



Long Island Sound Eutrophication Management-Moving Forward After Downstream Success

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Ammerman, NEIWPC

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Thanks to Mark Tedesco,
Director EPA Long Island Sound Office

[NŪ-Ē-PĪK]

NEIWPCC is a regional commission that helps the states of the Northeast preserve and advance water quality.

We engage and convene water quality professionals and other interested parties from New England and New York to collaborate on water, wastewater, and environmental science challenges across shared regions, ecosystems, and areas of expertise.



KEY AREAS OF WORK AND IMPACT

CONNECTIONS



We engage and convene water quality professionals and other stakeholders across the Northeast to collaborate on clean water and environmental science challenges across shared regions, ecosystems, and areas of expertise.

PROTECTION



We conduct research into water-related topics, monitor environmental factors, and fund such work by others. We also implement and fund environmental restoration and other on-the-ground projects.

TRAINING



We develop, coordinate, and conduct training courses that serve water quality professionals regionally and nationwide.

EDUCATION



We fund and/or staff programs that engage the public through events, exhibits, web and print publications, and other outreach activities.

ENGAGEMENT



We actively represent the interests of member states at meetings with federal and state officials and in regional and national water and wastewater associations.

NEIWPCC

• MISSION •

To advance clean water in the Northeast through collaboration with, and service to, our member states.

• VISION •

Clean and sustainable water throughout the Northeast.

• VALUES •

Leadership • Collaboration • Education • Service • Science

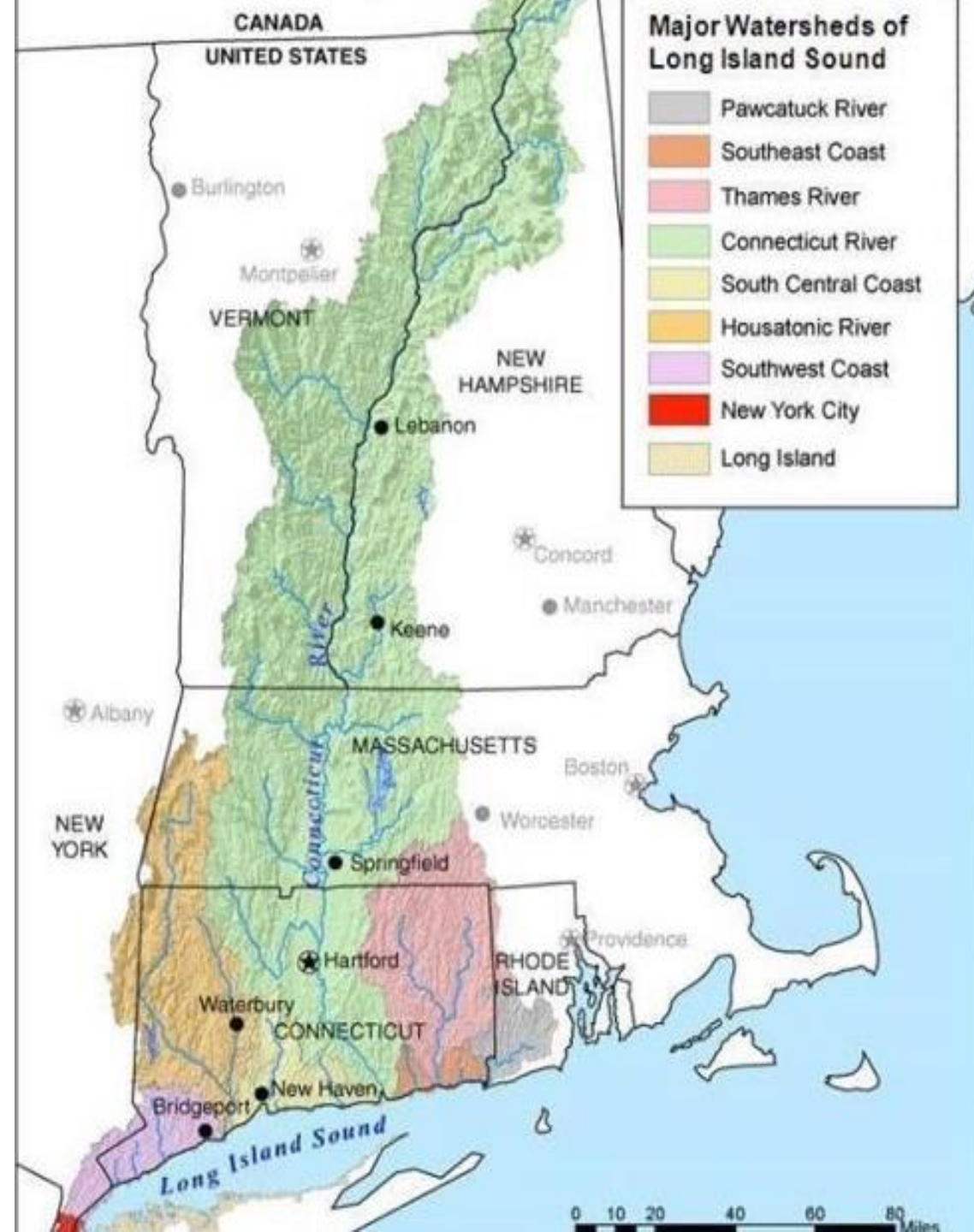




Long Island Sound Study
A Partnership to Restore and Protect the Sound

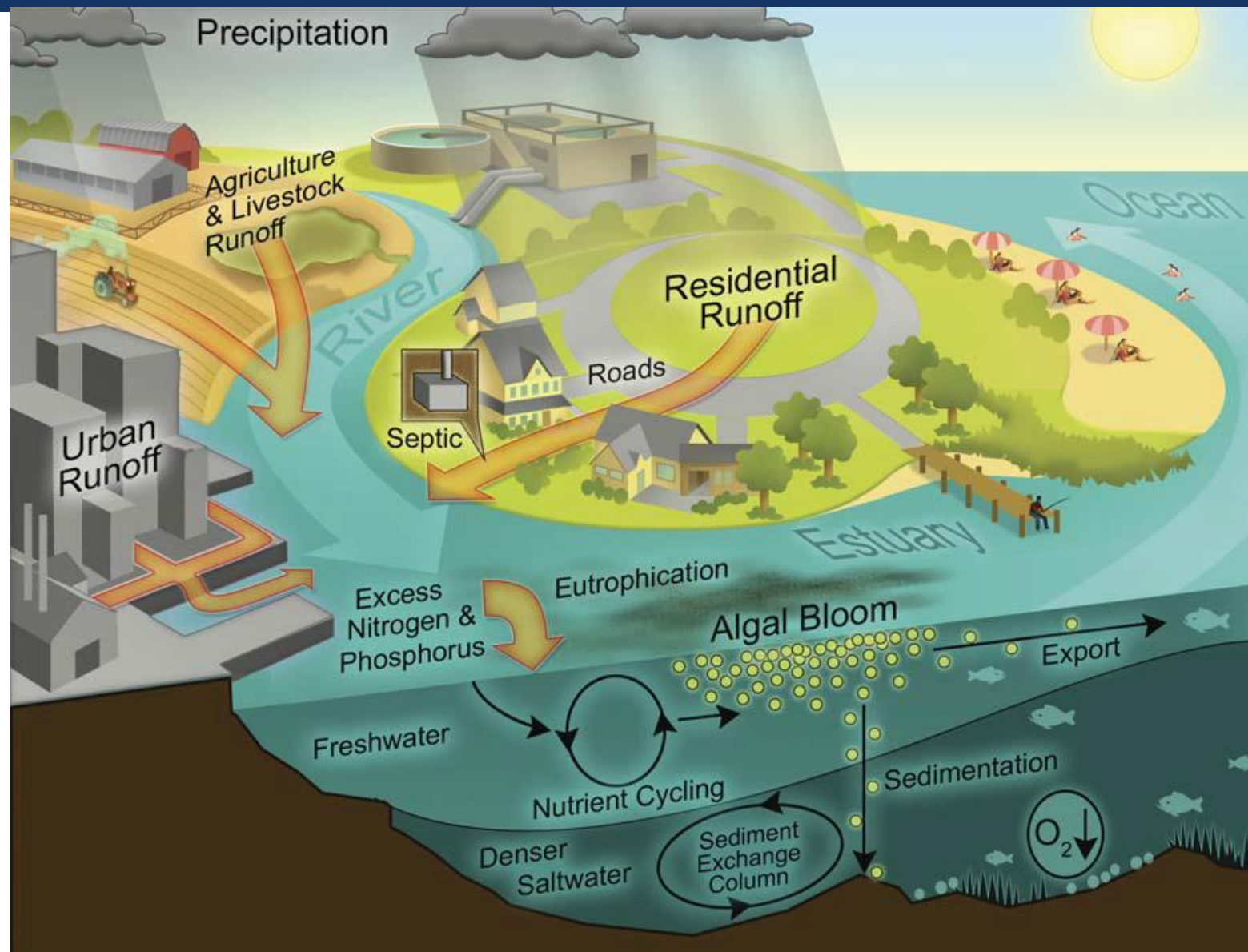
Long Island Sound (LIS) – An Unusual Urban Estuary

1. Oriented East-West, 20 m mean depth
2. Connected to ocean at both ends
3. 70% of freshwater from the CT River near the mouth
4. Long Island Sound Watershed (44,000 km² area) extends to Canada and includes 9 M people (23 M within 50 mi)
5. Part of the Virginian Atlantic Ecoregion (Mid-Atlantic) extending from Cape Hatteras to Cape Cod



Eutrophication (Paerl, 2006)

In Long Island Sound, nitrogen loading from Point Sources like WWTPs and Non-Point Sources like septic systems and fertilizer runoff lead to eutrophication impacts like hypoxia and harmful algal blooms.



