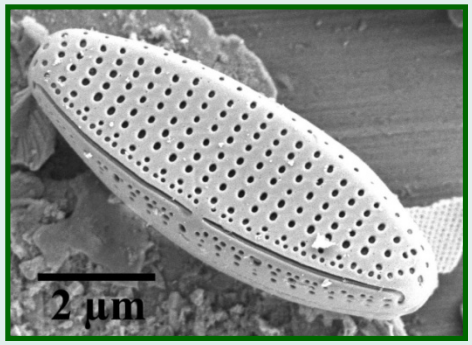
Connecticut Department of Energy and Environmental Protection

Connecticut Department of
ENERGY & ENVIRONMENTAL PROTECTION

CT DEEP Interim Phosphorus Management Strategy for Non-Tidal Waste Receiving Streams



November 7, 2018
Rowland C. Denny
Supervising Environmental Analyst
ACWA Nutrients Permitting Workshop

Connecticut Department of Energy and Environmental Protection

Connecticut's Interim Phosphorus Program

- Development of the Interim Phosphorus Program
- Implementing the Interim Phosphorus Program
- Developing the Final Phosphorus Management Strategy

CT's Phosphorus Program Development

Final Proposed BMP Requirement		Feasib
High	0.2	sible with Additional Filters l Addition.
Medium	0.7 m	nd Economically Feasible with n Or Biological Treatment If
Low		May reatment if Future Expans d.

- CT DEP Wen Public Notice w Beacon Falls NPDES Permit in May of 2010
- EPA Evaluated and Objected to the Permit Primarily Based on Concerns with Phosphorus Limits

CT's Phosphorus Program Development

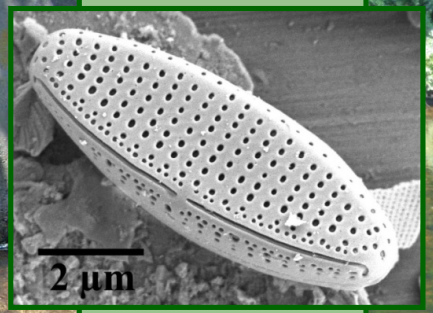
EPA Concerns (Re: Beacon Fall CT NPDES Draft Permit Letter June 18, 2010)

- "The Naugatuck River is listed as impaired for aquatic life, and municipal point source discharges are listed as one of the causes of impairment."
- "No analyses of (aquatic life) data relative to general impairment status or eutrophication impacts was presented."
- "CTDEP must conduct an appropriate analysis of the potential that phosphorus in the discharge will cause or contribute to a violation of water quality standard and, if so, must establish a WQBEL…"

Connecticut's Interim Phosphorus Program

CT DEP Response to EPA objection

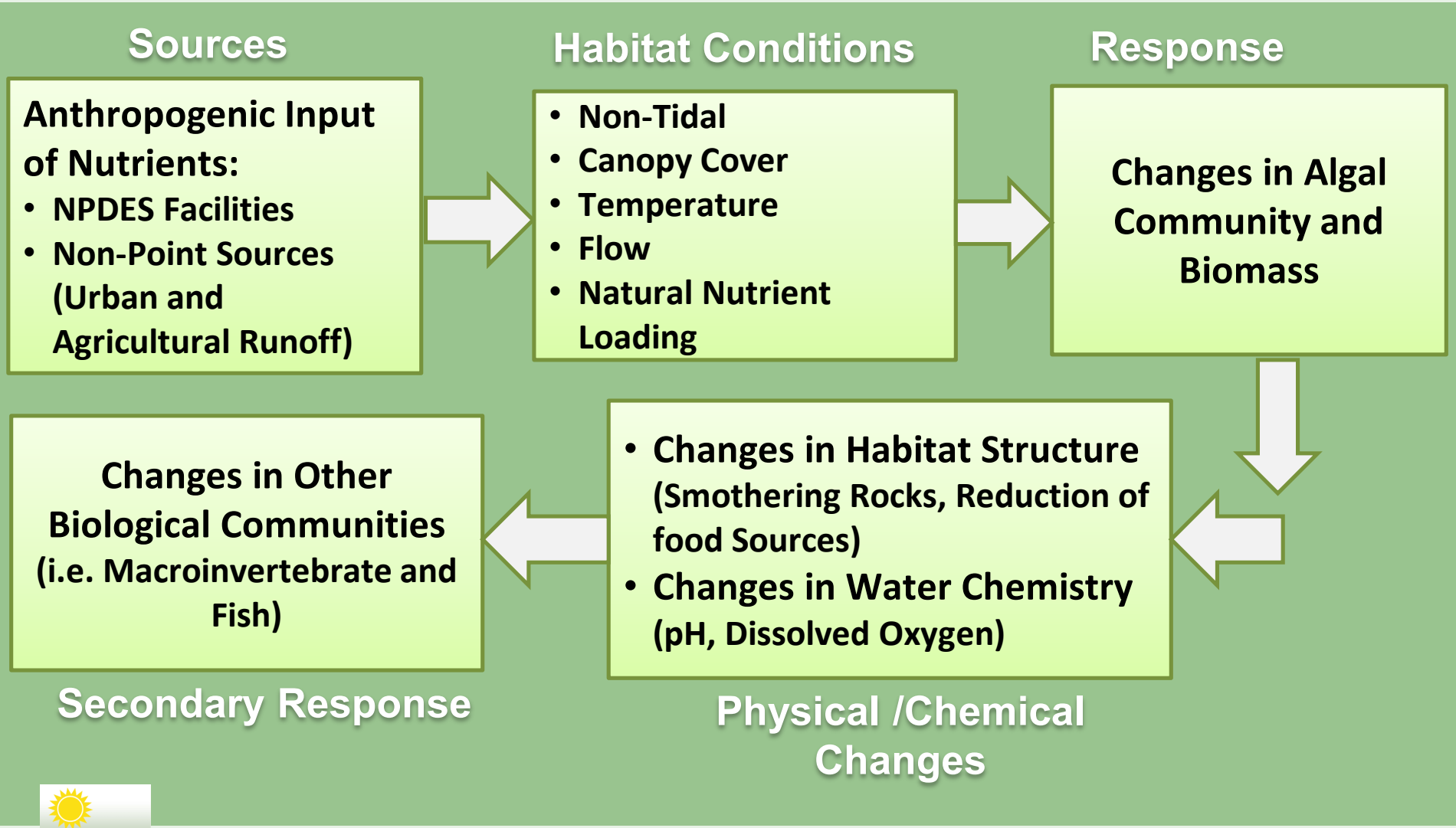
- Using best available science, we shifted the strategy to develop biologically based phosphorus limits for NPDES facilities that meet aquatic life designated uses



CT's Interim Nutrient Management Strategy

- Focused on changes in stream algal species composition because they respond directly to nutrients and provide a better indicator of enrichment condition in streams than assessment of water chemistry, macroinvertebrates, fish or algal biomass (EPA, 2000).
- Species composition of stream algae communities is also more likely to reflect actual stream conditions because they integrate the effects of stressors over time and space (Stevenson, 2006).

