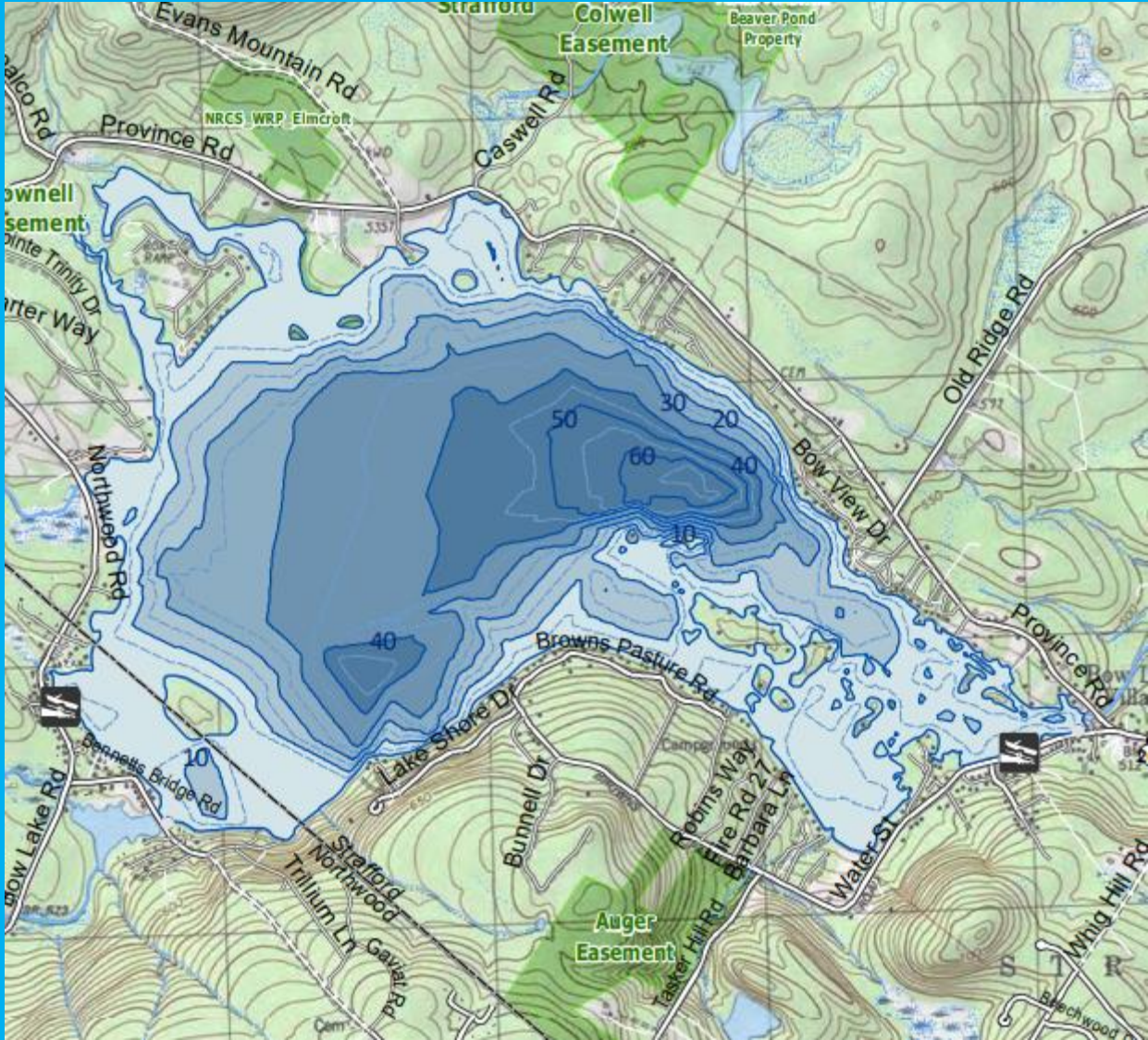


Bow Lake, Stafford, NH: Water Quality and Cyanobacteria



David Neils
Chief Aquatic Biologist
NHDES
david.e.neils@des.nh.gov

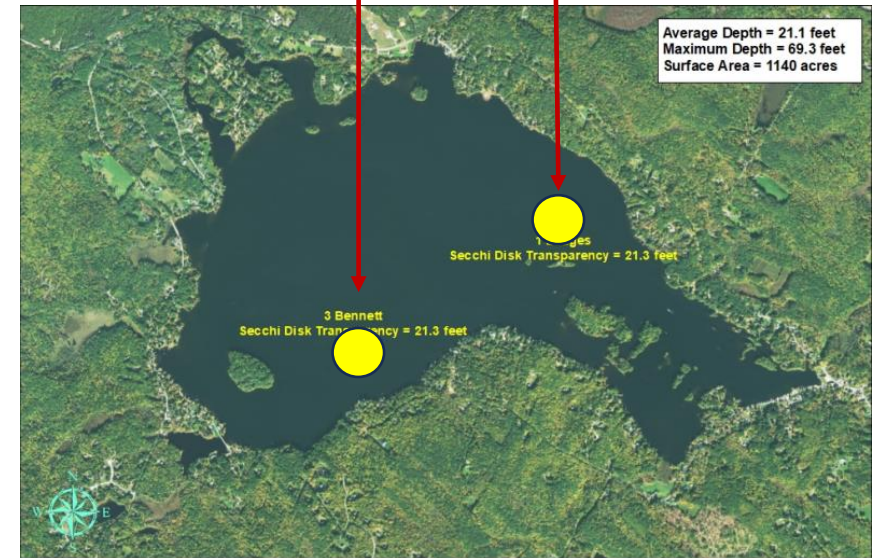
Presentation Outline

1. Brief Water Quality Summary
2. Cyanobacteria History
3. Cyanobacteria Prevention Strategies
4. Statewide cyanobacteria plan preview

UNH Lay Lake Monitoring Program Participant since 1983

NH LLMP Reports		SAMPLING STATION	REPORT YEAR	REPORT TYPE	WATER BODY TYPE
		All stations	All years	All types	All types
SELECT A LAKE Baboosic Lake Balch Pond Belleau Lake Bow Lake Canaan Street Lake Chalk Pond Chocorua Lake Conner Pond Conway Lake Crescent Lake Crystal Lake (Eaton) Crystal Lake (Enfield) Downing Pond Dublin Lake Eaton Lakes Flint Pond Goose Pond Great East Lake Horn Pond Horseshoe Pond	Bow Lake, 2022	Station 1 - Ledges	[View Report]	[Highlight]	
	Bow Lake, 2022	Station 3 - Bennett	[View Report]	[Highlight]	
	Bow Lake, 2022	Nearshore Sites	[View Report]	[Highlight]	
	Bow Lake, 2021	Nearshore Sites	[View Report]	[Highlight]	
	Bow Lake, 2021	Station 1 - Ledges	[View Report]	[Highlight]	
