1.0 INTRODUCTION

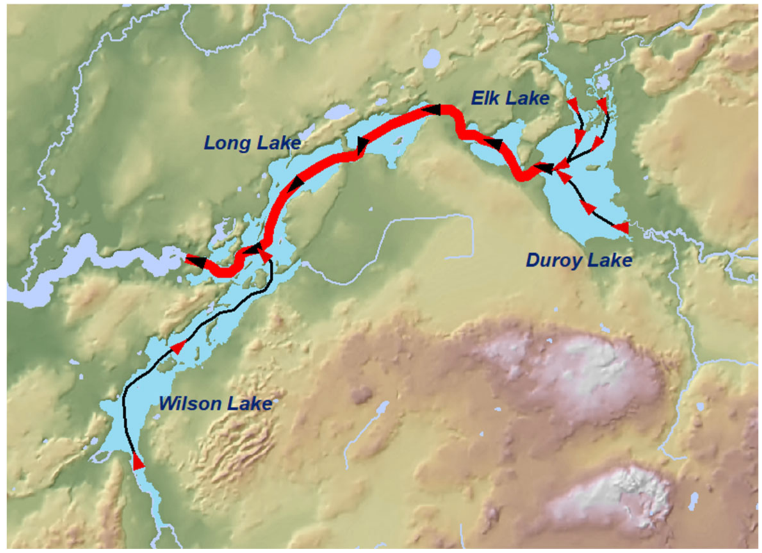


Figure 1.0-1. Phillips Chain of Lakes, Price County, Wisconsin.

The Phillips Chain, Price County, comprises four lakes with a surface area of nearly 1,221 acres (Figure 1.0-1). These lakes are classified as an impoundment, and were formed through the damming of the Elk River. Eurasian watermilfoil (EWM) was first located in Duroy Lake in 2000, and by 2002, was located in Elk, Long, and Wilson Lakes as well. The Phillips Chain O' Lakes Association (PCOLA) has sponsored a number of AIS control projects aimed at managing the EWM population on the Phillips Chain, starting in 2011.

The PCOLA completed an updated *Comprehensive Management Plan* for the entire system in 2019. With Onterra's assistance, the PCOLA received almost $29,000 in grant funds to cost-share management and monitoring efforts in 2022-2023. This included a spot herbicide treatment in spring 2022. This final report details the efforts conducted during this three-year project, including serving as the final grant deliverable for ACEI-285-22.

1.1 EWM Management Planning

In 2019, the PCOLA was awarded a WDNR AIS Education, Prevention, and Planning Grant to complete studies and planning that resulted in an updated *Comprehensive Management Plan* for the entire system. The previous management planning effort was conducted in 2011. The management plan was approved and accepted by the WDNR in December 2021.

The PCOLA considered an herbicide spot treatment for spring of 2021 with florpyrauxifen-benzyl (ProcellaCOR™) within the southern basin of Wilson Lake. Although the treatment targeted a specific area of dense EWM, basin-wide concentrations and potential outcomes were conveyed. After discussion, the PCOLA opted to postpone herbicide management until spring 2022, allowing the management planning project to be completed and for WDNR grant funds to be sought.

During fall of 2021, the PCOLA applied for a WDNR AIS Control Grant for a 2-year project aimed at managing the EWM population on Wilson Lake. The PCOLA goal was to bring the EWM population down through strategic herbicide spot treatments that may have basin-wide potential. High use areas would be targeted and follow-up hand-harvesting would be conducted as part of their IPM framework.

1.2 2022 EWM Treatment Summary

The 2022 herbicide treatment strategy embraced the likelihood that EWM control is likely to extend outward and potentially throughout the entire southern basin. The 2022 treatment design included treatment of one 10.8-acre site in the south end of Wilson Lake with ProcellaCOR™ at 3.5 PDU's which results in a potential concentration of 0.45 ppb if mixed within the water volume in the southern end of

Wilson Lake (Map 1). The herbicide application was conducted on June 10, 2022 by Schmidt's Aquatic, LLC.

A large decrease in the EWM population occurred in the herbicide application area as well as throughout the southern basin of Wilson Lake during the *year of treatment*. Initial concentrations of the active ingredient within the application area was high at 5.3 ppb during the first sampling interval a few hours after treatment (Figure 1.2-1). The active ingredient concentration reducedto about 0.3 ppb at three days after treatment (DAT). At 14 DAT, the concentration of active ingredient reduced below detectable levels in the application area. Florpyrauxifen acid, the primary measured breakdown product, peaked at 1 DAT and slowly reduced to <0.1 ppb at 14 DAT.

Little to no herbicide active ingredient was detected in the untreated water sampling location in the then northern part of Wilson Lake at site W3, whereas the acid metabolite was found to persist at relatively low levels in the untreated sampling location through the duration of the sampling intervals spanning two weeks after treatment. Wilson Lake contains islands, flowing waters, and other factors that likely complicates uniform mixing which the limited water sampling locations may not fully represent where the herbicide ultimately dispersed after treatment.

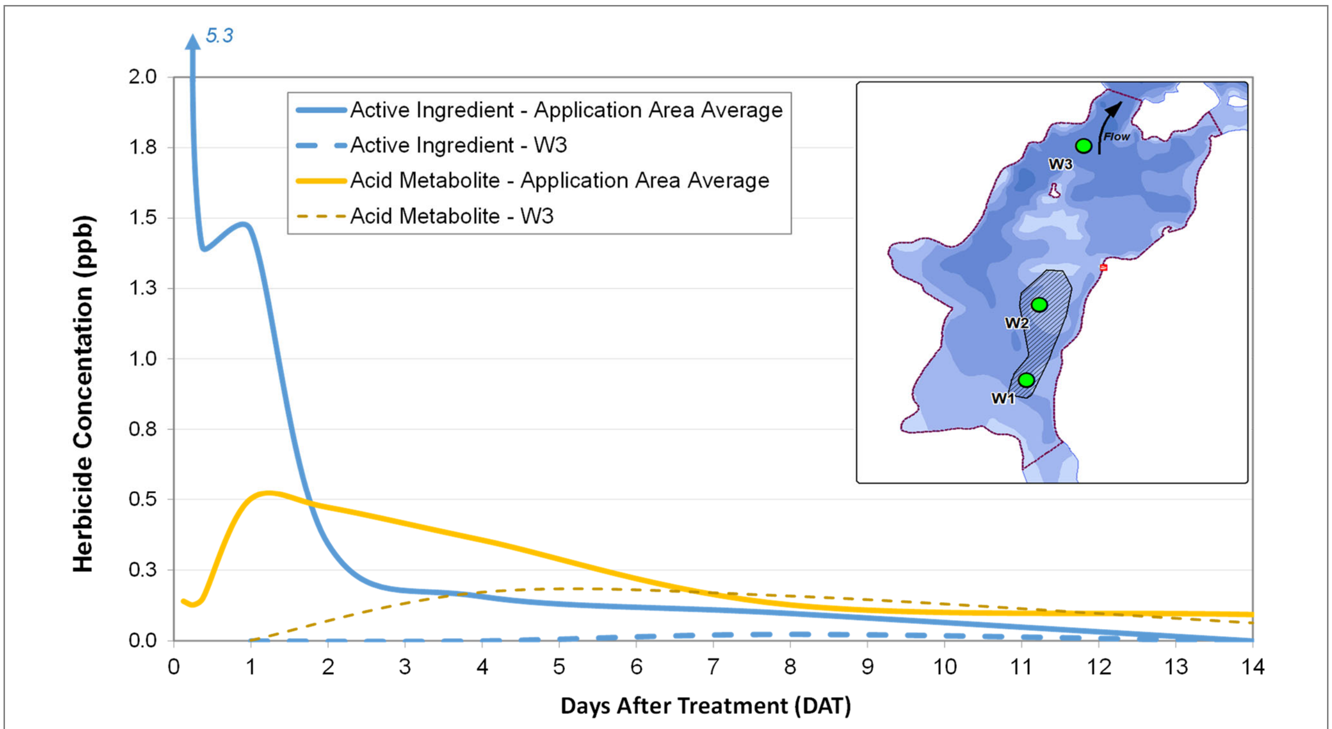


Figure 1.2-1. Wilson Lake 2022 herbicide concentrations. Active ingredient: Florpyrauxifen-benzyl, Acid metabolite: Florpyrauxifen acid

Quantitative monitoring in 2022 showed limited impacts to native species within the application area including a predicted decline in the dicot, coontail. The *year after treatment* data that was collected during 2023 allows for an understanding of EWM and native plant dynamics during the *year after treatment* and is discussed within this report.

2.0 2023 AQUATIC PLANT MONITORING RESULTS

It is important to note that two types of surveys are discussed in the subsequent materials: 1) point-intercept surveys and 2) EWM mapping surveys. Overall, each survey has its strengths and weaknesses, which is why both are utilized in different ways as part of this project.

The point-intercept survey provides a standardized way to gain quantitative information about a lake's aquatic plant population through visiting predetermined locations and using a rake sampler to identify all the plants at each location (Photo 2.0-1). The survey methodology allows comparisons to be made over time, as well as between lakes.

The point-intercept survey can be applied at various scales. The point-intercept survey is most often applied at the whole-lake scale. The whole-lake point-intercept survey was most recently conducted on Wilson Lake in 2019 and was replicated during 2023. These data are discussed in section 2.3.

If a smaller area is being studied, a modified and finer-scale point-intercept sampling grid may be needed to produce a sufficient number of sampling points for comparison purposes. This sub-sample point-intercept survey methodology is often applied over herbicide application sites. This type of sampling is used within this project for the herbicide application areas and is discussed in Section 2.2 below.

Photograph 2.0-1. Point-intercept survey on a WI lake. Photo credit Onterra.

Photo 2.0-2. EWM mapping survey on a Wisconsin lake. Photo credit Onterra.

While the point-intercept survey is a valuable tool to understand the overall plant population of a lake, it does not offer a full account (census) of where a particular species exists in the lake. During the EWM mapping survey, the entire littoral area of the lake is surveyed through visual observations from the boat (Photo 2.0-2). These data are discussed in Section 2.1. Field crews supplemented the visual survey by deploying a submersible camera along with periodically doing rake tows. The EWM population is mapped using sub-meter GPS technology by using either 1) point-based or 2) area-based methodologies. Large colonies >40 feet in diameter are mapped using polygons (areas) and are qualitatively attributed a density rating based upon a five-tiered scale from *highly scattered* to *surface matting*. Point-based techniques were applied to AIS locations that were considered as *small plant colonies* (<40 feet in diameter), *clumps of plants*, or *single or few plants*.

2.1 Qualitative Monitoring: EWM Mapping Surveys

The late-summer 2020 EWM mapping survey documented *highly dominant* and near-*surface matting* conditions in the southern basin of Wilson Lake (Figure 2.1-1, top-left frame). These colonies were near a public access location as well in front of riparian frontage. A preliminary herbicide treatment strategy for spring 2021 was developed based upon the 2020 survey. After discussion, the PCOLA opted to postpone herbicide management until spring 2022, allowing the management planning project to be completed and for WDNR grant funds to be sought.

