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White River Flowage
2024 Aquatic Plant Survey Report

October 29, 2024

Prepared for:
White River Flowage Lake Management District

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INTRODUCTION / SUMMARY

The White River Flowage Lake Management District (WRFLMD or the District) is a group responsible for the management of White River Flowage's aquatic invasive species (AIS), particularly Eurasian water-milfoil (*Myriophyllum spicatum* - EWM). Wisconsin Lake & Pond Resource (WLPR) was contracted by the District to provide aquatic plant surveys and a report summarizing results and historical comparisons for the Lake. WLPR furnished all labor, materials, tools and equipment necessary to perform all operations. This report provides a summary of observations and conclusions for the management of AIS and recommendations for the upcoming 2025 season.

Waterbody Morphology

White River Flowage is a 125-acre man-made impoundment located in the Town of Dakota, Waushara County, Wisconsin. White River Flowage has a maximum depth of 21 feet with a mean depth of 8.8 feet. The White River Flowage Lake Management District is an active lake District that has been managing the lake and its habitat. Eurasian water-milfoil (EWM), curly-leaf pondweed (CLP), and flowering rush are all AIS and present within the waterway. Currently, only EWM currently a concern for active management along with mechanical harvesting of a mix of native and invasive vegetation causing a navigational nuisance.

Aquatic Plant Management Background

The aquatic plant community of the White River Flowage has been healthy, though periodically dense. However, introduction of aquatic invasive species caused an expanding problem with excessive aquatic plant growth. Eurasian water-milfoil has caused the most significant problem within the Lake. Past management has ranged from small-scale, spot treatments to moderately large (>5.0 acres) areas for EWM control. The last, active AIS management was completed in spring, 2022 to 4.43 acres of EWM. A fall, 2022 mapping documented 1.77 acres of scattered, low density- EWM. No active AIS management occurred in 2023.

Aquatic Plant Surveys

The entire aquatic plant community of the lake was last surveyed with a whole-lake point intercept survey in 2018. The survey was completed according to the point-intercept sampling method described by Madsen (1999) and as outlined in the WDNR draft guidance entitled "Aquatic Plant Management in Wisconsin" (WDNR, 2005) and was used assess aquatic invasive species growth and the entire plant community. This survey was repeated in 2024 by WLPR.

In total, 249 individual locations were created to be sampled and spaced on a 45-meter grid. Latitude and longitude coordinates and sample identifications were assigned to each intercept point. Geographic coordinates were uploaded into a global positioning system (GPS) receiver. The GPS unit was then used to navigate to intercept points. At each intercept point, plants were collected by either tossing a specialized rake on a rope in depths 13' or greater or by using a specialized rake on a pole in depths less than 13' by dragging the rake along the bottom sediments. All collected plants were identified to the lowest practicable taxonomic level (e.g., typically genus or species) and recorded on field data sheets. Visual observations of aquatic plants were also recorded. Water depth and, when detectable, sediment types at each intercept point were also recorded on field data sheets. Further description of methods used and data calculated from these surveys are included in Appendix A.

2024 AQUATIC PLANT SURVEY

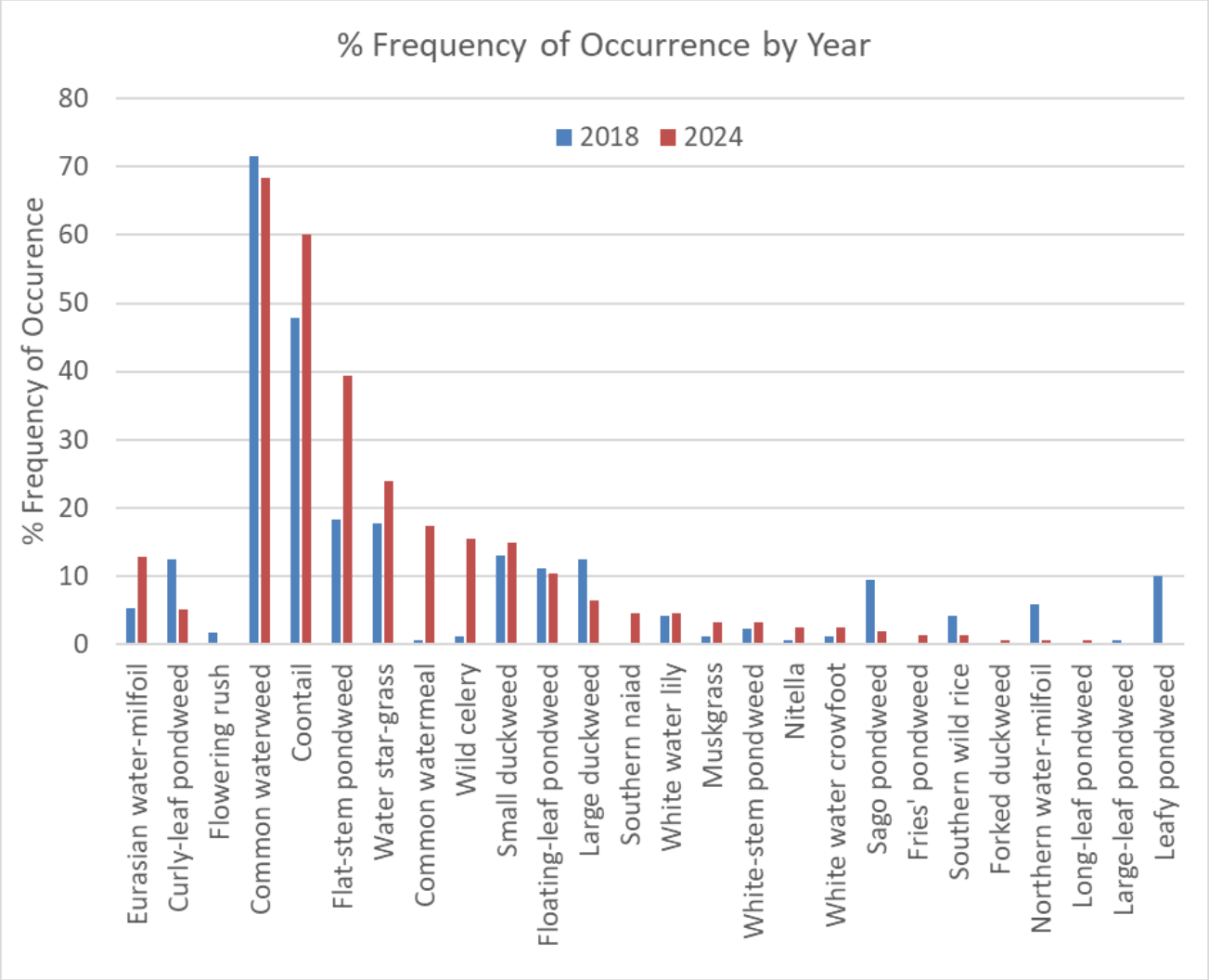
The entire aquatic plant community was surveyed on September 9, 2024 by WLPR and repeated sampling at the same 249 locations from past surveys. Curly-leaf pondweed is an AIS present in White River Flowage that dies back in mid-summer and is often under-represented by point-intercept surveys in July or later when whole-lake surveys take place. It is likely that surveys on White River Flowage may not accurately capture the abundance of CLP in the lake. However, CLP has not been noted to be found at nuisance levels during field visits by staff from WDNR, WLPR, or by members of the WRFLMD.

