BMP OPTIMIZATION FOR COST REDUCTIONS IN MUNICIPAL STORMWATER PERMITTING

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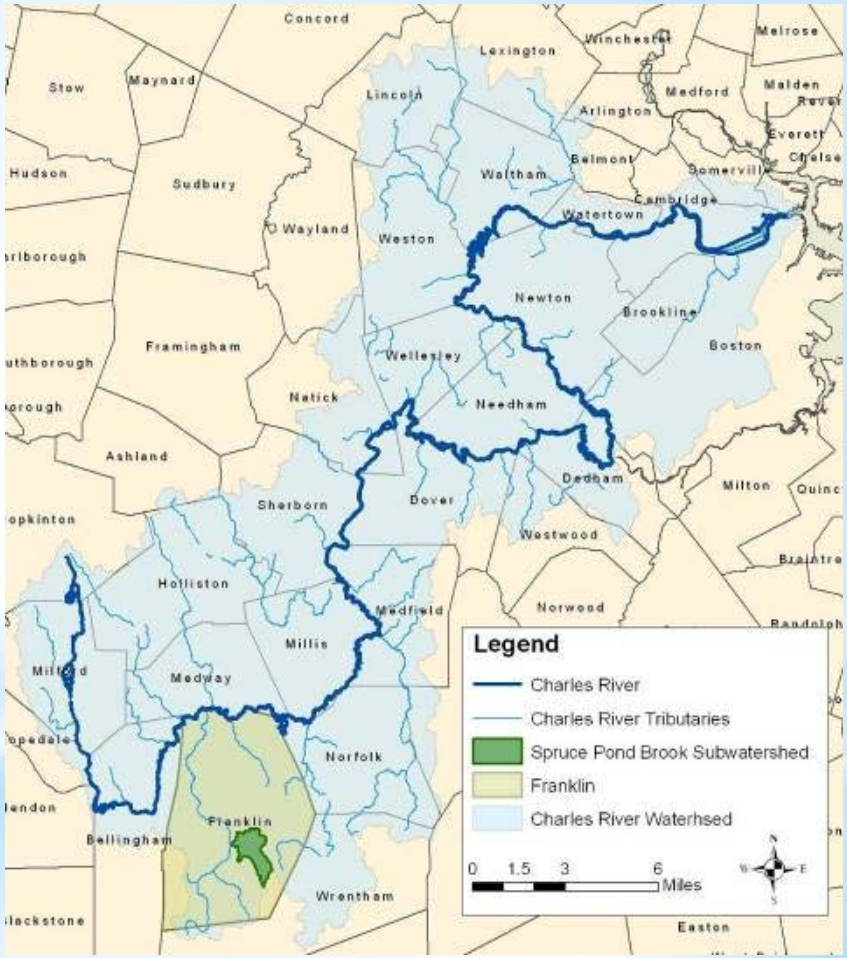
2016 New Hampshire Water & Watershed Conference
Plymouth State University
Friday, March 18, 2016

Geosyntec consultants
University of New Hampshire
Rockingham Planning Commission
National Estuarine Research Reserve System Science Collaborative
cbi Consensus Building Institute

Meeting the Charles R Phosphorus TMDL

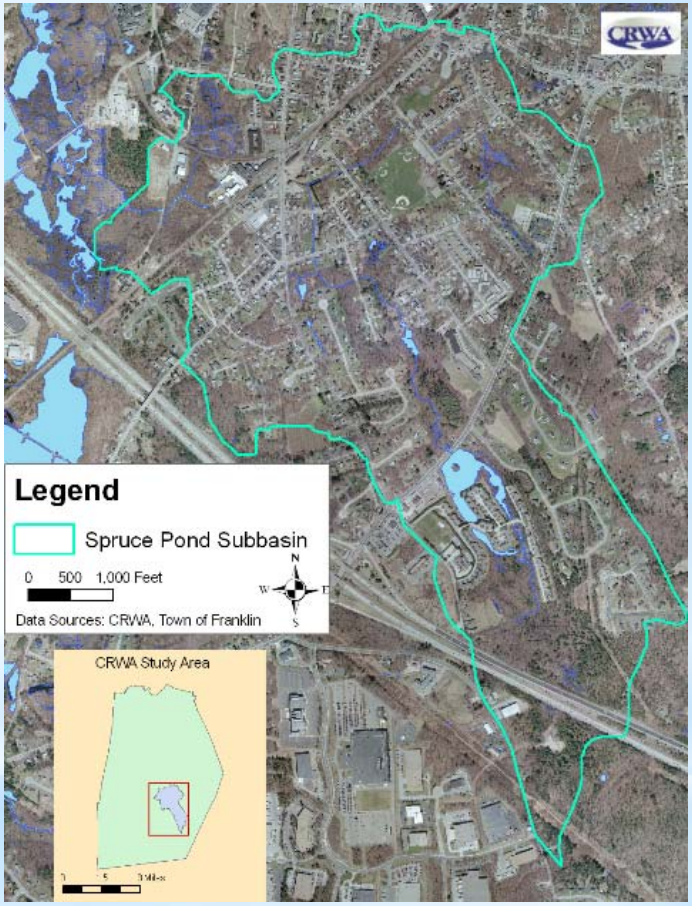
Franklin, MA

- Identified a suitable sub-basin
  - Spruce Pond Brook
  - 42% TP reduction
- Identified stormwater BMPs that will meet the required sub-basin phosphorus reduction
- Investigated ways to minimize costs

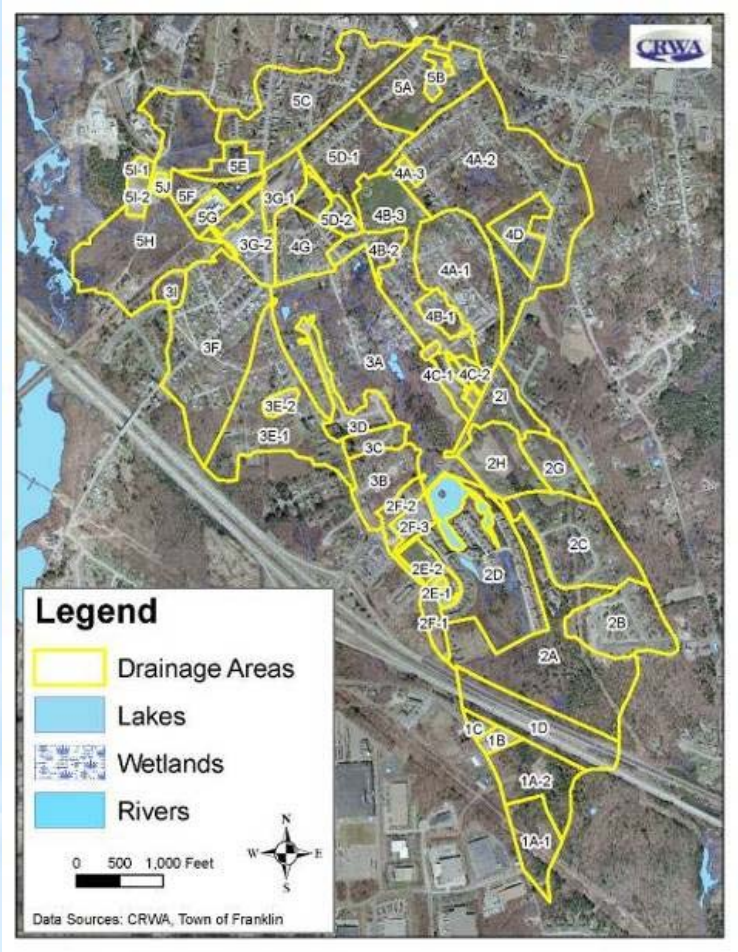


Spruce Brook Pond Subwatershed

- Approx. 1 square mile
- Land Use Mixed
  - Residential
  - Comm/Ind/Trans (I-495)
  - Undeveloped
- Stormwater
  - Some old dry basins
  - Some newer development w/BMPs
  - Several designated discharge Sites (>2 ac impervious)



