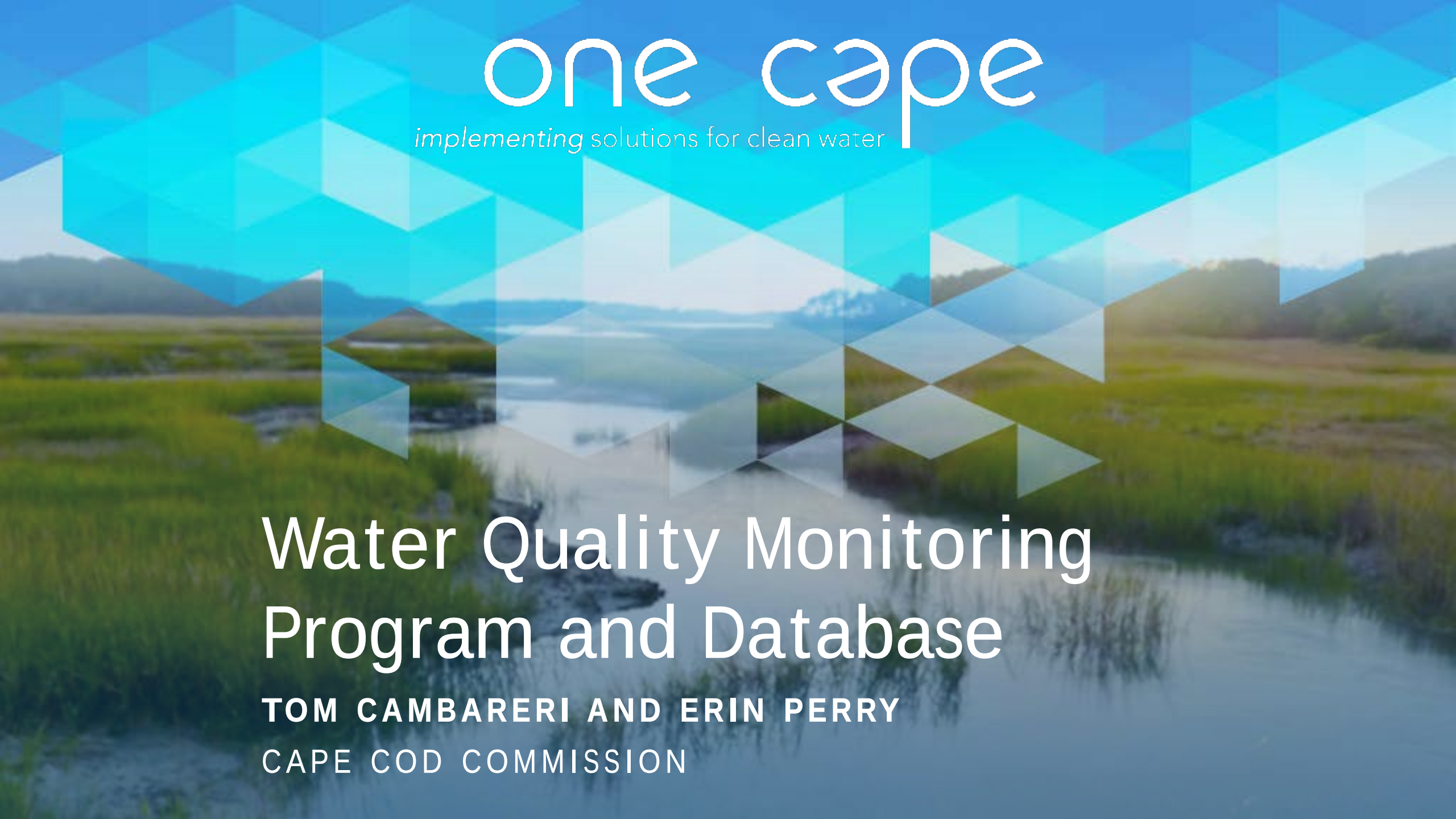


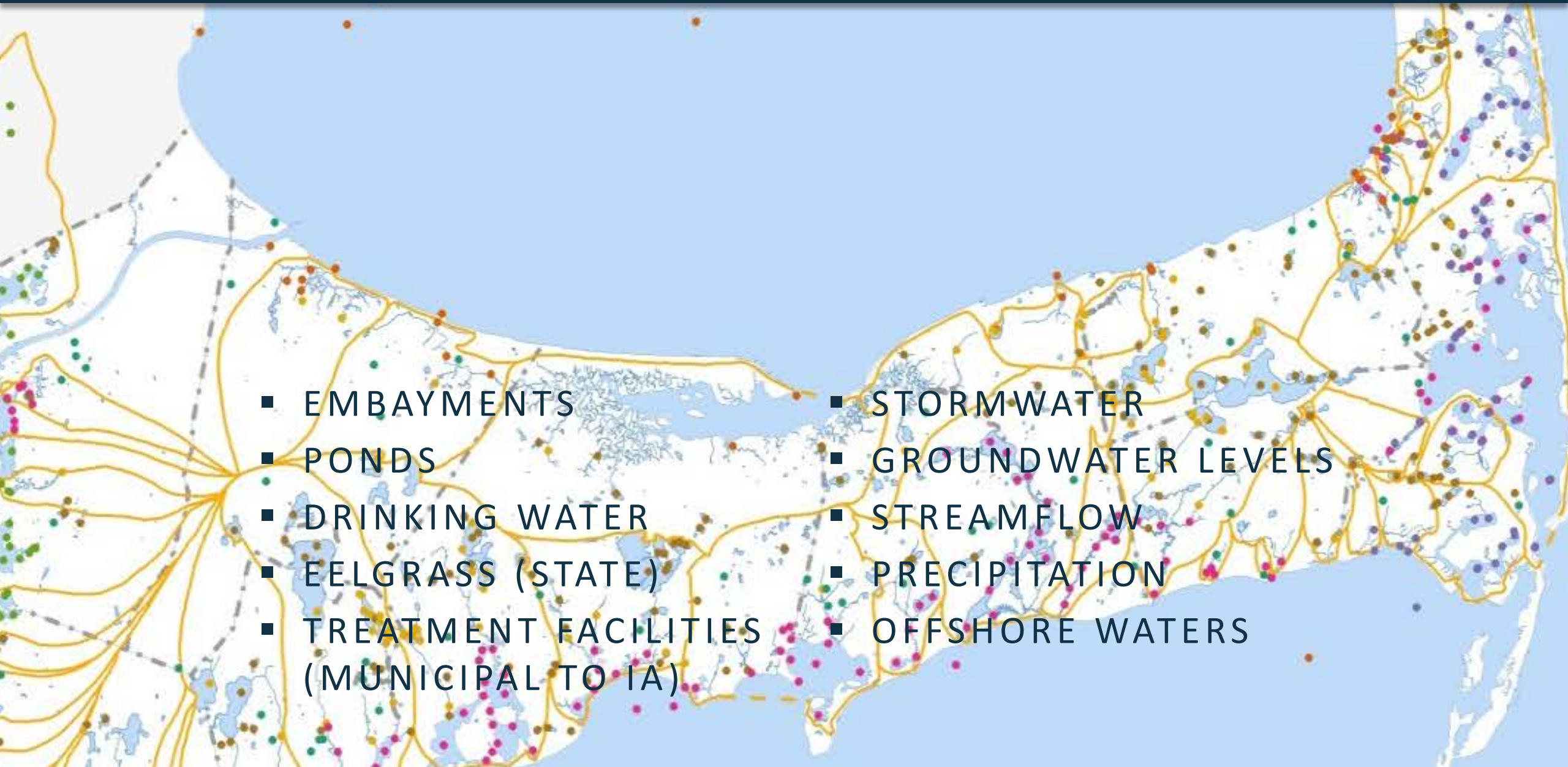
Water Quality Monitoring Program and Database

TOM CAMBARERI AND ERIN PERRY

CAPE COD COMMISSION


WATER RESOURCE MONITORING IS
BEING CONDUCTED ACROSS THE
WATERS OF CAPE COD...

CURRENT WATER RESOURCE MONITORING



- EMBAYMENTS
- PONDS
- DRINKING WATER
- EELGRASS (STATE)
- TREATMENT FACILITIES (MUNICIPAL TO IA)
- STORMWATER
- GROUNDWATER LEVELS
- STREAMFLOW
- PRECIPITATION
- OFFSHORE WATERS

COMPLIANCE MONITORING

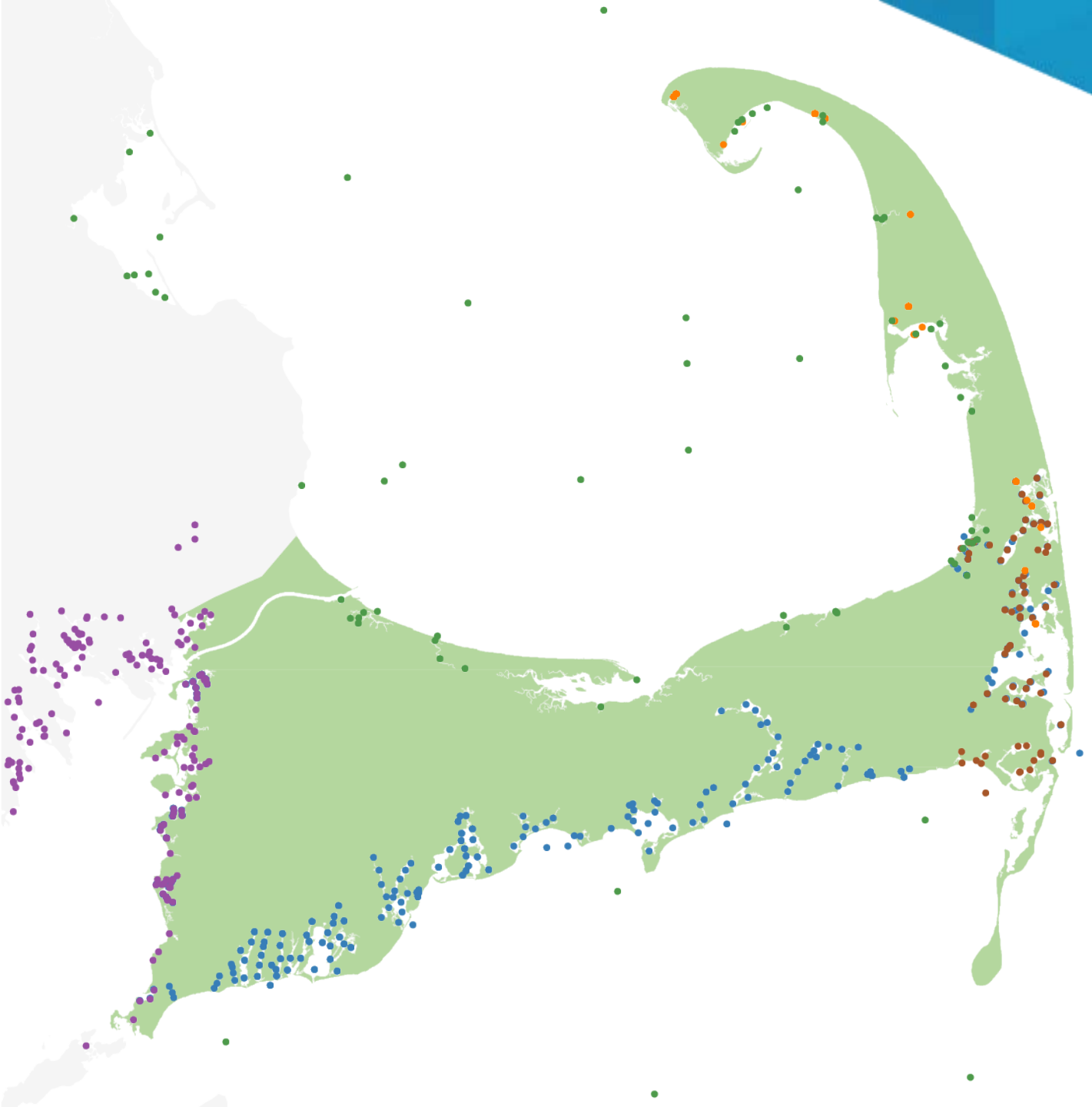
- **Water quality**
- **Ecosystem**
  - **Benthic**
  - **Aquatic-eelgrass**
- **Watershed nitrogen reduction progress**
- **Adaptive management**

PERFORMANCE MONITORING

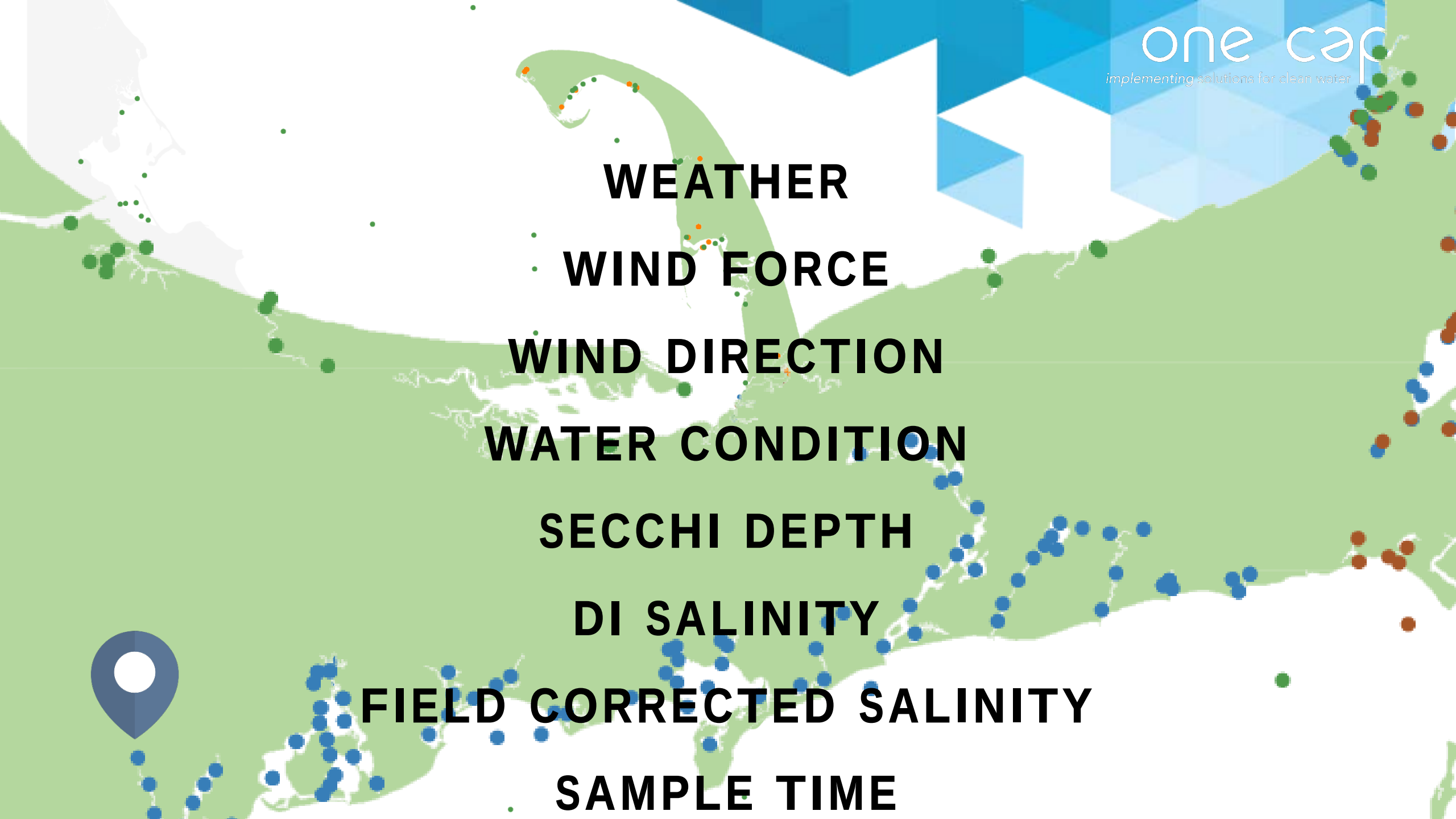
- **Piloting innovative technologies**
- **Wastewater Treatment Facilities**