In 2024 vegetation was identified to a maximum depth of 16 feet (photic zone). The photic zone was again primarily vegetated with aquatic vegetation detected at 93.55 percent (%) of it. The Simpson Diversity Index (SDI) value of the community was 0.87 with an average of 3.03 native species identified at points with vegetation. Table 1 below summarizes the overall aquatic plant community statistics along with historical results. Figure 1 displays the rake fullness by sample site.

Table 1: Aquatic Plant Community Statistics. White River Flowage, Waushara County, WI.

	2018	2024
Number of sites sampled	181	156
Number of sites with vegetation	154	145
Number of sites shallower than maximum depth of plants	169	155
Frequency of occurrence at sites shallower than maximum depth of plants (%)	91.12	93.55
Simpson Diversity Index	0.86	0.87
Maximum Depth of Plants (Feet)	11	16
Taxonomic Richness (Number Taxa - includes visuals)	22	23
Average Number of Species per Site (less than max depth of plant growth)	2.53	3.01
Average Number of Species per Site (sites with vegetation)	2.78	3.22
Average Number of Native Species per Site (less than max depth of plant growth)	2.36	2.83
Average Number of Native Species per Site (sites with vegetation)	2.58	3.03
Average Rake Fullness	1.74	1.36
Floristic Quality Index	25.01	27.28
Average Coefficient of Conservatism	5.74	5.95

Table 2 in Appendix B includes the abundance statistics for each species from each survey. The following chart displays frequency of occurrence for the species sampled over time.



The most abundant aquatic plant identified during the 2024 aquatic plant survey was again common waterweed (*Elodea canadensis*). It exhibited a 68.4% frequency of occurrence (percent of photic zone intercept points at which the taxa were detected). Common waterweed had been found at a high frequency for the past survey as well and often is one of most abundant species in Wisconsin lakes. In some instances, it can grow to nuisance levels – including on the Flowage.

The second most abundant was coontail (*Ceratophyllum demersum*). Coontail was sampled at 60% of photic zone points. Coontail is also a very common species throughout Wisconsin and has been one of the most common species found in past surveys of White River Flowage. Coontail does not root and can drift from one area of the lake to another. It is also an important species for fisheries habitat under ice cover as it remains green most of the winter.

Flat-stem pondweed (*Potamogeton zosteriformis*) was the third most abundant species, occurring at 39.4% of photic zone sample points. Similar to the species above, flat-stem pondweed was also one of the most common species found from the 2018 survey. Populations of flat-stem pondweed provide good habitat for fish and aquatic organisms.

Shallow water and dense vegetation limited navigation within areas of the flowage, especially in the northern section. Southern wild rice (*Zizania aquatica*) is a tall, emergent species that grows in the shallow flats in the northern third of the lake. This species is native and an important food source for many birds, including migratory waterfowl.

Floristic Quality Index

Higher FQI numbers indicate higher floristic quality and biological integrity and a lower level of disturbance impacts. FQI varies around the state of Wisconsin and ranges from 3.0 to 44.6 with the average FQI of 22.2 (WDNR, 2005). Calculation allows for the comparison of waterbodies to one another within the same eco-region of the State. White River Flowage lies within the Northcentral Hardwood Forests eco-region.

