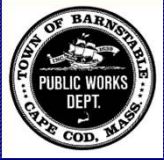


# ***Long Pond Diagnostic Nutrient Assessment and Management Plan***

Department of Public Works  
November 29, 2022

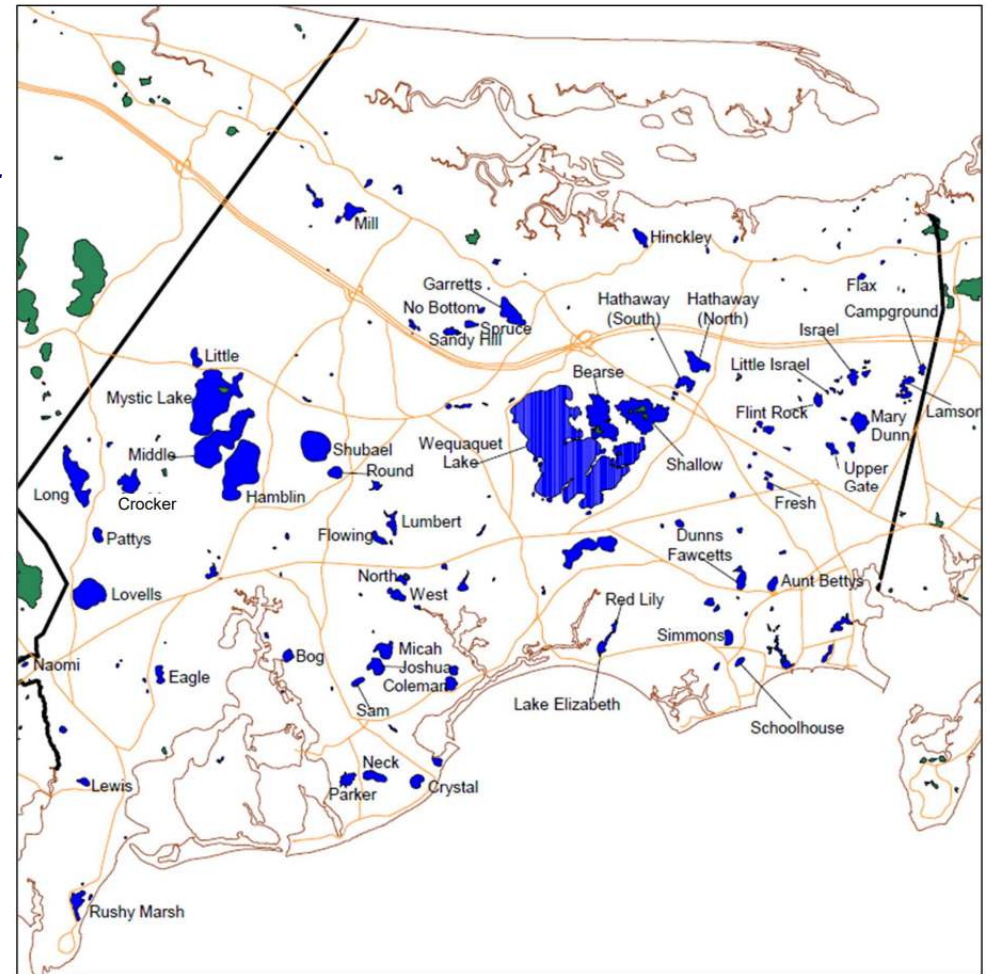


# Barnstable Ponds and Lakes



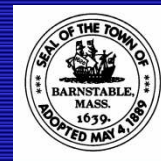
## Overview

- ~180 ponds in Barnstable
- 25 ponds are designated as Great Ponds
  - Most of these are impaired to some degree
- Pond and Lake Management Plan Program was initiated in 2020
- Ponds were prioritized based on available data
  - Shubael Pond
  - Long Pond MM
  - Lovells Pond





# Cyanobacteria in Long Pond



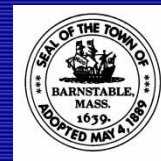
- **Cyanobacteria monitoring conducted by the Town Health Division revealed no blooms prior to 2018**
- **Cyanobacteria Warnings were issued in:**
  - 2018
  - 2019
  - 2020
  - 2021
  - 2022







# DPW Approach

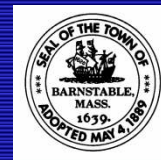


- *Systematic and science based approach to target effective management*
- *Initiated a study in April 2021:*
  - *Part 1- Nutrient Diagnostic Assessment*
    - *Dissolved Oxygen and Temperature*
    - *Nitrogen, phosphorus, chlorophyll-a pigments, pH, alkalinity*
    - *Phytoplankton composition (including cyanobacteria)*
    - *Nutrient regeneration from the internal sediments*
    - *Septic System assessment*
    - *Stormwater monitoring*
    - *Runoff from surrounding watershed*
  - *Part 2 - Develop a Management Plan*
    - *Set nutrient reduction targets*
    - *Evaluate management options to meet those targets*

