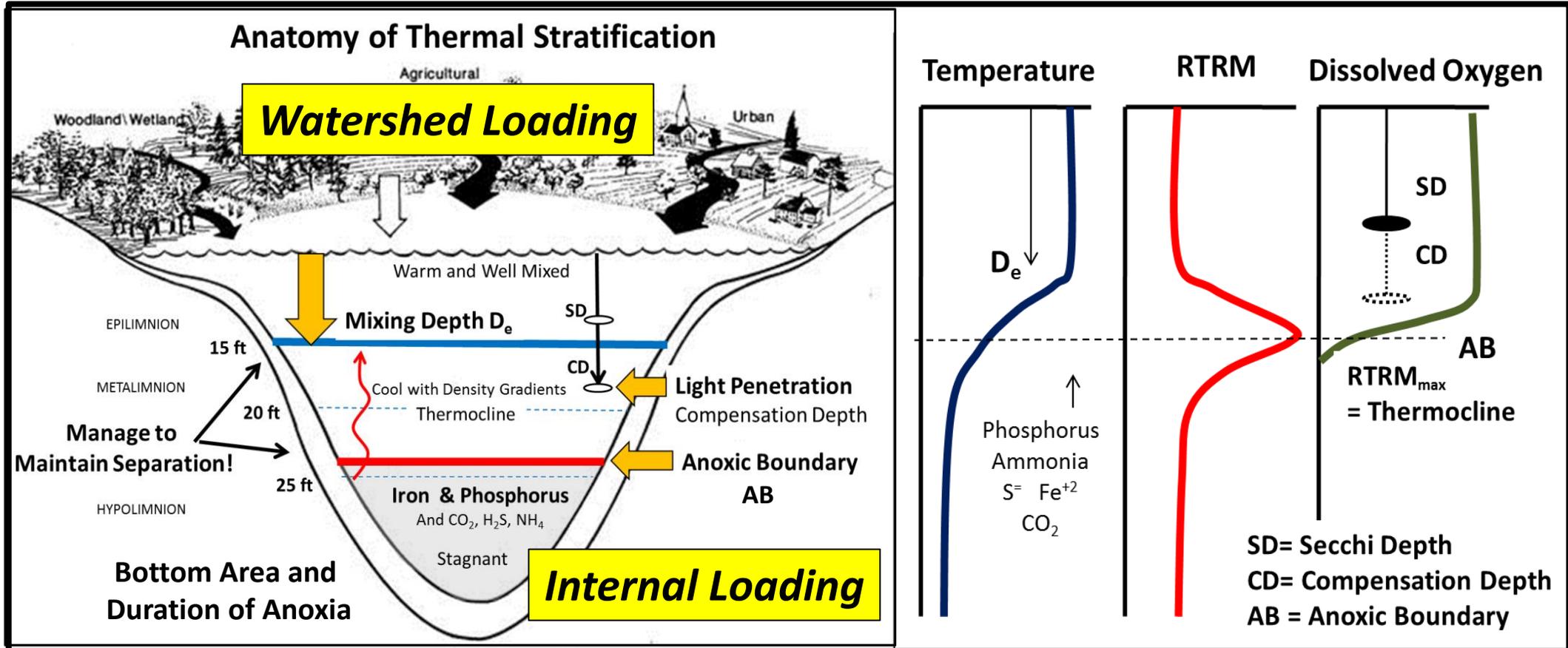


# Coventry Lake

- 2024 (so far)
- Some History and Data Trends
- Observations and Concerns

Bob Kortmann, Ph.D.  
GZA - Ecosystem Consulting Service

# Critical Natural Features of Coventry Lake



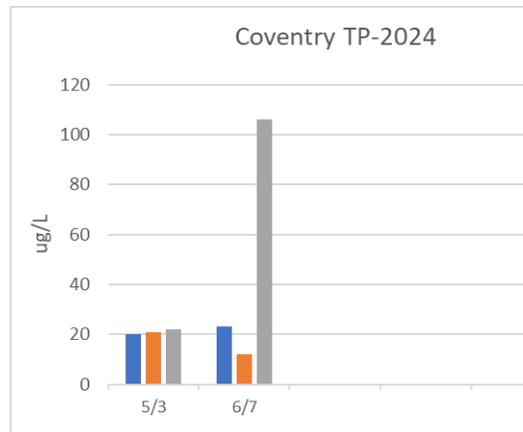
- The relative vertical position of the oxygen loss boundary, the depth of surface layer mixing, and penetration of photosynthetically active light are critical natural features, especially for surface blooms of cyanobacteria.
- When the oxygen loss boundary ascends upward and approaches the mixing depth, the stage is set for Cyanobacteria Blooms. Deepening of the Mixing Depth to the Oxygen Loss Boundary can also set that stage; commonly seen during Fall Turnover and following storm mixing events.
- It is important to maintain separation of the Red and Blue lines and reduce the duration and bottom coverage of anoxic water.

# 2024 so far.

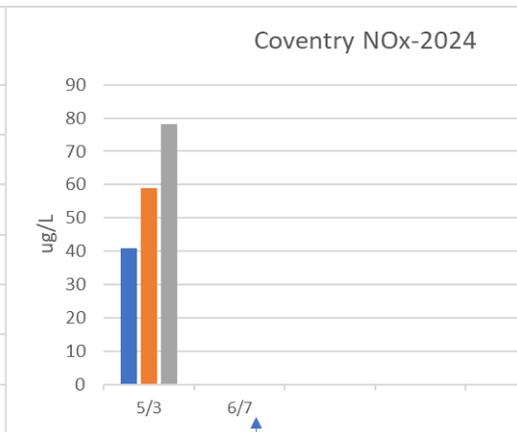
Coventry - Temperature (deg C)-2024						
Staff	SH	co-op	co-op	PG		
Date	5/3	5/3	6/7	8/21		
0.0	15.5	--	---	23.6	---	---
0.5	15.4	16.3	24.6	23.7	---	---
1.0	15.4	15.4	23.8	23.7	---	---
2.0	15.4	15.3	23.7	23.6	---	---
3.0	15.3	15.2	23.4	23.5	---	---
4.0	14.5	13.0	20.8	23.3	---	---
5.0	12.5	12.1	17.5	23.3	---	---
6.0	11.1	10.9	13.7	23.2	---	---
7.0	10.6	10.4	12.0	21.3	---	---
8.0	10.2	10.2	11.0	17.0	---	---
9.0	9.7	9.9	10.4	12.8	---	---
10.0	9.6	9.7	10.1	11.6	---	---
11.0	9.5	9.6	9.8	11.0	---	---
12.0	---	---	---	---	---	---

