Ponds Need Love Too

Tara Nye Lewis
June 12, 2024 | SNEP Symposium

CAPE COD COMMISSION

Assessing the Status of Freshwater Ponds on Cape Cod

APCC Association to Preserve Cape Cod

CENTER FOR COASTAL STUDIES PROVINCETOWN

NOAA

CAPE COD COMMISSION

CAPE COD COMMISSION

The Cape Cod Commission

…is the regional land use planning, economic development, and regulatory agency created in 1990 to serve the citizens and 15 towns of Barnstable County, Massachusetts

KEEPING A SPECIAL PLACE SPECIAL
·SINCE· ·1990·

MISSION

…To protect the unique values and quality of life on Cape Cod by coordinating a balanced relationship between environmental protection and economic progress.

Cape Cod Ponds by the Numbers

CAPE COD PONDS AND LAKES

890 PONDS

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

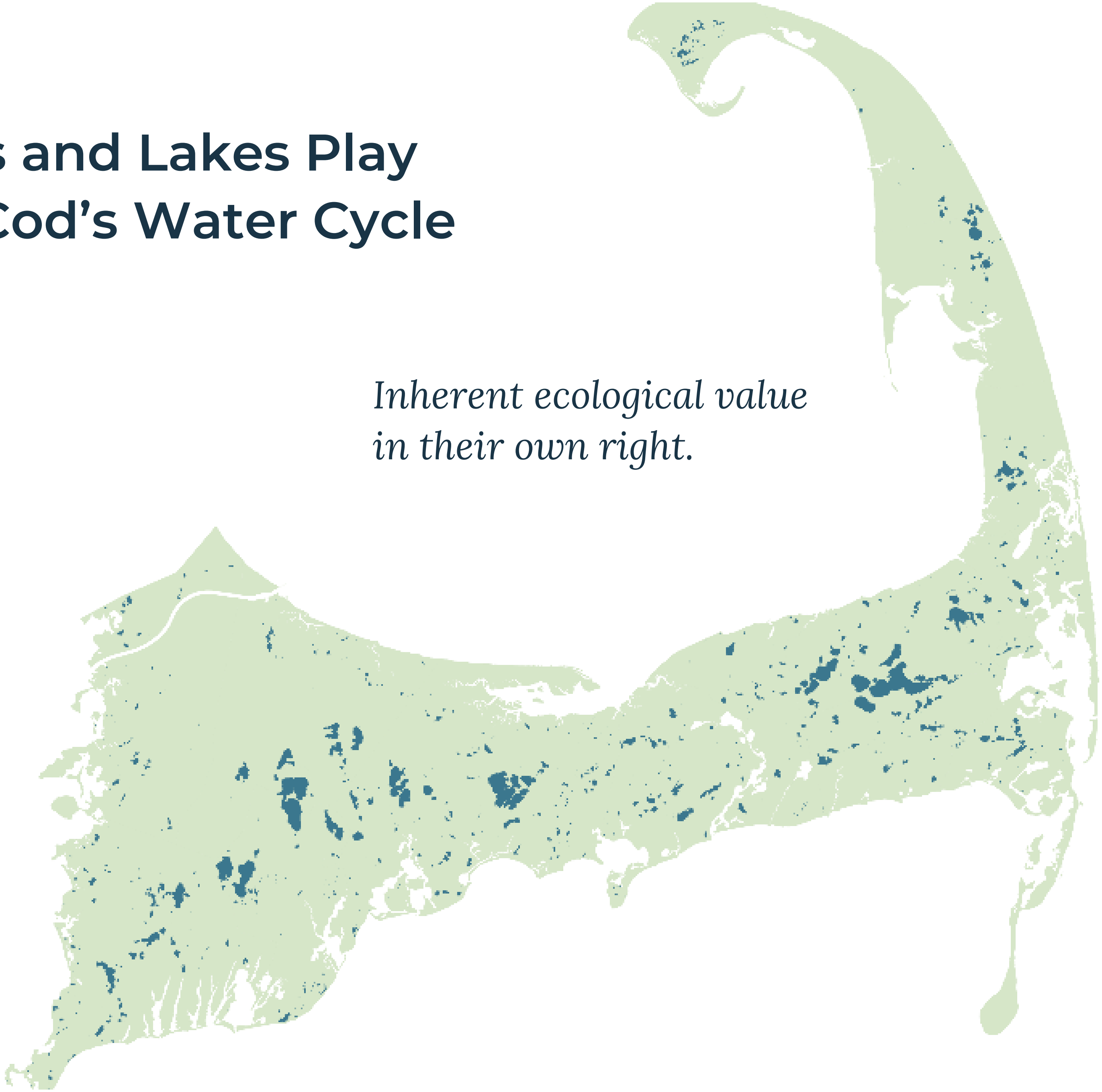
14% Impervious Surfaces
within pond 300ft buffer

Includes public beaches, boat ramps, and launches

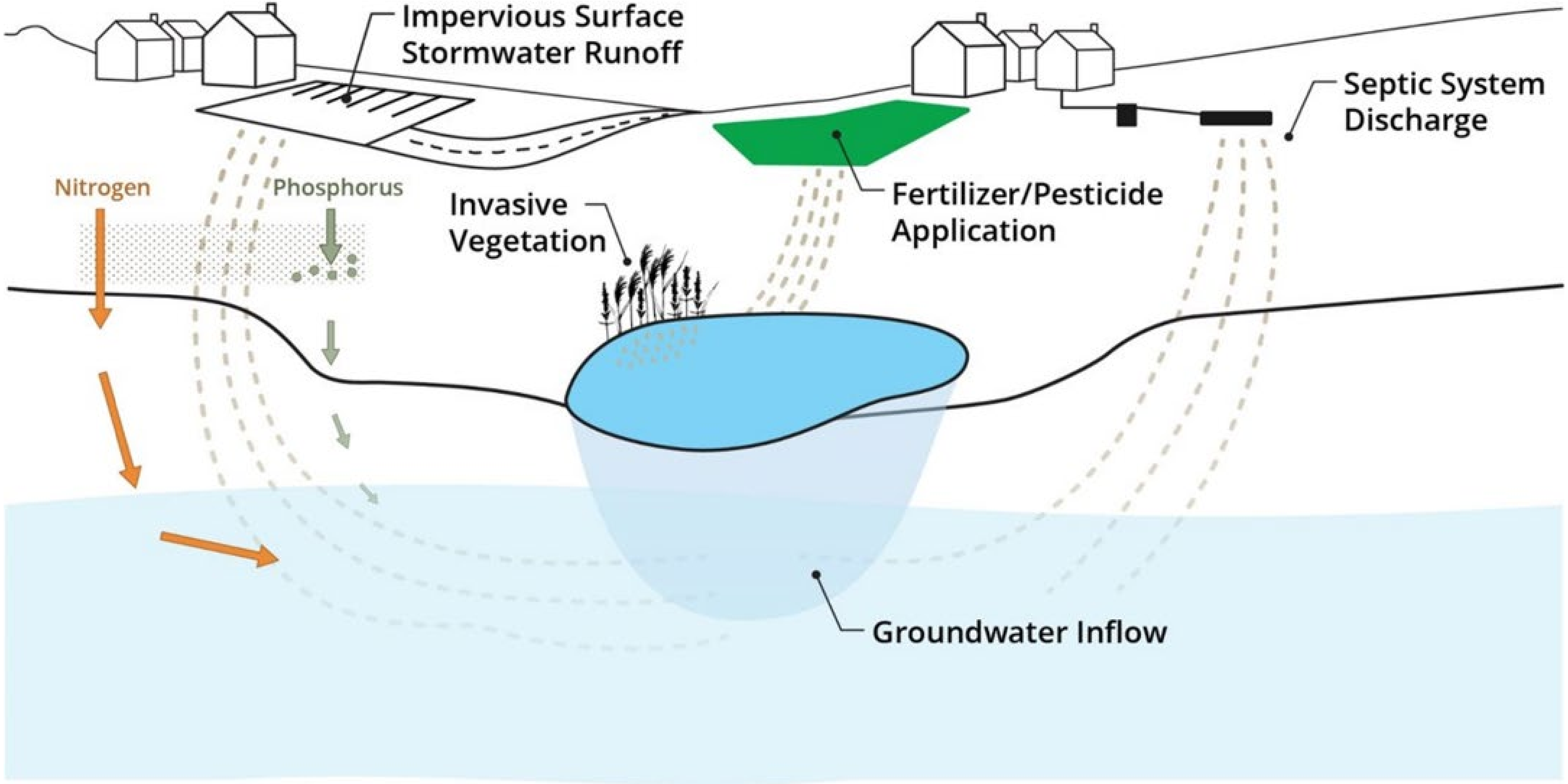
Properly Functioning Ponds and Lakes Play an Important Role in Cape Cod's Water Cycle

Inherent ecological value in their own right.

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



Ponds at Risk



Cape Cod Freshwater Initiative

A science-based, information-driven planning process that engages stakeholders and enables 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

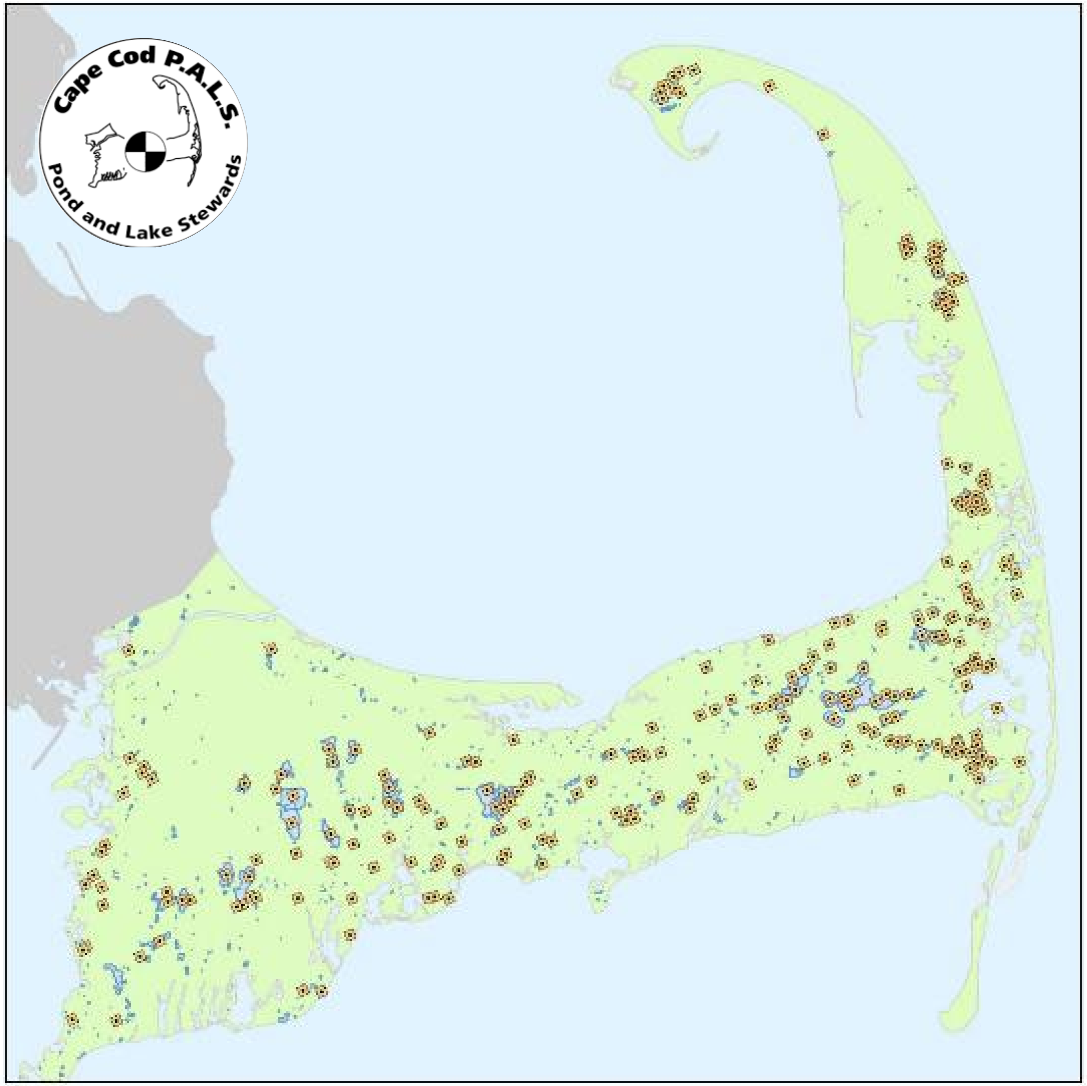
STRATEGY DEVELOPMENT

- Engagement and Outreach
- Strategies Database
- Economic Analysis
- Legal Analysis

ONGOING MONITORING AND ANALYSIS

- Monitoring Program
- Ongoing Data Management and Analysis

CAPE COD'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

Lack of Consistent and Consecutive Data Collection

Limited data prevents our ability to gather a clear understanding of pond health. Consistent and consecutive data collection, is needed to inform pond management/improvement strategies.

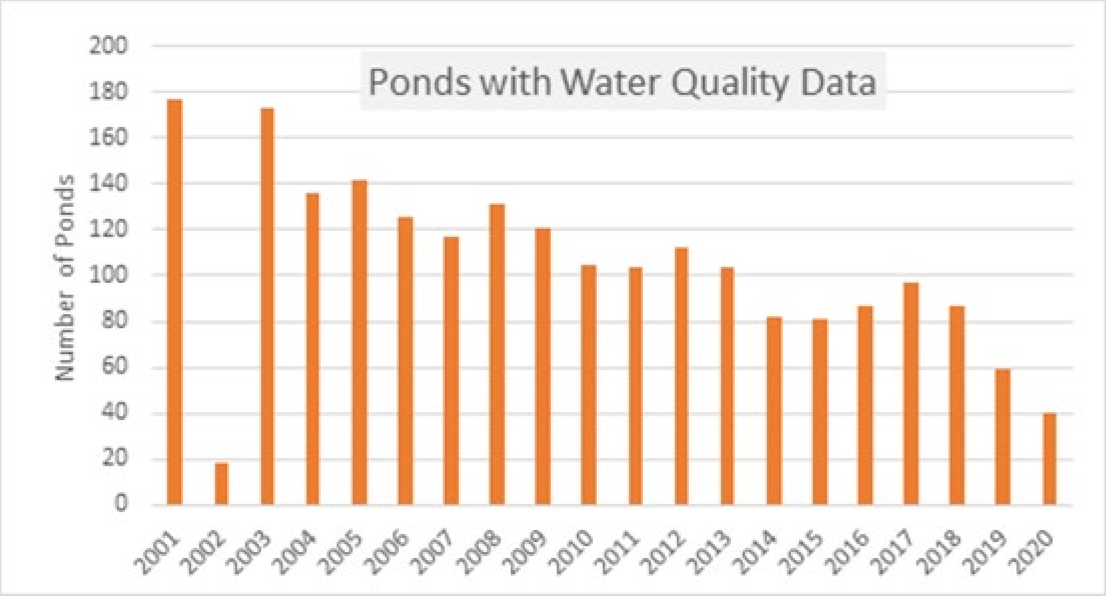
less than 10%

OF CAPE COD'S PONDS AND LAKES ARE MONITORED

just 4%

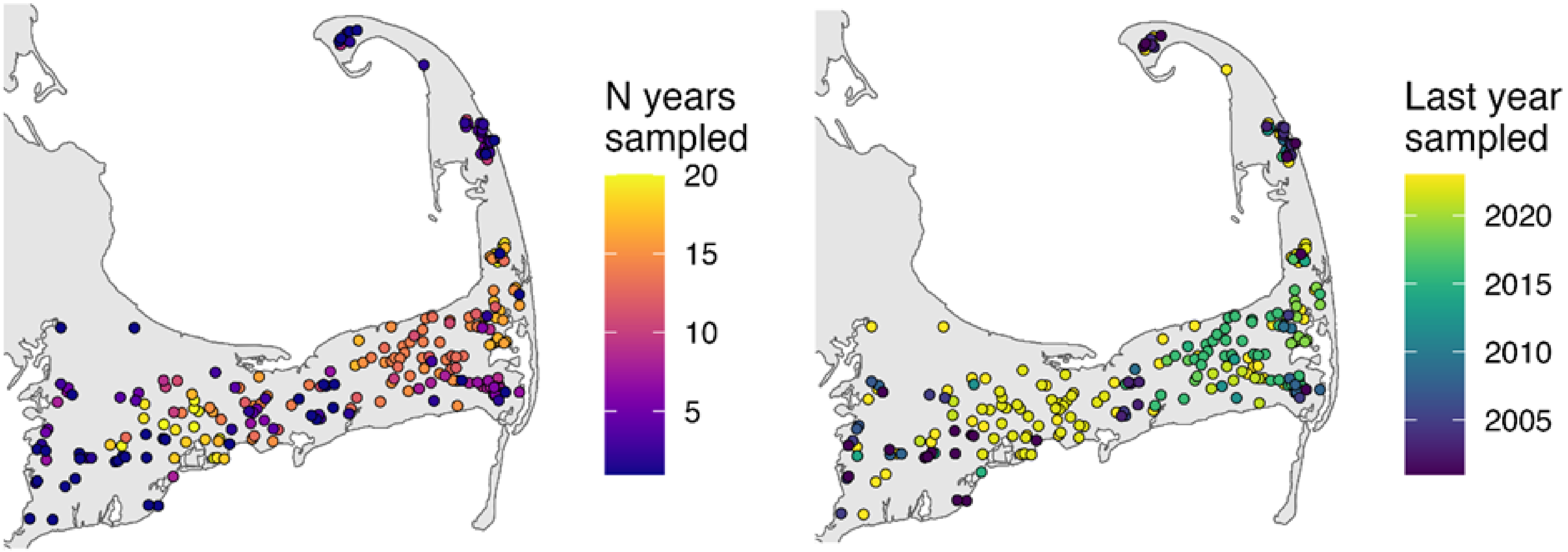
HAD SUFFICIENT RECENT WATER QUALITY DATA TO GRADE POND HEALTH IN 2021

Ponds Monitored by PALS

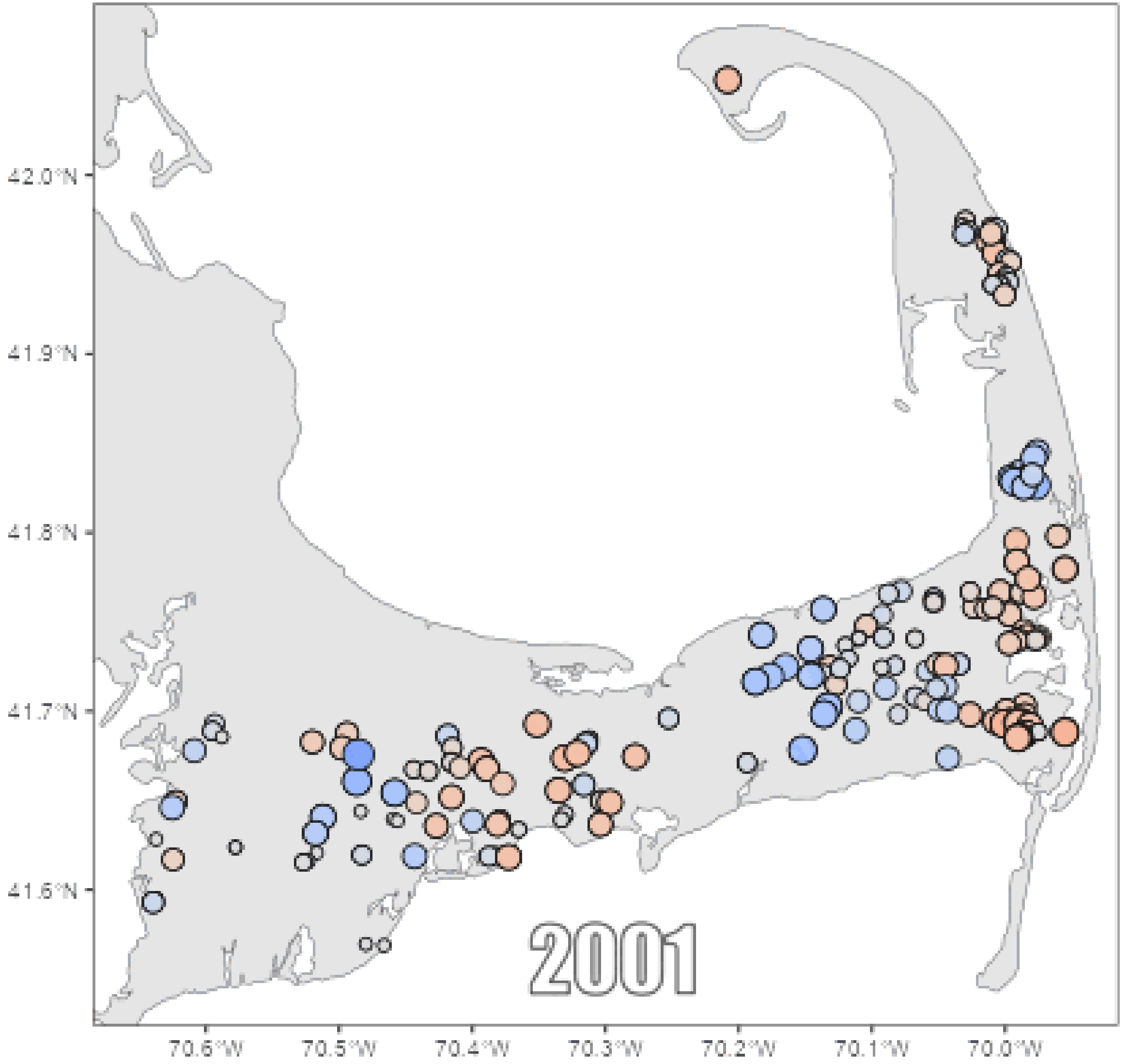


Independent pond groups collect water quality data, but the ponds monitored changes year to year, and many are sampled without a Quality Assurance Project Plan (QAPP), complicating needed long-term and regional analysis.

Ponds Monitored



Ponds Monitored



Regional Pond Monitoring Program

First season of monitoring - 2023

- **50 ponds** monitored from April to Oct
- **346 pond** visits by staff and volunteers

Monitoring efforts resumed March 2024

- **Expanded in 2024 -** March through November to capture turn over events
- 118 pond visits through May 2024

APCC Association to Preserve Cape Cod

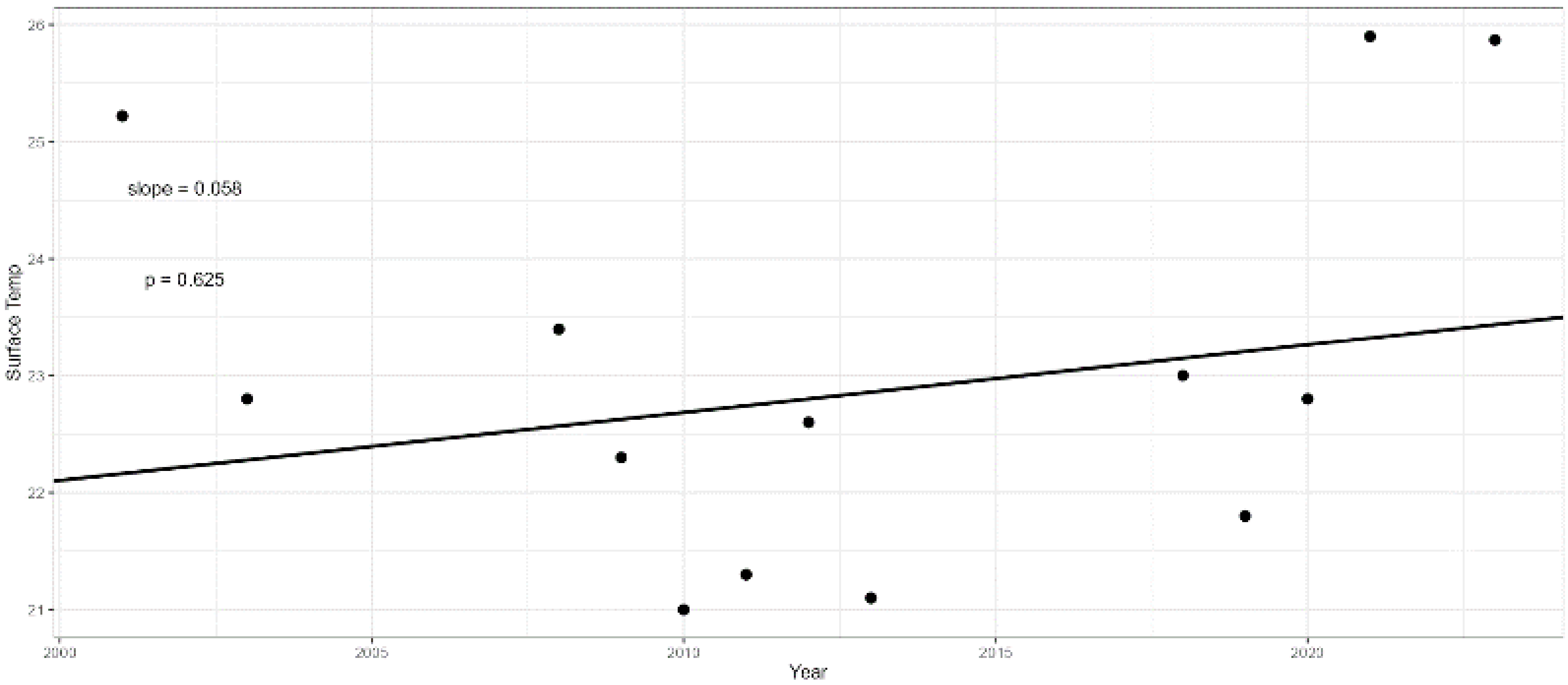
CENTER FOR COASTAL STUDIES PROVINCETOWN

Data Management and Analysis

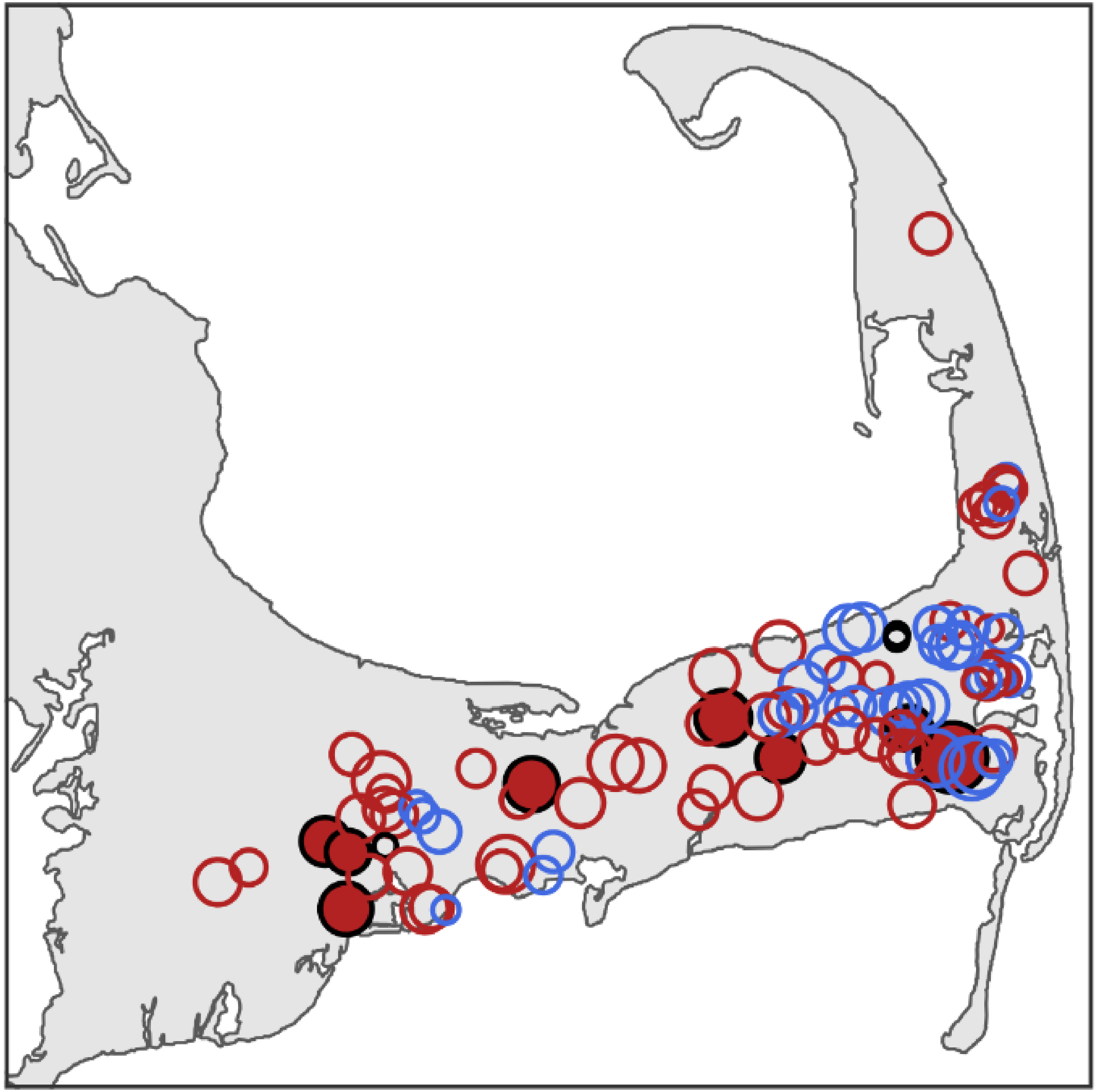
- Developing pond data management and analysis tools, including:
  - Freshwater monitoring database
  - Processing scripts for trend analyses
  - Accessible user interface

