

2022/26 Management Activities and Lake Update

Indian Lake, Cass County, MI

Barr Engineering Company

September 23, 2026

Indian Like Issues and Concerns

1. **Nutrient and pollutant sources to Indian Lake**
2. **Potential for severe or harmful algae blooms**
3. **Aquatic vegetation extent and abundance in Indian Lake**
4. Extent of muck in the lake
5. Introduction and management of invasive species
6. Fishery management in the lake
7. **Lake outlet and associated potential flooding of adjacent, downstream properties**

Objectives to Address in First Five Years (2022-2027)





- **Reduce EWM and CLP frequencies of occurrence**
  - Whole lake fluridone treatment followed by spot treatments
- **Maintain aquatic vegetation to support recreational use**
  - Maintain channels and dock access (harvesting)
  - Clean up floating plant fragments along shorelines (harvesting)
- **Assess and reduce, if necessary, nutrient loading**
  - Evaluate nutrient loading from the Mann Drain
    - Two years of detailed monitoring including flow and watershed delineations
    - Concept and engineering cost estimate in conjunction with EGLE (if necessary)
- **Develop Harmful Algal Bloom Risk and Response Plan**
  - Evaluate monitoring needs
  - Develop response plan

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2022/2023/2024 Management Actions

- **Discontinued aeration**
  - No clear evidence that it was improving water quality
  - Unaffordable to manage aquatic plant community to the required level and continue aeration
- **Implemented whole lake fluoridone treatment for EWM and CLP control (2023)**
- **Purchase equipment and installed level loggers at the Mann Drain and Indian Lake**
  - Monitored flow and water quality at the outlet of the Mann Drain
  - Measured lake level for Indian Lake
- **Began development of a Harmful Algal Bloom strategy**
  - Recommending increased cyanobacteria and toxin monitoring
- **Continued monitoring the aquatic plant community and water quality in Indian Lake**

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Indian Lake Aquatic Plant Management

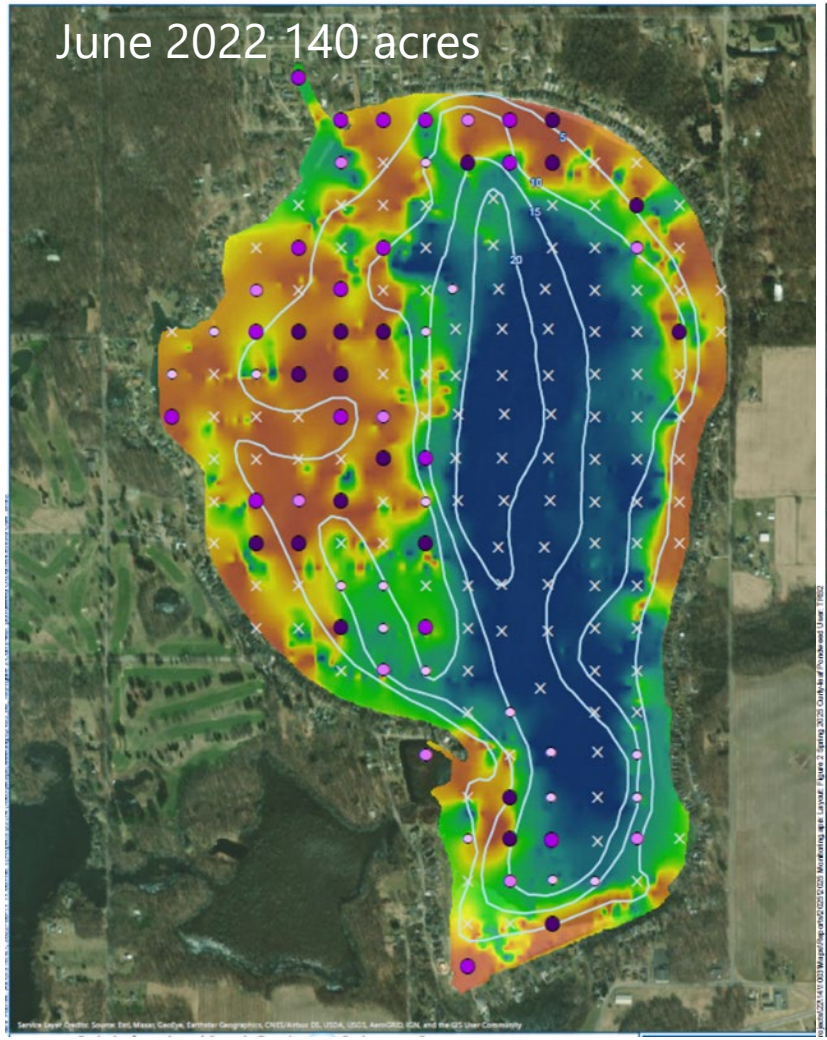
Curly-leaf pondweed

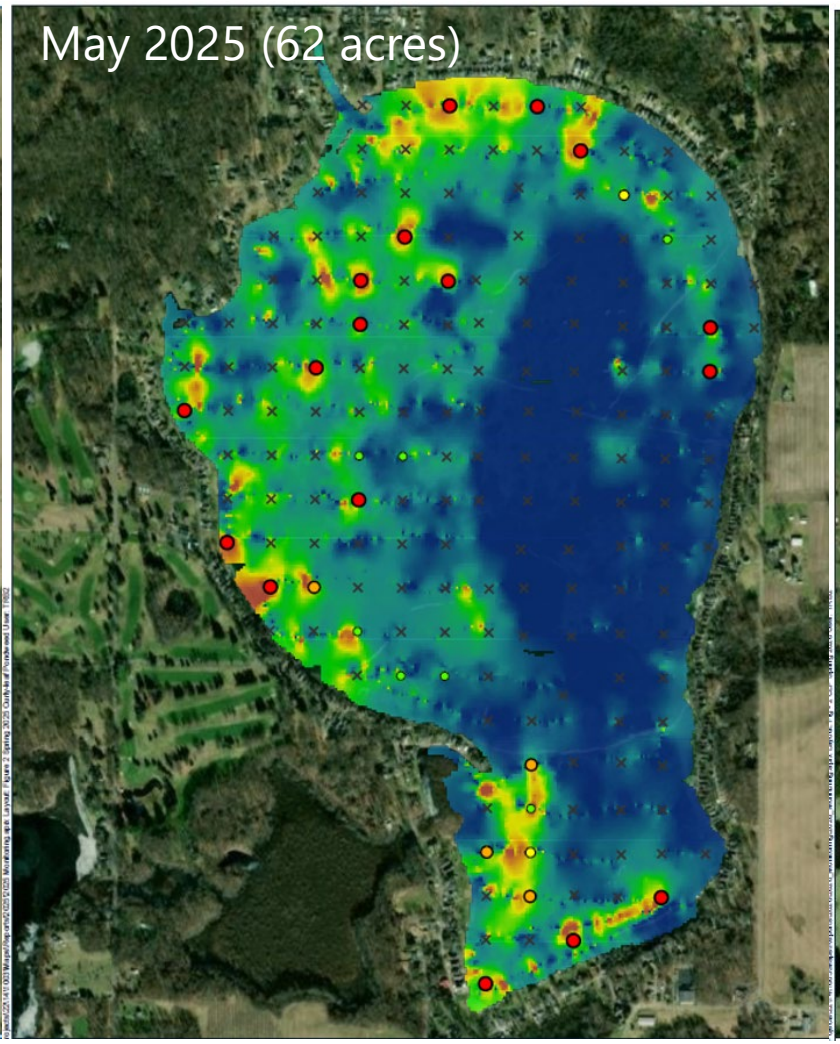


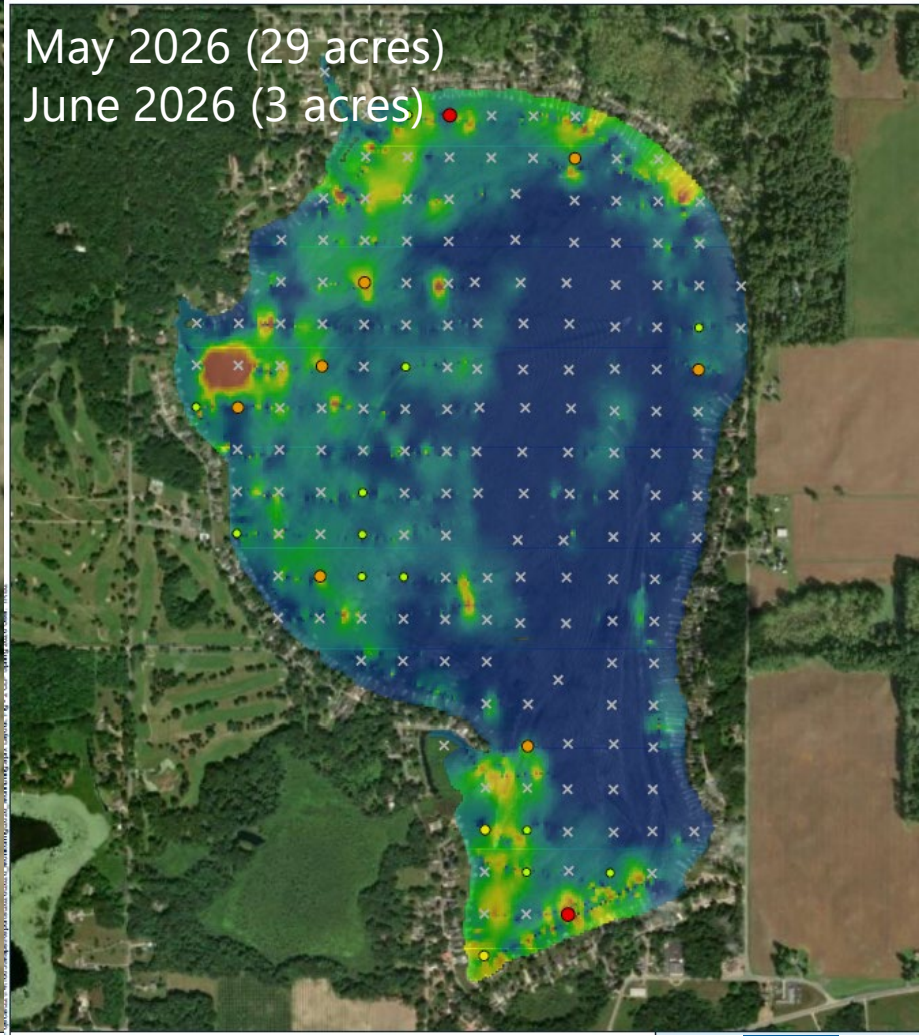
Indian Lake
August 27, 2021

Turion production and sprouting

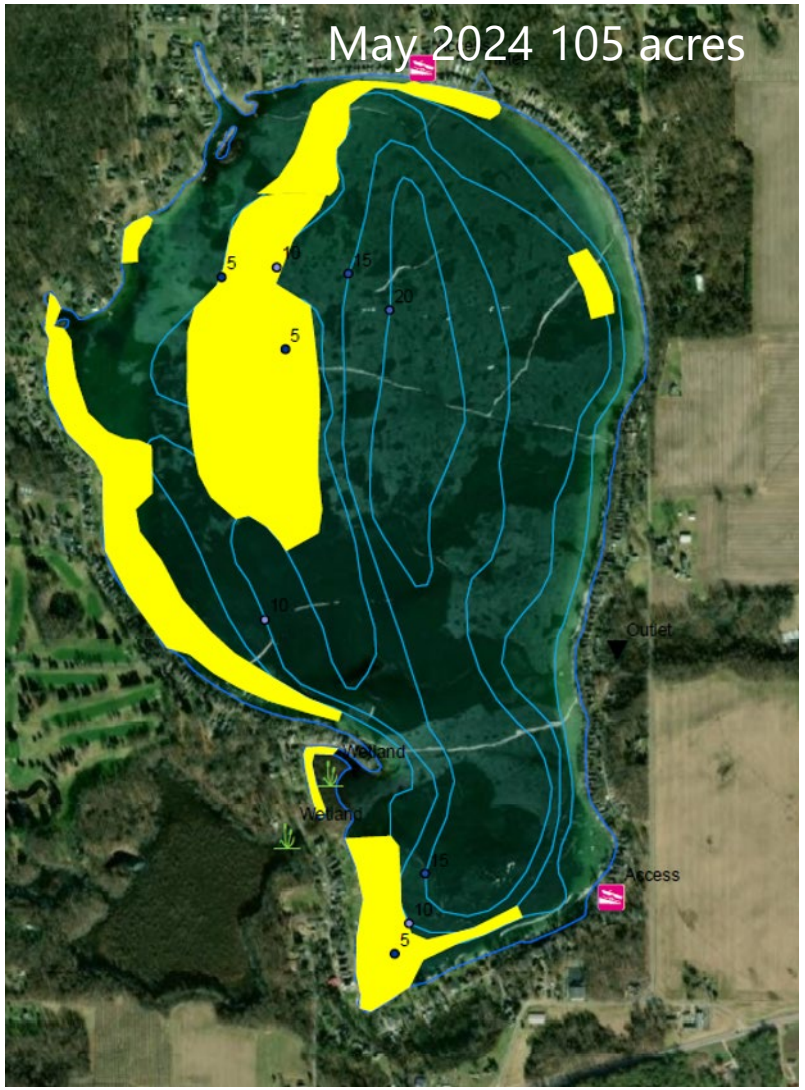
Curly-leaf Pondweed Extent in Indian Lake Spring 2022-2024