Coventry - RTRM-2024						
Staff	SH	co-op	co-op	PG		
Date	5/3	5/3	6/7	8/21		
0.0	0	---	---	0	---	---
0.5	0	0	---	-3	---	---
1.0	0	18	24	3	---	---
2.0	2	2	3	3	---	---
3.0	2	2	9	3	---	---
4.0	13	38	73	3	---	---
5.0	33	13	78	0	---	---
6.0	21	16	74	6	---	---
7.0	5	6	26	54	---	---
8.0	6	2	13	102	---	---
9.0	5	3	7	79	---	---
10.0	0	2	3	16	---	---
11.0	1	1	3	8	---	---
12.0	---	---	---	---	---	---
Sum	87	104	314	273	0	0

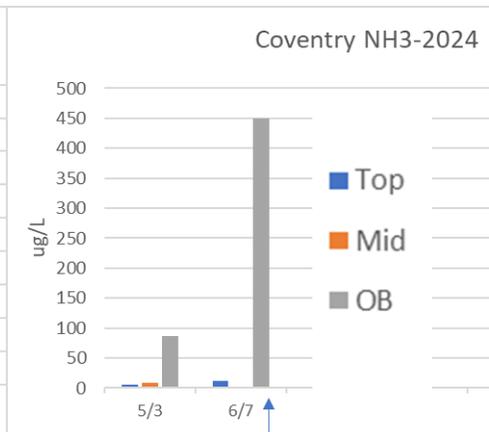
Coventry - DO (mg/L)-2024						
Staff	SH	co-op	co-op	PG		
Date	5/3	5/3	6/7	8/21		
0.0	9.9	---	---	7.3	---	---
0.5	9.9	10.6	---	7.2	---	---
1.0	9.9	10.2	---	7.2	---	---
2.0	9.9	10.2	---	7.3	---	---
3.0	9.9	10.1	---	7.3	---	---
4.0	9.8	10.3	---	7.3	---	---
5.0	10.3	10.6	---	7.3	---	---
6.0	9.8	11.5	---	7.1	---	---
7.0	9.4	12.3	---	5.7	---	---
8.0	8.4	12.6	---	2.9	---	---
9.0	6.7	13.5	---	1.3	---	---
10.0	6.3	14.1	---	0.6	---	---
11.0	6.0	15.1	---	0.4	---	---
12.0	---	---	---	---	---	---



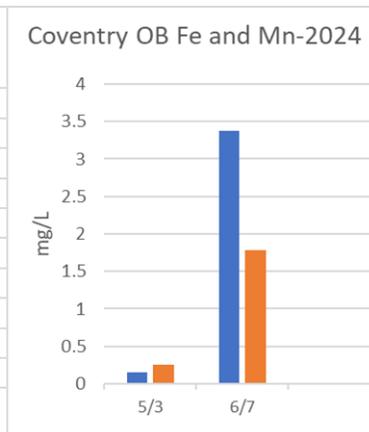
> 20  $\mu\text{g/L}$  TP Surface & Mid  
 > 100  $\mu\text{g/L}$  TP Over Bottom Early June  
*Potential Post-Turnover Bloom*



Nitrate Exhausted Early June  
 Secchi Transparency 2.4 m in May; 3.6 m in June



High Ammonia Early June



High Fe Mn Early June

↑  
**Still aerobic below the thermocline**  
**Separation between De and AB**

# All Phytoplankton (Eukaryotic Algae and Cyanobacteria)

Coventry	0-5m	0-5m	
	5/3	6/7/24	
<b>DIATOMS</b>	1148	33	
<b>DINOPHYCEAE</b>	0	12	
<b>CYANOBACTERIA</b>	1373	1997	
<b>EUGLENOPHYCEAE</b>	0	0	
<b>GREENS</b>	59	713	
<b>CRYPTOPHYCEAE</b>	732	244	
<b>CHRYSOPHYCEAE</b>	183	2927	
<b>NANNOPLANKTON</b>	1875	183	
<b>TOTAL Cells/mL</b>	<b>5370</b>	<b>6109</b>	<b>0</b>