	Bow Lake, 2021	Station 3 - Bennett	[View Report]	[Highlight]	
	Bow Lake, 2020	Station 1 - Ledges	[View Report]	[Highlight]	
	Bow Lake, 2020	Station 3 - Bennett	[View Report]	[Highlight]	
	Bow Lake, 2019	Lakewide	[View Report]	[Full]	
	Bow Lake, 2019	Station 1 - Ledges	[View Report]	[Highlight]	
	Bow Lake, 2019	Station 3 - Bennett	[View Report]	[Highlight]	
	Bow Lake, 2018	Lakewide	[View Report]	[Full]	
	Bow Lake, 2018	Station 1 - Ledges	[View Report]	[Highlight]	
	Bow Lake, 2018	Station 3 - Bennett	[View Report]	[Highlight]	
	Bow Lake, 2017	Lakewide	[View Report]	[Full]	
	Bow Lake, 2017	Station 3 - Bennett	[View Report]	[Highlight]	
	Bow Lake, 2017	Station 3 - Bennett	[View Report]	[Highlight]	
	Bow Lake, 2016	Lakewide	[View Report]	[Full]	
	Bow Lake, 2016	Station 1 - Ledges	[View Report]	[Highlight]	
	Bow Lake, 2015	Lakewide	[View Report]	[Full]	
	Bow Lake, 2015	Station 1 - Ledges	[View Report]	[Highlight]	
	Bow Lake, 2014	Station 1 - Ledges	[View Report]	[Highlight]	
	Bow Lake, 2013	Lakewide	[View Report]	[Full]	
	Bow Lake, 2013	Station 1 - Ledges	[View Report]	[Highlight]	