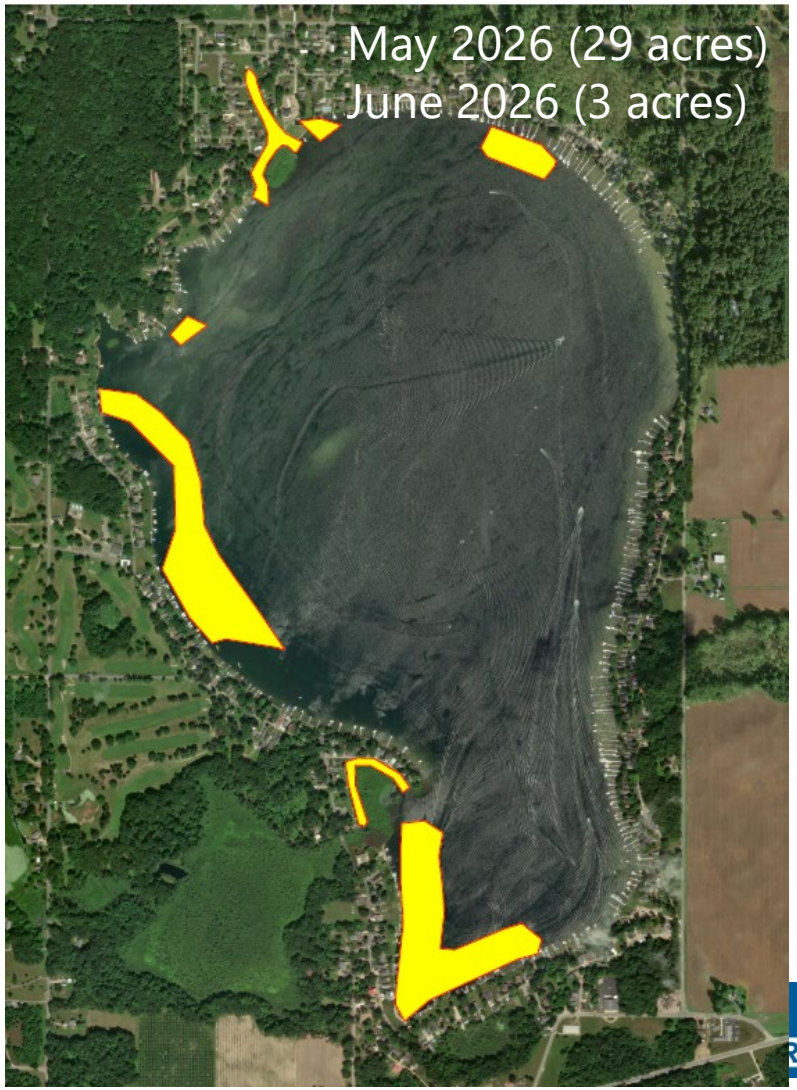




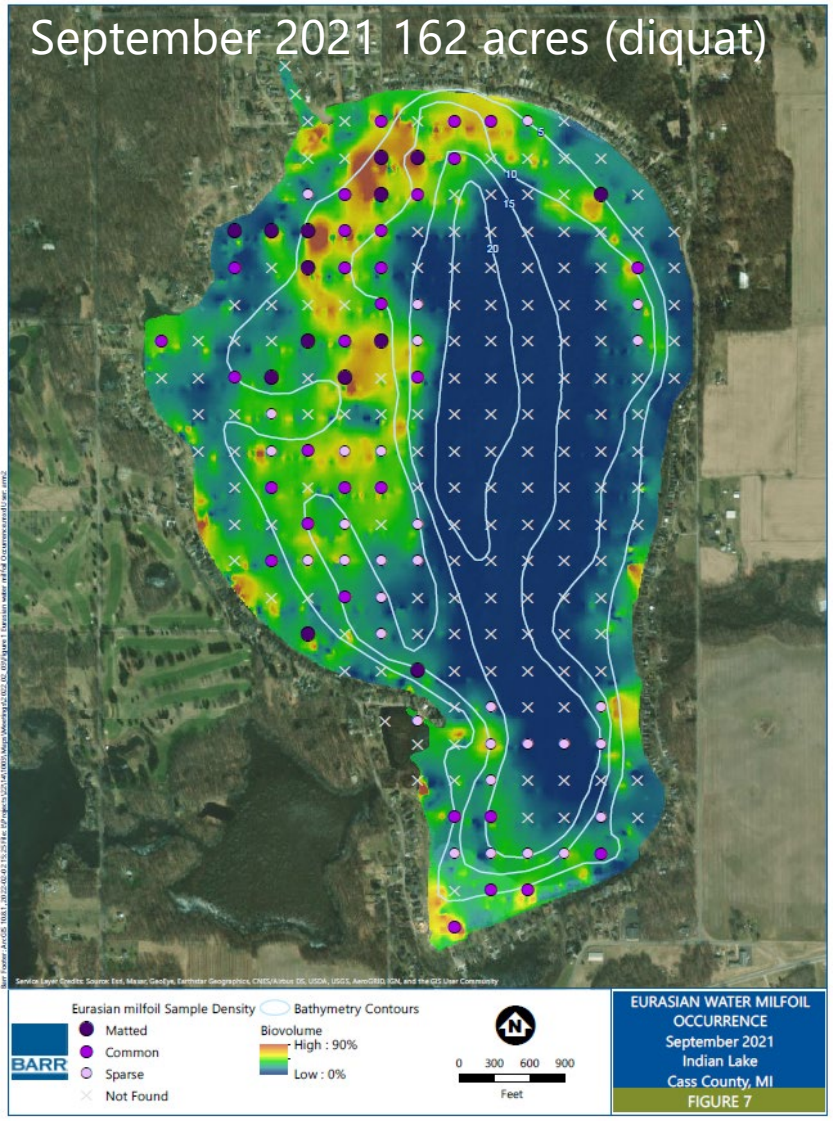
Curly-leaf pondweed treatments

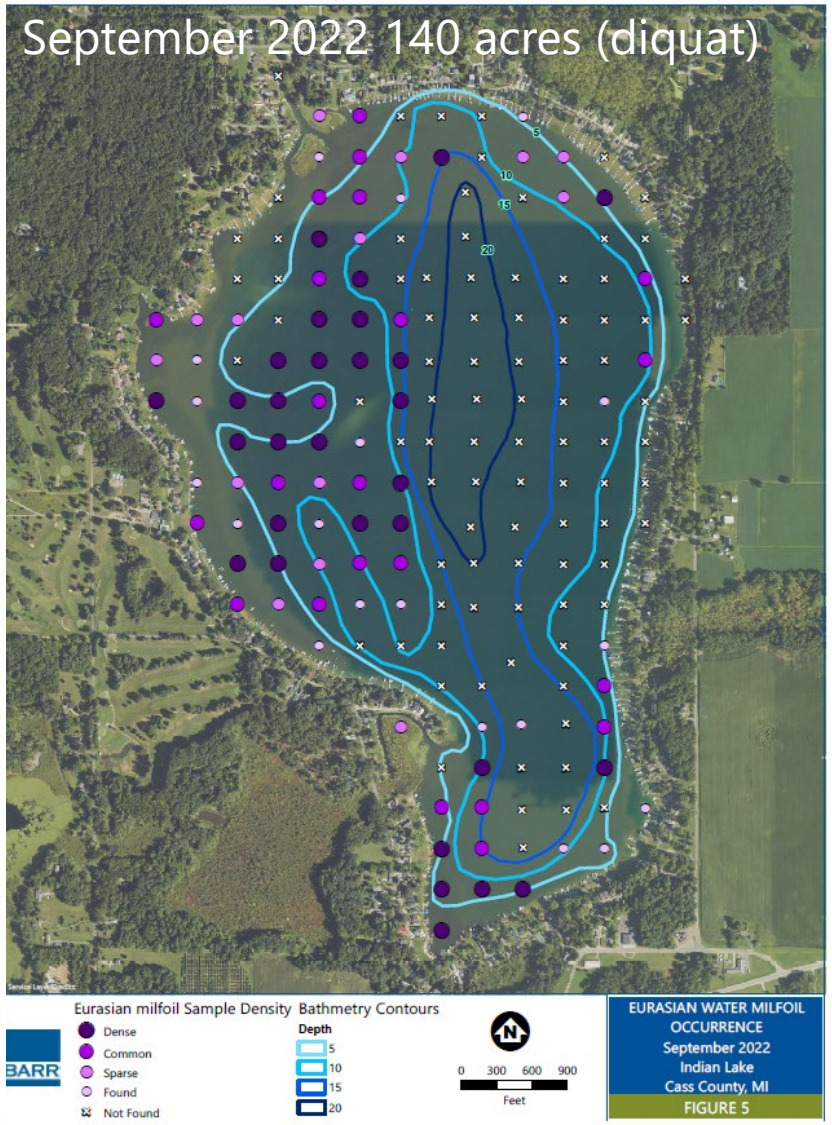


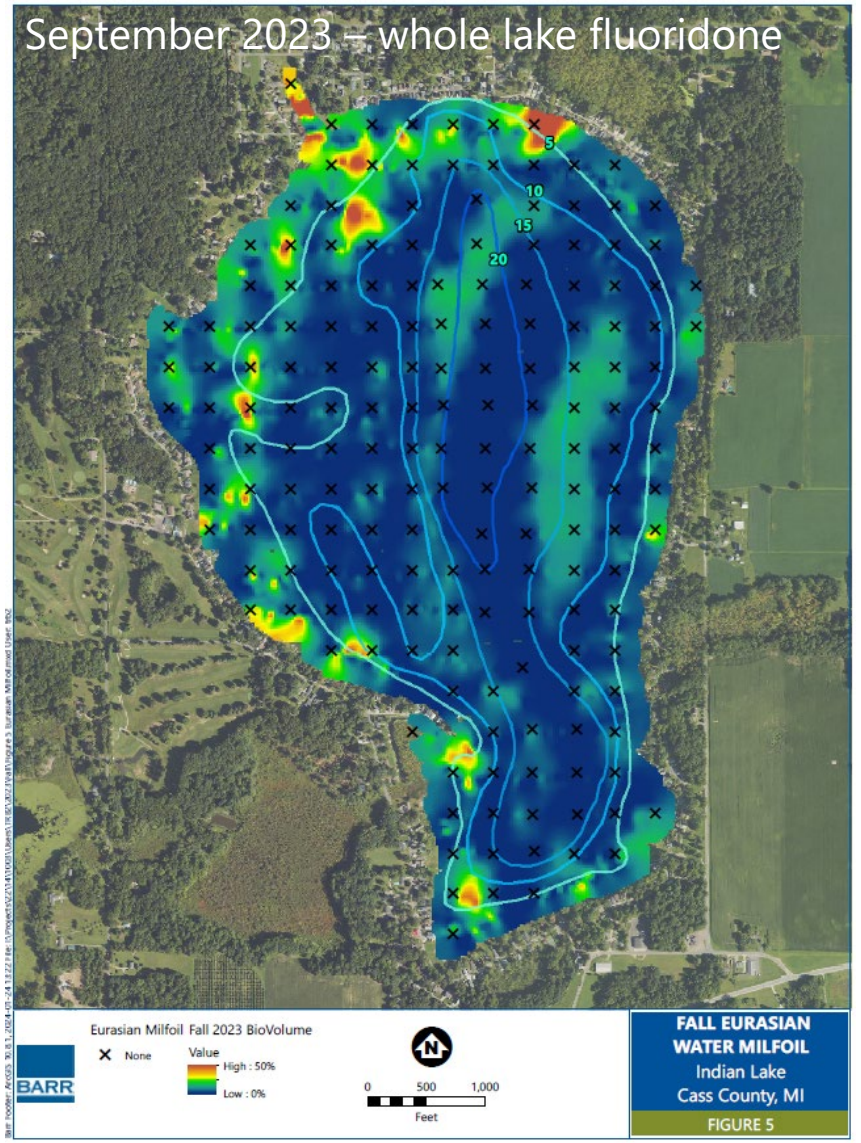




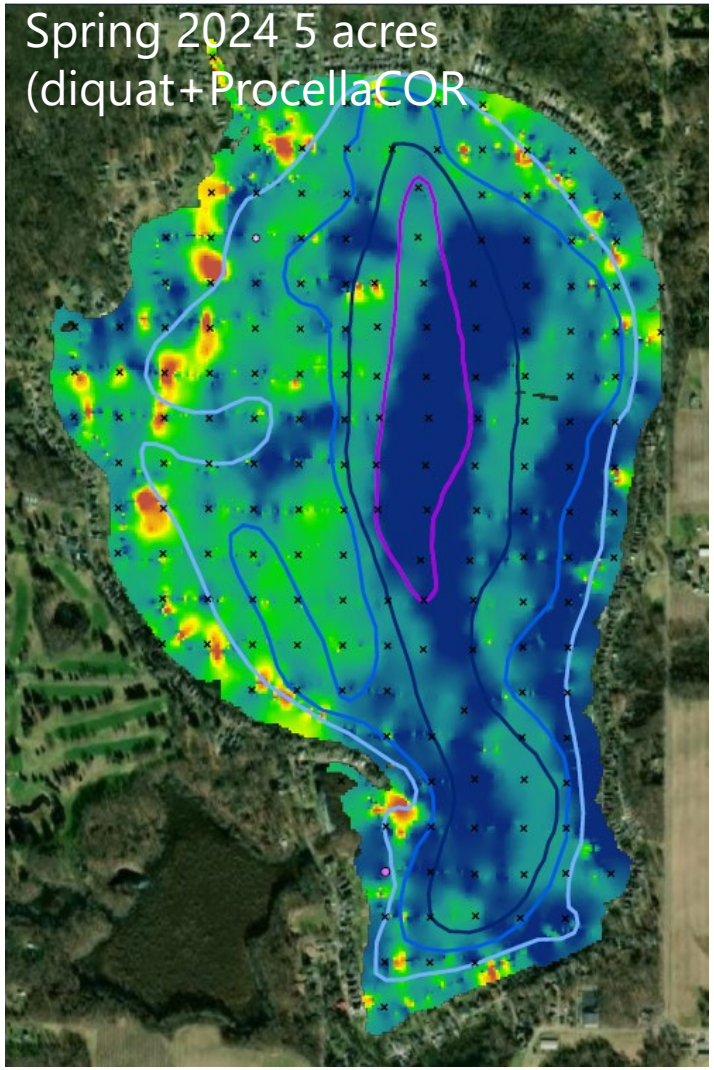
September Eurasian Watermilfoil 2021-2023

