GRCx

Green Infrastructure: Addressing Boston's Stormwater Woes

Janaury 11, 2023

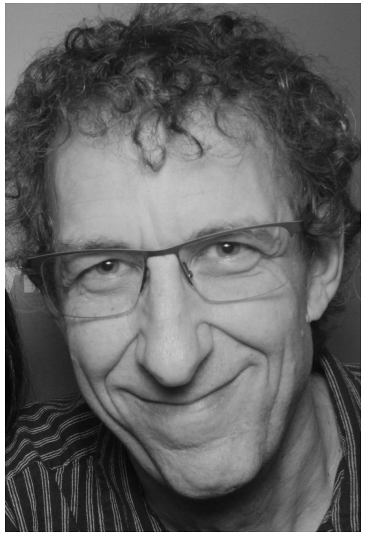
Boston
Green Ribbon
Commission

GRCx is an interactive program series from the Boston Green Ribbon Commission designed to accelerate the implementation of the City's Climate Action Plan by providing high-quality, useful content on climate resilience and carbon mitigation to the Boston community.

www.greenribboncommission.org

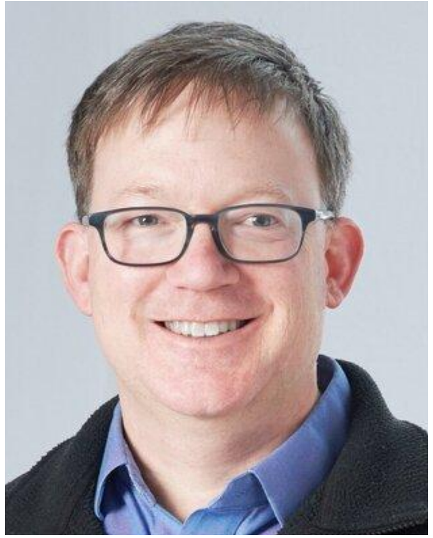
Speakers

Adam Chapdelaine
Deputy Director,
Boston Green Ribbon
Commission
(Moderator)



Ken Moraff
EPA Region I
Water Division
Director

Kate England
Director of Green
Infrastructure
City of Boston



Patrick Herron
Executive Director
Mystic River
Watershed Association

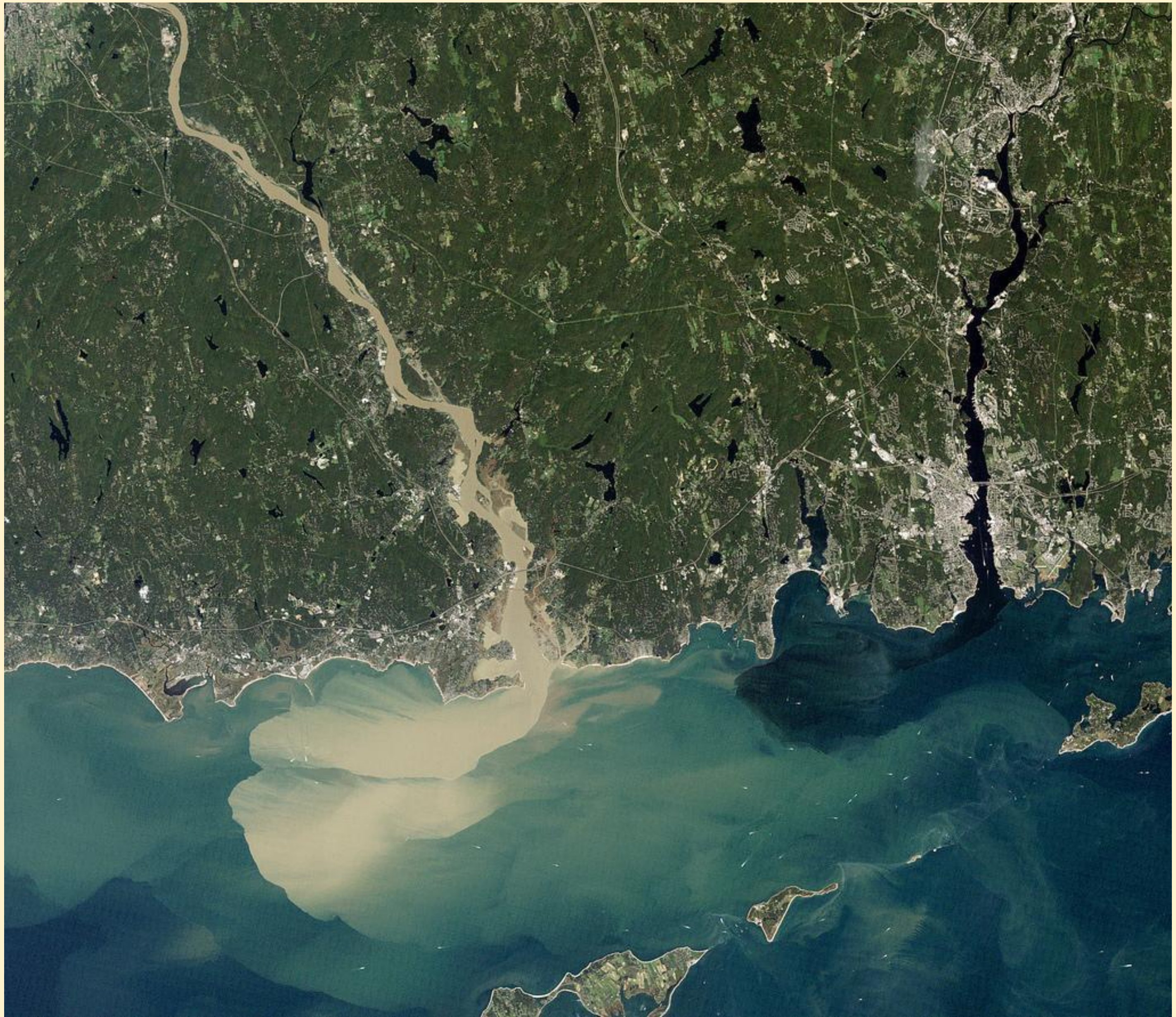
Stormwater and Green Infrastructure in Boston

Boston Green Ribbon Commission
January 11, 2023

Ken Moraff
EPA New England

Charles River Algae Bloom

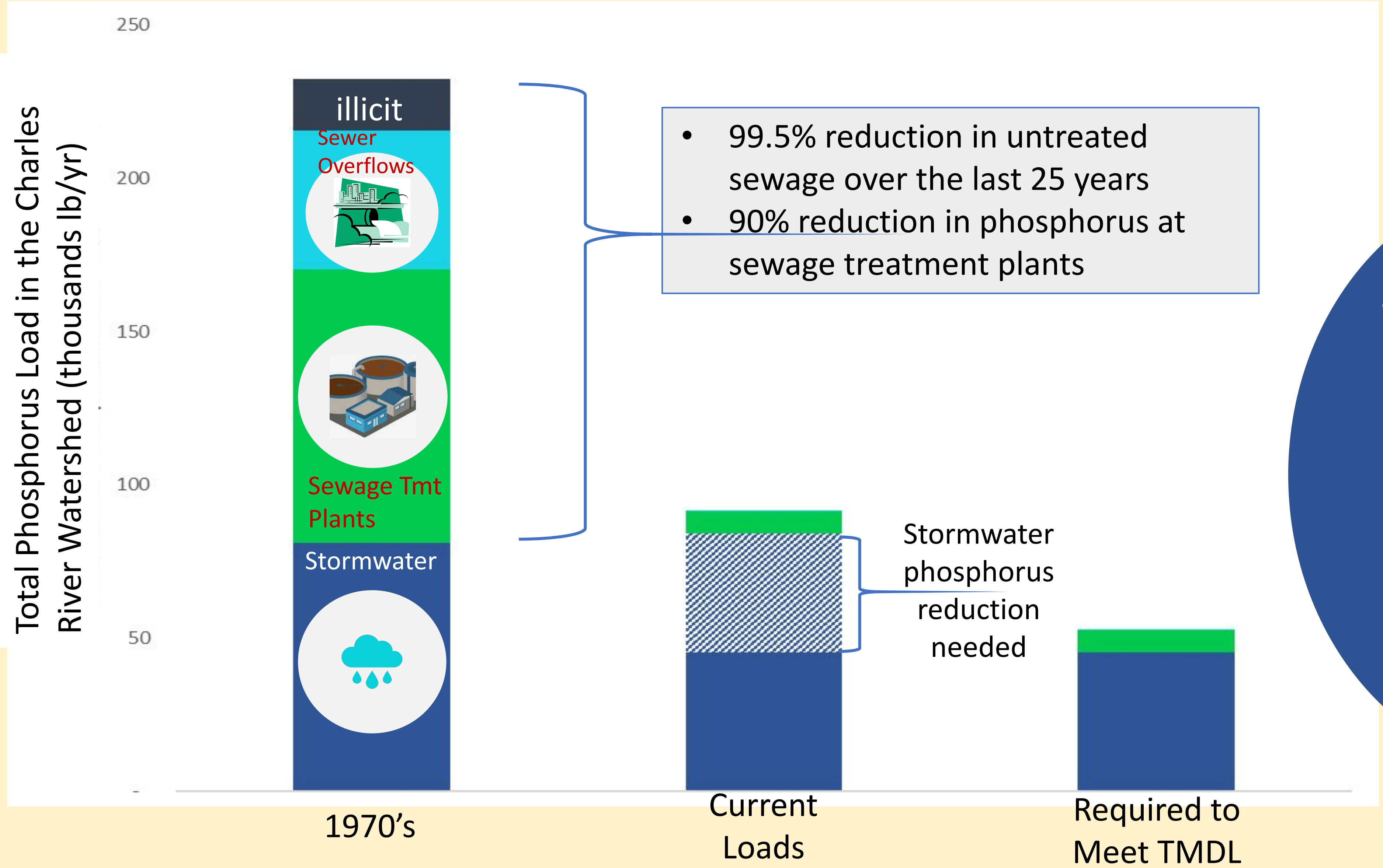
Connecticut River After Tropical Storm Irene



http://www.flickr.com/photos/gsfc/6128808470/

Charles River Algae Bloom

Phosphorus from Other Sources has been Greatly Reduced



- 99.5% reduction in untreated sewage over the last 25 years
- 90% reduction in phosphorus at sewage treatment plants

Stormwater runoff from impervious surfaces is the <u>biggest</u> remaining source of phosphorus and is largely uncontrolled

Charles River Phosphorus Targets

Land Use Group	Upper TMDL WLA % Reduction Rate	Lower TMDL WLA % Reduction Rate
Commercial	65%	62%
Industrial	65%	62%
High Density Residential	65%	62%
Medium Density Residential	65%	62%
Low Density Residential	45%	62%
Highway	65%	62%
Open Space	35%	62%
Agriculture	35%	62%
Forest	0%	0%

Charles River Phosphorus Targets

Charles River Watershed Community	Commercial	Industrial	High Denisty Residential	Medium Density Residential	Low Density Residential	Agriculture	Forest	Open Land	Total	Percent Reduction Required
Bellingham										
Drainage Area (ha)	58.8	212.0	134.2	240.0	212.2	57.1	1315.9	245.0	2475.3	
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%**
Belmont										
Drainage Area (ha)	7.2	10.0	105.1	0.9	30.5	0.0	99.9	96.5	350.1	
1998-2002 Loading (kg/yr)	12.3	14.7	118.9	0.5	1.4	0.0	13.0	3.3	164.1	
TMDL Loading (kg/yr)	4.2	5.1	41.0	0.2	0.8	0.0	13.0	2.1	66.4	**59.5%**
Boston										
Drainage Area (ha)	587.1	541.5	2556.5	43.4	20.2	7.4	688.2	1444.0	5888.3	
1998-2002 Loading (kg/yr)	996.4	796.4	2892.4	24.6	0.9	3.7	89.7	49.6	4853.8	
TMDL Loading (kg/yr)	343.7	274.7	997.6	8.5	0.5	2.4	89.7	32.0	1749.0	**64.0%**
Brookline										
Drainage Area (ha)	135.9	10.0	588.2	209.4	254.8	42.9	157.0	357.1	1755.5	
1998-2002 Loading (kg/yr)	230.7	14.8	665.5	118.5	11.6	21.7	20.5	12.3	1095.5	
TMDL Loading (kg/yr)	79.6	5.1	229.5	40.9	6.3	14.0	20.5	7.9	403.8	**63.1%**
Cambridge										
Drainage Area (ha)	123.1	126.9	205.7	0.0	0.0	0.0	3.1	181.7	640.4	
1998-2002 Loading (kg/yr)	208.9	186.6	232.7	0.0	0.0	0.0	0.4	6.2	634.8	
TMDL Loading (kg/yr)	72.0	64.3	80.3	0.0	0.0	0.0	0.4	4.0	221.1	**65.2%**

Regulatory Structure – Clean Water Act

§ 1311. Effluent limitations

(a) Illegality of pollutant discharges except in compliance with law

Except as in compliance with this section and sections 1312, 1316, 1317, 1328, 1342, and 1344 of this title, the discharge of any pollutant by any person shall be unlawful.

