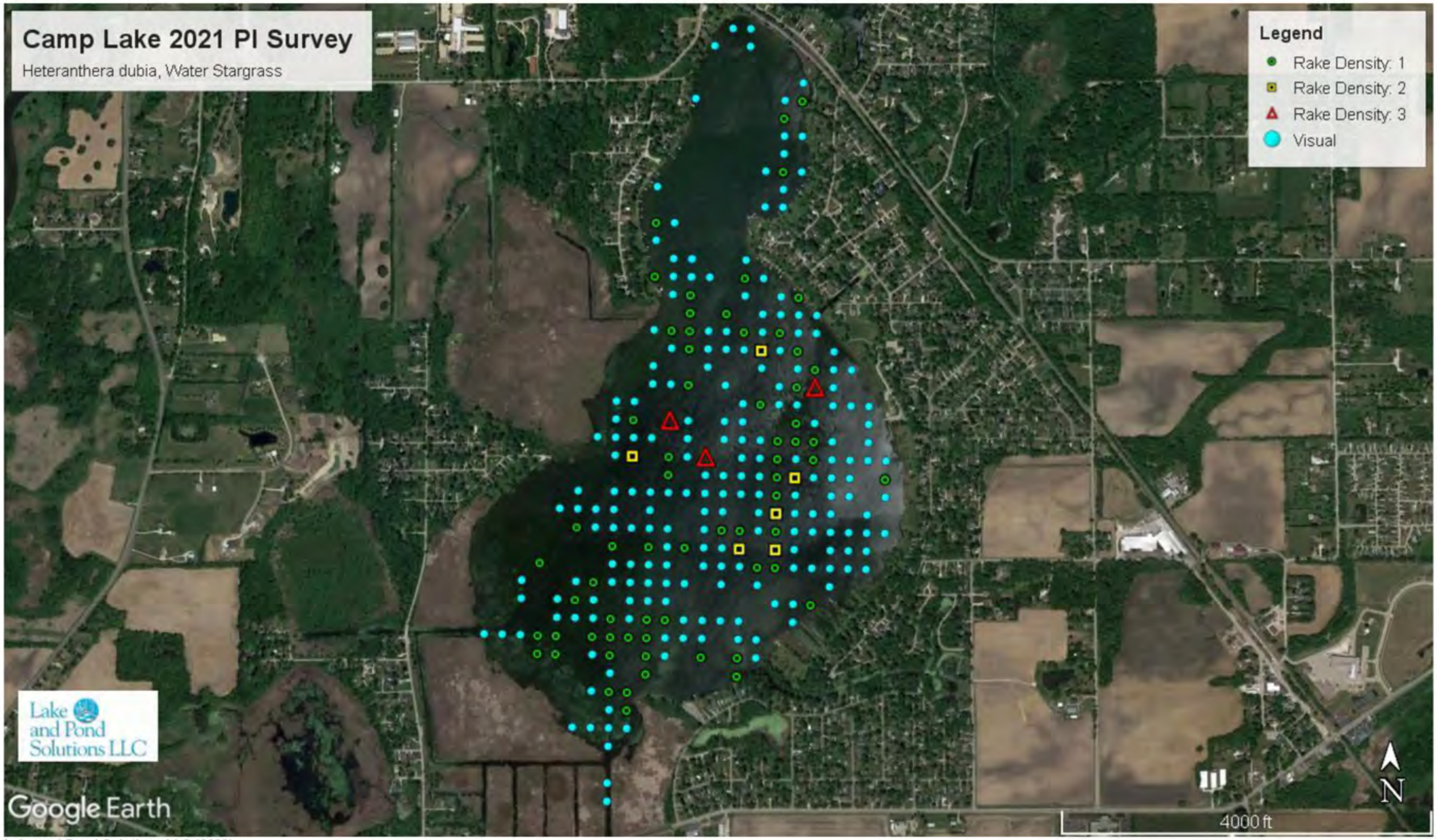
Lake and Pond Solutions LLC (2022)

Figure 13: Camp Lake Bushy Pondweed, *Najas flexilis* (2021)



Lake and Pond Solutions LLC (2022)

Figure 14: Camp Lake Water Stargrass, *Heteranthera dubia* (2021)



Lake and Pond Solutions LLC (2022)

Figure 15: Camp Lake Common Waterweed, *Elodea canadensis* (2021)

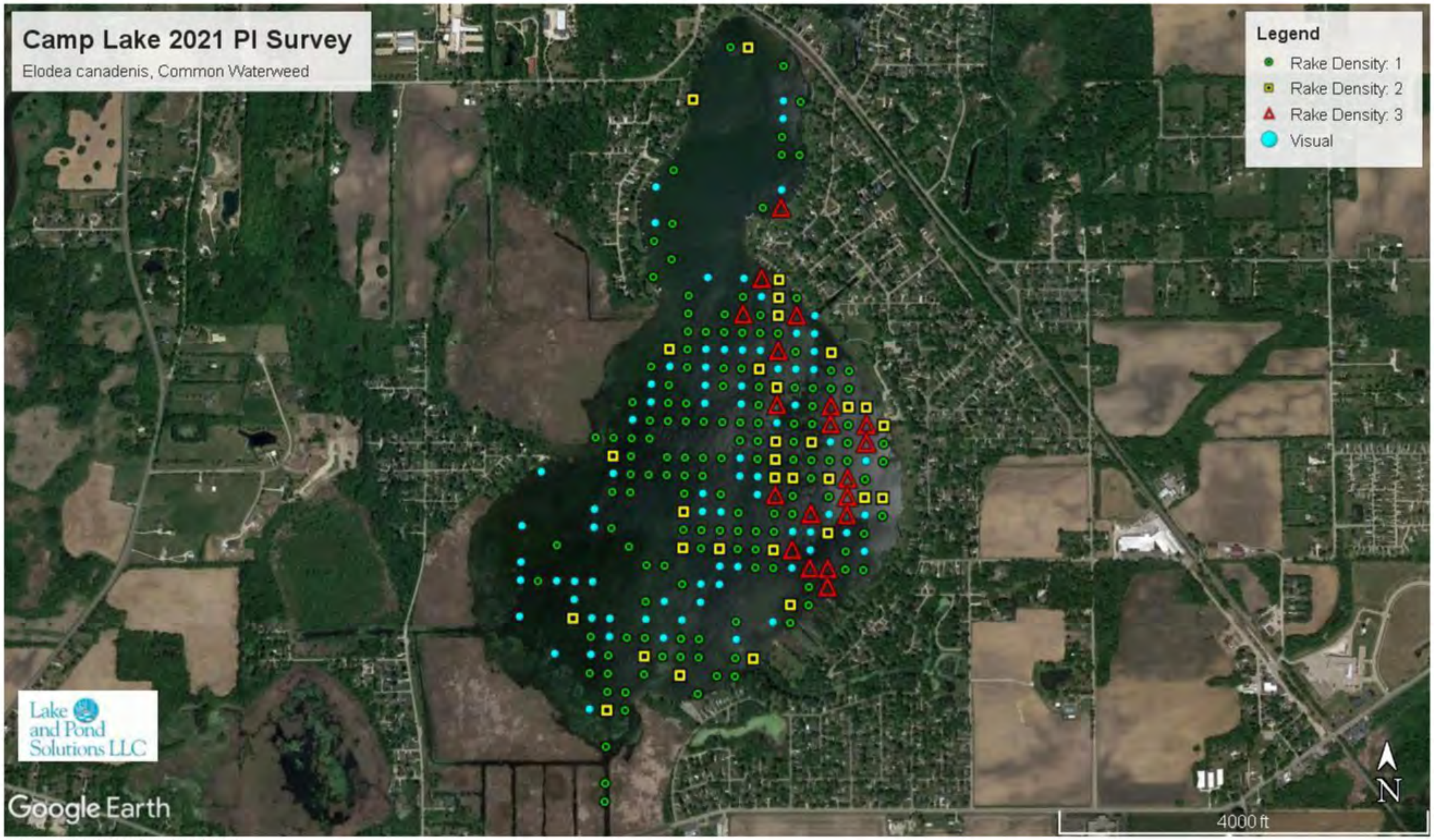


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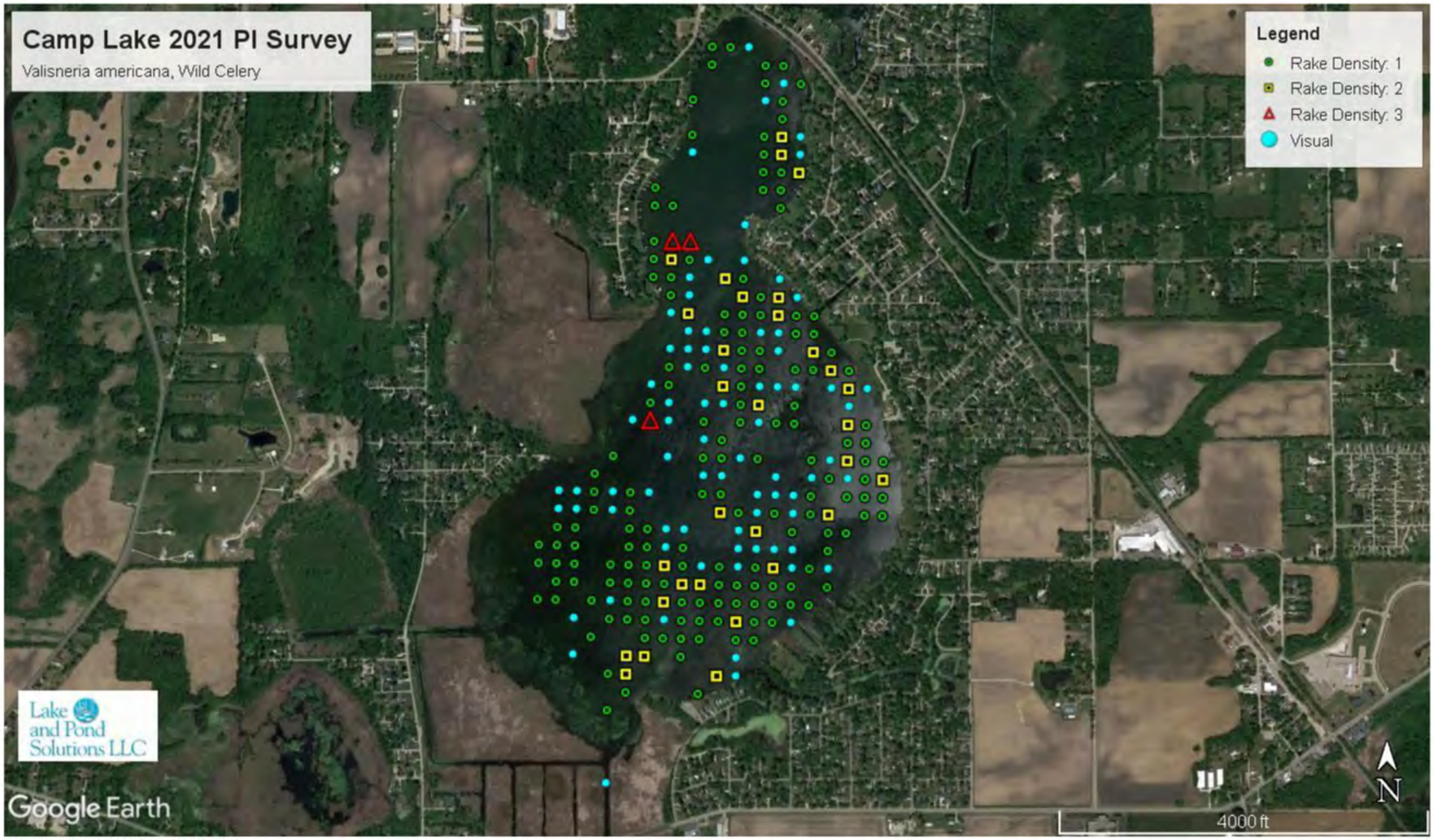
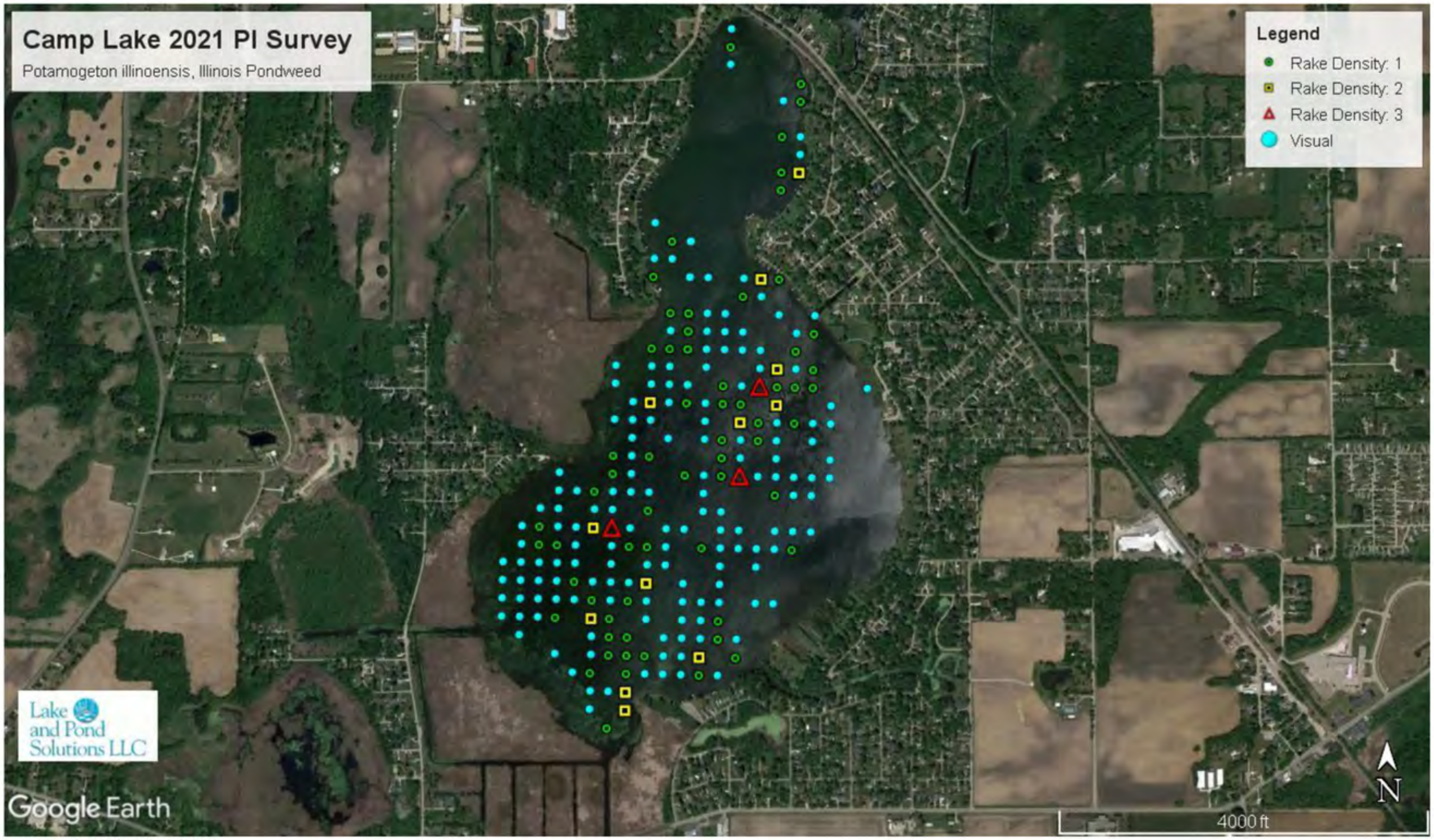
Figure 16: Camp Lake Wild Celery, *Vallisneria americana* (2021)