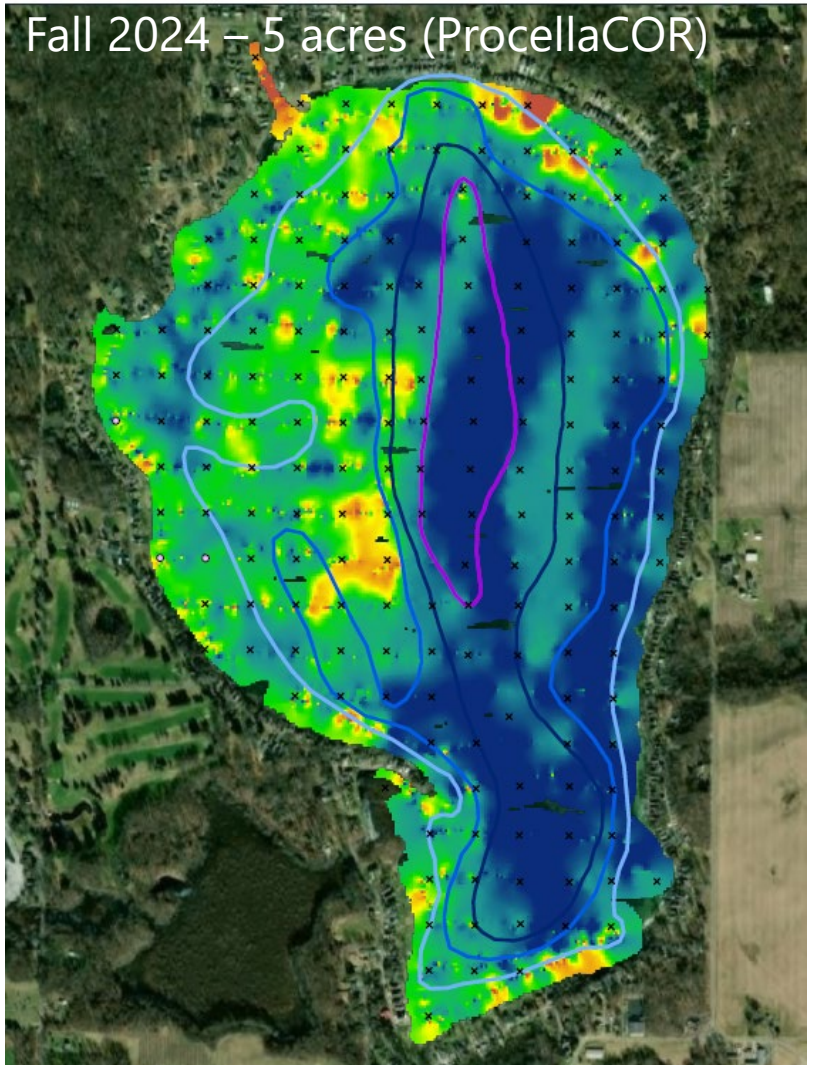


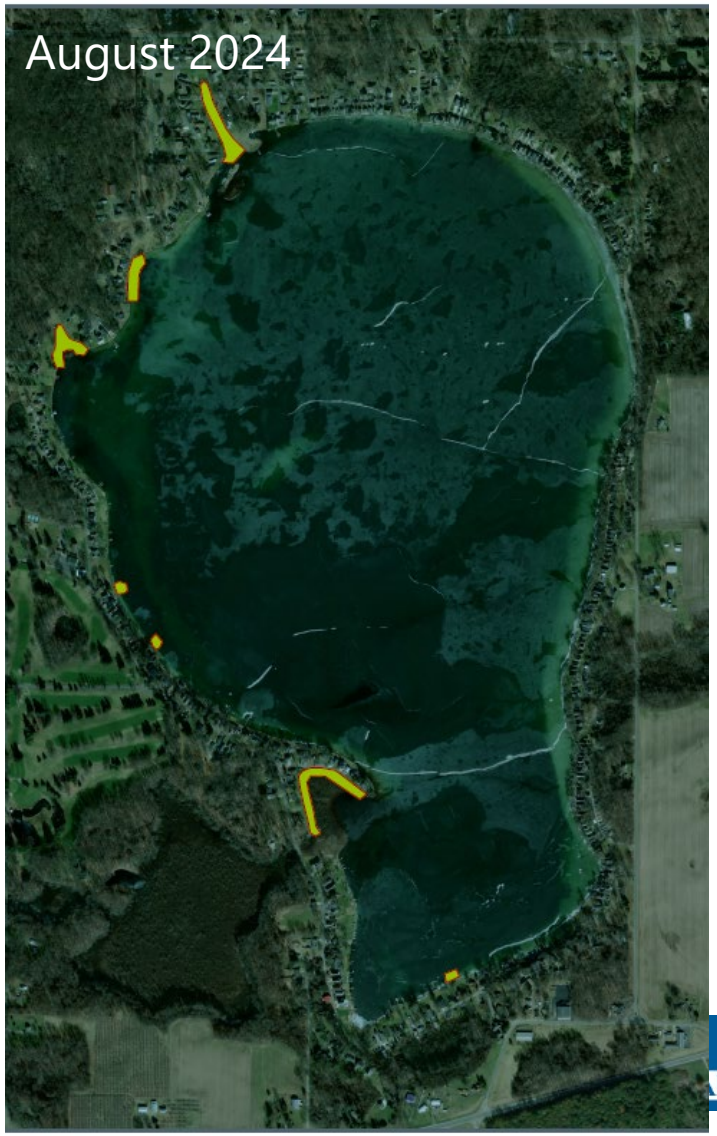




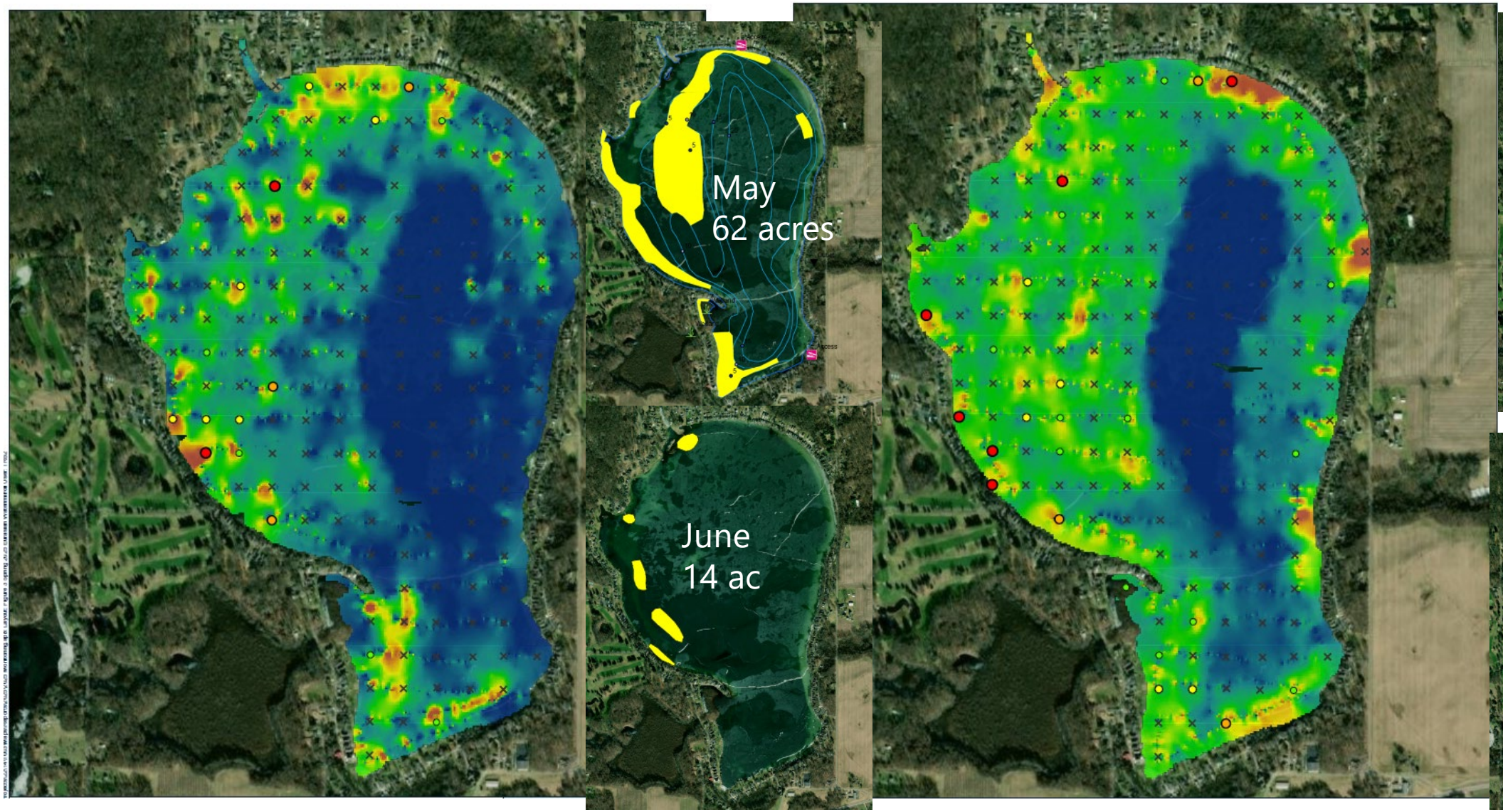
Eurasian Watermilfoil 2024-2025



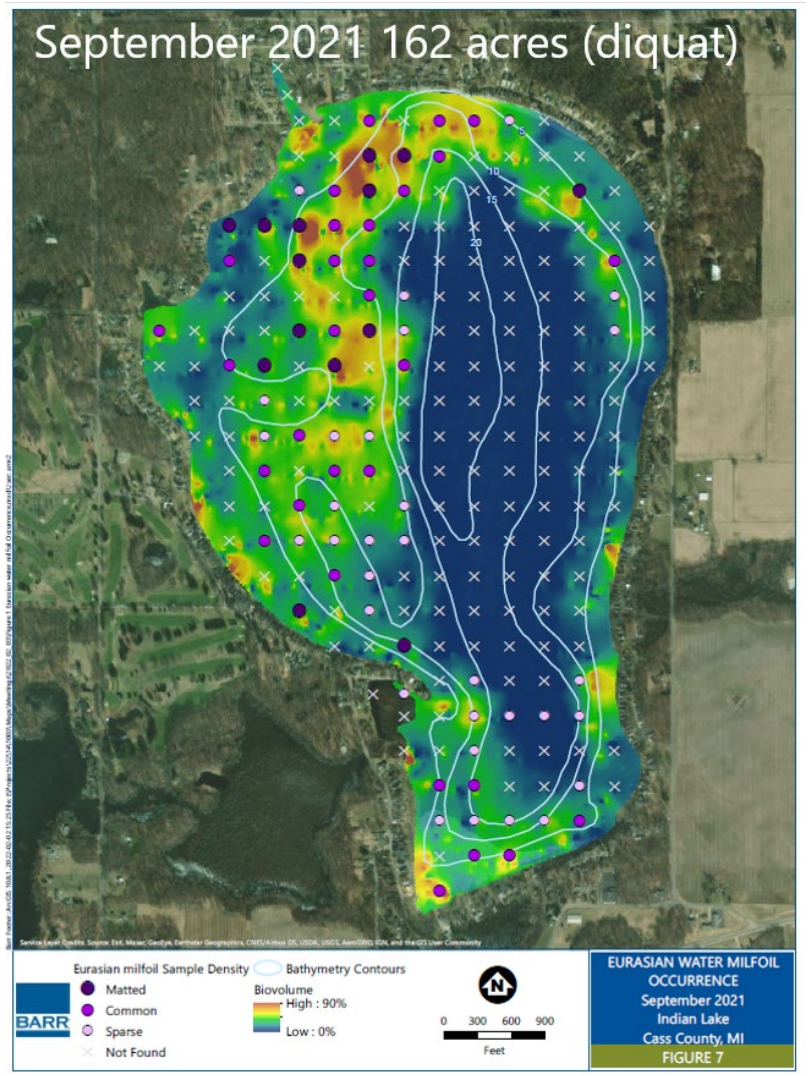


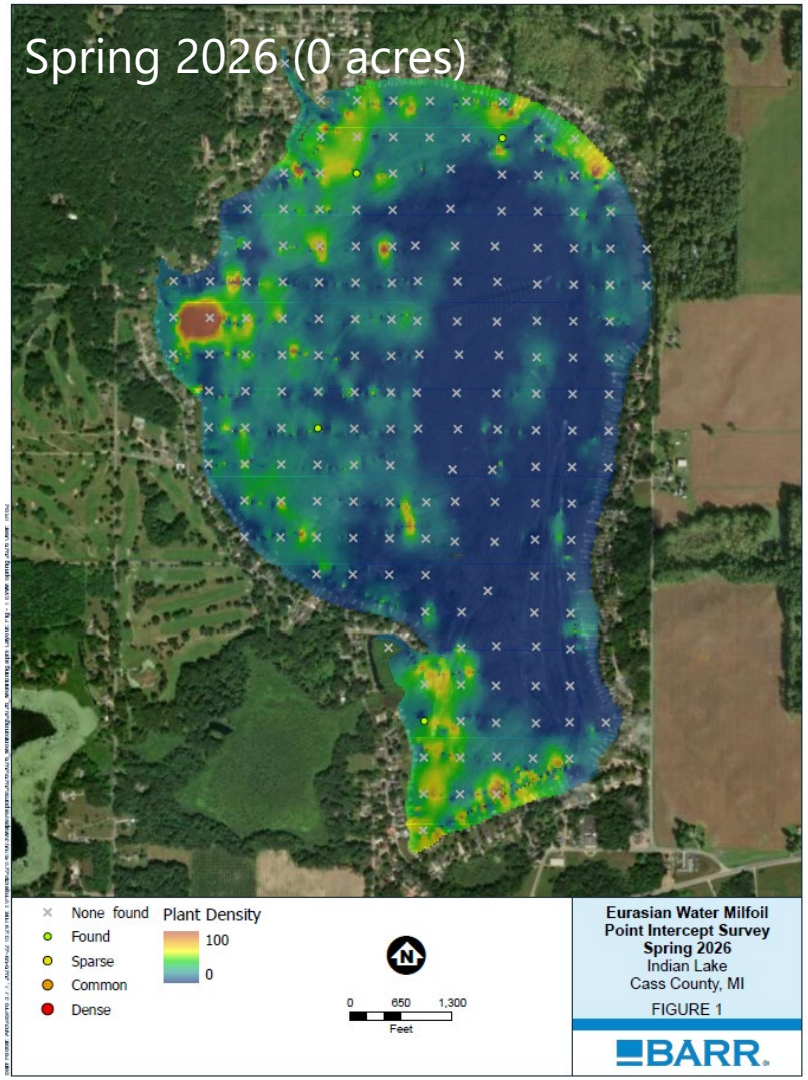


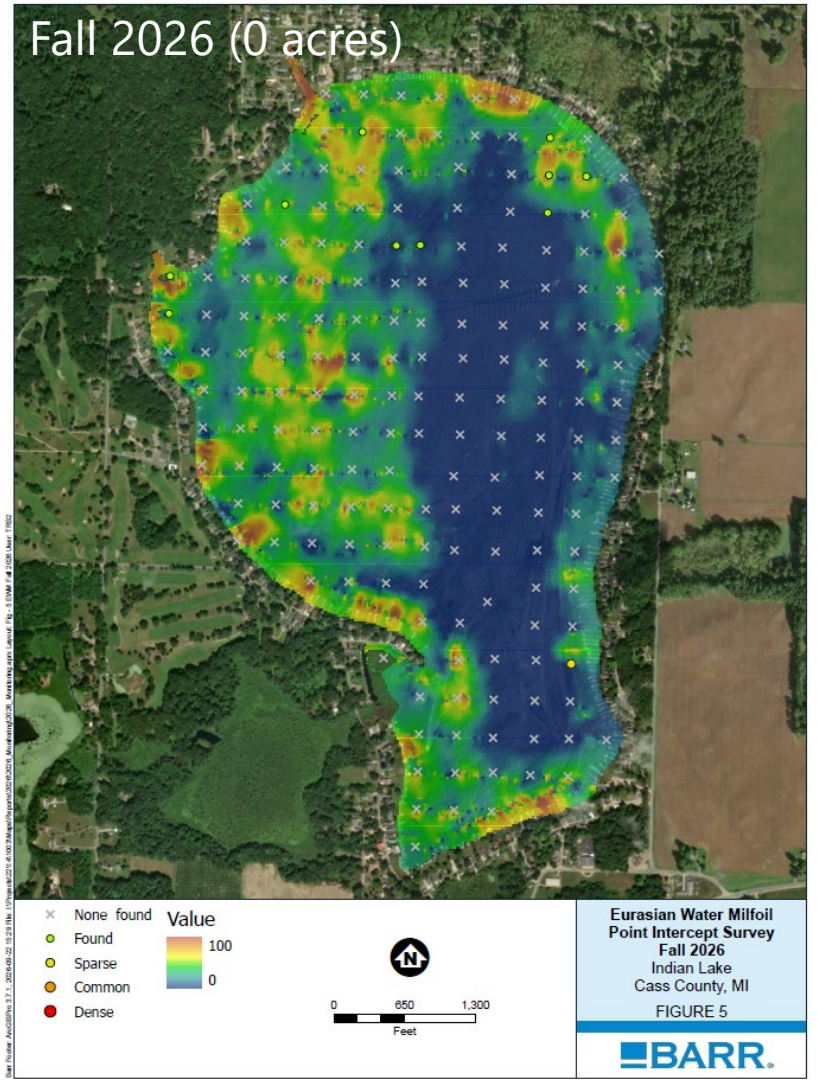
Eurasian Watermilfoil 2025



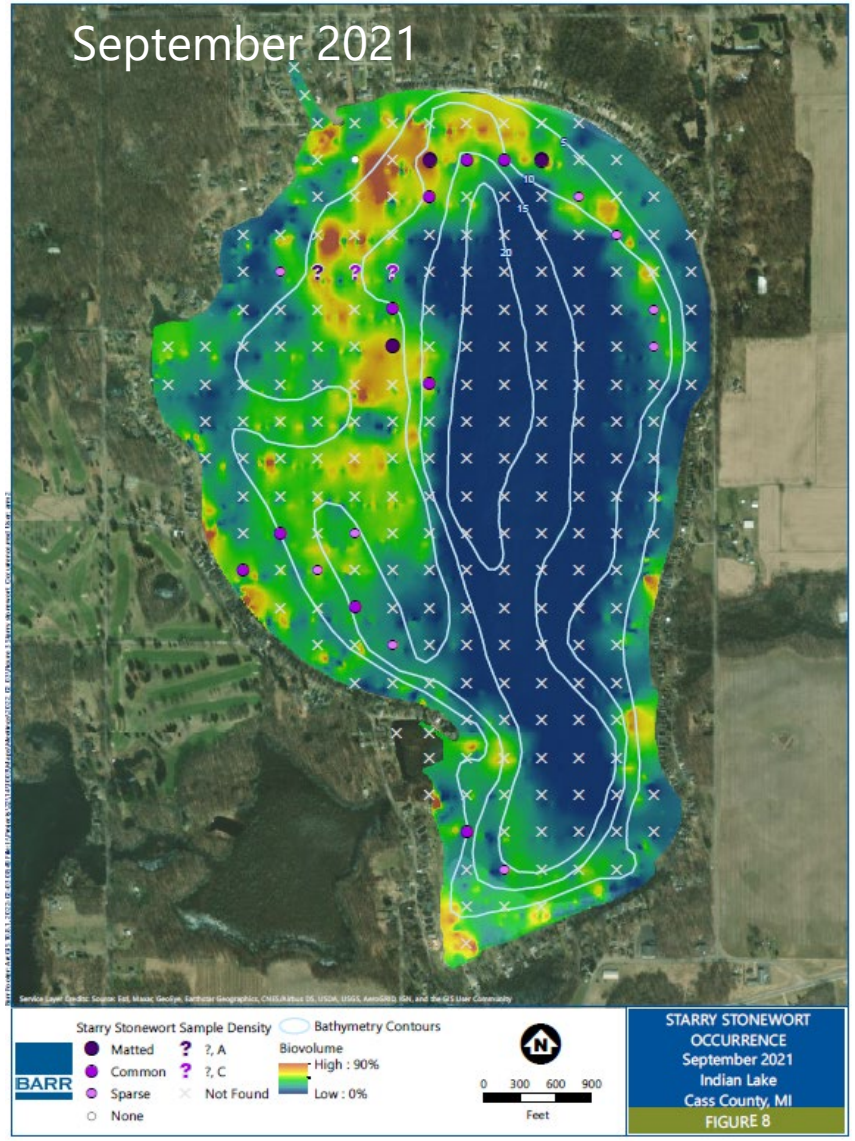
Eurasian watermilfoil

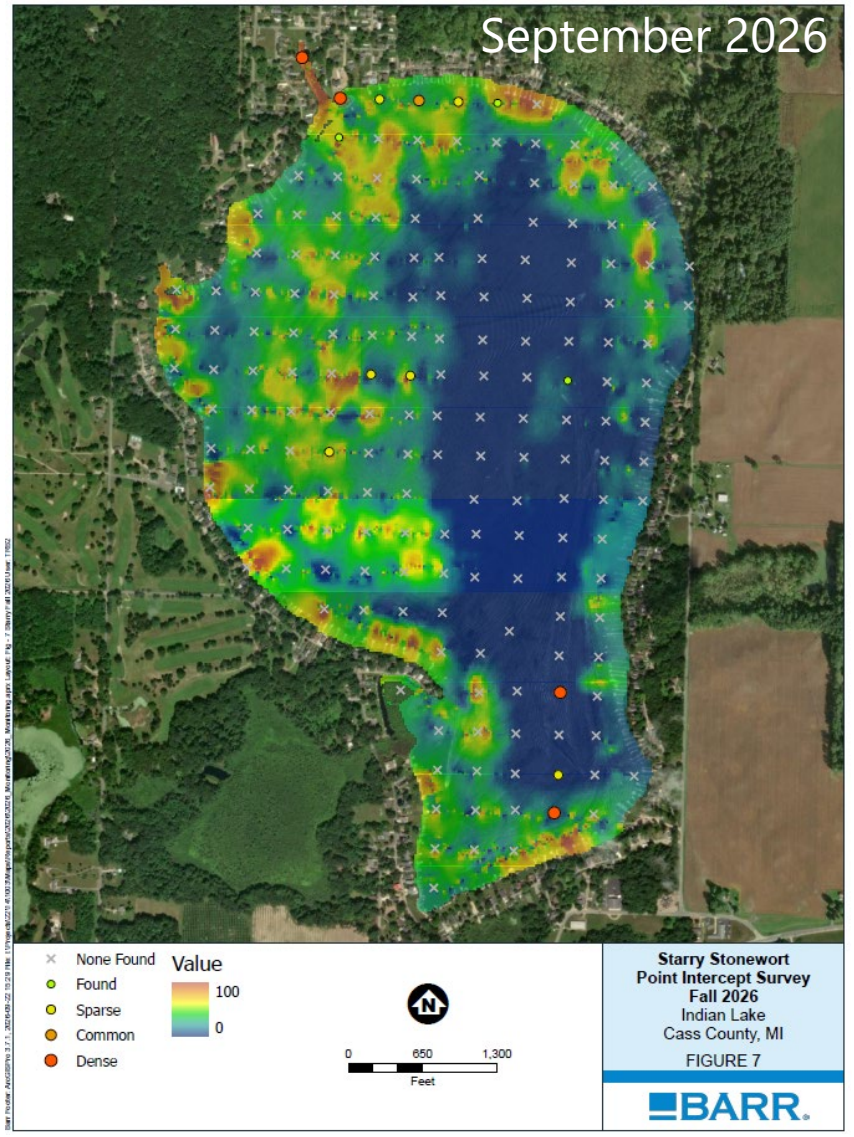




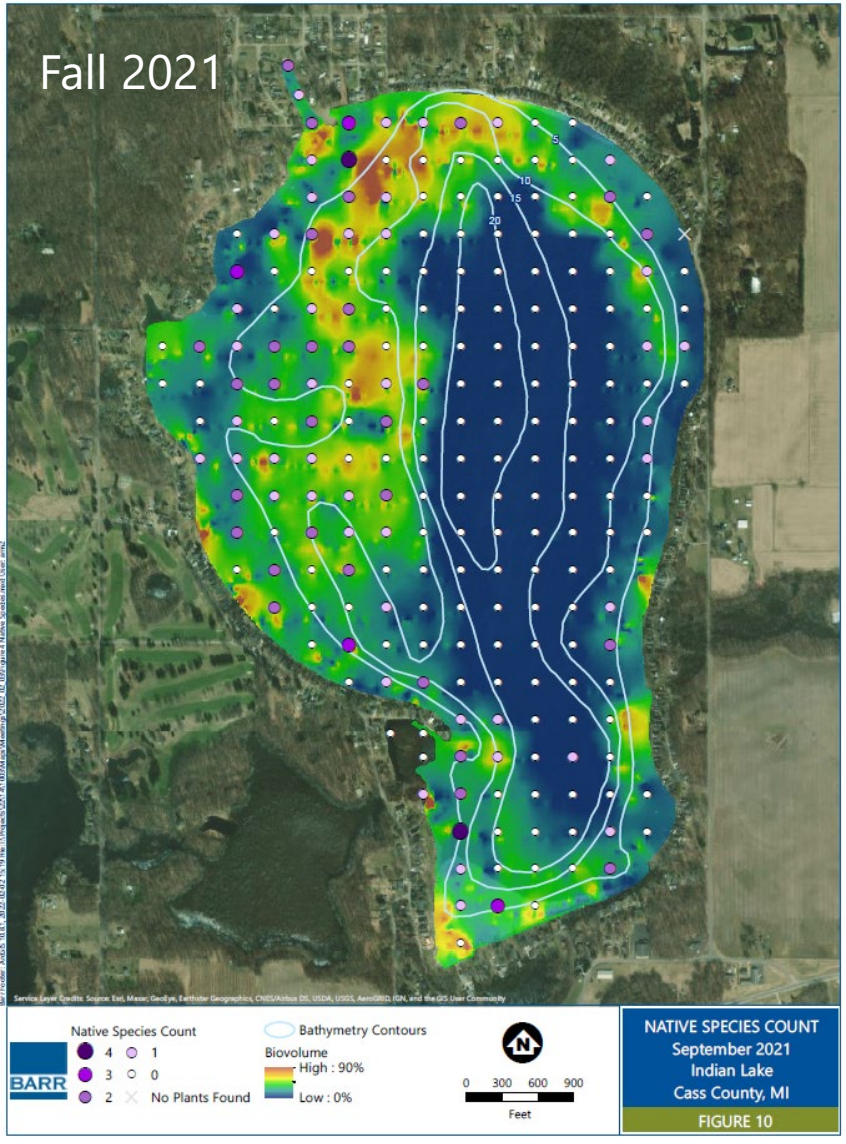


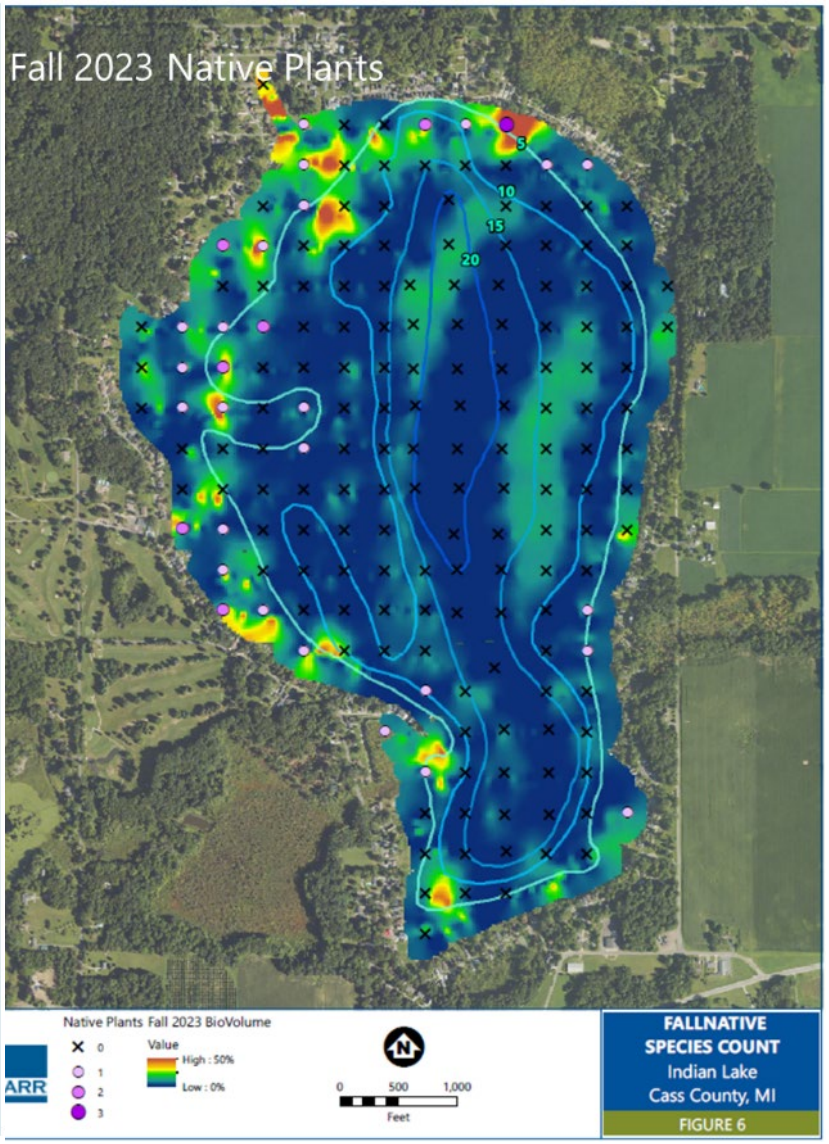
Starry Stonewort Fall 2021-2026

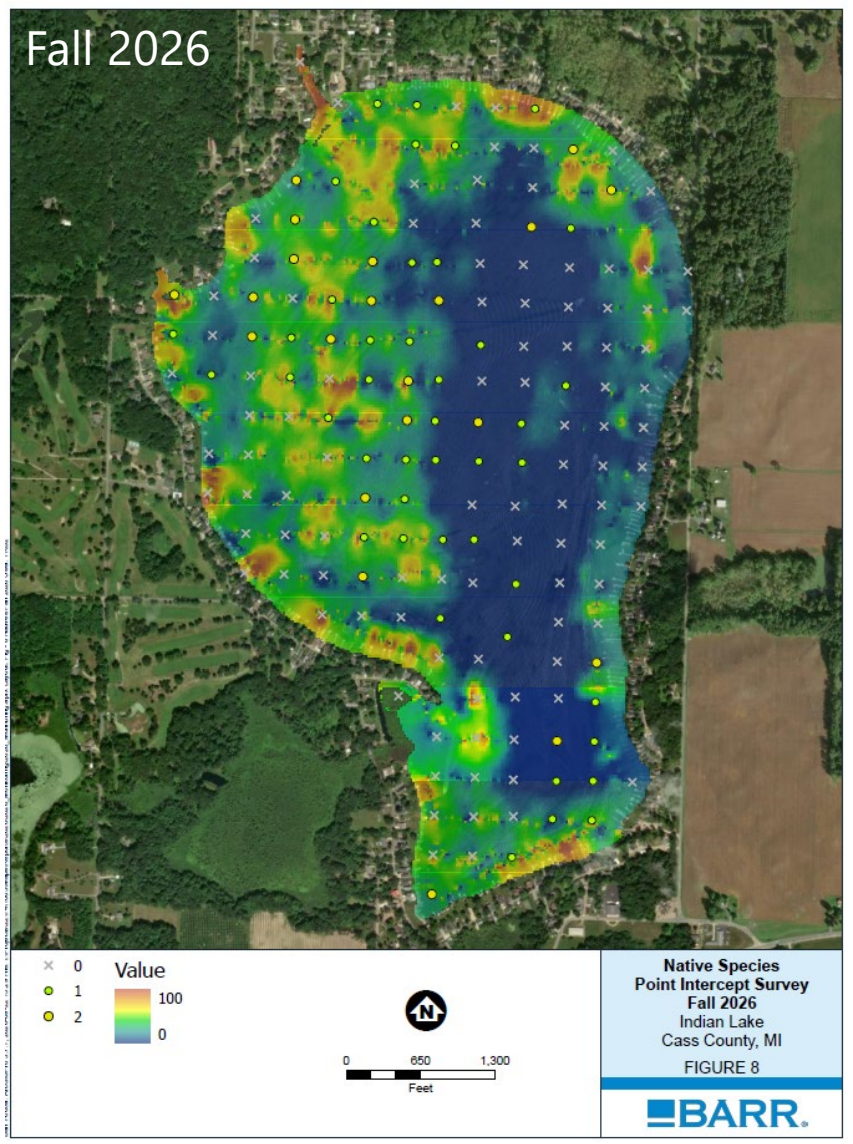




Native Vegetation



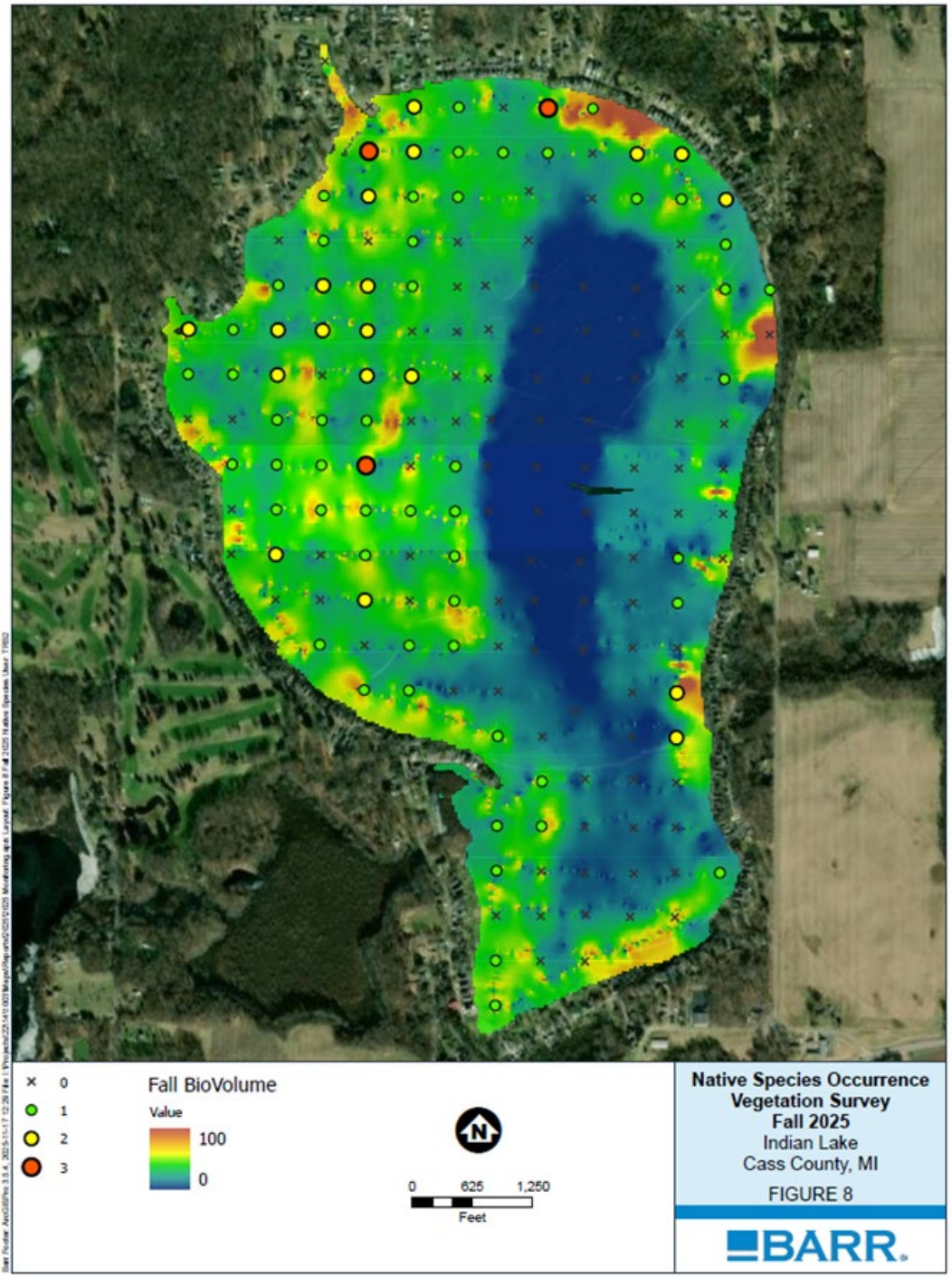




Aqautic Plant Species Frequency of Occurrence