Data Management and Analysis

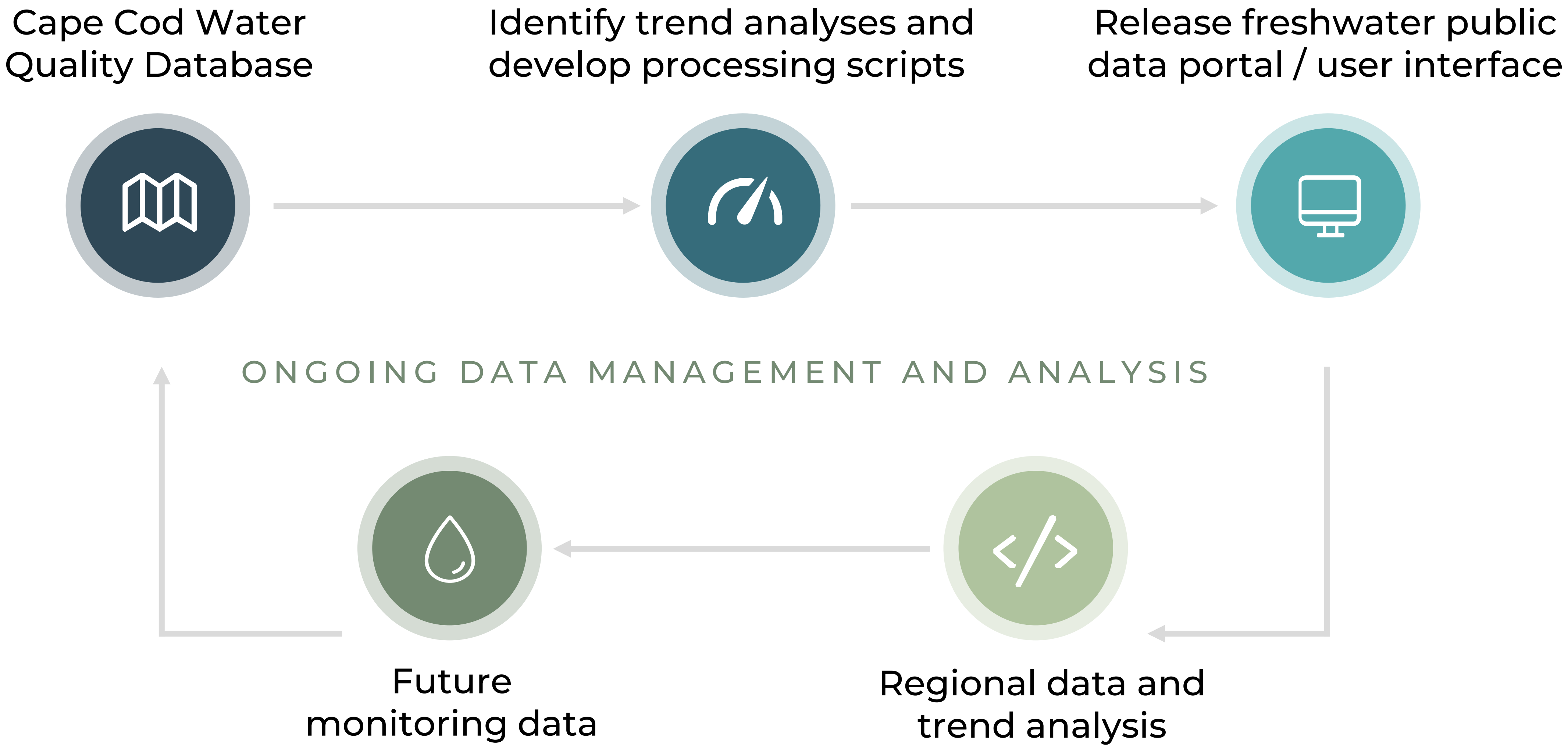
Surface Water Temperature



Surface Water Temperature



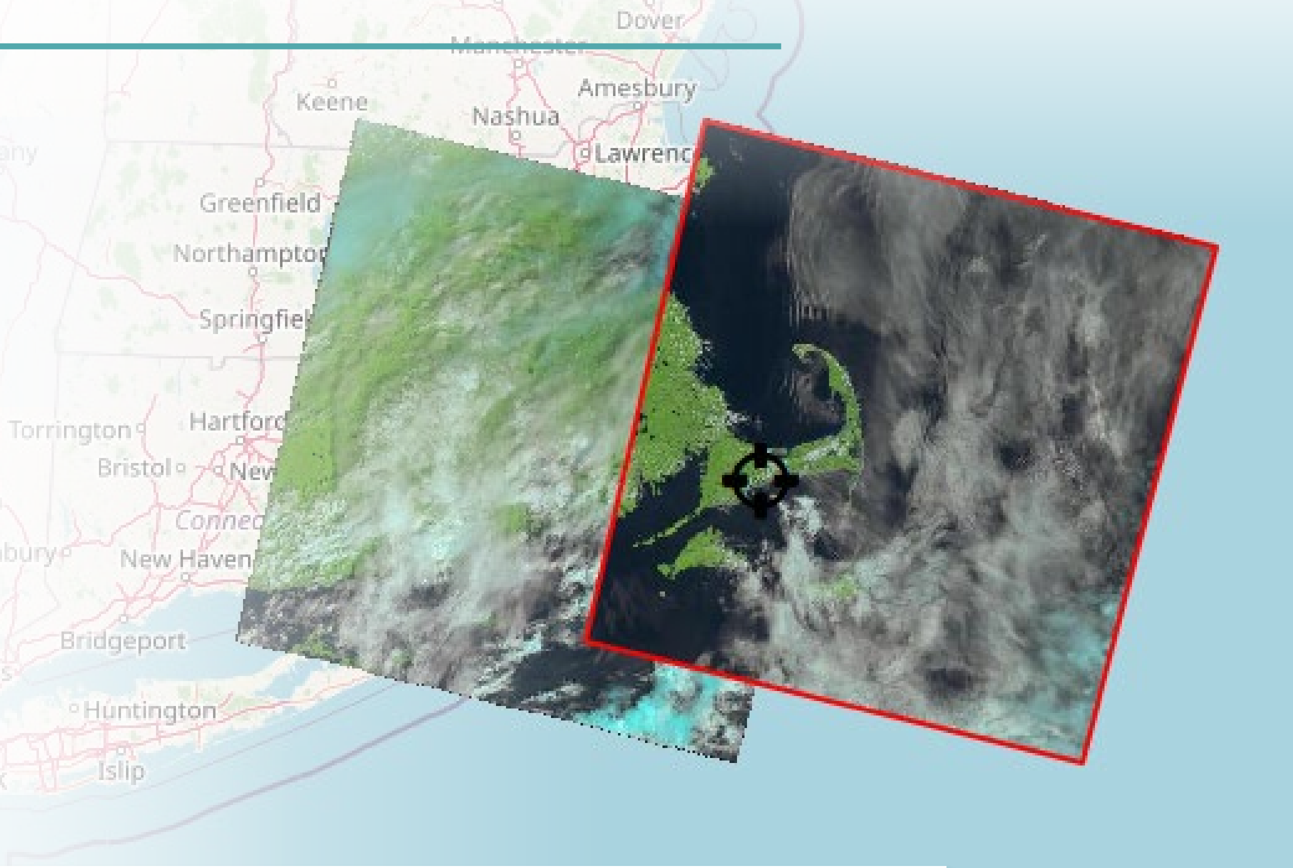
Data Management and Analysis



Remote Sensing

Using satellite-derived imagery and existing pond water quality data to quantify changes in pond characteristics

- Connecting satellite imagery to pond water quality monitoring data
- Calibrating with Secchi Disk Depth (SDD) collected during satellite overpasses

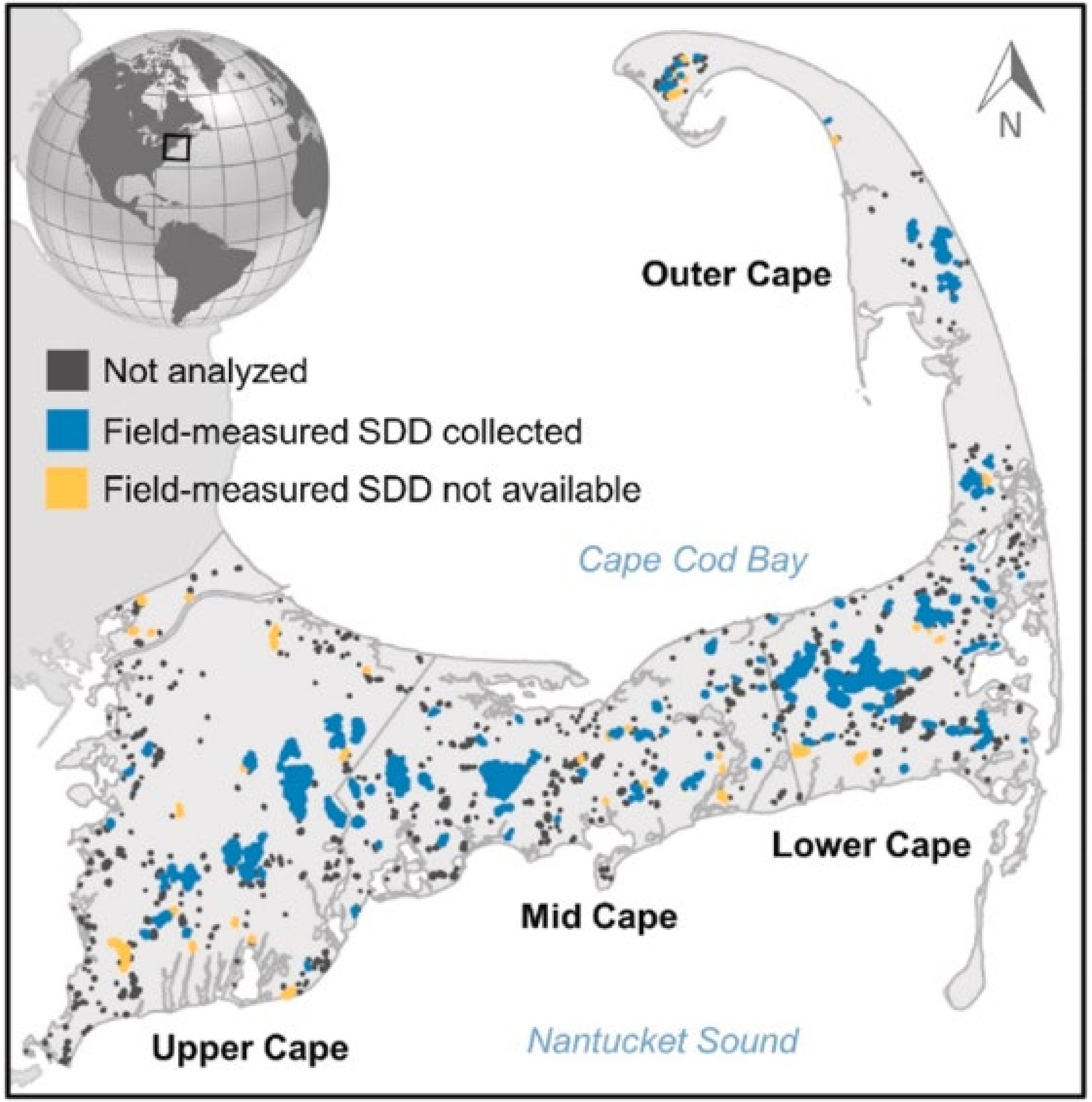


CAPE COD COMMISSION

APCC Association to Preserve Cape Cod

THE UNIVERSITY OF RHODE ISLAND

Remote Sensing



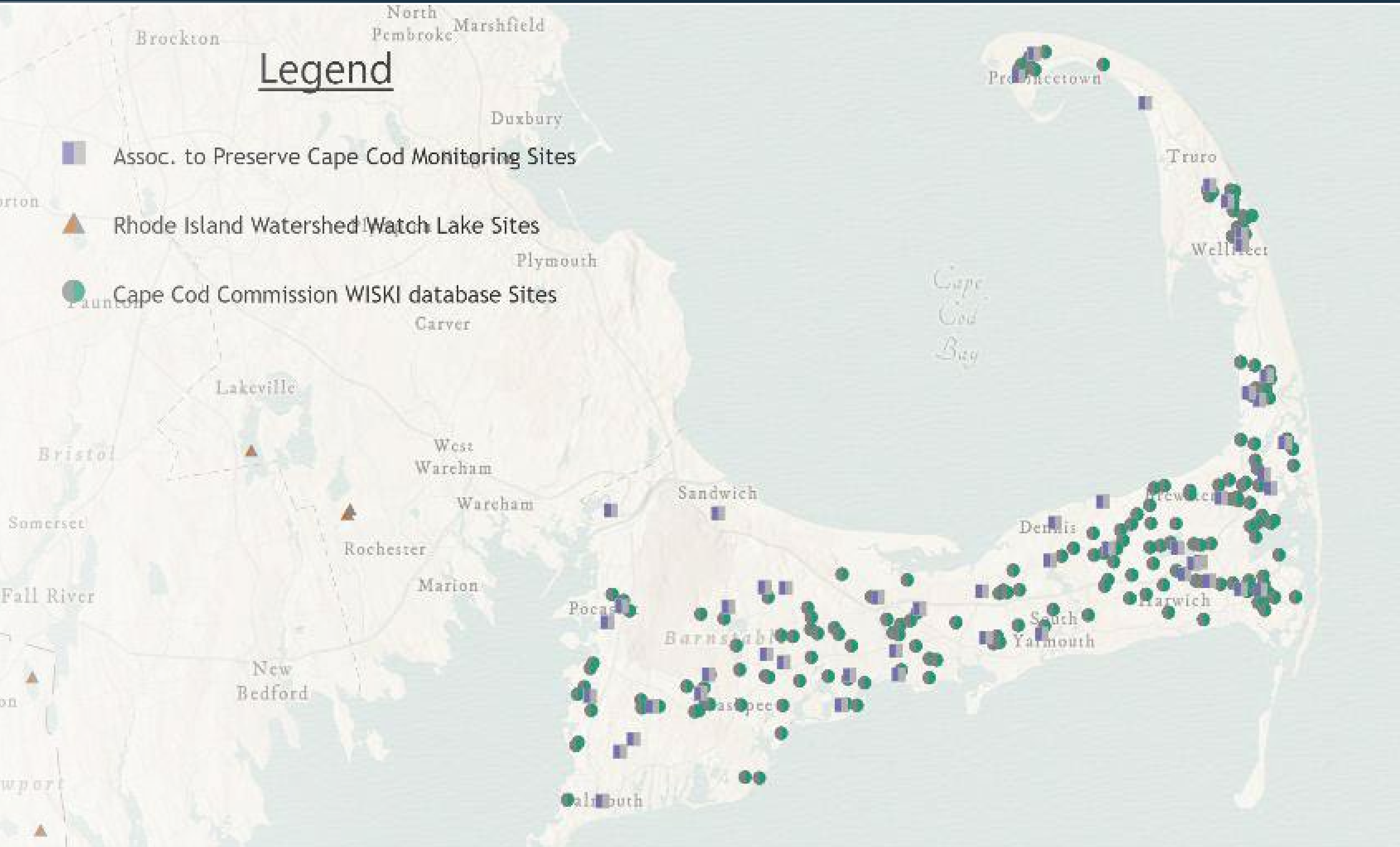
- Satellite imagery well-suited to estimate water clarity at 193 Cape Cod ponds.
- Framework defined for routine, large-scale monitoring and change assessments.
- Long-term trends generally suggest improving water clarity since 1984
- Methods can assist stakeholders in resource management and prioritization.

CAPE COD COMMISSION

APCC Association to Preserve Cape Cod

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



SNEP Southeast New England Program
CAPE COD COMMISSION
APCC Association to Preserve Cape Cod
THE UNIVERSITY OF RHODE ISLAND

Physical Characteristics

- Assessed pond and watershed characteristics that may impact water quality
- Used GIS to query potential drivers of water quality degradation

Potential Stressors:

- Land cover / land use
- Septic system density
- Phosphorus loading
- Inlets / outlets
- Pond depth
- Pond volume

Physical Characteristics

Cape Cod Pond Atlas

Jemima Pond

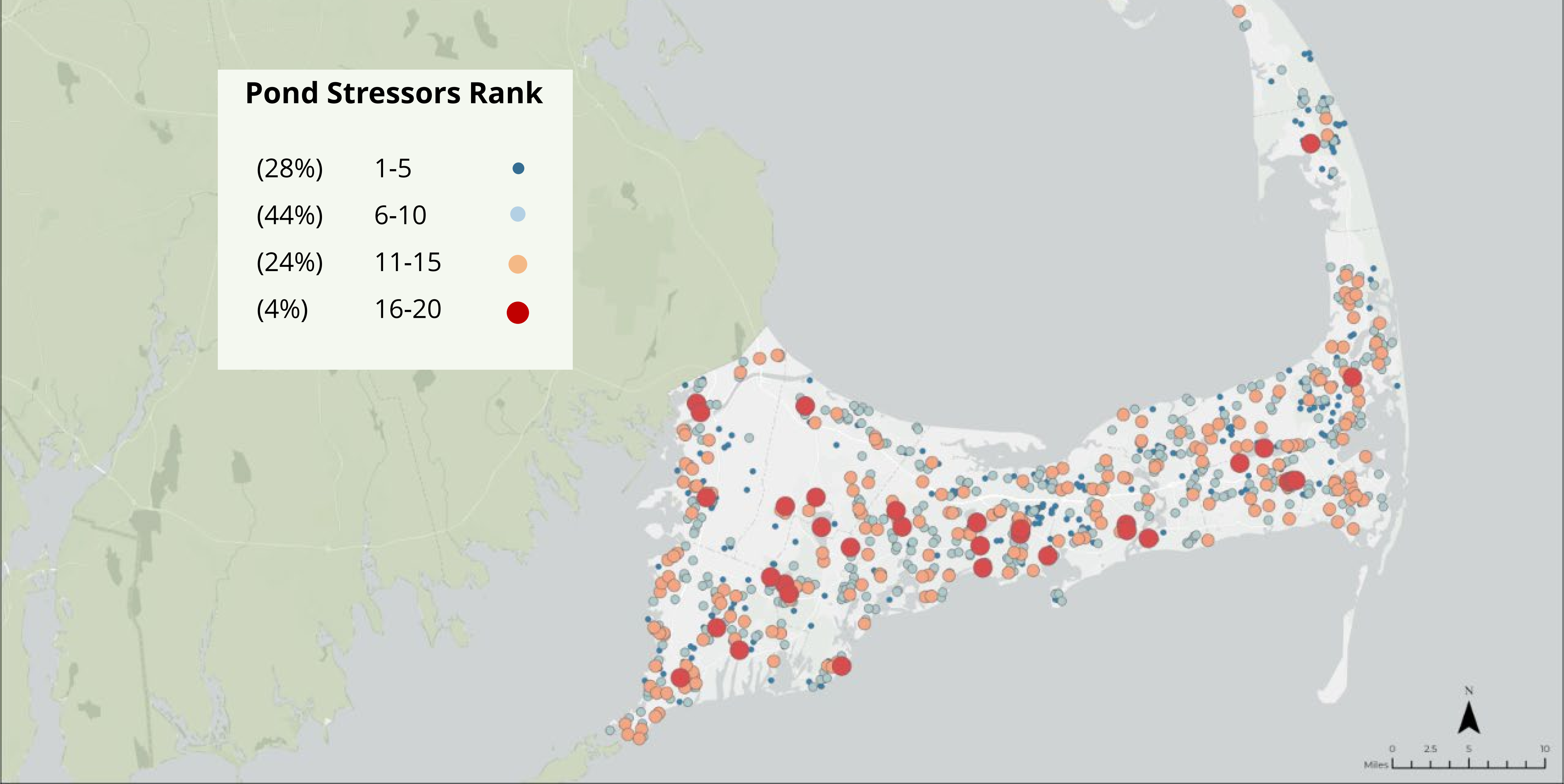
Alternative Name	
CCC-GIS-ID	EA-100
Town	Eastham
Village	Eastham
Acres	6.53
Maximum Depth (ft)	15.0
Great Pond	No
Watershed Delineated	Yes
Ponds stocked with fish	No
NHESP Natural Community	No
Percent Protected Open Space in Pond's 300ft. buffer	14%
Cranberry Bogs within 300ft Buffer	No
Golf Course within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

Physical Characteristics

Stressors

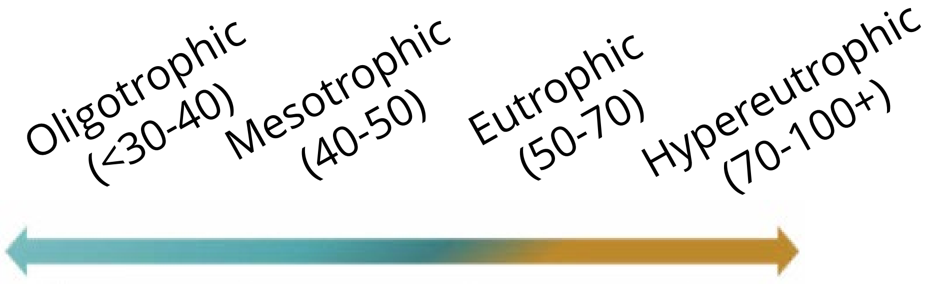
- **Location**
  - Adjacent to cranberry bog
  - Adjacent to golf course
- **Pond Characteristics**
  - Depth
  - Volume
  - Retention time
- **Pond Management**
  - Stocked with fish
- **Watershed Characteristics**
  - % of Protected Open Space
  - % of Impervious Cover
  - Septic/sewer
- **Quantity & Quality of stormwater runoff (HRU)**
  - Phosphorus load
  - Nitrogen load
  - Total Suspended Solids (TSS)

Physical Characteristics



Physical Characteristics

- Carlson Trophic Index:
  - A biomass-related trophic state index.
  - Indicates the degree of eutrophication within a pond.
- Useful for comparing ponds within a region and for assessing status changes over time.



Pond	Town	Stressor Score	CTI
Long Pond	Yarmouth	20	42.2
Wequaquet Lake	Barnstable	20	42.1
Ashumet Pond	Mashpee	18	46.1
Long Pond	Brewster	17	41.4
Mashpee Pond	Mashpee	17	50.2
Wakeby Pond	Mashpee	17	45
Santuit Pond	Mashpee	16	61.1
Shubael Pond	Barnstable	15	36.4
Scargo Lake	Dennis	14	40.4
Cliff Pond	Brewster	12	40.6

Hydrologic Response Unit (HRU)

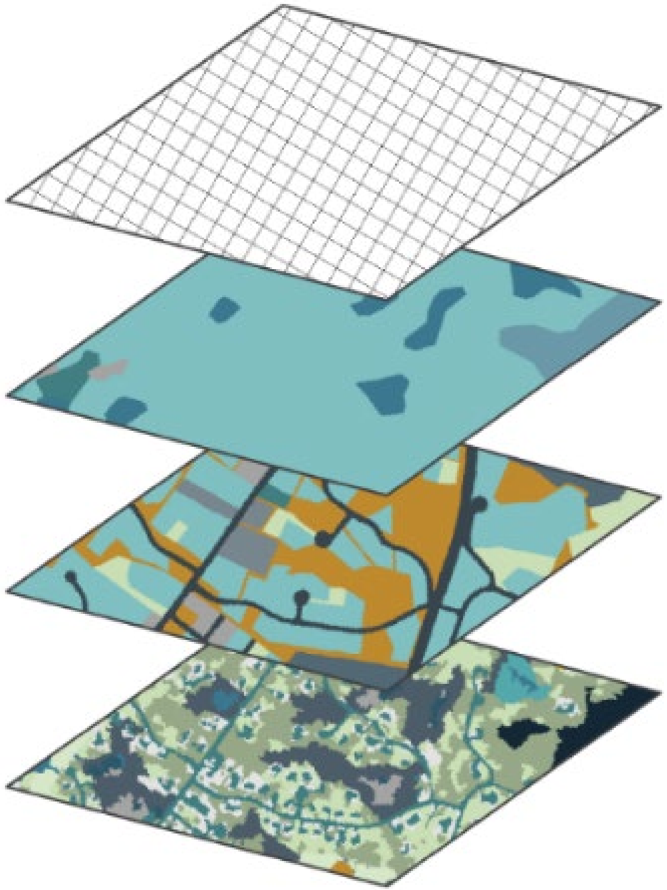
HRUs represent areas with similar physical characteristics that respond to precipitation in a similar way