Lakes within the Northcentral Hardwood Forests are typically natural lakes that vary from natural conditions to at least moderately developed shorelines. Increased development around the lake and overall use of these lakes leads to more disturbance from an expected natural condition, which leads to lower plant community metrics like FQI and coefficient of conservatism.

Aquatic plant communities are impacted slightly by this level of nearshore development, with both the average Coefficient and FQI for lakes within the region below State averages, showing a more disturbed community. For White River Flowage, the 2024 average coefficient (5.95) is above the upper quartile for the eco-region and right at the median for all Wisconsin lakes. FQI and number of species are both comparable and above the upper quartile for the ecoregion and at or slightly below the upper quartile for Wisconsin. These indicate a plant community associated with below-normal disturbance levels and of high quality. All indicators are in line to slightly above historical averages for White River Flowage. Table 3 displays aquatic community indicators for White River Flowage over time compared to eco-region and all Wisconsin lakes.

Table 3: FQI and Average Coefficient of White River Flowage Compared to Wisconsin and North Central Hardwood Forests.

	Avg. Coefficient of Conservatism			Floristic Quality			Number of Species		
Quartile*	Lower	Mean	Upper	Lower	Mean	Upper	Lower	Mean	Upper
Wisconsin Lakes	5.5	6	6.9	16.9	22.2	27.5	8	13	20
North Central Hardwood Forests	5.2	5.6	5.8	17	20.9	24.4	10	14	19
2024	5.95			27.28			23		
2018	5.74			25.01			22		

* - Values indicate highest value of the lowest quartile, mean, and lowest value of the upper quartile

Floristic quality index for White River Flowage has historically been high for the eco-region, falling within the upper quartile. The FQI calculated from the 2024 survey data was 27.28, slightly increased from the 2018 survey result of 25.01. These values are above the upper quartile values for the eco-region and indicates a stable, healthy native plant community. Table 4 displays the expanded breakdown of FQI by species.

Table 4: Historical Floristic Quality Index, White River Flowage, Waushara Co., WI

	Coefficient of Conservatism	
Common Name	**2018**	**2024**
Coontail	3	3
Muskgrass	7	7
Common waterweed	3	3
Water star-grass	6	6
Small duckweed	4	4
Forked duckweed	---	6
Northern water-milfoil	6	6
Southern naiad	---	8
Nitella	7	7
White water lily	6	6
Large-leaf pondweed	7	---
Fries' pondweed	---	8
Leafy pondweed	6	---
Floating-leaf pondweed	5	5
Long-leaf pondweed	---	7
White-stem pondweed	8	8
Flat-stem pondweed	6	6
White water crowfoot	8	8
Large duckweed	5	5
Sago pondweed	3	3
Wild celery	6	6
Common watermeal	5	5
Southern wild rice	8	8
Total Species	19	21
Mean C	5.74	5.95
Floristic Quality Index (FQI)	**25.01**	**27.28**

Native Aquatic Plant Species

To assess changes between 2024 and 2018 surveys, statistical analysis was completed using a Chi-square test with a 5% Type-I error rate. This error rate is standard in ecological studies and equals that there is a 5% chance of claiming statistically significant change when no real change occurred. Only those species that display a p-value of 0.05 or lower changed significantly population-wise between years. To calculate these values, the total number of sample locations each species was found at is compared between years. Table 5 displays statistical changes, if any, for each species sampled in 2024 versus 2018.

Table 5: Statistical Significance of Species between Sampling Events, White River Flowage, Waushara Co., WI.

Species	2024 v. 2018	
	Significance	+ / -
Eurasian water-milfoil	*	+
Curly-leaf pondweed	*	-
Flowering rush	n.s.	-
Coontail	*	+
Muskgrass	n.s.	+
Common waterweed	n.s.	-
Water star-grass	n.s.	+
Small duckweed	n.s.	+
Forked duckweed	n.s.	+
Northern water-milfoil	**	-
Southern naiad	**	+
Nitella	n.s.	+
White water lily	n.s.	+
Large-leaf pondweed	n.s.	-
Fries' pondweed	n.s.	+
Leafy pondweed	***	-
Floating-leaf pondweed	n.s.	-
Long-leaf pondweed	n.s.	+
White-stem pondweed	n.s.	+
Flat-stem pondweed	***	+
White water crowfoot	n.s.	+
Large duckweed	n.s.	-
Sago pondweed	**	-
Wild celery	***	+
Common watermeal	***	+
Southern wild rice	n.s.	-

* - somewhat significant change, ** - moderatly significant change, *** - very significant change

n.s. - Change not significant, n.c - no change

--- - Species was not sampled in both comparison years

The 2024 survey was completed following past procedures to further assess the aquatic plant community and plan for future management. In comparing 2024 to historic data, three native and one invasive species saw a statistically significant decline from 2018 to 2024; curly-leaf pondweed (AIS), northern water-milfoil, leafy pondweed, and sago pondweed. Conversely, five native and one invasive species saw a significant increase since 2018: Eurasian water-milfoil (AIS), coontail, southern naiad, flat-stem pondweed, wild celery, and common watermeal.

Overall, the native aquatic plant community of White River Flowage was in excellent condition during the 2024 survey. Even with increasing EWM populations, the native community has remained stable and healthy as noted by relatively even FQI, average coefficient of conservancy, species diversity, and SDI. In addition, though some species have reduced abundances, the overall evenness of the spread of the most common native species has remained level. This shows continued diversity and health with an excellent population of native pondweeds present. Pondweed species are vital for the health of a lake and create excellent fisheries habitat.