Establish Water Quality Standards (WQS)

Designated Uses + Water Quality Criteria

Conduct Water Monitoring

Meeting WQS?

Yes

No

303(d)

Pollution Diet + Allocation

Antidegradation
Keep it that way

Pollution Reduction
Clean Water Act Gives us Options

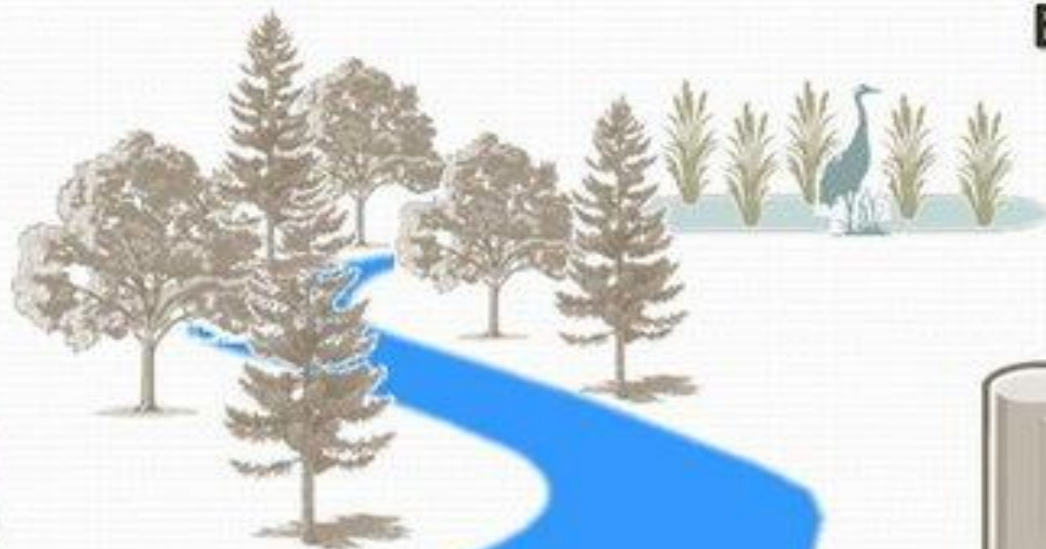
Background Load

- Naturally occurring from wetlands, forests



Load Allocation

- Runoff from the landscape



Waste Load Allocation

- Municipal Wastewater
- Industrial Wastewater
- Stormwater (MS4s)

TMDL

Load
Allocation

+

Waste Load
Allocation

+

Margin of
Safety



303(d) = Total Maximum Daily Load
The Pollution Diet

TMDL = All nonpoint sources + All point sources + fudge factor

Or

TMDL = Σ load allocation + Σ waste load allocation + margin of safety

Or

TMDL = Σ LA + Σ WLA + MOS

2000 TMDL to Attain DO

In-Basin WWTPs	60%
In-Basin NPS	10%
Upper Basin WWTPs	25%
Upper Basin NPS	10%
Atmospheric Deposition	18% from CAA
Alternatives to N Reduction	E.g. bioextraction

With \$2.5 billion invested since the 2000 TMDL, NY & CT are discharging 49 million fewer pounds of nitrogen annually by sewage treatment plants compared to the early 1990s, a 60% reduction

A Total Maximum Daily Load Analysis to Achieve Water Quality Standards for Dissolved Oxygen in Long Island Sound

Prepared in Conformance with Section 303(d) of the Clean Water Act and the Long Island Sound Study

Prepared by:

New York State Department of Environmental Conservation
 50 Wolf Road
 Albany, NY 12233-0001
 (518) 457-5400



December 2000

Connecticut Department of Environmental Protection
 79 Elm Street
 Hartford, CT 06106-5127
 (860) 424-3020



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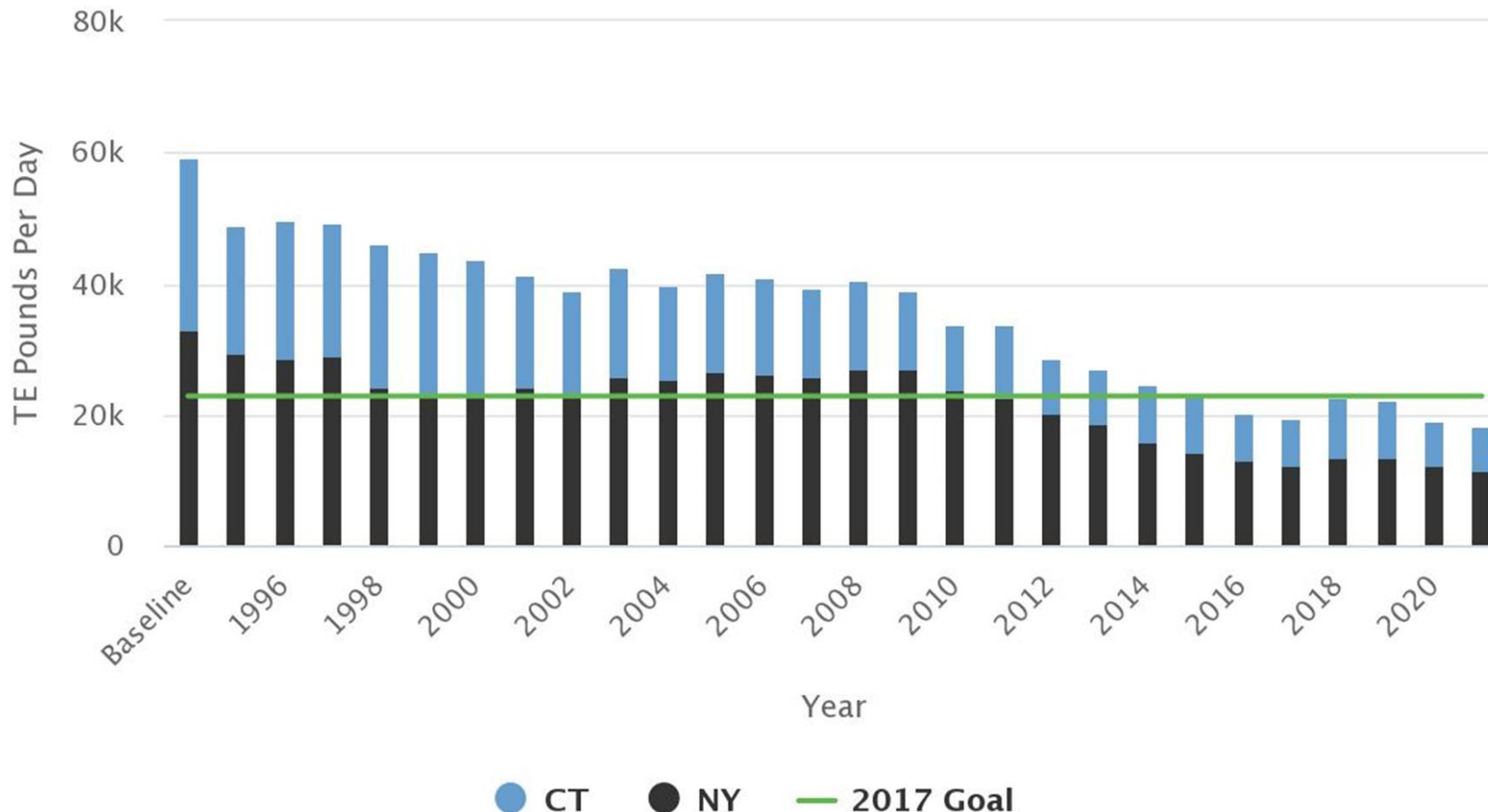