Unit – 10x10 m grid cells
~ 2 car garage

Soil – influences runoff and infiltration

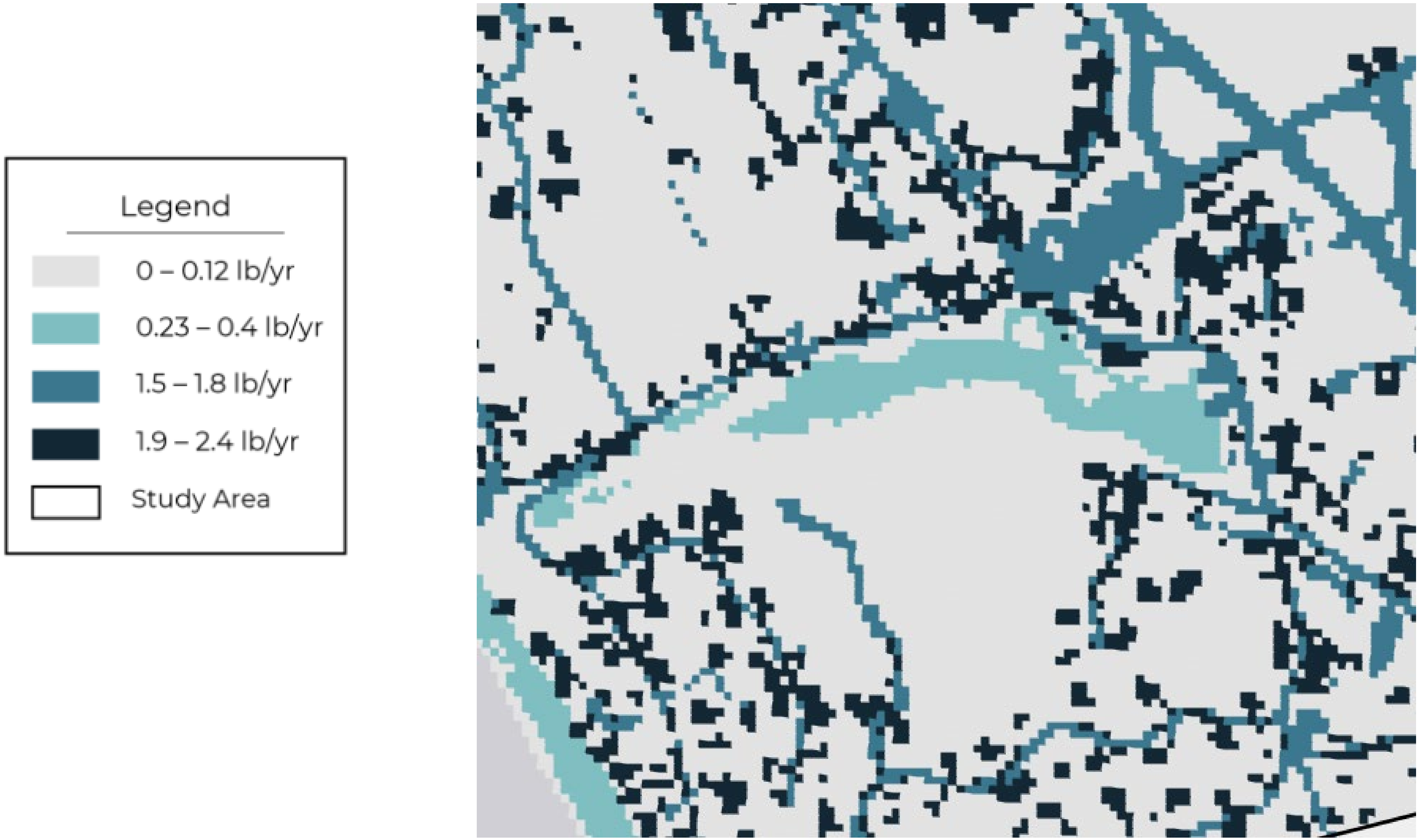
Land use – determines pollutants

Land cover – influences runoff



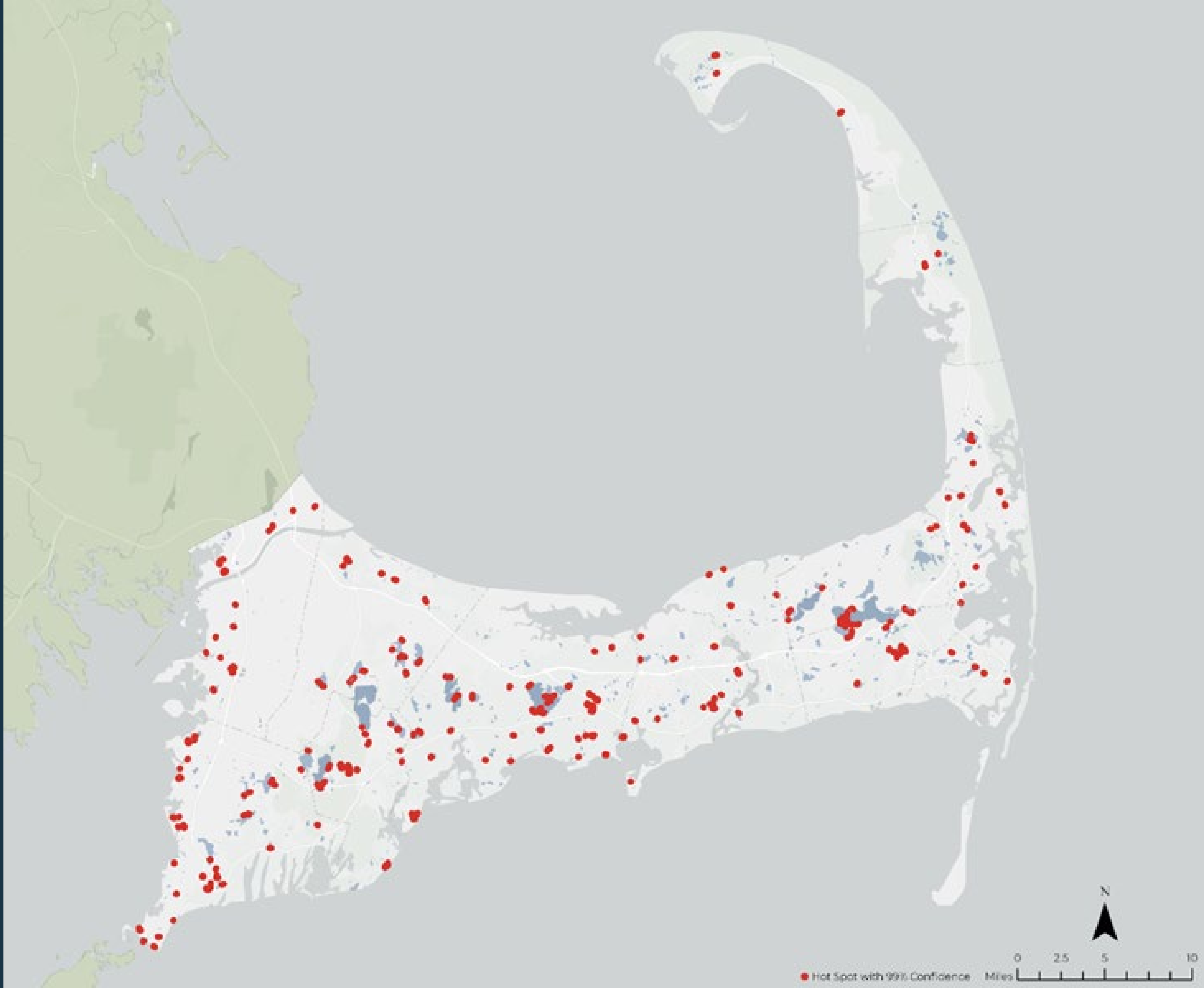
HRU Output

Phosphorus Load Results

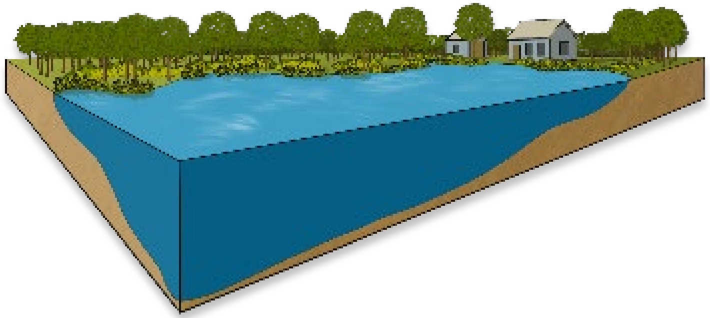


HRU Hot Spots

Phosphorus Loading along pond shores

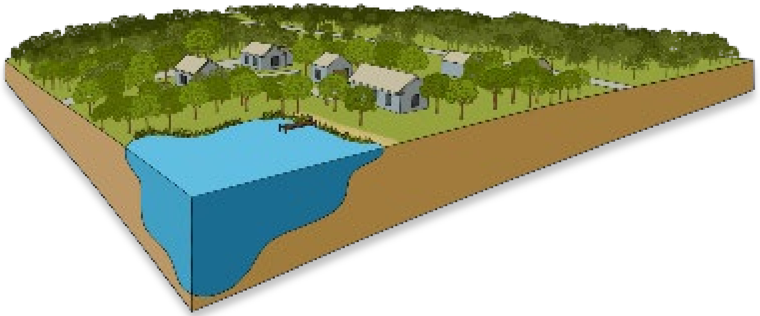


SCALE OF APPROACHES



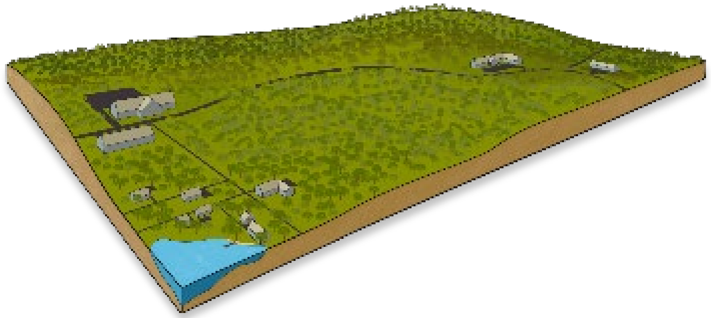
IN POND

Sediment, nutrient, algae, and vegetation management approaches



POND SHORE

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



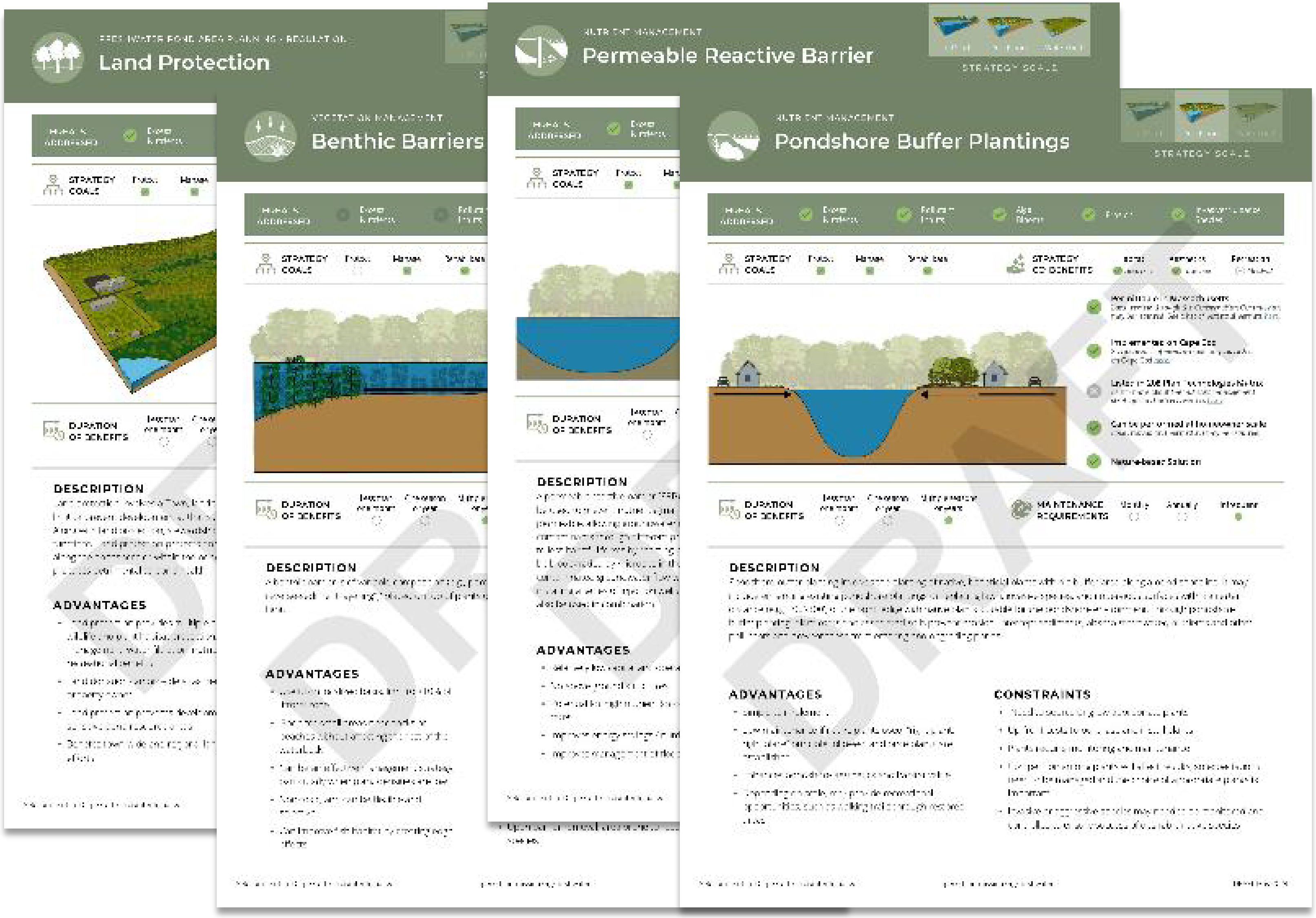
WATERSHED

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

THREATS ADDRESSED

- ✓ Excess Nutrients
- ✓ Pollutant Inputs
- ✓ Algal Blooms
- ✓ Erosion
- ✓ Invasive/Nuisance Species

40 DRAFT STRATEGY FACT SHEETS

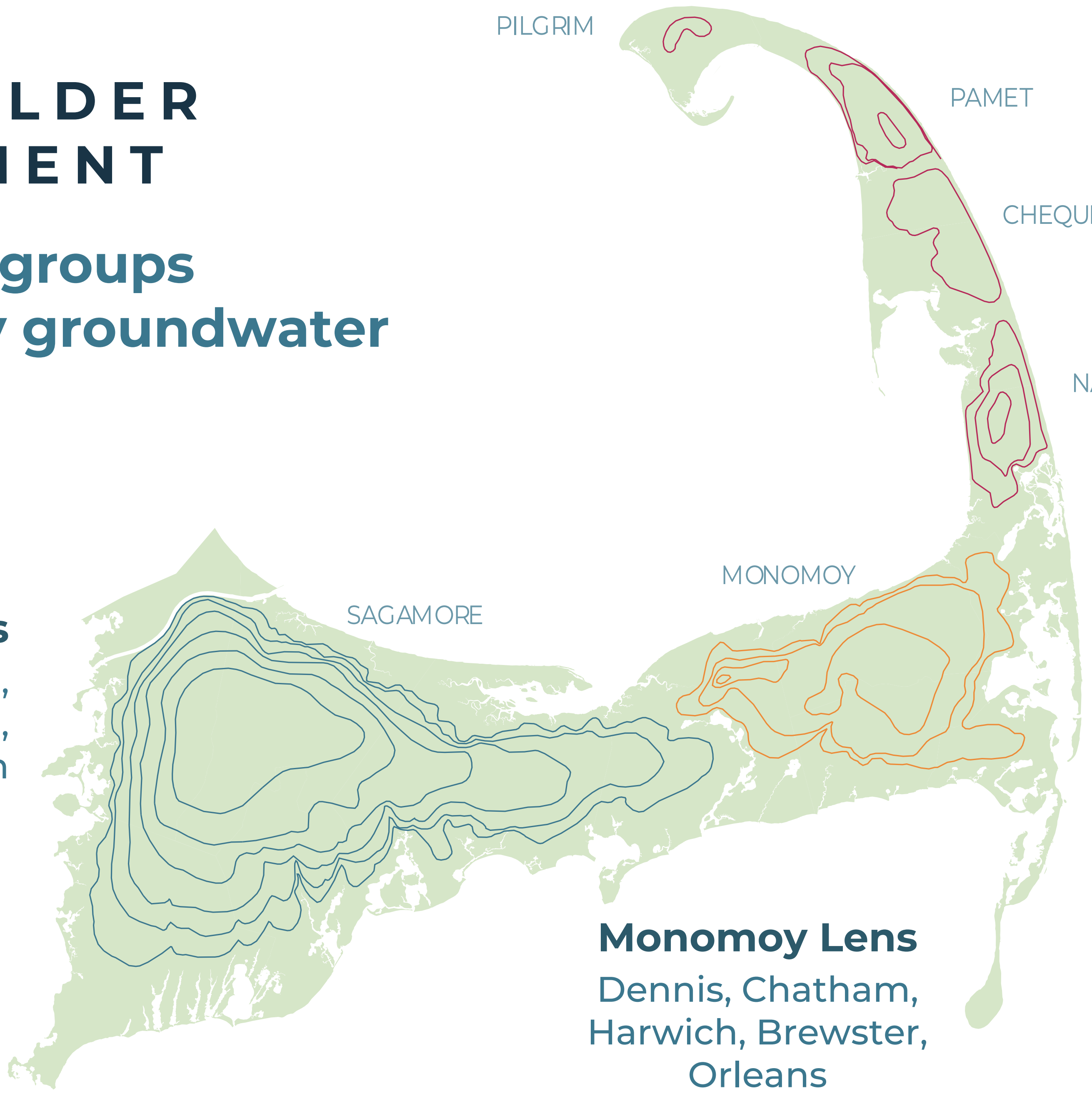


MANAGEMENT APPROACHES

- Planning & Regulations
- Nutrient Management
- Sediment Management
- Algae Management
- Vegetation Management
- Fisheries Management

STAKEHOLDER ENGAGEMENT

Stakeholder groups organized by groundwater lenses



Outer Cape Lenses

Eastham, Wellfleet, Truro, Provincetown

Sagamore Lens

Bourne, Falmouth, Sandwich, Mashpee, Barnstable, Yarmouth

Monomoy Lens

Dennis, Chatham, Harwich, Brewster, Orleans

Thank you!

www.capecodcommission.org/freshwater

capecodcommission.org/our-work/cape-cod-freshwater-initiative/

tara.lewis@capecodcommission.org

CAPE COD COMMISSION

Investigating the Intersection of Trail Usage and Water Quality Impacts within the Big River Management Area

Prepared for: **SNEP Symposium 2024**

Prepared by:

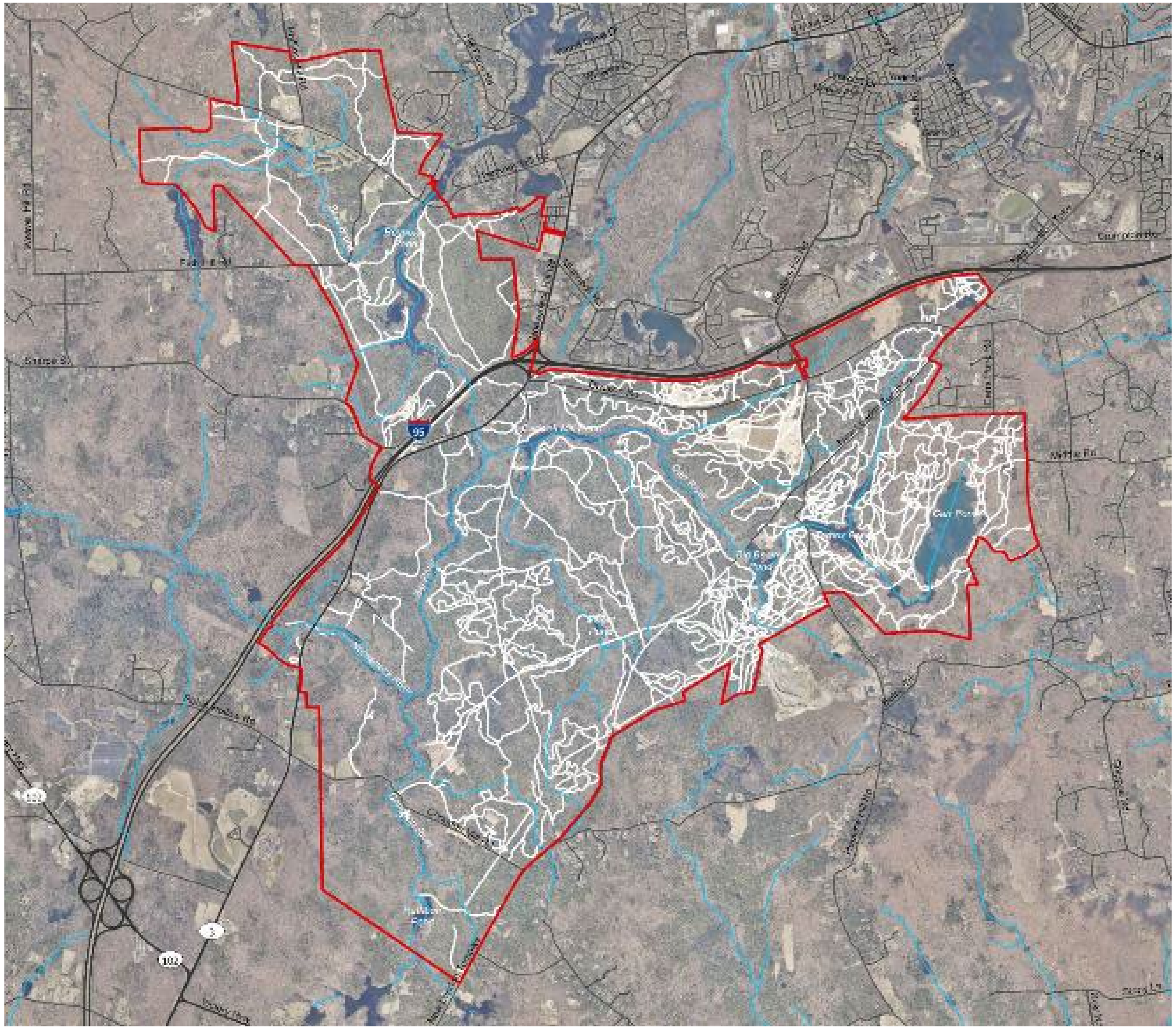
EA Engineering, Science, and Technology, Inc., PBC

Jessica Morrissey, GISP | 12 June 2024

Agenda

- **Site Introduction**
- **Project Background**
- **Trail Analysis Methodology**
  - Slope
  - Usage
  - Trail Density
  - Priority for Further Investigation
- **Rapid Field Assessment Application using Survey 123**

Site Introduction



Big River Management Area (BRMA)

West Greenwich and Coventry, Rhode Island

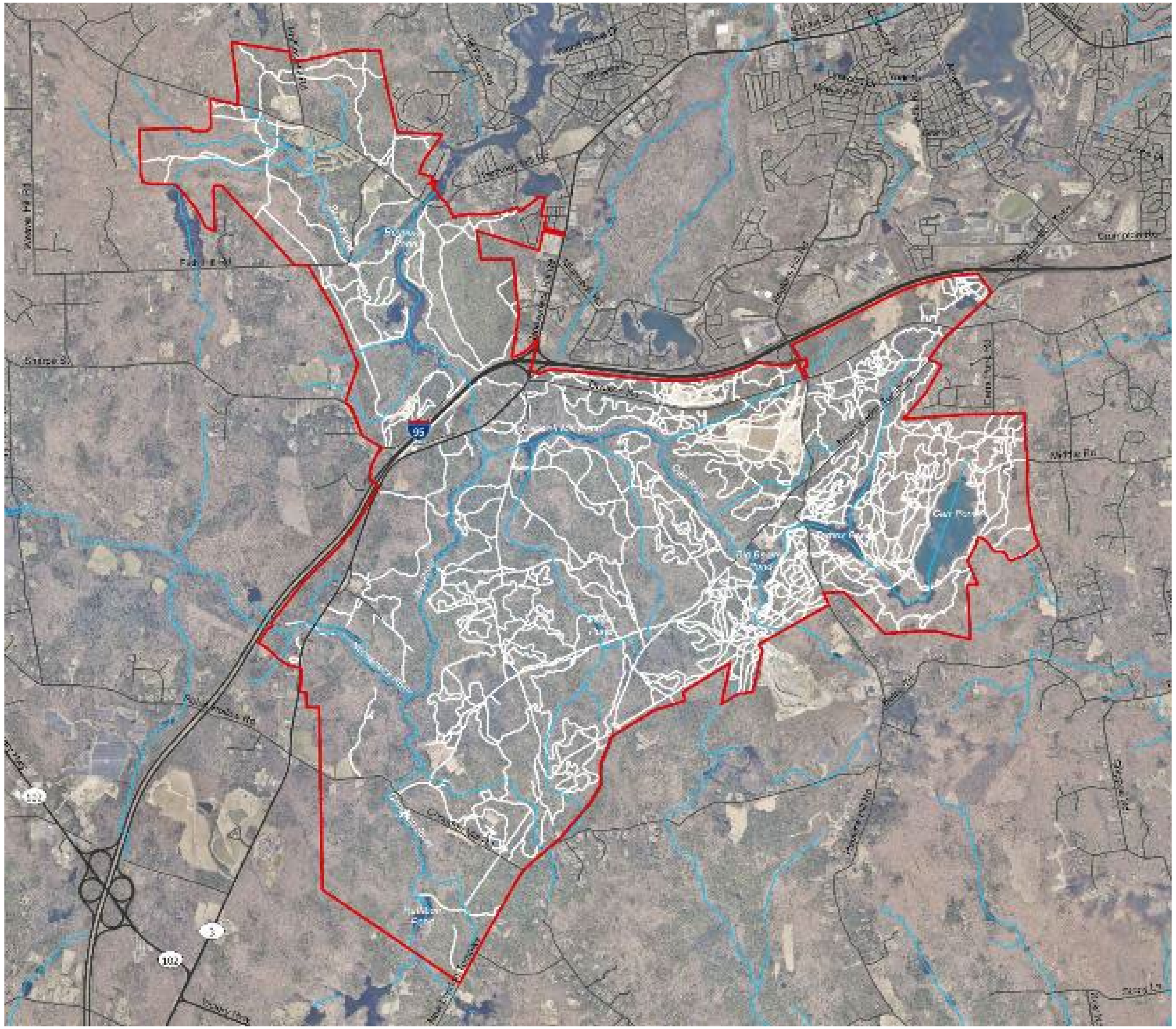
8,400 acres

30 miles of mapped streams

130 miles of trails

36 Stream Crossings

Project Background



EA created a method to look at potential water quality impacts using desktop analysis and a rapid field assessment tool.

We tested this method in BRMA since it is a potential future water supply area for the state, with significant recreational usage. Making this an important study area for impacts to water quality.

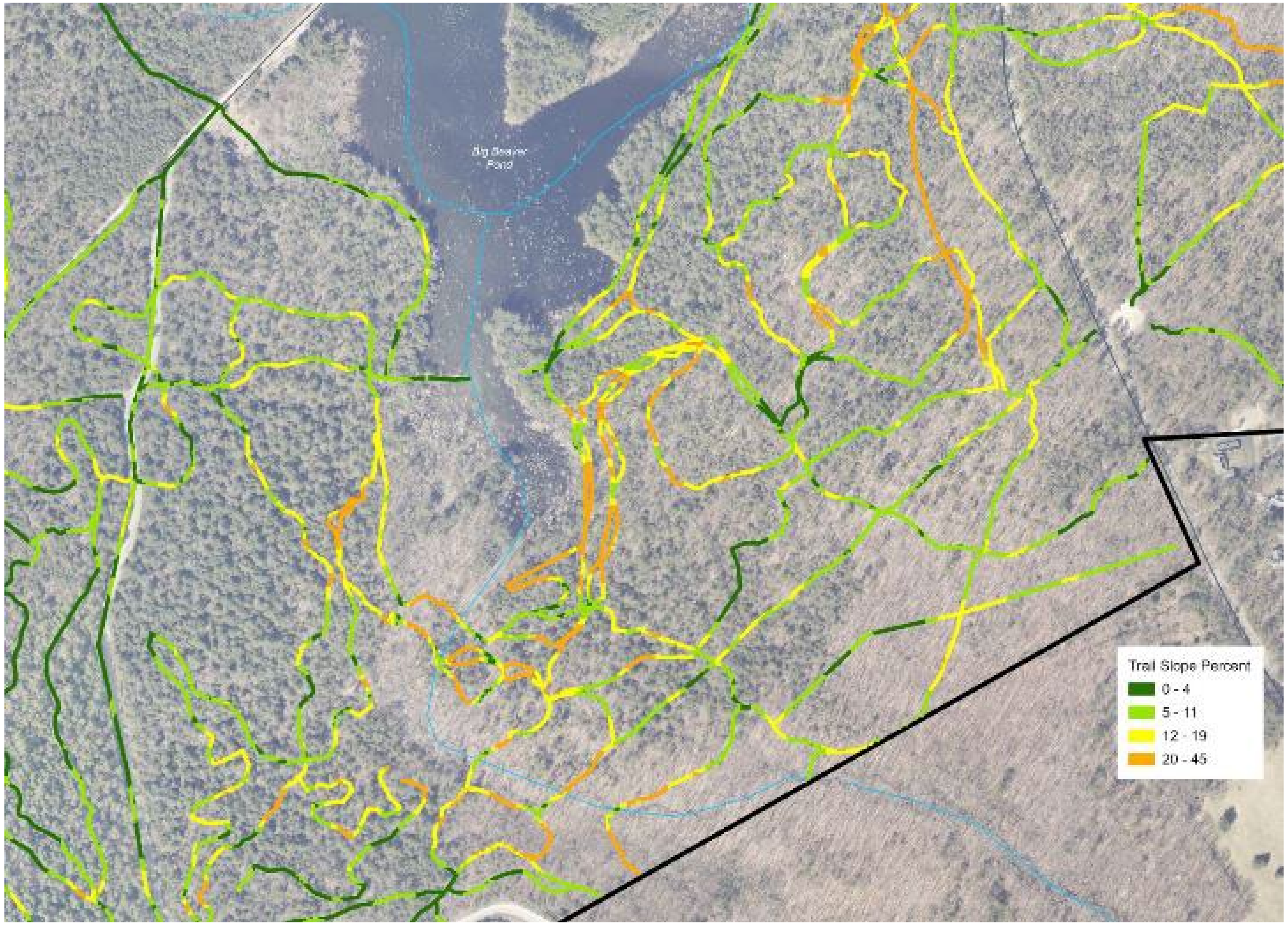
Trail Analysis : Slope

GIS Process:

1. Run slope percentage across whole site
2. Clip to trails to approximate slope along trails

What this tells us:

- Shows slope percentage across the trails
- Highlights what areas along the trail potentially have higher slope



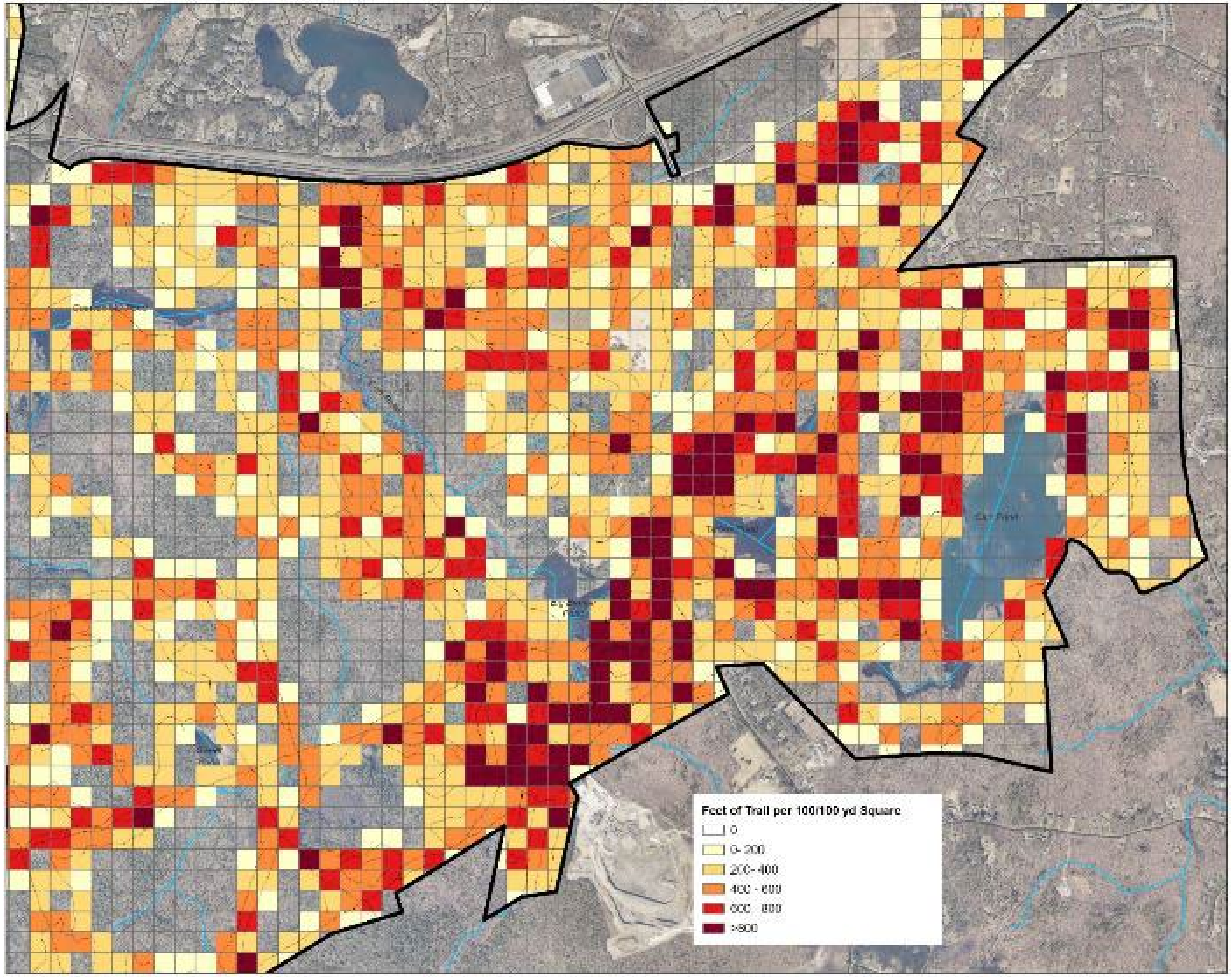
Trail Analysis : Trail Density

GIS Process:

1. Create 100/100 yd square grid across site
2. Intersect with trail layer to get feet of trails per square
3. Symbolize to highlight squares with highest density of trails

What this tells us:

- Shows us where there is a high concentration of trails



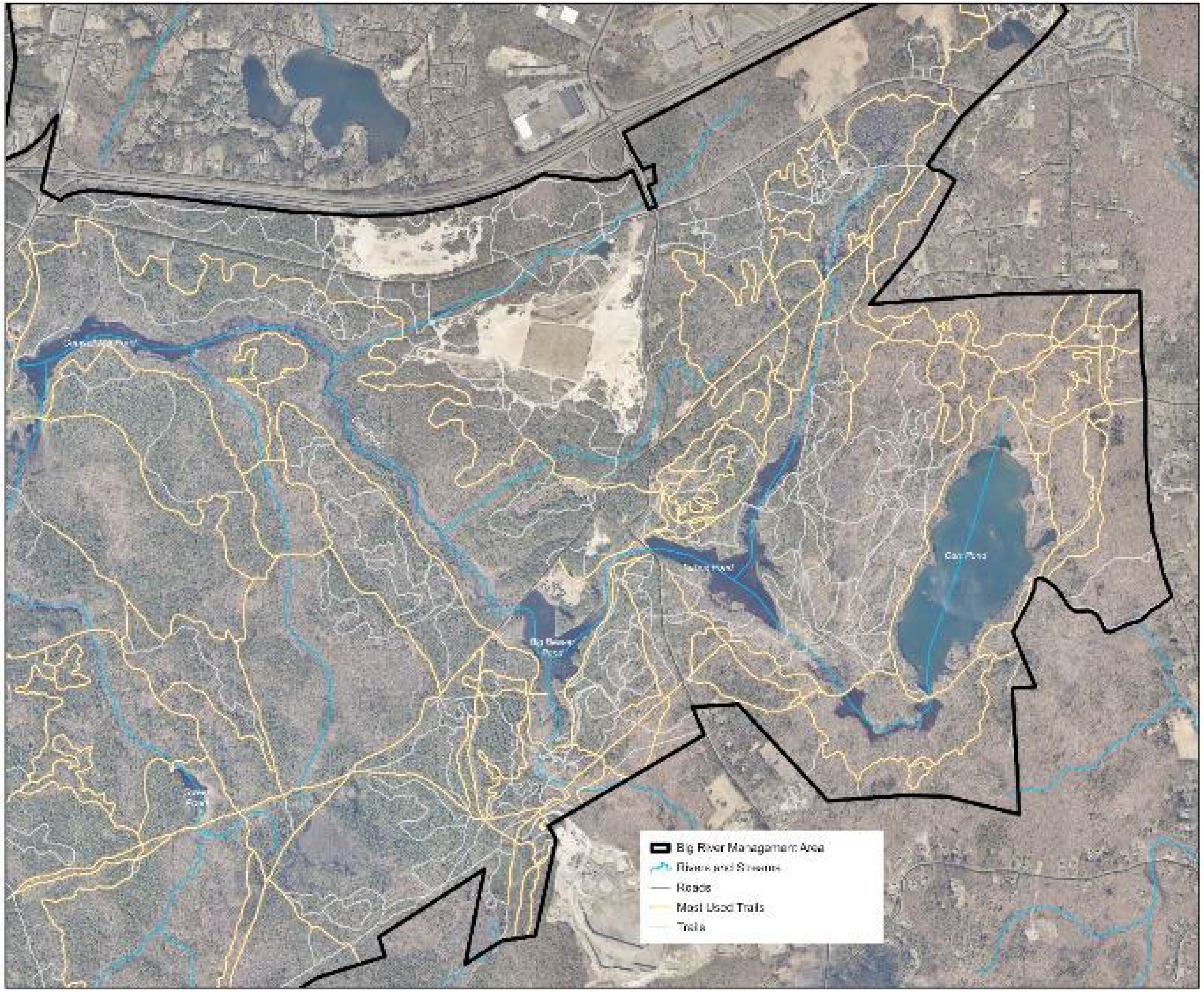
Trail Analysis : Trail Usage

GIS Process:

1. Using Strava as a reference, extract out trails that are shown to have the most use based on heat maps

What this tells us:

- These trails are the most trafficked trails by hikers and mountain bikers
- Higher risk of erosion due to frequent use



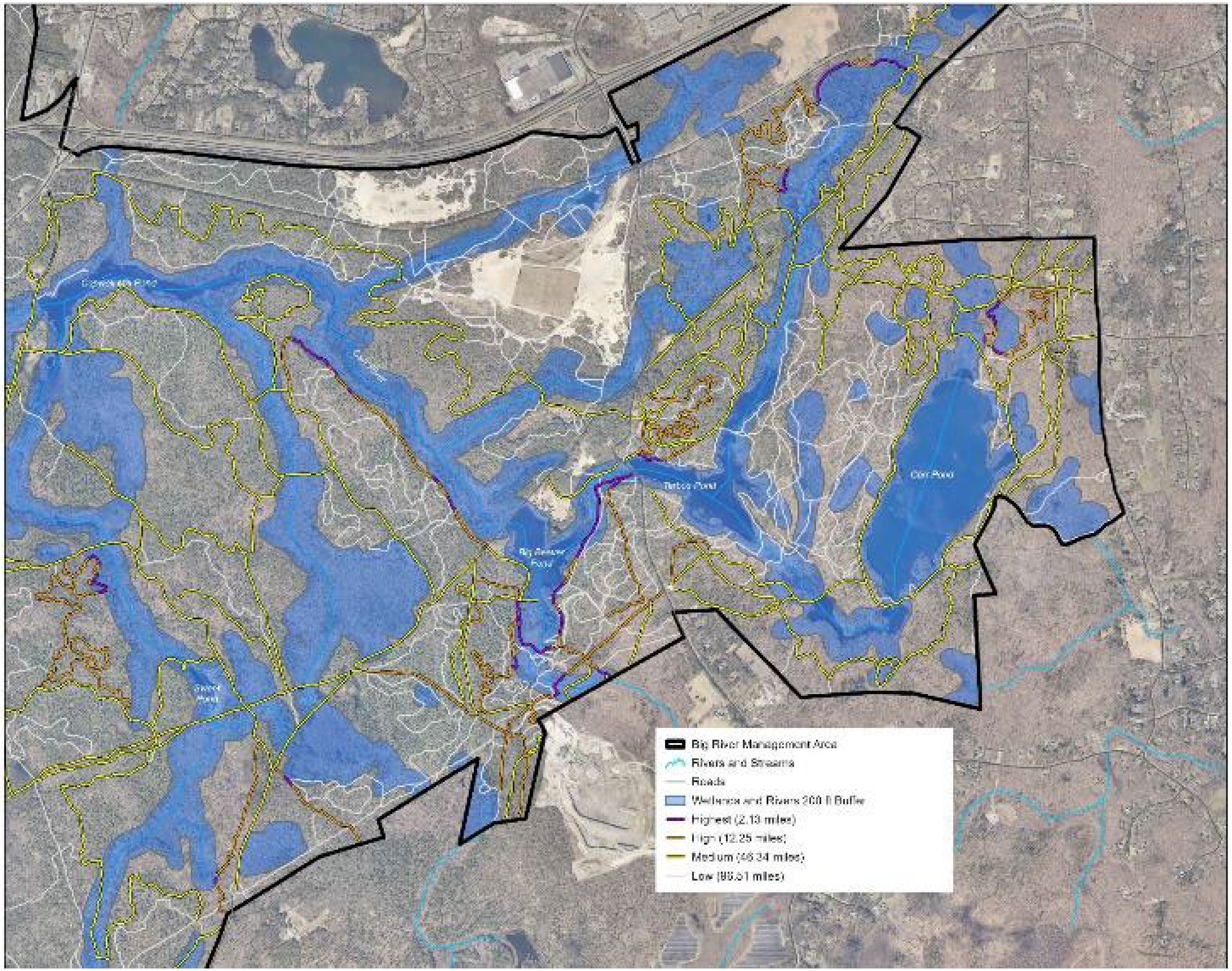
Trail Analysis : Priority Trails for Further Investigation

GIS Process:

1. Intersect all trails with higher slope, high density and high usage
2. Intersect this output with wetlands and waterbodies

What this tells us:

- Trails that hit all three analysis plus water resources were ranked the **highest** for further investigation
- Trails that hit just the three analysis were ranked high
- Trails that were high usage and hit water resources were ranked medium
- Remaining trails we ranked low



Rapid Assessment Tool

Trail Assessment

Current Date and Time *

Tuesday, June 4, 2024

4:10 PM

Description of Location *
i.e. Trail off of New London Turnpike Parking

Coordinates of Location *
Coordinates should automatically fill in next two questions.