An aquatic plant community is dynamic and will see changes in species from year to year under natural conditions. There has been 6 years since the last whole-lake survey was completed so a change in individual species is not uncommon.

Aquatic Invasive Species

EWM populations in White River Flowage increased slightly from 2018 to 2024, but decreased in density when found. Current populations are now found mostly in a small, central portion of the lake in a band around just under half of the lake's perimeter. During the 2024 survey, EWM as the eight most common species, sampled at 12.9% of littoral zone points. Overall density was moderate to low and decreased from past surveys with an average rake density of 1.0 (Figure 2).

Curly-leaf pondweed has continued to remain background levels and a very low frequency if found. Scattered stems of CLP were identified during the 2024 survey (Figure 4). Though an AIS and often aggressive in other lakes, CLP is being held in check by the robust native plant community of White River Flowage and has simply become part of it. It has remained at low rake-density when sampled and no mono-typic beds have been found yet. CLP reproduces by seed-like structures called turions, which can accumulate in the sediment and cause significant growth of plants. High amounts of turions may require multiple years of management to reduce turion seed banks.

During the 2024 point-intercept survey locations of EWM outside the survey grid and between direct sample points were also recorded. This survey identified EWM growing at various densities and distribution in the survey locations. The following densities were used to describe the EWM populations:

1. **Spots** – small locations of individual plants or clumps that were not large enough to map around their perimeter.
2. **Scattered** – locations of EWM that had plants close enough to map as an area, but were still widely scattered. EWM is merely present and not a large component of the biomass.
3. **Low** – EWM identified in distinct beds. While individual plants or clumps may reach the surface, most are lower growing or not as dense, often mixed with other vegetation.
4. **Moderate** – EWM occupies over half the water column with many plants or clumps at or just below the surface. Few other plant species were found.
5. **High** – locations of EWM that were at or near the surface and occupied much of the water column. EWM may be the only plant found growing in these locations.

Within the densest areas EWM was commonly found growing at scattered to low densities in depths of 4-8 ft, especially in the central portion of the lake. EWM mapped during the 2024 PI survey totaled 5.79 acres (Figure 3), which is 4.6% coverage of the entire lake. Current spread of EWM in the lake has is still largely scattered and low density. Care must be taken in choosing a management approach that will be successful while also limiting non-target impacts.

2024 MANAGEMENT RECOMMENDATIONS

Management of aquatic plants can take many facets, depending on each lake's unique condition and desire by the community. To be successful, a management option must be accepted by its users. Current DNR recommendations for control of AIS use an integrated pest management approach (IPM). Use of IPM includes changing methods of control, including, but not limited to: varying herbicide active ingredients, mechanical harvesting, hand or suction harvesting, and no-action.

Past management has focused on annual mechanical harvesting for nuisance relief of a mix of species (native and AIS) and targeted herbicide applications for EWM and/or CLP when populations become dense enough to warrant control. Herbicides for aquatic plant management can have negative connotations and can be misunderstood by some users, making it potentially controversial. However, periodic large-scale whole lake type treatments for AIS have shown to reduce the need and frequency of management in following years.

It is important that appropriate management actions continue as needed on a targeted basis to ensure that nuisance invasive aquatic plant growth does not reach unmanageable levels. Though three AIS are currently present within the White River Flowage, the native plant community is in excellent condition with great diversity. Care must be taken in planning to maintain the native community for the health of the lake while controlling and reducing the spread of AIS.

AIS have the biggest impact to a lake's ecosystem and should be the main target for active management. In the White River Flowage EWM is currently the AIS of biggest concern. Populations of CLP and flowering rush are currently at very low levels, not requiring active management. Though the population of EWM within the lake has increased in frequency from past surveys, it was found at scattered to low densities. Complete removal of EWM from the system is unlikely and current populations, though moderate in abundance, are low in density.

The specific strain of EWM present is likely tolerant to common active ingredients used in whole-lake treatments, such as 2,4-D. If a whole-lake dosed approach is used another active ingredient, such as fluridone, should be used. The native plant community in the lake is tremendous and the lake's greatest asset. Future control actions should minimize non-target impact to native species. Going into 2025, there are twp potential management options for the EWM within the lake.

1. **No active management:** Currently, EWM was found at 12.9% of vegetated sample points and 5.79 acres (Figures 2 & 3). Historical surveys show EWM is increasing in frequency, but is at low density. It is expected that EWM will continue to increase in density during a year of no management, especially in locations currently mapped as low or scattered density. Potentially delaying control, however, may benefit the District. It will allow for increased funds and planning. However, future control will be more costly due to increased EWM and product application pricing.

2. **Spot-management of densest areas of EWM control:** A majority of EWM growth was found in an east to west band in the central portion of the flowage. Control of the densest areas may allow for relief of nuisance for lake users. Targeted management with Diver Assisted Suction Harvesting (DASH) or chemical applications with fast-acting ingredients, such as florpyrauxifen-benzyl (ProcellaCOR EC) are potential options, depending on budget. At the current size and depth of infestation, DASH may be prohibitively expensive and time

consuming. Spot-management may not significantly reduce the overall EWM population and may only act as a stop-gap to potential whole-lake control.