2 Deep spot locations:
Station 1- Ledges
Station 3 - Bennett



+ Nearshore sites (24 in 2022)

A superior effort by the lake association and volunteers

Long term water quality data is the only way to understand what is going on in the lake

Station 1 - Ledges

Blue = Oligotrophic
 Yellow = Mesotrophic
 Red = Eutrophic
 Gray = No Data

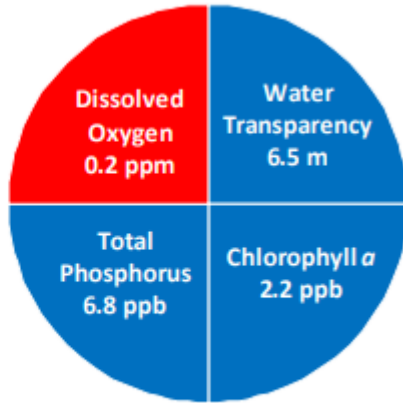


Figure 1. Bow Lake Water Quality (2022)

Deep spot water quality summary

- Water transparency > NH avg. for oligotrophic lakes (4.5m)
- Chl a = NH avg. for oligotrophic lakes (2.5 ppb)
- TP = NH avg. for oligotrophic lakes (6.7 ppb)

Long Term Trends

- Water transparency = 5 – 8m
 - Chl a = 1 – 3 ppb
 - TP = 6 – 8 ppb
- No major changes over time

Station 3 - Bennett

Blue = Oligotrophic
 Yellow = Mesotrophic
 Red = Eutrophic
 Gray = No Data

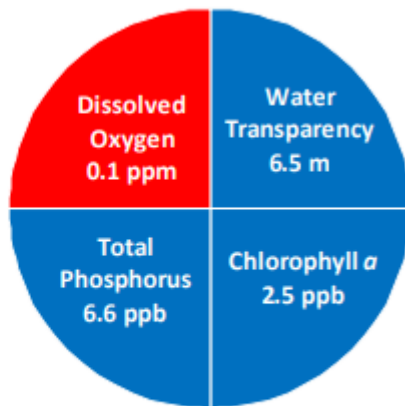


Figure 1. Bow Lake Water Quality (2022)

NH Water Quality Thresholds

Chlorophyll a

Trophic Class	Chl-a (µg/L)
Oligotrophic	< 3.3
Mesotrophic	≤ 5.0
Eutrophic	≤ 11

(NHDES, 2009)

Total Phosphorus

Trophic Class	TP (µg/L)
Oligotrophic	< 8.0
Mesotrophic	≤ 12.0
Eutrophic	≤ 28

(NHDES, 2009)

Dissolved Oxygen – Ledges & Bennett

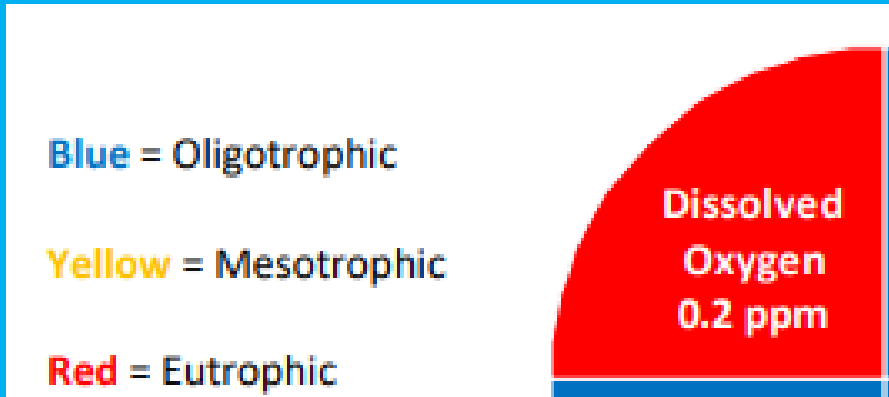


Figure 7. Bow Lake - Site 3 Bennett
Dissolved Oxygen Profiles (June 22 through September 7, 2022)