CT's Interim Nutrient Management Strategy



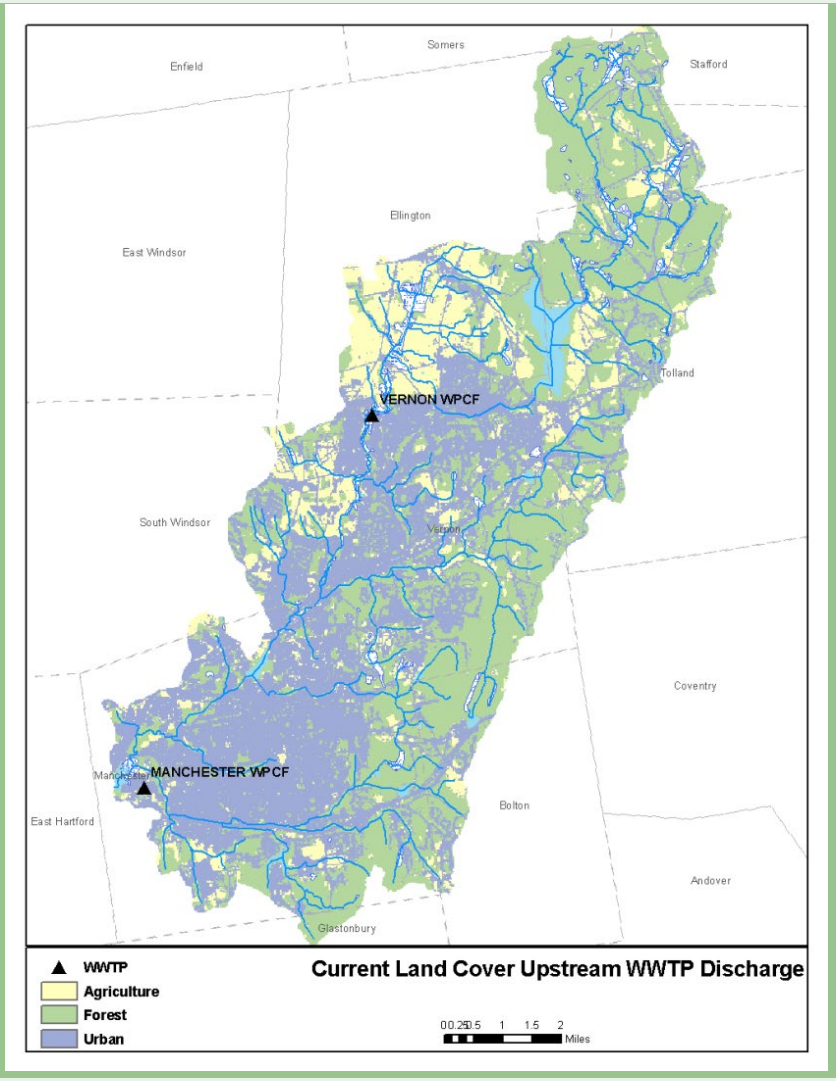
CT's Interim Nutrient Management Strategy

Sources

Anthropogenic Input of Nutrients:
NPDES Facilities

Calculated Current NPDES Load

- **DMR/NAR submitted flow and concentration data (Typically 2001 – 2007)**
- **Seasonal Data (April – October)**



CT's Interim Nutrient Management Strategy

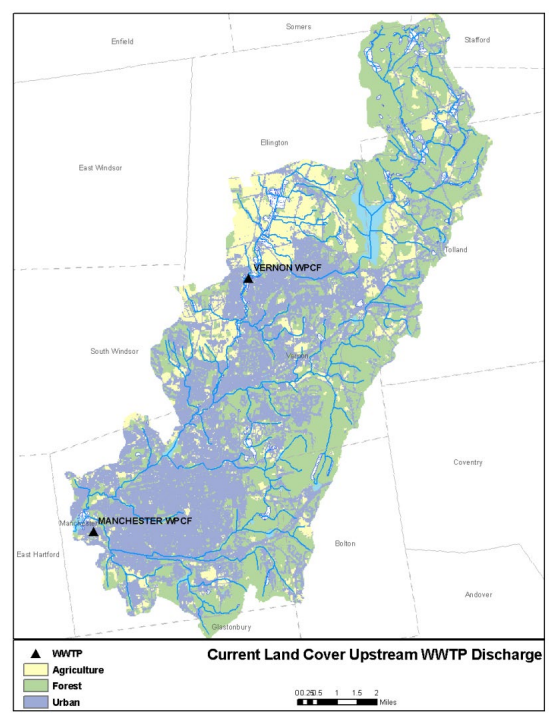
Sources

Anthropogenic Input of Nutrients:

- **Non-Point Sources (Urban and Agricultural Runoff)**

Estimated Seasonal Land Cover Load Using Export Coefficients

Land Cover*	Export Coefficient ** (lbs/acre/day)
Forest	1.03×10^{-4}
Urban	4.33×10^{-4}
Agriculture	19.75×10^{-4}



Current land use

Forested condition

* Becker & Dunbar, 2009
** 2002 Center for Land Use Education & Research (CLEAR) Land Cover Data

CT's Interim Nutrient Management Strategy

Sources

Anthropogenic Input of Nutrients:

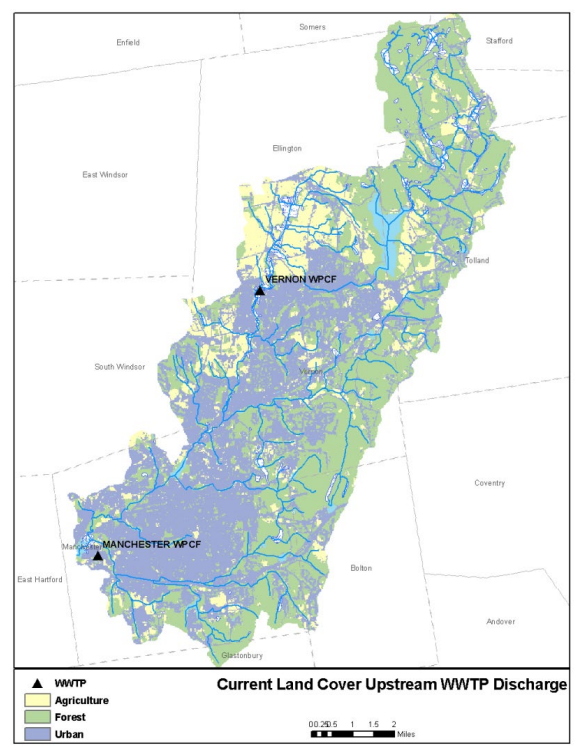
- **NPDES Facilities**
- **Non-Point Sources (Urban and Agricultural Runoff)**

Enrichment Factor =

$$\frac{\text{Total NPDES Load (lbs/day) + Land Cover Load (lbs/day)}}{\text{Forested Condition Load (lbs/day)}}$$

Enrichment Factor example:

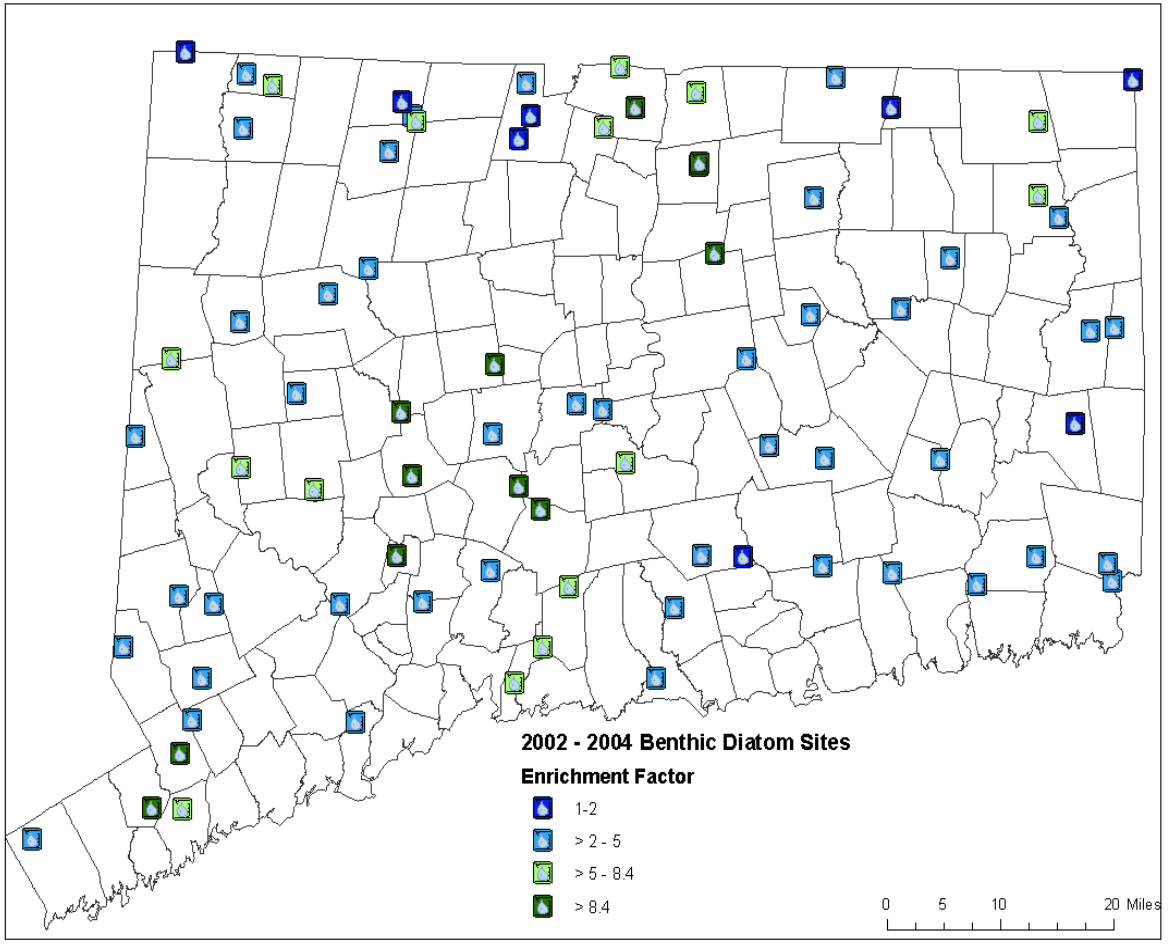
Current Load (lbs/day)	205.3
Forested Load (lbs/day)	4.80
Enrichment Factor	42.79



CT's Interim Nutrient Management Strategy

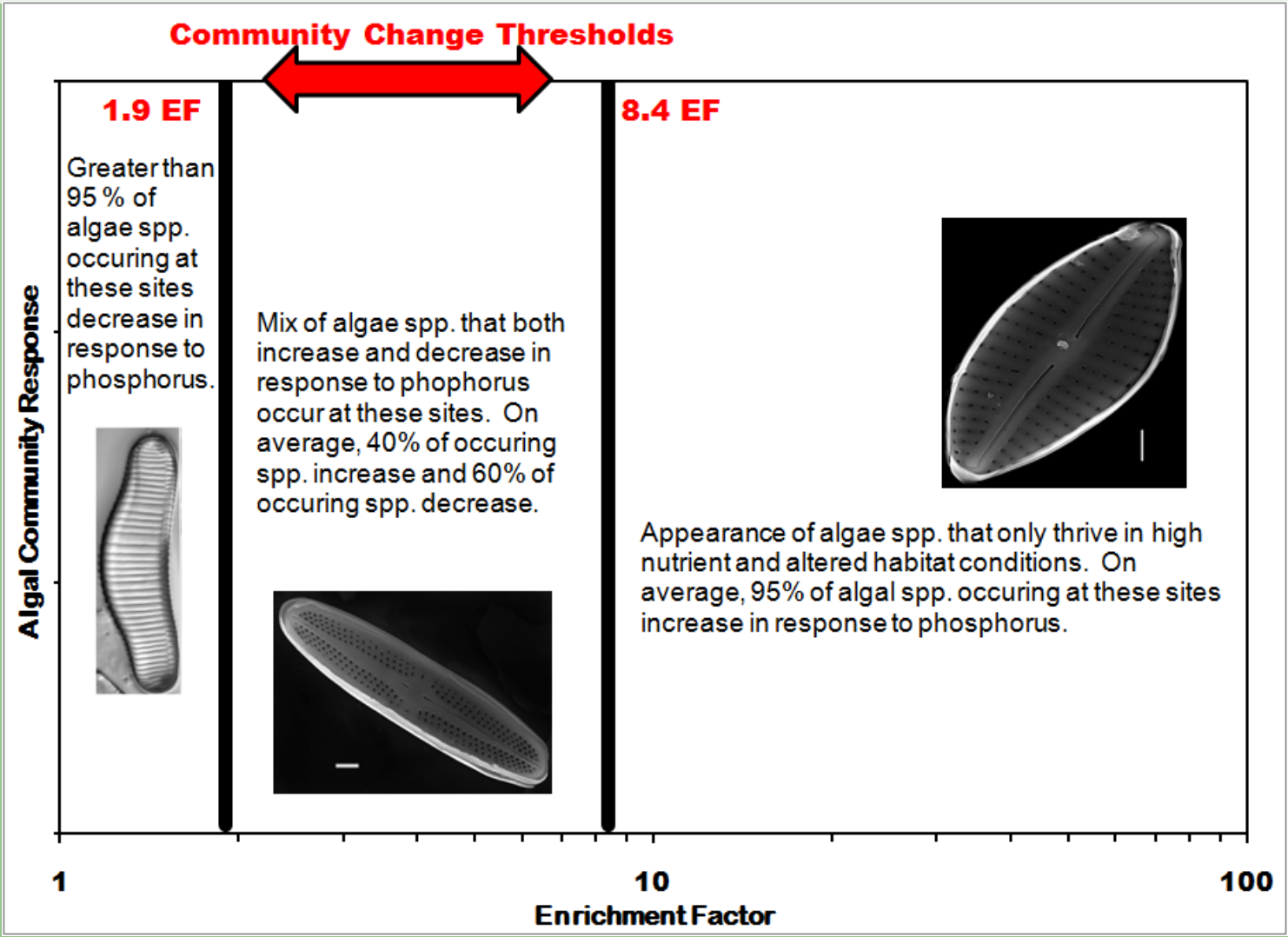
- Stream Algae Species Data Collected From 2002-04
- 78 Sites
- EF Range from 1.2 - 76
- Readily Available GIS Data and Statistical Tools
- Identify Initial Statewide EF goal to Issue Permits and Protect the Environment.

