Connecticut Department of Energy and Environmental Protection

Connecticut Department of
ENERGY &
ENVIRONMENTAL
PROTECTION

Water Quality-based Planning to Address Nutrient Impacts in CT Lakes

July 29, 2021
Public Meeting

Connecticut Department of Energy and Environmental Protection

Thank You

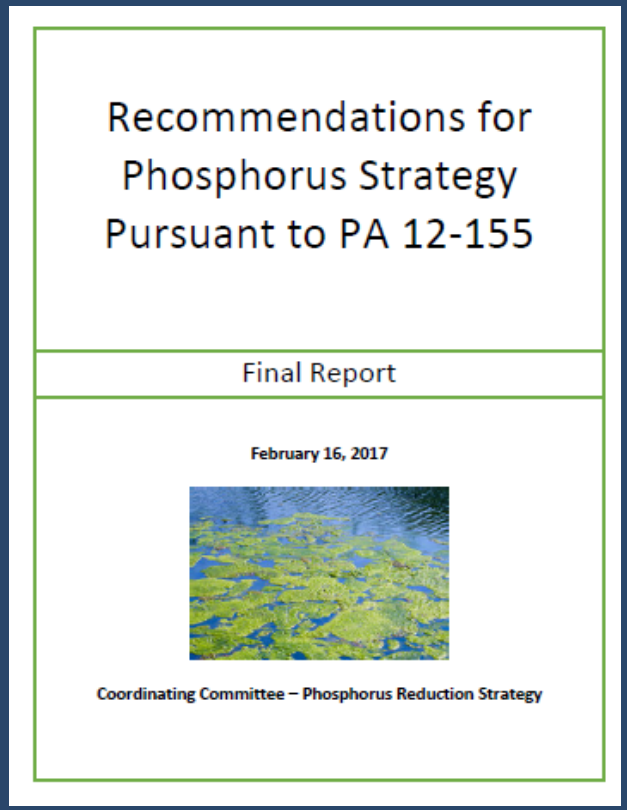
- Thank you to those who have:
  - funded water quality studies and monitoring for Bantam Lake
  - Worked to improve these lakes for the community
  - Offered assistance to us through this current project

Presentation Topics

- Overview of Nutrient Impacts on Water Quality in Lakes
- Setting Lake-Specific WQ Targets for Lakes
- Analyzing Sources and Nutrient Loading to Lakes
- Developing WQ Plans for Lakes
  - Statewide Lake TMDL Core Document
  - Bantam Lake Watershed TMDL
  - Watershed-Based Plan for Bantam Lake Watershed
- Review of Public Comment Opportunities
- Questions/Discussion

Why Focus on Nutrients & Lakes?

Integrated Water Resource Management


Recommendations for Phosphorus Strategy Pursuant to PA 12-155

Final Report

February 16, 2017

Coordinating Committee – Phosphorus Reduction Strategy

Clean Water Act requires development of plans to restore water quality in water bodies where current WQ is impaired

Public comments submitted requested that DEEP develop plans to address nutrient impacts on lakes

Included recommendation to address phosphorus impacts on lakes

Lake Project Overview

Program Development

- Develops an approach to evaluate and manage nutrient loads to CT Lakes and Impoundments
- Streamline plan development activities
- Facilitate community engagement and implementation

TMDL

- Evaluate watershed and water quality
- Set lake-specific water quality goals
- Provide technical support for implementation activities
- Reduce Harmful Algal Blooms where possible

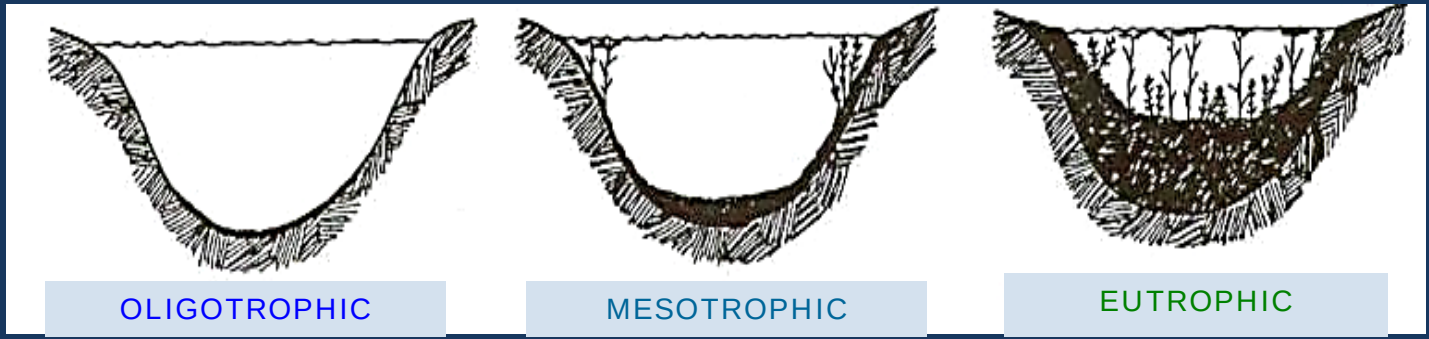
Watershed Based Plan

- Identify specific problem areas for potential BMPs
- Provide education and information to communities
- Creates a flexible plan that will support achieving water quality goals for lake

Nutrient Impacts on Lakes

Trophic State in Lakes

Trophic state relates to the biological productivity in lakes



EUTROPHICATION: **The natural process by which nutrients, organic matter and sediments gradually accumulate within a water body, resulting in decreased depth and increased biological productivity.**

Factors that influence trophic state

- Rate of nutrient supply
- Climate
- Shape of the lake
  - Depth
  - Volume/Surface Area
  - Watershed to Lake Area Ratio

Lake Chemistry related to Trophic State

- Nutrients:
  - Phosphorus & Nitrogen
  - Associated with plant & algae growth
  - Can be natural or from human-based sources
  - Can affect other water quality considerations such as oxygen level, chlorophyll a and clarity
- Chlorophyll A:
  - Pigment found in plants & algae
- Water Clarity
  - Water quality conditions such as algae or sediment suspended in the water column, Color or dissolved solid can impact clarity
  - Measured by secchi disk

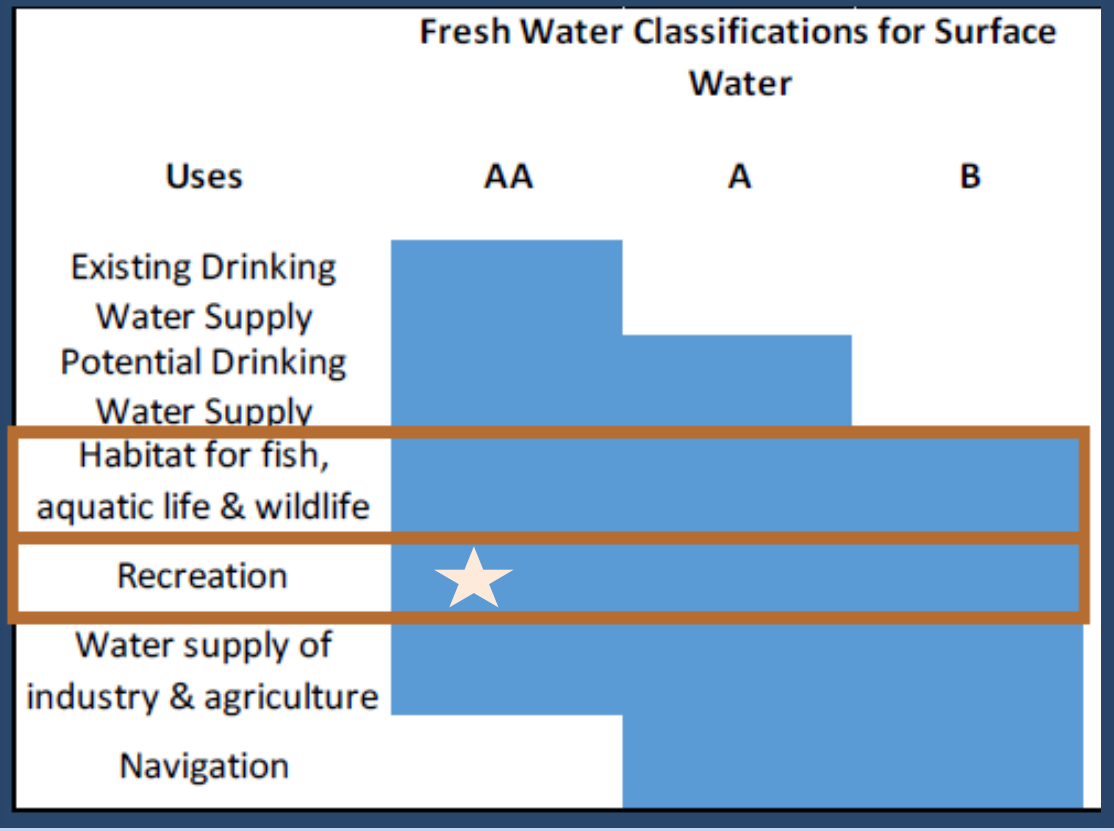
These parameters are used to define the trophic state of lakes

CT Water Quality Standards

Applicable CT Narrative Criteria & Standards

- Narrative Nutrient Criteria (22a-426-9 Table 1)
- The loading of nutrients, principally phosphorus and nitrogen, to any surface water body shall not exceed that which supports maintenance or attainment of designated uses

Bantam Lake is a Class AA water that is impaired for Recreational Uses due to chlorophyll A, excess algal growth & nutrient / eutrophication bioindicators



Based on assessment data, Aquatic Life Uses and Recreation are most commonly affected uses in impaired lakes

Applicable CT Narrative Criteria & Standards

Lakes (22a-426-6)

- Identifies nutrient levels associated with various trophic states
- Provides consideration to adjust trophic state evaluation based on macrophyte coverage
- Identifies the Natural Trophic State of the lake as the WQ Goal