Drainage Areas



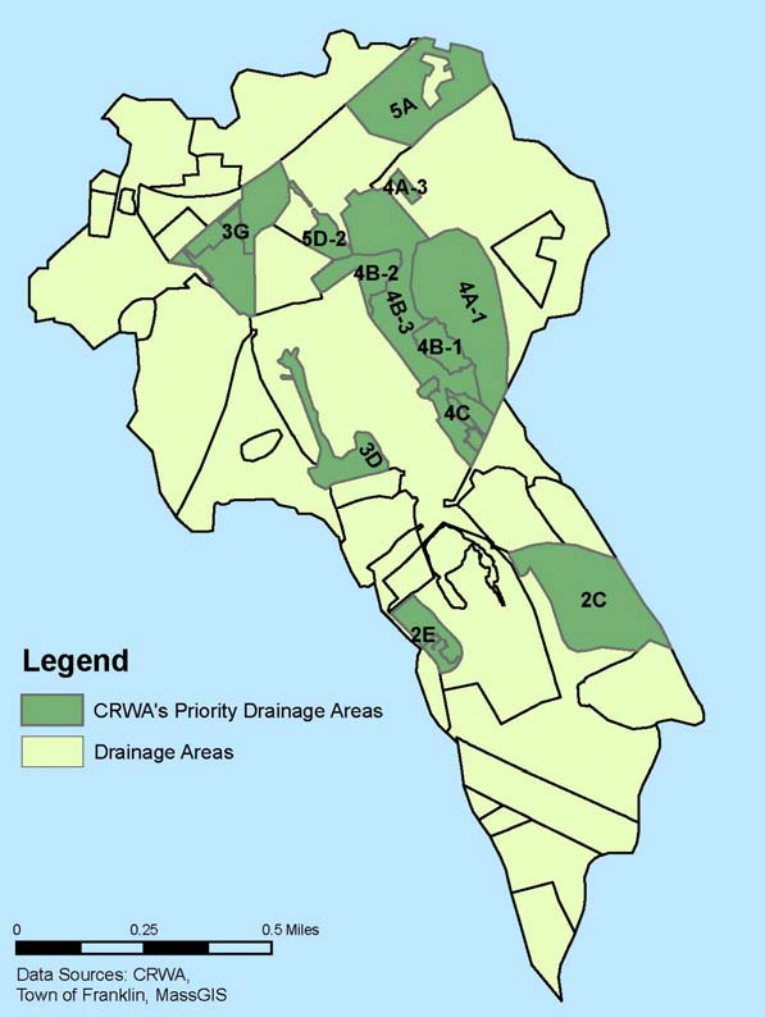
- 49 Drainage Areas delineated based on:
  - Topography
  - Stormwater infrastructure
  - Property boundaries of designated discharge (>2 acres impervious, in commercial, residential or high-density LU) sites

Site Visits

BMP Systems Considered

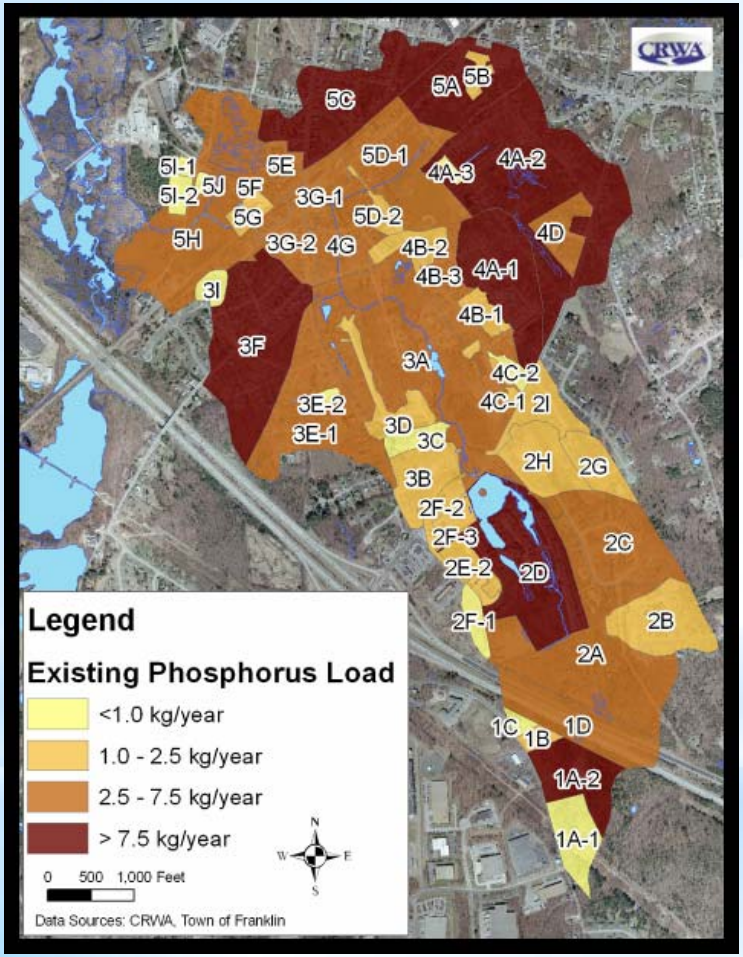
- Infiltration basin
- Infiltration trench
- Infiltration chamber
- Rain garden
- Bioretention
- Green street
- Gravel wetland

Traditional Plan (S0)



- Treatment systems sited and sized based on:
  - Site visit results
  - Available space
  - Project team input
- Detailed designs developed for 12 priority drainage areas