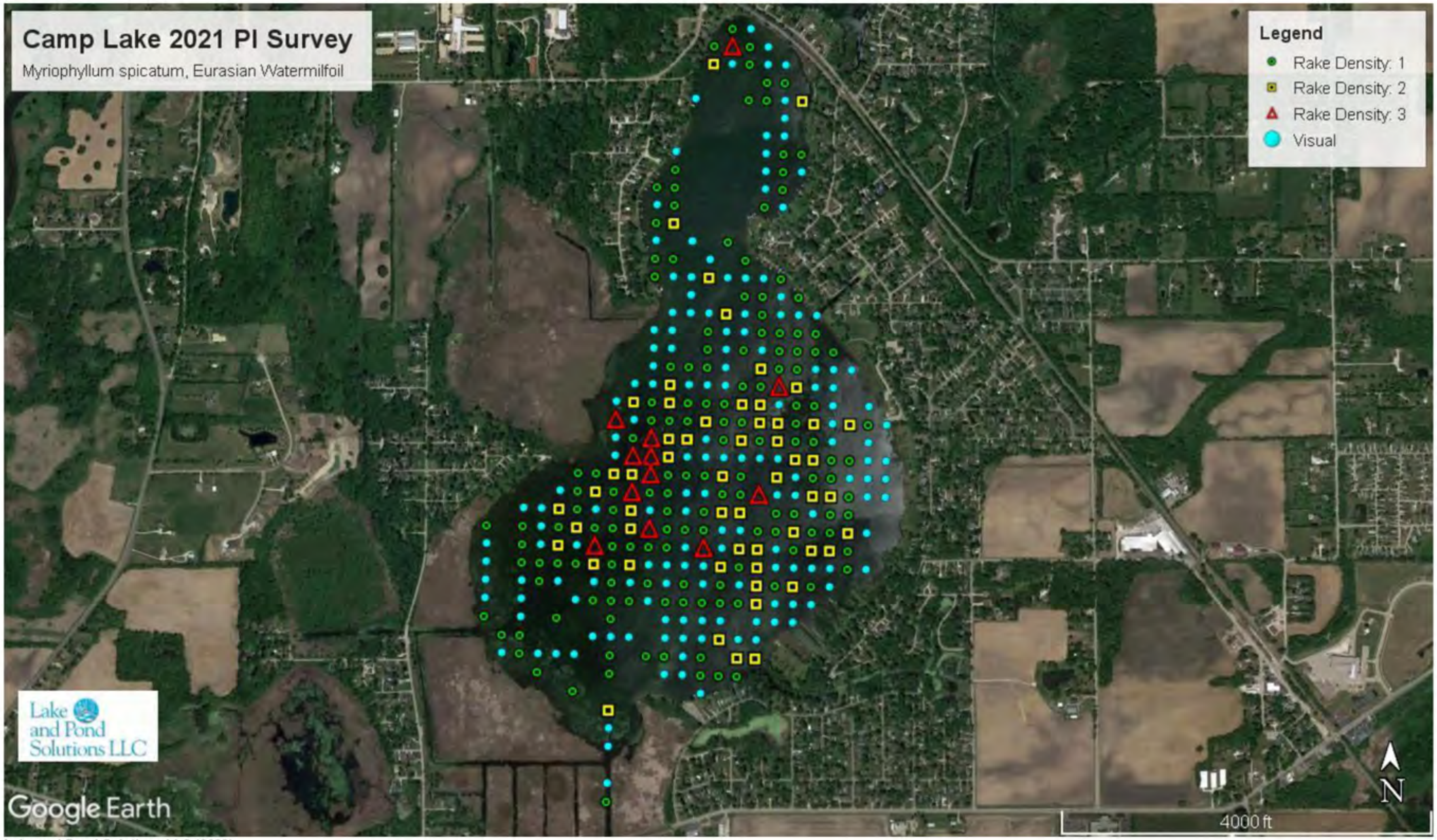
Lake and Pond Solutions LLC (2022)

Figure 17: Camp Lake Illinois Pondweed, *Potamogeton illinoensis* (2021)



Lake and Pond Solutions LLC (2022)

Figure 18: Camp Lake Eurasian Milfoil, *Myriophyllum spicatum* (2021) - INVASIVE

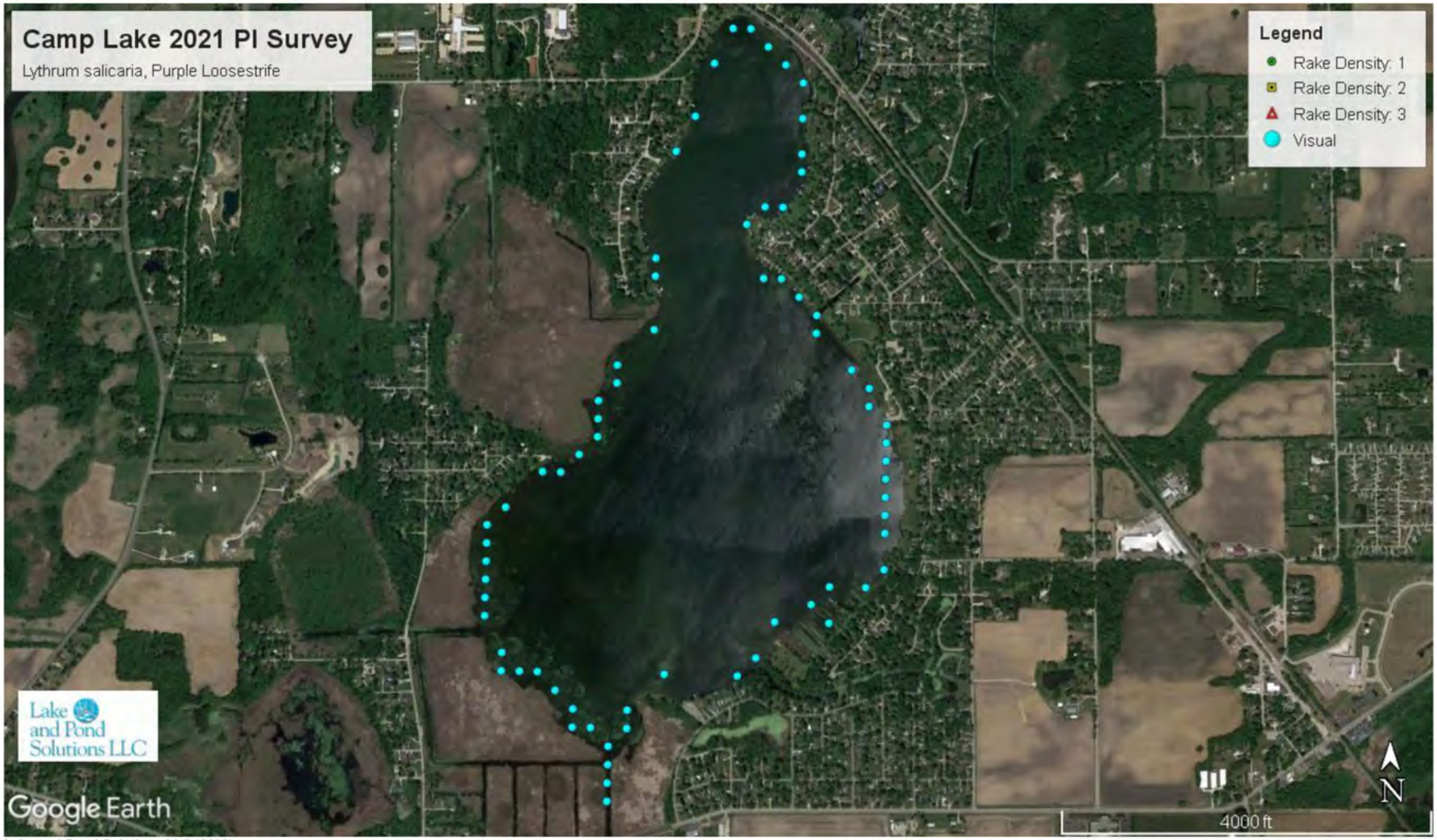


Lake and Pond Solutions LLC (2022)

Figure 19: Camp Lake Starry Stonewort, *Nitellopis obtusa* (2021) - INVASIVE

Lake and Pond Solutions LLC (2022)

Figure 20: Camp Lake Purple Loosestrife, *Lythrum salicaria* (2021) - INVASIVE



Lake and Pond Solutions LLC (2022)

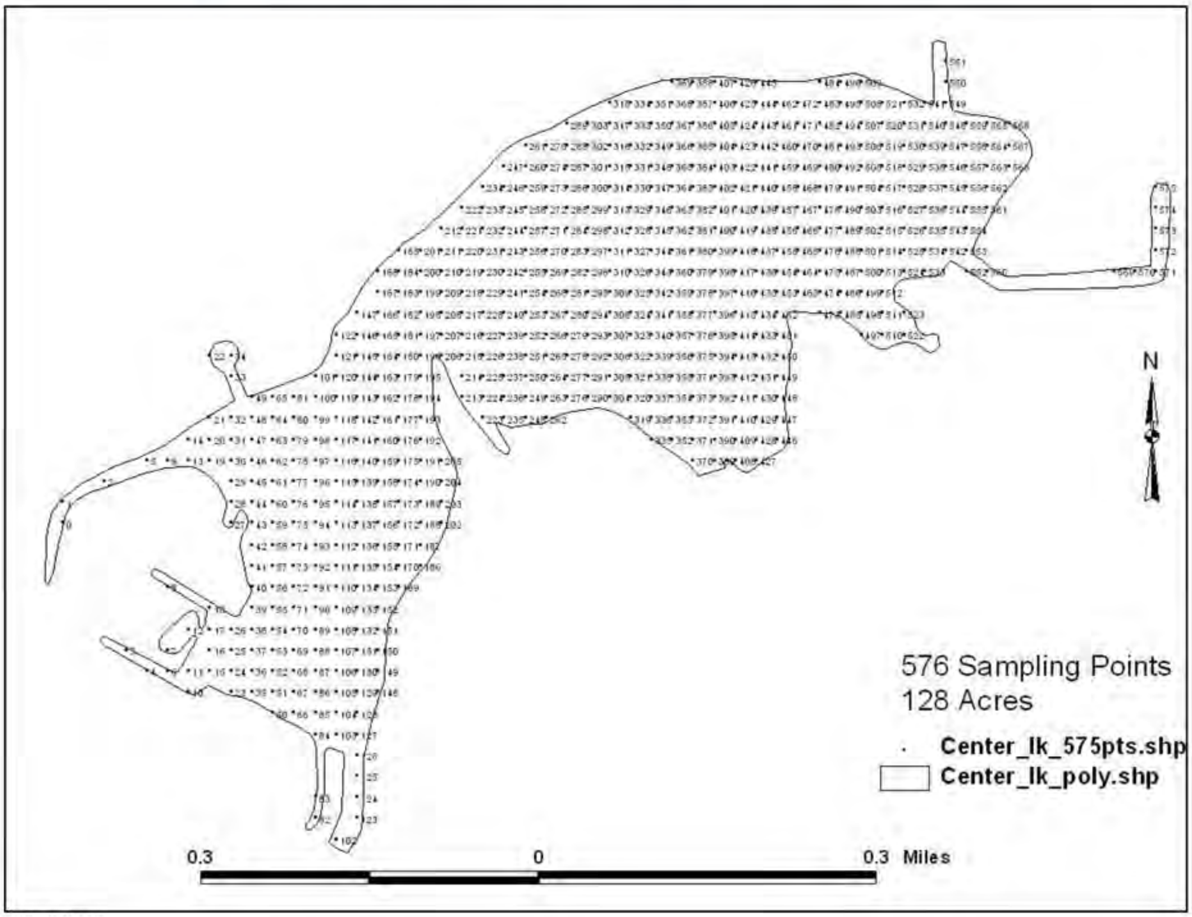
Figure 21: Camp Lake Common Reed, *Phragmites australis* (2021)

Lake and Pond Solutions LLC (2022)

Center Lake

Plants were surveyed on August 12th and 13th, 2021 using the 576 pre-determined WDNR points (Figure 22). The twenty-nine different species of plants identified on Center Lake are outlined in Figure 23 from highest to lowest frequency of occurrence. The C-value for each species is also recorded. The C-value is the estimated probability that a plant is likely to occur in a landscape that is believed to be relatively unaltered from pre-settlement conditions. The C-value ranges from 0 – 10 with 10 being assigned to species most sensitive to disturbance.