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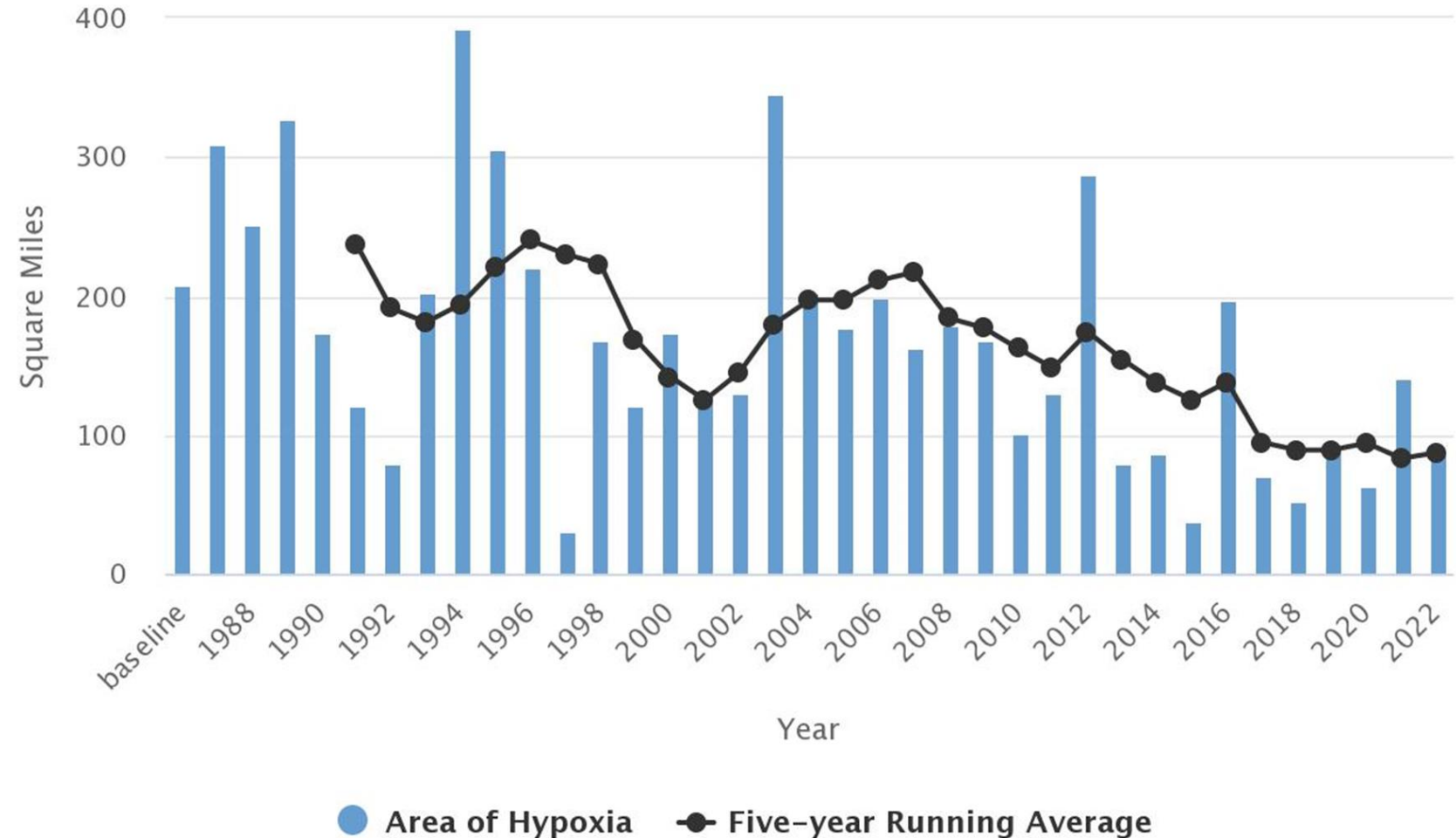
Wastewater Treatment Plant Point Sources–Nitrogen Trade Equalized (TE) Loads, 1995–2021



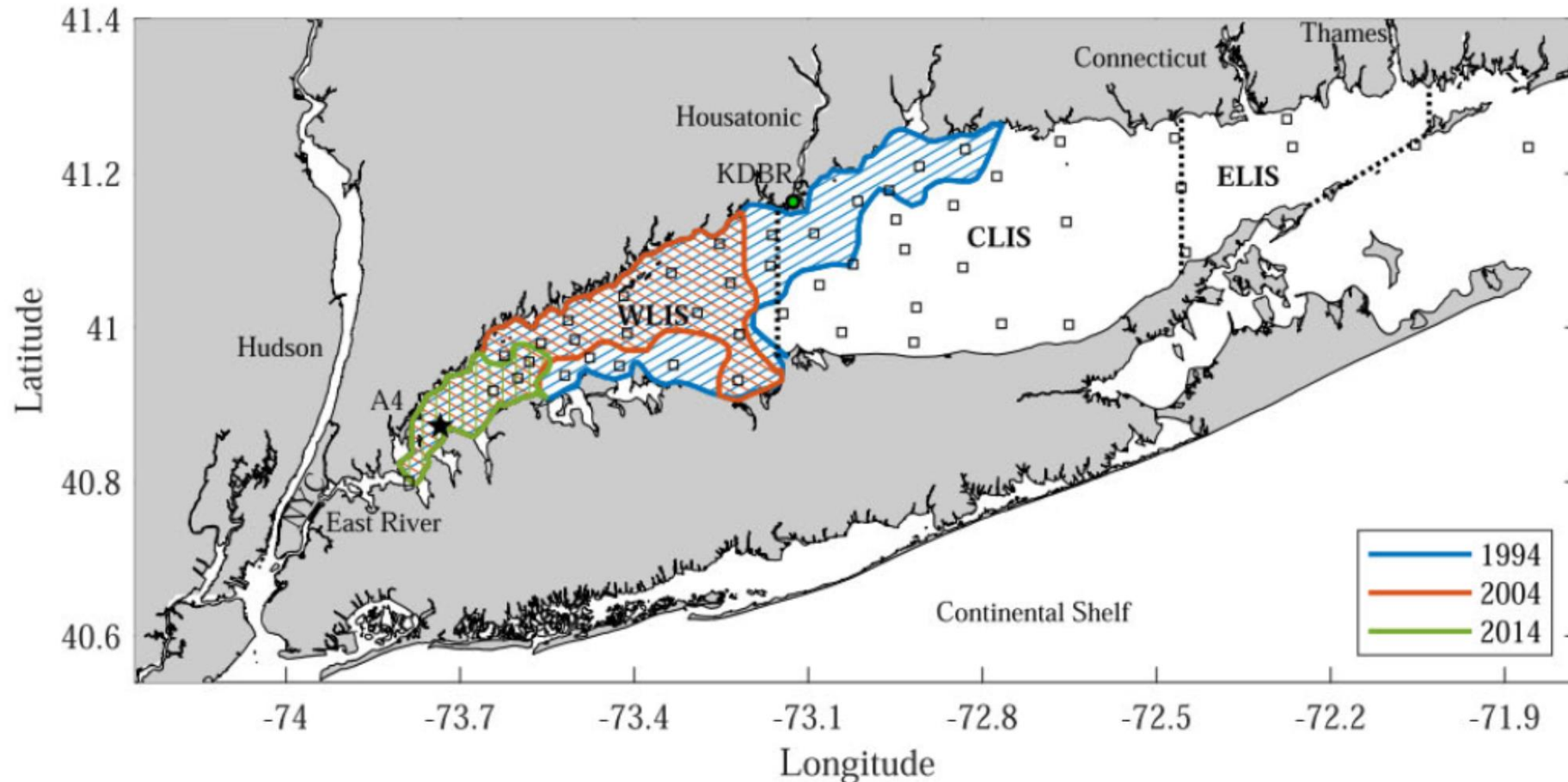
The TMDL called for a 60% reduction in nitrogen loading, it was achieved in 2016 and has been maintained

Though not widely known, the hypoxic area has now been reduced by almost 60%, the most recent 5-year rolling average (2018-2022) was 87 mi².