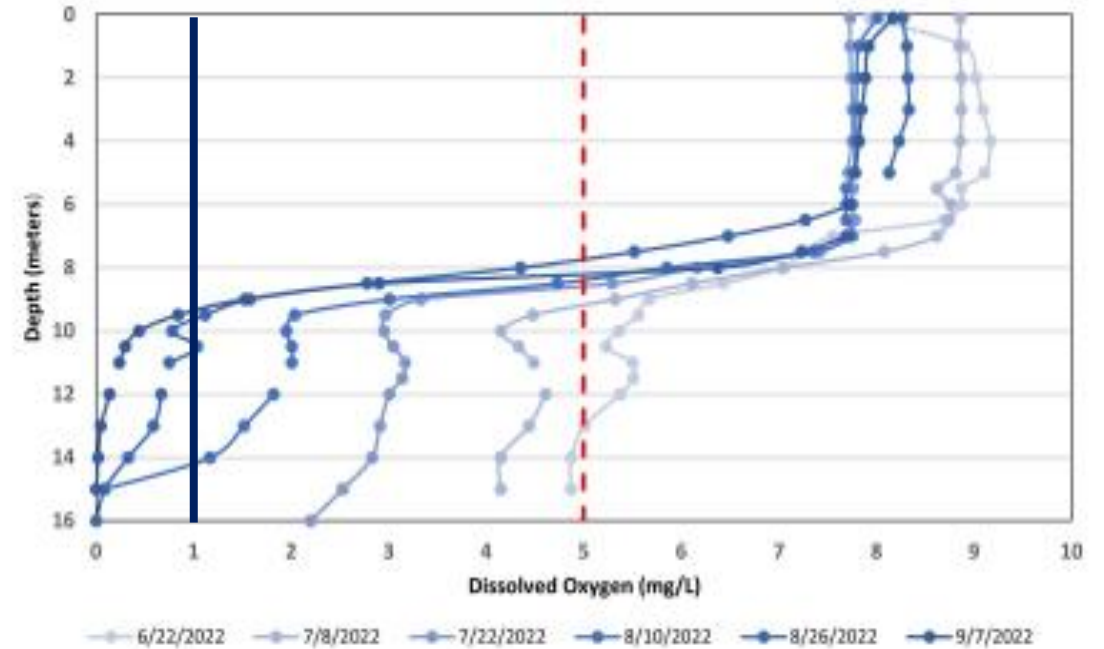
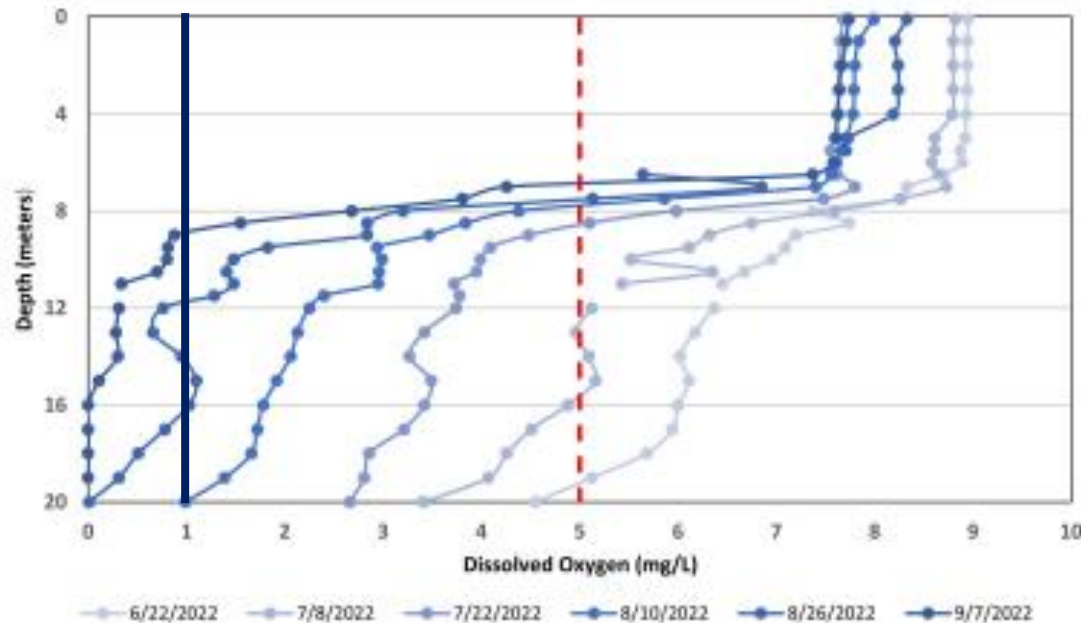