THE 208 PLAN UPDATE RECOMMENDS A REGIONAL WATER QUALITY MONITORING PROGRAM AND DATA WAREHOUSE

one cape
implementing solutions for clean water



- Center for Coastal Studies
- Buzzards Bay Coalition
- National Park Service
- Pleasant Bay Alliance
- Massachusetts Estuaries Project


one cap
implementing solutions for clean water
WEATHER
WIND FORCE
WIND DIRECTION
WATER CONDITION
SECCHI DEPTH
DI SALINITY
FIELD CORRECTED SALINITY
SAMPLE TIME

Cape Cod Water Quality

Search by Embayment and Station

Embayment: * All Embayments

Station: * All Stations

Filter By Embayments and Stations

Download Blank Template | Export Data to Excel

Nh4 Um Fin	Nox Um Fin	Din Um Fin	Din Ppm Fin	Tdn Um	Don Um	Don Ppm Fin	Pon Ppm Fin	Pon Um	Ton Ppm Fin	Ton Um
102.65652973	0.4922	103.14872973		130.294	27.145270273			35.386932674		
276.29503421	0.71769030356	277.01272451		292.73169732	15.718972809			56.489231976		
65.830286124	1.3025911082	67.132877233		87.390834569	20.257957337			40.637280034		
28.808701567	1.4591760649	30.267877632		65.868153347	35.600275716			62.038720378		
37.029927704	1.0229156509	38.052843355		66.269361549	28.216518194			40.760530016		
334.82871326	1.8274012677	336.65611453		347.40872023	10.752605707			39.418276893		
88.165480416	0.68750737986	88.852987796		120.07553678	31.22254898			33.984510132		
107.80094787	0.53384159255	108.33478946		120.70340397	12.368614505			56.381058744		
17.577831395	0.025	17.602831395		36.385403111	18.782571716			44.748497341		
3.825813801	0.14425087108	3.970064672		30.356861314	26.386796642			24.753241038		
5.0156450507	0.025	5.0406450507		35.475474453	30.434829402			15.079208611		
2.3287567983	0.025	2.3537567983		23.431678832	21.077922034			12.810879421		
1.230991981	0.025	1.255991981		21.542236102	20.286244121			12.880027981		
1.2966151693	0.65230961298	1.9489247823		27.788251583	25.839326801			14.915191106		
1.2304030369	0.63171036205	1.862113399		60.300403594	58.438290195			11.406938804		
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0.30799061447	0.56208660926	0.87007722373		24.688660075	23.818582851			8.6242690993		
0.90928683703	0.46333878887	1.3726256259		26.5617675	25.189141874			19.321599354		

Results per page: 25 50 75 100 | << Page 1 of 1332 >>


COMPLIANCE MONITORING
COUPLED WITH PERFORMANCE
MONITORING WILL BE NECESSARY
TO MEASURE PROGRESS

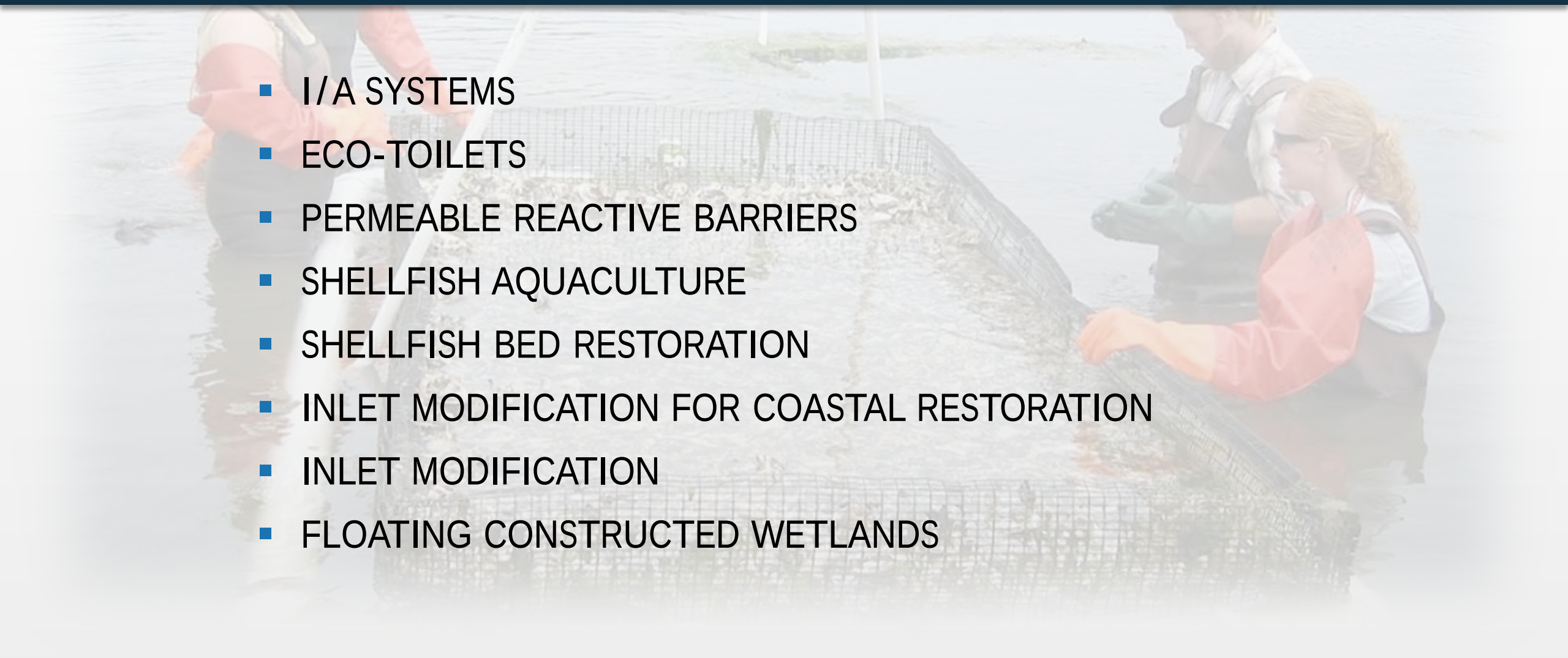
To provide advice and guidance on appropriate monitoring protocols for technology efficiency and total maximum daily loads, while identifying a process for consolidating all available monitoring data in a central location and format.

— Mission

SECTION 208 AREA WIDE WATER QUALITY MANAGEMENT PLAN

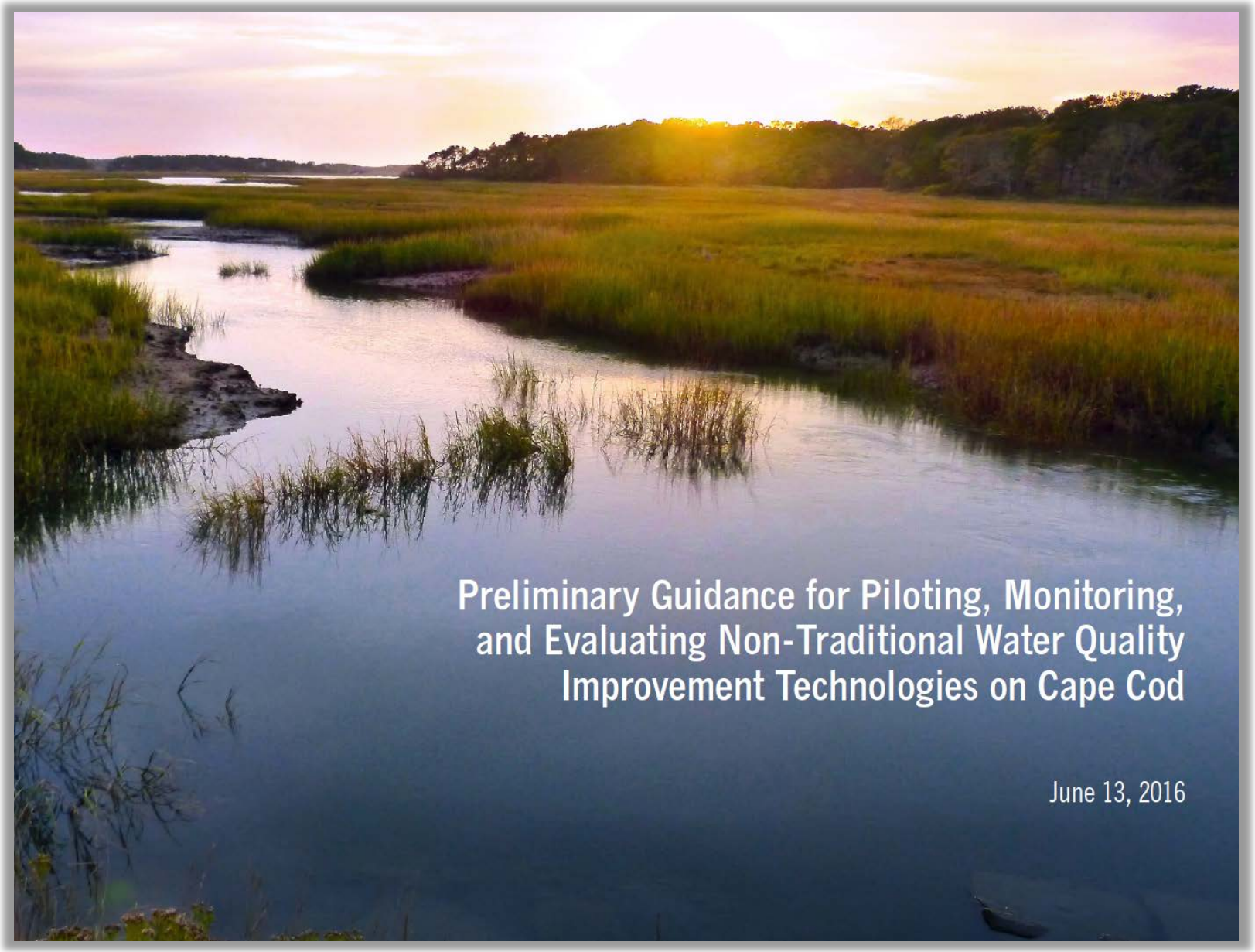
MONITORING SUBCOMMITTEE

NON- TRADITIONAL TECHNOLOGY MONITORING PROTOCOLS



- I/A SYSTEMS
- ECO-TOILETS
- PERMEABLE REACTIVE BARRIERS
- SHELLFISH AQUACULTURE
- SHELLFISH BED RESTORATION
- INLET MODIFICATION FOR COASTAL RESTORATION
- INLET MODIFICATION
- FLOATING CONSTRUCTED WETLANDS

one cape
implementing solutions for clean water



Preliminary Guidance for Piloting, Monitoring, and Evaluating Non-Traditional Water Quality Improvement Technologies on Cape Cod

June 13, 2016

- **Criteria for selecting Pilot Projects**
- **General Monitoring Guidance & Monitoring Protocols** for eight priority non-traditional technologies so that essential data is consistently collected.
- **Evaluation Considerations** to help determine which water quality improvement technologies are best to prioritize for implementation.