Current EWM infestation covers 5.79 acres, or 4.6% of the lake. Roughly 1/3 of the EWM population is noted as scattered density while a couple portions of the central band are low density, occupying 2.25 acres. These denser band are recommended for control in 2024 with a fast-acting, selective chemical application and highly targeted approach using ProcellaCOR EC to reduce impacts to non-target species (Figure 3). Any control should be coupled with continued monitoring and planning for 2026. For 2025 management, we recommend the following course of action:

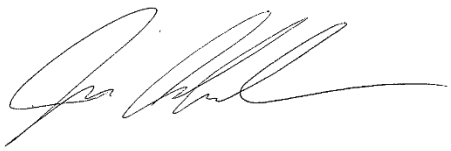
- **February 2025**: Apply for WDNR permit for up to 2.25 acres for control of EWM (Figure 3).
- **May/June 2025**: Herbicide application for EWM control using ProcellaCOR EC. Rates are to be determined based on further discussion with the product manufacturer.
- **Summer/Fall, 2025**: Complete an assessment of 2025 EWM control actions for 2026 planning
    - Targeted AIS meander survey
    - Update management report and recommendations to the WRFLMD. Future planning may involve any of the following actions:
        - Varying scale of AIS control in 2025
        - Continued monitoring
        - No action

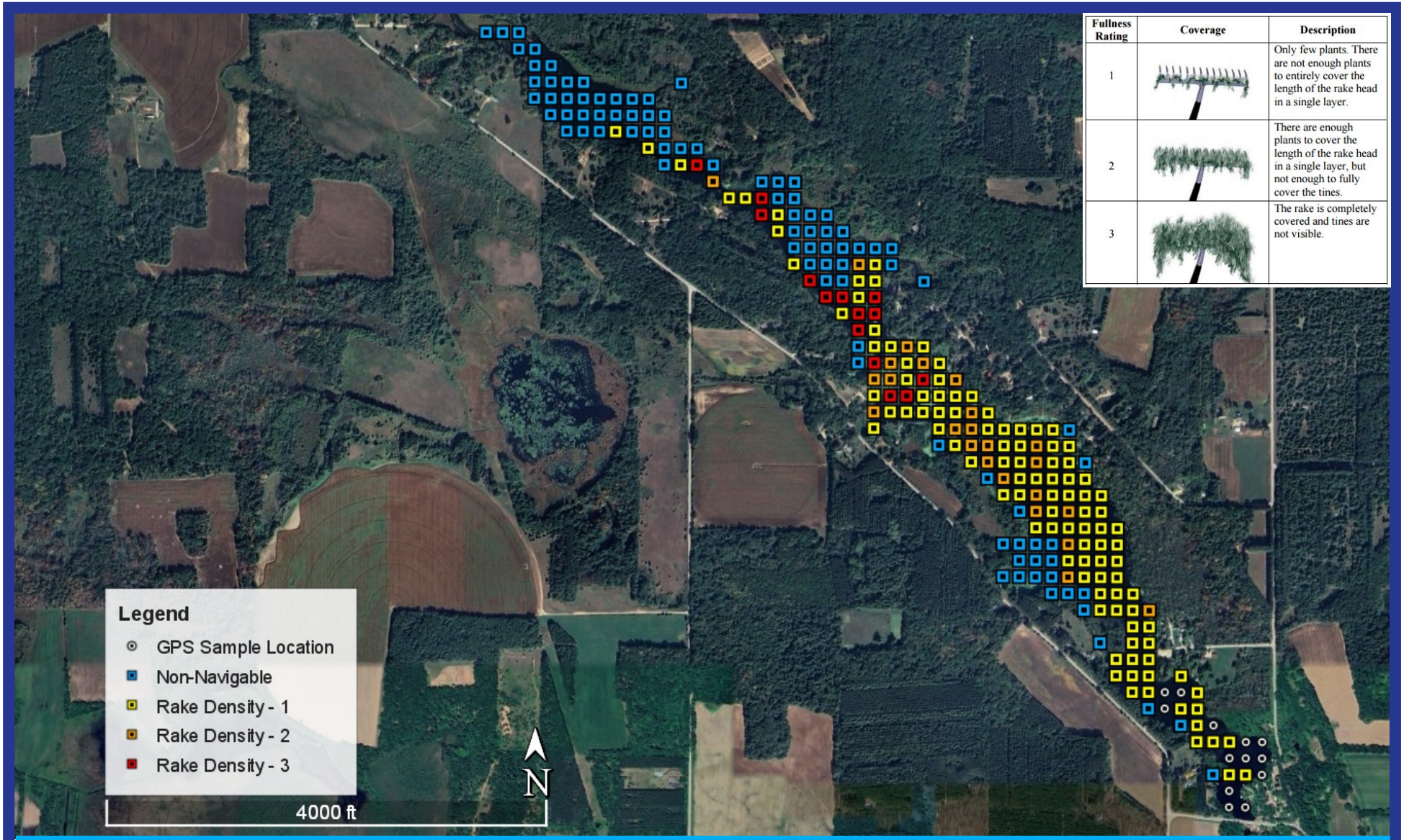
Because of the District's proactive approach in dealing with AIS they are in a good spot to successfully manage nuisance conditions. However, the White River Flowage Lake Management District should continue to be involved in some type of aquatic plant management program to help monitor and manage nuisance aquatic plant growth of AIS, if present, posing recreational impediments to riparian property owners and lake users. AIS are extremely opportunistic plants and can grow to nuisance levels in a very short period of time. Continued monitoring and possible management actions must occur to ensure that the health, aesthetic, and recreational value of the lake is not degraded.