During a subsequent mapping survey in September 2021, the southern basin of Wilson Lake was packed with aquatic plants and surface matted filamentous algae, making large areas non-navigable (Photo 2.1-1). While the density of the EWM population seemed to be somewhat reduced within the proposed treatment site, much of the population in the southern portions of Wilson Lake increased in density including many surface matted areas (Figure 2.1-1, top-right frame).

Photo 2.1-1. Surface-matted filamentous algae on Wilson Lake on 9/1/2021. Photo credit Onterra. Likely cladophora species.

Following the herbicide management, just one single EWM plant was located within the extents of the herbicide application area during the September 2022 mapping survey (Figure 2.1-1, bottom-left frame). The survey also documented a large decrease in EWM throughout most of the southern end of Wilson Lake including the *area of potential impact* that was predicted during the treatment planning stages.

Onterra field crews completed the *year after treatment* late-summer EWM mapping survey on August 28, 2023. This survey identified just one single EWM plant occurrence within the direct 2022 herbicide application area. Relatively modest EWM population were located to the west of the application area in the 2023 survey which consisted of small colonized areas as well as a number of single plants and clumps of plants (Figure 2.1-1, bottom-right frame). These data indicate that EWM reductions in the treated area extended through the *year after treatment* and therefore met the control expectations for the strategy. Although some amount of EWM has rebounded within the other areas of the southern end of Wilson Lake, the population remains well below *pretreatment* levels documented during 2020-2021.

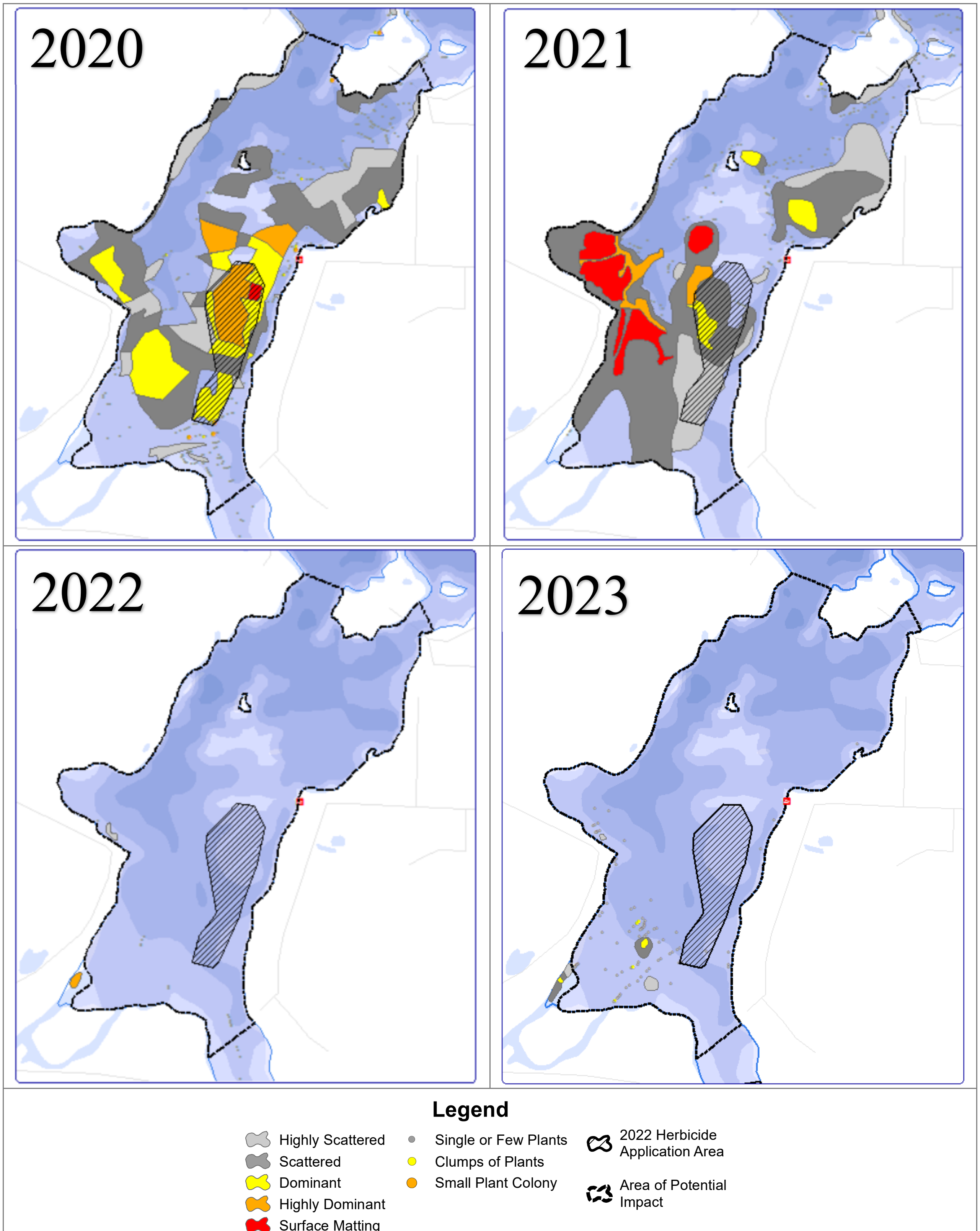


Figure 2.1-1. EWM Population from 2020-2023 in Southern Wilson Lake. ProcellaCOR™ herbicide spot-treatment occurred in spring 2022, so 2022 map is approx.. 3 months post treatment..

Starting in 2009, late-season EWM mapping surveys have taken place on Wilson Lake most years using the consistent density rating system discussed above (Figure 2.1-2). Similar to the *year of treatment* data collected in 2022, a total of 7.1 acres of colonized EWM was delineated throughout Wilson Lake during the 2023 *year after treatment* survey (Map 2). The EWM throughout Wilson Lake was reduced from almost 82 acres *prior to treatment* to under 10 acres for two consecutives summers post treatment.

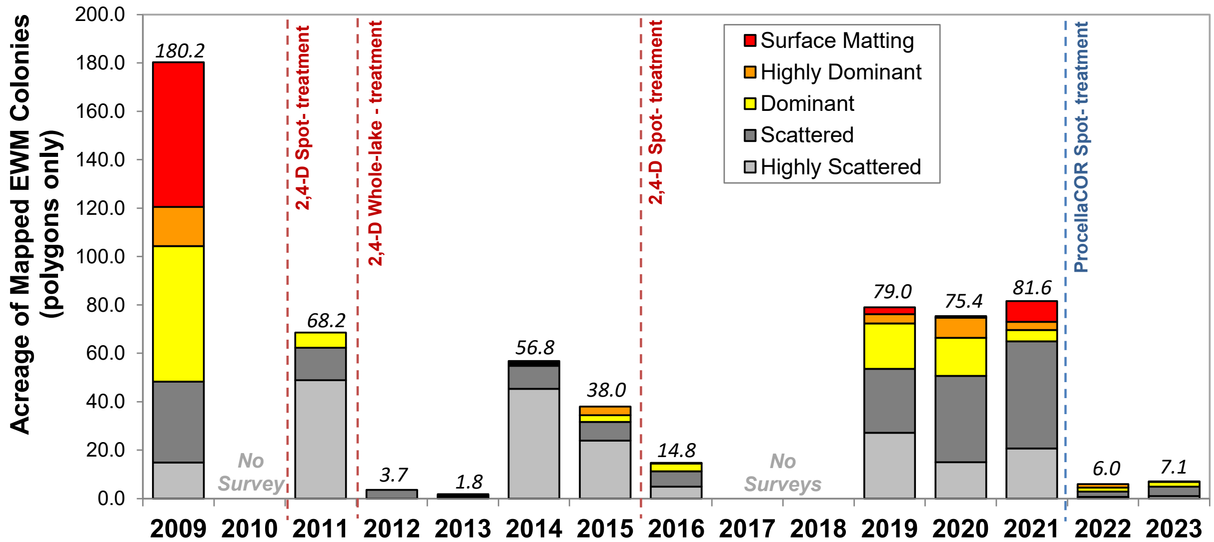


Figure 2.1-2. Wilson Lake EWM Population from 2009-2023. Data from Late-Summer EWM Mapping Surveys.

2.2 Quantitative Monitoring: Sub-Sample Point-Intercept Survey

A quantitative monitoring plan was created for this trial treatment site in which a total of 75 sub-sample point-intercept sampling locations were contained within the herbicide application area. The quantitative assessment is completed through the comparison of the sub-sample point-intercept survey from late-summer 2021 (*year prior to treatment*), late-season 2022 (*year of treatment*), and late-season 2023 (*year after treatment*). The occurrence of all species sampled in all three surveys is displayed in Appendix A.

In the pretreatment survey, EWM was present at 42 of the 75 sampling locations resulting in an occurrence of 69.3% (Figure 2.2-1). EWM was not present at any sampling locations in the post-treatment replications of the survey in late-summer 2022 or 2023 (0% occurrence).

During the planning phase, the collateral native plant impacts in Wilson Lake were projected to be from a few sensitive broad-leaved (i.e. dicot) species. Coontail (*Ceratophyllum demersum*) is known to be impacted by ProcellaCOR™ treatments with many case studies showing populations reduced by around 50%. With this treatment, coontail populations were reduced by 69.2% during the *year of treatment* and remained statistically lower in the *year after treatment*. Coontail remains relatively common in the site with a 2023 occurrence of 26.7%.

Flat-stem pondweed (*Potamogeton zosteriformis),* exhibited a statistically valid decrease in occurrence during the *year of treatment*; however, increased during 2023 to be statistically higher than the pre-treatment survey. Fern-leaf pondweed (*Potamogeton robbinsii*) exhibited a valid increase in occurrence during the *year of treatment* and increased further in 2023 to an occurrence of 30.7%. The combined occurrences of slender and small pondweed (*Potamogeton berchtoldii* and *P. pusillus*) exhibited statistically valid increases in occurrence between 2021 and 2023 as well as common waterweed (*Elodea canadensis*), muskgrasses (*Chara* spp.) and Vasey's pondweed (*Potamogeton vaseyi*).