CHAPTER 3

CRITERIA FOR PROPOSED PILOT PROJECTS

for Non-Traditional Technology Implementation

Pilot Project Context, Approach and Evaluation

- Site Selection
- Site Characterization
- Suitability
- Pilot Project Scale
- Performance Measures
- Pilot Results
- Evaluation of Risks
- Contingency Planning
- Adverse Impacts
- Permitting
- Qualifications
- Project Scope

CHAPTER 4

MONITORING GUIDELINES

for Non-Traditional Technologies

- Watershed Scale
- Pilot Project Monitoring
- Data Collection Categories
  - Cost
  - Performance
  - Operation and Maintenance
- Data Collection and Tracking
- Data Flow
- Data Collection and Utilization
- Roles and Responsibilities
- Reporting Format and Frequency
- Feedback mechanisms

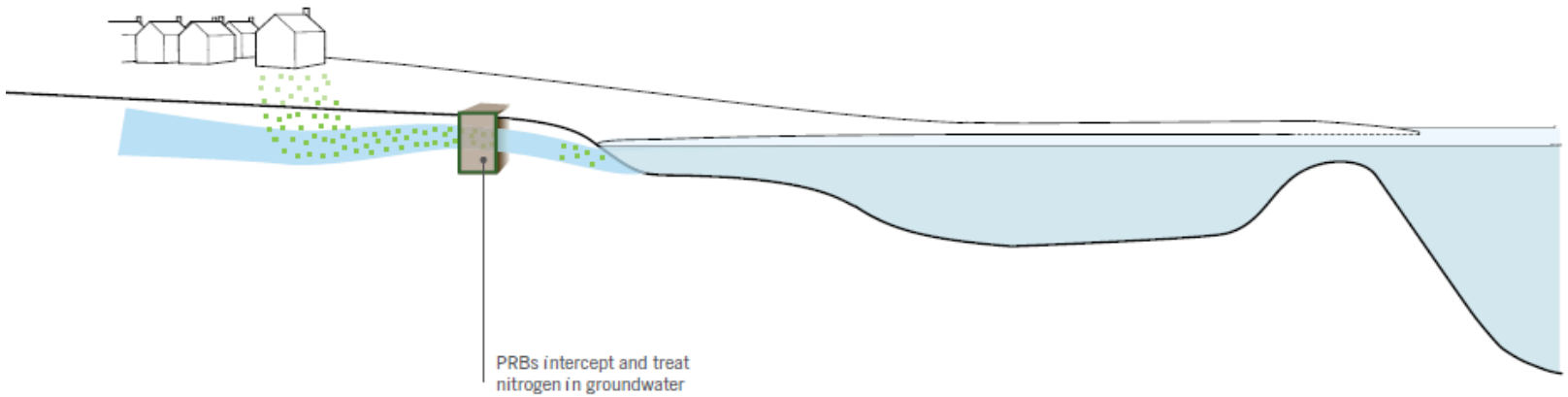
CHAPTER 5

TECHNOLOGY MONITORING PROTOCOLS

for Non-Traditional Technologies

REMEDIATION

PRB



Permeable Reactive Barrier

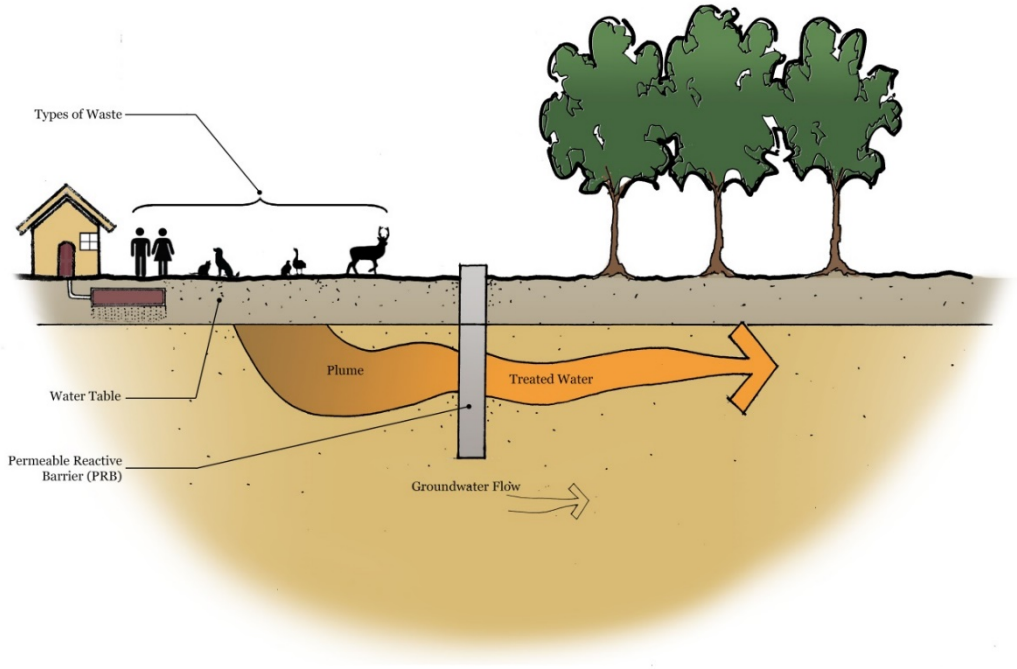
Permeable Reactive Barrier

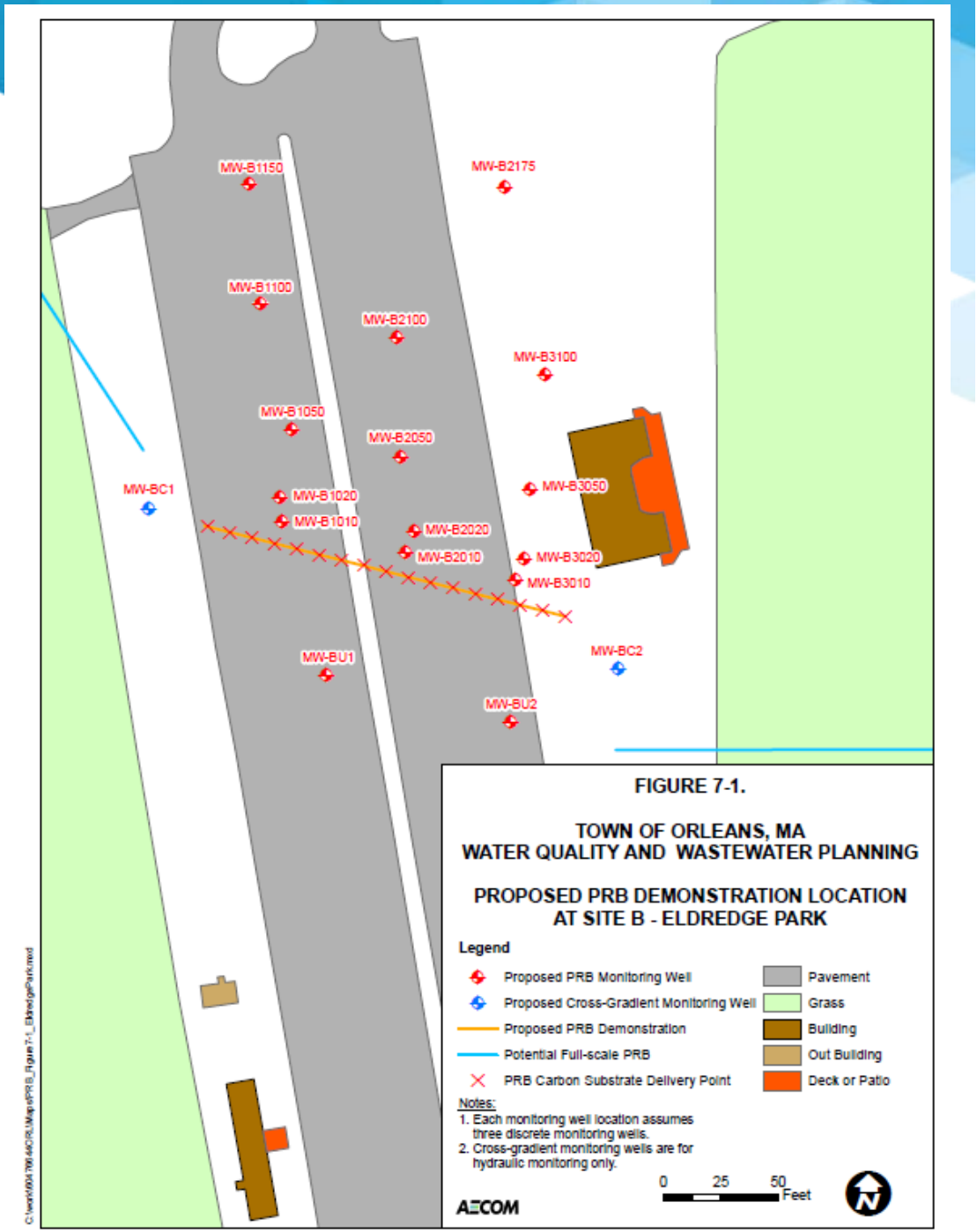
PRB

PILOT OF 250 FEET

17 MONITORING WELLS

MULTIPLE PARAMETERS



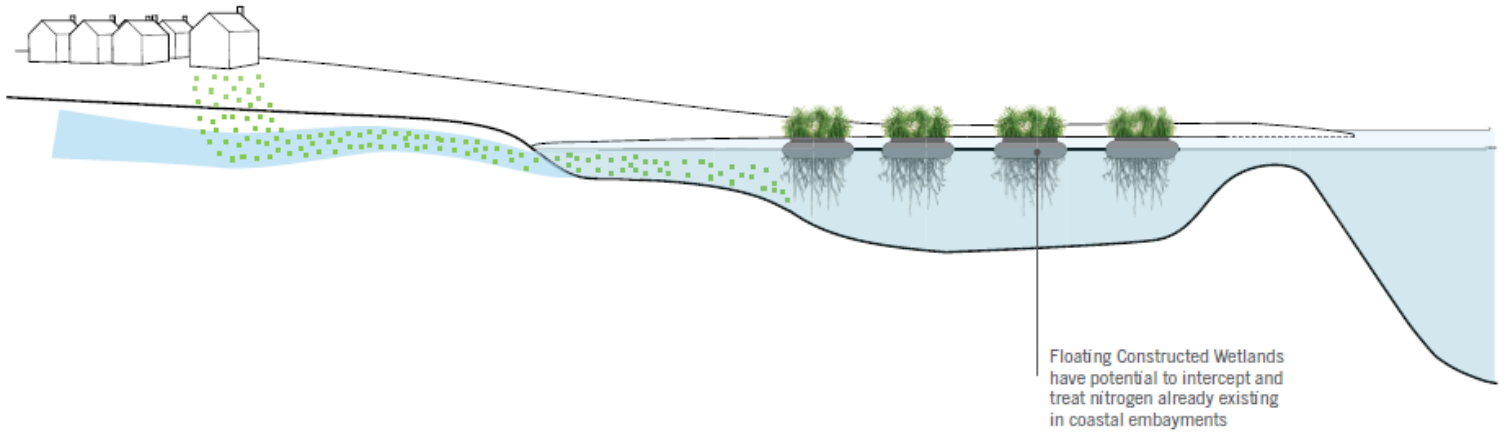


CHAPTER 5

TECHNOLOGY MONITORING PROTOCOLS

for Non-Traditional Technologies

RESTORATION



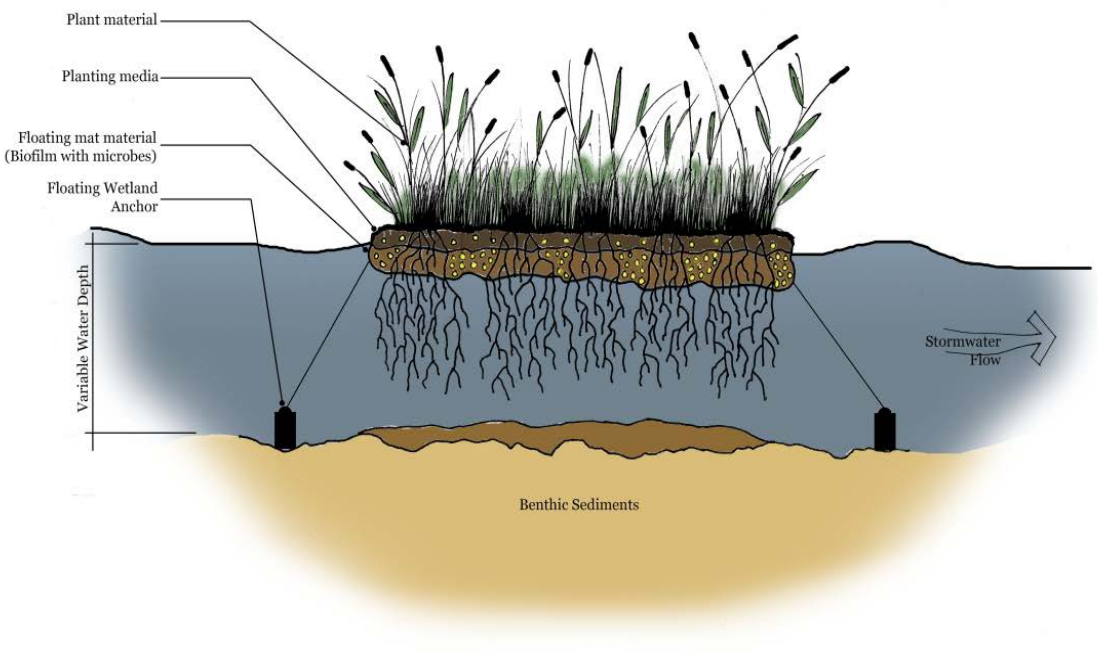
Floating Constructed Wetlands

Floating Constructed Wetlands

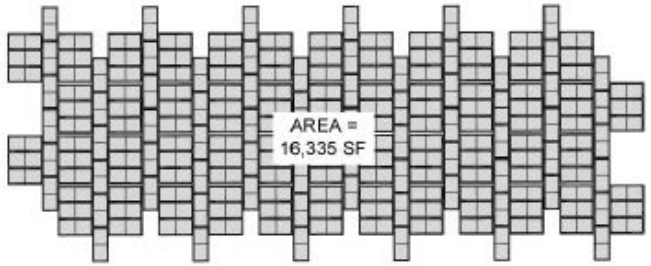
4 X 16,000 SQ FT

8 MONITORING POINTS

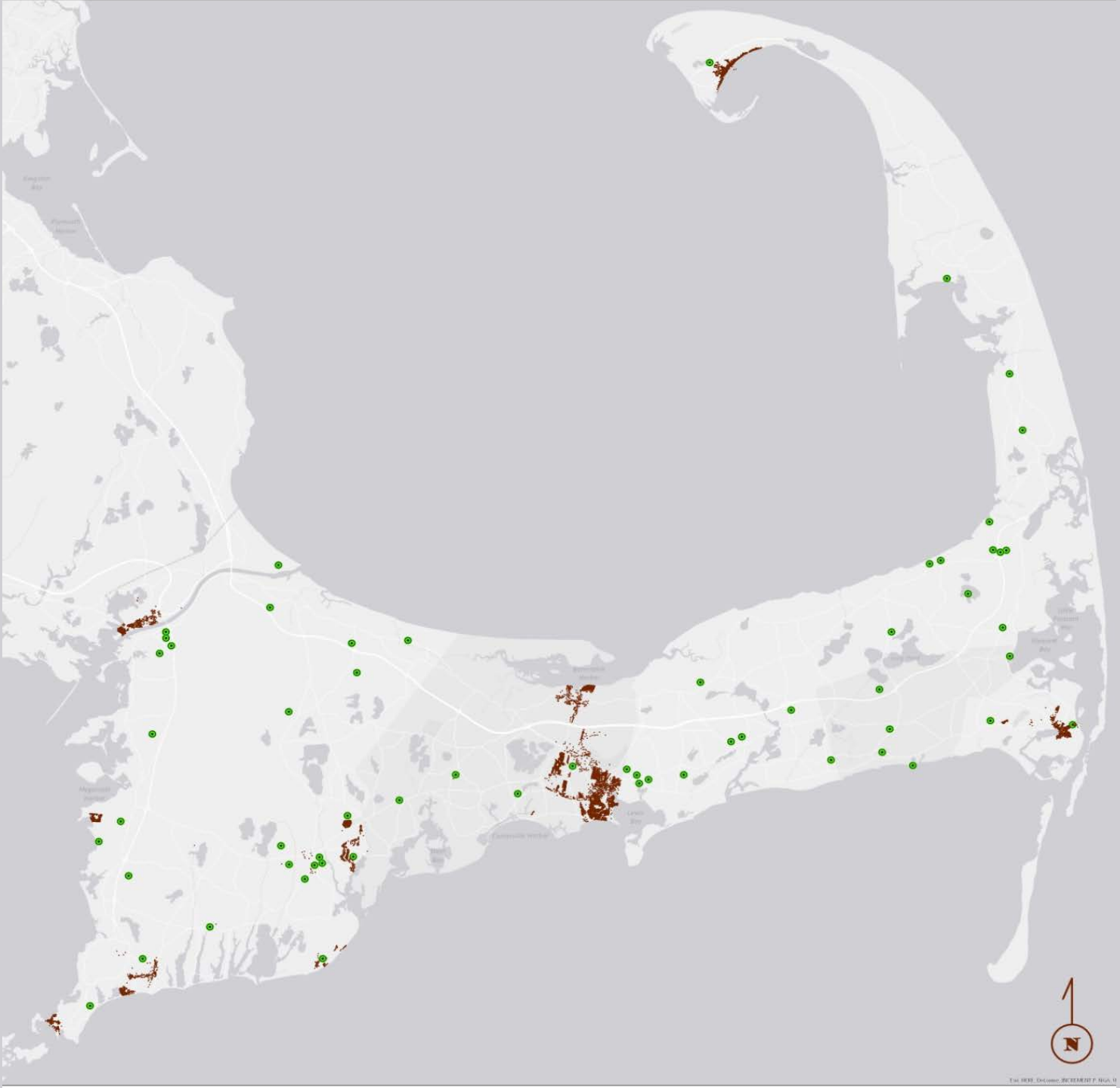
MULTIPLE PARAMETERS



FLOATING CONSTRUCTED WETLAND SITE PLAN



FLOATING CONSTRUCTED WETLAND (24 MODULE CLUSTERS)