Municipal Stormwater Permits

EPA's general permit for municipal stormwater covers 34 Charles River communities

Updated permit took effect in 2018

Phosphorus reduction target for each community

Communities have five years to develop plan, then 15 years to implement (with interim targets)

Clean Water Act Authority to Regulate Stormwater

NPDES Permits are required for certain stormwater discharges:

- Large, Medium, and Small Municipal Separate Storm Sewer Systems (MS4s)
- Industrial Activities from specific industrial categories
- Construction Activities Disturbing ≥ 1 acre
- & Others — Additional Discharges on a Case-By-Case Basis

Residual Designation Authority (RDA)

Phosphorus Control Strategies

- **Reduce or disconnect impervious cover**
- Small-scale infiltration practices (e.g., rain gardens, tree trenches, dry wells, infiltration trenches)
- Stormwater capture (e.g., irrigation cisterns, rain barrels, green roofs)
- Filtration practices (e.g., biofiltration, gravel wetland)
- Non-Structural control strategies (e.g., leaf litter pickup, street/parking lot sweeping)

Phosphorus Reduction Credits

SW Controls

Surface Infiltration
(6 infiltration rates)

Infiltration trenches
(6 infiltration rates)

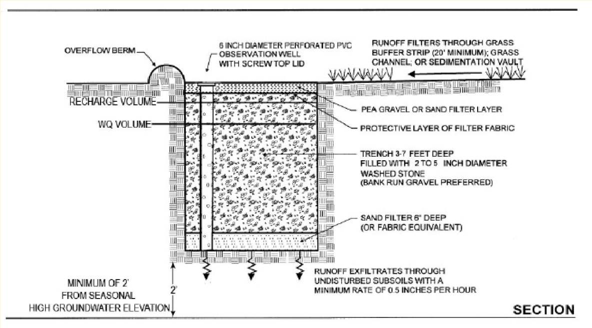
Bio-filtration

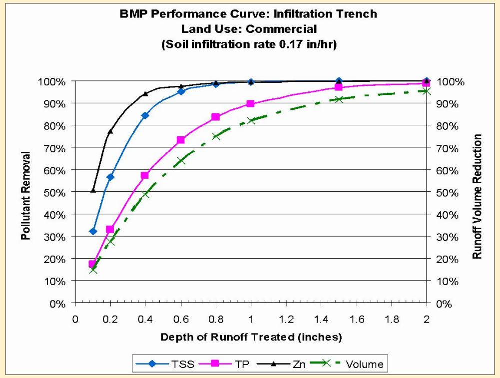
Porous pavement
with underdrain

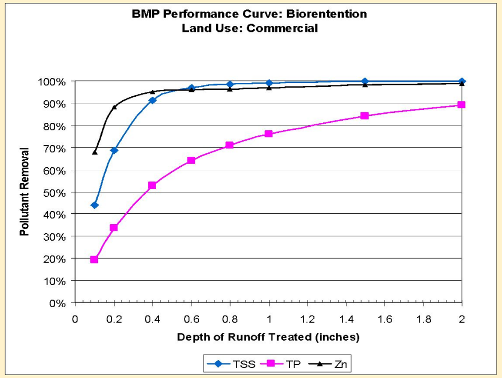
WQ Swales
(non-infiltration)

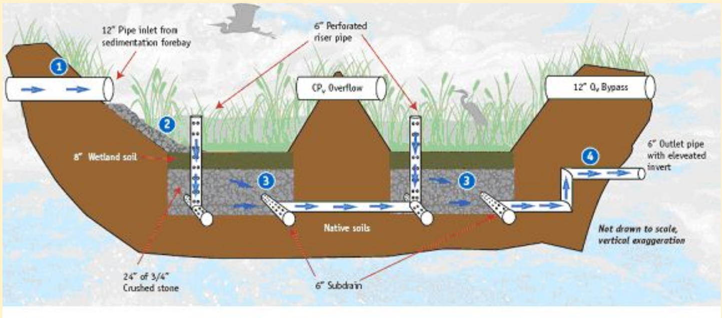
Gravel wetland

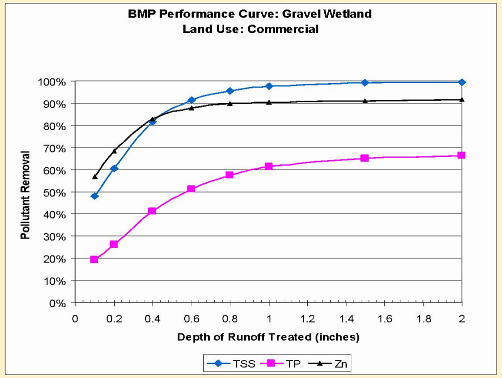
Enhanced Bio-filtration*



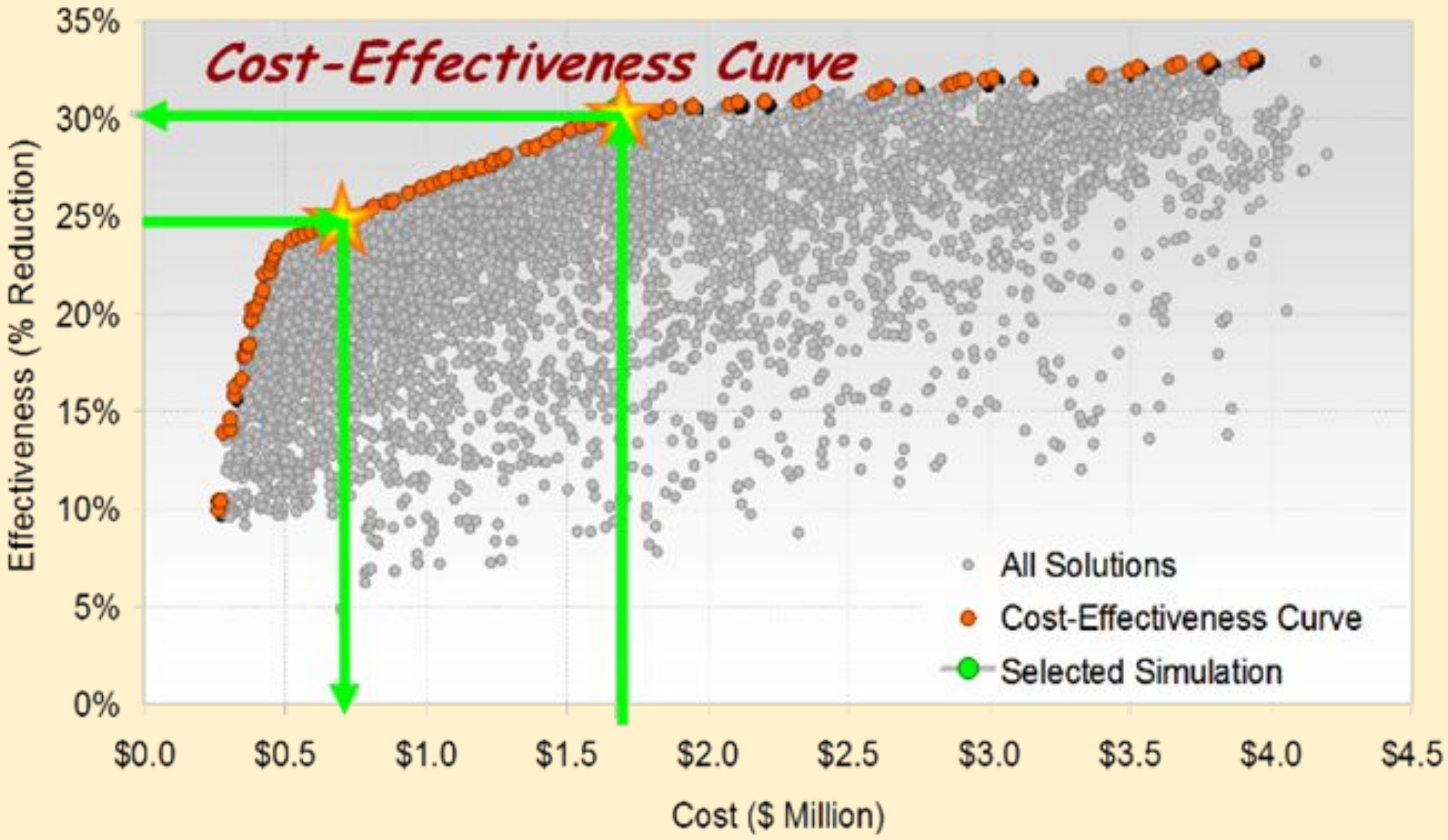








How will we choose BMPs?



Thank you!