Trophic State	Parameter	Range
Oligotrophic	Total Phosphorus	0-10 µg/l
	Total Nitrogen	0-200 µg/l
	Chlorophyll-*a*	0-2 µg/l
	Secchi Disk	6 + meters
Mesotrophic	Total Phosphorus	10-30 µg/l
	Total Nitrogen	200-600 µg/l
	Chlorophyll-*a*	2-15 µg/l
	Secchi Disk	2-6 meters
Eutrophic	Total Phosphorus	30-50 µg/l
	Total Nitrogen	600-1000 µg/l
	Chlorophyll-*a*	15-30- µg/l
	Secchi Disk	1-2 meters
Highly Eutrophic	Total Phosphorus	50 + µg/l
	Total Nitrogen	1000 + µg/l
	Chlorophyll-*a*	30 + µg/l
	Secchi Disk	0-1 meters

Natural means the biological, chemical and physical conditions and communities that occur within the environment which are unaffected or minimally affected by human influences. (22a-426-1(47)

Weight of Evidence Approach

- Expected Range of Trophic Conditions
  - Existing Trophic Condition
  - Modeled Trophic Condition for Reference Conditions (no anthropogenic inputs)
  - This range provides the boundaries within which Natural Trophic Condition is expected
- Predictive Models for Trophic State
  - Models that relate Landscape Condition to Expected Trophic Status
  - Predicts trophic state based on information on lakes in New England that meet water quality goals
- Additional Lake-specific Studies

Weight of Evidence Evaluation: Bantam Lake

Weight of Evidence Evaiuation Bantam Lake	EPA Chl A Targets (ppb) CT Chl A Targets (ppb) CT Total Phosphorus (ppb) CT Total Nitrogen (ppb) CT Secchi Disk (m)	0-2 0-2 0-10 0-200 6+	2-7 2-15 10-30 200-600 2-6	7-30 15-30 30-50 600-1000 1-2	>30 >30 >50 >1000 0-1
Line of Evidence	**Confidence**	**Oligotrophic**	**Mesotrophic**	**Eutrophic**	**Highly Eutrophic**
Current Trophic Level	High			★	
Taylor Landscape Analysis	Medium		★		
EPA Hollister Model	Medium		★		
New England Lake & Pond Model	Medium	0.457 ★	0.286	0.21	0.047
Fully Forested Model			★		
Lake Specific Studies			★		

Recommended Water Quality Goal for Bantam Lake: Middle Mesotrophic

Total Phosphorus Goal = 20 ug/l

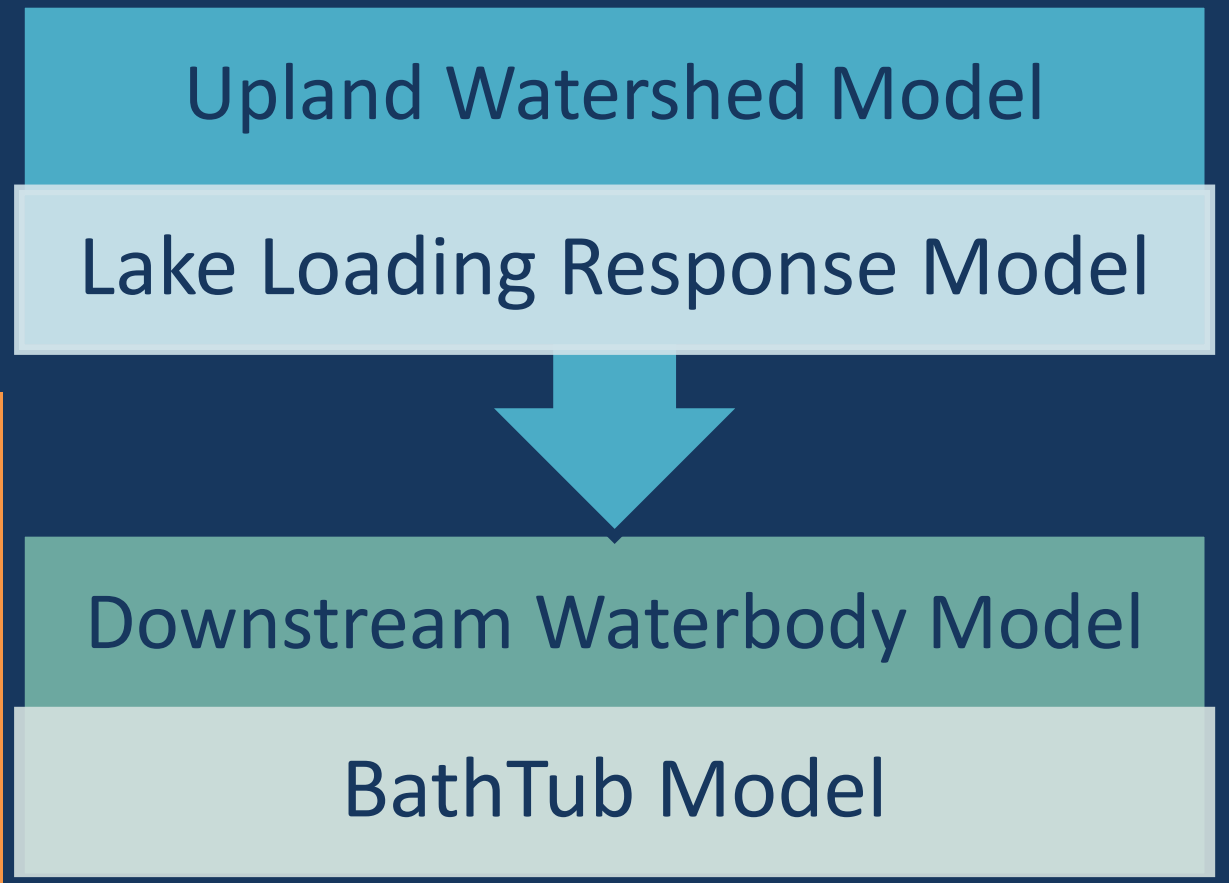
Total Nitrogen Goal = 400 ug/l

Analyzing Sources and Nutrient Loads to Lakes

CTDEEP Watershed Modeling Approach for Nutrients

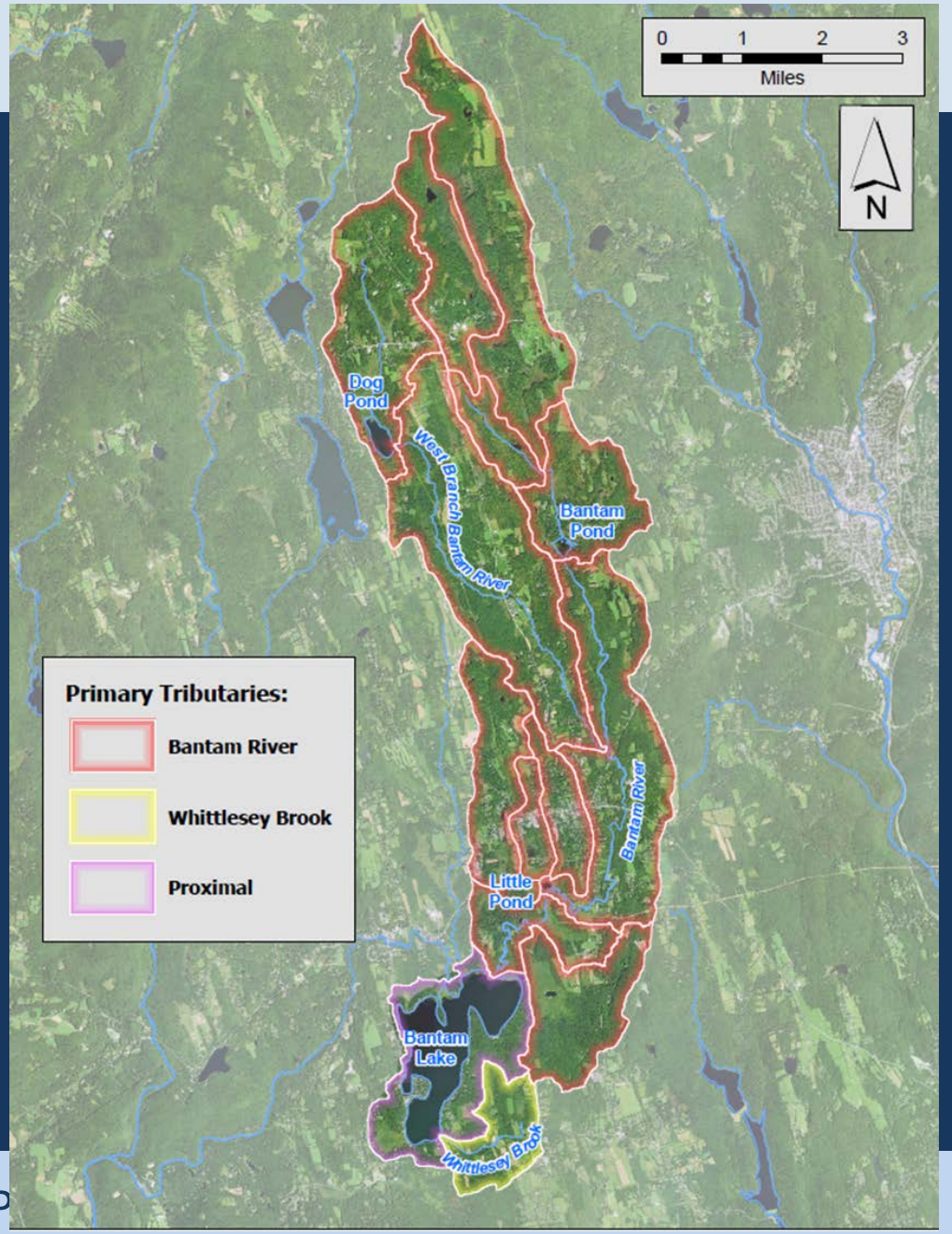
- Models
  - Developed a watershed scale approach
  - Focus on Nitrogen & Phosphorus
  - Uses data on water quality and sources

- Models are calibrated & validated for existing conditions (2007-2018)
- Models then used to identify in-lake nutrient concentration under reference & target WQ conditions



Lake Loading Response Model

- Watershed Analysis
  - Predicts nutrient load that reaches the lake
  - Sources Considered in Model
    - Land Use Contributions under Wet and Dry conditions
    - Point Sources: Woodridge Lake WPCF
    - Septic System Contributions near lake
    - Birds



BathTub Model

- Water quality-based model
- Uses information from LLRM as model input
- Includes additional sources
  - Atmospheric Deposition
  - Internal Loading
- Converts watershed loads into in Lake concentrations

