

Freshwater Initiative

Stakeholder Meeting 1 – Sagamore Lens

SAND HILL SCHOOL COMMUNITY CENTER | MARCH 19, 2024



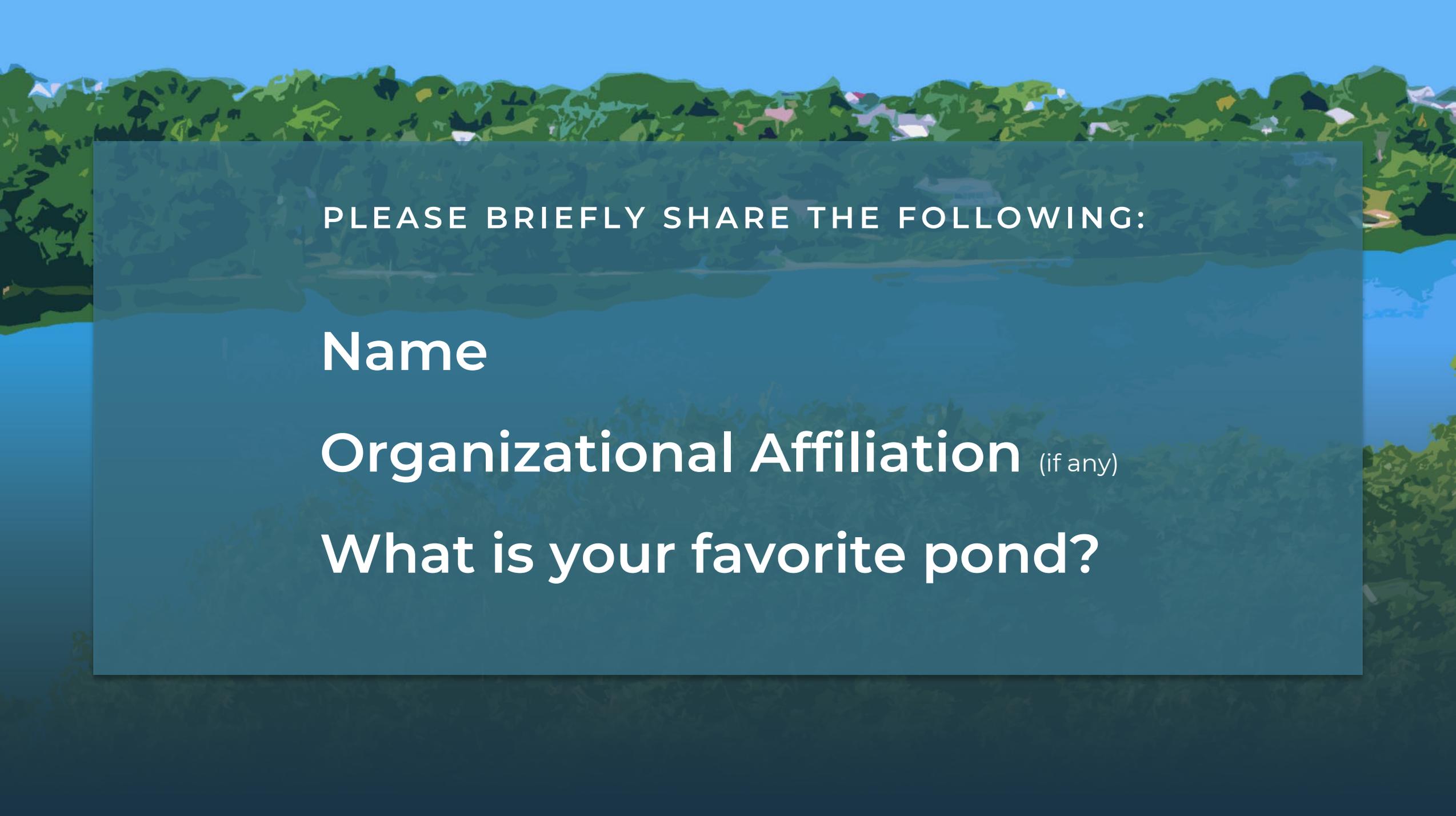
CAPE COD
COMMISSION

**FRESHWATER
INITIATIVE**

Agenda

Meeting 1

- Welcome
- Introductions
- Freshwater Initiative Overview
- Cape Cod Ponds and Lakes in Context
- Understanding Economic Impacts of Cape Cod's Freshwater
- The Data
- Discussion
- Next Steps



PLEASE BRIEFLY SHARE THE FOLLOWING:

Name

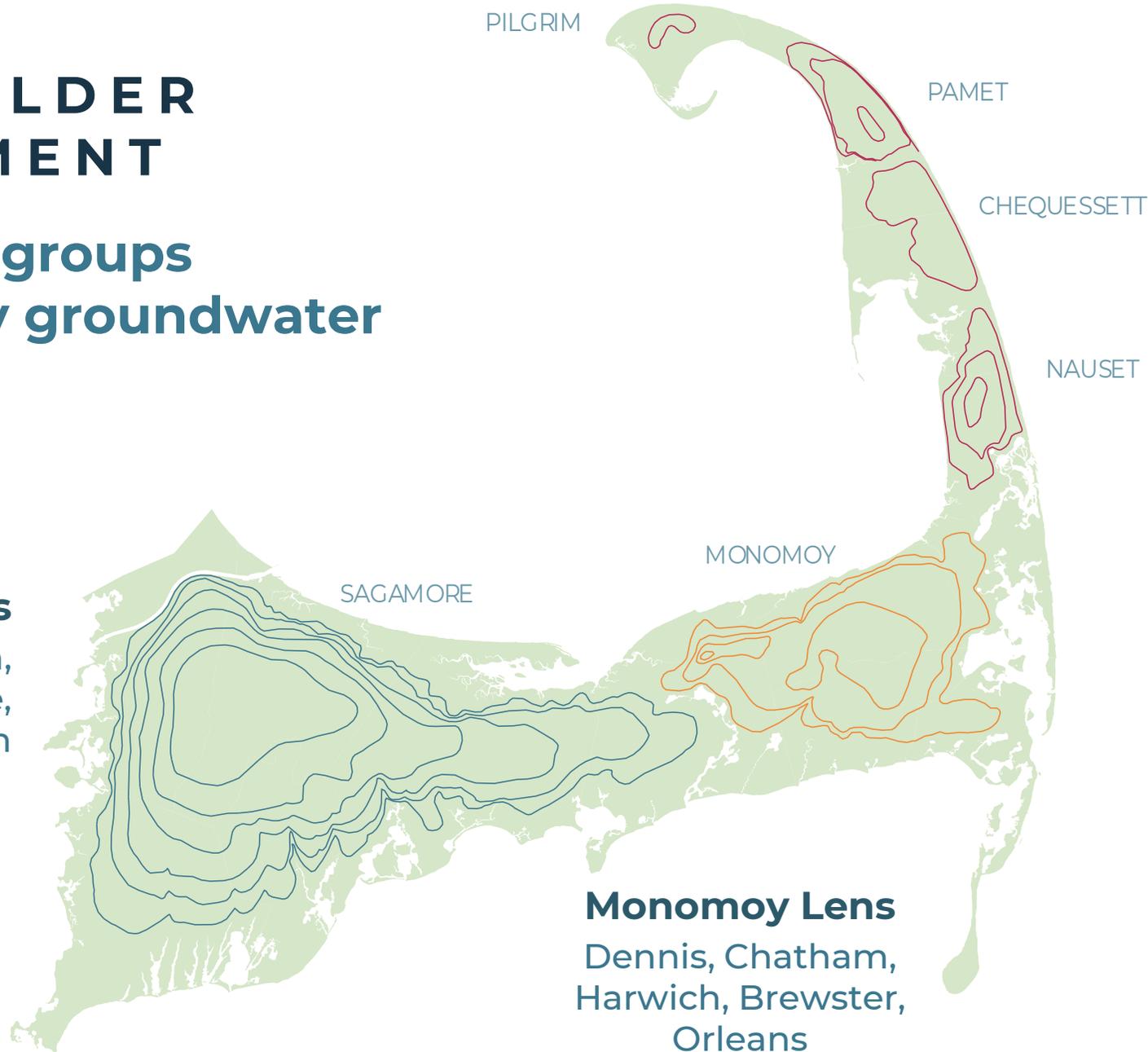
Organizational Affiliation (if any)

What is your favorite pond?

STAKEHOLDER ENGAGEMENT

Stakeholder groups
organized by groundwater
lenses

Sagamore Lens
Bourne, Falmouth,
Sandwich, Mashpee,
Barnstable, Yarmouth



**Outer Cape
Lenses**
Eastham,
Wellfleet, Truro,
Provincetown

Monomoy Lens
Dennis, Chatham,
Harwich, Brewster,
Orleans

Stakeholder Meetings

MARCH 19 AND 20

Meeting 1
Defining the Problem

Establish a shared understanding of freshwater systems, the Freshwater Initiative, and stakeholder perspectives

APRIL 22 AND 23

Meeting 2
Exploring Strategies and Priorities

Highlight existing pond management strategies, review breadth of potential strategies and identify priorities, discuss future pond management prioritization

JUNE 3 AND 4

Meeting 3
Reviewing the Implementation Plan

Discuss recommendations and implementation plan; solicit stakeholder feedback



Freshwater Initiative

Overview







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

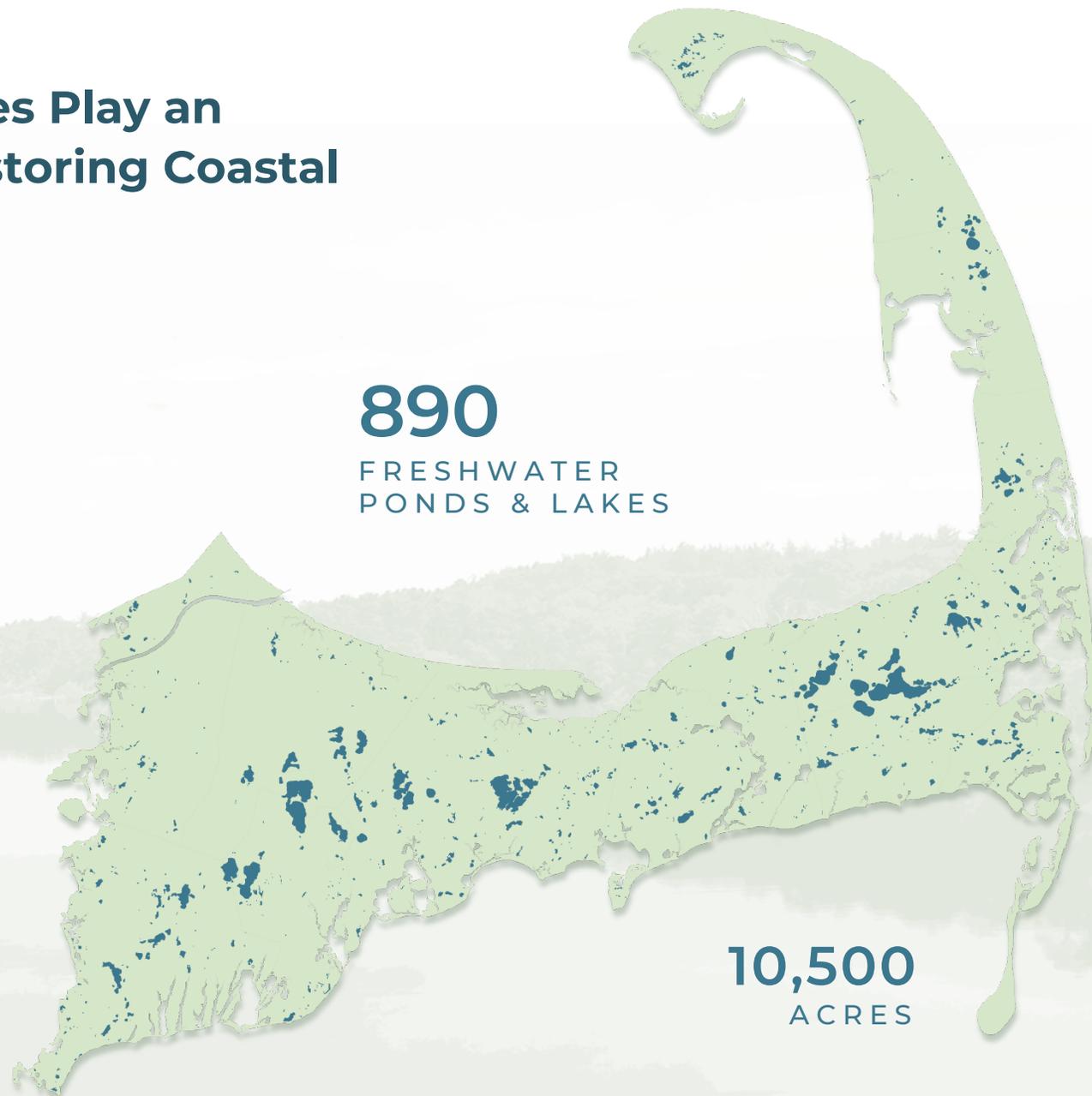
Ponds are credited with reducing up to 50% of the nitrogen that passes through them on its way to coastal embayments.

.....

Lack of Consistent and Consecutive Data Collection

less than **10%**

of Cape Cod's ponds and lakes are monitored



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



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



Monitoring Program



Ongoing Data Management and Analysis

Cape Cod Pond and Lake Atlas

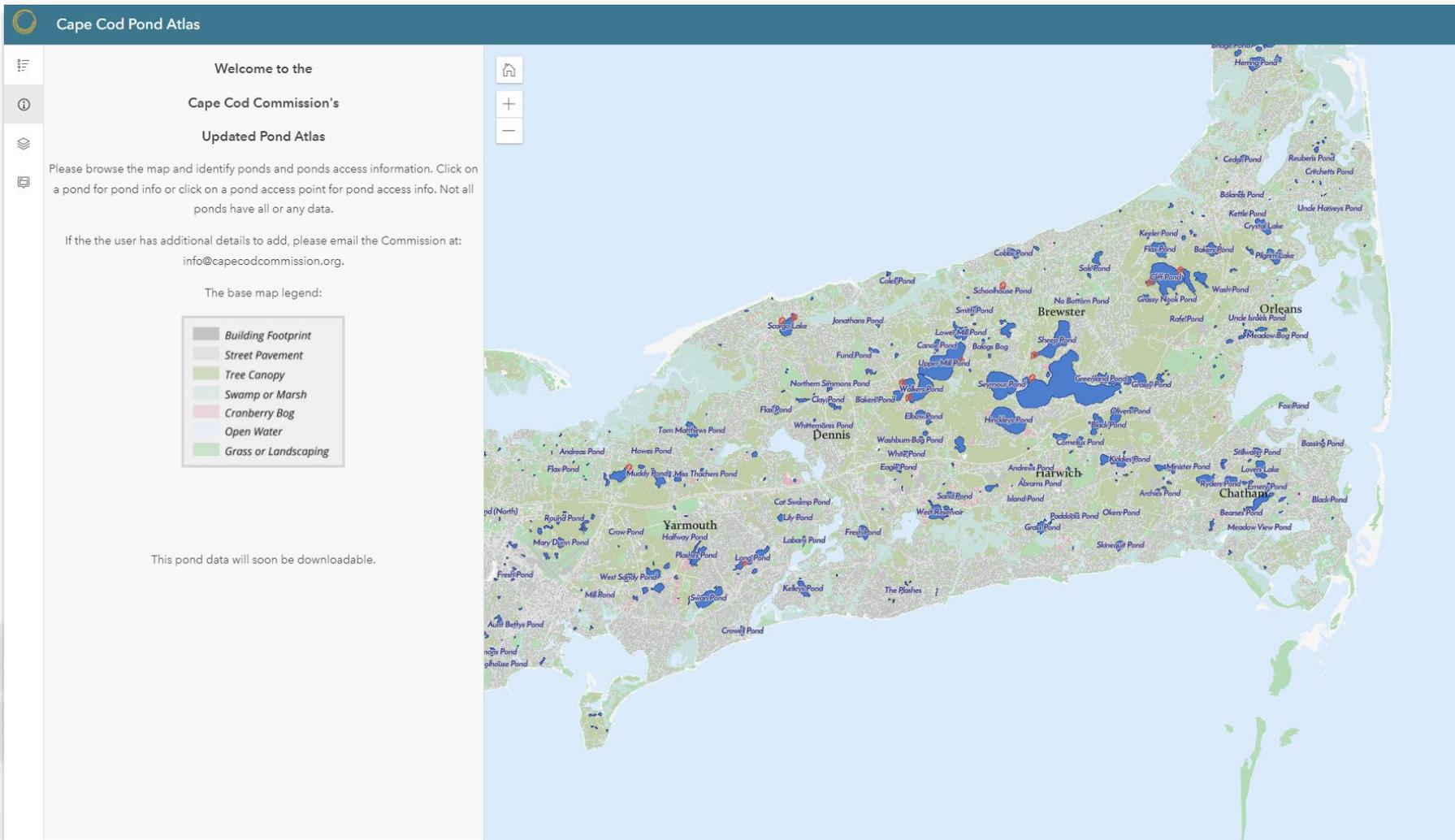
The updated Pond and Lake Atlas provides a current assessment of the importance of ponds on Cape Cod, the threats they face, and what is needed to improve and properly manage these valued and unique resources.



