

Piloting an "Embankment Filter" as a Stormwater Treatment Practice on Steep Slopes with Site Constraints

dcr Massachusetts

Comprehensive Environmental Incorporated

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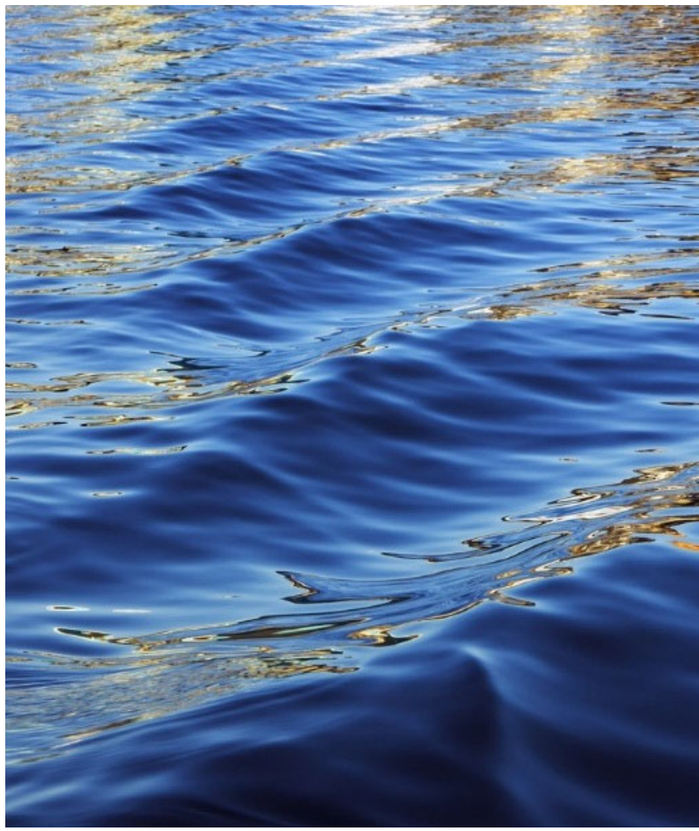
Presented by:

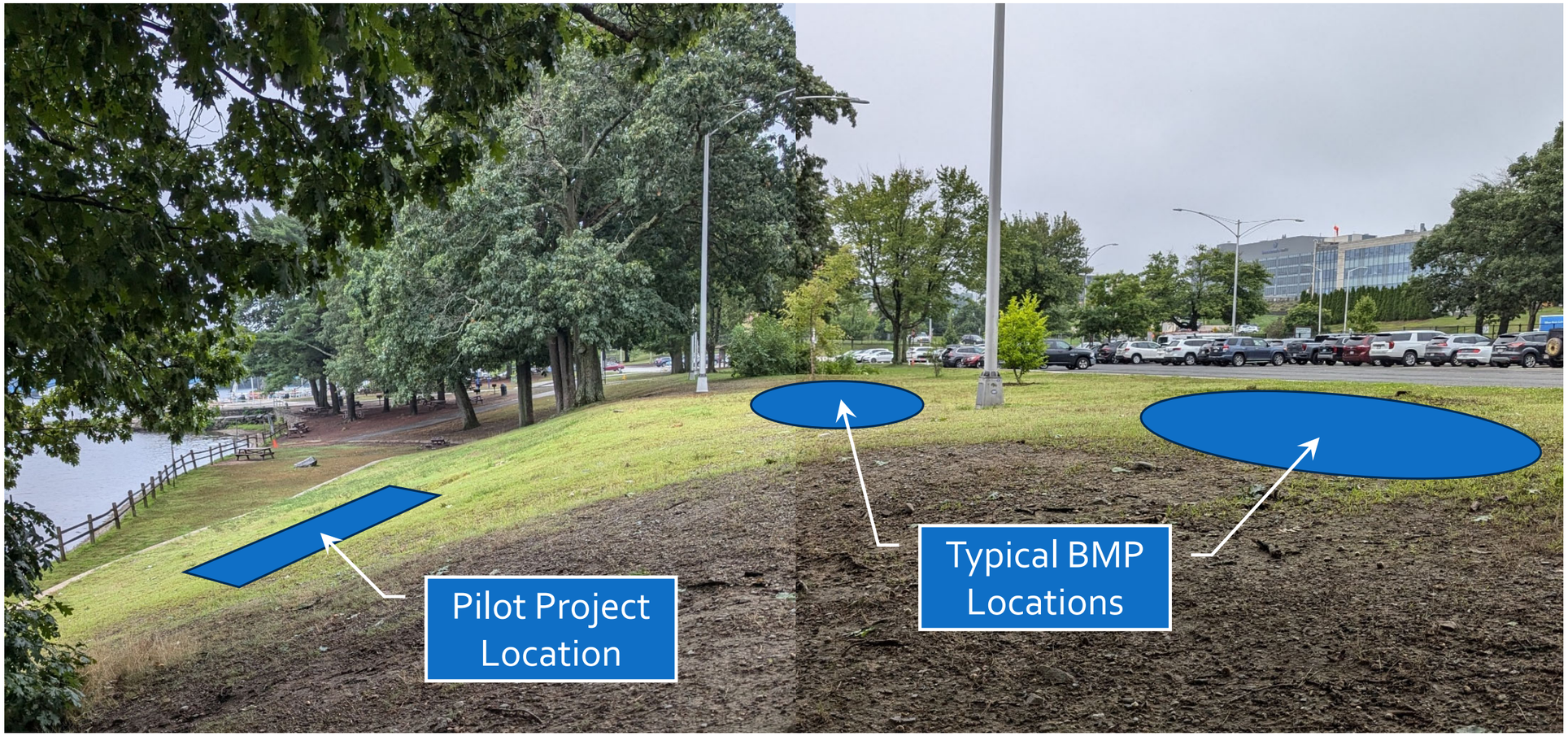
Nick Cristofori, P.E.
Comprehensive Environmental