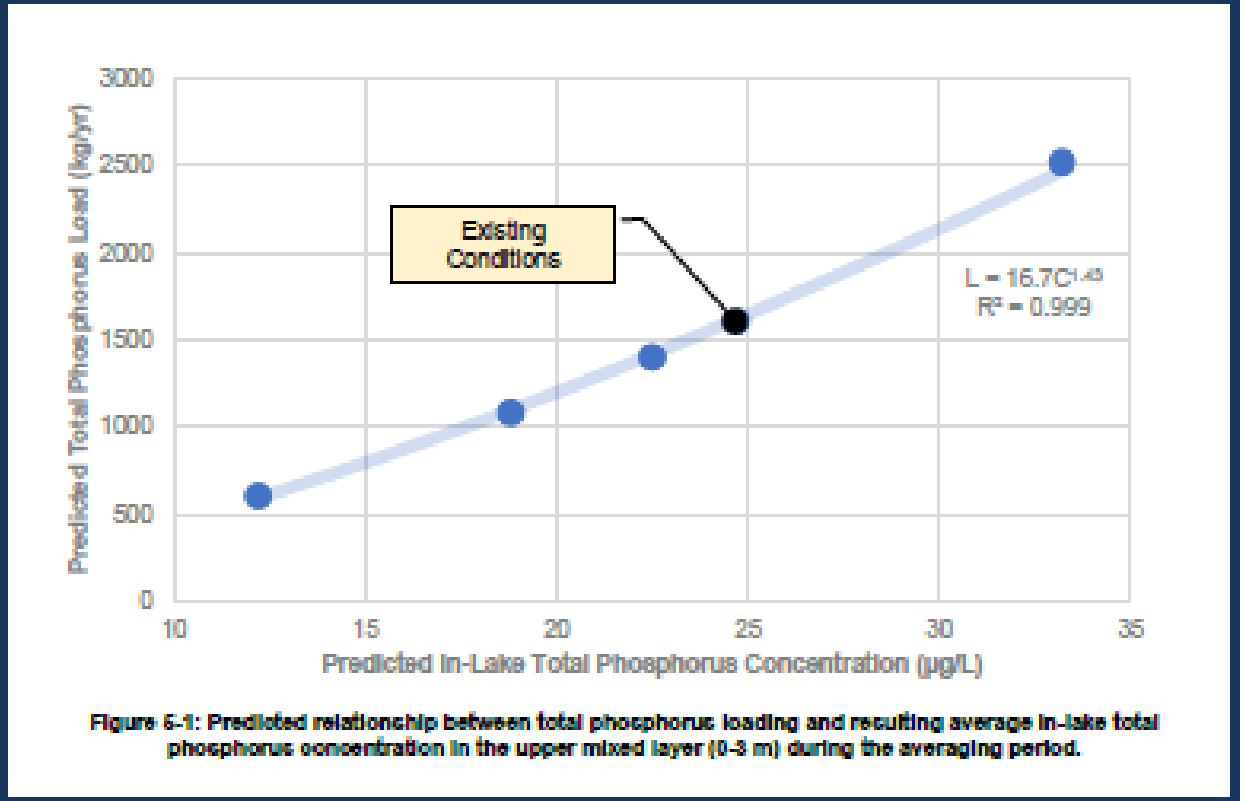
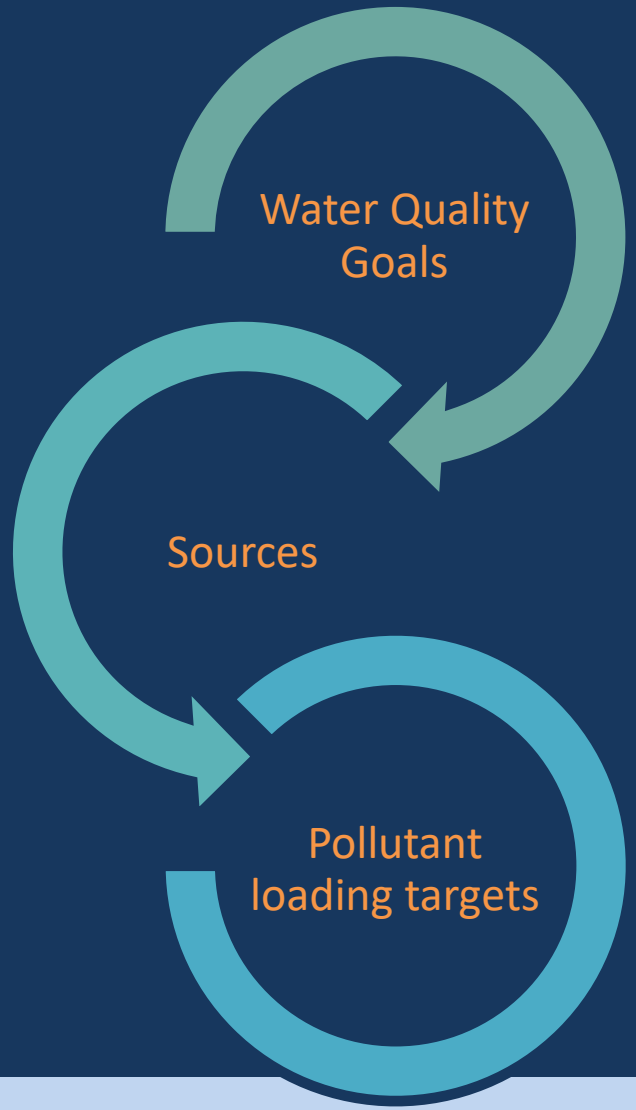


Figure 6-1: Predicted relationship between total phosphorus loading and resulting average in-lake total phosphorus concentration in the upper mixed layer (0-3 m) during the averaging period.

Water Quality Planning:
Statewide Lake Nutrient TMDL Core Document
Bantam Lake TMDL

What is a Total Maximum Daily Load Analysis?

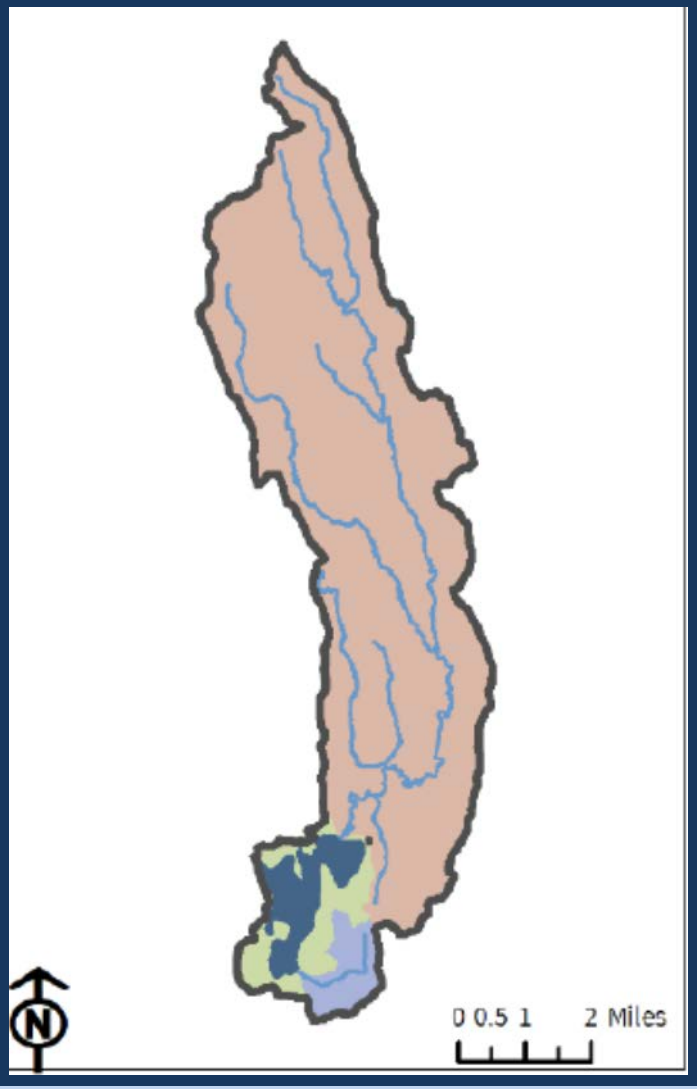
- A TMDL is a structured scientific evaluation of the water quality conditions within a water body
- It can be designed either to restore or protection water quality
- It links water quality goals to point & nonpoint sources that can affect water quality
- It identifies pollutant loadings needed to achieve goals



Bantam Lake

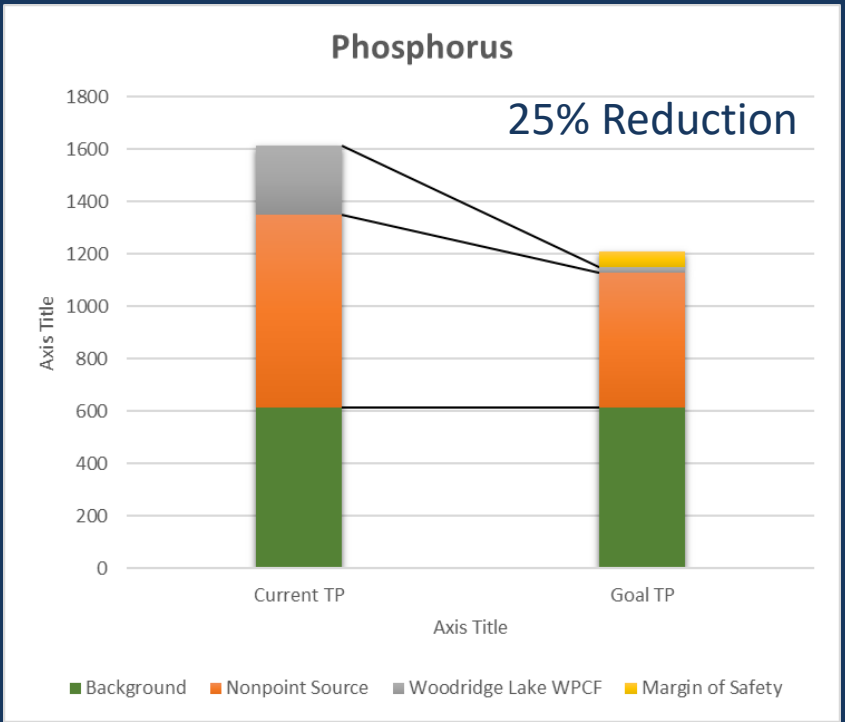
- CT's largest natural lake
- Important public resource for swimming, water skiing, fishing, boating, other recreation
- Affected by nuisance aquatic vegetation
- Summer algal blooms beginning in July or August
- Bottom phosphorus concentration increase as dissolved oxygen decreases