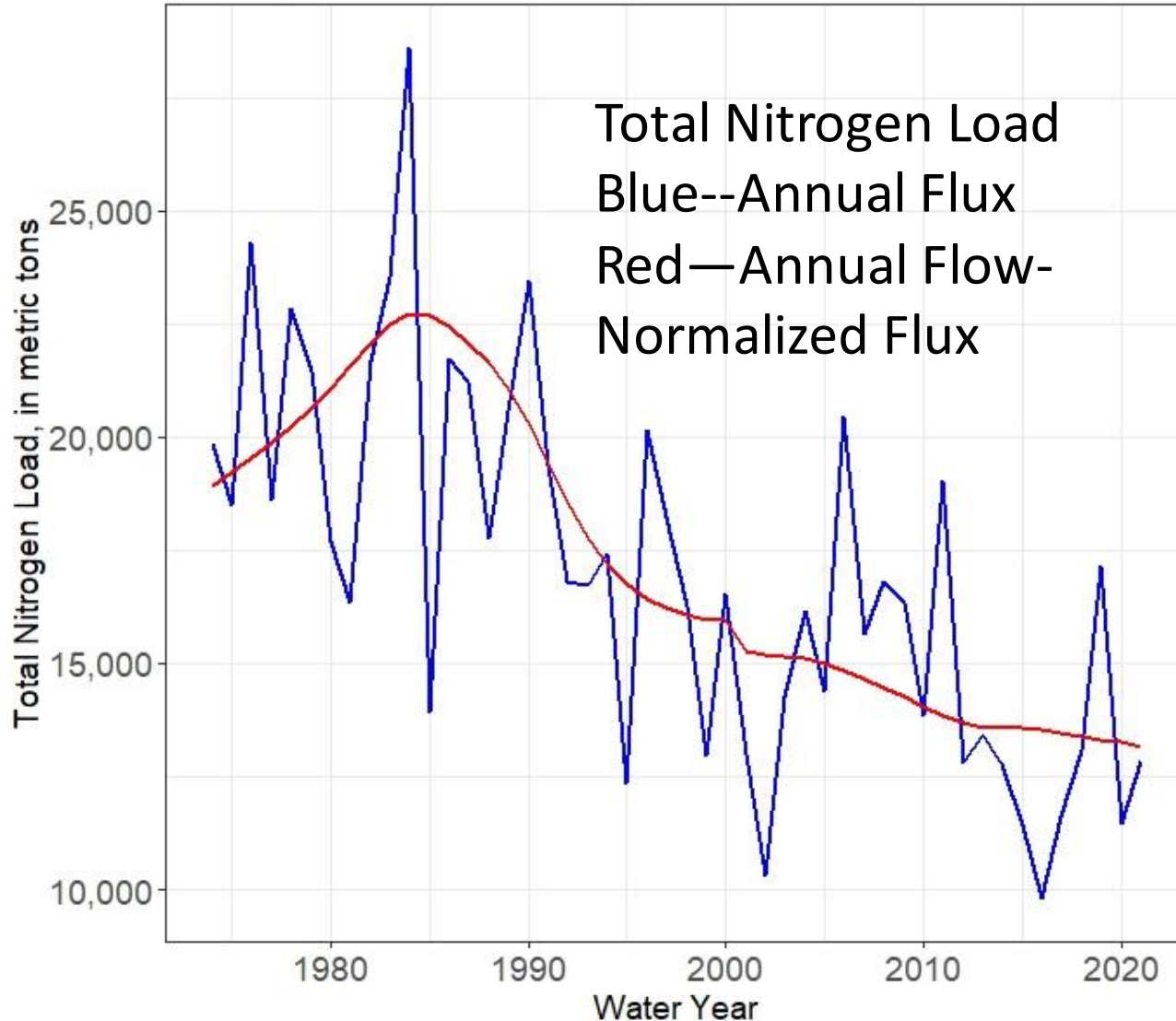
Hypoxia (Dissolved Oxygen \leq 3 mg/L) in Long Island Sound



Each Decade has seen a Decline in the Hypoxic Area (1994, 2004, 2014) (Whitney & Vlahos, 2021)



Nitrogen Loads to Long Island Sound
from 7 major tributaries



Connecticut Fall Line Nitrogen Load--USGS

(Combined from 7 Major Tributaries)

Site Name

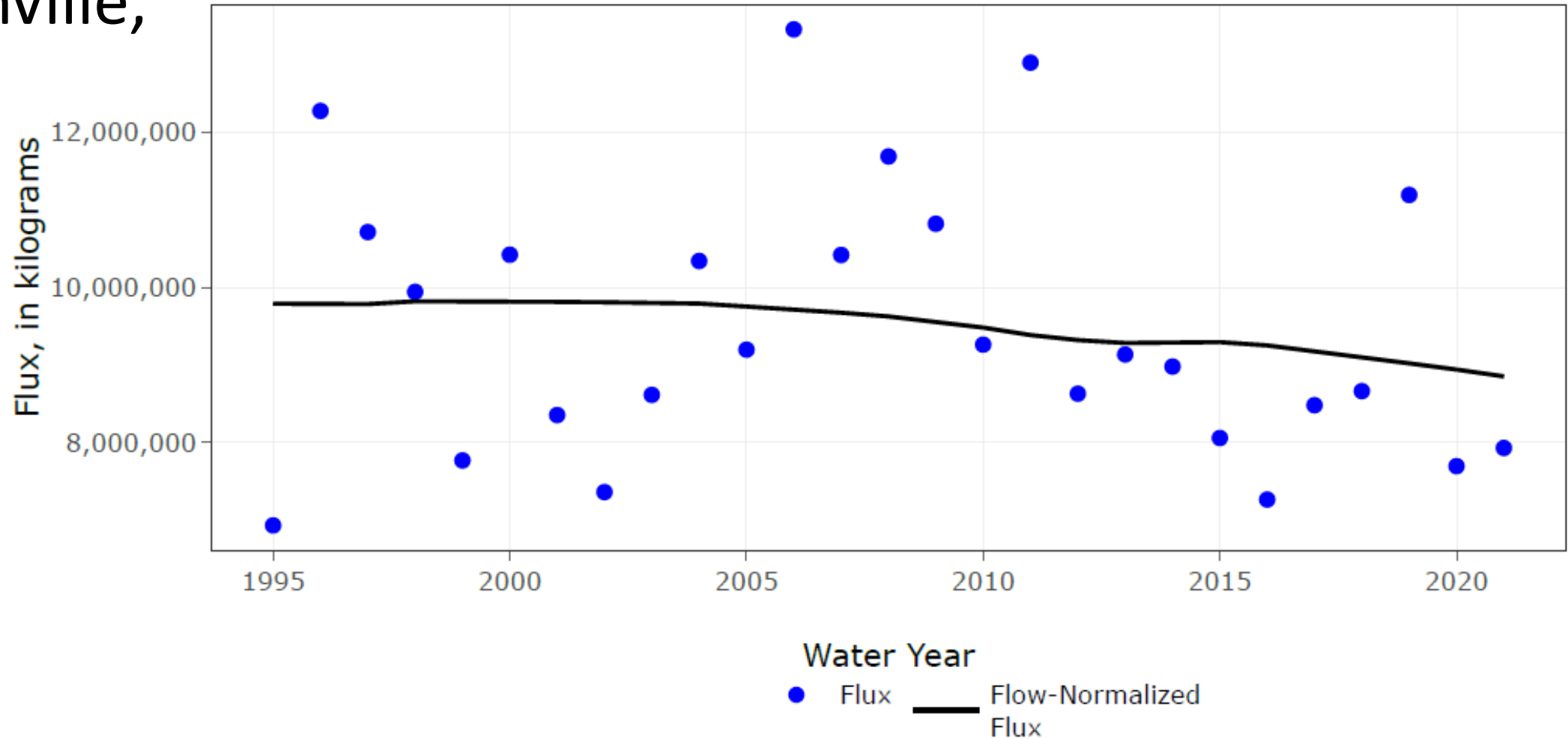
SHETUCKET R AT SOUTH WINDHAM, CT
QUINEBAUG RIVER AT JEWETT CITY, CT
CT RIVER AT THOMPSONVILLE, CT
FARMINGTON RIVER AT TARIFFVILLE, CT
QUINNIPIAC RIVER AT WALLINGFORD, CT
HOUSATONIC RIVER AT STEVENSON, CT
NAUGATUCK RIVER AT BEACON FALLS, CT

A fall line is the area where an upland region and a coastal plain meet and is noticeable especially where rivers cross it, with resulting rapids or waterfalls.