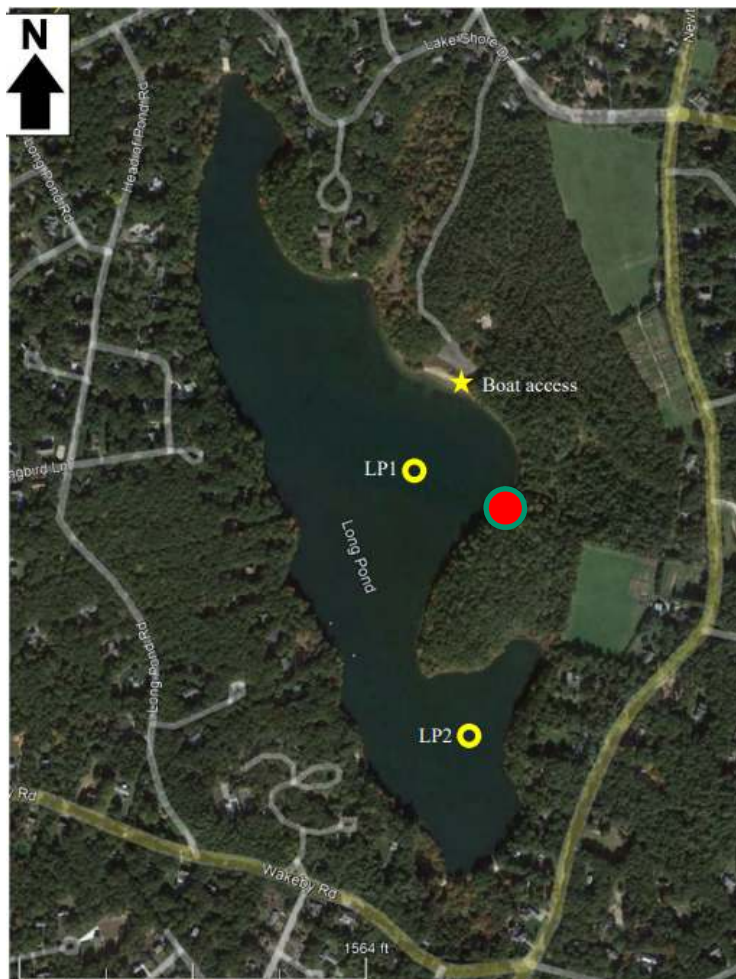




# Long Pond Overview



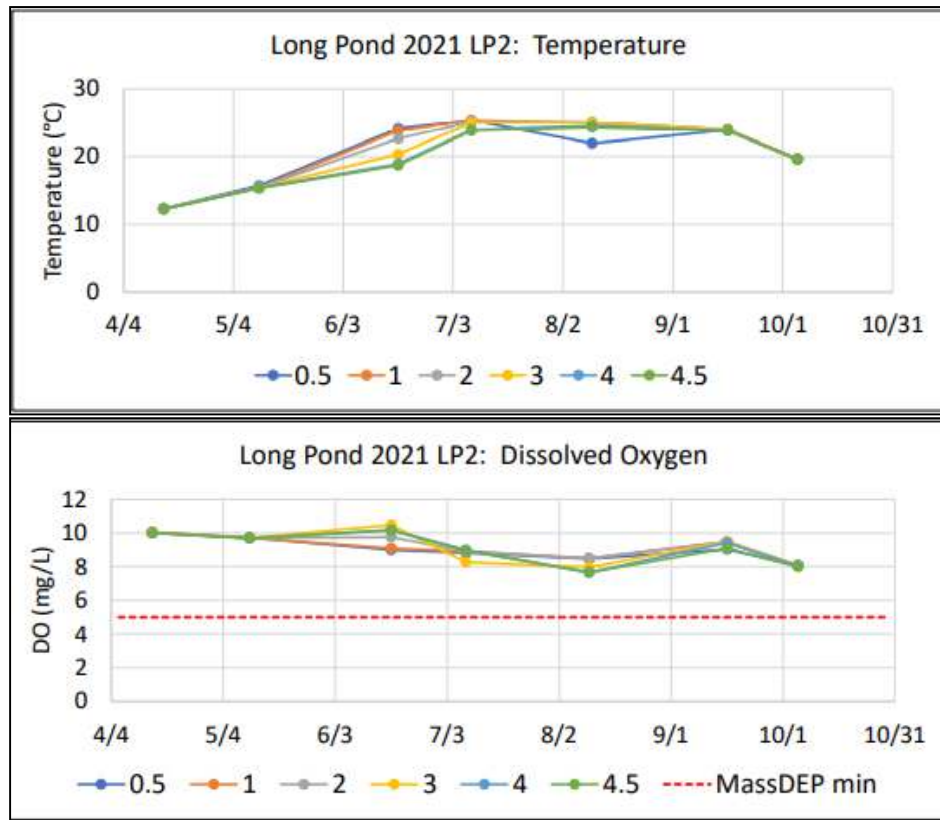
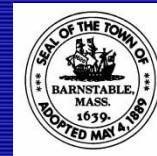
- *General*