Latitude *
auto filled

Longitude *
auto filled

Image(s) of Trail *

Surface Slope *

Impact Rating *

Muck/Mud Index *

Trail Drainage *

Trail Assessment

Trail Width *

Impeding Vegetation *

Divots/Potholes *

Trail Erosion *

Manmade Feature or Obstacle *
Check all that apply then continue to related question below.

i.e. If ATV Tracks and Bike Ramps are chosen, fill out "Type of Obstruction" for each.

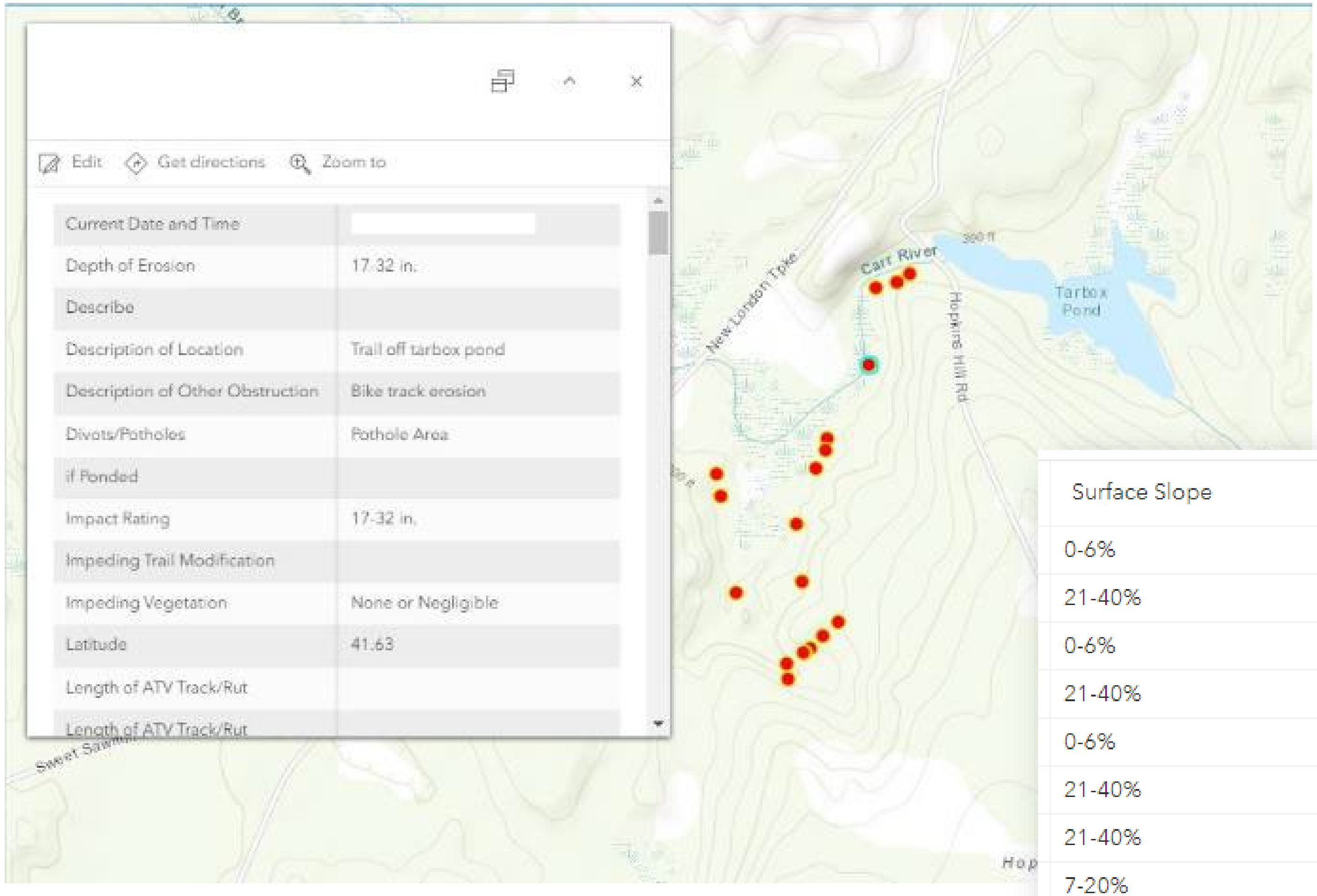
- [ ] None or Negligible
- [ ] ATV Tracks/Ruts
- [ ] ATV Trail Jumps/Features
- [ ] Bike Ramps/Course
- [ ] Bike Jumps/Obstacles
- [ ] Bridge
- [ ] Stream/Wetland Crossing
- [ ] Other

Type of Obstruction (ATV Tracks/Ruts)

Type of Obstruction (ATV Trail Jumps/Features)

Type of Obstruction (Bike Ramps/Course)

Rapid Assessment Tool



Surface Slope	Impact Rating	Muck/Mud Index	Trail Drainage
0-6%	None or Negligible	None or Negligible	Well Drained
21-40%	33-60 in.	None or Negligible	Well Drained
0-6%	9-16 in.	Extremely Muddy	Saturated
21-40%	33-60 in.	None or Negligible	Well Drained
0-6%	Exposed Roots	None or Negligible	Well Drained
21-40%	None or Negligible	None or Negligible	Well Drained
21-40%	>60 in.	None or Negligible	Well Drained
7-20%	17-32 in.	None or Negligible	Well Drained
21-40%	17-32 in.	None or Negligible	Well Drained

Trail Impact Examples

Trail Impact Examples

Trail Impact Examples

Summary

- There are many factors to consider when reviewing trails and their impacts to water quality.
- Slope, Trail Usage, Trail Density and their intersection to surrounding watercourses are a few important ones to look at.
- The use of a Rapid Field Assessment tool can aid in assessing trail systems to identify trails in need of maintenance and monitoring.

Thank You!

Jessica Morrissey
jmorrissey@eaest.com

Incorporating Climate Change into Flood Risk Mapping in the Housatonic River Watershed

Hurricane Sandy flooding in Fairfield County, CT.

James LeNoir
Hydrologist, U.S. Geological Survey New England Water Science Center

USGS
science for a changing world

U.S. Department of Homeland Security
FEMA

Today's Discussion

Future Flood Risk Project: Motivation

Current flood risk mapping practices and limitations

Future Flood Risk Project: Future Streamflows

How future streamflows are determined and results

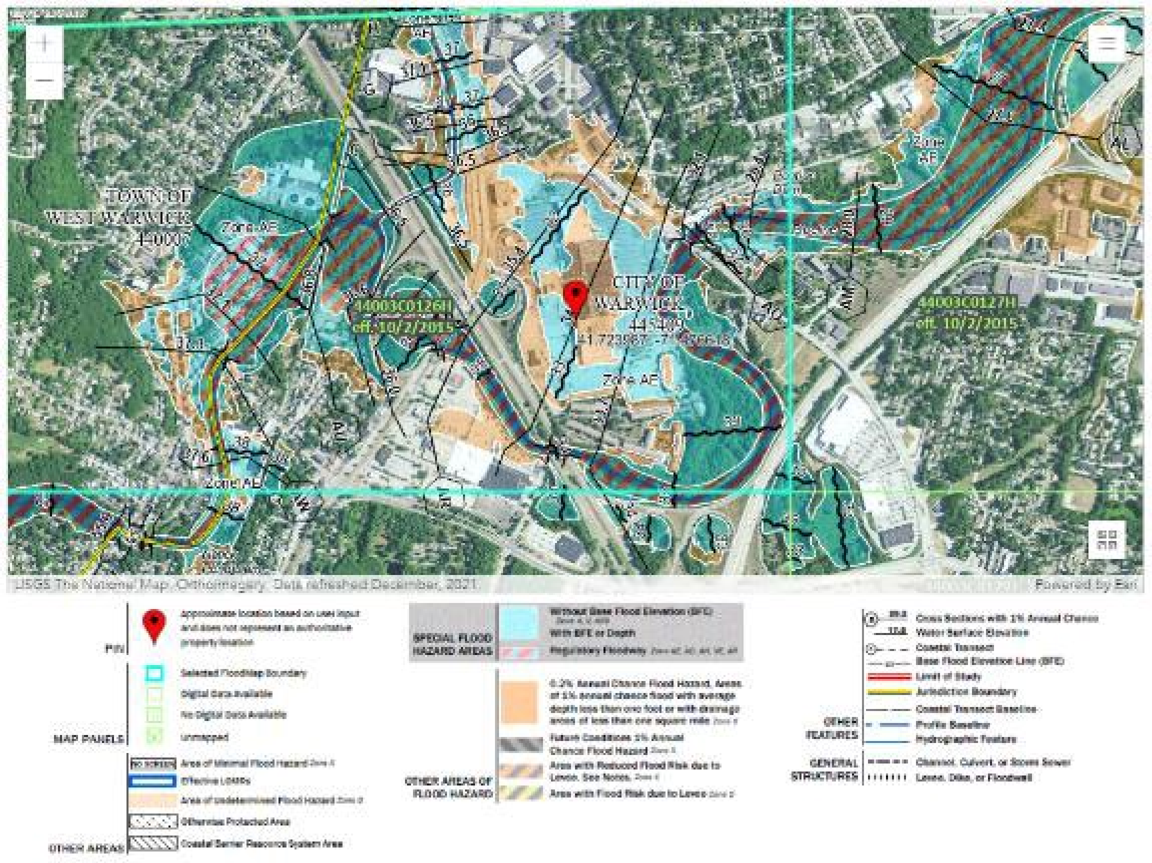
Future Flood Risk Project: Floodplain Mapping

Going from streamflows to floodplains and displaying floodplains in interactive web application (in development)

Current Flood Risk Mapping

100-year Floodplain Flood Zones:

- Zone AE (new)
- Zone AE (re-delineated)
- Zone A
- Based on historical streamflow data
- Assumes stationarity



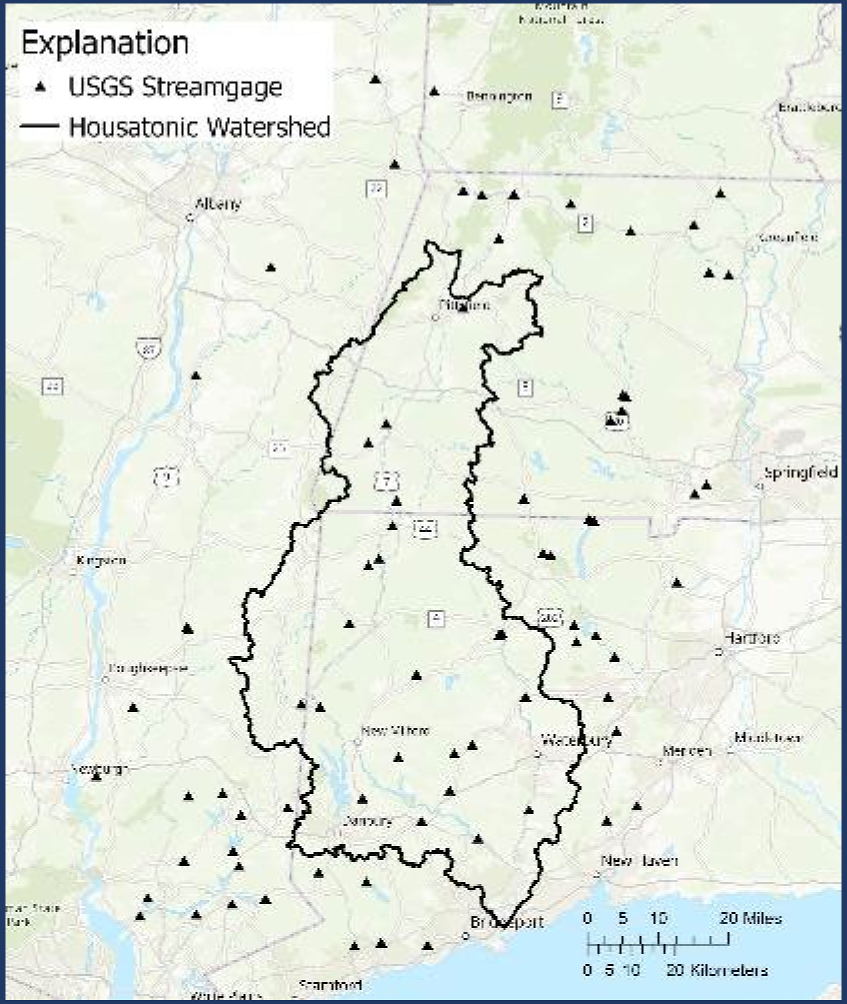
National Flood Hazard Layer (NFHL) displaying the effective flood hazard information in the vicinity of the Warwick Mall in Warwick, RI. (https://msc.fema.gov/portal/search?)

USGS science for a changing world FEMA

Future Flood Risk Project

Project Overview

- Pilot project in Housatonic River watershed
- Assess how streamflow might change with anticipated changes in temperature and precipitation (RCP 8.5 emissions scenario)
- Use future flood flows to predict future floodplains
- Methods:
  - Estimate streamflows using Precipitation-Runoff Modeling System (PRMS)
    - Scaled precipitation and temperature inputs
  - Use model output to characterize changes in peak flow hydrology
  - Use future flood flows to generate future floodplains
  - Compare baseline conditions to changes in streamflow and floodplain extent associated with climate change



The Housatonic River watershed and 78 streamgages used in this study span CT, MA, NY, VT.

USGS science for a changing world FEMA

Future Flood Risk Project

Project Overview

https://www.usgs.gov/centers/new-england-water-science-center/science/characterizing-future-flood-flows-flood-insurance


Characterizing Future Flood Flo...
https://cms.usgs.gov/centers/new-england-water-science-center/science/characterizing-future-flood-flows-flood-insurance
An official website of the United States government Here's how you know
USGS science for a changing world
SCIENCE PRODUCTS NEWS CONNECT ABOUT
Latest Earthquakes |
NEW ENGLAND WATER SCIENCE CENTER | SCIENCE

Characterizing Future Flood Flows for Flood Insurance Studies

ACTIVE

By New England Water Science Center September 21, 2022

Overview Science Data Publications Partners

Current methods of flood-frequency analyses for flood insurance studies assume that the statistical distribution of data from past observations will continue unchanged in the future. This is known as the assumption of stationarity. This assumption allows scientists to estimate flood magnitude and frequency based on past records and the expectation that those estimates will represent current and future conditions. However, observed trends of increases in rainfall intensity and changes in seasonal snowmelt hydrology in the northeastern United States suggest that peak-flow stationarity may no longer be an appropriate assumption. To improve the information and mapping available for decision-making throughout New England in the face of a changing climate, the U.S. Geological Survey (USGS) is developing a series of potential flood map scenarios in a pilot watershed in New England for the years 2030, 2050 and 2100.

The National Hydrologic Model (NHM) is a deterministic hydrologic model for the conterminous United States and draws on topography, land cover, soils, geology, and hydrography parameters derived from a Geographic Information System (GIS). This investigation employed a Precipitation-Runoff Modeling System (PRMS) model extracted from the

Study Area

Contacts

Scott A Olson
Hydrologist
New England Water Science Center
Email: solson@usgs.gov
Phone: 603-226-7815

Amanda Schoen

USGS science for a changing world FEMA

Future Flood Risk Project

Project Overview

https://www.usgs.gov/publications/characterizing-changes-1-percent-annual-exceedance-probability-streamflows-climate

https://www.sciencebase.gov/catalog/item/63dc12acd34e9fa19a98a183

Characterizing Changes in the 1-Percent Annual Exceedance Probability Streamflows for Climate-Change Scenarios in the Housatonic River Watershed of Massachusetts, Connecticut, and New York

By Scott A. Olson

Abstract

Current methods for determining the 1-percent annual exceedance probability (AEP) for a streamflow assume stationarity (the assumption that the statistical distribution of data from past observations does not contain trends and will

maps (Federal Emergency Management Agency, undated), which delineate areas susceptible to flooding, including areas that have a 1-percent chance of flooding in any given year. Along rivers and streams, the mapped areas that have a 1-percent chance of flooding are based on streamflows with a 1-percent annual exceedance probability (AEP).

Current methods for completing flood-frequency analy-

ScienceBase Catalog → USGS Data Release Products → Data for Characterizing Cha...

Data for Characterizing Changes in the 1-percent Annual Exceedance Probability Streamflows for Climate Change Scenarios in the Housatonic River Watershed, Massachusetts, Connecticut, and New York

View

Dates

Publication Date :	2023-09-29
Start Date :	1949-10-01
End Date :	2015-09-30

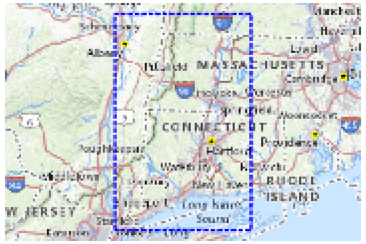
Citation

Olson, S.A., 2023, Data for characterizing changes in the 1-percent annual exceedance probability streamflows for climate change scenarios in the Housatonic River watershed, Massachusetts and Connecticut: U.S. Geological Survey data release, https://doi.org/10.5066/P91CSH0P

Summary

The U.S. Geological Survey in cooperation with the Federal Emergency Management Agency has conducted a study to evaluate potential changes to1-percent annual exceedance probability (AEP) streamflows. The study was conducted using the Precipitation Runoff Modeling System (PRMS). Climate inputs to the model of temperature and precipitation were scaled to anticipated changes that could occur in 2030, 2050, and 2100 based on global climate models. The output from the models were used to characterize the 1-percent AEP streamflows for the years 2030, 2050, and 2100

Map »



Communities

- USGS Data Release Products
- USGS New England Water Science Center

USGS science for a changing world

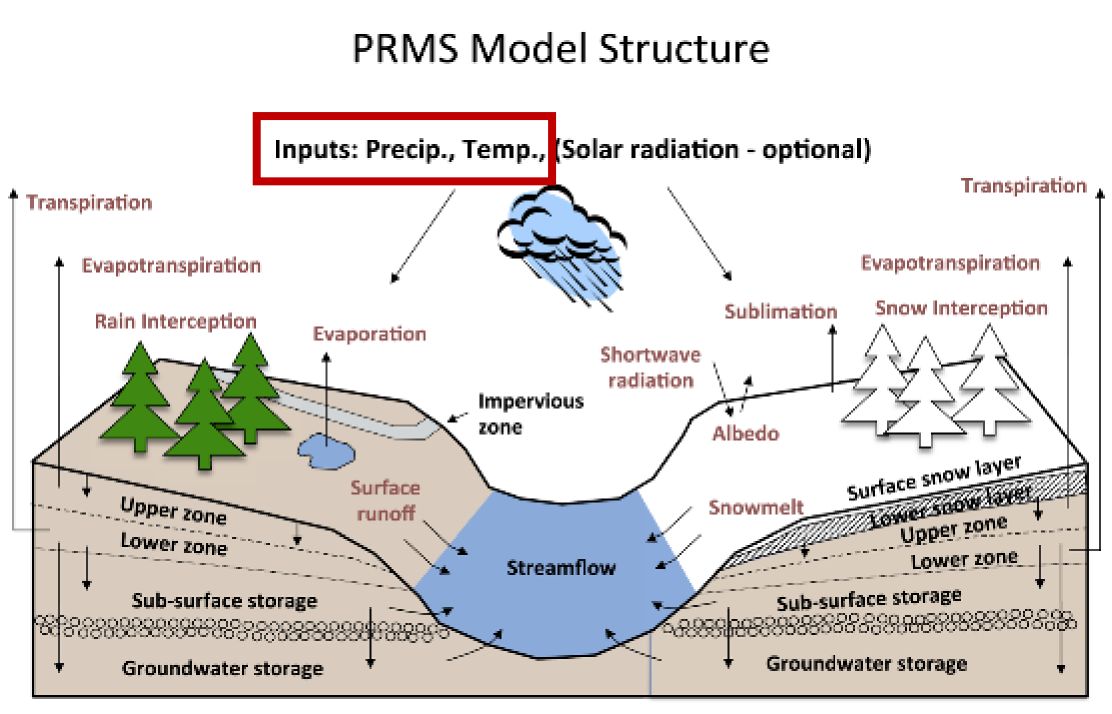
FEMA

Future Flood Risk Project

Future Flows

- Characterize 1 % annual-exceedance probability (AEP) flood flows for years 2030, 2050, and 2100
- Simulate streamflows using PRMS
- Inputs of temperature and precipitation are scaled using estimates from General Circulation Models
- Baseline conditions compared to changes associated with climate change to develop scalar for years 2030, 2050, and 2100

Olson, S.A., 2023, Characterizing changes in the 1-percent annual exceedance probability streamflows for climate-change scenarios in the Housatonic River watershed of Massachusetts, Connecticut, and New York: U.S. Geological Survey Scientific Investigations Report 2023–5090, 16 p., https://doi.org/10.3133/sir20235090



Visual representation of the process used in PRMS (https://pubs.usgs.gov/of/2012/1274/methods.html).

Future Flood Risk Project

Future Flows

Table 3. Temperature and precipitation adjustments applied to the climate datasets input to the Precipitation Runoff Modeling System models for the Housatonic River and surrounding watersheds in Massachusetts, Connecticut, and New York.

[Data are from Olson (2023). The Precipitation Runoff Modeling System is from Leavesley and others (1983)]

Adjusted parameter	Adjustment applied to climate dataset		
	2030	2050	2100
Temperature increase, in degrees Fahrenheit	2.8	4.9	10.2
Precipitation increase, in percent	5.04	7.74	12.05

Table 4. Percentage change in the 1-percent annual exceedance probability computed using the annual instantaneous peak streamflows based on changes in precipitation and temperature at streamgages with unregulated and regulated streamflows in Massachusetts, Connecticut, and New York.

[Data are from Olson (2023). %, percent; °F, degree Fahrenheit]

Temperature change	Precipitation change			
	0%	5.04%	7.74%	12.05%
Streamgages with unregulated streamflow				
0 °F	0.0	8.8	13.3	20.7
2.8 °F	1.5	7.4	11.9	19.5
4.9 °F	−1.6	7.0	11.7	19.2
10.2 °F	3.1	5.3	9.9	17.3
Streamgages with regulated streamflow				
0 °F	0.0	9.1	13.7	21.3
2.8 °F	−1.7	7.0	11.5	18.8
4.9 °F	−2.0	7.0	11.7	18.9
10.2 °F	−3.1	5.5	10.3	17.8

Table 5. Percentage changes in the 1-percent annual exceedance probability streamflows for 2030, 2050, and 2100 computed using the annual instantaneous peak streamflows in Massachusetts, Connecticut, and New York.

Parameter	Scenario		
	2030	2050	2100
Unregulated streamflow	7.4	11.7	17.3
Regulated streamflow	7.0	11.7	17.8

Olson, S.A., 2023, Characterizing changes in the 1-percent annual exceedance probability streamflows for climate-change scenarios in the Housatonic River watershed of Massachusetts, Connecticut, and New York: U.S. Geological Survey Scientific Investigations Report 2023–5090, 16 p., https://doi.org/10.3133/sir20235090

USGS science for a changing world

FEMA

Future Flood Risk Project

Future Flows to Generate Future Floodplains

Table 5. Percentage changes in the 1-percent annual exceedance probability streamflows for 2030, 2050, and 2100 computed using the annual instantaneous peak streamflows in Massachusetts, Connecticut, and New York.

Parameter	Scenario 2030	Scenario 2050	Scenario 2100
Unregulated streamflow	7.4	11.7	17.3
Regulated streamflow	7.0	11.7	17.8

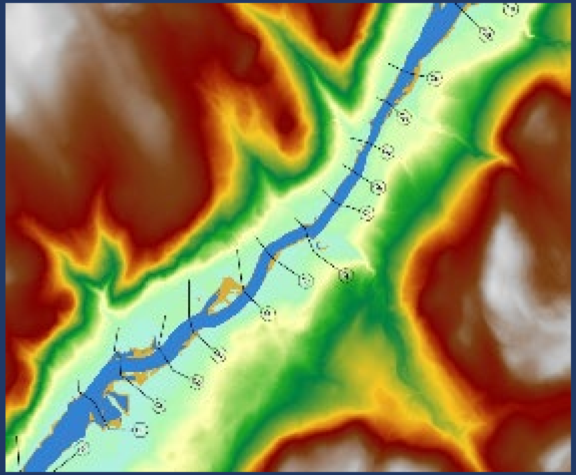
Non-regulatory product similar to NFHL map above

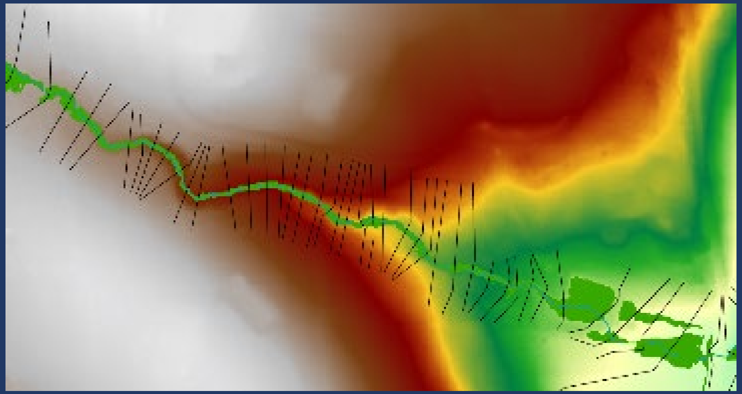
USGS science for a changing world FEMA

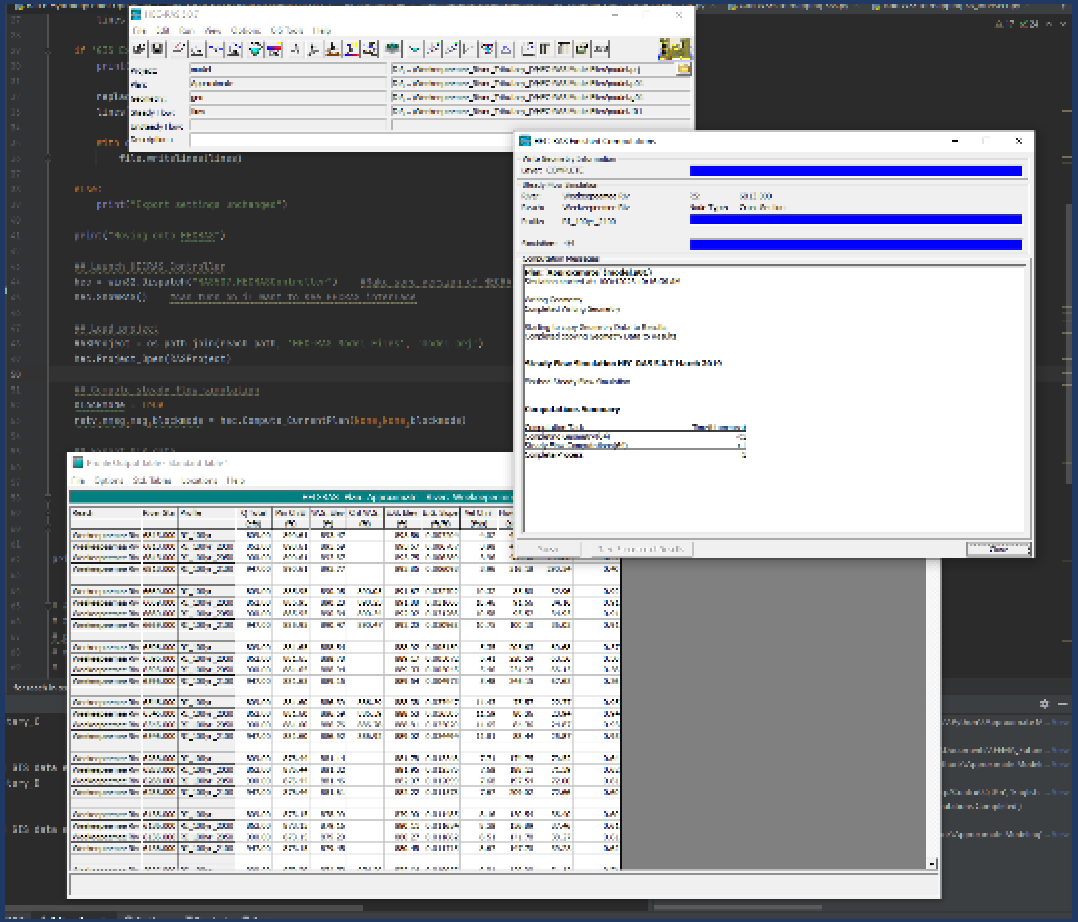
Future Flood Risk Project

Generate Future Floodplains

- Generate future 100-year floodplains using anticipated future streamflows
- Method varies by model
    - New Zone AE and Zone A models:
        - Take advantage of existing HEC-RAS models and API