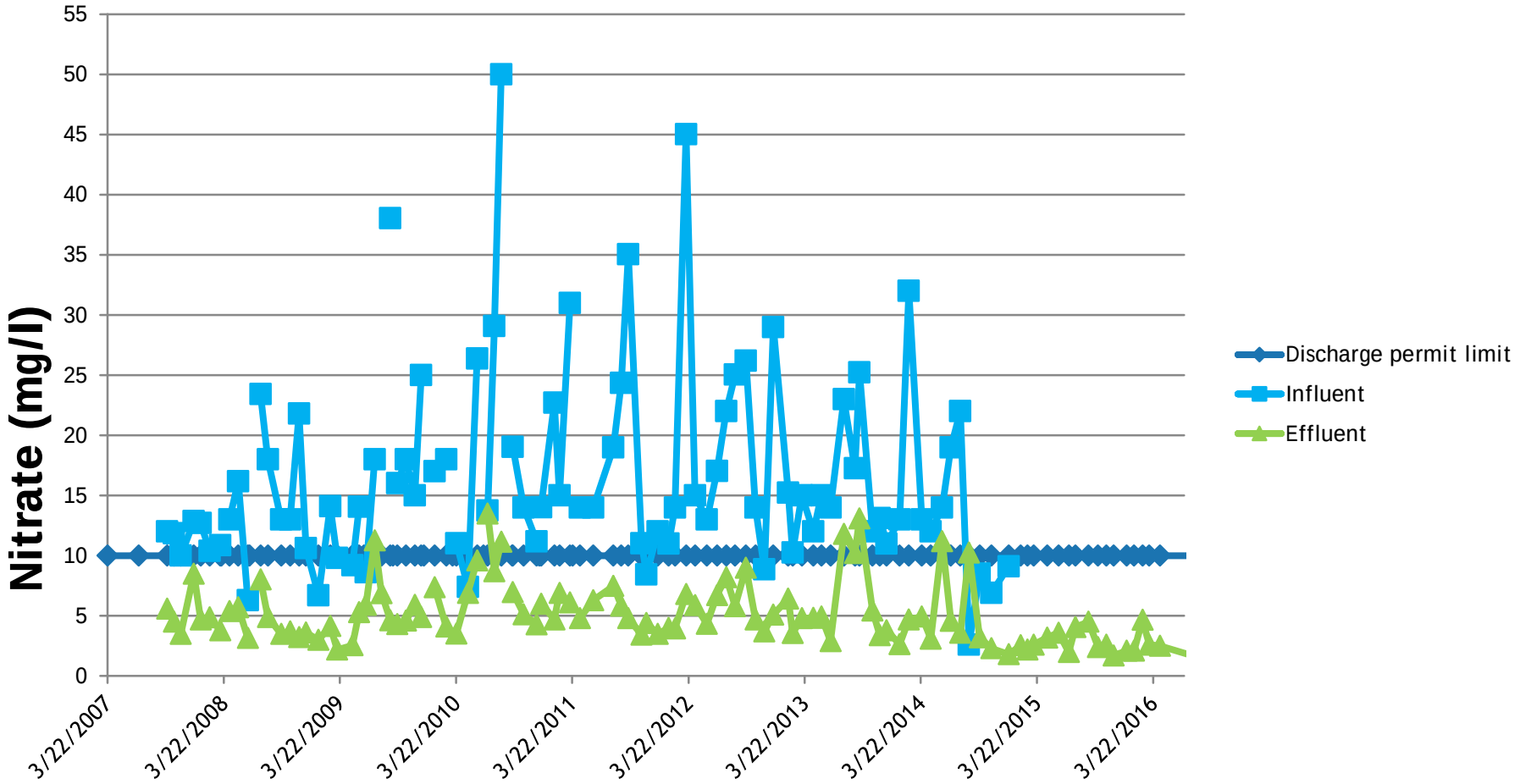


Wastewater Compliance Monitoring

Municipal and Private Wastewater Treatment Facilities

IA Systems

Skaket Corners Wastewater Influent and Effluent



one cape
implementing solutions for clean water

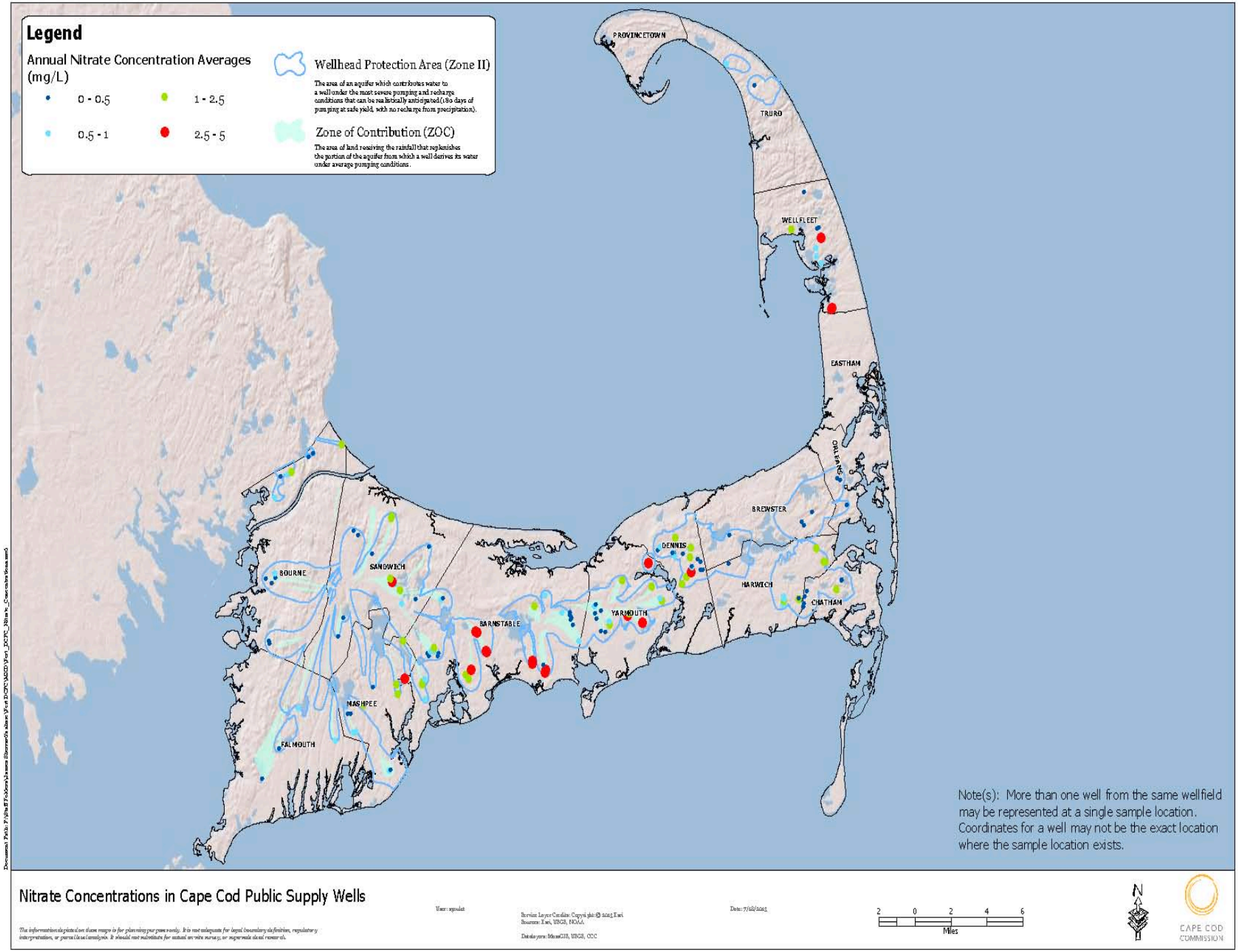
Additional Regional Data for Water Resource Management

