# East Twin Lake

## 2020 Water Quality Monitoring

Aquatic Ecosystem Research

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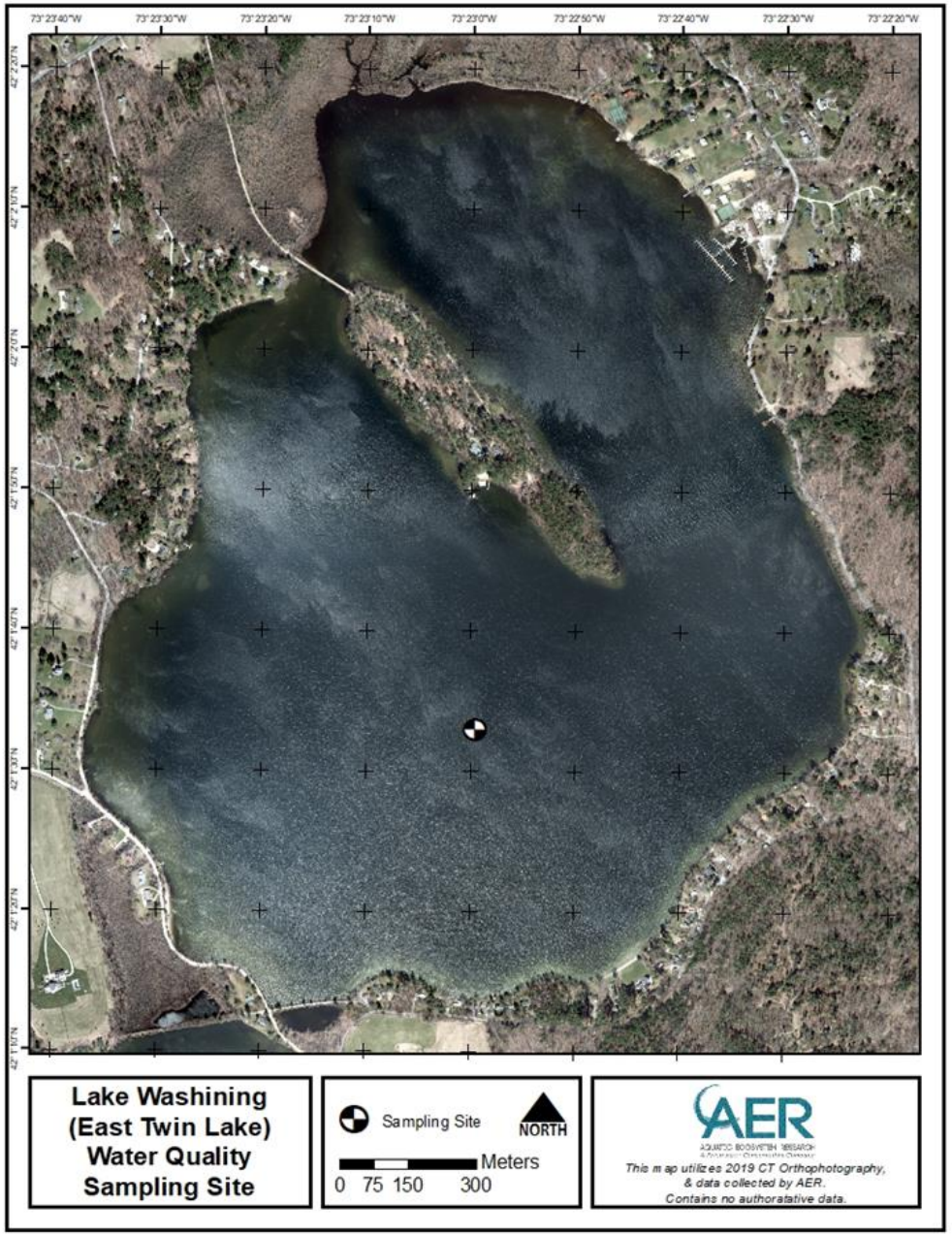
# Tonight…

- Monitoring program
- Familiarize you with the Report
- Important Findings
- Implications on Future Management