2021 Cape Cod Pond and Lake Atlas

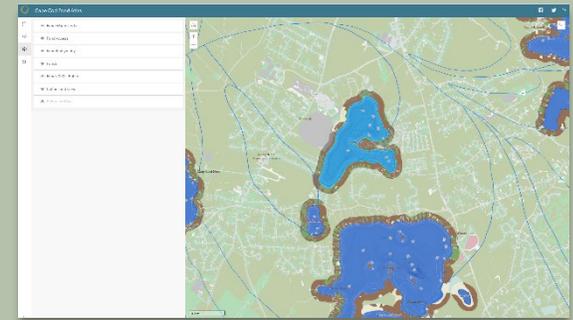


CAPE COD
COMMISSION



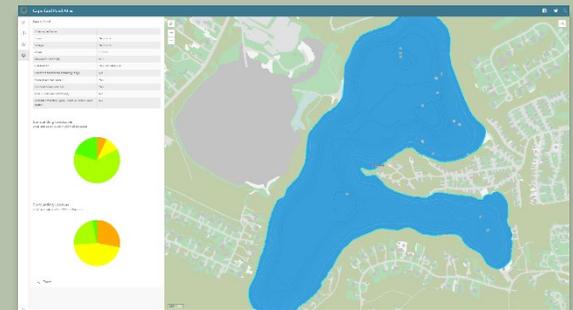
Cape Cod Pond Viewer

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.



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 buffer area.

EXPLORE: cccom.link/pond-atlas

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

Cape Cod
LAND AREA: 263,985 acres
POND AREA: 10,534 acres
4% of total regional area is comprised of freshwater ponds and lakes

Top 5 Largest Ponds

POND	AREA
1. Long Pond (Brewster)	742.0
2. Mashpee-Wakeby Pond	735.0
3. Wequaquet Lake	673.0
4. Johns Pond	336.0
5. Upper Mill Pond	260.0

Top 5 Deepest Ponds

POND	DEPTH
1. Cliff Pond	8 ft.
2. Ashumet Pond	8 ft.
3. Flax Pond	7 ft.
4. Long Pond (Brewster)	7 ft.
5. Higgins Pond	6 ft.

167 Pond Watersheds Delineated
43,762 Acres of Pond Watershed Area
31 Pond Watersheds that Cross Town Boundaries

40 Local Pond Organizations

Sandwich Ponds Profile
A RESOURCE OF THE CAPE COD FRESHWATER INITIATIVE

Sandwich
TOWN AREA: 28,078 acres
POND AREA: 754 acres
3% of total town area is comprised of freshwater ponds and lakes

Top 5 Largest Ponds

POND	AREA
1. Mashpee-Wakeby Pond	735.9 acres
2. Lawrence Pond	138.6 acres
3. Peters Pond	135.0 acres
4. Spectacle Pond	106.2 acres
5. Snake Pond	87.5 acres

Top 5 Deepest Ponds

POND	DEPTH
1. Peters Pond	57 ft.
2. Spectacle Pond	43 ft.
3. Hoxies Pond	37 ft.
4. Snake Pond	33 ft.
5. Triangle Pond	30 ft.

25 Pond Watersheds Delineated
10,623 Acres of Pond Watershed Area
14 Pond Watersheds that Cross Town Boundaries

16 Town Specific Freshwater Reports
41 Pond Specific Freshwater Reports

0 Town Specific Freshwater Reports
2 Pond Specific Freshwater Reports

Percentage of Land Use in Pond Buffer Area

Land Use Type	Percentage
Residential Land Use	35%
Commercial & Industrial Land Use	30%
Right of Way Land Use	22%
Other Land Use	6%
Protected Open Space	7%

Documented Town Reports and Actions

Local Pond Organizations

Pond Strategies Implemented

There are 0 implemented pond strategies in the regional dataset.

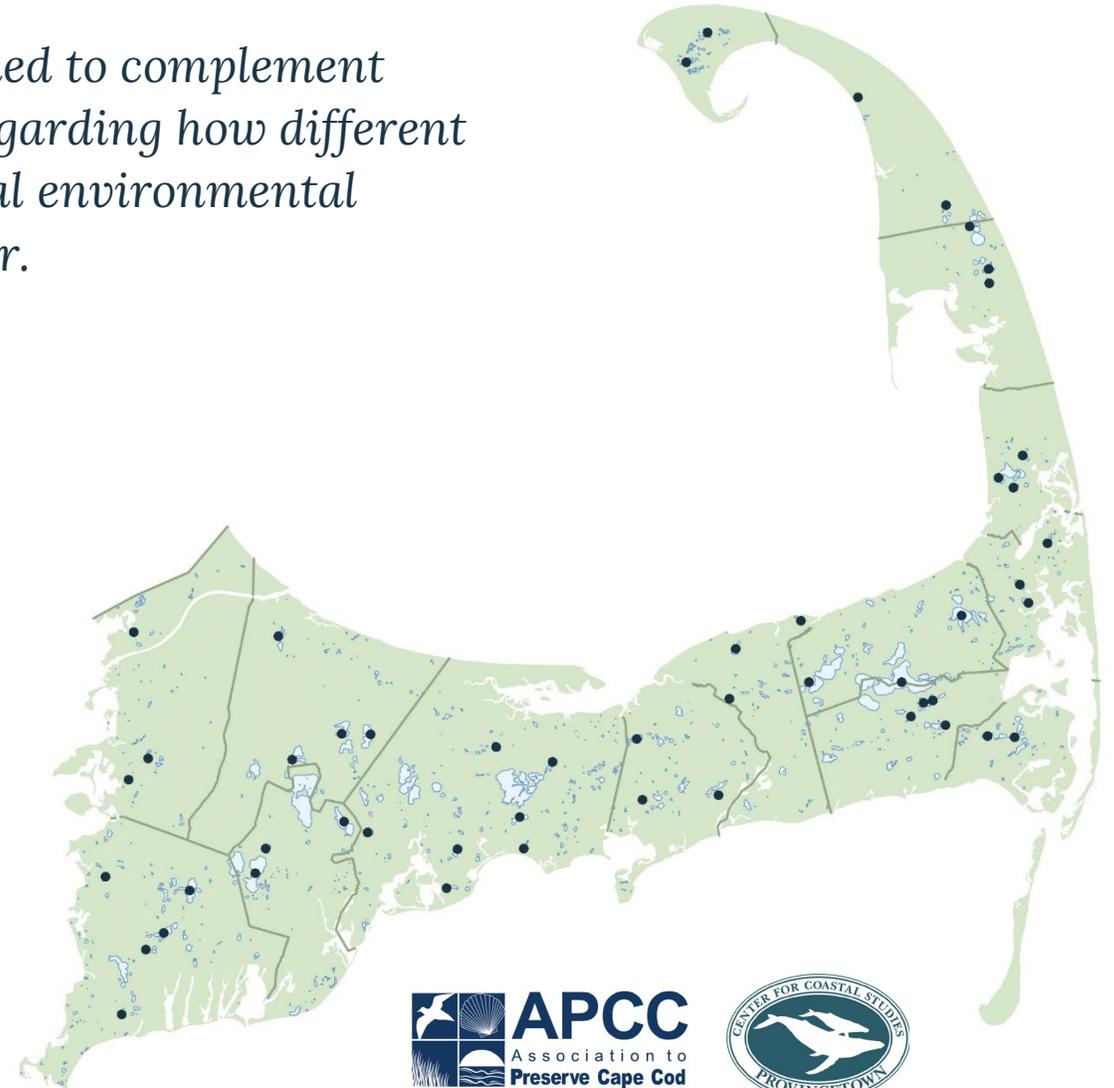
Learn more about the region's freshwater resources in the Cape Cod Pond and Lake Atlas at: capecodcommission.org/freshwater

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 pond physical characteristics (e.g., size, depth, level of watershed development)
- Stream/herring run connections, implementation projects, and Coastal Plain Pondshores
- Water quality status
- Public uses of ponds
- Located in or adjacent to environmental justice area



REGIONAL POND MONITORING PROGRAM

First season of monitoring program complete

- **50 ponds** monitored from April to November
- **346 pond visits** by staff and volunteers
- **3,113 sample bottles** sent to the lab for processing and analysis
- **Over 500 volunteer hours** spent monitoring ponds

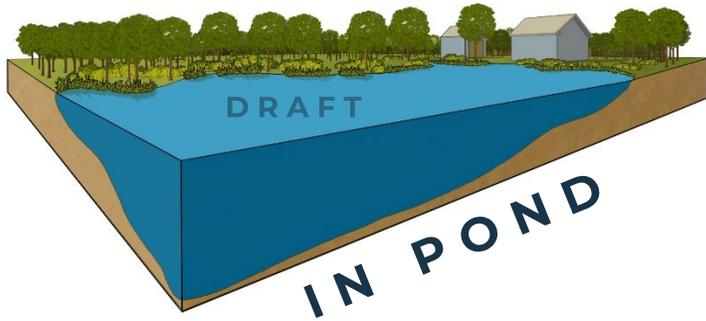
Center for Coastal Studies analyzed samples

Monitoring efforts will resume in March 2024



POND STRATEGIES DATABASE

SCALE OF APPROACHES



Sediment, nutrient, algae,
and vegetation management
approaches



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



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

STRATEGIES DATABASE INCLUDES

Policy
Approaches



Physical
Approaches



Chemical
Approaches



Biological
Approaches



| GOALS OF THE ECONOMIC ANALYSIS



Identify the **key pond features**, perspectives, and attitudes of residents, non-resident owners, and tourists.



Understand and quantify the **impact of proximity to clean freshwater** on the property value and rental prices.



Estimate freshwater quality's **economic impact and contribution to Cape Cod's economy**.



Assess the potential **public's willingness to pay for key freshwater pond features**.

| ENGAGEMENT AND OUTREACH



Pond Network

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



Technical Advisory Groups

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



Community Outreach and Input

Engage the broader community to understand public perception, awareness, and priorities



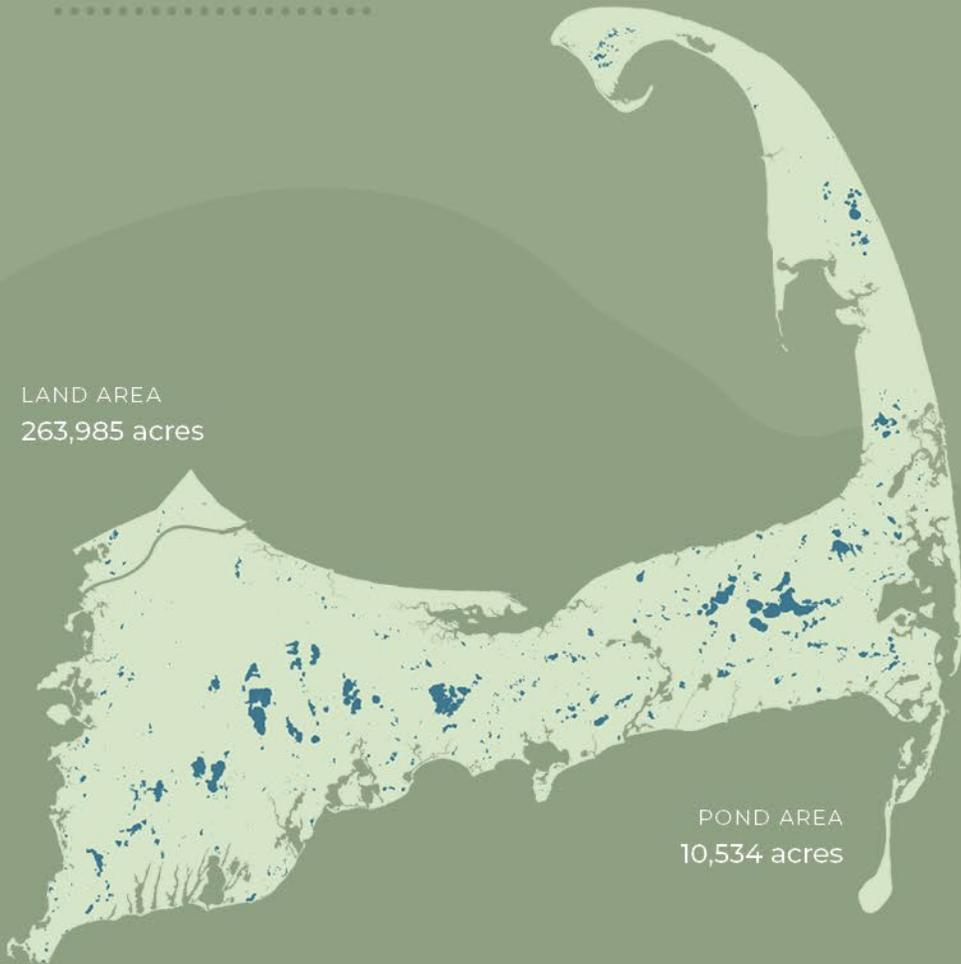
Stakeholder Engagement

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



Cape Cod Ponds and Lakes in Context

Cape Cod Ponds by the Numbers



CAPE COD PONDS AND LAKES

890
POND S

171
10+ Acre Ponds

395
Named Ponds

LARGEST PONDS *by area*

1. Long Pond
Brewster and Harwich
2. Mashpee-Wakeby Pond
Mashpee and Sandwich
3. Wequaquet Lake
Barnstable

DEEPEST PONDS *with data available*

1. Cliff Pond
Brewster
2. Hamblin Pond
Barnstable
3. White Pond
Chatham

27 

Fish Stocked Ponds

107 

Ponds Adjacent to Cranberry Bogs

22 

Ponds that Cross Town Boundaries

96 

Ponds with Public Access*

30% 

Protected Open Space within pond 300ft buffer

14% 

Impervious Surfaces within pond 300ft buffer

*Includes public beaches, boat ramps, and launches

C A P E C O D
REGIONAL
P O L I C Y P L A N

FRAMING THE FUTURE

CAPE COD COMMISSION | 2019

RECOMMENDED ACTION

**Update and Expand Understanding
of Freshwater Resources Data**

Compile available freshwater resources water quality data into a regional database.

*Seek funding to update **the Cape Cod Ponds and Lakes Atlas** to reflect current water quality data collected by the Ponds and Lakes Stewardship Program.*



Cape Cod's freshwater ponds are fragile systems especially vulnerable to pollution and human activity.