If you have any questions, require any additional information, or would like a formal proposal on any of the above management options please contact us directly as follows:

Jim Scharl: (920) 872-2032 or jim@wisconsinlpr.com

Respectfully,





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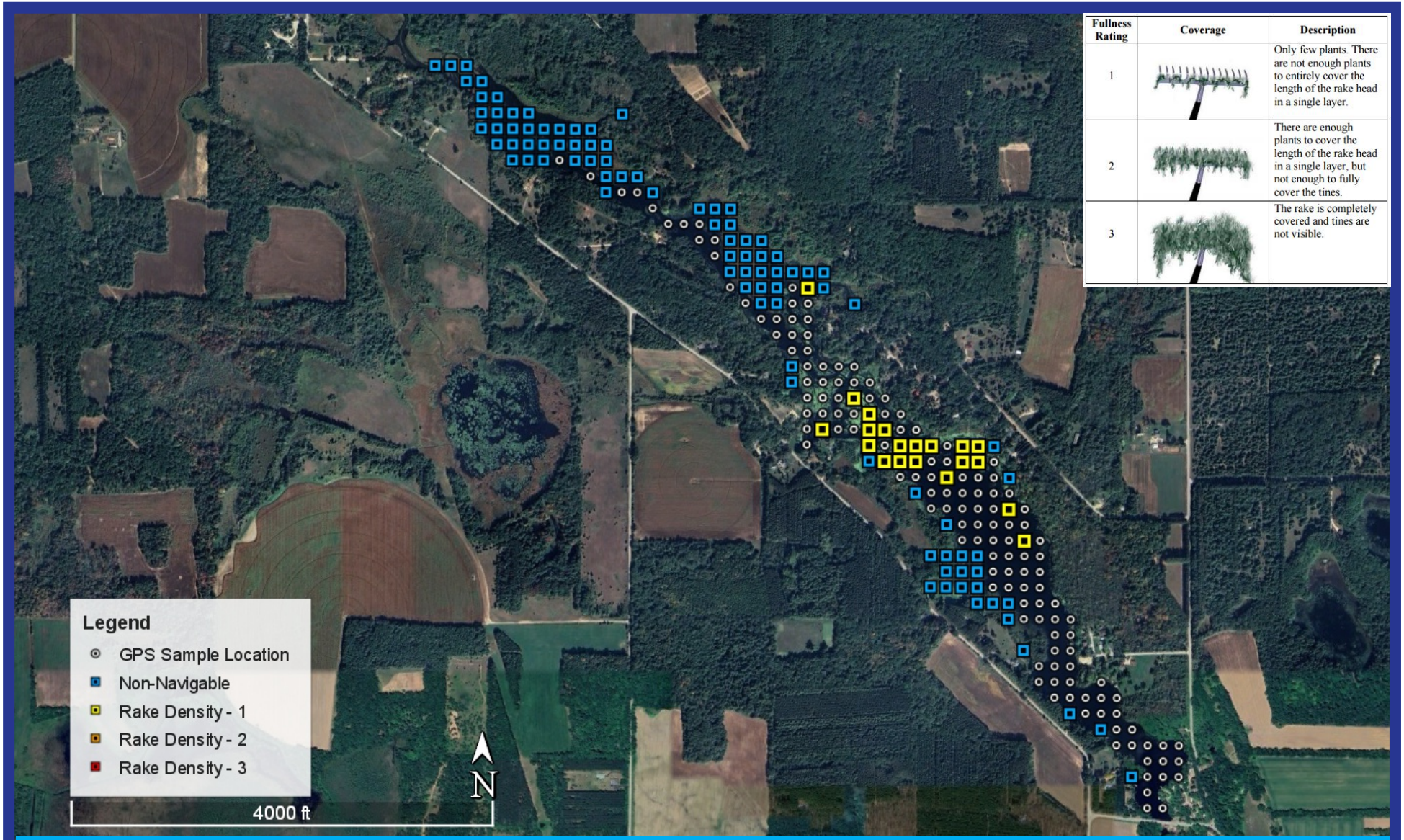
2024 Total Rake Fullness