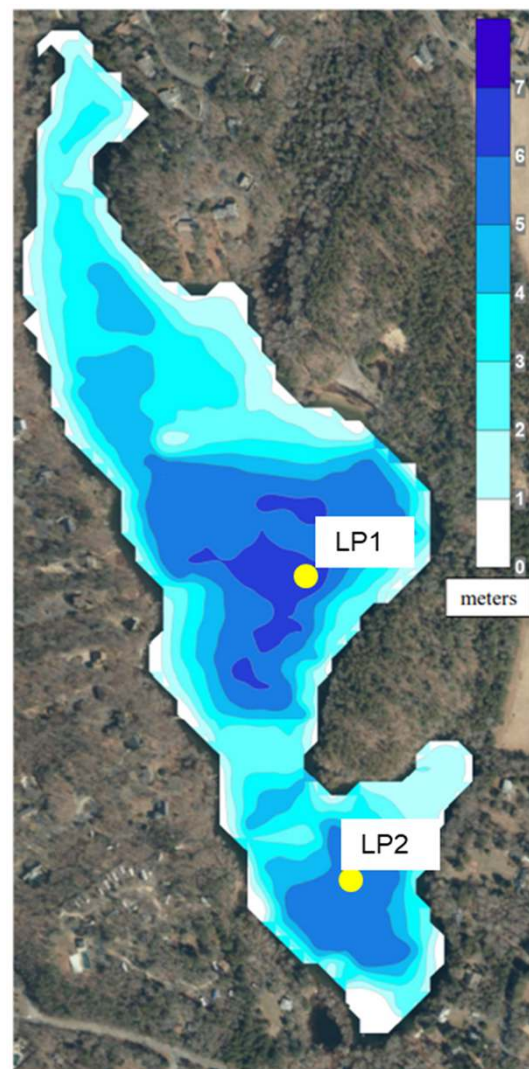
- **Size:** ~54-acres (Great Pond)
- **Depth:** Max depth of ~7-meters
- **Beaches:** ★
  - Long Pond Farms Association
- **Town Way to Water:** ●
  - Long Pond Conservation Area



# Depth Profile Temperature and Dissolved Oxygen



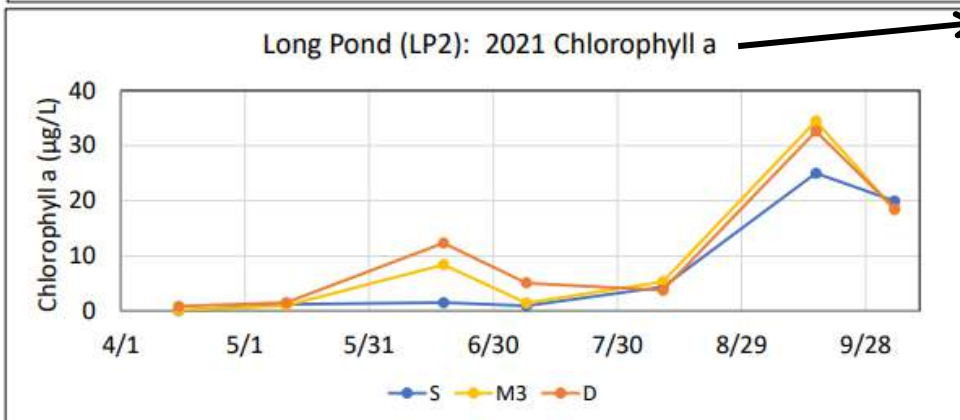
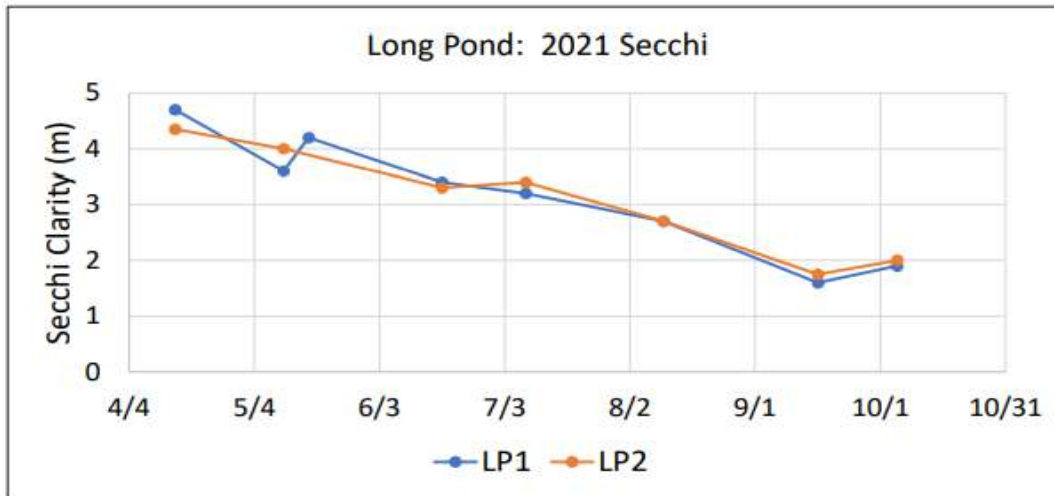
- Long Pond has a well mixed, well oxygenated water column