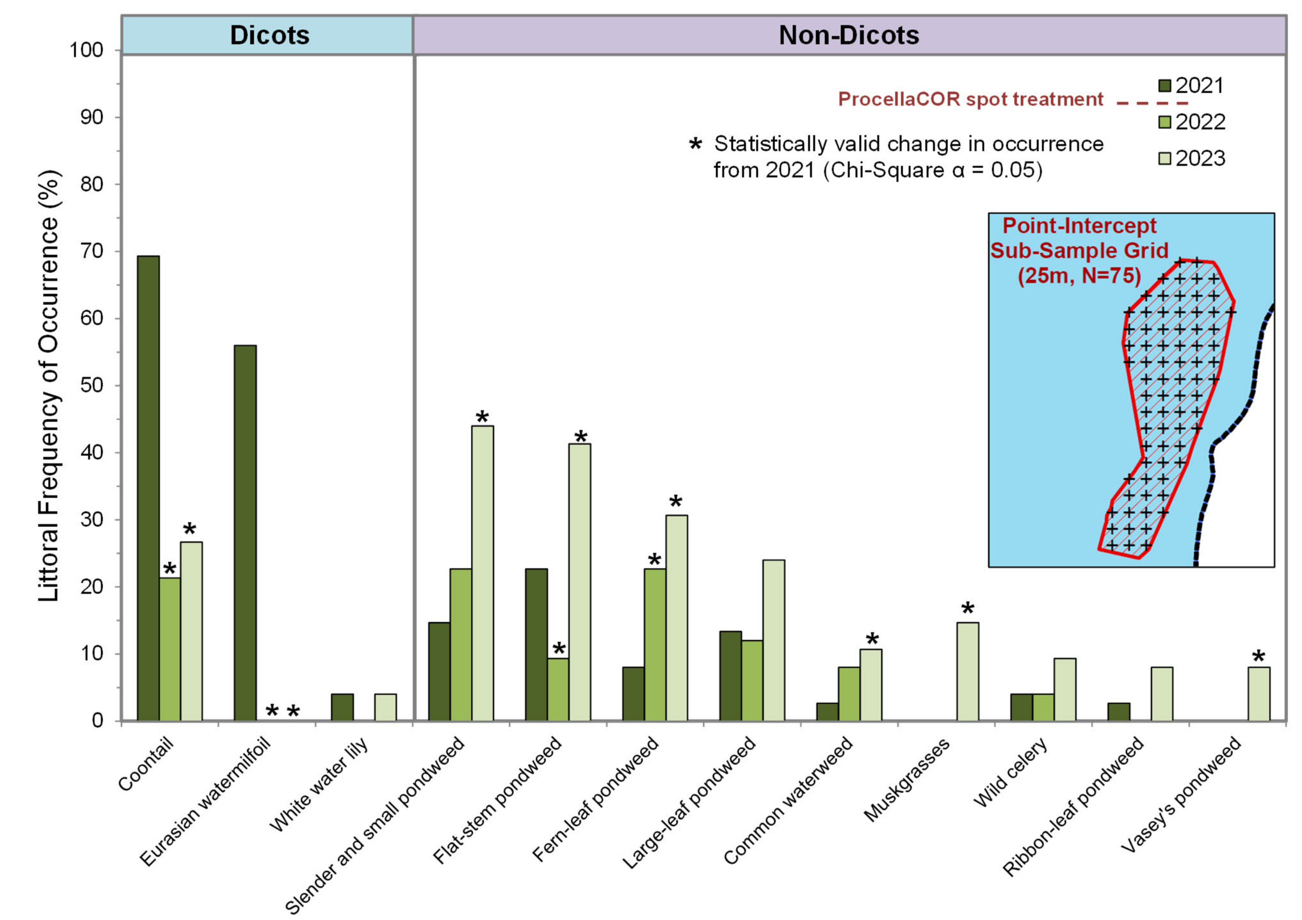


Figure 2.2-1. Littoral frequency of occurrence of aquatic plants from sub-sample point-intercept surveys in Wilson Lake.

The presence of Vasey's pondweed is particularly encouraging as this species is listed as a special concern species in Wisconsin's Natural Heritage Inventory (NHI) due to being rare within the state. Vasey's pondweed produces very fine, narrow leaves which alternate along a long, slender stem. As it approaches the surface, it produces small floating leaves no larger than a human finger nail which help support a small cluster of flowers which emerge above the surface (Photo 2.2-1). In Wisconsin, Vasey's pondweed is primarily found in the northern and central portions of the state. Vasey's pondweed requires high quality conditions and does not tolerate disturbed environments well. Vasey's pondweed was present at six sampling points in the 2023 survey (8.0% occurrence) and was not present in either of the 2021 or 2022 surveys.

Photo 2.2-1. Vasey's pondweed. Photo credit Onterra.

2.3 Quantitative Monitoring: Whole-Lake Point-Intercept Survey

A whole-lake point-intercept aquatic plant survey was conducted in Wilson Lake by Onterra on July 24, 2023. Point-intercept surveys covering the entire lake were also conducted in 2007, 2011, 2012, 2014, 2015 and 2019. This report highlights the results of the 2023 survey and compares it to previous surveys. Aquatic plants have been found growing to a maximum depth of 6-8 feet in the point-intercept surveys.

Species List

Approximately 60 aquatic plant species have been recorded from Wilson Lake or its immediate shoreline over the course of multiple surveys, with those sampled during the point-intercept survey shown in Table 2.3-1. The list also contains the species' scientific name, common name, status in Wisconsin, and its coefficient of conservatism. The latter is discussed in more detail below. Changes in this list over time, whether it is differences in total species present, gains and losses of individual species, or changes in growth forms that are present, can be an early indicator of changes in the ecosystem.

Table 2.3-1. Aquatic plant species located in Wilson Lake during monitoring surveys.

Growth Form	Scientific Name	Common Name	Status in Wisconsin	Coefficient of Conservatism	2007	2011	2012	2014	2015	2019	2023
Emergent	*Carex comosa*	Bristly sedge	Native	5	X						
	Carex sp. 1	Sedge sp. 1	Native	N/A		X		X	X		
	Eleocharis palustris	Creeping spikerush	Native	6		X					
	Sagittaria rigida	Stiff arrowhead	Native	8		X					
	Schoenoplectus acutus	Hardstem bulrush	Native	5			X				
	Schoenoplectus tabernaemontani	Softstem bulrush	Native	4				X		X	
	Typha spp.	Cattail spp.	Unknown (Sterile)	N/A		X		X			
FL	*Brasenia schreberi*	Watershield	Native	7		X	X			X	X
	Nuphar variegata	Spatterdock	Native	6		X	X	X		X	X
	Nymphaea odorata	White water lily	Native	6	X	X	X	X	X	X	X
FL/E	*Sparganium emersum var. acaule*	Short-stemmed bur-reed	Native	8			X				
Submergent	*Ceratophyllum demersum*	Coontail	Native	3	X	X	X	X	X	X	X
	Ceratophyllum echinatum	Spiny hornwort	Native	10						X	
	Chara spp.	Muskgrasses	Native	7		X		X	X	X	X
	Elodea canadensis	Common waterweed	Native	3	X	X	X	X	X	X	X
	Elodea nuttallii	Slender waterweed	Native	7				X		X	X
	Myriophyllum heterophyllum	Various-leaved watermilfoil	Native	7						X	
	Myriophyllum sibiricum	Northern watermilfoil	Native	7	X	X		X			
	Myriophyllum spicatum	Eurasian watermilfoil	Non-Native - Invasive	N/A	X	X		X	X	X	X
	Myriophyllum verticillatum	Whorled watermilfoil	Native	8	X						
	Najas flexilis	Slender naiad	Native	6	X	X		X		X	X
	Nitella spp.	Stoneworts	Native	7	X	X	X	X	X	X	X
	Potamogeton amplifolius	Large-leaf pondweed	Native	7	X	X	X	X	X	X	X
	Potamogeton berchtoldii	Slender pondweed	Native	7				X		X	X
	Potamogeton epihydrus	Ribbon-leaf pondweed	Native	8	X	X	X	X	X	X	X
	Potamogeton foliosus	Leafy pondweed	Native	6				X	X	X	X
	Potamogeton natans	Floating-leaf pondweed	Native	5	X	X	X	X	X	X	X
	Potamogeton obtusifolius	Blunt-leaved pondweed	Native	9	X			X	X	X	
	Potamogeton pusillus	Small pondweed	Native	7	X	X	X	X		X	X
	Potamogeton robbinsii	Fern-leaf pondweed	Native	8	X	X	X	X	X	X	X
	Potamogeton spirillus	Spiral-fruited pondweed	Native	8	X	X					X
	Potamogeton vaseyi	Vasey's pondweed	Native - Special Concern	10						X	X
	Potamogeton zosteriformis	Flat-stem pondweed	Native	6	X	X	X	X		X	X
	Sagittaria sp. (rosette)	Arrowhead sp. (rosette)	Native	N/A		X				X	X
	Stuckenia pectinata	Sago pondweed	Native	3						X	X
	Utricularia vulgaris	Common bladderwort	Native	7	X		X			X	
	Vallisneria americana	Wild celery	Native	6	X	X				X	X
S/E	*Eleocharis acicularis*	Needle spikerush	Native	5		X					X
FF	*Lemna minor*	Lesser duckweed	Native	5	X				X		
	Lemna trisulca	Forked duckweed	Native	6	X	X	X	X	X		X
	Lemna turionifera	Turion duckweed	Native	2			X			X	X
	Riccia fluitans	Slender riccia	Native	7						X	
	Spirodela polyrhiza	Greater duckweed	Native	5	X	X	X	X	X	X	X

X = Located on rake during point-intercept survey
FL = Floating-leaf; FL/E = Floating-leaf & Emergent; S/E = Submergent and/or Emergent; FF = Free-floating

Frequency of Occurrence

Frequency of occurrence describes how often a certain aquatic plant species is found within a lake. Obviously, all of the plants cannot be counted in a lake, so samples are collected from pre-determined areas. In the case of the whole-lake point-intercept survey completed on Wilson Lake; plant samples were collected from plots laid out on a grid that covered the lake. Using the data collected from these plots, an estimate of occurrence of each plant species can be determined. The occurrence of aquatic plant species is displayed as the *littoral frequency of occurrence*. Littoral frequency of occurrence is used to describe how often each species occurred in the plots that are within the maximum depth of plant growth (littoral zone), and is displayed as a percentage.

A total of 26 aquatic plant species were encountered directly on the rake during the 2023 whole-lake point-intercept survey. Coontail was the most frequently encountered species during the survey with an occurrence of 27.5% (Figure 2.3-1). Fern-leaf pondweed (13.5%), flat-stem pondweed (10.7%) and small pondweed (9.6%) were also some of the most frequently encountered species. Eurasian watermilfoil was located on three sampling points resulting in an occurrence of 1.7%.

