

Name

Affiliation

**What is YOUR biggest challenge
in stormwater control measure
accounting/planning?**



Opti-Tool Outreach Workshop Part 1

Research Based Stormwater System Accounting



November, 2017



Introduction

Unit Operations & Processes (UOPs)

Review of BMPs

Review of BMP Worksheets and Cross-walks

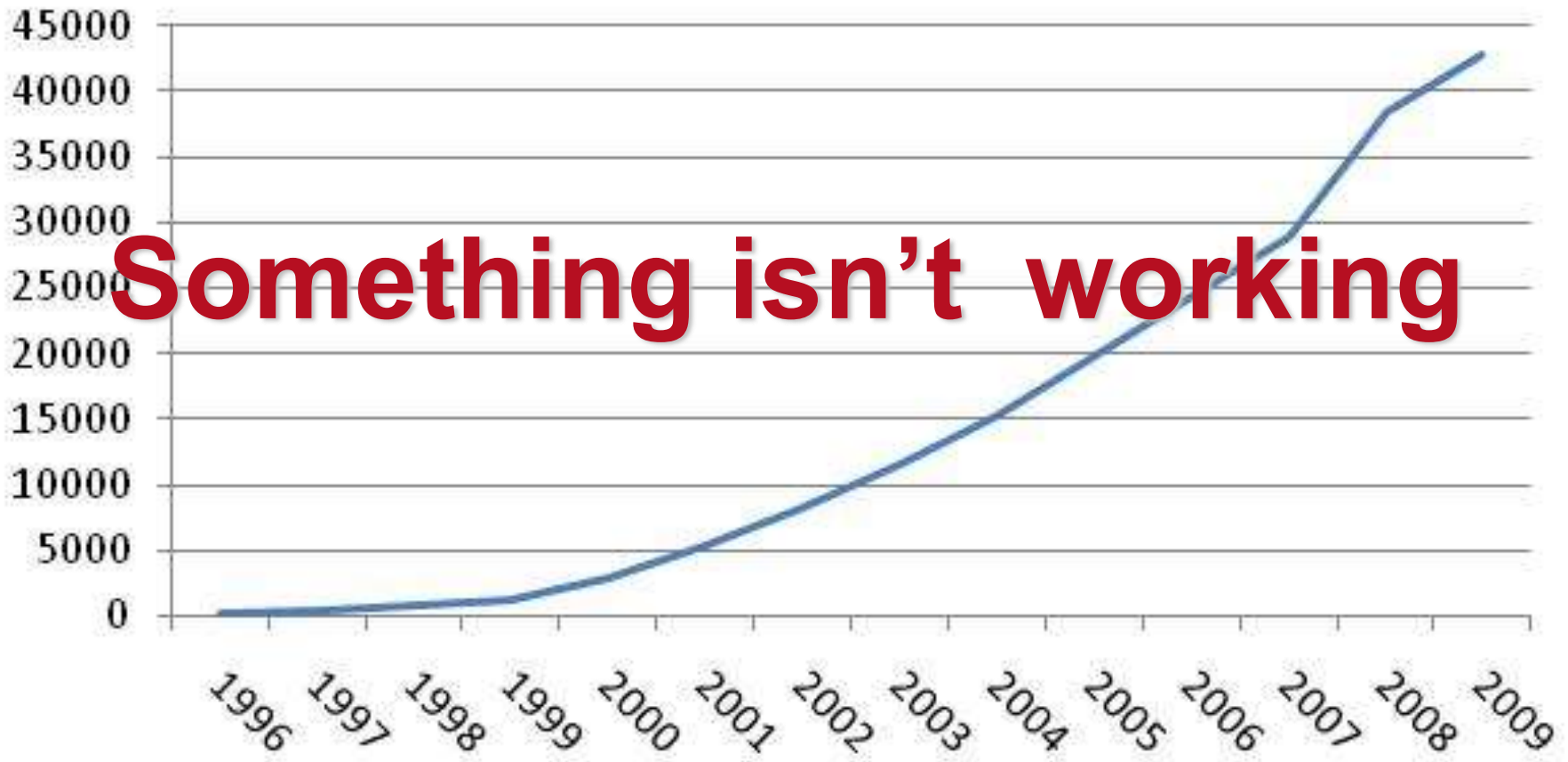
Costs

Effective SWM Case Study

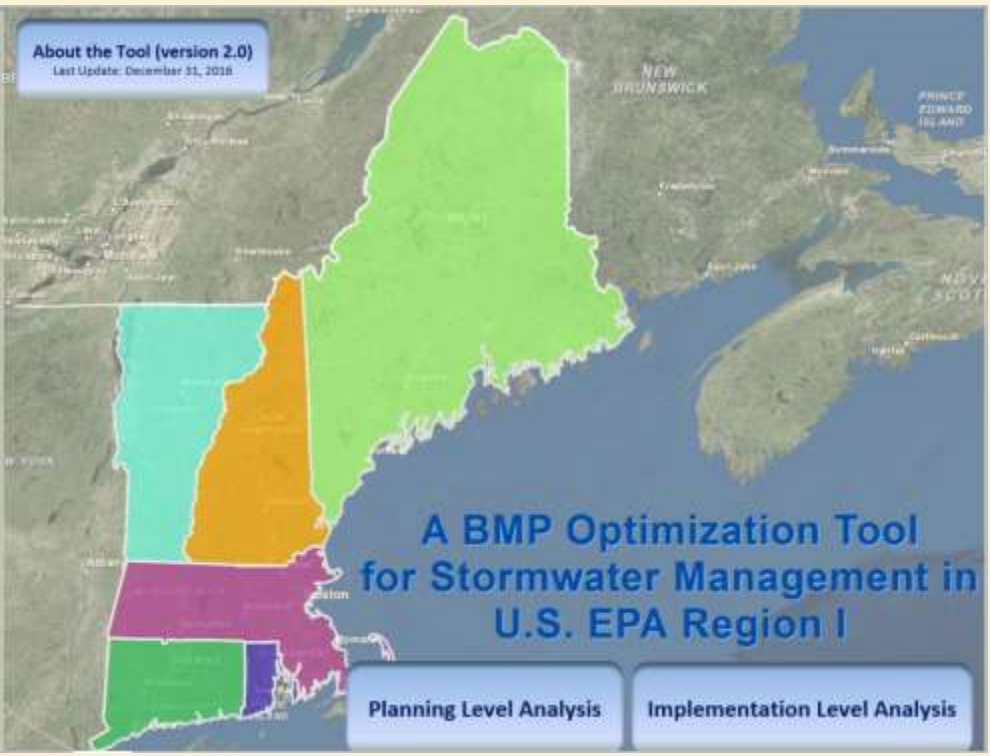
Site Design Assessment

Group Debrief & Discussion

Number of TMDLs



What is the Opti-Tool



About the Tool (version 2.0)
Last Update: December 31, 2018

**A BMP Optimization Tool
for Stormwater Management in
U.S. EPA Region I**

Planning Level Analysis Implementation Level Analysis

MA MS4 General Permit

United States Environmental Protection Agency (EPA)
National Pollutant Discharge Elimination System (NPDES)

**GENERAL PERMITS FOR STORMWATER DISCHARGES FROM
SMALL MUNICIPAL SEPARATE STORM SEWER SYSTEMS
IN MASSACHUSETTS**

**AUTHORIZATION TO DISCHARGE UNDER THE
NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM**

In compliance with the provisions of the Clean Water Act (CWA), as amended (33 U.S.C. §1251 *et seq.*), and the Massachusetts Clean Waters Act, as amended (M.G.L. Chap.21 §§ 26-53), any operator of a small municipal separate storm sewer system whose system:

- Is located in the areas described in part 1.1;
- Is eligible for coverage under part 1.2 and part 1.9; and
- Submits a complete and accurate Notice of Intent in accordance with part 1.7 of this permit and EPA issues a written authorization

is authorized to discharge in accordance with the conditions and the requirements set forth herein.