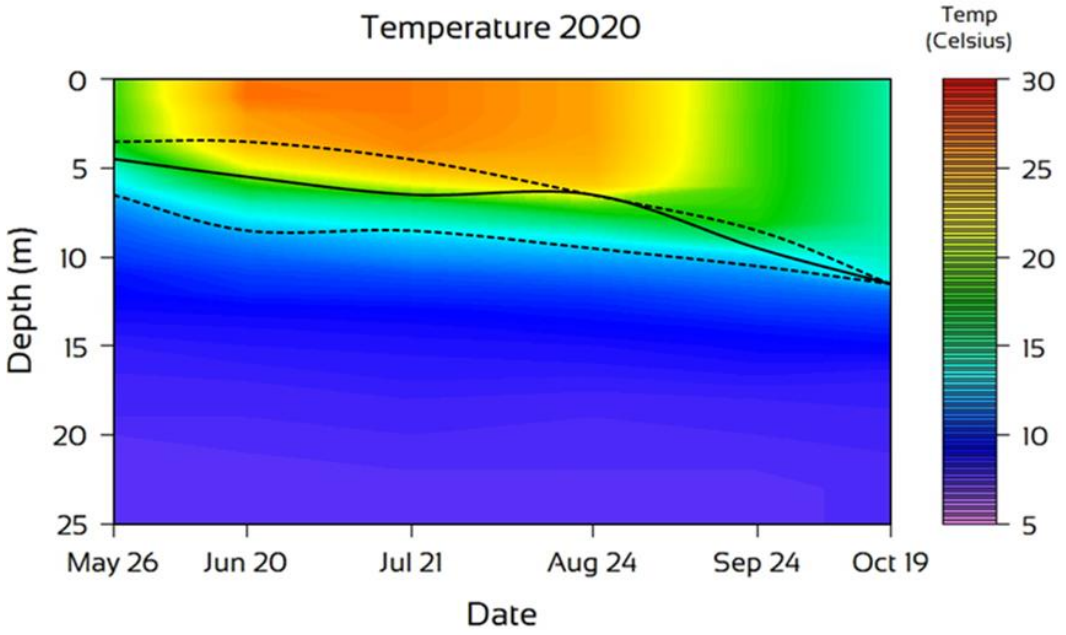
# Monitoring Program

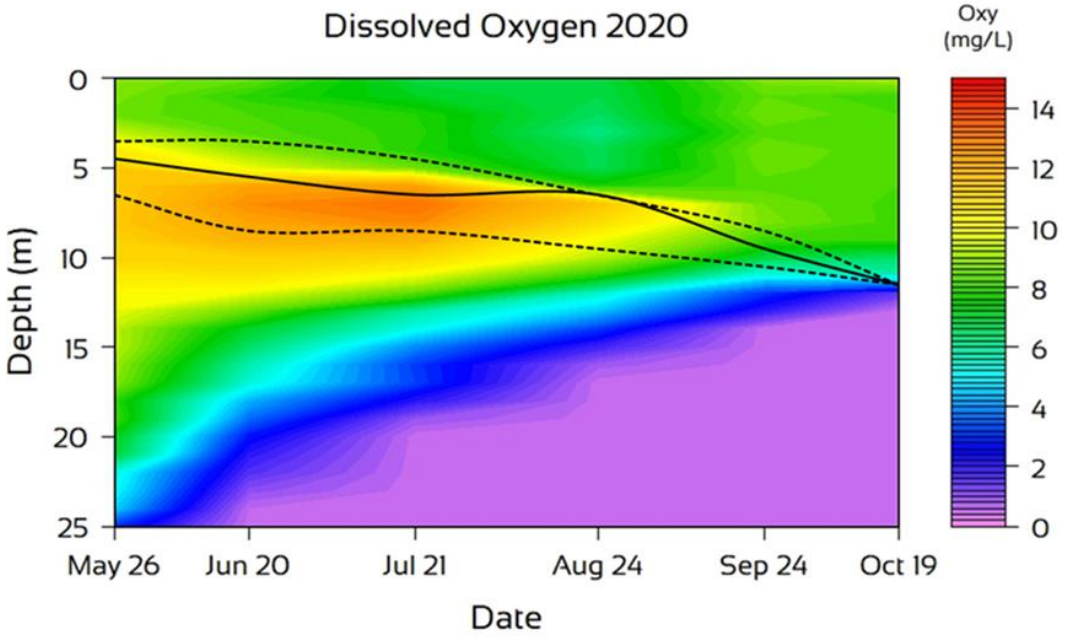
- Data and sample collection monthly by Peter and Kathy Neely monthly from May – October
- Most laboratory analyses by HydroTechnologies, LLC
- Algal analyses by AER
- Field and lab results to AER for assessment



# Temperature and Oxygen

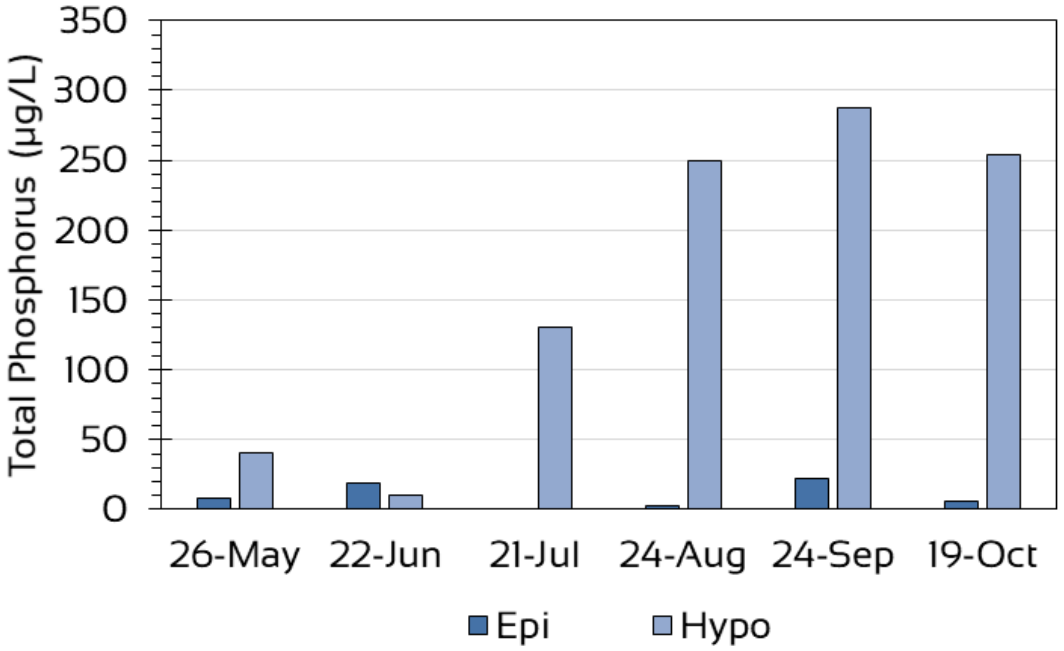
- Measured 0.5m, 1m and every meter to bottom
- Isopleth diagrams infer conditions between depths and dates
- Provides visual of change over time
- Epilimnion, Metalimnion, Hypolimnion
- What changed?



# Total Phosphorus

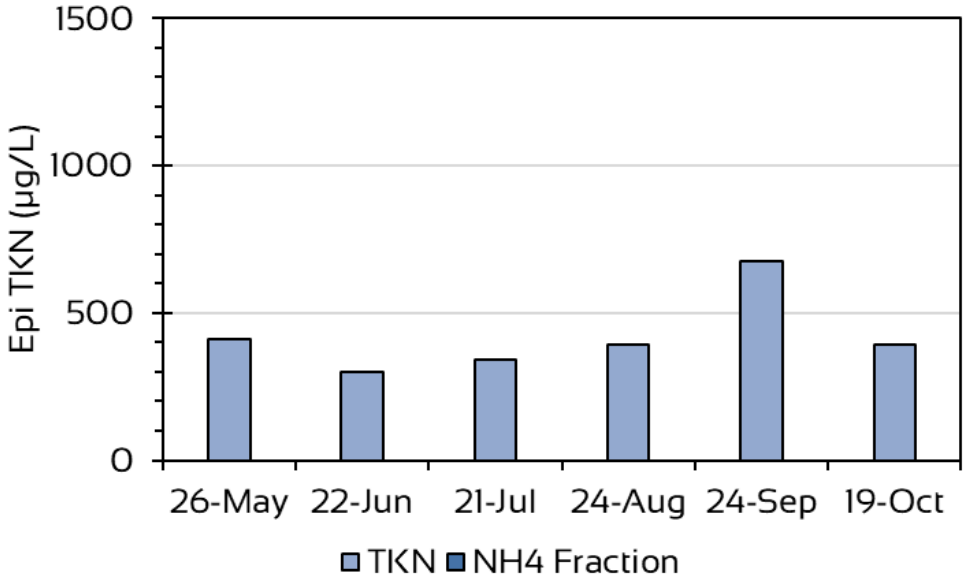
- Nutrient limiting algal productivity
- Epilimnetic average was 9.7µg/L; range was 0 to 24µg/L
- Hypolimnetic average was 162µg/L; range was 10 to 288µg/L