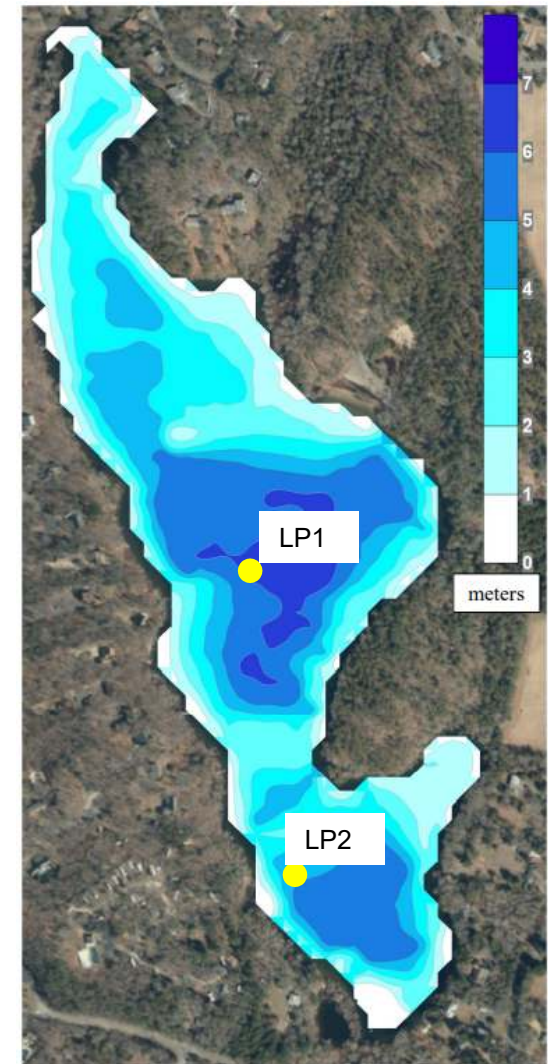




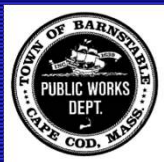
# Water Clarity and Chlorophyll-a



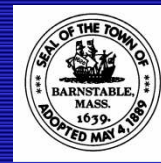
Indicator of  
algae (good and  
bad) in the pond



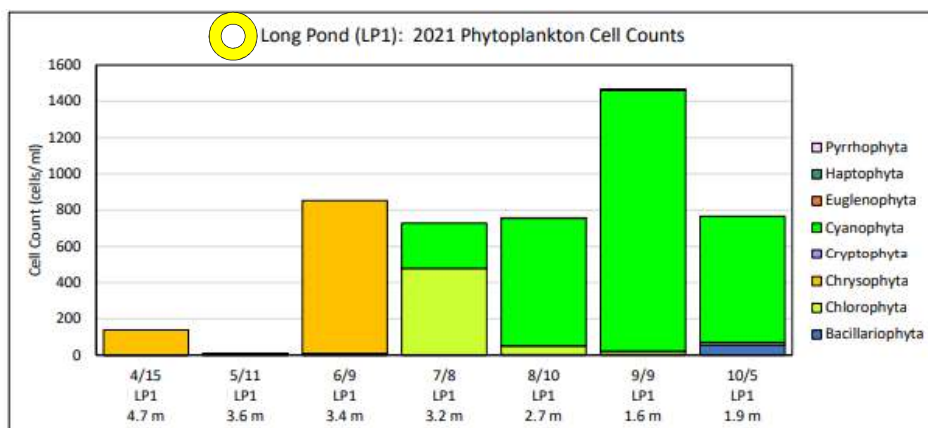
- *Water clarity decreases as chlorophyll-a increases*



# 2021 Phytoplankton (including cyanobacteria)



- SMAST Sampling Station
- ★ Health Division Sampling Station
- ▲ FLPMM Sampling Station



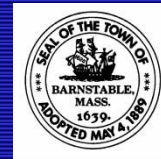
## Guidance for Posting Public Health Advisory

1. A visible cyanobacteria scum or mat is evident;
2. Total cell count of cyanobacteria exceeds 70,000 cells/mL;
3. Concentration of the toxin microcystins exceeds 8 µg/L; or
4. Concentration of the toxin cylindrospermopsin exceeds 15 µg/L.