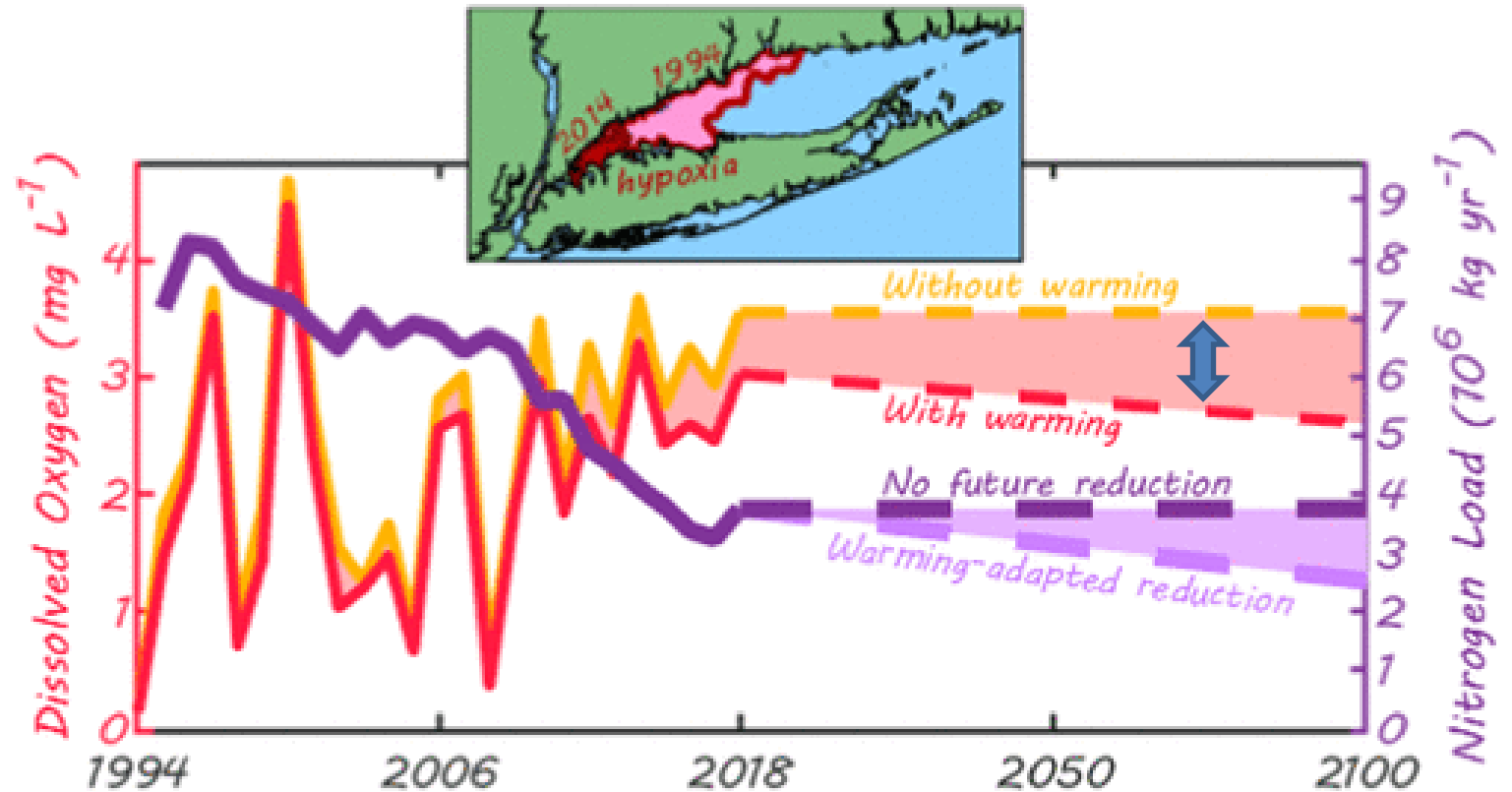
CT RIVER at Thompsonville, CT

Flux for station 01184000: Total nitrogen



Improvements will not be sustained in the warming climate without intervention

- Warming-induced oxygen solubility loss has dampened the observed increase in dissolved oxygen in LIS by **27%**.
- By 2099 (0.4 mg L⁻¹) projected to erode another **35%** of the observed oxygen gains achieved to date. (Whitney and Vlahos 2021).



Other Eutrophication Impairments

Milford, CT

Harmful algal growth

Decreasing open water hypoxia area and severity...but hypoxia

Wetland degradation

Fishers Island, NY

Reduced seagrass area

remains along with other eutrophication impairments

Diurnal embayment hypoxia

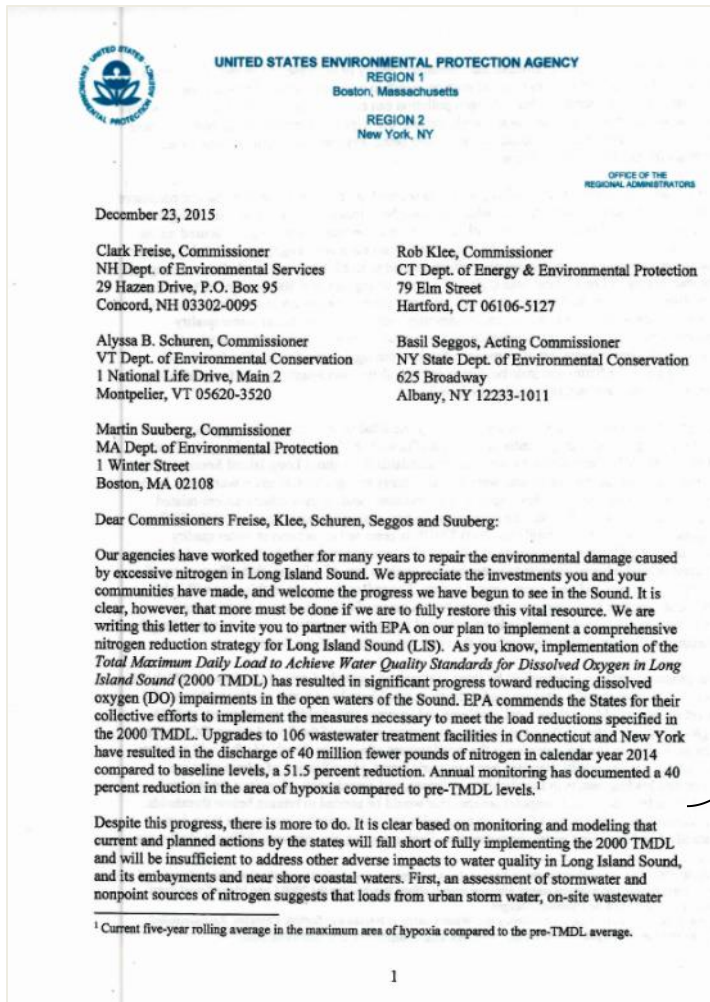
Goal: Develop Nitrogen (N) loads to meet desired water quality conditions in the Long Island Sound (LIS)

1. Coastal watersheds that directly drain to embayments or nearshore waters
2. Tributary watersheds that drain inland reaches
3. WLIS coastal watersheds with large, direct discharging wastewater facilities

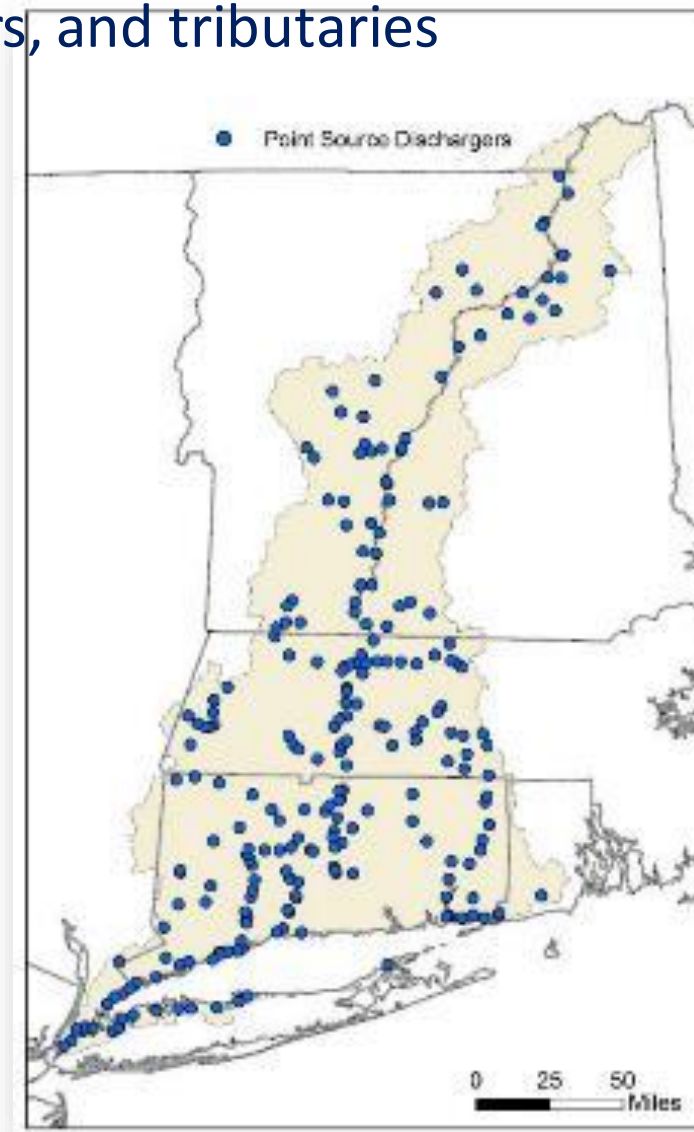


The EPA Nitrogen Reduction Strategy

Goal: Identify N loading targets for coastal embayments, open waters, and tributaries



