

# Pond Summit 2023

June 16, 2023

Hosted By  
The Brewster Ponds Coalition  
and The Town Of Brewster



# Brewster Ponds Coalition Mission Statement

Protecting and improving the health of Brewster's ponds through science, education and advocacy.



# Pond Summit 2023 Agenda

- Opening Remarks
- I. Introduction - John Keith, Griffin Ryder
- II. Scientific Research Planned or In Progress - John Keith, Chris Miller, Erin Perry
- Q&A
- Break
- III. Title 5 Regulations - Mark Nelson

# Pond Summit 2023 Agenda (continued)

- IV. Regulatory Management Entities (RMEs) for Alternative Septic Systems - Brian Baumgaertel
- V. State and Local Funding Sources - Peter Lombardi
- Q&A
- VI. What About PFAs and Other Toxics? - Kim Pearson
- Q&A
- Thank You and Adjournment







## Introduction on Pond Pollution

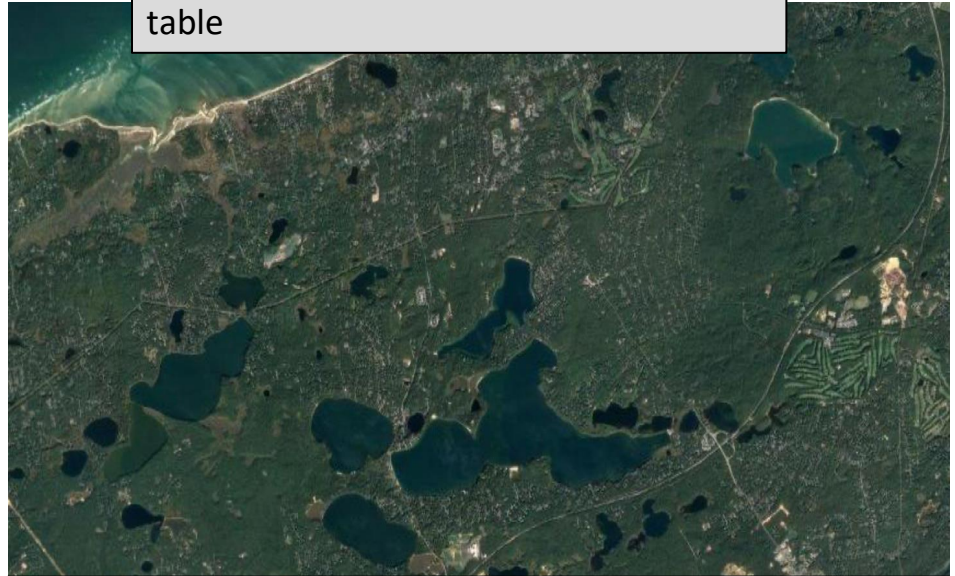


John Keith, PE  
Environmental Engineer  
Vice-President, Brewster  
Ponds Coalition

# Most Cape Ponds Are Kettlehole Ponds

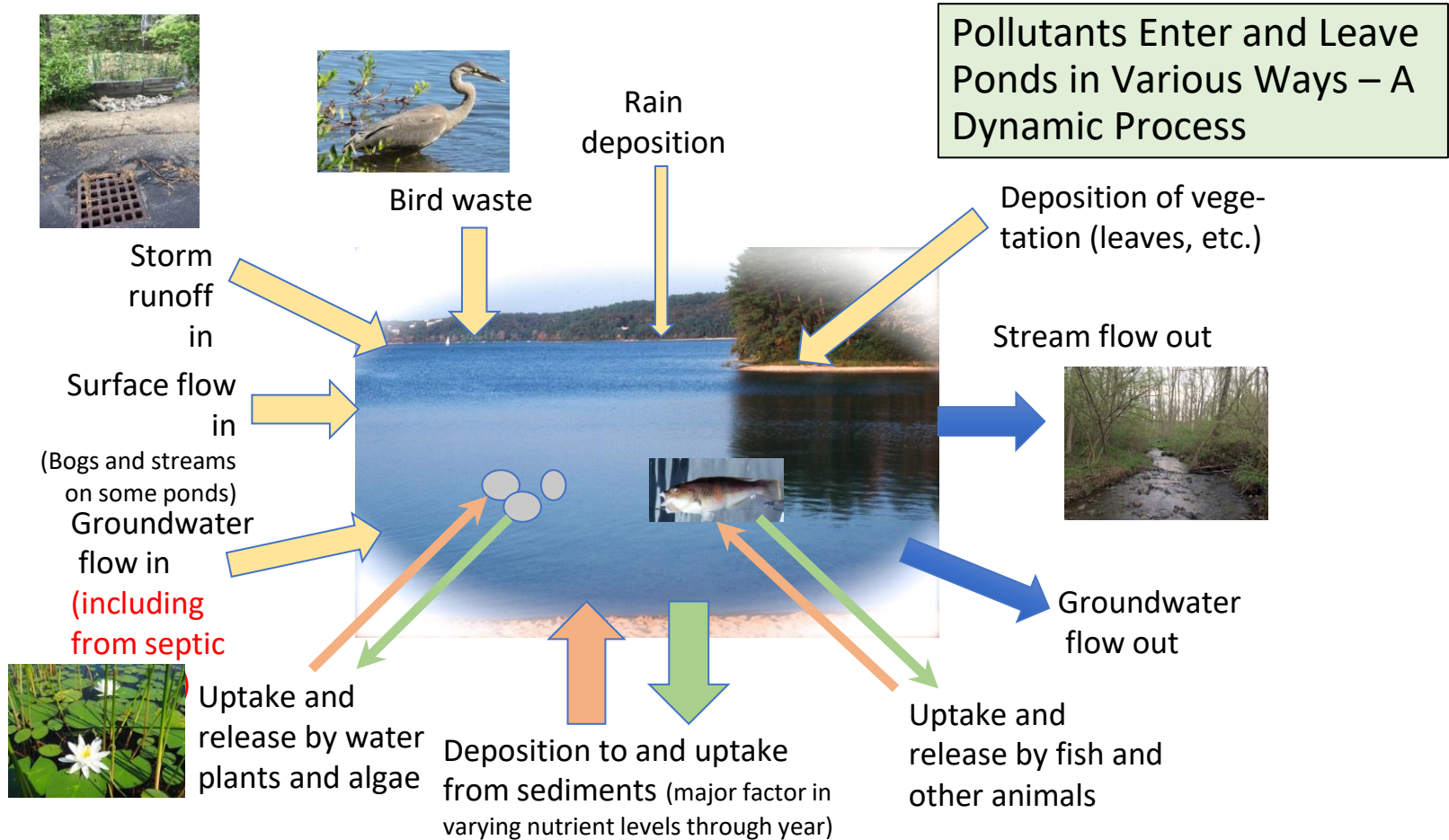
- Depths often >10m
- Often bowl shaped, w/ steep side slopes
- Small surface watershed areas
- Often no outlet
- Fed by rain and groundwater
- Slow water turnover
- Possible past agriculture pollution
- Some cranberry bogs
- Slow accumulation of organic matter, Phos.
- **Water quality sensitive to small changes in input**

Kettlehole ponds are glacial potholes where the land dips below the water table



- Natural background water quality was very good:
  - Low pH (<6.5) - Soft
  - Low Phosphorus - Low Nitrogen
  - Low Algae - High Clarity (>15 feet)

# Ponds Are a Complicated Ecosystems





# Types of Pond Impairment

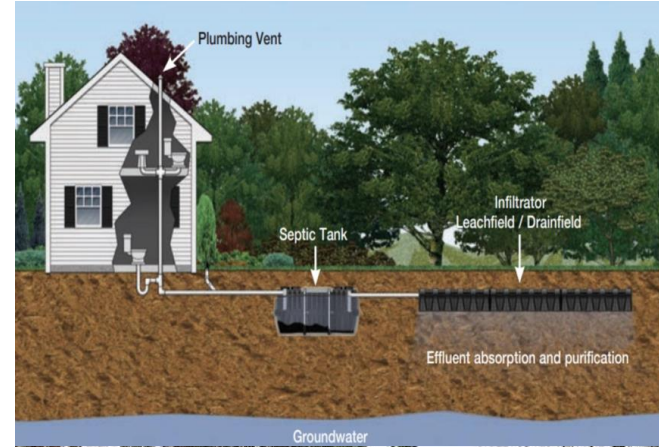
Red – Also important  
for well water quality

Types of Impairment	Indicators	Causes
Low Dissolved Oxygen (DO)	<ul style="list-style-type: none"> <li>- Low DO, especially near bottom</li> <li>- Fish kills</li> </ul>	<ul style="list-style-type: none"> <li>- <b>High nutrients (esp. Phosphorus)</b> and resulting algae growth</li> <li>- Stratification</li> </ul>
Poor Clarity	<ul style="list-style-type: none"> <li>- Cloudy or “murky” water</li> <li>- Floating particles in water</li> </ul>	<ul style="list-style-type: none"> <li>- Storm runoff with lots of silt</li> <li>- Algae blooms</li> </ul>
<b>High Nutrients (Phosphorus, Nitrogen)</b>	<ul style="list-style-type: none"> <li>- Algae blooms</li> <li>- Cyanobacteria (blue-green algae)</li> <li>- High chlorophyll (indicates algae)</li> </ul>	<ul style="list-style-type: none"> <li>- <b>Septic systems</b> upgradient of ponds</li> <li>- Fertilizer runoff from lawns, bogs</li> </ul>
<b>Harmful Bacteria</b>	<ul style="list-style-type: none"> <li>- E. Coliform, indicator of pollution with fecal matter, sewage</li> </ul>	<ul style="list-style-type: none"> <li>- Poorly operating <b>septic systems</b></li> <li>- Animal waste</li> </ul>
<b>Chemicals – PFAs, oils, pesticides, pharmaceuticals, detergents</b>	<ul style="list-style-type: none"> <li>- Oil sheens, detergent foams</li> <li>- Testing for specific chemicals</li> </ul>	<ul style="list-style-type: none"> <li>- <b>Septic systems</b> if close to ponds &amp; wrong disposal practices</li> <li>- Pesticides from lawns, bogs, trees</li> </ul>
Invasive Species	<ul style="list-style-type: none"> <li>- Invasive water plants, mussels</li> </ul>	<ul style="list-style-type: none"> <li>- Introduction by boats, plantings</li> </ul>
Nuisance Level of Plants	<ul style="list-style-type: none"> <li>- Excessive spread of water plants</li> </ul>	<ul style="list-style-type: none"> <li>- <b>High nutrients, esp. phosphorus</b></li> </ul>

Some ponds have brownish color due to natural tanins – not a pollution problem.

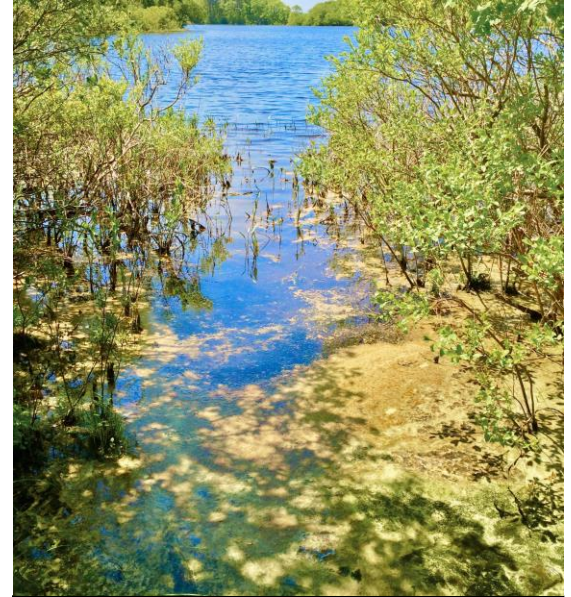
# Pollution Sources for Cape Cod Ponds

- **Septic tanks often the major source for nutrients**
  - Phosphorus and nitrogen
  - Also for toxic chemicals like PFAs and pharmaceuticals
- Other important human-related sources:
  - Road and driveway runoff during rain – silt, salts, oil
  - Lawns and gardens near ponds - fertilizers runoff
  - Cranberry bogs – nutrients, pesticides? – contribution unclear
  - Animal waste – especially from dogs
- Sources that add nutrients with little ability to control:
  - Plant deposition (leaves, pollen, etc.)
  - Birds, other wildlife
  - Rainfall deposition
- Sediments often a critical factor in pond impairment
  - Low DO (<2 ppm) at pond bottom releases P from sediments



# Why the Concern About Phosphorus?

- Two major nutrients impact ponds – phosphorus and nitrogen
- Impact of high nutrients on ponds:
  - Lower clarity – largely due to algae
  - Algae – green masses on water
  - Increased risk of cyanobacteria (blue-green algae)
    - Can release toxics making water unsafe for people and pets
- Higher algae depletes oxygen in water
  - Called “anoxia”
  - Can lead to fish kills
  - Decreases fauna in sediments, causing imbalance



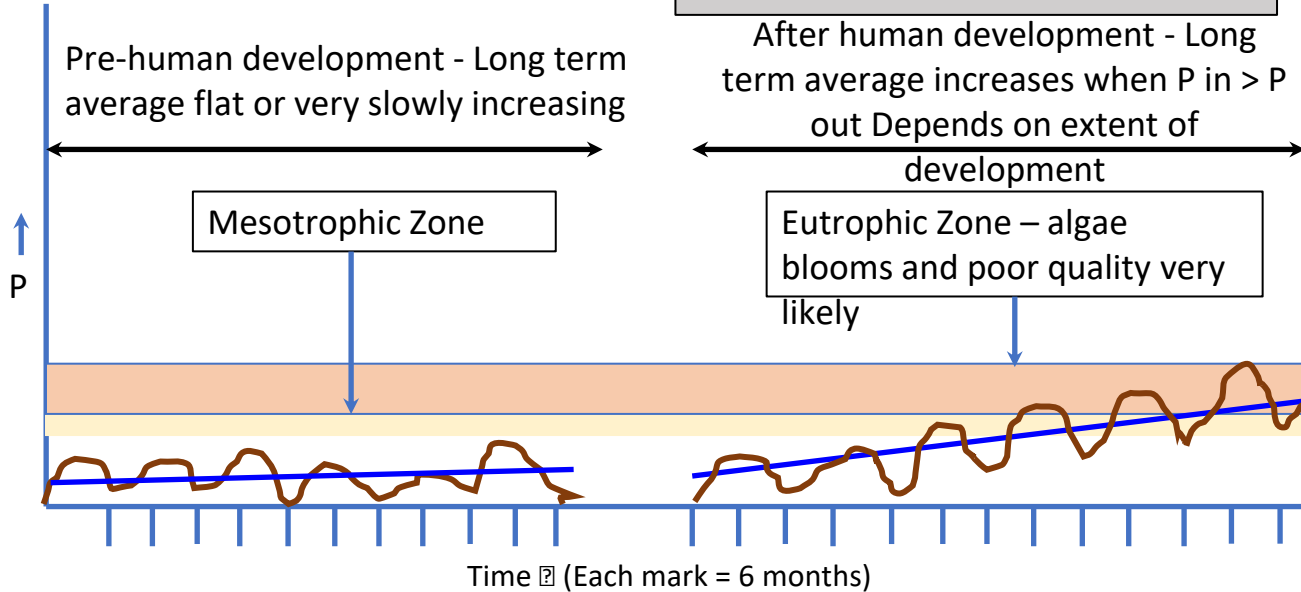
**Phosphorus is usually the limiting nutrient with respect to algae growth in Cape ponds**

# Phosphorus Accumulates in Ponds Over Time

- Higher P = more algae bloom risk (though nitrogen levels also important)

Natural Phosphorus Sources:  
- Vegetation detritus, birds, wildlife

Human Phosphorus Sources:  
- **Septic Systems**, fertilizer, pet waste



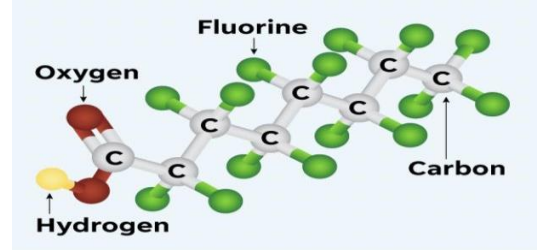
Sediments store P from year to year and release P in summer if DO is low

Problems occur when P rises, even if only in summer



# What About PFAs and Other Toxic Chemicals?

(“Pollutants of Emerging Concern”)



Polyfluoroalkyl Substances

- PFAs, pharmaceuticals, BPA & other plasticizers, pesticides, paints & coatings
- Research suggests that high levels of certain PFAS may lead to:
  - Increased risk of high blood pressure or pre-eclampsia in pregnant women
  - Increased cholesterol levels
  - Decreased vaccine response in children
  - Decreases in infant birth weights
  - Increased risk of kidney or testicular cancer
- **Septic systems can be a significant source of groundwater contamination if discharged into them**
  - Septic systems do not remove them
  - No practical way to upgrade to remove them
  - Need to keep them out of septic systems!

# What About PFAs and Other Toxic Chemicals?

- Ingestion is the primary pathway for PFAs into the body
- A primary PFA exposure concern for Cape Cod is drinking water

- Key: prevent discharges
  - Never dispose of medicines to wastewater
  - Bring hazardous materials to collection centers
  - Encourage bans of PFAs in household items
  - End use in fire fighting foam (a major source of groundwater contamination)



# Conclusion

- Septic systems can be a major source of nutrients and chemicals impacting ponds
- If septic system discharges and other sources are not addressed, water quality in our ponds will get worse
  - More algae and cyanobacteria blooms
  - Possible fish kills, reduced animal life
  - More pond closures to protect health
  - Risks to wells and drinking water – public and private
- Solutions require:
  - Understanding of nutrient and biological conditions in ponds
  - Understanding which septic systems impact ponds
  - Evaluation of options in terms of cost, time and effectiveness
  - Broad support from the people of Cape Cod
  - Sound funding
  - A good number of years to implement and show effects







# Town of Brewster Water Quality Actions

JUNE 2023

- Agenda
  - Stormwater Management Bylaw
  - Municipal Separate Storm Sewer System (MS4) Permit
  - Examples of Stormwater Control Measures (SCMs) or Best Management Practices (BMPs)
  - BPC & DPW coordination
  - Fertilizer Bylaw



# Chapter 272- Stormwater Management Bylaw

- Effective March 2022 (adopted Fall TM 2021)
- Regulations also adopted
- Water quality protection- primary purpose (MS4)
- Requires permit for certain activities (minor/ major)
  - Net new impervious 500 sq ft or greater
  - Total land disturbance 10k sq ft or greater
- Conscom authority w/in wetlands jurisdiction
- Enforceable performance standards (“BMPs”)
  - MA Stormwater Handbook minimum
  - Heightened treatment standards in Brewster
  - Hydrology report
  - Requires LID/ nature-based elements
- Construction and post-construction BMPs

# Chapter 272- Stormwater Management Bylaw

- Permits applied for or issued since inception
  - 2022
    - 3 Major
    - 15 Minor
  - 2023 (as of 6.9.2023)
    - 13 Major
    - 13 Minor
  - Limited number of waivers included with approvals



# Municipal Separate Storm Sewer System (MS4) Permit

- Administered by the US Environmental Protection Agency (US EPA) in conjunction with Mass Department of Environmental Protection (MassDEP).
  - Initially born out of the need to separate sewer systems from stormwater
  - Permit has evolved with the focus now being on stormwater water quality
  - In Year 5 of 5 of the permit
  - Anticipate a new permit to come forward in the near future (no major changes anticipated)
  - Required tasks within each permit year are generally defined
  - Education/Public Outreach is a major component
  - Working with new consultant, Woodard & Curran.

# Municipal Separate Storm Sewer System (MS4) Permit

- Stormwater Mapping On-going
  - Identifying and locating stormwater discharge points
    - The permit is focused on discharge points
    - Many discharge points in Brewster are not formalized
    - Not only discharge points need to be looked at especially due to the nature of the soils in Brewster.
  - Locating and identifying Stormwater Control Measures (SCMs)
    - A more holistic approach (approx. 30 identified to date)
    - Developing Operation and Maintenance Procedures for each SCM
- Inventory helps to create a baseline for identifying the stormwater infrastructure in Town and where Retro-Fit projects may be implemented.