Public Drinking Water Supplies

~170 Gravel Packed Wells

Nitrate

Compounds of Emerging Concern

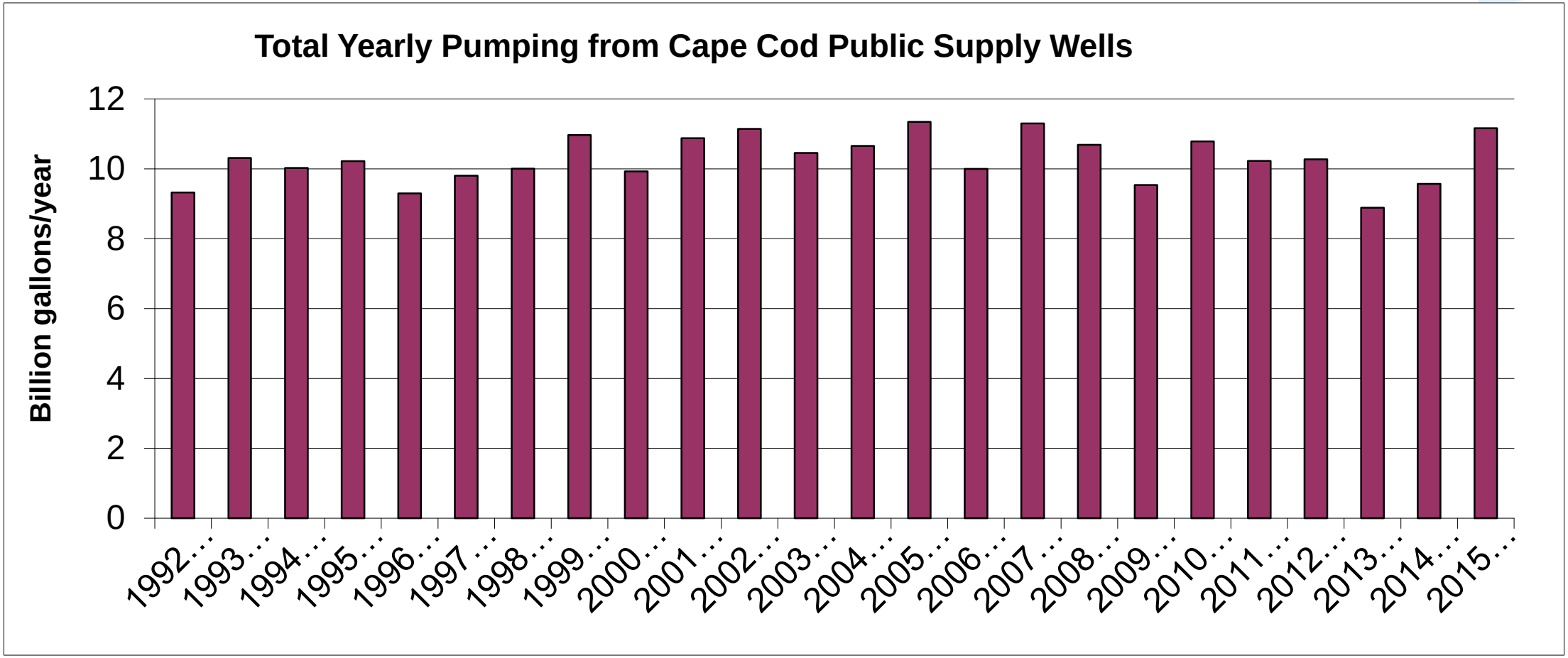


Emerging Compounds of Concern

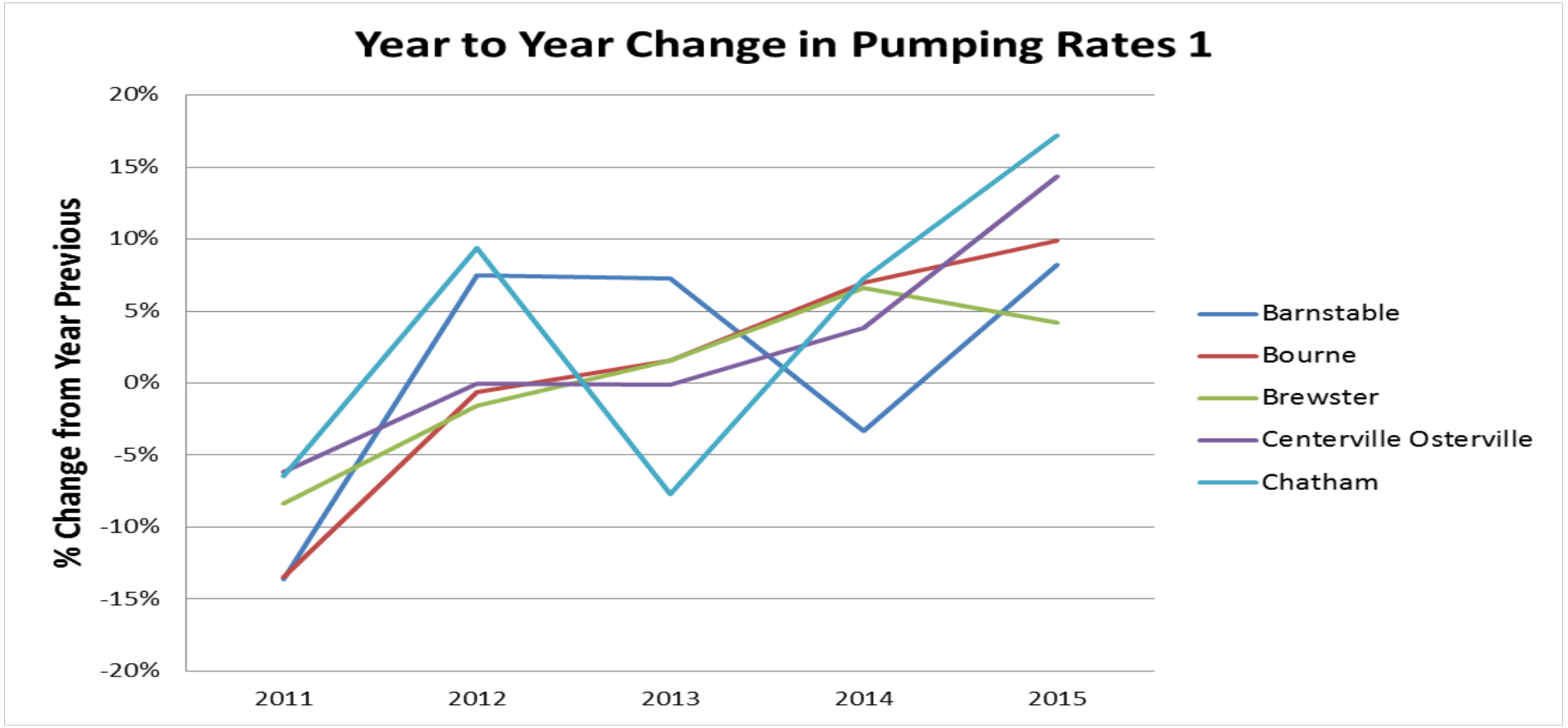
- Unregulated Contaminant Monitoring Rule (UCMR) Safe Drinking Water Act
  - 10,797 National Supply Sources Sampled
  - 82 Detections of PFOS

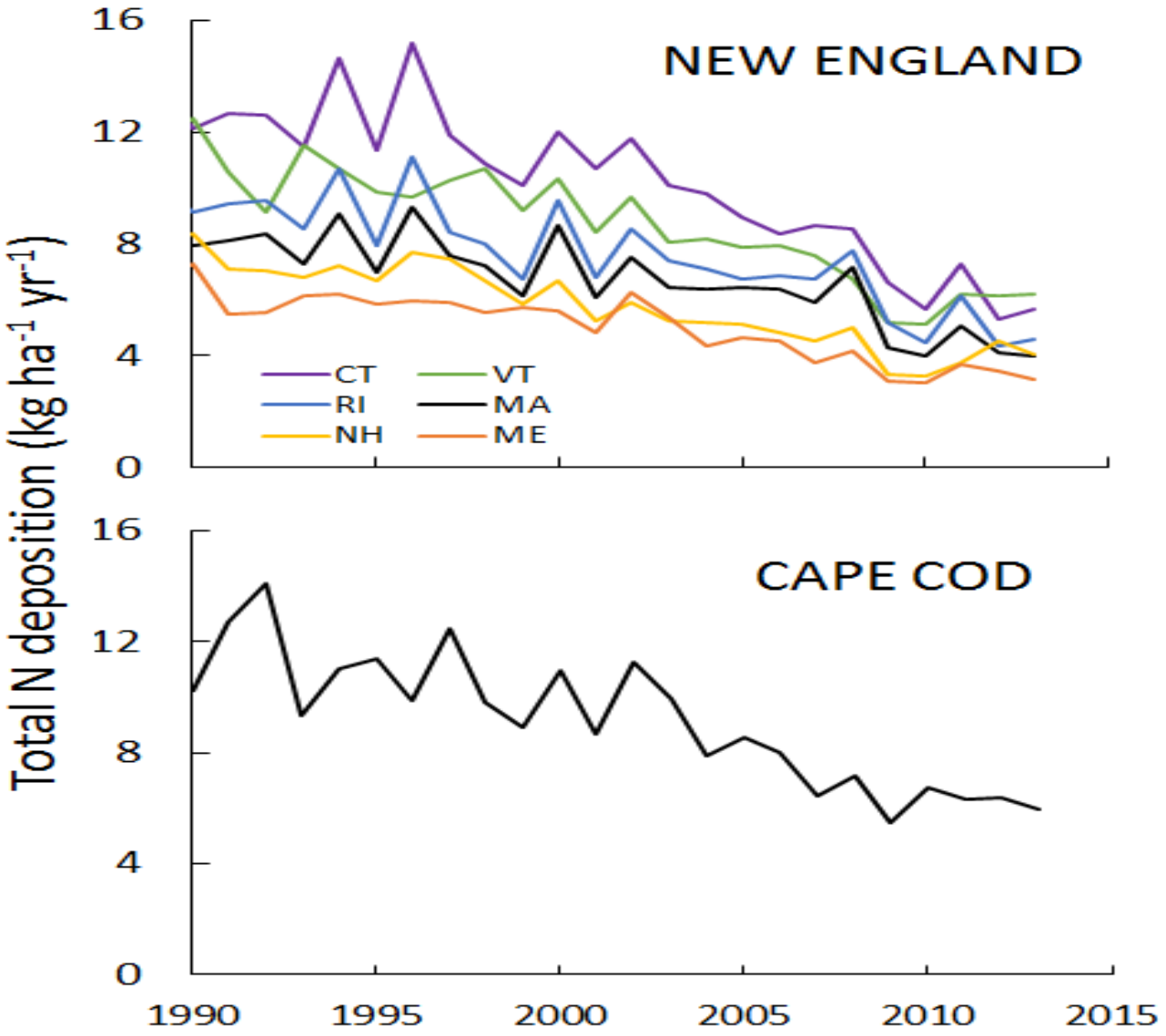
  - 25 Cape Supply Sources Sampled
  - 5 detections of PFOS

Aggregate Trend in Pumping Rates



Trends in Pumping Rates

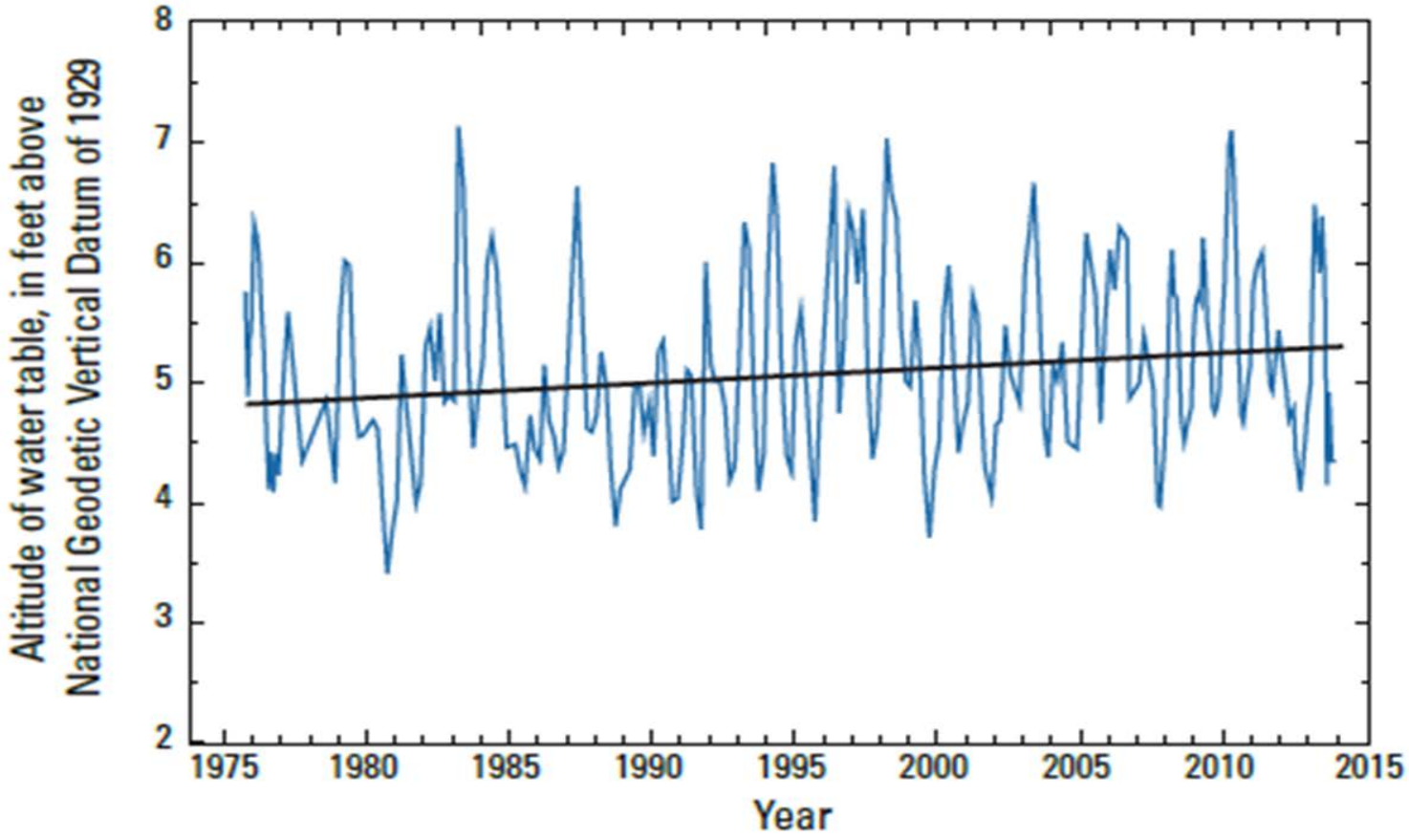




Since the year 2000, the atmospheric deposition of nitrate across New England, and Cape Cod, has decreased by about 50%.

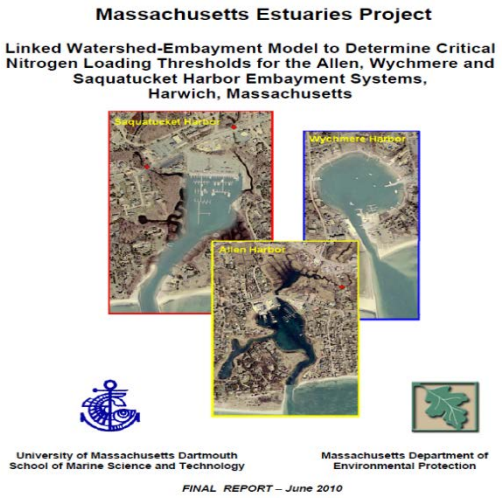
(Lloret and Valiela, in press)

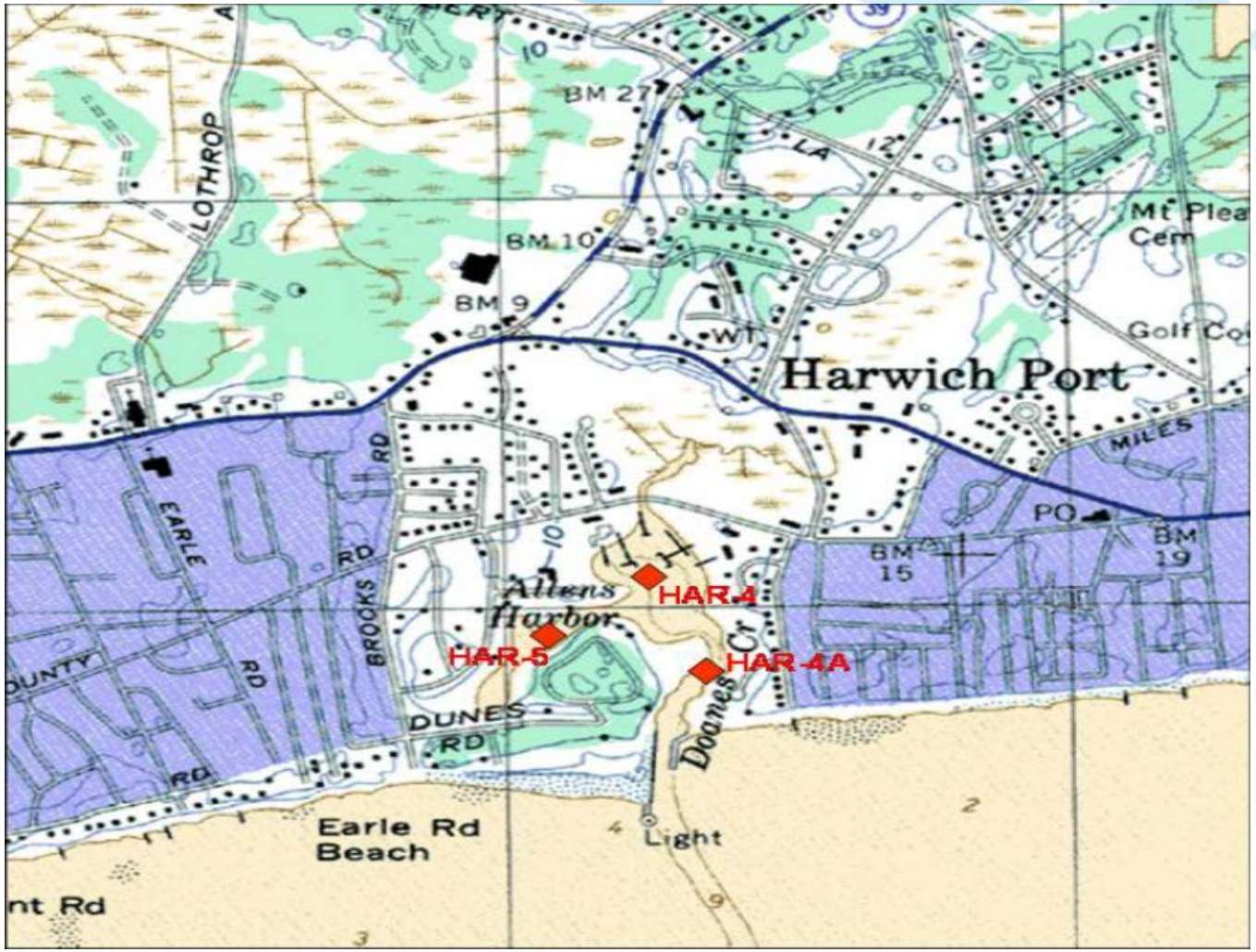
USGS Study of the Effect of Sea Level Rise on Groundwater



