Sustainable Stormwater Funding for the Upper Charles River

Steering Committee Meeting #3
February 09, 2011

Meeting Post-Script

The costs presented herein and at the Feb 9, 2011 Steering Committee Mtg in Franklin, MA, should be viewed as preliminary and based on best professional estimates for calculating a planning level boundary for implementing phosphorous controls in the three towns of Bellingham, Franklin and Milford. These initial estimates are likely to be refined in the coming weeks and months.

The lower and upper cost limits are necessary to 'calibrate' a cost of storm water services range for use in providing meaningful revenue projections for this storm water utility project. Without the counter-balancing revenue context however, some attendees may have viewed the presented upper threshold costs as a determination of immediate out-of-pocket expense. In all probability, this would be an incorrect interpretation of the presented information.

This post-script is intended to clarify that the case studies used to illustrate the upper cost limit represent high-end scenarios under an assumption that requisite phosphorous load reductions cannot be achieved from other less technically or otherwise less logistically-complicated areas, such as the range of non-structural measures.

Draft findings that incorporate the revenue-side calculus of this analysis will be presented at a future Steering Committee meeting (TBA).

R. Cody, EPA Region 1

Agenda

1:00-1:20 Review on-going assessment of existing program costs

1:20-1:45 Review approach for estimating compliance costs of TMDL/Small MS4 Stormwater GP

1:45-2:15 Examples of TP reduction:

- 15 North Main St – Bellingham;
- Milford Public Library and vicinity;
- Spruce Pond Brook subwatershed – Franklin.

2:15-2:45 Open Discussion; Input from potentially regulated DD properties

2:45 - 3:00 Survey of stormwater infrastructure on DD properties

Stormwater Program Cost Centers

- Administrative;
- Billing and Finance;
- Regulation/Enforcement;
- Engineering/Master Planning;
- Operations and Implementation;
- Monitoring

Administrative Costs
(for example)

General Stormwater Program Administration	*includes admin support and direct costs(mailings, budget prep, collection of filling and enforcement fees, etc)*
Legal Support Services	*legal review of regulatory changes, permits, etc*
Inter-Agency Coordination (MA hwy, CRWA, EPA)	*information sharing; meeting to review and coordinate programs*
Inter-Municipal Coordination (adj. Towns)	*information sharing; meeting to review and coordinate programs*
Emergency/Disaster Management Coordination	*specific coordination with emergency personal and community response*
NPDES NOI and SWMP	*admin tasks associated with preparation of SWMP and permits*
NPDES Annual Reporting	*preparing and submitting annual reports; or reviewing reports prepared by others*
NPDES MS4 Public Education Programs	*coordinating with outreach and ed. Providers, press releases, event coordination, volunteer coord.*
NPDES MS4 Public Involvement Programs	*includes stormwater advisory committee meetings*
NPDES MS4 & SPCC Training	*preparing, providing, or attending trainings*
RDA Compliance	*the administrative component of RDA compliance, tracking and communicating with permittees, processing paperwork, etc*
Certified Municipal Phosphorous Program (CMPP)	*administering CMPP program*
Grants Program (s319, 604b, CZM)	*applying for grants*

Operations and Implementation (for example)

Operations and Maintenance Management	construction oversight , project bidding, etc
CIP/Infrastructure Implementation	construction costs (design and engineering in previous section); could be % of large road project (for example)
PCP implementation	retrofitting
Voluntary CMPP/RDA implementation	retrofitting
IDDE	elimination of IDDEs
Storm Sewer and Culvert Maintenance/Repair	equipment, labor, transport and disposal
Inlet, Catch Basin, and Manhole Cleaning	equipment, labor, transport and disposal & repair
Stormwater BMP Facility Maintenance	equipment, materials, labor, transport and disposal associated with maintenance and repair
Street Sweeping	equipment, labor, transport and disposal
Fall Leaf-pickup	equipment, labor, transport and disposal
Maintenance/Repair/Installation of ESC practices	includes cleanup of sediment and repair of eroded areas
Stream Restoration/Stabilization	equipment, materials, labor, transport and disposal
Ditch and Channel Maintenance	equipment, labor, transport and disposal
Waterfowl & Pet Waste Management Programs	equipment, labor, materials
Public Assistance Program	equipment, labor, materials for rainbarrel, disconnection, raingarden programs
Emergency Drainage Repairs	allowance for unexpected repairs
Land, Easement, and Rights Acquisition	

Preliminary Program Assessment and Costs

- Bellingham: $303,000/year
  - Basic program (mech. street sweeping - most streets, some cb cleaning, SM insp/maint. could improve)
  - Modest mapping
- Franklin: $712,000/year
  - Basic program (regen. street sweeping – all streets, cb cleaning, I&I program, SM insp/maint. could improve)
  - Good mapping
- Milford: $578,000/year
  - Basic program (regen. street sweeping – all streets, cb cleaning, leaf pick-up, SM insp/maint. could improve)
  - Need more mapping (GIS)

Future Cost Items
(not related to TMDL compliance)

- Update written Stormwater Mgmt Plan;
- Increased reporting/record keeping on annual reports;
- Targeted public education (2 messages to 4 audiences) and report results;
- Illicit discharge priority catchment assessments (including SSOs);
- Detailed outfall monitoring for both dry and wet weather;
- Written IDDE program with mapping and prioritization of problem catchments;
- Complete stormwater system mapping (all pipes/manholes/inlets/structures. Catch basin inspection/cleaning/inspection data;

Future Cost Items
(continued)

- Track # of site plan reviews, inspections, enforcement actions;
- ID/rank retrofit opportunities for municipally owned facilities;
- Develop a SWPPP for municipally owned facilities;
- Complete a code review and update/report;
- Impervious cover/DCIA tracking;
- Street sweeping optimization(2 times/yr);
- Written O&M procedures for municipal activities for trash, pet wastes, leaf litter control, fertilizer use & yard wastes;
- Pet waste & waterfowl mgmt plans.

Sample EPA Guidance Documents

Assessing Street and Parking Design Standards to Reduce Excess Impervious Cover in New Hampshire and Massachusetts

Small MS4 Permit Guidance, December 2010

New NPDES Permits require evaluation of local street and parking lot design standards

The draft NPDES Small MS4 permits for New Hampshire and North Coastal Massachusetts require permittees to evaluate and report on local street design and parking requirements that affect the **creation of impervious cover**. This assessment will be used to determine if design standards need to be revised to support the application of Low Impact Development (LID) techniques. Recommendations and a schedule for changing any relevant standards and policies need to be incorporated into the Stormwater Management Program (SWMP), with status updated in annual reports. This requirement is detailed in the draft permit Section 2.3.6.6 for New Hampshire and Section 2.4.6.7 for North Coastal Massachusetts, respectively.

Why evaluate current standards?

Roads and parking lots are a significant component of the urban landscape, and often constitute the majority of impervious area in a given the watershed. In many communities, the current standards guiding road design and parking lot layout were established decades ago with little consideration of potential impacts to pedestrians or the local environment. Consequently, outdated zoning by-laws, subdivision regulations, and road standards may not only promote excessive impervious cover (Figure 1), but they may effectively prohibit the application of many LID practices (Figure 2). Even where variances and special permitting procedures allow for design alternatives, these additional steps can be time-consuming and unpredictable; and therefore, unattractive to developers.

Figure 1. Unnecessarily wide cul-de-sacs and residential roads generate additional stormwater runoff, create un-friendly pedestrian environments, and increase overall construction costs.

Figure 2. (A) Example of narrow residential road with a bio-swale, utilities, and single-sided sidewalk in Duxbury, MA. (B) Use of pervious pavers and bioretention practices in the landscape islands in spillover parking lot in Wilmington, MA.

What design factors lead to excess imperviousness?

At a minimum, the following street and parking standards should be evaluated to determine if they are contributing to the unnecessary generation of surplus impervious cover from new construction or redevelopment projects:

Local street design:

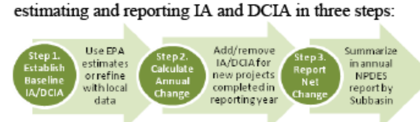
- **Residential roadway pavement widths**—pavement widths should be set based on the number of homes served, anticipated vehicle usage, and on-street parking requirements. Establish minimum and maximum standards to meet these needs while avoiding excessively wide streets.
- **Non-residential and mixed use roadway pavement widths**—pavement widths should be set based on traffic volumes, types of vehicles, parking, and pedestrian requirements, which often require

Estimating Change in Impervious (IA) and Directly Connected Impervious Areas (DCIA) for Massachusetts Small MS4 Permit

Small MS4 Permit Guidance, May 2010

New NPDES Permit Focuses on DCIA

The 2010 NPDES Small MS4 permits for Massachusetts require regulated communities to estimate the number of acres of **impervious area (IA)** and **directly connected impervious area (DCIA)** that have been added or removed each year due to development, redevelopment, and or retrofitting activities (Draft North Coastal Permit Section 2.4.6.9). Beginning with the second year annual report, IA and DCIA estimates must be provided for each subbasin within your regulated MS4 area. This technical guidance outlines accepted methods for estimating and reporting IA and DCIA in three steps:



What does DCIA really mean?