USGS science for a changing world FEMA

Future Flood Risk Project

Generate Future Floodplains

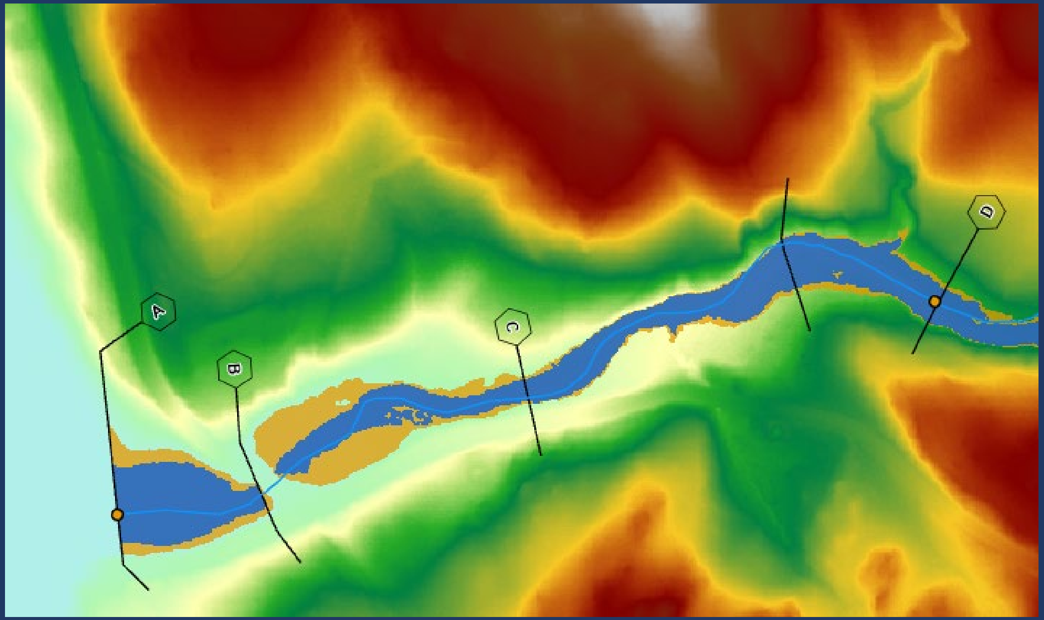
- Generate future 100-year floodplains using anticipated future streamflows
- Method varies by model
    - Redelineated Zone AE:
        - HEC-RAS model not available
        - Knowns: present water-surface elevations and flow values from Flood Insurance Study report
        - Utilize relationship between streamflow and water-surface elevation

TABLE 1: SUMMARY OF DISCHARGES (continued)

FLOODING SOURCE AND LOCATION	DRAINAGE AREA SQ MILES	PEAK DISCHARGES (CFS) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
CLAPBOARD OAK BROOK					
Mouth at Lake Lillinonah	2.4	330	690	920	1,725
1,900 Feet Upstream of Mouth	2.0	320	670	895	1,675
8,340 Feet Upstream of Mouth	0.8	275	355	395	505
Upstream Study Limit	0.4	160	210	235	295

$$future\ WSE = \left(\frac{\left(\frac{\log(500yr\ Q)}{\log(future\ Q)} \right)}{\log(500yr\ Q) - \log(100yr\ Q)} \right) * (500yr\ WSE - 100yr\ WSE) + 500yr\ WSE$$

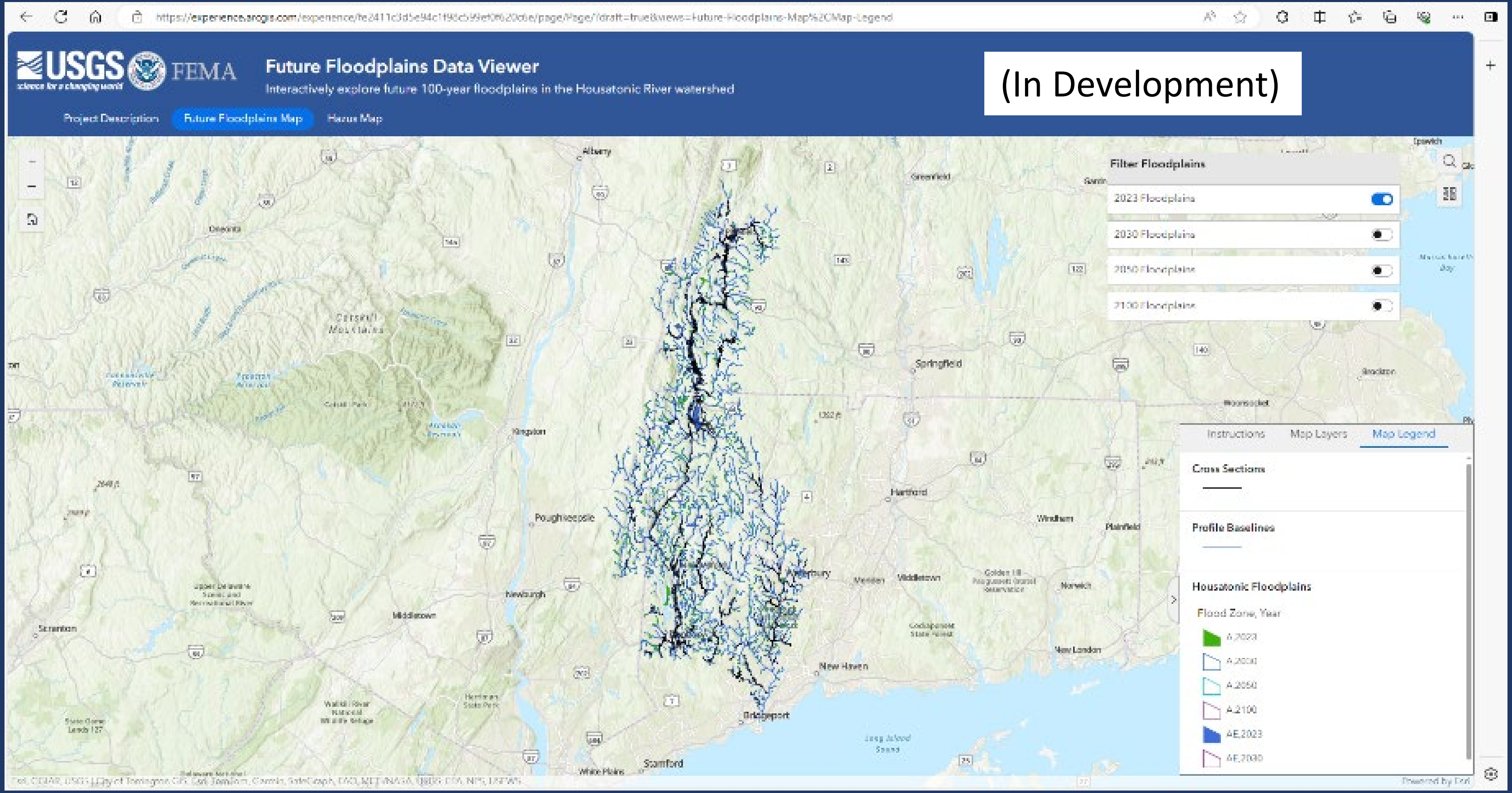
where, $future\ Q = 100yr\ Q * scalar + 100yr\ Q$



USGS science for a changing world FEMA

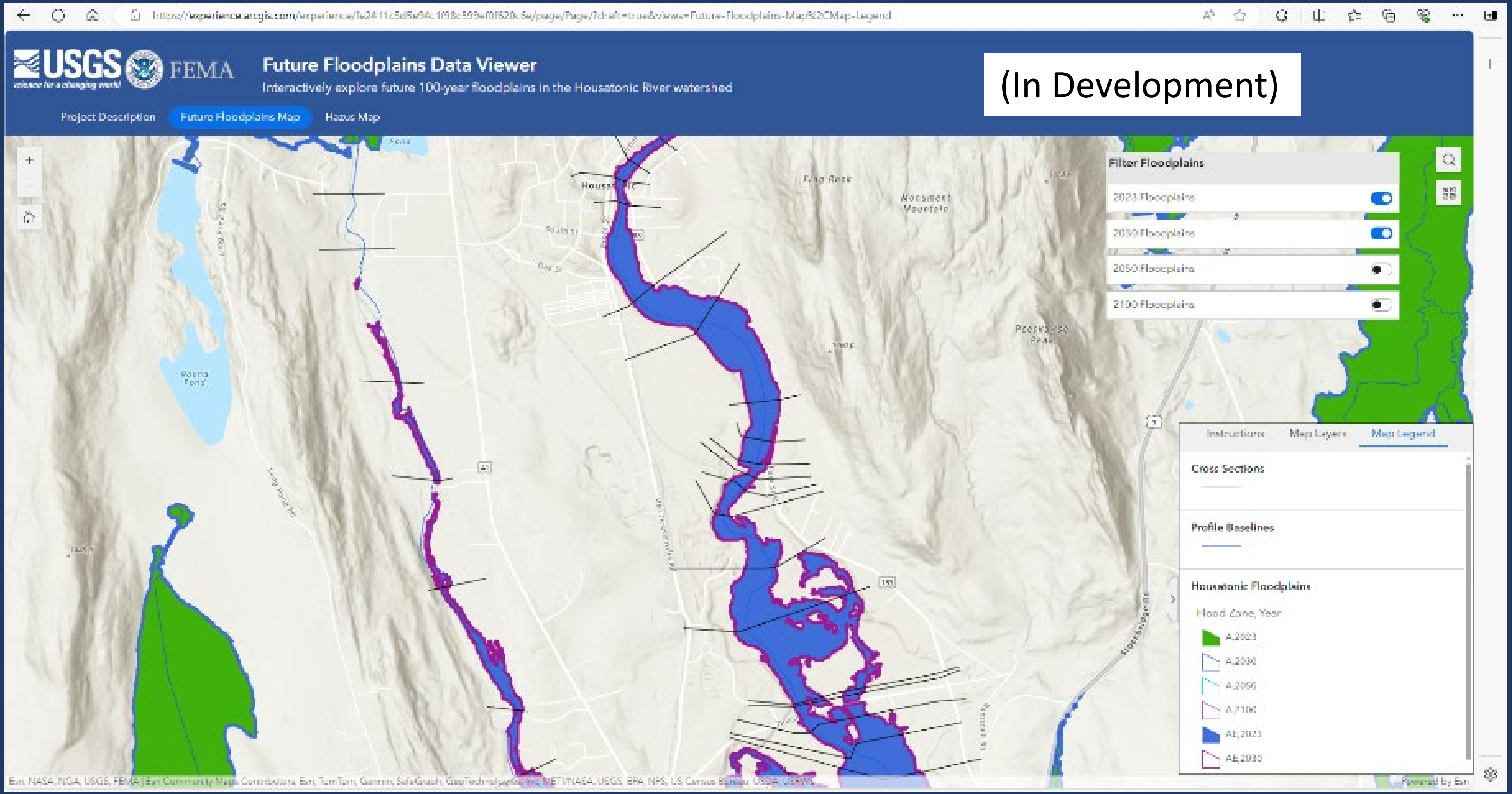
Future Flood Risk Project

Future Floodplains Data Viewer



Future Flood Risk Project

Future Floodplains Data Viewer



USGS science for a changing world FEMA

Future Flood Risk Project

Future Products

Anticipated Spring/Summer 2025 (with preliminary flood risk mapping products)

- Online web application to communicate expected difference in floodplain extent
- USGS Report discussing how the future floodplains were generated
- Data Release to support USGS Report and web application

Acknowledgements

Scott Olson, USGS New England Water Science Center

Amanda Schoen, USGS New England Water Science Center

Pamela Lombard, USGS New England Water Science Center

Luke Sturtevant, USGS New England Water Science Center

Contact Information

James LeNoir, USGS New England Water Science Center
jlenoir@usgs.gov

FEMA

USGS science for a changing world

Housatonic River at Falls Village, CT USGS gage during normal flows on March 30, 2017 (top image) and high flows following Hurricane Irene on August 29, 2011 (bottom image).

MassBays Ecohealth Tracking Tool:

A Regional Approach for Coastal Data Exploration

NEIWPCC
NPS Conference
April 11, 2024

Massachusetts Bays National Estuary Partnership

Prassede Vella,
Senior Scientist

Comprehensive Environmental Inc

Bob Hartzel, Principal

MassBays Study Area:
large, diverse, complex

- **National Estuary Program since 1990**
- **Watershed area >7,000 sq. mi**
- **~1650 sq. mi extending to Stellwagen Bank**
- **1100 miles of shoreline (Salisbury to Provincetown)**
- **50 communities, 1.7 million residents**

Ecohealth Tracking Tool

Goals

1. Provide a gateway for **the public, scientists, and policy makers** to access data about coastal habitats and water quality in the MassBays region.

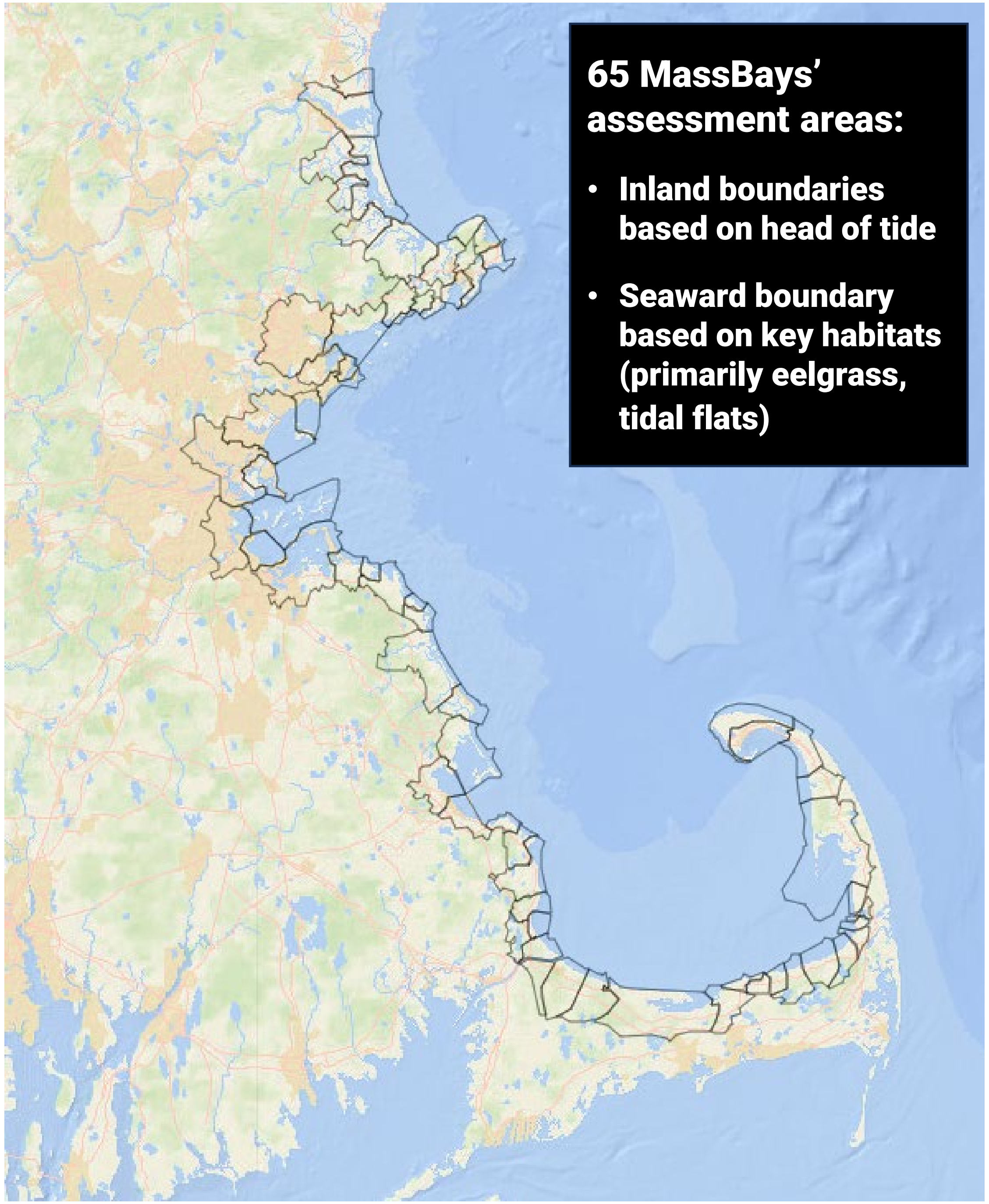
2. Establish a means for **visualizing and comparing environmental conditions to ecological benchmarks** for improvement.

Lobster existential crisis

Ecohealth
Tracking Tool

Goals

3. National Estuary Programs are required by the Clean Water Act to provide regular **reporting on conditions and trends** in their study areas.



Ecohealth
Tracking Tool

Goals

4. Increase regional use of Water Quality Exchange (WQX)

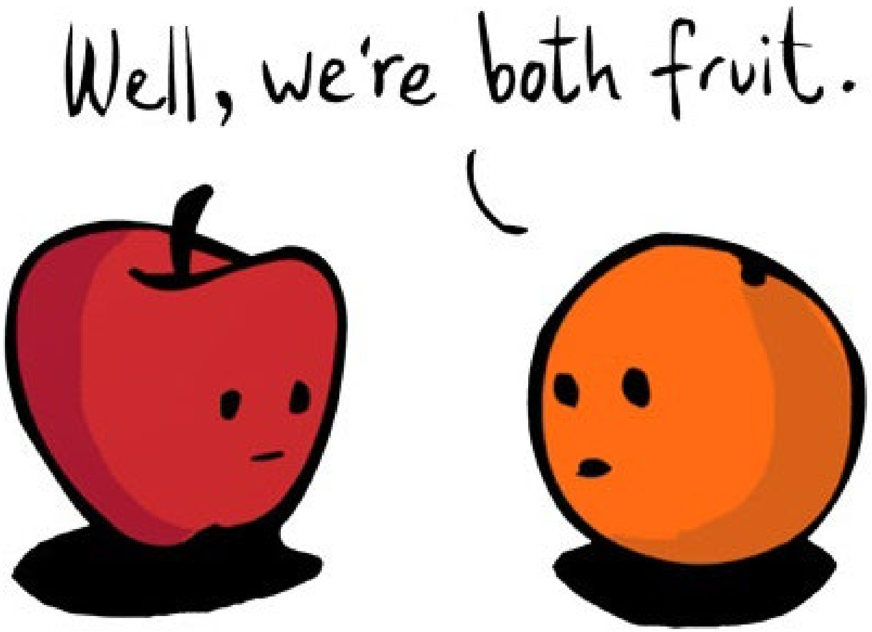
- One stop shopping for quality-assured data!
- Make data gaps apparent, to prompt expanded monitoring in MassBays region

Ecohealth Tracking Tool

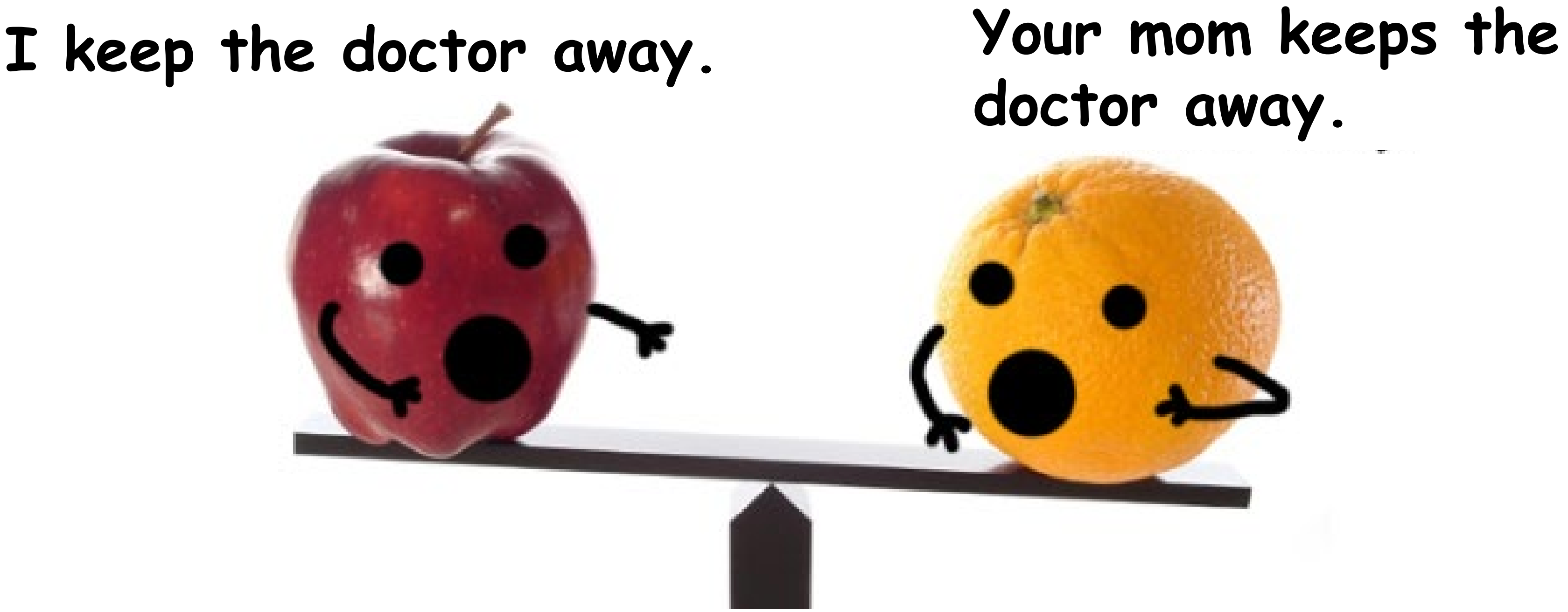
Goals

5. **Provide water quality / habitat data that is <u>available</u> and <u>comparable</u> for MassBays region**

    - Compare apples to apples
    - Focus on data with good **region-wide availability**, not all possible parameters



Honorable Mention
Apple vs. Orange Graphic



Ecohealth Tracking Tool

Goals

6. **Provide data exploration format that is:**

to use

to understand

to update

Keep it simple…

just because you can doesn't mean you should

Ecohealth Tracking Tool

Goals

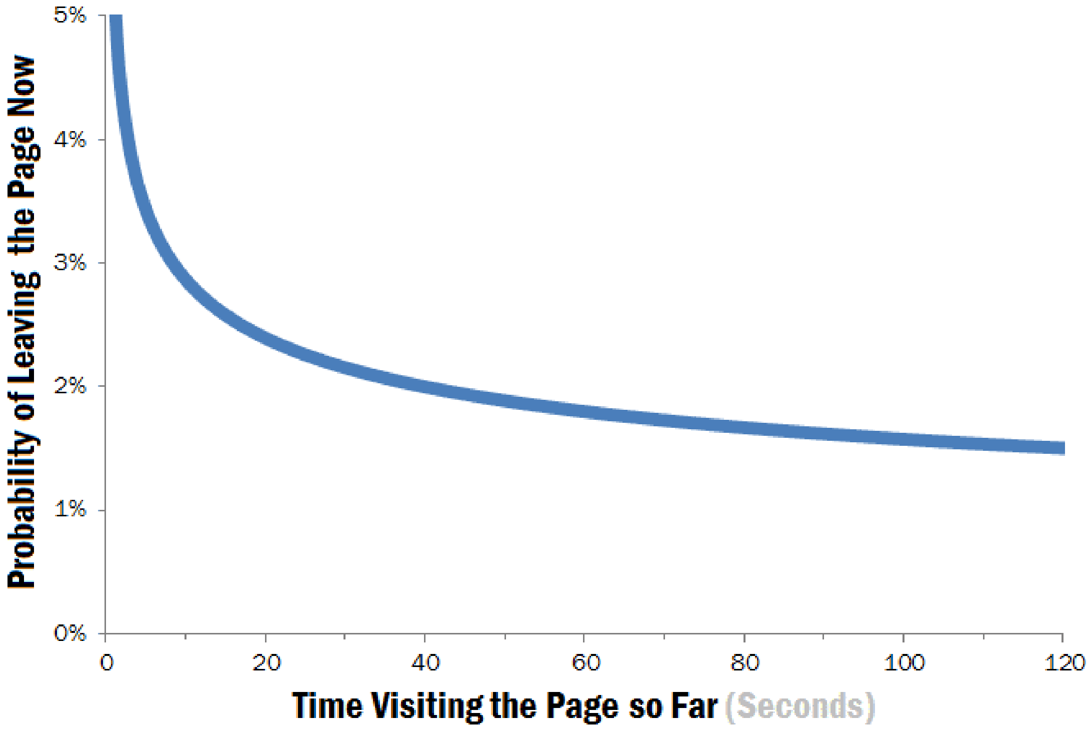
- Users often leave web pages in **10–20 seconds**
- **Pages with clear value** to user can hold attention for much longer.
- To gain several minutes of user attention, you must **clearly communicate value within 10 seconds**.

6. Provide data exploration format that is:

to use

to understand

to update



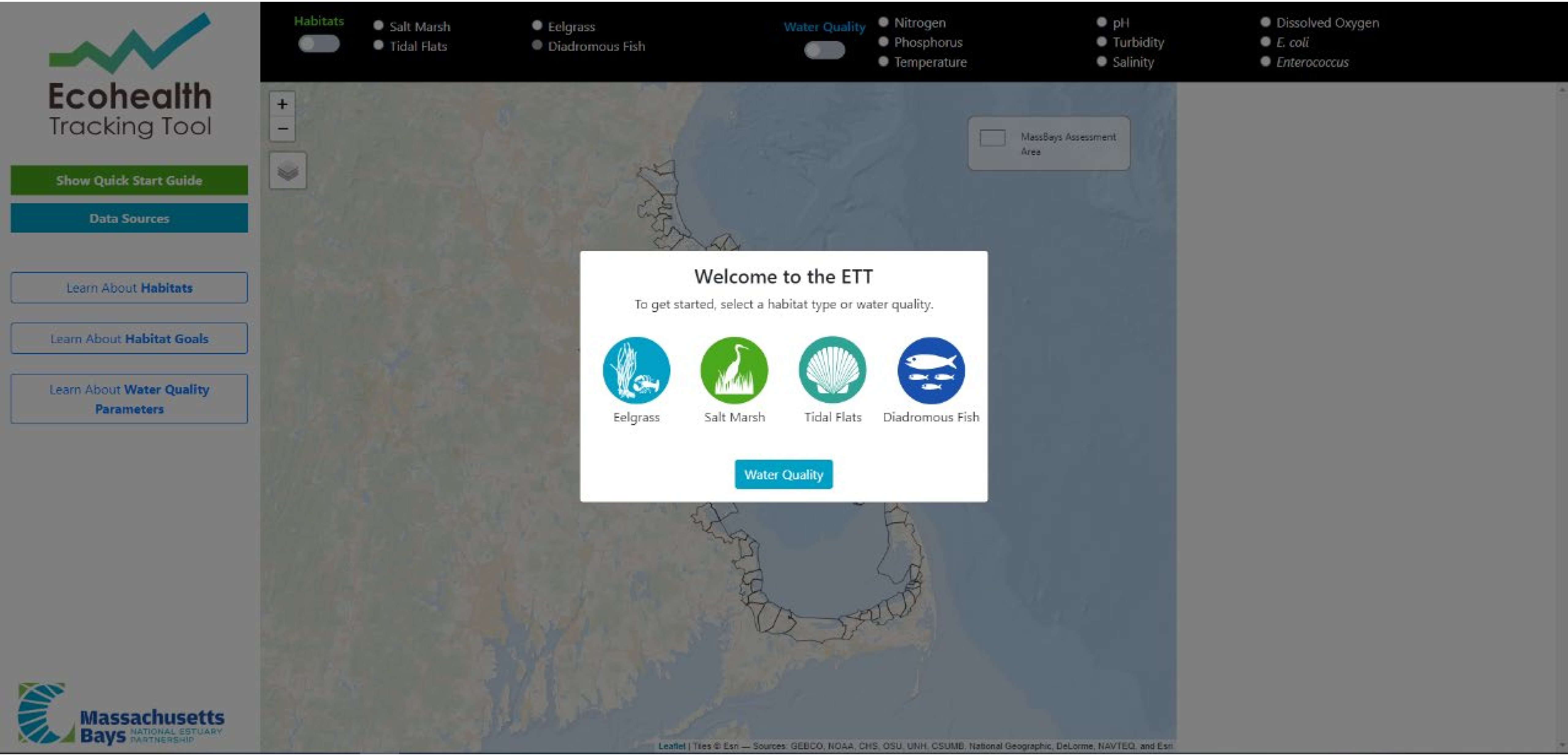
Explore Coastal Habitats and Water Quality in the Massachusetts Bays Region

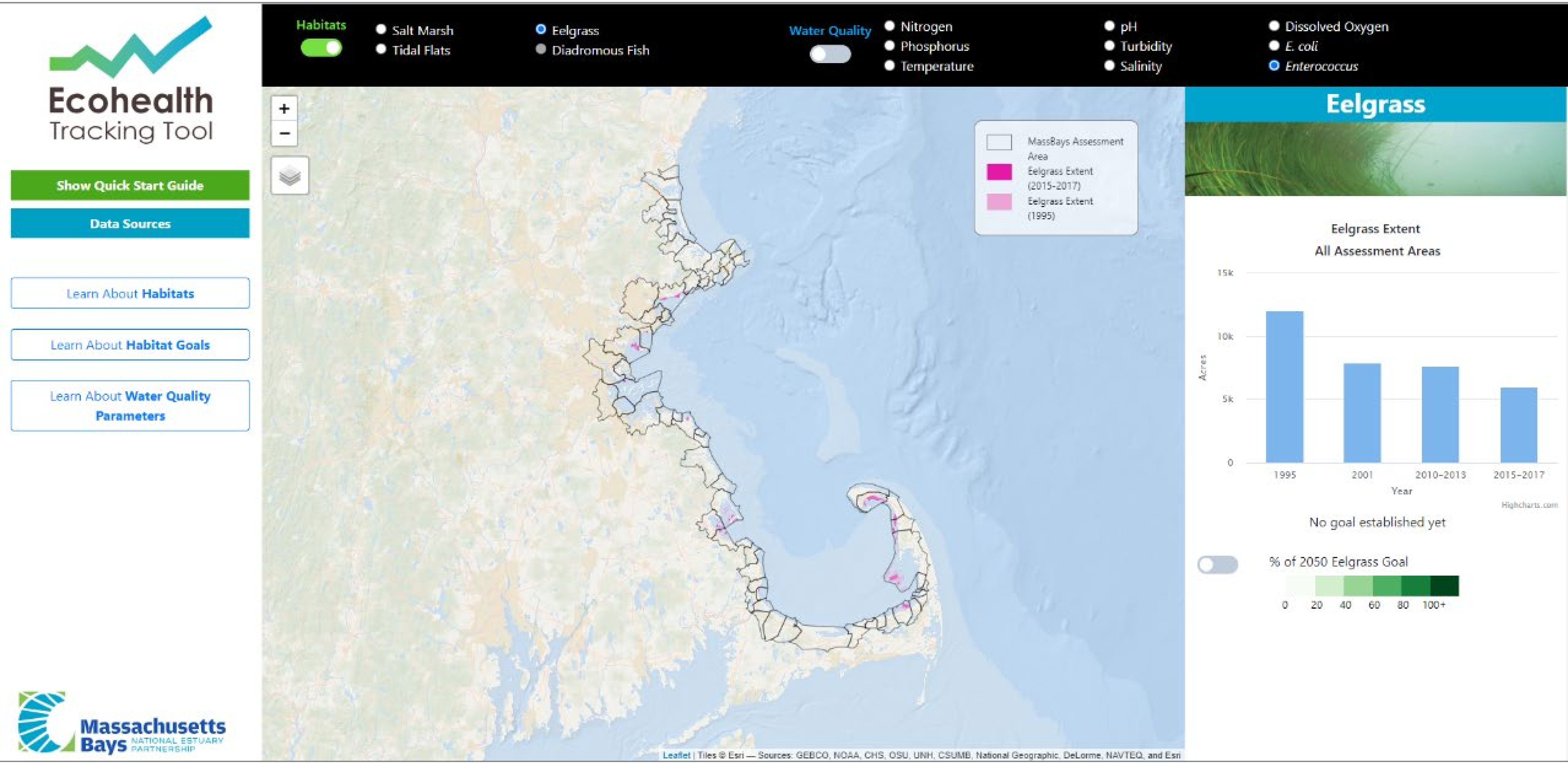
Start Exploring

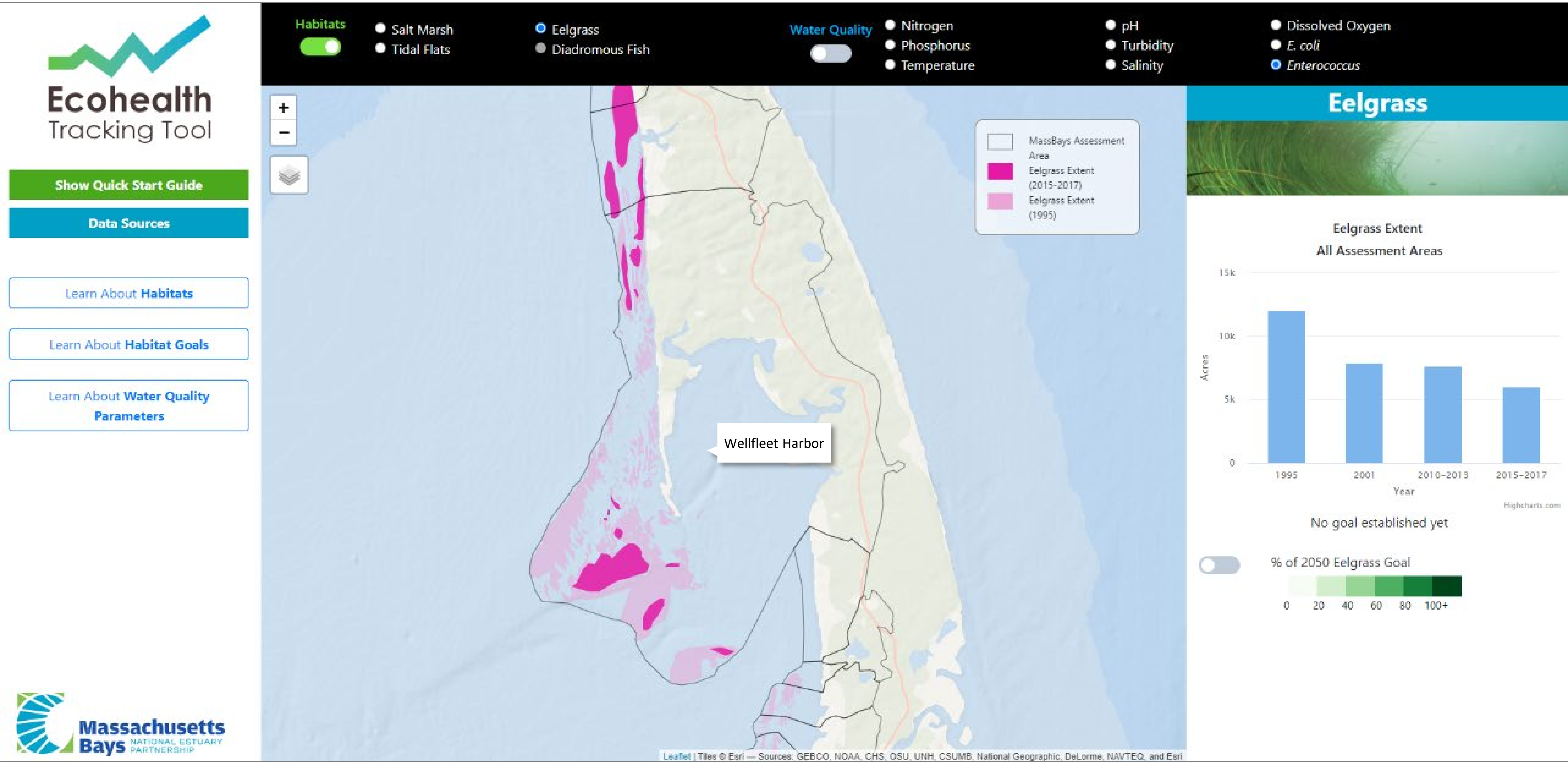
The **Ecohealth Tracking Tool** is a gateway for the public, scientists, and policy makers to access information about coastal habitats, the water quality conditions that sustain healthy habitats, and the many benefits these habitats provide. You'll find data for the entire MassBays region, as well as your favorite beach, salt marsh, or estuary.