Figure 22: Overview of 2021 Plant Sampling Points - Center Lake



WDNR (2007)

Figure 23: 2021 Plant Sampling Species Summary - Center Lake

Common Name	Scientific Name	Total Number of sites found (includes Visuals)	% Relative Frequency of Occurance* (Includes Visuals)	Average Density Rating	C-value
Coontail	*Ceratophyllum demersum*	210	60.69	1.56	3
Common watermeal	*Wolffia columbiana*	199	57.51	1.00	5
Sago pondweed	*Stuckenia pectinata*	124	35.84	1.14	3
Wild celery	*Vallisneria americana*	118	34.10	1.31	6
Purple loosestrife**	***Lythrum salicaria***	**101**	**29.19**	**V**	**Invasive**
Cattail	*Typha spp.*	91	26.30	V	1
Small duckweed	*Lemna minor*	87	25.14	1.00	4
Illinois pondweed	*Potamogeton illinoensis*	74	21.39	1.00	6
Orange Jewelweed	*Impatiens capensis*	74	21.39	V	3
Eurasian water-milfoil**	***Myriophyllum spicatum***	**67**	**19.36**	**1.34**	**Invasive**
White water lily	*Nymphaea odorata*	61	17.63	1.30	6
Water star-grass	*Heteranthera dubia*	59	17.05	1.31	6
Filamentous Algae		57	16.47	1.23	n/a
Muskgrasses	*Chara spp.*	51	14.74	1.98	7.00
Swamp loosestrife	*Decodon verticillatus*	50	14.45	V	n/a
Slender naiad	*Najas flexilis*	50	14.45	1.31	6
Curly-leaf pondweed**	***Potamogeton crispus***	**44**	**12.72**	**1.11**	**Invasive**
Common waterweed	*Elodea canadensis*	38	10.98	1.04	3
Flat-stem pondweed	*Potamogeton zosteriformis*	26	7.51	1.00	6
Leafy pondweed	*Potamogeton foliosus*	23	6.65	1.18	6
Spatterdock	*Nuphar variegata*	15	4.34	1.33	6
White-stem pondweed*	*Potamogeton praelongus*	14	4.05	1.00	8
Common reed**	***Phragmites australis***	**11**	**3.18**	**V**	**1**
Forked duckweed	*Lemna trisulca*	9	2.60	1.00	6
Variable pondweed	*Potamogeton gramineus*	9	2.60	1.33	7
Ditch grass	*Ruppia cirrhosa*	6	1.73	1.50	8
Arrowhead	*Sagittaria spp.*	6	1.73	V	3
Small pondweed	*Potamogeton pusillus*	5	1.45	1.00	7
Floating-leaf pondweed	*Potamogeton natans*	2	0.58	1.00	5
Softstem bulrush*	*Schoenoplectus tabernaemontani*	2	0.58	V	4

Lake and Pond Solutions LLC (2022)

*Relative frequency shown as a percentage of occurrence within vegetated sites including visuals

**** Non-native (exotic) species**

Figure 24: 2021 Plant Sampling Data Summary - Center Lake

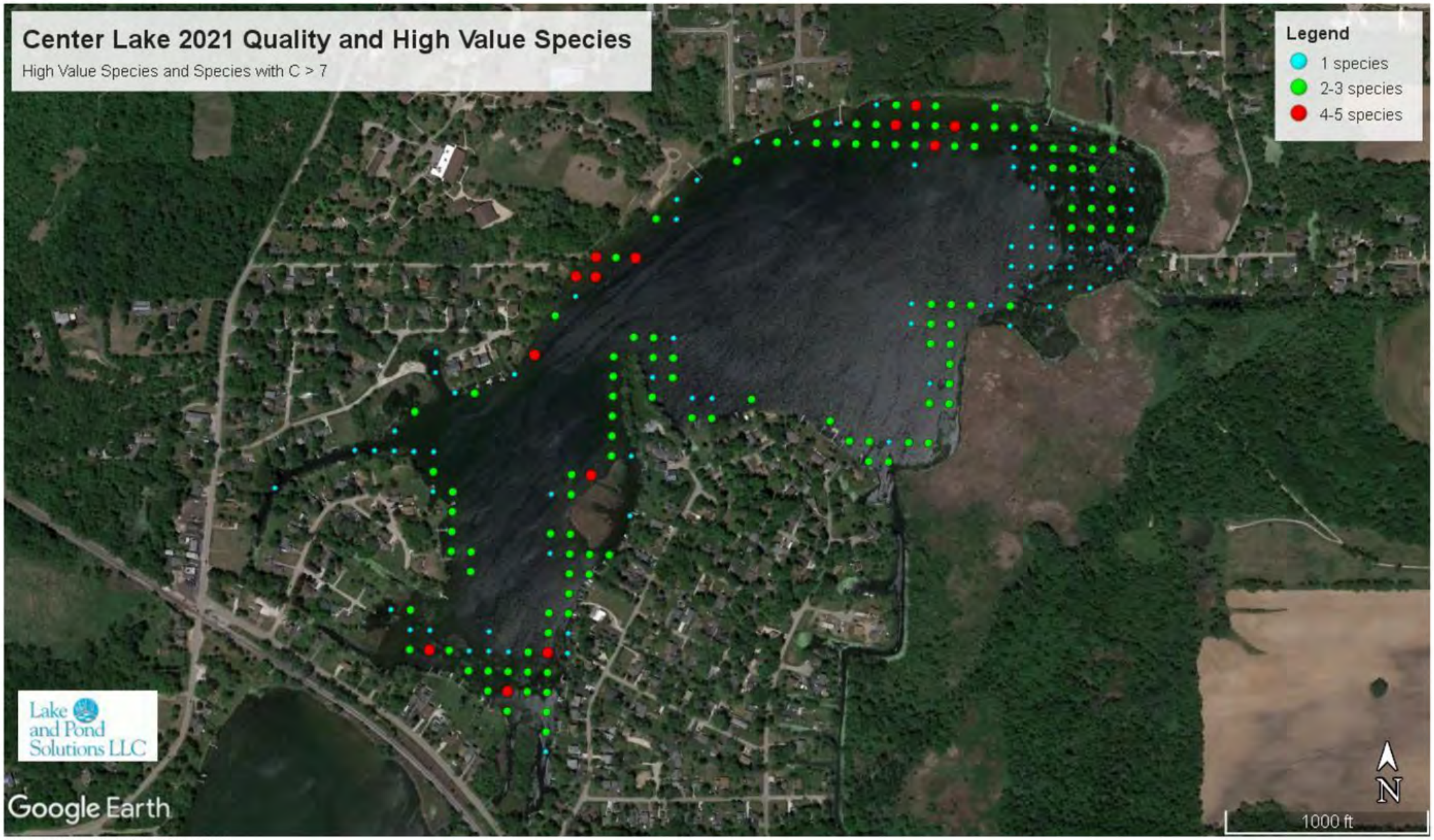
Total number of sites with vegetation	346 / 576 (60.06%)
Maximum depth of plants	15.5 feet
Species Richness (including visuals)	29
Average number of all species per site (vegetated sites only)	5.26
Average number of native species per site (vegetated sites only)	4.66

Lake and Pond Solutions LLC (2022)

Lake-wide, there was an average of 4.66 native species found per site, up from 2.16 in 2011, and 3.63 in 2016. Populations of non-native plants like Eurasian watermilfoil have remained scattered around the shoreline as 2,4-D treatments have become less effective over time. There remains a healthy distribution of native plant species, including five species listed as "high value" by the WDNR NR109.05(3)(g) document. Figure 25 depicts a total of the number of these high value species, as well as species deemed "quality" with a C-Value (Figure 23) greater than or equal to seven at each of the points. The high value species in Figure 25 include Illinois Pondweed (*Potamogeton illinoensis)*, Sago Pondweed (*Stuckenia pectinate)*, Wild Celery (*Vallisneria americana)*, White-stem pondweed (*Potamogeton praelongus*), and Softstem bulrush (*Schoenoplectus tabernaemontani*) while the quality species include Muskgrasses (*Chara spp.*), Variable Pondweed (*Potamogeton gramineus)*, Small Pondweed (*Potamogeton pusillus)*, and Widgeon Grass (*Ruppia cirrhosa)*.

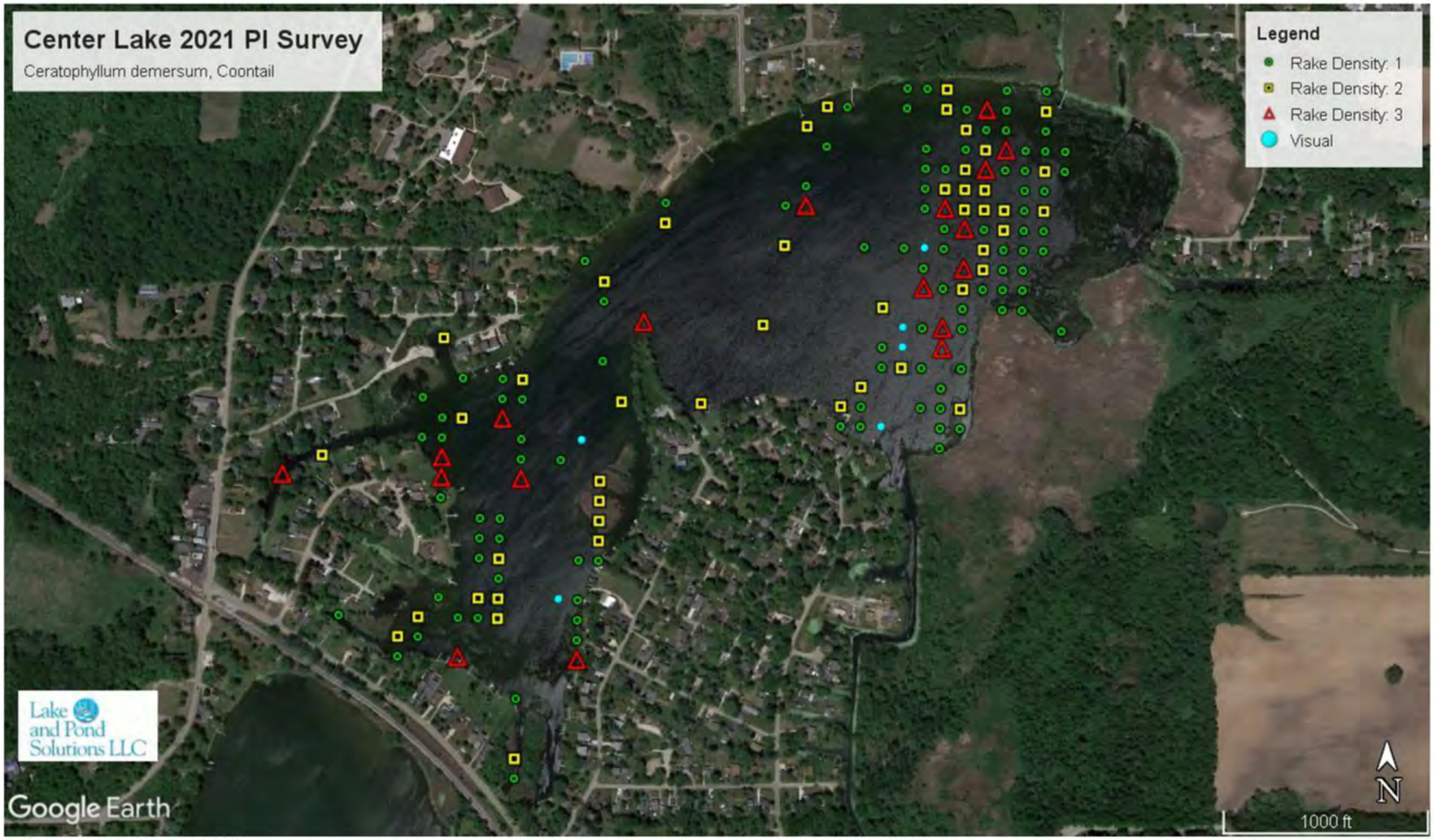
The five most common native aquatic plant species, including visuals, ranked by percent frequency of occurrence at all vegetated points surveyed on Center Lake were Coontail (60.7%), Watermeal (57.5%), Sago Pondweed (35.8%), Wild Celery (34.1%), and Cattail (26.3%). Figures 26 through 30 show locations of these top five most common native plants. We've omitted maps for watermeal, cattails, and small duckweed to show rooted aquatic species. Non-native species include Purple Loosestrife (29.2%), Eurasian Watermilfoil (19.4%), Curly-leaf Pondweed (12.7%), and Common Reed (3.2%). Figures 31 through 34 show locations of these four non-native plants. Species from the 2021 survey are compared with previous surveys in Figure 37.

Figure 25: Center Lake Quality and High Value Species (2021)



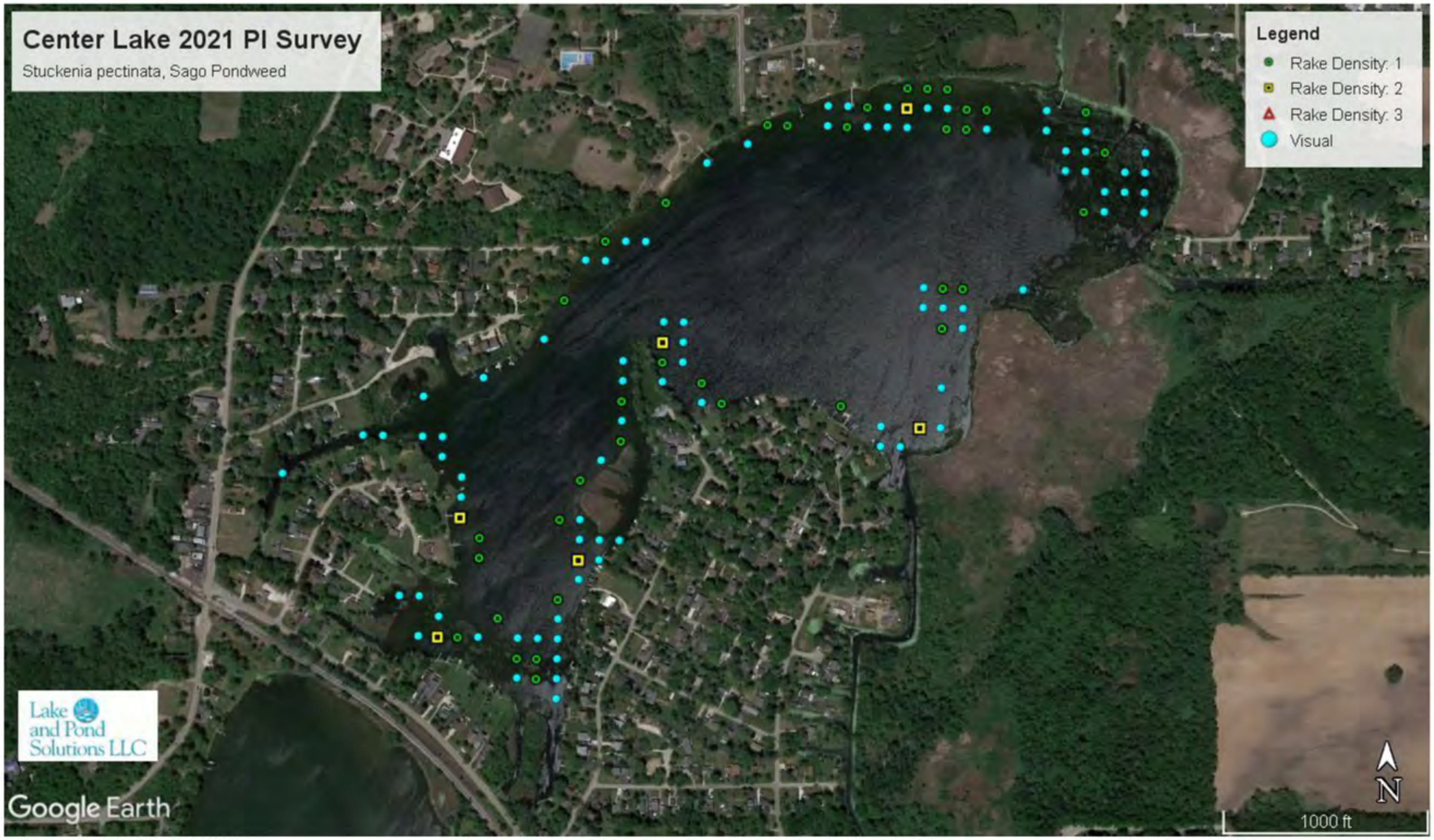
Lake and Pond Solutions LLC (2022)