Figure 7. Bow Lake - Site 1 Ledges
Dissolved Oxygen Profiles (June 22 through September 7, 2022)



- DO < 5 ppm (red vertical line) does not support fish for extended periods (~8m by mid-summer).
- DO < 1 ppm (black vertical line) allows phosphorus to be released from bottom sediments (9-10m by late summer).

Nearshore Sampling Locations

BOW LAKE

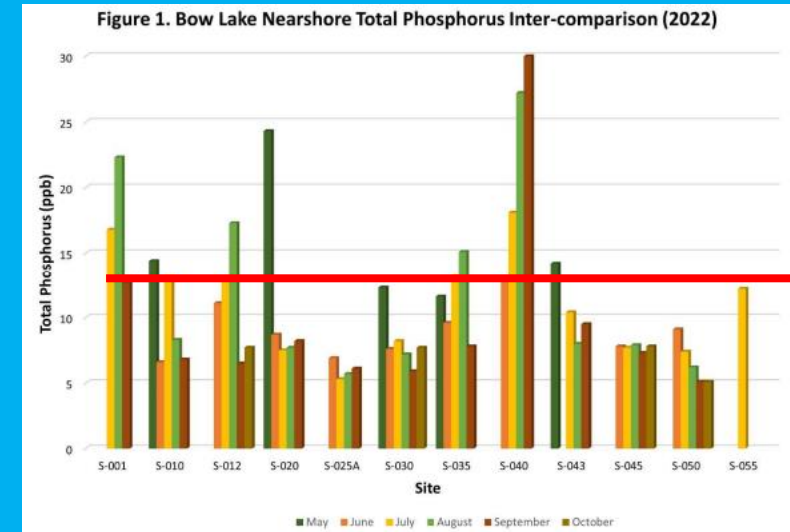
2022 SAMPLING HIGHLIGHTS

Nearshore sampling locations

Strafford and Northwood, NH



- Most sites between 5 – 10 ppb
- Some sites >12 ppb (eutrophic)