Ken Moraff

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GREEN INFRASTRUCTURE IN THE CITY OF BOSTON

GRCx Webinar: Addressing Boston's Stormwater Woes
Kate England, Director of Green Infrastructure
January 11, 2023

Agenda

1. What’s the Problem?
2. What is Green Infrastructure?
3. City of Boston Green Infrastructure
4. Private Green Infrastructure
5. The Future of Green Infrastructure in Boston

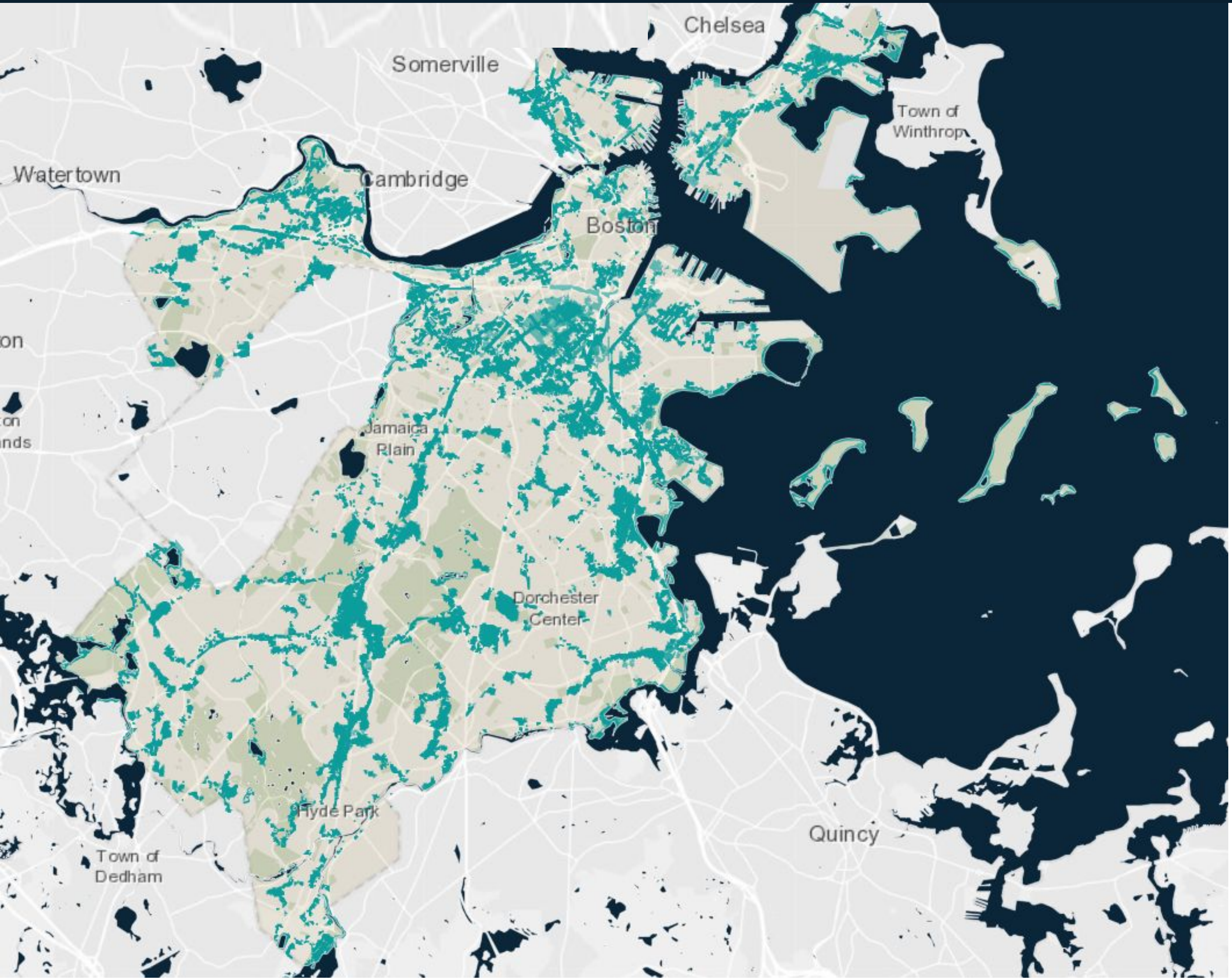
What's the problem?

- As stormwater travels along hard, impervious surfaces, it picks up pollutants and litter along the way.

- Storm drains then release pollutant laden stormwater into receiving waters, which creates impaired water bodies and damages ecosystems.

- 303(d) Impaired Waters: Boston Harbor, Charles River, Mystic River and Neponset River and tributaries

Expected Stormwater Impacts



- Stormwater Inundation Mapping shows the Long Term Impacts of Stormwater (10 year storm, 24-hour storm event)
- Flooding in every neighborhood
- This affects us all!

Source: Climate Ready Boston Map Explorer

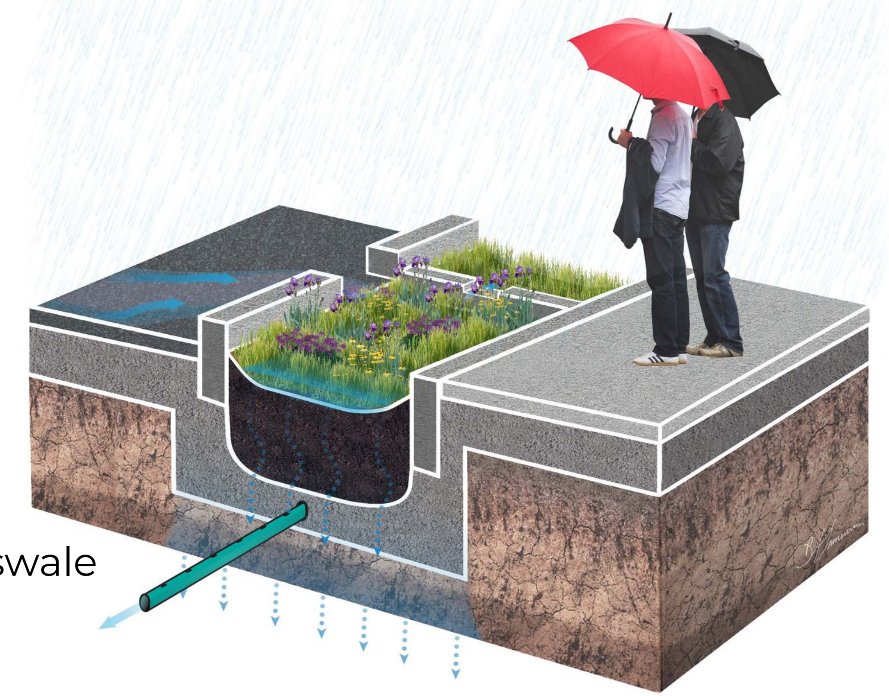
Green Infrastructure

South Street & Bussey Street (Jamaica Plain)

What is Green Infrastructure?

- Green Infrastructure ("GI") is an approach to water management that restores or mimics the natural water cycle.
- GI features features, like rain gardens and right-of-way bioswales, utilize natural hydrologic processes to capture, purify and infiltrate stormwater back into the ground.