“Aggressively continue progress on nitrogen reductions, in parallel with the States' continued implementation of the 2000 TMDL, and achieve water quality standards throughout Long Island Sound and its embayments and near shore coastal waters.”



Now

- Optimization requirements added in permits based upon 2012 Enhanced Implementation Plan
- Now reissuing permits to establish WQBELs for TN based on 2001 TMDL (see tables)

Future

- Consistent with N Strategy, EPA will consider lower TN limits if needed to meet nitrogen thresholds or allocations adopted into enforceable watershed plans or TMDLs
- Also consider regulated MS4s (202 in CT, 86 in NY, 47 in MA)

Tributary State Requirements based on the TMDL

Annual Average TN limits for MA WWTP dischargers to the LIS watershed

Facility Design Flow, Q_D (MGD)	# of Facilities	Annual Average TN Limit (lb/day)
$Q_D > 10$	4	Q_D (MGD) * 5 mg/L * 8.34 + optimize
$5 < Q_D \leq 10$	5	Q_D (MGD) * 8 mg/L * 8.34 + optimize
$1 \leq Q_D \leq 5$	20	Q_D (MGD) * 10 mg/L * 8.34 + optimize
$0.1 \leq Q_D < 1$	17	Optimize
$Q_D < 0.1$	8	TN monitoring only

Tributary State Requirements based on the TMDL

Annual Average TN limits for NH WWTP dischargers to the LIS watershed

Facility Design Flow, Q_D (MGD)	# of Facilities	Annual Average TN Limit (lb/day)
$Q_D > 6$	0	Q_D (MGD) * 8 mg/L * 8.34 + optimize
$1.5 \leq Q_D \leq 6$	5	Q_D (MGD) * 10 mg/L * 8.34 + optimize
$0.1 \leq Q_D < 1.5$	17	Optimize
$Q_D < 0.1$	3	TN monitoring only

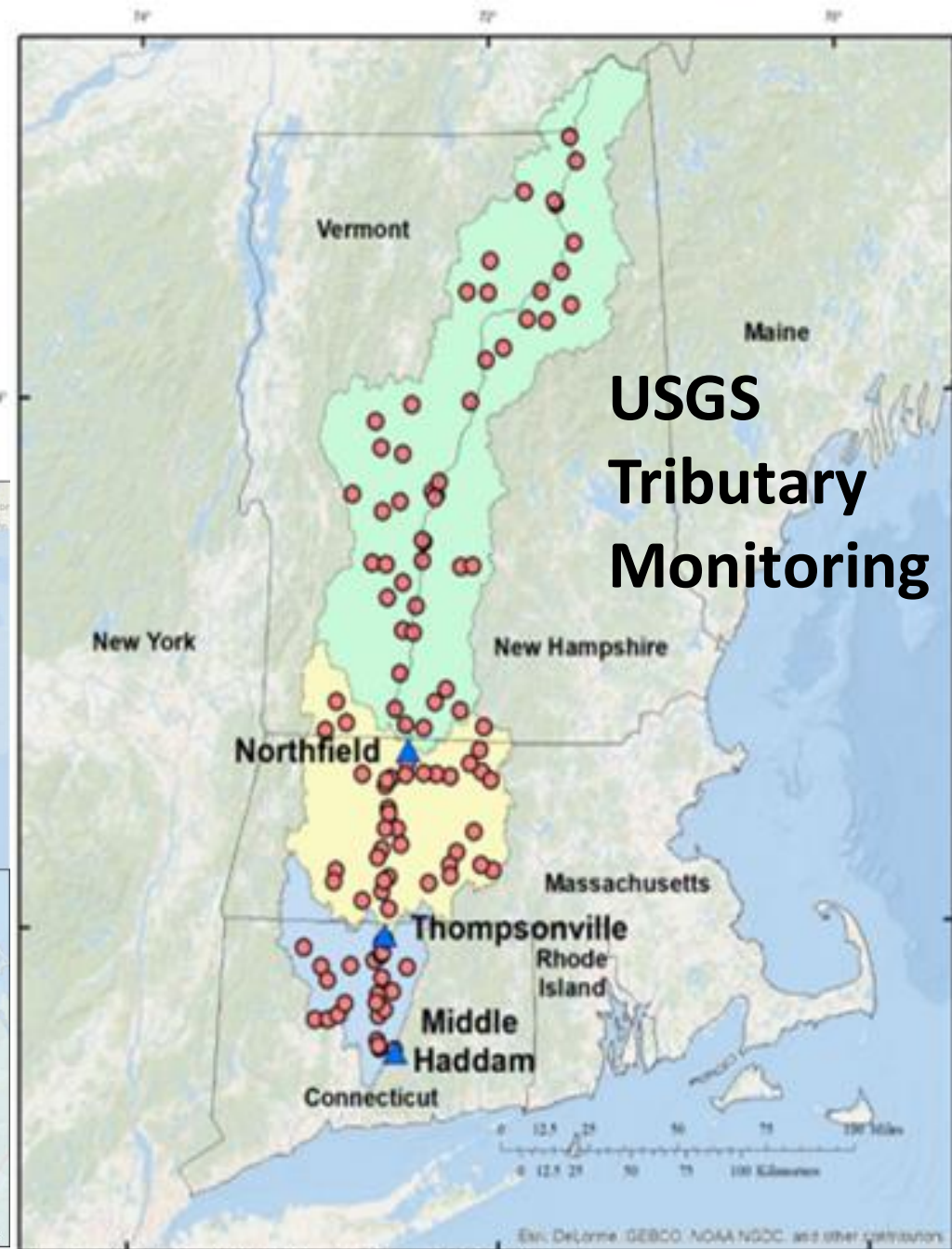
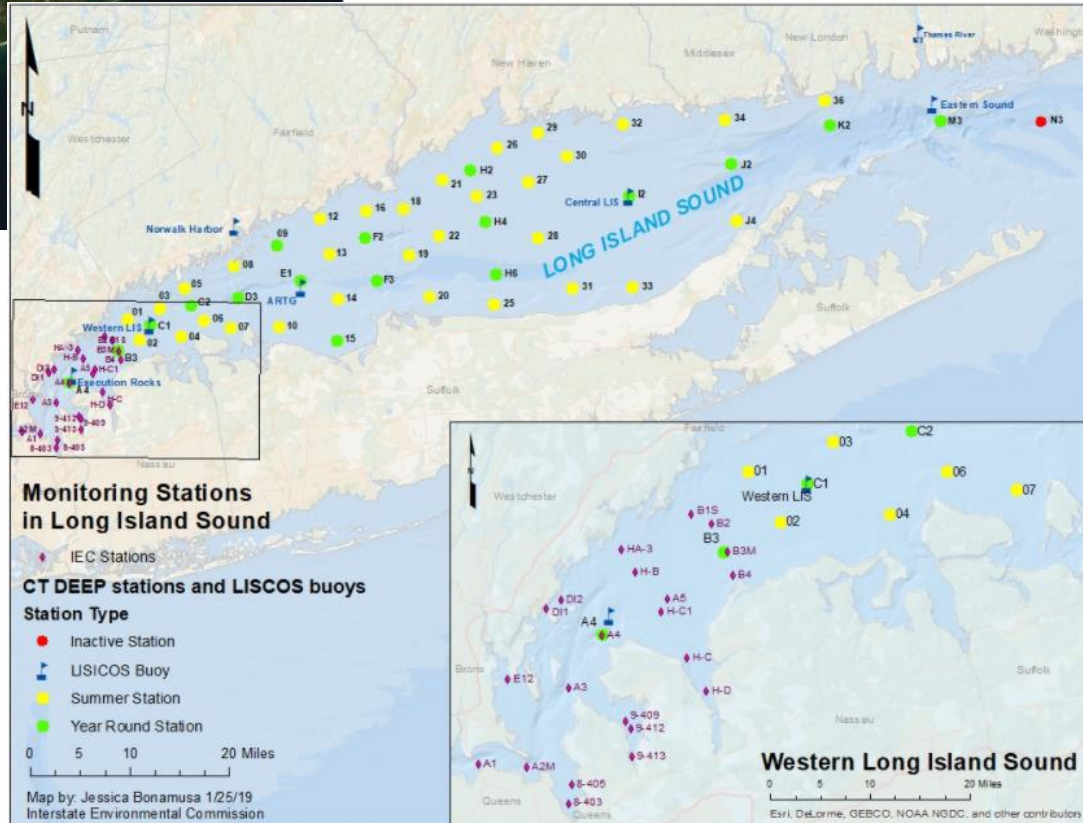
- ❑ Expand efforts to monitor and model the flow of nutrients and the associated impacts to the Sound and its embayments.
- ❑ Address deficiencies in regional circulation and water quality models by designing an integrated model framework to forecast how the Sound responds to change, including climate.
- ❑ Improve data sharing and visualization tools as well as enhanced coordination among monitoring groups.
- ❑ Evaluate progress under 2000 TMDL and set systemwide and subwatershed nitrogen targets protective of water quality.