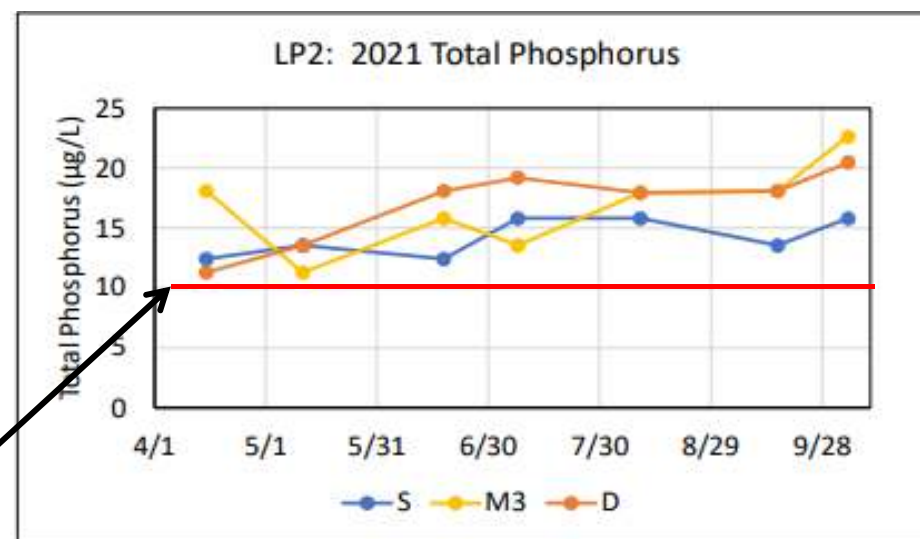


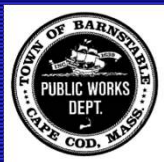


# Phosphorus is the key to management

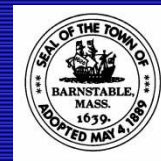


- Study determined phosphorus is the limiting nutrient
- Excess phosphorus can lead to increased algae blooms, cyanobacteria, and poor water clarity
- In 2021, phosphorus concentrations were above 10  $\mu\text{g/L}$  from April through October
- Management of phosphorus levels to less than 10  $\mu\text{g/L}$  is protective from cyanobacteria blooms



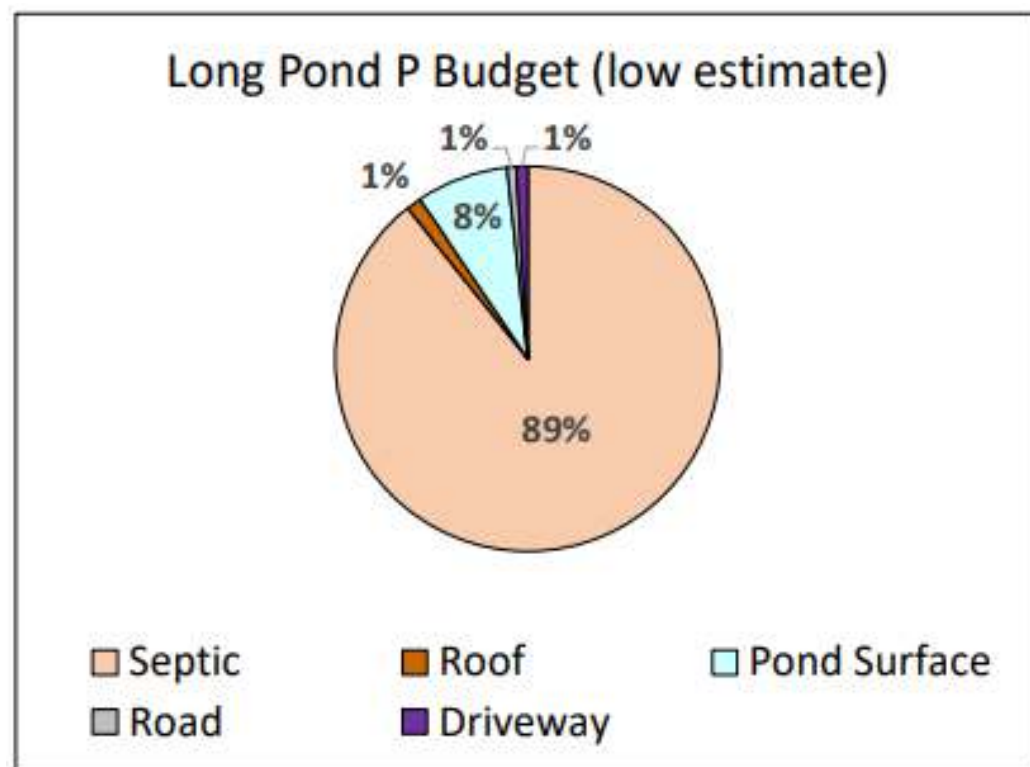


# Sources Contributing Phosphorus to Long Pond



*Contributing sources of phosphorus in and around the pond:*

- 1. Septic systems within 300-ft of the pond and in the contributing watershed*
- 2. Natural atmospheric deposition to the pond surface (not controllable load)*
- 3. Overland runoff to the pond*