The following appendices are also included as part of these permits:

- Appendix A – Definitions, Abbreviations, and Acronyms;
- Appendix B – Standard permit conditions applicable to all authorized discharges;
- Appendix C – Endangered Species Act Eligibility Guidance;
- Appendix D – National Historic Preservation Act Eligibility Guidance;
- Appendix E – Information required for the Notice of Intent (NOI);
- Appendix F – Requirements for MA Small MS4s Subject to Approved TMDLs;
- Appendix G – Impaired Waters Monitoring Parameter Requirements;
- Appendix H – Requirements related to discharges to certain water quality limited waterbodies;

These permits become effective on **July 1, 2017**.

These permits and the authorization to discharge expire at midnight, **June 30, 2022**.

Signed this 4th day of April, 2016


Ken Moraff, Director
Office of Ecosystem Protection
United States Environmental Protection Agency
5 Post Office Square – Suite 100
Boston, Massachusetts 02109-3912

Signed this 4th day of April 2016


Douglas E. Fine
Assistant Commissioner for Water Resources
Department of Environmental Protection
One Winter Street
Boston, Massachusetts 02108

Materials We Will Use Today

Infiltration Trench Factsheet

Infiltration Trench is a practice that provides temporary storage of runoff from the roof system within the roof and paved area for use to backfill the trench for subsequent infiltration into the surrounding subsoils. Performance credits for the infiltration trench can be used for all surface infiltration practices including systems that include pipes and structures that provide temporary storage. Also, the credits for the BMP type can be used for stormwater systems that rely on infiltration along the majority of the temporary storage capacity to provide to the roof space of the roof. Other trade and permit parameters that allow infiltration to occur. General design specifications for infiltration trench systems are provided in the next section of the *New England Stormwater Manual*, Volume 2: *Pre-Construction Best Management Practices Selection and Design*.



Permitted Infiltration Rates by Land Use¹

| Land Use Category | Permitted Infiltration Rate (inches per hour) |
|------------------------------------|---|
| Residential (Single-Family) | 0.75 |
| Commercial (Office and Industrial) | 1.50 |
| Industrial (Light and Heavy) | 1.50 |
| Highway (Highway) | 1.50 |
| Airport (Runway) | 1.50 |

General Equations

$$\text{Physical Storage Capacity} = \text{Depth of Storage} \times \text{Design Area}$$

$$\text{Cost Physical Storage Capacity} = \text{Cost Index} \times \text{Design Area}$$

$$\text{Yearly Pollutant Removal} = \text{Pollutant Load} \times \text{Design Area} \times \text{Efficiency}$$

| Infiltration Trench System | Materials and Installation Cost (\$/SF) (2012) ² | Design Cost (\$/SF) (2012) ² | Materials and Installation Cost (\$/SF) (2017) ³ | Design Cost (\$/SF) (2017) ³ |
|----------------------------|---|---|---|---|
| Gravel | 8 | 2.8 | 8.88 | 8.88 |
| Mixed | 18 | 3.8 | 20.88 | 8.88 |
| Urban | 24 | 8.4 | 29.22 | 13.22 |

¹From 2005 and 2012 New England Stormwater Manual, Volume 2: Pre-Construction Best Management Practices Selection and Design. ²Costs based on 2012 prices. ³Costs based on 2017 prices.

| Stormwater Management Material | Non-Stormwater Management Material | EPA Pollutant Criteria | EPA Cost Estimate |
|--------------------------------|------------------------------------|------------------------|-------------------|
| Concrete | Asphalt | SS, Sediment | Concrete |
| Gravel | Grass | SS, Sediment | Gravel |
| Geotextile | Geotextile | SS, Sediment | Geotextile |
| ... | ... | ... | ... |

Stormwater Design Credits

| Design Practice | Design Credit |
|-----------------|---------------|
| Gravel Trench | 1.00 |
| Mixed Trench | 1.50 |
| Urban Trench | 2.00 |

Stormwater Design Credits

Comparison of design credits for different stormwater management practices. Includes a bar chart showing credits for various practices like pervious concrete, gravel trench, and mixed trench.