Impervious surfaces such as roadways, parking lots, rooftops, sidewalks, driveways, and other pavements impede stormwater infiltration and generate surface runoff. Research has shown that total watershed IA is correlated with a number of negative impacts on our water resources such as increased flood peaks and frequency, increased sediment, nutrient, and other pollutant levels, channel erosion, impairments to aquatic biota, and reduced recharge to groundwater (Center for Watershed Protection, 2003). Typically watersheds with 4-6% IA start to show these impacts, though recent work has found lower % IA threshold values for sensitive species (Wenger et al., 2008). Watersheds exceeding 12% IA often fail to meet aquatic life criteria and narrative standards (Stanfield and Kilgore, 2006).

For the purposes of the MS4 permit, DCIA is considered the portion of IA with a direct hydraulic connection to the permittee's MS4 or a waterbody via continuous paved surfaces, gutters, drain pipes, or other conventional conveyance and detention structures that do not reduce runoff volume. DCIA does not include:

- IA draining to stormwater practices designed to meet recharge and other volume reduction criteria.
- Isolated IA with an indirect hydraulic connection to the MS4, or that otherwise drain to a pervious area.
- Swimming pools or man-made impoundments, unless drained to an MS4.
- The surface area of natural waterbodies (e.g., wetlands, ponds, lakes, streams, rivers).

Accepted Methods for Estimating IA & DCIA

Step 1. Establish Baseline IA/DCIA — Use the estimates of existing IA and DCIA provided by EPA to establish the baseline acreage from which future additions or reductions of impervious cover can be tracked and measured.

For each regulated municipality in Massachusetts, EPA will provide graphical and tabular estimates of IA/DCIA ordered by land use type and subbasin. **Permittees may simply use these baseline estimates as is, or develop more accurate estimates when justified.** This may include using local data to refine EPA's estimates or the direct measure of IA (Figure 1). If the EPA estimates are not used for the baseline, permittees must provide in the annual report a description of the alternative methodology used.

Figure 1. EPA will use IA extrapolated from 2005, 1-meter orthoimagery provided by MassGIS (upper). A comparison of a MassGIS-derived IA estimate (shown in purple) vs. a refined direct measurement (shown in green) by the Town of Reading, MA illustrates differences in precision (lower).

Phosphorus Control Cost Items

- Phosphorus control plan (PCP);
- Phosphorus control mapping of priority areas;
- Off-site phosphorus mitigation plan (trading); and
- Increased/targeted public education on phosphorus control and increased public involvement.

Both structural and non-structural practices can be used to achieve phosphorus reduction.

Relationship between DD's and MS4s

Phosphorus removal requirements:

- Bellingham = 52%
- Franklin = 52%
- Milford = 57%

- DD sites = 65%

Note: DD phosphorus removal is nested within MS4 total removal

PHOSPHORUS LOADING REQUIRED REDUCTION

Town	Area (ac)(1)	Imp Area (ac)(2)	Existing Load (#/yr)	TMDL Allowable Load (#/yr)	Required Load Reduction (#/yr)
Bellingham	6116	918	2024	975	1049
Franklin	15539	2364	4650	2228	2422
Milford	8101	1662	3313	1426	1887

(1) from Attachement 3 to RDA Factsheet (Table 6)
(2) from Optimization Study Table 2-1

Structural Mgmt Practices

Currently referenced in RDA docs

- Infiltration (trenches/basins/chambers);
- Porous Pavement;
- Bioretention;
- Gravel Wetlands;
- Wet Ponds;
- Dry Ponds; and
- Water Quality Swales.

Suggestions to add to the list

- Constructed Surface Wetlands;
- Dry Swales;
- Green Roofs;
- Sand/organic Filters;
- Adaptations;
  - Foundation Planters;
  - Extended Tree Pits;
  - Filter Strips


Infiltration Practices


Bioswales


Bioretention


Detention Basins


Constructed Wetlands


Sand Filters


Permeable Pavements


Open Channels

Existing Structural Practices (how to account for them)

- Divide into 2 Groups (before/after 2000)
  - BMPs constructed after year 2000:
    - Credit practices based on WQ storage provided using performance curves (RDA, Appendix D, Attachment 3);
  - BMPs constructed before year 2000:
    - No credit for TP removal.

Adjust non-structural limitations based on year practice was constructed.

Non-Structural Mgmt Practices

Currently referenced in GP docs

- Street sweeping;
- Catch basin cleaning;
- Fertilizer reduction; and
- Leaf litter pickup.

Suggestions to add to the list

- Soil restoration;
- Reforestation;
- Urban tree planting;
- Disconnection credits;
- Precipitation Harvesting (reuse); and
- Impervious cover reduction.

Non-Structural Practices (how to account for them)

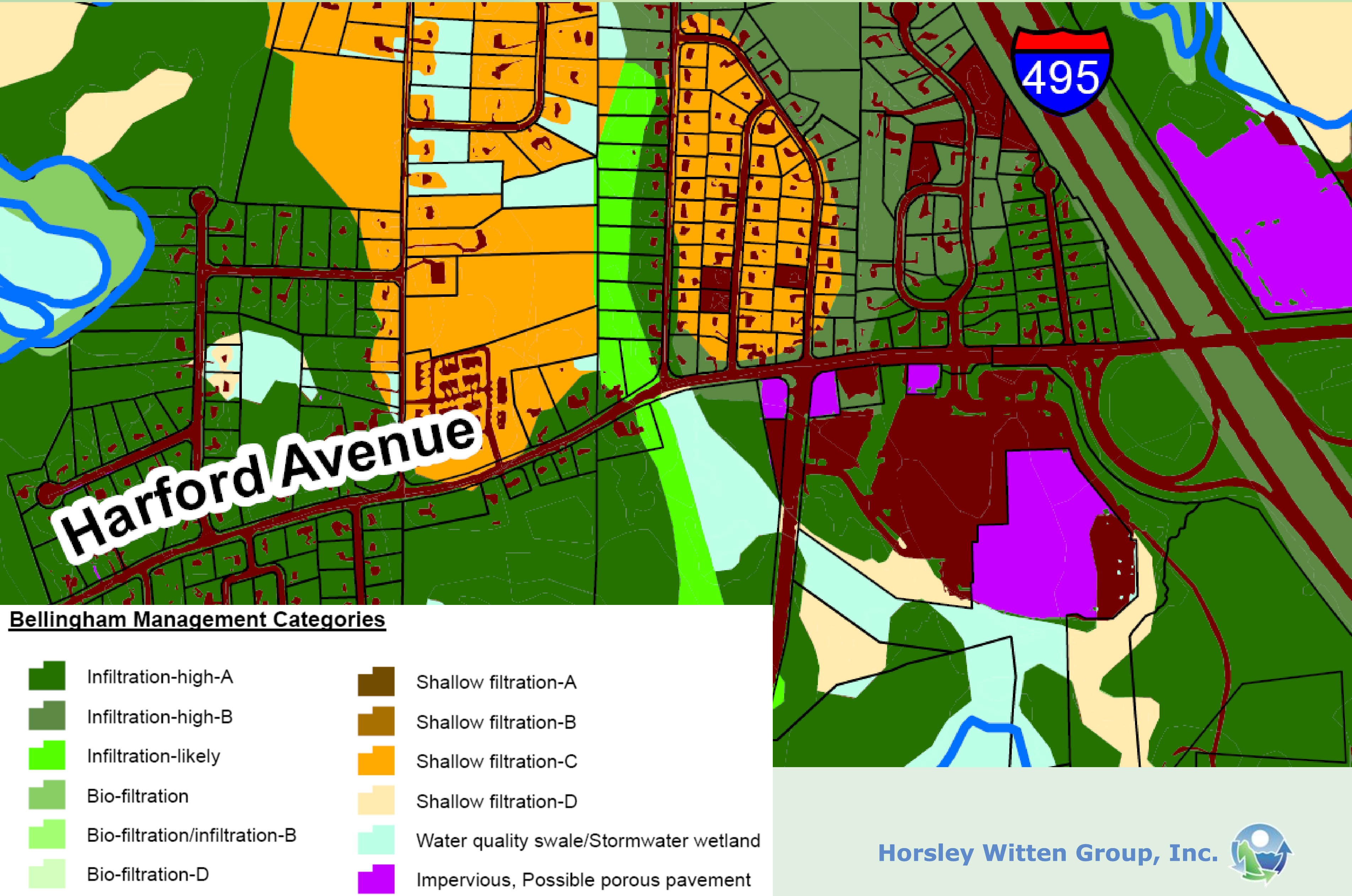
- Consider re-evaluation of credit for street sweeping based on actual loads collected versus street sweeping frequency and prescribed reduction percentage;
- Consider re-evaluation of credit for leaf pick-up based on actual load collected versus area of program and prescribed reduction percentage.