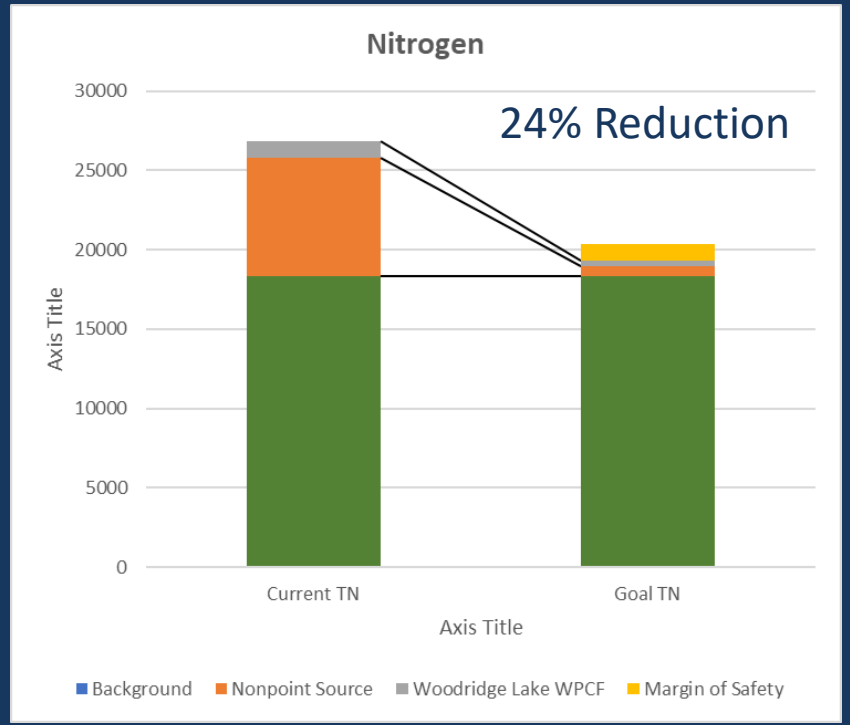
Photo from Bantam Lake Protective Association
http://bantamlakect.com/aboutus.html



Bantam Lake TMDL Nutrient Analysis

	Total Phosphorus		Total Nitrogen	
	Existing Conditions	*Load Reduction (TMDL Target)*	*Existing Conditions*	*Load Reduction (TMDL Target)*
In-Lake Concentration (µg/L)	24.7	20.0	528.6	400.0
Total Loading (kg/yr)*	1,614.3	1,211.1	26,806.0	20,326





- Bantam Lake Trophic Level Target = middle Mesotrophic Range
- In lake concentrations translated to loads using modeled relationships for Bantam Lake

Sources Evaluated within TMDL

Natural Land Uses

Birds on Lake

Atmospheric Deposition

CTDOT Stormwater

Woodridge Lake WPCF

Human Influenced Land Uses

Septic Systems near Lake

Internal Loading in Lake

Non-Regulated Stormwater

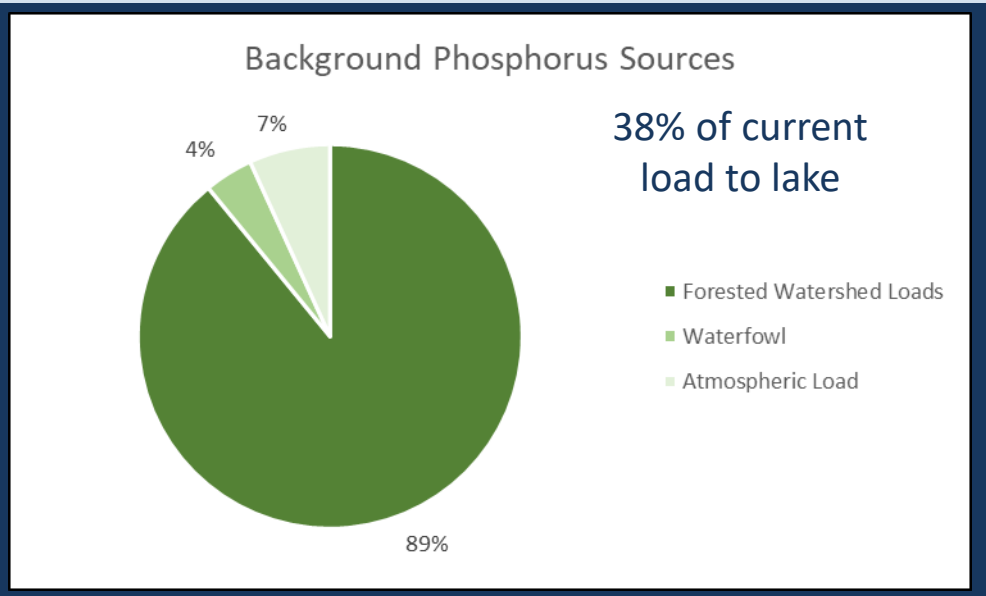
Background

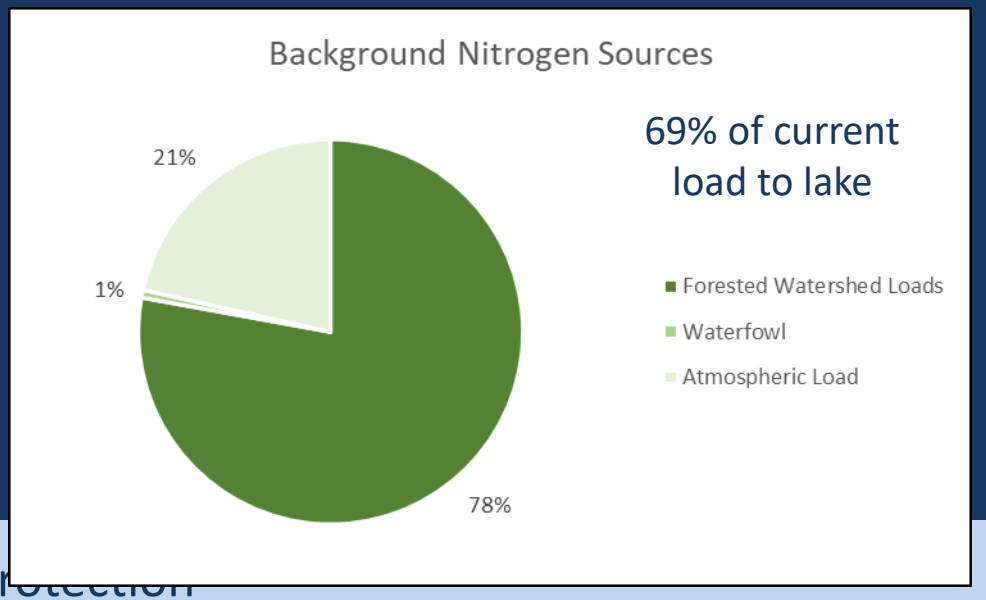
Regulated Pollution Sources

NonPoint Pollution Sources

Background Nutrient Sources

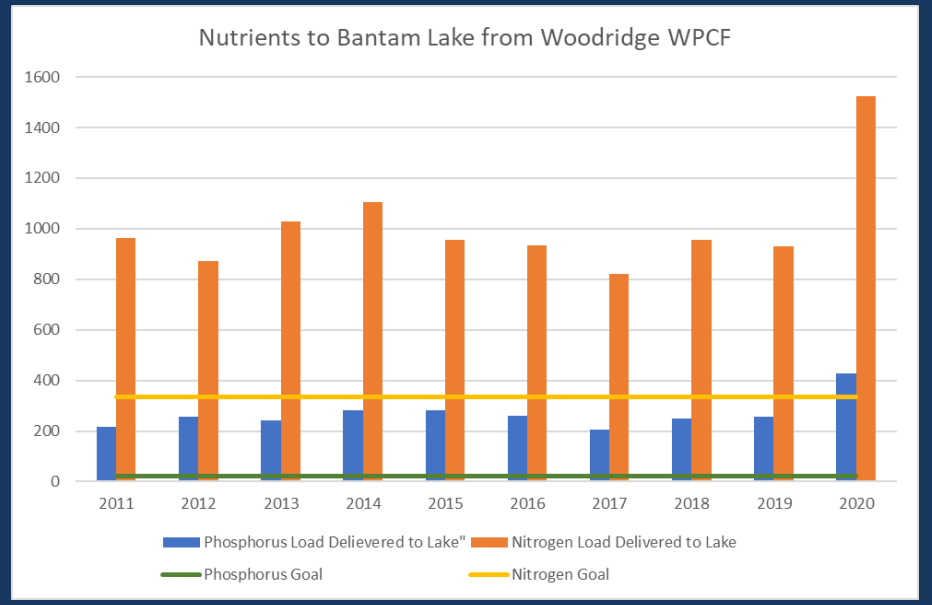
- Background Conditions
  - Estimates nutrient loading with minimal inputs from people
- Sources
  - Land Use assuming fully forested condition
  - Waterfowl
  - Atmospheric deposition
- Contribution assumed not to change in the future





Point Sources

- CTDOT MS4 Stormwater
  Loads included in Land Use estimates
  - Not evaluated separately.
- Woodridge Lake Water
  Pollution Control Facility
  - Loadings based on treatment system upgrade to Membrane Bioreactor System technology or equivalent