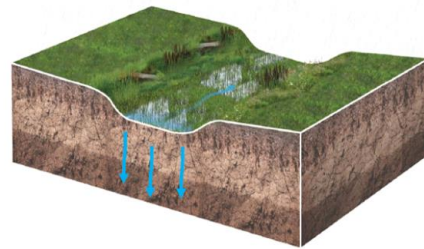
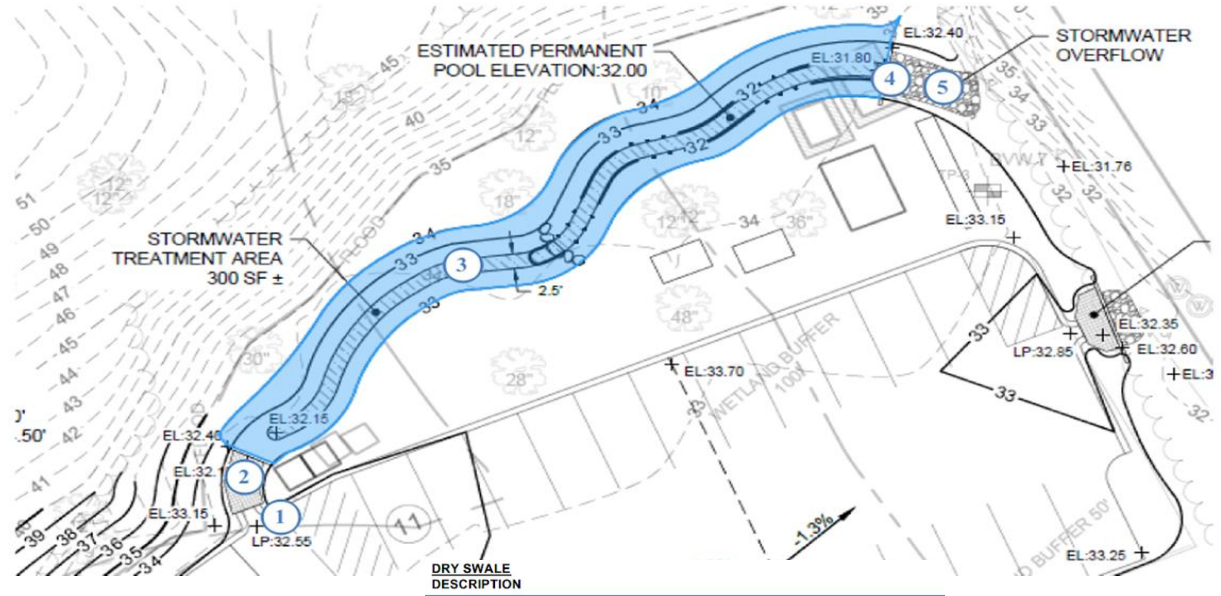


# Long Pond Landing Improvement Project

June 2023

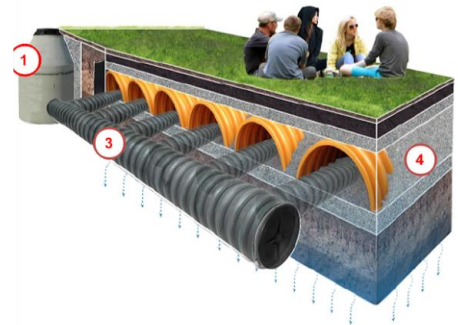
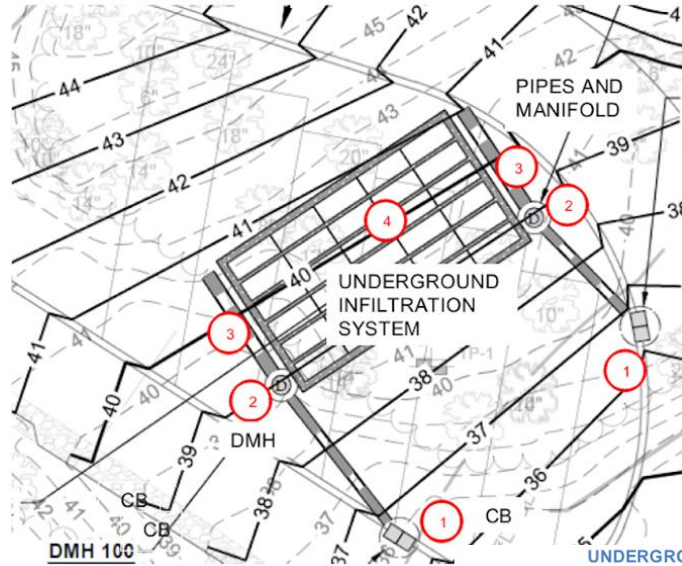
# Long Pond Landing Improvement Project

## Stormwater Areas



# Long Pond Landing Improvement Project

## UNDERGROUND CHAMBERS – PLAN





# First Light Beach Parking Lot



June 2023



# First Light Beach Parking Lot

June 2023





# Brewster Community Pool Parking Lot





# Brewster Dog Park



June 2023



# Foster Road Paving & Drainage Improvements



June 2023



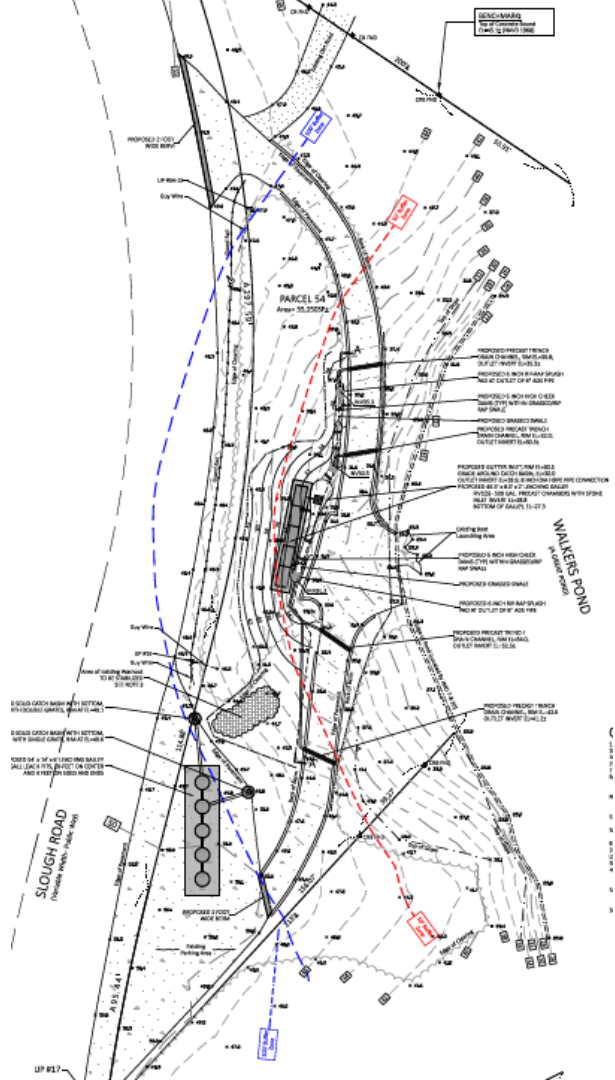
# Breakwater Road Paving & Drainage Improvements



# Municipal Separate Storm Sewer System (MS4) Permit

# Retro-Fit Design Walkers Pond

JUNE 2023



# Brewster Ponds Coalition and DPW Coordination

- BPC has helped to identify locations in Town where retro-fits could occur
- Work with engineers to develop desktop analysis with conceptual design options
- Review the options to determine best fit
- Finalize Design
- Permitting & Construction
- New BMPs/SCMs are incorporated into the list
- On-going O&M



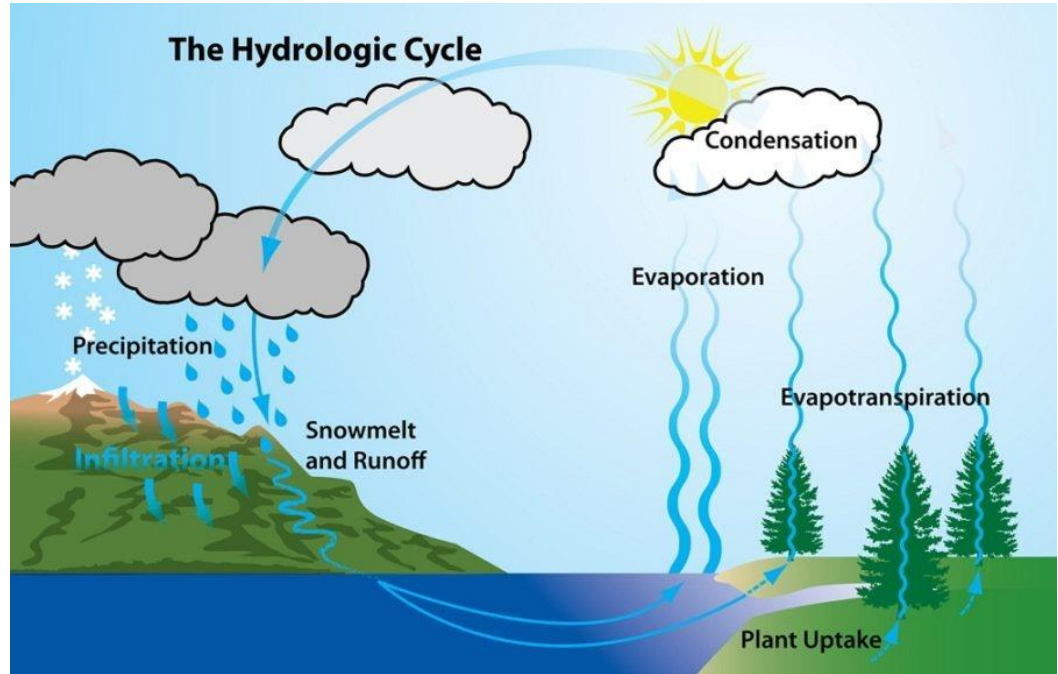
# Chapter 119– Brewster Fertilizer Bylaw

- Adopted per CCC Cape-wide DCPC (2014)
- Regulates turf fertilizer applications town-wide
- Time/place/ manner restrictions & standards
  - Includes 100' wetlands buffer prohibition
- Enforceable
- Also emphasizes education about practices





Thank You.





An aerial photograph of a coastal area, likely in Brewster, Massachusetts. The image shows a dense network of ponds and wetlands, with a prominent shoreline in the upper left corner. The water bodies vary in size and color, from dark blue to light green. The surrounding land is a mix of green vegetation and brownish areas, possibly indicating different types of terrain or land use. The overall scene is a complex, interconnected water system.

# **Brewster Ponds Coalition Septic System Impact Study**

**Done in coordination with:  
Brewster Natural Resources Department  
Horsley Witten Consultants  
Massachusetts Alternative Septic System Test Center**

# Pollution Sources for Cape Cod Ponds

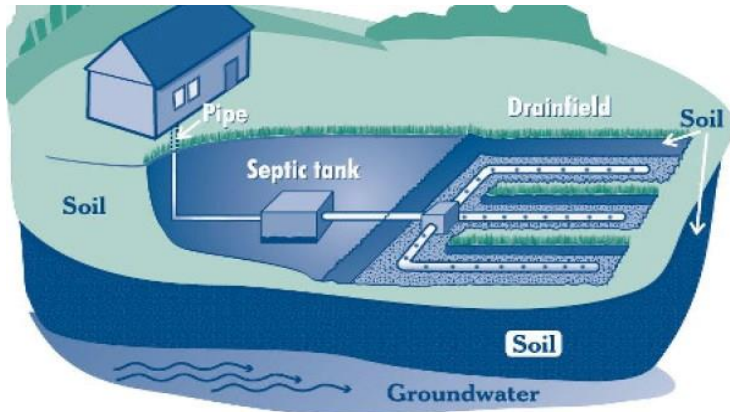
- **Septic tanks often the major source for nutrients – P & N**
  - Also for toxic chemicals like PFAs and pharmaceuticals
- Other important human-related sources:
  - Road and driveway runoff during rain – silt, salts, oil
  - Lawns and gardens near ponds - fertilizers runoff
  - Cranberry bogs – nutrients, pesticides? – contribution unclear
  - Animal waste – especially from dogs
- Sources that add nutrients with little ability to control:
  - Plant deposition (leaves, pollen, etc.)
  - Birds, other wildlife
  - Rainfall deposition
- Sediments often a critical factor in pond impairment
  - Low DO (<2 ppm) at pond bottom releases P from sediments





# Septic System Impact on Ponds

- It is known that the greatest impact is from:
  - Systems close to and upgradient of ponds and wells
  - Systems close to groundwater level (i.e. pond levels)
  - Old systems – leach pits and especially cesspools
  - Poorly managed systems – overloaded, not pumped regularly
- But there is a lot not known – specifically which septic systems impact ponds? How far away from ponds?



*Typical Title V Septic System Layout*

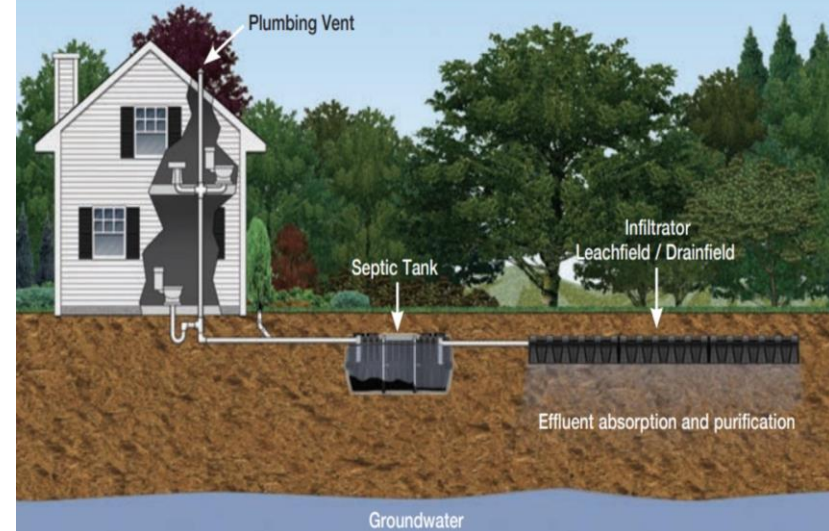
*Septic Tank being pumped out*



# How far away from ponds do septic systems need to be to not impact ponds?

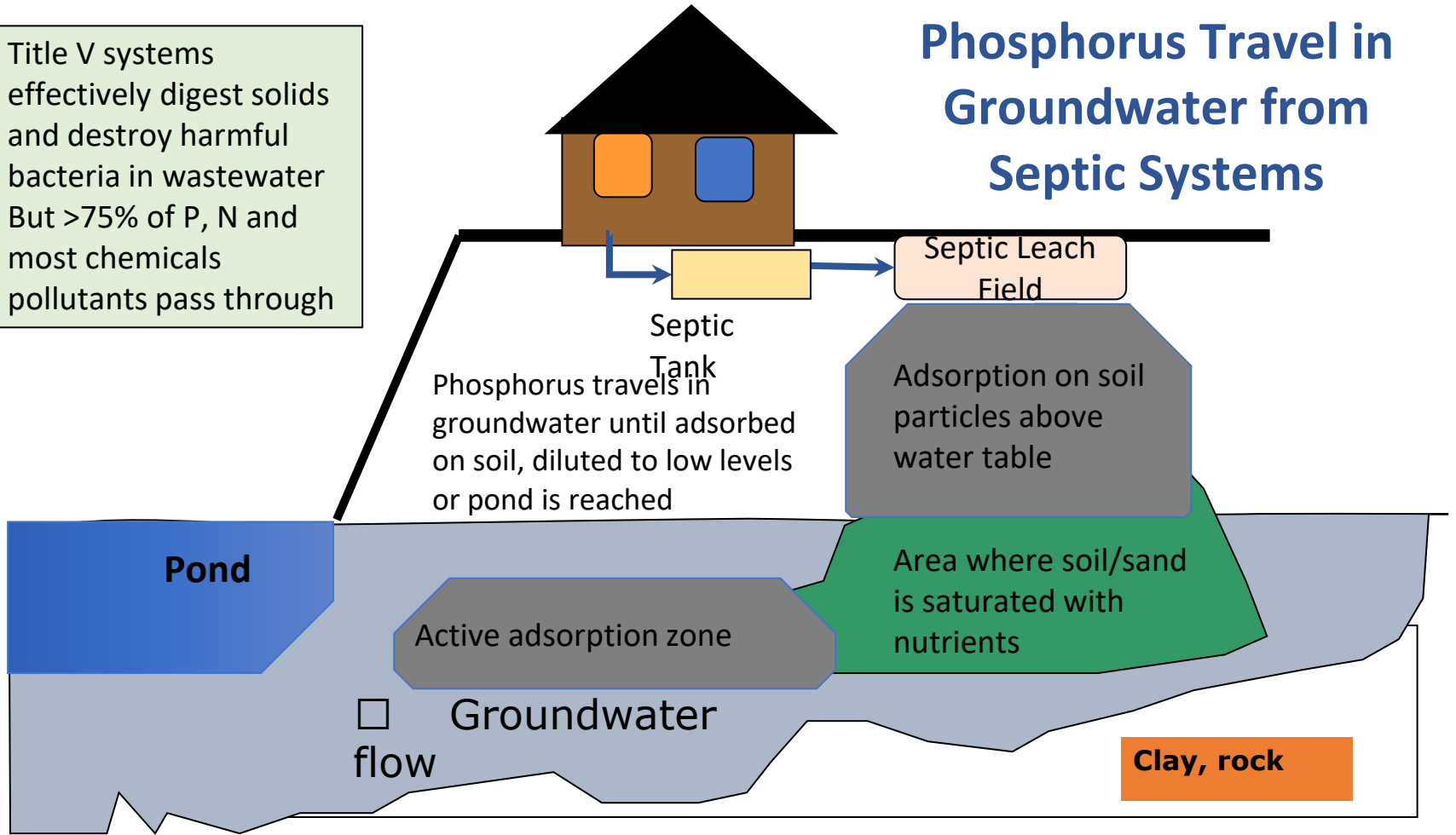
- Rule of thumb from past studies: Systems upgradient and <300 ft from ponds might impact ponds within the life of a typical house (50 years)
  - But studies not done on Cape Cod
  - Do not consider all important factors
- Many variables influence this:
  - Age of house
  - Distance to pond
  - Elevation of leach field above pond
  - Number of people in house
  - Year round use or summer only
  - Iron and manganese levels in soil (they absorb P)
  - How many septic systems nearby
  - Are there fertilized lawns using phosphorus?
- Actual distance for Cape ponds likely varies - not well known

Groundwater moves 0.5 to 2 ft/day through sand, but P maybe only 0.005 to 0.02 ft/day. At 0.01 ft/day, would take 27 years to move 100 ft. But reality depends on many things.



- Title V systems effectively digest solids and destroy harmful bacteria in wastewater
- But >75% of P, N and most chemicals pollutants pass through

# Phosphorus Travel in Groundwater from Septic Systems

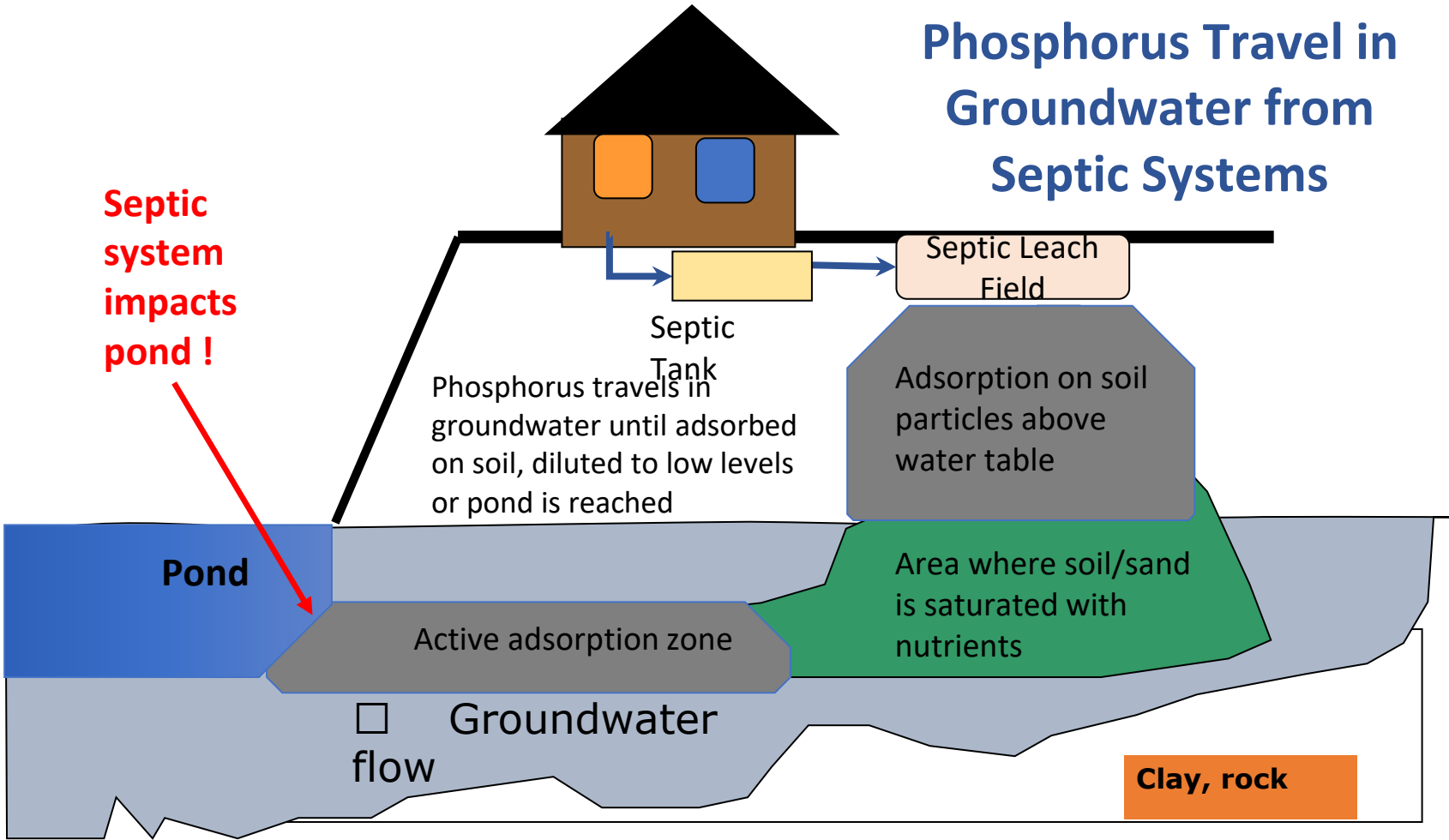


Septic system has not impacted pond yet



# Phosphorus Travel in Groundwater from Septic Systems

Septic system impacts pond !



# Brewster Ponds Coalition Septic System Impact Study

Elbow Pond

A map showing a large blue pond labeled 'Elbow Pond' in the center. The pond has an irregular shape with a narrow neck extending to the right. Surrounding the pond is a residential area with property lines shown as thin grey lines and several small orange squares representing septic systems. A road or driveway is visible on the left side of the pond. The background is a light tan color.

2 septic  
systems in  
study on Elbow  
Pond

## Project Purpose:

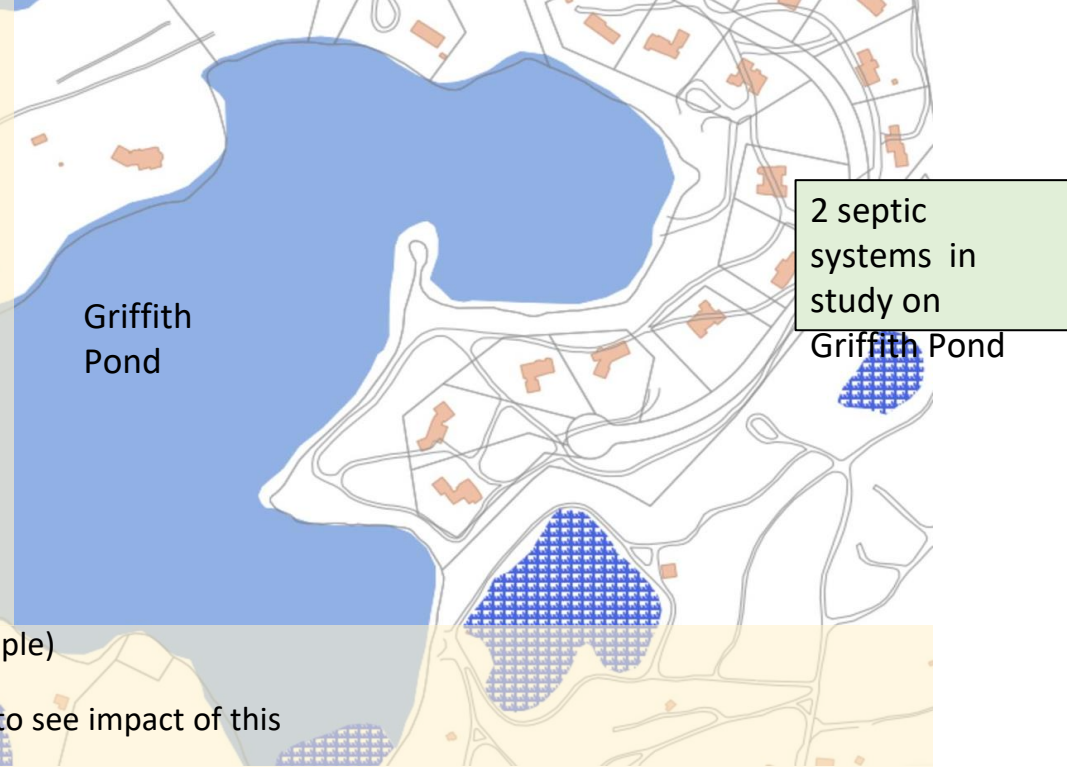
Improve understanding of phosphorus travel from septic systems towards ponds, considering both distance from and elevation above pond.

This will help determine impacts of septic systems on ponds, and help assure that any improvement measures focus on septic systems impacting ponds.

## Study Scope

Examine 4 representative septic system discharges to determine P and N movement in soil from leach field discharges considering both vertical and horizontal movement of water

- Varying house occupancy (1 to 3 people)
  - Average in Brewster is about 2
- Varying heights above groundwater to see impact of this
  - 20 to 45 ft. above groundwater
  - Typical of houses around kettle hole ponds
- Monitor vertical and horizontal movement in groundwater by constructing monitoring wells at and down-gradient from systems
  - With extensive effort to assure wells are exactly downstream
- Sample wells over 1 year period for P, N and other parameters
- Also do enhanced sampling of ponds at the same time for P and N



# Possible Future Study

What about impact when there are many septic systems up-gradient of a pond?