Method provided by Schueler, 2011.

Methods/Approaches to estimate cost of compliance with future GPs

1. EPA/HW GIS/Spreadsheet parcel-by-parcel assessment;
2. Unit costs
   - Cost per acre of impervious treated;
   - Cost per pound of phosphorus removed.
3. Comparison to other recent retrofit work (with multipliers to account for land use variability)
4. Actual retrofit assessment in each town.

1. GIS-Based: Management Categories



Capital Costs for Implementation

Table 3: Unit Construction Costs for Various Structural BMPs

BEST MANAGEMENT PRACTICE	unit construction cost ($\$/ft^3$)
INFILTRATION BASIN	10.80
RAIN GARDEN	13.50
INFILTRATION TRENCH	21.60
INFILTRATION CHAMBER	32.40
BIOFILTRATION	27.00
GRAVEL WETLAND	21.60

From N. Pickering, 2010

Note: Costs are for retrofit facilities (2x new const) & 35% mark-up for soft costs

Source of Cost Data

BMP	Units	New?	New	New	Retrofit	Spreadsheet	Retrofit
		TT (2010)	EPA (1999)	CWP (2007)	CWP (2007)	CWP (2007)	HW (2010)
Pond retrofits	per ft3 treated	-	-	-	3*		-
Retention/detention basins	per ft3 treated	1.57	0.5-10	1.4**	7 (5x)	3	-
Constructed wetland	per ft3 treated	1.77	0.6-1.25	1.1**	7.7 (7x)	7	-
Gravel wetland	per ft3 treated	?	?	?	?		-
Gravel wetland	*per ft2*	-	-	-	-		25
Wet pond	per ft3 treated	-	-	3.1**	7.1 (2.3x)	5	-
Raingarden	per ft3 treated	-	-	4	-	30	-
Raingarden	*per ft2*	-	-	-	-		30
Bioretention	per ft3 treated	3.2	5.3	7.5	10 (lg) - 30 (sm)	11	-
Bioretention	*per ft2*	-	-	-	-		30
Planters/Street Bioretention	per ft3 treated	-	-	-	26-30		-
Treepits	per ft3 treated	-	-	70*	-	26	-
Tree Planter	*per ft2*	-	-	-	-		50
Dry wells	per ft3 treated	-	-	12	-	12	-
Infiltration basin	per ft3 treated	-	1.3	7.5	15 (2x)	15	-
Infiltration basin	*per ft2*	-	-	-	-		20
Infiltration trench	per ft3 treated	2.88	4	?	?		-
Infiltration trench	*per ft2*	-	-	-	-		20
Underground infiltration	per ft3 treated	-	-	-	-		-
Stormwater filters	per ft3 treated	-	-	52	-	20	-
Sand filter	per ft3 treated	3.48	3-6				-
Filter Strip	*per ft2*	-	0-1.3	6	-	6	-
Grass swale	*per ft2*	0.45	0.5	-	-	13	-
Water quality swale	per ft3 treated	-	-	4-8	12 (2x)		-
Porous pavement	*per ft2*	1.52	-	-	-		-
Permeable pavers	*per ft2*	-	-	10	-		-
Permeable pavers	per ft3 treated	-	-	120	-	120	-
Greenroofs	per ft3 treated	-	-	225-360	-	170	-
D&E included		No?	No	No	No		No?
Land costs included		No?	No	Yes?	No?		No?
Base Year for Costs		2010?	1997	2006	2006		2010

*not in calcs, only in Table E4

** estimated from $/ac imp costs and WQV

References

TT, 2010. Optimal Stormwater Management Plan Alternatives (combined data from the 3 refs below). TetraTech.

EPA, 1999. Preliminary Data Summary of Urban Stormwater Best Management Practices. US Env Protection Agency.

CWP, 2007. Manual 3: Urban stormwater retrofit practices. Appendix. Center for Wtershd Protection.

NCSU, 2003. An Evaluation of Costs and Benefits of Structural Stormwater Best Management Practices in N Carolina. NC State Univ.

HW, 2010. Personal Communication. Horsley Witten.

2. Unit Costs: Data from Mid-Atlantic Region (and elsewhere, as applicable)

Table 7
Cost to Treat One Acre of Impervious Cover in Maryland[1,2]

Stormwater Management Scenario	Sector	$ [3]
New Development Pre-ESD (MDE 2000 manual)	Private	$ 31,700
New Development, ESD to MEP (MDE, 2009)	Private	$ 46,500
Urban Redevelopment Using LID (IC >85%)	Private	$ 191,000
Storage Retrofits in Urban Watershed	Public	$ 32,500
Green Street Retrofits, Highly Urban	Public	$ 167,100
Stream Restoration, Nutrient Equivalent	Public	$ 35,600

[1] also equivalent to reducing one pound of total phosphorus.
[2] Costs in other states will be slightly different, based on their sizing requirements in their stormwater regulations
[3] costs expressed in 2010 dollars

From T. Schueler, 2011

3. Comparison to similar watershed:
Spruce Pond Brook Subwatershed in Franklin, MA

Table 1. Target Phosphorus Reduction for Spruce Pond Brook Subwatershed based on Area Weighted Land Use

Land Cover/Source Category	1999 Land Use Area (square miles)	Existing Phosphorus Loading by Land Use (lbs/yr/sq mi)	Existing Phosphorus Loading in Subbasin by Land Use (lbs/yr)	Percent Load Reduction (As determined by TMDL)	Percent of Total Subwatershed	Percent Load Reduction Based on Weighted Average of Land Use Area
Commercial	0.037	967.37	35	65%	3.39%	2.21%
Industrial	0.073	838.08	61	65%	6.79%	4.41%
Higher Density Residential	0.054	644.62	35	65%	5.03%	3.27%
Medium Density Residential	0.395	322.54	127	65%	36.63%	23.81%
Low Density Residential	0.100	25.90	3	45%	9.25%	4.16%
Agriculture	0.013	287.99	4	35%	1.16%	0.41%
Forest	0.311	74.23	23	0%	28.88%	0.00%
Open Space	0.096	19.55	2	35%	8.88%	3.11%
Total	**1.1**		**290**			**41.37%**

Table 6. Phosphorus loading and TMDL reductions by land use for the Charles River watershed in Bellingham, Franklin, and Milford, MA