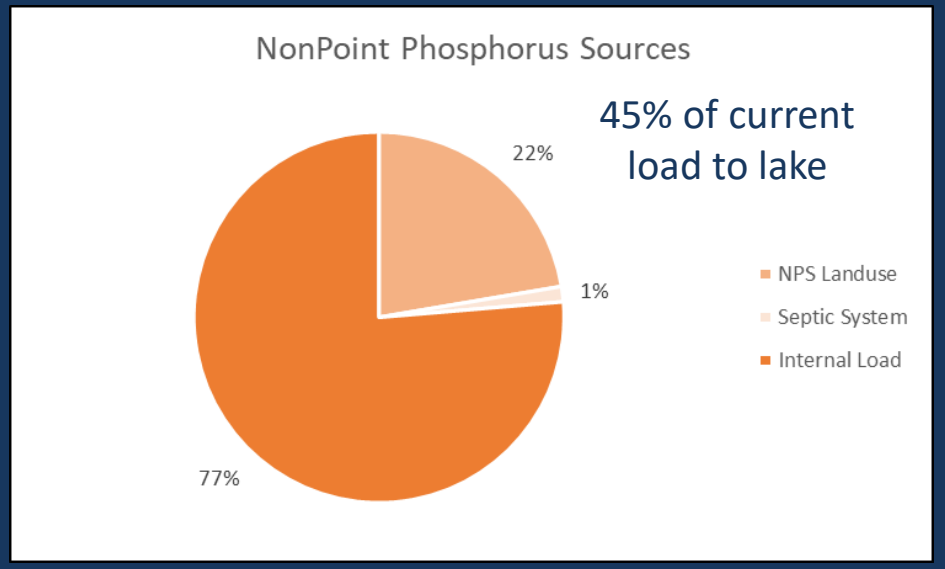


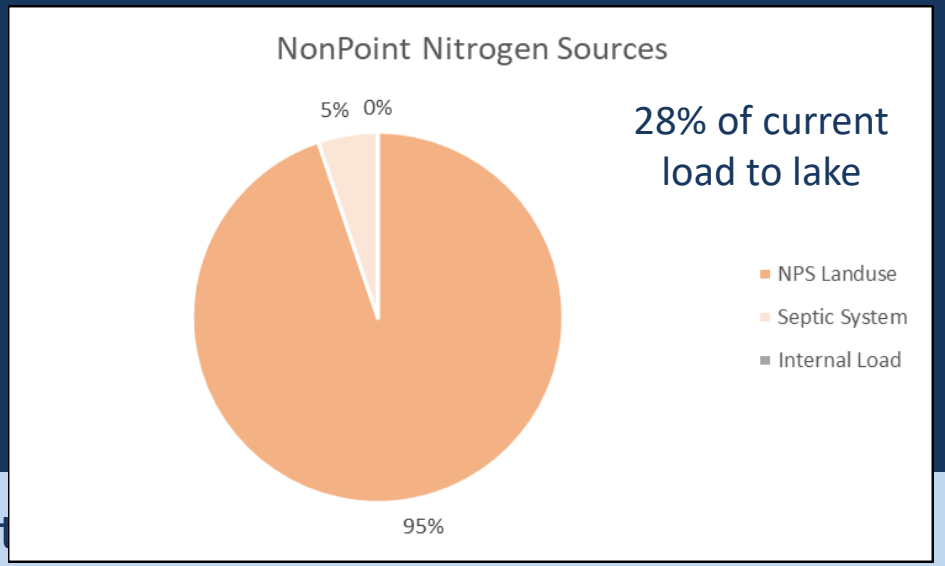
% of Current Load to Lake: 16.5% Phosphorus, 3.7% Nitrogen

Approximately 65% of nutrient discharged from Woodridge Lake WPCF reach Bantam Lake

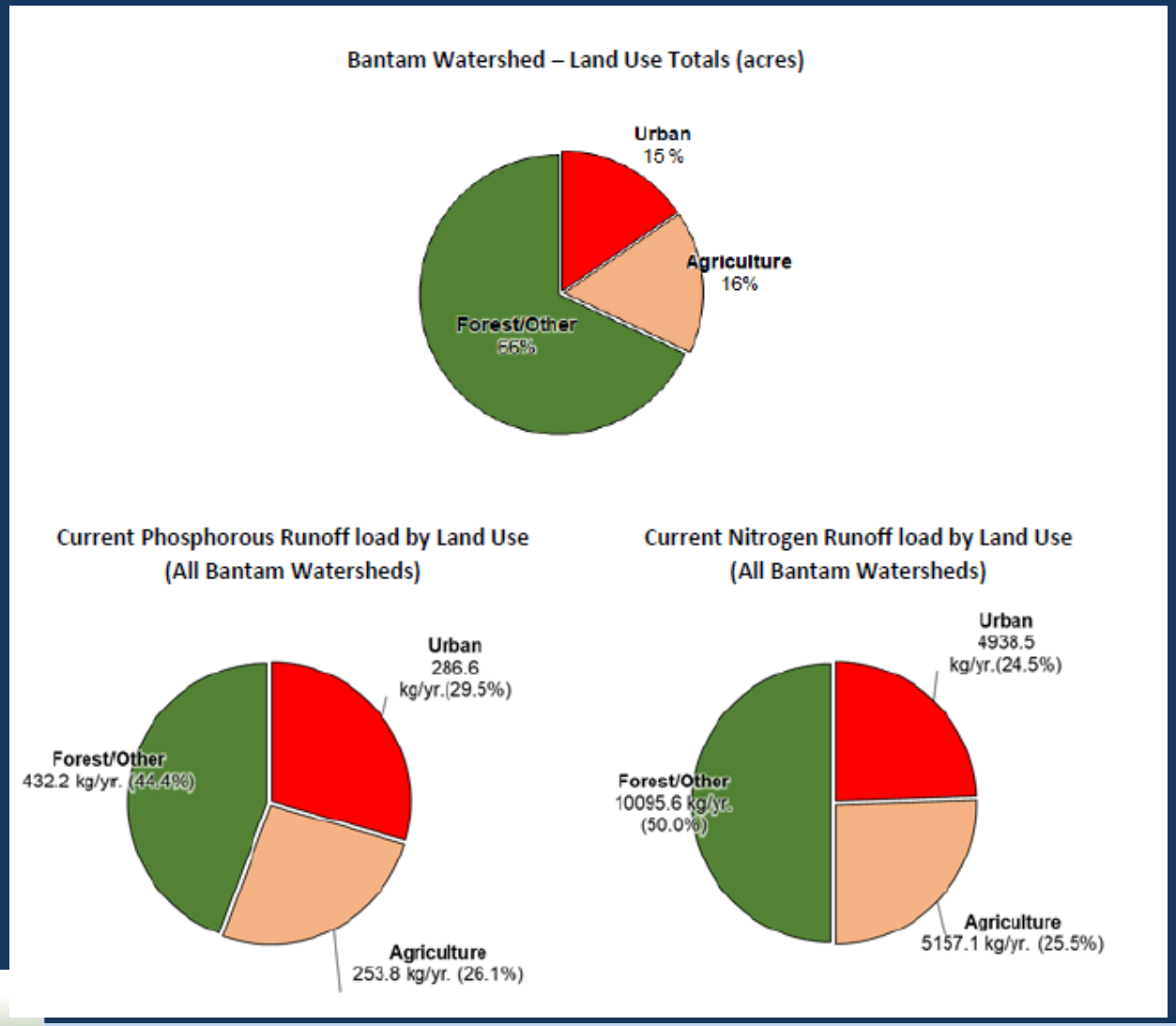
NonPoint Nutrient Sources

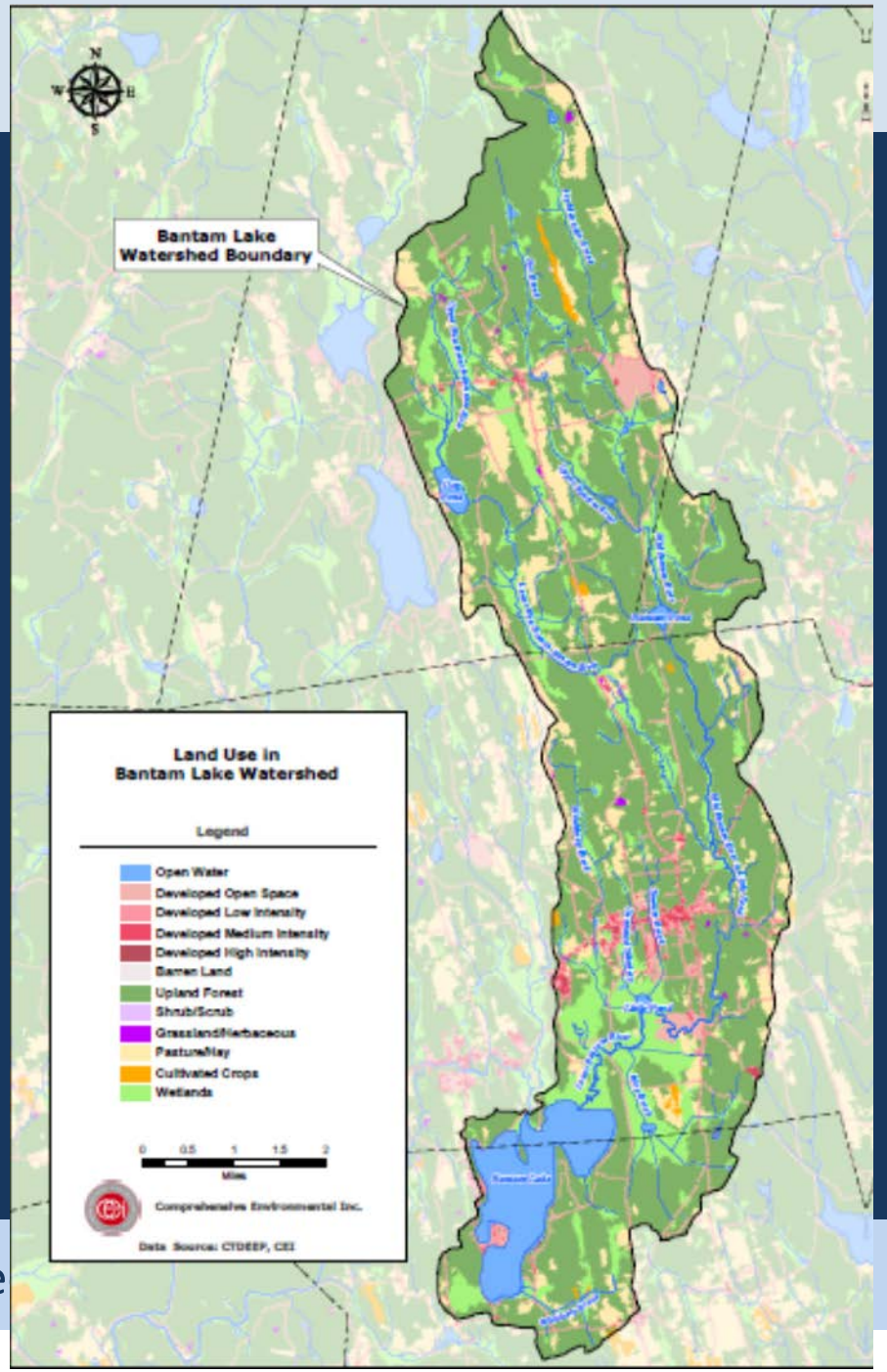
- NonPoint Sources
  - Estimates nutrient loading from non-regulated human-based activities
- Sources
  - Current Land Use
  - Septic Systems near lake
  - Internal Nutrient Load from Lake
  - Non-regulated stormwater
- Reduction recommended, starting the land use-based sources
- Land use estimates for TN likely include internal loading within Lake