Stormwater Champion: John Sullivan

John Sullivan is a stormwater champion in the city of Durham, NH. He has implemented various stormwater management practices in his community, including infiltration trenches. He is proud of his work and the positive impact it has on the environment.

Introduction

Unit Operations & Processes (UOPs)

Review of BMPs

Review of BMP Worksheets and Cross-walks

Costs

Effective SWM Case Study

Site Design Assessment

Group Debrief & Discussion

Because we don't always speak
the same language

Swale Permeable Interlocking Concrete Pavers
Retention Pond
Permeable Interlocking Concrete Pavers
Subsurface Detention Interlocking Concrete Pavers
Water Quality Inlet
Permeable Interlocking Concrete Pavers
Downstream Defender Bio-Swale Naturalized Basin
Permeable Interlocking Concrete Pavers
Storm Trooper Vort-Sentry V2B1 Bay Saver
Permeable Interlocking Concrete Pavers
Bioretention Rain Garden River Filter
Permeable Interlocking Concrete Pavers Filtera
Sand Filter Delaware Austin ADS StormTech
Permeable Interlocking Concrete Pavers
Gravel Wetland Stormwater Wetland Surface Wetland
Permeable Interlocking Concrete Pavers
Pervious Concrete Porous Asphalt Constructed Wetland

Imagine the Ultimate System...



Now Consider Bioretention



Use Unit Operations & Processes (UOPs)

- Physical Operations
- Biological Processes
- Chemical Processes
- Hydrologic Operations



Sedimentation

Enhanced Sedimentation

Filtration

Screening



Vegetative Process

Microbial Process



Sorption

Antibacterial

Flocculation

Coagulation



Flow Alteration

Volume Reduction



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| BMP Type | Design Storage Capacity (ft ³) | BMP Cost (\$) | Treated Impervious Area (ac) | O&M (hr/yr) | Load Reduction (lbs) | Treated Runoff Depth (in) |
|------------------------|--|---------------|------------------------------|-------------|----------------------|---------------------------|
| Biofiltration with ISR | - | \$ - | - | - | - | - |
| Bioretention | - | \$ - | - | - | - | - |
| Dry Pond | - | \$ - | - | - | - | - |
| Grass Swale* | - | \$ - | - | - | - | - |
| Gravel Wetland | - | \$ - | - | - | - | - |
| Infiltration Basin | - | \$ - | - | - | - | - |
| Infiltration Chambers* | - | \$ - | - | - | - | - |
| Infiltration Trench | - | \$ - | - | - | - | - |
| Porous Pavement* | - | \$ - | - | - | - | - |
| Sand Filter | - | \$ - | - | - | - | - |
| Wet Pond | - | \$ - | - | - | - | - |

Note: Only fill in the yellow highlighted cells.

* Place holder for future option (not implemented)

<https://www.epa.gov/tmdl/opti-tool-epa-region-1s-stormwater-management-optimization-tool>

Covered in Opti (8)

- Biofiltration with ISR
- Biofiltration
- Dry Pond
- Gravel Wetland
- Infiltration Basin
- Infiltration Trench
- Sand Filter
- Wet Pond

Covered in MS4 (2)

- Pemeable (Porous) Pavement
- Grass Swale

Design Storage Volume (DSV), aka Design Storage Capacity

L = length

W = width

D = depth at design capacity before bypass

n = porosity/void space of fill material

- soil media (bio-retention soil mix, engineered soil mix, etc.) = 0.2
- peastone ($\frac{3}{8}$ " washed) = 0.3
- reservoir stone ($\frac{3}{4}$ " washed) = 0.4

A = average surface area for calculating volume

Infiltration Basin/Surface Infiltration for raingarden or bio-retention with no underdrains