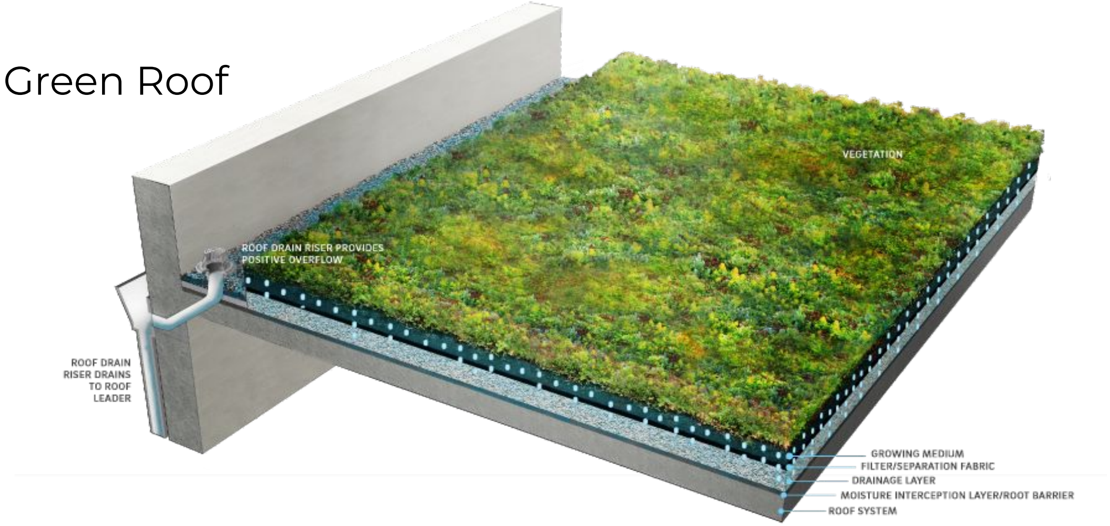
Rain Garden



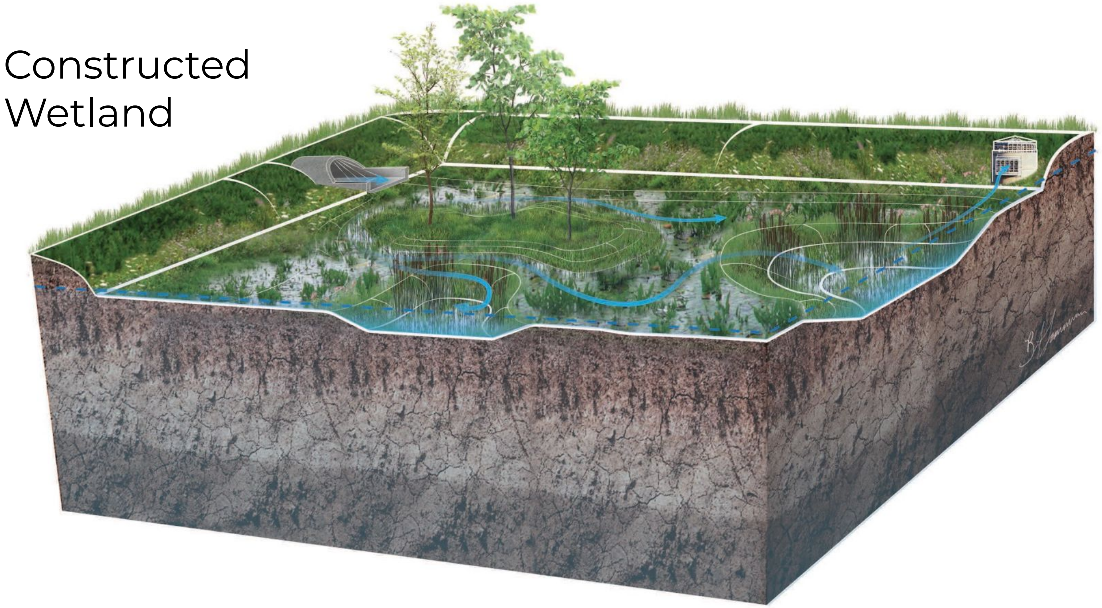
ROW Bioswale

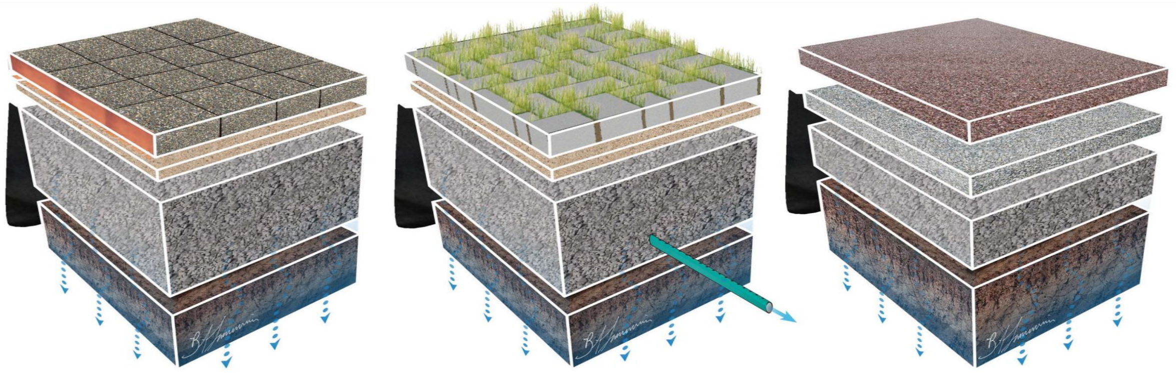
Green Infrastructure Features

Green Roof



Constructed
Wetland





Porous Paving
Materials

Tree Pit/Tree
Trench

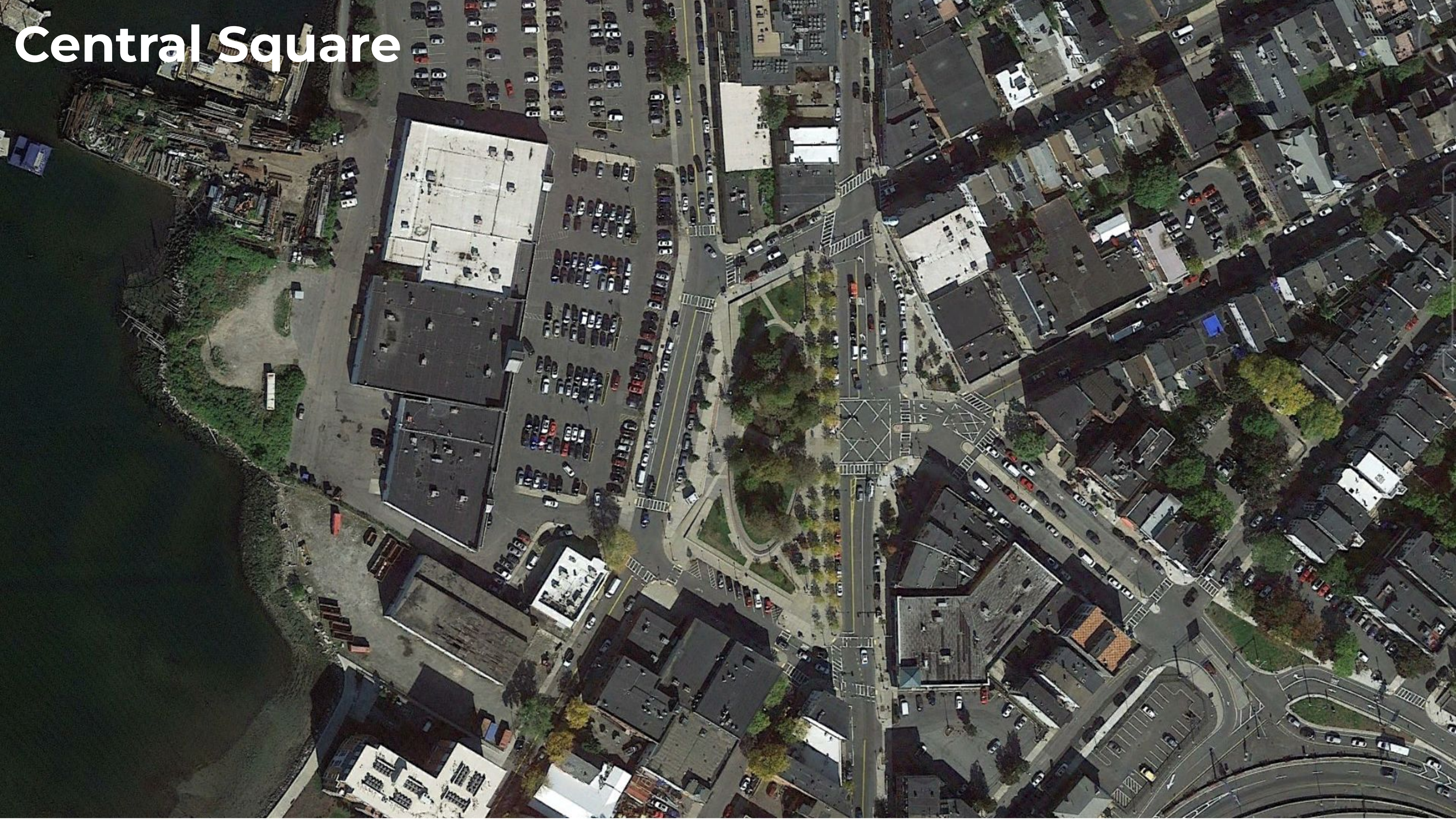
Co-Benefits

- Increased urban green space / tree canopy
- Reduced urban heat island effect
- Slower streets / improved pedestrian & cyclist safety
- More biodiversity / pollinator habitat
- Reduced energy usage
- Improved Environmental Justice
  (e.g. air quality, access to nature, food security, etc.)
- Opportunities for environmental education

City of Boston Green Infrastructure

Central Square

Central Square



GREEN INFRASTRUCTURE @ CENTRAL SQUARE

Boston Water and Sewer Commission

What is Green Infrastructure?

Green infrastructure offers an alternative to traditional storm drain systems or 'grey infrastructure'. The goal of Green Infrastructure is to mimic nature to capture, clean and infiltrate the rain that falls to the ground. Green Infrastructure installations help limit the amount of stormwater entering pipes that drain to Boston Harbor.

The Green Infrastructure demonstration project in Central Square is a collaborative effort between Boston Water and Sewer Commission , Boston Public Works, Boston Transportation and Boston Parks Departments. Central Square now has 11 Green Infrastructure features including porous pavement, infiltration trenches and tree trenches. To learn more about the program or how the Green Infrastructure works in Central Square, visit:

La Infraestructura Verde ofrece una alternativa a los sistemas tradicionales de "Infraestructura Gris" Los objetivos de la Infraestructura Verde son imitar la condición natural a captura, limpia e infiltra la lluvia que cae al suelo. Las instalaciones de Infraestructura Verde ayudan a limitar la cantidad de aguas pluviales que entran a los desagües del Boston Harbor.

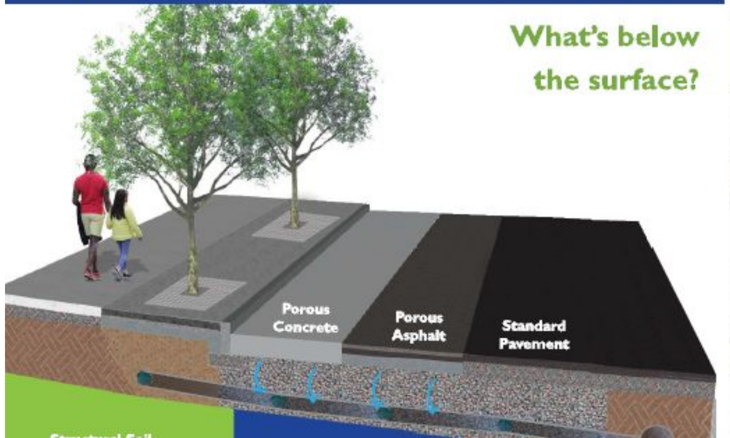
El proyecto de demostración de Infraestructura Verde en Central Square es un esfuerzo de colaboración entre la Comisión de Agua y Alcantarillado de Boston y la Ciudad de Boston. Central Square ahora tiene 11 características de Infraestructura Verde incluyendo pavimento poroso, zanjas de infiltración y trincheras de árboles. Para obtener más información sobre el programa o sobre cómo funciona la Infraestructura Verde en Central Square, consulte:

http://bwsc.org/GI_LID.asp

Benefits of Green Infrastructure

- REDUCES STORMWATER RUNOFF AND IMPROVES WATER QUALITY
- IMPROVES URBAN AIR QUALITY AND REDUCES ENERGY USE
- IMPROVES HABITAT AND MITIGATES URBAN HEAT ISLAND EFFECT
- INCREASES GROUNDWATER RECHARGE AND REDUCES RISK OF FLOODING
- REMOVES PHOSPHORUS AND OTHER POLLUTANTS FROM RUNOFF
- CULTIVATES PUBLIC EDUCATION OPPORTUNITIES

What's below the surface?



Structural Soil Tree Trench
Pollutants, such as phosphorus, are filtered out by healthy soil and trees as rainwater is absorbed into the ground

Stormwater Infiltration Trench
Porous surfaces allow stormwater to soak into the ground instead of being directed to a catch basin

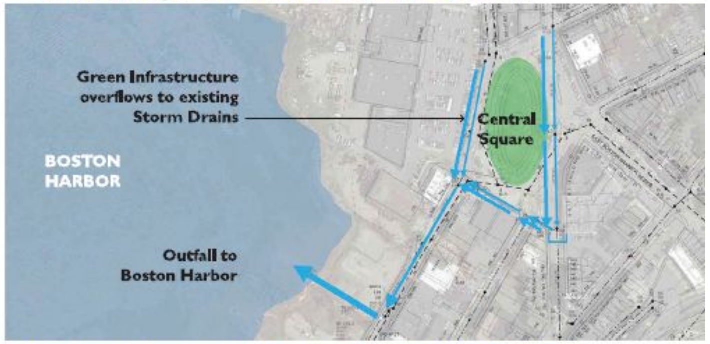
Reservoir layers below standard pavement allow for storage of additional stormwater

Overflow drains manage excess stormwater by redirecting treated water to the storm drain

Central Square Green Infrastructure Plan

- Structural Soil Tree Trench
- Stormwater Infiltration Trench under porous paving (asphalt/concrete)
- Stormwater Infiltration Trench under standard pavement

Central Square Storm Drain System



Protect Boston Harbor from Pollutants

Most catch basins in Boston connect to storm drains that discharge runoff to the nearest brook, river or Boston Harbor. Substances carelessly spilled or dumped onto our streets or directly into a catch basin can pollute Boston Harbor.

La mayoría de las cuencas de captura en Boston se conectan a los desagües de tormenta que descargan el escurrimiento al arroyo, al río o al Boston Harbor, cual de ellos este más cercano. Las sustancias descuidadamente derramadas o vertidas en nuestras calles o directamente en una cuenca pueden contaminar el Boston Harbor.

Why Green Infrastructure?

In 2012, BWSC reached a consent decree with U.S. Environmental Protection Agency (EPA) to modify its storm drain system to address and mitigate the amount of pollutants reaching the Charles River, Neponset River, and Boston Harbor. Stormwater runoff carries sediment, litter and other pollutants, like phosphorus, to receiving waters during storm events.

In order to reduce the impacts of stormwater runoff on our waterbodies, BWSC now implements Green Infrastructure/Low Impact Development stormwater management techniques. The goal of the Central Square Green Infrastructure project is to eliminate the volume of runoff associated with the first one inch of rainfall over 3.1 acres. The Green Infrastructure features at Central Square are designed to absorb 12,759 cubic feet of stormwater. That's over 95,000 gallons, almost as much water as the Paris Street pool!

En 2012, BWSC llegó a un decreto de consentimiento con la Agencia de Protección Ambiental de los Estados Unidos (EPA, por sus siglas en inglés) para modificar su sistema de drenaje de aguas pluviales para tratar y mitigar la cantidad de contaminantes que llegan al Boston Harbor, Charles River y al Neponset River. La escorrentía de aguas pluviales lleva sedimentos, basura y otros contaminantes como el fósforo a aguas receptoras durante eventos de tormenta.