*Despite data gathered by citizen monitoring groups and assessments that document water quality impairment, the state has listed only a few freshwater ponds on the 303d list for impaired waters for nutrients under the Clean Water Act. **Additional dialogue is needed** between the towns, state and county to evaluate the best use of the information collected and how it should be incorporated into the Commonwealth's clean water program.*



Cape Cod Pond Ecology

Liz Moran – Anchor QEA, LLC



Kettle Ponds: Unique Ecosystems

- Remnants of glacial ice retreat, 14,000 – 17,000 years ago
- Varied ecology based on landscape position, depth, and soil texture
- Provide terrestrial, wetland, and aquatic habitat to a diverse assemblage of native species

Unique but Interconnected

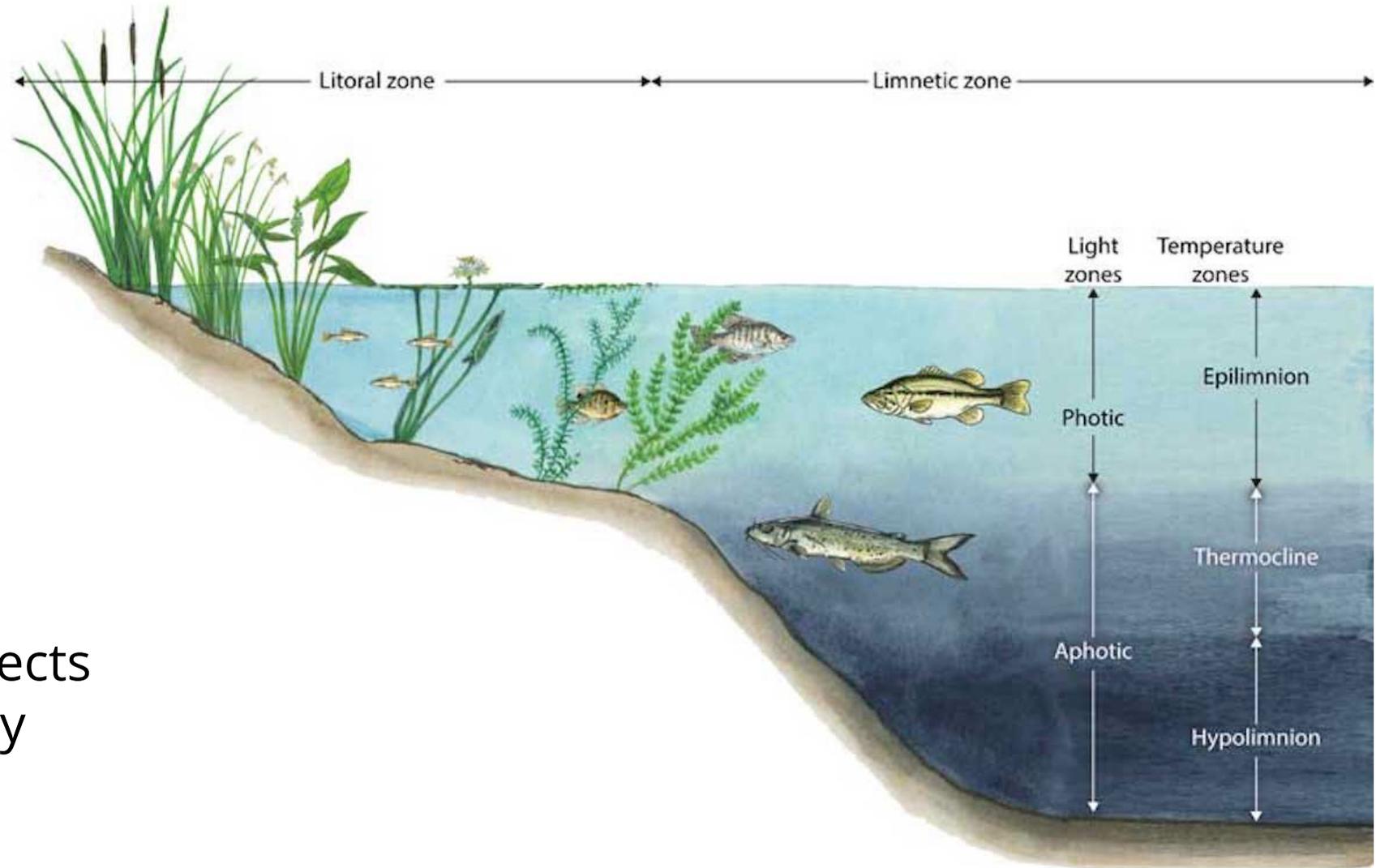
- Surface water and groundwater connections
- Discharge to coastal estuaries
- Conditions influenced by local actions and regional trends
 - Nutrient sources
 - Changing climate
 - Water level/sea level rise



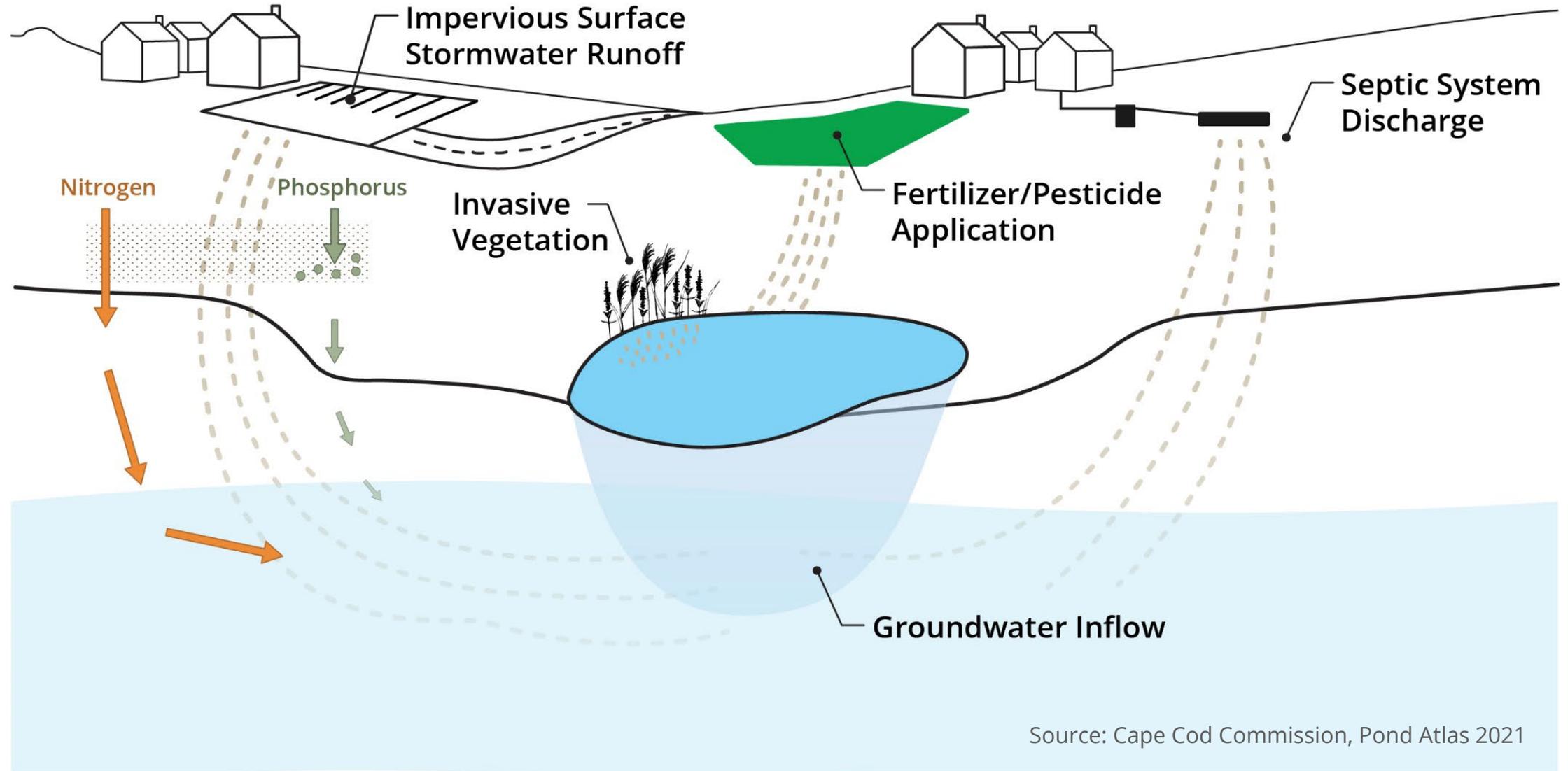
Source: Cape Cod Commission Pond Atlas, 2021

Phosphorus (P) is Key to Pond Ecology

- Limiting nutrient
- Accumulates in ponds
- P cycle affected by pond depth, thermal stratification, and productivity
- Dissolved oxygen affects habitat and chemistry



LANDSCAPE CONDITIONS AFFECT NUTRIENT FLUX



Source: Cape Cod Commission, Pond Atlas 2021

POND CHARACTERISTICS AFFECT THEIR RESPONSE

Morphometry

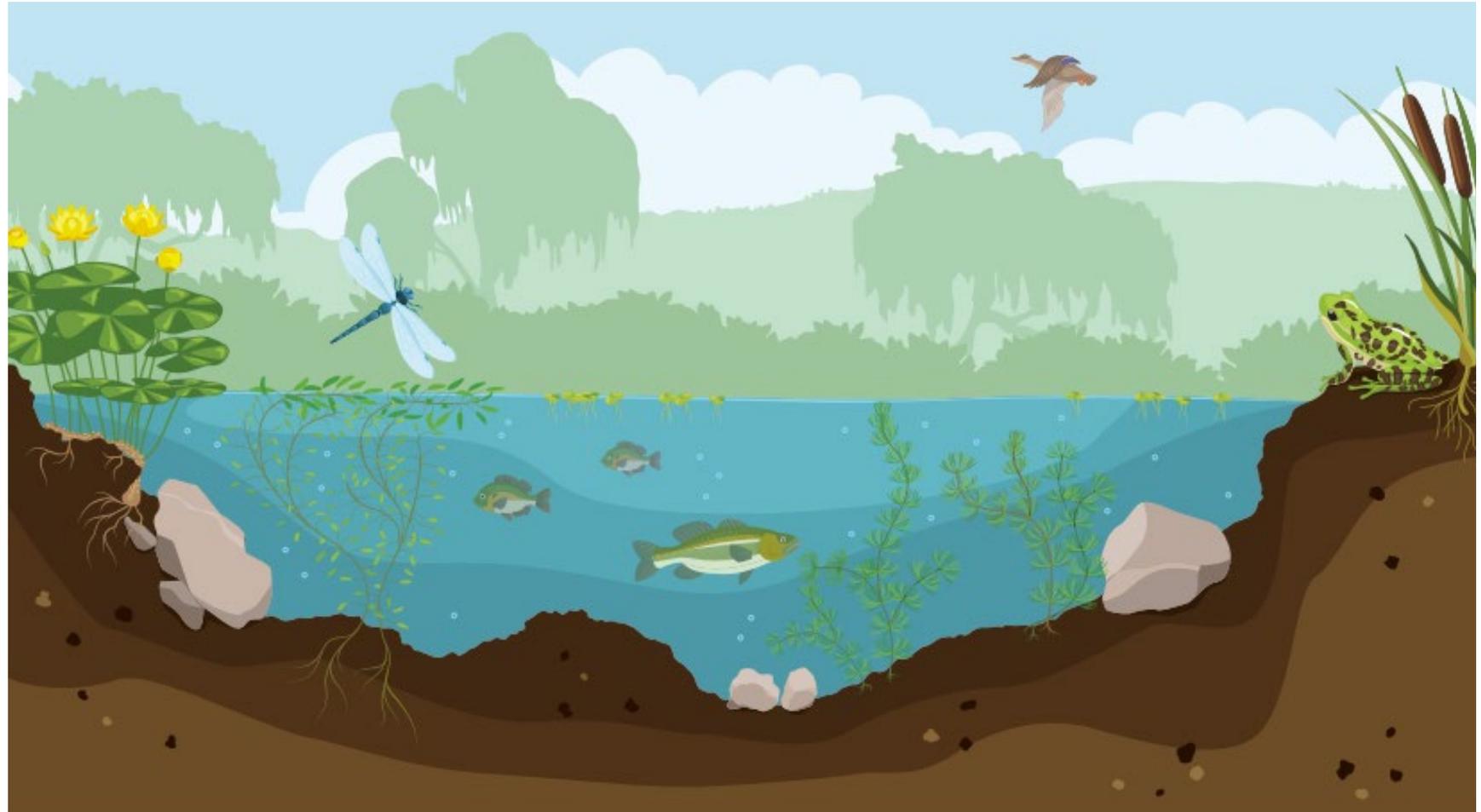
- Depth
- Surface Area
- Water Residence Time
- Connectivity

Ecology

- Fish community
- Invasive species

Management

- Fish stocking
- Interventions



POND CHARACTERISTICS



Jemima Pond

Alternative Name	
CCC-GIS-ID	EA-100
Town	Eastham
Village	Eastham
Acres	6.53
Maximum Depth (ft)	15.0
Great Pond	No
Watershed Delineated	Yes
Ponds stocked with fish	No
NHESP Natural Community	No
Percent Protected Open Space in Pond's 300ft. buffer	14%
Cranberry Bogs within 300ft Buffer	No
Golf Course within 300ft Buffer	No

Surrounding Landcover

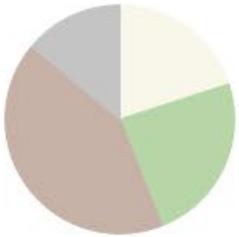


POND CHARACTERISTICS



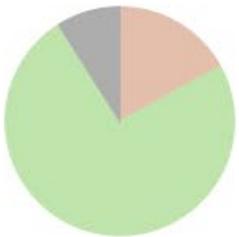
Surrounding Landcover

what land cover is within 300 ft of the selected pond



Surrounding Landuse

what land use is within 300 ft of the selected pond



Zoom

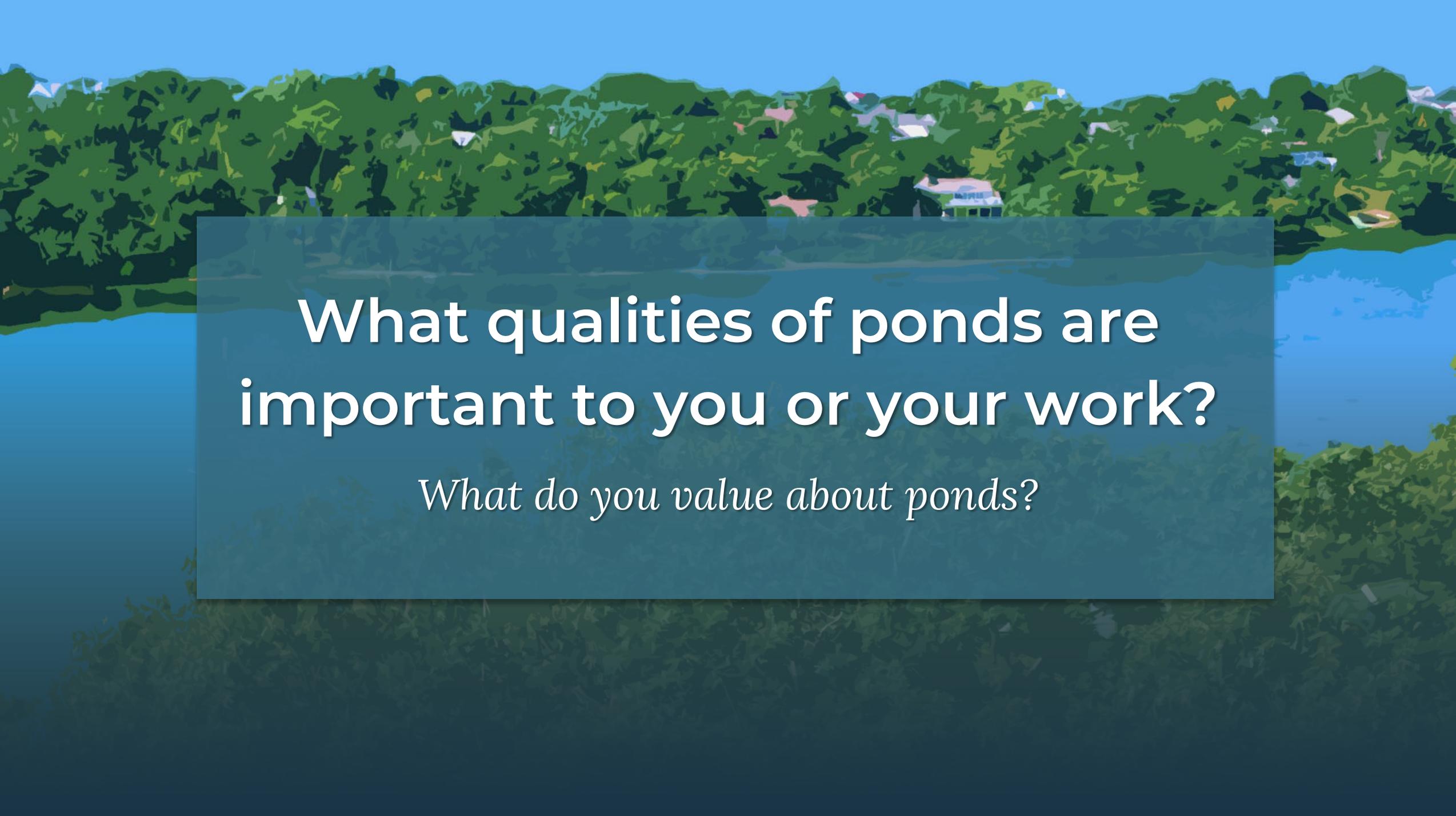


500 ft

Ponds Support Human Well-being

- Sense of Place
- Recreation
- Aesthetics
- Environmental education
- Denitrification – coastal estuary goals
- Angling – food and recreation
- Economy – tourism and tax base





**What qualities of ponds are
important to you or your work?**

What do you value about ponds?