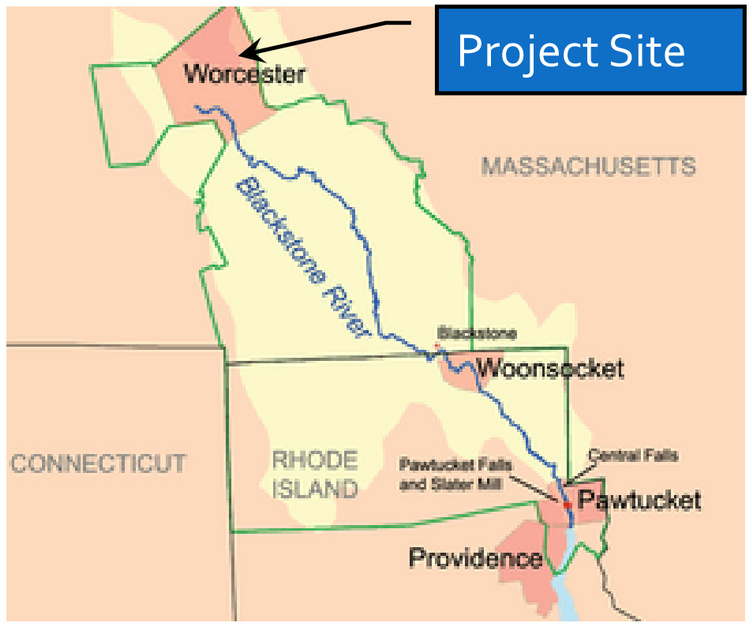
Project Goal

- Pilot and Design an "Embankment Filter" as a SCM that can be installed on slopes typically considered too steep
- Final phase of a 3-phase project to eliminate untreated runoff



Watershed and Receiving Waters

- Site on the west side of Lake Quinsigamond, between Lake Ave. and the lake near Route 9
- Highly developed watershed in Worcester and Shrewsbury
- Lake is ~4 miles long, used for swimming, boating, fishing, etc.
- Lake Quinsigamond, impaired for:
  - Bacteria
  - Dissolved Oxygen
  - Invasive plants
  - Others
- Flows to the Blackstone River, impaired for:
  - Phosphorus
  - Nutrients
  - Bacteria
  - Suspended solids
  - Others, e.g. metals