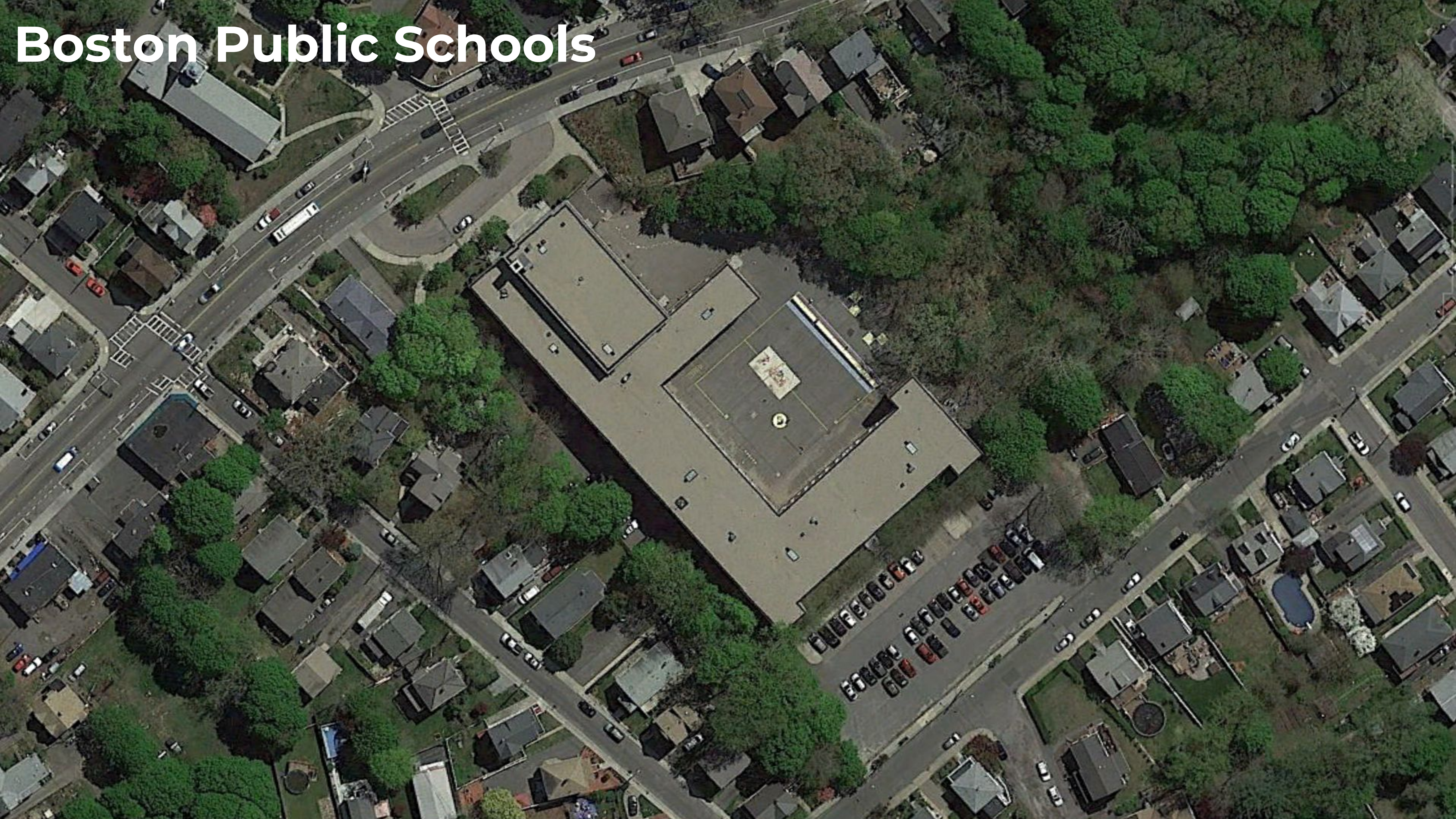
Con el fin de reducir los impactos de la escorrentía de aguas pluviales en nuestros cuerpos de agua, BWSC ahora implementa técnicas de gestión de aguas pluviales de bajo impacto ambiental. El objetivo del Proyecto de Infraestructura Verde en Central Square es, eliminar el volumen de escorrentía asociado con la primera pulgada de lluvia sobre 3.1 hectareas. Las características de la Infraestructura Verde en Central Square están diseñados para absorber 12,759 pies cúbicos de aguas pluviales, es decir, más de 95,000 galones, casi tanto como la Piscina de la calle de París!

95,000 Gallons of Stormwater Storage

Central Square

Central Square

Boston Public Schools



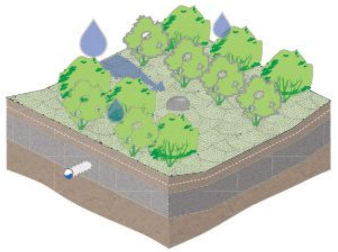
Boston Public Schools

GREEN INFRASTRUCTURE

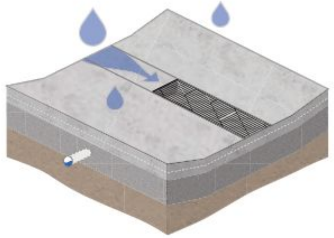
AT WASHINGTON IRVING MIDDLE SCHOOL

When rain falls on hard surfaces, like roads or roofs, it becomes "stormwater runoff." Traditional "Grey" Infrastructure collects stormwater and sends it through pipes to nearby waterbodies, like the Charles River or Boston Harbor, with minimal treatment. Green Infrastructure features, like Rain Gardens, collect and treat stormwater where it falls. Green Infrastructure mimics, protects, and restores the natural water cycle by allowing stormwater to absorb, or "infiltrate," into the ground. Plants and soils remove pollutants from stormwater, which improves water quality in local waterbodies, creates habitat for wildlife, and enhances the ecosystem in Boston. The Washington Irving Middle School is one of five Green Infrastructure pilot schools and has the largest public Bioretention Feature in the entire City of Boston!

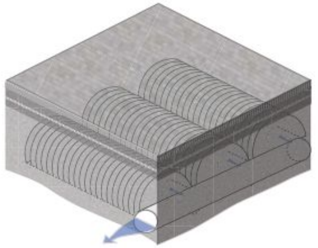
THE COMPONENTS



Bioswales are long, thin, shallow features that collect stormwater from surfaces that water cannot pass through, like pavement. Bioswales are made of a special soil mix and plants over a layer of crushed stone, allowing stormwater to soak into the ground. Bioswales use plants that drink up water in their roots and soil that removes harmful pollutants from stormwater to improve water quality.



A **Concrete Swale** is a long, thin, shallow feature that collects stormwater. Concrete swales usually drain to a catch basin and solid pipes that send stormwater away from the site as quickly as possible. While not considered "Green Infrastructure," a Concrete Swale was installed here to convey stormwater and compare it to the nearby Bioswale!



Stormwater Chambers are large plastic arches surrounded by crushed stone. Stormwater is collected by a drain at the surface, then runs into a pipe that is connected to the Stormwater Chambers. The Stormwater Chambers allow stormwater to slowly absorb into the ground. Stormwater Chambers exist completely underground and are often used at urban sites where space is limited, like in Boston!

Boston Water and Sewer Commission

WE ARE ALL CONNECTED

THE SITE

THE BENEFITS

62,450

GALLONS

This site treats 62,450 gallons of stormwater for every 1 inch of rain, nearly **625 bathtubs** worth of water!

3.5

POUNDS OF PHOSPHOROUS PER YEAR

Phosphorus is an important nutrient for plants, but it can be harmful in our waterways. This site prevents 3.5 pound of phosphorus - **the same as 7,525 cups of milk** - from reaching rivers, streams, and Boston Harbor every year! Instead, it is being used by the plants you see here to grow and reproduce.

2.3

ACRES TREATED

100% of the play yard, parking lot, and driveways are treated by the Green Infrastructure on site.

THE NEIGHBORHOOD

GREEN INFRASTRUCTURE AT WASHINGTON IRVING MIDDLE SCHOOL

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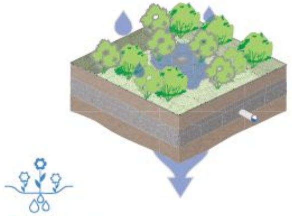
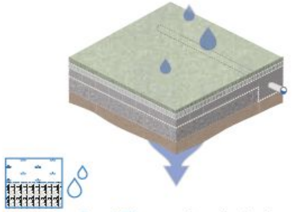
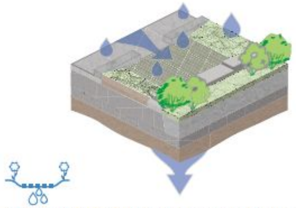


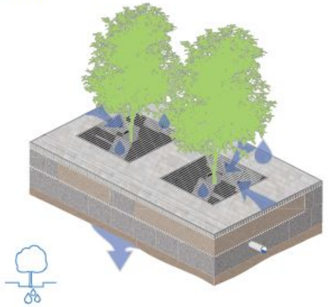
Bioretention Features are Green Infrastructure features planted with native plants. They capture runoff from surfaces that water cannot pass through, like pavement, and allow stormwater to absorb into the ground. Bioretention features, like Rain Gardens, use plants and soil to clean stormwater and reduce the amount of pollutants that reach local waterbodies, like the Charles River.



Subsurface Gravel Filters are large beds of crushed stone below the ground. Pipes with holes in them, also called perforated pipes, feed stormwater into the Subsurface Gravel Filter. Stormwater enters the perforated pipes and the Subsurface Gravel Filter, where it slowly absorbs into the ground.



A **Sediment Forebay** is part of a Green Infrastructure feature that slows and holds incoming stormwater. Sediment Forebays capture litter and small solid particles, known as sediment, before stormwater reaches the larger Green Infrastructure feature. Forebays make the larger Green Infrastructure feature work better by removing larger solid pollutants.



Tree Pits collect stormwater from roofs, roads, and sidewalks. Tree Pits are filled with crushed stone, which allows stormwater to absorb into the ground. Tree Pits also bring more water to the trees and give more room for tree roots! Tree Pits make trees healthier so they can help to clean stormwater and reduce the amount of pollutants that reach local waterbodies.

THE SITE

THE BENEFITS

62,450

GALLONS

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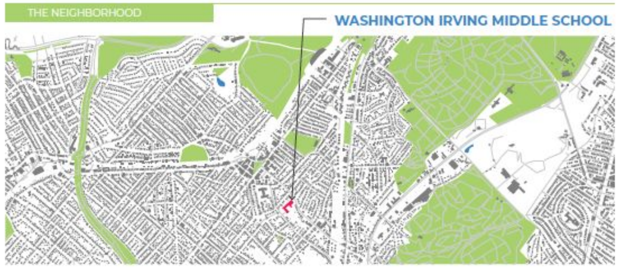