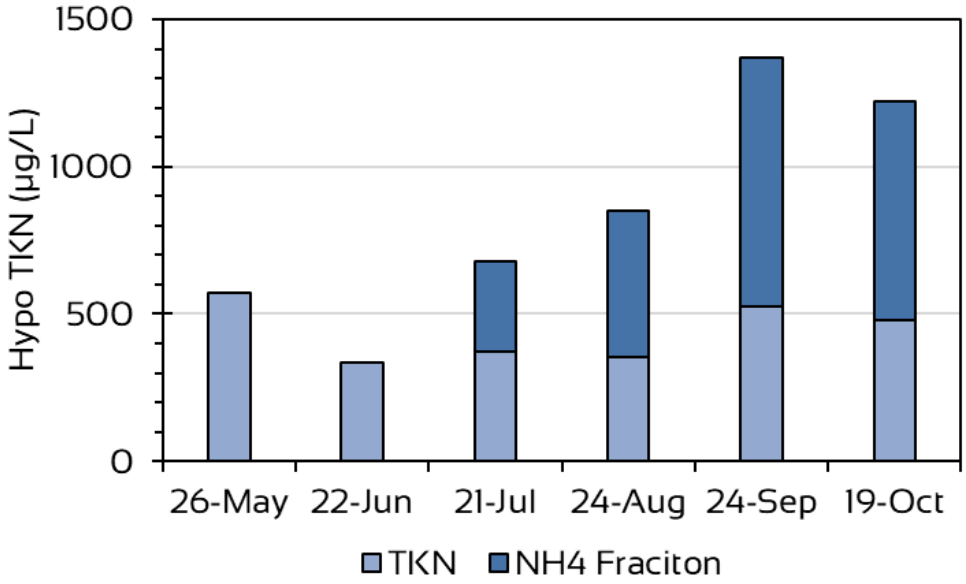



Total phosphorus concentrations measured in the epilimnion (Epi) and hypolimnion (Hypo) in East Twin Lake during the 2020 season.

# Nitrogen

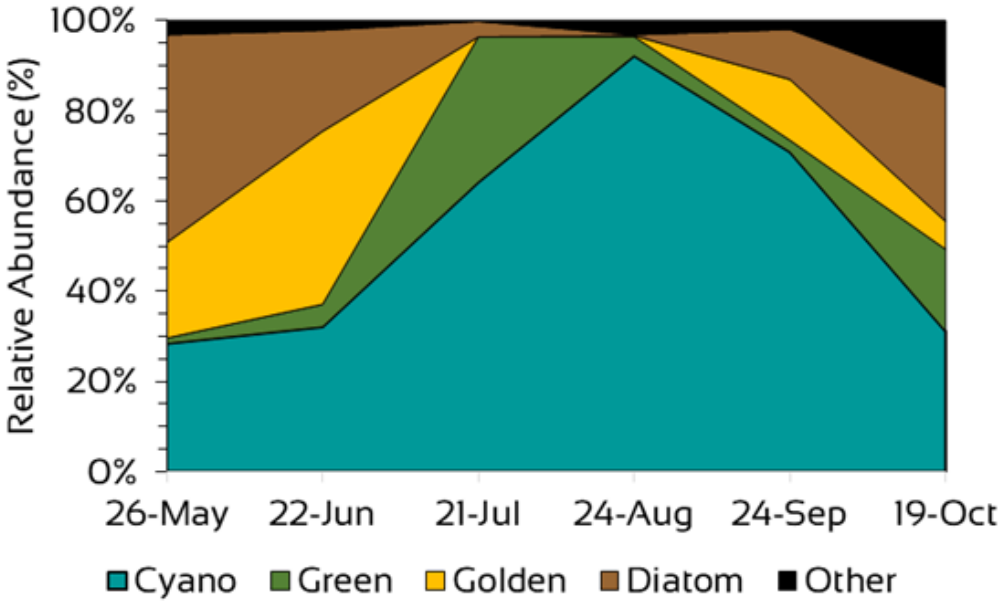
- Total Kjeldahl N, ammonia, nitrate, nitrite
- Nitrate only detected on May 26th in hypo
- Nearly a three fold increase of TKN in hypo driven by loading of ammonia
- Ammonia loads as oxidized forms of nitrogen are used in cellular respiration