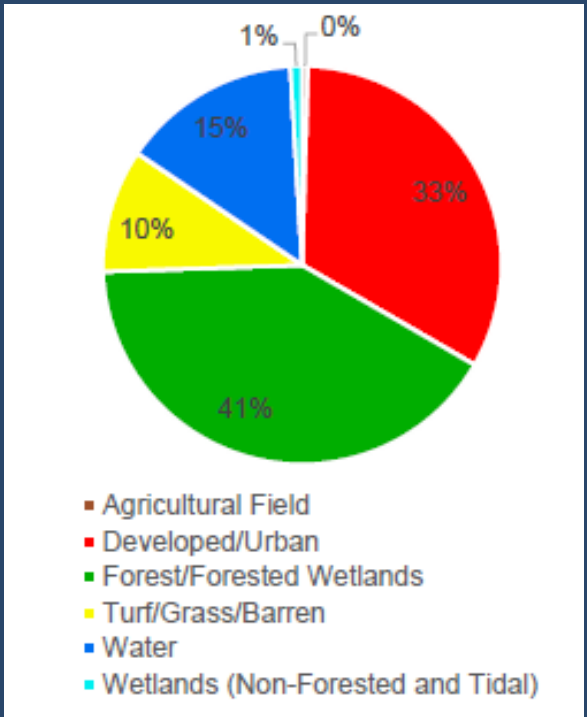


Land Use Analysis

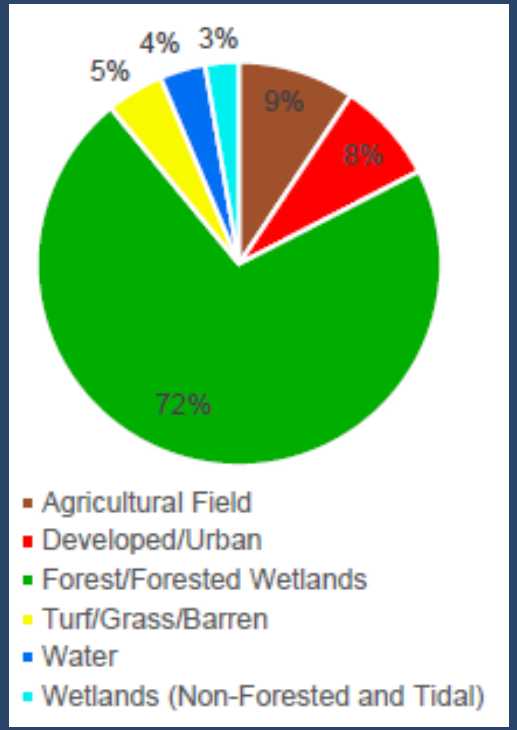




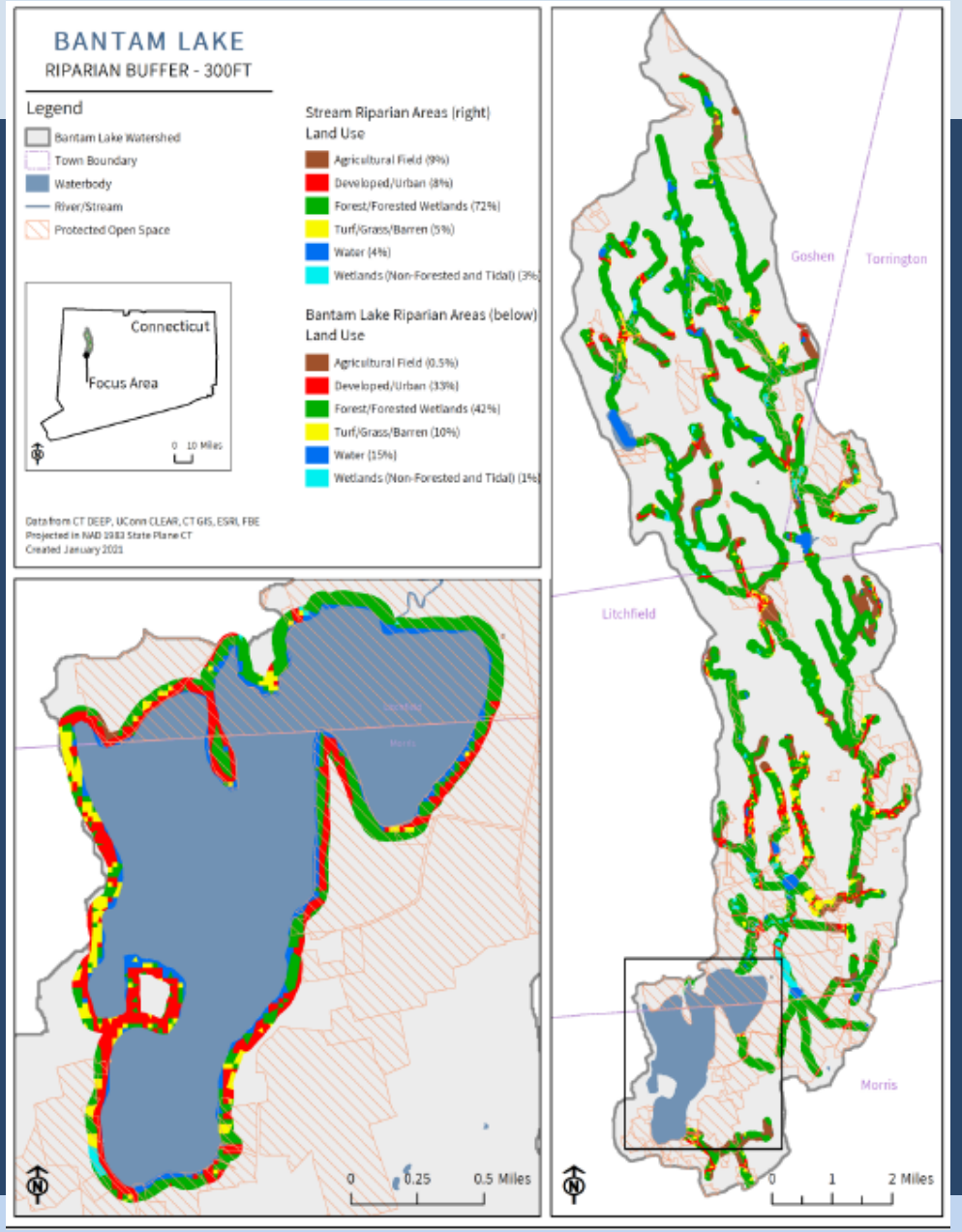
Land Use Near Waterbodies



300 ft buffer around Bantam Lake

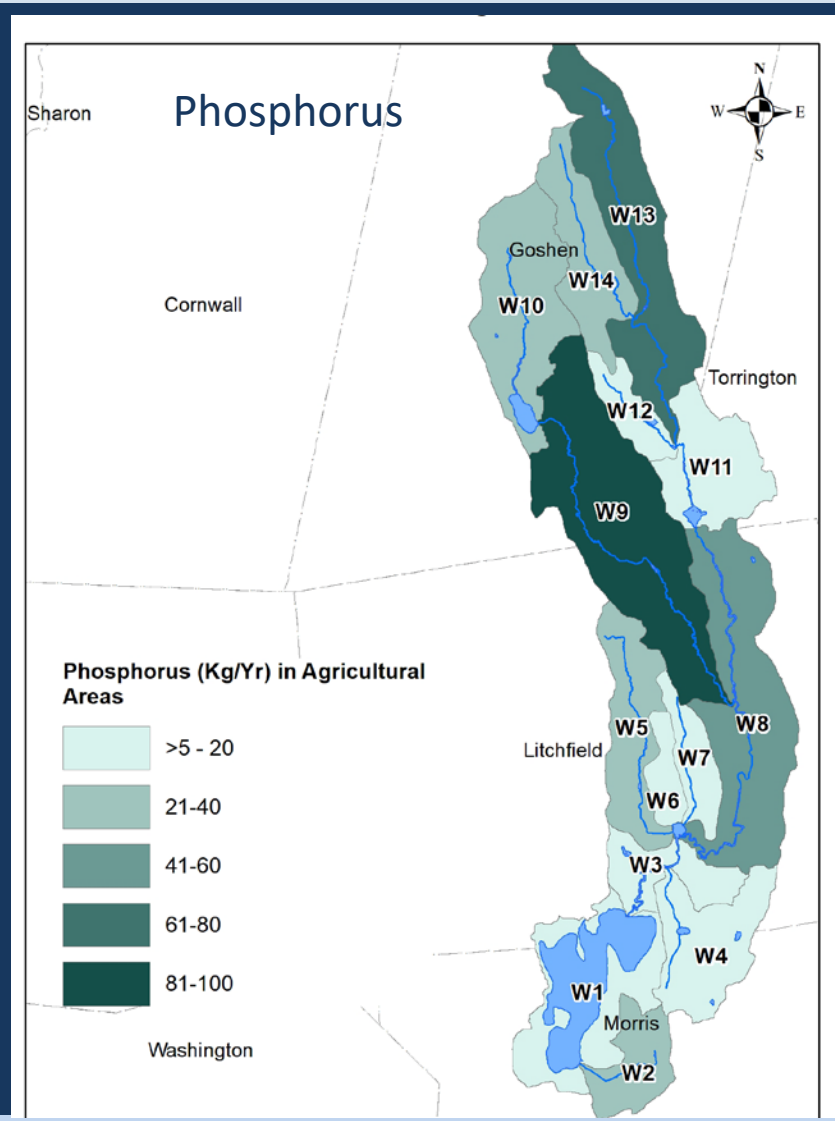


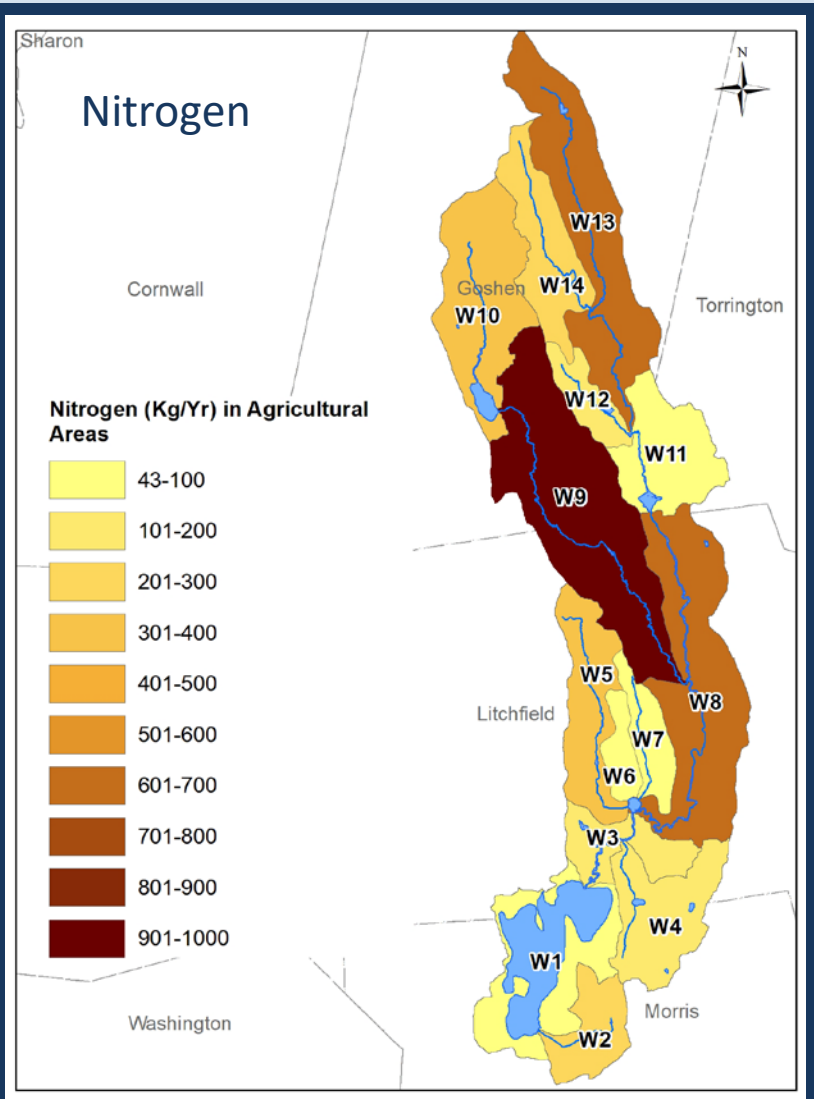