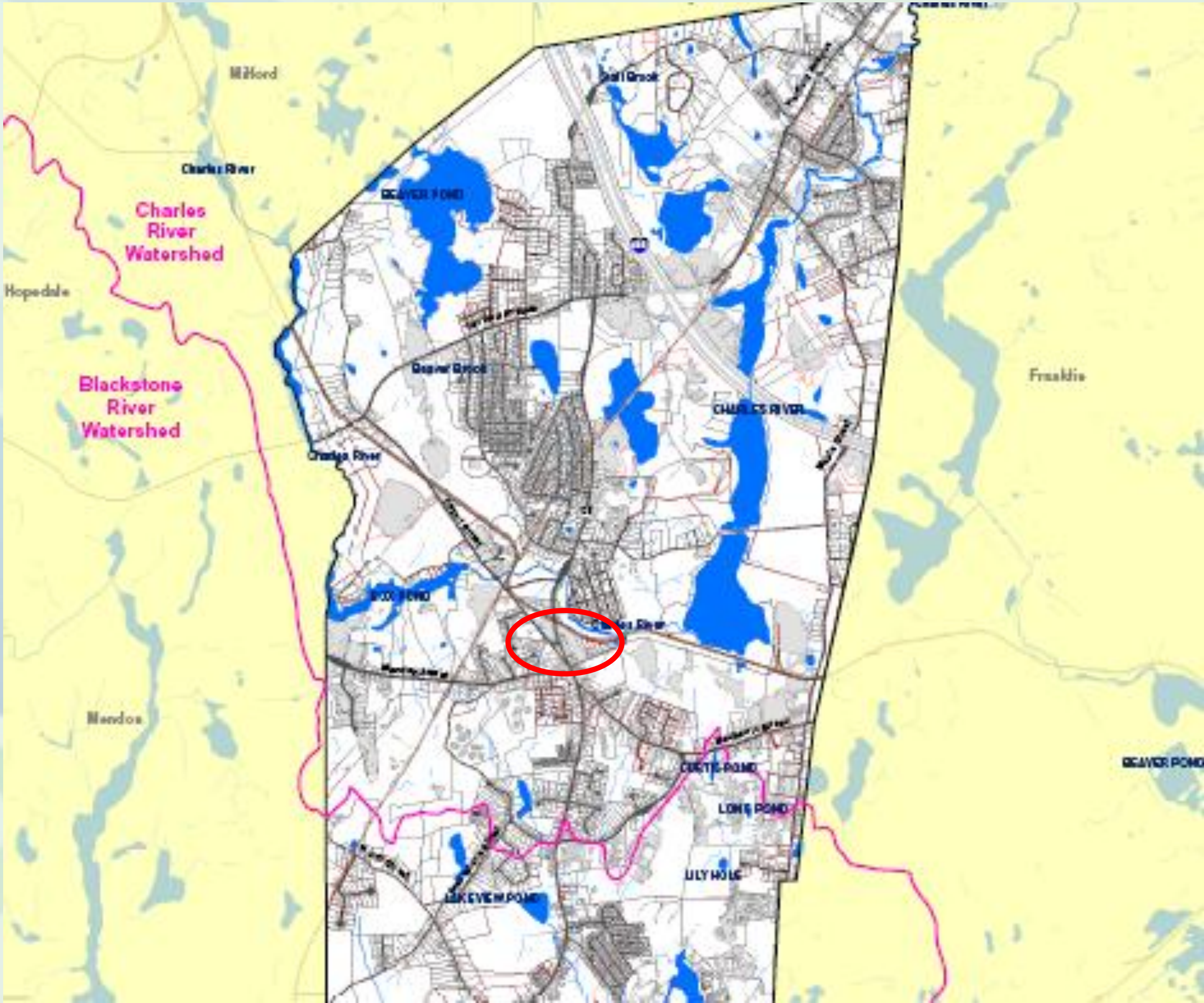
Charles River Watershed Community	Comm.	Industrial	High Density Residential	Medium Density Residential	Low Density Residential	Agricul.	Forest	Open land	Total	Percent Reduction Required
Bellingham	2.4%	8.6%	5.4%	9.7%	8.6%					
Drainage Area (ha)	58.8	212.0	134.2	240	212.2	57.1	1,315.9	245.0	2,475.3	
1998-2002 Loading (kg/yr)	99.8	311.7	151.9	135.9	9.7	28.8	171.6	8.4	917.8	
TMDL Loading (kg/yr)	34.4	107.5	52.4	46.9	5.3	18.6	171.6	5.4	442.1	51.8%
Franklin	1.4%	5.6%	1.8%	23.1%	9.5%					
Drainage Area (ha)	87.5	351.2	110.5	1,455.0	597.6	119.8	2,966.7	600.3	6,288.6	
1998-2002 Loading (kg/yr)	148.6	516.4	125.0	823.5	27.2	60.6	386.8	20.6	2,108.7	
TMDL Loading (kg/yr)	51.2	178.1	43.1	284	14.9	39.1	386.8	13.3	1,010.6	52.1%
Milford	2.4%	10.0%	8.3%	19.8%	7.4%					
Drainage Area (ha)	80.3	328.9	270.7	647.7	243.4	3.1	149.1	265.2	3,278.4	
1998-2002 Loading (kg/yr)	136.4	483.7	306.3	366.6	11.1	1.6	187.6	9.1	1,502.3	
TMDL Loading (kg/yr)	47	166.8	105.6	126.4	6.1	1.0	187.6	5.9	646.5	57.0%

4. Retrofit examples from each town:

to help confirm implementation costs

- **Bellingham:** Designated Discharge property – older shopping center (prior to 1997 Stormwater Policy Manual) – among the more challenging of the DD properties;
- **Milford:** Dense urban center developed long before modern stormwater management – among the most challenging retrofit areas;
- **Franklin:** Subwatershed scale of mixed land uses, range of age over a 1.1 square mile area – fairly typical of the 3 communities.

15 North Main St. Bellingham, MA



15 North Main St. Bellingham

	Area (acres)	TP Load (lb/year)	Reduction required (%)	Reduction Needed (lb/yr)
Impervious areas	6.39	14.25	65	9.26
Pervious areas	1.17	0.32	65	0.21
Woods	0.98	0.00	0	0.00
Total	**8.55**	**14.57**	**65**	**9.47**

Soils suitable for infiltration

245B	Hinckley sandy loam, 3 to 8 percent slopes
245C	Hinckley sandy loam, 8 to 15 percent slopes
253D	Hinckley loamy sand, 15 to 35 percent slopes