Common Name	Species	2021	2022		2023		2024		2025		2026	
		F.	Sp.	F.	Sp.	F.	Sp.	F.	Sp.	F.	Sp.	F.
Eurasian watermilfoil[1]	*Myriophyllum spicatum*	31	42	55	51	--	2	2	13	19	13	7
Muskgrasses	*Chara spp.*	19	13	9	11	26	46	27	31	35	31	28
Starry stonewort[1]	*Nitellopsis obtusa*	10	1	4	7	36	32	25	20	11	20	9
Slender naiad	*Najas flexilis*	9	1	9	1	--	2	8	--	14	--	15
Naiad species	*Najas sp.*	7	--	--	--	--	--	8	--	--	--	--
Illinois pondweed	*Potamogeton illinoensis*	5	3	3	5	21	11	9	12	10	12	8
Curly-leaf pondweed1	*Potamogeton crispus*	4	34	3	17	1	4	4	23	1	23	5
Spiny naiad	*Najas marina*	3	--	--	--	--	--	9	--	7	--	9
Coontail	*Ceratophyllum demersum*	2	--	1	--	--	--	--	--	--	--	--
Wild celery/eel grass	*Vallisneria americana*	2	3	4	--	9	--	3	--	3	1	5

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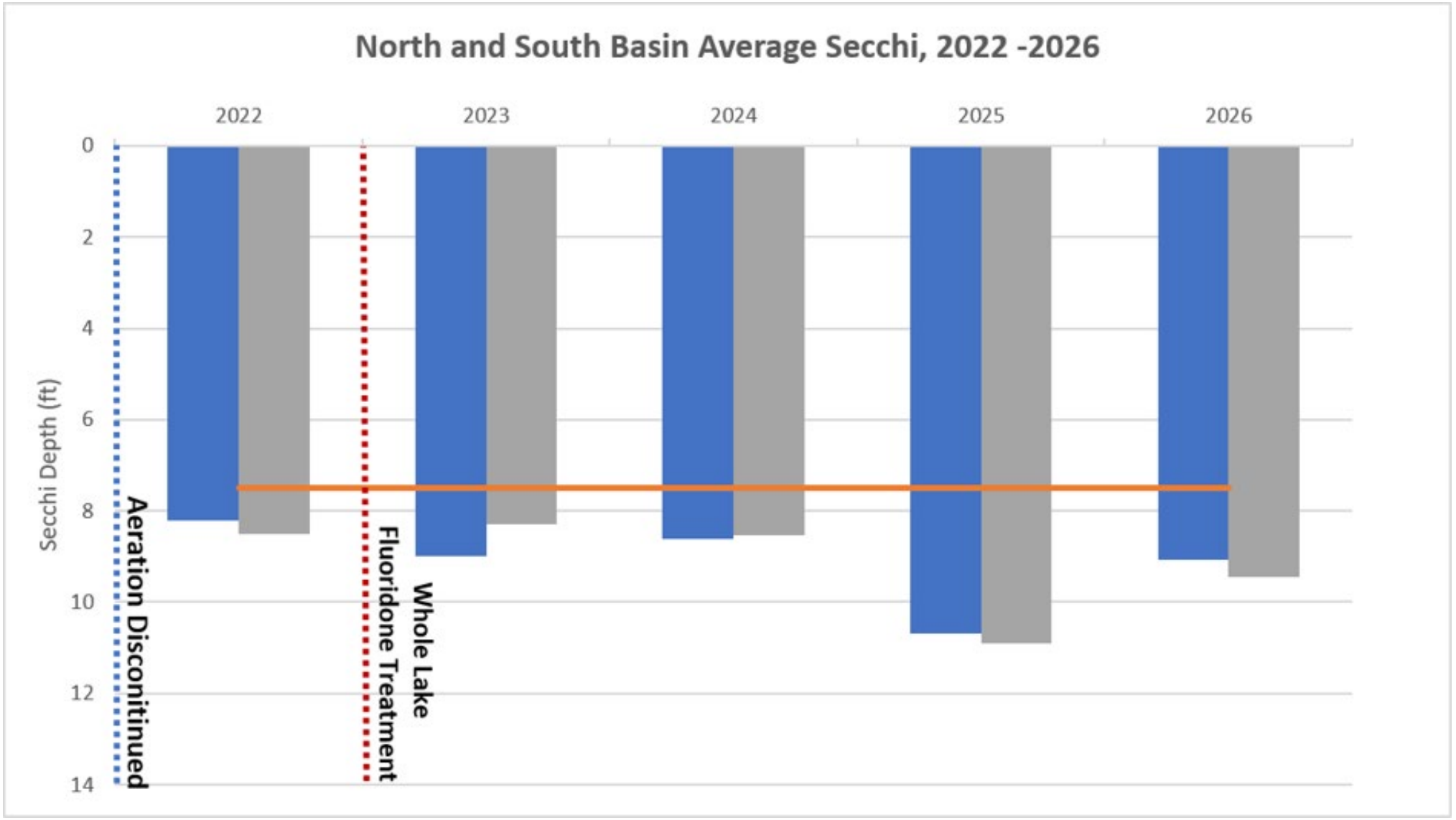
Aquatic Plant Management – Next Steps

- **Some native plants/macroalgae thriving following fluridone treatment**
  - Chara or Muskgrass, Illinois Pondweed, Wild Celery
- **Manage CLP and EWM to allow natives to repopulate**
  - Spring CLP/EWM spot treatments (starve sediments of turions)
  - Fall EWM treatments with systemic herbicide
  - *Potential summer starry stonewort copper treatments*
  - Harvesting CLP and starry stonewort (avoid EWM)
    - Fragment collection

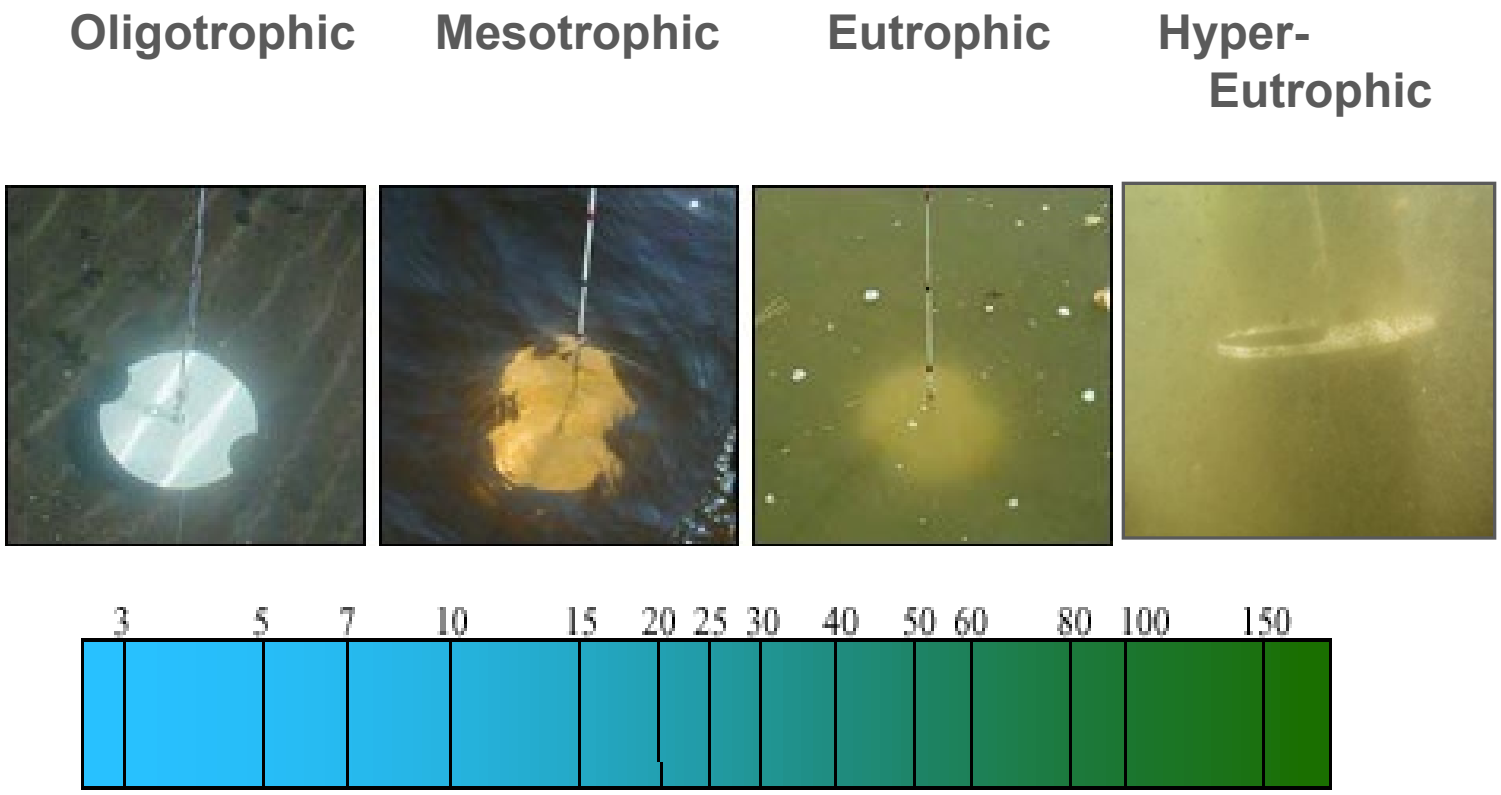
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Indian Lake Water Quality and Harmful Algal Blooms