Figure 26: Center Lake Coontail, Ceratophyllum demersum (2021)



Lake and Pond Solutions LLC (2022)

Figure 27: Center Lake Sago Pondweed, *Stuckenia pectinata* (2021)



Lake and Pond Solutions LLC (2022)

Figure 28: Center Lake Wild Celery, *Vallisneria americana* (2021)

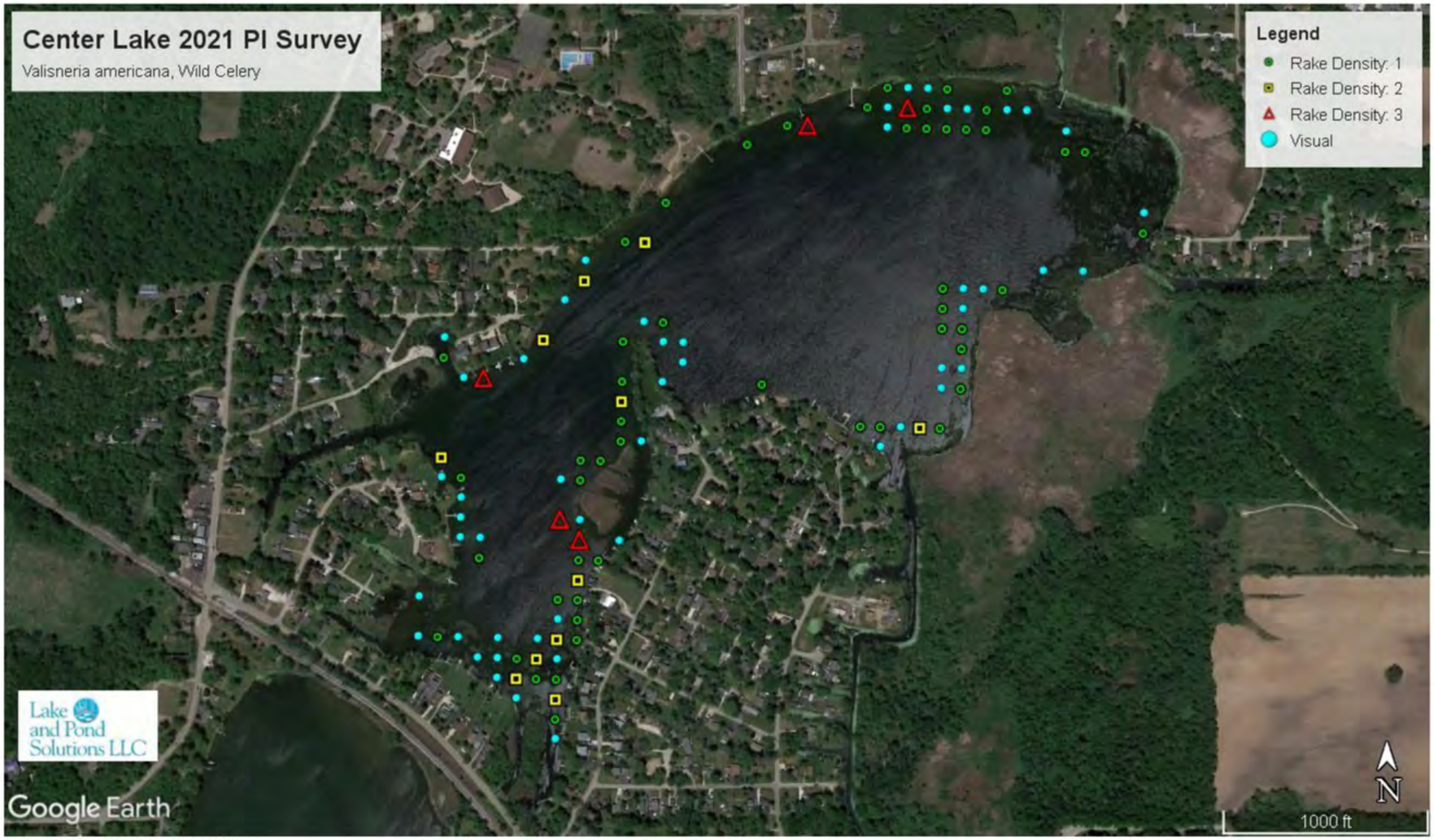


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Figure 29: Center Lake Illinois Pondweed, *Potamogeton illnoensis* (2021)

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Figure 30: Center Lake White Water Lily, *Nymphaea odorata* (2021)

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Figure 31: Center Lake Eurasian Milfoil, *Myriophyllum spicatum* (2021) - INVASIVE

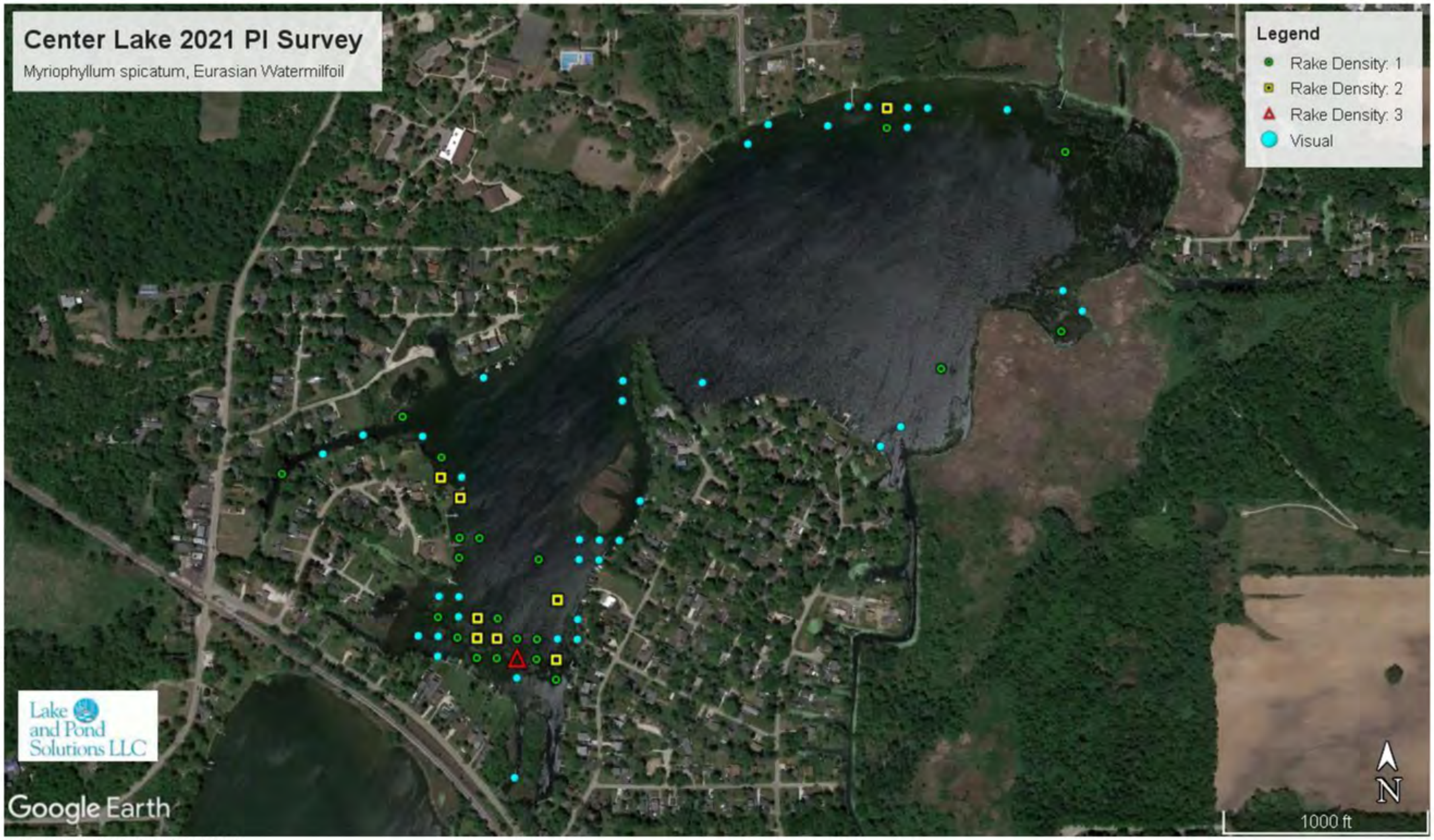

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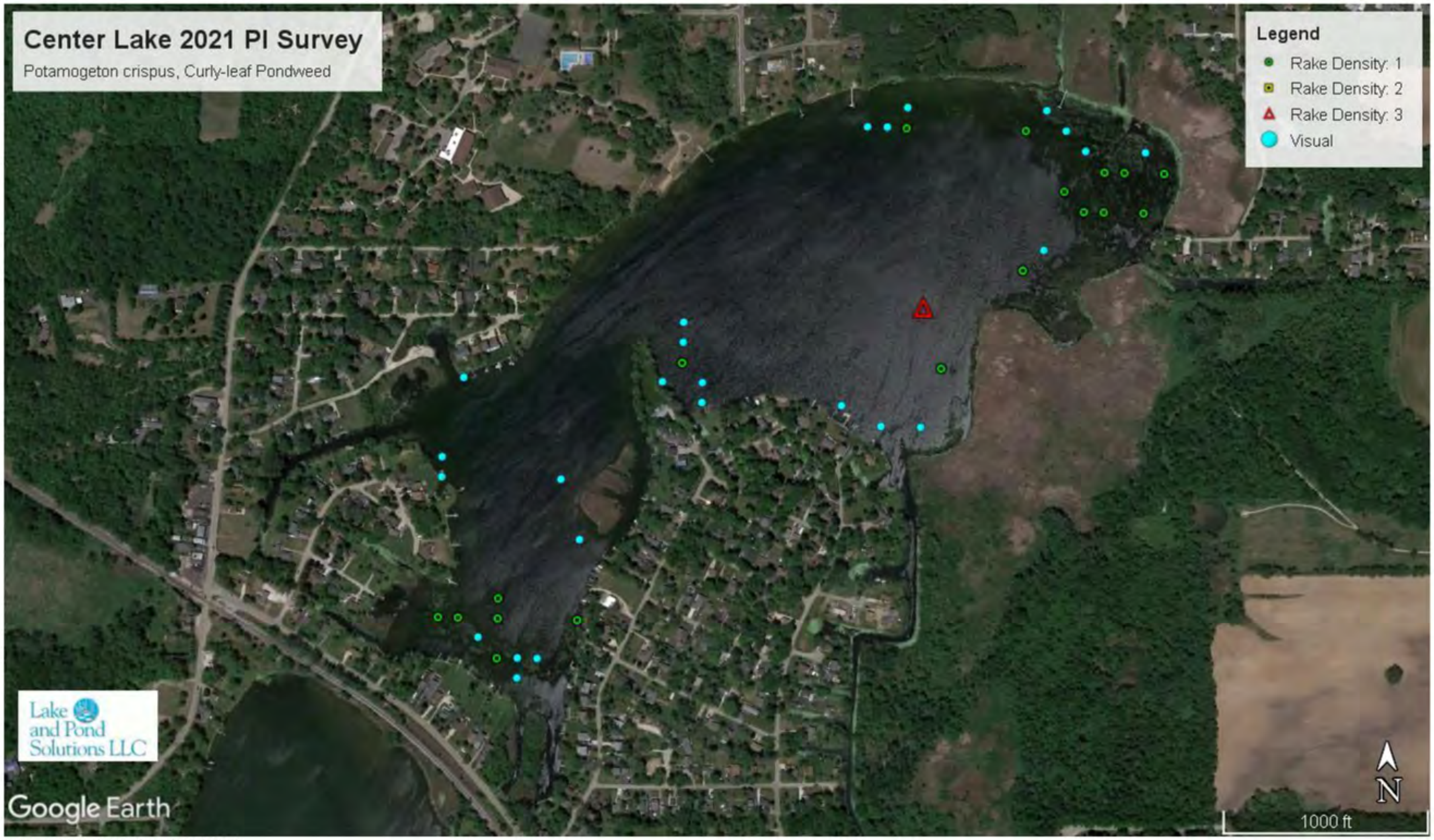
Figure 32: Center Lake Curly-leaf Pondweed, *Potamogeton crispus* (2021) - INVASIVE



Lake and Pond Solutions LLC (2022)

Figure 33: Center Lake Purple Loosestrife, *Lythrum salicaria* (2021) - INVASIVE

Lake and Pond Solutions (2021)

Figure 34: Center Lake Common Reed, *Phragmites australis* (2021) - INVASIVE

Lake and Pond Solutions (2021

Comparison of Aquatic Plant Surveys (2011 – 2021)

A comparison of past plant surveys serves as a valuable resource indicating how the plant community and aquatic system changes over time. The point-intercept surveys from 2011 – 2021 were compiled using a modified grid sampling method determined by the size and morphology of the lake. Sampling takes place at each point in the WDNR generated grid and the survey allows for the ability to catalog visual sightings of species not directly sampled. These surveys are comprehensive and the same GPS points are used year after year.

Camp Lake

Figure 35 shows the species summary from the last three surveys and the important trends include:

- One invasive species, Starry Stonewort, was added from the last survey. Three native species were added (Swamp Loosestrife. Narrow-leaved Bur-reed, and Small Pondweed) while five native species were lost (Northern Milfoil, White-stem Pondweed, Flat-stem Pondweed, Spiny Naiad, and Fries Pondweed). This results in a net loss of two total native species since 2016.

- EWM was in 80.35% of vegetated sites in 2021, 45.12% in 2016 and only 7.69% in 2011. Much of this resurgence is likely due to a 2,4-D resistance over time which may be related to hybridized strains of milfoil. It will be important to examine alternative treatment methods (i.e. fluridone or ProcellaCOR) in future years.

- Five species increased by more than twenty-five percentage points from the 2016 survey: Water Stargrass, Common Waterweed, Long-leaf Pondweed, Illinois Pondweed, and Eurasian Milfoil. Besides increases of the five species above, four additional species also saw over a two-fold increase in number of sites since the last survey: Leafy Pondweed, Phragmites, Coontail, and Illinois Pondweed.