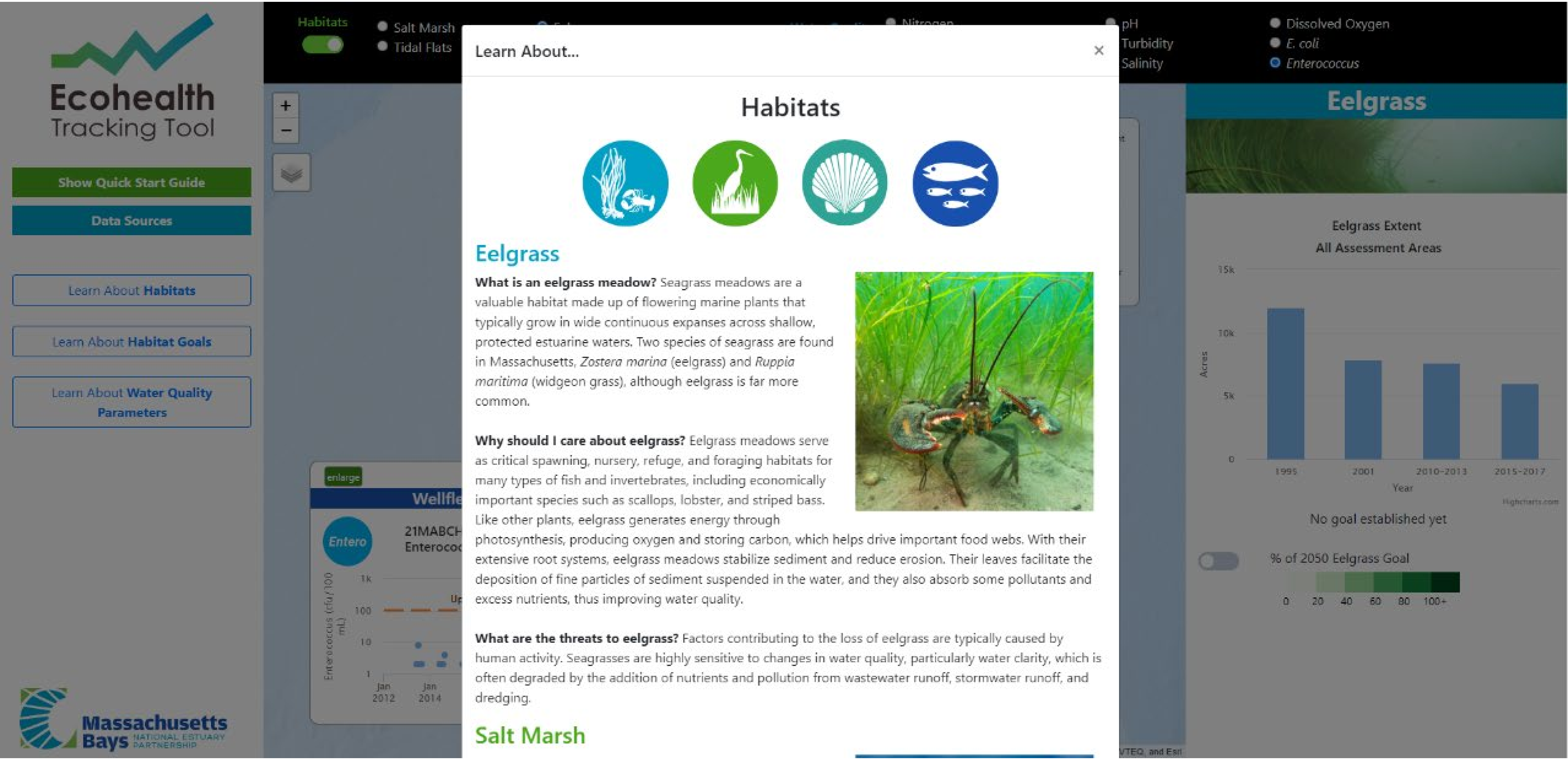
Dive in to learn more about efforts to maintain and restore healthy coastal habitats...and how you can help!

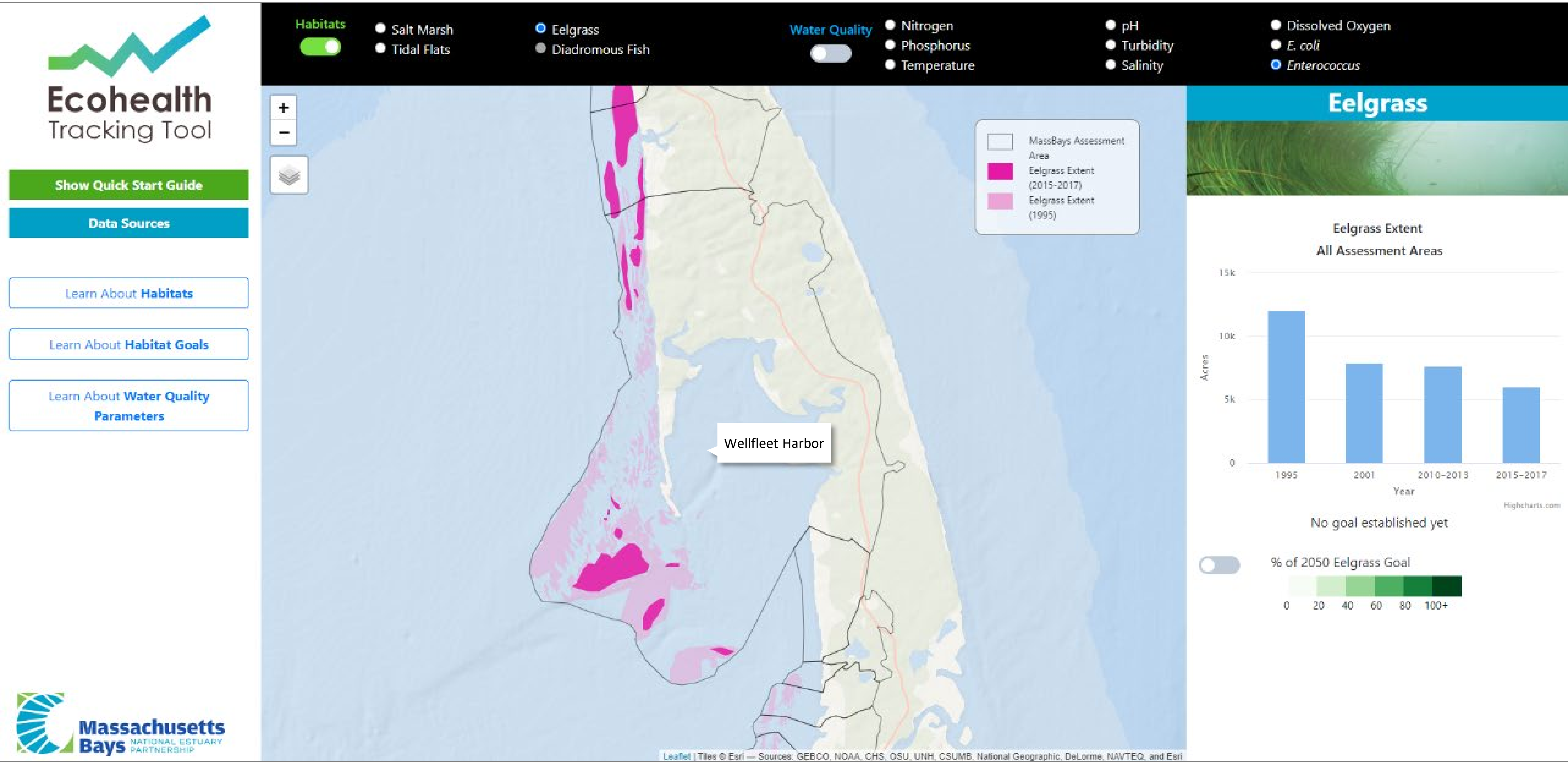
Massachusetts Bays National Estuary Partnership


Ecohealth
Tracking Tool
Show Quick Start Guide
Data Sources
Learn About Habitats
Learn About Habitat Goals
Learn About Water Quality Parameters
Massachusetts Bays NATIONAL ESTUARY PARTNERSHIP
Habitats
Salt Marsh
Tidal Flats
Eelgrass
Diadromous Fish
Water Quality
Nitrogen
Phosphorus
Temperature
pH
Turbidity
Salinity
Dissolved Oxygen
E. coli
Enterococcus
MassBays Assessment Area
Welcome to the ETT
To get started, select a habitat type or water quality.
Eelgrass
Salt Marsh
Tidal Flats
Diadromous Fish
Water Quality
Leaflet | Tiles © Esri — Sources: GEBCO, NOAA, CHS, OSU, UNH, CSUMB, National Geographic, DeLorme, NAVTEQ, and Esri

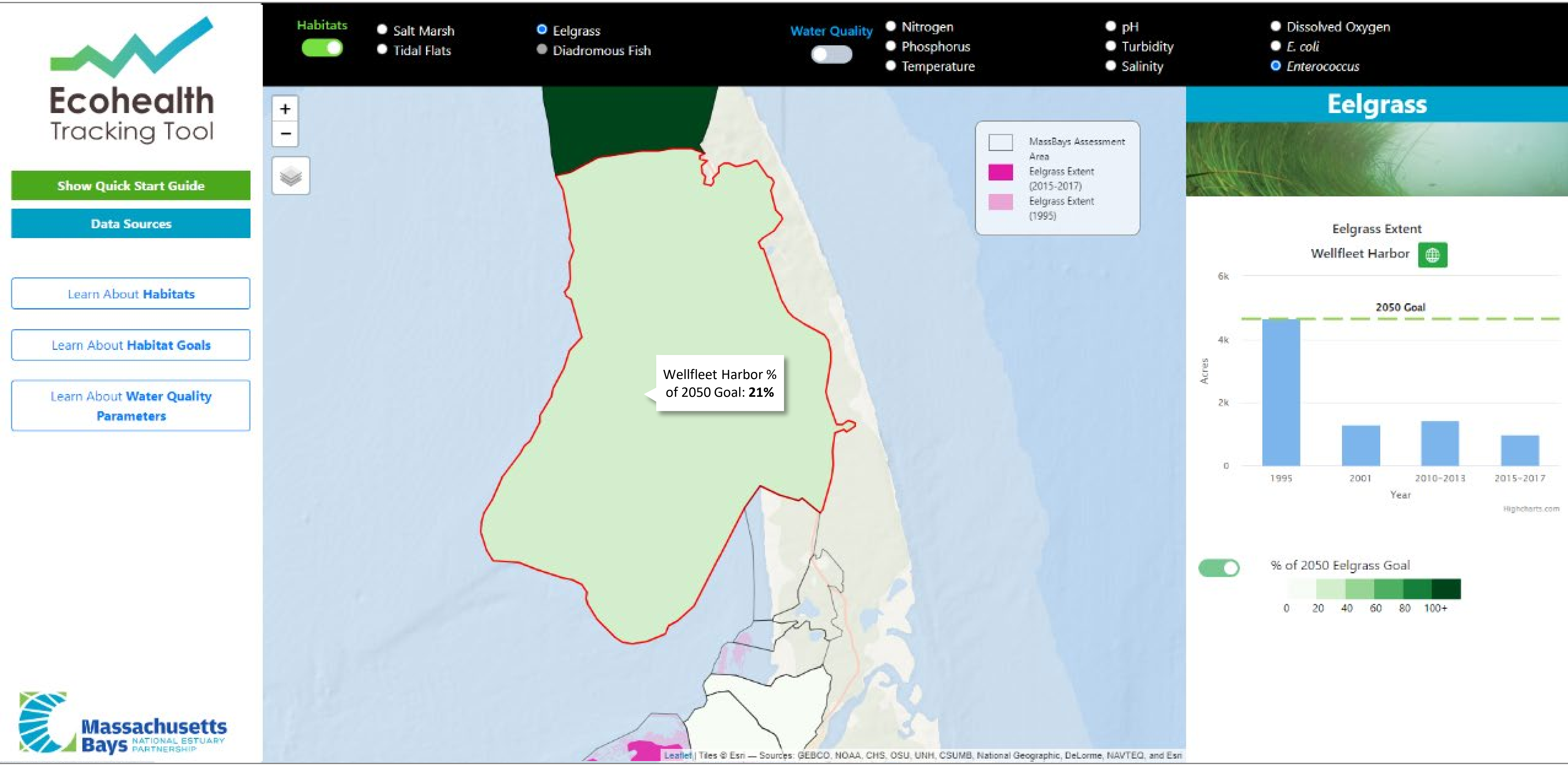

Ecohealth
Tracking Tool
Show Quick Start Guide
Data Sources
Learn About Habitats
Learn About Habitat Goals
Learn About Water Quality Parameters
Massachusetts Bays NATIONAL ESTUARY PARTNERSHIP
Habitats
Salt Marsh
Tidal Flats
Eelgrass
Diadromous Fish
Water Quality
Nitrogen
Phosphorus
Temperature
pH
Turbidity
Salinity
Dissolved Oxygen
E. coli
Enterococcus
MassBays Assessment Area
Eelgrass Extent (2015-2017)
Eelgrass Extent (1995)
Leaflet | Tiles © Esri — Sources: GEBCO, NOAA, CHS, OSU, UNH, CSUMB, National Geographic, DeLorme, NAVTEQ, and Esri
Eelgrass
Eelgrass Extent
All Assessment Areas
15k
10k
5k
0
Acres
1995
2001
2010-2013
2015-2017
Year
Highcharts.com
No goal established yet
% of 2050 Eelgrass Goal
0
20
40
60
80
100+


Ecohealth
Tracking Tool
Show Quick Start Guide
Data Sources
Learn About Habitats
Learn About Habitat Goals
Learn About Water Quality Parameters
Massachusetts Bays NATIONAL ESTUARY PARTNERSHIP
Habitats
Salt Marsh
Tidal Flats
Eelgrass
Diadromous Fish
Water Quality
Nitrogen
Phosphorus
Temperature
pH
Turbidity
Salinity
Dissolved Oxygen
E. coli
Enterococcus
MassBays Assessment Area
Eelgrass Extent (2015-2017)
Eelgrass Extent (1995)
Wellfleet Harbor
Leaflet | Tiles © Esri — Sources: GEBCO, NOAA, CHS, OSU, UNH, CSUMB, National Geographic, DeLorme, NAVTEQ, and Esri
Eelgrass
Eelgrass Extent
All Assessment Areas
15k
10k
5k
0
Acres
1995
2001
2010-2013
2015-2017
Year
Highcharts.com
No goal established yet
% of 2050 Eelgrass Goal
0
20
40
60
80
100+

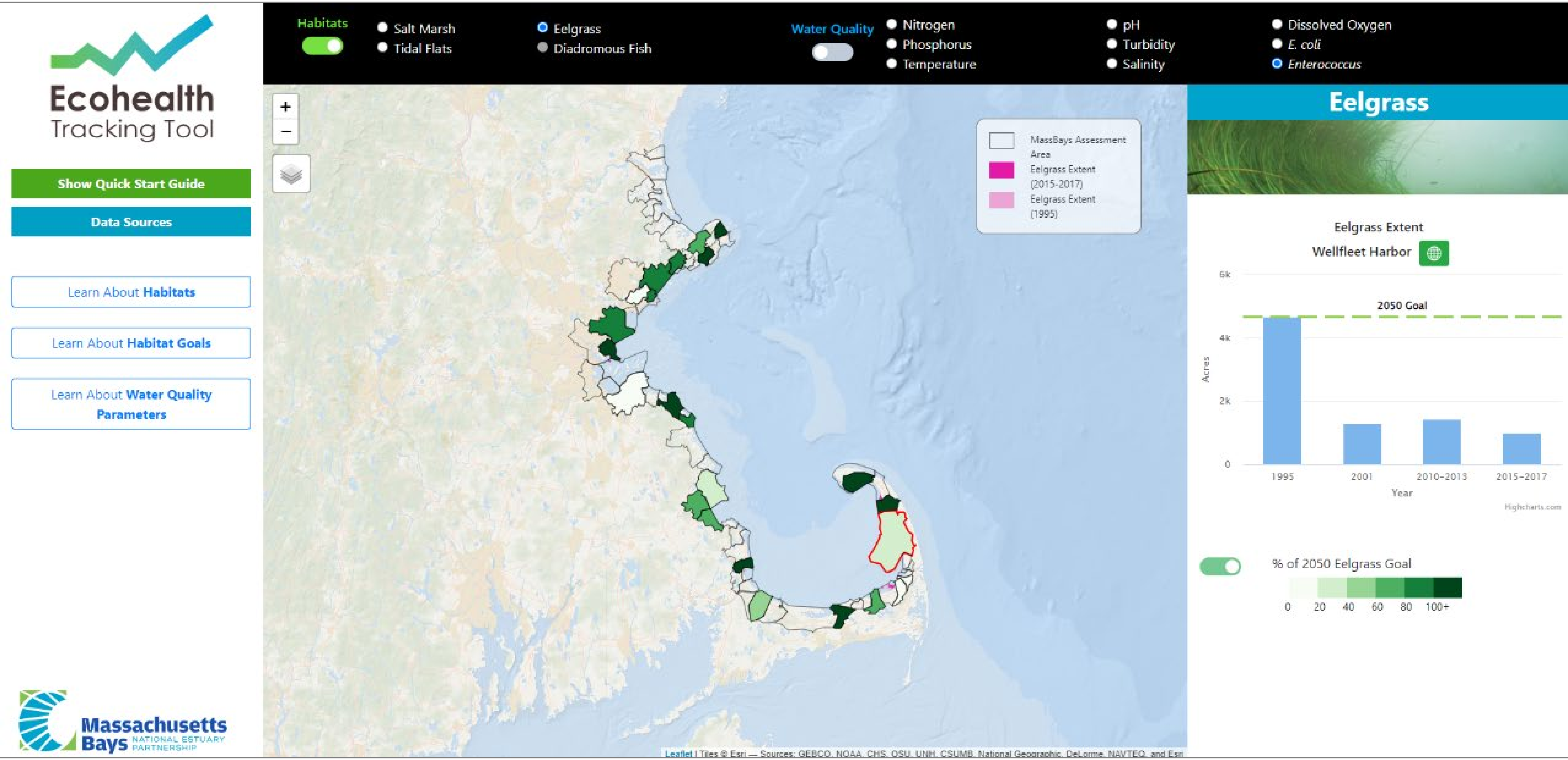

Ecohealth Tracking Tool
Show Quick Start Guide
Data Sources
Learn About Habitats
Learn About Habitat Goals
Learn About Water Quality Parameters
Massachusetts Bays NATIONAL ESTUARY PARTNERSHIP
Habitats
Salt Marsh
Tidal Flats
Nitrogen
pH
Turbidity
Salinity
Dissolved Oxygen
E. coli
Enterococcus
Learn About...
Habitats
Eelgrass
What is an eelgrass meadow? Seagrass meadows are a valuable habitat made up of flowering marine plants that typically grow in wide continuous expanses across shallow, protected estuarine waters. Two species of seagrass are found in Massachusetts, Zostera marina (eelgrass) and Ruppia maritima (widgeon grass), although eelgrass is far more common.
Why should I care about eelgrass? Eelgrass meadows serve as critical spawning, nursery, refuge, and foraging habitats for many types of fish and invertebrates, including economically important species such as scallops, lobster, and striped bass. Like other plants, eelgrass generates energy through photosynthesis, producing oxygen and storing carbon, which helps drive important food webs. With their extensive root systems, eelgrass meadows stabilize sediment and reduce erosion. Their leaves facilitate the deposition of fine particles of sediment suspended in the water, and they also absorb some pollutants and excess nutrients, thus improving water quality.
What are the threats to eelgrass? Factors contributing to the loss of eelgrass are typically caused by human activity. Seagrasses are highly sensitive to changes in water quality, particularly water clarity, which is often degraded by the addition of nutrients and pollution from wastewater runoff, stormwater runoff, and dredging.
Salt Marsh
Eelgrass
Eelgrass Extent
All Assessment Areas
15k
10k
5k
0
Acres
1995
2001
2010-2013
2015-2017
Year
Highcharts.com
No goal established yet
% of 2050 Eelgrass Goal
0
20
40
60
80
100+
enlarge
Entero
1k
100
10
1
Jan 2012
Jan 2014

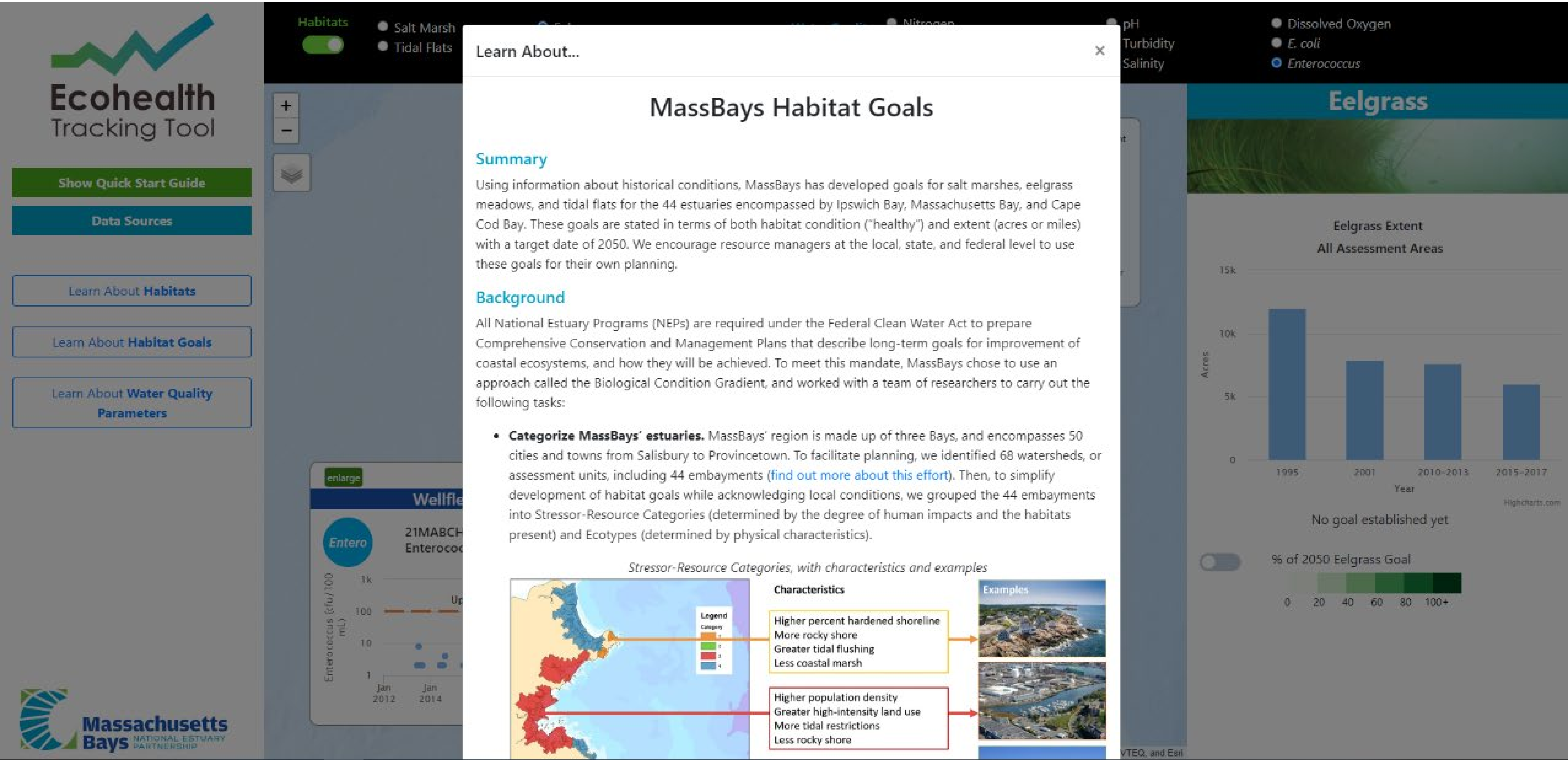


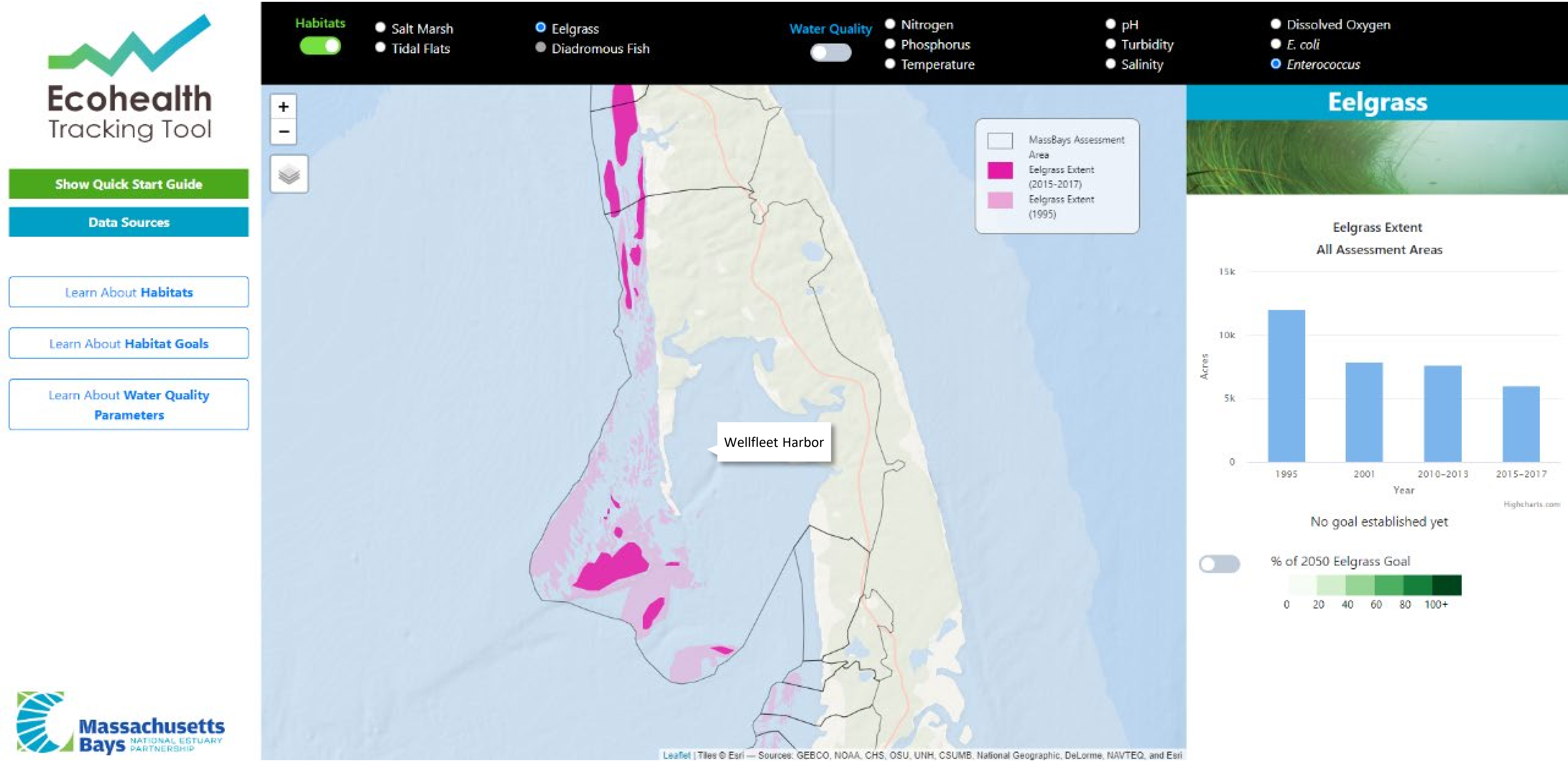
Ecohealth
Tracking Tool
Show Quick Start Guide
Data Sources
Learn About Habitats
Learn About Habitat Goals
Learn About Water Quality Parameters
Massachusetts Bays NATIONAL ESTUARY PARTNERSHIP
Habitats
Salt Marsh
Tidal Flats
Eelgrass
Diadromous Fish
Water Quality
Nitrogen
Phosphorus
Temperature
pH
Turbidity
Salinity
Dissolved Oxygen
E. coli
Enterococcus
MassBays Assessment Area
Eelgrass Extent (2015-2017)
Eelgrass Extent (1995)
Wellfleet Harbor
Leaflet | Tiles © Esri — Sources: GEBCO, NOAA, CHS, OSU, UNH, CSUMB, National Geographic, DeLorme, NAVTEQ, and Esri
Eelgrass
Eelgrass Extent
All Assessment Areas
15k
10k
5k
0
Acres
1995
2001
2010-2013
2015-2017
Year
Highcharts.com
No goal established yet
% of 2050 Eelgrass Goal
0
20
40
60
80
100+