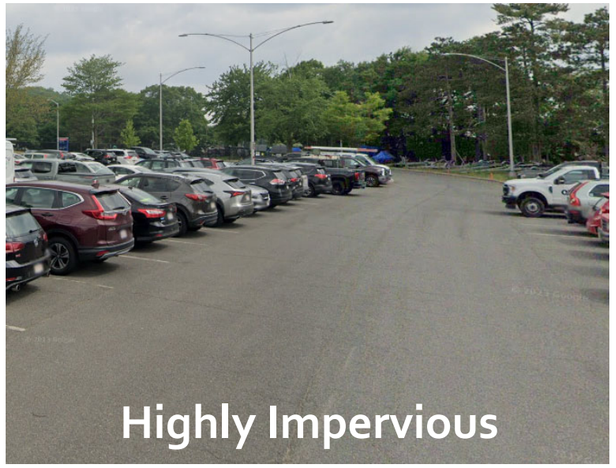


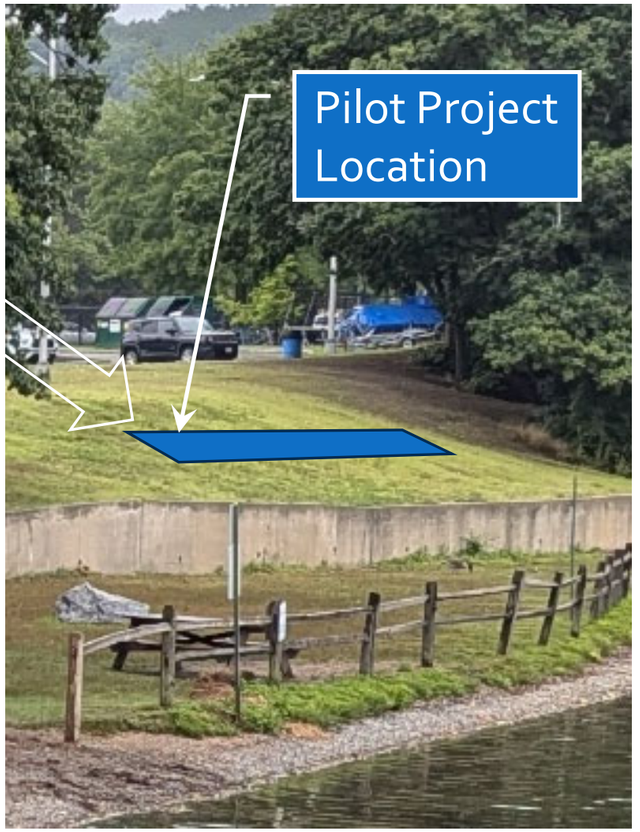


Existing Site – Regatta Point







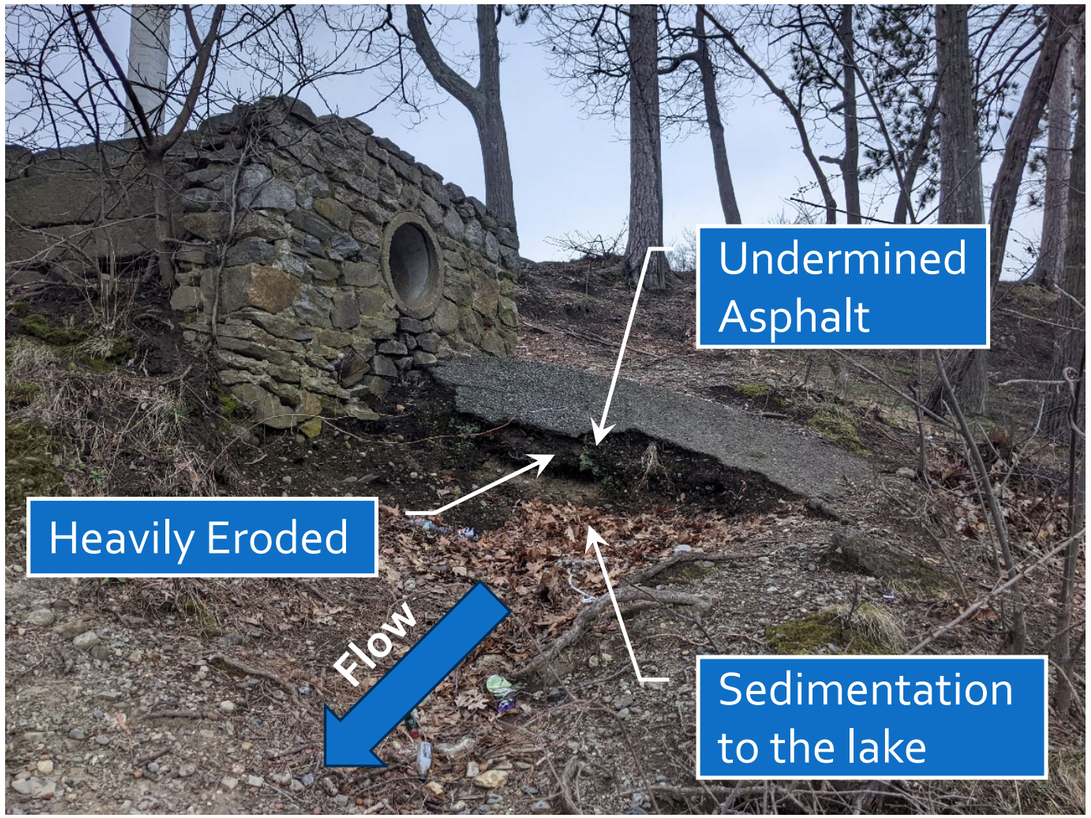






Existing Site – Outfall





Site Constraints

- Relatively steep 4:1 slope
- 4’ high retaining wall
- Close to water
- Commuter parking lot, can’t lose parking spaces or similar









Environmental Permitting

- Proximity to inland bank
- 100’ MassDEP wetland buffer
- 15’ and 30’ Worcester local buffers
- Bordering Land Subject to Flooding (BLSF)

IMPACT NOTES:

INLAND BANK

15 15-FT BUFFER ZONE

30 30-FT BUFFER ZONE

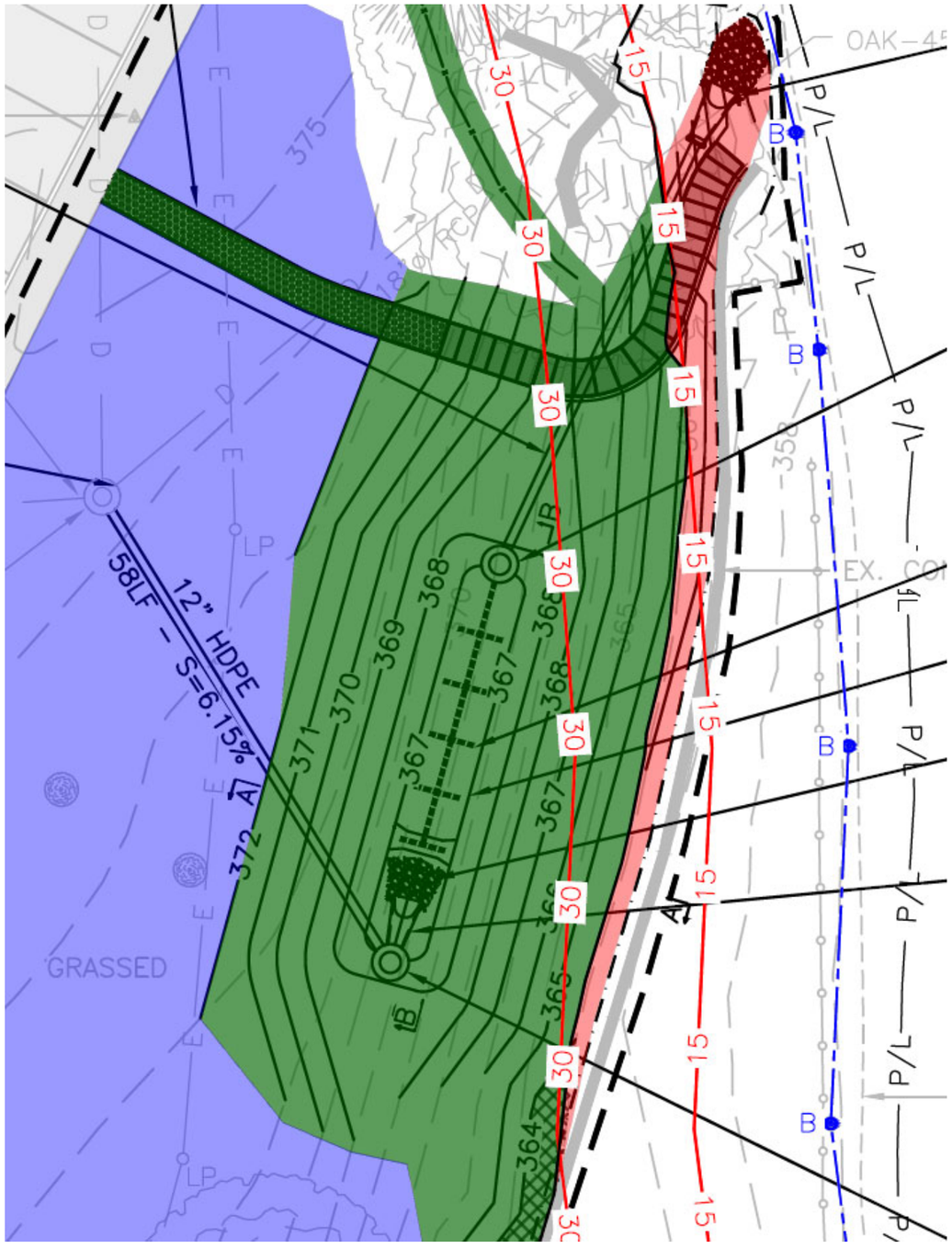
100’ 100-FT BUFFER ZONE

100-FT BUFFER PERMANENT IMPACTS: 4,590 SF

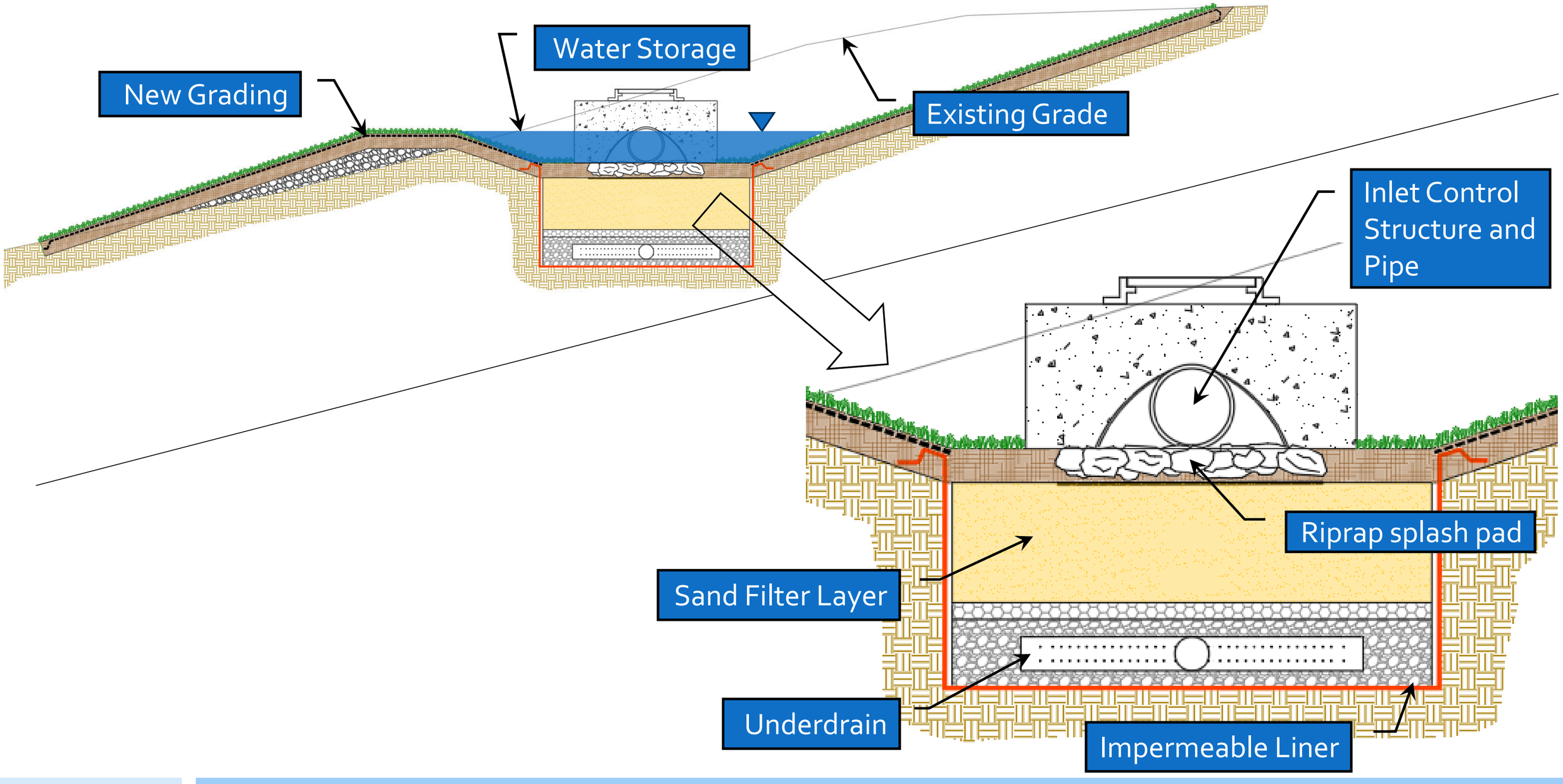
100-FT BUFFER TEMPORARY IMPACTS: 10,675 SF