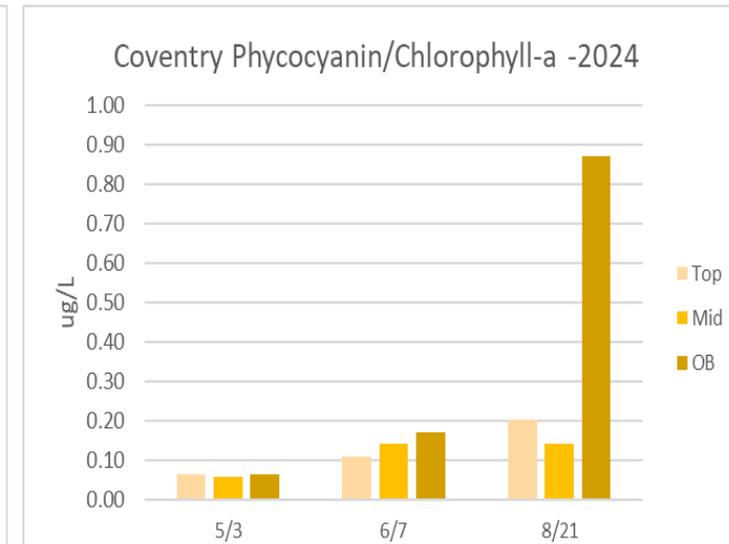
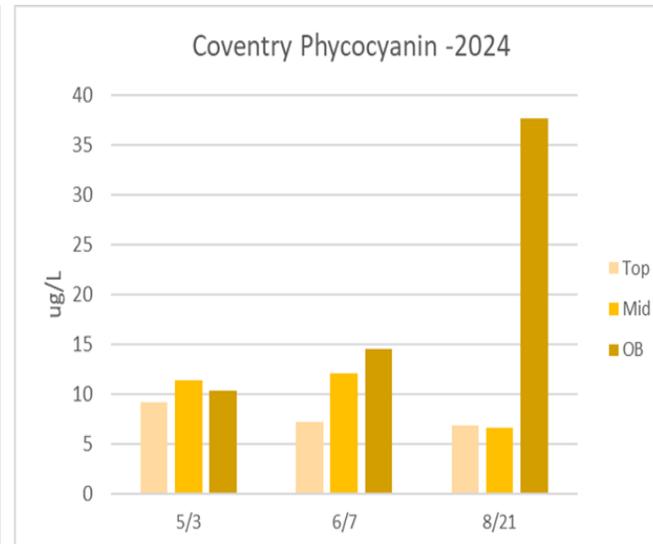
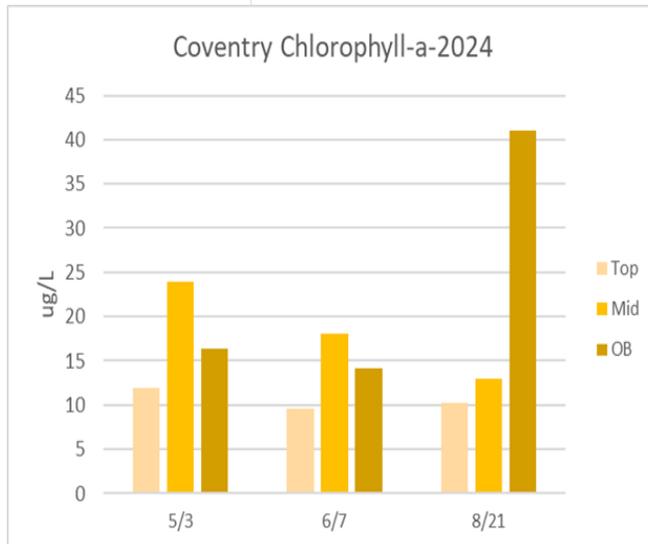
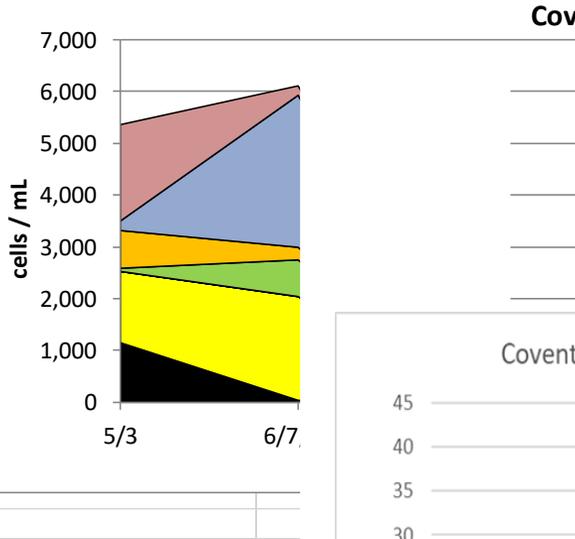
# Cyanobacteria

	5/3	6/7/2024
Agmenellum spp. (Merismopedia s	0	0
Anabaena spp.	0	1372
Aphanizomenon spp.	884	625
Aphanocapsa spp.	0	0
Chroococcus spp.	0	0
Cylindrospermopsis spp.	0	0
Dactylococcopsis raphidiodes	0	0
Gloeothece spp.	0	0
Gomphosphaeria spp.	0	0
Gomphosphaeria aponina	0	0
Lyngbya spp.	0	0
Microcystis spp.	0	0
Microcystis aeruginosa	0	0
Oscillatoria spp.	489	0
Pseudanabaena spp.	0	0
Spirulina spp.	0	0
Synechococcus sp.	0	0
	<b>5/3</b>	<b>6/7/2024</b>