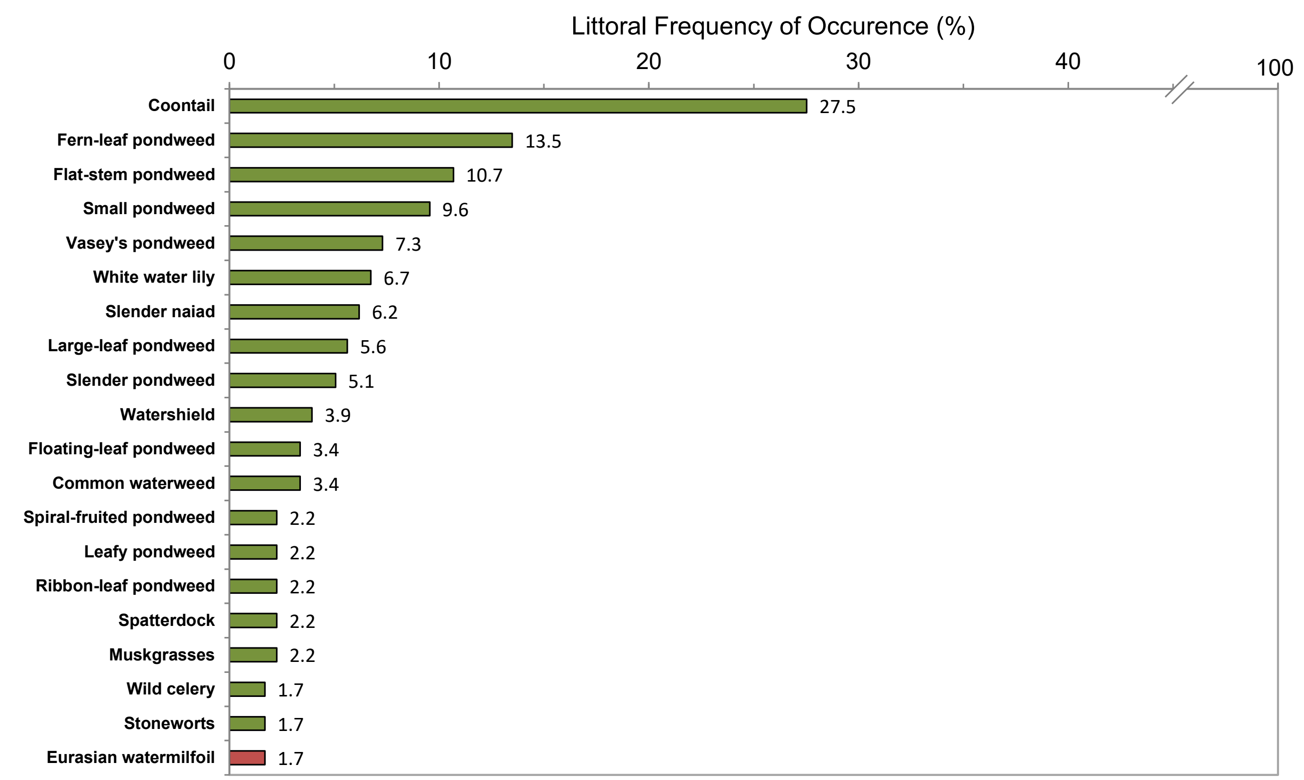


Figure 2.3-1. 2023 littoral frequency of occurrence of aquatic plant species. Less frequently encountered species are excluded from this graphic.

Figure 2.3-2 compares the littoral frequency of occurrence for the some of the most commonly encountered aquatic plant species located in all point-intercept surveys between 2007-2023 in Wilson Lake. Note that some morphologically similar species are lumped together within the analysis. These data show aquatic plant species population dynamics in relation to past herbicide management that has taken place. Some species such as large-leaf pondweed or fern-leaf pondweed have been relatively stable over the period of study while species such as coontail and flat-stem pondweed have shown frequent statistically valid changes in occurrence between many surveys.

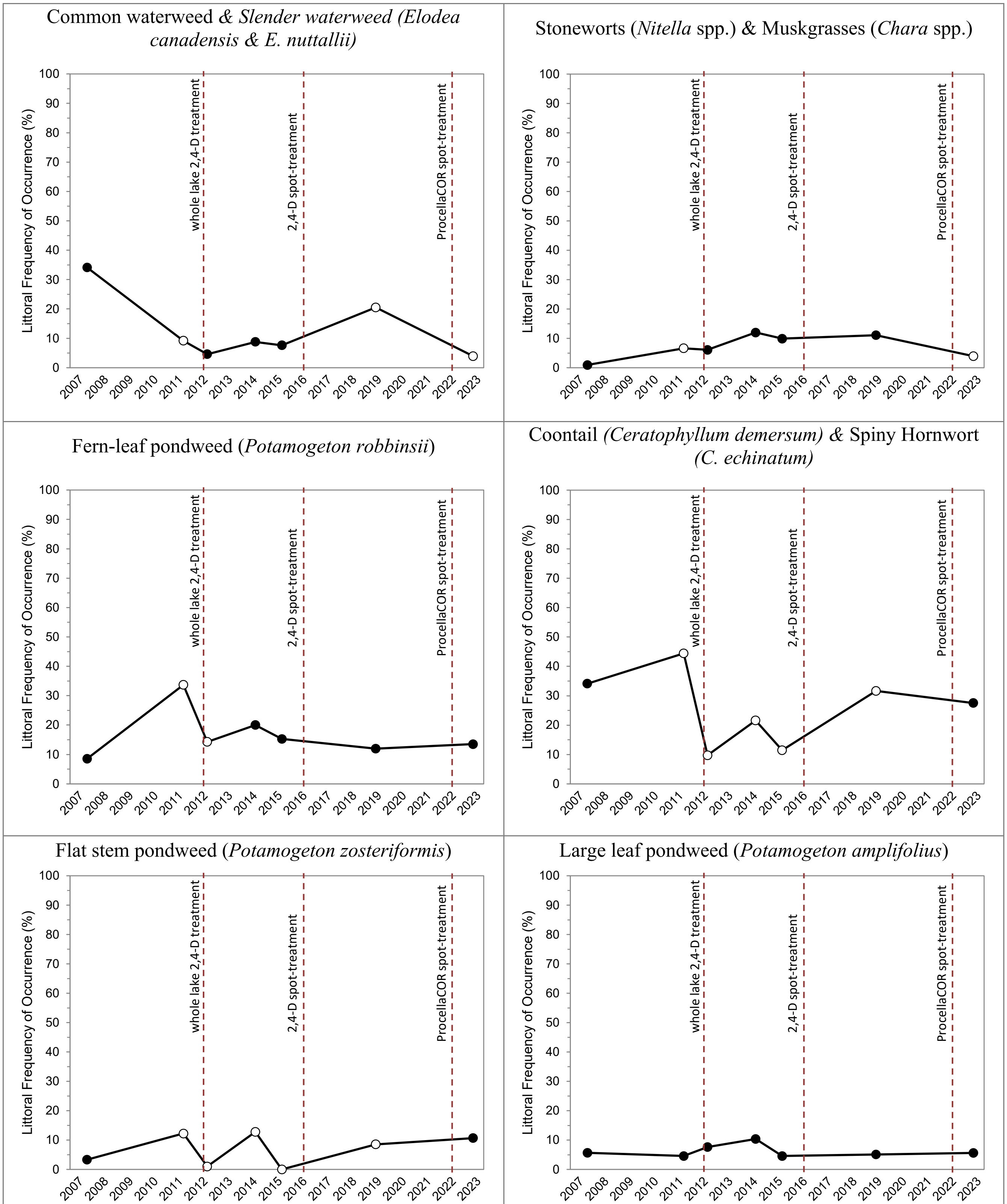


Figure 2.3-2. Littoral occurrence of select native aquatic plant species commonly found in Wilson Lake. Open circle represents a statistically valid change in occurrence from previous survey (Chi-square α = 0.05).

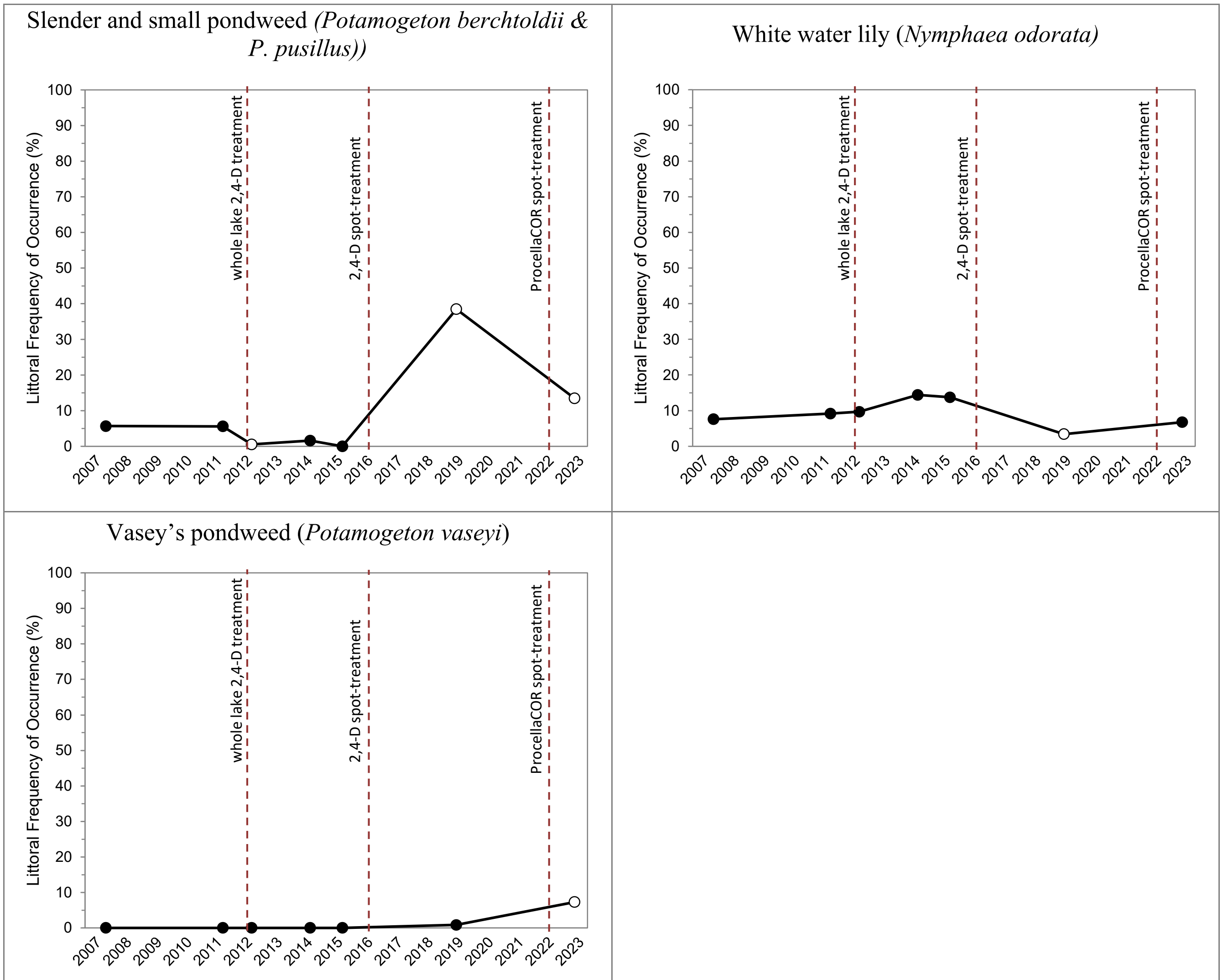


Figure 2.3-2 - continued. Littoral occurrence of select native aquatic plant species commonly found in Wilson Lake. Open circle represents a statistically valid change in occurrence from previous survey (Chi-square α = 0.05).

Native species that exhibited statistically valid decreases in occurrence between the 2019 and 2023 survey include muskgrasses/stoneworts, common/slender waterweed, and slender/small pondweed. Vasey's pondweed was not present on the 2007-2015 surveys and then had a 0.9% occurrence in 2019. The occurrence of Vasey's pondweed increased to 7.3% in 2023, representing a statistically valid increase in occurrence since 2019. A full matrix that displays the littoral frequency of occurrences for all species sampled during the point-intercept surveys is included in Appendix B.