Understanding Economic Impacts of Cape Cod's Freshwater

Charles Goodhue – ERG

Core Components of the Economic Analysis

Perceptions Survey

Identifies preferences, perceptions and attitudes towards freshwater

Intercept Survey

Assesses the economic impact of freshwater ponds on the economy

Hedonic Analysis

Quantifies the impact of freshwater ponds on property values

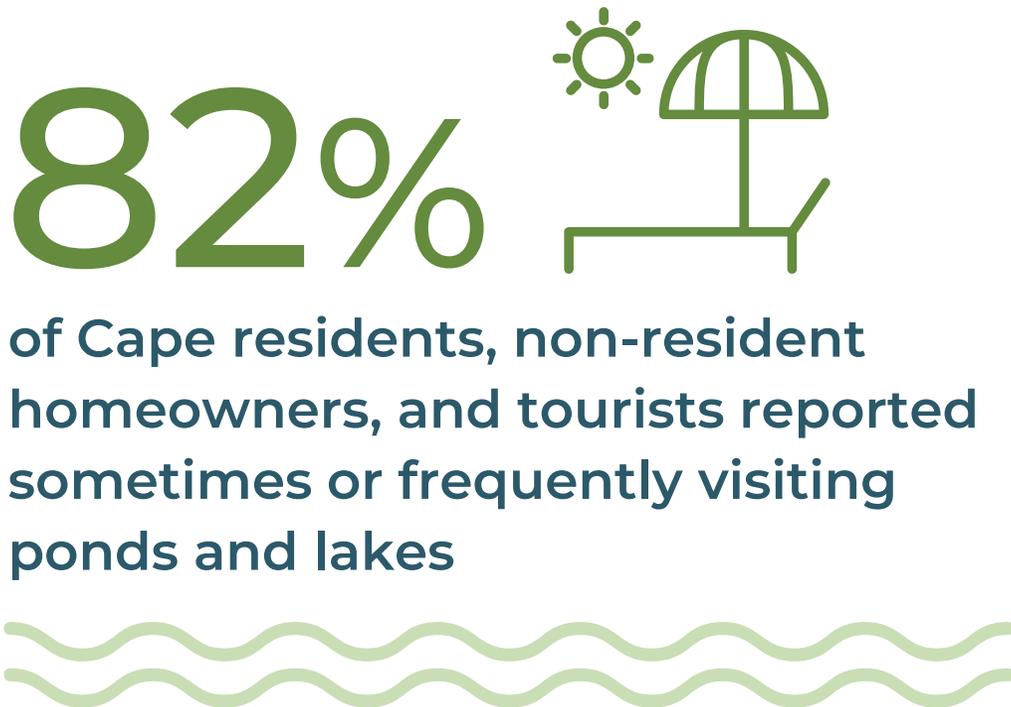
Discrete Choice Experiment

Estimates the value of certain freshwater attributes based on “willingness to travel”

Perception Survey Methods

What:	Web-based survey using Qualtrics panel
Why:	Attitudes, recreation, visitation rates
Details:	827 respondents <ul style="list-style-type: none">▪ 587 visitors▪ 154 residents▪ 86 non-resident homeowners

Cape Cod ponds and lakes are popular destinations.



1.3 to 1.7 million
Estimated visits to Cape Cod ponds and lakes annually



66%
of visits come between June and August

Cape residents and non-resident homeowners support targeted pond improvements.



The **most impaired** ponds and lakes, the ones with the **highest support** for improvement, and the **most used/visited should be prioritized.**



Cape residents and NROs also overwhelmingly indicated that pond improvement projects with **ecosystem benefits should be prioritized.**

Discrete Choice Experiment Methods

What:	"Stated preference" survey asking about preferences for specific attributes
Why:	Understand value of water quality signs, bacterial issues, beach size, litter, shoreline development, amenities, and time to travel
Details:	382 respondents <ul style="list-style-type: none">▪ 102 residents▪ 13 non-resident owners▪ 267 visitors

People prefer to visit ponds and lakes with clean water and clean beaches.

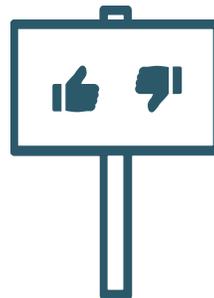


Visitors are **1.8 TIMES** more likely to visit

A pond that rarely or never has bacterial issues than a pond with issues every summer.



Visitors are **2.5 TIMES** more likely to visit a pond that has little to no litter than a pond with a noticeable amount of litter.



Visitors are **1.2 TIMES** more likely to visit a pond that has signs about recent water testing than one with no sign.

Discrete Choice Experiment

We Asked Cape Cod Residents and Visitors What Attribute They Considered **Most Important** When Deciding to Visit a Lake or Pond:



37%
said bacterial issues



20%
said signs of water quality



14%
said litter or garbage



11%
said amenities (picnic tables,
bathrooms)



8%
said beach size



4%
said shoreline development



4%
said time to drive to pond



2%
said none in particular

Hedonic Property Price Analysis Methods

What:	Value of attributes of a property
Why:	Value of proximity to ponds and pond water quality
Details:	<ul style="list-style-type: none">▪ 21,000+ home sales▪ 8,000 rental properties

Cape residents and non-resident homeowners value clean ponds.

A **home** near a pond with clear water will sell for **\$22,300 more*** than a similar home near a pond with algal issues.

(5 percent more than the median sales price)



A **rental property** near a pond with clear water will rent for **\$189 MORE** per week than a similar rental property near a pond with algal issues.

(8 percent increase over median weekly rental value)

91% either “agree” or “strongly agree” that ponds and lakes are important to the Cape Cod environment, and they are willing to pay a premium to live near them.

Intercept Survey Methods

What:	In-person survey of people at ponds
Why:	Counts and spending to get economic contribution
Details:	<ul style="list-style-type: none">▪ 75 unique ponds▪ 606 surveys covering spending of 2,252 people▪ 20 days of data collection

Lakes and ponds are important to the Cape Cod economy.

84%

of Cape residents and non-resident homeowners either “agree” or “strongly agree” that **ponds and lakes are important to the Cape Cod economy**

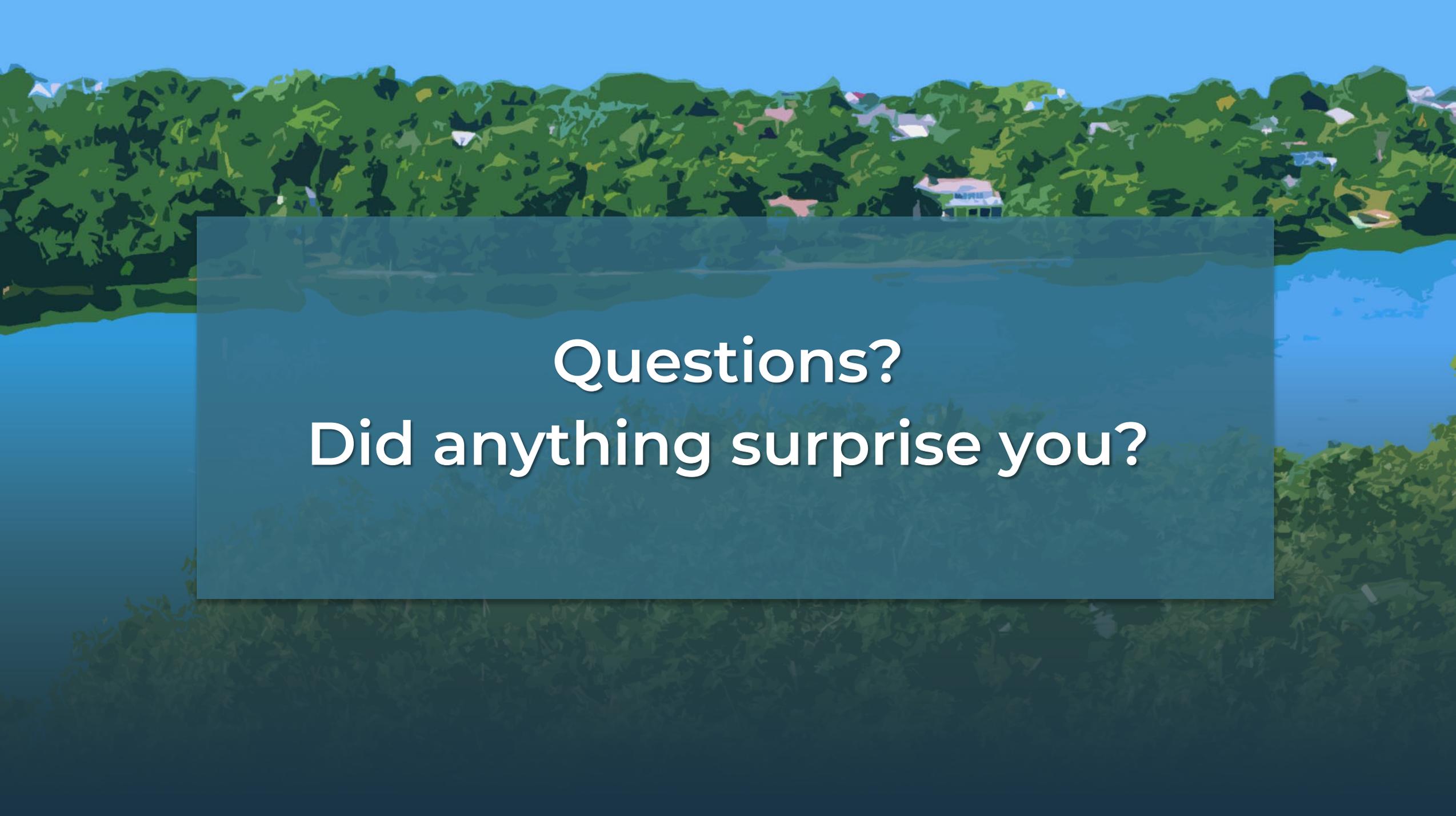


660 to 830 jobs annually can be attributed to spending associated with visits to lakes and ponds



\$70 - \$89 million of the region’s GDP is associated with visits to lakes and ponds

Visitors **spend an average of \$50** locally per visit



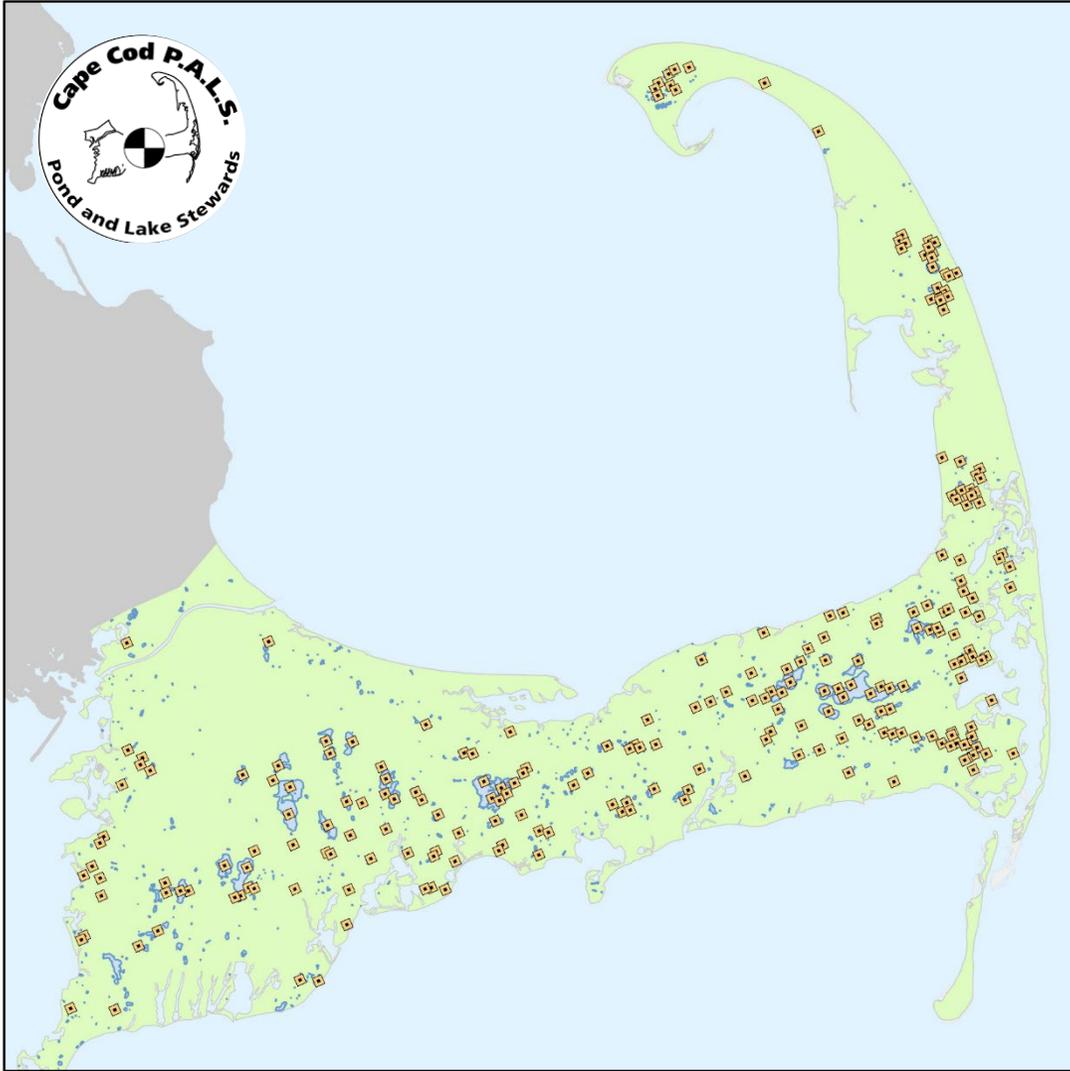
Questions?
Did anything surprise you?

A scenic view of a lake with a forested shoreline and houses in the background. The water is calm and reflects the surrounding greenery and sky. The houses are nestled among the trees on the far shore.