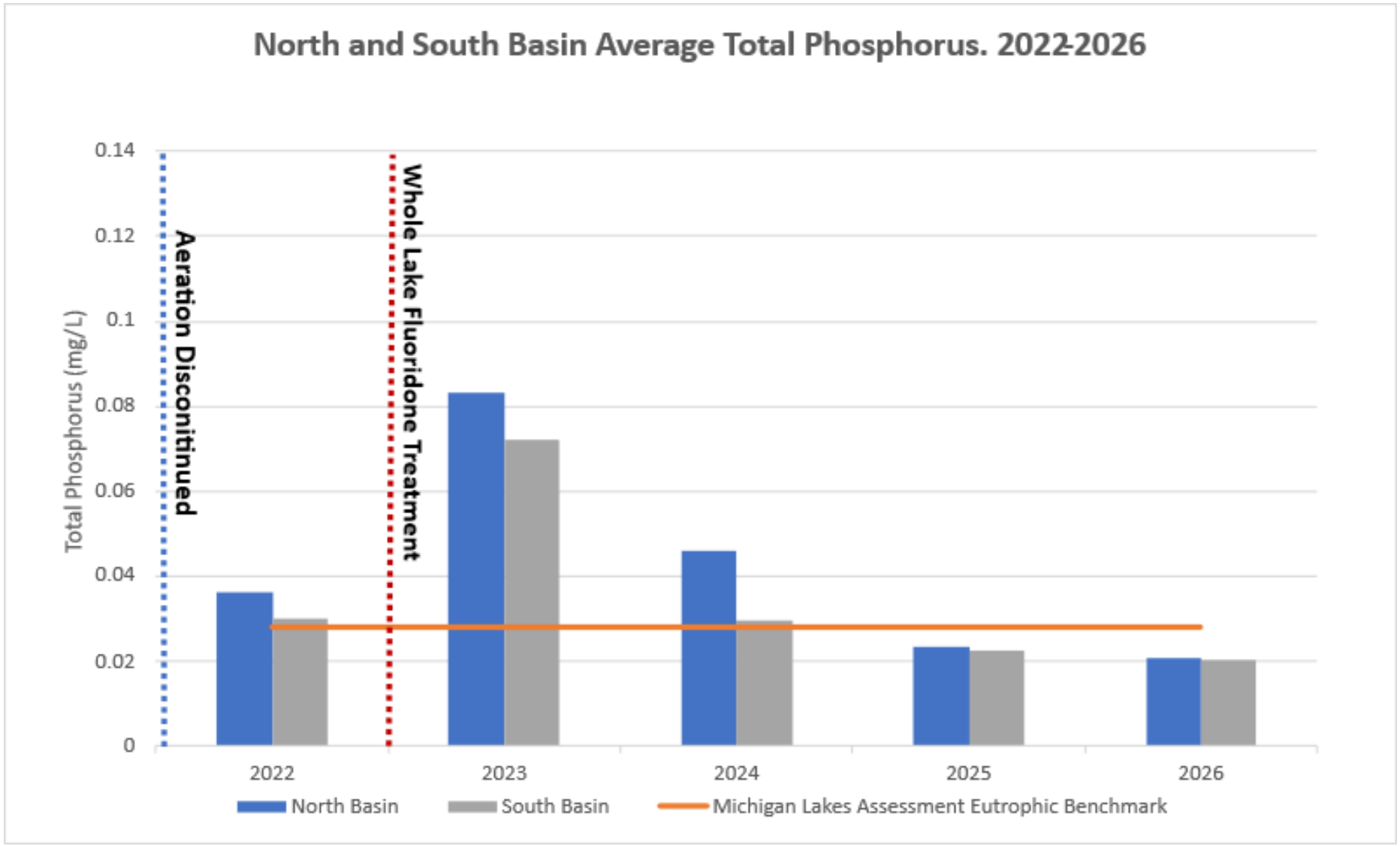
Secchi Depth – Water Clarity



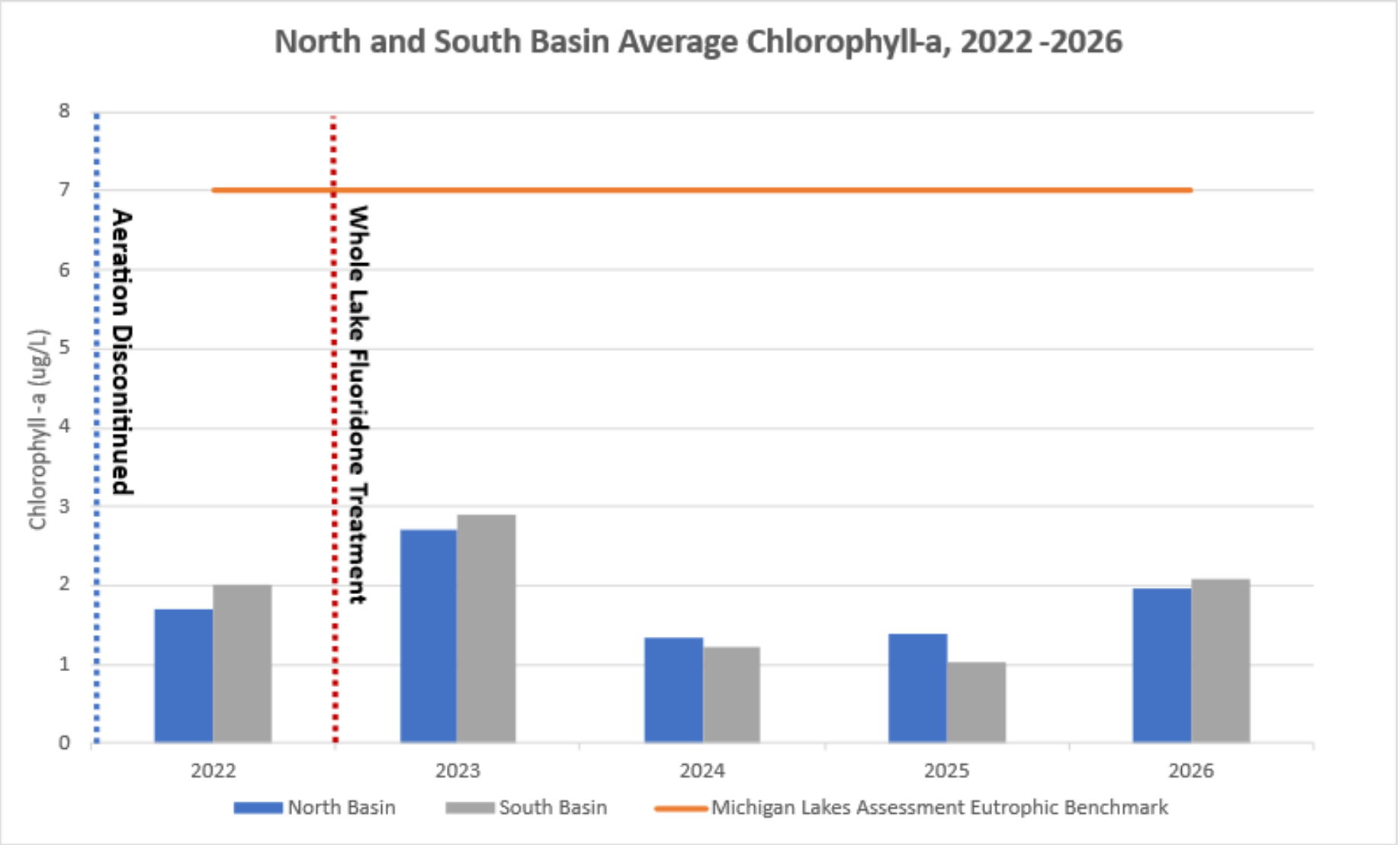
Relationship between TP and Transparency



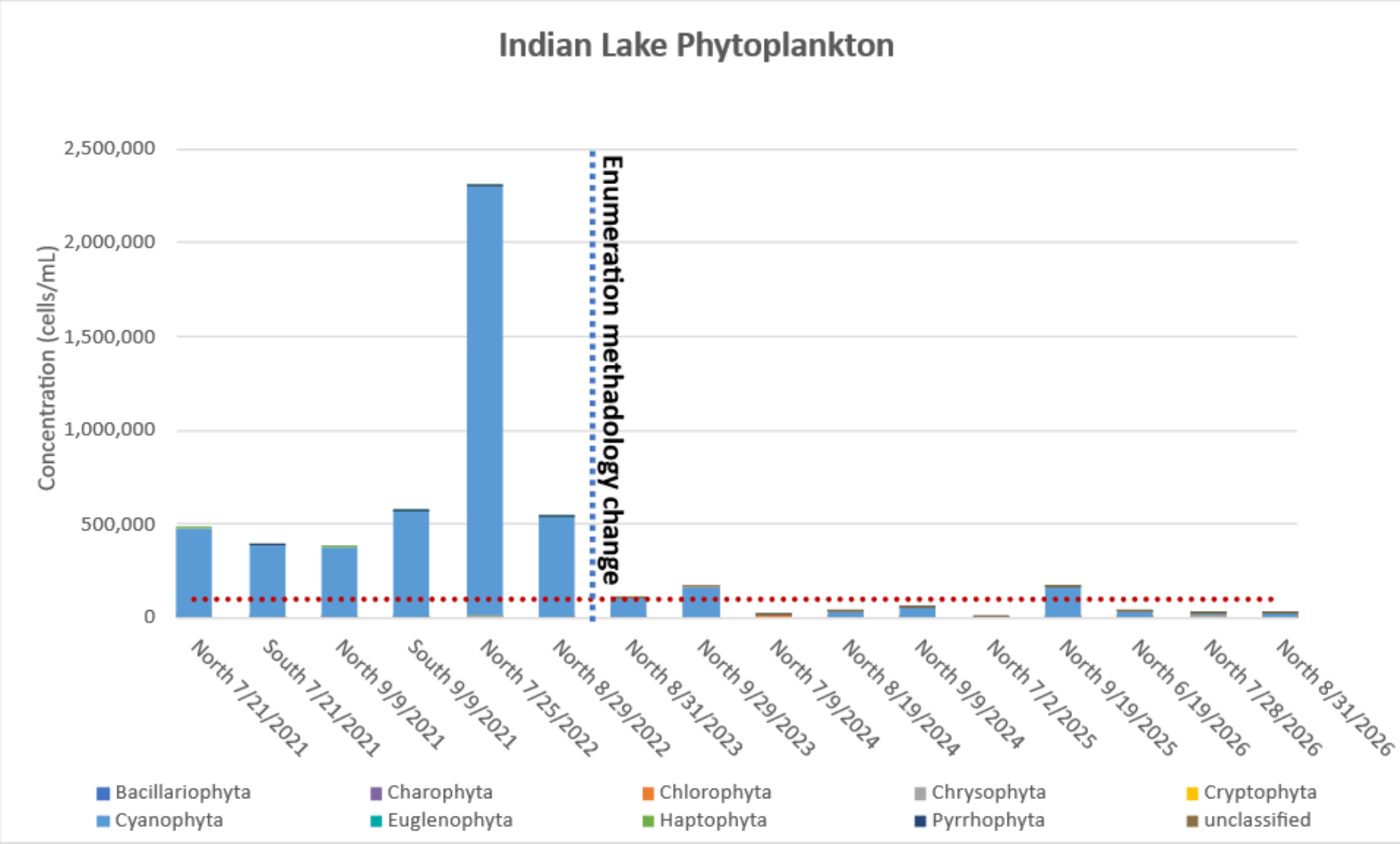
Total Phosphorus



Chlorophyll-a



Indian Lake Phytoplankton Community

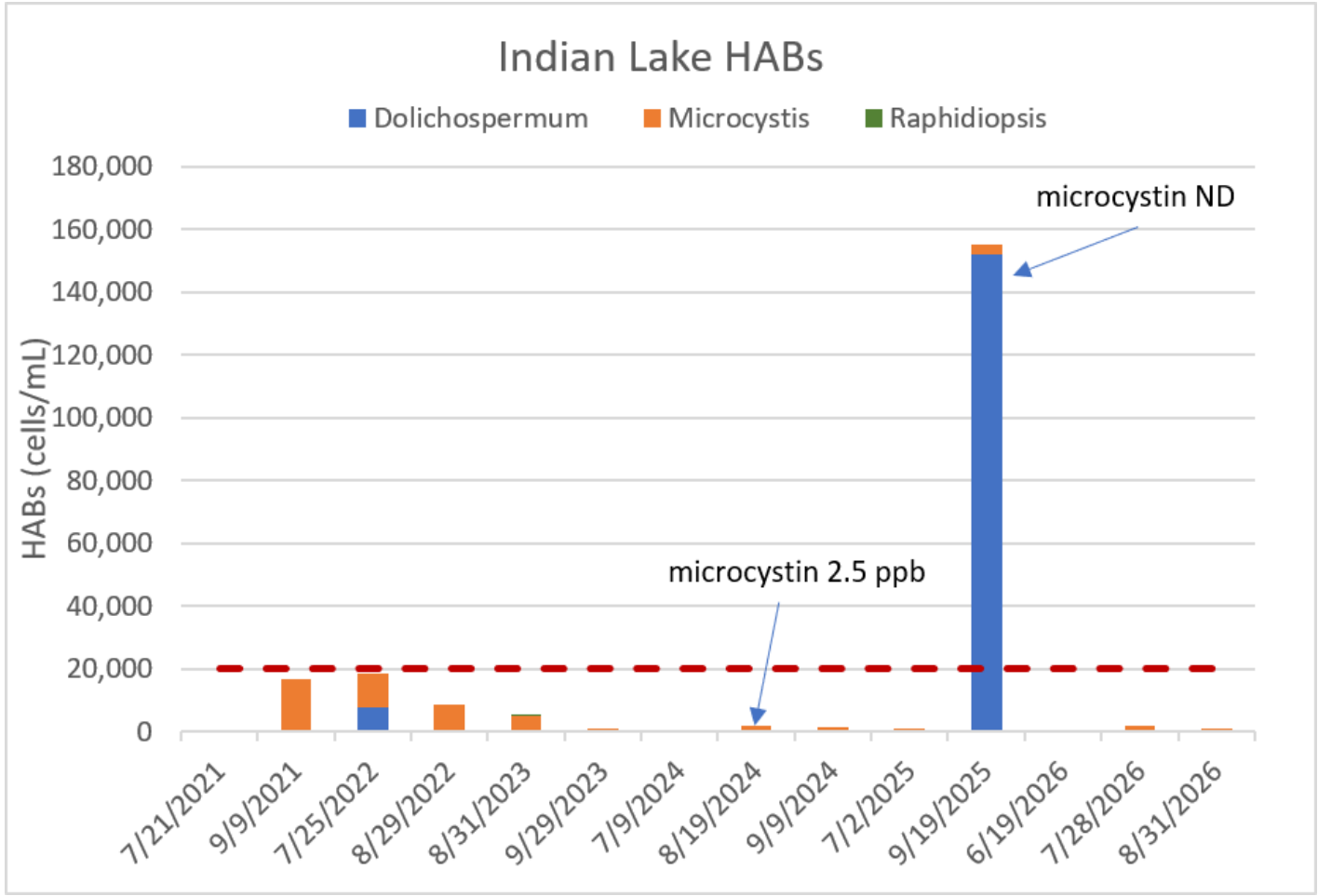


NOTE: In 2023, the analysis methodology changed to using an Imaging FlowCytobot (IFCB, McLane Research Labs)

Potential for Severe or Harmful (Toxic) Algal Blooms



Photo: Angelo Ippilito October 29, 2022



Severe ***Microcystis*** blooms likely occurred in **2011, 2012, 2013, 2014, 2015, 2018 and 2019** based on previous reports where cyanobacteria counts were greater than 25,000 cells/ml and Microcystis reported as the dominant species.