- DSV = Ponding water storage volume and void space volumes of soil filter media and stone layers, if applicable.
- $DSV = (A_{\text{pond}} \times D_{\text{pond}}) + (A_{\text{soil}} \times D_{\text{soil}} \times n_{\text{soil}}) + (A_{\text{stone}} \times D_{\text{stone}} \times n_{\text{stone}})$

Infiltration Basin/Surface Infiltration for raingarden or bio-retention with no underdrains

- $DSV = (A_{\text{pond}} \times D_{\text{pond}}) + (A_{\text{soil}} \times D_{\text{soil}} \times n_{\text{soil}}) + (A_{\text{stone}} \times D_{\text{stone}} \times n_{\text{stone}})$

A = 100 sf

Ponded Depth = 1'

Soil Depth = 2'

Stone Depth = 1.5'

$$DSV = (100 \times 1 \times 1) + (100 \times 2 \times 0.2) + (150 \times 1 \times 0.4)$$

$$DSV = 200 \text{ cf}$$

Treated Runoff Depth

$$= DSV/WQV \times 12$$

| | |
|----------------------|-----------------------|
| Drainage Area | 1 acre (43,560 sf) |
| Impervious Area | 0.6 acres (26,136 sf) |
| WQV = Area sf x 1/12 | 2,000 cf |
| DSV | 200 cf |
| Treated Runoff Depth | 0.1 inches |

Review of Worksheets

Infiltration Trench Factsheet

Infiltration Trench is a practice that provides temporary storage of runoff using the void spaces within the undisturbed substrate that is used to backfill the trench for subsequent infiltration into the surrounding substrate. Performance credits for infiltration trenches can be used for all substrate infiltration practices including systems that include pipes and/or structures that provide temporary storage. Also, the credits for the DDF type can be used for bio-retention systems that rely on infiltration when the majority of the temporary storage capacity is provided in the void spaces of the soil. When tanks and porous pavements that allow infiltration to occur. General design specifications for infiltration trench systems are provided in the most recent version of *The New Hampshire Stormwater Manual, Volume 2: Post-Construction Best Management Practices Selection and Design*.

Sample Design

Physical Storage Capacity: Depth of Backfill * Drainage Area
Cost: Physical Storage Capacity * Cost/Unit * Adjustment Factor
Yearly Pollutant Removal: Pollutant Load/Event Rate * Drainage Area * Efficiency

| Source Category by Land Use | Load Surface Coefficient | P Load Export Rate (lb/acre/year) | R Load Export Rate (lb/acre/year) |
|---|---------------------------|-----------------------------------|-----------------------------------|
| Commercial (CCM) and Institutional (IPI) | Stormwater imperviousness | 1.75 | 1.0 |
| Multi-Family (MFU) and High Density Residential (HDR) | Stormwater imperviousness | 1.52 | 1.1 |
| Medium Density Residential (MDR) | Stormwater imperviousness | 1.08 | 1.1 |
| Low Density Residential (LDR) - "Paver" | Stormwater imperviousness | 1.12 | 1.1 |

| Infiltration Trench System | Materials and Installation Cost (\$/ft ²) (2002) ² | Design Cost (\$/ft ²) (2002) | Materials and Installation Cost (\$/ft ²) (2013) ³ | Design Cost (\$/ft ²) (2013) |
|----------------------------|---|--|---|--|
| Rock | 8 | 2.8 | 9.88 | 9.88 |
| Mixed | 16 | 3.4 | 20.68 | 9.88 |
| UBan | 24 | 3.4 | 29.52 | 12.28 |

¹ From 1990² Cost Database (www.nhdes.com) (1990 to 2011 inflation using U.S. Department of Labor (BLS) CPI-U) (1990 = 100)
² U.S. Bureau of Labor Statistics consumer price index inflation index
³ Estimated from Cost Database (1990 = 100 index)