Water Quality Data

Tim Pasakarnis – Cape Cod
Commission

CAPE COD'S HISTORY OF POND MONITORING



1+ data sheet
per town
per year

x



15 towns

x



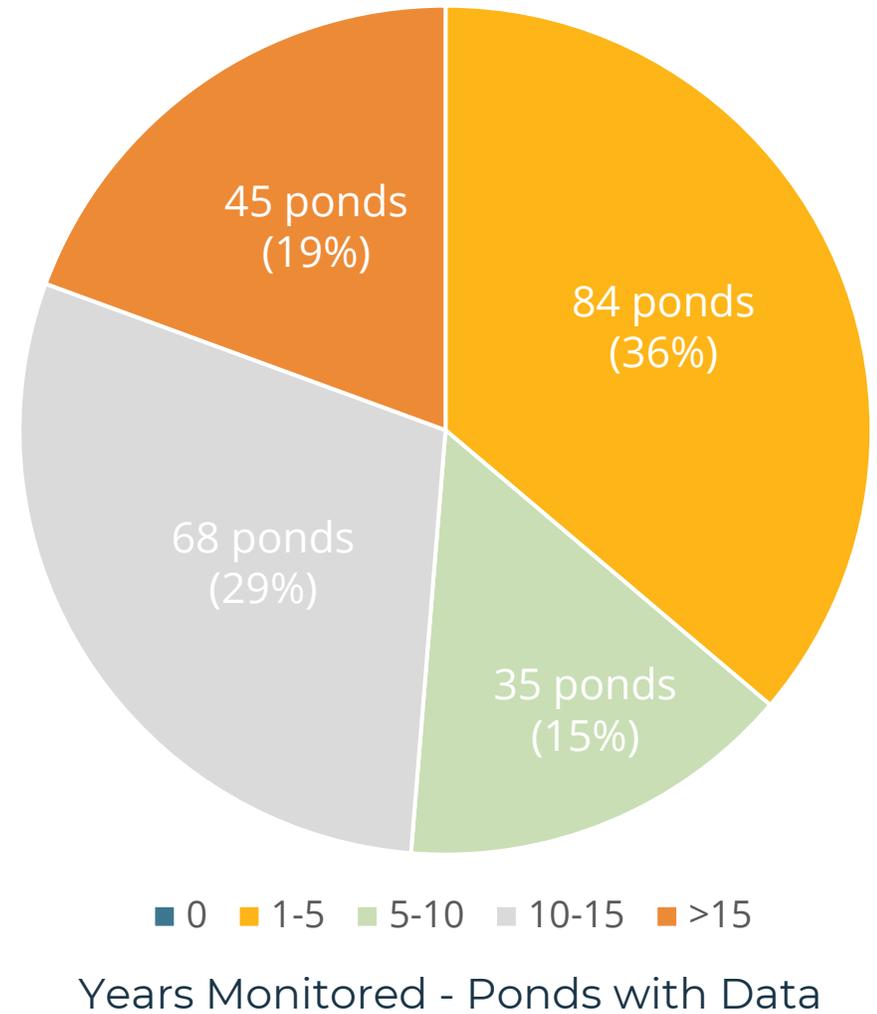
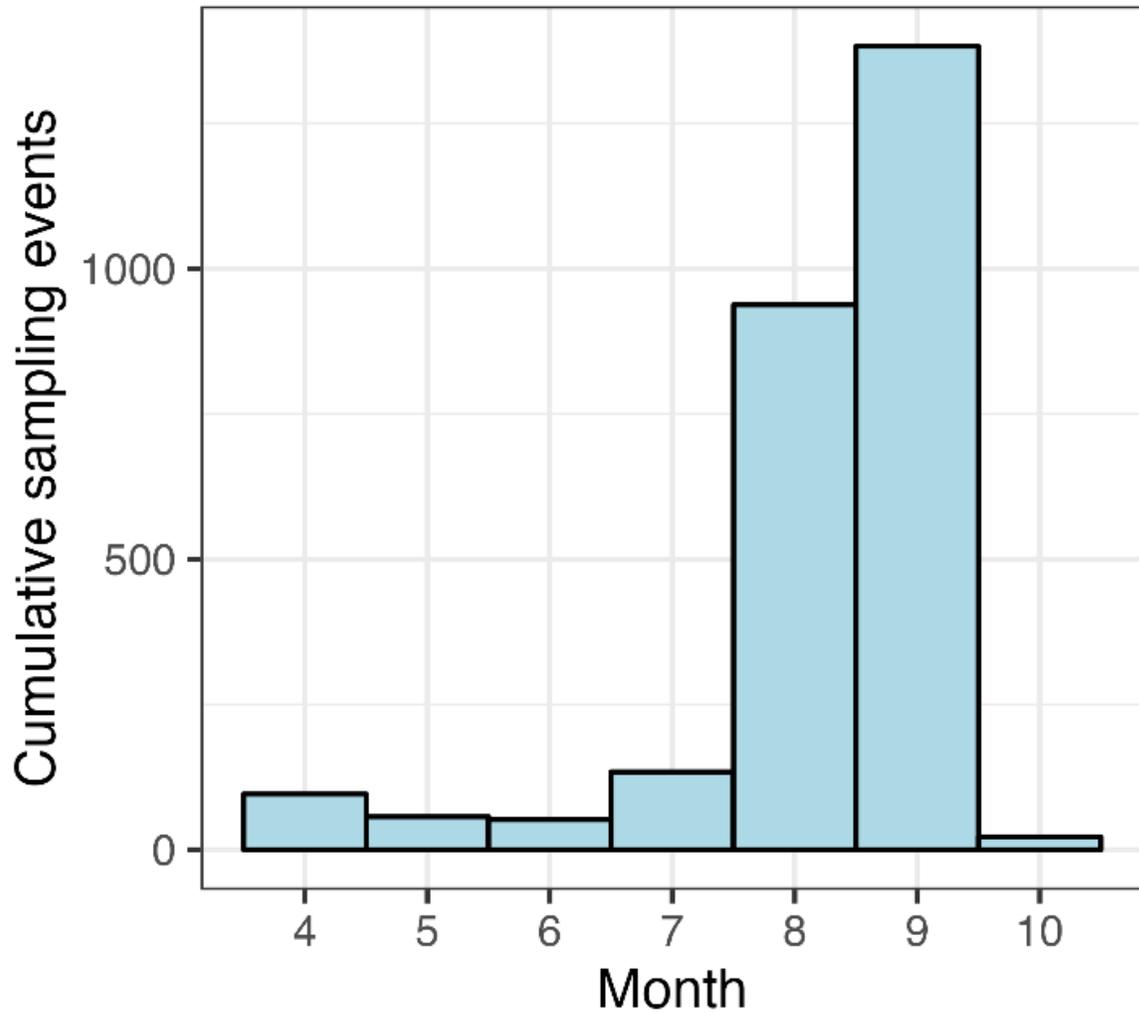
20+ years of
pond monitoring