Potential Toxins Associated with Cyanbacteria

Toxins	EPA	MPCA	WHO
Microcystins	8 µg/L	6 µg/L	24 µg/L
Cylindrospermopsin	15 µg/L	15 µg/L	6 µg/L
Anatoxin-a	-	7 µg/L	60 µg/L*
Saxitoxins	-	-	30 µg/L

Cyanotoxins

- Hepatotoxins (liver and kidney damage): Microcystins, Cylindrospermopsin
- Neurotoxins (Nervous system damage): Anatoxin-a, Saxitoxins
- Dermatoxins (Skin irritation)

Cyanobacteria Potential Toxins Summary

Cyanobacteria Species	Hepatotoxins		Neurotoxins	
	Cylindrospermopsin	Microcystins	Anatoxin-a	Saxitoxins
Aphanizomenon flos-aquae	**X**			**X**
Aphanocapsa sp.		X		
Limnothrix redekei		X		
Merismopedia tenuissima		X		
Microcystis aeruginosa		**X**		
Microcystis wesenbergii		**X**	**X**	
Planktothrix agardhii		**X**	**X**	**X**
Planktolyngbya limnetica				X
Pseudanabaena limnetica	X	X		
Pseudanabaena mucicola		X		
Raphidiopsis raciborskii	**X**	**X**	**X**	**X**

*__Bolded__ taxa are typically recognized as more prolific toxin producers in freshwater ecosystems

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HAB Action Plan



YouTube video on identifying Harmful Algal Blooms (Cyanobacteria)





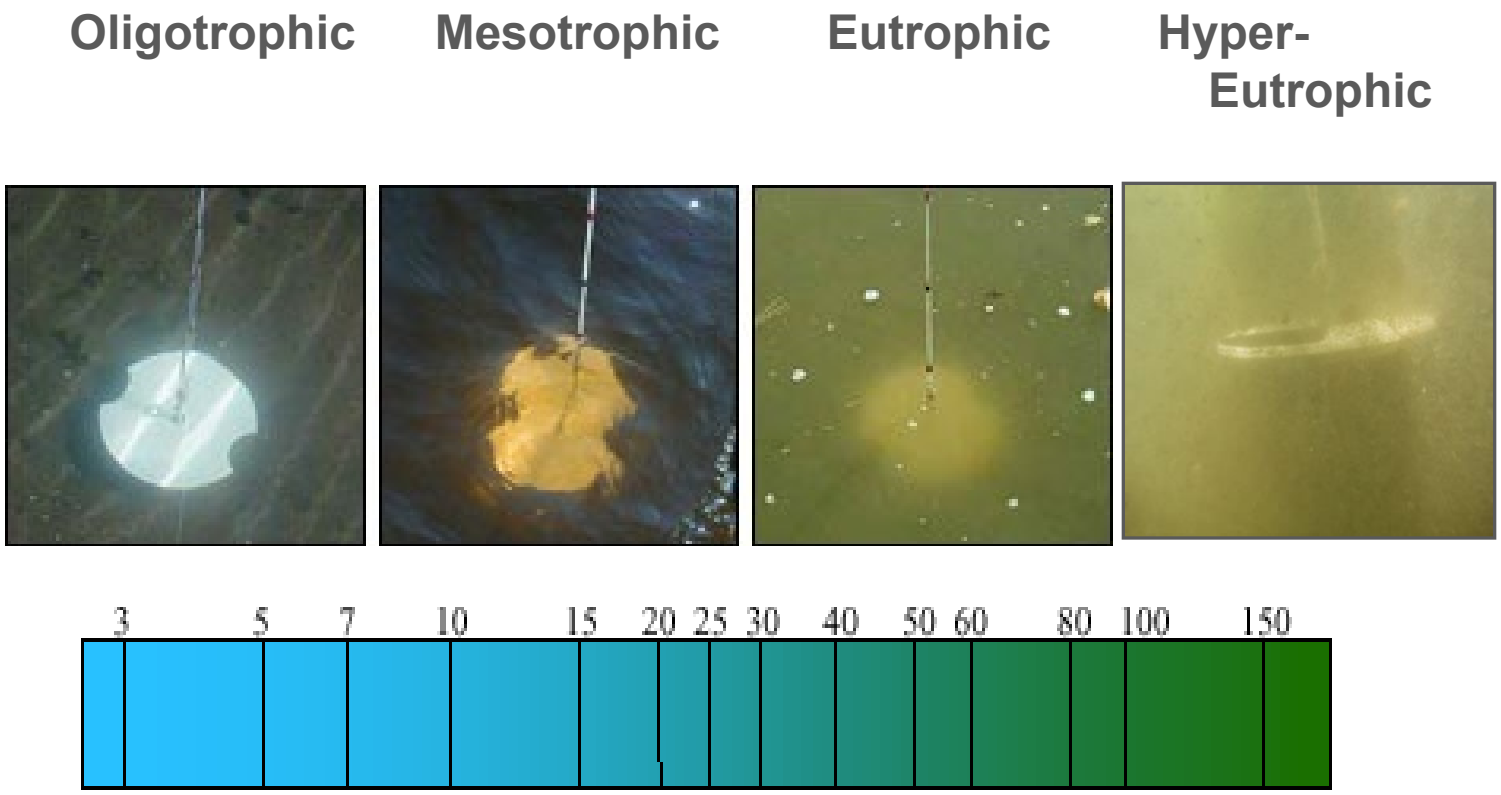


- **Learn to Identify blooms**
  - Jar test
  - Stick test
- **Monitoring**
  - PhycoTech in St. Joseph, MI
  - Cytobot rapid test
  - Microcystin test strips
  - Bloom timing (August/***September***)
- **When in doubt, stay out**
  - Know the risk

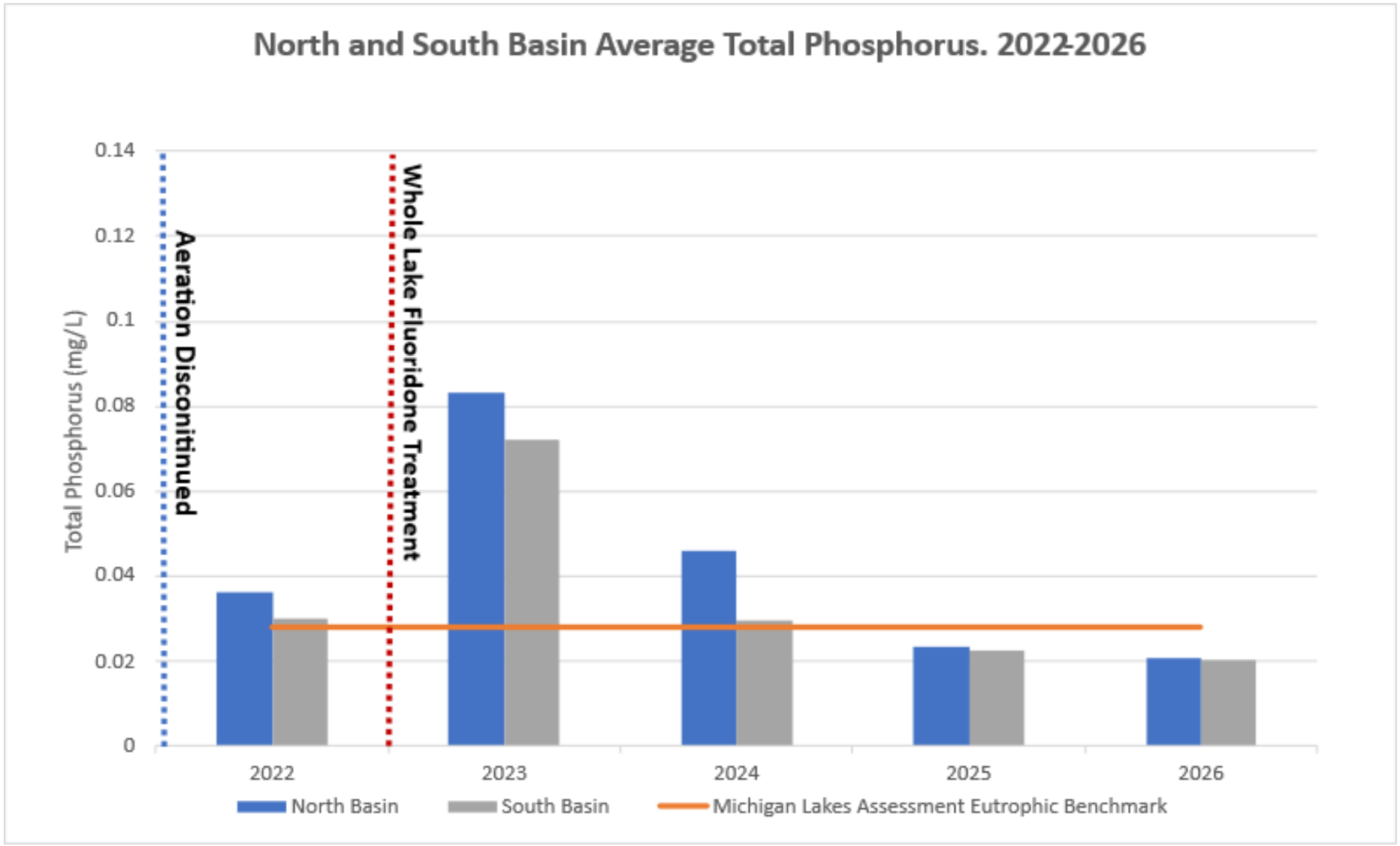
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Potential Nutrient Sources to Indian Lake

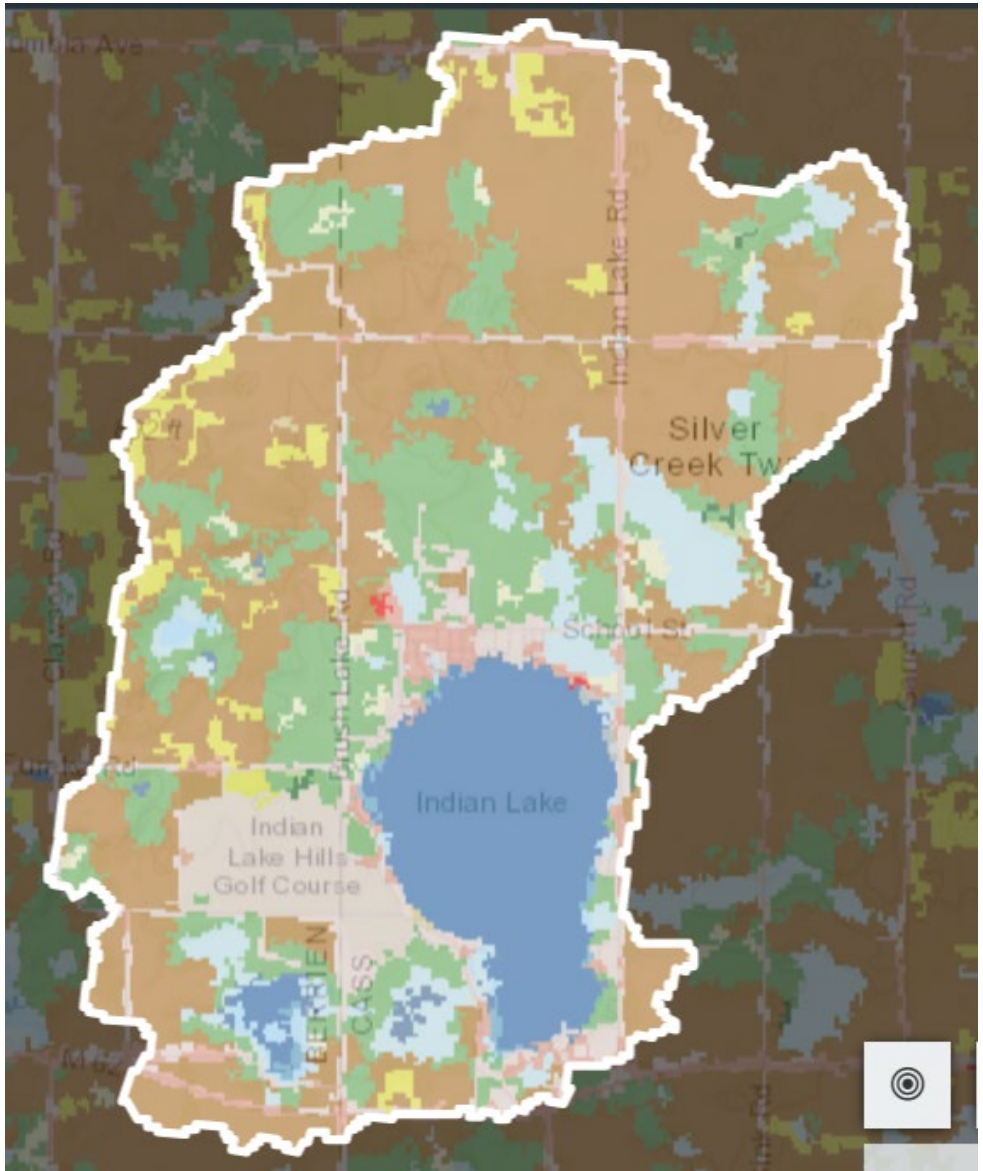
Relationship between TP and Transparency