Waterbody buffers throughout watershed



Estimated Nutrient Contributions: Agricultural Land Use

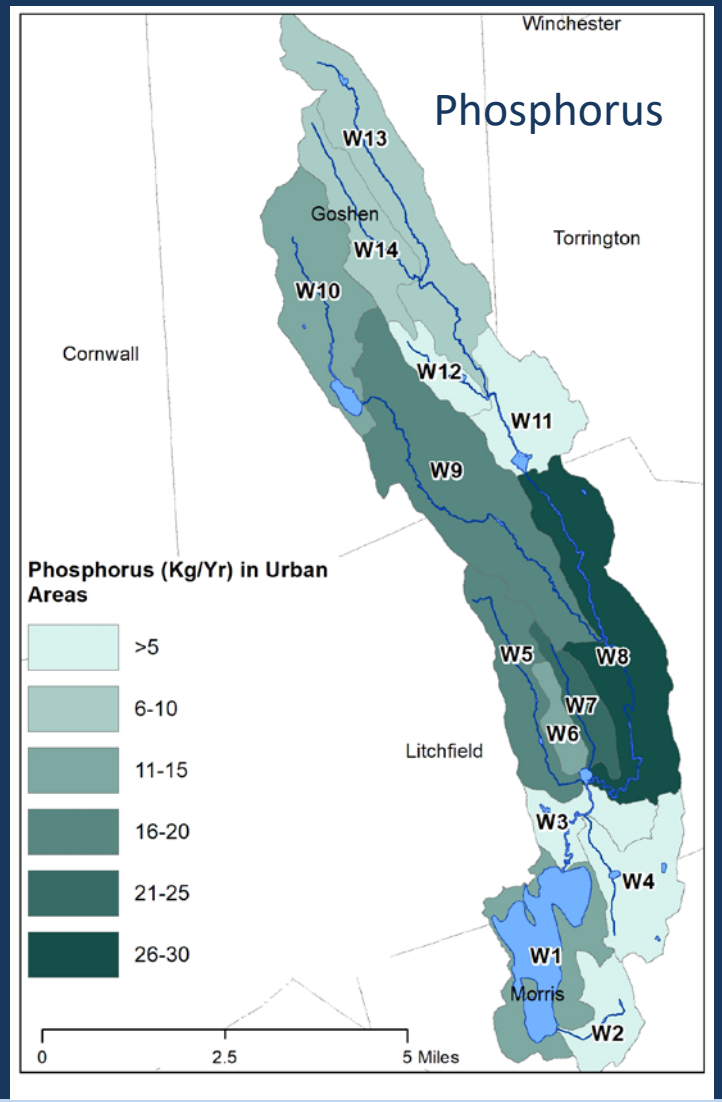
Modeled nutrient contributions during wet weather

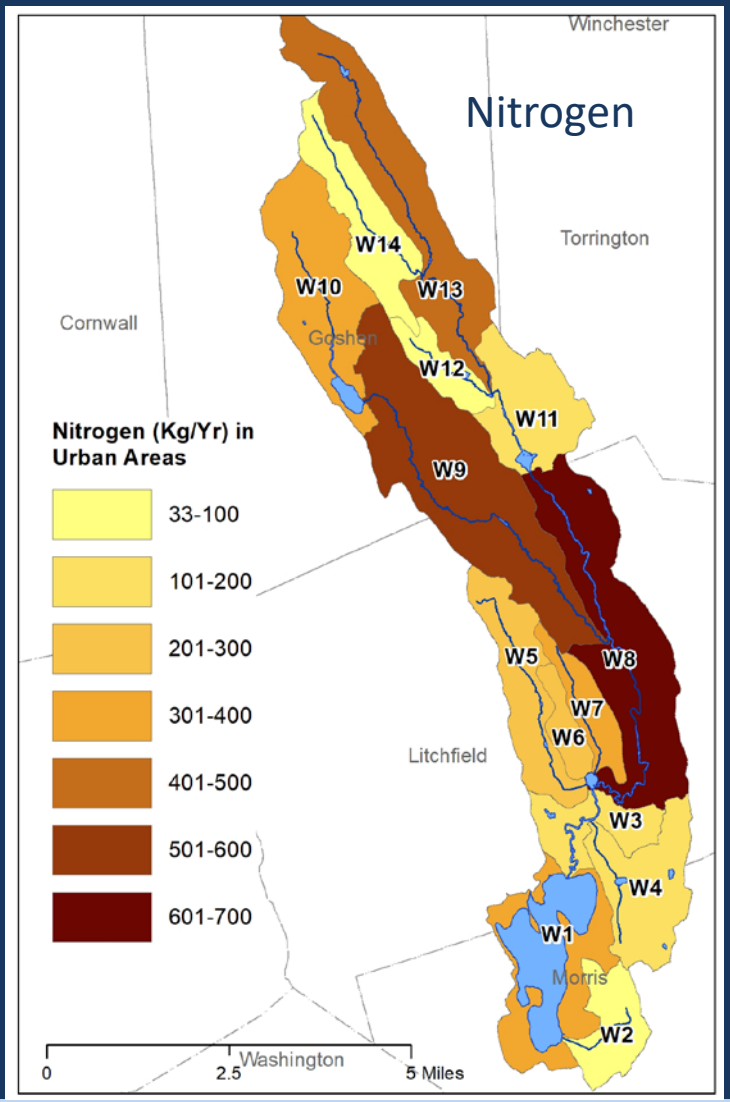




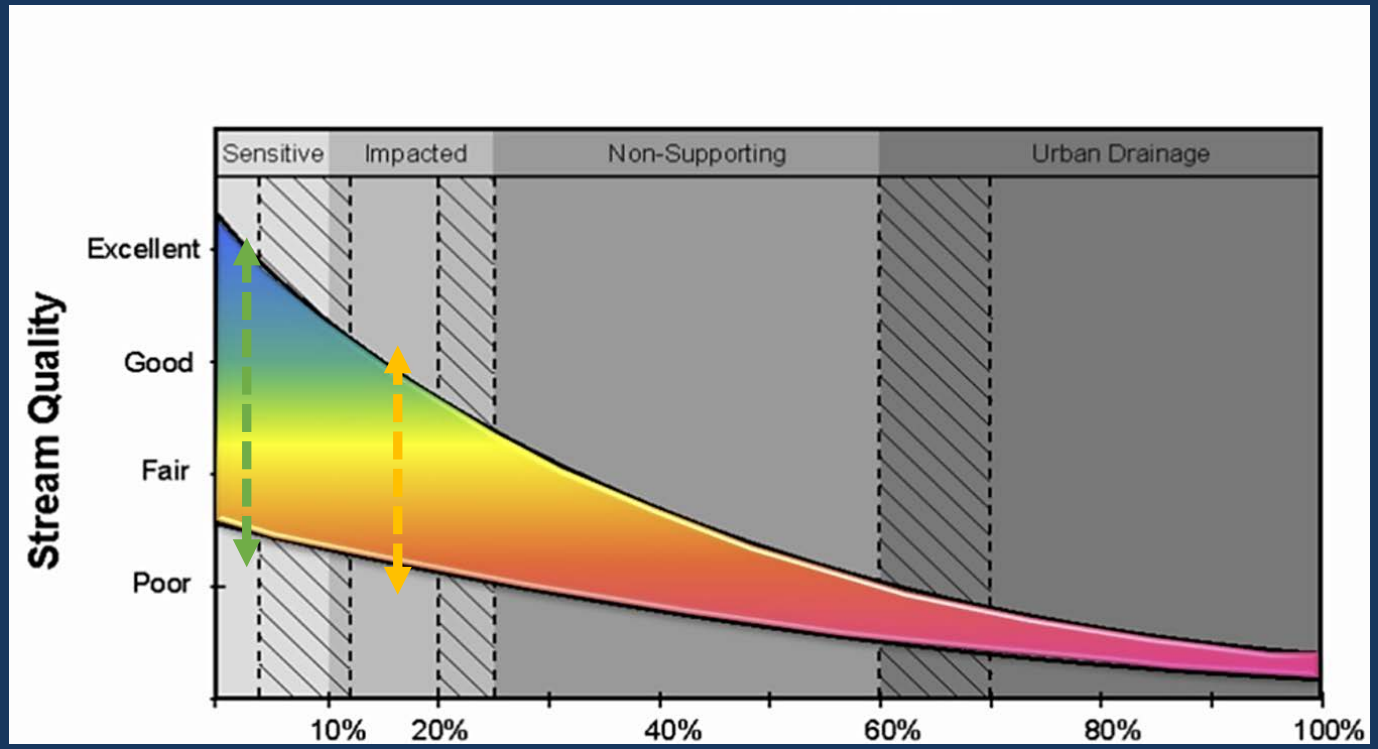
Estimated Nutrient Contributions: Developed Land Use