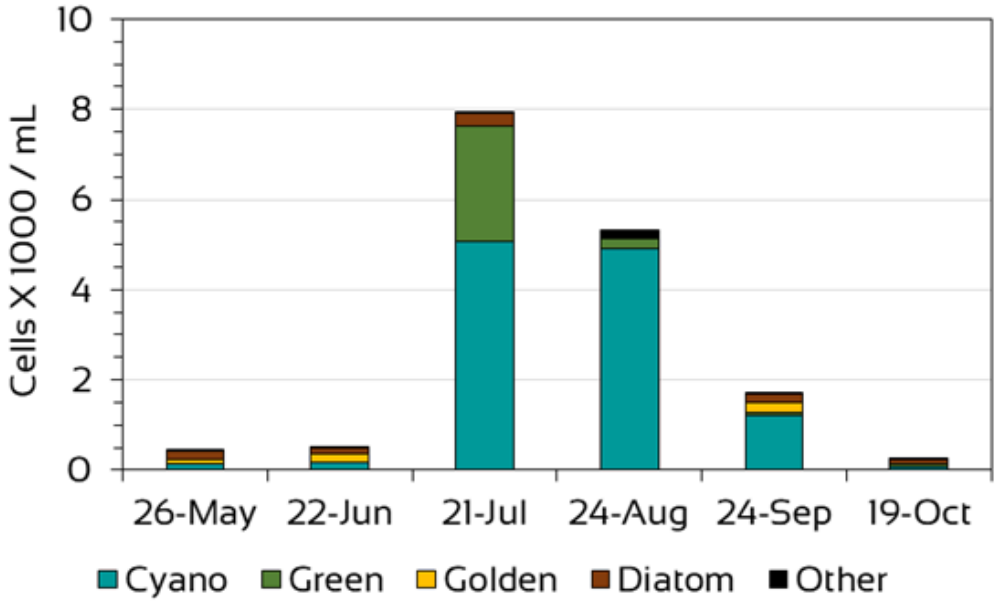


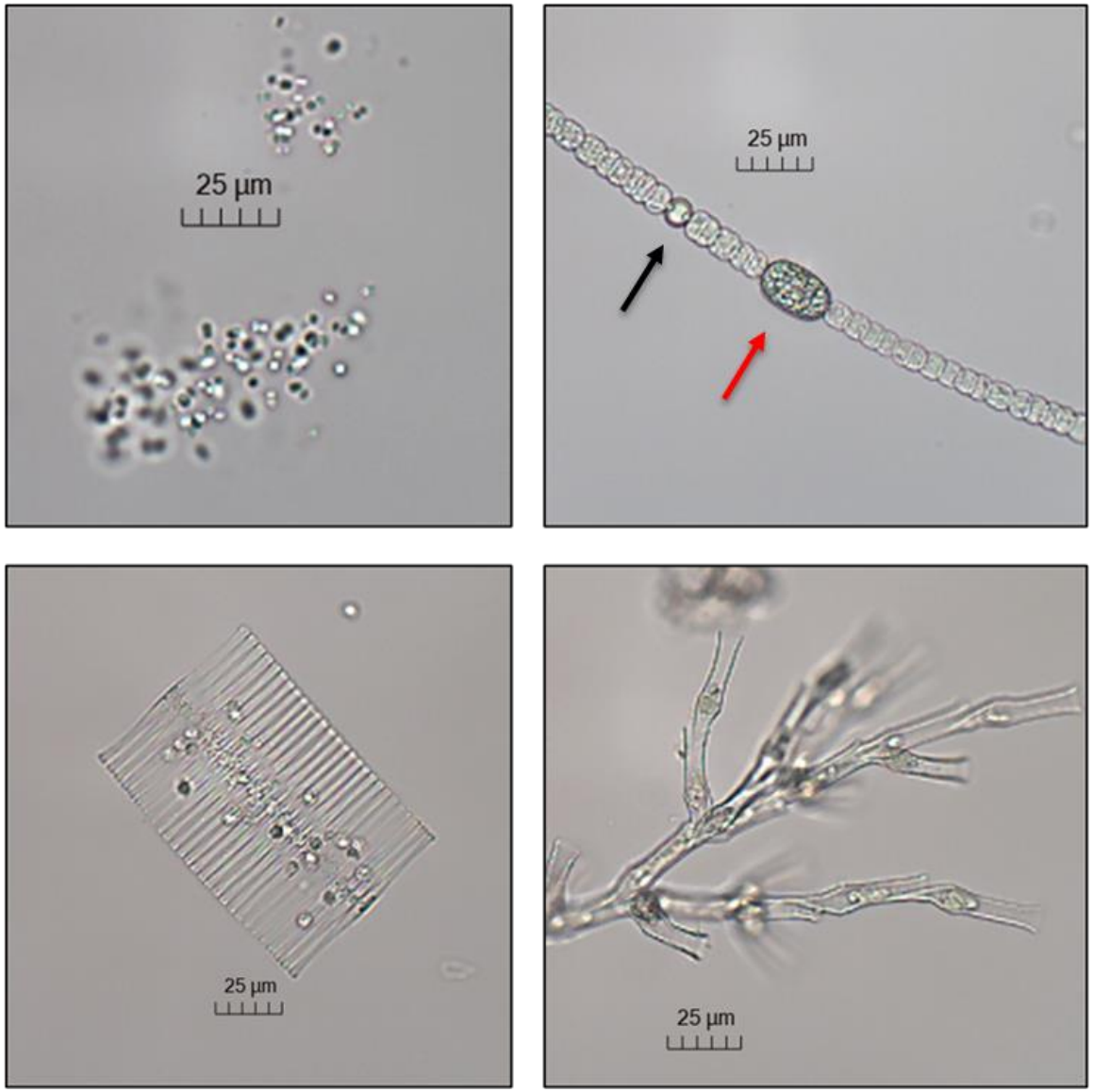
# Algae Dynamic

- Much focus on Cyanobacteria (aka Blue-green Algae) because of toxigenic characteristics
- Cyanos comprise a large percentage on a cell basis July – September
- Cell concentrations are low
- Relative abundance (top) and cell concentrations (bottom) of major taxonomic groups of the algae observed in East Twin Lake in the 2020 season.



Micrographs of selected algae specimens in samples collected at East Twin Lake. A) the colonial cyanobacteria *Aphanocapsa spp*.; B) the filamentous cyanobacteria *Dolichospermum spp*. The black arrow points to a heterocyst, a specialized cell that is the site of nitrogen fixation. The red arrow points to an akinete, another specialized cell which overwinters in the sediments, and germinates the following season. C) the colonial diatom *Fragilaria spp*., and D) the colonial golden algae *Dinobryon spp*.