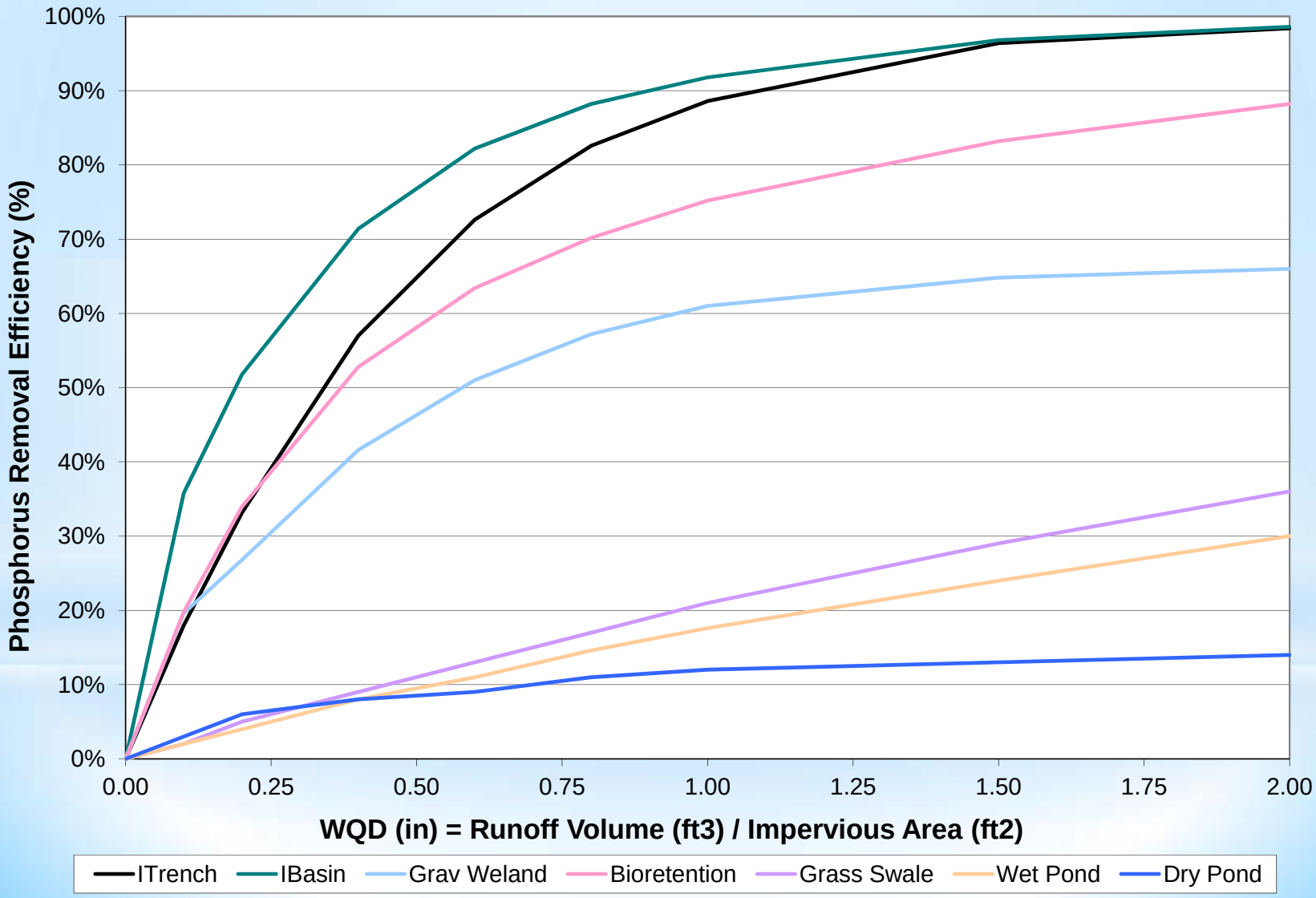
Optimized Plan (S2)



- Treatment systems sized by optimization algorithm
- Used eVolver genetic algorithm (GA) to minimize construction costs
- Constraints:
  - Min. overall TP reduction of 42%
  - Min. and Max. WQD for each BMP
  - Max. available space each BMP

BMP Performance

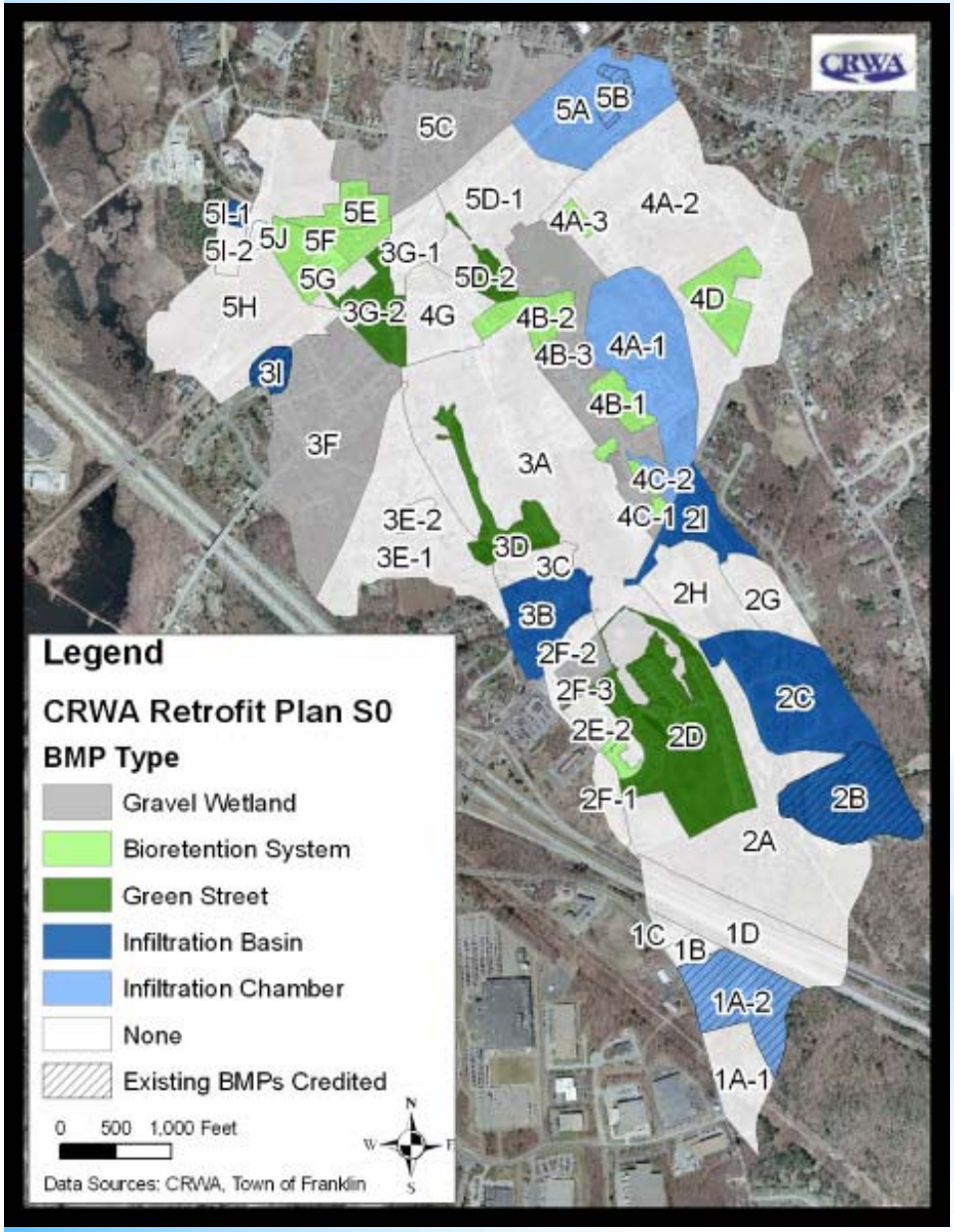
https://www3.epa.gov/region1/npdes/stormwater/assets/pdfs/BMP-Performance-Analysis-Report.pdf