Figure 1
White River Flowage, Waushara Co.
Surveyed: September 9, 2024



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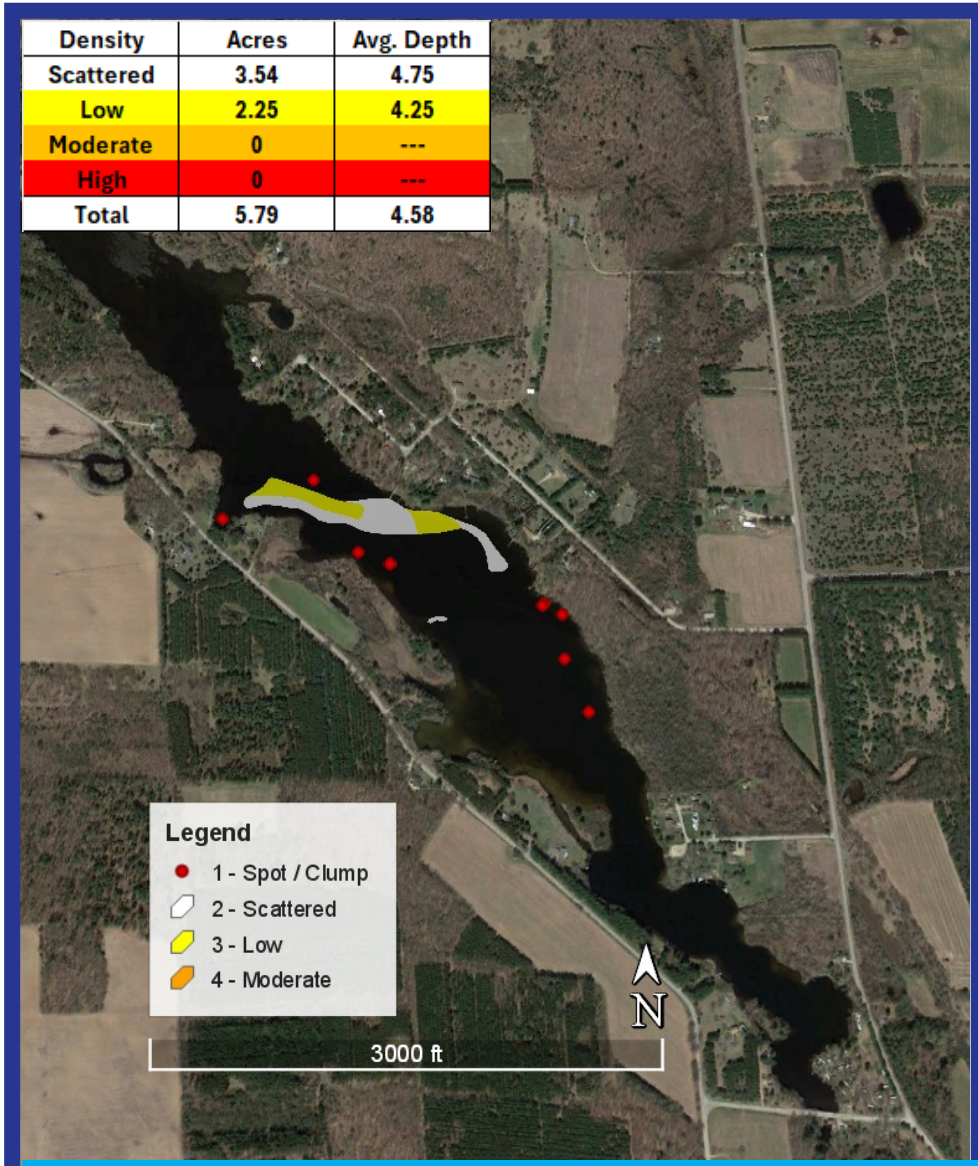
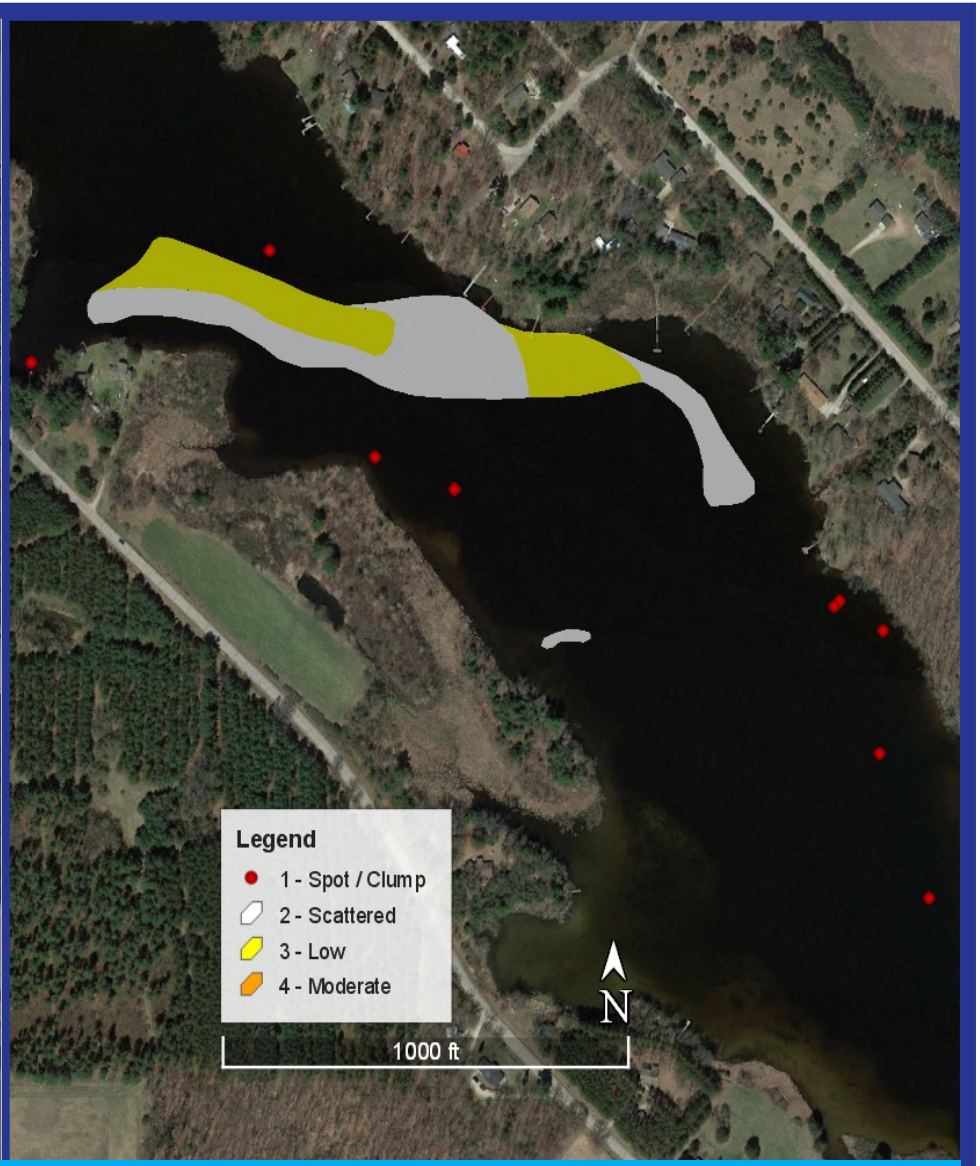
Eurasian Water-milfoil Locations