Total Phosphorus



Indian Lake Watershed Land Use



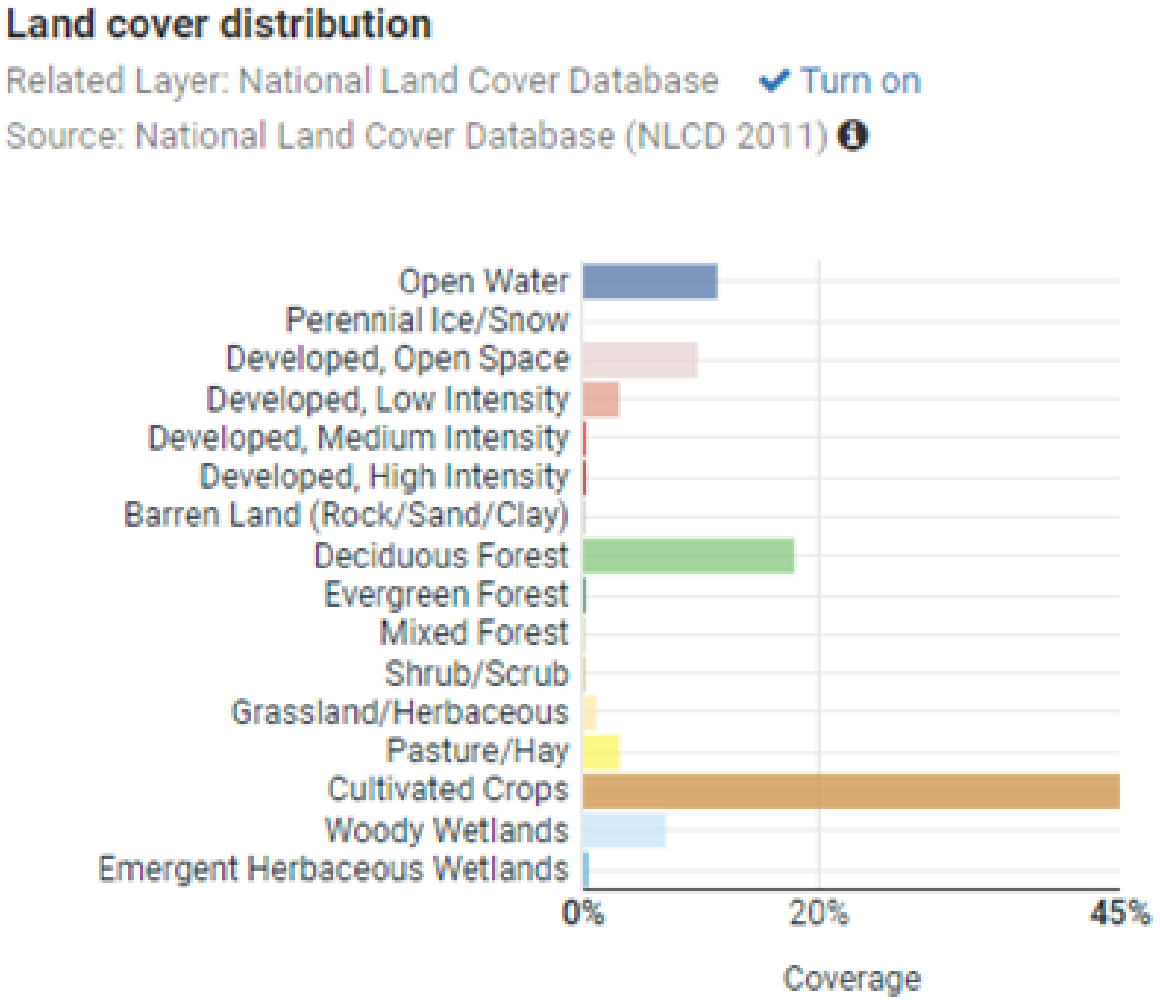
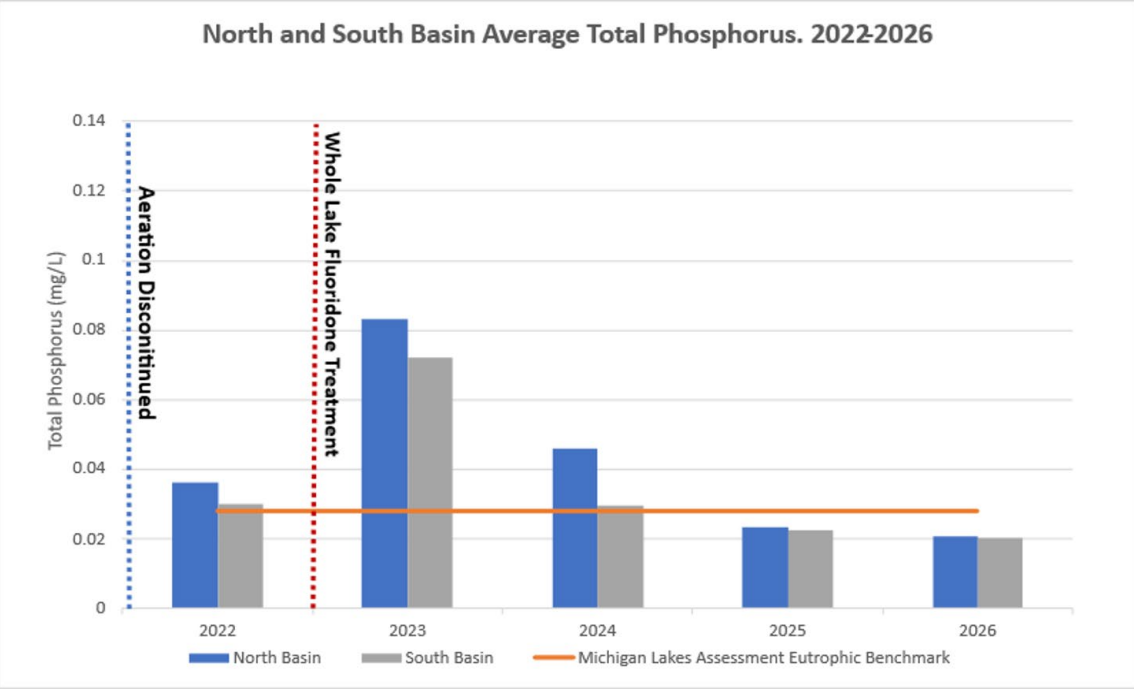
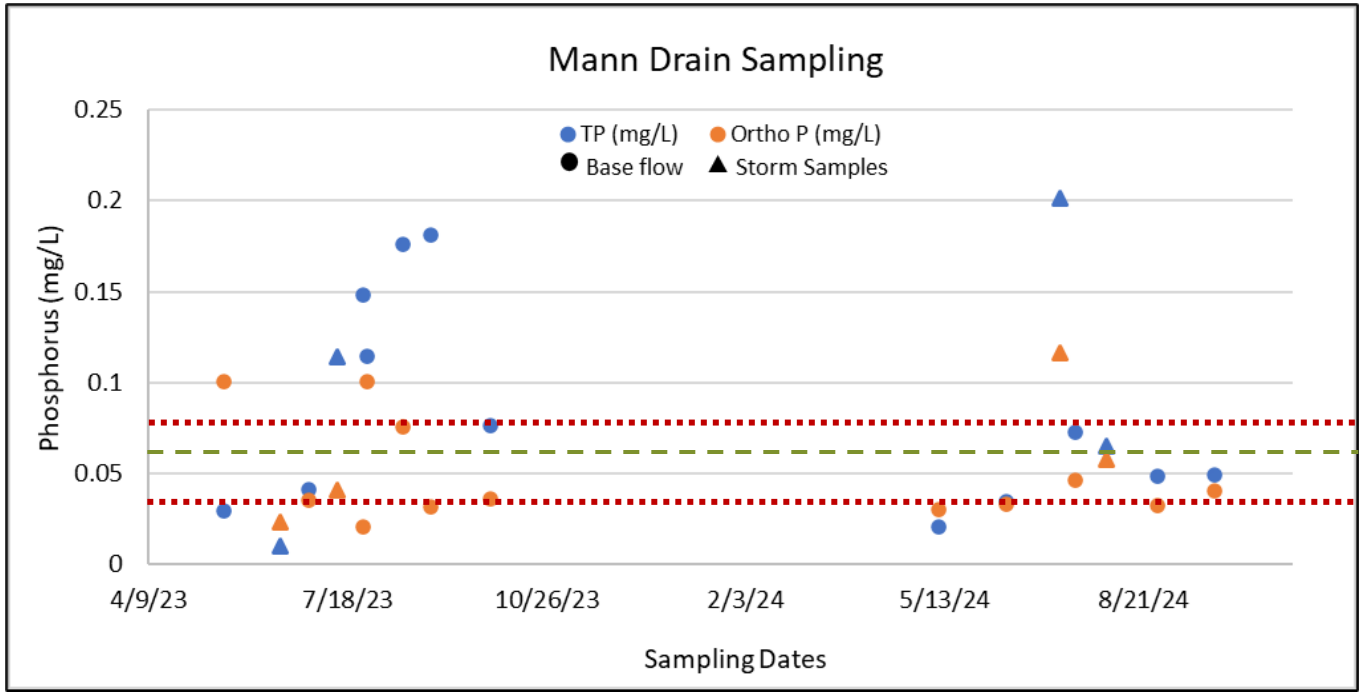


Figure 2. Land-cover distribution in the Indian Lake Watershed (modelmywatershed.org)

Mann Drain Total Phosphorus





Median: 69 ug/L; small streams: 77 ug/L; St. Joseph streams: 36 ug/L; Indian Lake Model: 59 ug/L

Wetland Drainage to Indian Lake





2027-2031 Indian Lake Action Plan

Five-Year Plan

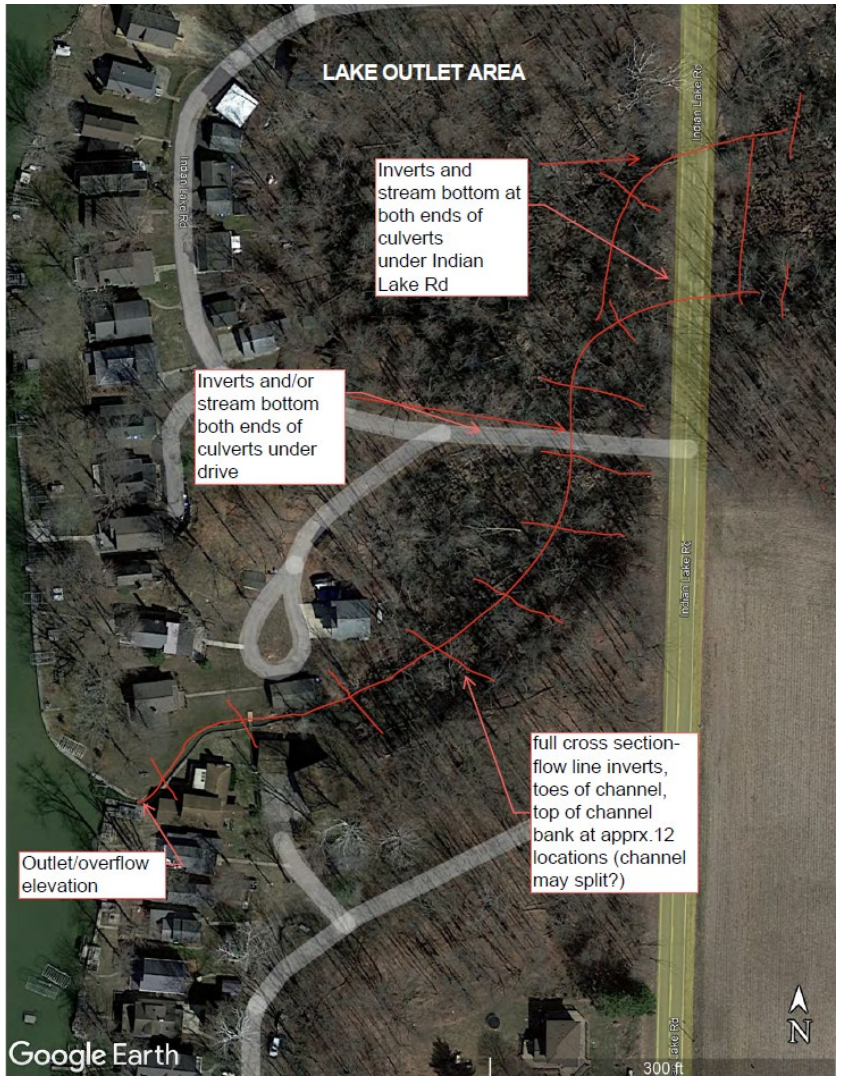
Contractor	Action	2027	2028	2029	2030	2031
Barr	Aquatic plant management oversight	$3,500	$3,700	$3,900	$4,100	$4,200
PLM	Spot herbicide treatments for invasive control	$29,000	$30,000	$32,000	$34,000	$36,000
ILIA	Harvesting for recreational support	$5,000	$5,000	$5,000	$5,000	$5,000
Barr	Aquatic vegetation monitoring and management	$ 14,000	$15,000	$16,000	$17,000	$18,000
PhycoTech	Phytoplankton and HAB monitoring	$1,500	$1,500	$1,500	$1,500	$1,500
Barr	Lake water quality monitoring	$ 13,000	$14,000	$15,000	$16,000	$17,000
Barr	Lake level monitoring	$1,000	$1,000	$1,000	$1,000	$1,000
Barr	Annual reporting and lake management support	$ 13,000	$14,000	$15,000	$16,000	$17,000
	TOTAL	**$79,000**	**$84,200**	**$89,400**	**$94,600**	**$99,700**

2027 Schedule of Activities

Activity	Projected Date
Water Quality Monitoring (Indian Lake)	May, 2027
Spring Vegetation Survey	May, 2027
Curly-leaf pondweed and Eurasian watermilfoil treatment	May, 2027
Water Quality Monitoring (Indian Lake)	June 2027 (phytoplankton sampling)
Water Quality Monitoring (Indian Lake)	July 2027 (phytoplankton sampling)
Water Quality Monitoring (Indian Lake)	August 2027 (phytoplankton sampling)
Water Quality Monitoring (Indian Lake)	September 2027 (phytoplankton sampling)
Fall Vegetation Survey	September 2027

Other Tasks – Survey Outlet



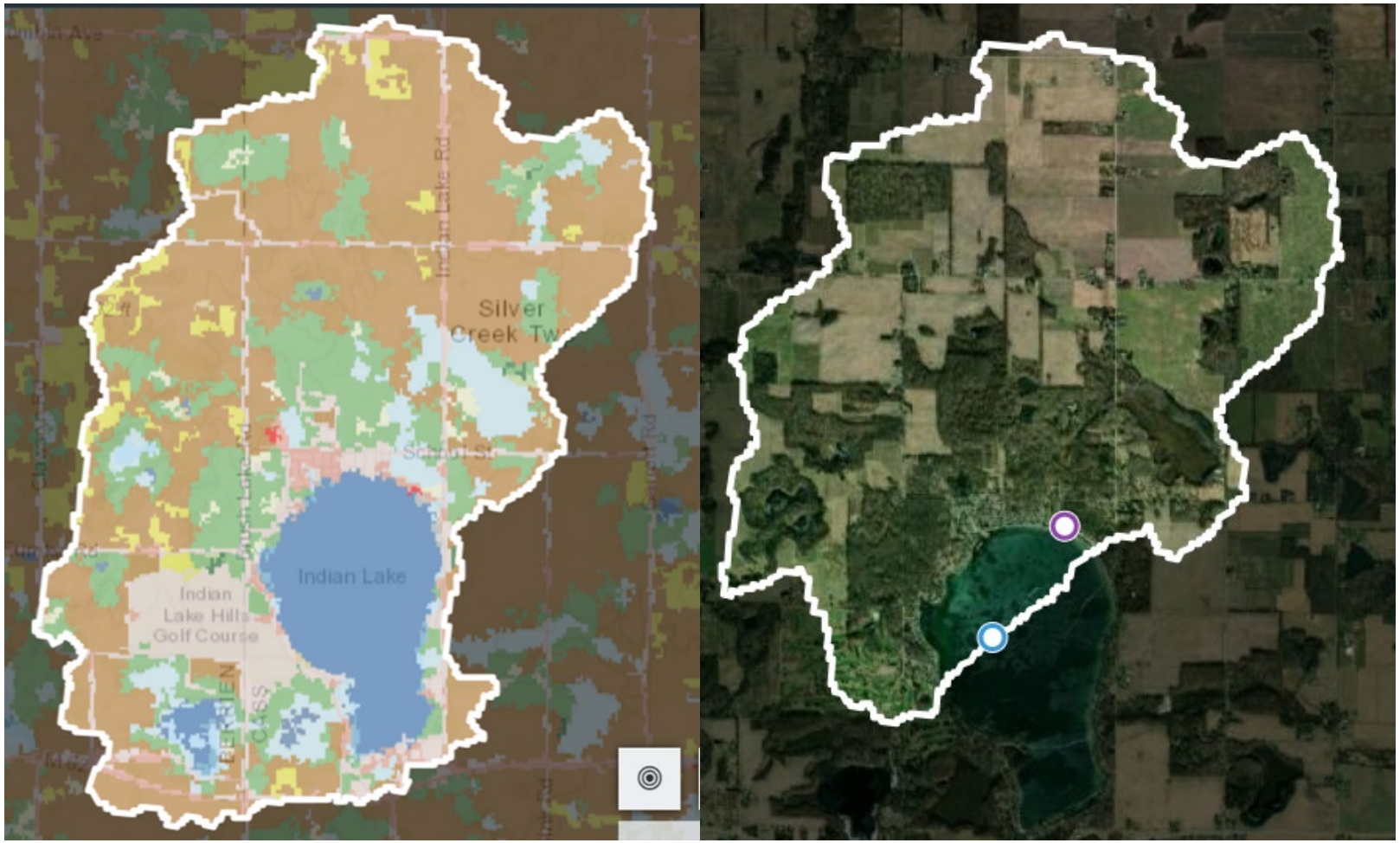


Other Tasks – Survey Mann Drain





Other Tasks – Delineate subwatershed



- Subwatersheds
  - P sources
  - Drainage patterns
  - On-line tools limited
  - County LiDAR data

Action Items

- Approve Barr for 2027-2031 services
- Approve 2027 monitoring plan
- Approve work order for outlet and Mann Drain survey

Questions?