= 125,000+ sample results

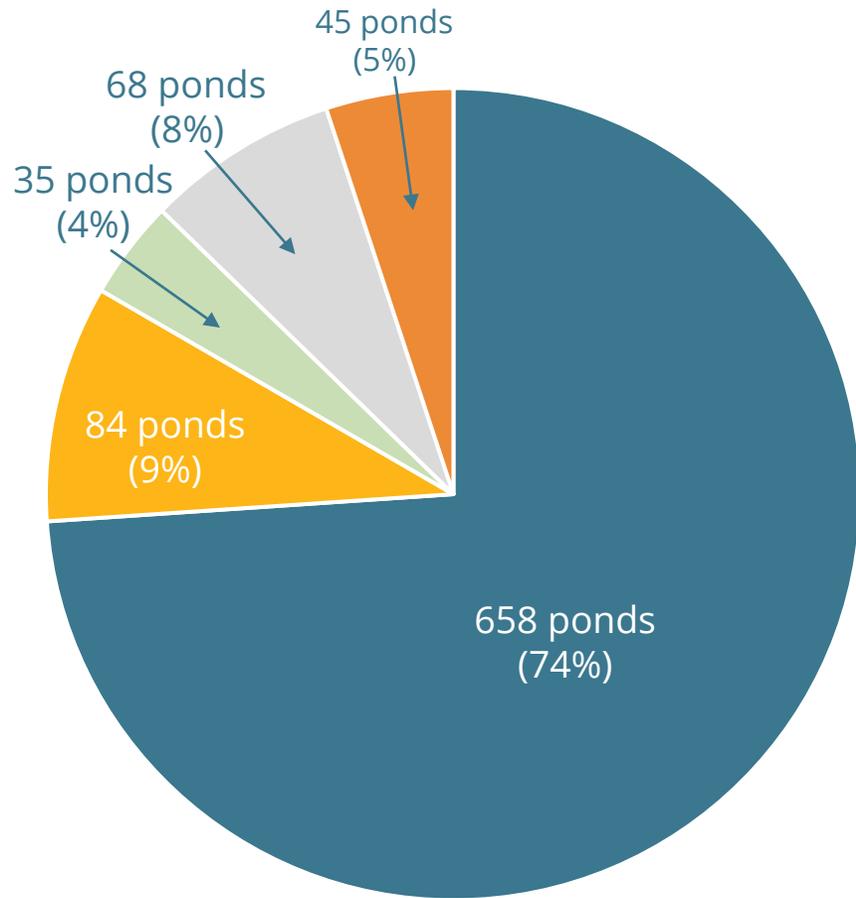
= 200+ ponds

= 100+ spreadsheets

PONDS MONITORED

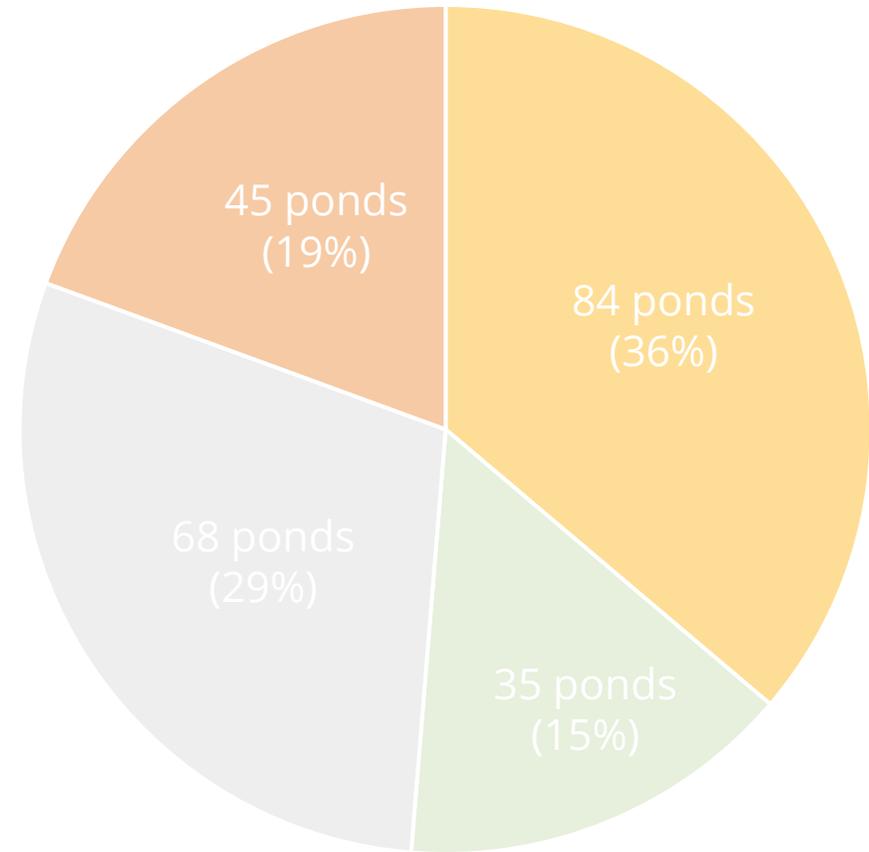


| PONDS MONITORED



■ 0 ■ 1-5 ■ 5-10 ■ 10-15 ■ >15

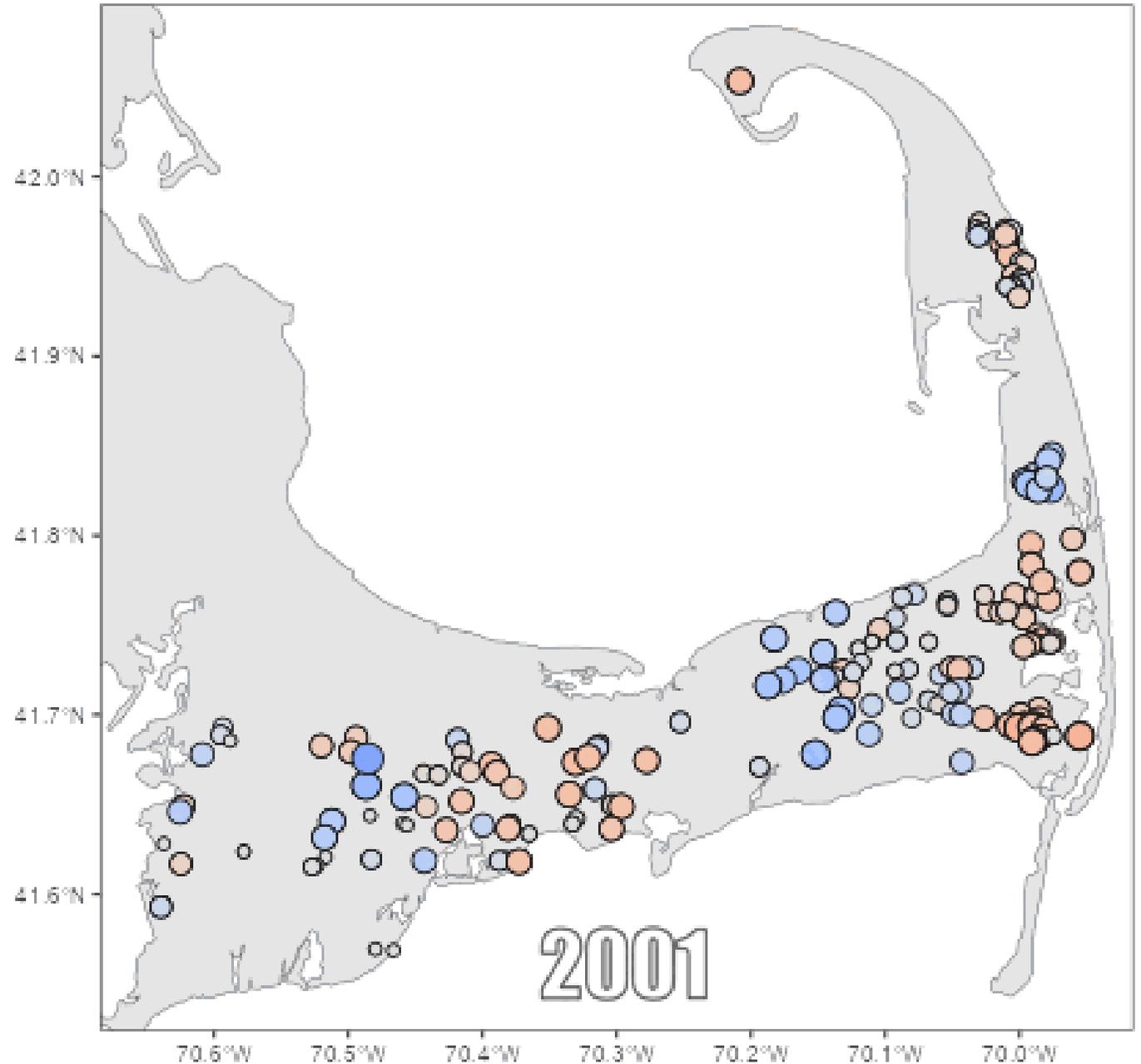
Years Monitored - All Ponds



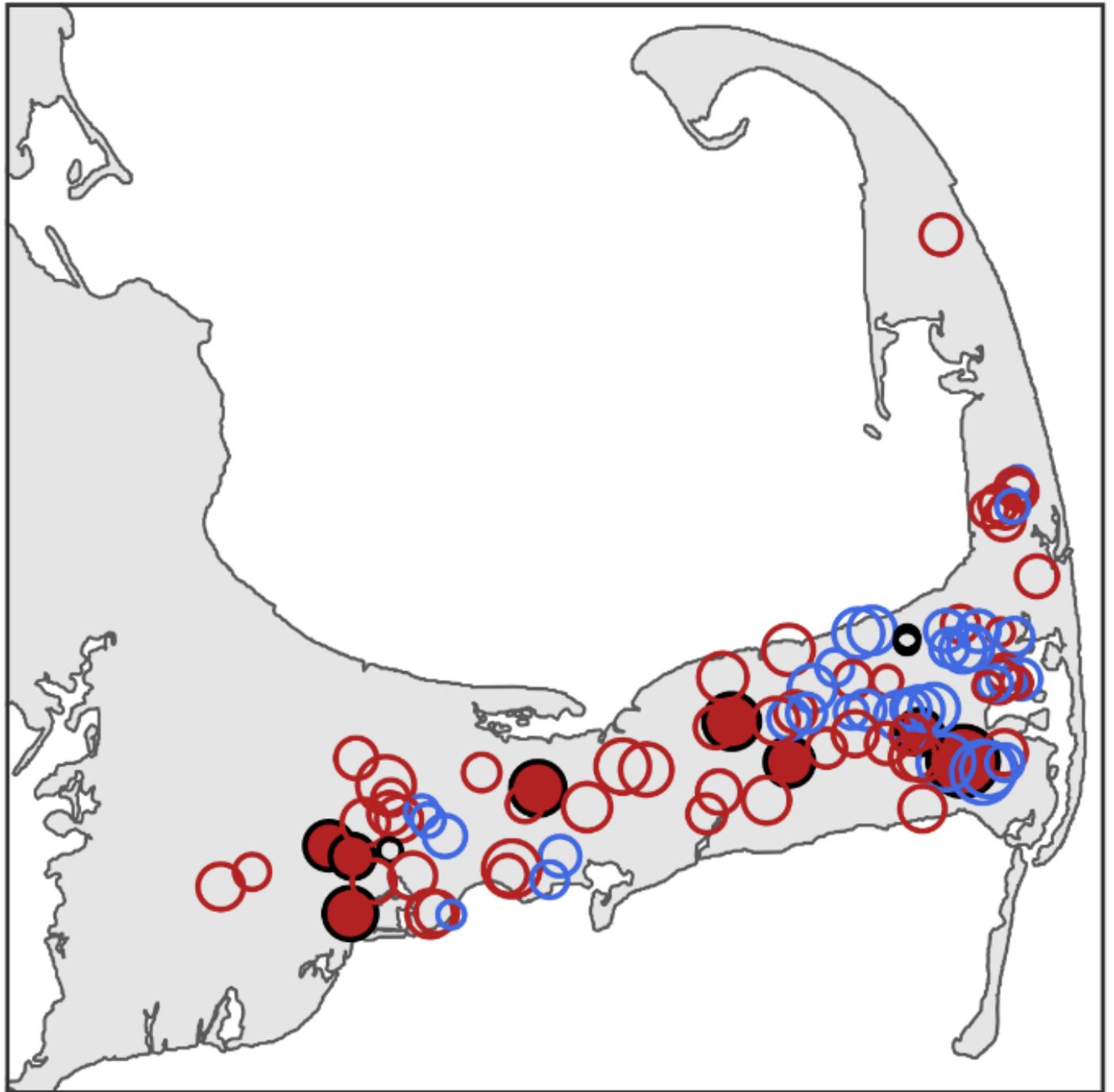
■ 0 ■ 1-5 ■ 5-10 ■ 10-15 ■ >15

Years Monitored - Ponds with Data

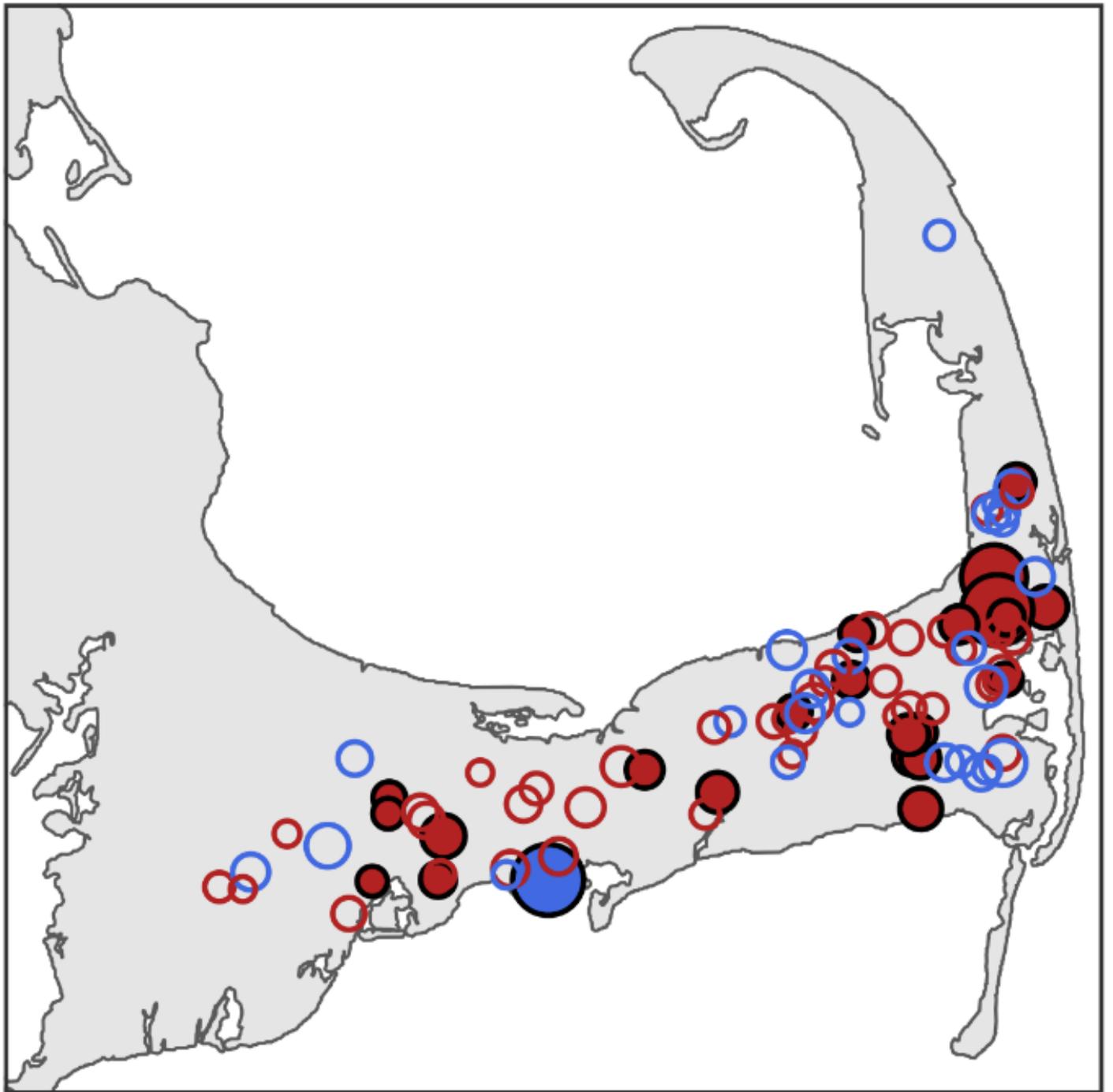
Ponds Monitored



Regional Trends in Surface Temperature



Regional Trends in Phosphorus



Pond Water Quality Monitoring Program

Develop and implement a plan for coordinated and consistent regional pond monitoring

Data Collection

Collect and manage data from representative ponds under EPA-approved Quality Assurance Project Plan

Centralized Database

Report data directly to Water Quality Database

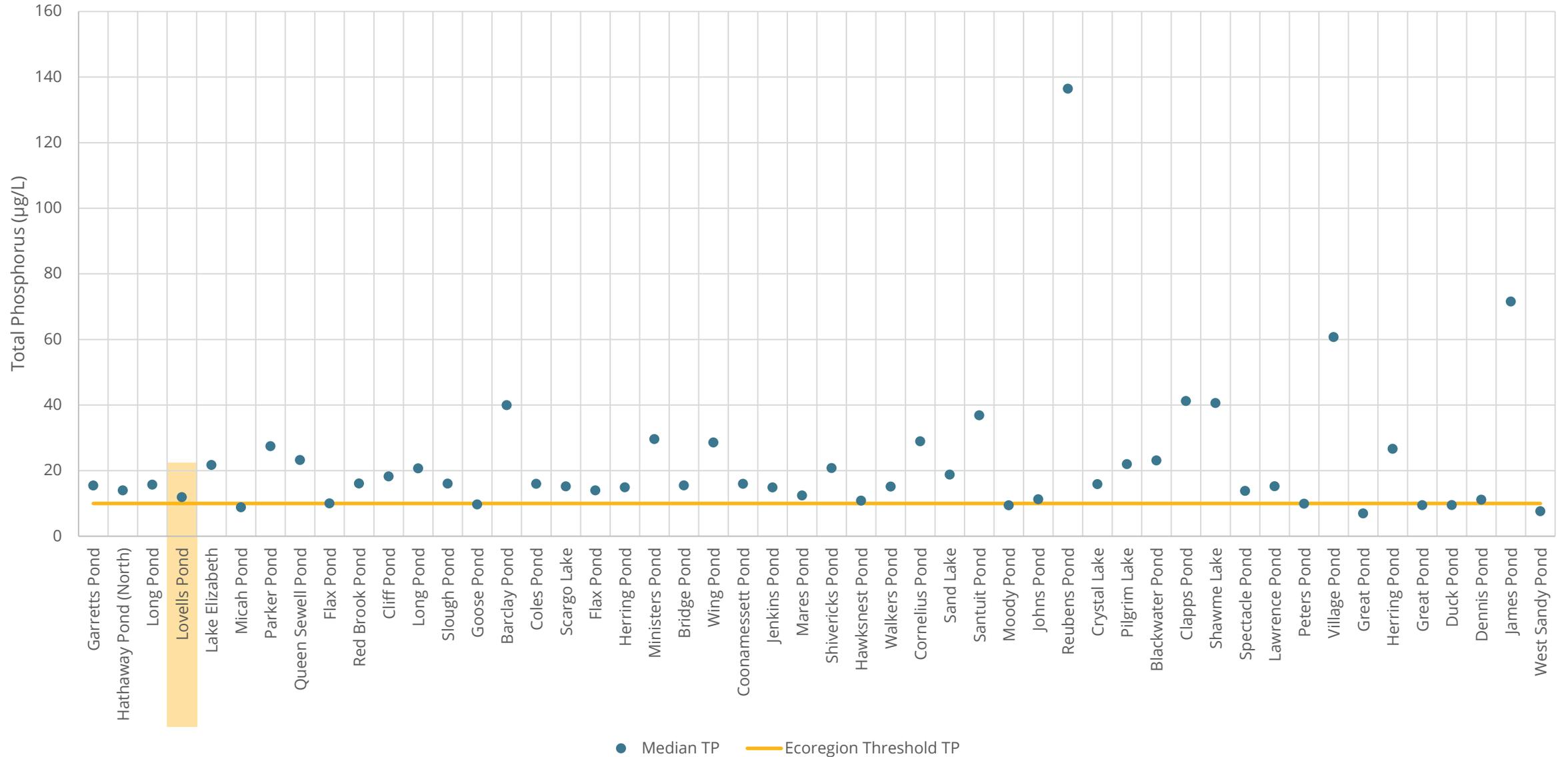
Integrated Planning

Coordinate with other Freshwater Initiative elements (regional trend analysis, GIS screening)