Floristic Quality Assessment

The floristic quality of a lake's aquatic plant community is calculated using its native *species richness* and their *average conservatism*. Species richness is the number of native aquatic plant species that were physically encountered on the rake during the point-intercept survey. Average conservatism is calculated by taking the sum of the coefficients of conservatism (C-values) of the native species located and dividing it by species richness. Every plant in Wisconsin has been assigned a coefficient of conservatism, ranging from 1-10, which describes the likelihood of that species being found in an undisturbed environment. Species which are more specialized and require undisturbed habitat are given higher coefficients, while species which are more tolerant of environmental disturbance have lower coefficients. Higher average conservatism values generally indicate a healthier lake as it is able to support a greater number of environmentally-sensitive aquatic plant species. Low average conservatism values indicate a degraded environment, one that is only able to support disturbance-tolerant species.

On their own, the species richness and average conservatism values for a lake are useful in assessing a lake's plant community; however, the best assessment of the lake's plant community health is determined when the two values are used to calculate the lake's floristic quality. The floristic quality is calculated using the species richness and average conservatism value of the aquatic plant species that were solely encountered on the rake during the point-intercept surveys (equation shown below). This assessment allows the aquatic plant community of Wilson Lake to be compared to other lakes within the region and state.

FQI = Average Coefficient of Conservatism * √ Number of Native Species

Data collected during the aquatic plant surveys was also used to complete a Floristic Quality Assessment (FQA) which incorporates the number of native aquatic plant species recorded on the rake during the point-intercept survey and their average conservatism. The data used for these calculations does not include any incidental species (visual observations) but only considers plants that were sampled on the rake during the survey. Figure 2.3-3 displays the species richness, average conservatism, and floristic quality of Wilson Lake along with ecoregion and state median values.

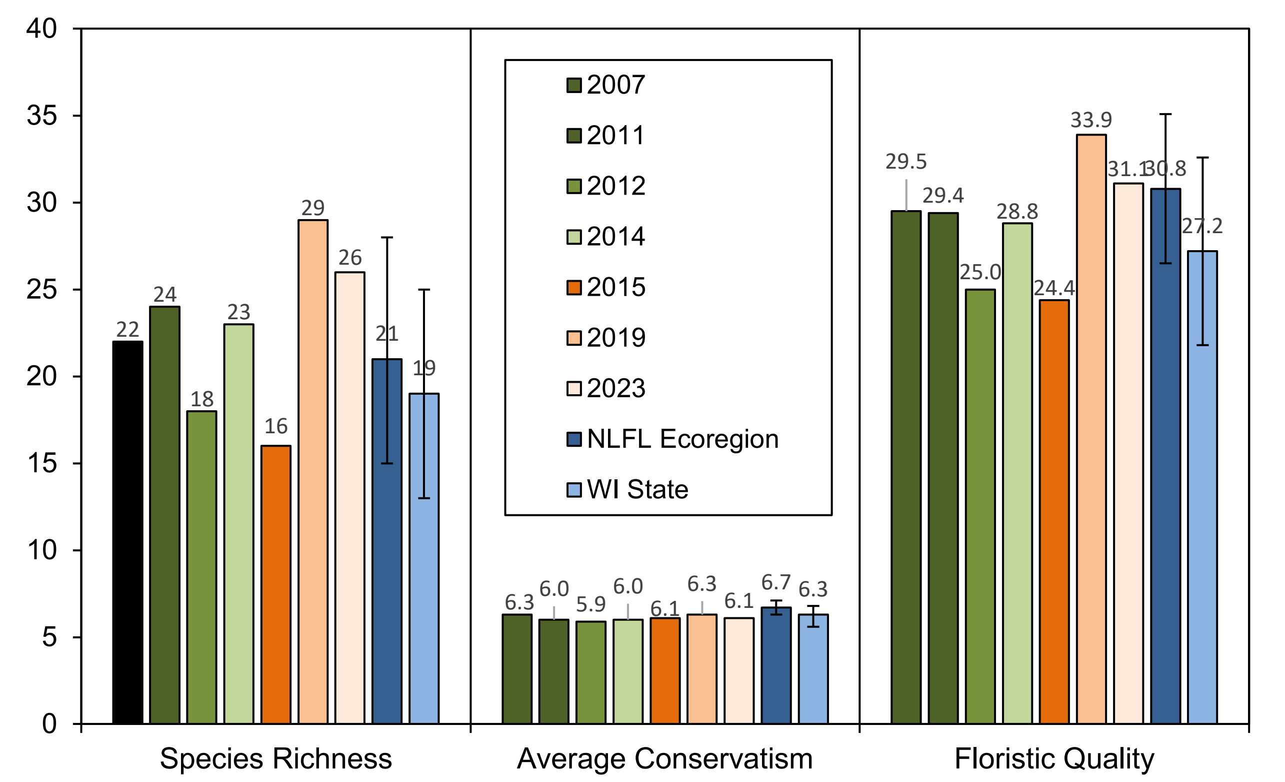


Figure 2.3-3. Floristic Quality Assessment. Created using data from point-intercept surveys. Analysis following Nichols (1999) where NLFL = Northern Lakes and Forests Ecoregion.

Wilson Lake's native plant species richness values have ranged from 16 in 2020 to 29 in 2021 compared to the median values for lakes within the NLFL ecoregion (21) and lakes across Wisconsin (19). Wilson Lake's average species conservatism of 6.1 in 2023 falls slightly below the ecoregion and state median values and 6.1 is also the average value from all surveys in Wilson Lake to date. Using the species richness and average conservatism values, Wilson Lake's Floristic Quality Index was 31.1 in 2023 which call near the ecoregion median and above the state median. This indicates that Wilson Lake contains a high quality aquatic plant population.

Species Diversity

Species diversity is often confused with species richness. Species richness is simply the number of species found within a given community. While species diversity utilizes species richness, it also takes into account evenness or the variation in abundance of the individual species within the community. For example, a lake with 10 aquatic plant species that had relatively similar abundances within the community would be more diverse than another lake with 10 aquatic plant species were 50% of the community was comprised of just one or two species.

If a lake has a diversity index value of 0.90, it means that if two plants were randomly sampled from the lake there is a 90% probability that the two individuals would be of a different species. The Simpson's Diversity Index value from Wilson Lake is compared to data collected by Onterra and the WDNR Science Services on lakes within the Norther Lakes and Forests ecoregion and on lakes throughout Wisconsin (Figure 2.3-4). While a method for characterizing diversity values of fair, poor, etc. does not exist, lakes within the same ecoregion may be compared to provide an idea of how Wilson Lake's diversity values rank. Wilson Lake's Simpson's Diversity Index value has varied from 0.86 to 0.92 over time. The 0.91 value from 2023 falls above the upper quartile.

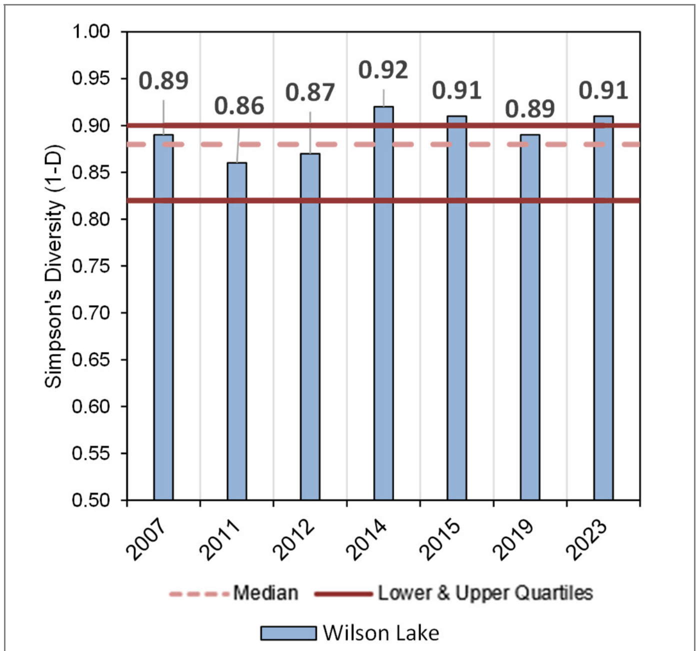


Figure 2.3-4. Simpson's Diversity Index. Created using data from point-intercept surveys.

Eurasian watermilfoil

The occurrence of EWM in Wilson Lake from all point-intercept surveys is displayed on Figure 2.3-5. These data show large fluctuations for EWM over time, largely in response to this species being the target of herbicide management strategies.

EWM was found at 41.9% of the littoral sampling locations in 2019. The 2023 survey indicated an occurrence of 1.7%, one of the lowest EWM populations from this period of study.

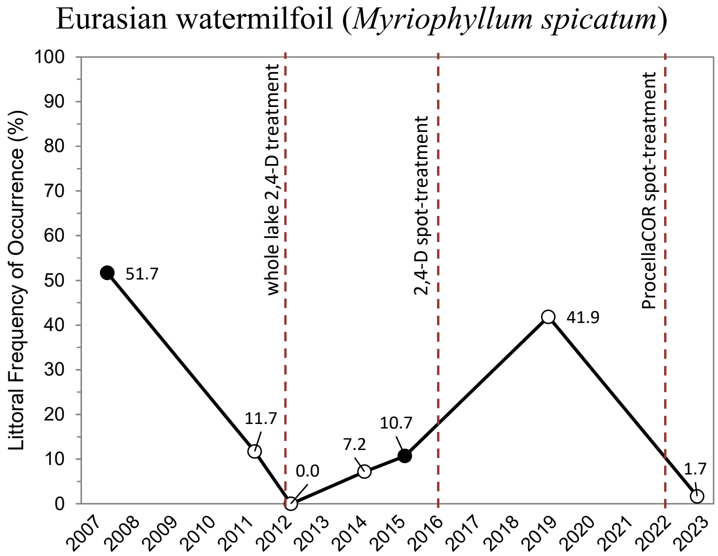


Figure 2.3-5. Wilson Lake EWM littoral frequency of occurrence. Open circles on represent a statistically valid change from previous survey.

Photograph 2.1-8. Eurasian watermilfoil, a non-native, invasive aquatic plant. Photo credit Onterra.

Figure 2.3-6 displays number of sampling locations that contained native plants, EWM and native plants, or EWM only from the point-intercept surveys. These data show a large EWM population in 2007 which was lowered by 2011 and reduced to zero in 2012, the year of a whole-lake 2,4-D treatment. The figure demonstrates a gradually increasing EWM population from 2014-2019, followed by a reduction of points with EWM in 2023 which corresponds to the first survey after the 2022 ProcellaCOR treatment which had impacts to much of the southern portions of Wilson Lake. The number of points with native species present was highest in 2007 at 135 and reached a low point of 58 in 2012. Since 2012, the sampling points with native species present have gradually increased to 86 in the 2023 survey.