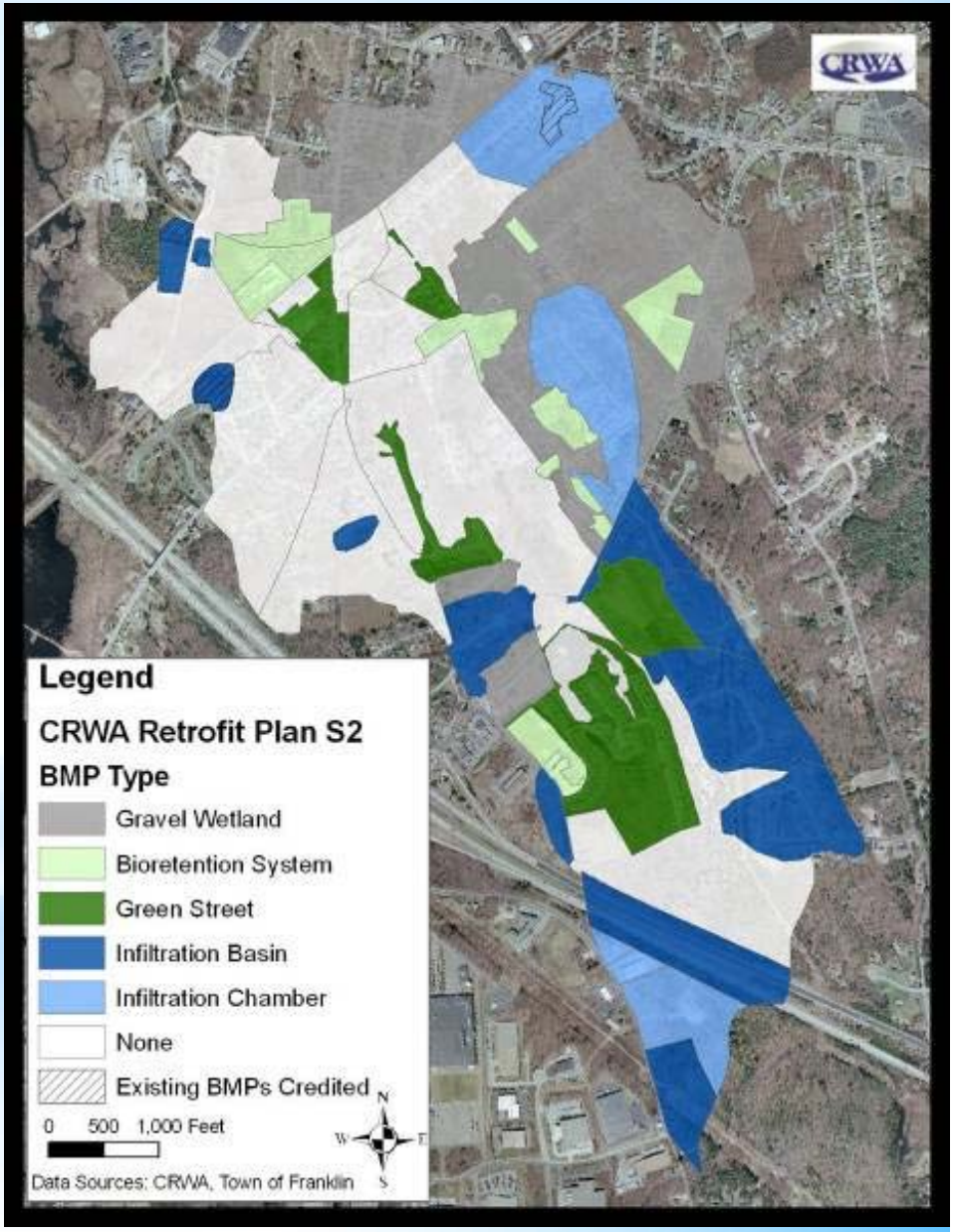


Spreadsheet Approach

- Developed averaged performance curves over all land uses
- Accounting of phosphorus loads and reductions for all DAs and overall sub-watershed
- Estimation BMP practice area based on selected WQD
- Calculation of BMP cost using lookup tables of $/ft3 treated and added a multiplier for site difficulty
- Land cost for private sites estimated based on BMP practice area and local land values

Drainage Area Retrofit Treatment Systems



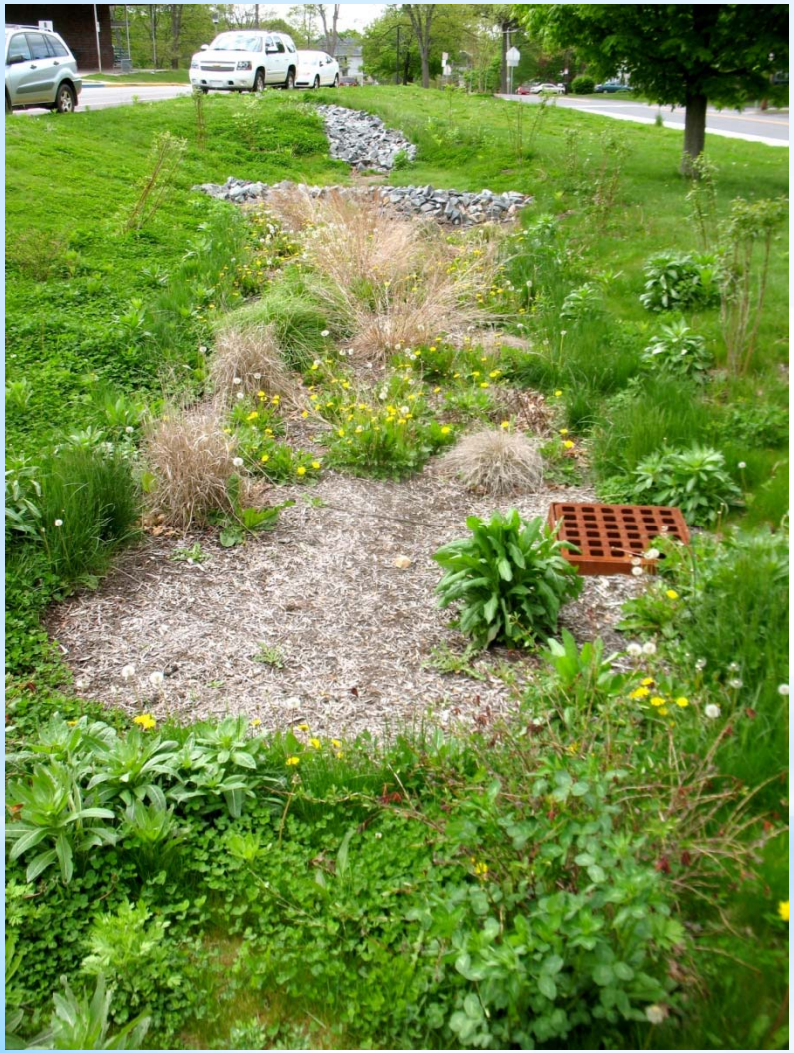


Scenario Cost Comparison

Without Design & Permitting		
Scenario	Cost per lb TP removed	Cost per IA acre treated
S0	31,707	28,078
S2	18,854	17,770
With Design & Permitting (35%)		
Scenario	Cost per lb TP removed	Cost per IA acre treated
S0	42,805	37,906
S2	25,453	23,990