TOTAL 100-FT BUFFER IMPACTS: 15,265 SF

BLSF IMPACTS: 2,150 SF
(400 SF OF IMPACTS ASSOCIATED WITH STAIRS, STORMWATER OUTFALL AND GRADING
1750 SF OF IMPACTS ASSOCIATED WITH LOAM AND SEED)



Embankment (Sand) Filter – Key Components



Embankment Filter – Key Components



Arctic Fire Red Twig Dogwood



Lowbush Blueberry

Sediment Forebay with Splash Pad

Plantings

Outlet Control Structure with High Flow Bypass

Deep Sump Inlet Structure and Pipes

Overflow Berm

Sand Filter Layer

Underdrain Cleanout

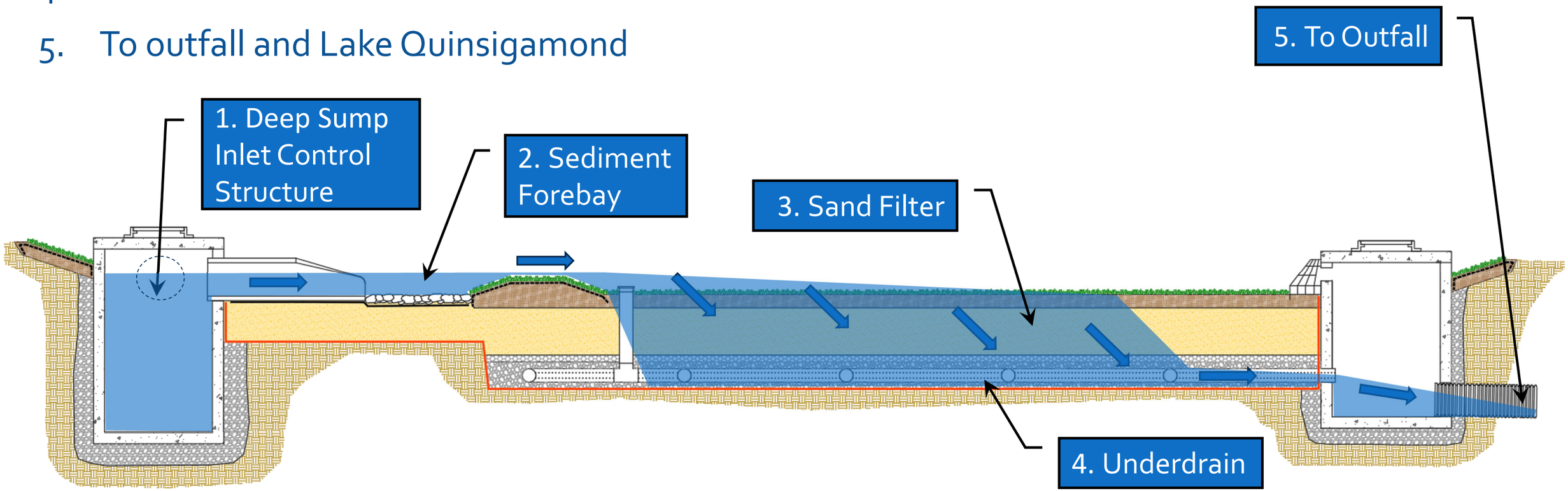
Underdrain with Crushed Stone

Impermeable Liner

Pipe To Outfall

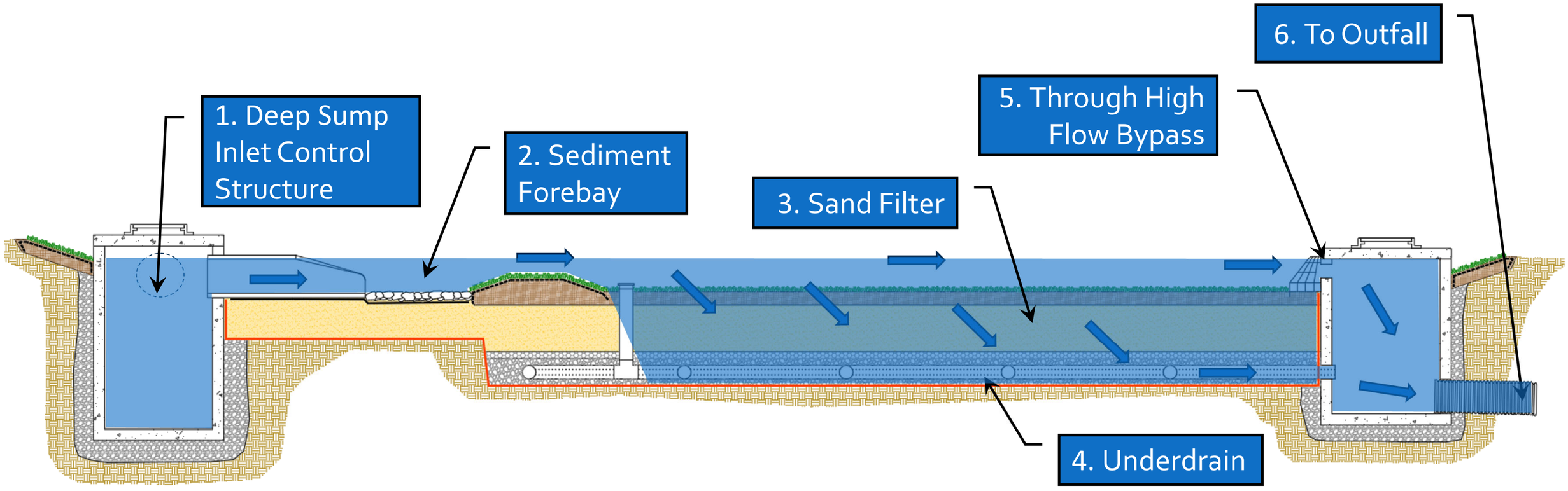
BMP Function Overview – Low Flow Conditions

