# Trends in New Hampshire's Water Quality

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## Watershed Management Bureau (WMB)

Monitor & assess the quality of the state's surface waters

Thousands of water quality samples each year

Make informed and accurate water management decisions

Communicate to public the status of health and safety of state's waters



New Hampshire Department of Environmental Services Water Monitoring Strategy

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## Water Monitoring Strategy

### WMB's water monitoring plan

- 2014 2024
- Serve as manual to implementation of surface water quality programs
- Probability, trend, & synoptic monitoring

For trend-based lake & pond monitoring

- Trend report due every five years
- First report due in 2020
- Data collected primarily through VLAP
- Secondary: Exotics & Beach

## Volunteer Lake Assessment Program (VLAP)

- Initiated 1985
- ~500 volunteers for 170 lakes
- Trains volunteers to collect high quality data
  - Biennial biologist visits
  - Surface water quality assessments
  - VLAP QAP







**Exotic Species Program** 

- Control & management of exotic aquatic plants
- Initiated 1981

### **Beach Inspection Program**

- Sample swimming beaches for fecal bacteria (E. coli)
- Respond to reports of cyanobacteria
- Issue advisories



150 lakes & ponds used in these analyses

Minimum 10 years of data

1991 - 2018



## Water Monitoring Strategy Questions

- 1. What are current conditions with respect to statewide data?
- 2. Are trends stable, improving, or worsening over the long term?
- 3. How do conditions for the current reporting period compare with data from the recent past?

Individual waterbody & trophic class



## **Current Condition**

- Statewide frequency distribution by trophic class
- All available lake data, 1991 2018
- Determine percentiles
  - < 25<sup>th</sup> percentile
  - > 75<sup>th</sup> percentile



- Annual medians, 1991 2018
  - Individual waterbody & trophic class
- Mann Kendall non-parametric trend test
  - ≥ 5 waterbodies/year
- Sen slope
  - 95% confidence interval
- Significance at p < 0.05



## Short-Term Change

- Data from Group 1 (2009 2013) vs. Group 2 (2014 2018)
- Wilcoxon Rank Sum Test (a.k.a. Mann-Whitney U Test)
- Significance at p < 0.05



## Water Monitoring Strategy Parameters

### **Primary Indicator**



- Bacteria (E. coli)
- Chlorophyll-a
  - Cyanobacteria
  - Exotic aquatic plants
- 👍 pH
- Secchi depth
  - Specific conductance
  - Total phosphorus

### **Accessory Indicator**

- Alkalinity
- Dissolved oxygen
  - Ice in/out records
  - Water temperature



## Water Monitoring Strategy Parameters

### **Primary Indicator**



- Bacteria (E. coli)
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### **Accessory Indicator**

## Alkalinity

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#### **Current Condition**







**Current Condition** 

None

< 25th</p>

>75th

### **Significant Increase** in eutrophic waterbodies

10%

4%

19%





### **Current Condition**



## No Trend









## **Significant Increase** in eutrophic & mesotrophic waterbodies





**Current Condition** 

None

< 25th</p>

> 75th

26%

**Significant Decrease** in mesotrophic & oligotrophic waterbodies





Sen's Slope By Trophic Class

Current Condition None < 25th > 75th

 35%



### **Significant Increase** in eutrophic & mesotrophic waterbodies

#### **Current Condition**



#### **Long-Term Trend**



## Significant Increase in mesotrophic &

oligotrophic waterbodies



**Short-Term Change** 



### Chlorophyll-a

- No long term trophic trends
- ~10% decreasing short-term

### & Total Phosphorus

- Increasing trend eutrophic
- ~ equal short-term changes



Secchi Depth

- Decreasing trend mesotrophic & oligotrophic
  - ~16% all waterbodies decreasing
- ~ equal short-term changes
  - ~4% decreasing, 6% increasing



### **Specific Conductance**

- Increasing trend eutrophic & mesotrophic
  - ~41% all waterbodies increasing
- ~80% increasing short-term





### Alkalinity

- Increasing trend eutrophic & mesotrophic
  - ~59% all waterbodies increasing
- ~74% increasing short-term

### & pH

- No long term trophic trends
  - ~13% all waterbodies increasing
- ~ 24% increasing short-term
  - ~4% decreasing







#### Temperature

- Increasing trend mesotrophic
   & oligotrophic
  - ~18% all waterbodies increasing
- ~5% increasing short-term





Recovery from acid rain

Lake Browning



Chlorophyll-a Phosphorus Temperature Alkalinity рΗ Secchi depth

Climate change

Secchi depth Alkalinity pН Temperature Chlorophyll-a Phosphorus

Alkalinity

рΗ

NaC (NaC **Freshwater salinization** syndrome NaC NaC NaC Specific conductance NaC (NaCl Specific conductance Chlorophyll-a Phosphorus **Cultural eutrophication** 28

## Final notes & future directions

- Not representative of the entire state
- 2022 Probability Survey Report
- Next report planned for 2025



# Questions?

Thanks to our many VLAP volunteers, VLAP interns, & Sara Steiner, VLAP coordinator!

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