Modeled nutrient contributions during wet weather



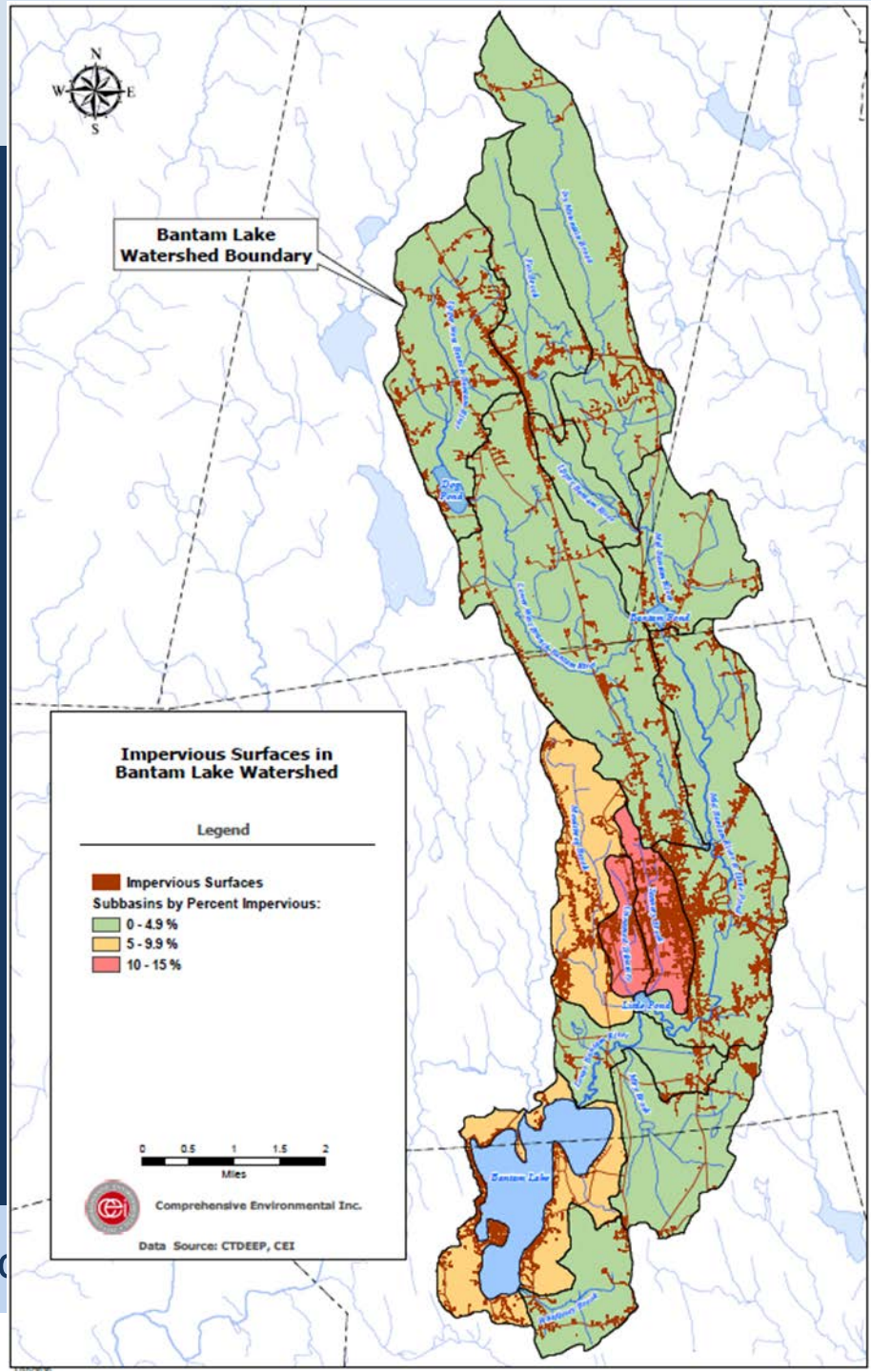


Impervious Surfaces



Subwatershed W7 Imperviousness = 14.7%

Bantam Lake Watershed Imperviousness = 3.8%



Target Nutrient Load Analysis (kg/year)

	Phosphorus	Nitrogen
Point Source	22.5	335.7
NonPoint Source	513.2	615.6
Background	614.9	18,358.1
Margin of Safety	60.6	1,016.3
Target Load for Mesotrophic Conditions	1,211.2	20,325.7

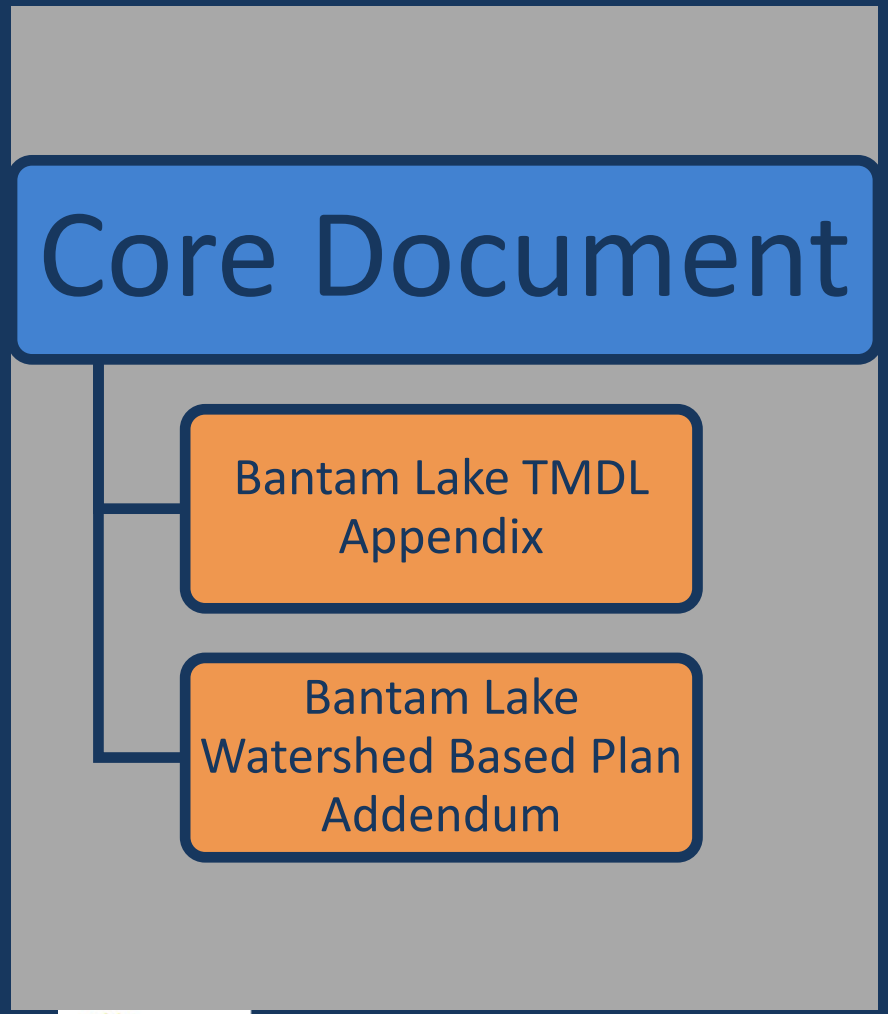
Next Step: Implementation Planning

- CT DOT MS4: Follow permit requirements
- Woodridge Lake WPCF: Treatment System Upgrade
- Septic Systems: Make sure functioning properly
- Nonpoint Source Control: Watershed Based Plan
- Internal Loading: Address after other sources have been controlled

Water Quality Planning:
Watershed Based Plan for Bantam Lake:
See separate slides

Public Notice Opportunity Questions/Discussion

Documents Available for Public Review



Core Document (applies Statewide)

- Contains general information on required elements for TMDLs and Watershed Based Plans
- Includes reference & resource materials to assist implementation

TMDL Appendix for Bantam Lake

- Watershed Specific Appendices consistent with TMDL requirements

Watershed Plan Addendum for Bantam Lake

- Developing Watershed-Based Plan Addendum Template to streamline process
- Include EPA's 9-Element components not fully covered in Core document or TMDL Appendix
- Focus on Implementation Activities

Benefits to Communities

- Provides a holistic view of the watershed connecting the watershed and lake
- Improved water quality in watershed and lake
- Improve recreational opportunities for community
- State and federal support via funding and staff resources benefit community
- Provides a tool for community-based collaboration and action

Plan needed to address water quality issues in Bantam Lake

Public Comment Opportunity

- All three documents are available for public review and comment
- **Comments due by August 19, 2021**
- Comments should be submitted in writing, email preferred
- Documents available on CTDEEP Bantam Lake Watershed Project website

Submit comments to:

Sarah Hurley
CT DEEP
sarah.hurley@ct.gov

CTDEEP Bantam Lake Watershed Project Website

https://portal.ct.gov/DEEP/Water/Watershed-Management/Bantam-Lake-Watershed-Projects