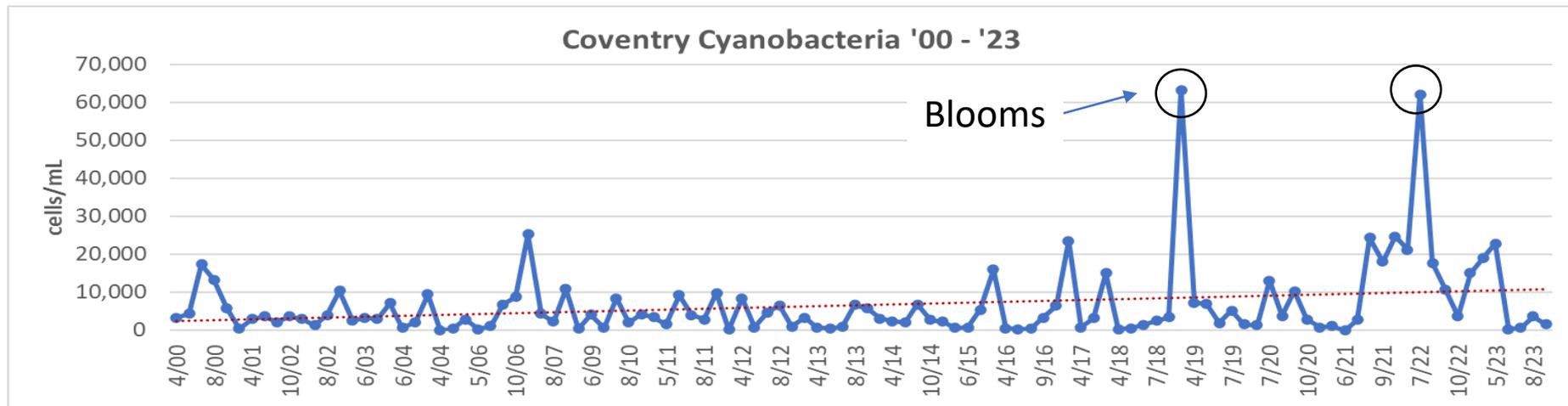
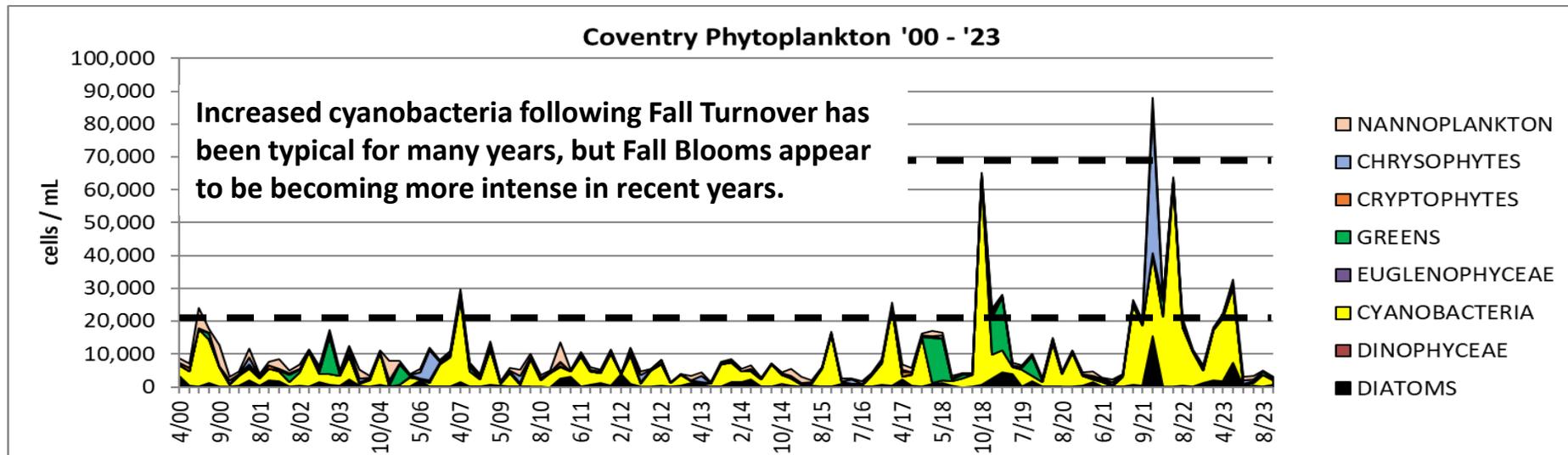
2024 so far.

Once again, cyanobacteria persisted through the winter as a large component of the phytoplankton assemblage.

Oscillatoria (Planktothrix) is becoming more common.