Response | **Changes in Algal Community and Biomass**



CT's Interim Nutrient Management Strategy

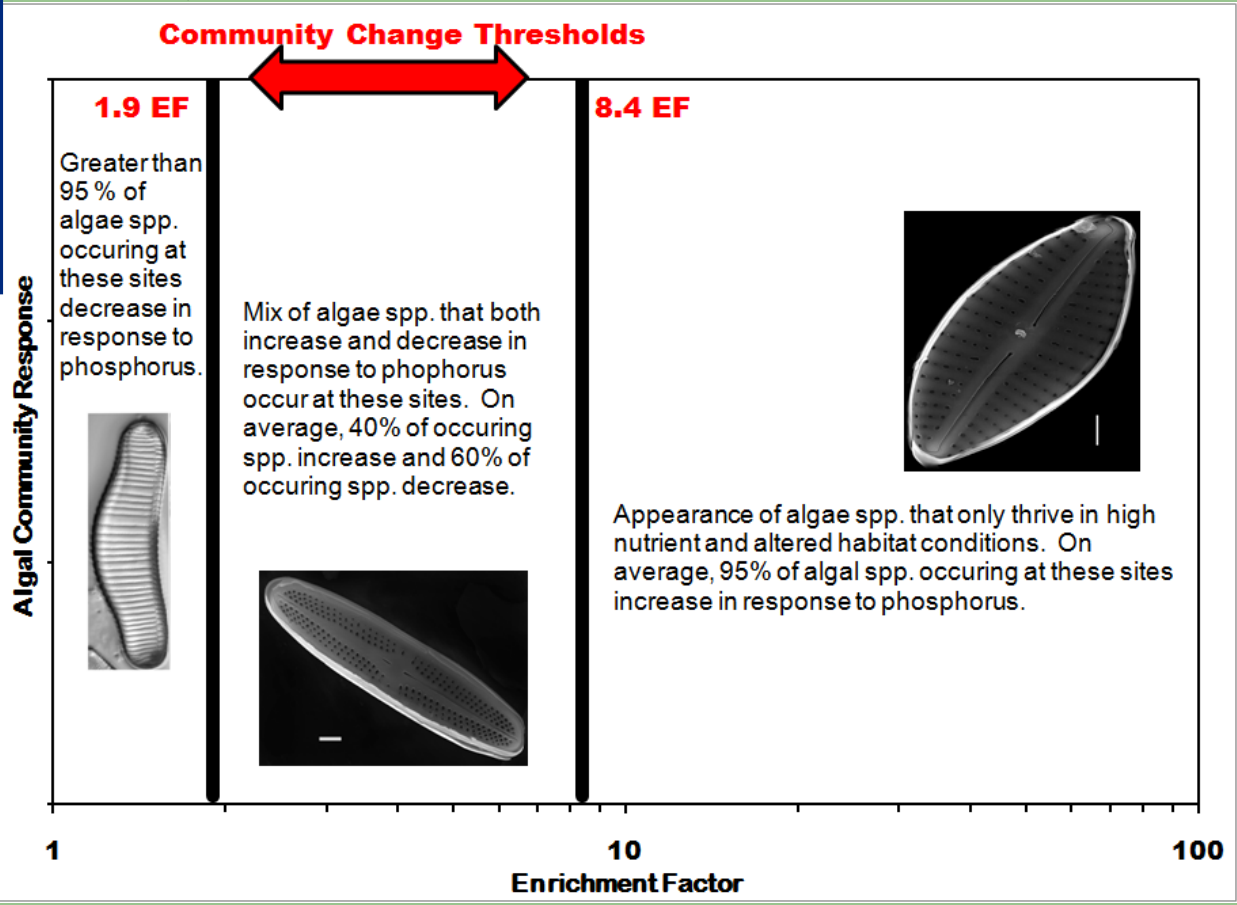
Conducted a statistical analysis that looked at algal species changes in response to the Enrichment Factor (EF)



CT's Interim Nutrient Management Strategy

- Small Drainage Basin (**1.2 mi²**)
- Minimal Disturbance
- Dense Canopy

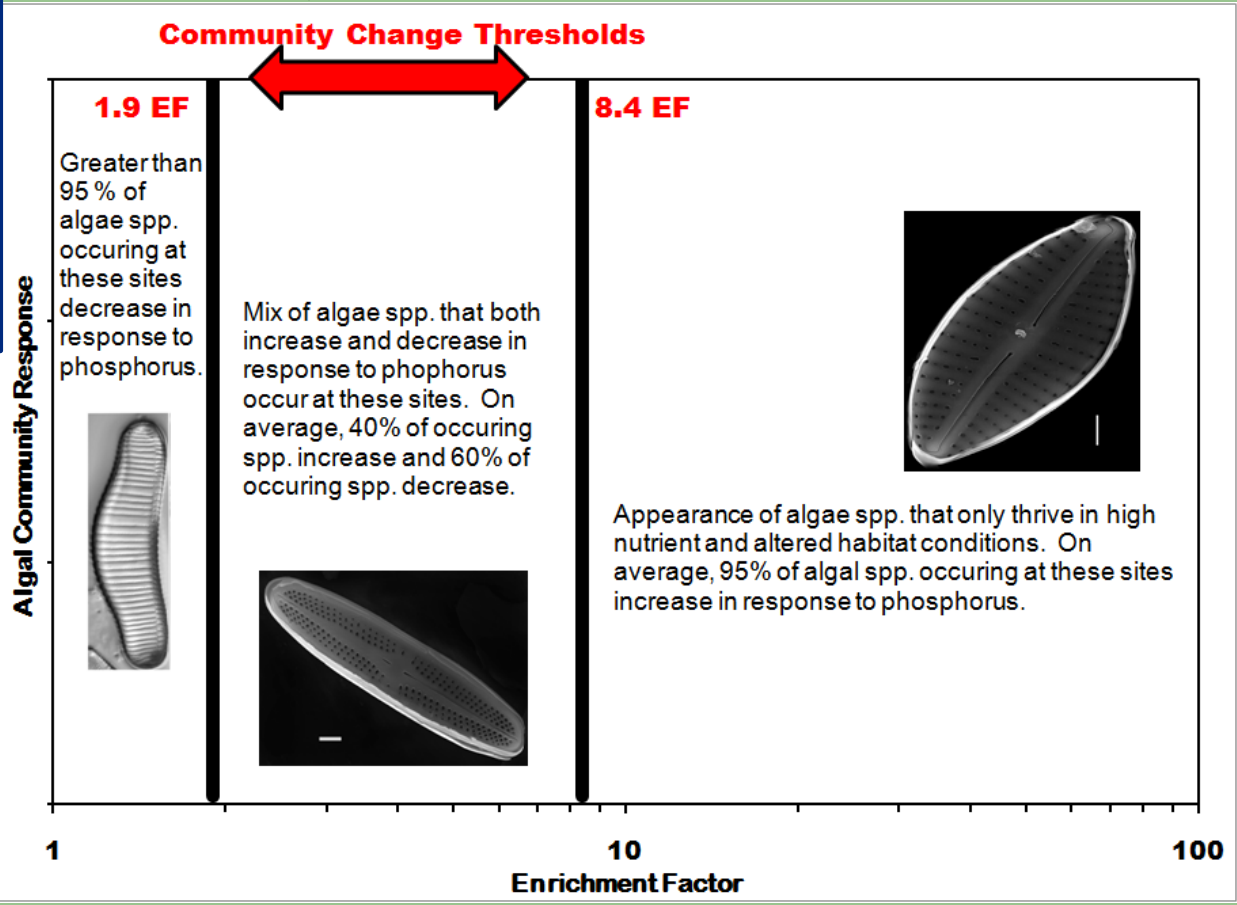
Beach Brook in Granby (EF = 1.89)