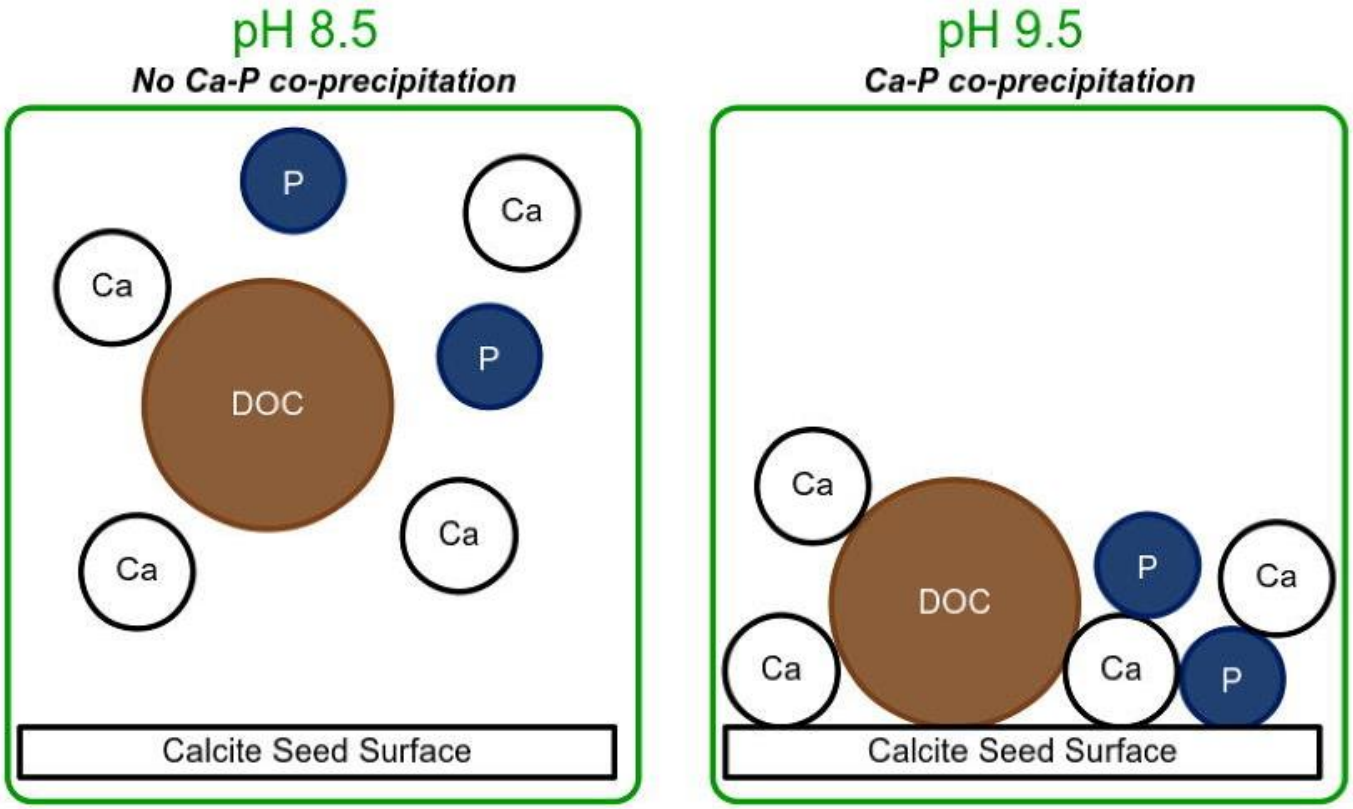

Total magnification for all images is 400X.

# Trophic Classification

Table 1 . Trophic classification criteria used by the Connecticut Experimental Agricultural Station (Frink and Norvell 1984) and the CT DEP (1991) to assess the trophic status of Connecticut lakes. The categories range from oligotrophic or least productive to highly eutrophic or most productive.

| Trophic Category | Total Phosphorus (µg / L) | Total Nitrogen (µg / L) | Summer Chlorophyll-*a* (µg / L) | Summer Secchi Disk Transparency (m) |
|---|---|---|---|---|
| Oligotrophic | 0 - 10 | 0 - 200 | 0 - 2 | >6 |
| Early Mesotrophic | 10 - 15 | 200 - 300 | 2 - 5 | 4 - 6 |
| Mesotrophic | 15 - 25 | 300 - 500 | 5 - 10 | 3 - 4 |
| Late Mesotrophic | 25 - 30 | 500 - 600 | 10 - 15 | 2 - 3 |
| Eutrophic | 30 - 50 | 600 - 1000 | 15 - 30 | 1 - 2 |
| Highly Eutrophic | > 50 | > 1000 | > 30 | 0 - 1 |

# Phosphorus Co-precipitation




Hugo R. Sindelar, Mark T. Brown, Treavor H. Boyer. Effects of natural organic matter on calcium and phosphorus co-precipitation. Chemosphere. Volume 138, 2015, pp. 218-224

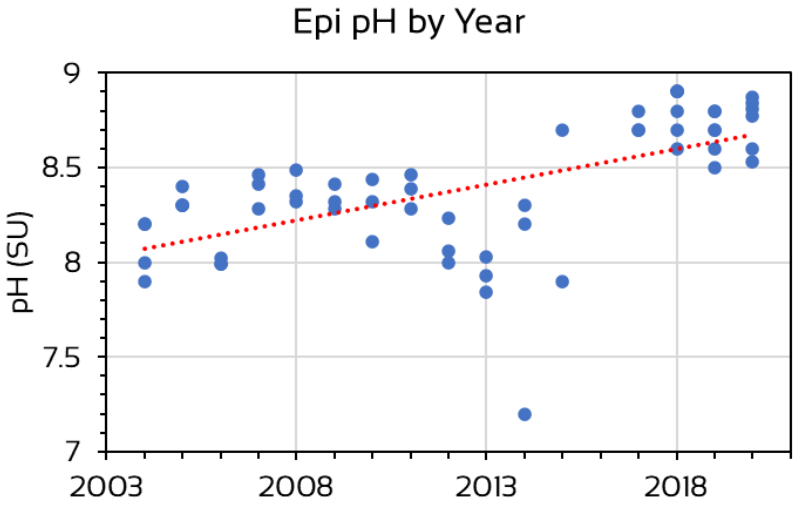
# Trend Analyses

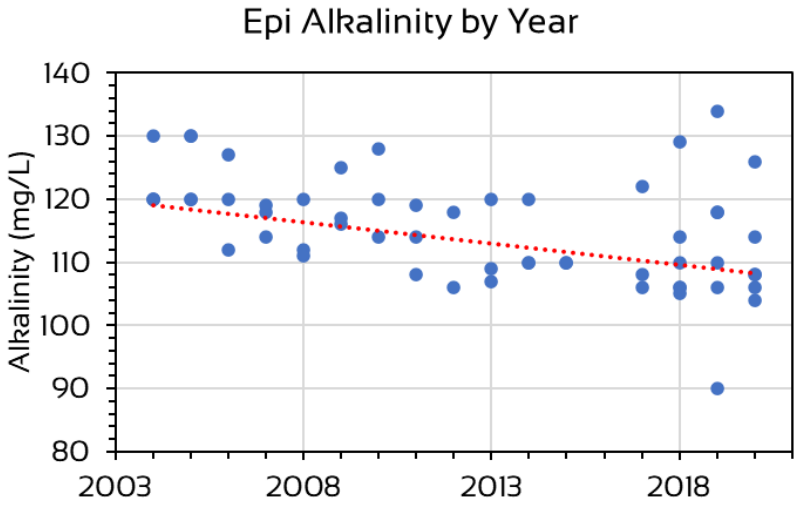
- First, a **Multiple Linear Regression** (MLR) method was employed to determine if the epilimnion, hypolimnion, and/or the entire water column – based on all the variables – had changed significantly.
- MLR indicated that significant ($p<0.005$) changes occurred in the epilimnion, hypolimnion, and the water column in its entirety (i.e., the whole lake) between 2004 and 2020.
- **pH, ammonia**, and **nitrate** were those contributing to the significance of both the whole lake and hypolimnetic models. **Alkalinity** was also an important contributor to the whole lake model and the epilimnetic model.
- Other variables contributing to the significance of the epilimnetic model included **pH** and **nitrate**.