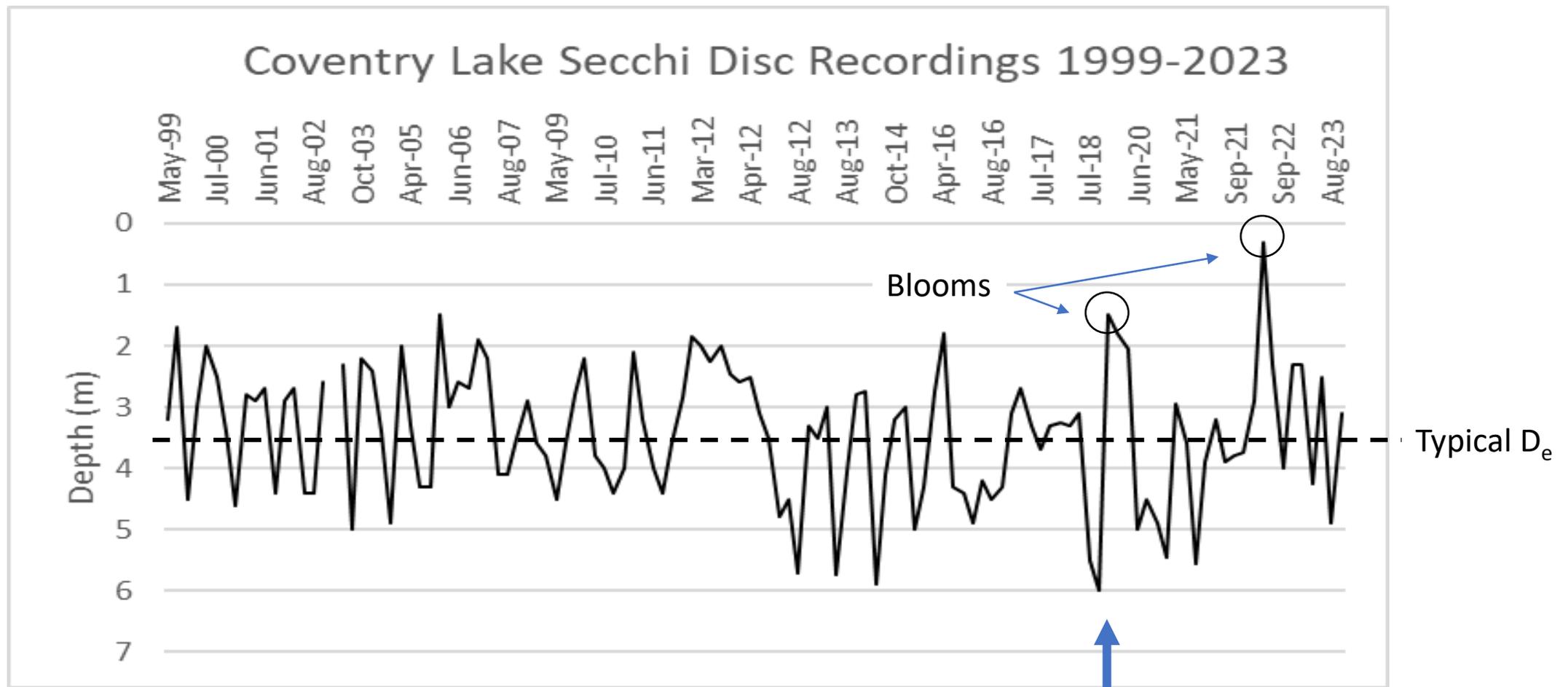


# Some History and Recent Trends



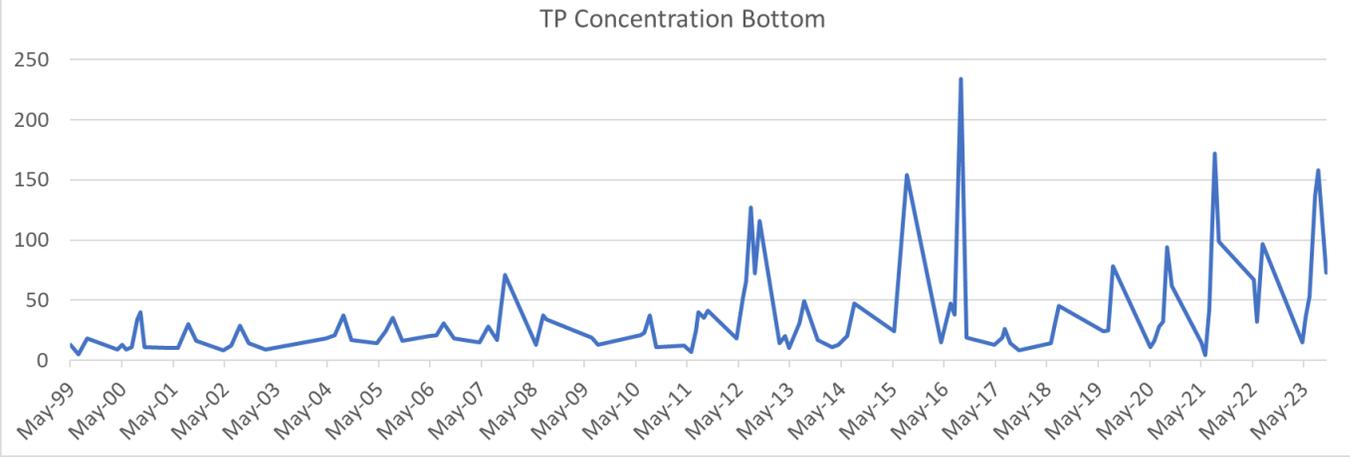
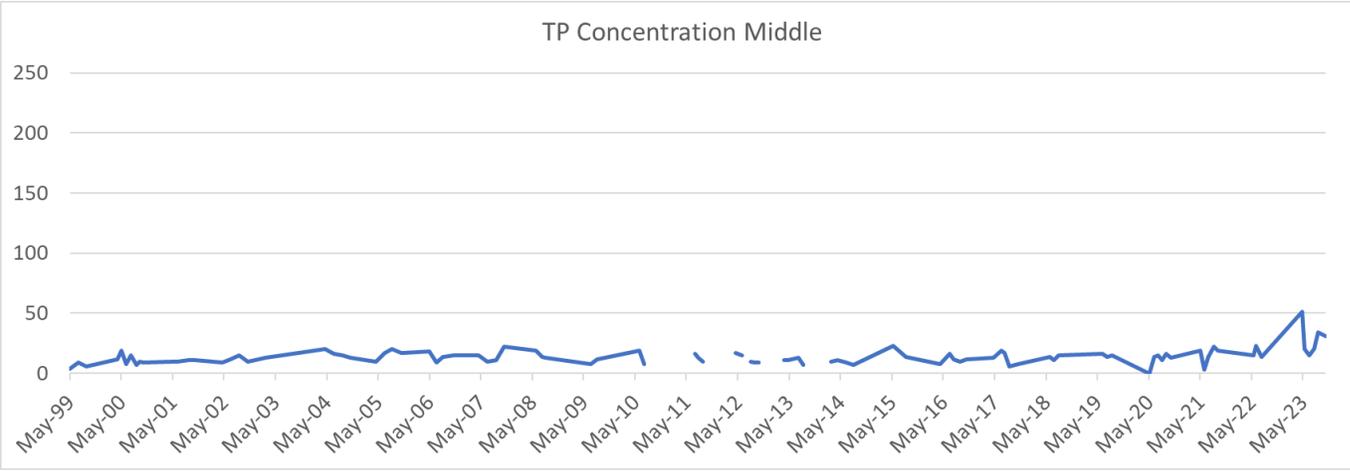
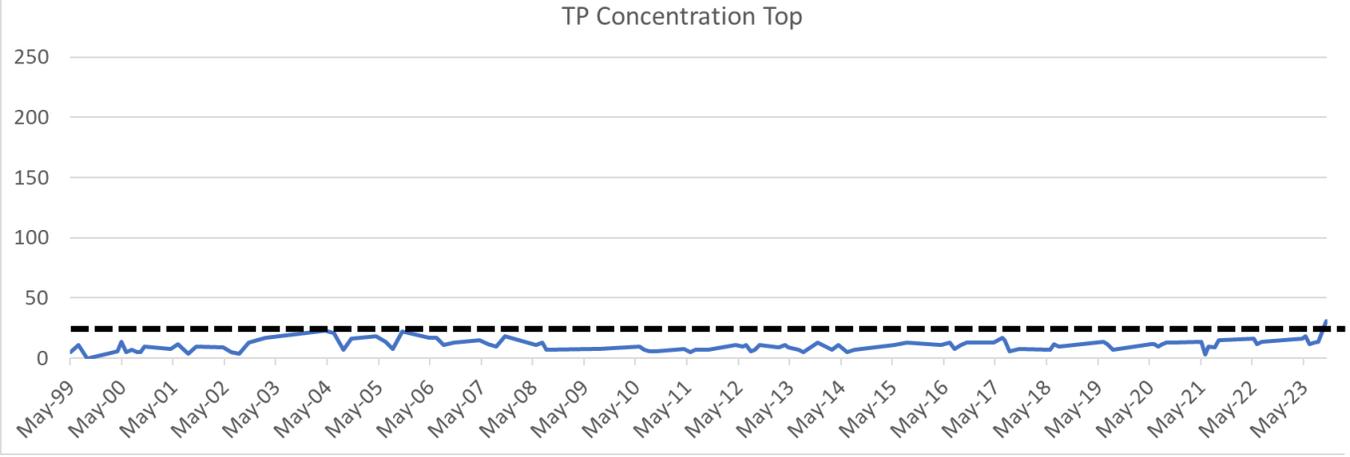
It appears that cyanobacteria are becoming more abundant and dominant in the phytoplankton assemblage, especially over the past decade.