USDA Natural Resources Conservation Service

Web Soil Survey
National Cooperative Soil Survey

Underground infiltration chambers in rear for rooftop runoff

Infiltrating bioretention

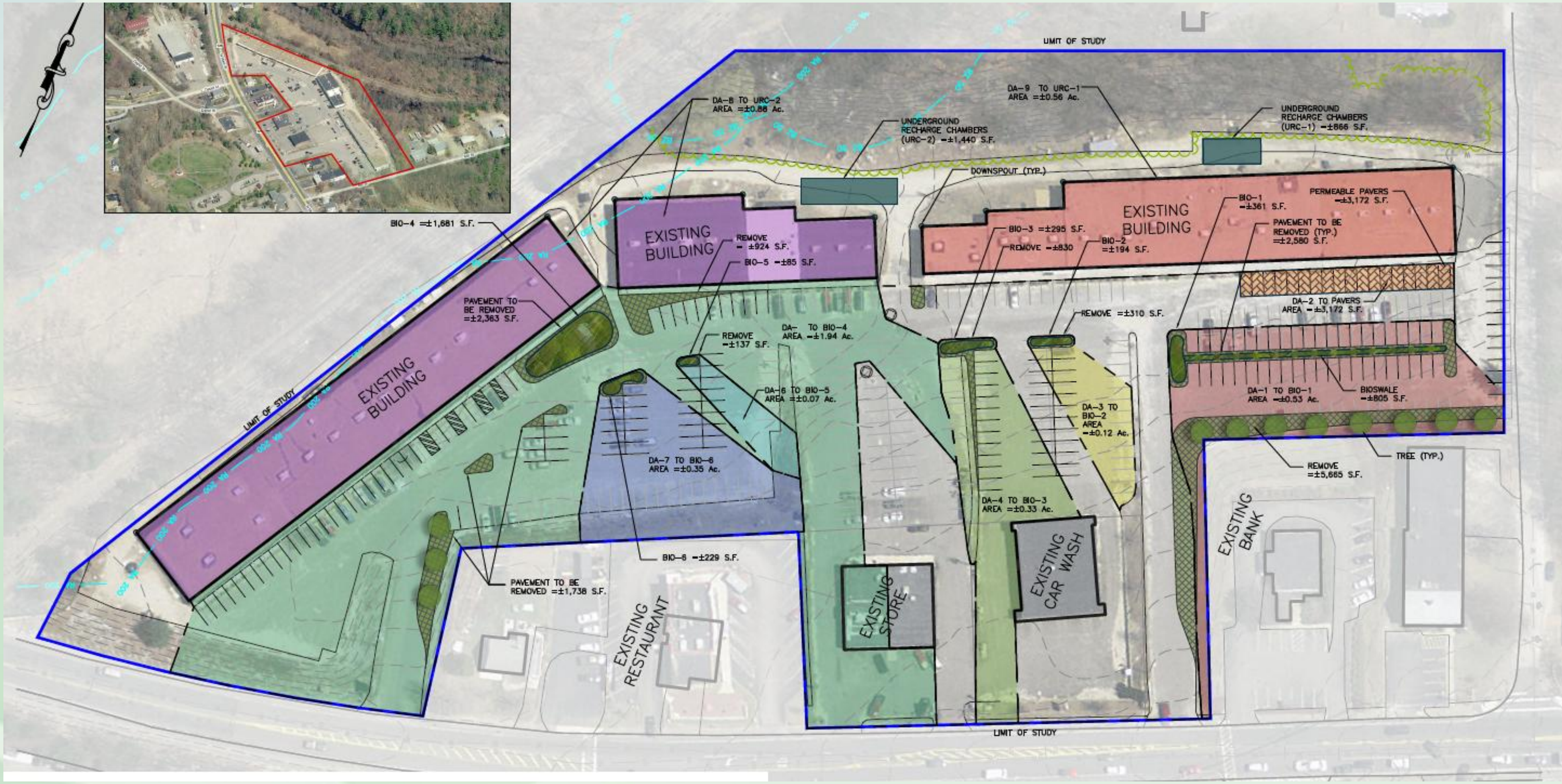
Impervious Removal

Reforestation/Canopy Interception

Porous pavement spillover parking stalls

Infiltrating bio at existing low point

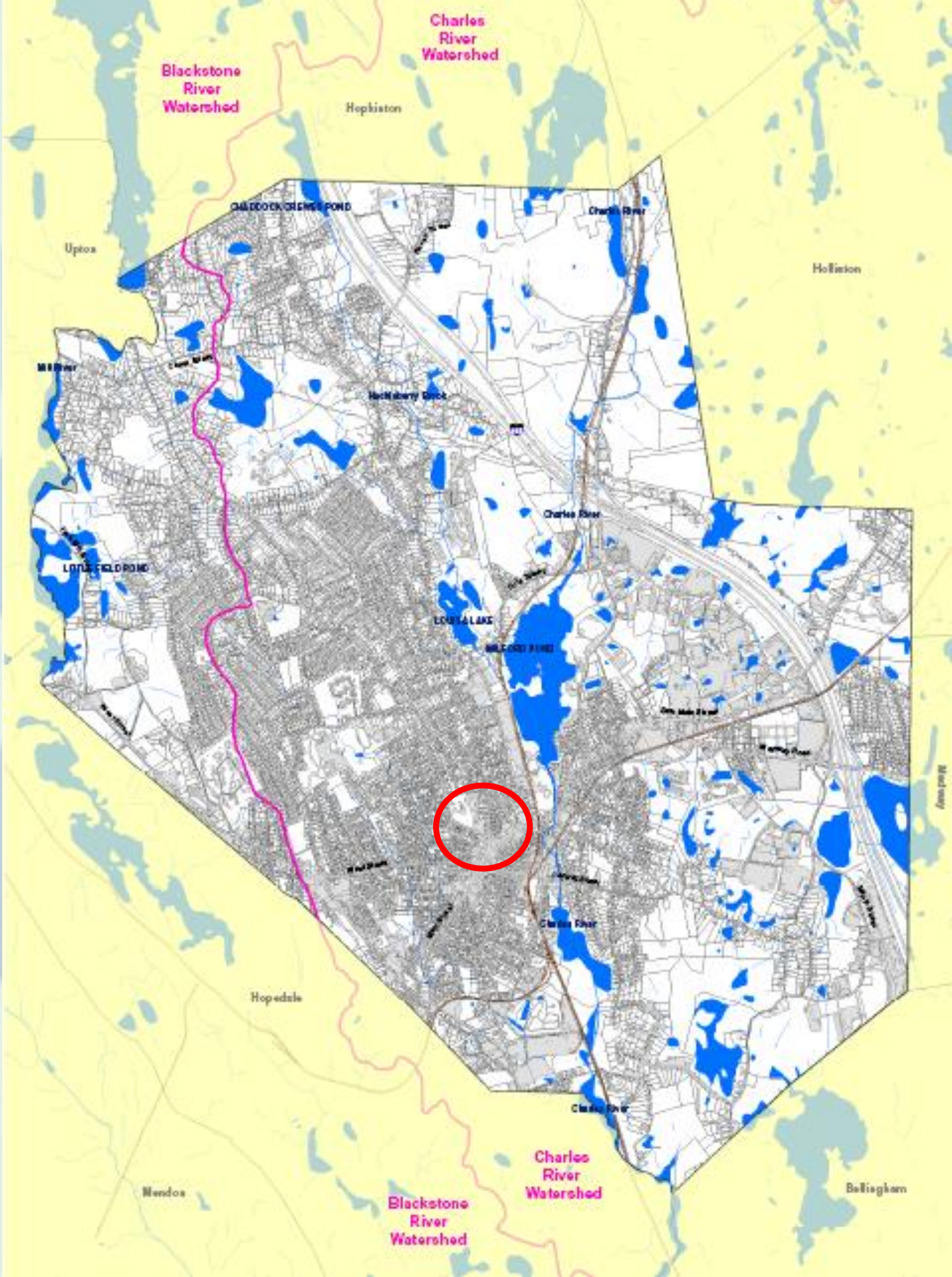
15 N Main Street, Bellingham Retrofit Concept



15 N Main Street, Bellingham MA

- Total site area: 8.55 acres (6.39 IA)
- Total Area treated: 5.21 acres
- Total IA treated: 4.44 acres
- TP Removal: 9.47 lbs/yr (65% reduction)
- Construction Cost: $580,000
- Unit cost: $90,400/IA; $68,000/acre

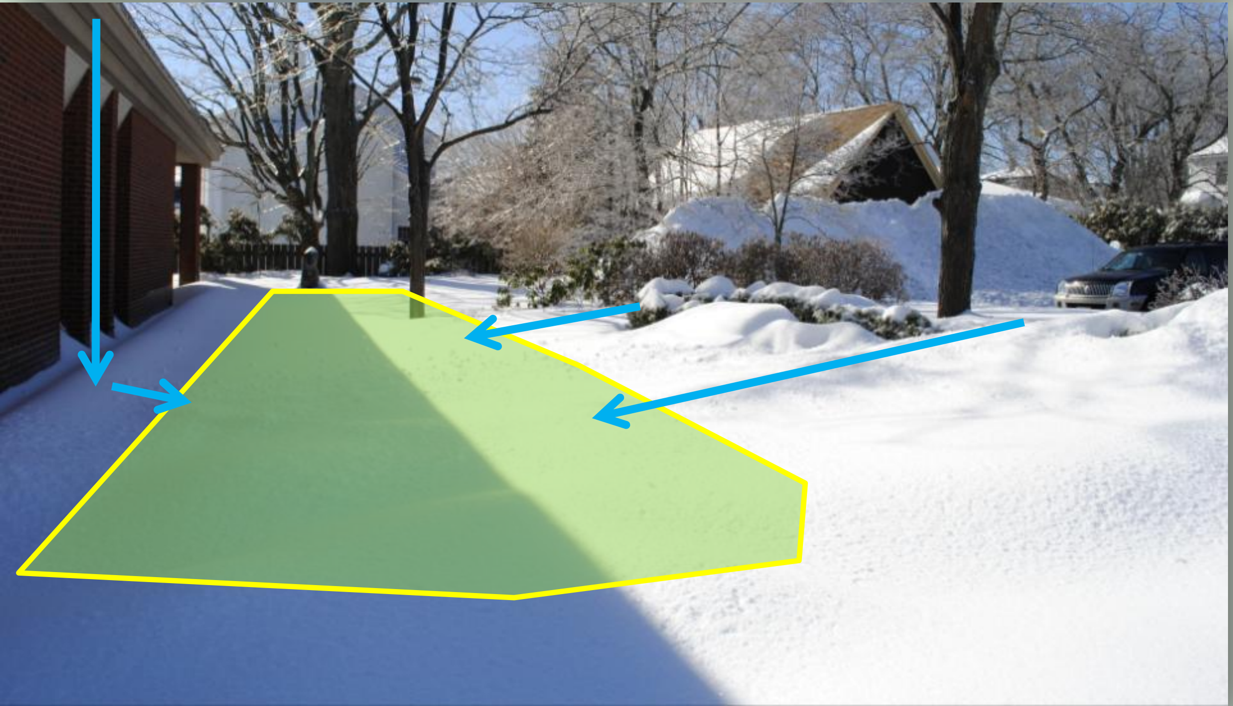
Milford Public Library
Milford, MA



Milford Public Library and Vicinity

	Area (acres)	TP Load (lb/year)	Reduction Required (%)	Reduction Required (lb/yr)
Impervious areas	3.18	7.09	57	4.04
Pervious areas	1.09	0.29	57	0.17
Total	**4.27**	**7.39**	**57**	**4.21**

Soils not conducive to infiltration



Bioretention for large Church parking lot

Bioretention at Milford Public Library parking area

Bioretention to capture portion of School St. runoff

Porous asphalt at small parking lot on Pine St.

Foundation planters at Library

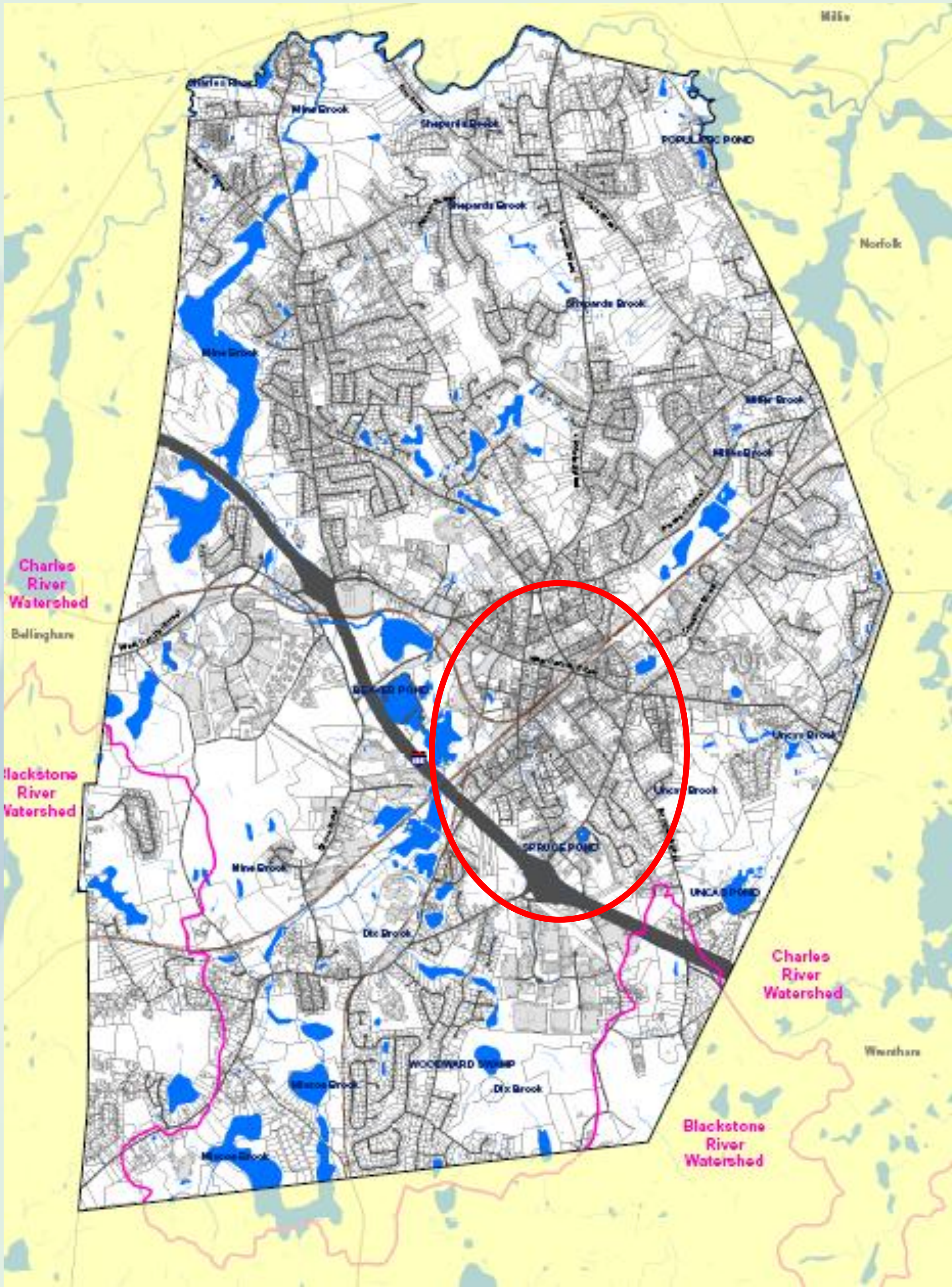
Milford Library Vicinity Retrofit Concept