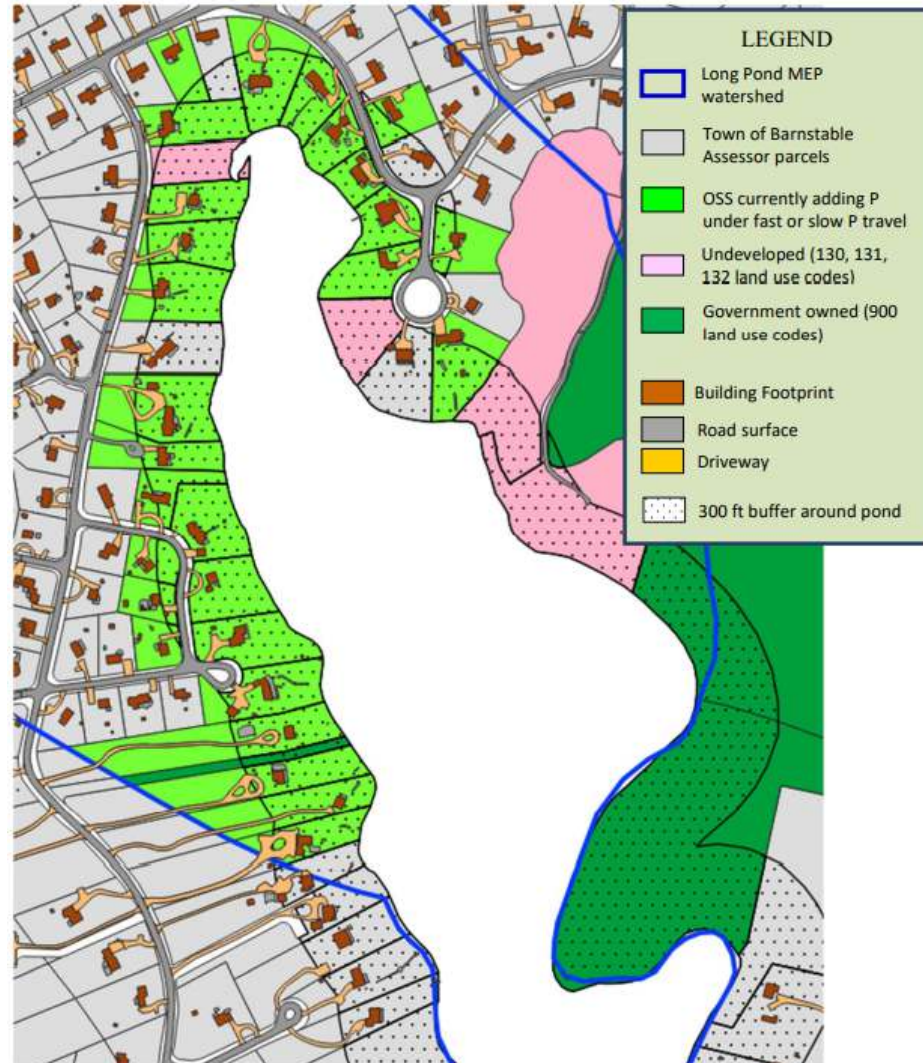




# Septic System Inputs



- 89% of the phosphorus load to Long Pond is coming from 28 septic systems in the upgradient watershed
- 3 additional septic systems within 300-ft of the pond are not yet contributing to Long Pond



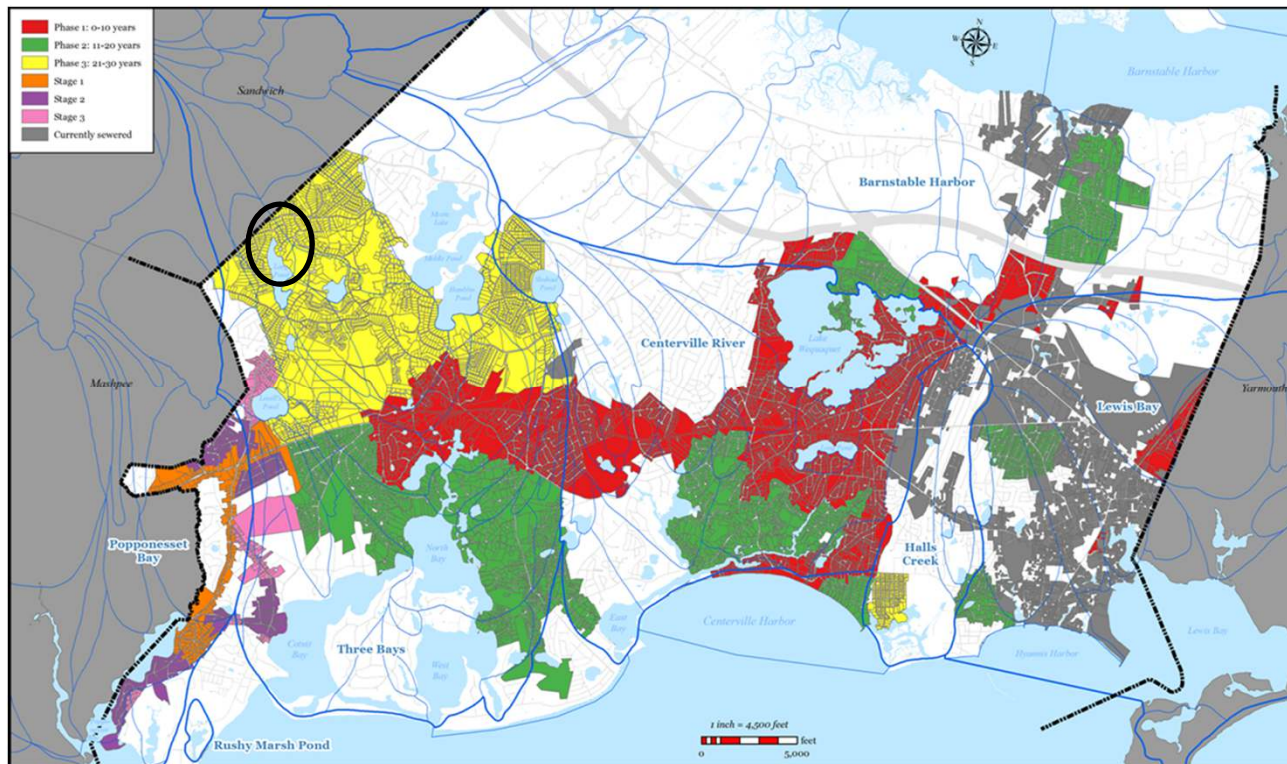




# Recommended Solution

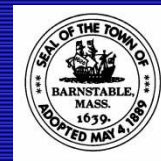


- *Long Term: Sewer the homes contributing phosphorus to Long Pond*
  - *The Town will bring sewer to these homes during Phase 3 of the Comprehensive Wastewater Management Plan (CWMP).*
  - *Modeling indicates this will reduce the phosphorus load enough to achieve phosphorus concentrations less than 10 ug/L.*