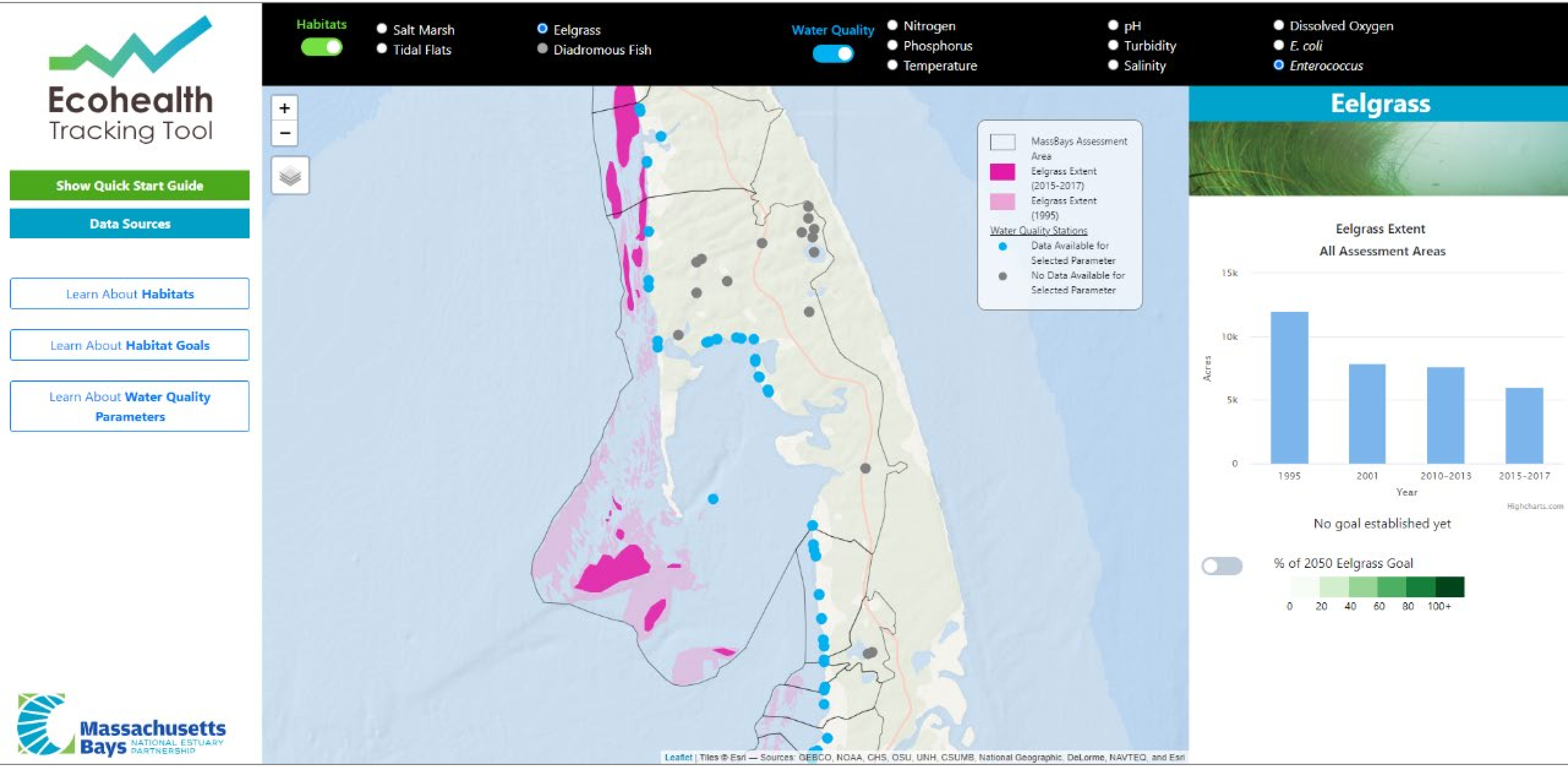


Ecohealth
Tracking Tool
Show Quick Start Guide
Data Sources
Learn About Habitats
Learn About Habitat Goals
Learn About Water Quality Parameters
Massachusetts Bays NATIONAL ESTUARY PARTNERSHIP
Habitats
Salt Marsh
Tidal Flats
Eelgrass
Diadromous Fish
Water Quality
Nitrogen
Phosphorus
Temperature
pH
Turbidity
Salinity
Dissolved Oxygen
E. coli
Enterococcus
+
−
MassBays Assessment Area
Eelgrass Extent (2015-2017)
Eelgrass Extent (1995)
Wellfleet Harbor % of 2050 Goal: 21%
Leaflet | Tiles © Esri — Sources: GEBCO, NOAA, CHS, OSU, UNH, CSUMB, National Geographic, DeLorme, NAVTEQ, and Esri
Eelgrass
Eelgrass Extent
Wellfleet Harbor
6k
4k
2k
0
Acres
2050 Goal
1995
2001
2010-2013
2015-2017
Year
Highcharts.com
% of 2050 Eelgrass Goal
0
20
40
60
80
100+

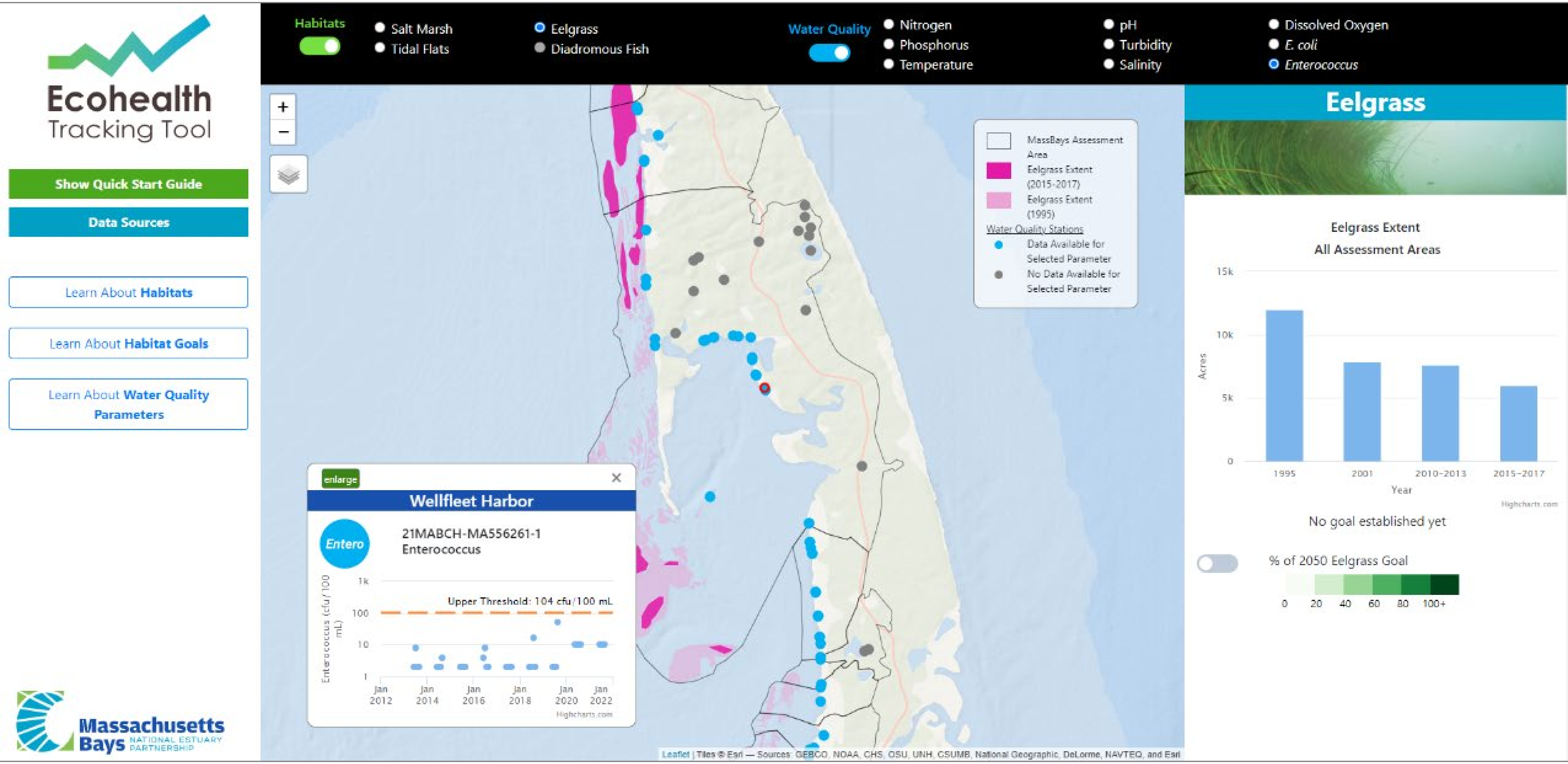

Ecohealth
Tracking Tool
Show Quick Start Guide
Data Sources
Learn About Habitats
Learn About Habitat Goals
Learn About Water Quality Parameters
Massachusetts Bays
NATIONAL ESTUARY PARTNERSHIP
Habitats
Salt Marsh
Tidal Flats
Eelgrass
Diadromous Fish
Water Quality
Nitrogen
Phosphorus
Temperature
pH
Turbidity
Salinity
Dissolved Oxygen
E. coli
Enterococcus
MassBays Assessment Area
Eelgrass Extent (2015-2017)
Eelgrass Extent (1995)
Leaflet | Tiles © Esri — Sources: GEBCO, NOAA, CHS, OSU, UNH, CSUMB, National Geographic, DeLorme, NAVTEQ, and Esri
Eelgrass
Eelgrass Extent
Wellfleet Harbor
6k
4k
2k
0
Acres
2050 Goal
1995
2001
2010-2013
2015-2017
Year
Highcharts.com
% of 2050 Eelgrass Goal
0
20
40
60
80
100+

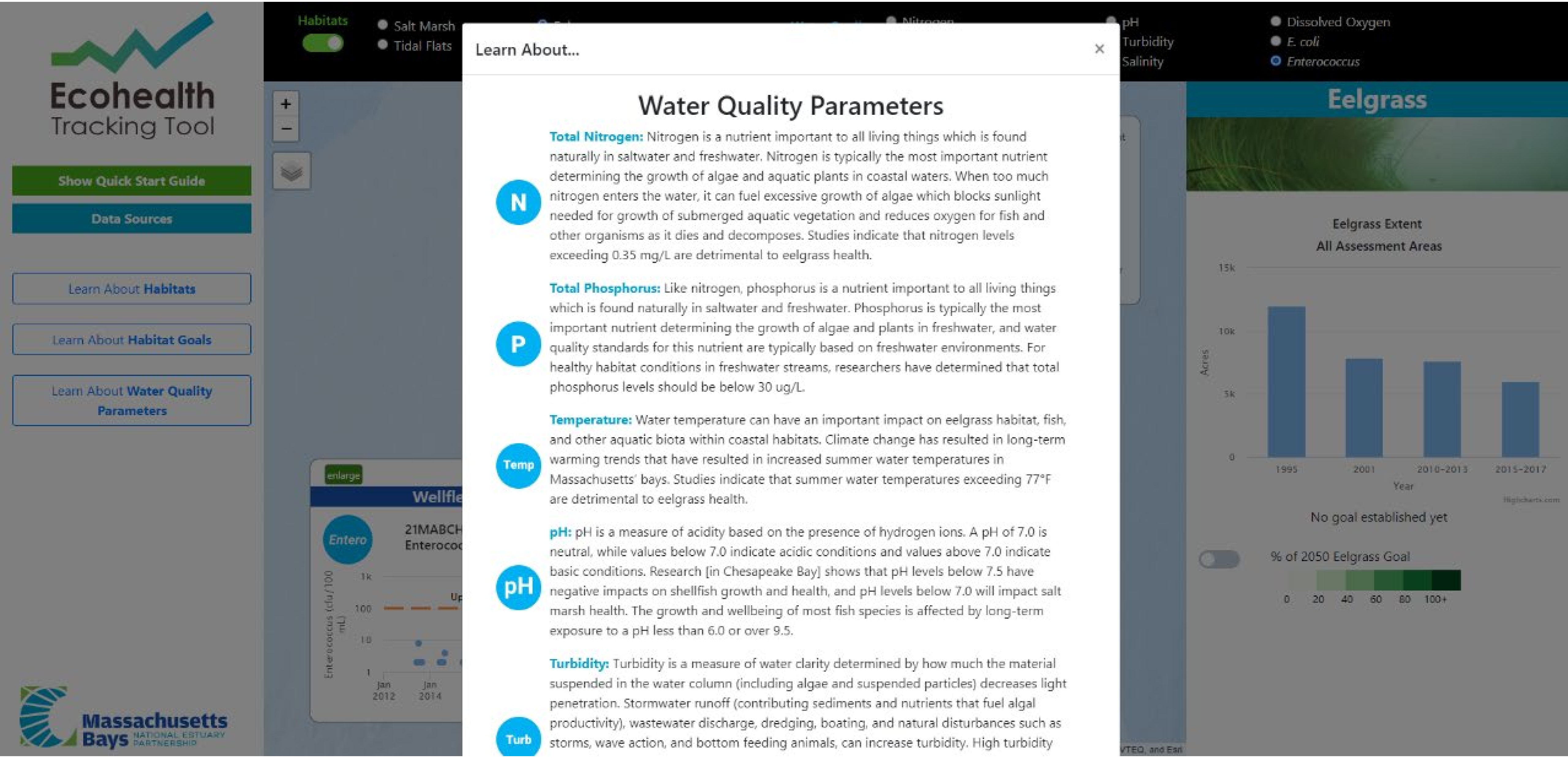

Ecohealth Tracking Tool
Show Quick Start Guide
Data Sources
Learn About Habitats
Learn About Habitat Goals
Learn About Water Quality Parameters
Massachusetts Bays National Estuary Partnership
Habitats
Salt Marsh
Tidal Flats
Nitrogen
pH
Turbidity
Salinity
Dissolved Oxygen
E. coli
Enterococcus
Learn About...
MassBays Habitat Goals
Summary
Using information about historical conditions, MassBays has developed goals for salt marshes, eelgrass meadows, and tidal flats for the 44 estuaries encompassed by Ipswich Bay, Massachusetts Bay, and Cape Cod Bay. These goals are stated in terms of both habitat condition ("healthy") and extent (acres or miles) with a target date of 2050. We encourage resource managers at the local, state, and federal level to use these goals for their own planning.
Background
All National Estuary Programs (NEPs) are required under the Federal Clean Water Act to prepare Comprehensive Conservation and Management Plans that describe long-term goals for improvement of coastal ecosystems, and how they will be achieved. To meet this mandate, MassBays chose to use an approach called the Biological Condition Gradient, and worked with a team of researchers to carry out the following tasks:
Categorize MassBays' estuaries. MassBays' region is made up of three Bays, and encompasses 50 cities and towns from Salisbury to Provincetown. To facilitate planning, we identified 68 watersheds, or assessment units, including 44 embayments (find out more about this effort). Then, to simplify development of habitat goals while acknowledging local conditions, we grouped the 44 embayments into Stressor-Resource Categories (determined by the degree of human impacts and the habitats present) and Ecotypes (determined by physical characteristics).
Stressor-Resource Categories, with characteristics and examples
Legend
Characteristics
Higher percent hardened shoreline
More rocky shore
Greater tidal flushing
Less coastal marsh
Higher population density
Greater high-intensity land use
More tidal restrictions
Less rocky shore
Examples
enlarge
Wellfle
Entero
21MABCH
Enterococ
Eelgrass
Eelgrass Extent
All Assessment Areas
15k
10k
5k
0
Acres
1995
2001
2010-2013
2015-2017
Year
Highcharts.com
No goal established yet
% of 2050 Eelgrass Goal
0
20
40
60
80
100+


Ecohealth
Tracking Tool
Show Quick Start Guide
Data Sources
Learn About Habitats
Learn About Habitat Goals
Learn About Water Quality Parameters
Massachusetts Bays NATIONAL ESTUARY PARTNERSHIP
Habitats
Salt Marsh
Tidal Flats
Eelgrass
Diadromous Fish
Water Quality
Nitrogen
Phosphorus
Temperature
pH
Turbidity
Salinity
Dissolved Oxygen
E. coli
Enterococcus
MassBays Assessment Area
Eelgrass Extent (2015-2017)
Eelgrass Extent (1995)
Wellfleet Harbor
Leaflet | Tiles © Esri — Sources: GEBCO, NOAA, CHS, OSU, UNH, CSUMB, National Geographic, DeLorme, NAVTEQ, and Esri
Eelgrass
Eelgrass Extent
All Assessment Areas
15k
10k
5k
0
Acres
1995
2001
2010-2013
2015-2017
Year
Highcharts.com
No goal established yet
% of 2050 Eelgrass Goal
0
20
40
60
80
100+



Ecohealth
Tracking Tool
Show Quick Start Guide
Data Sources
Learn About Habitats
Learn About Habitat Goals
Learn About Water Quality Parameters
Massachusetts Bays NATIONAL ESTUARY PARTNERSHIP
Habitats
Salt Marsh
Tidal Flats
Eelgrass
Diadromous Fish
Water Quality
Nitrogen
Phosphorus
Temperature
pH
Turbidity
Salinity
Dissolved Oxygen
E. coli
Enterococcus
MassBays Assessment Area
Eelgrass Extent (2015-2017)
Eelgrass Extent (1995)
Water Quality Stations
Data Available for Selected Parameter
No Data Available for Selected Parameter
Leaflet | Tiles © Esri — Sources: GEBCO, NOAA, CHS, OSU, UNH, CSUMB, National Geographic, DeLorme, NAVTEQ, and Esri
Eelgrass
Eelgrass Extent
All Assessment Areas
15k
10k
5k
0
Acres
1995
2001
2010-2013
2015-2017
Year
Highcharts.com
No goal established yet
% of 2050 Eelgrass Goal
0
20
40
60
80
100+


Ecohealth
Tracking Tool
Show Quick Start Guide
Data Sources
Learn About Habitats
Learn About Habitat Goals
Learn About Water Quality Parameters
Massachusetts Bays NATIONAL ESTUARY PARTNERSHIP
Habitats
Salt Marsh
Tidal Flats
Eelgrass
Diadromous Fish
Water Quality
Nitrogen
Phosphorus
Temperature
pH
Turbidity
Salinity
Dissolved Oxygen
E. coli
Enterococcus
MassBays Assessment Area
Eelgrass Extent (2015-2017)
Eelgrass Extent (1995)
Water Quality Stations
Data Available for Selected Parameter
No Data Available for Selected Parameter
enlarge
Wellfleet Harbor
Entero
21MABCH-MA556261-1
Enterococcus
Upper Threshold: 104 cfu/100 mL
Enterococcus (cfu/100 mL)
1k
100
10
1
Jan 2012
Jan 2014
Jan 2016
Jan 2018
Jan 2020
Jan 2022
Highcharts.com
Leaflet | Tiles © Esri — Sources: GEBCO, NOAA, CHS, OSU, UNH, CSUMB, National Geographic, DeLorme, NAVTEQ, and Esri
Eelgrass
Eelgrass Extent
All Assessment Areas
Acres
15k
10k
5k
0
1995
2001
2010-2013
2015-2017
Year
Highcharts.com
No goal established yet
% of 2050 Eelgrass Goal
0
20
40
60
80
100+


Ecohealth
Tracking Tool
Show Quick Start Guide
Data Sources
Learn About Habitats
Learn About Habitat Goals
Learn About Water Quality Parameters
Massachusetts Bays NATIONAL ESTUARY PARTNERSHIP
Habitats
Salt Marsh
Tidal Flats
pH
Turbidity
Salinity
Dissolved Oxygen
E. coli
Enterococcus
Learn About...
×
Water Quality Parameters
N
Total Nitrogen: Nitrogen is a nutrient important to all living things which is found naturally in saltwater and freshwater. Nitrogen is typically the most important nutrient determining the growth of algae and aquatic plants in coastal waters. When too much nitrogen enters the water, it can fuel excessive growth of algae which blocks sunlight needed for growth of submerged aquatic vegetation and reduces oxygen for fish and other organisms as it dies and decomposes. Studies indicate that nitrogen levels exceeding 0.35 mg/L are detrimental to eelgrass health.
P
Total Phosphorus: Like nitrogen, phosphorus is a nutrient important to all living things which is found naturally in saltwater and freshwater. Phosphorus is typically the most important nutrient determining the growth of algae and plants in freshwater, and water quality standards for this nutrient are typically based on freshwater environments. For healthy habitat conditions in freshwater streams, researchers have determined that total phosphorus levels should be below 30 ug/L.
Temp
Temperature: Water temperature can have an important impact on eelgrass habitat, fish, and other aquatic biota within coastal habitats. Climate change has resulted in long-term warming trends that have resulted in increased summer water temperatures in Massachusetts' bays. Studies indicate that summer water temperatures exceeding 77°F are detrimental to eelgrass health.
pH
pH: pH is a measure of acidity based on the presence of hydrogen ions. A pH of 7.0 is neutral, while values below 7.0 indicate acidic conditions and values above 7.0 indicate basic conditions. Research [in Chesapeake Bay] shows that pH levels below 7.5 have negative impacts on shellfish growth and health, and pH levels below 7.0 will impact salt marsh health. The growth and wellbeing of most fish species is affected by long-term exposure to a pH less than 6.0 or over 9.5.
Turb
Turbidity: Turbidity is a measure of water clarity determined by how much the material suspended in the water column (including algae and suspended particles) decreases light penetration. Stormwater runoff (contributing sediments and nutrients that fuel algal productivity), wastewater discharge, dredging, boating, and natural disturbances such as storms, wave action, and bottom feeding animals, can increase turbidity. High turbidity
enlarge
Entero
Eelgrass
Eelgrass Extent
All Assessment Areas
15k
10k
5k
0
Acres
1995
2001
2010-2013
2015-2017
Year
No goal established yet
% of 2050 Eelgrass Goal
0
20
40
60
80
100+

Ecohealth
Tracking Tool

Water Quality Data Analysis

Water Quality

- Nitrogen
- Phosphorus
- Temperature
- pH
- Turbidity
- Salinity
- Dissolved Oxygen
- *E. coli*
- *Enterococcus*

Many data sources = many data formats=

- Units
- Naming
- Reporting Limits
- Depth Zones
- Etc.

WQ Data from Water Quality Data Portal (WQP)

NCBN0001	Estuarine	NCBN	11NPSWR	Monitoring Location CACO_Hx23_1 at CACO	41.8145	-69.9609	NCBN_SO	11NPSWR	NCBN SOF	Once on s	Water Bot	STORET-920926419		Chlorophy	Total	10.17	ug/l		Final		Actual
NCBN0001	Estuarine	NCBN	11NPSWR	Monitoring Location CACO_Hx1_2 at CACO	41.675	-69.9432	NCBN_SO	11NPSWR	NCBN SOF	Once on s	Water Bot	STORET-920920737		Chlorophy	Total	4.3	ug/l		Final		Actual
NCBN0001	Estuarine	NCBN	11NPSWR	Monitoring Location CACO_SpF_10 at CACO	41.76044	-69.9829	NCBN_SO	11NPSWR	NCBN SOF	Once on s	Water Bot	STORET-920937211		Chlorophy	Total	42.5	ug/l		Final		Actual
NCBN0001	Estuarine	NCBN	11NPSWR	Monitoring Location CACO_Hx7_1 at CACO	41.73024	-69.9697	NCBN_SO	11NPSWR	NCBN SOF	Once on s	Water Bot	STORET-920931266		Chlorophy	Total	12.3	ug/l		Final		Actual
NCBN0001	Estuarine	NCBN	11NPSWR	Monitoring Location CACO_LS_SP at CACO	41.83521	-69.9711	NCBN_SO	11NPSWR	NCBN SOF	Once on s	Water Bot	STORET-920935663		Chlorophy	Total	15.26	ug/l		Final		Actual
NCBN0001	Estuarine	NCBN	11NPSWR	Monitoring Location CACO_Hx19_4 at CACO	41.7978	-69.9752	NCBN_SO	11NPSWR	NCBN SOF	Once on s	Water Bot	STORET-920924449		Chlorophy	Total	13.47	ug/l		Final		Actual
NCBN0001	Estuarine	NCBN	11NPSWR	Monitoring Location CACO_Hx17_4 at CACO	41.78969	-69.9805	NCBN_SO	11NPSWR	NCBN SOF	Once on s	Water Bot	STORET-920923279		Chlorophy	Total	25.08	ug/l		Final		Actual
NCBN0001	Estuarine	NCBN	11NPSWR	Monitoring Location CACO_Hx11_6 at CACO	41.75815	-69.9523	NCBN_SO	11NPSWR	NCBN SOF	Once on s	Water Bot	STORET-920921970		Chlorophy	Total	2.48	ug/l		Final		Actual
NCBN0001	Estuarine	NCBN	11NPSWR	Monitoring Location CACO_SpC_2 at CACO	41.79328	-69.9499	NCBN_SO	11NPSWR	NCBN SOF	Once on s	Water Bot	STORET-920936477		Chlorophy	Total	95.57	ug/l		Final		Actual
NCBN0001	Estuarine	NCBN	11NPSWR	Monitoring Location CACO_Hx3_1 at CACO	41.70025	-69.9363	NCBN_SO	11NPSWR	NCBN SOF	Once on s	Water Bot	STORET-920929250		Chlorophy	Total	6.37	ug/l		Final		Actual
NCBN0001	Estuarine	NCBN	11NPSWR	Monitoring Location CACO_Hx18_1 at CACO	41.7995	-69.9769	NCBN_SO	11NPSWR	NCBN SOF	Once on s	Water Bot	STORET-920923666		Chlorophy	Total	8.71	ug/l		Final		Actual
NCBN0001	Estuarine	NCBN	11NPSWR	Monitoring Location CACO_Hx3_1 at CACO	41.69936	-69.9364	NCBN_SO	11NPSWR	NCBN SOF	Once on s	Water Bot	STORET-920928892		Chlorophy	Total	3.1	ug/l		Final		Actual
NCBN0001	Estuarine	NCBN	11NPSWR	Monitoring Location CACO_SpA_2 at CACO	41.83421	-69.9719	NCBN_SO	11NPSWR	NCBN SOF	Once on s	Water Bot	STORET-920935907		Chlorophy	Total	7.37	ug/l		Final		Actual
NCBN0001	Estuarine	NCBN	11NPSWR	Monitoring Location CACO_LS_NH at CACO	41.81919	-69.9582	NCBN_SO	11NPSWR	NCBN SOF	Once on s	Water Bot	STORET-920932757		Chlorophy	Total	10.44	ug/l		Final		Actual
NCBN0001	Estuarine	NCBN	11NPSWR	Monitoring Location CACO_Hx27_11 at CACO	41.83176	-69.9678	NCBN_SO	11NPSWR	NCBN SOF	Once on s	Water Bot	STORET-920927227		Chlorophy	Total	9.63	ug/l		Final		Actual
NCBN0001	Estuarine	NCBN	11NPSWR	Monitoring Location CACO_LS_NH at CACO	41.8213	-69.9591	NCBN_SO	11NPSWR	NCBN SOF	Once on s	Water Bot	STORET-920932203		Chlorophy	Total	3.95	ug/l		Final		Actual
NCBN0001	Estuarine	NCBN	11NPSWR	Monitoring Location CACO_Hx18_1 at CACO	41.7995	-69.9769	NCBN_SO	11NPSWR	NCBN SOF	Once on s	Water Bot	STORET-920924218		Chlorophy	Total	15.67	ug/l		Final		Actual
NCBN0001	Estuarine	NCBN	11NPSWR	Monitoring Location CACO_LS_PB at CACO	41.75226	-69.9578	NCBN_SO	11NPSWR	NCBN SOF	Once on s	Water Bot	STORET-920934233		Chlorophy	Total	3.53	ug/l		Final		Actual
NCBN0001	Estuarine	NCBN	11NPSWR	Monitoring Location CACO_Hx16_4 at CACO	41.78829	-69.9854	NCBN_SO	11NPSWR	NCBN SOF	Once on s	Water Bot	STORET-920923041		Chlorophy	Total	40.34	ug/l		Final		Actual
NCBN0001	Estuarine	NCBN	11NPSWR	Monitoring Location CACO_Hx11_6 at CACO	41.75716	-69.9511	NCBN_SO	11NPSWR	NCBN SOF	Once on s	Water Bot	STORET-920921902		Chlorophy	Total	2.5	ug/l		Final		Actual
NCBN0001	Estuarine	NCBN	11NPSWR	Monitoring Location CACO_Hx28_2 at CACO	41.8334	-69.9653	NCBN_SO	11NPSWR	NCBN SOF	Once on s	Water Bot	STORET-920927450		Chlorophy	Total	1.67	ug/l		Final		Actual
NCBN0001	Estuarine	NCBN	11NPSWR	Monitoring Location CACO_Hx3_1 at CACO	41.70041	-69.9356	NCBN_SO	11NPSWR	NCBN SOF	Once on s	Water Bot	STORET-920929200		Chlorophy	Total	4.2	ug/l		Final		Actual
NCBN0001	Estuarine	NCBN	11NPSWR	Monitoring Location CACO_SpG_12 at CACO	41.75539	-69.9702	NCBN_SO	11NPSWR	NCBN SOF	Once on s	Water Bot	STORET-920937498		Chlorophy	Total	6.3	ug/l		Final		Actual
NCBN0001	Estuarine	NCBN	11NPSWR	Monitoring Location CACO_LS_NH at CACO	41.82133	-69.9591	NCBN_SO	11NPSWR	NCBN SOF	Once on s	Water Bot	STORET-920932023		Chlorophy	Total	2.17	ug/l		Final		Actual
NCBN0001	Estuarine	NCBN	11NPSWR	Monitoring Location CACO_Hx3_1 at CACO	41.70024	-69.9363	NCBN_SO	11NPSWR	NCBN SOF	Once on s	Water Bot	STORET-920929292		Chlorophy	Total	2.98	ug/l		Final		Actual
NCBN0001	Estuarine	NCBN	11NPSWR	Monitoring Location CACO_LS_PB at CACO	41.75229	-69.9578	NCBN_SO	11NPSWR	NCBN SOF	Once on s	Water Bot	STORET-920933841		Chlorophy	Total	4.6	ug/l		Final		Actual
NCBN0001	Estuarine	NCBN	11NPSWR	Monitoring Location CACO_LS_PB at CACO	41.75235	-69.9577	NCBN_SO	11NPSWR	NCBN SOF	Once on s	Water Bot	STORET-920934365		Chlorophy	Total	2.11	ug/l		Final		Actual
NCBN0001	Estuarine	NCBN	11NPSWR	Monitoring Location CACO_Hx23_1 at CACO	41.81455	-69.9608	NCBN_SO	11NPSWR	NCBN SOF	Once on s	Water Bot	STORET-920925812		Chlorophy	Total	4.33	ug/l		Final		Actual
NCBN0001	Estuarine	NCBN	11NPSWR	Monitoring Location CACO_LS_NH at CACO	41.8213	-69.9591	NCBN_SO	11NPSWR	NCBN SOF	Once on s	Water Bot	STORET-920932975		Chlorophy	Total	7.95	ug/l		Final		Actual
NCBN0001	Estuarine	NCBN	11NPSWR	Monitoring Location CACO_Hx10_4 at CACO	41.7522	-69.9581	NCBN_SO	11NPSWR	NCBN SOF	Once on s	Water Bot	STORET-920921064		Chlorophy	Total	16.81	ug/l		Final		Actual
NCBN0001	Estuarine	NCBN	11NPSWR	Monitoring Location CACO_LS_PB at CACO	41.75228	-69.9579	NCBN_SO	11NPSWR	NCBN SOF	Once on s	Water Bot	STORET-920933232		Chlorophy	Total	5.89	ug/l		Final		Actual
NCBN0001	Estuarine	NCBN	11NPSWR	Monitoring Location CACO_Hx3_1 at CACO	41.69987	-69.9363	NCBN_SO	11NPSWR	NCBN SOF	Once on s	Water Bot	STORET-920929041		Chlorophy	Total	1.11	ug/l		Final		Actual
NCBN0001	Estuarine	NCBN	11NPSWR	Monitoring Location CACO_Hx17_5 at CACO	41.79084	-69.9795	NCBN_SO	11NPSWR	NCBN SOF	Once on s	Water Bot	STORET-920923304		Chlorophy	Total	13	ug/l		Final		Actual
NCBN0001	Estuarine	NCBN	11NPSWR	Monitoring Location CACO_Hx28_2 at CACO	41.83334	-69.9656	NCBN_SO	11NPSWR	NCBN SOF	Once on s	Water Bot	STORET-920927978		Chlorophy	Total	6	ug/l		Final		Actual
NCBN0001	Estuarine	NCBN	11NPSWR	Monitoring Location CACO_Hx2_4 at CACO	41.69289	-69.9433	NCBN_SO	11NPSWR	NCBN SOF	Once on s	Water Bot	STORET-920924742		Chlorophy	Total	1.63	ug/l		Final		Actual
NCBN0001	Estuarine	NCBN	11NPSWR	Monitoring Location CACO_Hx22_5 at CACO	41.80309	-69.9734	NCBN_SO	11NPSWR	NCBN SOF	Once on s	Water Bot	STORET-920925448		Chlorophy	Total	52	ug/l		Final		Actual
NCBN0001	Estuarine	NCBN	11NPSWR	Monitoring Location CACO_Hx11_6 at CACO	41.75753	-69.9507	NCBN_SO	11NPSWR	NCBN SOF	Once on s	Water Bot	STORET-920921239		Chlorophy	Total	11.3	ug/l		Final		Actual