- Only Widgeon Grass decreased by more than twenty-five percentage points from the 2016 survey. The number of identified sites of Widgeon Grass, Variable Pondweed, and Muskgrass (Chara spp.) decreased by over 30%.

- From 2011 to 2021, the number of native species with a frequency of occurrence greater than 30% has increased from three in 2011 to six in 2016 to nine in 2021. This demonstrates that the native plant community is becoming more diverse and widespread throughout the lake.

- There were 3.34 native species per vegetated site in 2011, 4.18 in 2016, and 6.30 in 2021.

- Maximum depth of plant growth ranged from 13.0' in 2011 to 10.5' in 2016 to 16.0' in 2021 likely due to seasonal changes in clarity.

- Species richness ranged from 25 in 2011, to 34 in 2016, and 33 in 2021.

- The Simpson Diversity Index has remained consistent, ranging from 0.91 – 0.94 (maximum diversity is 1.0)

Figure 35: Plant Species Annual Comparison Summary for Camp Lake (2011-2021)

		Frequency of Occurrence within Vegetated Areas (%) incl visuals		
Common Name	**Scientific Name**	**Aug-11**	**Aug-16**	**Aug-21**
Eurasian Water-Milfoil**	*Myriophyllum spicatum*	7.69	45.12	80.35
Bushy Pondweed	*Najas flexilis*	48.87	39.68	63.97
Water Star-grass	*Heteranthera dubia*	0.90	4.76	60.04
Common Waterweed	*Elodea canadensis*	26.02	12.24	58.30
Wild Celery*	*Vallisneria americana*	19.68	34.01	58.30
Illinois Pondweed*	*Potamogeton illinoensis*	27.60	23.81	50.87
Long-leaf Pondweed	*Potamogeton nodosus*	3.85	9.52	48.47
Sago Pondweed*	*Stuckenia pectinata*	7.01	31.97	41.70
White Water Lily	*Nymphaea odorata*	14.71	27.44	37.34
Coontail	*Ceratophyllum demersum*	19.46	10.88	31.00
Muskgrass	*Chara spp.*	54.98	41.50	26.64
Common Watermeal	*Wolffia Columbiana*	n/a	6.12	20.31
Variable Pondweed	*Potamogeton gramineus*	n/a	32.88	19.00
Purple Loosestrife**	*Lythrum salicaria*	6.79	9.98	15.50
Common Bladderwort	*Utricularia vulgaris*	20.81	16.55	14.63
Cattail spp.	*Typha spp.*	6.79	14.74	11.57
Floating-leaf Pondweed	*Potamogeton natans*	4.75	13.38	11.14
Soft-stem bulrush*	*Schoenoplectus tabernaemontani*	7.01	10.20	8.73
Spatterdock	*Nuphar variegatum*	4.07	7.48	8.73
Leafy Pondweed	*Potamogeton foliosus*	n/a	0.45	7.42
Swamp loosestrife	*Decodon verticillatus*	n/a	n/a	6.33
Widgeon Grass	*Ruppia cirrhosa*	53.62	45.35	4.37
Starry Stonewort**	*Nitellopsis obtusa*	n/a	n/a	2.62
Small Duckweed	*Lemna minor*	0.23	2.49	2.18
Common Reed**	*Phragmites australis*	n/a	0.45	1.97
Pickerelweed	*Pontedaria cordata*	0.68	1.13	1.97
Small Bladderwort	*Utricularia minor*	n/a	2.27	1.75
Forked Duckweed	*Lemna trisulca*	n/a	0.45	0.44
Curly-leaf Pondweed**	*Potamogeton crispus*	0.45	0.23	0.44
Common Arrowhead	*Sagittaria latifolia*	n/a	0.23	0.22
Flat-stem Pondweed	*Potamogeton zosteriformis*	5.20	10.66	n/a
White-stem Pondweed*	*Potamogeton praelongis*	5.88	4.31	n/a
Northern Water-Milfoil	*Myriophyllum sibiricum*	n/a	2.49	n/a
Spiny Naiad	*Najas marina*	1.36	0.45	n/a
Fries Pondweed	*Potamogeton friesii*	n/a	0.23	n/a
Various-leaved Milfoil	*Myriophyllum heterophyllum*	0.45	n/a	n/a

Lake and Pond Solutions LLC (2022)

*Species are considered "high value" plant species under Wisconsin Administrative Code NR 109.05(g)

****Denotes non-native species**

Center Lake

Figure 36 shows the species summary from the last three surveys and the important trends include:

- Three native species were added: Swamp Loosestrife, Variable Pondweed, and Arrowhead spp.. Three species were lost: Northern Milfoil, Spiny Naiad, and Common Bladderwort. This results in a net gain of zero total native species since the last survey.

- EWM was in 19.36% of vegetated sites in 2021, 18.44% in 2016, and 5.49% in 2011. Recently, CCLRD has taken efforts to target larger beds of EWM which looks to have increased native diversity and stabilized EWM populations.

- Five species increased by more than ten percentage points from the 2016 survey: Common Watermeal, Purple Loosestrife, Cattail spp., Illinois Pondweed and Curly-leaf Pondweed. Additionally, the number of identified sites of Phragmites increased over fivefold from the last survey.

- One species decreased by more than ten percentage points from the 2016 survey: Muskgrass (Chara spp.). The number of identified sites of three species decreased by over 50% from the last survey: Widgeon Grass, Forked Duckweed, and Spatterdock.

- Native species found at a frequency of occurrence greater than 25% increased from 2 in 2011 to 5 in 2016 and 6 in 2021. This again demonstrates that the plant community is becoming more diverse and widespread throughout the lake.

- There were 2.16 native species per vegetated site in 2011, 3.63 in 2016, and 4.66 native species in 2021, demonstrating a positive trend in diversity of native plants at each site.

- Maximum depth of plant growth has dropped from 19.5' in 2011 to 15.5' in 2021 likely due to seasonal changes in clarity.

- Species richness was 29 in 2021, up from 27 in 2016 and 25 in 2011.

- The Simpson Diversity Index has followed the same trend, increasing from 0.85 to 0.93 (maximum diversity is 1.0).

Figure 36: Plant Species Summary for Center Lake (2011-2021)

		Frequency of Occurrence within Vegetated Areas (%) incl visuals		
Common Name	**Scientific Name**	**Aug-11**	**Aug-16**	**Aug-21**
Coontail	*Ceratophyllum demersum*	69.60	69.38	60.69
Common Watermeal	*Wolffia columbiana*	32.23	46.56	57.51
Sago Pondweed**	*Stuckenia pectinata*	4.40	35.31	35.84
Wild Celery*	*Vallisneria americana*	10.62	25.63	34.10
Purple Loosestrife**	*Lythrum salicaria*	9.89	0.63***	29.19
Cattail spp.	*Typha spp.*	19.05	7.19***	26.30
Small Duckweed	*Lemna minor*	13.92	21.56	25.14
Illinois Pondweed*	*Potamogeton illinoensis*	0.73	10.00	21.39
Eurasian Water-Milfoil**	*Myriophyllum spicatum*	5.49	18.44	19.36
White Water Lily	*Nymphaea odorata*	19.05	24.69	17.63
Water Star-grass	*Heteranthera dubia*	1.47	13.75	17.05
Muskgrass	*Chara spp.*	2.56	25.94	14.74
Swamp Loosestrife	*Decodon verticillatus*	n/a	n/a***	14.45
Slender Naiad	*Najas flexilis*	0.73	8.13	14.45
Curly-leaf Pondweed**	*Potamogeton crispus*	3.30	1.25	12.72
Common Waterweed	*Elodea canadensis*	0.37	14.38	10.98
Flat-stem Pondweed	*Potamogeton zosteriformis*	1.47	9.06	7.51
Spatterdock	*Nuphar variegatum*	9.89	8.44	4.34
White-stem Pondweed*	*Potamogeton praelongis*	0.37	3.13	4.05
Common Reed**	*Phragmites australis*	n/a	0.63	3.18
Variable Pondweed	*Potamogeton gramineus*	n/a	n/a	2.60
Forked Duckweed	*Lemna trisulca*	5.13	6.25	2.60
Widgeon Grass	*Ruppia cirrhosa*	5.86	8.44	1.73
Common Arrowhead	*Sagittaria latifolia*	0.37	n/a***	1.73
Small Pondweed	*Potamogeton pusillus*	0.73	0.63	1.45
Soft-stem bulrush*	*Schoenoplectus tabernaemontani*	0.73	0.31	0.58
Common Bladderwort	*Utricularia vulgaris*	n/a	3.44	n/a
Spiny Naiad	*Najas marina*	0.73	1.56	n/a
Northern Water-Milfoil	*Myriophyllum sibiricum*	n/a	0.31	n/a
Bottle Brush Sedge	*Carex comosa*	0.73	n/a***	n/a

Lake and Pond Solutions LLC (2022)

*Considered "high value" plant species under Wisconsin Administrative Code NR 109.05(g)

****Denotes non-native (exotic) species**

***Survey crew cataloged emergent species differently than previous surveys

Floristic Quality Assessment

Floristic quality (Swink and Wilhelm, 1994) is a rapid assessment metric designed to evaluate the similarity of the flora of a defined area to undisturbed conditions. It can be used to: 1) identify natural areas, 2) compare the quality of different sites or different locations within a single site, 3) monitor long-term floristic trends, and 4) monitor habitat restoration efforts.

For any area (lake in this case), floristic quality (I) equals the average coefficient of conservatism (C-value) times the square root of the number of native species ($\sqrt{N}$).

The coefficient of conservatism (C-value) was assigned to 128 aquatic plants, compared to regional studies, and reviewed by a number of biologists familiar with Wisconsin lake plants. They range from 0 to 10 with 10 being assigned to species most sensitive to disturbance. These final C-values were used in calculating the Floristic quality for Camp and Center Lakes.

Camp Lake

Figure 37 shows the floristic quality from 2011 to 2021 for Camp Lake compared to the Southeastern Till Plain (STP) average, Wisconsin average, and the Wisconsin 75th percentile average. The STP average categorizes the lakes in the southeast corner of the state. The average C-Value from plants in Camp Lake has remained consistent over the past 11 years and is slightly below the STP average. The number of native species and overall floristic quality ranks higher than the WI 75th Percentile. We theorize that the subtle drop in all floristic variables since the last survey is due to the expansion of EWM.

Figure 37: Floristic Quality Comparison for Camp Lake

	2011	2016	2021	STP Average	WI Average	WI 75th Percentile
Avg. C-value	5.57	5.58	5.41	5.6	6	6.9
# of natives (N)	21	29	27	14	13	20
Floristic Quality	25.53	30.08	28.09	20.9	22.2	27.5

Lake and Pond Solutions LLC (2022)

Figure 38 shows the five most common plant species from the last three surveys including an average C-Value and Floristic Quality. The average C-Value and Floristic Quality of these five species have dropped since 2011 although this is likely due to EWM making resurgence throughout the lake in the past eleven years. Widgeon Grass (C-Value of 8) has been replaced with EWM (C-Value of 0) in the top 5 partially causing this trend.

Figure 38: Five Most Common Plant Species in Camp Lake

2011 Plant Survey			2016 Plant Survey			2021 Plant Survey		
Species	Percent Frequency	C-Value	Species	Percent Frequency	C-Value	Species	Percent Frequency	C-Value
Muskgrass	54.98	7	Widgeon Grass	45.35	8	Eurasian Water-milfoil	80.35	0
Widgeon Grass	53.62	8	Eurasian Water Milfoil	45.12	0	Bushy Pondweed	63.97	6
Bushy Pondweed	48.87	6	Muskgrass	41.50	7	Water star-grass	60.04	6
Illinois Pondweed	27.60	6	Bushy Pondweed	39.68	6	Common waterweed	58.30	3
Common Waterweed	26.02	3	*Wild Celery*	34.01	6	Wild celery	58.30	6
Avg. C-Value of Top 5		6.00	Avg. C-Value of Top 5		6.75	Avg. C-Value of Top 5		5.25
Floristic Quality of Top 5		13.42	Floristic Quality of Top 5		13.50	Floristic Quality of Top 5		10.50

Lake and Pond Solutions LLC (2022)

Both figures above show how the lake is reacting to the CCLRD restoration efforts. There has been an improvement lake-wide in the number of native species in the last five years. However, the average C-Value and the Floristic quality have both decreased, likely due to a heavy resurgence in Eurasian Milfoil in the lake competing with higher quality native species (like Widgeon Grass and Muskgrass). Large scale treatments for EWM have had lower efficacy than in the past. While harvesting using the topping method can provide better recreation opportunities and allow for more native plant growth, it is not keeping up with the increased EWM growth. Uncollected fragments of EWM from either harvesting or general boat traffic through dense beds is likely accelerating its spread.

Center Lake

Figure 39 shows the floristic quality index from 2011 to 2021 for Center Lake compared to the Southeastern Till Plain (STP) average, Wisconsin average, and the Wisconsin 75th percentile average. The average C-Value from plants in Center Lake has remained consistent over the past 11 years but is below the STP average. The number of native species and overall floristic quality has been steadily increasing over time.

Figure 39: Floristic Quality Comparison for Center Lake

	2011	2016	2021	STP Average	WI Average	WI 75th Percentile
Avg. C-value	5.19	5.43	5.12	5.6	6	6.9
# of natives (N)	21	21	24	14	13	20
Floristic Quality	23.8	24.9	25.1	20.9	22.2	27.5

Lake and Pond Solutions LLC (2022)

Figure 40 shows the five most common plant species from the last three surveys on Center Lake including an average C-Value and Floristic Quality. These metrics increased from 2011 to 2016 but regressed in 2021 despite the increase in native species.

Figure 40: Five Most Common Plant Species in Center Lake

2011 Plant Survey			2016 Plant Survey			2021 Plant Survey		
Species	Percent Frequency	C-Value	Species	Percent Frequency	C-Value	Species	Percent Frequency	C-Value
Coontail	69.60	3	Coontail	69.38	3	Coontail	60.69	3
Common Watermeal	32.23	5	Watermeal	46.56	5	Watermeal	57.51	5
White Water Lily	19.05	6	*Sago Pondweed*	35.31	3	*Sago Pondweed*	35.84	3
Cattail	19.05	1	Muskgrass	25.94	7	Wild Celery	34.10	6
Small Duckweed	13.92	4	Wild Celery	25.63	6	Purple Loosestrife	29.19	0
Avg. C-Value of Top 5		**3.80**	**Avg. C-Value of Top 5**		**4.80**	**Avg. C-Value of Top 5**		**4.25**
Floristic Quality of Top 5		**8.50**	**Floristic Quality of Top 5**		**10.73**	**Floristic Quality of Top 5**		**8.50**

Lake and Pond Solutions LLC (2022)

The above figures show how the lake is reacting to the CCLRD restoration efforts. The C value and floristic quality of the top five species decreased in 2021 despite an increasing overall floristic quality on the Lake. This is likely due to the large increase in frequency of purple loosestrife. Native species have been increasing and seem to have relatively stable populations. This may be due, in part, to better control of EWM that allows native species to take hold.