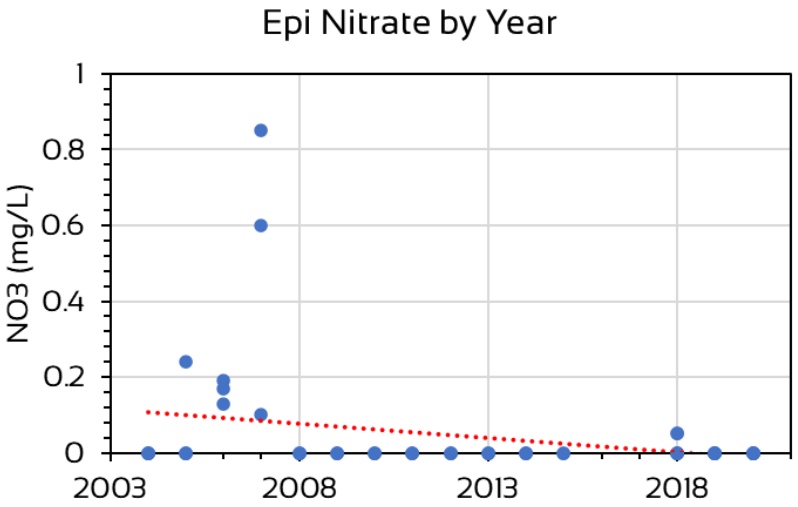
# Trend Analyses

- The second analysis performed was analysis of variance or ANOVA. With ANOVA each variable was examined independently to determine whether a change had occurred in a statistically significant manner over time.
- Variables measured in epilimnion
- Variables measured in the hypolimnion
- Combination of epilimnetic and hypolimnetic data