CT's Interim Nutrient Management Strategy

- Large Drainage Basin (**354 mi²**)
- Moderate Disturbance
- Open Canopy

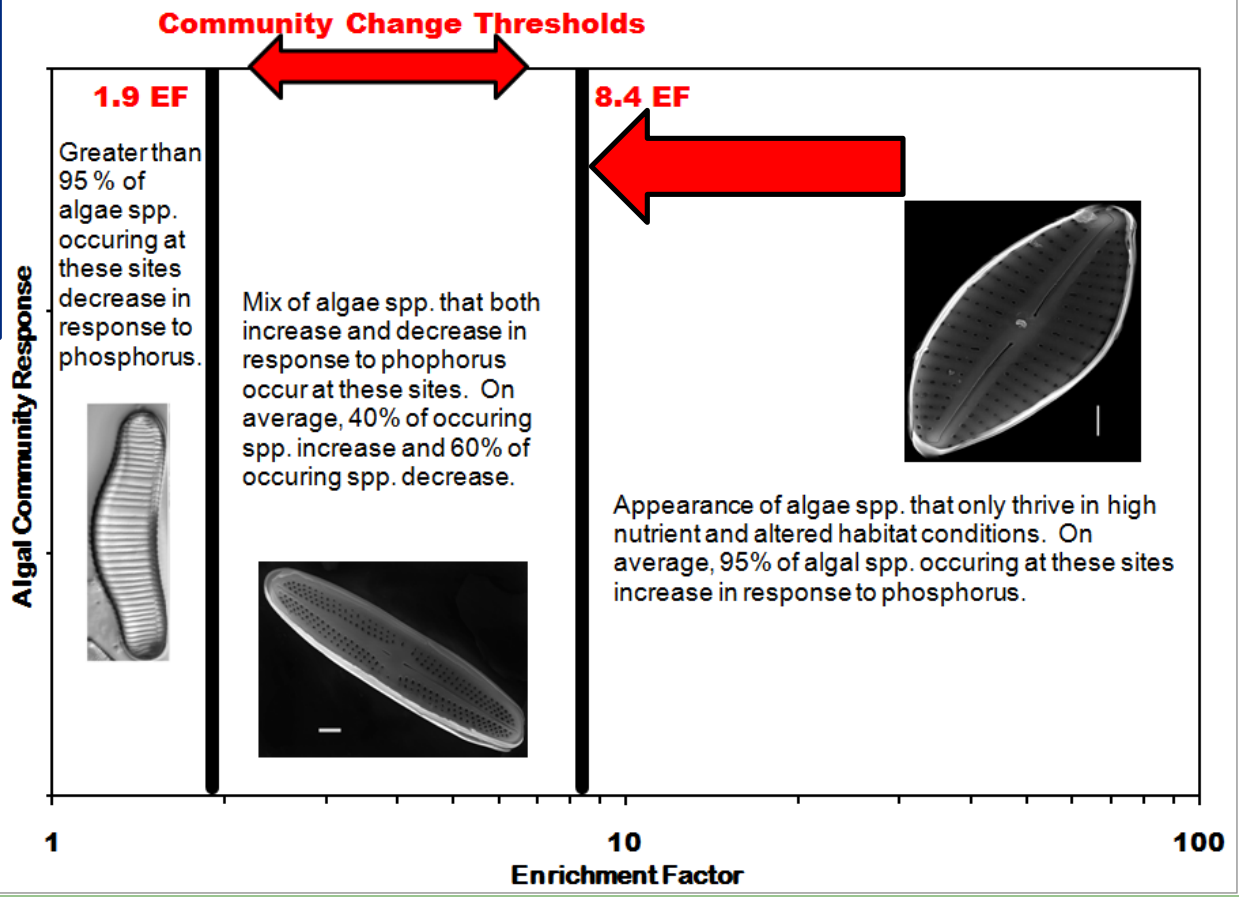
Farmington River in Canton (EF = 3.8)



CT's Interim Nutrient Management Strategy

Naugatuck River in Beacon Falls (EF = 50)
Quinnipiac River in Meriden (EF=52)