Boston Water and Sewer Commission

WE ARE ALL CONNECTED

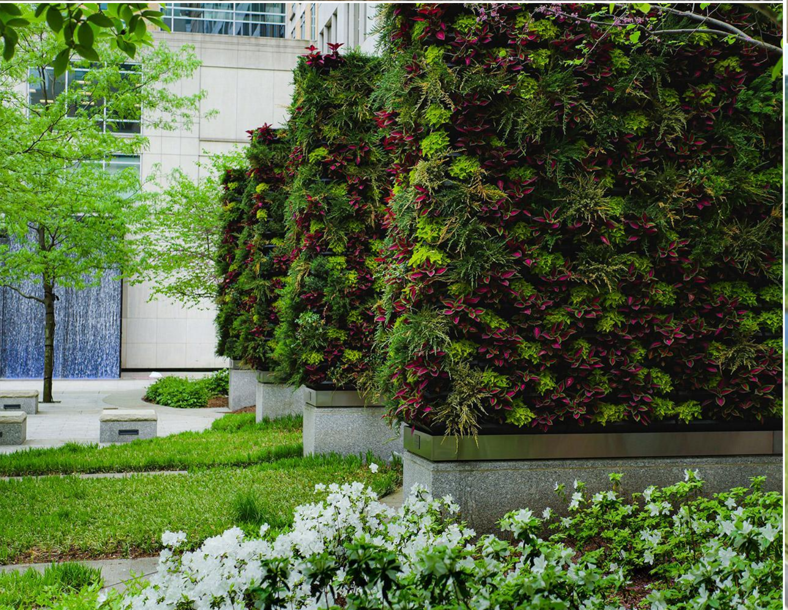
Boston Public Schools

Boston Public Schools

Private Green Infrastructure

Innovative Green Infrastructure Designs

Innovative Green Infrastructure Designs



Boston Children’s Hospital

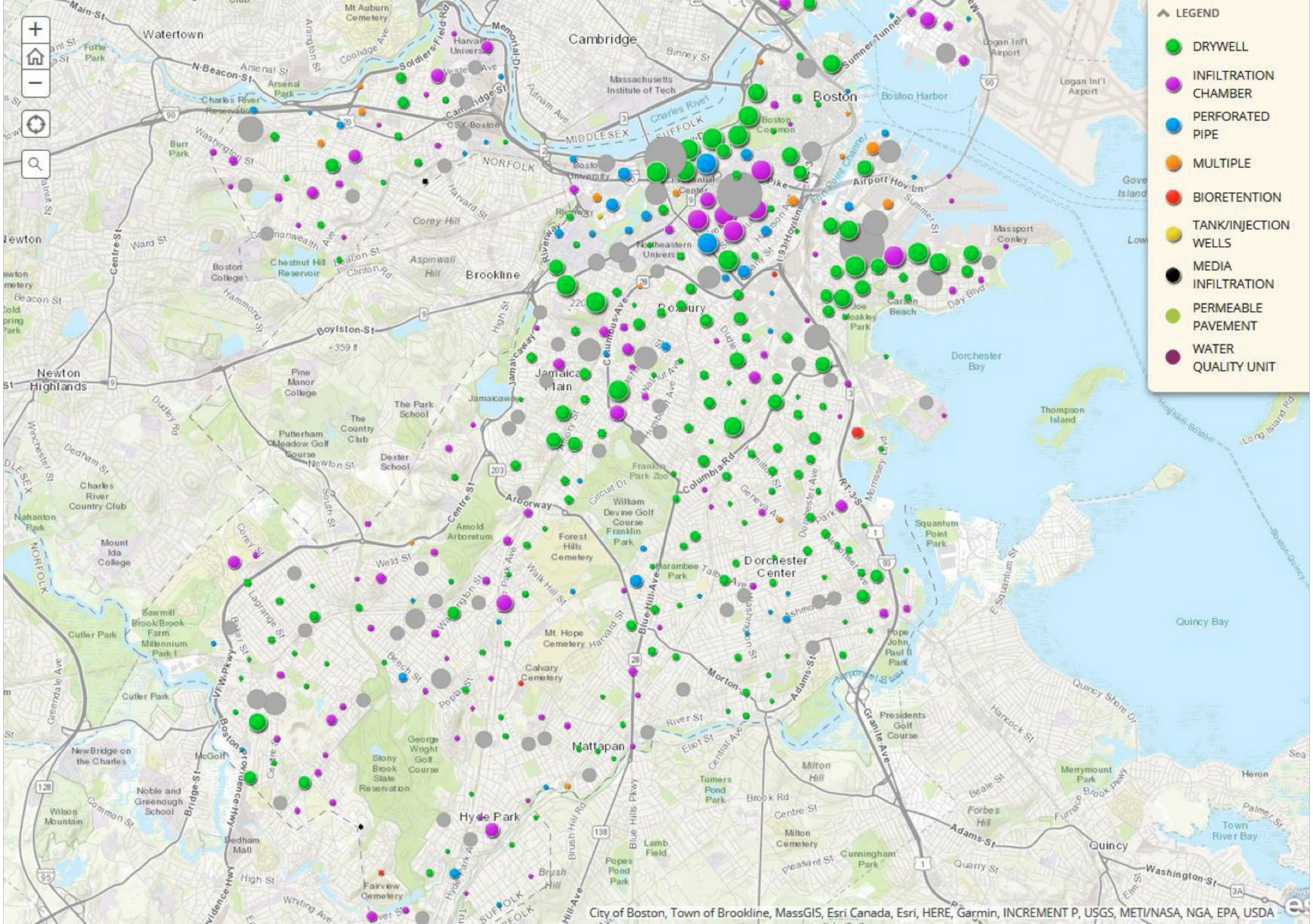
Stone Living Lab

Northeastern University


The Future of
Green Infrastructure in Boston
SOUTHERN AVE

Existing Stormwater Requirements

- BWSC Site Plan Review Requirements
  - All projects must infiltrate 1” x total impervious, or 1.25” x total impervious in the GCOD
- Article 80 - Smart Utilities
  - All projects must infiltrate 1.25” x total impervious
- Wetland Protection Act Requirements
  - All projects within jurisdictional boundaries must manage stormwater (using the MA Stormwater Handbook)
- NPDES Permits
  - Commercial, Industrial & Institutional properties with >1 acre of impervious cover must apply for permits


LEGEND
DRYWELL
INFILTRATION CHAMBER
PERFORATED PIPE
MULTIPLE
BIORETENTION
TANK/INJECTION WELLS
MEDIA INFILTRATION
PERMEABLE PAVEMENT
WATER QUALITY UNIT
Boston
Cambridge
Brookline
Roxbury
Jamaica Plain
Dorchester Center
Mattapan
Hyde Park
Quincy
City of Boston, Town of Brookline, MassGIS, Esri Canada, Esri, HERE, Garmin, INCREMENT P, USGS, METI/NASA, NGA, EPA, USDA

Existing Stormwater Requirements

- Regulations capture development and redevelopment projects
- Regulations require “stormwater management” or “infiltration”
- Regulations do not require the use of “green” (vegetated) infrastructure
- Currently working on updates to existing stormwater requirements to specifically include language about “green infrastructure”

First Green Infrastructure Policy: Curb Extensions

Three (3) components:

1. Five (5) Design Alternatives
   a. ROW Bioretention
   b. Infiltration Tree Pit/Tree Trench
   c. Porous Paving
   d. Subsurface Infiltration Area
   e. One-time Seeding
2. Two (2) Maintenance Contracts
   a. Regenerative Air Vacuum Sweeping
   b. Landscape Maintenance
3. Volunteer Program

Additional Efforts

- The Director of Green Infrastructure now receives and comments on plan submissions to the Public Improvement Commission (PIC)

- Considering policies for other departments that are similar to the City's Green Infrastructure Policy for curb extensions

- Also considering other programmatic changes and events to increase implementation of green infrastructure across the city (e.g. Rain Barrel distribution)

Kate England
Director of Green Infrastructure
City of Boston
katherine.england@boston.gov

Central Square (East Boston)

Green Infrastructure in the Mystic River Watershed

Patrick Herron, Executive Director

January 11, 2023

Mystic River
WATERSHED ASSOCIATION

About the Mystic River Watershed Association

Water Quality

Greenways

Climate Resilience

Education

Restoration

Stewardship

Mystic River
WATERSHED ASSOCIATION

The **Mystic River watershed** is a network of streams, rivers, and lakes, all draining into the Mystic River.

76
SQUARE MILES

44
LAKES & PONDS

21
COMMUNITIES

600,000
PEOPLE

LEARN MORE
MYSTICRIVER.ORG

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Cities change rivers

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Green Infrastructure in the Mystic

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1. Regulatory/funding environment

2. Regional collaboration

3. Infiltration trench experiment

1. Regulatory/Funding

NO VOLUNTARY ACTORS

- Permits (and enforcement) drive municipal funding investment

- Points of leverage for cleaner water
  - Alternative Total Maximum Daily Load (TMDL) – 60% TP reduction target
  - Small Municipal Separate Storm Sewer Systems (MS4 Permit)
  - Combined Sewer Overflow (CSO) – Long Term Control Plan (LTCP)
  - Residual Designated Authority (RDA)

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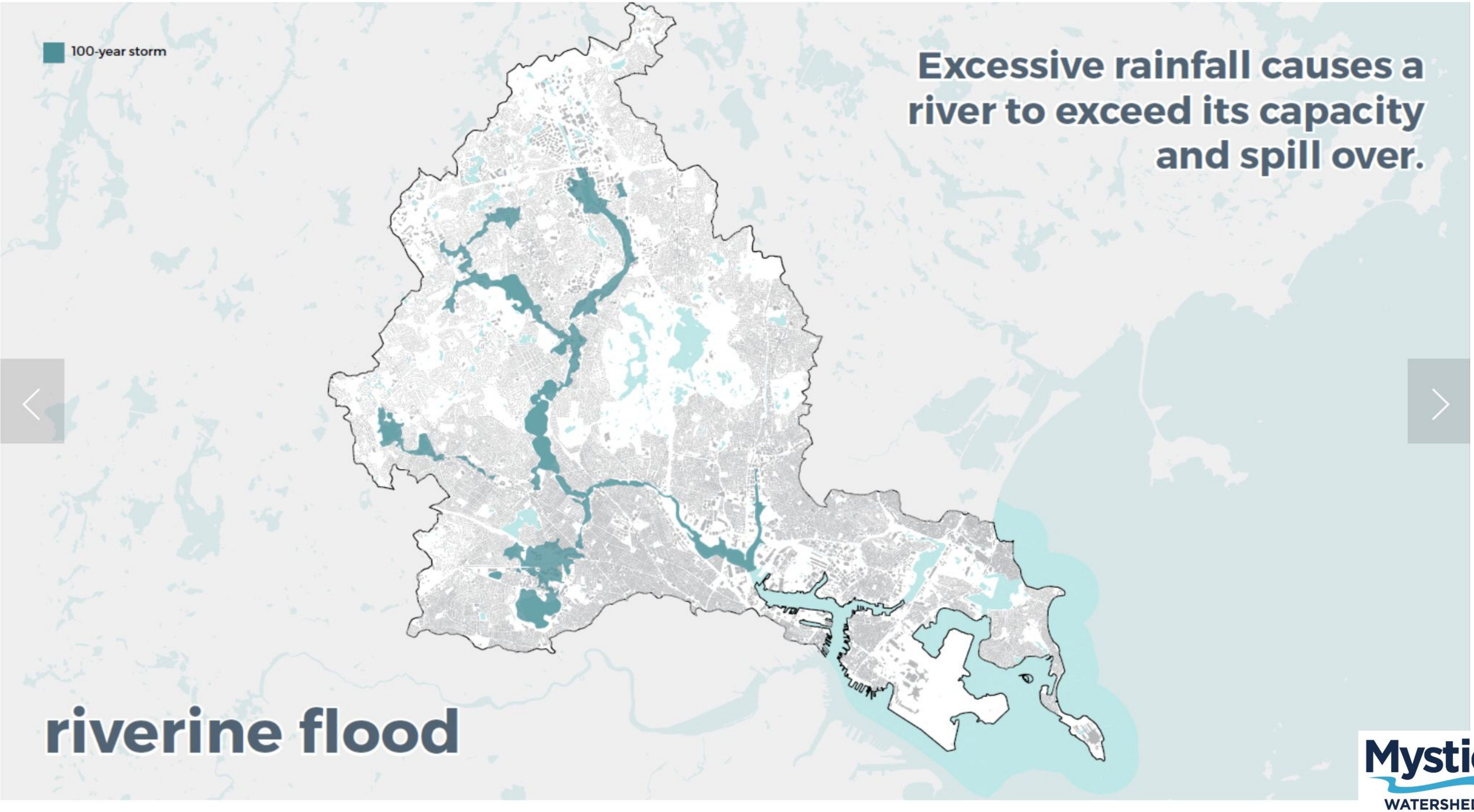
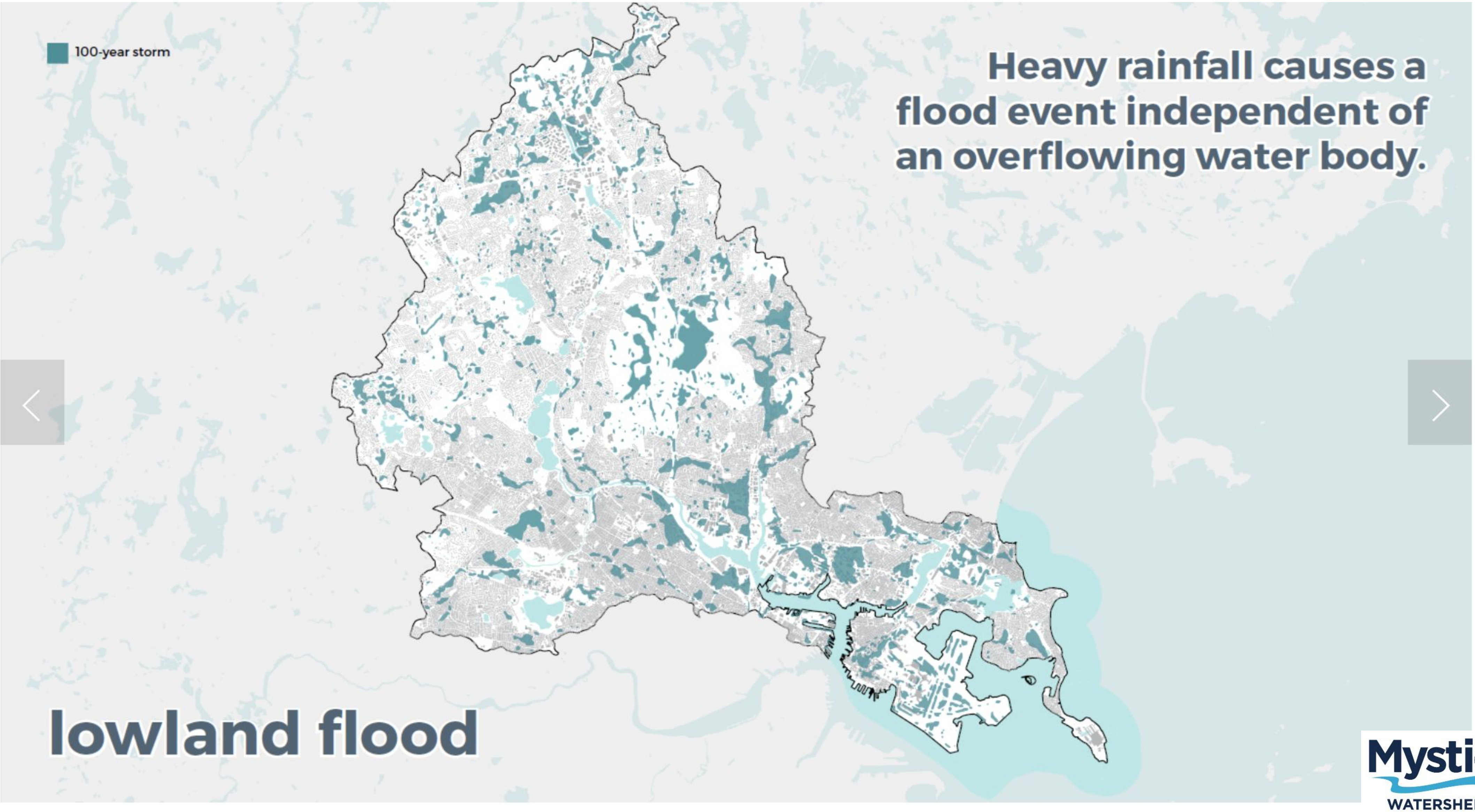
2. Regional collaboration