Prepared By:
 University of New Hampshire Stormwater Center
 2013-2014
 02/15/2014
 August 2017

| Non-Point Source Stormwater Manual | New Hampshire Stormwater Manual | TPA Pollutant Credit | TPA Cost Estimate |
|---|--------------------------------------|----------------------|-------------------|
| Construction Area 1: Non-Construction Activities | Construction (Type 1) (2002) (100%) | 100% Total | 100% Total |
| Construction Area 2: Non-Construction Activities | Construction (Type 2) (2002) (100%) | 100% Total | 100% Total |
| Construction Area 3: Non-Construction Activities | Construction (Type 3) (2002) (100%) | 100% Total | 100% Total |
| Construction Area 4: Non-Construction Activities | Construction (Type 4) (2002) (100%) | 100% Total | 100% Total |
| Construction Area 5: Non-Construction Activities | Construction (Type 5) (2002) (100%) | 100% Total | 100% Total |
| Construction Area 6: Non-Construction Activities | Construction (Type 6) (2002) (100%) | 100% Total | 100% Total |
| Construction Area 7: Non-Construction Activities | Construction (Type 7) (2002) (100%) | 100% Total | 100% Total |
| Construction Area 8: Non-Construction Activities | Construction (Type 8) (2002) (100%) | 100% Total | 100% Total |
| Construction Area 9: Non-Construction Activities | Construction (Type 9) (2002) (100%) | 100% Total | 100% Total |
| Construction Area 10: Non-Construction Activities | Construction (Type 10) (2002) (100%) | 100% Total | 100% Total |
| Construction Area 11: Non-Construction Activities | Construction (Type 11) (2002) (100%) | 100% Total | 100% Total |
| Construction Area 12: Non-Construction Activities | Construction (Type 12) (2002) (100%) | 100% Total | 100% Total |
| Construction Area 13: Non-Construction Activities | Construction (Type 13) (2002) (100%) | 100% Total | 100% Total |
| Construction Area 14: Non-Construction Activities | Construction (Type 14) (2002) (100%) | 100% Total | 100% Total |
| Construction Area 15: Non-Construction Activities | Construction (Type 15) (2002) (100%) | 100% Total | 100% Total |
| Construction Area 16: Non-Construction Activities | Construction (Type 16) (2002) (100%) | 100% Total | 100% Total |
| Construction Area 17: Non-Construction Activities | Construction (Type 17) (2002) (100%) | 100% Total | 100% Total |
| Construction Area 18: Non-Construction Activities | Construction (Type 18) (2002) (100%) | 100% Total | 100% Total |
| Construction Area 19: Non-Construction Activities | Construction (Type 19) (2002) (100%) | 100% Total | 100% Total |
| Construction Area 20: Non-Construction Activities | Construction (Type 20) (2002) (100%) | 100% Total | 100% Total |
| Construction Area 21: Non-Construction Activities | Construction (Type 21) (2002) (100%) | 100% Total | 100% Total |
| Construction Area 22: Non-Construction Activities | Construction (Type 22) (2002) (100%) | 100% Total | 100% Total |
| Construction Area 23: Non-Construction Activities | Construction (Type 23) (2002) (100%) | 100% Total | 100% Total |
| Construction Area 24: Non-Construction Activities | Construction (Type 24) (2002) (100%) | 100% Total | 100% Total |