Horsley Witten Group, Inc.

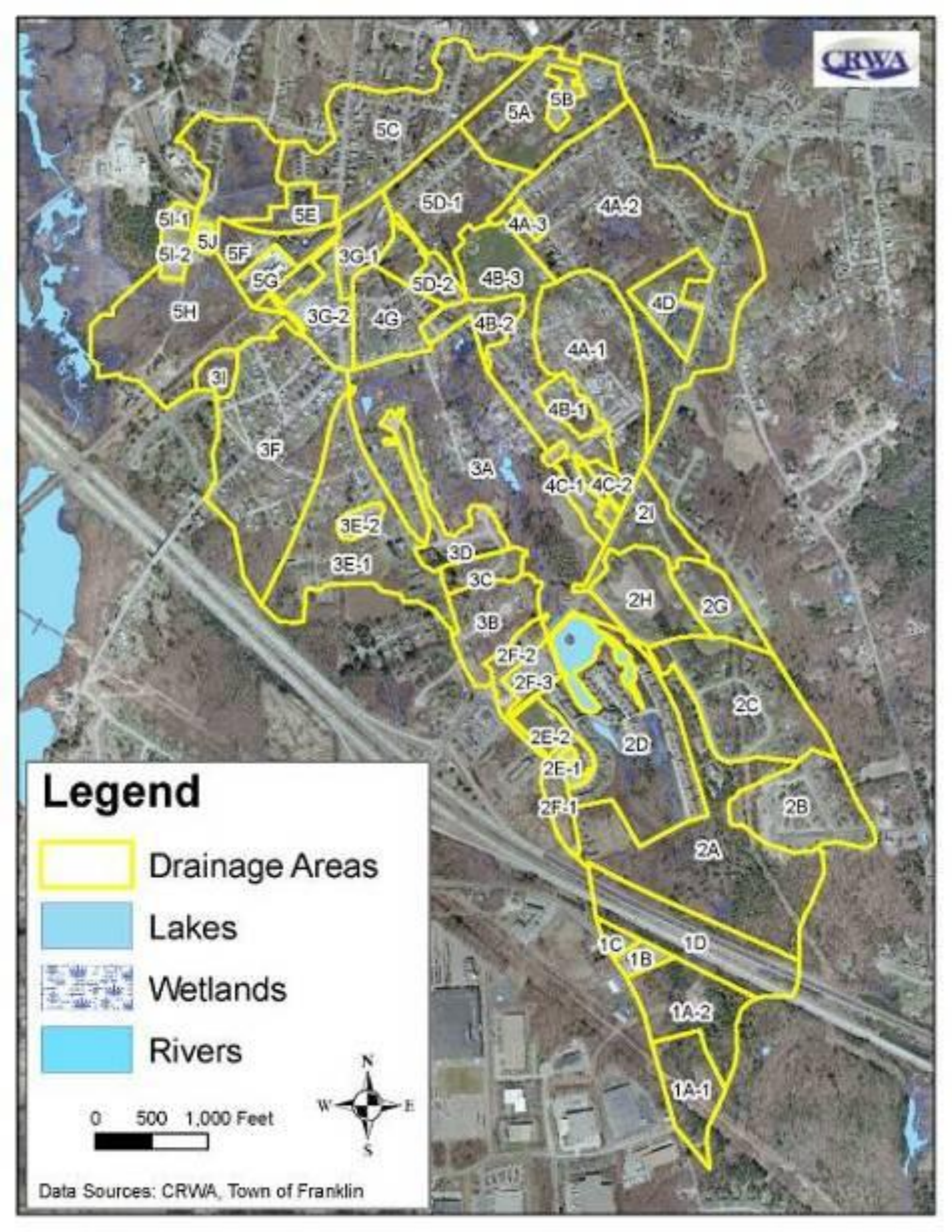
Milford Library Vicinity

- Total site area: 4.27 acres (3.18 IA)
- Total area treated: 3.07 acres
- Total IA treated: 2.30 acres
- TP removal: 4.21 lbs/yr (% reduction)
- Construction cost: $480,000
- Unit cost: $150,000/imp acre; $112,000/ acre

Spruce Pond Brook Franklin, MA



Sub-watershed Drainage Areas



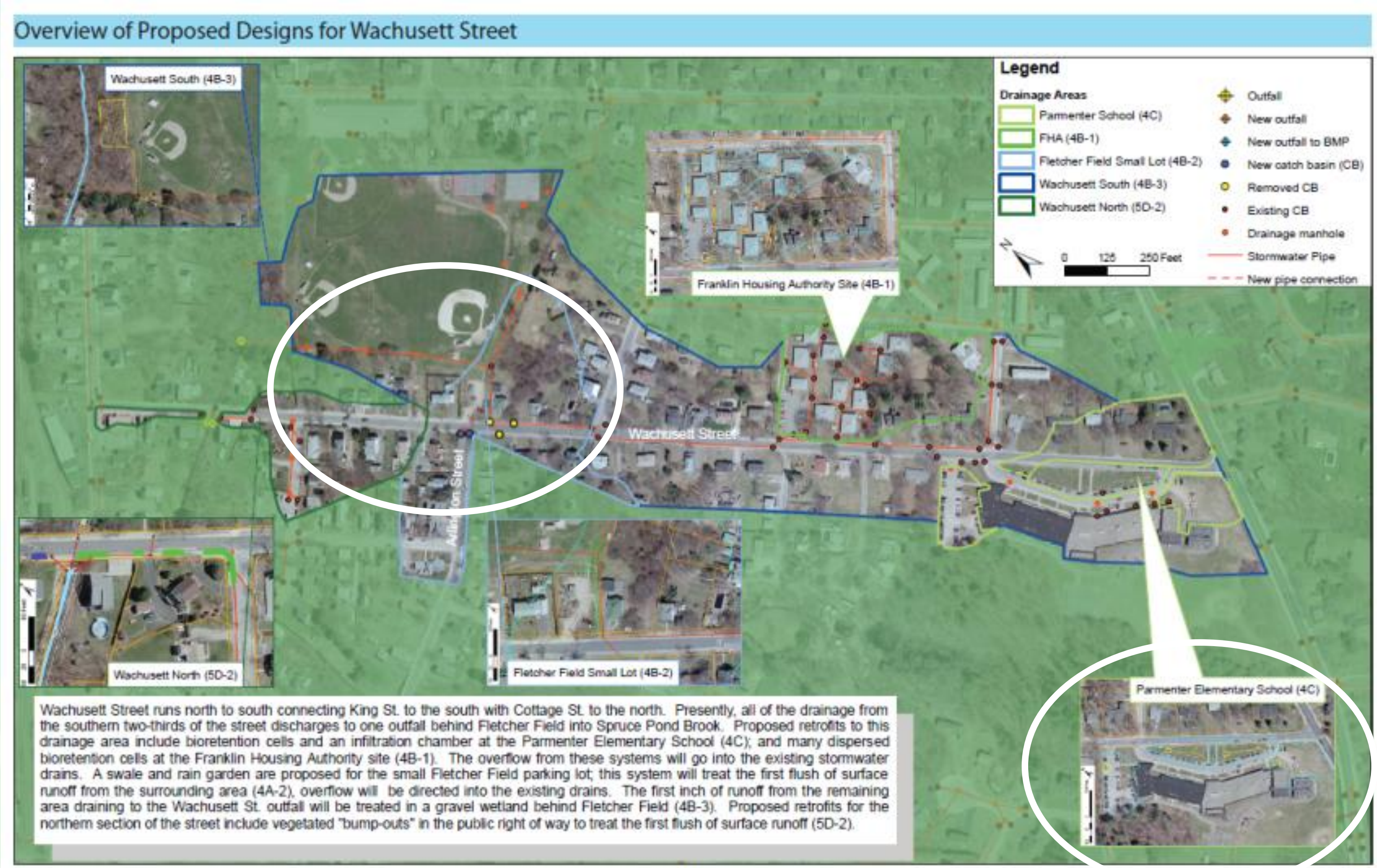
51 total drainage areas

DAs selected:

(1) To capture RDA sites (2+ acres impervious cover)
(2) Based on natural topography and existing stormwater infrastructure

Courtesy CRWA

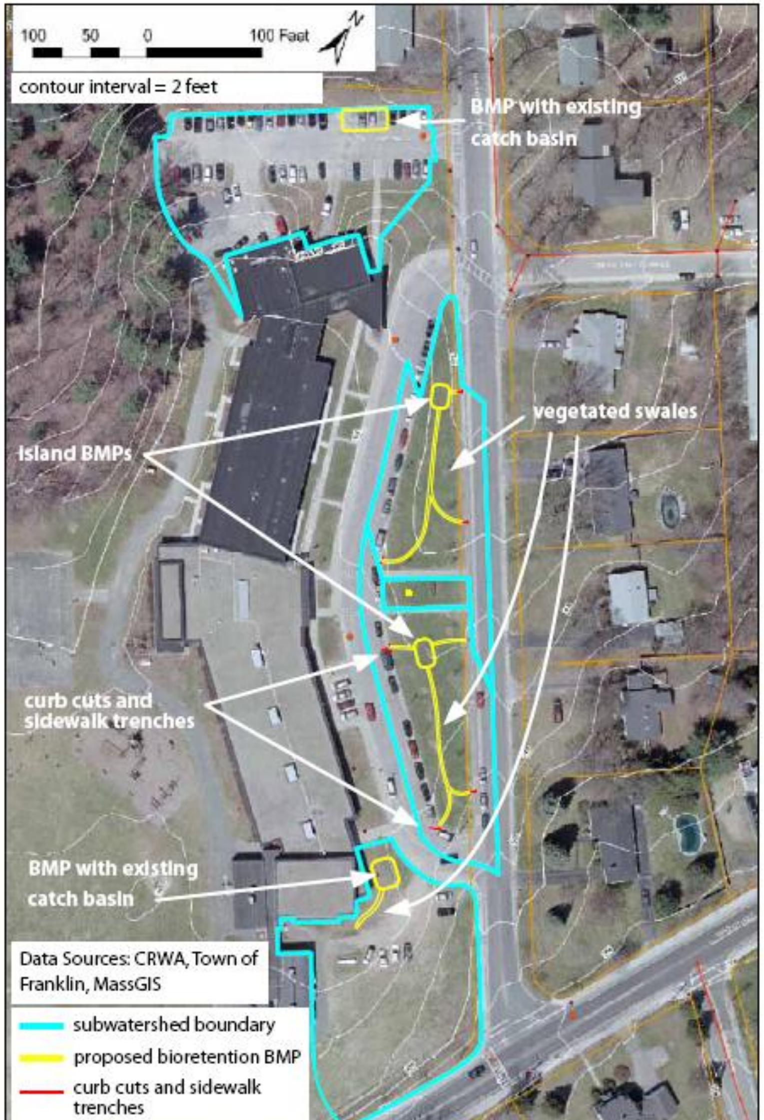
Wachusett Street Drainage Area



Courtesy CRWA

CRWA Stormwater Plan
Parmenter School

Proposed Designs for Drainage Area 4C - Parmenter School




BEFORE: Photo of the existing islands in front of the school.


AFTER: Visualization of proposed bioretention areas.

BMP DESCRIPTION

The proposed plan includes bioretention areas that treat the parking lot runoff on the southeast and northwest sides of the school. These systems would include retrofit catch basins used as overflow pipes. The plan also includes bioretention areas in the islands in front of the school which will have overflow pipes installed and tied into existing stormwater pipes. The runoff from the roads surrounding the islands is directed into the bioretention areas through curb cuts and trenches through the sidewalks. Within the islands, the water moves along vegetated swales to get to the bioretention areas.


Source: http://picasaweb.google.com/buildgreeninfrastructure

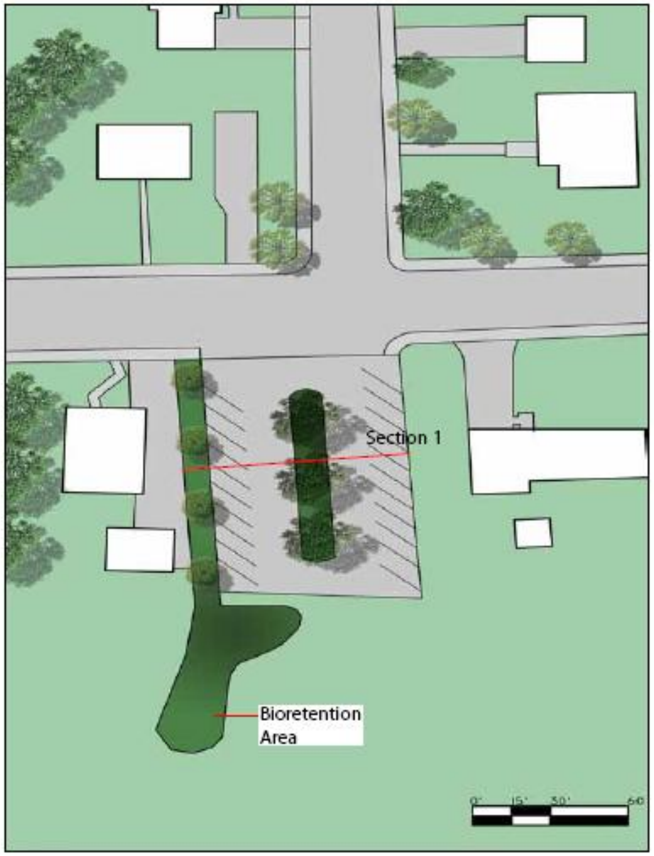
BIORETENTION SIZING - 1" storm

DRAINAGE AREA TOTAL	91,190	sq. ft.
IMPERVIOUS AREA	49,697 (54.5%)	sq. ft.
PERVIOUS AREA	41,494 (45.5%)	sq. ft.
PONDING HEIGHT	0.5	ft.
MEDIA DEPTH	3	ft.
BMP SURFACE AREA	2,416	sq. ft.

New Bioretention Facility
Parmenter School

CRWA Stormwater Plan
Fletcher Field Parking Lot

Proposed Designs for Drainage Area 4B-2 - Fletcher Field Small Parking Lot

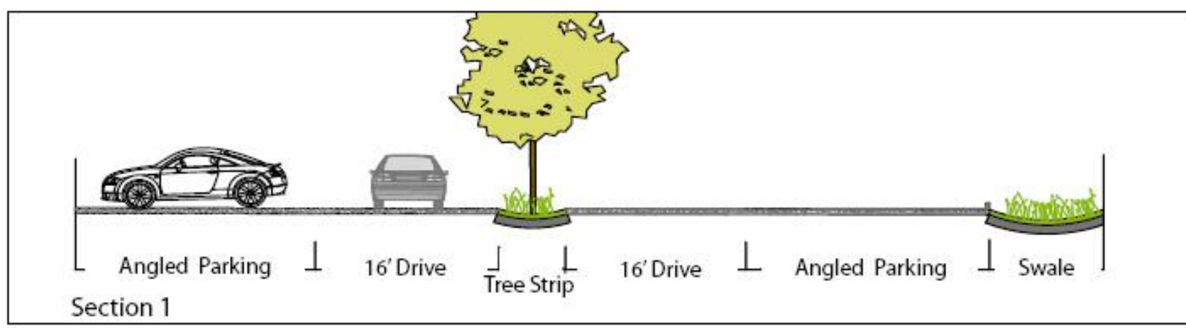


BEFORE: Photo of existing concrete swale on western edge of small parking lot.

AFTER: Visualization of the vegetated swale.

BMP DESCRIPTION

The proposed retrofit for the smaller Fletcher Field parking lot will treat drainage from Wachusett Street and Arlington Street being redirected by new catch basins placed at the end of Arlington. The drainage will travel through a vegetated swale into a bioretention area located in the field. This design will not only create a lush greenscape but provide a vital educational tool for stormwater management.