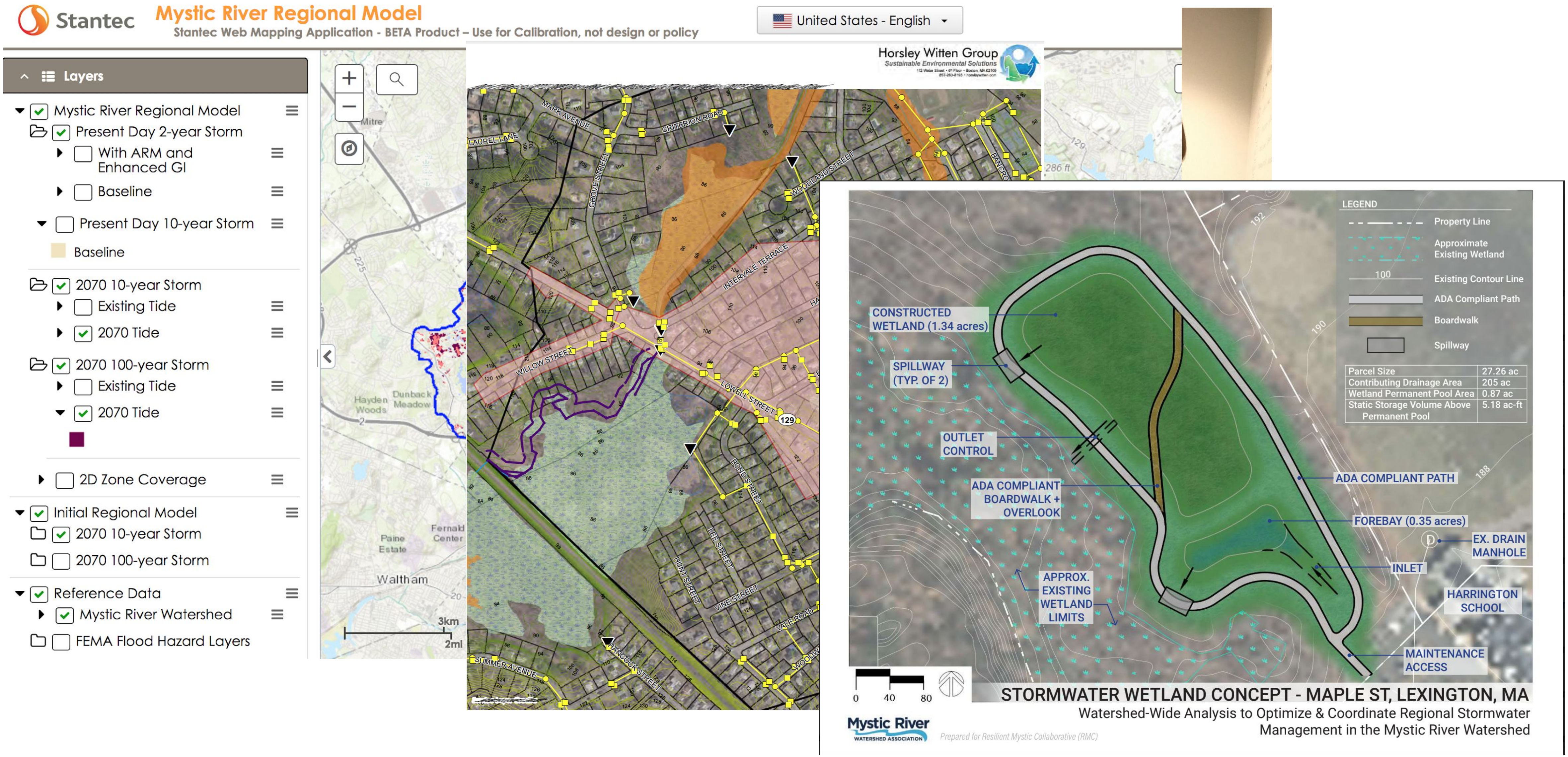
Mystic River WATERSHED ASSOCIATION

2. Regional collaboration



Mystic River WATERSHED ASSOCIATION

2. Resilient Mystic Collaborative



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Model: Cambridge - Alewife Stormwater Wetland (3.4 acre)

https://www.stantec.com/en/projects/united-states-proje
alewife-reservation-stormwater-wetland