Cobbs Pond



- Example: Cobb's has large groundwater catchment area, including old settled areas
- Phosphorus from septic systems, cesspools & outhouses has had hundreds of years to accumulate and migrate. Likely large amount of P in groundwater moving toward pond





Thank You





# Brewster Ponds Summit 2023

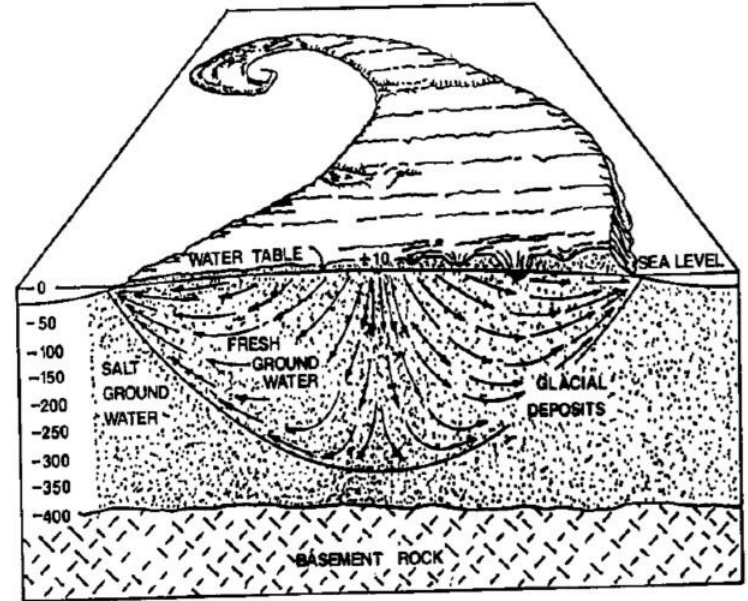
Chris Miller, Director of Natural Resources,  
Town of Brewster

- What has been done to understand the water quality and impairment of ponds
- PALS sampling
- The Mill Pond study
- Review of PALS and other testing data
- Brief review of pond quality levels as known now



Cape Cod is a mound of sediments pushed into place by glacial action over a period of several thousand years during the last ice age and distributed as **outwash plain** by the melting of the glaciers. Beneath our feet, in the sand, lies our groundwater/drinking water. The water-saturated soil, known as the **aquifer**, extends in some places to a depth of approximately 400 feet (130 meters), then grows more shallow toward the edges of the land as seen in the cross-section to the left. When drawn true to scale the aquifer appears as a thin film of water, which because of its convex shape resembles a lens. On Cape Cod, water moves about one foot (30 cm) per day through the soil. It is pushed by gravity toward the shore or tidal river where it is gradually discharged and lost from the aquifer.

*vertical scale greatly exaggerated*

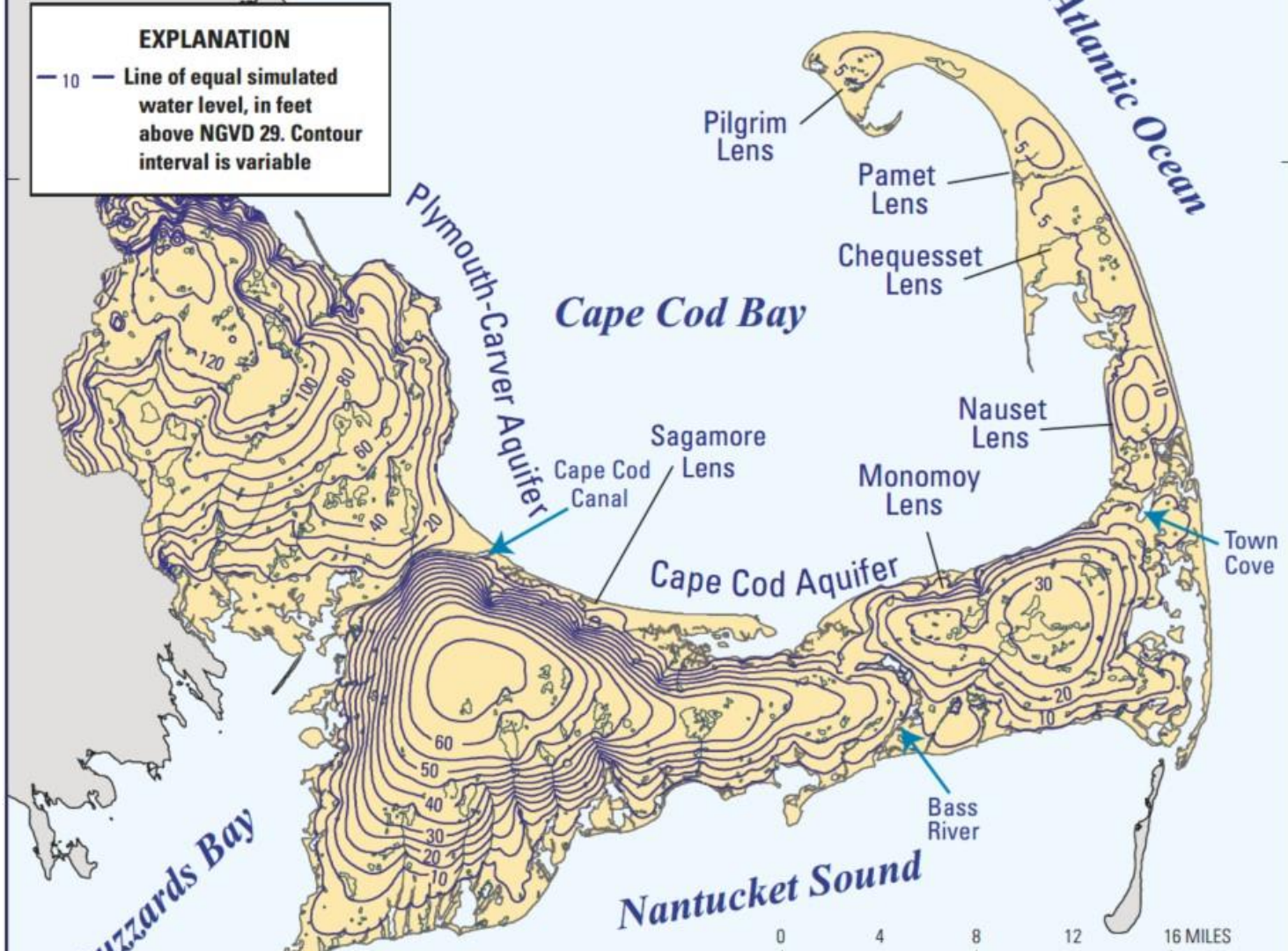




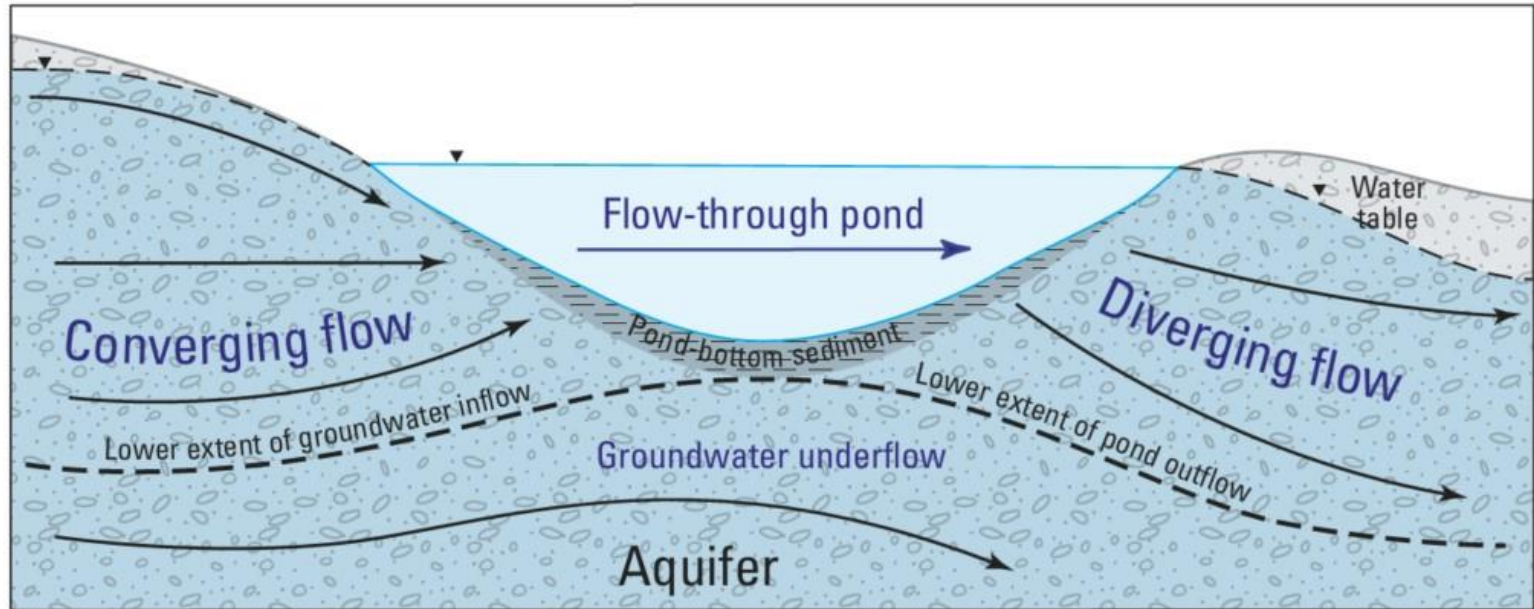
### EXPLANATION

— 10 — Line of equal simulated water level, in feet above NGVD 29. Contour interval is variable

42°



#### 4 Estimated Hydrologic Budgets of Kettle-Hole Ponds in Coastal Aquifers of Southeastern Massachusetts

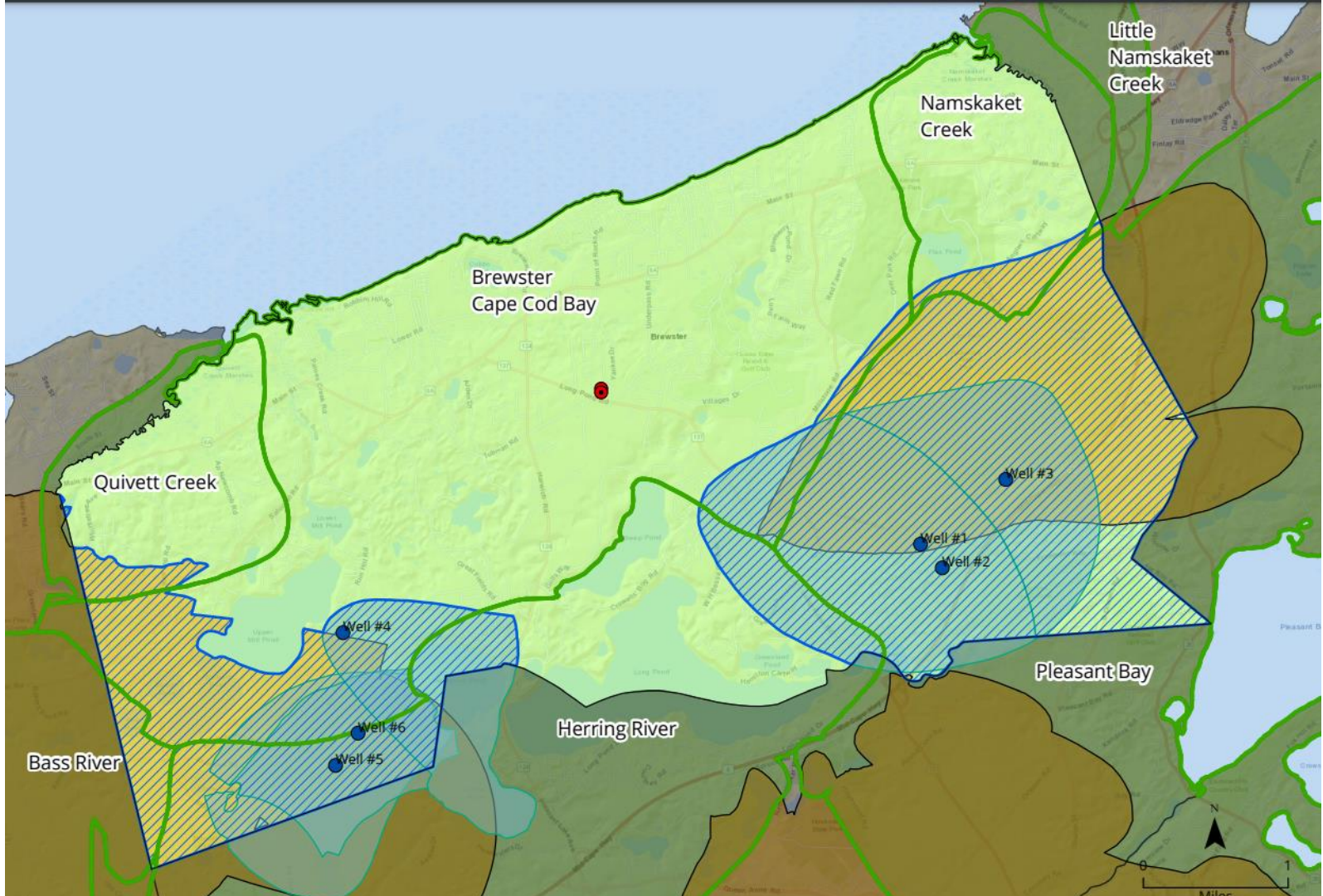


Schematic only, not to scale


Modified from Winter and others (1998)

**Figure 3.** Vertical groundwater-flow paths upgradient and downgradient from kettle-hole ponds typical of those found in coastal aquifers of southeastern Massachusetts.







A scenic view of a pond surrounded by lush green trees. In the foreground, an orange canoe is on the sandy shore. The water is clear and reflects the surrounding greenery. The sky is bright and clear.

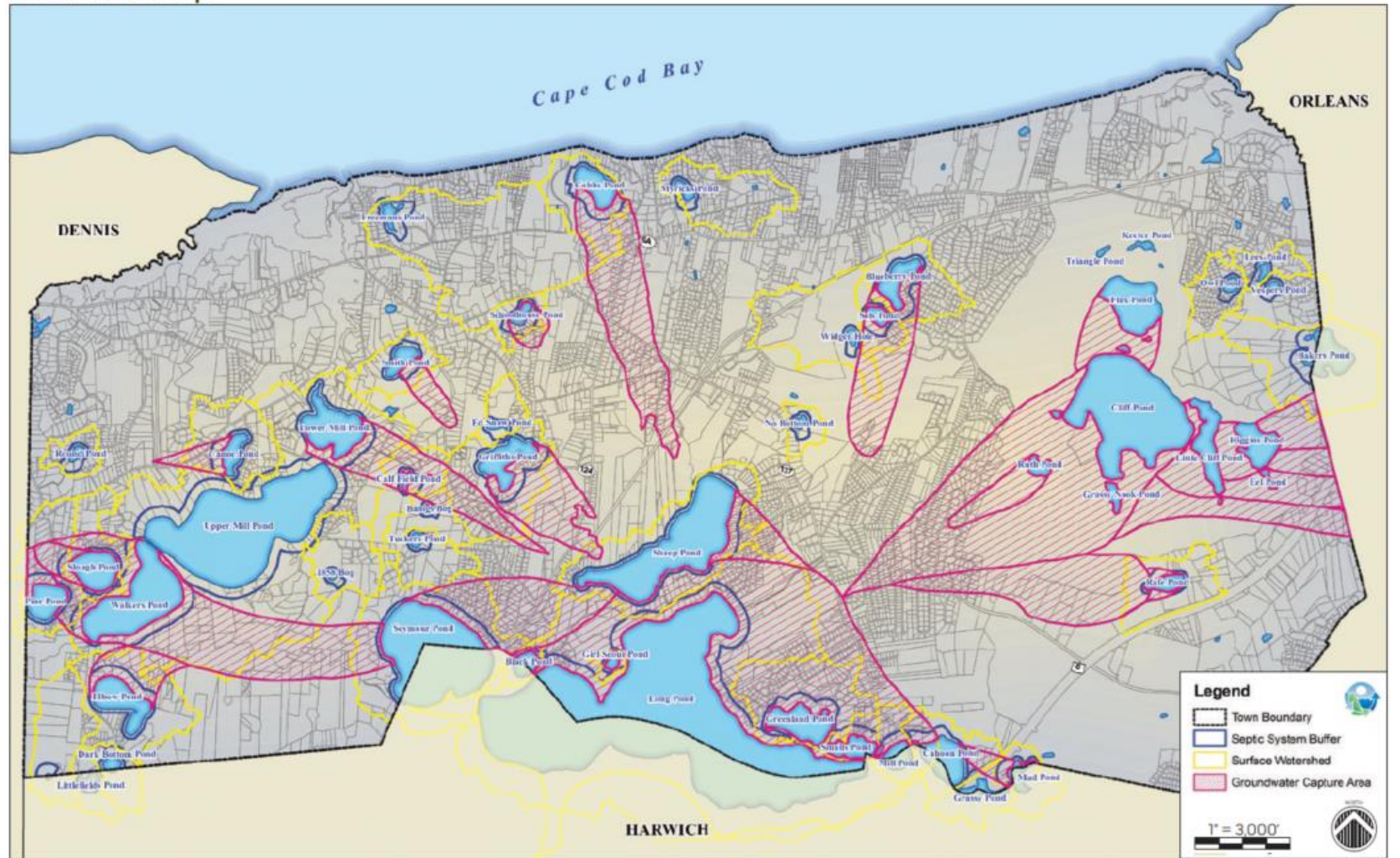
# Water Resource Atlas

## Fresh Water Ponds

Brewster, Massachusetts



# Town-wide Map





# Mill Ponds - Walkers Pond, Upper Mill Pond and Lower Mill Pond



# Sheep Pond

## **Management History:**

The first complete survey of Sheep Pond was made on July 25, 1911. This survey and a 1903 report indicated black bass, chain pickerel, yellow perch, sunfish, shiners and smelt were present. An August 1948 pond survey reported smallmouth bass, yellow perch, white suckers and banded killifish. Sheep Pond was reclaimed in September of 1957. The 3060 pounds of fish picked up (estimated 45-50% pickup) were composed by weight of 60% white sucker, 30% brown bullhead, 7% yellow perch, 3% banded killifish and small amounts of rainbow trout, brown trout, smallmouth bass and johnny darters. It was reclaimed again in 1966 and 1972. Sheep Pond was limed with agricultural limestone in 1971 and 1982 to counteract increasing acidity. Adult smallmouth bass were stocked in 1979 and 1982. The pond has been illegally stocked in the past with alewives by angler seeking to increase trout growth.

## **Fish Populations:**

The most recent fisheries survey, conducted in 1988, recorded five species: smallmouth bass, pumpkinseed, yellow perch, brown bullhead and banded killifish. Sheep Pond is annually stocked in the spring and fall with brook, brown and rainbow trout. Atlantic salmon broodstock are annually stocked.



## GREAT PONDS ON CAPE COD

LENS	TOWNS	# OF GREAT PONDS	AREA (acres)
SAGAMORE	Bourne, Sandwich Falmouth, Mashpee Barnstable, Yarmouth	111	6318
MONOMOY	Dennis, Brewster, Harwich, Chatham, Orleans	74	3881
NAUSET	Eastham, South Wellfleet	7	239
CHEQUESSET	Wellfleet, South Truro	12	354
PAMET	Truro	1	351
PILGRIM	Provincetown	3	65

*Source: An Inventory of the Ponds, Lakes, and Reservoirs of Massachusetts, 1969*

## Executive Summary

Long Pond is the largest great pond on Cape Cod covering over 740 acres and split between the Towns of Brewster and Harwich. Long Pond has begun to experience water quality problems that threaten the environmental health and the enjoyment of the pond by town residents. A large algal bloom occurred on the lake during 1996 and a significant fish kill (> 100 fish) occurred in June 1997. To help address concerns about these events, the Towns, the Cape Cod Commission, and the Long Pond Watershed Association contributed matching funds and staff and volunteer time to help obtain a \$10,000 state Department of Environmental Management grant to complete an analysis of factors influencing the water quality in Long Pond. This analysis includes collection and analysis of water quality data and a phosphorus loading assessment. Phosphorus was a primary focus of the analysis because it is the key nutrient in pond ecosystems.

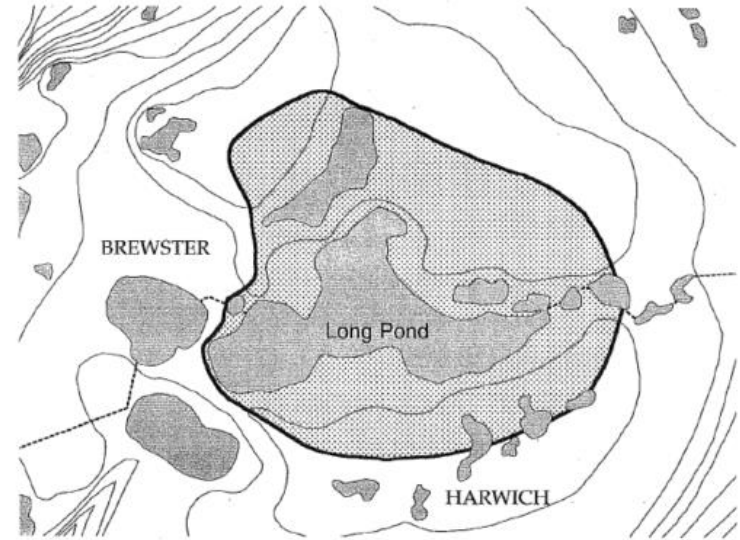
Based on analyses of the collected data, the Commission staff concluded that Long Pond is experiencing low oxygen conditions in its bottom waters during summer stratification due to bacterial respiration during the decomposition of organic sediment materials. Limited oxygen is a habitat impairment for bullheads, trout, and other creatures who live in the colder bottom waters during summer months and is the likely cause of the 1997 fish kill.

Low oxygen conditions also cause the release of phosphorus from the sediments. Phosphorus loads from land uses surrounding Long Pond are approximately half of the load regenerated from the sediments. In-lake phosphorus reductions will improve water quality in the short run, but phosphorus reductions within a 250 ft deep buffer strip around Long Pond are necessary to sustain good water quality in the long term.

# Long Pond Water Quality Assessment

Final Report

March, 1999



Completed by:

Water Resources Office  
Cape Cod Commission

Completed for:

Town of Brewster  
Conservation Commission

# 2001 Ponds in Peril Workshop

North American Lake Management  
Society:

<https://www.nalms.org/secchidipin/about/history/>

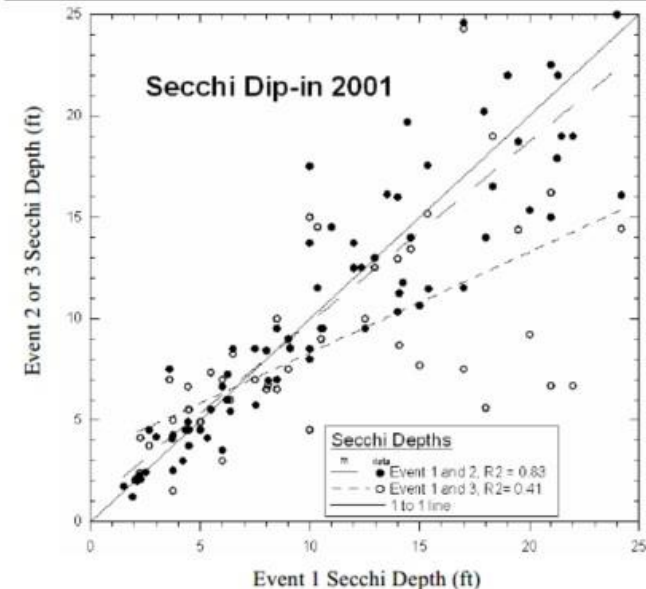
### 3. PALS Secchi Disk Monitoring

As mentioned previously, at the first “Ponds in Peril” workshop in May 2001, prospective Pond and Lake Stewards (PALS) were encouraged to begin collecting Secchi disk readings. Over 100 Secchi disks were distributed free of charge to volunteers along with postage-paid, preaddressed postcards for reporting of results. Cape Cod Commission staff coordinated these activities and ensured that each pond had only one sampler. Samples were collected in early July, late July, and early August.