Summary: Lessons Learned

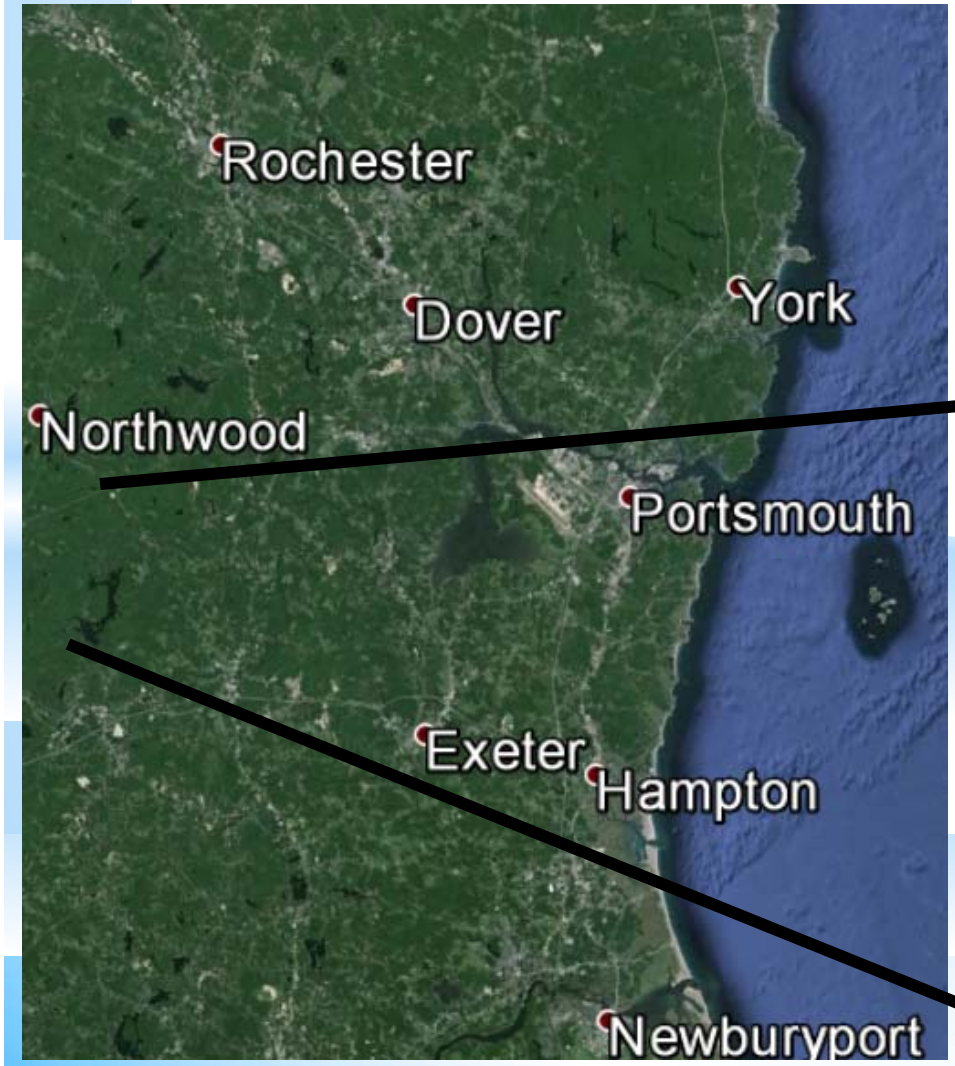
Planning and Design Process



- Site visits are vital for finding viable BMP locations
- Not all treatment systems are appropriate at all sites
- Optimization can reduce costs significantly
- Small BMPs more cost effective
- Infiltration is the most cost effective BMP for TP removal

WATER INTEGRATION FOR SQUAMSCOTT--EXETER (WISE)

Coastal NH, ME, MA

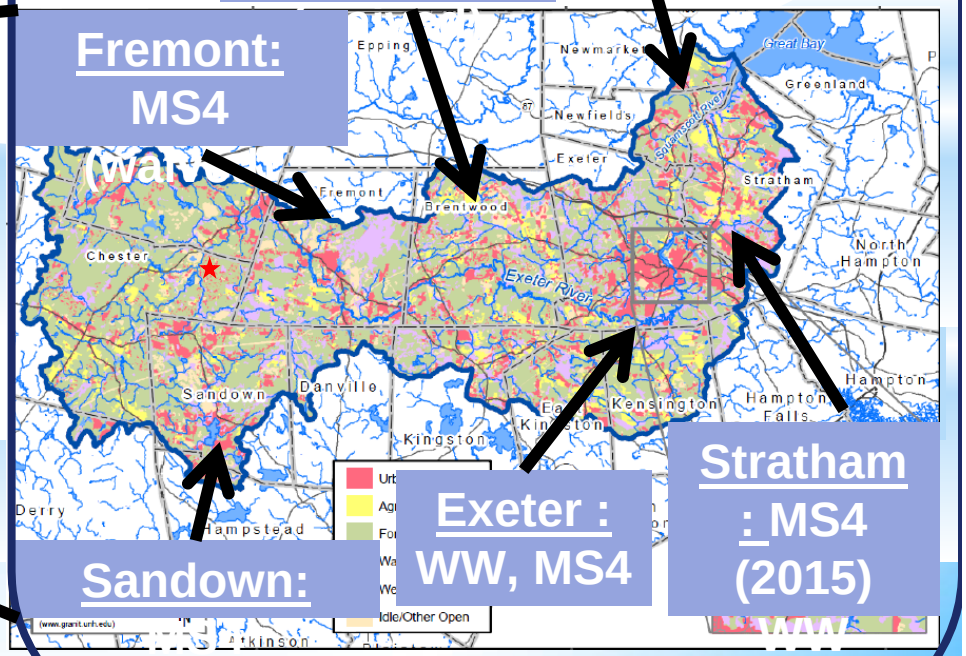


Exeter & Squamscott River Watershed

Brentwood: MS4

Newfields: WW, MS4 (waived)

Fremont: MS4



Exeter : WW, MS4

Stratham : MS4 (2015)

Sandown:

needs

WISE PROJECT TEAM

Robert Roseen, Project Coordinator
Renee Bourdeau, Project Manager
Chad Yaindl, Senior Staff Engineer

Alison Watts, Watershed Science Lead

Cliff Sinnott and Theresa Walker, Intended User Representatives

Doug Thompson and Eric Roberts, Collaboration Experts

Paul Stacey, Science Investigator, Steve Miller, Training Program and Climate Adaptation

Jennifer Royce Perry, Public Works Director, Exeter
Don Clement, Council
Paul Vlasich, Town Engineer
Sylvia VonAulock, Town Planner

Paul Deschaine, Town Administrator, Stratham
Lincoln Daley, Town Planner

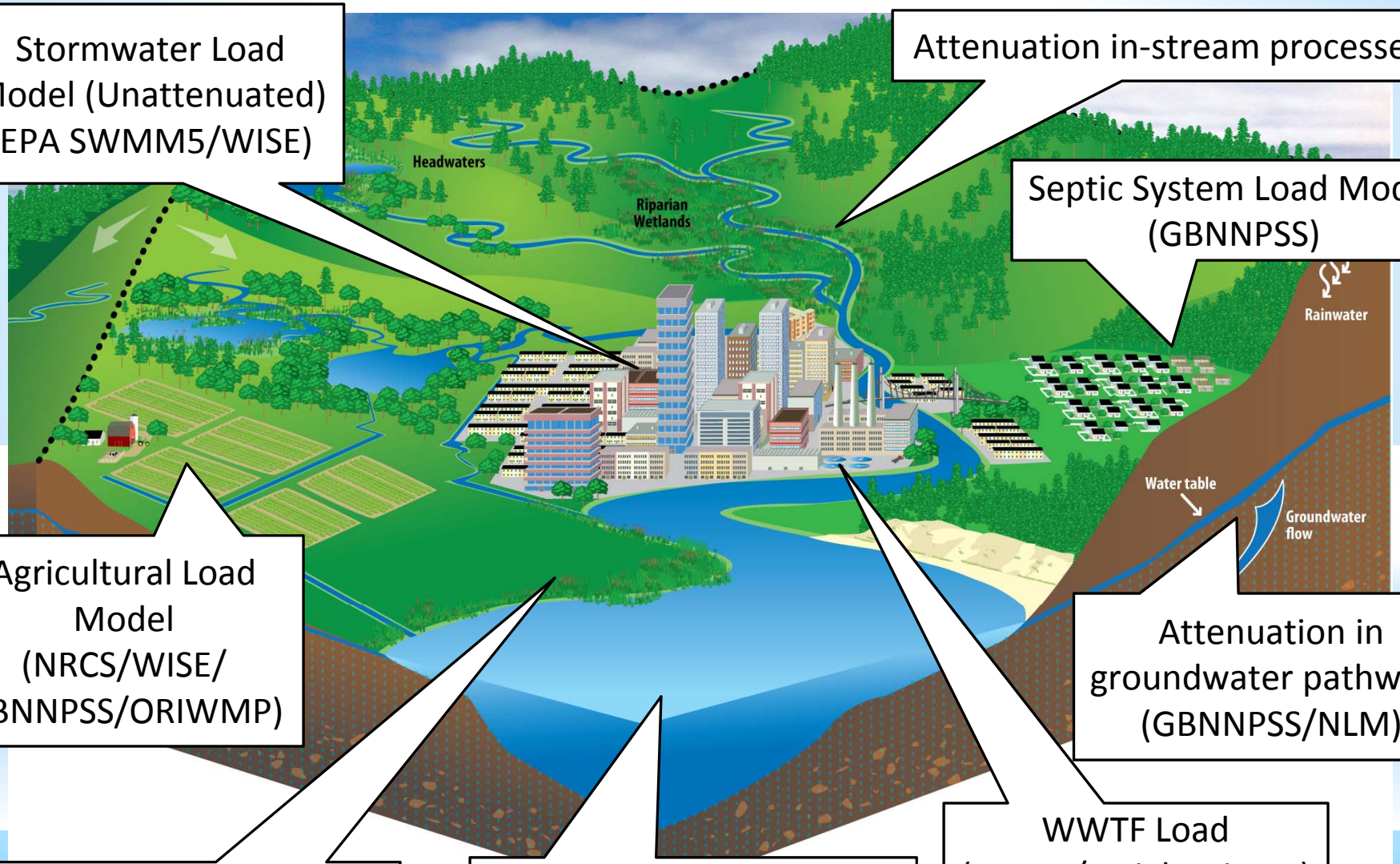
Clay Mitchell, Town Planner, Newfields
Bill Meserve, Municipal Rep.