# Some History and Recent Trends



2018 exhibited the best Summer transparency and worst Fall transparency.

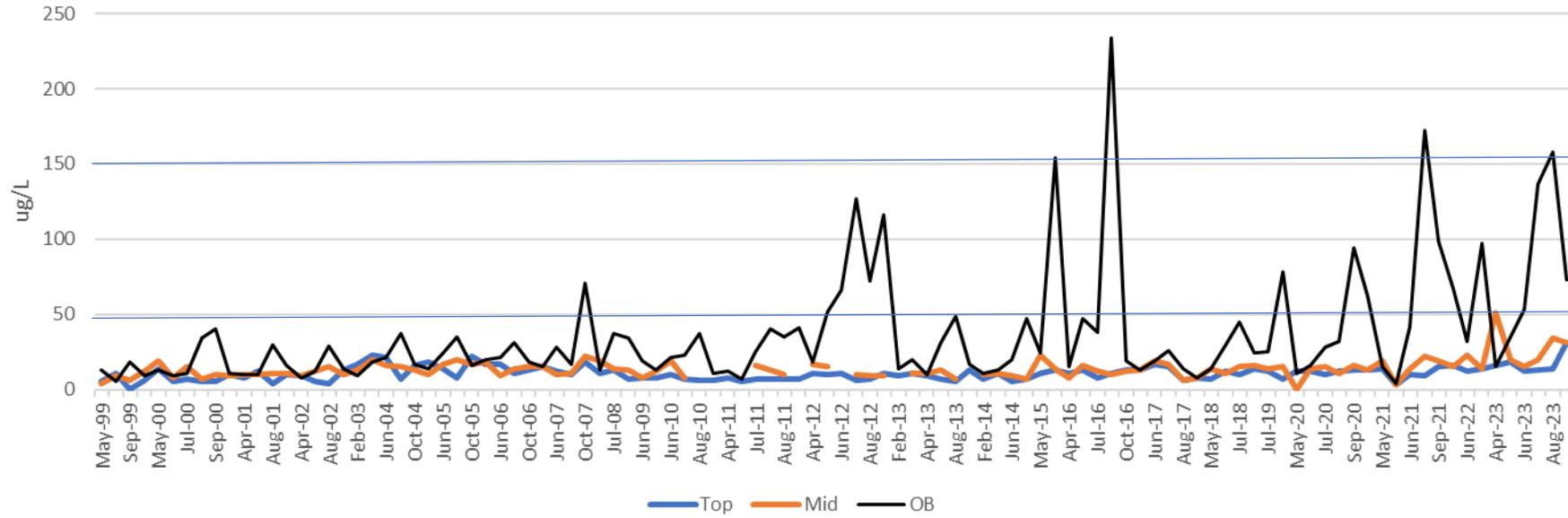
# Some History and Recent Trends



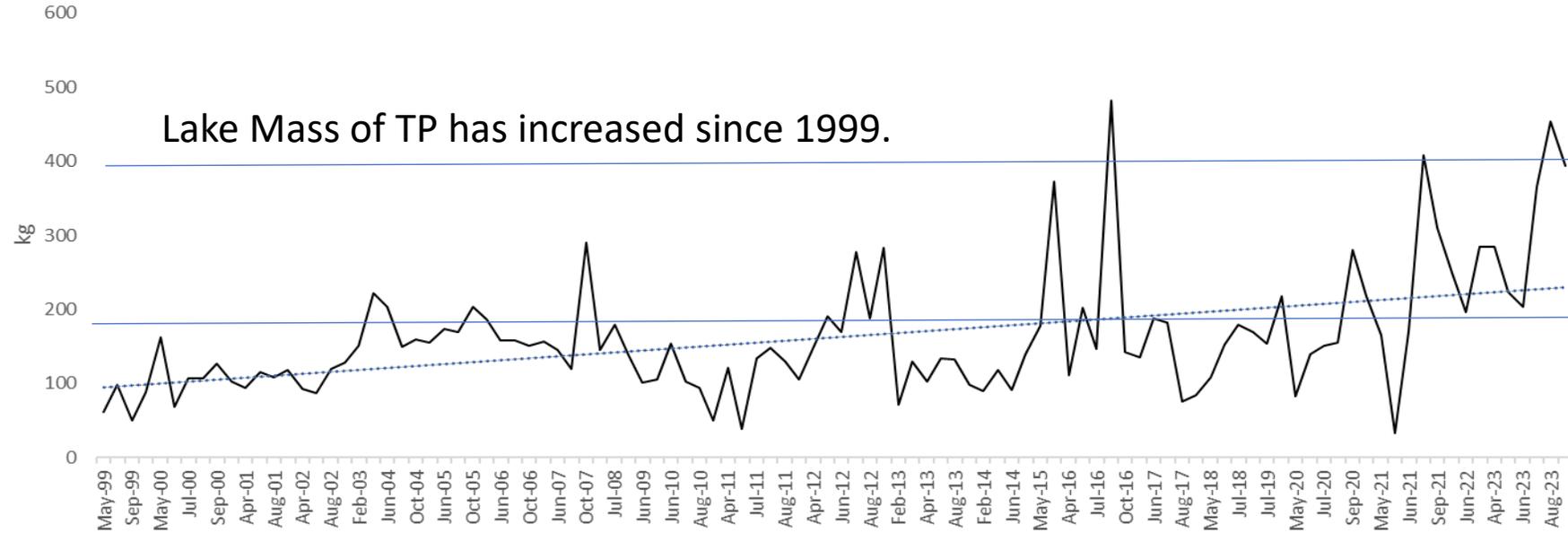
An examination of TP concentrations since 1999 suggests that the accumulation in deep strata may be increasing, especially over the past decade. Fortunately, adequate separation between De and AB has kept the deep P from becoming available to cyanobacteria in the mixed, illuminated surface layer *(so far, most of the time)*.