Parameter Units and Naming

Ecohealth Tracking Tool

ETT Parameter	WQP Characteristic Name	Exclude Units	Target Units
Total Phosphorous	Phosphorus		ug/L
Total Phosphorous	Total Phosphorus, mixed forms		ug/L
Total Kjedldahl Nitrogen	Kjeldahl nitrogen (Organic N & NH3)		mg/L
Total Kjedldahl Nitrogen	Kjeldahl nitrogen		mg/L
Total Kjedldahl Nitrogen	Total Kjeldahl nitrogen		mg/L
Nitrate + Nitrite	Inorganic nitrogen (nitrate and nitrite)		mg/L
Nitrate + Nitrite	Nitrate + Nitrite		mg/L
Total Nitrogen	Nitrogen		mg/L
Total Nitrogen	Nitrogen, mixed forms (NH3), (NH4), organic, (NO2) and (NO3)		mg/L
Total Nitrogen	Total Nitrogen, mixed forms		mg/L
Total Nitrogen	Total Nitrogen, mixed forms (NH3), (NH4), organic, (NO2) and (NO3)		mg/L
Total Nitrogen	Nutrient-nitrogen		mg/L
Total Nitrogen	Computed: [TKN] + [Nitrate + Nitrite]		mg/L
Chlorophyll a	Chlorophyll a (probe)		ug/L
Chlorophyll a	Chlorophyll a		ug/L
Enterococcus	Enterococcus		#/100mL
E. coli	Escherichia coli		#/100mL
Temperature	Temperature, water		deg C
pH	pH		std units
Dissolved Oxygen	Dissolved oxygen (DO)	%	mg/L
Salinity	Salinity		ppt
Turbidity	Turbidity	NTRU,FNU,FTU,JTU	NTU
Turbidity	Turbidity Field	NTRU,FNU,FTU,JTU	NTU

TKN and Inorganic N not shown on ETT…only used to compute TN

Include MPN/100ml and cfu/100ml… these are interchangeable

NUTRIENTS UNIT CONVERSION (molar -> ppm)

From uM to mg/L	To mg/L
TP	(uM x 30.97)/1000
TN	(uM x 14.01)/1000

Ecohealth Tracking Tool

Sample fractions

characteristic_name	result_sample_fraction_text	n
Dissolved oxygen (DO)	None	381
Dissolved oxygen (DO)	Total	91
Dissolved oxygen (DO)	Unfiltered	333
Dissolved oxygen (DO)	NA	12418
Nitrogen	Dissolved	227
Nitrogen	Suspended	82
Nitrogen	Total	208
pH	None	338
pH	Total	353
pH	Unfiltered	330
pH	NA	9767
Phosphorus	Dissolved	610
Phosphorus	Total	1582
Temperature, water	None	407
Temperature, water	Total	91
Temperature, water	Unfiltered	221
Temperature, water	NA	17869

Units

characteristic_name	result_measure_measure_unit_code	n
Dissolved oxygen (DO)	%	564
Dissolved oxygen (DO)	mg/l	12450
Dissolved oxygen (DO)	ml/l	4
Dissolved oxygen (DO)	ppm	205
Nitrogen	mg/l	226
Nitrogen	umol	289
Nitrogen	NA	2
pH	None	10520
pH	std units	268
Phosphorus	mg/l	800
Phosphorus	mg/l as P	1149
Phosphorus	ug/l	50
Phosphorus	umol	180
Phosphorus	NA	13
Temperature, water	deg C	17927
Temperature, water	deg F	661

Total P and N vs. Dissolved Fractions

Ecohealth
Tracking Tool

Phosphorus

	organization_identifier	monitoring_location_identifier	activity_identifier	activity_start_date	activity_start_time_time	result_sample_fraction_text	result_measure_value
1	USGS-MA	USGS-01100823	nwisma.01.02000977	2020-06-08	18:35:00	Total	0.037
2	USGS-MA	USGS-01100823	nwisma.01.02000977	2020-06-08	18:35:00	Dissolved	0.011
3	USGS-MA	USGS-01100823	nwisma.01.02000978	2020-06-08	18:10:00	Total	0.032
4	USGS-MA	USGS-01100823	nwisma.01.02000978	2020-06-08	18:10:00	Dissolved	0.015
5	USGS-MA	USGS-01100823	nwisma.01.02001296	2020-06-30	12:35:00	Total	0.057
6	USGS-MA	USGS-01100823	nwisma.01.02001296	2020-06-30	12:35:00	Dissolved	0.011
7	USGS-MA	USGS-01100823	nwisma.01.02001297	2020-06-30	12:20:00	Total	0.049
8	USGS-MA	USGS-01100823	nwisma.01.02001297	2020-06-30	12:20:00	Dissolved	0.016
9	USGS-MA	USGS-01100823	nwisma.01.02001501	2020-07-28	11:25:00	Total	0.049
10	USGS-MA	USGS-01100823	nwisma.01.02001501	2020-07-28	11:25:00	Dissolved	0.023
11	USGS-MA	USGS-01100823	nwisma.01.02001502	2020-07-28	11:15:00	Total	0.054
12	USGS-MA	USGS-01100823	nwisma.01.02001502	2020-07-28	11:15:00	Dissolved	0.022
13	USGS-MA	USGS-01100823	nwisma.01.02002125	2020-09-01	13:25:00	Total	0.043
14	USGS-MA	USGS-01100823	nwisma.01.02002125	2020-09-01	13:25:00	Dissolved	0.027
15	USGS-MA	USGS-01100823	nwisma.01.02002126	2020-09-01	13:15:00	Total	0.039
16	USGS-MA	USGS-01100823	nwisma.01.02002126	2020-09-01	13:15:00	Dissolved	0.029

Nitrogen

	organization_identifier	monitoring_location_identifier	activity_identifier	activity_start_date	activity_start_time_time	result_sample_fraction_text	result_measure_value
47	11NPSWRD_WQX	11NPSWRD_WQX-NETN_SAIR_19	11NPSWRD_WQX-NETN_SAIR_19_20090508_W_0.2_F...	2009-05-08	08:00:00	Total	0.866
48	11NPSWRD_WQX	11NPSWRD_WQX-NETN_SAIR_19	11NPSWRD_WQX-NETN_SAIR_19_20090508_W_0.2_F...	2009-05-08	08:00:00	Dissolved	0.92
49	11NPSWRD_WQX	11NPSWRD_WQX-NETN_SAIR_19	11NPSWRD_WQX-NETN_SAIR_19_20090820_W_0.2_E...	2009-08-20	08:00:00	Total	1.41
50	11NPSWRD_WQX	11NPSWRD_WQX-NETN_SAIR_19	11NPSWRD_WQX-NETN_SAIR_19_20090820_W_0.2_E...	2009-08-20	08:00:00	Dissolved	1.05
51	11NPSWRD_WQX	11NPSWRD_WQX-NETN_SAIR_19	11NPSWRD_WQX-NETN_SAIR_19_20100524_W_0.2_E...	2010-05-24	16:00:00	Total	1.03
52	11NPSWRD_WQX	11NPSWRD_WQX-NETN_SAIR_19	11NPSWRD_WQX-NETN_SAIR_19_20100524_W_0.2_E...	2010-05-24	16:00:00	Dissolved	0.888
53	11NPSWRD_WQX	11NPSWRD_WQX-NETN_SAIR_19	11NPSWRD_WQX-NETN_SAIR_19_20110523_W_0.2_E...	2011-05-23	14:00:00	Dissolved	0.96
54	11NPSWRD_WQX	11NPSWRD_WQX-NETN_SAIR_19	11NPSWRD_WQX-NETN_SAIR_19_20110523_W_0.2_F...	2011-05-23	14:00:00	Total	1.04
55	11NPSWRD_WQX	11NPSWRD_WQX-NETN_SAIR_19	11NPSWRD_WQX-NETN_SAIR_19_20110824_W_0.2_F...	2011-08-24	10:00:00	Dissolved	0.931
56	11NPSWRD_WQX	11NPSWRD_WQX-NETN_SAIR_19	11NPSWRD_WQX-NETN_SAIR_19_20110824_W_0.2_E...	2011-08-24	10:00:00	Total	0.934
57	11NPSWRD_WQX	11NPSWRD_WQX-NETN_SAIR_20	11NPSWRD_WQX-NETN_SAIR_20_20080519_W_0.2_E...	2008-05-19	10:30:00	Dissolved	0.542
58	11NPSWRD_WQX	11NPSWRD_WQX-NETN_SAIR_20	11NPSWRD_WQX-NETN_SAIR_20_20080519_W_0.2_E...	2008-05-19	10:30:00	Total	0.946

Present TP and TN
…exclude dissolved fractions

Samples Below or Above Quantification Limit

Ecohealth Tracking Tool

<u>Options</u>

- Exclude (skews and limits data set)
- 0 (skews low, optimistic)
- at detection limit (skews high, conservative)
- at ½ detection limit

Other options require more complex statistical analysis (e.g., statistical distribution of data > limit)

Based on MassDEP CALM:

- Data < or > quantification limit will be shown **<u>at the limit</u>** (e.g. < 10 ug/L shown as 10 ug/L)

Result Detection Condition Text

.	n	percent	valid_percent
Detected Not Quantified	11	8.839957e-05	6.178387e-04
Not Detected	17724	1.424358e-01	9.955066e-01
Not Reported	1	8.036324e-06	5.616715e-05
Present Above Quantification Limit	2	1.607265e-05	1.123343e-04
Present Below Quantification Limit	66	5.303974e-04	3.707032e-03
<NA>	106631	8.569213e-01	NA

Detection Quantitation Limit

	wq_param	result_measure_value	result_detection_condition_text	detection_quantitation_limit_measure_measure_value	detection_quantitat
1	TP	NA	Not Detected	0.004	mg/l as P
2	TP	NA	Not Detected	0.008	mg/l as P
3	TP	NA	Not Detected	0.050	mg/l as P
4	TP	NA	Not Detected	0.008	mg/l as P
5	TP	NA	Not Detected	0.050	mg/l as P
6	DO	NA	Present Below Quantification Limit	0.200	mg/l
7	DO	NA	Present Below Quantification Limit	0.200	mg/l
8	DO	NA	Present Below Quantification Limit	0.200	mg/l
9	DO	NA	Present Below Quantification Limit	0.200	mg/l
10	DO	NA	Present Below Quantification Limit	0.200	mg/l

Sample Depth

Ecohealth Tracking Tool

- Only **3% at Surface**
- Nearly 50% are unknown (“blank”)
- Nearly 50% of all samples are “**Midwater**”
  - ➢ Vast majority of “midwater” samples are from EPA BEACH and MA DPH bacteria sampling, where protocol is to sample at 3 ft …**keep these!**

```
> ett_wq_data$activity_relative_depth_name %>%
           .     n      percent valid_percent
      Bottom  1273 0.0101309140  0.0196350624
    Midwater 59494 0.4734710119  0.9176499622
 Near Bottom    16 0.0001273328  0.0002467879
     Surface  4050 0.0322311090  0.0624681875
        <NA> 60822 0.4840396323            NA
```

Show data in ETT if...

- ActivityRelativeDepthName = blank (OR) “Surface” AND
- “ActivityDepthHeightMeasure/MeasureValue” <= 0.1 m (OR) is blank
- Midwater sample = EPA BEACH or MA DPH bacteria sample

Do not show data if...

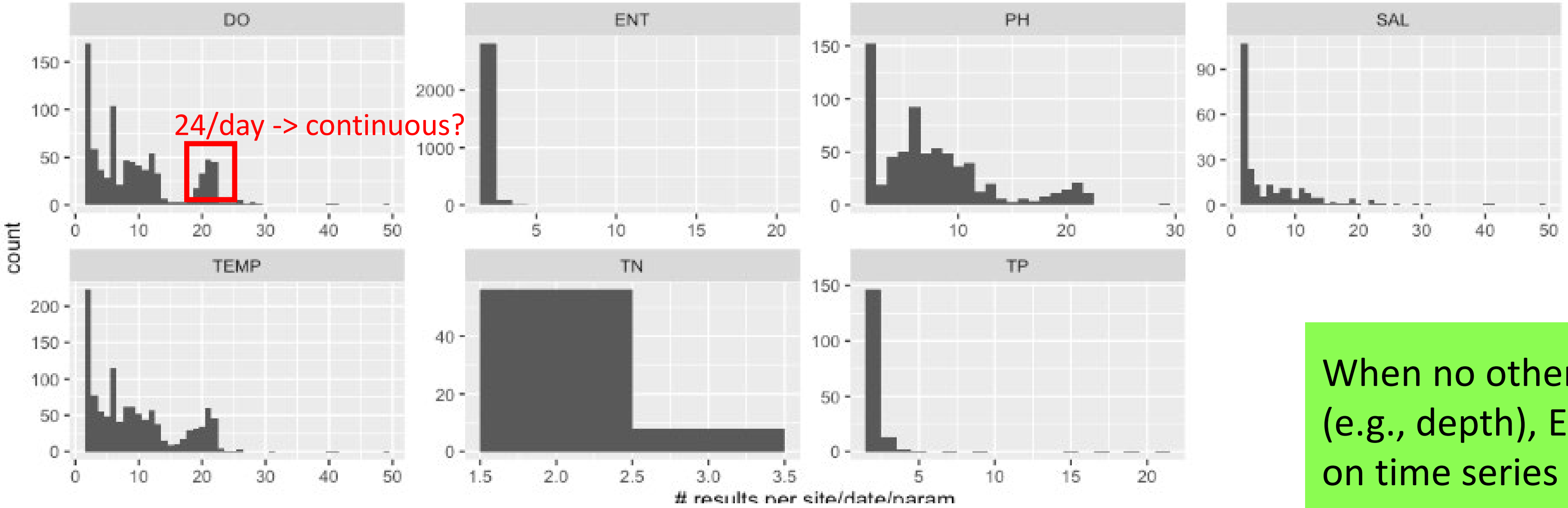
- Bottom or Near Bottom sample
- Midwater sample depth = **> 3 feet**

Replicates

Same station, date, no depth info, different values

	monitoring_location_identifier	activity_start_date	characteristic_name	activity_depth_height_measure_measure_value	result_depth_height_measure_measure_value	result_measure_value	n
1	11NPSWRD_WQX-CACO_DYER	1997-04-29	Phosphorus	0.50	NA	0.2000	2
2	11NPSWRD_WQX-CACO_DYER	1997-04-29	Phosphorus	0.50	NA	0.2700	2
3	11NPSWRD_WQX-CACO_DYER	1997-08-27	Phosphorus	0.50	NA	0.4500	3
4	11NPSWRD_WQX-CACO_DYER	1997-08-27	Phosphorus	0.50	NA	0.3600	3
5	11NPSWRD_WQX-CACO_DYER	1997-08-27	Phosphorus	0.50	NA	0.2200	3

Histograms of # results per site/date/param



When no other excluding data is present (e.g., depth), ETT **includes all data** as **points** on time series (not line graph)

Result status

characteristic_name	result_status_identifier	n
Dissolved oxygen (DO)	Final	13223
Nitrogen	Accepted	89
Nitrogen	Final	405
Nitrogen	Preliminary	23
pH	Accepted	97
pH	Final	10520
pH	Historical	116
pH	Preliminary	55
Phosphorus	Accepted	917
Phosphorus	Final	999
Phosphorus	Historical	161
Phosphorus	Preliminary	115
Temperature, water	Accepted	189
Temperature, water	Final	17476
Temperature, water	Historical	868
Temperature, water	Preliminary	55

Result value type

characteristic_name	result_value_type_name	n
Dissolved oxygen (DO)	Actual	12659
Dissolved oxygen (DO)	Calculated	564
Nitrogen	Actual	507
Nitrogen	Calculated	10
pH	Actual	10788
Phosphorus	Actual	2166
Phosphorus	Calculated	10
Phosphorus	Estimated	16
Temperature, water	Actual	18587
Temperature, water	Estimated	1

Data Quality Decisions

Ecohealth Tracking Tool

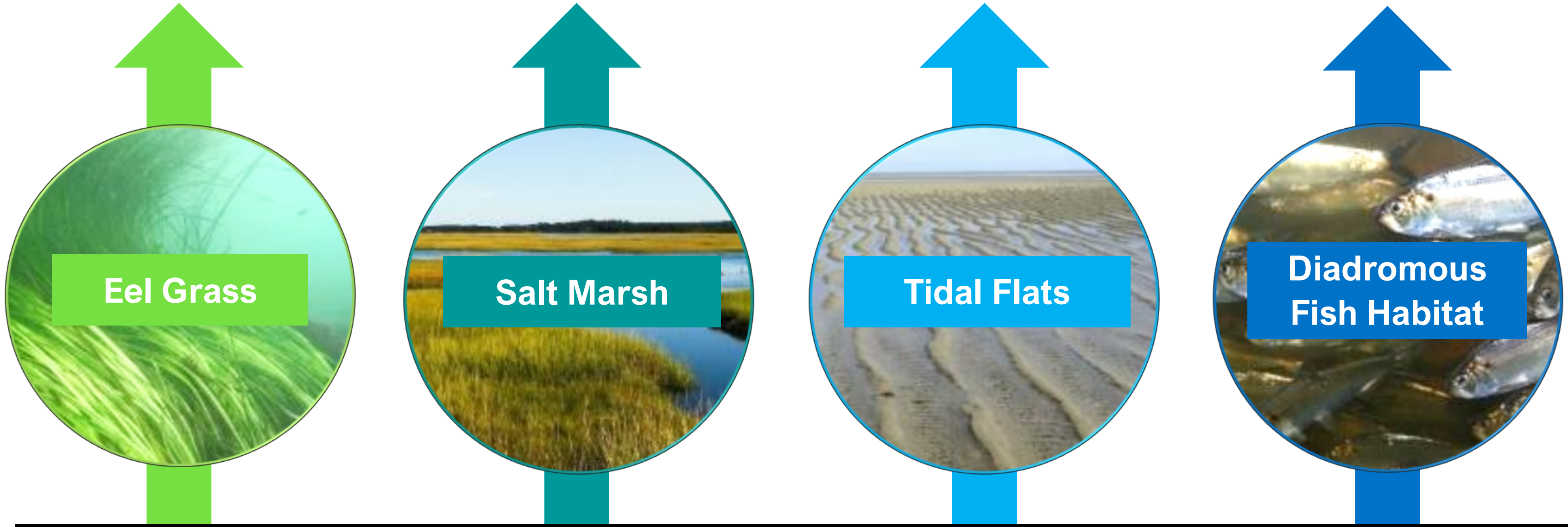
- How far back in time?
- Vertical profiles/varying depths?
- Multiple values per station/date/parameter?
- Remove outliers (TP=999)?
- Exclude stations with < N samples? (median ~= 10 samples/station)
- Unit conversion necessary for TN, TP, Temperature
- Exclude “preliminary” or “estimated” results?
- Exclude any ambiguous sample fractions?

ETT Phase 2…

Why is it important to monitor nitrogen?

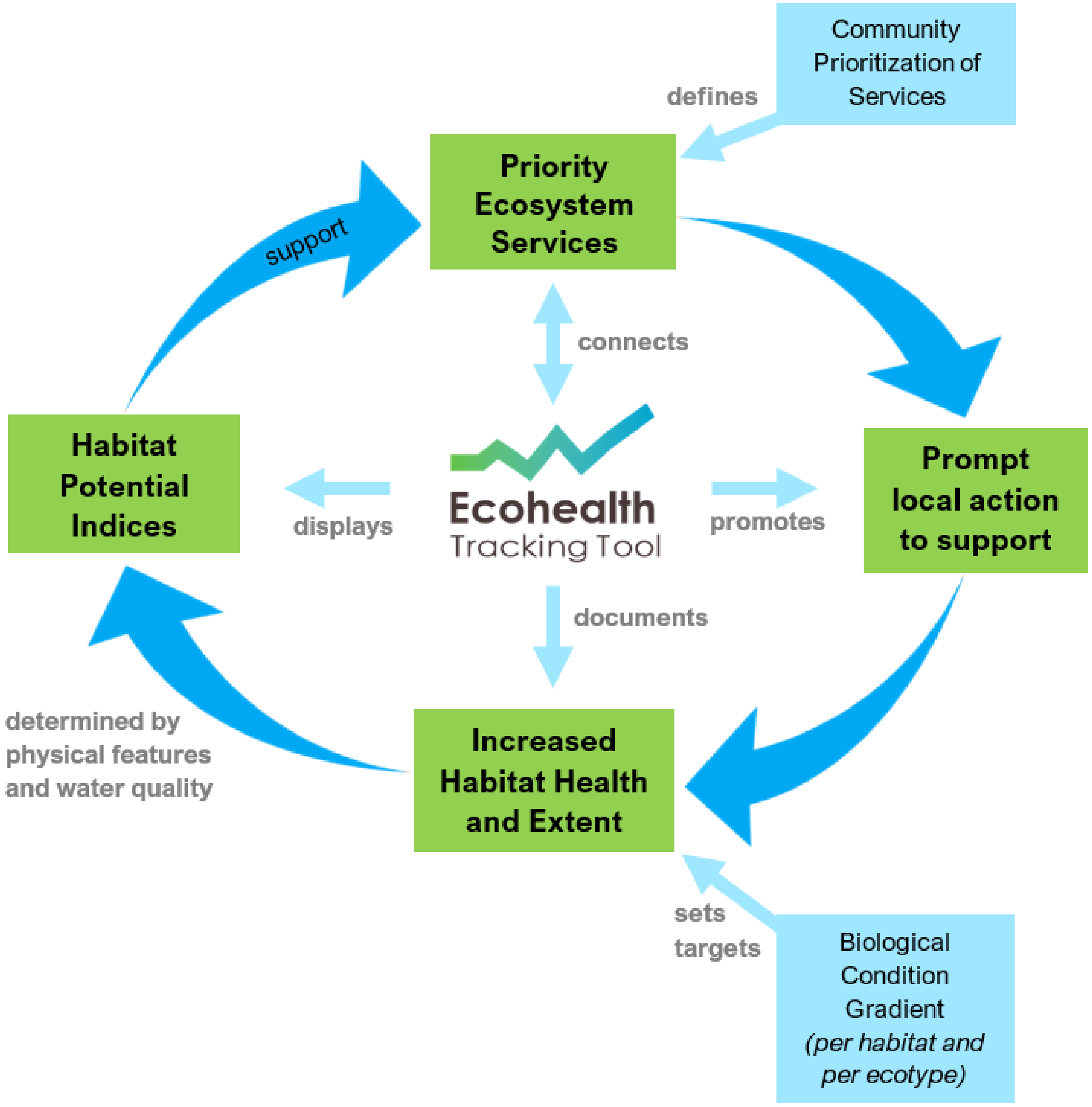
- ➔ Nitrogen is a key indicator of eel grass health
- ➔ Eel grass supports multiple ecosystem services (e.g., recreational fishing, erosion control, etc.).

Ecosystem Services (ES)



Habitat Potential Indices (HPIs)

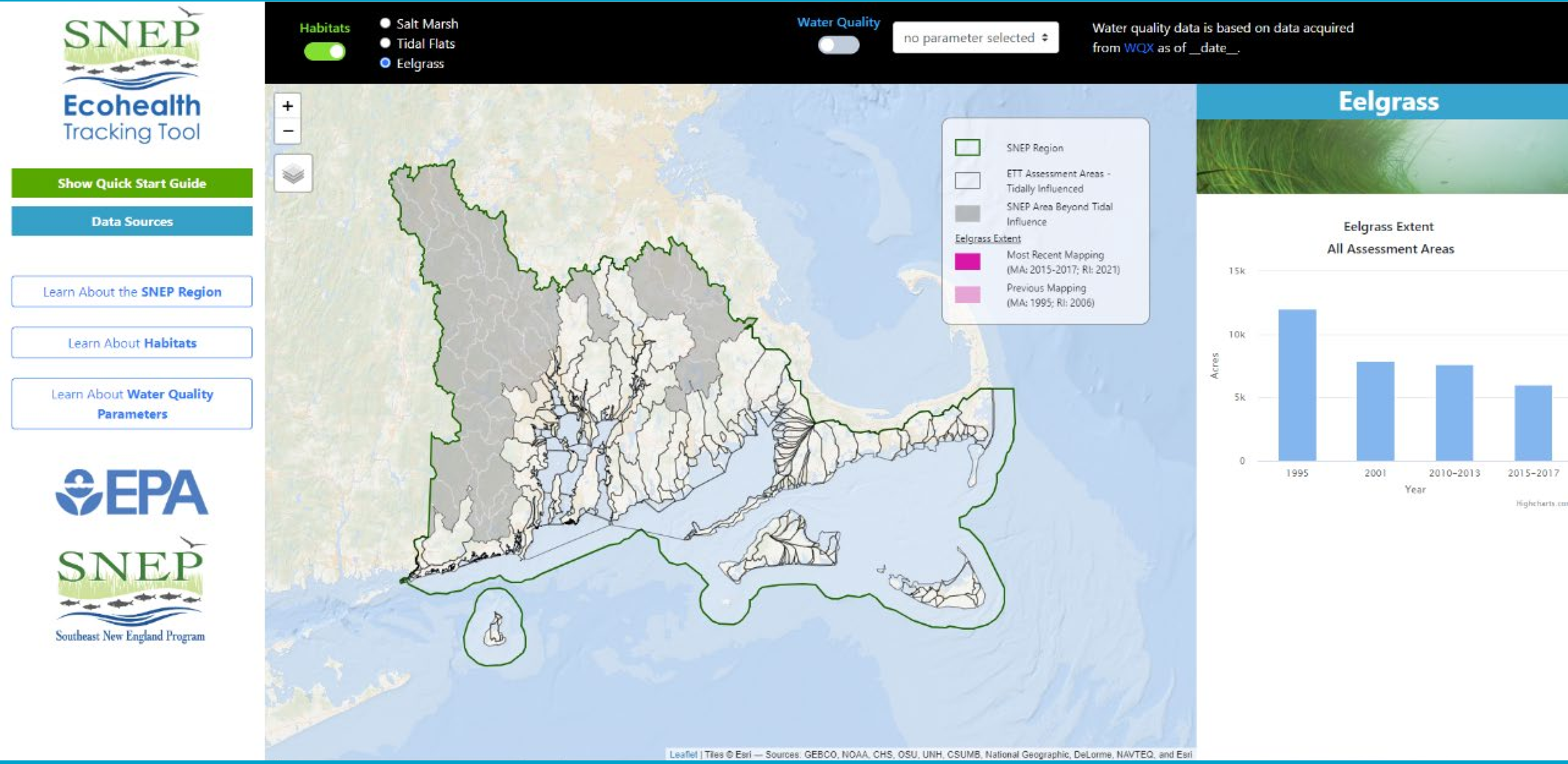
Reflect the ability to maintain or achieve target extents of healthy habitat supporting all associated ecosystem services


Community Prioritization of Services
defines
Priority Ecosystem Services
support
connects
Habitat Potential Indices
displays
Ecohealth Tracking Tool
promotes
Prompt local action to support
documents
determined by physical features and water quality
Increased Habitat Health and Extent
sets targets
Biological Condition Gradient *(per habitat and per ecotype)*

…in progress


Explore
Coastal Habitats and Water Quality in
Southeast New England
The **Ecohealth Tracking Tool** is a gateway for exploring coastal habitats and water quality for the EPA Southeast New England Program (SNEP) region… or take a closer look data for your favorite beach, salt marsh, or estuary.
This took was developed based on the MassBays Ecohealth Tracking Tool which displays data for the Massachusetts Bay region.
EPA
SNEP
Southeast New England Program
SNEP
Ecohealth
Tracking Tool
Start Exploring

...in progress



SNEP
Ecohealth Tracking Tool
Show Quick Start Guide
Data Sources
Learn About the SNEP Region
Learn About Habitats
Learn About Water Quality Parameters
EPA
SNEP
Southeast New England Program
Habitats
Salt Marsh
Tidal Flats
Eelgrass
Water Quality
no parameter selected
Water quality data is based on data acquired from WQX as of __date__.
SNEP Region
ETT Assessment Areas - Tidally Influenced
SNEP Area Beyond Tidal Influence
Eelgrass Extent
Most Recent Mapping (MA: 2015-2017; RI: 2021)
Previous Mapping (MA: 1995; RI: 2006)
Eelgrass
Eelgrass Extent
All Assessment Areas
15k
10k
5k
0
Acres
1995
2001
2010-2013
2015-2017
Year
Leaflet | Tiles © Esri — Sources: GEBCO, NOAA, CHS, OSU, UNH, CSUMB, National Geographic, DeLorme, NAVTEQ, and Esri

Any questions?

MassBays
NATIONAL ESTUARY PROGRAM

COMPREHENSIVE ENVIRONMENTAL INC.