RECOMMENDATIONS

For these purposes, nuisance species shall be defined as those native species which can produce excessive biomass as to hinder realistic lake uses and may include plants such as Coontail, Widgeon Grass and Common Waterweed (elodea). *It should be explicitly noted that the aforementioned species are beneficial natives and comments about their nuisance behavior is limited to excessive growth that limits lake use and navigation.* Exotic species include Eurasian Milfoil, Starry Stonewort, Curly-leaf pondweed, Purple Loosestrife, and Common Reed (Phragmites). Limiting disruption of non-nuisance, native aquatic plant beds should be a priority to meet long-term management goals. The protection of the desirable species will provide natural seedbanks or "plantbanks" for re-establishment into other areas of the lake.

Aquatic Plant Harvesting

As of 2021, the Lake District owns and operates two Aquarius Systems HM-420 7-foot aquatic plant harvesters, one transporter, two shore conveyors, and two International DT466 long box dump trucks. The purpose of each harvester is to accomplish harvesting in recreational boating use areas and cut boating accessing channels and fishing lanes in water three feet and deeper. Due to the results shown in the 2021 plant survey and harvest summary, no deviation from the previous plan is recommended at this time.

"Topping" is a harvesting practice employed on Camp and Center Lakes, where harvesters essentially cut up to ¼ of the plant tops off. This process allows the cut plants to survive but also allows other native plants to establish thus increasing diversity. The harvesters have been used to transport and re-populate high quality native vegetation, such as Muskgrass, to areas of the lakes where it can compete with invasive species. After the discovery of Starry Stonewort (SSW) during this PI survey in 2021, the harvesting crew ceased transplanting from known SSW areas. ***It is strongly recommended that transplanting of muskgrass be discontinued indefinitely since SSW frequently mixes with chara. Additionally, the harvesting operation should avoid known SSW beds as the species can be easily spread via disturbed fragments and bulbils.***

Specific areas on both lakes will continue to need harvesting repeatedly each year, concentrating on removing nuisance levels of aquatic plants to provide navigation along with recreational boating and fishing activities. In 2021, harvesting didn't begin until the 2nd week of June and was conducted 4 days per week. The key goal of the harvesting program must be adequate control of aquatic plants in common use areas of the lakes, while protecting ecologically important aquatic resources. Prior to the implementation of the annual harvesting program, it would be highly desirable to dispatch a "weed scout" to determine area-specific management strategies for that harvesting period. The weed scout could be any reasonably trained person familiar with overall aquatic plant management strategies and basic plant identification. By executing spot monitoring of the aquatic plant communities within specific areas, priority harvesting zones, cutting depths and intensities can be formulated.

Camp Lake

The primary goals of the aquatic plant management program are to increase recreational boating and fishing opportunities by clearing a wide navigation area in the central portion of lake, along with channel cutting in the access channels and fishing channels. By far the largest management hurdle is the extensive and dense aquatic plant beds, which occupy much of the southern two thirds of this lake. Water depths generally range from three to six feet. The northern end of the lake is deeper and water depth tends to control plant growth in that area, though the shallow shoreline areas also contain dense macrophyte beds.

Figure 41 shows the harvesting priorities for Camp Lake while Figure 42 shows the planned harvesting areas and access lanes. Access to and from all boat landings and private piers should be prioritized although **care should be taken around the south boat launch where SSW is present**. A wide navigation area within the lake proper will be necessary to allow multiple recreational uses. The main navigation areas should be harvested at least five cutter widths wide (wider if time permits). When dealing with beds of native, non-nuisance species, it is important to harvest only as much vegetation as needed to increase recreational opportunities. This will allow the "topped" species of plants to thrive underneath the water surface and protect plant diversity.

Cutting needs to be limited in the southern and southwestern ends of the lake, roughly corresponding with the water lily and soft-stem bulrush beds. Some of these areas contain high numbers of desirable native species and are not suitable or safe for intense recreational uses because of their shallow depth. Motorboat intrusions into these areas should be kept to a minimum to prevent fragmentation of species such as Eurasian Milfoil, which may then invade the beds of native species. Also, boat traffic and harvesting should be limited in near shore areas along undeveloped shorelines, which are found to contain low densities of nuisance species.

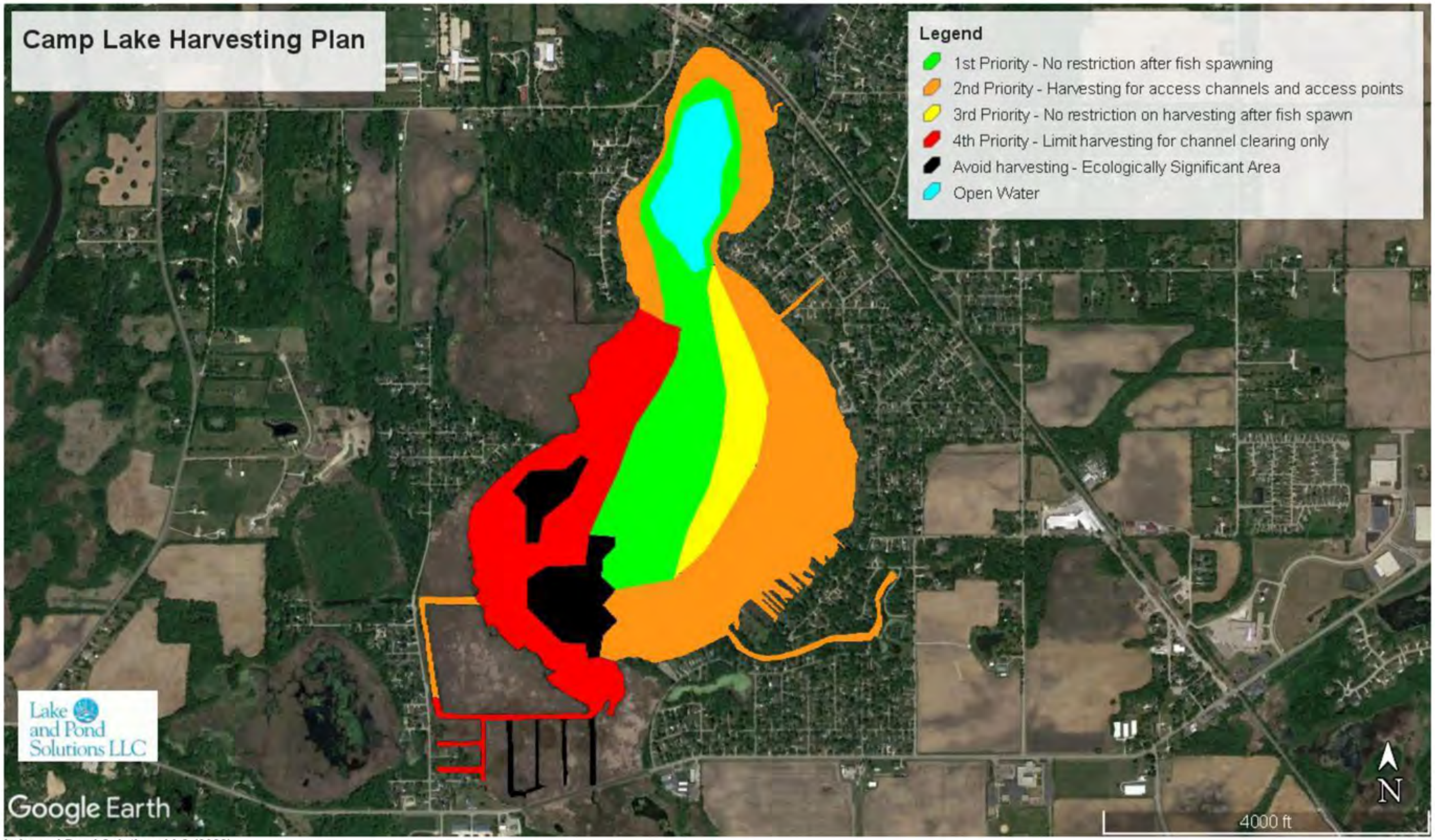
To increase fishing and hunting opportunities, spot harvesting of nuisance species to create fishing and waterfowl channels three cutter widths wide in strategic areas for fishing boat access is acceptable, as well as channels two cutter widths wide so predatory fish can gain access to the prey fish that live in the dense vegetation, so the harvesting does not promote the expansion of undesirable species. Access lanes to provide better access to waterfowl blinds, particularly late in the harvesting season, could be a helpful addition to increase recreational use of the lake. With harvest depths limited to 3 feet or more, lanes to blinds will be limited, but a few narrow lanes two to three cutter widths wide in certain areas could create easier access.

It is generally recommended that harvesting activities avoid fish spawning periods. The WDNR will not approve any harvesting that promotes large scale cutting during the time of fish spawning. However, with weed growth often becoming excessive by late May, harvesting can begin in areas that do not support fish spawn. Early harvesting should avoid natural shorelines and larger plant beds away from shore to allow for spawning fish to complete their breeding and disperse from the nesting grounds.

To increase fishery opportunities, lanes can be cut in plant beds to allow more access for fishing. Research conducted in Wisconsin has shown that areas at the edge of aquatic plant beds generally have the highest usage by bluegill and other prey species (Storlie, et al, 1995). This is likely due to the increased macroinvertebrate production along the ecotonal edge between plant beds and open water. By harvesting lanes in the previously dense plant beds, greater edge habitat could be created. This would provide greater food success for smaller fish and better access for larger fish to prey upon them. Also, angler access would be greater, allowing for more of the lake to be successfully fished.

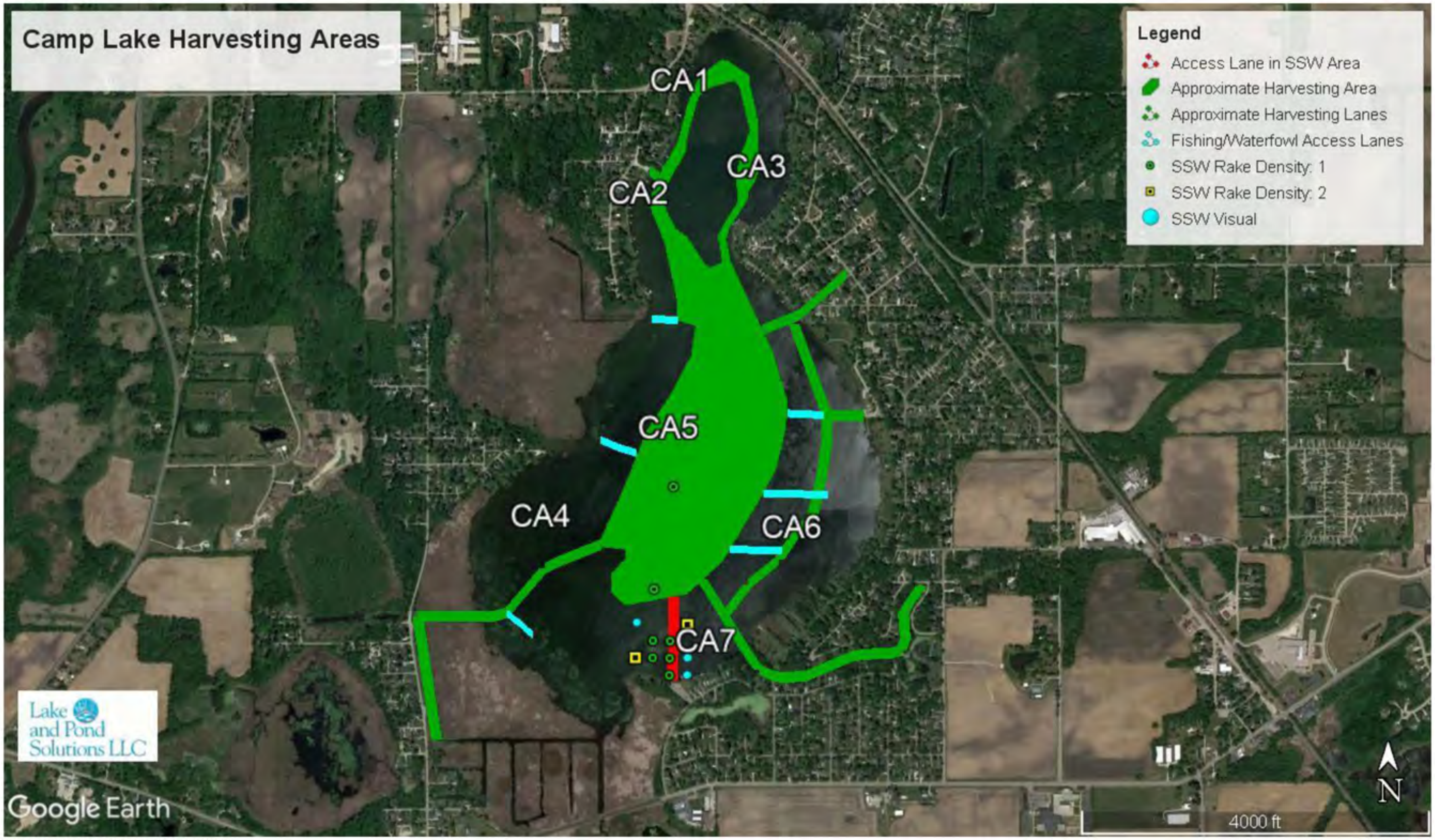
A summary of overall recommendations can be found at the end of this plan in Figure 54.