# Some History and Recent Trends

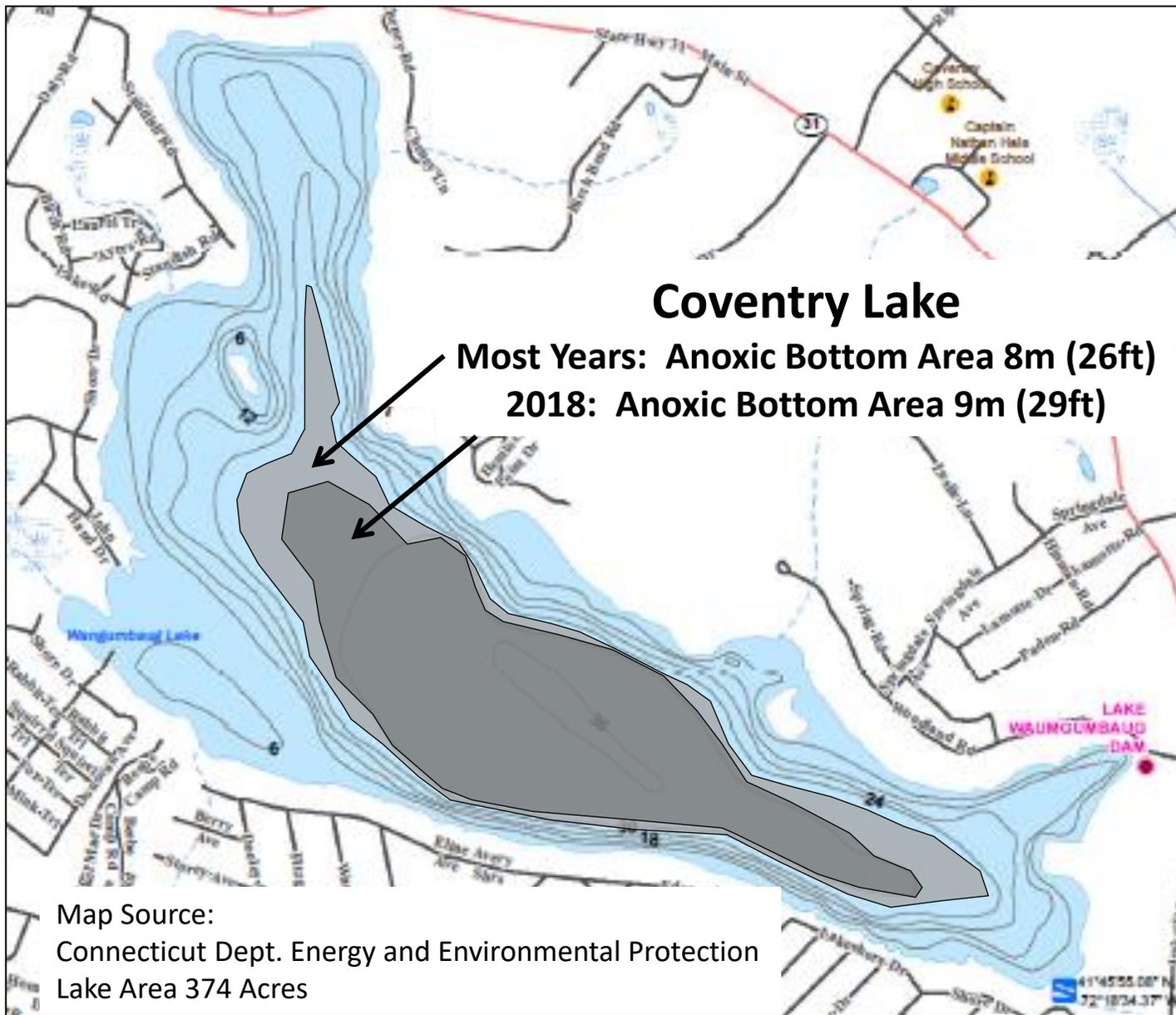
## Coventry TP concentrations 1999-2023



## kg of TP in Coventry Lake 1999-2023



Not only are deep TP concentrations increasing, but when the total amount of TP in lake water is computed by multiplying concentration by volumes the total pounds or kilograms of TP in the lake is increasing.



Although deeper mixing can have benefits in some lakes and reservoirs (shallow lakes), in Coventry Lake deeper mixing doesn't decrease the anaerobic bottom area much but does significantly reduce the separation of the mixing depth and anaerobic boundary.

**Coventry Lake is susceptible to increased duration of anoxia and increased intense storm mixing frequency caused by climate change.**

# Coventry Lake

## Concerns

- Climate Change
- Induced Development by Sewer Availability
- Watershed and Waterfront Development  
(Lawn is not a pervious cover type)

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# Coventry Lake 2022 Bloom

## Possible Forcing Factors (Causes):

- Effects of Climatic Weather Patterns starting in 2018
  - Altered Phytoplankton Seasonal Succession
  - Impacts to Stratification Structure –  $D_e$  vs AB
  - Increased Anoxic Factor (area and duration of anoxia)
- More Intense Fall Blooms
  - More “Akinete Spores” for next year
  - Cyanobacteria Persist through Winter
- Extended Stratification Period / Growing Season
- Altered Nitrogen Availability, Nitrate Depletion (N:P) (no Nitrate in Surface Water)
- Altered Micronutrient Availability (Silica, Fe)
- Shift in pH, hence Free  $\text{CO}_2$  Availability (pH > 9 in July Surface)

Kortmann, R.W., Elizabeth Cummins, 2018. **Climate Change in the Northeast: What Might it Mean to Water Quality Management?** *NEWWA Journal*

Kortmann, R.W., March 2021. **Managing Reservoir Stratification in a Variable Climate.** *NEWWA Journal*.