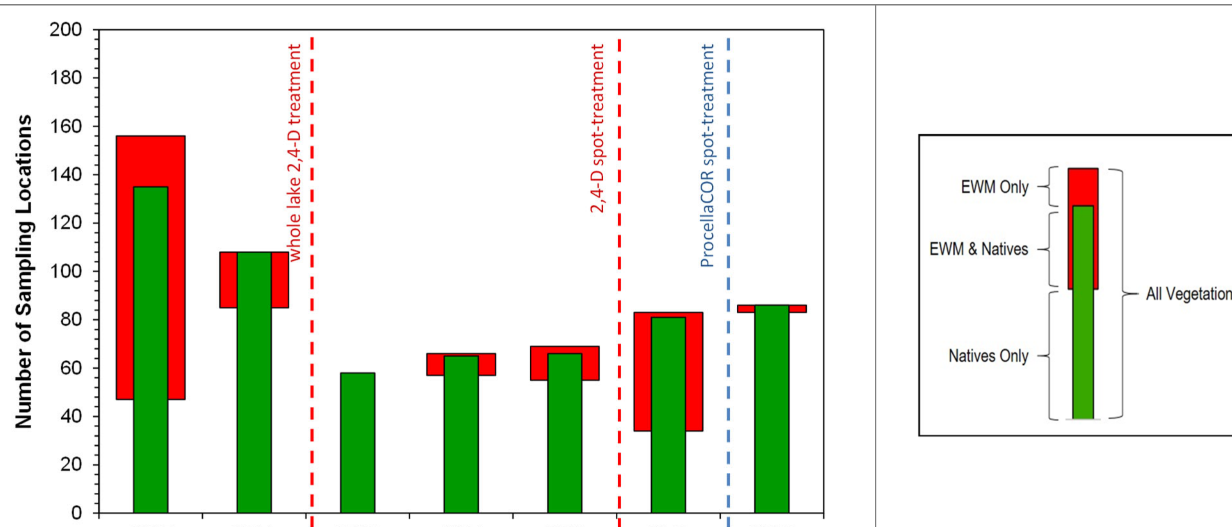


Figure 2.3-6. Number of point-intercept sampling locations that contained native plants, EWM, or native plants and EWM.

3.0 WATER QUALITY MONITORING

During a scoping meeting while this project was being developed, the WDNR requested water quality data be collected during the *year of the treatment* (2022) on Wilson Lake. Herbicide treatments have the potential to influence water quality parameters primarily through altered nutrient dynamics and reductions in zooplankton habitat.

This project included the collection of volunteer-based water quality data consistent with the Citizens Lake Monitoring Network (CLMN) schedule, including funding for laboratory analysis for the volunteer-based effort to be conducted. Following the outline of the CLMN program, volunteers collected Secchi disk transparency samples once in spring and 3 times in summer (once a month during June, July, and August). During the spring, surface total phosphorus samples were collected. During the three summer collection intervals, surface chlorophyll-a and total phosphorus samples were collected. Samples were properly preserved and shipped on ice to the Wisconsin State Laboratory of Hygiene (WSLH).

Near-surface total phosphorus data from Wilson Lake are available for 1998-2008, 2019, and 2022 (Figure 3.0-1). Phosphorus is the primary nutrient in Wilson Lake that drives the growth of aquatic plants and algae. The data collected in 2022 are similar to the previous collection period in 2019, and slightly lower than the weighted average from all years.

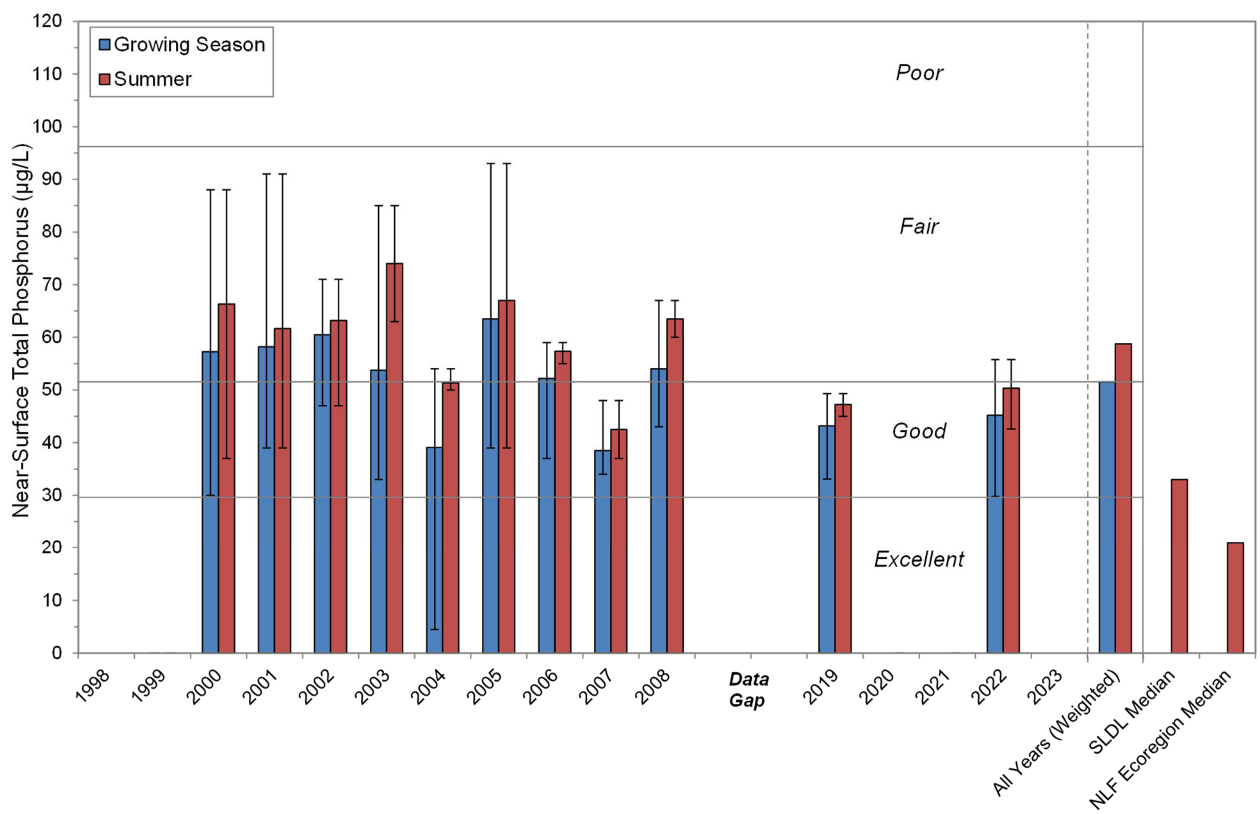


Figure 3.0-1. Wilson Lake, state-wide shallow, lowland drainage lakes, and regional total phosphorus concentrations. Mean values calculated with summer and growing season surface sample data. Water Quality Index values adapted from WDNR 2013.

Chlorophyll-*a* is the green pigment in aquatic plants and algae that converts nutrients into energy when in the presence of sunlight. When measured from lake water samples, it shows the number of free-floating algae growing in the water. Chlorophyll-*a* data are available from Wilson Lake for the same years as phosphorus (Figure 3.0-2). Chlorophyll-*a* concentrations in 2022 were considerably higher than in 2019, even though the primary nutrient driver, phosphorus, was relatively the same. Chlorophyll-*a* concentrations in 2022 were most with concentrations observed in 2001-2003.

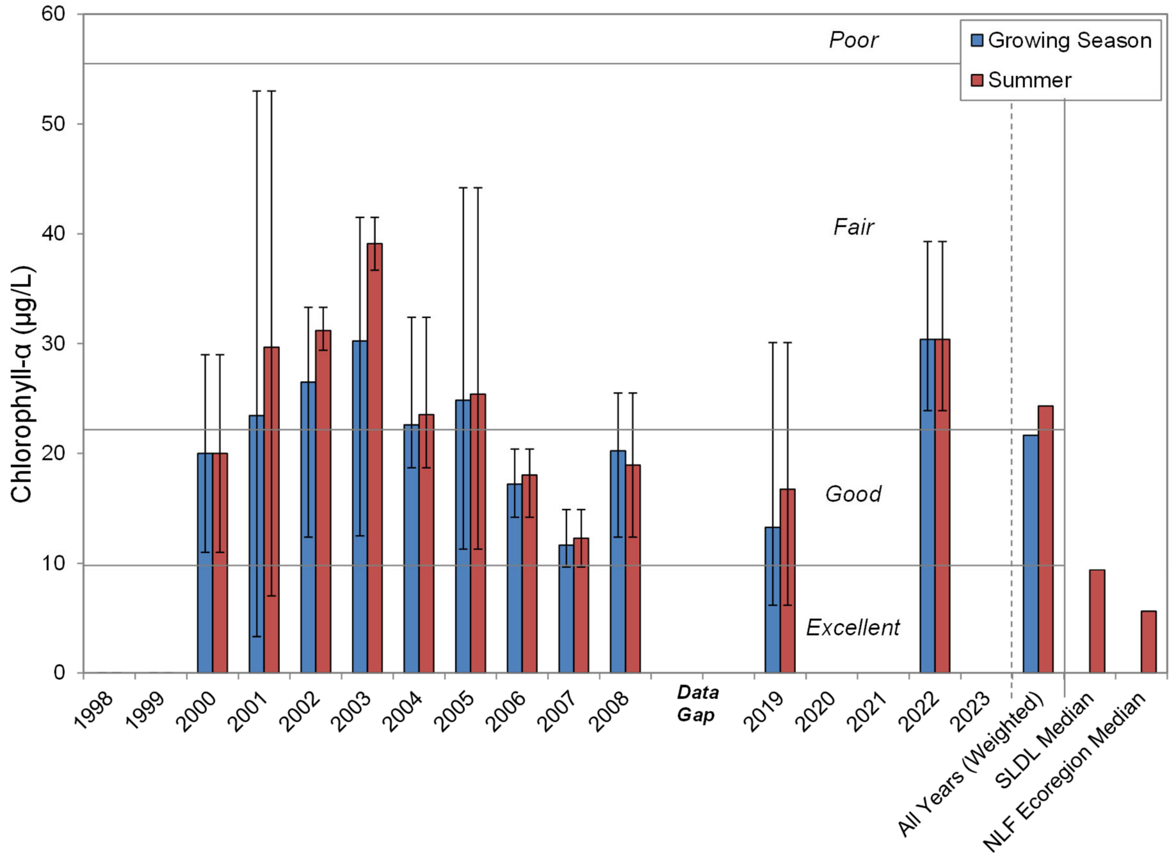


Figure 3.0-2. Wilson Lake, state-wide shallow, lowland drainage lakes, and regional chlorophyll-a concentrations. Mean values calculated with summer and growing season surface sample data. Water Quality Index values adapted from WDNR 2013.

Secchi disk transparency data are available from Wilson Lake for the same years as phosphorus and chlorophyll-*a*, as well as 1998 and 1999 (Figure 3.0-3). The deeper the Secchi disk, the clearer the water. In Wilson Lake, the water clarity is primarily driven by the amount of free-floating algae in the lake (i.e. chlorophyll-*a*), but also by staining organic tannins picked up from overland water flow. Likely related to the slightly increased chlorophyll-*a* in Wilson Lake in 202, the water clarity of Wilson Lake as slightly less than in 2019, but in-line within the overall dataset and all years weighted means. Water clarity data was also collected in 2023, found to be similar to 2022.