Figure 41: Camp Lake Harvesting Priorities



Lake and Pond Solutions LLC (2022)

Figure 42: Camp Lake Planned Harvesting Areas



Lake and Pond Solutions LLC (2022)

Figure 43: Summary of Number of Loads of Milfoil Harvest for Camp Lake, 2002-2021

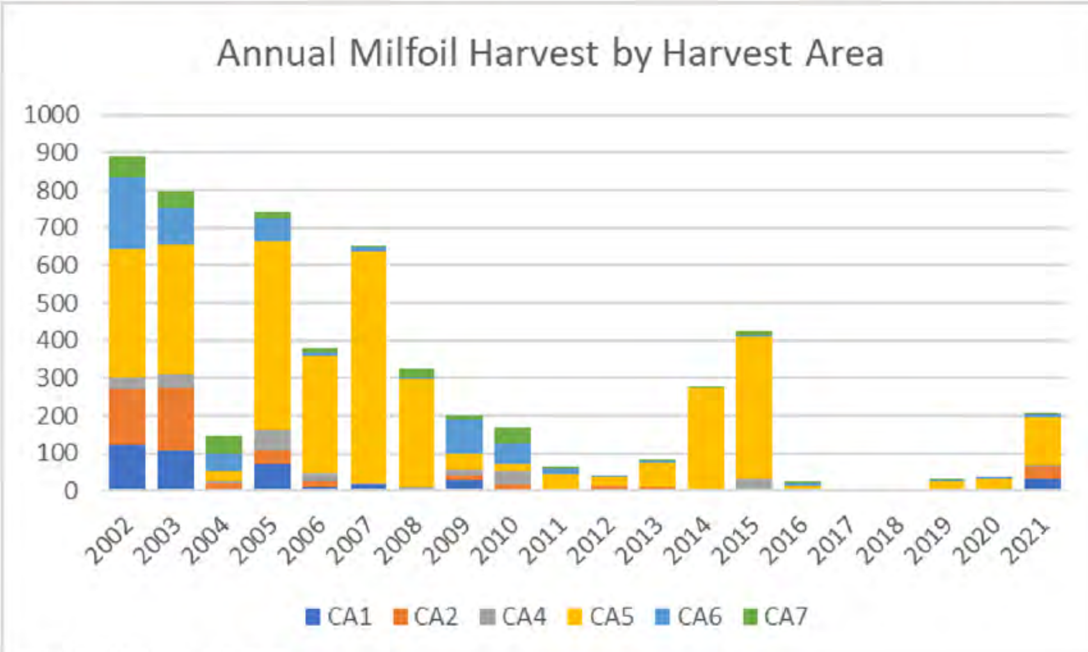
Camp Lake Harvester Load Summary for Milfoil								
Percent of Total Milfoil Loads by Harvest Area (Figure 44)								
Year	CA1	CA2	CA3	CA4	CA5	CA6	CA7	TOTAL
2002	11.3	14.0	17.0	2.9	31.8	18.1	4.9	1071.1
2003	11.3	18.2	14.3	3.6	37.7	10.2	4.6	927.6
2004	2.0	11.1	2.6	4.2	18.2	29.1	32.8	151.4
2005	9.6	4.4	2.0	7.3	66.5	8.5	1.8	757.2
2006	2.1	4.1	2.4	6.1	80.5	1.8	3.0	389.7
2007	2.5	0.0	0.4	0.7	94.5	1.6	0.3	651.6
2008	0.2	0.5	0.7	2.2	88.4	1.3	6.7	327.4
2009	12.9	5.5	8.0	8.2	18.2	41.5	5.8	218.1
2010	2.3	6.8	6.7	19.0	10.5	31.7	23.1	181.8
2011	0.3	2.0	0.7	2.0	67.2	24.6	3.3	60.9
2012	0.0	30.8	0.0	1.0	66.7	1.5	0.0	39.0
2013	5.6	3.3	7.4	2.3	75.6	4.2	1.6	86.0
2014	0.0	0.0	1.0	0.7	98.2	0.0	0.1	278.6
2015	0.9	0.2	1.7	6.6	86.9	0.5	3.2	434.2
2016	0.0	2.0	0.0	1.0	55.0	41.0	1.0	20.0
2017	25.0	0.0	0.0	0.0	0.0	50.0	25.0	3.2
2018	0.0	0.0	0.0	0.0	0.0	0.0	100.0	2.0
2019	1.6	1.3	13.3	1.9	59.4	17.2	5.3	37.5
2020	3.0	0.0	4.8	5.7	83.9	2.7	0.0	33.6
2021	14.9	14.2	3.8	2.1	60.6	2.4	2.0	215.0

CCLRD (2022)

Figure 43 above shows the number of loads of Milfoil species in Camp Lake separated by harvest area (Figure 42) from 2002 to 2021. This provides a useful image of where the heaviest milfoil harvest occurred on Camp Lake in the past. In 2021, the total number of loads was 539.7% higher than the previous year, with most of the harvest occurring in the center of the south basin and the shorelines of the north basin. This demonstrates the distribution and change in milfoil harvest for 2021.

Figure 44 below is a visual chart of the data in Figure 43. It shows how the milfoil harvest has been steadily decreasing on Camp Lake. Of particular interest is the increase observed in 2021 from the low levels of harvest in the previous five years. This could be due to increased 2,4-D tolerance in the milfoil population, possibly from hybridization.

Figure 44: Annual Milfoil Harvest by Area in Loads for Camp Lake, 2002-2021



Lake and Pond Solutions, LLC. (2022)

Access for unloading harvested plants onto shore conveyors is located at the NW public boat launch (Figure 45) which is 1.23 miles from the DNR approved dumping site (Figure 46). It is the most economical for fuel consumption and allows for the fastest turnaround or cycle time. Any dump site farther away would result in a reduction in productivity while harvesters sit idle waiting for the transport to return.

Figure 45: Camp Lake Harvesting Off-Load and Disposal Sites

Lake and Pond Solutions LLC (2022)

Figure 46: Harvesting Disposal Site

Lake and Pond Solutions LLC (2022)

Center Lake

Like Camp Lake, the primary goals of the aquatic plant management program are to increase recreational boating and fishing opportunities by clearing a wide navigation area into the central portion of lake, along with channel cutting in the access channels and fishing channels. By far the largest management hurdle is the extensive and dense aquatic plant beds, occupying the northern and southern portions of the lake. Water depths generally range from three to six feet.

Figure 47 shows the harvesting priorities for Center Lake while Figure 48 shows the planned harvesting areas and access lanes. To provide lake access, aquatic plant harvesting in the channels adjoining residential properties is permitted. It is, however, limited to harvesting in the center of a channel in less than 3-foot depths or where high percentages of native aquatic plants exist. Once out of the channels, harvesting locations depend on the specific locations of plant beds.

Harvesting on the south and northeast ends should be optimized to "top" the nuisance coontail growth and allow more beneficial natives a chance to compete. Access to and from all boat landings and private piers should be prioritized. A wide navigation area within the lake proper will be necessary to allow multiple recreational uses. The main navigation areas should be harvested at least five cutter widths wide (wider if time permits). When dealing with beds of native, non-nuisance species, it is important to harvest only as much vegetation as needed to increase recreational opportunities. This will allow the "topped" species of plants to thrive underneath the water surface and protect plant diversity.

Cutting depths should be raised where high concentrations of wild celery and widgeon grass exist. Harvesting in the lily beds along the northeastern shore should be conducted for fishing and access channels only. To increase fishing opportunities, spot harvesting of nuisance species to create "Fishing Channels" three cutter widths wide in strategic areas for fishing boat access is acceptable as well as, "Fish" channels two cutter widths wide so predatory fish can gain access to the prey fish that live in the dense vegetation, as long as the harvesting does not promote the expansion of undesirable species. Motorboat intrusions into these areas should be kept to a minimum to prevent fragmentation of species such as Eurasian Milfoil, which may then invade the beds of native species.

It is generally recommended that harvesting activities avoid fish spawning periods. The WDNR will not approve any harvesting that promotes large scale cutting during the time of fish spawning. However, realizing that weed growth already can be excessive by late May, harvesting can begin in areas that do not support fish spawn such as creating a channel from the DNR boat landing to deep water. Early harvesting should avoid natural shorelines and larger plant beds away from shore to allow for spawning fish to complete their breeding and disperse from the nesting grounds.

A summary of overall recommendations can be found at the end of this plan in Figure 54.

Figure 47: Center Lake Harvesting Priorities

Lake and Pond Solutions LLC (2022)

Figure 48: Center Lake Planned Harvesting Areas

Lake and Pond Solutions LLC (2022)

Figure 49: Summary of Number of Loads of Milfoil Harvest for Center Lake, 2002-2021

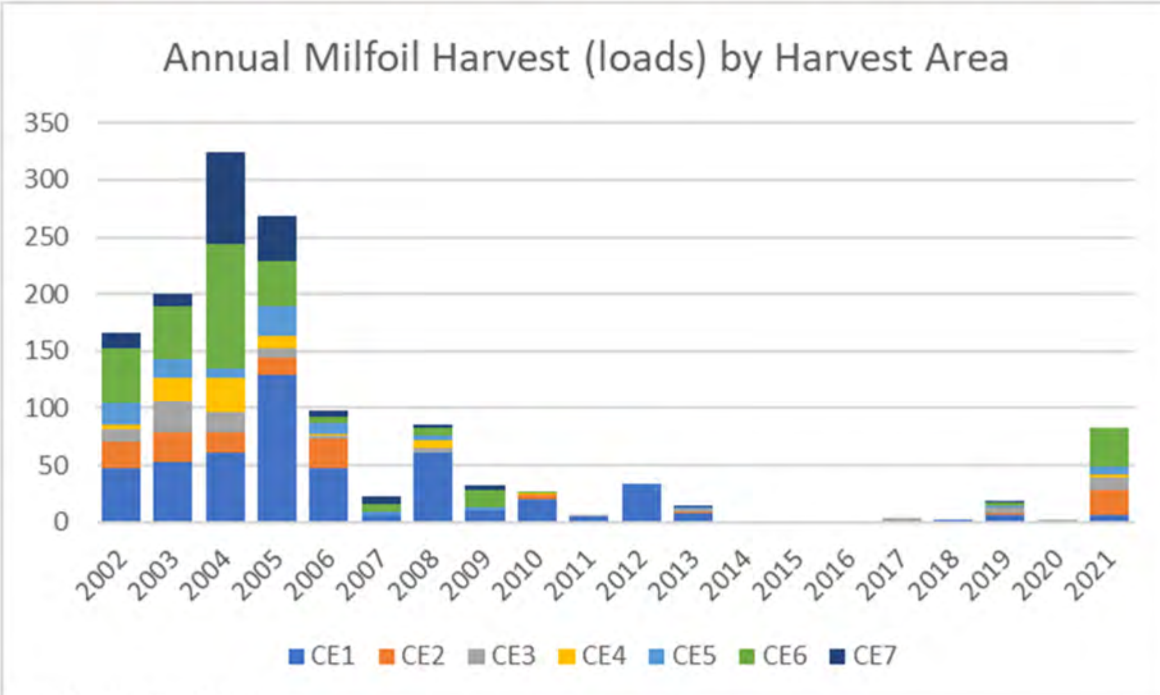
Center Lake Harvester Summary for Milfoil								
	Percent of Total Milfoil Loads by Harvest Area (Figure 50)							
Harvest Area	CE1	CE2	CE3	CE4	CE5	CE6	CE7	TOTAL
2002	28.5	13.6	7.1	2.2	11.3	28.7	8.6	166.6
2003	26.4	13.0	13.4	10.7	8.2	23.0	5.4	200.6
2004	19.0	5.1	5.6	9.2	2.6	33.8	24.6	323.8
2005	48.3	5.2	3.2	3.9	9.9	14.5	14.9	268.6
2006	47.5	26.4	3.0	1.5	9.9	5.9	5.7	98.5
2007	28.4	0.0	0.0	0.0	13.1	27.9	30.6	22.9
2008	71.1	0.9	4.2	8.8	3.5	8.2	3.3	85.2
2009	34.4	0.0	0.0	0.0	4.9	46.6	14.1	32.6
2010	72.9	17.6	0.0	5.1	0.0	4.4	0.0	27.3
2011	89.7	0.0	10.3	0.0	0.0	0.0	0.0	5.8
2012	100.0	0.0	0.0	0.0	0.0	0.0	0.0	33.2
2013	51.3	8.6	15.8	0.0	11.2	4.6	8.6	15.2
2014	0.0	100.0	0.0	0.0	0.0	0.0	0.0	1.2
2015	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4
2016	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2017	0.0	0.0	100.0	0.0	0.0	0.0	0.0	3.3
2018	100.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0
2019	36.0	12.3	26.9	2.3	3.7	16.0	2.6	17.5
2020	33.3	41.7	25.0	0.0	0.0	0.0	0.0	1.2
2021	8.4	25.4	12.8	4.2	7.7	41.5	0.0	83.1

Lake and Pond Solutions LLC (2022)

Figure 49 above shows the annual milfoil harvest by percent of total loads separated by harvest area (Figure 48) from 2002 to 2021 for Center Lake. This provides a useful image of where the heaviest milfoil harvest occurred on Center Lake in the past. In 2021, the total number of loads was the highest since 2008, with most of the harvest occurring in the southwest bay and the center of the north and south shorelines.

Figure 50 below is a visual chart of the data in Figure 49. It shows how the milfoil harvest has been steadily decreasing on Camp Lake. Of particular interest is the increase observed in 2021 from the low levels of harvest in the previous twelve years. This is likely due to increased 2,4-D tolerance in the milfoil population, a theory discussed more under the Herbicide section.

Figure 50: Annual Milfoil Harvest by Area in Loads for Center Lake, 2002-2021



Lake and Pond Solutions LLC (2022)

Figure 51: Center Lake Harvesting Off-Load and Disposal Sites

Lake and Pond Solutions LLC (2022)

Access for unloading harvested plants onto shore conveyors is located at the SW public boat launch (Figure 51) which is 1.67 miles from the DNR approved dumping site (Figure 46).

Herbicides

In May of 2017 and 2018, spot treatments for EWM were conducted with 2,4-D and polyan (a weighting agent) on both lakes. In May of 2019 and 2020, treatments for EWM at whole lake concentrations of 2,4-D were conducted on both lakes. In May of 2021, a spot treatment for EWM was conducted on Center Lake with 2,4-D and ProcellaCOR while a whole lake treatment for EWM with 2,4-D was conducted on Camp Lake. Large herbicide treatment areas for exotic plants are determined on an annual basis by the operations manager in conjunction with the contracted consultant. In the past, lake residents would opt in to EWM treatment via a spring mailer sent by the CCLRD. The individual lakefront treatments ceased after the 2018 treatment due to a shift towards a whole lake management strategy.

An early season treatment for Eurasian Milfoil and Curly-leaf Pondweed is strongly encouraged as many native aquatic plant species have yet to begin growing and plant biomass is limited. Purple Loosestrife and Phragmites treatments are typically most effective when performed after mid-July. Currently, no treatments are performed for native plants (nuisance or non-nuisance).