*Lakes are the “canaries in the coal mine” for climate change impacts.*



*I consider climate change to be the second biggest threat to the quality of Coventry Lake.*

### • **Are Blooms Likely in the Future ?**

- Yes, Blooms Following Turnover
  - Blooms result in Increased Oxygen Demand, Decreased Light Penetration, and Increased Internal Nutrient Loading
- Will Late Summer & Fall Blooms become more intense? (Probably?)
- Will cyanobacteria persist through winter? (Maybe, Depends on Mother Nature)
- Will more cyanobacteria in the Fall mean more akinete seeds next year? (Probably?)

I am concerned with the trend I've seen, especially over the past decade- more development, loss of undisturbed woodland, and altering the character of the perimeter of the lake (the "ecotone", land-water interface).

Original= 0.1349 lb P/yr

Target P Export = 0.0896 lb P/yr

- ReBuilt without Regulatory controls, % cover, etc.= 0.2792 lb P/yr  
100% Increased P Export
- ReBuilt with Regulatory Controls= 0.2280 lb P/yr  
70% Increased P Export
- Rebuilt Some Added BMPs= 0.1093 lb P/yr 20%  
P Export Reduction; Not Target  
Landscaping, Some Roof First Flush Capture
- Rebuilt More BMPs= 0.0877 lb P/yr Reached  
Allocation Goal    More First Flush BMPs

*That will result in a gradual, incremental, cumulative increase in watershed and internal nutrient loading and cyanobacteria blooms.*

Regulations, and Town projects on right-of-ways, can only do so much. More can, and should, be done by private property owners on their property.

**There is no better nutrient removal and retention system than an undisturbed woodland. Landscaping techniques can mimic the function of a woodland- reduce surface runoff, especially the first wash of a storm, and get as much rainfall into the ground where it falls as possible.**

Target= 0.0896 lb P/yr

Original= 0.1349lb P/yr

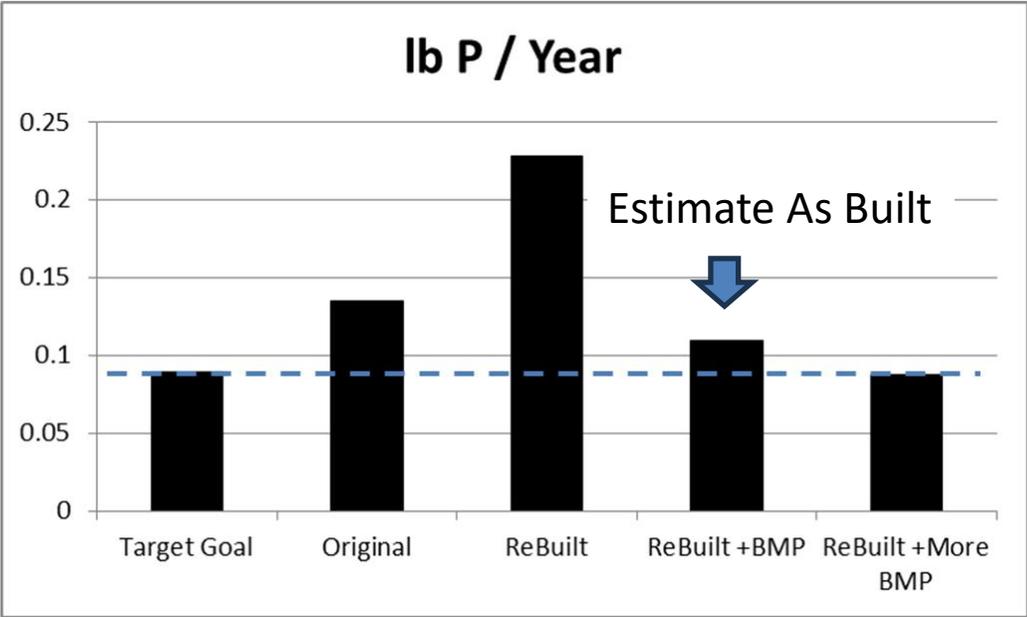
ReBuilt= 0.2280 lb P/yr

Rebuilt Some BMPs= 0.1093 lb P/yr

Rebuilt More BMPs= 0.0877 lb P/yr

(This example only estimates stormwater impacts.)

*Very nice redevelopment, but more TP export.*



Development or redevelopment of one small 0.3 acre lot will not make Coventry Lake eutrophic with cyanobacteria blooms. *But multiply that by the many hundreds of lots in the watershed- the cumulative effect.*

Simply converting a part of a lawn to “simulated woodland”, while maintaining view corridors, can reduce P export. ***Watershed management can be effective, but it needs to occur on individual private properties.***

**OPINION:** The “reasonable use of private property” for which the small lake area lots were created was “summer bungalow get-away”, today’s uses exceed that.

Lakefront properties present additional challenges. Managing stormwater runoff is important, as discussed previously. However, the shoreline perimeter of the lake is an important “ecotone”. An ecotone is an area where two different habitat forms intersect, in this case the land-water interface. It is a particularly important habitat area. In the land-water ecotone the energy of wave action and littoral drift also need to be managed relative to both winter and summer lake levels (and wake waves are becoming larger).

**What will the perimeter of Coventry Lake look like in the future? 10 years? 50 years? And beyond?  
Will there be any near-lake Nature left?**

# **Coventry Lake Questions**