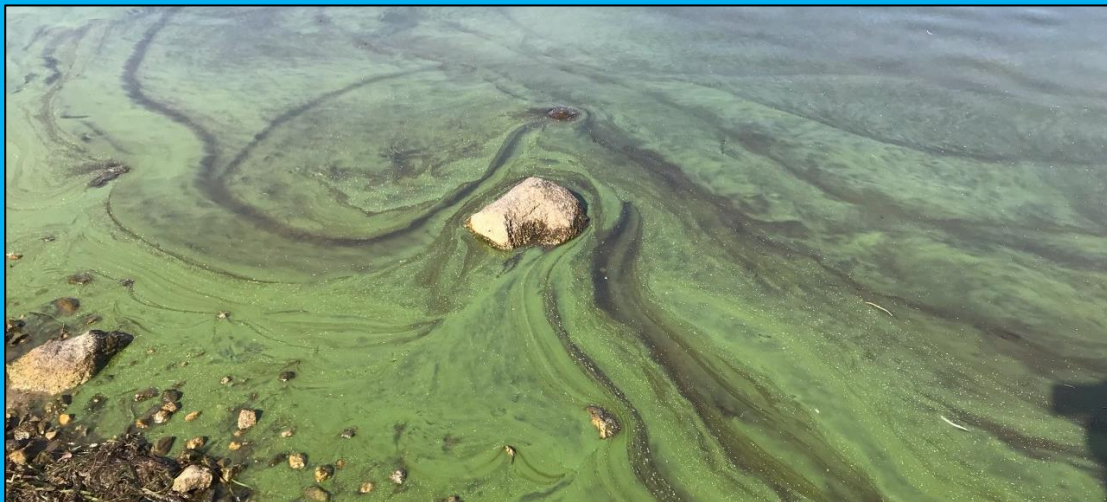
= 12 ppb

- Sample locations in “bays” tended to have higher phosphorus concentrations and may be more susceptible to nutrient loading or cyanobacteria blooms
- Sample locations in less “protected” areas had lower phosphorus concentrations
- Stormwater management projects are important to control runoff into the lake

Cyanobacteria Overview

Background

- Originated 3.5 billion years ago
- Microscopic
- “Native” to NH lakes
- Previously called blue-green algae
- Can produce toxins that cause nausea, skin irritation, tingling, numbness, seizures, and promote tumor growth

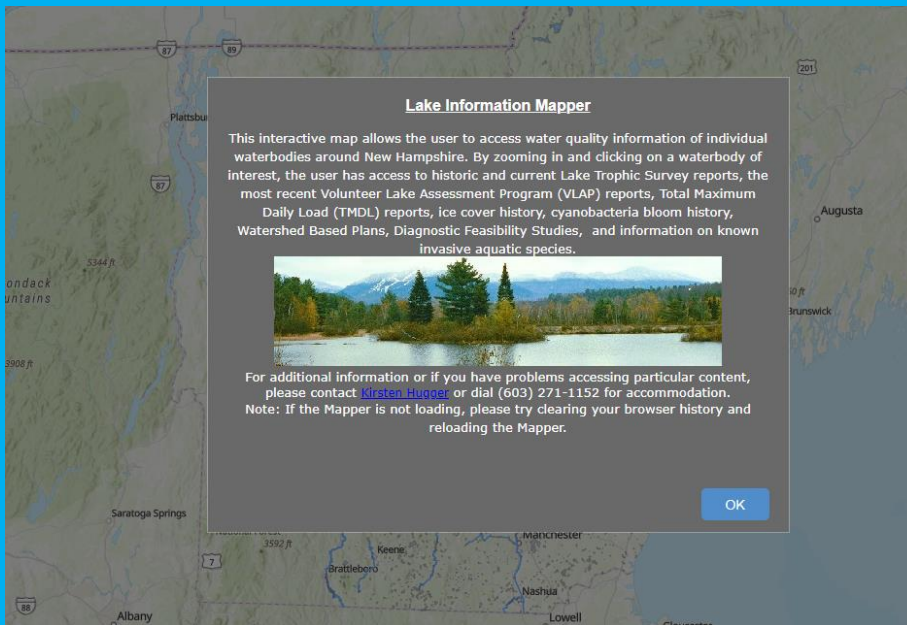


Cyanobacteria in Bow Lake

NHDES issued “warnings”

- 6/4/2021: 9 days total, >70,000 cells/ml
- 5/31/2022: 7 days total, 3 mil. cells/ml
- 6/1/2023: 15 days total, 963,000 cells/ml

Lake Information Mapper



Cyanobacteria Bloom Report Form



- Consistent format for reporting blooms to NHDES
- Response is typically within 24 hours
- Allows pictures of bloom to be included in report

Waterbody name*
Example: Silver Lake

Where on the waterbody is the bloom located?*

Shoreline

Main Body

Both

Location details
Please add details about the location or extent of the bloom as necessary. Example: Southwest corner, Fisher's Cove, etc.