A total of 66 volunteers participated in the first measurement of 107 ponds. Repeat measurements scheduled for late July and early August were made for 83 and 65 ponds, respectively, with 55 and 45 volunteers participating for each measurement event. Results collected between June 29 and July 14 were submitted to the Great North American Secchi Dip-In, which is coordinated through Kent State University (<http://dipin.kent.edu/>) and the North American Lake Management Society. Results for all three measurement events were presented at the second “Ponds in Peril” workshop.

Water clarity generally declined by a larger magnitude between the first and third measurement events as compared to the decline observed between the first and second events (Figure 23). Overall, more than half of the ponds experienced reduced water clarity.

Figure 23. 2001 Secchi Dip-In: Comparison of Results





# Cape Cod Pond and Lake Atlas

Project 2000-02

Prepared by:

Cape Cod Commission  
Eduard M. Eichner, Water Scientist/Project Manager  
Thomas C. Cambareri, Water Resources Program Manager  
Gabrielle Belfit, Hydrologist  
Donna McCaffery, Water Resources Project Assistant  
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Margo Fenn, Executive Director

Prepared for:

MASSACHUSETTS EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS

COMMUNITY FOUNDATION OF CAPE COD

AND

SCHOOL OF MARINE SCIENCE AND TECHNOLOGY  
AT UNIVERSITY OF MASSACHUSETTS - DARTMOUTH

May, 2003

This project has been partially funded by and carried out in partnership with the Massachusetts Executive Office of Environmental Affairs. The contents do not necessarily reflect the views and policies of EOEPA or of the Department, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

This Pond and Lake Atlas is a status report on the PALS program. It documents the outreach and education activities leading to the creation of the PALS program, reviews water quality data collected by volunteers during the 2001 PALS Snapshot from over 190 ponds, uses this data to develop Cape Cod-specific indicators of pond impacts, reviews data collected in previous studies, and details further efforts necessary to move pond protection and remediation forward on the Cape.

Cape Cod has nearly 994 ponds covering nearly 11,000 acres. These ponds range in size from less than an acre to 735 acres; with the 21 biggest ponds having nearly half of the total Cape-wide pond acreage. Approximately 40% of the ponds are less than an acre. Prior to the creation of this Pond Atlas, a complete count of all the ponds on Cape Cod had not been accomplished. Of the 994 ponds, only 176 have maximum depth measurements and only 89 have bathymetric information, which is important for understanding water quality information.

As part of the overall PALS program, SMAST provided laboratory services at no cost to towns or volunteers for the 2001 PALS Snapshot of pond water quality. Volunteers collected dissolved oxygen and temperature profiles, clarity readings, and 421 water quality samples from 195 ponds between August 15 and September 30. Samples were analyzed for chlorophyll *a*, alkalinity, pH, total nitrogen, and total phosphorus. This information is the most comprehensive dataset on Cape Cod ponds.

This dataset was used to provide a general assessment of pond water quality on Cape Cod. The authors reviewed existing tools for evaluating pond ecosystem nutrient levels, including Carlson's Trophic Status Index and USEPA's ecoregion nutrient thresholds, and applied USEPA's nutrient threshold calculation methodology to develop Cape Cod-specific nutrient thresholds. These tools were used to look at the general status of ponds on town by town basis and select number of individual ponds.

# Secchi Depth

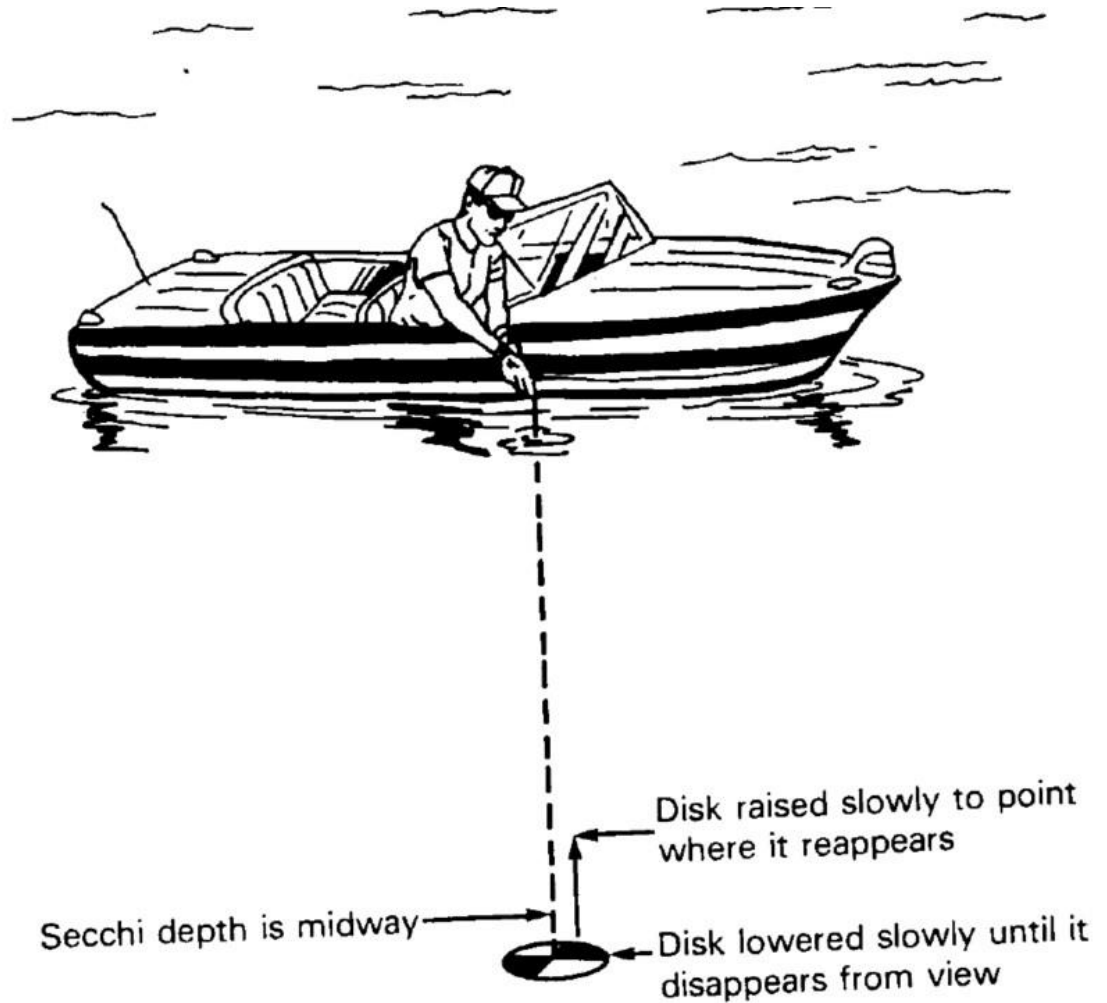
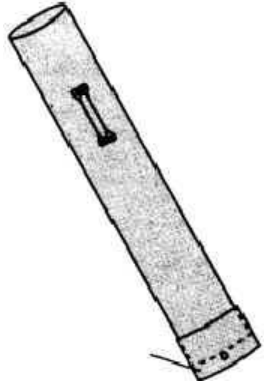
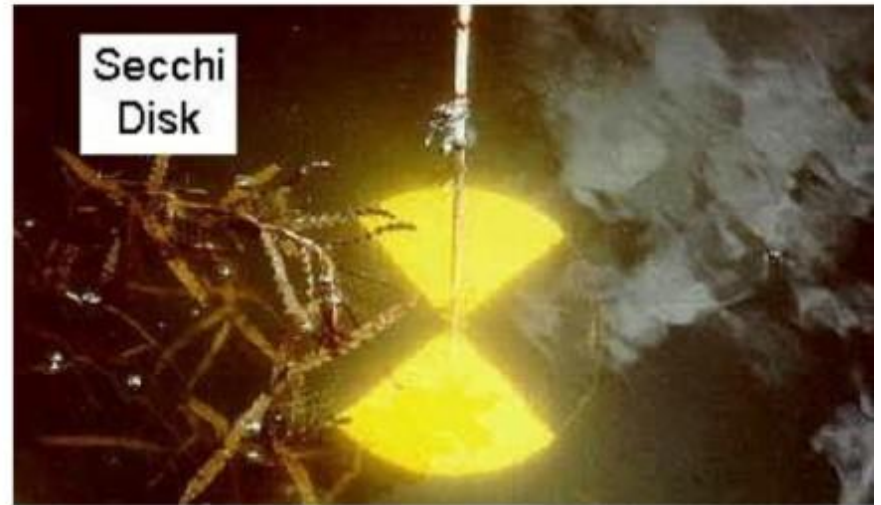




Figure 16 presents the comparison of the 2001 Snapshot results to the Cape Cod reference criteria. During the 2001 Snapshot sampling, 192 Secchi depth readings were collected. The average of depth of these readings is 2.66 m (or 8.7 ft), while the median is 2.26 m. Town results show how many pond's Secchi depth readings are above the reference depth (6.8 m) based only on data from unimpacted ponds, below the reference depth (3.8 m) based on data from all the ponds, and how many are between these two depths. For example, Brewster volunteers collected Secchi depth readings from 25 ponds, 20 of which had Secchi depths of less than 3.8 m (12.5 ft) (see Figure 16). As would be expected by the method used to develop the reference criterion, the analysis shows that about a three-quarters (75%) of the ponds on Cape Cod have been "impacted" by human activities. Individual pond results are included in the town-specific sections of this Atlas.

Figure 15. – Secchi Disk



From: [www.epa.state.il.us/water/conservation-2000/volunteer-lake-monitoring/secchi-disk.jpg](http://www.epa.state.il.us/water/conservation-2000/volunteer-lake-monitoring/secchi-disk.jpg)

# Pond and Lake Stewards (PALS) Sampling



**Smast**  
University of Massachusetts Dartmouth

**CAPE COD COMMISSION**

### POND AND LAKE SAMPLING DATA SHEET

2013 Cape Cod Pond and Lake Stewardship (PALS) Snapshot

LAKE/POND NAME: Sheep  
TOWN: EASTAMSTER  
Date: 4/27/23 Time: 8:45 (AM or PM) Sample Collector: DAZ RDB

Observations (write in or circle as appropriate):  
 Water Color: 1.0 (slab brown, green, blue/green, red/orange, white, etc)  
 Weather (circle): 1. Clear, 2. Pt. Cloudy, 3. Overcast, 4. Rain, 5. Fog/Haze, 6. Drizzle, 7. Internet: Rain  
 Wind (circle): 1. Light Breeze, 2. Light Wind, 3. Steady Wind, 4. Strong Wind

Plants on Pond (check conditions):	Over 50%	25% to 50%	10% to 25%	up to 10%	less than 1% or None
Floating Algae on pond surface:					X
Emergent Grasses/Sedges of surface:					X
Other plant #1:					
Other plant #2:					
Other Notes:					

TOTAL DEPTH: 18.06 meter  
 SECTH READING: Disappearing: 9.46 meter Reappearing: 9.31 meter

DISSOLVED OXYGEN/TEMPERATURE PROFILE  
 Meter Manufacturer: YSI Model: PRO 020  
 Record DO/Temp profiles in one-meter increments except for the first surface reading which is taken at 0.5 m (for example: 0.5 m, 1 m, 2 m, 3 m, etc). If the pond is very shallow (3 meters or less), record readings at 0.5 meter increments (for example: 0.5 m, 1 m, 1.5 m, 2 m, etc).

Depth (m)	Temp (°C)	Dissolved Oxygen (mg/l)	Depth (m)	Temp (°C)	Dissolved Oxygen (mg/l)	Depth (m)	Temp (°C)	Dissolved Oxygen (mg/l)
0.5	12.7	10.30	11.0	9.8	11.65			
1.0	12.7	10.32	12.0	9.4	11.67			
2.0	12.7	10.35	13.0	9.1	11.66			
3.0	12.6	10.36	14.0	8.8	11.03			
4.0	12.6	10.33	15.0	8.6	10.35			
5.0	12.6	10.31	16.0	8.5	9.66			
6.0	12.5	10.32	17.0	8.4	9.63			
7.0	12.5	10.32	18.0					
8.0	12.3	10.36						
9.0	12.1	10.70						
10.0	12.0	11.26						

COMPLETE BOTH SIDES OF DATA SHEET

LAKE/POND NAME: \_\_\_\_\_ Sample Collector: \_\_\_\_\_  
 TOWN: \_\_\_\_\_

WATER QUALITY SAMPLING

LIST POND NAME, SAMPLE DEPTH, AND DATE ON BOTTLE LABEL

⇒ POND GREATER THAN 9 METERS DEEP ⇒

Sampling Depth	Bottle Label (Pond Name, Sample Depth, & Date)
a. just below the surface	
b. 3 m down	
c. 9 m down	
d. 1 m above the bottom	

⇒ In ponds ~9 m deep, collect three samples (just below the surface, 3 m down, and 1 m above the bottom).

⇒ POND LESS THAN 9 METERS DEEP ⇒

Sampling Depth	Bottle Label (Pond Name, Sample Depth, & Date)
a. just below the surface	
b. 1 m above the bottom	

⇒ In ponds approximately 1 m deep, please collect two samples just below the surface.

TIME SAMPLING COMPLETED: \_\_\_\_\_ (AM or PM)

All water samples must be kept cold, in a cooler with ice packs, and delivered to the Cape Cod Commission offices the same day (prior to 3:30 PM)! Alternative arrangements can be made by calling Ed Eichner @ 508-737-5991.

Cape Cod Commission offices are at 3225 Main Street/Route 6A in Barnstable Village (across from the Post Office).

SAMPLE SIGNOFFS	Signature	Received	Delivered
		Date/Time	Date/Time
Pond Monitor			
Sampling Coordinator			
Cape Cod Commission			
SMAST			

COMPLETE BOTH SIDES OF DATA SHEET



# PALS Testing





Recommended citation for use of any PALS Snapshot laboratory data:

August/September Laboratory Data provided without cost and in support of  
 the Cape Cod Pond and Lake Stewardship (PALS) Program by:  
 Coastal Systems Group  
 School for Marine Science and Technology  
 University of Massachusetts Dartmouth  
 706 Rodney French Blvd.  
 New Bedford, MA 02744  
 © [2023] University of Massachusetts  
 All Rights Reserved



Key	Weather Conditions:	Wind:
NES = Not Enough Sample	1 Clear	1 Calm
NS = No Sample	2 Partly Cloudy	2 Light Breeze
NC = No Chain Of Custody	3 Overcast	3 Steady Wind
ND = No Data, samples being	4 Fog/Haze	4 Strong Wind
BDL = Below Detection Limit	5 Drizzle	
NA = Not Applicable	6 Intermit. Rain	
	7 Rain	

Please contact Ed Eichner (508.737.5991) at TMDL Solutions or Sara Horvet (508.910.6325) at SMASST for data interpretation, development of pond databases, pond sampling and/or other pond and lake information

Town	Pond	Sample Depth (M)	Date	QC	Number of Samples	Total Depth (M)	Secchi Depth (M)	% Secchi	DO (mg/L)	Temp C	pH	Alk (mg CaCO3/L)	Chla (ug/L)	Phaeo (ug/L)	TP (uM)	TN (uM)	T-pig ug/L	Water Color	Weather	Wind	Plants
BREWSTER	SHEEP	0.5	4/21/2022		4	18.1	7.535	41.6%	11.03	10.6	6.19	5.8	0.80	0.12	0.63	17.68	0.92	ND	ND	ND	ND
BREWSTER	SHEEP	1	4/21/2022						11.02	10.6	NS	NS	NS	NS	NS	NS	NS				
BREWSTER	SHEEP	2	4/21/2022						11.01	10.6	NS	NS	NS	NS	NS	NS	NS				
BREWSTER	SHEEP	3	4/21/2022						10.98	10.6	6.20	5.3	1.11	0.03	0.25	16.18	1.14				
BREWSTER	SHEEP	4	4/21/2022						10.98	10.6	NS	NS	NS	NS	NS	NS	NS				
BREWSTER	SHEEP	5	4/21/2022						10.97	10.5	NS	NS	NS	NS	NS	NS	NS				
BREWSTER	SHEEP	6	4/21/2022						10.94	10.5	NS	NS	NS	NS	NS	NS	NS				
BREWSTER	SHEEP	7	4/21/2022						10.92	10.4	NS	NS	NS	NS	NS	NS	NS				
BREWSTER	SHEEP	8	4/21/2022						10.88	10.4	NS	NS	NS	NS	NS	NS	NS				
BREWSTER	SHEEP	9	4/21/2022						10.89	10.3	6.18	6	1.32	0.03	1.81	18.69	1.34				
BREWSTER	SHEEP	10	4/21/2022						10.88	10.3	NS	NS	NS	NS	NS	NS	NS				
BREWSTER	SHEEP	11	4/21/2022						10.84	10.3	NS	NS	NS	NS	NS	NS	NS				
BREWSTER	SHEEP	12	4/21/2022						10.82	10.3	NS	NS	NS	NS	NS	NS	NS				
BREWSTER	SHEEP	13	4/21/2022						10.81	10.3	NS	NS	NS	NS	NS	NS	NS				
BREWSTER	SHEEP	14	4/21/2022						10.81	10.2	NS	NS	NS	NS	NS	NS	NS				
BREWSTER	SHEEP	15	4/21/2022						10.78	10.2	NS	NS	NS	NS	NS	NS	NS				
BREWSTER	SHEEP	16	4/21/2022						10.74	10.2	NS	NS	NS	NS	NS	NS	NS				
BREWSTER	SHEEP	17	4/21/2022						10.64	10.2	6.15	5.8	1.46	0.03	0.38	18.54	1.48				
BREWSTER	SHEEP	0.5	9/8/2022						ND	ND	6.37	32.4	0.40	0.08	0.23	14.52	0.49				
BREWSTER	SHEEP	3	9/8/2022						ND	ND	6.30	6.1	0.55	0.03	0.15	13.01	0.58				
BREWSTER	SHEEP	9	9/8/2022						ND	ND	6.24	5.9	0.52	0.03	0.26	15.23	0.55				
BREWSTER	SHEEP	16	9/8/2022						ND	ND	6.26	5.9	1.44	0.03	0.57	15.27	1.47				
BREWSTER	SLOUGH	0.5	4/25/2022		2	5.5	2.425	44.1%	10.59	14.7	5.90	3.1	3.89	0.03	0.98	31.87	3.92	BROWN	OVERCAST	LIGHT BREEZE	NA
BREWSTER	SLOUGH	1	4/25/2022						10.55	14.6	NS	NS	NS	NS	NS	NS	NS				

# CAPE COD WATERSHED

## Assessment and 5-Year Action Plan



compiled by the  
Former EOEA Cape Cod Watershed Team

edited by  
Courtney Armentrout  
Former Assistant Watershed Team Leader

2004



The Commonwealth of Massachusetts  
**Executive Office of Environmental Affairs**

# Eutrophication and Aquatic Plant Management in Massachusetts

## Final Generic Environmental Impact Report



Executive Office of Environmental Affairs  
Commonwealth of Massachusetts  
2004

# The Practical Guide to Lake Management in Massachusetts

A Companion to the Final Generic Environmental  
Impact Report on Eutrophication and Aquatic Plant  
Management in Massachusetts



Commonwealth of Massachusetts  
Executive Office of Environmental Affairs

2004





# The Massachusetts Lake and Pond Guide

*Protection Through Education*



Massachusetts Department of  
Conservation and Recreation  
Lakes and Ponds Program

## State Publications

### Brochures

Lawns & Landscapes in Your Watershed (DEP)  
TMDL's: Another Step to Cleaner Waters (DEP)  
Don't Trash the Grass (DEP)  
Invasive Plants (DCR)  
Shoreline Surveys: Action Tool (DEP)  
Clean Rivers Begin at Home: A Guide to  
Understanding Nonpoint Pollution (DEP)  
Protect Your Pet and Preserve the Environment:  
Don't Release Exotic Species! (CZM)

### Manuals and Guides

- Guide to Selected Invasive Non-native Aquatic Species in Massachusetts (DCR)
- Guide to Aquatic Plants in Massachusetts (DCR)
- Final Generic Environmental Impact Report (GEIR) on Eutrophication and Aquatic Plant Management in Massachusetts (DCR)
- The Practical Guide to Lake Management in Massachusetts (A Companion to the Final Generic Environmental Impact Report on Eutrophication and Aquatic Plant Management in Massachusetts)(DCR)
- Nonpoint Source Management Manual: A Guidance Document for Municipal Officials (DEP)
- Massachusetts Erosion and Sediment Control Guidelines for Urban and Suburban Areas: A Guide for Planners, Designers, and Municipal Officials (DEP)
- Volume I: Stormwater Policy Handbook (DEP)
- Volume II: Stormwater Technical Handbook (DEP)
- A Guide to Lakes and Ponds in Massachusetts Forests and Parks
- Surveying a Lake Watershed and Preparing an Action Plan (DEP)
- Give Your Lake the Blues! (DEP)
- Shoreline Buffer Guide (BCRP + DEP)
- More than Just a Yard (EOEA)
- A Field Guide to the Animals of Vernal Pools (DFW)

- Critters of Massachusetts (DFW)
- Guide to the Dragonflies and Damselflies of Massachusetts (DFW)

### Other

- Boat Ramp Sign "Stop the Spread of Nuisance Species" (DCR)
- Invasive Species Poster (DCR)
- Waterline (a quarterly guide to watersheds, wetlands waterways, drinking water) (DEP)
- Online Lake and Pond Maps (DFW)  
[www.state.ma.us/dfwele/dfw/dfw\\_pond.htm](http://www.state.ma.us/dfwele/dfw/dfw_pond.htm)
- Abstracts of the Fish and Wildlife Laws (DFW)
- Boat Massachusetts Your Guide to Boating Laws and Responsibilities (Environmental Police)

Additional copies of DEP Materials can be obtained by calling a Regional DEP Service Center:

Northeast (978) 661- 7677  
Southeast (508) 946-2714  
Central (508) 792-7683  
Western (413) 755-2124  
[www.state.ma.us/dep](http://www.state.ma.us/dep)

Additional copies of DCR publications/materials can be obtained from:

Department of Conservation and Recreation  
[www.mass.gov/lakesandponds](http://www.mass.gov/lakesandponds)

Additional copies of DFW publications can be obtained from:

Division of Fisheries and Wildlife  
1-508-792-7270

Additional copies of Environmental Police publications, or for information on fishing and boating regulations call 1-800-632-8075 or visit [www.mass.gov/dfwele/dle](http://www.mass.gov/dfwele/dle)

# Long Pond Alum 2007

Anoxia has been a feature of deep water in Long Pond for at least half a century, but excessive internal recycling of nutrients accumulated over many years seems to be a more recent phenomenon. It may have taken many decades for the internal load to reach the threshold where it could supply sufficient phosphorus to cause the observed blooms. The release of previously bound and sedimented P inputs back into the water column is cause for concern on several grounds:

1. Some algae may be able to access this increased nutrient level by moving between lower and upper water layers
2. Some of the P accumulated in the bottom waters does pass into surface waters during summer, fueling algal growth
3. Upon eventual mixing, more of that accumulated P becomes available to algae
4. The long detention time of Long Pond means that seasonal events such as P release from sediment may have longer term impacts
5. The release of P without a commensurate release of nitrogen will lower N:P ratios and favor cyanobacteria, the most troublesome of algae

Remedial action aimed at that internal load was chosen to restore desirable conditions in Long Pond, and protective measures in the watershed are to be implemented to slow down the accumulation of phosphorus and internal loading in the future. Aluminum treatment was favored over aeration methods. The primary reason for the choice of alum over aeration was economics, as an appropriate aeration system would cost at least as much as an alum treatment, but also requires annual maintenance and operational costs not incurred with the alum treatment.