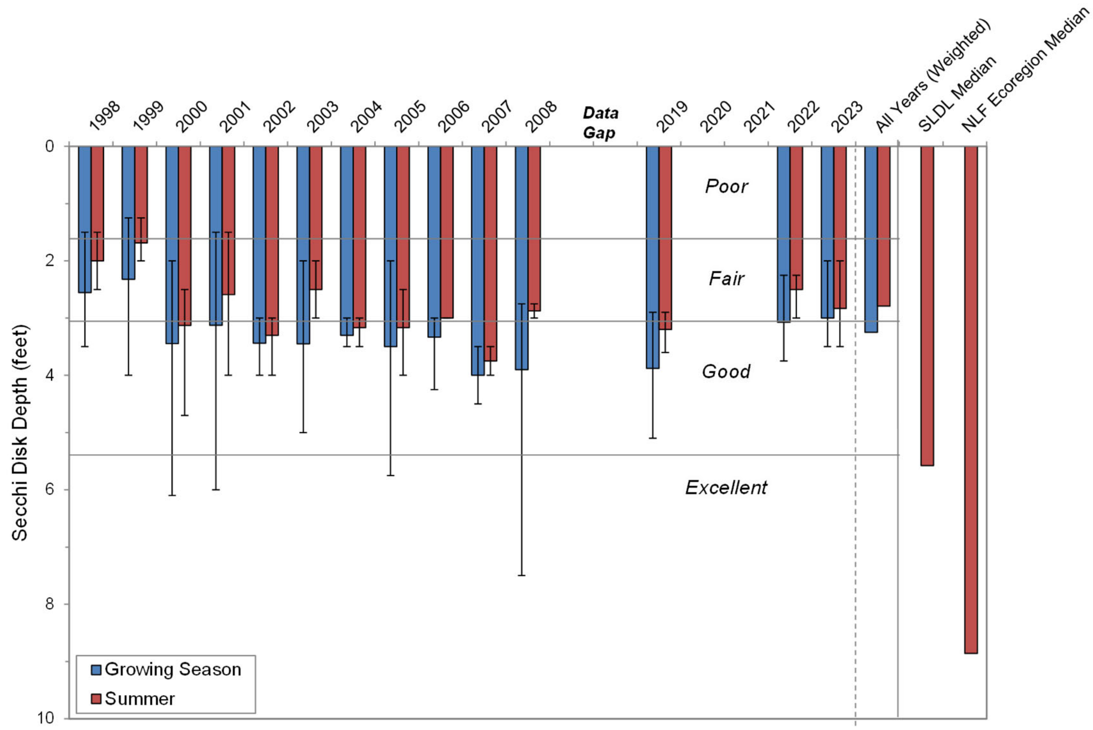


Figure 3.0-3. Wilson Lake, state-wide shallow, lowland drainage lakes, and regional Secchi disk clarity values. Mean values calculated with summer month surface sample data. Water Quality Index values adapted from WDNR 2013.

4.0 CONCLUSIONS & DISCUSSION

EWM efficacy was high surrounding the 2022 herbicide treatment, with almost no EWM being located in the application area for two summers post treatment. Compared to pretreatment, minimal EWM was located in the southern lobe of the lake, with some EWM reductions even extending into the northern lobe.

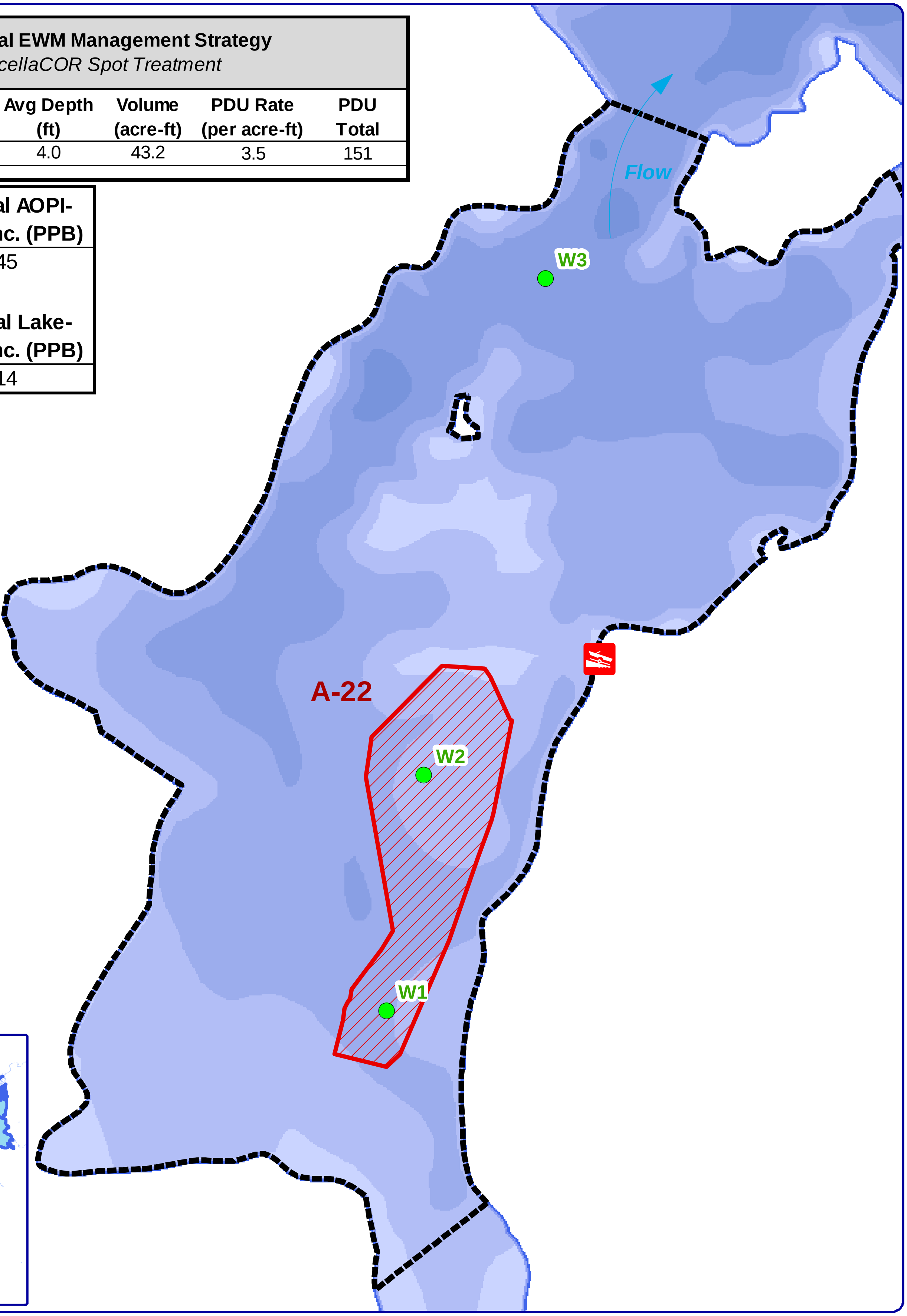
Based upon aquatic plant monitoring within the application area (sub-sample point-intercept survey) and within the entirety of Wilson Lake (whole-lake point-intercept survey), the native aquatic plant community continues to be healthy. Native plant declines were largely limited to coontail in the application area, although this plant species had stable lake-wide populations before and after the treatment within all of Wilson lake. Many pondweed species having higher frequency in the application area in the years following the treatment, including detection of Vasey's pondweed, a relatively rare and valuable species.

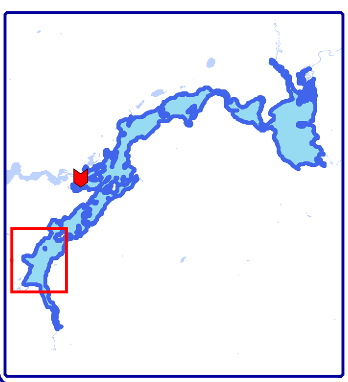
Water quality data collected during the *year of treatment* yielded no apparent changes in the overall water quality of Wilson Lake. Continued collection of water quality data when possible is recommended moving forward.

2022 Final EWM Management Strategy *ProcellaCOR Spot Treatment*					
Site	Proposed Acres	Avg Depth (ft)	Volume (acre-ft)	PDU Rate (per acre-ft)	PDU Total
A-22	10.8	4.0	43.2	3.5	151

Treat Area to AOPI	Potential AOPI-wide Conc. (PPB)
7.4%	0.45

Treat Area to Lake	Potential Lake-wide Conc. (PPB)
3.1%	0.14



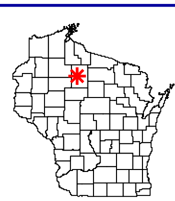


N
W E
S
600
Feet

Onterra LLC
Lake Management Planning
815 Prosper Road
De Pere, WI 54115
920.338.8860
www.onterra-eco.com

Sources:

Roads & Hydro: WDNR
Aquatic Plants: Onterra, 2020
Map date: June 8, 2022 - EJH



Project Location in Wisconsin

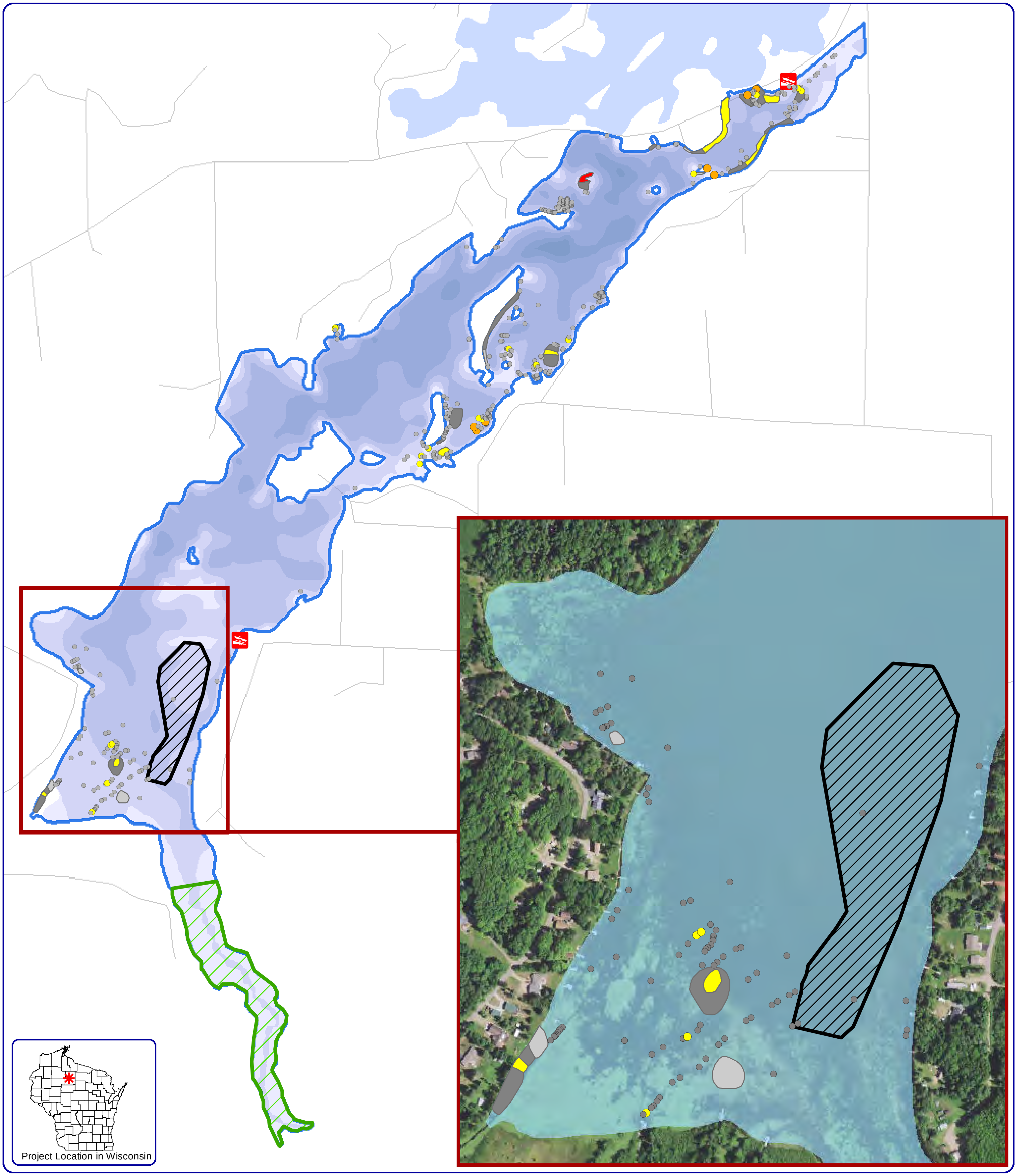
Legend

Final Herbicide Application Area

Area of Potential Impact

Map 1
Wilson Lake
Price County, Wisconsin

Final 2022 EWM Treatment Strategy



N
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1,300

Feet

Legend

EWM Survey: 8/28/2023

- Highly Scattered
- Scattered
- Dominant
- Highly Dominant *(none)*
- Surface Matting
- Single or Few Plants
- Clumps of Plants
- Small Plant Colony
- 2022 Herbicide Treatment Site
- Non-navigable (plants)

Map 2

Wilson Lake

Price County, Wisconsin

Late-Season 2023 EWM Survey Results

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www.onterra-eco.com

Sources
Roads and Hydro: WDNR
Bathymetry: Onterra
Aquatic Plants: Onterra, 2023
Orthophotography: NAIP, 2020
Map Date: 11/13/2023 RMF

A

APPENDIX A

2022 Treatment: Sub-Sample Point-Intercept Aquatic Plant Data Matrix

Wilson Lake 2022 Herbicide Applicaiton Site

Sub-Sample Point-Intercept Survey Data Matrix

Scientific Name	Common Name	LFOO (%)		
		2021	**2022**	**2023**
Ceratophyllum demersum	Coontail	69.3	21.3	26.7
Potamogeton berchtoldii & P. pusillus	Slender and small pondweed	14.7	22.7	44.0
Potamogeton pusillus	Small pondweed	10.7	22.7	42.7
Potamogeton zosteriformis	Flat-stem pondweed	22.7	9.3	41.3
Potamogeton robbinsii	Fern-leaf pondweed	8.0	22.7	30.7
Potamogeton amplifolius	Large-leaf pondweed	13.3	12.0	24.0
Myriophyllum spicatum	Eurasian watermilfoil	56.0	0.0	0.0
Elodea canadensis	Common waterweed	2.7	8.0	10.7
Chara spp.	Muskgrasses	0.0	0.0	14.7
Vallisneria americana	Wild celery	4.0	4.0	9.3
Potamogeton epihydrus	Ribbon-leaf pondweed	2.7	0.0	8.0
Potamogeton vaseyi	Vasey's pondweed	0.0	0.0	8.0
Nymphaea odorata	White water lily	4.0	0.0	4.0
Potamogeton berchtoldii	Slender pondweed	4.0	0.0	2.7
Najas flexilis	Slender naiad	0.0	0.0	2.7
Ranunculus aquatilis	White water crowfoot	0.0	0.0	1.3
Potamogeton strictifolius	Stiff pondweed	0.0	0.0	1.3
Potamogeton gramineus	Variable-leaf pondweed	0.0	0.0	1.3
Potamogeton friesii	Fries' pondweed	0.0	0.0	1.3
Potamogeton foliosus	Leafy pondweed	0.0	0.0	1.3
Nuphar variegata	Spatterdock	0.0	0.0	1.3
Heteranthera dubia	Water stargrass	2.7	0.0	0.0
Potamogeton obtusifolius	Blunt-leaved pondweed	0.0	0.0	0.0
Lemna trisulca	Forked duckweed	0.0	1.3	0.0
Brasenia schreberi	Watershield	0.0	1.3	0.0

B

APPENDIX B

Wilson Lake Whole-Lake Point-Intercept Aquatic Plant Data Matrix

Wilson Lake

Whole-Lake Point-Intercept Survey Data Matrix

Scientific Name	Common Name	LFOO (%)						
		2007	2011	2012	2014	2015	2019	2023
Ceratophyllum demersum & Ceratophyllum echinatum	Coontail & Spiny hornwort	34.1	44.4	9.7	21.6	11.5	31.6	27.5
Ceratophyllum demersum	Coontail	34.1	44.4	9.7	21.6	11.5	29.9	27.5
Potamogeton robbinsii	Fern-leaf pondweed	8.5	33.7	14.3	20.0	15.3	12.0	13.5
Myriophyllum spicatum	Eurasian watermilfoil	51.7	11.7	0.0	7.2	10.7	41.9	1.7
Elodea canadensis & Elodea nuttallii	Common waterweed & Slender waterweed	34.1	9.2	4.6	8.8	7.6	20.5	3.9
Elodea canadensis	Common waterweed	34.1	9.2	4.6	4.8	7.6	18.8	3.4
Potamogeton berchtoldii & Potamogeton pusillus	Slender pondweed & Small pondweed	5.7	5.6	0.5	1.6	0.0	38.5	13.5
Nymphaea odorata	White water lily	7.6	9.2	9.7	14.4	13.7	3.4	6.7
Potamogeton pusillus	Small pondweed	5.7	5.6	0.5	0.8	0.0	35.9	9.6
Potamogeton zosteriformis	Flat-stem pondweed	3.3	12.2	1.0	12.8	0.0	8.5	10.7
Chara spp. & Nitella spp.	Muskgrasses & Stoneworts	0.9	6.6	6.1	12.0	9.9	11.1	3.9
Potamogeton amplifolius	Large-leaf pondweed	5.7	4.6	7.7	10.4	4.6	5.1	5.6
Najas flexilis	Slender naiad	1.4	3.1	0.0	4.0	0.0	12.0	6.2
Nitella spp.	Stoneworts	0.9	4.1	6.1	5.6	4.6	1.7	1.7
Chara spp.	Muskgrasses	0.0	3.1	0.0	8.0	5.3	9.4	2.2
Potamogeton epihydrus	Ribbon-leaf pondweed	1.4	2.6	0.5	6.4	5.3	4.3	2.2
Potamogeton natans	Floating-leaf pondweed	5.2	1.5	2.0	3.2	0.8	0.9	3.4
Lemna trisulca	Forked duckweed	10.0	3.1	0.5	2.4	2.3	0.0	0.6
Potamogeton vaseyi	Vasey's pondweed	0.0	0.0	0.0	0.0	0.0	0.9	7.3
Nuphar variegata	Spatterdock	0.0	2.6	2.0	4.8	0.0	1.7	2.2
Potamogeton berchtoldii	Slender pondweed	0.0	0.0	0.0	0.8	0.0	3.4	5.1
Brasenia schreberi	Watershield	0.0	1.0	0.5	0.0	0.0	1.7	3.9
Spirodela polyrhiza	Greater duckweed	0.9	2.0	0.5	1.6	0.8	2.6	0.6
Potamogeton foliosus	Leafy pondweed	0.0	0.0	0.0	1.6	3.1	0.9	2.2
Vallisneria americana	Wild celery	0.5	2.0	0.0	0.0	0.0	1.7	1.7
Potamogeton spirillus	Spiral-fruited pondweed	1.4	0.5	0.0	0.0	0.0	0.0	2.2
Elodea nuttallii	Slender waterweed	0.0	0.0	0.0	4.8	0.0	2.6	0.6
Potamogeton obtusifolius	Blunt-leaved pondweed	1.9	0.0	0.0	0.8	0.8	0.9	0.0
Sagittaria sp. (rosette)	Arrowhead sp. (rosette)	0.0	0.5	0.0	0.0	0.0	2.6	0.6
Lemna turionifera	Turion duckweed	0.0	0.0	1.0	0.0	0.0	1.7	0.6
Ceratophyllum echinatum	Spiny hornwort	0.0	0.0	0.0	0.0	0.0	5.1	0.0
Stuckenia pectinata	Sago pondweed	0.0	0.0	0.0	0.0	0.0	0.9	1.1
Schoenoplectus tabernaemontani	Softstem bulrush	0.0	0.0	0.0	3.2	0.0	0.9	0.0
Myriophyllum sibiricum	Northern watermilfoil	0.9	0.5	0.0	0.8	0.0	0.0	0.0
Lemna minor	Lesser duckweed	1.4	0.0	0.0	0.0	0.8	0.0	0.0
Utricularia vulgaris	Common bladderwort	0.5	0.0	0.5	0.0	0.0	0.9	0.0
Eleocharis acicularis	Needle spikerush	0.0	0.5	0.0	0.0	0.0	0.0	0.6
Carex sp. 1	Sedge sp. 1	0.0	0.5	0.0	0.8	0.8	0.0	0.0
Typha spp.	Cattail spp.	0.0	0.5	0.0	0.8	0.0	0.0	0.0
Fissidens spp. & Fontinalis spp.	Aquatic Moss	0.0	0.0	0.0	0.0	1.5	0.0	0.0
Eleocharis palustris	Creeping spikerush	0.0	1.0	0.0	0.0	0.0	0.0	0.0
Sparganium emersum var. acaule	Short-stemmed bur-reed	0.0	0.0	0.5	0.0	0.0	0.0	0.0
Schoenoplectus acutus	Hardstem bulrush	0.0	0.0	0.5	0.0	0.0	0.0	0.0
Sagittaria rigida	Stiff arrowhead	0.0	0.5	0.0	0.0	0.0	0.0	0.0
Riccia fluitans	Slender riccia	0.0	0.0	0.0	0.0	0.0	0.9	0.0
Myriophyllum verticillatum	Whorled watermilfoil	0.5	0.0	0.0	0.0	0.0	0.0	0.0
Myriophyllum heterophyllum	Various-leaved watermilfoil	0.0	0.0	0.0	0.0	0.0	0.9	0.0
Carex comosa	Bristly sedge	0.5	0.0	0.0	0.0	0.0	0.0	0.0