| POND MONITORING PROGRAM RESULTS

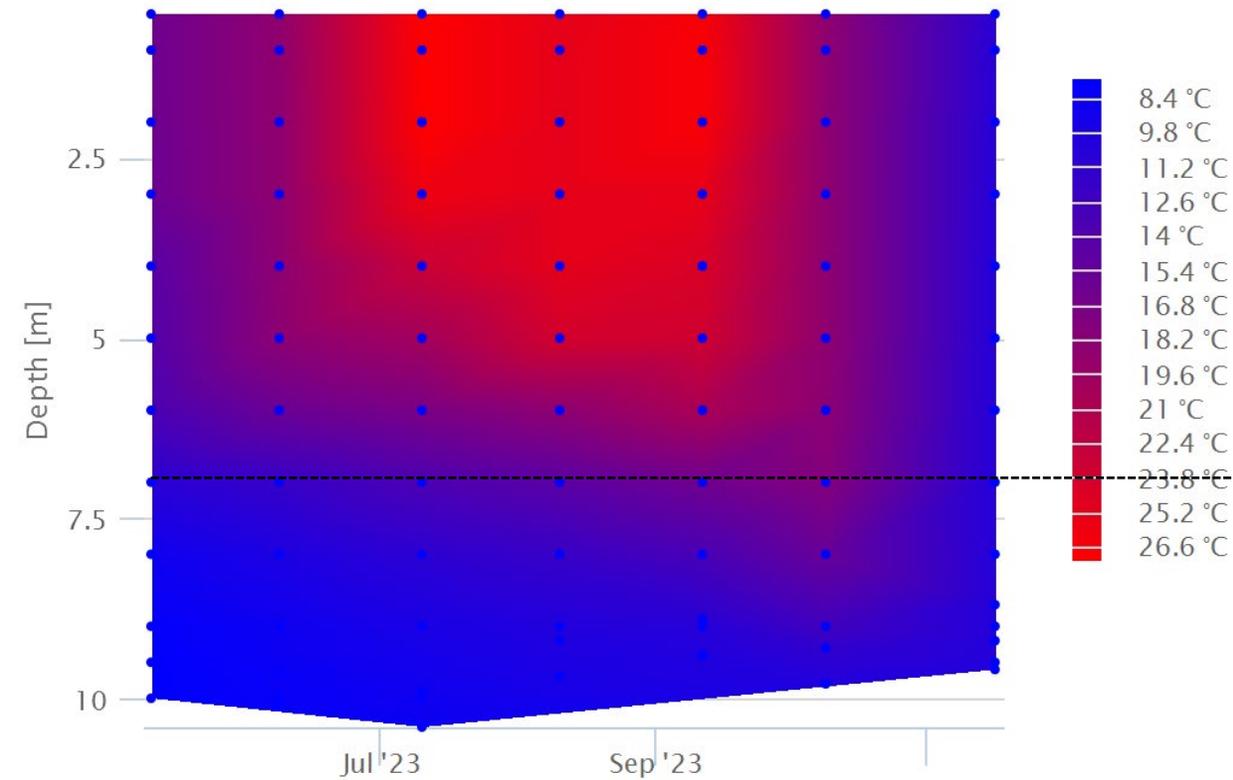


POND MONITORING PROGRAM RESULTS

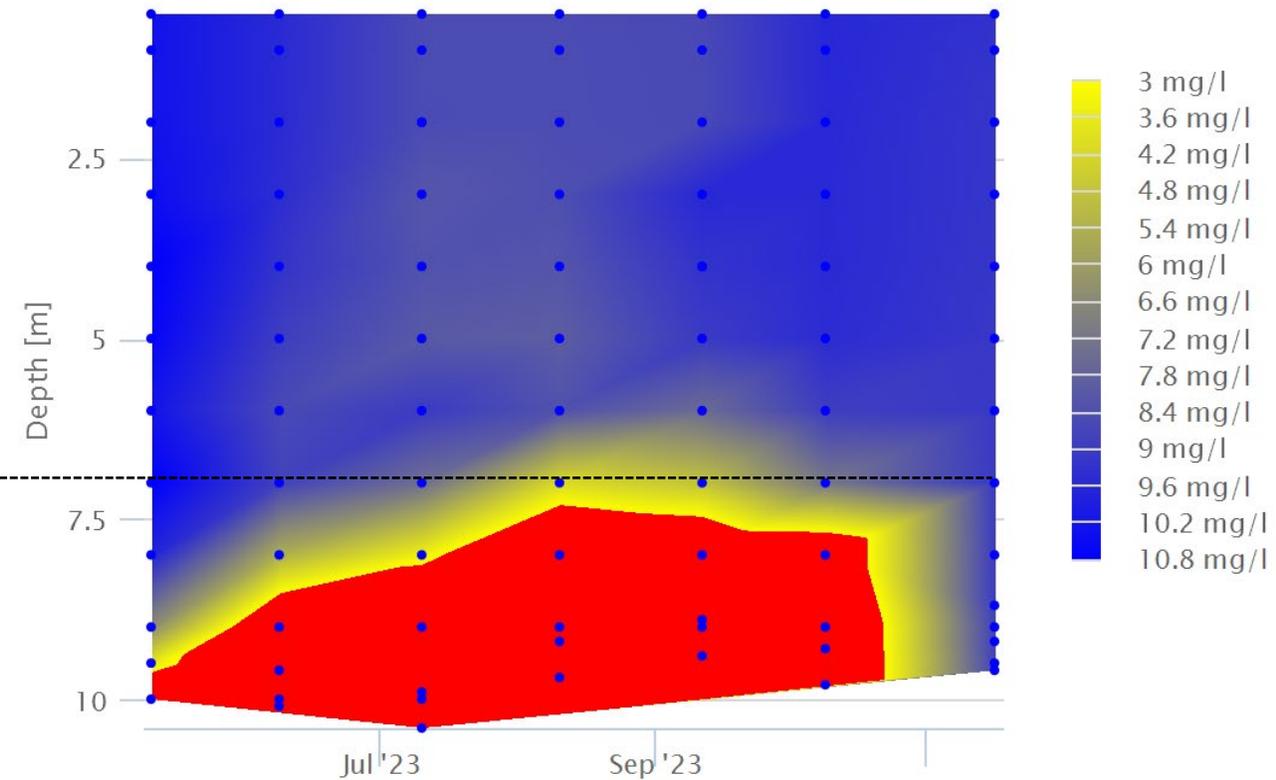


Lovells Pond - Barnstable

Water Temperature

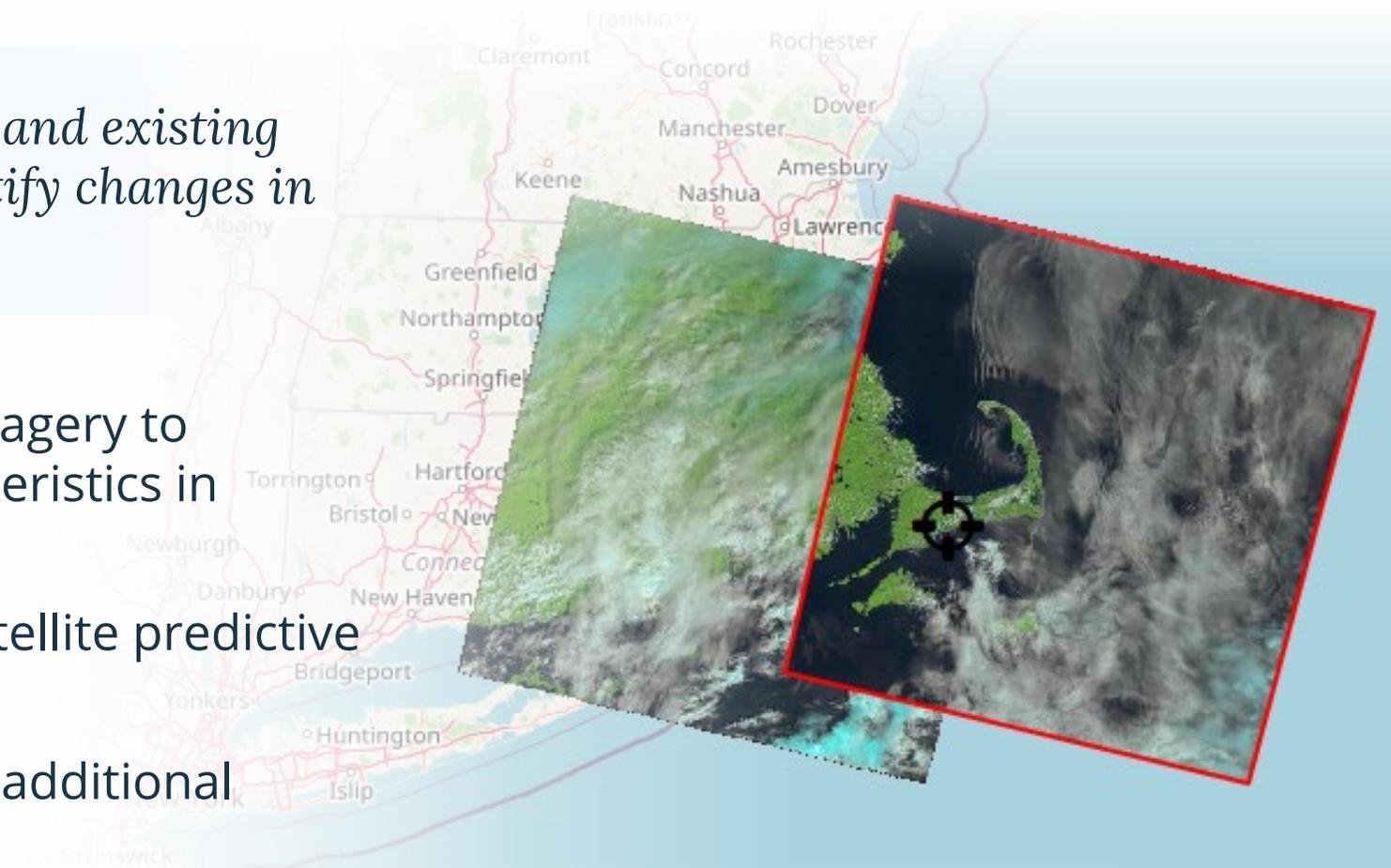


Dissolved Oxygen

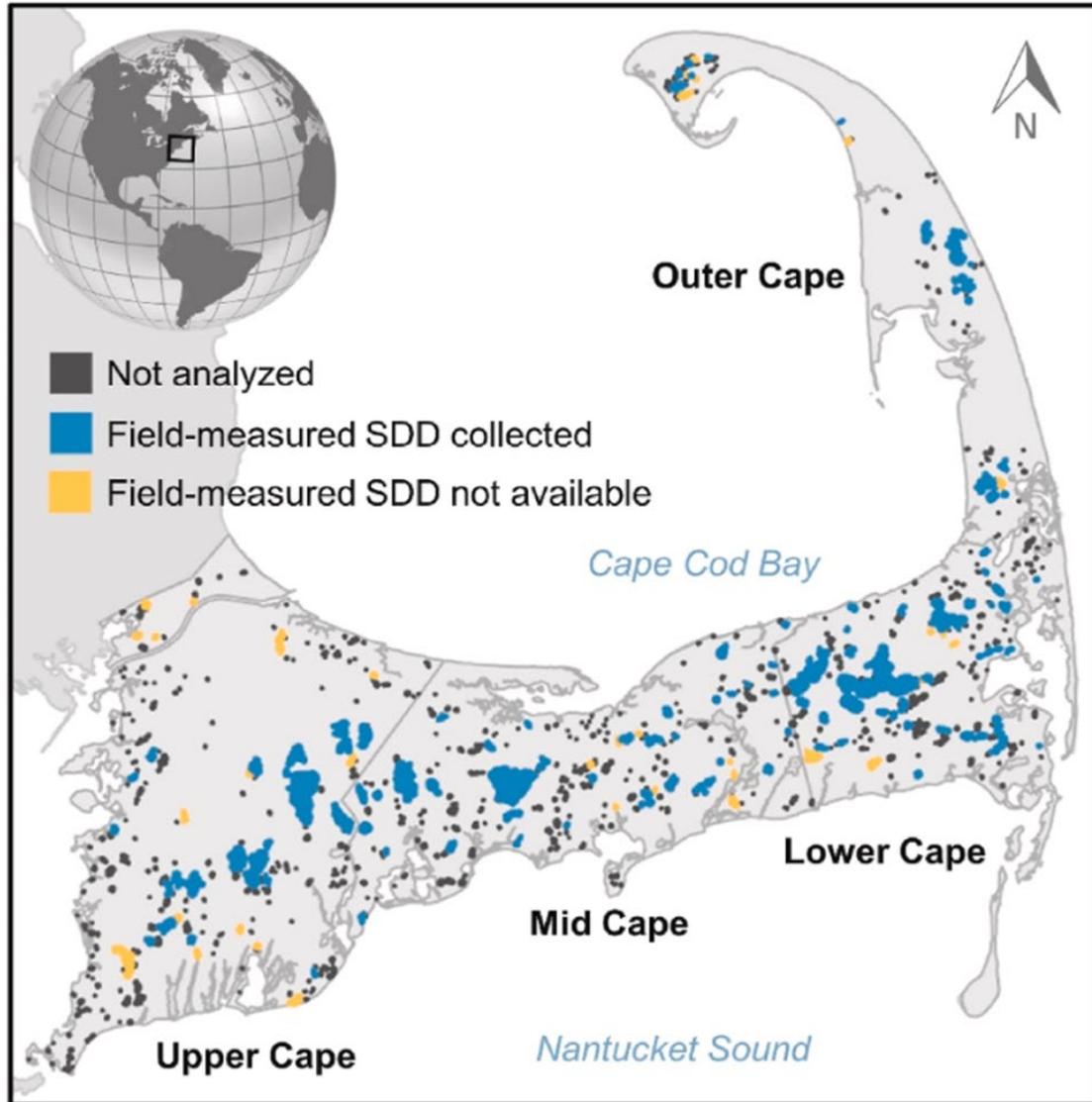


How can satellite-derived imagery and existing pond water quality data help quantify changes in pond characteristics?

- Two projects using satellite imagery to estimate water quality characteristics in ponds and lakes
- Field data used to calibrate satellite predictive model
 - Gather information about additional ponds



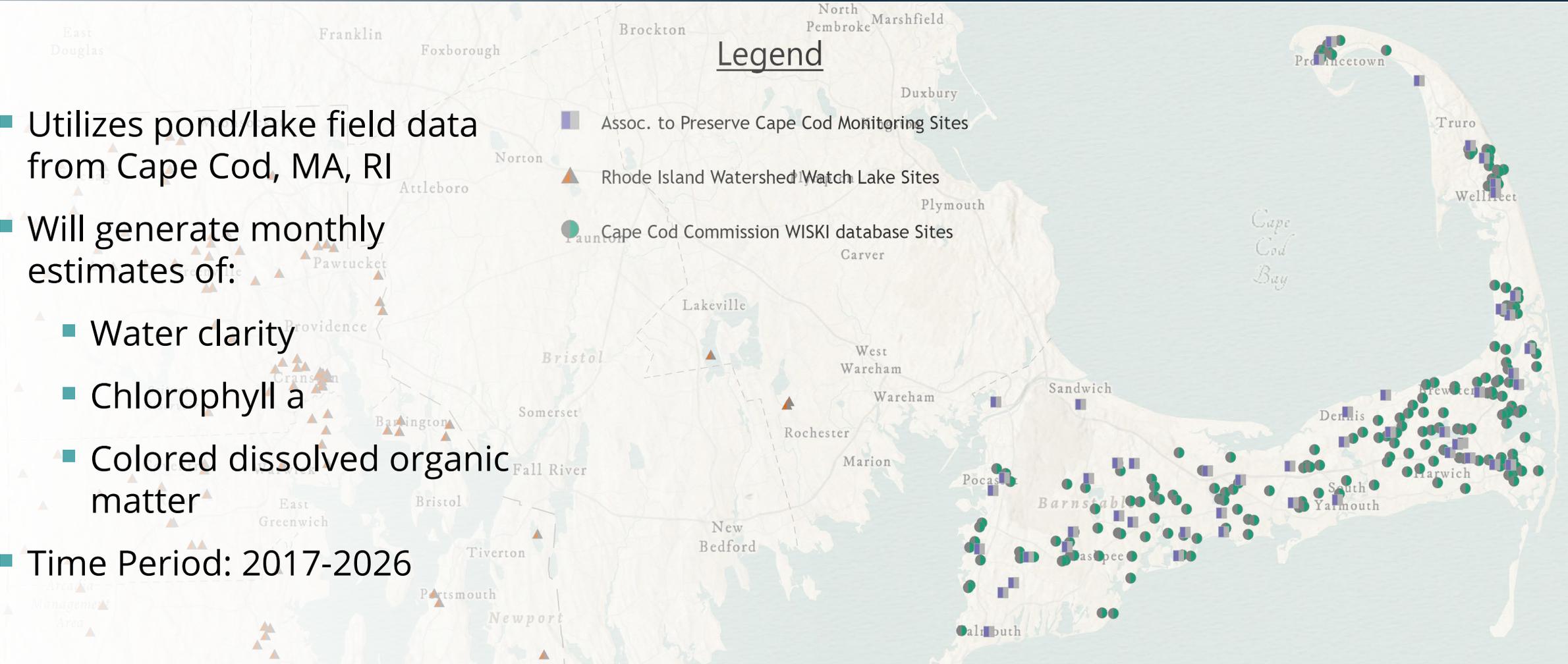
REMOTE SENSING

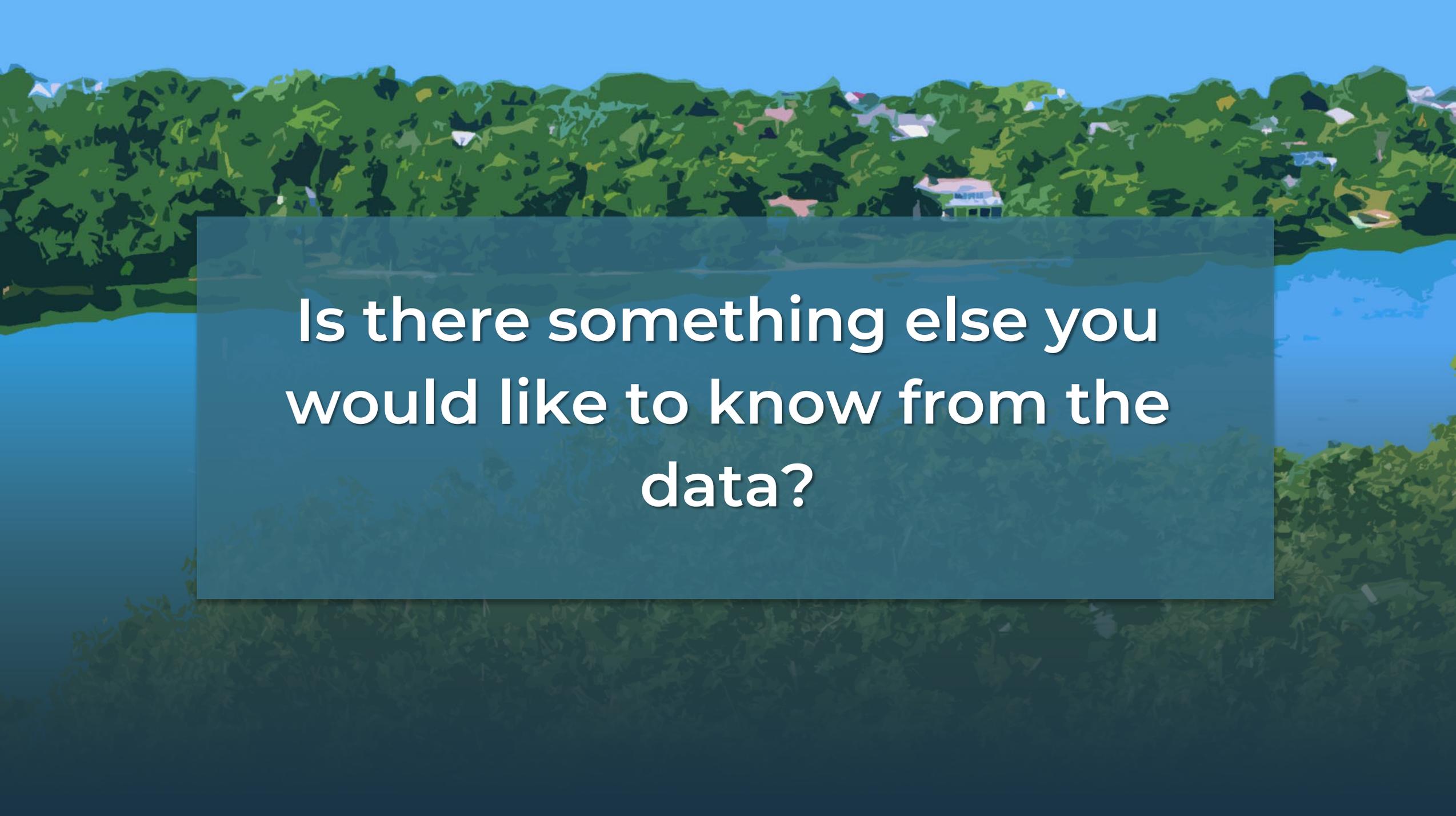


- ~40% of Cape Cod's ponds were large enough for analysis by satellite (> 1 hectare)
- Analyzed 193 ponds for long-term (1984-2022) water clarity trends
- Observed substantial interannual variability in water clarity, long-term water clarity generally improved across the Cape.
- Water Clarity \neq Quality

REMOTE SENSING – NEXT STEPS

- Utilizes pond/lake field data from Cape Cod, MA, RI
- Will generate monthly estimates of:
 - Water clarity
 - Chlorophyll a
 - Colored dissolved organic matter
- Time Period: 2017-2026