Prepared for:

The  
Towns of  
Brewster and  
Harwich,  
Massachusetts

## TREATMENT SUMMARY

for

## Phosphorus Inactivation in Long Pond

Brewster and Harwich,  
Massachusetts



Prepared by:

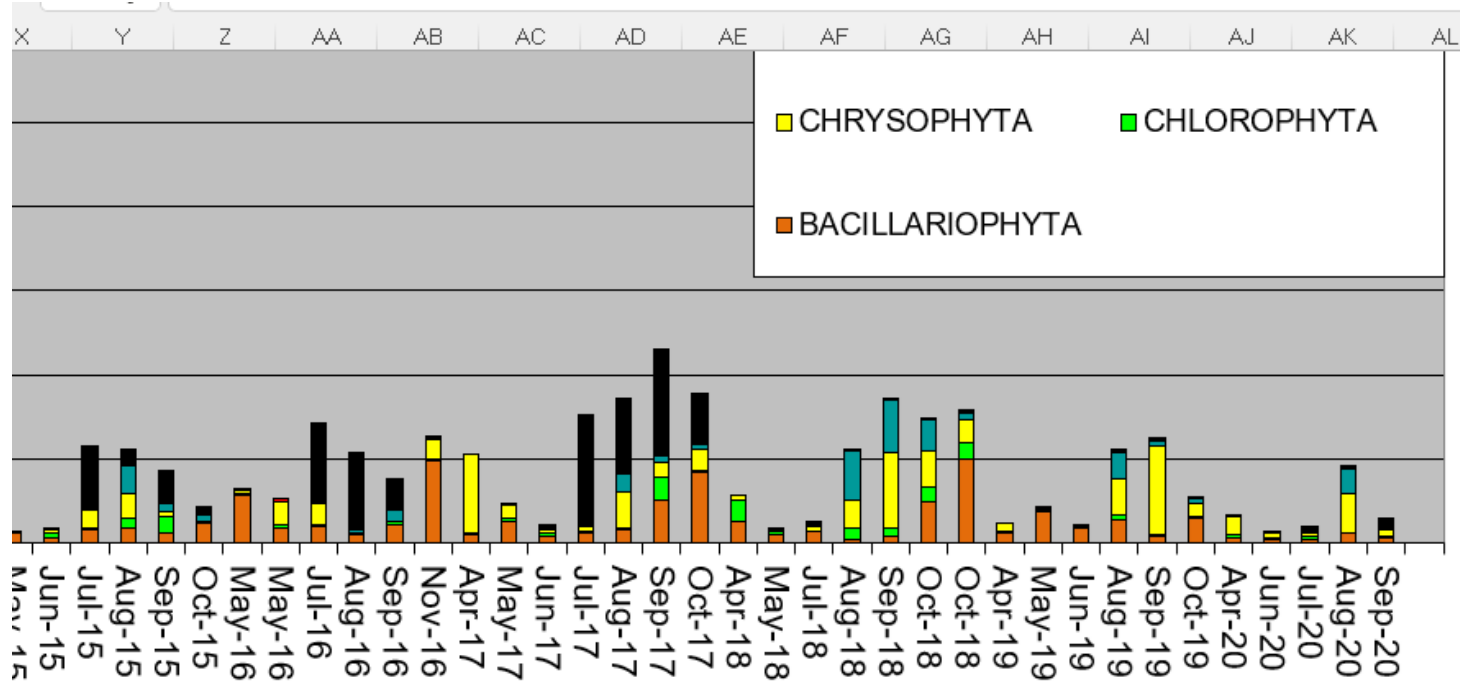
AECOM

February 2009

Document No. 12283-001C



# Long Pond continued monitoring



# 2009 Brewster Ponds Report

1. Reviewed citizens/PALS data for all 29 monitored ponds
2. Completed more detailed reviews of 6 selected ponds (including Walkers, Upper Mill and Lower Mill)
  - watershed delineations
  - comparison of water quality to regulatory standards
  - identify additional data needs

## Brewster Freshwater Ponds: Water Quality Status and Recommendations for Future Activities

FINAL REPORT  
September 2009

for the

Town of Brewster  
and  
Barnstable County



Prepared by:

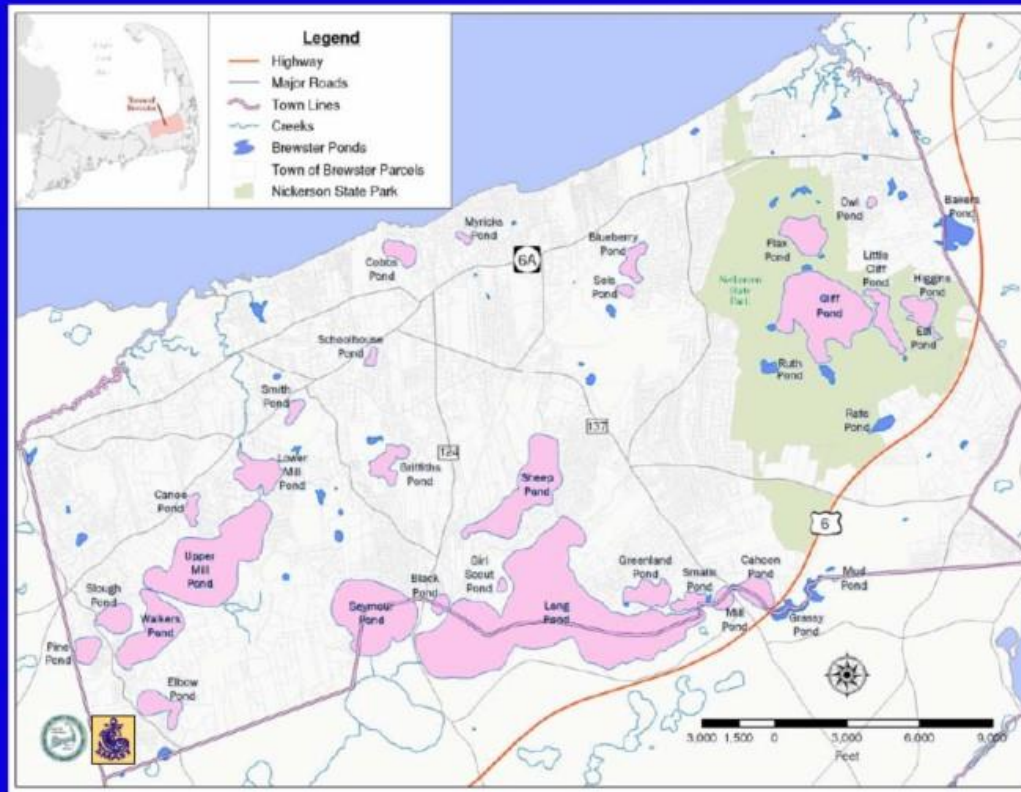
Coastal Systems Group  
School for Marine Science and Technology  
University of Massachusetts Dartmouth  
706 South Rodney French Blvd,  
New Bedford, MA 02744-1221

Cape Cod Commission  
Water Resources Program  
3225 Main St., PO Box 226  
Barnstable, MA 02632



# Ponds reviewed

- Data collected:  
DO, Temp, Secchi,  
TN and DIN, TP  
and ortho-P,  
chlorophyll,  
alkalinity, and pH
- Data analysis  
focused on June  
through September



Black	Cobbs	Greenland	Lower Mill	Schoolhouse	Smith
Blueberry	Eel	Griffiths	Mill	Seymour	Sol's
Cahoon	Elbow	Higgins	Myricks	Sheep	Upper Mill
Canoe	Flax	Little Cliff	Owl	Slough	Walker
Cliff	Girl Scout	Long	Pine	Smalls	





## Brewster Ponds Assessment



# Starting Point

- Over 11,000 data entries
- Data from 29 ponds (2001-2007)
- Laboratory analyses provided by National Park Service and School for Marine Science and Technology (SMAST), Coastal Systems Program
- Field data collected by Brewster PALS volunteers





# Brewster Ponds Assessment

## Summary of Water Quality Findings



- Town-wide: 24 of 29 have average dissolved oxygen concentrations that are less than state minimum regulatory standards and may require TMDLs;
- Town-wide: 23 to 28 of the 29 have average total phosphorus and chlorophyll a concentrations higher than Cape Cod-specific guidelines
- Detailed pond-specific analysis for 6 ponds:
  - Seymour, Canoe, and Blueberry do not meet state dissolved oxygen minimums, meet regulatory definition of impaired, and will require TMDLs under state regulations,
  - Walkers, Upper Mill, and Lower Mill generally have acceptable DO, but exceptionally high nutrient concentrations



# Brewster Ponds Assessment: Project Partners



## All Brewster PALS

especially

Jane Johnson

Carroll Johnson

Paul Alt

Ed Kassman

Chris Miller

Charlie Sumner

Bob Mant



Tom Cambareri  
Donna McCaffery  
Xiaotong Wu  
Scott Michaud  
Gabrielle Belfit  
Jay Detjens



## Coastal Systems

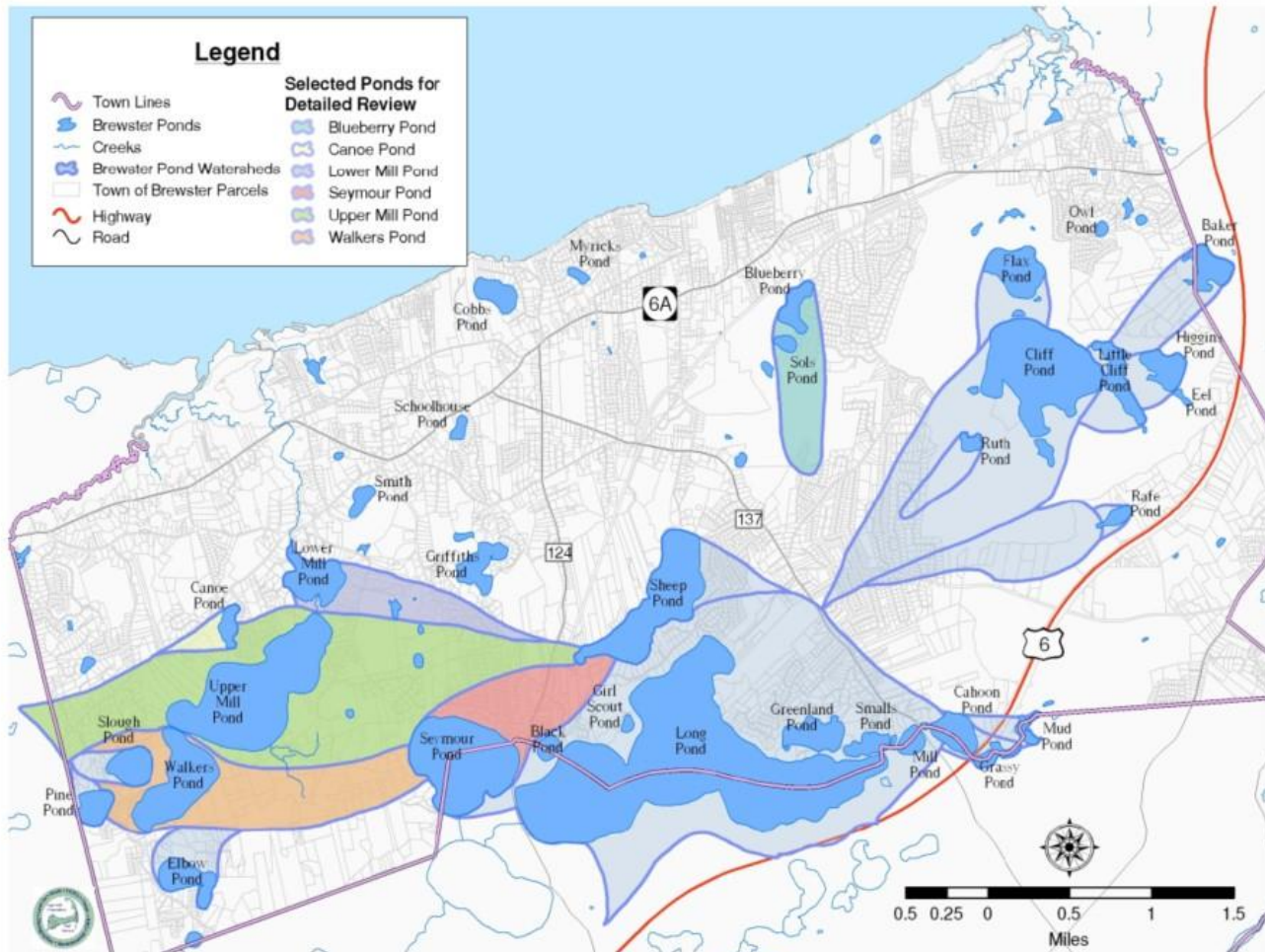
### Program

Brian Howes  
David White  
Dale Goehringer  
Dave Schlezinger  
Roland Samimy  
Sara Sampieri  
Jen Antosca  
Mike Bartlett  
Elizabeth White



Krista Lee





# Horsley Witten Group

*Sustainable Environmental Solutions*

90 Route 6A • Sandwich, MA • 02563

Tel: 508-833-6600 • Fax: 508-833-3150 • [www.horsleywitten.com](http://www.horsleywitten.com)



## **MEMORANDUM**

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---

DATE: October 11, 2013

TO: Town of Brewster

FROM: Horsley Witten Group, Inc

RE: Rapid Watershed Assessment of Schoolhouse Pond in the Town of Brewster, MA

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The purpose of this memorandum is to provide results on the rapid watershed assessment for Schoolhouse Pond located in the Town of Brewster, Massachusetts. The watershed assessment involved a desktop analysis using GIS data, a field assessment, and the development of a nutrient loading model to determine the potential nutrient loading to the pond. Results were used to identify actions and best management practices that may be used to reduce nutrient loads and improve pond water quality. The project findings will be used to help develop rapid watershed assessment approaches for other fresh water ponds in the Town of Brewster.

# Mills Ponds Complex Water Quality Assessment

Town of Brewster

Comprehensive Water Planning Committee

February 7, 2013



Ed Eichner

Senior Water Scientist

Coastal Systems Program

School for Marine Science And Technology

University of Massachusetts Dartmouth



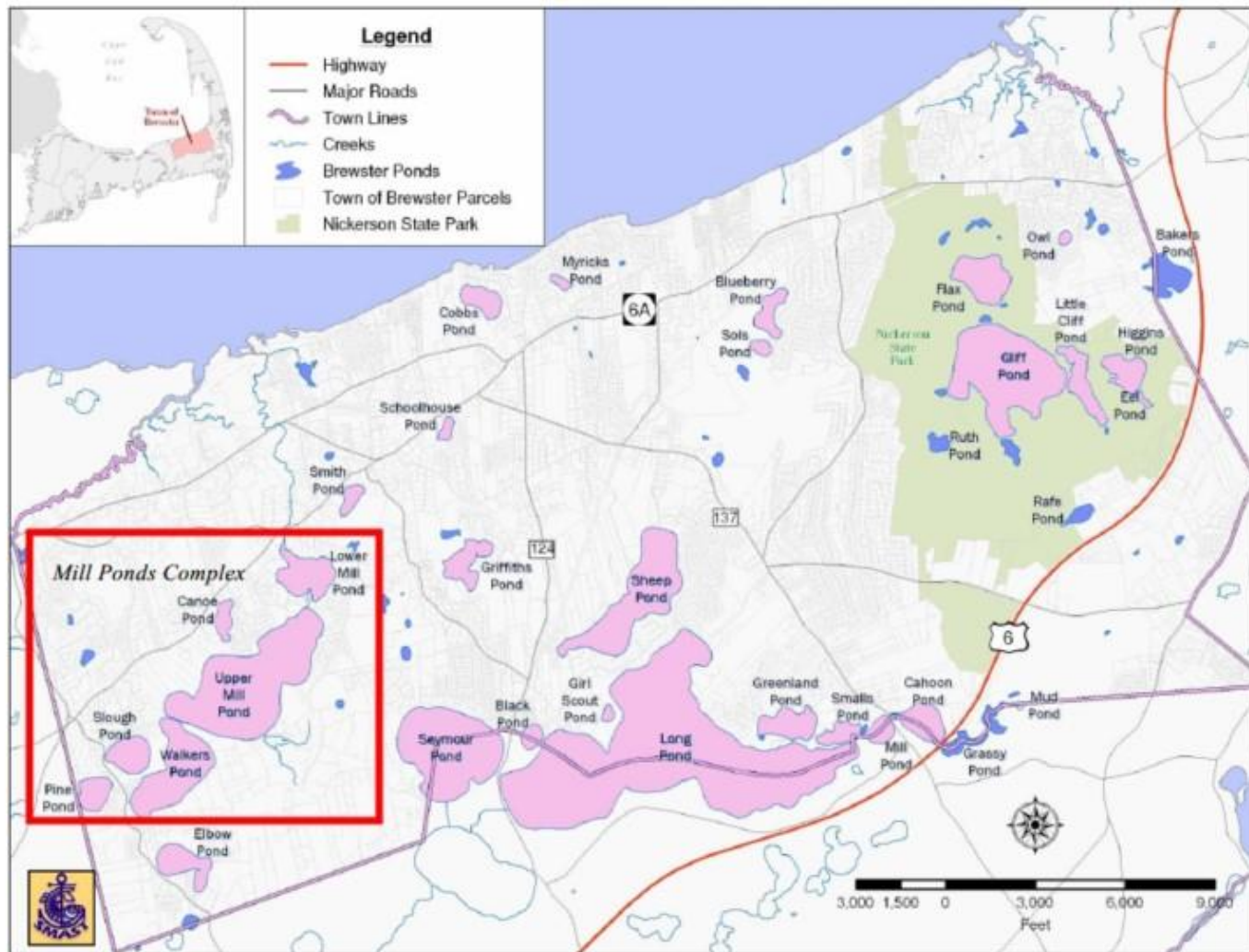


Figure I-1. Brewster Ponds and Mill Ponds Complex.

Table EX-1. Summary of Recommended Management Plan Actions				
Action	Description	Pond	Estimated Cost	Issues to Resolve
1	Macrophyte Harvesting	Walkers	\$15,000 to \$52,000	All costs and implementation details including optimal plant disposal, permitting, timing of harvesting, monitoring, and regular adaptation based on monitoring results; renting vs. buying harvester
2	Alum application	Upper Mill Pond	\$158,300	All costs and implementation details including mussel accommodations, permitting, monitoring (for at least two years), and regular adaptation based on monitoring results
3	Await results of management activities in other ponds	Lower Mill Pond	To be determined	Monitoring and adaptation based on transferred results from other two ponds; monitoring for at least two years
4	Shoreline Landowner Education Program	All ponds	To be determined	Best form of accessibility (website, pamphlets, etc.) for clear homeowner understanding of issues to reduce or eliminate phosphorus contributions to ponds including setbacks, buffer designs, alternative groundcover options, and stormwater design
5	Implement Stormwater Infiltration Program	All ponds	To be determined	Redesign six (6) identified areas that have direct stormwater discharges to pond surfaces. Initial step: complete elevation surveys in the areas and review design options to encourage infiltration. Program should also include regular (1-2 year) visual inspection of steeper slopes along the pond shorelines for stormwater scour channels and development of strategies to mitigate any identified channels.
6	Pond Monitoring Program	All ponds	To be determined	Program to monitor and regularly review benefits of management activities and adjust as indicated. Issues to resolve include components to be monitored (e.g., water, plant height, etc.), monitoring schedule, schedule for data review, and action thresholds for changes/adjustments.

# Mill Ponds Management Plan

## Walkers Pond, Upper Mill Pond, and Lower Mill Pond

### FINAL REPORT

November 2014

for the

## Town of Brewster



Prepared by:

Coastal Systems Group  
 School for Marine Science and Technology  
 University of Massachusetts Dartmouth  
 706 South Rodney French Blvd.  
 New Bedford, MA 02744-1221



# Weed Harvester





# Upper Mill Pond Alum treatment 2019

## Alum Treatment Final Completion Report Upper Mill Pond



Brewster, MA

Submitted: January 30, 2020

SOLitude Lake Management

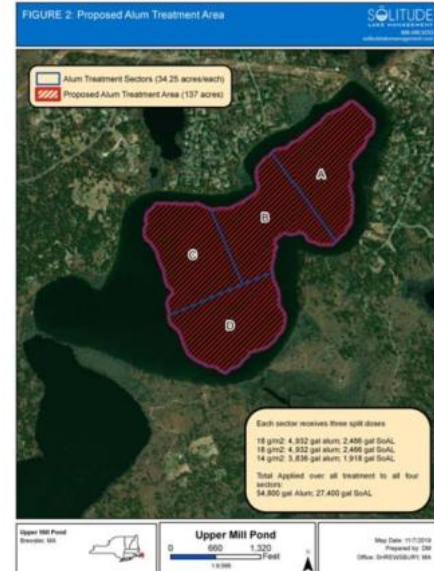
590 Lake Street  
Shrewsbury, MA 01524  
Phone: (888) 480-5253

FAX: (508) 865-1220

info@solitudelake.com  
www.solitudelakemanagement.com



Solitude Lake Management was contracted by the Town of Brewster to conduct an alum treatment at Upper Mill Pond in Brewster, Massachusetts. Based on extensive assessments, the project specifications called for the application of liquid aluminum sulfate and sodium aluminate to achieve a dose of 50 g/m<sup>2</sup> of aluminum over approximately 137-acre of Upper Mill Pond, corresponding with areas greater than 6 feet in depth (see map – left). The selected dose was determined to lower available phosphorus in the water column and sediment and reduce the likelihood of nuisance algal blooms. The project was conducted between November 18th and December 2<sup>nd</sup>, where the entire treatment area was traversed three times, each time with approximately one-third of the required dose. Splitting the dose



over multiple passes was a safeguard to limit the concentration of aluminum applied to the lake at any one time.