Figure 2
White River Flowage, Waushara Co.
Surveyed: September 9, 2024

Density	Acres	Avg. Depth
Scattered	3.54	4.75
Low	2.25	4.25
Moderate	0	---
High	0	---
Total	5.79	4.58





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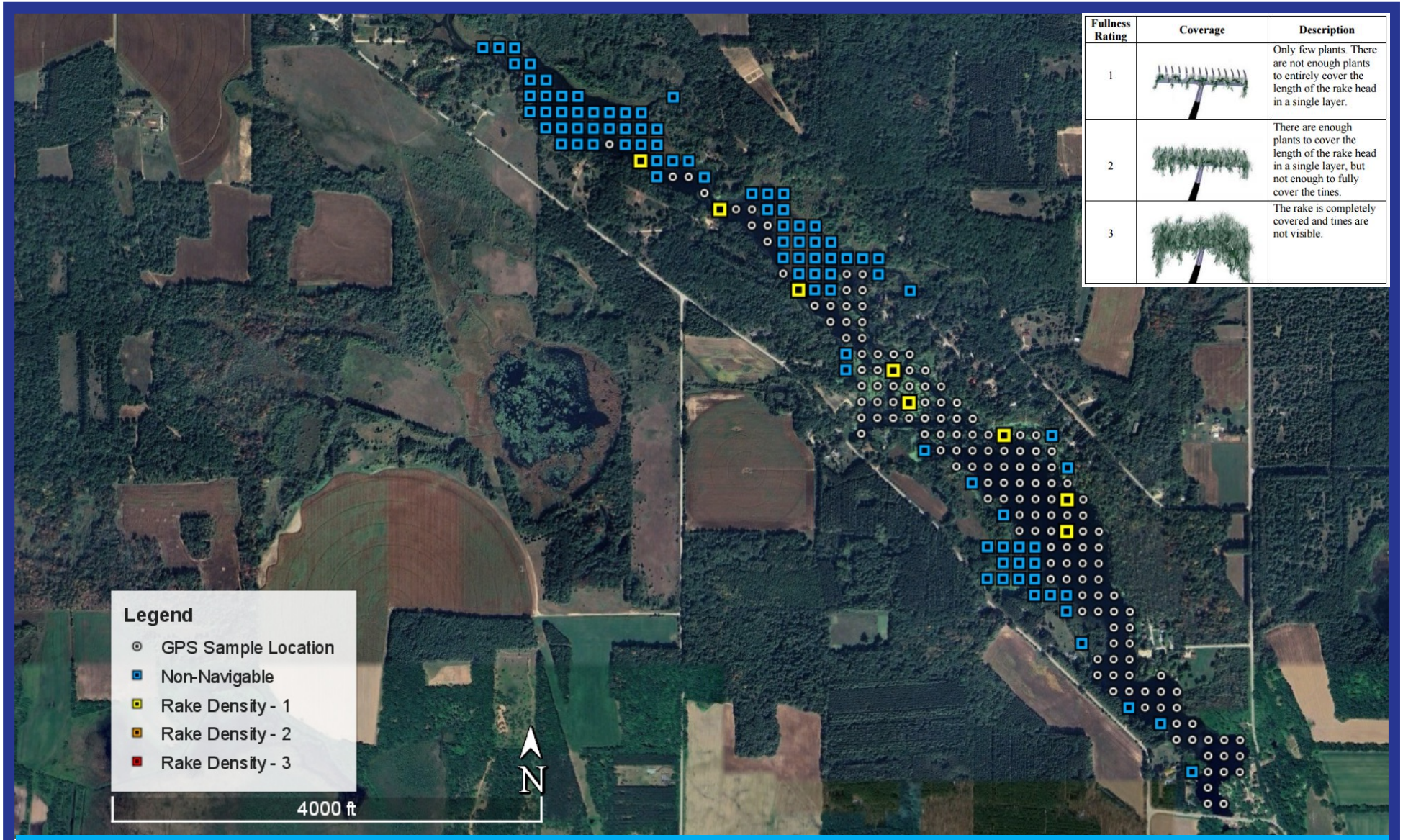
2024 Eurasian Water-Milfoil Density

Figure 3
White River Flowage, Waushara Co.
Surveyed: September 9, 2024



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Curly-leaf Pondweed Locations

Figure 4
White River Flowage, Waushara Co.
Surveyed: September 9, 2024