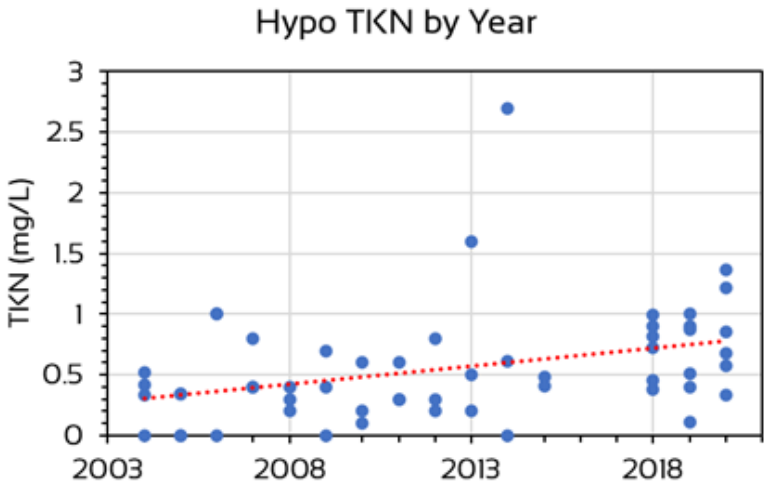
# ANOVA Results for Epilimnion

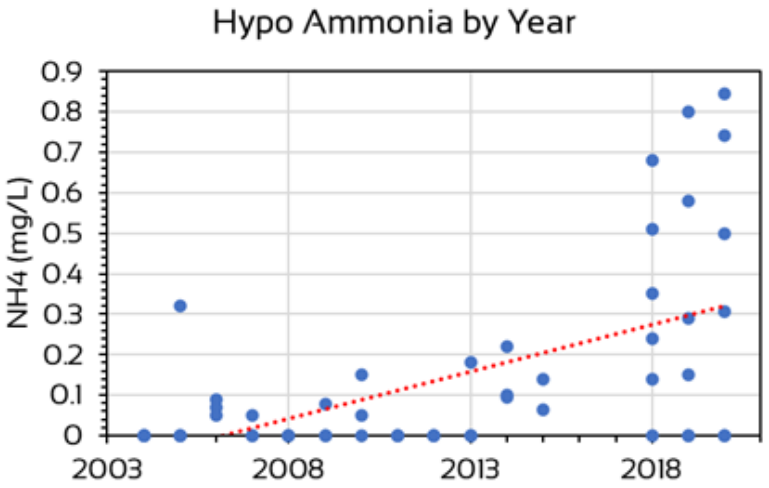


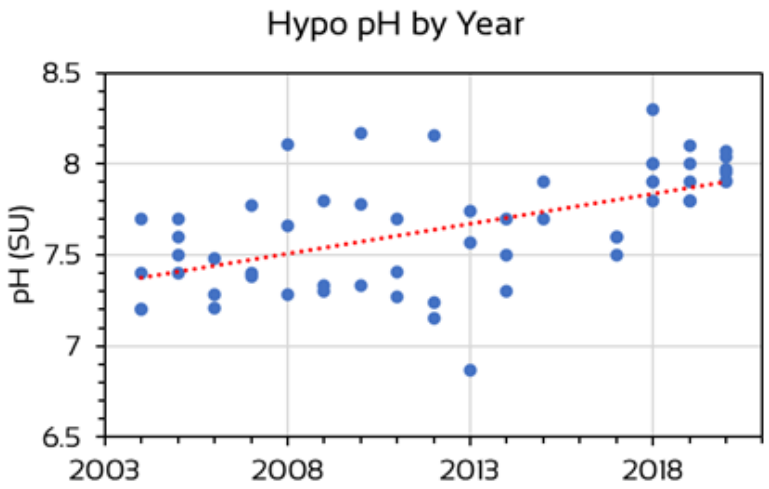



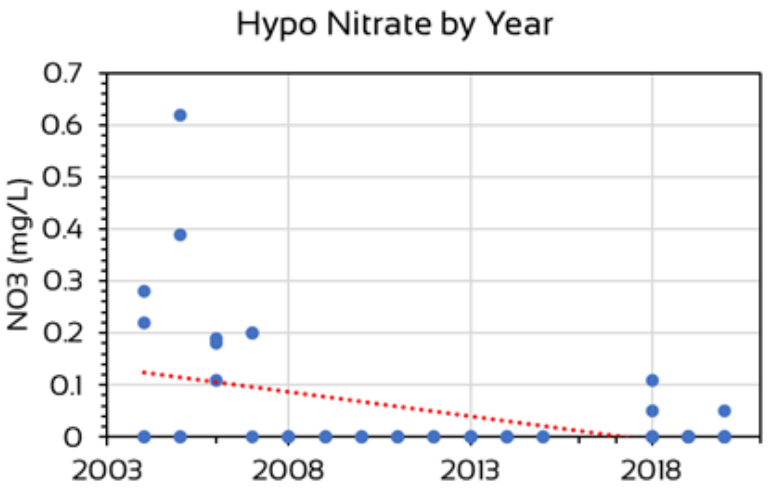



# ANOVA Results for Hypolimnion



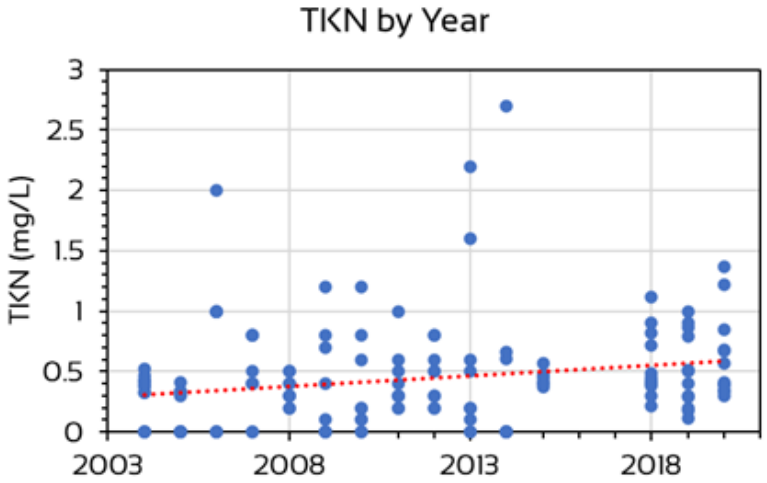



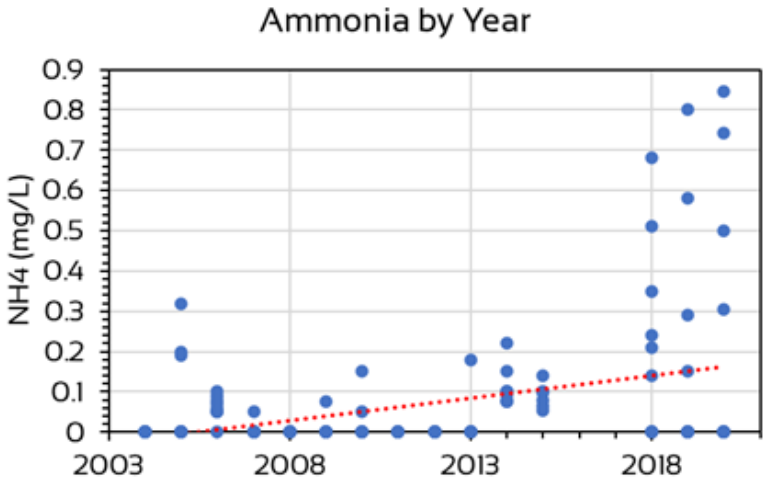



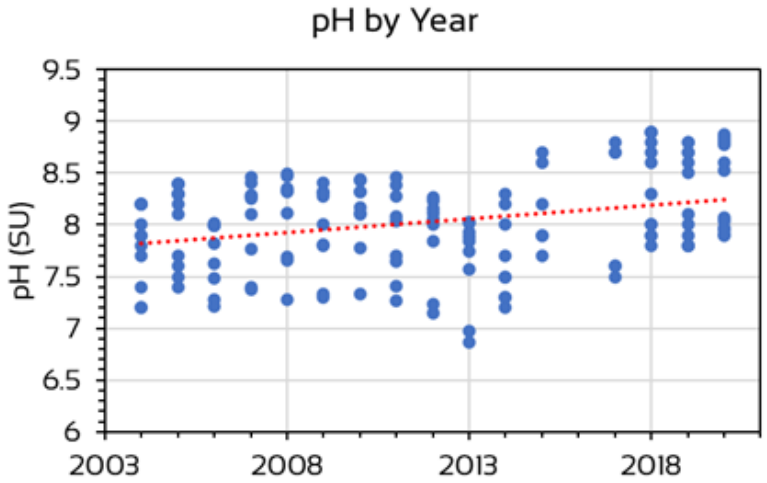



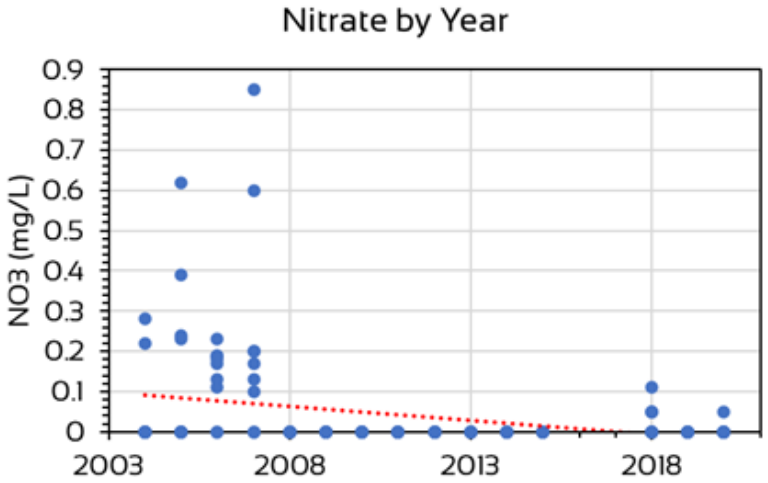
# ANOVA Results for Lake

## Epilimnion and Hypolimnion Data Combined



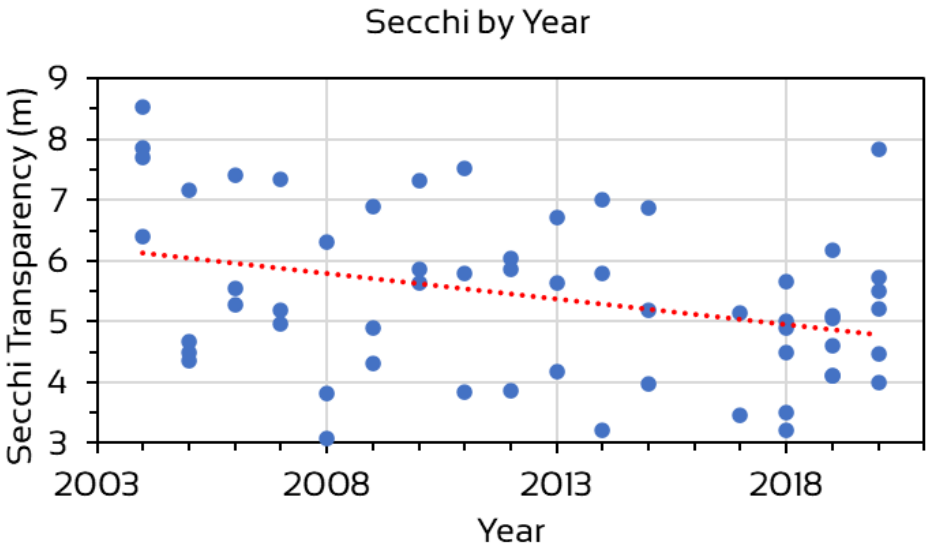



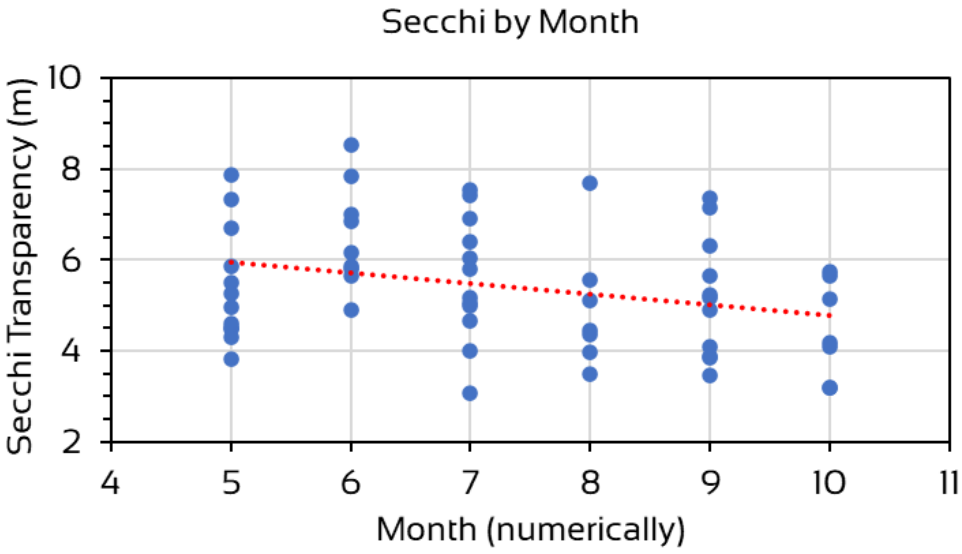



# ANOVA – Secchi

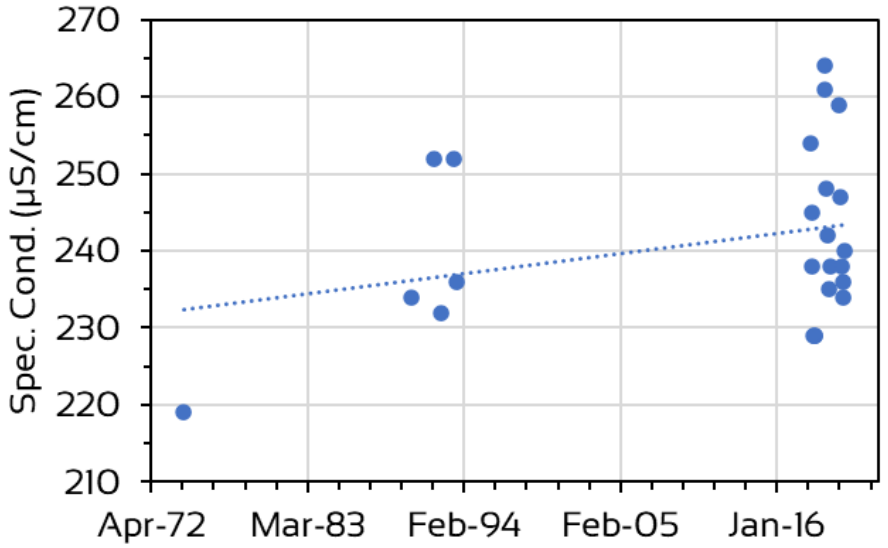