1. Water flows into inlet control structure
2. To deep sump & forebay – TSS removal
3. Through sand filter – nutrient removal
4. Into underdrain
5. To outfall and Lake Quinsigamond



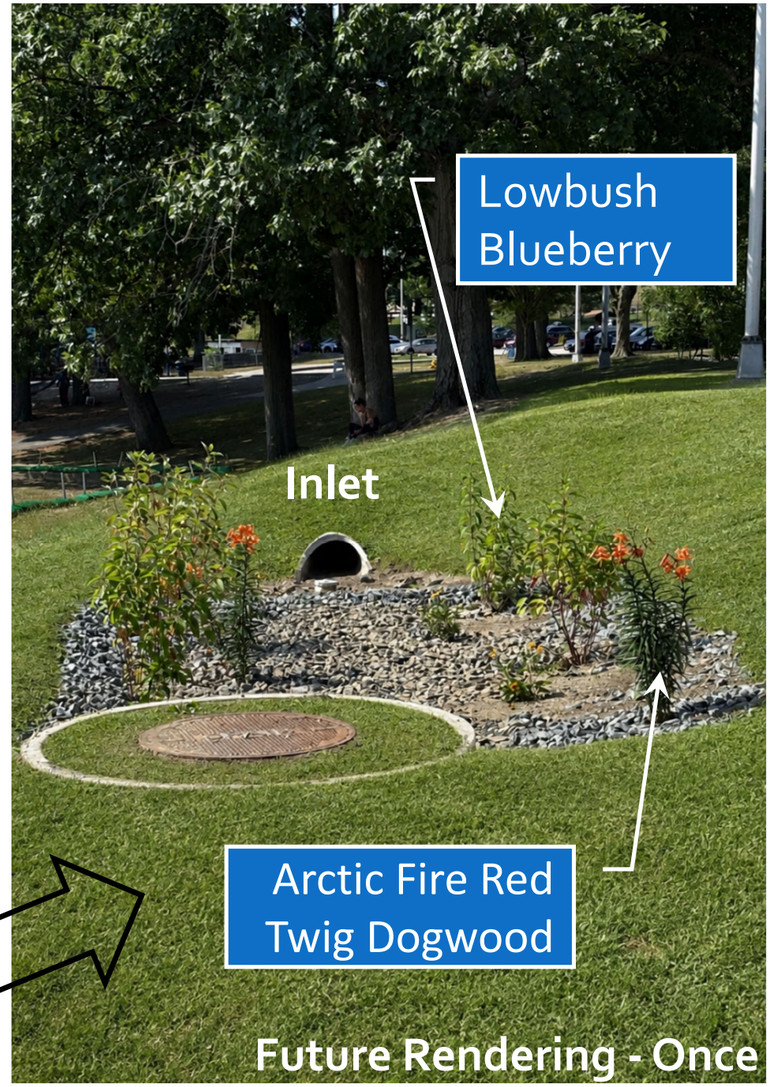
BMP Function Overview – Overflow Conditions

1. Water flows into inlet control structure
2. To sediment forebay – TSS removal
3. Through sand filter – nutrient removal
4. Into underdrain
5. Also through high flow bypass
6. To outfall and Lake Quinsigamond



After Construction







Water Quality Improvements

- BMP treats ~1” water quality volume
- Limited by a small contributing watershed
- Many site constraints means limited reduction potential
- Retaining wall means no infiltration which limits phosphorus treatment
- Unquantified improvements by fixing outfall

Treatment Calculations	
Total Project Drainage Area:	0.18 acre
Total Impervious Area:	0.11 acre
Water Quality Volume:	385 cf
Proposed Drainage Improvement Storage/Treatment Volume:	375 cf
Storage/Treatment of WQV:	97%

BMP Accounting and Tracking Tool (BATT) Pollutant Load and Reduction Estimates		
Pollutant	**Load (lb/yr)**	**Reduction (lb/yr)**
Total Phosphorus	0.15	0.08
Total Nitrogen	1.19	0.38
Total Suspended Solids	165	163

Other Project Components

- Designed for ease of construction
- Future walkway, stairs and railing – pedestrian control and fishing access
- Relocated and stabilized outfall
- Educational kiosk (next slide)


Old Outfall – Plugged and Abandoned


Old Outfall – Steep, Eroded and Undermined


New Outfall – Stabilized Splash Pad and No Steep Drop

Informational Kiosk Design – Overview



Quinsigamond State Park - Regatta Point Stormwater Management



What is Stormwater Runoff?