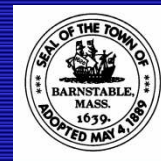
# *Interim Options*



- *Near Term: Enhanced Phosphorus Reducing I/A Septic Systems*
  - *Modeling indicates that installation of 23 phosphorus removing I/A systems will reduce the phosphorus concentration in Long Pond to 10-ug TP /L*
  - *Three systems have received MA DEP Piloting Approval for a set phosphorus concentration effluent:*
    - *PhosRID Phosphorus Removal System claims to achieve <1 mg TP/L.*
    - *Waterloo EC-P for Phosphorus Reduction claims to achieve <1 mg TP/L.*
    - *NORWECO Phos-4-Fade claims to achieve <0.3mg TP/L.*
  - *Installation of phosphorus reducing I/A septic systems is an option available to private homeowners who choose to upgrade their septic system and receive approval from the Board of Health*



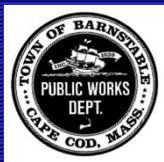
# Interim Options



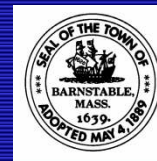
- *Floating Treatment Wetland (FTWs)*
  - *FTWs assimilate phosphorus into the plant biomass, which can later be harvested, permanently removing phosphorus from the pond.*
  - *This could be applied to Long Pond as a pilot study to determine the phosphorus removal of the FTWs.*
  - *A pilot study would be a small scale deployment to evaluate the phosphorus removal of the FTWs.*
  - *Phosphorus removal effectiveness varies ranging from 0.1 kg to 1.8 kg per 100 sq. ft. of FTW*







# Interim Options



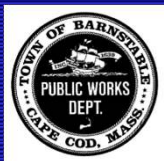
- *Near Term: Permeable Reactive Barriers (PRBs)*
  - *PRB with Iron Filings*
    - *Phosphorus contained within groundwater binds to the iron filings placed underground near the shoreline*
    - *Installation of at Long Pond would be costly and the buffer zone and private residences*
  - *Temporary PRBs with Biochar, alum, clays, etc.*
    - *Phosphorus absorbs to the media in the filter*
    - *Installation of filters would be experimental requiring a pilot study to determine effectiveness.*



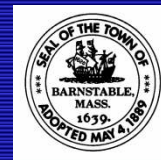
*Biochar filters installed in a New Jersey Pond*



*Iron filing barrier installation within the shoreline at Ashumet Pond, Falmouth*



# Interim Options



- *Near Term: Algaecides*
  - *Algaecides kill the phytoplankton (including cyanobacteria) in the pond*

## Advantages

- *Kills cyanobacteria*
- *Improves water clarity*



## Disadvantages

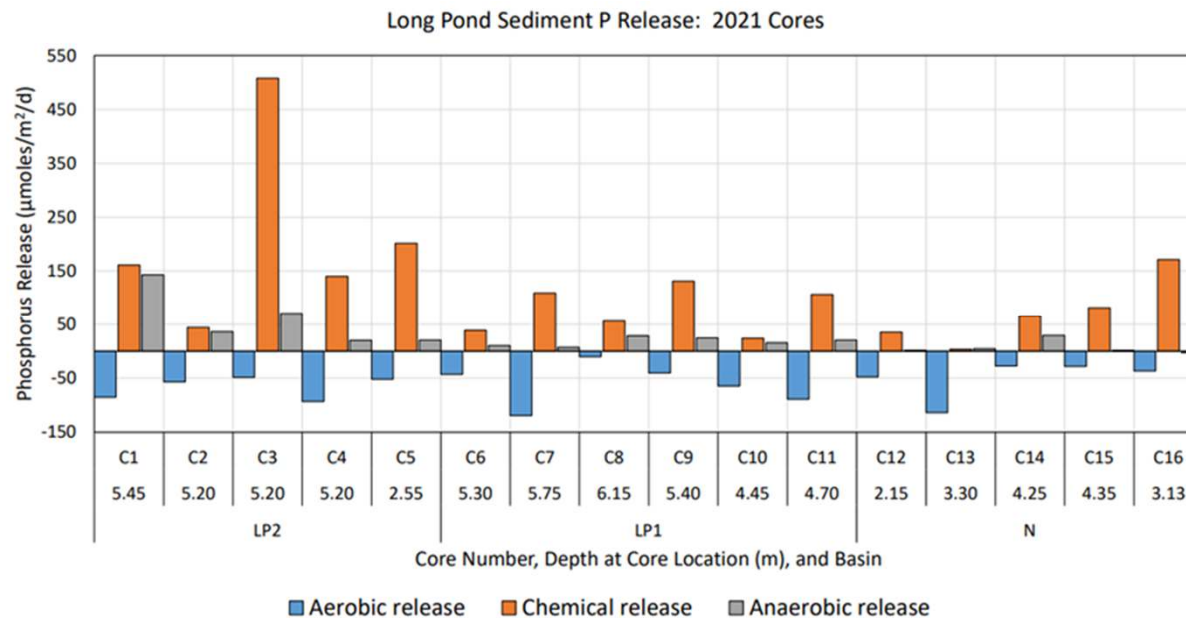
- *Temporary; requires regular treatment*
- *Kills good algae and zooplankton*
- *Lyses cyanobacteria cells, possibly increasing cyanotoxin levels in pond*
- *Increased organic matter deposition to sediments may result in low oxygen conditions and sediment phosphorus release*
- *Does not remove any phosphorus from the pond*
- *Not previously permitted in a Great Pond in Barnstable or on Cape Cod*