| Construction Area 25: Non-Construction Activities | Construction (Type 25) (2002) (100%) | 100% Total | 100% Total |
| Construction Area 26: Non-Construction Activities | Construction (Type 26) (2002) (100%) | 100% Total | 100% Total |
| Construction Area 27: Non-Construction Activities | Construction (Type 27) (2002) (100%) | 100% Total | 100% Total |
| Construction Area 28: Non-Construction Activities | Construction (Type 28) (2002) (100%) | 100% Total | 100% Total |
| Construction Area 29: Non-Construction Activities | Construction (Type 29) (2002) (100%) | 100% Total | 100% Total |
| Construction Area 30: Non-Construction Activities | Construction (Type 30) (2002) (100%) | 100% Total | 100% Total |
| Construction Area 31: Non-Construction Activities | Construction (Type 31) (2002) (100%) | 100% Total | 100% Total |
| Construction Area 32: Non-Construction Activities | Construction (Type 32) (2002) (100%) | 100% Total | 100% Total |
| Construction Area 33: Non-Construction Activities | Construction (Type 33) (2002) (100%) | 100% Total | 100% Total |
| Construction Area 34: Non-Construction Activities | Construction (Type 34) (2002) (100%) | 100% Total | 100% Total |
| Construction Area 35: Non-Construction Activities | Construction (Type 35) (2002) (100%) | 100% Total | 100% Total |
| Construction Area 36: Non-Construction Activities | Construction (Type 36) (2002) (100%) | 100% Total | 100% Total |
| Construction Area 37: Non-Construction Activities | Construction (Type 37) (2002) (100%) | 100% Total | 100% Total |
| Construction Area 38: Non-Construction Activities | Construction (Type 38) (2002) (100%) | 100% Total | 100% Total |
| Construction Area 39: Non-Construction Activities | Construction (Type 39) (2002) (100%) | 100% Total | 100% Total |
| Construction Area 40: Non-Construction Activities | Construction (Type 40) (2002) (100%) | 100% Total | 100% Total |
| Construction Area 41: Non-Construction Activities | Construction (Type 41) (2002) (100%) | 100% Total | 100% Total |
| Construction Area 42: Non-Construction Activities | Construction (Type 42) (2002) (100%) | 100% Total | 100% Total |
| Construction Area 43: Non-Construction Activities | Construction (Type 43) (2002) (100%) | 100% Total | 100% Total |
| Construction Area 44: Non-Construction Activities | Construction (Type 44) (2002) (100%) | 100% Total | 100% Total |
| Construction Area 45: Non-Construction Activities | Construction (Type 45) (2002) (100%) | 100% Total | 100% Total |
| Construction Area 46: Non-Construction Activities | Construction (Type 46) (2002) (100%) | 100% Total | 100% Total |
| Construction Area 47: Non-Construction Activities | Construction (Type 47) (2002) (100%) | 100% Total | 100% Total |
| Construction Area 48: Non-Construction Activities | Construction (Type 48) (2002) (100%) | 100% Total | 100% Total |
| Construction Area 49: Non-Construction Activities | Construction (Type 49) (2002) (100%) | 100% Total | 100% Total |
| Construction Area 50: Non-Construction Activities | Construction (Type 50) (2002) (100%) | 100% Total | 100% Total |