**Is there something else you
would like to know from the
data?**

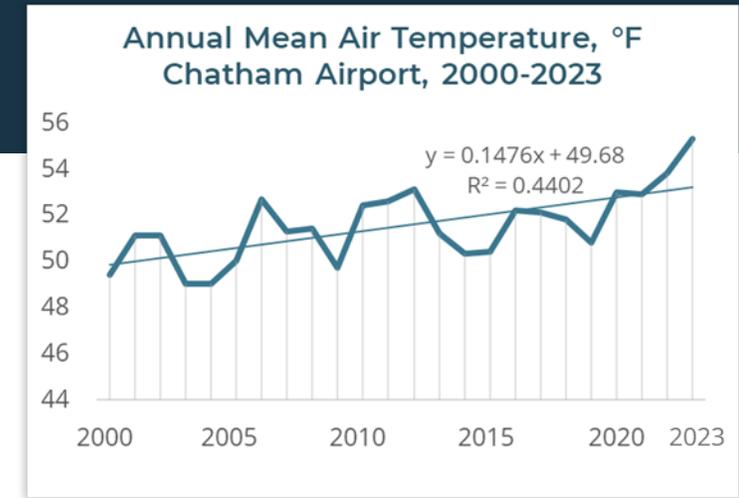


Regional Drivers of Change

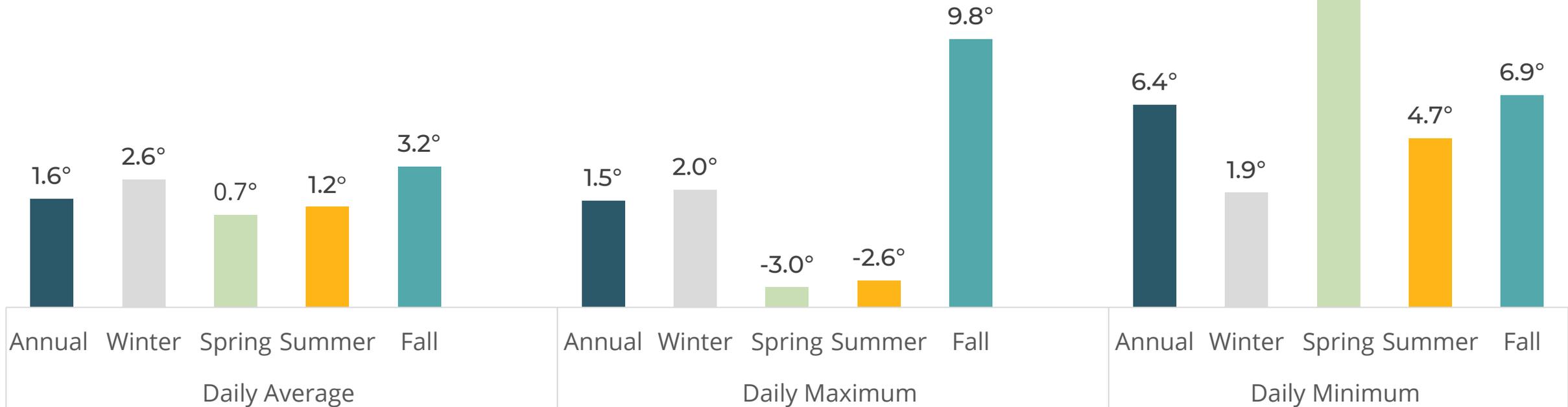
Liz Moran

CLIMATE IMPACTS: PHYSICAL

- Stratification and Mixing Regime
- Warming waters- Seasonal Impacts

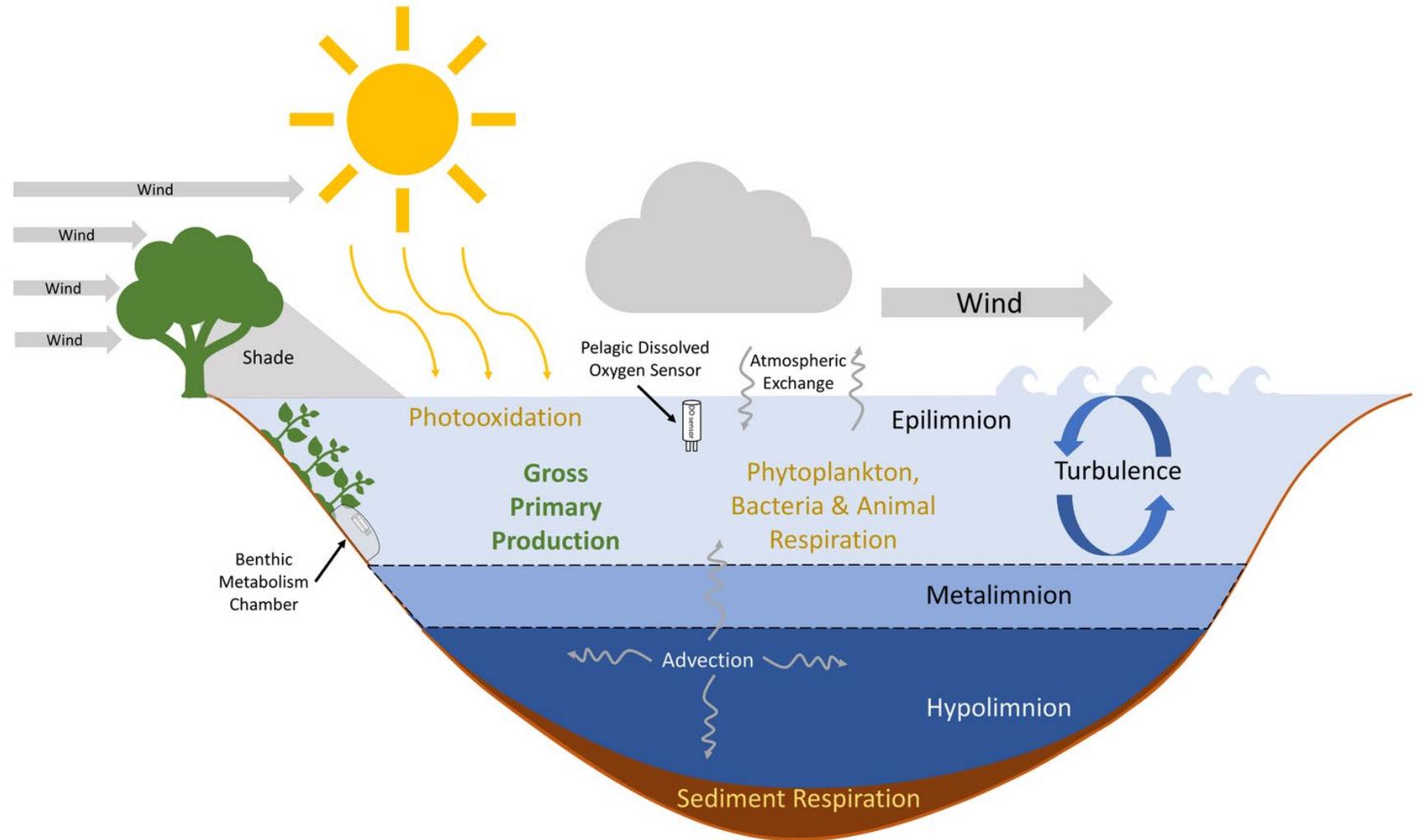


Air Temperature Change, Chatham Airport 1970 - 2000 compared with 2001 - 2023



Longer duration of stratification-
increased risk of oxygen depletion

Chemical changes at sediment surface-
phosphorus mobilization



- Warmer waters affect biochemical reaction rates
- Habitat impacts on aquatic biota – temperature and oxygen
- Expanding range for invasive species
- Cyanobacterial advantages: buoyancy, nitrogen-fixation, less grazing pressure



| CULTURAL DRIVERS OF CHANGE

- Population
- Wastewater
- Impervious Surfaces
- Emerging Contaminants

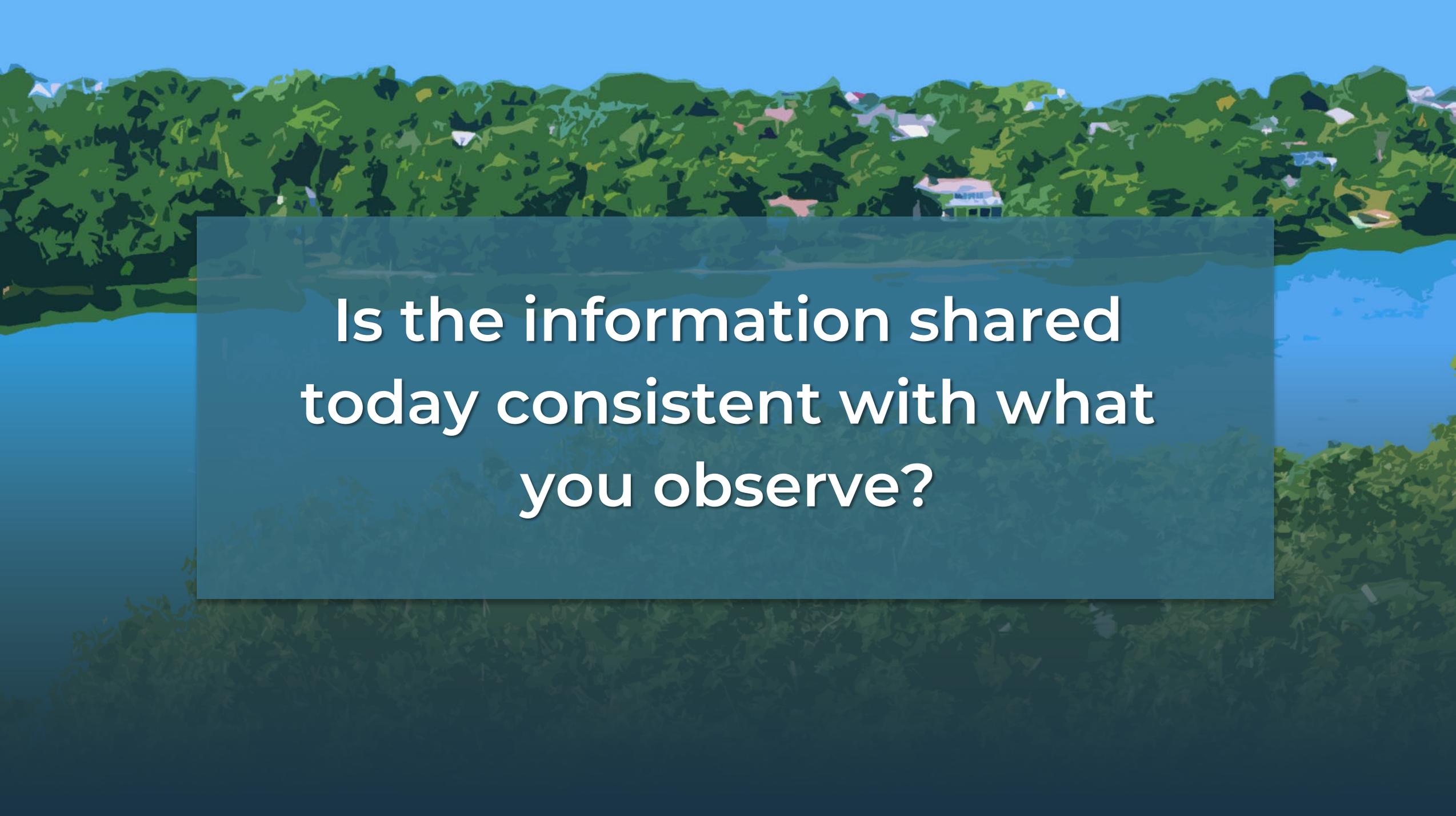
96,656
1970

222,230
2000

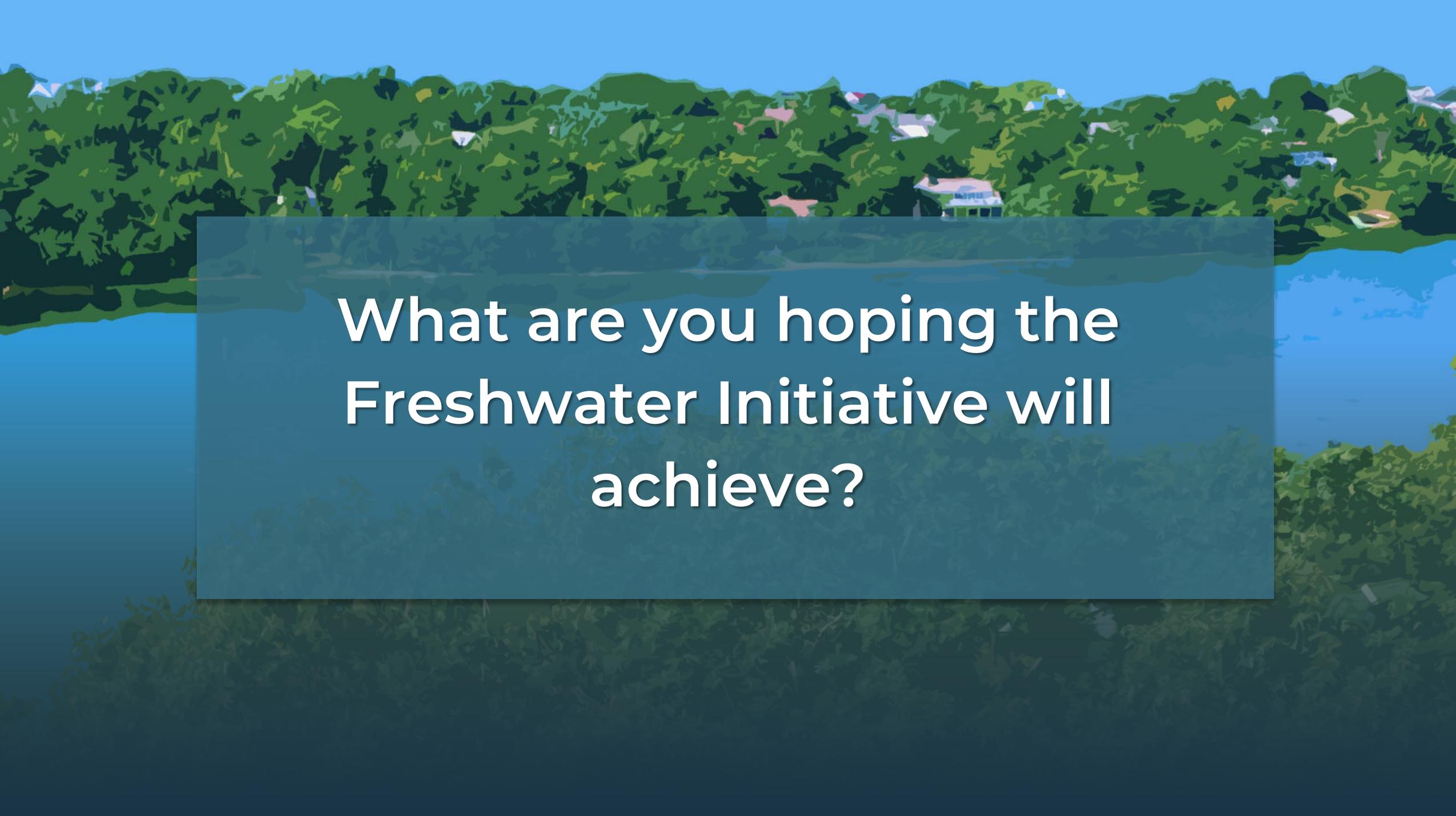
228,996
2020

COUNTY BARNSTABLE
POPULATION
(1970-2020)





Is the information shared
today consistent with what
you observe?



**What are you hoping the
Freshwater Initiative will
achieve?**

UPCOMING STAKEHOLDER MEETINGS

APRIL 22 AND 23

Meeting 2

Exploring Strategies and Priorities

- Strategies Overview
- Identifying Priorities
- Comment and Discussion

JUNE 3 AND 4

Meeting 3

Reviewing the Implementation Plan

- Incorporating Stakeholder Feedback
- Recommendations
- Implementation
- Discussion



Other questions or feedback?

www.capecodcommission.org/freshwater

Thank you!

www.capecodcommission.org/freshwater

STAKEHOLDER MEETING 1 | MARCH 2024



CAPE COD
COMMISSION