- Secchi transparency is decreasing
- Secchi transparency tends to decrease from May through October

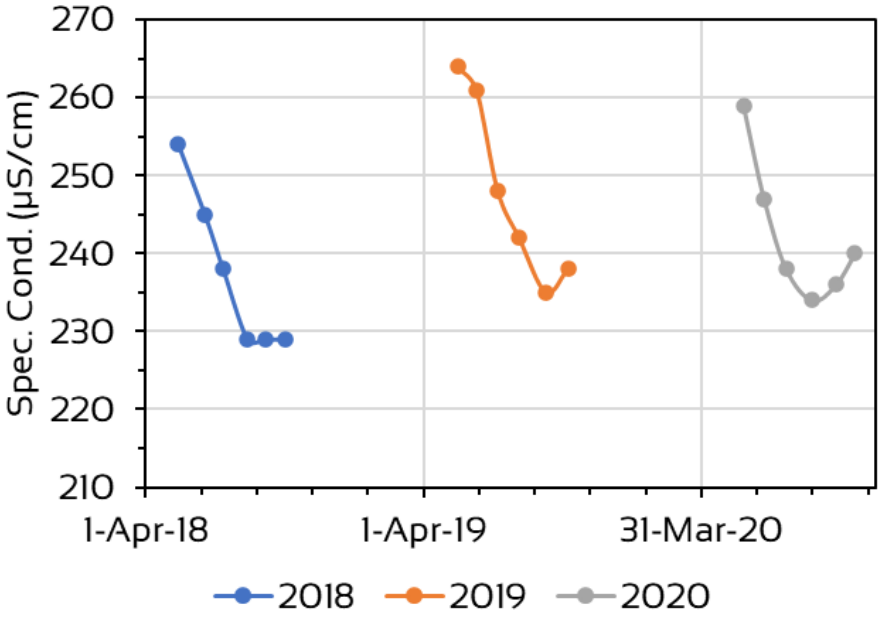


# Specific Conductance

- Trending upward
- Seasonally starts higher, then decreases by August or September
- Co-precipitation with calcium?



# 2020 Recommendation

- Water quality is still good but there are signs of aging.
  - Is it natural or is it cultural?
  - How can aquatic plant management impact water quality?
- Continue water quality monitoring
  - Possible additions: chlorophyll-*a*, base cations, chloride
- Pretreatment plant surveys for careful targeting of nuisance plants