Mark Voorhees, Newton Tedder, Dan Arsenault, David Pincumbe, Carl Deloi

Rich Langan, Funding Agency Director
Kalle Matso, Program Manager

Ted Diers, Matt Wood, Phil Trowbridge, Barbara MacMillan, Sally Soule, Eric Williams

POLLUTANT LOAD ANALYSIS COMPONENTS



Stormwater Load Model (Unattenuated) (EPA SWMM5/WISE)

Attenuation in-stream processes

Septic System Load Model (GBNNPSS)

Agricultural Load Model (NRCS/WISE/ GBNNPSS/ORIWMP)

Attenuation in groundwater pathways (GBNNPSS/NLM)

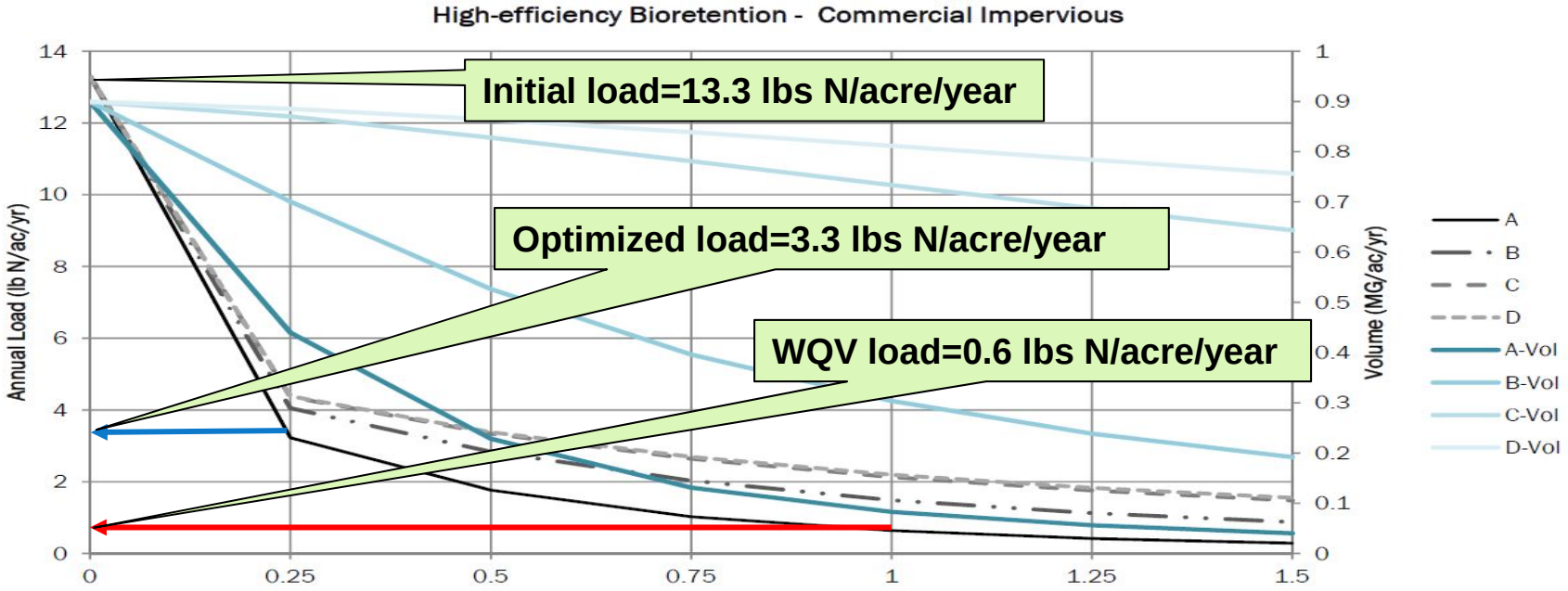
Attenuation in buffer zones

Attenuated Load To Estuary (GBNNPSS/NLM)

WWTF Load (Exeter/Wright Pierce)

Source: Michigan Seagrant

BMP OPTIMIZATION



BMP Sizing Example:

•1 system treating a 1" water quality volume for 1 acre will remove approximately 12.7 lbs N/acre/year.

•4 smaller systems across 4 acres designed to treat 0.25" WQV/acre/yr will each remove 10 lbs N/acre/year for a total of 40 lbs N per year.

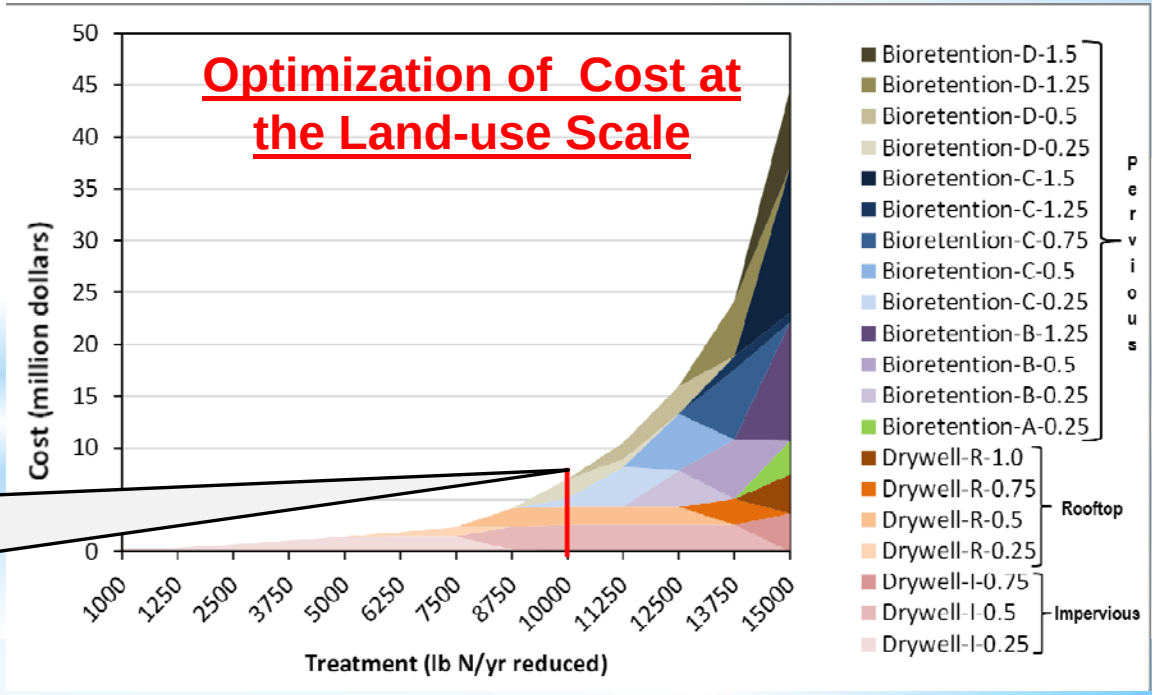
•An additional 27 lbs of nitrogen per year at nearly equivalent costs, or approximately 315% increase.