Tracking Water Quality Changes

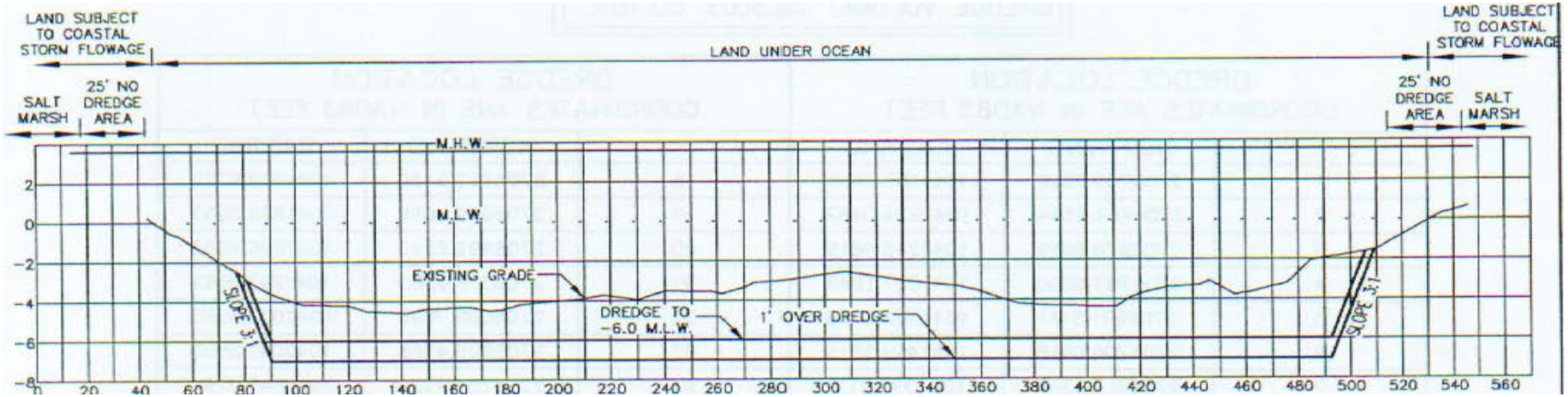
- **Station 4**
  - Allens Harbor Marina
- **Station 4A**
  - Allen's Hulse Pt.
- **Station 5**
  - Allen's Harbor Creek



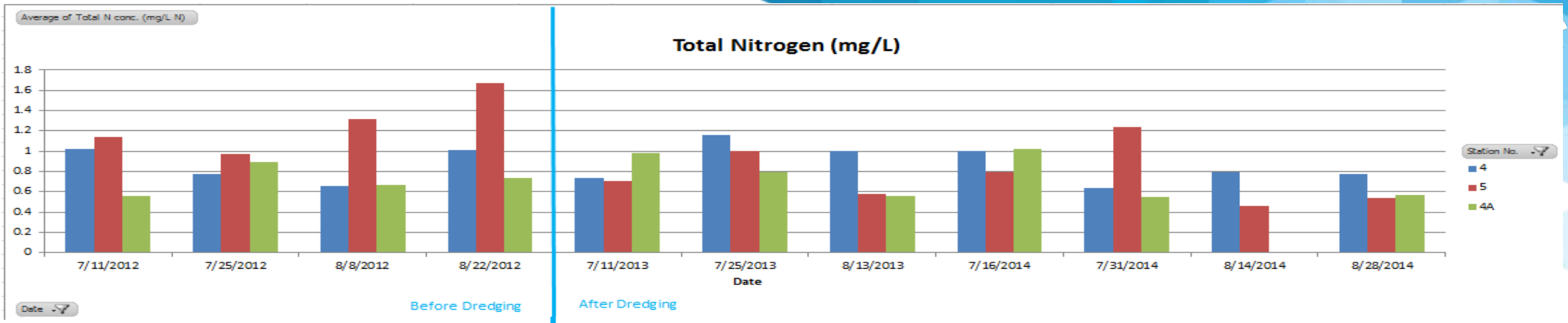


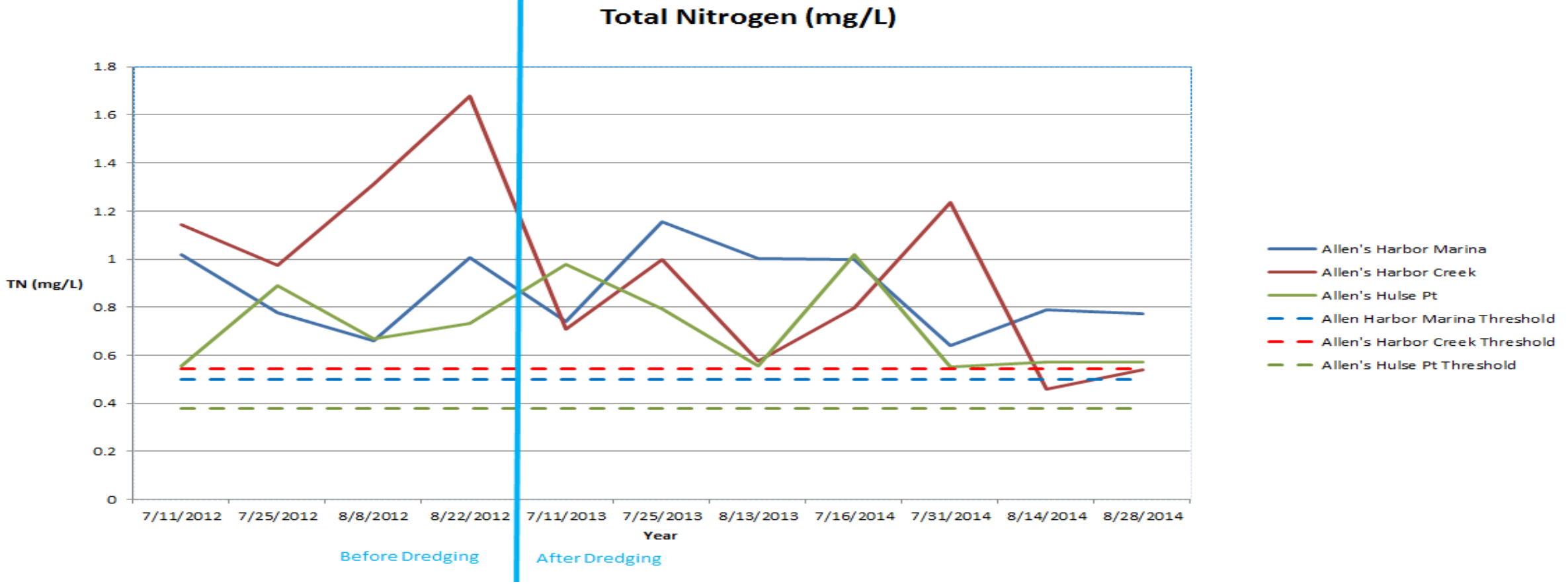
Allen's Harbor Dredging Needs

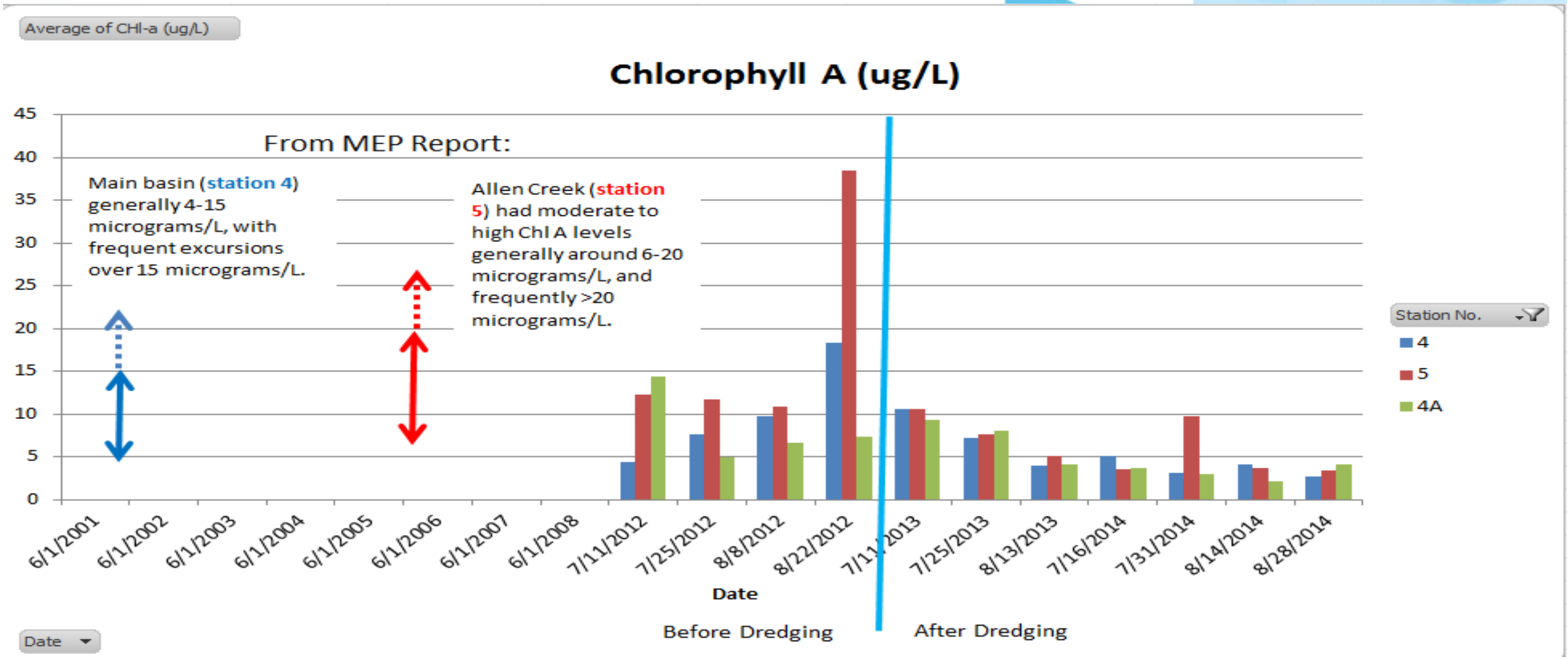
- Depth of Harbor was 2' TO 4.5' (MLW)
- Adequate Navigable Depth: 6'



MEP indicates benthic flux is 3 times the watershed load


Average of Total N conc. (mg/L N)
Total Nitrogen (mg/L)
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
7/11/2012
7/25/2012
8/8/2012
8/22/2012
7/11/2013
7/25/2013
8/13/2013
7/16/2014
7/31/2014
8/14/2014
8/28/2014
Date
Station No.
4
5
4A
Date
Before Dredging
After Dredging

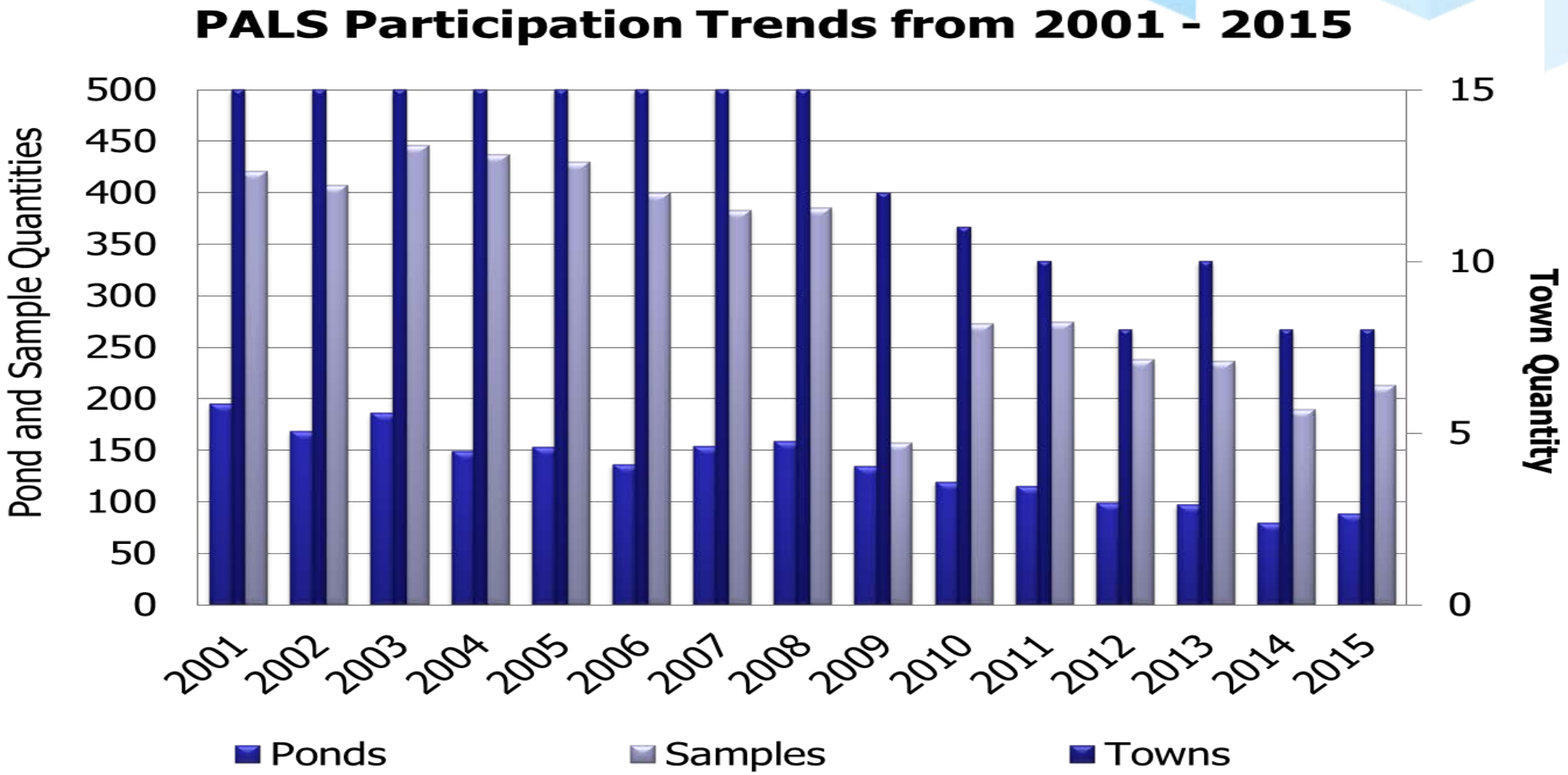

Total Nitrogen (mg/L)
TN (mg/L)
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
7/11/2012
7/25/2012
8/8/2012
8/22/2012
7/11/2013
7/25/2013
8/13/2013
7/16/2014
7/31/2014
8/14/2014
8/28/2014
Year
Allen's Harbor Marina
Allen's Harbor Creek
Allen's Hulse Pt
Allen Harbor Marina Threshold
Allen's Harbor Creek Threshold
Allen's Hulse Pt Threshold
Before Dredging
After Dredging