# Walkers Pond

## Water Quality Change and Adaptive Management

**Town of Brewster**  
**Natural Resources Department**  
**December 8, 2022**



Ed Eichner  
Principal/Water Scientist, TMDL Solutions  
Coastal Systems Program  
School for Marine Science And Technology  
University of Massachusetts Dartmouth





# Walkers Pond Water Quality Management

## 2014 Mill Ponds Management Plan

### Walkers Pond Diagnostic Assessment (2011-2013 data)

- High nutrient and chlorophyll (pigment) concentrations
- Low clarity (~1.5 m)
- Generally acceptable dissolved oxygen, but some indication of excessive levels
- Regular mixing of entire water column (max depth 3.5 m)
- Extremely dense submerged aquatic vegetation (SAV) from shoreline to ~1.5 m all around pond transferring P to the water column (~90% of overall budget)

Recommended: Regular aquatic plant harvesting to slowly remove phosphorus and create active SAV growth

## Mill Ponds Management Plan Walkers Pond, Upper Mill Pond, and Lower Mill Pond

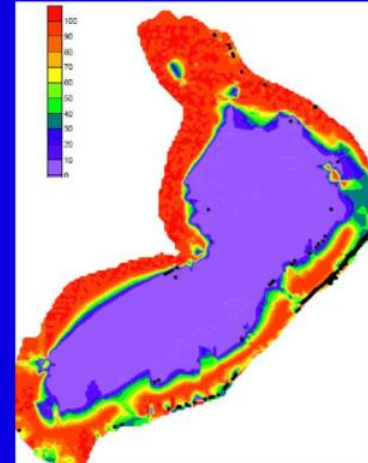
FINAL REPORT  
November 2014

for the  
Town of Brewster



Prepared by:

Coastal Systems Group  
School for Marine Science and Technology  
University of Massachusetts Dartmouth  
706 South Rocker French Blvd.  
New Bedford, MA 02744-1223







# Walkers Pond Water Quality Management



2017

Town purchases Pond Weed Harvester and harvests submerged aquatic plants (harvests again in 2018)

2019-2020

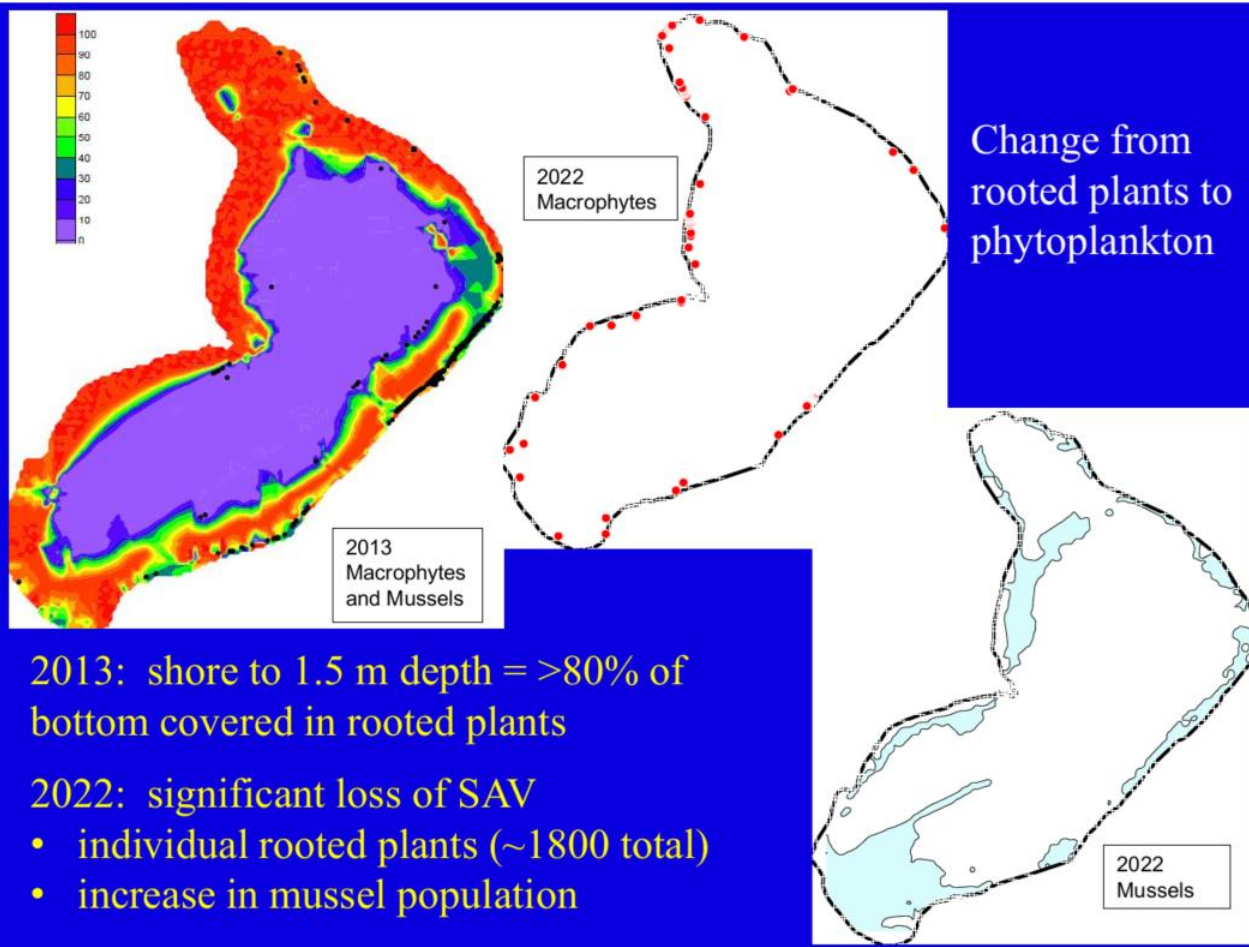
Town notes plants not growing back as expected

2020

TMDL Solutions and CSP/SMAST review PALS Snapshot and APCC water column data since Management Plan

- No significant differences from 2011 data collection







# Walkers Pond 2022 Diagnostic Summary



1. Conditions have changed substantially since 2011-2013
2. Phytoplankton population has become the primary plant community in Walkers Pond largely through shading submerged aquatic vegetation (SAV).
3. Increased phytoplankton was driven by sediment P release due to increased bottom anoxia.
4. Increased phytoplankton has allowed freshwater mussel population to increase.
5. In order to restore acceptable water quality in Walkers Pond, one of the components of the phosphorus/phytoplankton feedback loops need to be disrupted.



# 2023 Pond Water Quality Data Review



141 Pine Tree Drive, Centerville, MA 02632  
Tel: 508-737-5991  
eichner@tmdlsolutions.net

## Scope of Work

### Technical Support for the Town of Brewster Freshwater Pond Water Quality Database and Trend Analysis Project

April 20, 2023

#### Overview

The Town of Brewster has been significantly invested in freshwater pond water quality management planning for several decades. Citizens have played an active role in these planning discussions, as well as collecting crucial water quality data.

In 2009, the Town, through the Coastal Systems Program from the School for Marine Science and Technology at UMass-Dartmouth (CSP/SMAST) and the Cape Cod Commission, organized, reviewed, and synthesized pond water column data collected by Brewster volunteers from 29 ponds between 2001 and 2007.<sup>1</sup> This effort also included detailed review of six ponds selected by the Town: Blueberry, Seymour, Canoe, Walkers, Upper Mill, and Lower Mill. These detailed reviews included watershed delineations, land use analysis, development of preliminary water and nutrient budgets, and identification of data gaps to be addressed prior to developing water quality management options.

In 2011, the Town worked with CSP/SMAST to address the identified data gaps for the primary ponds in the Mill Ponds complex (Upper Mill Pond, Lower Mill Pond, and Walkers Pond). This effort was completed for a diagnostic assessment of these pond and included a) collection and incubation of sediment cores to measure phosphorus regeneration and b) measurement of surface water flow and phosphorus transfer between the connected ponds and out of the system to Stony Brook. Using the refined data gap information and historical water column data collected by volunteers, CSP/SMAST subsequently developed a water quality management plan in 2014 that identified potential and recommended remedial options and their likely costs.<sup>2</sup> Based on management plan review of management options, the Town implemented a 2019 alum treatment of Upper Mill Pond, began harvesting rooted plants in Walkers Pond in 2017, and began review of Walkers Pond water quality to decide on adaptive management strategies in 2022.<sup>3</sup>





# Cape Cod Freshwater Initiative

ERIN PERRY, DEPUTY DIRECTOR

JUNE 16, 2023 | BREWSTER PONDS SUMMIT



CAPE COD  
COMMISSION



## Properly Functioning Ponds and Lakes Play an Important Role in Preserving and Restoring Coastal Water Quality

Ponds are credited with reducing up to 50% of the nitrogen that passes through them on its way to coastal embayments.

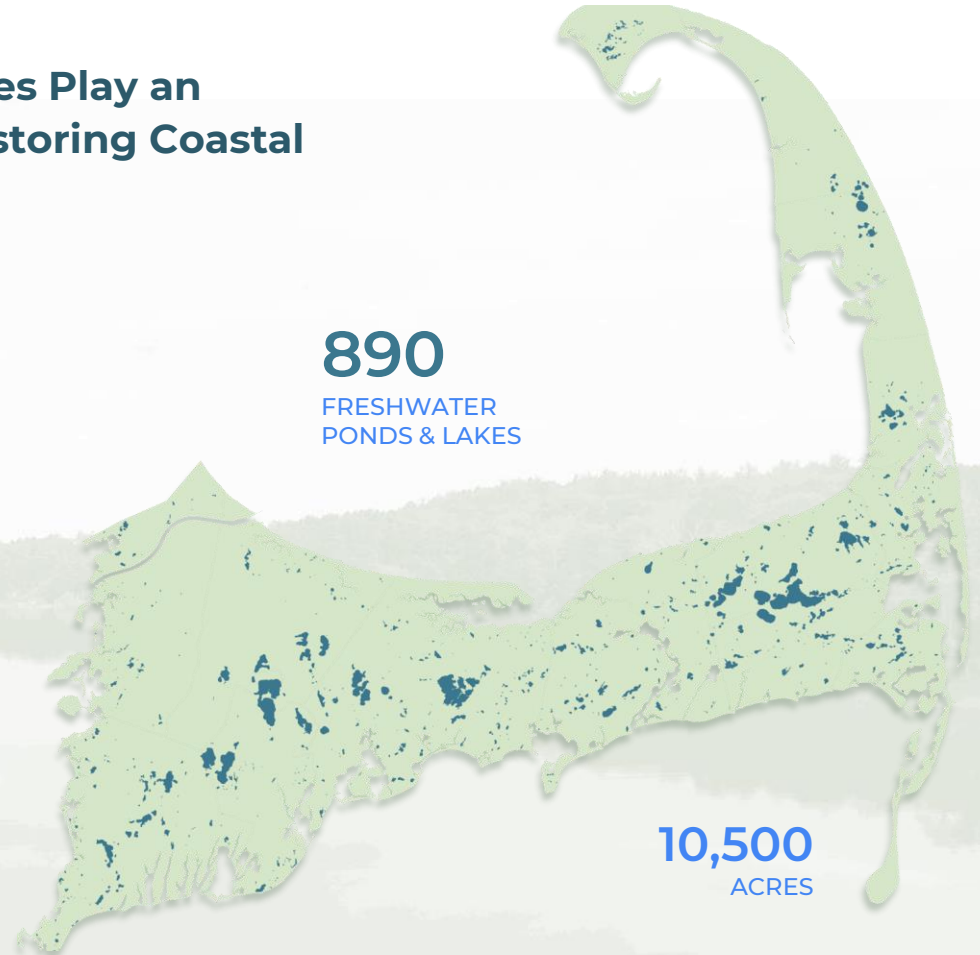
.....

## Lack of Consistent and Consecutive Data Collection

*less than* **10%** *just* **4%**

Of Cape Cod's ponds and lakes are monitored

Had sufficient recent water quality data to grade pond health in 2021



## THE FRESHWATER INITIATIVE PURPOSE

To understand, characterize, and analyze the contributing factors to water quality degradation, develop data-driven policies and strategies, and enable action at both the local and regional scale for sustained and dedicated efforts to preserve, protect, and restore Cape Cod's freshwater ponds, fundamental for the region's environment and economy.

# Cape Cod Freshwater Initiative

A science-based, information-driven planning process that will engage stakeholders and enable action to protect and restore Cape Cod's freshwater ponds

.....

## ESTABLISHING THE BASELINE

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Ponds And Lakes Atlas Update



Physical Characteristics



Data Management And Analysis



Remote Sensing

## STRATEGY DEVELOPMENT

---



Engagement and Outreach



Strategies Database



Economic Analysis



Legal Analysis

## ONGOING MONITORING AND ANALYSIS

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Monitoring Program



Ongoing Data Management and Analysis



Welcome to the  
Cape Cod Commission's  
Updated Pond Atlas

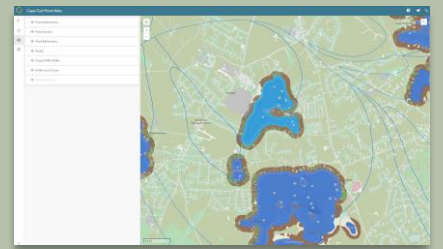
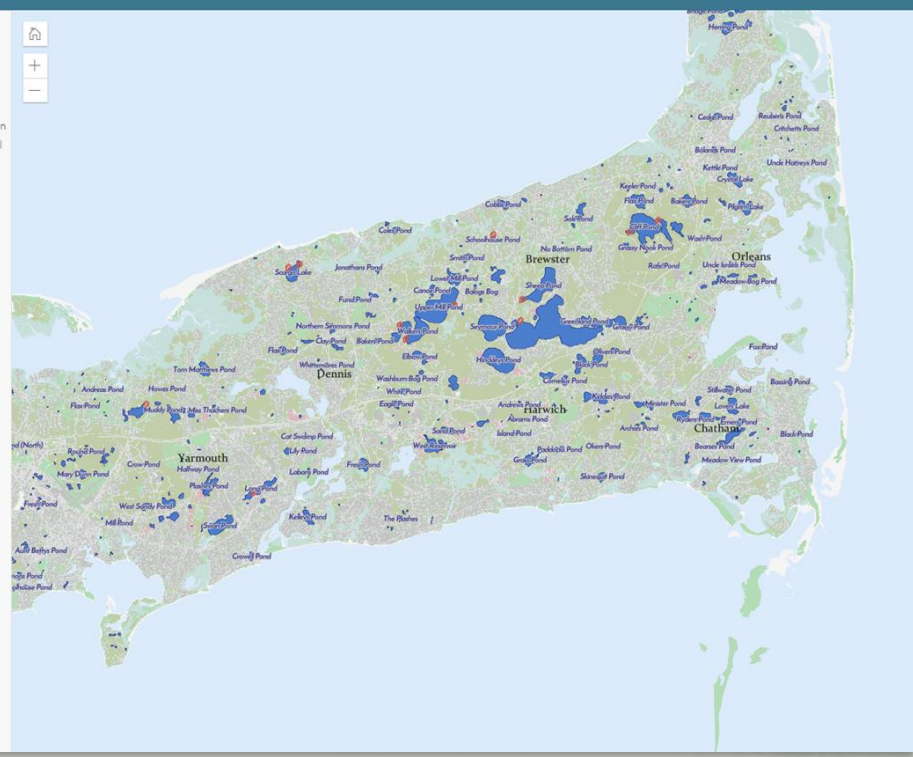
Please browse the map and identify ponds and ponds access information. Click on a pond for pond info or click on a pond access point for pond access info. Not all ponds have all or any data.

If the user has additional details to add, please email the Commission at:  
info@capecodcommission.org.

The base map legend:

- Building Footprint
- Street Pavement
- Tree Canopy
- Swamp or Marsh
- Cranberry Bog
- Open Water
- Grass or Landscaping

This pond data will soon be downloadable.



### MAP LAYERS

Available map layers include access points, pond watershed delineations, bathymetry data, 300 ft. pond buffer area, and other pond and surrounding land use characteristics.



### POND CHARACTERISTICS

Select a pond and open the Info Panel to view related characteristics including acreage, depth, and more. Users can also explore surrounding land cover and land use summaries within a 300 ft. pond area.

EXPLORE: [cccom.link/pond-atlas](http://cccom.link/pond-atlas)

# Cape Cod Pond Viewer

The Pond Viewer serves as a companion to the Atlas and can be used to explore Cape Cod's ponds, ecology, and the challenges they face.

# Brewster Pond Watersheds

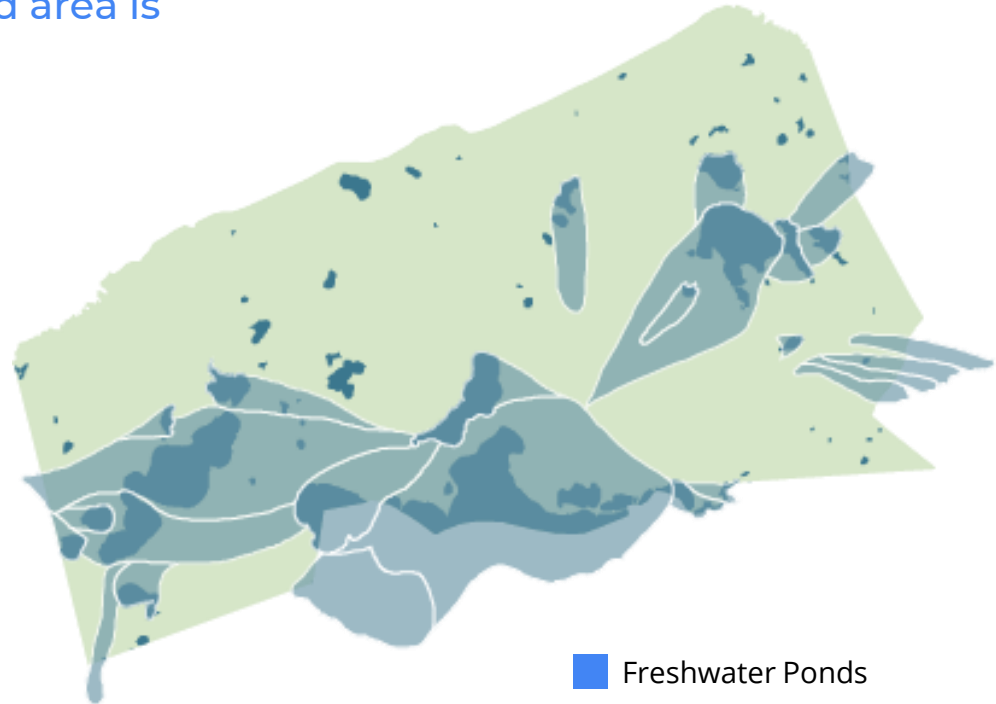
In Brewster, 34% of the town's total land area is within a delineated pond watershed.



26   
Pond Watersheds  
Delineated

5,480   
Acres of Pond  
Watershed Area

13   
Pond Watersheds  
that Cross  
Town Boundaries

*The land area that contributes to freshwater ponds and lakes is referred to as a pond watershed. Relatively few pond watersheds have been delineated across the Cape. Land area within pond watersheds is much larger than the water bodies themselves.*



 Freshwater Ponds  
 Pond Watershed Area


# Pond Profiles

Expanded Pond Profiles provide a snapshot of regional and town-by-town pond information, including physical characteristics, existing monitoring efforts, watersheds, strategies, and more.

## Barnstable County Ponds Profile

A RESOURCE OF THE CAPE COD FRESHWATER INITIATIVE


JUNE 2023



Water quality is critical to the vitality of the region's pond ecosystems and coastal embayments. Yet pollutants found in stormwater runoff, and in groundwater by which ponds are recharged, threaten the region's freshwater quality. Understanding the broad issues that impact Cape Cod's freshwater ponds, characteristics of the region's ponds, and actions at the local level all help set a baseline for understanding and action.

### Cape Cod

LAND AREA  
263,985 acres



POND AREA  
10,534 acres

4% of total regional area is comprised of freshwater ponds and lakes

<b>890</b> PONDS	171 10+ Acre Ponds	395 Named Ponds	12 ACRES Average Pond Size	24 FEET Average Pond Depth
27 Fish Stocked Ponds	107 Ponds Adjacent to Cranberry Bogs	22 Ponds that Cross Town Boundaries	96 Ponds with Public Access	
122 State Listed Great Ponds	14% Impervious Surfaces in Pond 300ft Buffer	63 Ponds with Coastal Plain Pondshores	388 Ponds with Rare Species Habitat	

### Pond Monitoring

Of the region's 890 ponds, only 61 have three consecutive years of recent monitoring data and only 24% of all the ponds have available monitoring data. The data record for this monitoring spans 20 years with an average of 1 sampling event every other year at each monitored pond.

218 Ponds Monitored	61 Ponds with 3 Consecutive Years of Recent Data (2016-2021)
------------------------	---

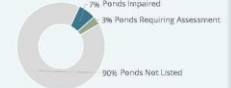
### Water Quality Impairments

A lack of consistent and available monitoring data for all ponds means that we may be underestimating threats to waterbody health.

25 Harmful Algal Bloom Advisories Issued by EPA Since 2017	88 Ponds listed on MassDEP's Draft 2022 Integrated List of Waters
---	--

### 25

Freshwater Bathing Beaches with Sampling Failures for Fecal Coliform in 2022



7% Ponds Impaired  
3% Ponds Requiring Assessment  
90% Ponds Not Listed

## Barnstable County Ponds Profile


A RESOURCE OF THE CAPE COD FRESHWATER INITIATIVE

JUNE 2023

### Pond Watersheds

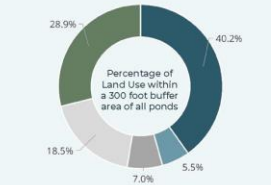
The land area that contributes to freshwater ponds and lakes is referred to as a pond watershed. Relatively few pond watersheds have been delineated across the Cape. Land area within pond watersheds is much larger than the water bodies themselves. On Cape Cod, 17% of the region's total land area is within a delineated pond watershed.

167 Pond Watersheds Delineated	43,762 Acres of Pond Watershed Area	31 Pond Watersheds that Cross Town Boundaries
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### Land Use in Pond Buffer Area

Understanding the way that land is used around our freshwater ponds contributes to a better understanding of potential pond impacts, stressors, and viable strategies to protect or restore pond health. 17,681 acres (or 7%) of the region's total land area is within 300 feet of a freshwater pond.



Percentage of Land Use within a 300 foot buffer area of all ponds:

- Residential Land Use
- Right of Way Land Use
- Commercial & Industrial Land Use
- Other Land Use
- Protected Open Space

### Documented Town Reports and Actions

16 Town Specific Freshwater Reports	41 Pond Specific Freshwater Reports
--	--

### Local Pond Organizations

Independent groups, organizing around a single or multiple ponds, voluntarily conduct educational and advocacy efforts and collect water quality monitoring data, which is not always available or sufficient for regional analysis.