LAND USE SCALE OPTIMIZATION

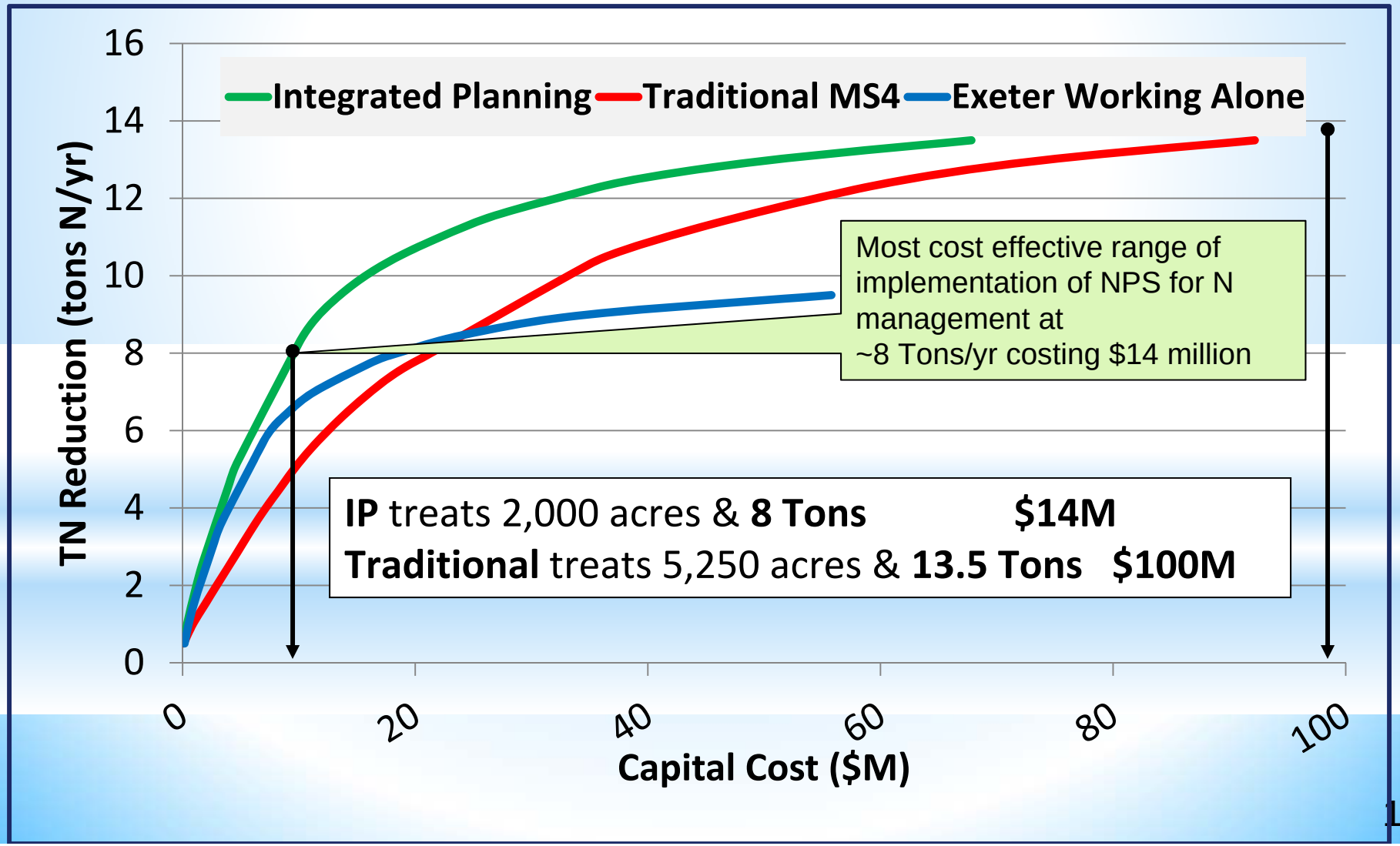
This process enables the identification of the **maximum extent practicable (MEP)**, or the point at which cost effectiveness is greatest and feasibility begins to decline.

To achieve **10,000 lbs** of reduction by treating residential land, use a mix of:

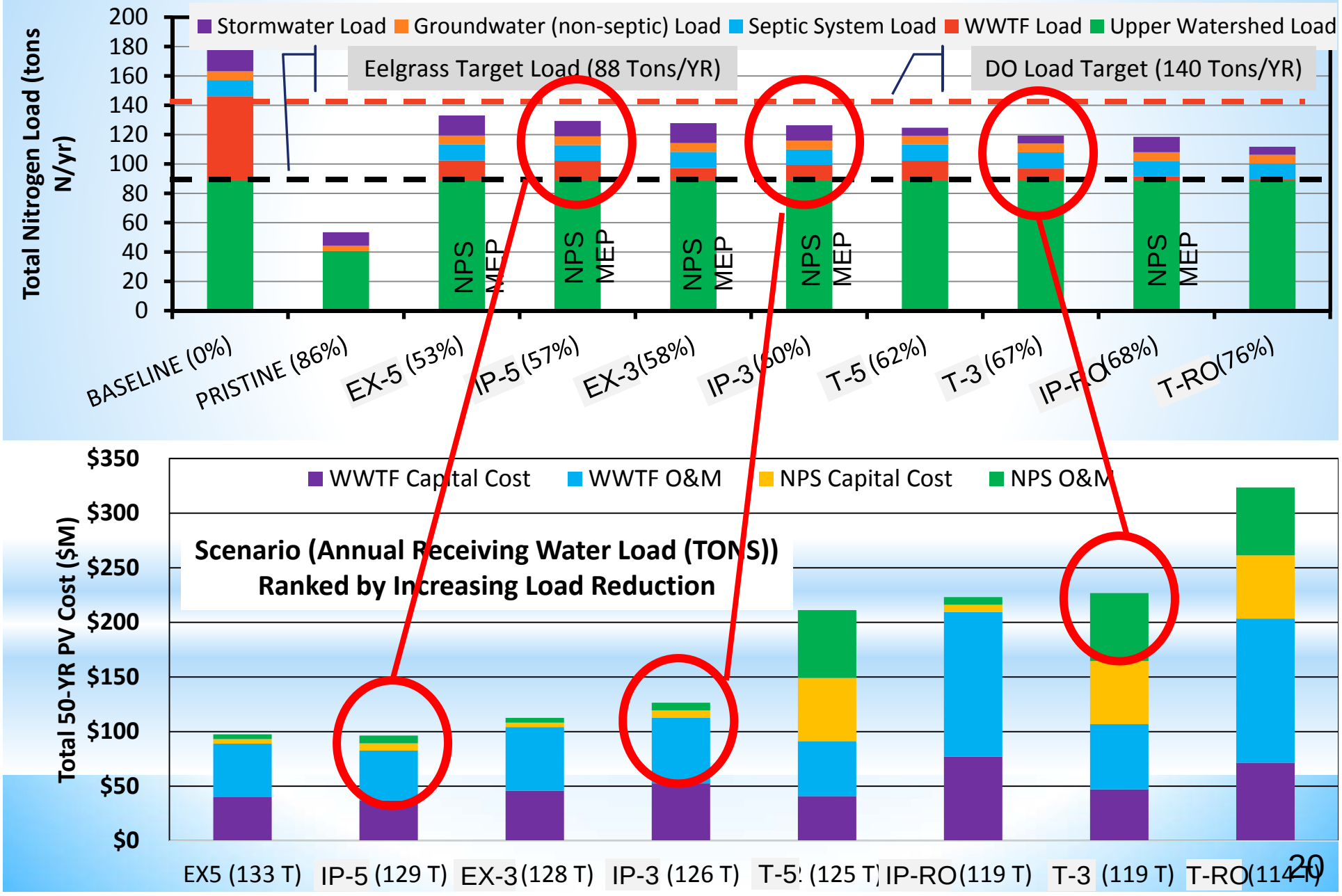
- Drywell/Infiltration trenches, 0.5” capture depth, treating runoff from driveways/sidewalks
- Drywells, 0.5” capture depth, treating roof runoff
- Bioretention (rain gardens), 0.25” capture depth, treating runoff from pervious C soils
- Bioretention (rain gardens), 0.25” capture depth, treating runoff from pervious D soils