- 68 & 165 mi^2 respectively
- Moderate Disturbance
- Open Canopy



CT's Interim Nutrient Management Strategy

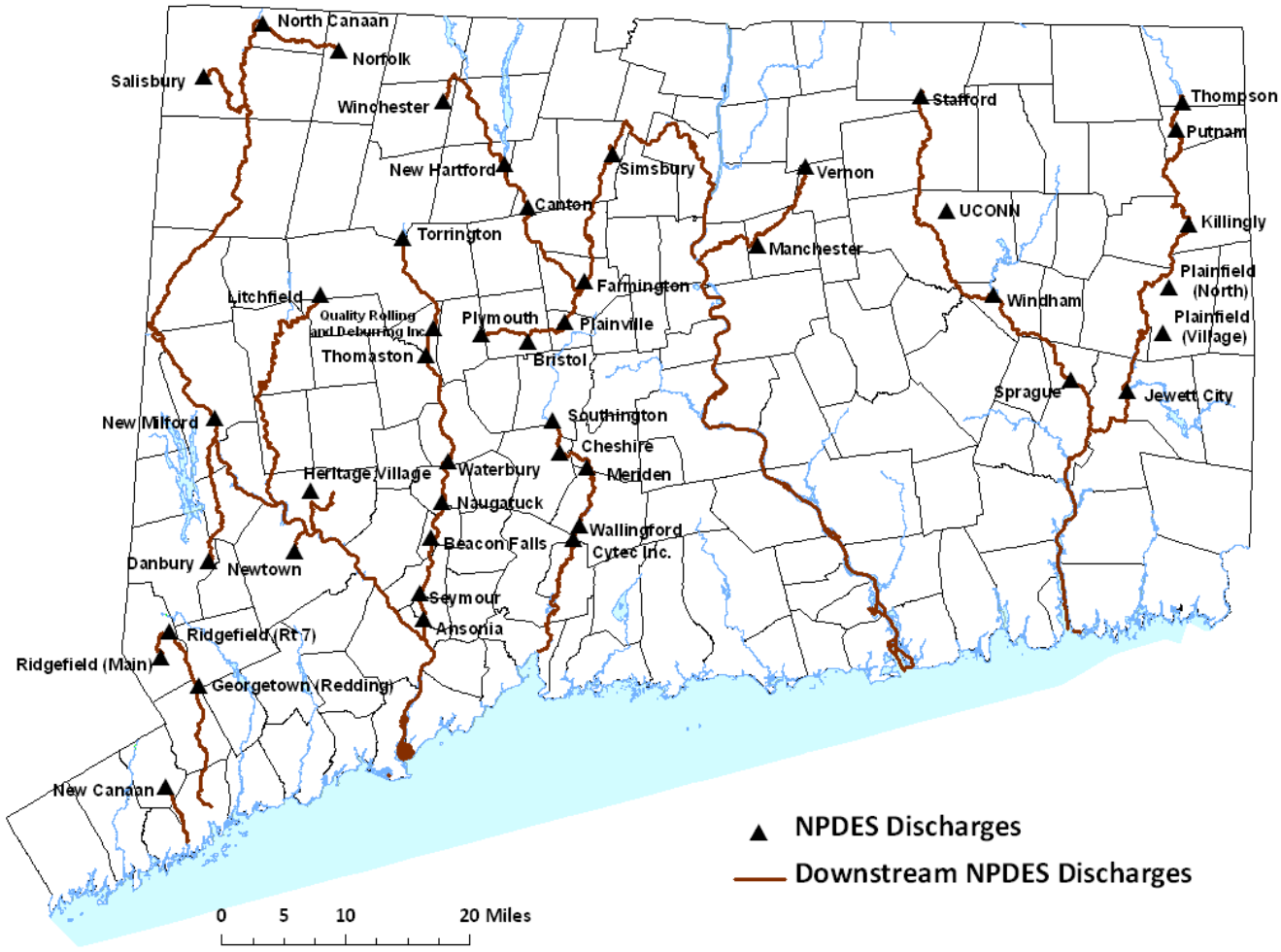
Goal

Maintain an in-stream enrichment factor of 8.4 throughout the drainage basin

Margin of Safety

- Conservatively Assumed No Reductions in Current Land Cover/Use Loadings
- Assumed No Attenuation
- NPDES Facilities Load Based on Current Flow Rate

CT's Interim Nutrient Management Strategy

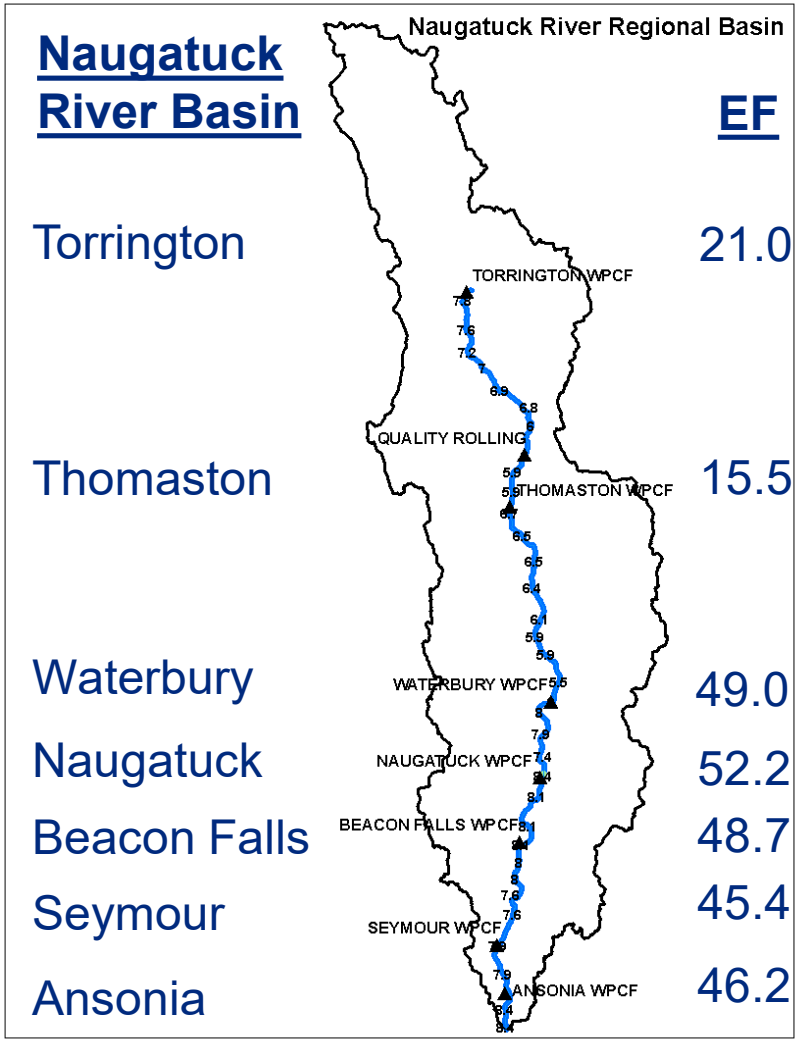


Connecticut Department of Energy and Environmental Protection

Implementing the Interim Phosphorus Program

Implementation Example: Naugatuck River Basin

- Watershed-Based Analysis Using GIS To Assess Current Phosphorus Loads
- Calculated the Current Enrichment Factor at Multiple Locations along Waste Receiving Streams
- Conducted a Loading-Based Analysis to Determine Reductions in Phosphorus Needed at Each Facility to Meet the Goal of 8.4 or Less



Implementing the Interim Phosphorus Program

Example: Naugatuck River Basin

Enrichment Factor = $\frac{\text{Total NPDES Load (lbs/day) + Land Cover Load (lbs/day)}}{\text{Forested Condition Load (lbs/day)}}$

NPDES	Flow (MGD)	Concentration (mg/L)	Upstream NPDES Load (lbs/day)	Est. Land Use Export Load (lbs/day)	Forested Load (lbs/day)	Enrichment Factor At Discharge
TORRINGTON WPCF	5.18	**1.68**	64.73	11.52	3.63	**21.0**
THOMASTON WPCF	0.88	**3.29**	87.95	25.36	7.29	**15.5**
WATERBURY WPCF	20.52	**3.19**	627.87	51.35	13.87	**49.0**
NAUGATUCK WPCF	4.92	**4.3**	787.84	61.32	16.26	**52.2**
BEACON FALLS WPCF	0.32	**3.19**	795.75	64.55	17.66	**48.7**
SEYMOUR WPCF	1.29	**3.98**	836.84	72.85	20.05	**45.4**
ANSONIA WPCF	2.04	**2.89**	880.16	74.85	20.65	**46.2**

Implementing the Interim Phosphorus Program

Example: Naugatuck River Basin

Proposed Seasonal (April through October) Management Limits

NPDES	Flow (MGD)	Concentration (mg/L)	Proposed upstream NPDES Load (lbs/day)	Est. Land Use Export Load (lbs/day)	Forested Load (lbs/day)	Enrichment Factor At Discharge
TORRINGTON WPCF	5.18	**0.40**	17.29	11.52	3.63	**7.9**
THOMASTON WPCF	0.88	**1.00**	25.17	25.36	7.29	**6.9**
WATERBURY WPCF	20.52	**0.20**	59.42	51.35	13.87	**8.0**
NAUGATUCK WPCF	4.92	**0.40**	75.85	61.32	16.26	**8.4**
BEACON FALLS WPCF	0.32	**1.00**	78.52	64.55	17.66	**8.1**
SEYMOUR WPCF	1.29	**0.70**	86.06	72.85	20.05	**7.9**
ANSONIA WPCF	2.04	**0.70**	97.98	74.85	20.65	**8.4**