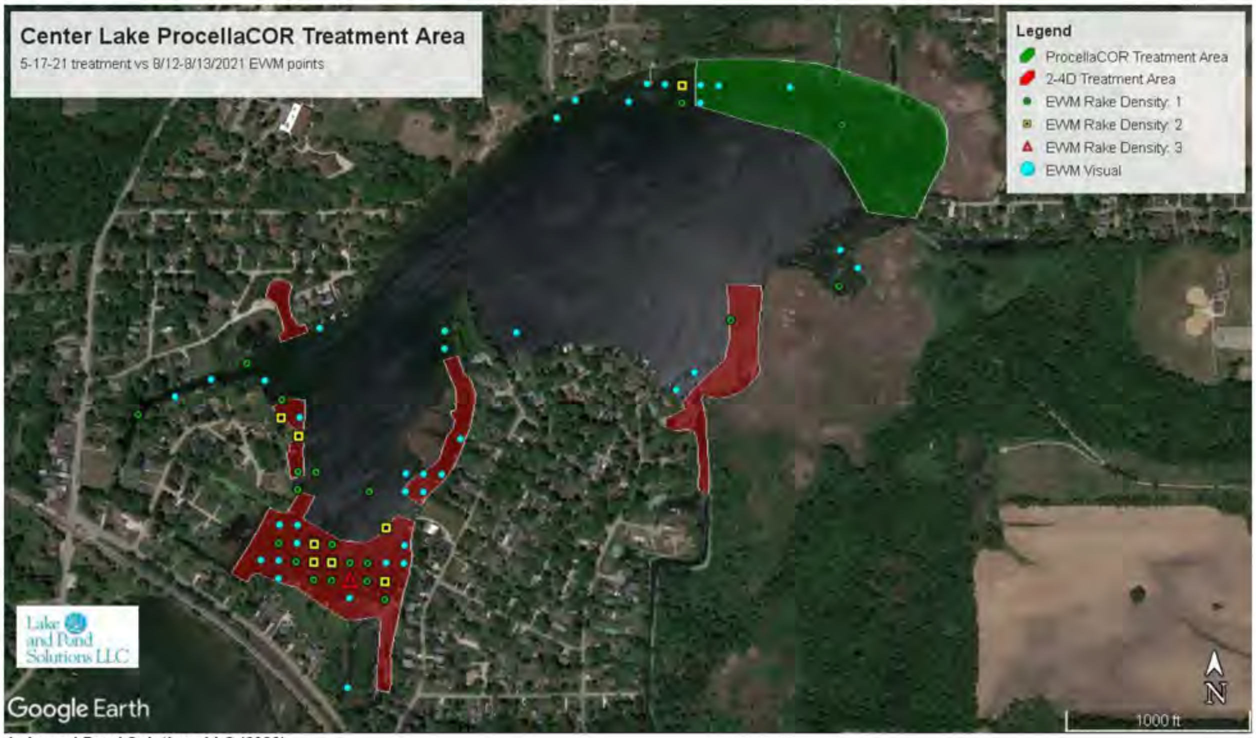
With the discovery of Starry Stonewort (SSW) on Camp Lake for the first time in the 2021 survey, management direction for this invasive species should be discussed. Frequency of SSW should be closely monitored, and if the plant becomes an issue and begins overtaking native species and/or restricting lake use, treatment should be strongly considered. Although intensive treatment on Long Lake in 2016-2017 resulted in SSW and bulbil reductions, the WDNR is currently not allowing treatment of this species unless navigation is impeded. If allowed in the future, either Komeen Crystal at 1ppm or a mix of Clipper SC (200 ppb) and Captain XTR (0.8 ppm) would be recommended based on previous results.

The density, frequency, and distribution of EWM in the 2021 Camp Lake survey show that current 2,4-D treatment methods were not effective at control of late season EWM growth. It is likely that EWM has become more resistant to 2,4-D, possibly as populations become hybridized. It has been shown that treatments with 2,4-D have lower efficacy with hybrid strains, and repeated treatments can increase the frequency of hybrid strains compared to less tolerant strains (Groves et al. 2015). These Hybrid strains are difficult to distinguish from pure EWM without genetic testing, so plants identified as EWM in the survey could have been Hybrid Milfoil.

Figure 52 below shows the August EWM densities overlaid on May treatment areas for Center Lake in 2021. EWM was still present within many of the 2,4-D treatment areas, particularly in the southwest bay and the west shoreline. This may be due, in part, to smaller treatment areas and lower rates (2 ppm) as well as resistant hybrid strains of milfoil. One section in the northeast bay of Center Lake was treated with ProcellaCOR EC, a different product and mode of action, which resulted in fantastic control.

Based on the milfoil harvest shown in Figures 49-50, the area of the ProcellaCOR EC treatment (CE1), went from roughly 33 percent of the loads in 2020 to roughly 8 percent loads in 2021. Area CE6, treated with 2,4-D, went from no harvest in 2020 to over 41 percent of the loads in 2021. This provides further information supporting the efficacy of the ProcellaCOR EC treatment compared to traditional 2,4-D treatments.

Figure 52: Center Lake May 5/26/2021 Treatment vs 8/12-8/13/2021 EWM



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The ProcellaCOR EC treatment area had 9.7 quality and high value species per acre (see Figure 25) while the 2,4-D treatment areas had 9.4 per acre. This demonstrates that treatment with this product resulted in greater efficacy for EWM/Hybrid Milfoil and had no additional impact on high value and quality native species.

Due the widespread distribution and high frequency of milfoil in Camp Lake, we recommend moving towards either a whole lake treatment with Fluridone or spot treatments with ProcellaCOR EC and/or high rates of 2,4-D with a weighting agent. Whole lake, low dose 2,4-D treatments are not recommended at this time.

For Center Lake, EWM distribution has not quite increased to levels that would warrant a whole lake treatment with fluridone. ProcellaCOR EC was very successful in 2021 (Figure 52) while 2,4-D was only partially successful. We recommend moving to more ProcellaCOR EC and/or higher rates of 2,4-D to combat potential resistance issues.

Diver Assisted Suction Harvesting (DASH)

DASH is a process where a certified diver maintains control of a hydraulic pump and pulls selected plants by the root and feeds them into the vacuum of the pump. The plant is transferred to a collection station that can range from an onion sack to large on-shore drainage bags. The advantage of DASH includes the ability to select the target plant for removal. The disadvantage of this is the slow nature of this process and the high cost due to specially trained staff (see Figure 53). Also, as operations begin in a DASH location, visibility rapidly diminishes, further reducing the speed of removal. Low visibility and human error can contribute to missed plants or improper removal (not removing the roots). There is a chance for damage to non-target species when native plants get tangled with aquatic plants being removed or the hydraulic hose flattens areas as the diver(s) are searching for target plants. Mussels, snails, other mollusks, crustaceans and other species that live in and around the lake bottom, on or within the plants are also inevitable bycatch.

Figure 53: DASH Cost and Time Comparison

Acreage	DASH*	Chemical (2,4-D)	Harvesting**
1 acre	$12,000 - 4-7 days	$1,000 – 1.25 hours	$1,200 – 45 min.
5 acres	$60,000 – 1 month	$4,500 – 2.5 hours	$6,000 – 3.5 hours
20 acres	$240,000 – 1 season	$15,000 – 5 hours	$24,000 – 1 day
100 acres	$1,200,000 – years	$60,000 – 3 days	$120,000 – 1+ weeks

*Based on www.aquaticinvasivecontrol.com and local contractors
**Based on www.ecy.wa.gove and www.lakesaquaticweedremoval.com

DASH would be best used in instances of very small and relatively dense patches of plant species that are ideally located on a hard bottom. For Camp and Center Lake, DASH would not be a widespread recommended option although it could be considered for individual residents.

Public Information and Education

It is extremely important to provide information to lake property owners and lake users on the benefits of a healthy aquatic plant community including the management issues involved in controlling nuisance and exotic aquatic plants. Annual meetings, newsletters and informational materials provided by the Department of Natural Resources and the University of Wisconsin-Extension can assist lake users in understanding the many areas of aquatic plant management and ways to protect lakes from other invasive species. Currently, annual meetings and newsletters are the main form of communication between the district and lake residents.

The CCLRD supports and actively solicits volunteers from each lake to participate in the DNR-Self Help Lake Monitoring Program which assists in monitoring overall health of the lakes. Volunteer data collection could provide secchi disk data which has not been consistently collected on either lake since 2001. Additionally, Wisconsin Lakes (www.wisconsinlakes.org) provides some valuable resources including workshops and conferences geared towards lake owners and users.

Another potential education opportunity could be the Clean Boats, Clean Waters Program. This program includes teams of volunteers, as well as some paid staff from other organizations that perform boat and trailer checks at launches. The volunteers also help to disseminate informational brochures and educate boaters on how to prevent the spread of aquatic invasive species. The UW Extension conducts trainings for new boat inspectors and coordinates the volunteer effort. Visit http://www.uwsp.edu/cnr-ap/UWEXLakes/Pages/programs/cbcw/default.aspx for more information.

Lastly, it is always important to evaluate current signage at the public launches. Invasive signs should contain **all known species** found in the lake. Additionally, posting information about new invasives in the area may help play a role in educating the public and protecting the resource. With the discovery of Starry Stonewort in Camp Lake in the last survey, it should be noted to make sure this information is updated.

RAPID RESPONSE PLAN

Rapid response to a new aquatic invasive is imperative. The first step is ensuring that it is, in fact, an invasive species not previously found on the waterbody. This plan was acted upon when Starry Stonewort was discovered during the plant survey in 2021.

If a suspected invasive species is found:

- Take a digital photo of the plant in the setting where it was found and mark with a GPS (if possible). Then collect 5 – 10 intact specimens. Try to get the root system, all leaves as well as seed heads and flowers when present. Place in a Ziploc bag with no water. Place on ice and transport to refrigerator.
- Fill out form http://dnr.wi.gov/lakes/forms/3200-125-plantincident.pdf.
- Contact the WDNR Aquatic Invasive Species Program Coordinator (currently Amy Kretlow) and deliver the specimens, report, digital photo, and coordinates (if available). Do this as soon as possible; but no later than 4 days after the plant is discovered. A CCLRD board member and current lake consultants should also be notified.

Upon determination of species, a coordinated response plan should be developed in consultation with the DNR, the County, and lake consultants as needed.

*The Rapid Response Plan language was developed in coordination with Craig Helker (WNDR)

SUMMARY

Camp and Center Lakes continue to provide diverse aquatic plant communities and a multitude of recreational opportunities. The 2021 season saw exceptionally low water levels, estimated at 12 to 18 inches below the prior season. This allowed for an increase in the overall volume of plant growth. Over the last ten years, EWM densities have significantly increased on Camp Lake. Beneficial native plant densities have increased on Camp Lake but remained stable on Center Lake. With healthy native plant populations on both lakes, harvesting of invasive species and early season exotic species treatments have benefited the system in the past and allowed development of a healthy native plant community. The rapid increase in EWM frequency is becoming a threat to the diversity of the native plant community that has been improving over time.

Based on the results of the plant surveys, the priority for management should be controlling Eurasian and Hybrid Milfoil on Camp Lake. The frequency has increased from 46 to 80 percent of vegetated sites from the last survey, and current treatment is becoming less effective. Secondly, Starry Stonewort was discovered for the first time on Camp Lake during the 2021 survey. This species should be closely monitored for spread throughout Camp Lake and into Center Lake. As a new invasive, monitoring spread in new areas is critical to assess whether control is needed. The WDNR is currently not in favor of Starry Stonewort treatments unless the invasive is causing a navigational issue. A third species to focus eradication efforts on should be Purple Loosestrife which saw an increase in frequency of over 28 percent on Center Lake since the last survey. There has also been a steady increase over the last ten years on Camp Lake. With this rate of increase, control at an early stage is important to stop the spread before it reaches a point where treatment would become much more costly and less effective, and manual removal becomes much more difficult.

With the demand for recreational opportunities by lake users, the CCLRD has demonstrated an ongoing effort to effectively manage the aquatic resources while providing for multiple use recreation on both lakes. In the 2021 season, recreation on the lakes, particularly Camp Lake, has begun to be limited by growth of EWM. Moving to a different treatment strategy may be necessary to improve the recreational opportunities on the lakes. In the future, it is important to continue to educate landowners and lake users about the benefits of native plants and the detriments posed by non-natives. Figure 54 highlights overall management recommendations outlined in this plan revision.

Figure 54: Aquatic Plant Management Summary for Camp and Center Lakes

1. Mechanical Harvesting Plan

- Limit excessive harvesting of EWM to prevent fragmentation
- Limit harvesting in known areas of SSW to prevent fragmentation and bulbil spread
- Cut excessive aquatic plant growth as determined by the Operations Manager through the use of "topping" (the practice of only cutting the top ¼ of the plant)
- It is recommended that harvesting activities avoid fish spawning periods
- For Camp Lake, avoid or limit cutting in the southern and southwestern ends of the lake corresponding with the water lily and soft stem bulrush beds (Figure 41)
- For Center Lake, harvesting on the south and northeast ends should be optimized to "top" the nuisance coontail growth. Harvesting in lily beds along the northeastern shore should only be conducted for fishing, waterfowl, and access channels. Avoid cutting the ecologically significant areas on the south end of the lake (Figure 47).
- Harvesting should not be needed in water depths over 12' and should also not be performed in water less than three feet deep unless critical to channel navigation. Boating lanes should be approximately 50 – 70 feet wide while fishing and waterfowl channels should be 20 – 30 feet wide (Figures 42 and 48).
- Figures 45, 46, and 51 show the harvesting off-load sites, disposal site, and routes
- Manual raking can be continued for "floaters" along with a 30-foot area around private piers
- The "Harvesting manager" is responsible for satisfying the harvesting requirements of the APM Plan as well as fulfilling all the DNR permit requirements. This administrator will also submit copies of what is required by the DNR to the CCLRD Board for their annual meeting.

**Current conditions should be analyzed each year to select the most appropriate course of action*

2. Herbicide Treatment Recommendations

- Early season (May) treatment of EWM should be continued.
- Consider spot treatments on both Camp and Center lakes with ProcellaCOR EC targeting 4 ppb, as well as 2,4-D at 3.5 ppm with a weighting agent
- Whole lake Fluridone at 4 ppb should be strongly considered on Camp Lake if EWM frequency is elevated, along with subsequent 2 ppb "bump: treatments to maintain this concentration
- Purple loosestrife should be treated in August or September with glyphosate unless the district puts together a program for manual removal
- Monitor and collect data on effectiveness of the aquatic plant control measures each year via informal invasive species surveys. Present data at the CCLRD Annual Meeting.

**Current conditions should be analyzed each year to select the most appropriate course of action*

3. **Lake Monitoring**
    - The Camp and Center Lake Rehabilitation District (CCLRD) should recruit citizen volunteers to implement Citizen Lake Monitoring for water quality and Aquatic Invasive Species (AIS) monitoring on each lake
    - Consider volunteer or contracted surveys to monitor the spread of Starry Stonewort in the system
    - Consider a Clean Boats Clean Waters program
    - Continue with current turnover water sampling via private consultant
    - Follow the Rapid Response Plan for any new aquatic species not previously found on the waterbody
    - Continue with PI Surveys every 5 years (or sooner if needed) to evaluate efficacy and environmental impact of aquatic plant management activities

4. **Watershed Practices**
    - The CCLRD should continue to educate property owners about watershed best management practices to reduce nutrient inputs to the lakes
    - With the discovery of Starry Stonewort, transplanting of Muskgrass (Chara spp.) will be suspended by the harvesting team

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