Average of Chl-a (ug/L)
Chlorophyll A (ug/L)
From MEP Report:
Main basin (station 4) generally 4-15 micrograms/L, with frequent excursions over 15 micrograms/L.
Allen Creek (station 5) had moderate to high Chl A levels generally around 6-20 micrograms/L, and frequently >20 micrograms/L.
45
40
35
30
25
20
15
10
5
0
6/1/2001
6/1/2002
6/1/2003
6/1/2004
6/1/2005
6/1/2006
6/1/2007
6/1/2008
7/11/2012
7/25/2012
8/8/2012
8/22/2012
7/11/2013
7/25/2013
8/13/2013
7/16/2014
7/31/2014
8/14/2014
8/28/2014
Date
Before Dredging
After Dredging
Station No.
4
5
4A
Date

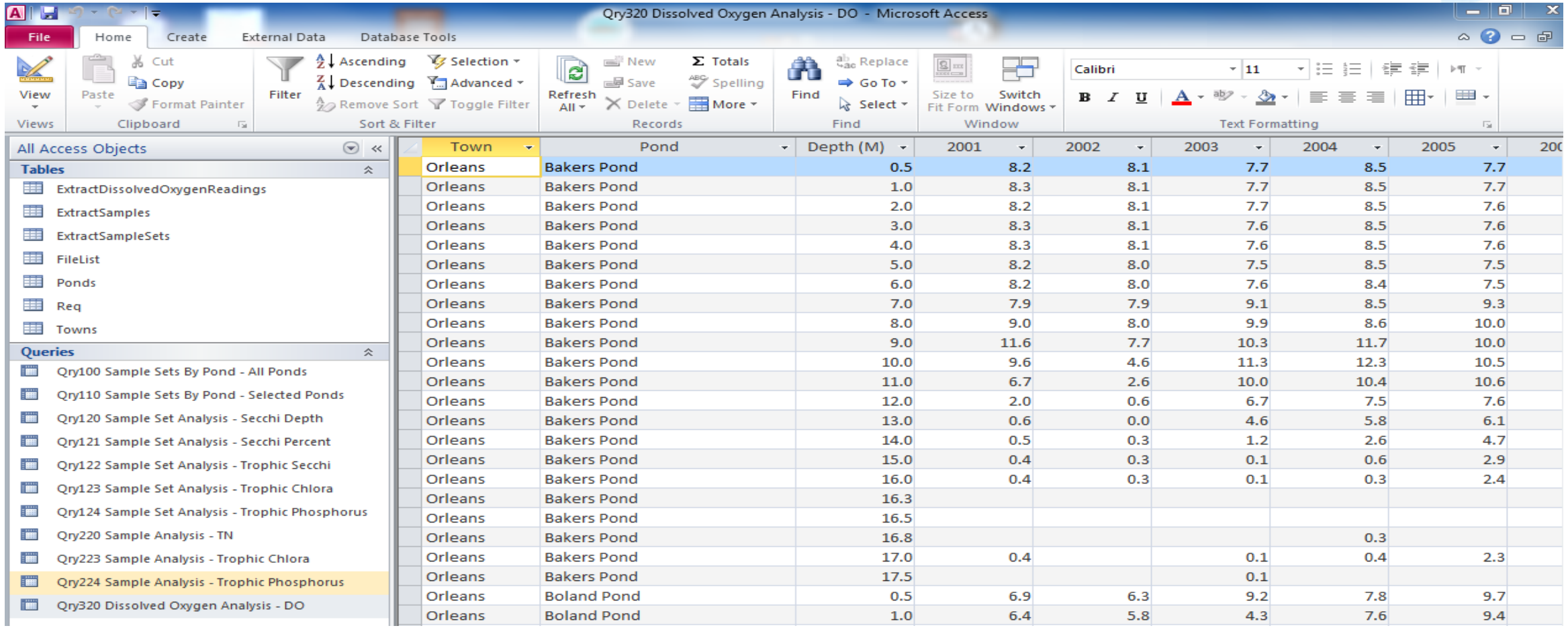
996 Ponds

one cape
implementing solutions for clean water

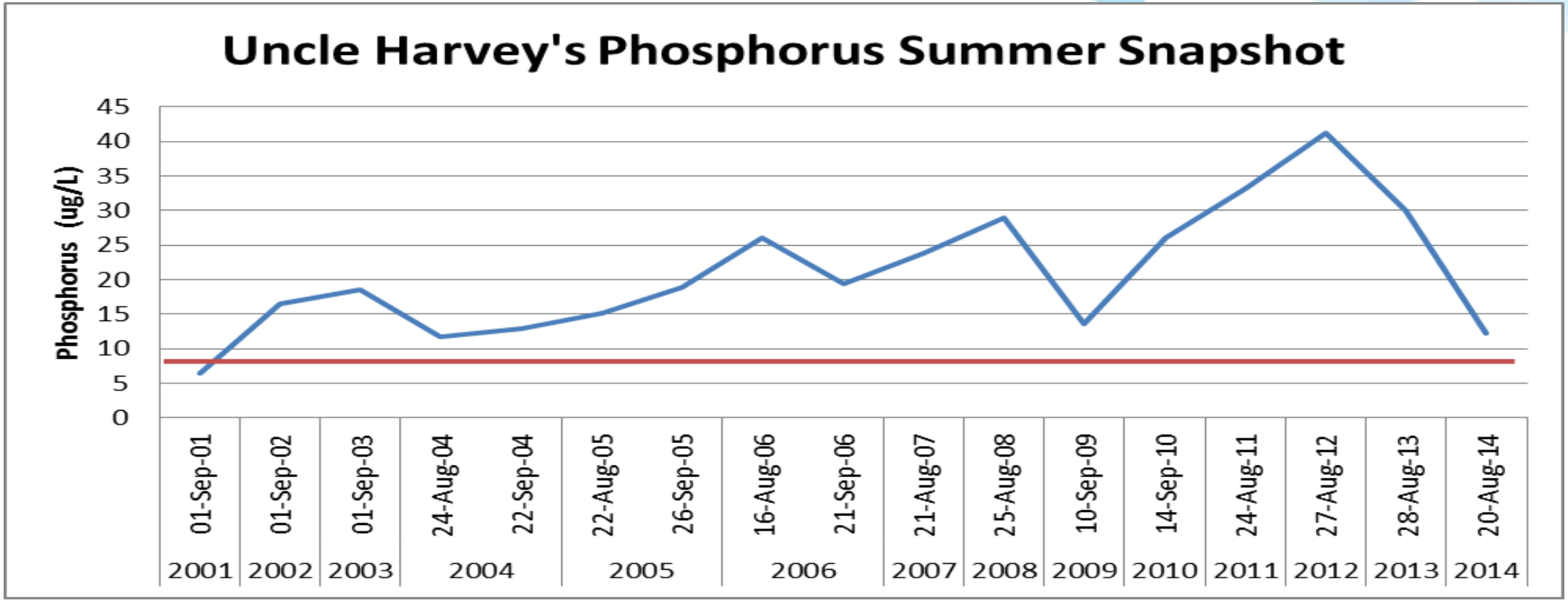
Pond and Lake Steward Sampling

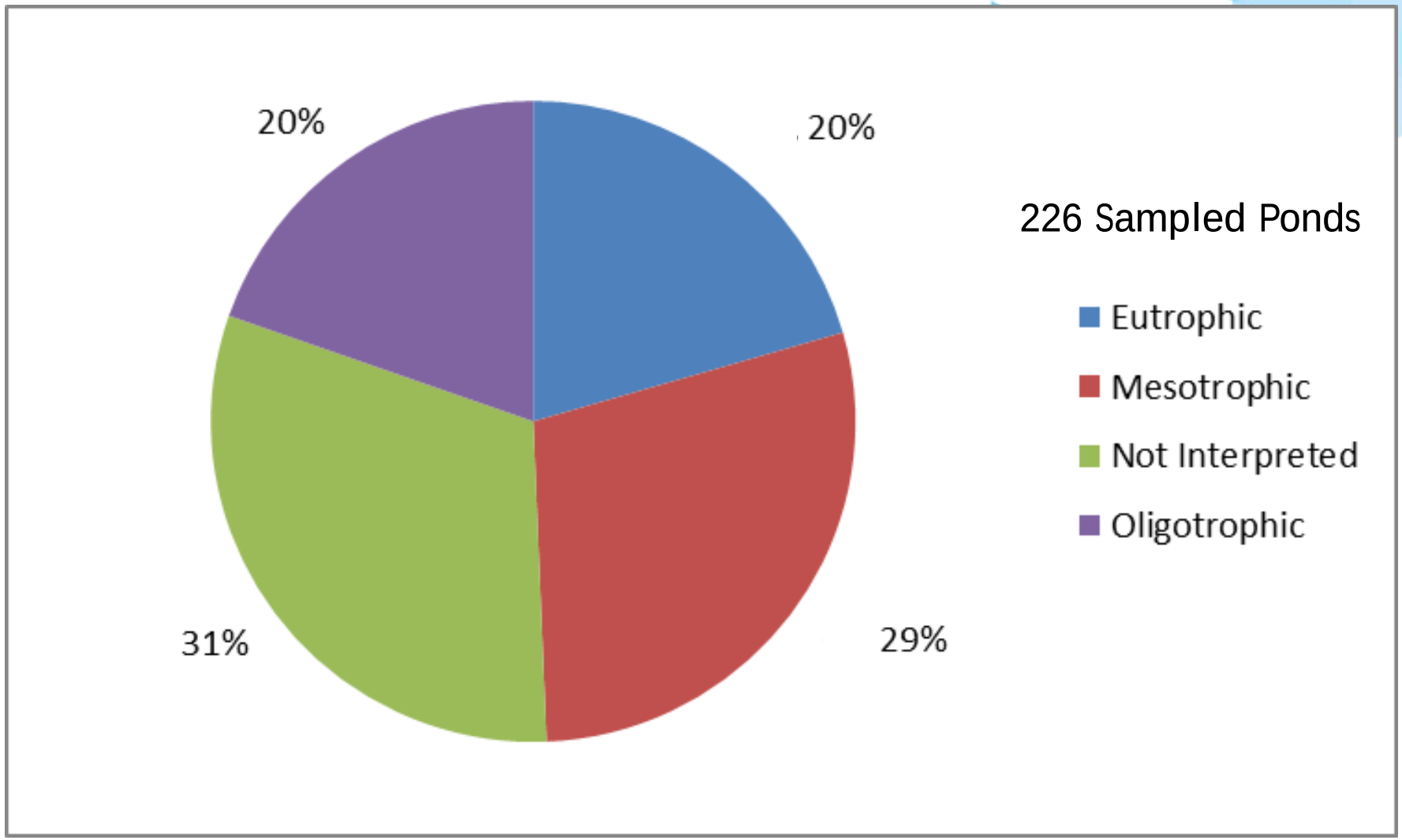


Improved Data Integrity and Analytics



Town	Pond	Depth (M)	2001	2002	2003	2004	2005	200
Orleans	Bakers Pond	0.5	8.2	8.1	7.7	8.5	7.7	
Orleans	Bakers Pond	1.0	8.3	8.1	7.7	8.5	7.7	
Orleans	Bakers Pond	2.0	8.2	8.1	7.7	8.5	7.6	
Orleans	Bakers Pond	3.0	8.3	8.1	7.6	8.5	7.6	
Orleans	Bakers Pond	4.0	8.3	8.1	7.6	8.5	7.6	
Orleans	Bakers Pond	5.0	8.2	8.0	7.5	8.5	7.5	
Orleans	Bakers Pond	6.0	8.2	8.0	7.6	8.4	7.5	
Orleans	Bakers Pond	7.0	7.9	7.9	9.1	8.5	9.3	
Orleans	Bakers Pond	8.0	9.0	8.0	9.9	8.6	10.0	
Orleans	Bakers Pond	9.0	11.6	7.7	10.3	11.7	10.0	
Orleans	Bakers Pond	10.0	9.6	4.6	11.3	12.3	10.5	
Orleans	Bakers Pond	11.0	6.7	2.6	10.0	10.4	10.6	
Orleans	Bakers Pond	12.0	2.0	0.6	6.7	7.5	7.6	
Orleans	Bakers Pond	13.0	0.6	0.0	4.6	5.8	6.1	
Orleans	Bakers Pond	14.0	0.5	0.3	1.2	2.6	4.7	
Orleans	Bakers Pond	15.0	0.4	0.3	0.1	0.6	2.9	
Orleans	Bakers Pond	16.0	0.4	0.3	0.1	0.3	2.4	
Orleans	Bakers Pond	16.3						
Orleans	Bakers Pond	16.5						
Orleans	Bakers Pond	16.8				0.3		
Orleans	Bakers Pond	17.0	0.4		0.1	0.4	2.3	
Orleans	Bakers Pond	17.5			0.1			
Orleans	Boland Pond	0.5	6.9	6.3	9.2	7.8	9.7	
Orleans	Boland Pond	1.0	6.4	5.8	4.3	7.6	9.4	