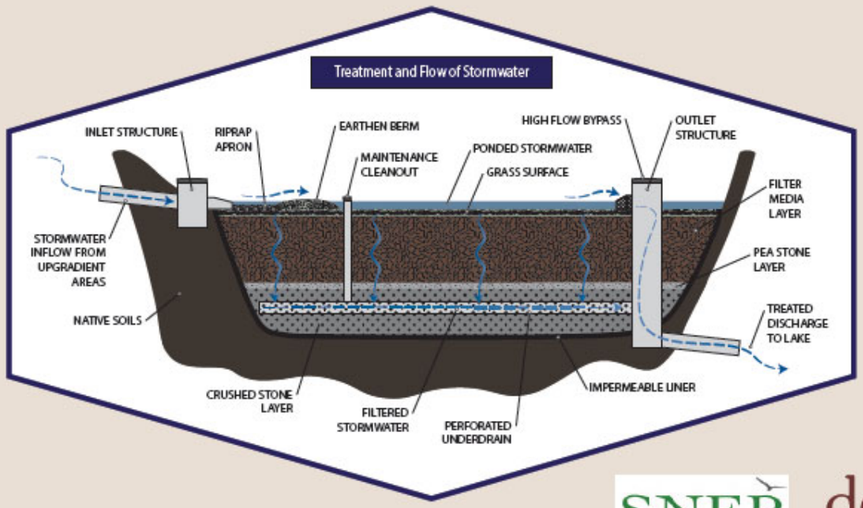
Stormwater runoff is rain or snowmelt that flows over the land's surface, rather than soaking into the ground. In urban areas, this includes water running off of impervious areas, such as pavement, concrete, or rooftops. As this runoff flows overland, it can pick up pollutants such as trash, sediment, pet waste, yard clippings, fertilizer, chemicals, and oils, also referred to as non-point source pollution. This contaminated runoff is collected through drains and pipes and transported to lakes, rivers, streams, and coastal waters.

What was Constructed?

This project features a sand filter designed to treat stormwater runoff from over 0.25-acre of paved surfaces before it reaches Lake Quinsigamond. The system uses filter media composed of washed concrete sand to remove key stormwater pollutants including phosphorus and nitrogen. With proper maintenance, this sand filter will treat over 350,000 gallons of stormwater runoff per year.

Why was this Constructed?

Stormwater runoff carrying pollutants from impervious surfaces can have detrimental impacts on water resources. Nutrients, such as phosphorus and nitrogen, are especially problematic as they contribute to a process called eutrophication, which leads to harmful algal blooms, and depleted oxygen levels, reducing the overall biodiversity and health of the ecosystem. This sand filter was constructed to attenuate, infiltrate, and treat stormwater runoff before it discharges to Lake Quinsigamond to mitigate these impacts.



SNEP Southeast New England Program

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Informational Kiosk Design – the What and the Why