WATERSHED SCALE OPTIMIZATION



ANNUAL LOAD VS. PRESENT VALUE



NPS CONTROLS FOR MEP

Total Present Value of NPS Management (including O&M): $13.6 M
Total Load Reduction from NPS Management: 17,000 lb N/yr
Total Acres Treated: 2,000 acres

BMP TYPE	SIZE	LAND USE	COVER	ACRES TREATED	ACRES AVAILABLE	%
Cover Crops	-	Agriculture	-	28	28	100%
Slow Release Fertilizer Program	-	Agriculture	-	253	253	100%
Gravel Wetland	0.25	Commercial	Impervious	104	144	72%
High Efficiency Bioretention	0.25	Commercial	Impervious	29	144	20%
Subsurface Infiltration	0.25	Commercial	Impervious	12	144	8%
Dry Well	0.25	Commercial	Roof	36	36	100%
Gravel Wetland	0.25	Industrial	Impervious	47	47	100%
Dry Well	0.25	Industrial	Roof	25	25	100%
Gravel Wetland	0.25	Institutional	Impervious	94	113	83%
High Efficiency Bioretention	0.25	Institutional	Impervious	19	113	17%
Dry Well	0.25	Institutional	Roof	39	39	100%
Gravel Wetland	0.25	Outdoor and Other Built-up Land	Impervious	30	30	99%
Raingarden	0.25	Residential	Impervious	300	369	81%
Raingarden	0.5	Residential	Impervious	69	369	19%
Dry Well	0.25	Residential	Roof	252	252	100%
Lawn Fertilizer Program	-	Residential	-	-	-	-
Bioretention	0.25	Road	Impervious	112	658	17%
Gravel Wetland	0.25	Road	Impervious	546	658	83%
Street Sweeping Program	-	Road	Impervious	658	658	100%

KEY FINDINGS

- **IP is more economical than traditional permitting because it satisfies elements of both the MS4 and wastewater permits.**
- **Maximum extent practicable (MEP) for NPS management may be feasible with a 6.5X increase for Exeter's current SW budget whereas traditional permitting would be nearly a 33X increase and is not financially feasible.**
- **Stratham cost of MS4 implementation is reduced by nearly 80% using IP. Extending WW to Stratham and Newfields is part of an effective Nitrogen control strategy.**
- **An extended implementation schedule combined with monitoring and adaptive management will help address uncertainty both in management actions and environmental response.**
- **"When" or "If" operating at 3 mg/l will be informed by future monitoring as to the need to achieve the**

APPLICATIONS

- The new proposed small MS4 permits for NH and MA include a requirement for
  - BMP optimizing, and
  - Ranking of retrofits opportunities and target areas.
- Optimization at the watershed scale can significantly reduce costs for achieving load reduction targets for nitrogen, phosphorous, and other pollutants.
- Optimization can be conducted for volume reduction for climate resiliency.
- "Small Systems" can be a tremendous way to increase the cost effectiveness

ADDITIONAL INFORMATION

http://www.wisenh.net/

The WISE project has been completed!

The final WISE Integrated Plan for Stratham, Exeter and Newfields, dated December 2015 is now available.

Thank You!!

Questions/ Comments?

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Horsley Witten Group

WHY INTEGRATED PLANNING?

- **Integrated Planning allows for crediting across the MS4 and WWTF permits which can have important economic benefits**
- **Integrated Planning allows a flexibility in implementation to plan for most cost effective measures first while still meeting regulatory standards that protect public health and water quality**
- **Encourages the use of green infrastructure which manages stormwater as a resource, and supports other economic benefits and quality of life.**

NACWA A Clear Commitment to America's Waters · ACWA · NEIWPCC

In cooperation with the Water Environment Federation (WEF)

Region 1 Integrated Planning Workshop

September 9, 2013
10:00 am – 3:00 pm
NHDES Portsmouth Regional Office
222 International Drive, Suite 175
Portsmouth, NH

10:00 – 10:20 **Welcoming Remarks, Introductions and Ground Rules**

Ronald Poltak, Executive Director, NEIWPCC
Alexandra Dunn, Executive Director & General Counsel, ACWA
Chris Hornback, Senior Director of Regulatory Affairs, NACWA

Region 1 has challenged the Great Bay communities to develop the first in the nation IP for MS4 and WW (EPA, 2013)

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

JUN – 5 2012

MEMORANDUM

SUBJECT: Integrated Municipal Stormwater and Wastewater Planning Approach Framework

FROM: Nancy Stoner
Acting Assistant Administrator
Office of Water

Cynthia Giles
Assistant Administrator
Office of Enforcement and Compliance Assurance

TO: EPA Regional Administrators
Regional Permit and Enforcement Division Directors

In recent years, EPA has increasingly embraced integrated planning approaches to municipal wastewater and stormwater management. EPA further committed to work with states and communities to implement and utilize these approaches in its October 27, 2011

Integrated Municipal Stormwater and Wastewater Planning Approach Framework (EPA, 2012)

COLLABORATION

EPA, NH DES, Communities of Exeter, Newfields, Stratham, Geosyntec, UNH, NERRS, Rockingham Planning Commission, Consensus Building Institute

THE WISE PROJECT PLAN

Integrated Plan for Watershed

- ☑ Community Specific Actions
- ☑ Costs & Benefits
- ☑ Adaptive Management and Flexible Scheduling

POTENTIAL UPPER WATERSHED CONTRIBUTIONS TO MEET WATER QUALITY GOALS

Adaptive management and monitoring fine tunes management of uncertainty