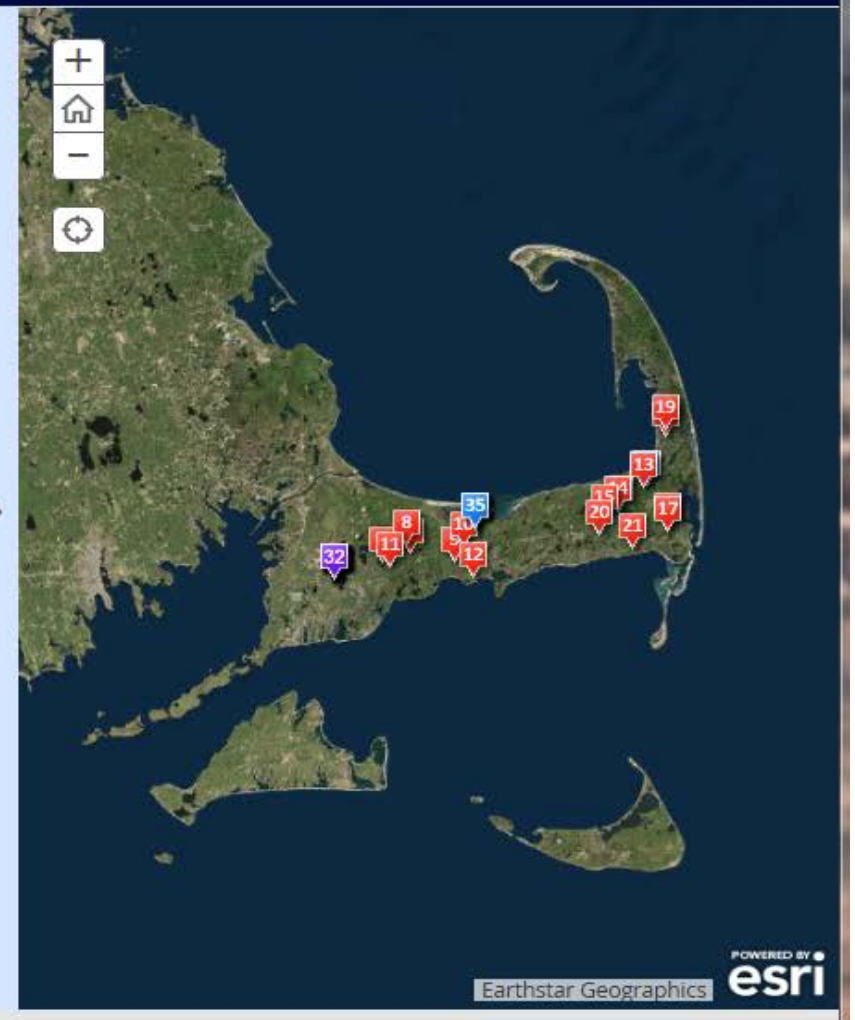

Uncle Harvey's Phosphorus Summer Snapshot
Phosphorus (ug/L)
45
40
35
30
25
20
15
10
5
0
01-Sep-01
01-Sep-02
01-Sep-03
24-Aug-04
22-Sep-04
22-Aug-05
26-Sep-05
16-Aug-06
21-Sep-06
21-Aug-07
25-Aug-08
10-Sep-09
14-Sep-10
24-Aug-11
27-Aug-12
28-Aug-13
20-Aug-14
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014


20%
20%
31%
29%
226 Sampled Ponds
Eutrophic
Mesotrophic
Not Interpreted
Oligotrophic

Cape Cod Freshwater Ponds Restoration Projects

Cape Cod Commission

CAPE COD COMMISSION



1

2 The Situation

3 The Consequences

4 The Solutions

5 Ashumet Pond
Mashpee/Falmouth

6 Santuit Pond
Cotuit

7 Hamblin Pond
Marstons Mills

8 Mystic Lake
Marstons Mills

9

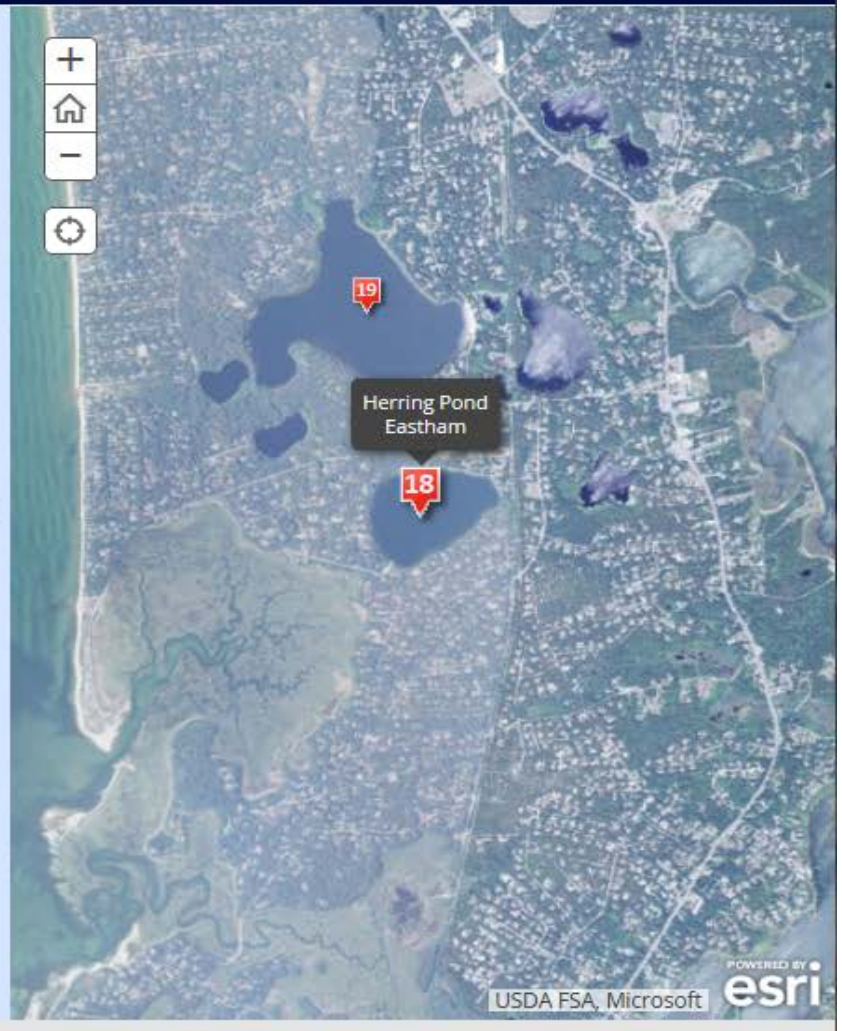
Cape Cod Freshwater Ponds Restoration Projects

Cape Cod Commission

CAPE COD COMMISSION

Herring Pond Eastham

Acres: 44
Issue: Algae blooms from elevated phosphorous levels, low dissolved oxygen levels, stressful fish habitat
Restoration technology: Alum Treatment
Year deployed: 2014
Results: Lake clarity improved
Cost: ~$140,000
Link to pond report: http://www.eastham-ma.gov/Public_Documents/EasthamMA_webdocs/WaterManagementDocs/pondsreports/PondsFinalRpt.pdf
Contact: Jane Crowley, jcrowley@eastham-ma.gov



Long Pond
Brewster/Harwich

Hinckley's Pond
Harwich

Stillwater Pond
Chatham

Lovers Lake
Chatham

Herring Pond
Eastham

Great Pond
Eastham

Flax Pond
Harwich

Skinequit Pond
Harwich

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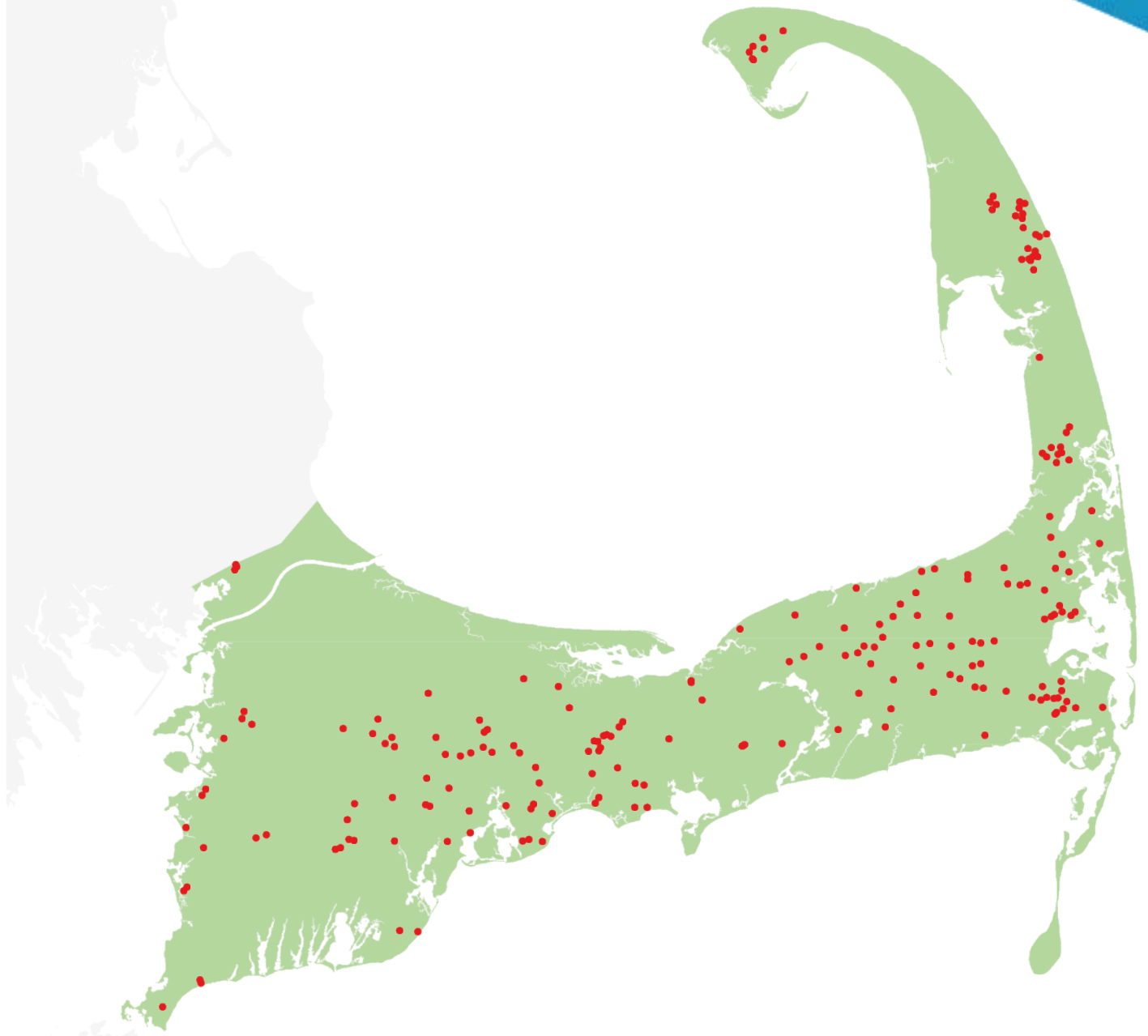
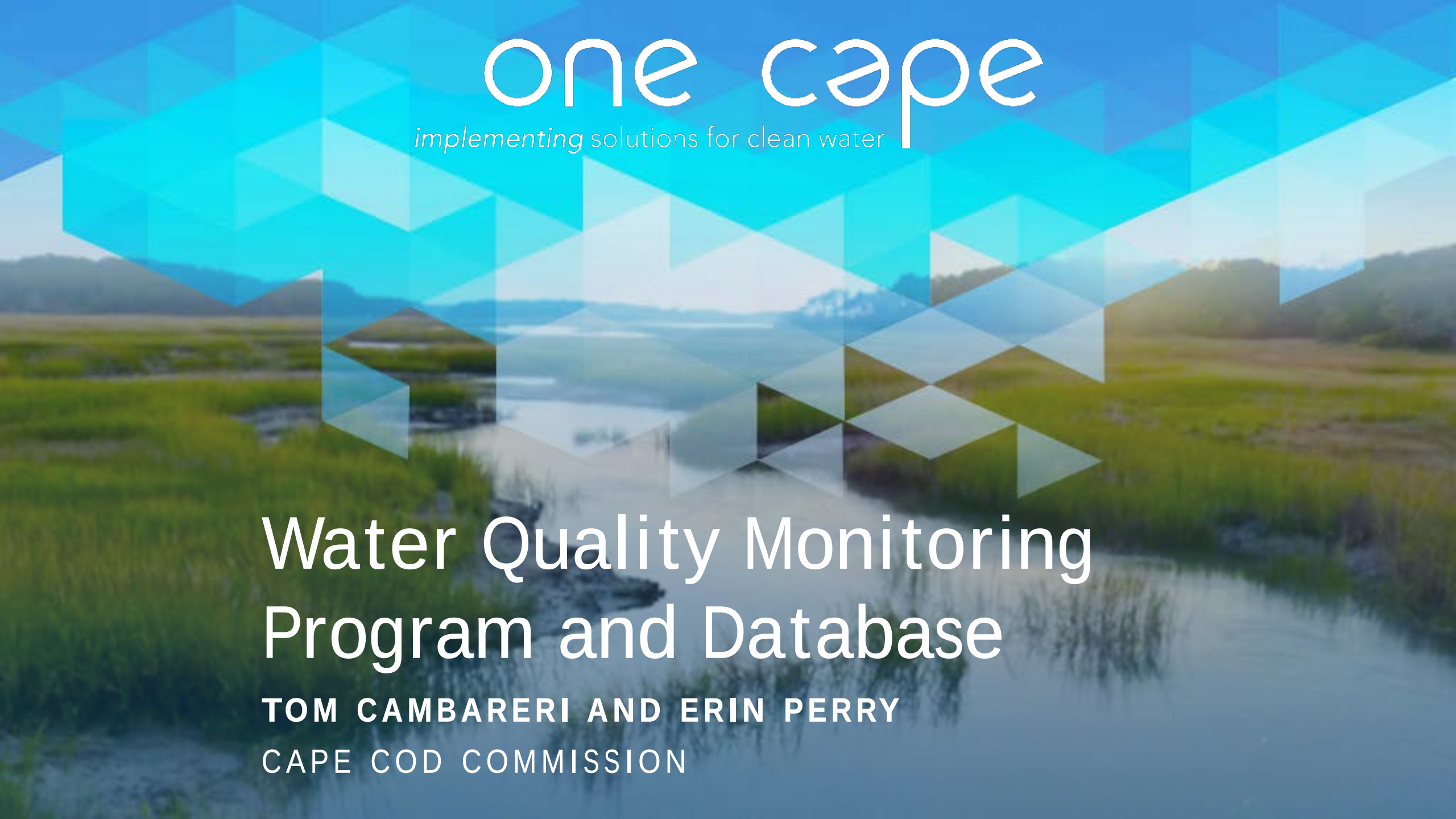
implementing solutions for clean water



- Ponds and Lakes Stewardship Program



Water Quality Monitoring Program and Database

TOM CAMBARERI AND ERIN PERRY

CAPE COD COMMISSION