Implementing the Interim Phosphorus Program

Example: Naugatuck River Basin

Proposed Seasonal (April through October) Management Limits

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ANSONIA WPCF	2.04	**0.70**	97.98	74.85	20.65	**8.4**

NPDES Phosphorus Limits

Parameter	Units	Ave Month	Max Day	Sample Freq	Sample Type
Phosphate, Ortho	mg/l	_ _ _	_ _ _	2/week	Daily Composite
Phosphorus A, Total (6)	mg/l	0.6	_ _ _	2/week	Daily Composite
Phosphorus B, Total (7)	mg/l	0.14	0.31	2/week	Daily Composite
Phosphorus, Total	lbs/day	_ _ _	_ _ _	2/week	Daily Composite
Phosphorus C, Total (Average Seasonal Load Cap) 8	lbs/day	7.55	_ _ _	2/week	Calculated

NPDES Phosphorus Limits

- This limit is consistent with the narrative policy statements in the CT WQS (Paragraph 19, page 6 and SURFACE WATER CLASSIFICATIONS AND CRITERIA, CLASS B DESIGNATED USES AND CRITERIA, page 12) and where the facility discharges its effluent is expected to result in the attainment and maintenance of all designated uses for that portion of _____ Brook. If the Department develops numeric criteria in the future, or it is found that the current limit is not sufficient to achieve designated uses, the facility may need to meet a more stringent limit.

NPDES Phosphorus Limits

- Translating the average performance level of 7.55 lbs/day into enforceable permit limits requires consideration of effluent variability and frequency of monitoring in order to comply with federal permitting regulations. The procedure used is as follows:

  1. Consider the permit performance level (0.10 mg/l) to be equivalent to the Long Term Average (LTA)

  2. Calculate the Maximum Daily Limit by multiplying the LTA by the 99th percentile LTA Multiplier appearing in Table 5-2 of the Technical Support Document (page 103 of EPA/50512-90-001) corresponding to a CV (co-efficient of variation) of 0.6% to account for effluent variability:

     Maximum Daily Limit: 0.10mg/1 * 3.11 = 0.311 mg/1

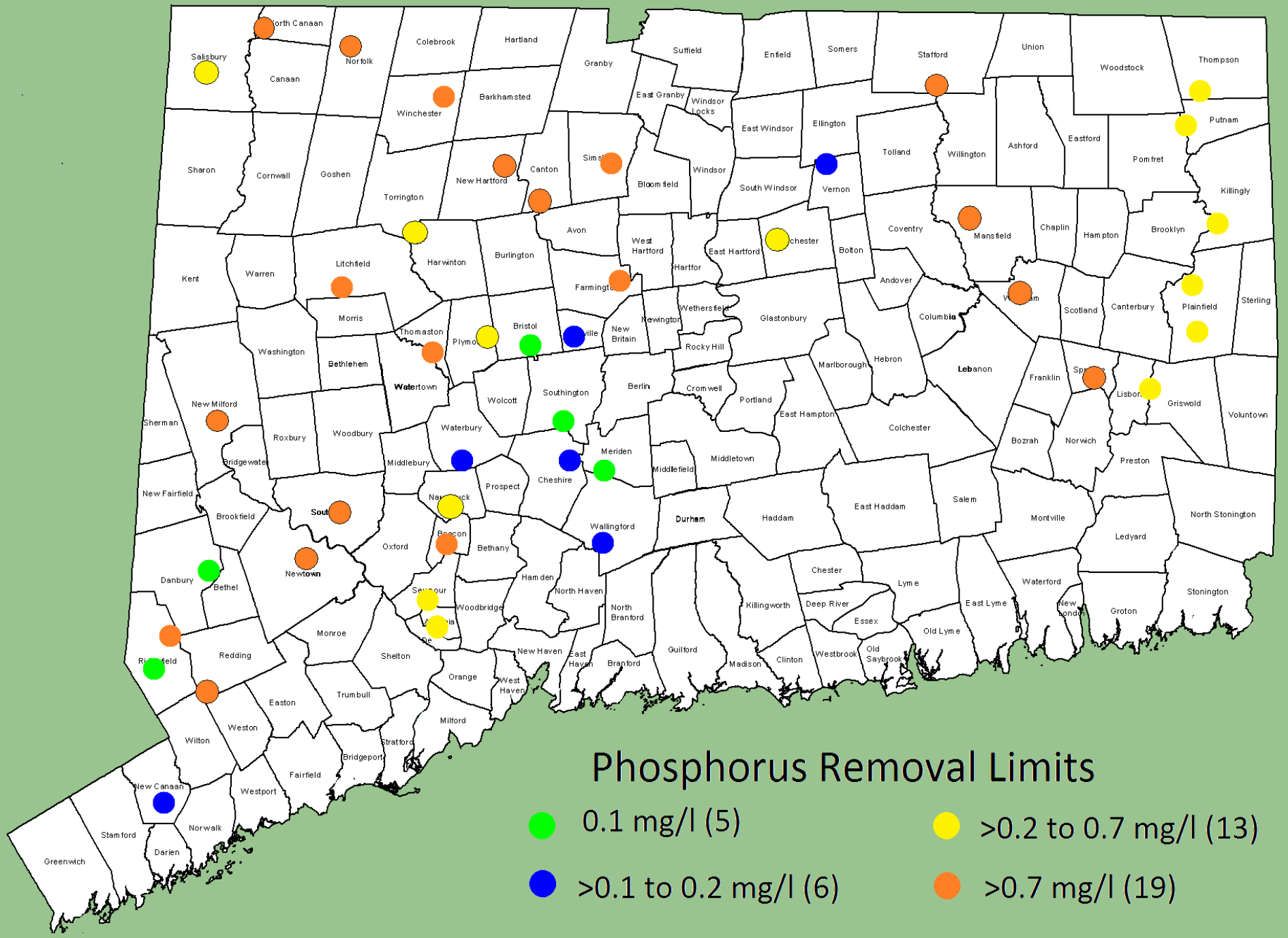
NPDES Phosphorus Limits

3. Calculate the Average Monthly Limit by multiplying the LTA by the 95th percentile LTA Multiplier appearing in Table 5-2 of the Technical Support Document corresponding to a CV of 0. 6% to account for effluent variability and either n=4 samples/month or n=10 samples/month as appropriate for the facility to account for the precision of estimating the true monthly average based on an average for the days the effluent was sampled:

Average Monthly Limit: 0.10 mg/1 * 1.38 = 0.138 mg/1

Total Seasonal Load =

(7.55 lbs/day * 214 Days/Season) = 1,615.7 lbs


Salisbury
North Canaan
Canaan
Norfolk
Colebrook
Hartland
Granby
Suffield
Enfield
Somers
Stafford
Union
Woodstock
Thompson
Putnam
Winchester
Barkhamsted
East Granby
Windsor Locks
East Windsor
Ellington
Tolland
Willington
Ashford
Eastford
Pomfret
Killingly
Sharon
Cornwall
Goshen
Torrington
New Hartford
Canton
Simsbury
Bloomfield
Windsor
South Windsor
Vernon
Coventry
Mansfield
Chaplin
Hampton
Brooklyn
Avon
West Hartford
East Hartford
Bolton
Andover
Scotland
Canterbury
Plainfield
Sterling
Kent
Warren
Litchfield
Harwinton
Burlington
Farmington
Hartford
Wethersfield
Glastonbury
Columbia
Morris
Thomaston
Plymouth
Bristol
New Britain
Newington
Rocky Hill
Marlborough
Hebron
Lebanon
Franklin
Lisbon
Griswold
Voluntown
Washington
Bethlehem
Watertown
Wolcott
Southington
Berlin
Cromwell
Portland
East Hampton
Colchester
Bozrah
Norwich
Preston
New Milford
Sherman
Roxbury
Woodbury
Waterbury
Middlebury
Meriden
Middlefield
Middletown
Bridgewater
Cheshire
Prospect
New Fairfield
Brookfield
Durham
Haddam
East Haddam
Salem
Montville
North Stonington
Ledyard
Wallingford
Oxford
Bethany
Beacon
Newtown
Danbury
Bethel
Hamden
North Haven
Chester
Lyme
Waterford
Stonington
Seymour
Woodbridge
North Branford
Killingworth
Deep River
East Lyme
New London
Groton
Essex
Old Lyme
Monroe
Redding
Shelton
New Haven
East Haven
Branford
Guilford
Madison
Clinton
Westbrook
Old Saybrook
Orange
West Haven
Trumbull
Easton
Weston
Milford
Wilton
Stratford
Bridgeport
Fairfield
Westport
New Canaan
Stamford
Norwalk
Darien
Greenwich
Phosphorus Removal Limits
0.1 mg/l (5)
>0.1 to 0.2 mg/l (6)
>0.2 to 0.7 mg/l (13)
>0.7 mg/l (19)

Permitting for Total Phosphorus

- **Public rollout**
- **EPA approval of revised draft Beacon Falls NPDES permit**
- **PA 12-155 Collaboration Act**
- **All 43 POTWs have phosphorus limits**

Funding for Total Phosphorus

- **PA 12-155 increased CWF grant funding for phosphorus to 30%**
- **PA 13-239 known as Phosphorus first 3, created an incentive for 3 POTWs with lowest permit limits and associated highest compliance costs to get increase CWF grant funding of 50%**
  - ✓ **Covers Meriden, Southington, Bristol**
- **PA 14-13 expanded to all POTWS with permit limits <0.2 mg/l**
  - ✓ **Added Danbury and Ridgefield**
- **PA 16-57 expanded to all POTWS with permit limits <0.2 mg/l**
  - ✓ **Added Cheshire, New Canaan, Plainville, Vernon, Wallingford and Waterbury**
- **Construction contracts must be signed by July 1, 2019**

Developing the Final Phosphorus Adaptive Management Strategy

- **Expand Approach to Include Non-Waste Receiving Streams.**
- **Collecting Additional Stream Algae (Diatom) Species Data to Test and Improve Statistical Models and added Dissolved Oxygen monitoring.**
- **Continue Ongoing Monitoring and Research that Incorporates the Responsiveness of the Aquatic Systems to these Initial Steps to Manage Phosphorus from NPDES Permitted Sources as well as Growing Emphasis on Land-Based Management Practices Required Under Connecticut's WQS.**
- **Improve GIS Model to Better Incorporate Spatial and Temporal Habitat Conditions That Effect Changes in Stream Algae.**
- **May Refine the EF Target Goal to Better Reflect Watershed-Specific Conditions if Sufficient Future Information Indicates a Change is Needed.**

Addressing Phosphorus Pollution From Other Sources Under Different Programs

- **Grants to towns and watershed groups through 319 Funding**
- **Changes in fertilizer formulation through voluntary formulation changes by manufacturers and legislation**
- **CAFO / AFO restrictions on agriculture**
- **Industrial, commercial, construction and MS4 stormwater permit program**
- **Outreach and education by CT DEEP staff and UCONN NEMO program**

Questions?

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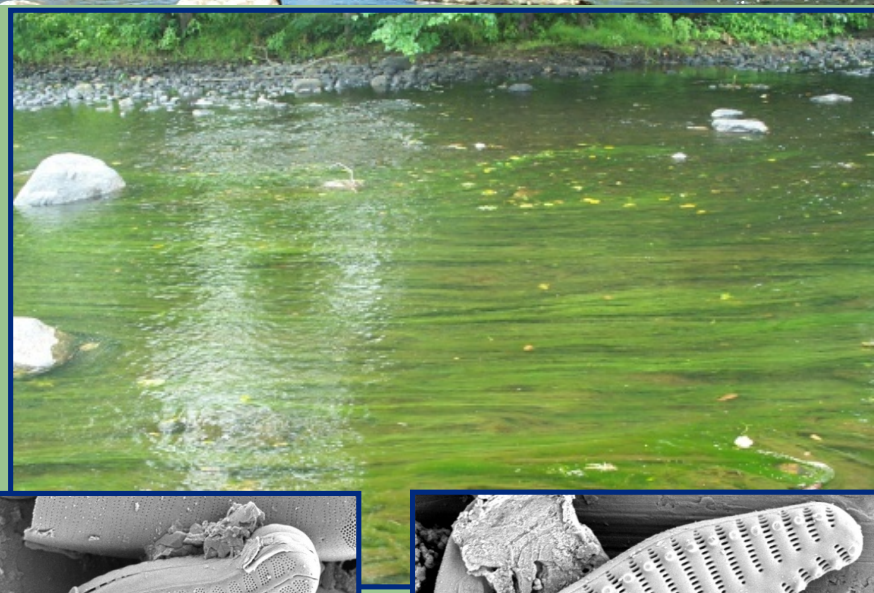

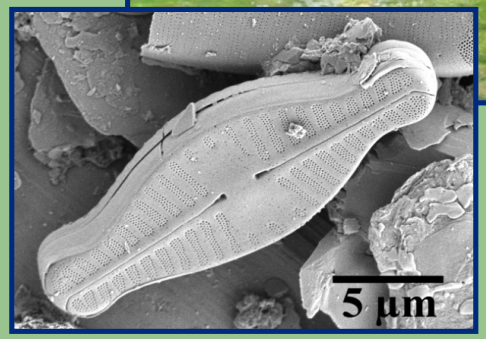

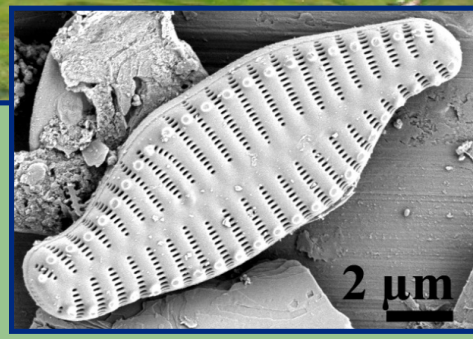

Diatom Images from Norwalk River at South Wilton, CT: ANSP Algae Image Database from the Phycology Section, Patrick Center for Environmental Research, The Academy of Natural Sciences at http://diatom.acnatsci.org/AlgaeImage/