40 Local Pond Organizations	20 Pond Strategies Implemented
--------------------------------	-----------------------------------

### Pond Strategies Implemented

Updates and additional projects will be added as information becomes available. Review project details at: [cccoc.com/link/pond-restoration-projects](https://cccoc.com/link/pond-restoration-projects)

Learn more about the region's freshwater resources in the Cape Cod Pond and Lake Atlas at: [capecodcommission.org/freshwater](https://capecodcommission.org/freshwater)





### **Pond Network**

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Coalition of pond groups and associations or pond water quality monitors to invite connection, collaboration, and shared resources



### **Municipal Meetings**

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Meetings with representatives from the 15 towns to better understand local priorities, challenges, and opportunities



### **Technical Advisory Group**

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Technical experts will advise components of the Initiative such as the freshwater quality strategies database



### **Stakeholder Engagement**

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Engagement that incorporates broad stakeholder representation to understand priorities, the range of potential solutions, and build consensus on a framework for action

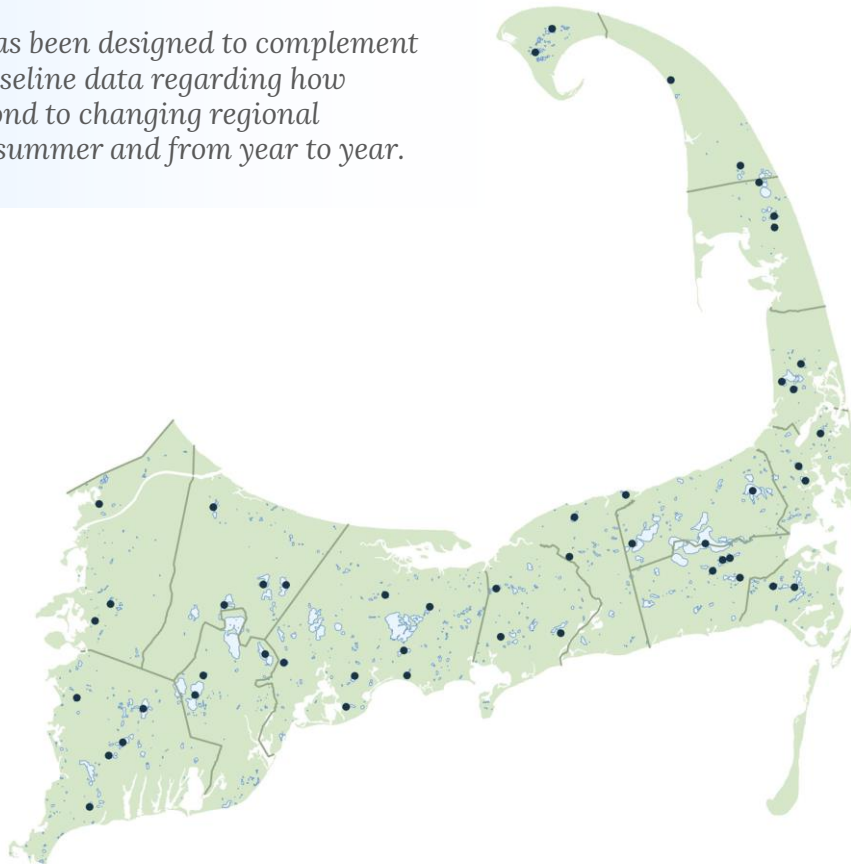


## REGIONAL POND MONITORING PROGRAM

*The Regional Pond Monitoring Program has been designed to complement existing monitoring efforts and provide baseline data regarding how different types of ponds on Cape Cod respond to changing regional environmental conditions throughout the summer and from year to year.*

### Pond selection criteria:

- Spatial coverage across all towns and aquifer lenses
- Range of physical characteristics e.g., pond size, depth, level of watershed development
- Stream/herring run connections, implementation projects, and Coastal Plain Pondshore community
- Water quality status
- Public uses of ponds
- Located in or adjacent to environmental justice area



### Ponds by Town

Barnstable	7
Bourne	3
Brewster	3
Chatham	2
Dennis	3
Eastham	3
Falmouth	5
Harwich	4
Mashpee	3
Orleans	3
Provincetown	2
Sandwich	4
Truro	2
Wellfleet	3
Yarmouth	3



## DATA MANAGEMENT AND ANALYSIS

Cape Cod Water  
Quality  
Database



Identify trend analyses and  
develop processing scripts



Release freshwater public  
data portal / user interface



ONGOING DATA MANAGEMENT AND ANALYSIS



Future  
monitoring data



Regional data and  
trend analysis

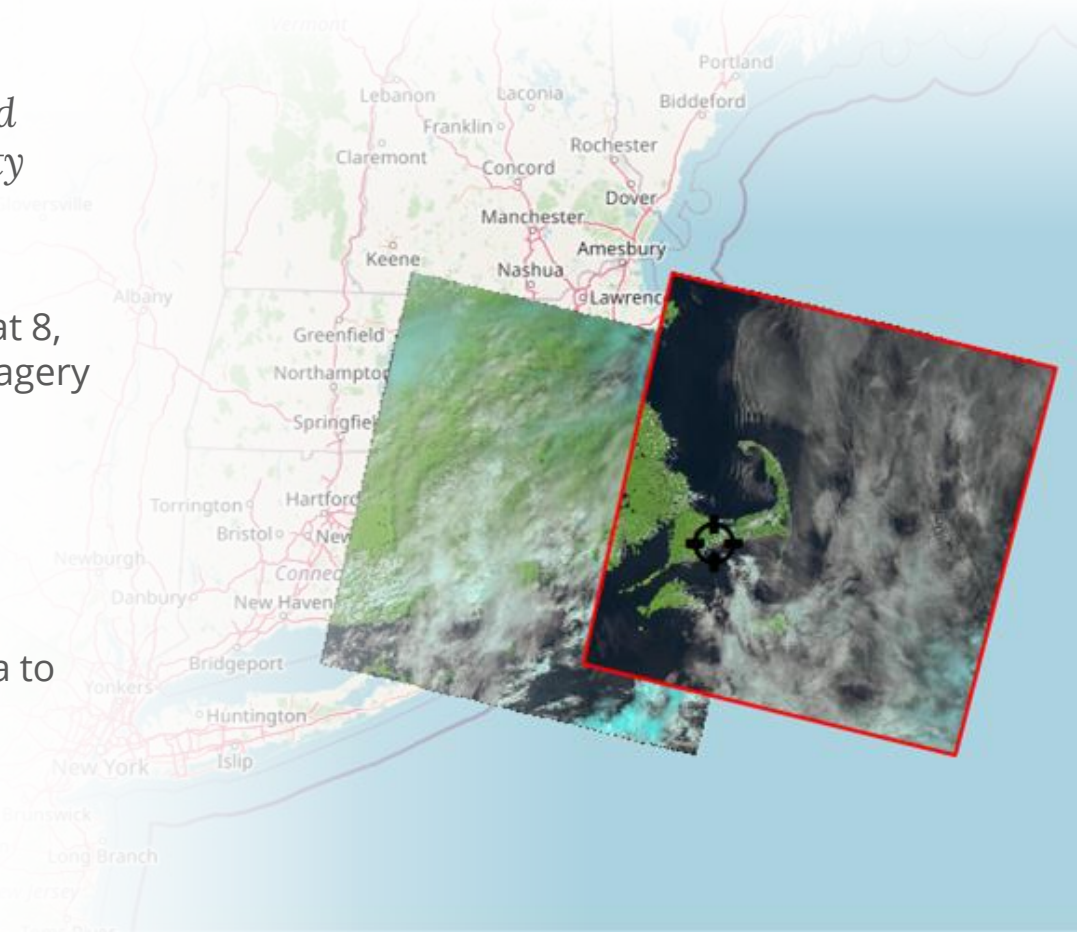






*Investigating the use of satellite-derived imagery and existing pond water quality data to quantify changes in pond characteristics*

- Partnership with NOAA, using Landsat 8, Landsat 9, and Sentinel 2 satellite imagery (images every 5-16 days)
- Connecting imagery to water clarity
- Field validation data collected during satellite overpass to calibrate
- Sufficient satellite and validation data to analyze 217 ponds





**SCALE OF APPROACHES:**

**WATERSHED**



Comprehensive watershed planning, land use regulations, land protection, advanced wastewater treatment

**POND SHORES**



Vegetated buffers, fertilizer management, septic setbacks, I/A septic systems

**IN POND**



Sediment, nutrient, algae, and vegetation management approaches

**DATABASE INCLUDES:**

Policy Approaches



Physical Approaches



Chemical Approaches



Biological Approaches





# Cape Cod Freshwater Initiative

ERIN PERRY, DEPUTY DIRECTOR

JUNE 16, 2023 | BREWSTER PONDS SUMMIT

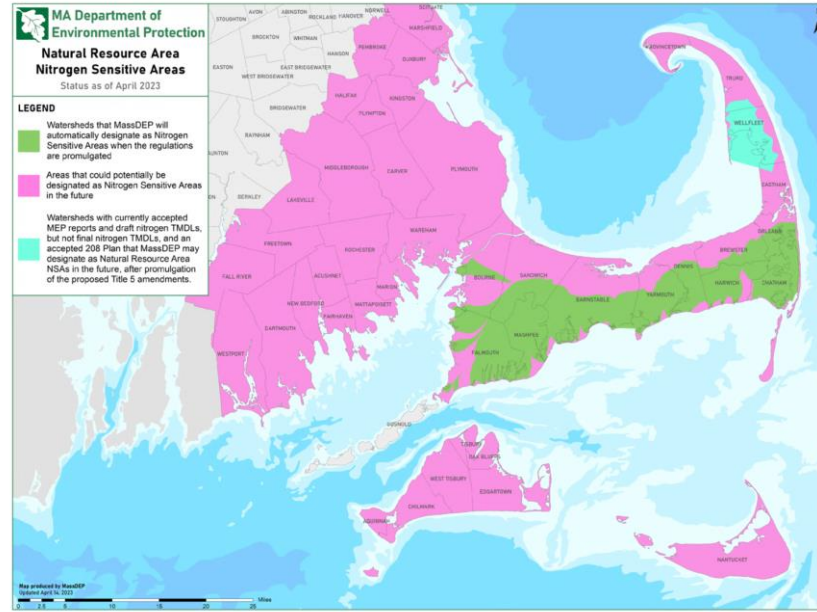


CAPE COD  
COMMISSION





# Restoring our Coastal Estuaries – Proposed Changes to Title 5



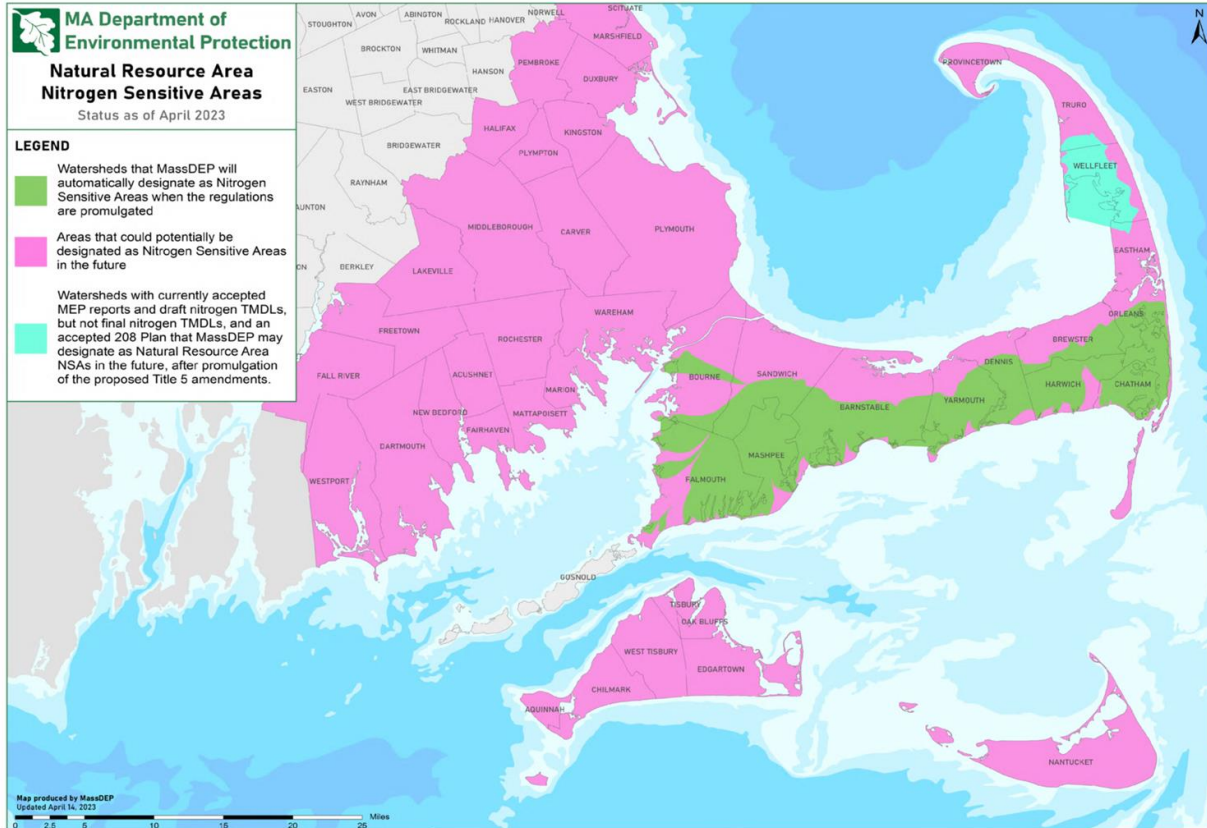
# Mass DEP's Goal - Accelerate the Restoration of Coastal Estuaries

- Two Proposed Options:
  - Require Septic System Upgrades  
- OR -
  - Initiate Watershed Permits for Specific Estuaries



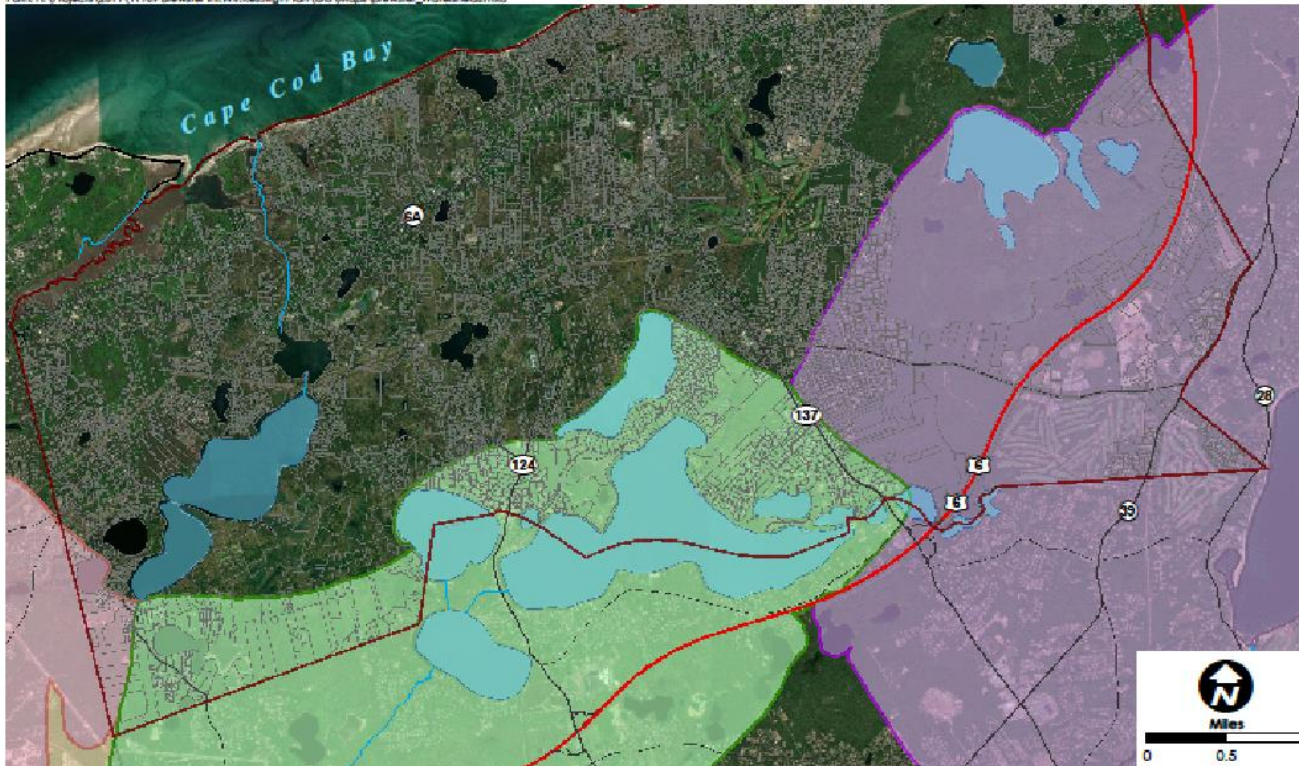


# Jurisdiction of Proposed Regs



# Brewster Watersheds Impacted by Proposed Regs

Path: H:\Project\2011\11109 Brewster ind\Wr\_Ken\Mg\Plan\GIS\Mapa\Brewster\_Watersheds.mxd



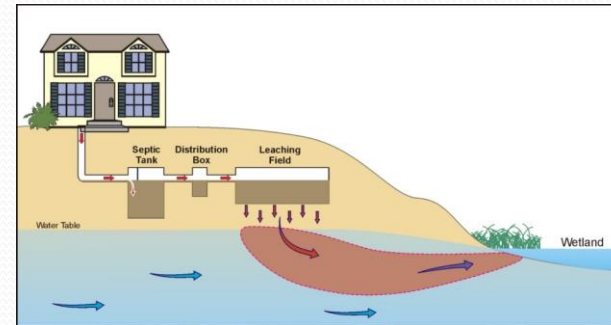
Date: 4/18/2023  
Data Sources: Bureau of Geographic Information (MassGIS), ESRI  
*This map is for informational purposes and may not be suitable for legal, engineering, or surveying purposes.*

- |                   |                     |               |                    |
|-------------------|---------------------|---------------|--------------------|
| Brewster Parcels  | Major MassDOT Roads | Watersheds    | Municipal Boundary |
| Brewster Boundary | U.S. Highway        | Bass River    |                    |
| Streams           | State Route         | Herring River |                    |
| Major Ponds       | Non-numbered route  | Pleasant Bay  |                    |
|                   |                     | Swan Pond     |                    |



# Proposed Title 5 Changes

- Septic Systems In Impaired Watersheds Must Be Upgraded to Treat for Nitrogen within 5 Years of the Regulations
- Unless:
- A Town or Towns File a Notice of Intent to Obtain a Watershed Permit



# Watershed Permits

- Similar to the Process Used to Obtain the Pleasant Bay Watershed Permit by Brewster, Chatham, Harwich and Orleans





# Watershed Permits

- If Towns can file a notice of intent to obtain a permit within 18 months the Title 5 upgrade regs are paused.
- Proposed permit must document the removal of 75% of the nitrogen needed to meet the watershed TMDL in 20 years.
- Permit can be for 1 town or combination of towns sharing a watershed.



# Watershed Permits

- Permit requires annual reporting on progress to restore the estuary.
- Provides flexibility in the options to remove nitrogen as new information is available.



# Proposed Title 5 Requirements

- If no permit is requested, homeowners have five years to upgrade their septic system.
- Must use “Best Available Nitrogen Reducing Technology”.
- Designed to encourage towns to request watershed permits.



# Current Status

- Public hearings held last November – January
- Comments received through January 30, 2023
- Recent Advisory Committee Meeting provided updates on status – potential changes



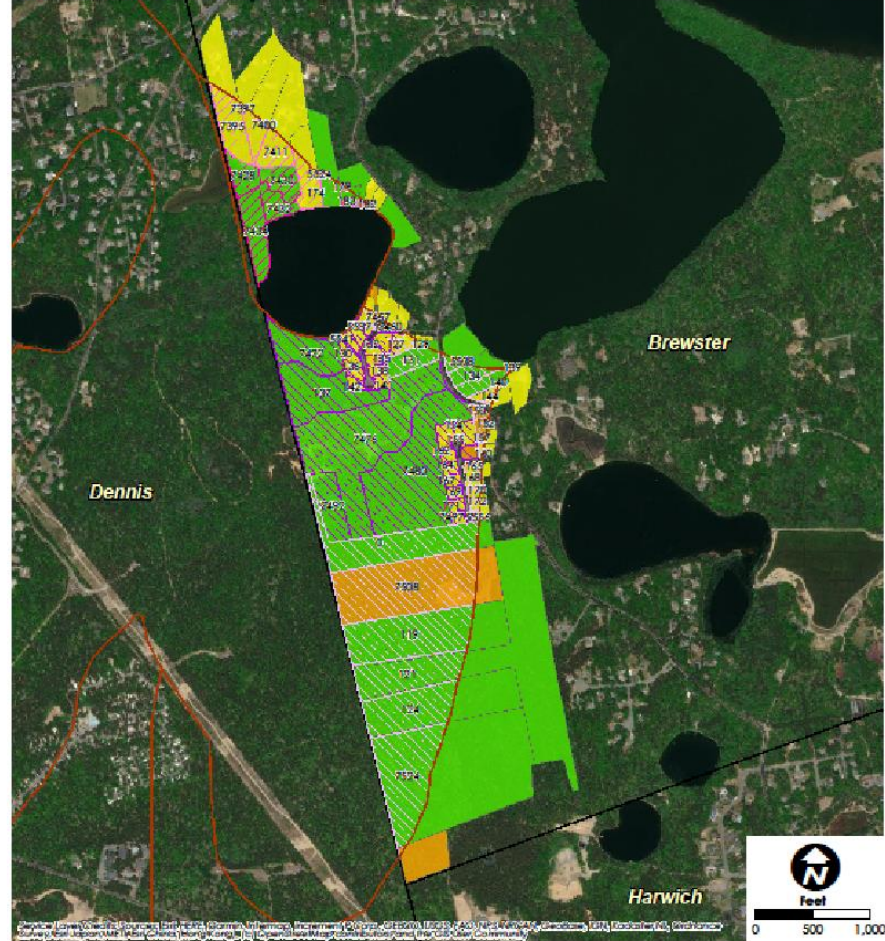


# Town and Ponds Coalition Comments

- 5-year timeframe to upgrade septic systems not feasible
- Concerns with “Best Available Nitrogen Reducing Technology.”
- Need a simplified permit process for small watershed areas that little nitrogen removal is needed.



# Bass River Watershed



Date: 1/4/2023

Data Sources: Bureau of Geographic Information (MassGIS), ESRI

This map is for informational purposes and may not be suitable for legal, engineering, or surveying purposes.

- |   |  |
|---|--|
|  Bass River Watersheds           |  NW Dennis Wells - Split (29) |
|  Developed/Residential (44)      |  NW Dennis Wells - Whole (26) |
|  Protected (22)                |  Pine Ponds - Split (9)     |
|  Vacant Land - Unprotected (7) |  Pine Ponds - Whole (4)     |
|   |  Municipal Boundary         |



Figure 1

# Town and Ponds Coalition Comments

- Proposed Regulations Need to Consider Ponds
  - Currently not part of the proposed regs
  - Could phosphorus treatment could be included in a septic system upgrade?



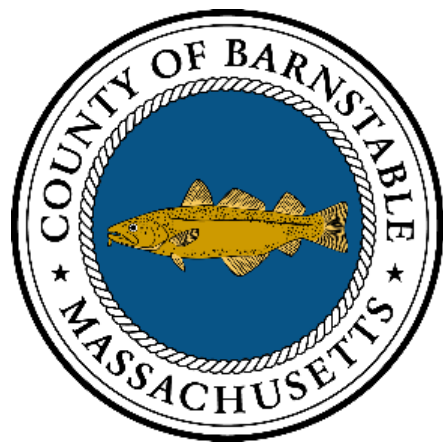
# Thanks

Mark Nelson, Principal  
Horsley Witten Group, Inc.  
mnelson@horsleywitten.com









# Managing Decentralized Wastewater Treatment Infrastructure

How to Make Septic Systems a Thing  
of the Past

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BRIAN BAUMGAERTEL

SENIOR ENVIRONMENTAL SPECIALIST

MASSTC DIRECTOR

---

# What is Decentralized Wastewater Treatment Infrastructure?

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# Hypothetica

|



Problem:  
Too Much  
Nitrogen (or  
Phosphorus)



---

## Infrastructure (*noun*)

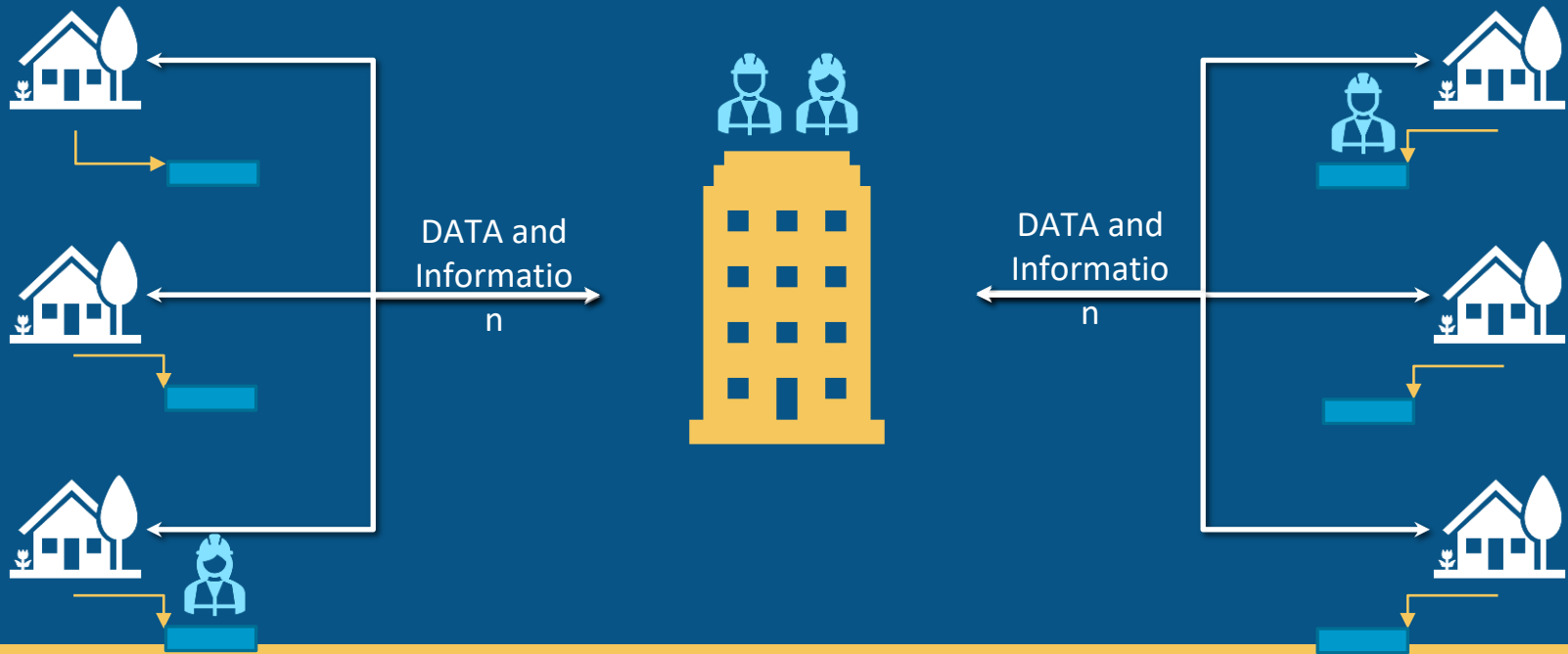
the basic physical and organizational structures and facilities (e.g. buildings, roads, power supplies) needed for the operation of a society or enterprise.