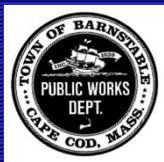
# Interim Options



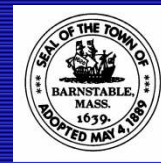
- *Near Term: Alum, Aeration, Dredging, and Solarbees*
  - *Long Pond is well mixed throughout the summer, maintaining an oxygenated the water column, and therefore aeration and solar bees would not improve Long Pond water quality*
  - *Under aerobic conditions the sediments in Long Pond are absorbing phosphorus, not releasing it, and therefore alum, aeration, and dredging would not improve Long Pond water quality*







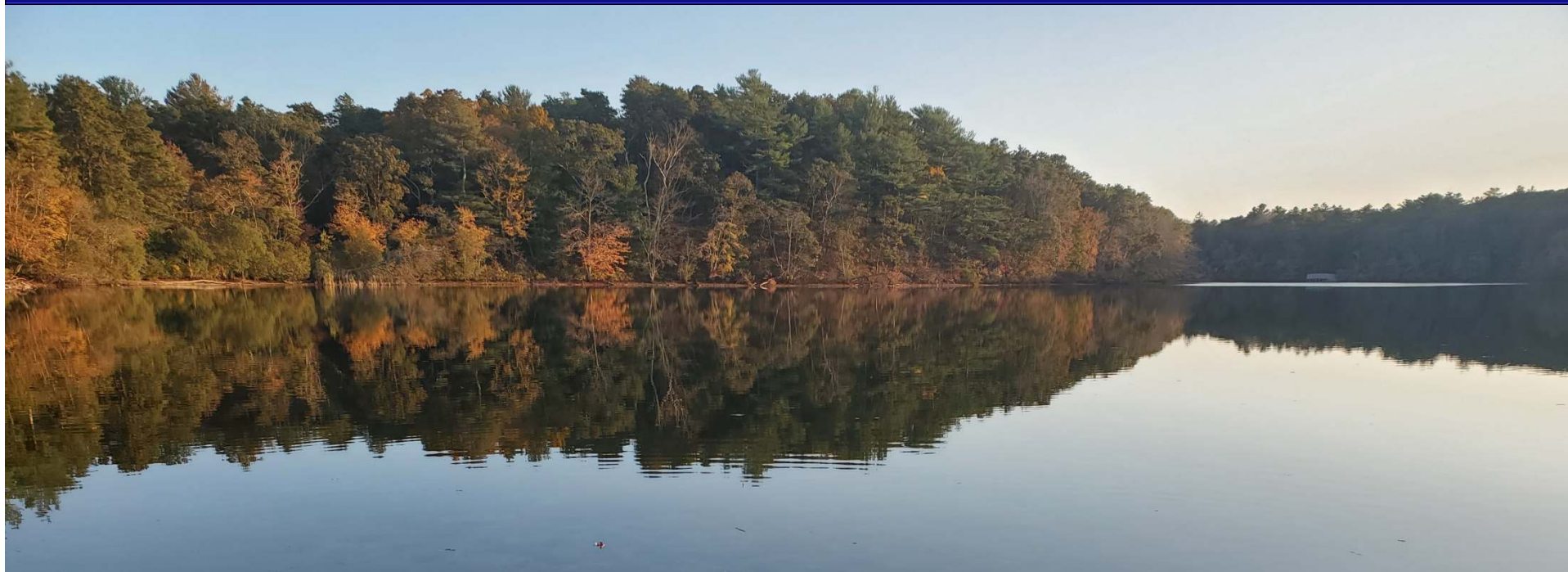
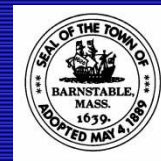
# Conclusions



- *Phosphorus management is needed to improve water quality*
- *89% of the phosphorus load to Long Pond was determined to be from septic systems within 300-feet of the pond*
- *Sewering of these homes will occur during Phase 3 (2040 – 2050) of the CWMP, reducing the phosphorus concentration in Long Pond to <10 ug/L*
- *Applicable interim solutions are experimental and need to be initiated as pilot studies to understand the effectiveness on Long Pond*
- *The Town will continue working with the Friends of Long Pond MM to monitor Long Pond for the purposes of adaptive management.*
- *As an initial effort, the Town proposes to conduct a Floating Treatment Wetland pilot study on Long Pond to assess feasibility of using FTWs for phosphorus management.*



# *Discussion?*



*Thank You*  
*Amber.Unruh@town.barnstable.ma.us*