Size of bloom*

Small, localized - size of a car or smaller

Widespread - size of a tennis court

Cyanobacteria Bloom Ingredients

Simplified Cyanobacteria Bloom Equation



Light

Can't control

+



Heat

Limited ability to control at local level

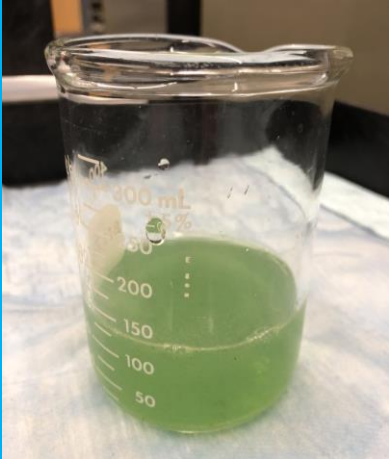
+

Phosphorus (P)
Nitrogen (N)

Nutrients

Direct influence possible

=



Boom!

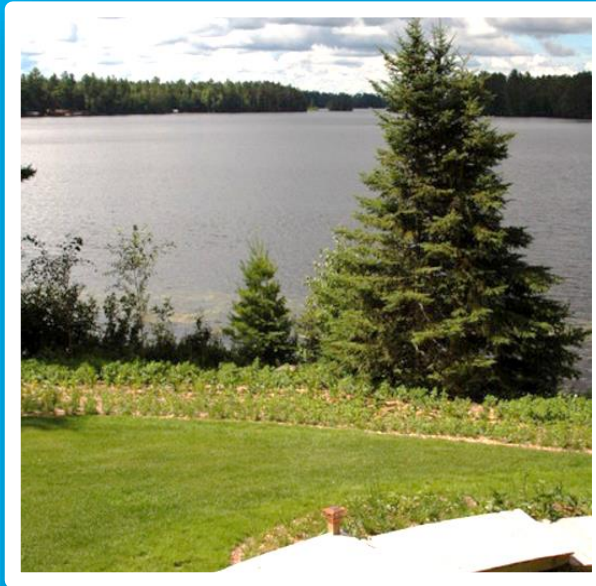
Cyanobacteria blooms and nutrient loading

Control of nutrient inputs is the best way to prevent blooms!

- Unmanaged Stormwater is the number #1 cause of excessive nutrient loading
- Lake bottom sediments can contribute large nutrient loads when dissolved oxygen is <1 mg/L
- Fertilizers contain lots of nutrients (nitrogen and some phosphorus)
- Failing/old/unmaintained septic systems can contribute unnecessary nutrient loads



Cyanobacteria Prevention Strategies



Cyanobacteria Prevention Strategies

Larger Scale Nutrient Prevention Strategies:

Complete a watershed plan – Models nutrient loading, establishes water quality targets, identifies projects to protect/restore water quality.

Review town ordinances – Are specific overlay districts in place to reduce runoff, require septic system inspections?

Maintain gravel roads – Identify gravel roads that drain to the lake or tributaries and document culverts, storm drains, etc.

Participate in voluntary lakeshore property programs – NHLAKES LakeSmart, NHDES 'SOAK up the rain' programs offer services the lakeside landowners to reduce stormwater impacts and protect the shoreland.

Protect undeveloped land – Identify undeveloped land and consider opportunities to keep it “as is”.

Cyanobacteria blooms result in recreational use restrictions that impact the enjoyment of the lake and can reduce property values.

It is in everyone's best interest to reduce nutrient loading.

Statewide cyanobacteria plan preview

HB1066 passed in 2022 requiring NHDES develop a statewide cyanobacteria plan

- 17 member cyanobacteria advisory committee provided input to NHDES on the plan's content
- Final plan due Nov. 1, 2023.

Four Strategies of the Plan:

- 1) Develop policies and practices to reduce nutrient inputs
- 2) Advance education and outreach efforts
- 3) Enhance cyanobacteria monitoring to track and communicate bloom conditions
- 4) Minimize risks from cyanobacteria blooms to public water supplies

Successful implementation of the plan will require broad support from lake associations and shorefront property owners

The Ultimate Goal is.....

THIS



NOT THIS



Thank you for your time.

Dave Neils, NHDES

david.e.neils@des.nh.gov