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# Centralized Treatment Infrastructure



# Decentralized Treatment Infrastructure

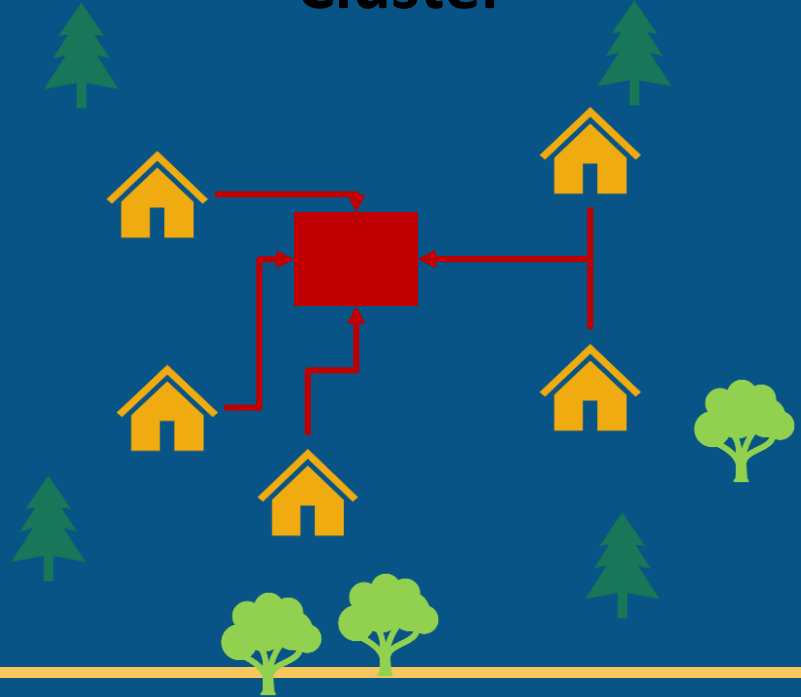


# Types of Decentralized Infrastructure

## Onsite



## Cluster





# Three Questions

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1. Do we have the technology?
  2. How do we pay for it?
  3. How do we install and manage it?
-

# Currently Best-Performing Technologies

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Less than 10  
mg/L TN

Nitroe by Kleantu

---

Nitrex by Lombardo Associates

---

Layer Cake “Nonproprietary Woodchip Systems”

---

Between 10  
and 15 mg/L  
TN

FujiClean

---

HydroAction

---

BioMicrobics MBBR

---

Others in  
the mix

Advantex

---

---

# How do we Manage the Lifecycle of DWTI?

---

# Lifecycle Management of DWTI: *A Spectrum Services*

---



Planning



Communication



Technology and  
Research



Finance



Design and Construction



Operation and  
Maintenance



Monitoring and  
Compliance



Records and Reporting



# Responsible Management Entities

An organization or collection of organizations tasked with overseeing the cradle-to-grave lifecycle of decentralized wastewater treatment infrastructure



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5-year project to develop and implement a

# **Regional RME Program**

---

# Regional Responsible Management Entity Primary Goals

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Help towns  
meet  
TMDL's

Reduce risk to  
homeowners

Cost  
Effective

Financially  
Self-  
Sustainable

Maintain  
Flexibility

---

How do we Pay for DWTI?

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# Cape Cod AquiFund (formerly CSMLP)

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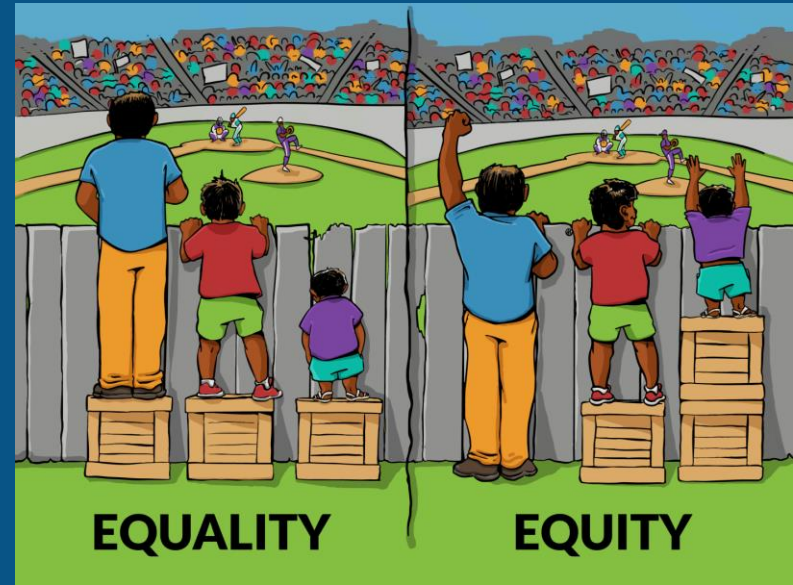
# Helping to make the costs of clean water solutions more equitable

0%, 2%, and 4% per annum betterment loans.

Lowest interest rate goes to those who need more help.

Image Credit:

Interaction Institute for Social Change | Artist: Angus Maguire.



# What kinds of projects are eligible?

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Installation of a nutrient-reducing I/A technology\*

Installation of a sewer connection

\*In a town-mandated nutrient removal project

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# Learn More

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[www.capecod.gov/aquifund](http://www.capecod.gov/aquifund)

[www.masstc.org/rme](http://www.masstc.org/rme)

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# FINANCING BREWSTER'S WATER RESOURCE INITIATIVES

## BREWSTER POND SUMMIT 2023

PETER LOMBARDI  
TOWN MANAGER



CAPE COD &  
ISLANDS  
WATER  
PROTECTION  
FUND (CCIWPF)

- Established by MA legislature in 2018 (Chapter 337 of the Acts of 2018) to help 15 Cape & Island towns pay for wastewater infrastructure and water quality remediation projects to meet obligations of the 208 Plan
- Affiliated with existing state programs – State Revolving Fund (SRF) and Clean Water Trust (CWT)
- Funded through new 2.75% additional surcharge added to all lodging transactions (both traditional and short-term rentals) on Cape effective July 1, 2019



## CCIWPF GOVERNANCE


- Board is comprised of member representatives from each town – must be Town staff or Select Board
- Cape Cod Commission (CCC) provides administrative support and technical assistance
- Board is responsible for determining allocating funds, including equitable distribution among participating towns for eligible projects and debt relief
- Regulations and bylaws originally developed and adopted in Fall 2020





CCIWPF  
FINANCIAL  
ASSUMPTIONS

- Assumed \$66M in prior eligible debt plus \$60M/year in new loans by FY22 with 2% annual escalator
- Assumed \$19M/year in revenues by FY23 with 2.5% annual escalator
- 25% subsidy for new projects in equal installments over 4 years for Clean Water Trust loans (SRF eligible) – 50% for projects less than \$1M
- 25% subsidy for pre-existing projects in equal installments over 10 years for already issued debt




## CCIWPF FINANCIAL ACTUALS

- \$167M in Cape-wide SRF eligible projects in FY23 – almost 275% higher than projected (more projects and at a higher cost)
- Eligible project costs are currently expected to drop down to \$125M in FY24 with 2% annual escalator – still 200% higher than originally anticipated
- \$21M in annual revenues with 2-3% annual escalator – slightly higher than expected



## CCIWPF FINANCIAL FUTURE

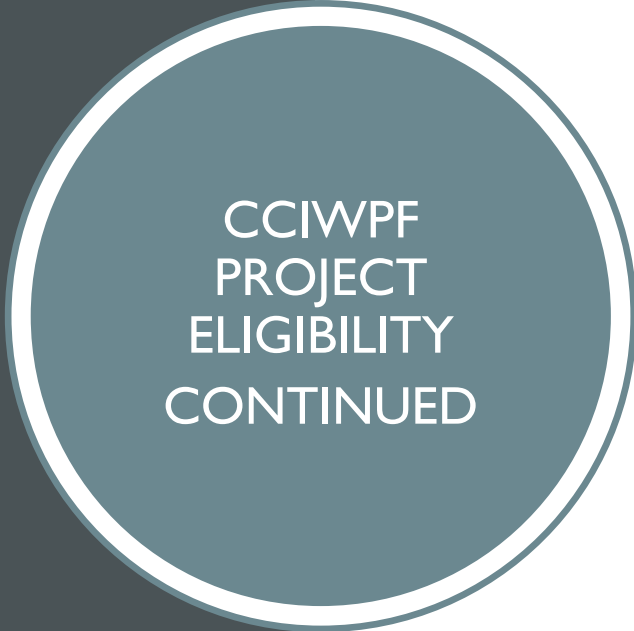
- At current rate, fund will be insolvent by FY24
- Does not account for increased funding requests related to proposed changes to Title 5 regulations and adoption of new DEP watershed regulations (focused solely on nitrogen mitigation)
- CCIWPF Board examining combination of potential reductions to subsidy levels and advocating for ~\$70M in supplemental state funding over next several years



## CCIWPF PROJECT ELIGIBILITY

- As drafted, statute explicitly allowed CCIWPF funds to cover costs of innovative/alternative (I/A) septic systems
- Eligibility of non-traditional wastewater solutions for SRF funding has been uncertain – must be on DEP’s annual Intended Use Plan (IUP)
- Brewster contributes ~\$1M/year to CCIWPF
- Brewster’s long-term non-traditional water quality initiatives projected to cost \$20-30+M as of Spring 2022





CCIWPF  
PROJECT  
ELIGIBILITY  
CONTINUED

- In March 2022, CCIWPF Board authorized CCC to provide technical assistance to help answer this question
- CCC completed their work this month – their analysis points to similar non-traditional initiatives that have received SRF funding (e.g. Wellfleet)
- DEP has also recently changed their SRF evaluation criteria to favor Cape projects – documenting environmental impacts and related goals in Town planning documents are key



## SHORT- TERM RENTAL TAX

- New 6% surcharge was placed on short-term rentals (STRs) statewide effective July 1, 2019
- Revenues are collected by state and disbursed to towns on quarterly basis
- Towns could not include STR revenues in operating budget projections until FY21
- State data on traditional lodging tax vs. STR revenues in first few years was lacking



SHORT-TERM  
RENTAL TAX  
CONTINUED

- Actual revenues have consistently outpaced projections
- \$1M in projected STR revenues in FY24 Town operating budget – comparable to traditional lodging revenues
- Select Board adopted policy in Spring 2020 that allocated 50% of projected STR revenues to the Affordable Housing Trust, 40% to Capital Stabilization Fund, and no more than 10% to General Fund



WATER QUALITY  
CAPITAL  
STABILIZATION  
FUND

- Brewster has historically funded water quality projects, including their Integrated Water Resource Management Plan, from Free Cash
- Town Meeting voted to create this new capital stabilization fund in May 2022
- Funds must be spent on water quality initiatives and require 2/3 vote of Town Meeting to be appropriated





WATER QUALITY  
CAPITAL  
STABILIZATION  
FUND  
CONTINUED

- Select Board updated their STR revenue allocation policy in Spring 2022 to direct 15% of projected revenues to new fund, effective in FY23 Town operating budget (\$112,500)
- \$150k in FY24 Town operating budget transferred to this fund
- Examples of funded projects include Town-wide pond water quality analysis updated (\$50k) and Walkers Pond water quality improvements (\$82k)



# Contaminants of Emerging Concern (CEC's) in Wastewater

Kimberley Crocker Pearson MS MD MPH

# What are CEC's?

- Contaminants of Emerging Concern (CECs) are chemicals that have been found in water bodies
- CEC's may cause ecological or human health impacts and are not currently regulated
- There are two general categories:
  - Those that are commonly used in households
  - Those primarily used in industry



## Household:

- Pharmaceutical and Personal Care Products (PPCP's)
  - Prescription and over-the counter drugs
  - Fragrances and Cosmetics
  - Sunscreen products
  - Detergents
  - Antimicrobials
- Other common products:
  - Microplastics
    - Microbeads banned in rinse-off products since 2015
    - Still may be used in deodorants, lotion and makeup

## Commercial:

- Industrial chemicals
  - Pesticides
  - Per- and polyfluorinated alkyl substances (PFAS)
    - i. Manufacturers use PFAS to make products resistant to oil, heat, stain, or water
    - ii. Flame retardants
- Agricultural pharmaceuticals
  - Antibiotics
- Endocrine Disruptors
  - Bisphenol A (BPA)
  - Phthalates



# CECs enter septic systems in three ways:

- Direct disposal – People may dispose of products down a household drain
  - Example: flushing unused pharmaceuticals in the toilet may lead to a high concentration of PPCPs in wastewater
- Indirect disposal – CECs enter the wastewater stream due to indirect contact with the substance
  - Example: microplastics enter wastewater from laundering synthetic material like fleece jackets, microfiber towels, and polyester materials
- Excretion – People and livestock consume – then excrete – drugs and their breakdown products. The chemicals then get into our wastewater treatment plants, septic systems, and stormwater runoff

Wouldn't sewers and treatment plants solve this problem?



# Standard Wastewater Treatment is not designed to remove CEC's

- Wastewater treatment plants are designed to remove excess nutrients like nitrogen and phosphorus, kill pathogens, and filter out items like gravel and sneakers that find their way into the waste stream
- Traditional treatment may remove some types of CECs from waste; however, there are multiple common CECs that are not removed by biological treatment
- In fact, the heat generated by microbial digestion of waste can change PFAS precursor molecules into PFAS toxins
- There are some newer, more advanced treatment technology options that can remove some of these contaminants but they tend to be expensive to implement and very energy intensive to operate

# The Deer Island Treatment Plant Outfall: Stellwagen Bank National Marine Sanctuary





# Unintended Consequences

- Scientists took water samples at various depths near the outfall and measured for 17 pharmaceuticals, caffeine, sucralose, and 25 per- and polyfluoroalkyl substances (PFAS) surrounding the wastewater discharge tunnel from Deer Island
- Ten of 17 pharmaceuticals, sucralose, caffeine, and 9 PFAS were detected in surface and bottom water at different points during the seasons
- Concentrations were proportional to proximity to the outfall
- In a companion study, PFAS was found in the livers of juvenile seabirds from Massachusetts Bay



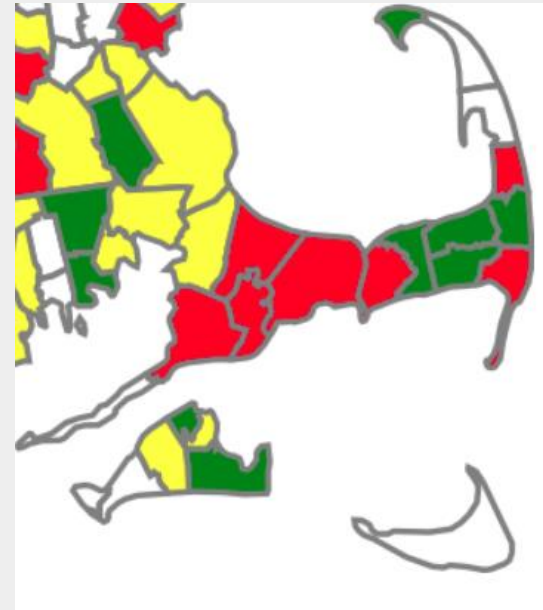


- We cannot treat our way out of our current CEC predicament; we must change our consumption habits
- Minimizing use and responsible disposal of CEC's does not need to disrupt day to day life
- With good information, consumers have the power to make choices that drive markets in more sustainable directions
- We don't need a handful of people avoiding CEC's perfectly. We need millions of people doing it imperfectly

## UN Sustainable Development Goal 12: Responsible Consumption and Production

“Unsustainable patterns of consumption and production are the root causes of the triple planetary crises of climate change, biodiversity loss and pollution. These crises, and related environmental degradation, threaten human well-being and achievement of the Sustainable Development Goals.”

Brewster drinking water has been tested for PFAS and none have been detected



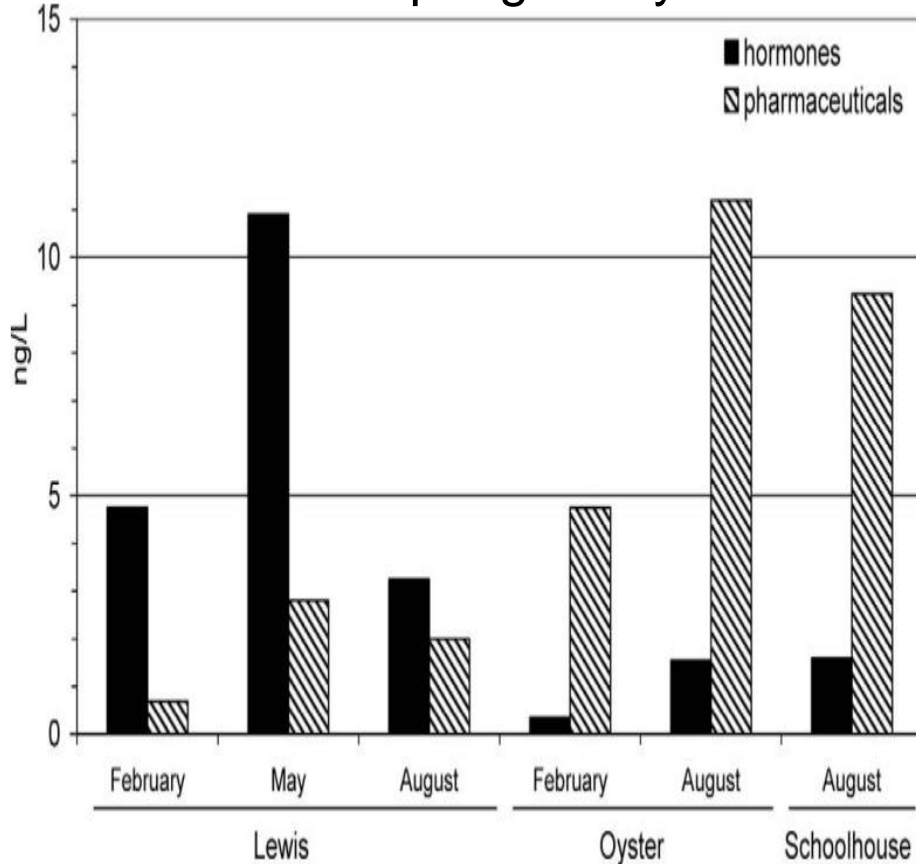
Key:

Green = 0 ppt of PFAS6 reported

Yellow = PFAS6 detected under state MCL

Red = exceeds state MCL for PFAS6

# Contaminants of Emerging Concern in Brewster Ponds: 2008 Silent Spring Study



- Silent Spring Institute studied six Cape Cod ponds, three in high-density residential areas and three in low-density residential areas.
- All of the homes near the six ponds have septic systems.
- Researchers found higher concentrations of pharmaceuticals in the ponds in higher-density areas than in lower-density areas

# CEC Detox: 6 small steps to reduce your use and protect our water

1. Take advantage of prescription and over-the-counter pharmaceutical take back events
2. Do a personal care product inventory. Avoid using water-resistant products and products with PTFE or “fluoro-” in the ingredients
3. Avoid taking thermal paper receipts which contain BPA. Many stores will provide receipts by email
4. Do not dispose of chemicals in household drains or toilets. Take advantage of local hazardous materials collections.
5. Maintain your septic system as recommended
6. Subscribe to the Green Science Policy Institute to receive consumer information on how to limit your use of CEC’s in future purchases

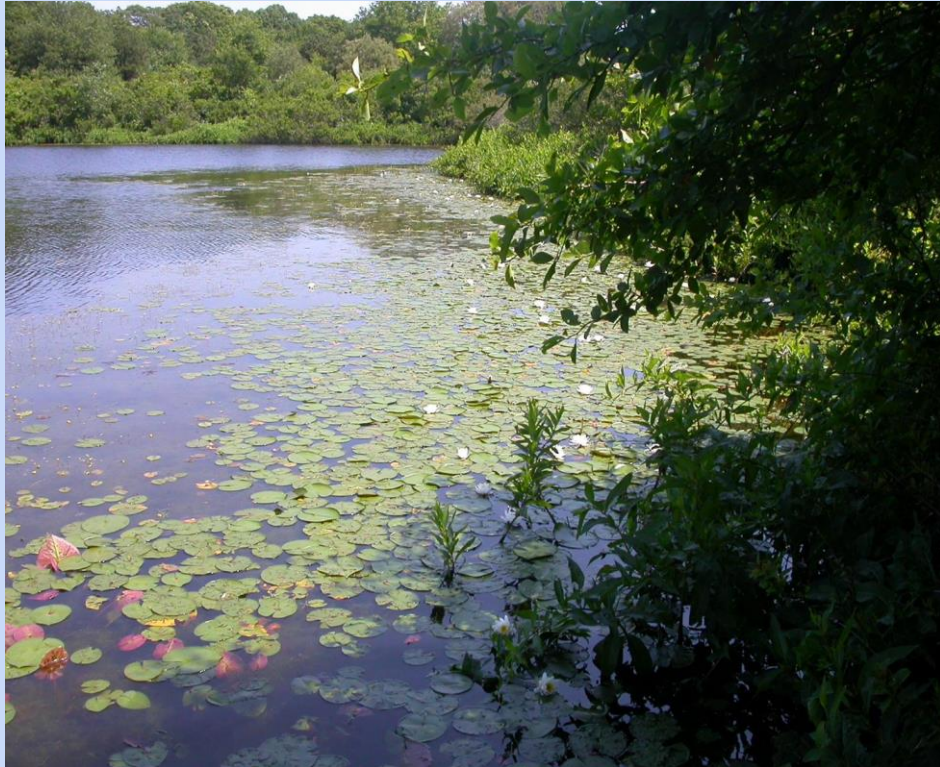




**The Brewster Ponds Coalition and  
the Town of Brewster thank  
the Leighton Team, a BPC Business Partner, for  
sponsoring this event.**



Thank you for coming!



**Our Mission:**  
Protecting and  
improving the health of  
Brewster's ponds  
through science,  
education and  
advocacy.