Expanded Water Quality Monitoring

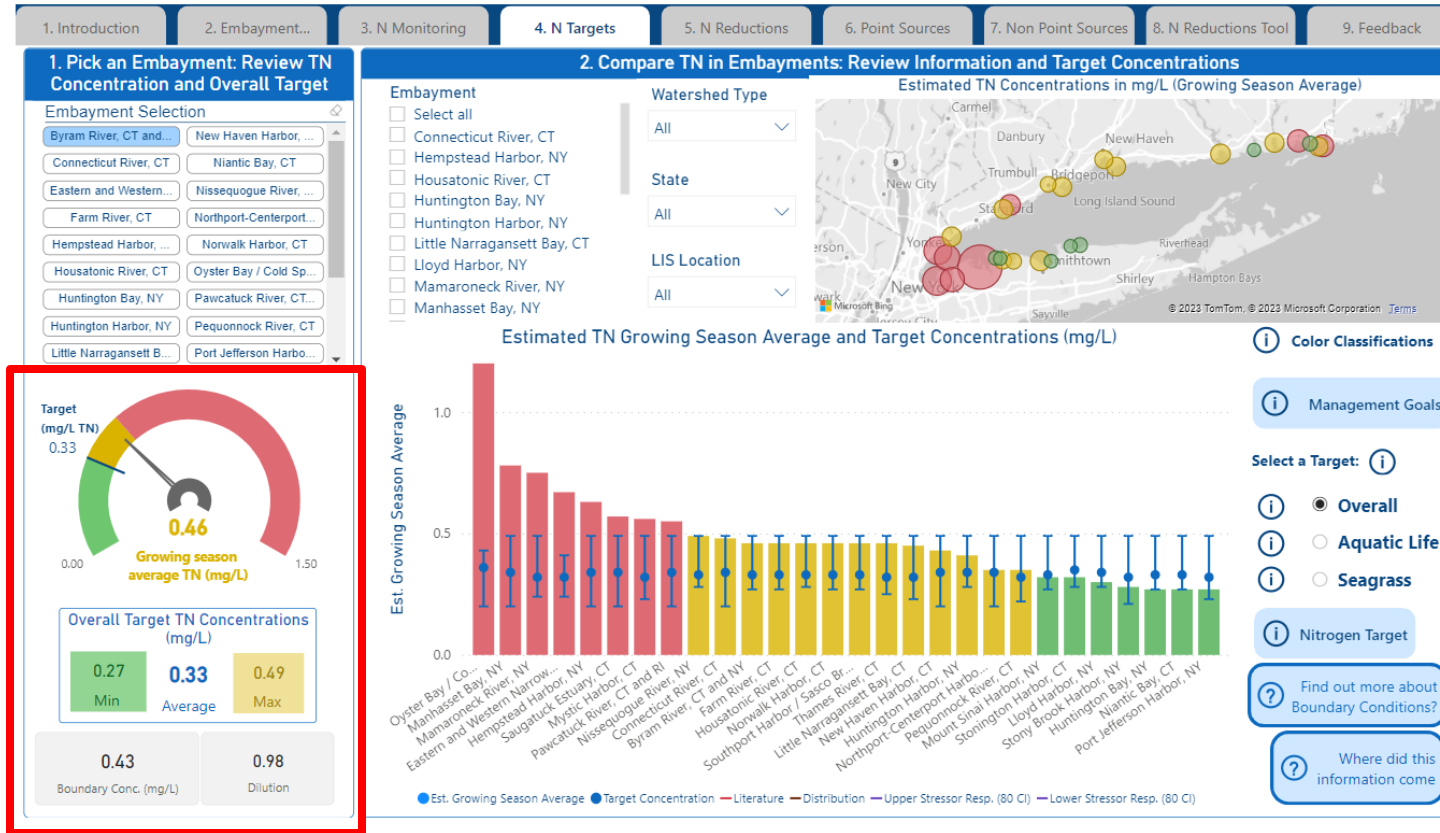
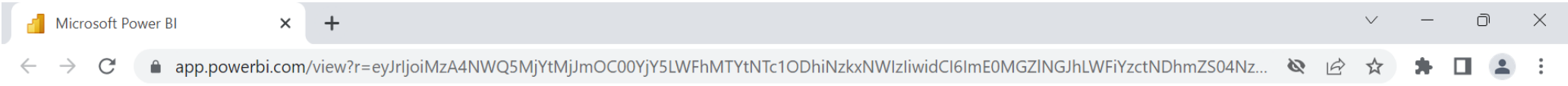