3. Biobasin to infiltration trenches in the Mystic

(Not an infiltration trench)
Bio-basin in Arlington, MA

Infiltration trench
in Arlington, MA

Mystic River
WATERSHED ASSOCIATION

Design

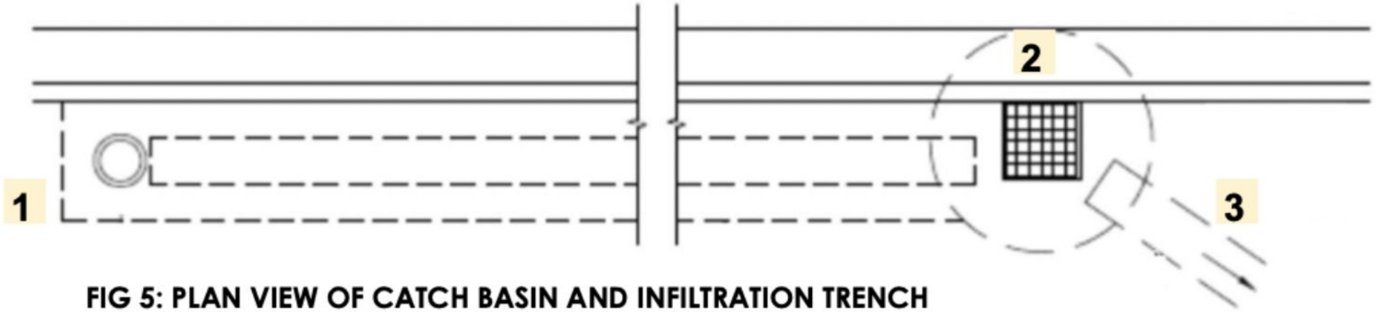

FIG 5: PLAN VIEW OF CATCH BASIN AND INFILTRATION TRENCH

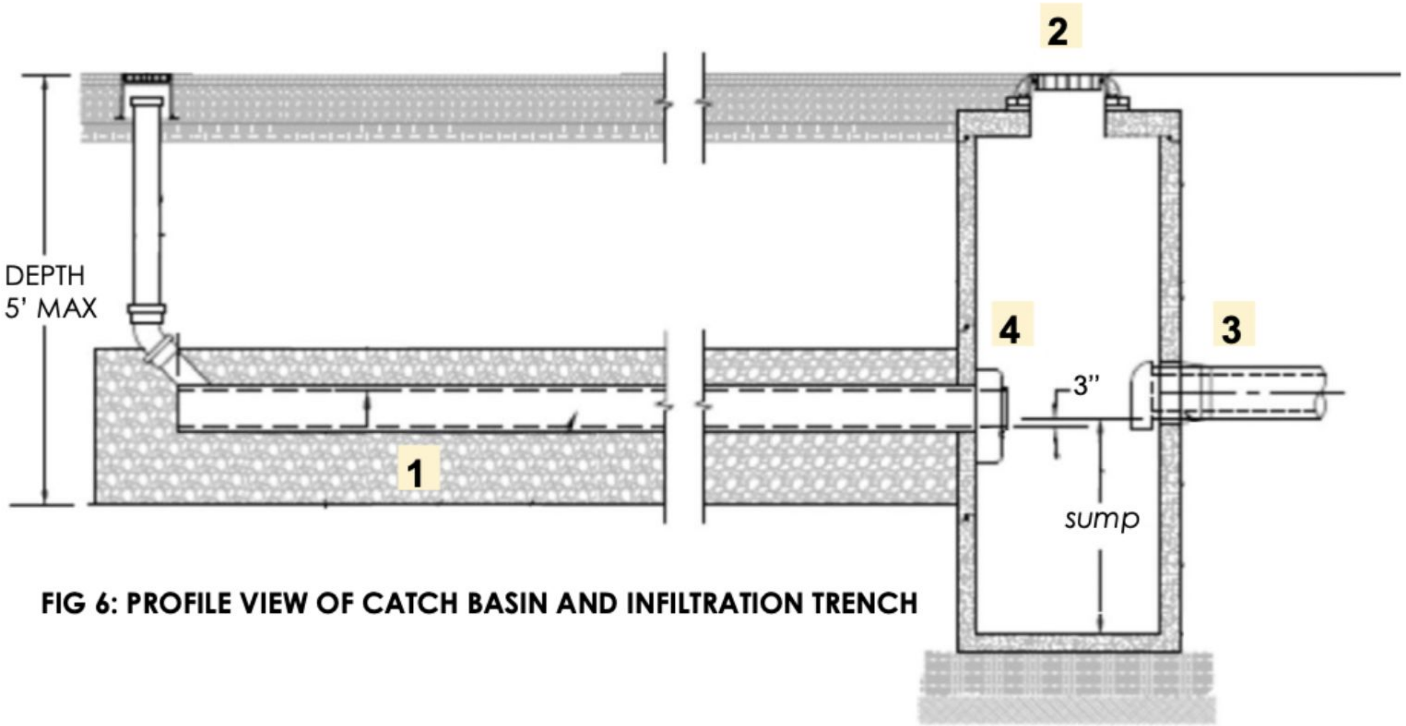

FIG 6: PROFILE VIEW OF CATCH BASIN AND INFILTRATION TRENCH

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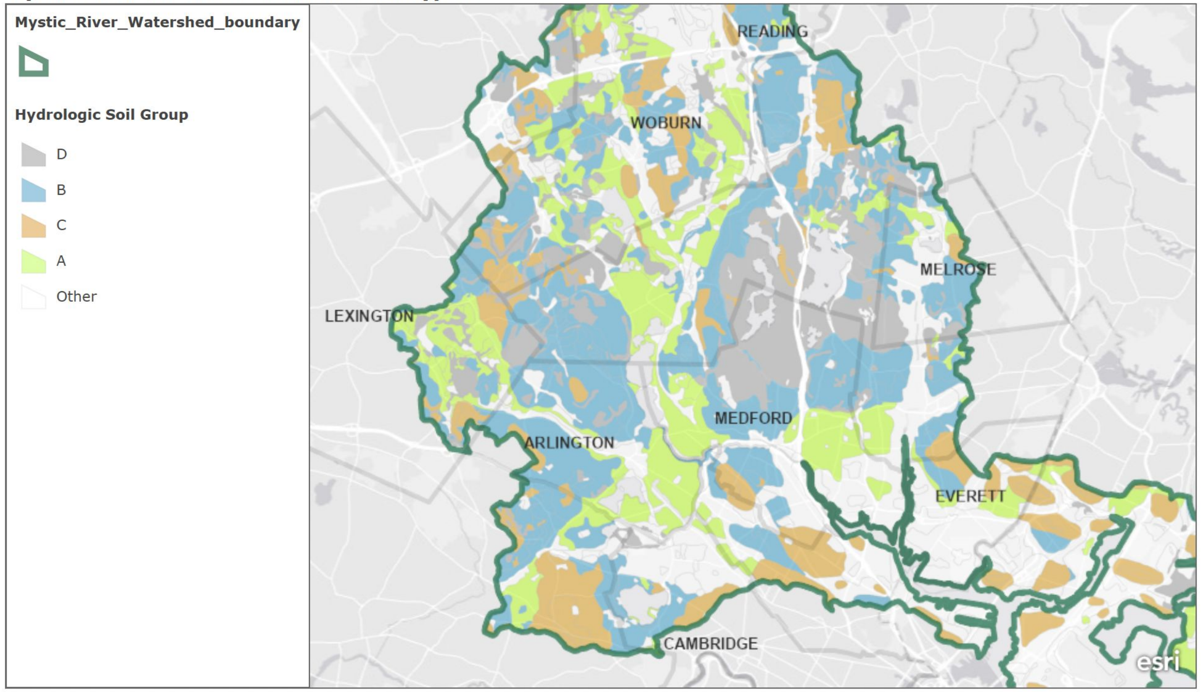
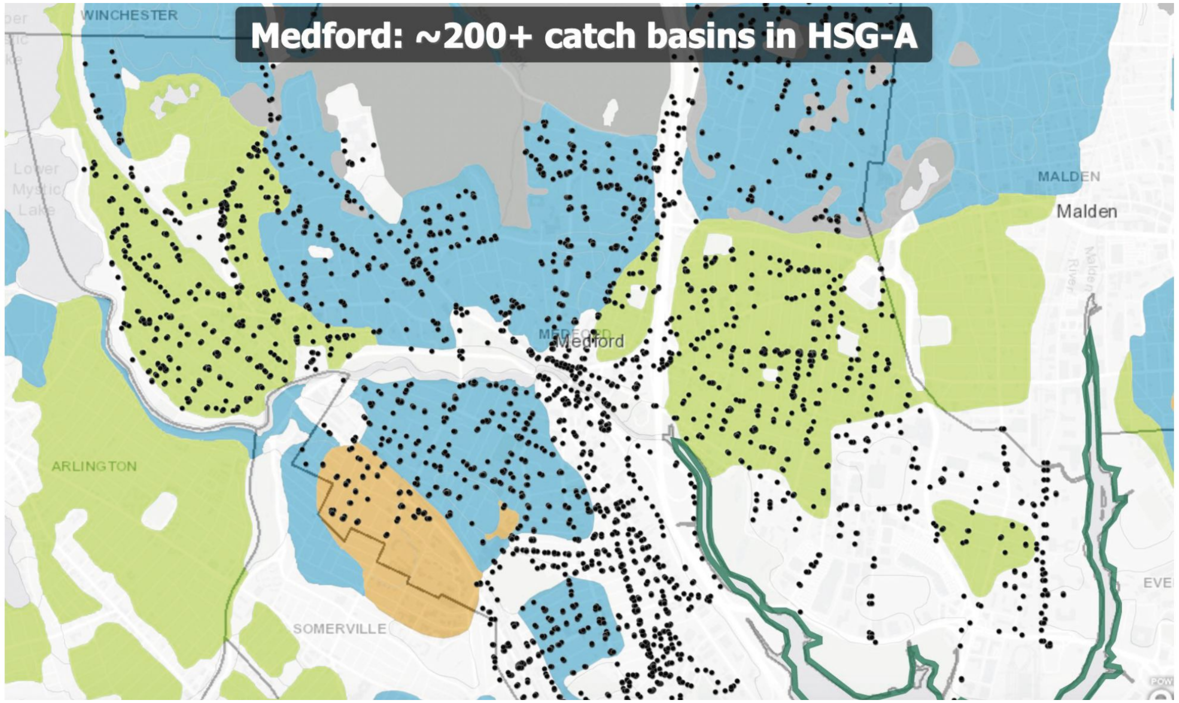
Siting constraints

Mystic River watershed with HSG soil types



Light green areas indicate Hydrologic Soil Group A, a screening criterion for site selection.

Source: USDA NRCS, Esri | Esri, HERE, NPS



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Siting of trenches in Arlington

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Estimated costs

Trench Number	Location (River St)	Tributary Area (acres)	Impervious Area (acres)	P Removed (lb/yr)	N Removed (lb/yr)	TSS Removed (lb/yr)	Vol Red (cf)	Bacteria Removed (%/yr)	IA >0.1	L	W	D	Effective D	Cost	Cost per 0.1 LBS P removed
1	21 Boulevard Road	0.332	0.232	0.40	2.90	89.00	0.16	63.00	0.27	35.00	4.00	6.75	4.00	$6,636.00	$1,659.00
2	41 Lafayette Street	0.211	0.148	0.30	2.10	62.00	0.12	73.00	0.36	30.00	4.00	6.75	4.00	$5,808.00	$1,936.00
3	69 Fairmont Street	0.213	0.149	0.30	2.00	61.00	0.11	71.00	0.33	30.00	4.00	7.00	3.75	$5,874.67	$1,958.22
4	44 Magnolia Street	0.395	0.277	0.30	3.10	82.00	0.14	46.00	0.15	30.00	4.00	6.50	3.25	$5,741.33	$1,913.78
9	10 Brooks Street	0.639	0.447	0.40	4.20	102.00	0.17	35.00	0.11	35.00	3.50	6.45	3.50	$6,179.83	$1,544.96
6	137 Herbert Road	0.416	0.291	0.40	3.40	95.00	0.16	51.00	0.19	35.00	4.00	7.05	3.50	$6,729.33	$1,682.33
7	13/15 Chandler Street	0.348	0.244	0.40	3.00	61.00	0.16	71.00	0.25	35.00	4.50	7.15	3.50	$7,150.50	$1,787.63
8	19 Edith Street	0.372	0.260	0.30	2.90	77.00	0.13	46.00	0.16	35.00	3.00	6.05	3.50	$5,723.67	$1,907.89
9	Opp 19 Edith Street	0.352	0.246	0.30	2.70	73.00	0.12	46.00	0.16	35.00	4.00	6.05	2.50	$6,418.22	$2,139.41
10	1 Osbourne Road	0.213	0.149	0.20	1.90	60.00	0.11	68.00	0.31	30.00	4.00	6.25	3.50	$5,674.67	$2,837.33
11	2 Osbourne Road	0.194	0.136	0.20	1.80	56.00	0.10	71.00	0.34	30.00	4.00	6.15	3.50	$5,648.00	$2,824.00
12	3 White Street	0.321	0.225	0.30	2.60	71.00	0.12	50.00	0.18	30.00	4.00	6.45	3.00	$5,728.00	$1,909.33
13	4 White Street	0.311	0.218	0.30	2.50	70.00	0.12	51.00	0.18	30.00	4.00	6.35	3.00	$5,701.33	$1,900.44
14	115 Mary Street	0.442	0.309	0.40	3.50	97.00	0.16	49.00	0.17	30.00	4.00	5.95	4.00	$5,594.67	$1,398.67
15	114 Mary Street	0.438	0.307	0.30	3.20	81.00	0.13	41.00	0.13	30.00	4.00	5.95	3.00	$5,594.67	$1,864.89
16	4 Littlejohn Street	0.276	0.193	0.30	2.30	66.00	0.11	54.00	0.21	30.00	4.00	6.55	3.00	$5,754.67	$1,918.22
17	15 Littlejohn Street	0.228	0.160	0.20	2.00	60.00	0.10	61.00	0.25	30.00	4.00	6.45	3.00	$5,728.00	$2,864.00
18	63 Mott Street	0.386	0.270	0.30	3.00	81.00	0.13	47.00	0.16	30.00	4.00	6.00	3.25	$5,608.00	$1,869.33
19	53 Dorothy Road	0.348	0.244	0.30	2.80	85.00	0.13	50.00	0.18	30.00	4.00	5.80	3.25	$5,554.67	$1,851.56
20	19 Fremont Street	0.466	0.326	0.30	3.50	91.00	0.15	43.00	0.14	35.00	4.00	6.35	3.00	$6,511.56	$2,170.52
21	4 Marrigan Street	0.349	0.244	0.30	3.00	77.00	0.13	42.00	0.14	35.00	4.00	5.85	2.50	$6,356.00	$2,118.67
22	60 Silk Street	0.395	0.277	0.30	2.70	73.00	0.12	48.00	0.17	30.00	4.00	6.45	3.00	$5,728.00	$1,909.33
23	37 Hilton Street	0.370	0.259	0.30	2.90	76.00	0.13	46.00	0.15	30.00	4.00	6.75	3.00	$6,636.00	$2,212.00
24	17 Heath Road	0.363	0.254	0.30	2.90	82.00	0.14	50.00	0.18	35.00	4.00	6.35	3.00	$6,511.56	$2,170.52
TOTALS:			5.865	7.40	66.9	1828	3.15								

$144K/24 sites to achieve 7.4 lbs TP/year

$19,500/ lb TP removed

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Lessons abound going to scale…

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Thank you

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Audience Q&A

*If you haven't done so,
please type your questions in the Chat function. The questions will be visible to the host & panelists only.*

Thank You

Look out for additional information on future GRCx webinars and Innovation Tours in the weeks ahead.