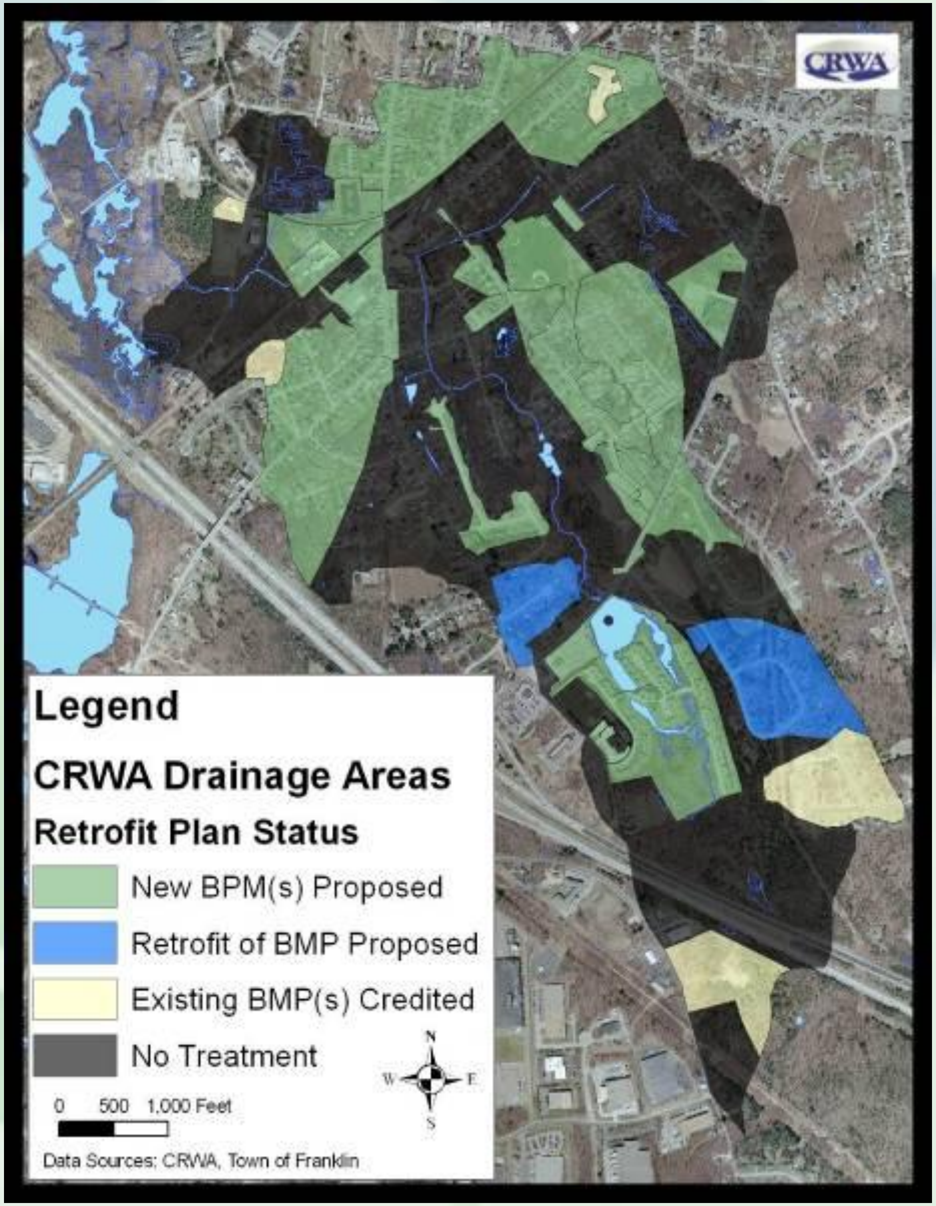


OPTION 1 - Includes angled parking, one way drive and a centered tree strip to provide shade and reduce the amount of impervious surface.

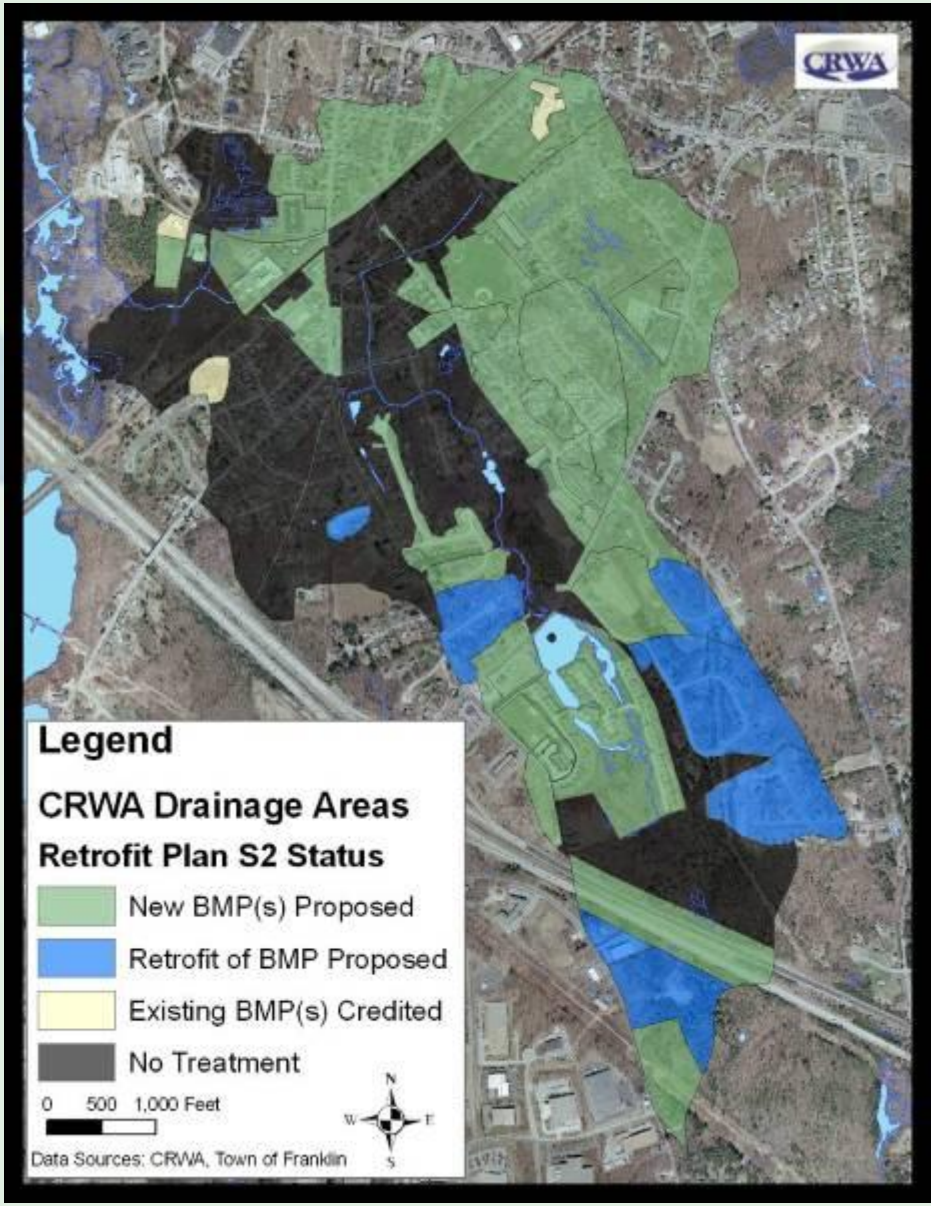
Bioretention Area
Fletcher Field

Proposed Drainage Area Retrofits: BMP Approach

Plan S0



Plan S2



Spruce Pond Brook Subwatershed Restoration Estimated Cost Range

51 potential catchments for stormwater improvements

- **<u>Field Verified Assessment Method</u>**
  - **28 sites selected**
  - **~ $4.9 m/1.1 sq mi ($7,040/ac or $28,080/IA)**
- **<u>Optimized</u>**
  - **41 sites selected**
  - **~ $3.1 m ($4,500/ac or $ 17,770/IA)**

Actual implementation cost likely in between.

Summary

Range of Implementation costs for 3 examples:

$28,000 to $150,000/Impervious Acre

- Consistent with other studies/analyses;
- These estimates use conservative assumptions;
- Not necessarily the least expensive measures – many options available – optimization analysis likely to save $;
- Final cost estimates will apply multipliers based on land use/drainage area/physical constraints;
- Future implementation costs can be reduced as “implementers” become more experienced;
- Non-structural measures may be very cost effective, particularly if widespread.

Immediate Next Steps

- Preliminary cost of future service for each town;
- Input from towns and regulated DD properties;
- Coordinate with EPA on inclusion/refinement of additional management measures;
- Refine cost of future service estimates and range for each town;
- Offer cost implications for regional cooperation and CMPP; and
- Concurrently, proceed with revenue assessments.

Designated Discharge Properties

- Provide stakeholder input – assess concerns;
- How can they help?
  - Location of existing BMPs (lat. & long.);
  - Type of existing BMPs and age;
  - Current non-structural control measures.