STS/UWS- Embayment Monitoring

IEC/CTDEEP- LIS Monitoring

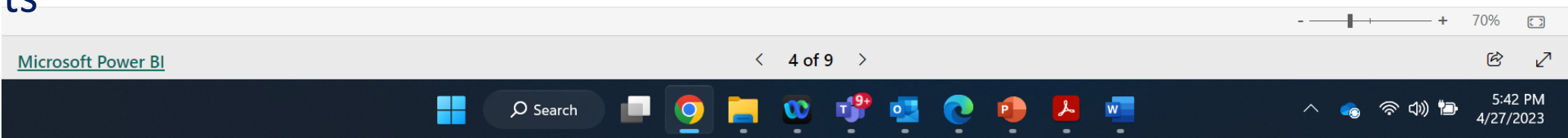


Embayment Nitrogen Target Dashboard-Tetra Tech

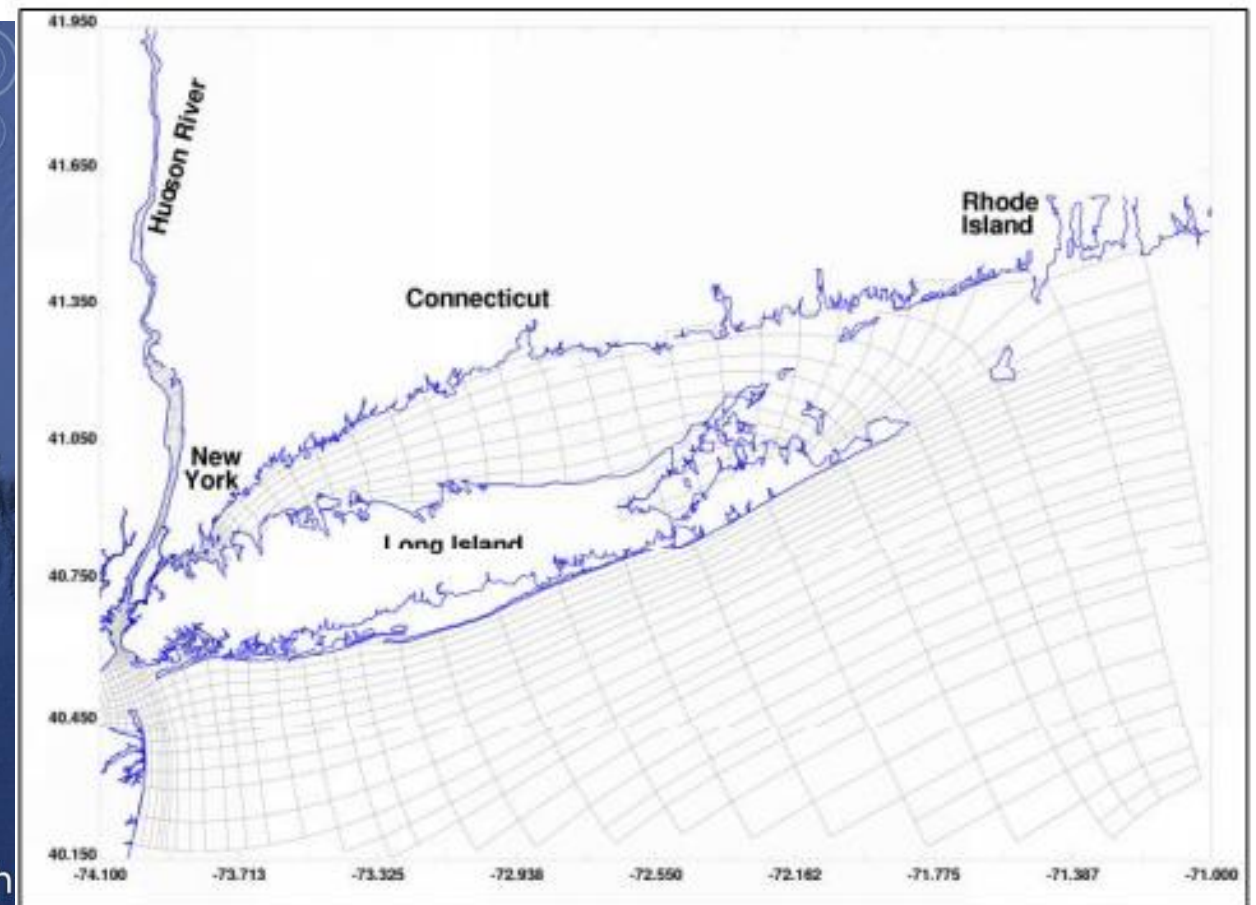
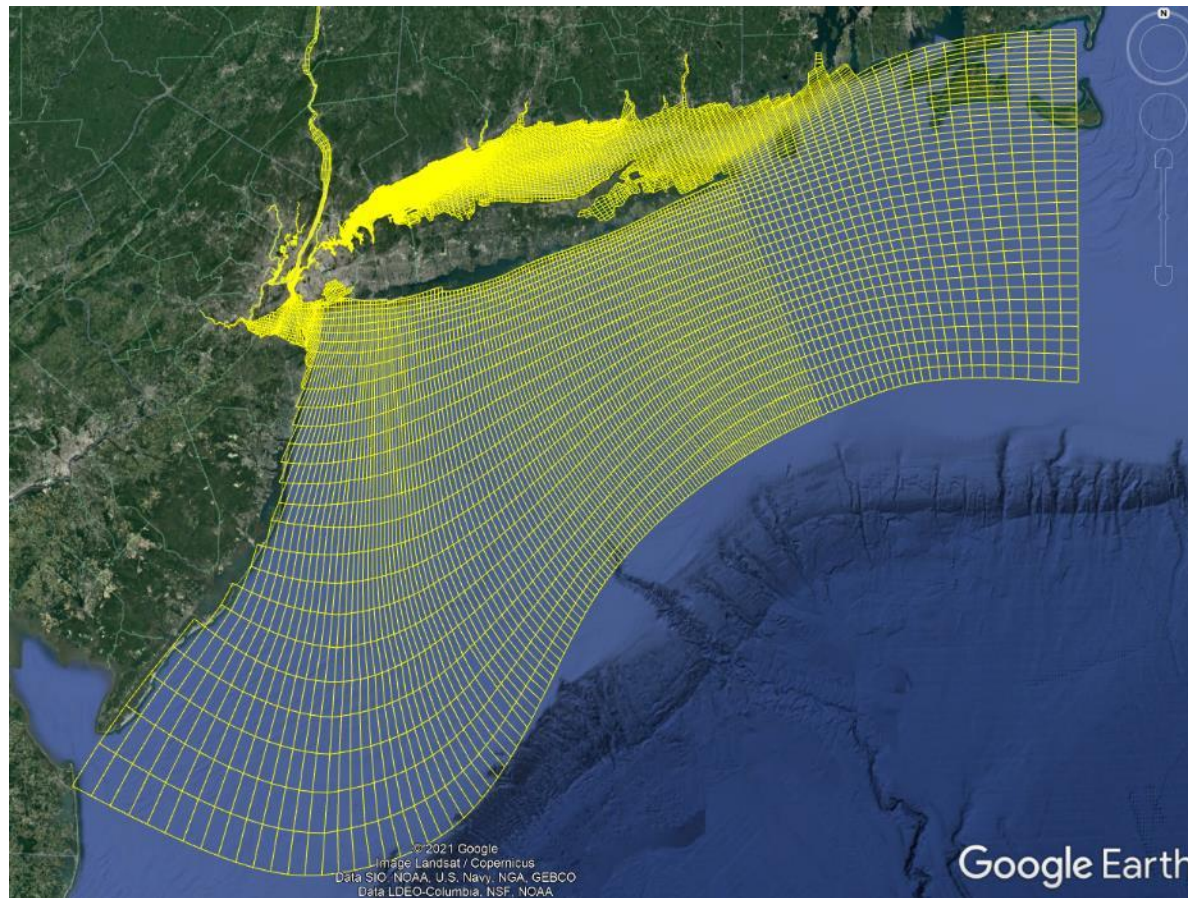


Link: [Long Island Sound Dashboard \(DRAFT\)](#)

- Minimum, maximum, and average TN target concentrations using weight of evidence approach compared to current concentrations
- Will be live on Long Island Sound Study website soon
- Potential future enhancements



New Integrated Hydrodynamic and Water Quality Model



Refined ROMS/RCA coupled model being developed under EPA/NYCDEP \$5.2 M Cooperative Agreement

Old systemwide eutrophication model grid structure

2016

2017

2018

2019

2020

2021

2022

2023

2024

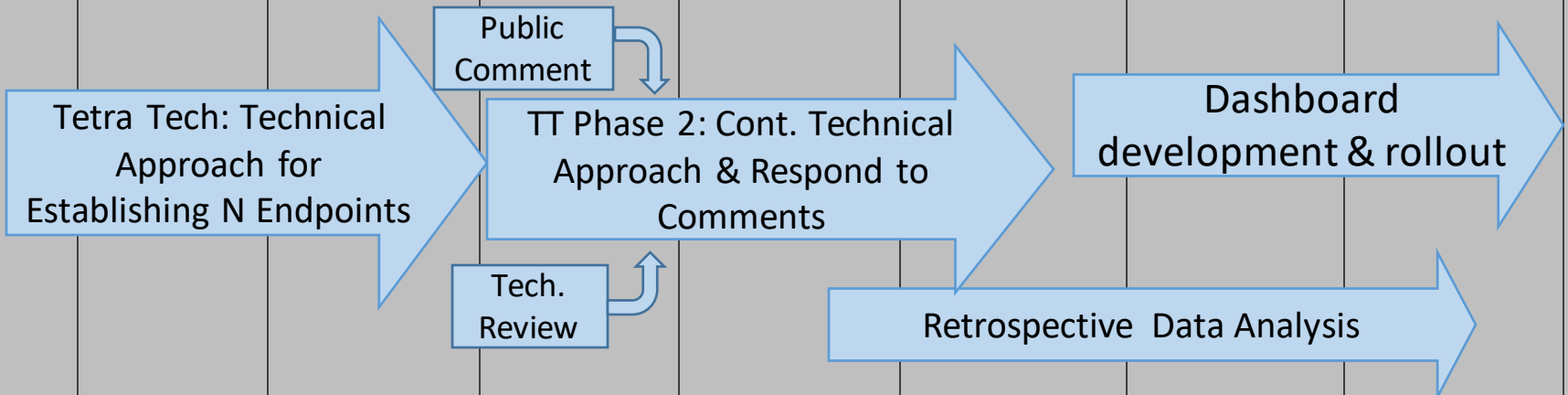
2025

Future

Ongoing Communication & Collaboration (Including LINAP & CT 2nd Gen)

Ongoing Monitoring Efforts (States, EPA, Other Federal Agencies, Community Groups)

Permitting: Continued Conditions to Meet Existing WQ Standards (EPA and States)



SWEM Eutrophication Modeling

EPA Long Island Sound Nitrogen Reduction Strategy

EPA LISS Funding for N Reduction Implementation

Questions & Discussion



An aerial view of the lower Connecticut River

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