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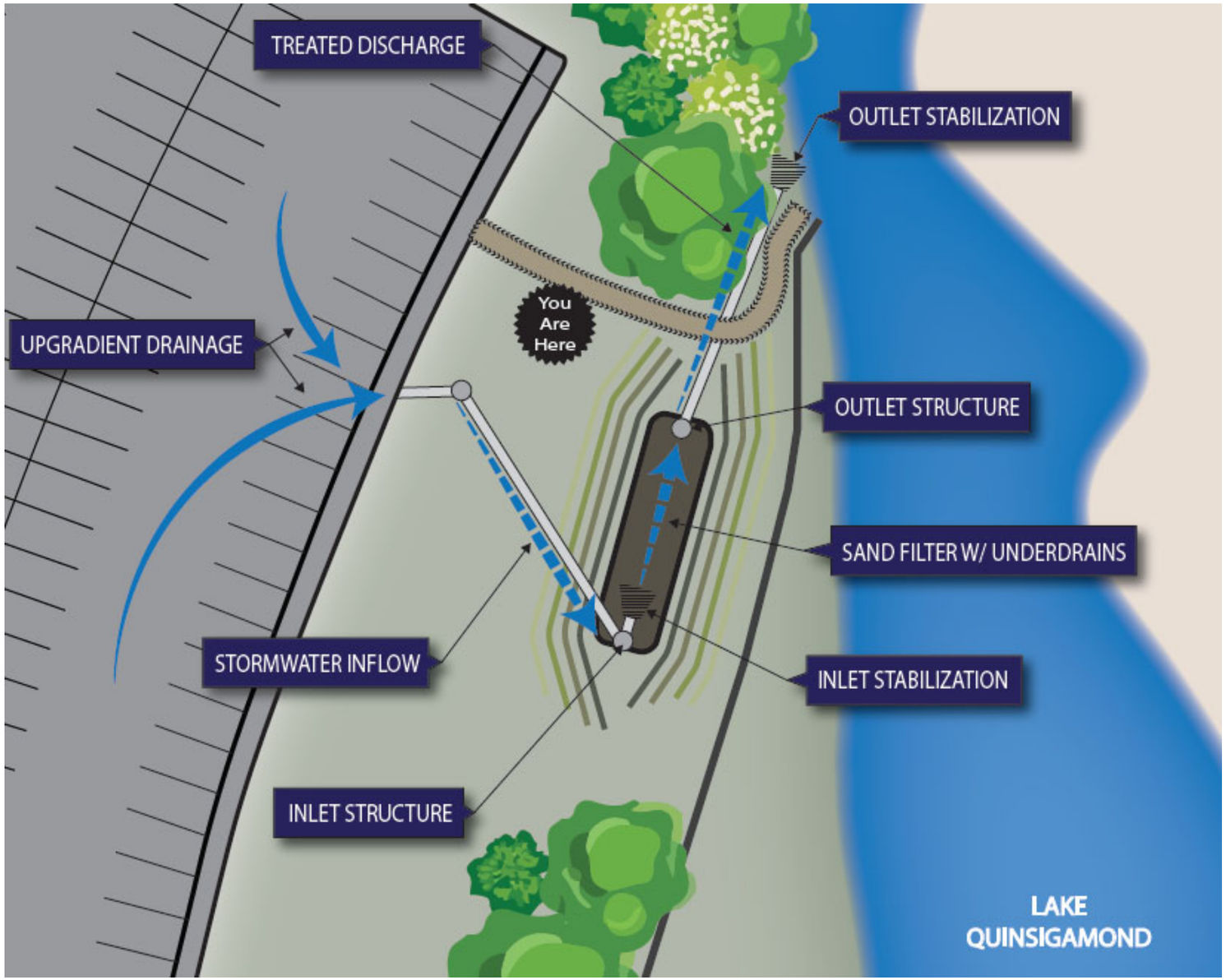
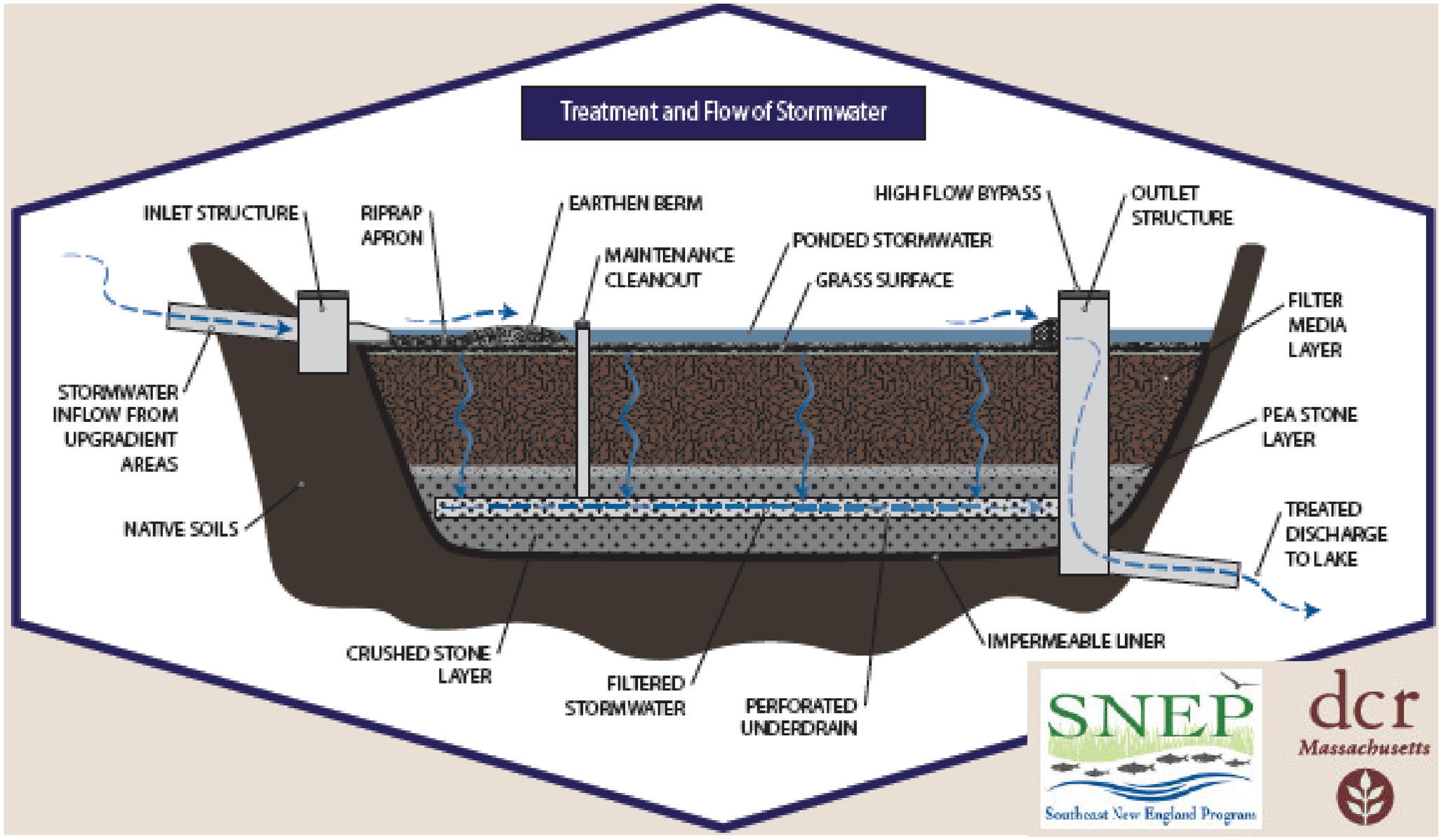
Informational Kiosk Design – Layout



Informational Kiosk Design – Function



Challenges and Lessons Learned

- Many site constraints – steep, retaining wall, resource areas, heavily used area, etc.
- Limited available watershed – most had already been disconnected
- Limited storage when running parallel to slopes – can only regrade so much
- Limited construction $$ for implementation
- Lack of infiltration limits phosphorus removal







Thank You

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