Notes: Not used without descriptive credit debit. **Notes:** Not used without descriptive credit debit.

Other Costs: Installation, Design, Construction, Operation & Maintenance, Decommissioning, etc.

Fill in the Blanks

| BMP Type | DSV (cf) | Treated IC acres (sf) | Treated Runoff Depth | % Load Reduction | | |
|-------------------------------------|----------|-----------------------|----------------------|------------------|----|----|
| | | | | TSS | TP | TN |
| Bioretention/ Infiltration Basin | 200 | 1 (26,136) | 1.2 | | | |
| | | | | | | |

HSG A = 8.24 in/hr

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Life Cycle Costs Including Maintenance

| BMP | Area of IC treated | WQv (cf) | BMP Area ft ³ | Annual Ave Maintenance \$ | Annual Maintenance hours | Capital Cost per acre of IC treated | 2010 Adj Capital Cost of system * | Added design contingency of 35% | Capital Costs per ft ³ | Capital Costs per cf treated (WQv) | Capital Costs per BMP storage volume (cf) | Capital Costs/sf of IC | Amortized Life Cycle Costs *** |
|--|--------------------|----------|--------------------------|---------------------------|--------------------------|-------------------------------------|-----------------------------------|---------------------------------|-----------------------------------|------------------------------------|---|------------------------|--------------------------------|
| Vegetated Swale | 1.00 | 3,630 | 5,400 | \$822.50 | 9.5 | \$11,200.00 | \$12,928.68 | \$17,453.72 | \$3.23 | \$4.81 | NA | \$0.26 | \$33,903.72 |
| Retention Pond | 1.00 | 3,630 | 12,880 | \$3,060.00 | 28.0 | \$13,700.00 | \$15,814.54 | \$21,349.63 | \$1.66 | \$5.88 | \$5.88 | \$0.31 | \$82,549.63 |
| Detention Pond | 1.00 | 3,630 | 12,880 | \$2,380.00 | 24.0 | \$13,700.00 | \$15,814.54 | \$21,349.63 | \$1.66 | \$5.88 | \$5.88 | \$0.31 | \$68,949.63 |
| Chamber System | 1.00 | 3,630 | 434 | Not assessed | Not assessed | \$34,000.00 | \$34,434.75 | \$46,486.91 | \$107.13 | \$12.81 | \$107.13 | \$0.78 | Not assessed |
| Sand Filter | 1.00 | 3,630 | 640 | \$2,807.50 | 28.5 | \$12,417.00 | \$14,333.52 | \$19,350.25 | \$30.23 | \$5.33 | \$15.51 | \$0.29 | \$75,500.25 |
| Gravel Wetland | 1.00 | 3,630 | 1,920 | \$2,138.33 | 21.7 | \$22,300.00 | \$25,741.92 | \$34,751.59 | \$18.10 | \$9.57 | \$7.59 | \$0.51 | \$77,518.26 |
| Bioretention | 1.00 | 3,630 | 4,326 | \$1,890.00 | 20.7 | \$20,000.00 | \$23,086.92 | \$31,167.34 | \$7.21 | \$8.59 | \$13.37 | \$0.46 | \$68,967.34 |
| Enhanced Bio | 0.39 | 935 | 373 | \$1,890.00 | 21.0 | \$29,000.00 | \$29,000.00 | \$39,150.00 | \$105.09 | \$41.86 | \$105.09 | \$0.67 | \$68,967.34 |
| Porous Asphalt | 1.00 | 3,630 | 32,670 | \$1,080.00 | 6.0 | \$21,780.00 | \$22,058.49 | \$29,778.96 | \$0.91 | \$8.20 | \$4.60 | \$0.50 | \$51,378.96 |
| Pervious Concrete** | 1.00 | 3,630 | 32,670 | \$1,080.00 | 6.0 | \$74,052.00 | \$74,998.88 | \$101,248.49 | \$3.10 | \$27.89 | \$15.63 | \$1.70 | \$122,848.49 |
| Permeable Interlocking Concrete Pavement** | 1.00 | 3,630 | 32,670 | \$1,080.00 | 6.0 | \$74,052.00 | \$74,998.88 | \$101,248.49 | \$3.10 | \$27.89 | \$15.63 | \$1.70 | \$122,848.49 |

note all costs were converted from 2004 dollars to 2010 dollars with the exception of the permeable pavements which were converted from 2008 dollars to 2010 dollars

* See reference information from USDOL

** PA cost estimates were calculated as the difference between PA installations and a typical dense mix pavement equivalent. PC and PICP costs were developed using the same methodology and compared to typical DMA, not typical concrete or paver pavements.

*** Life cycle costs were calculated based on 2010 capital costs and amortized annual maintenance costs over an expected useful life of 20 years

<https://www3.epa.gov/region1/npdes/stormwater/ma/green-infrastructure-stormwater-bmp-cost-estimation.pdf>

Design, Capital, and Construction Costs

| Infiltration Trench System | Materials and Installation Cost (\$/ft ³) (2010) ² | Design Cost (\$/ft ³) (2010) | Materials and Installation Cost (\$/ft ³) (2017) ³ | Design Cost (\$/ft ³) (2017) |
|----------------------------|---|--|---|--|
| Rural | 4 | 1.88 | 4.92 | 1.72 |
| Mixed | 8 | 3.76 | 9.84 | 3.44 |
| Urban | 12 | 5.64 | 14.76 | 5.16 |

Region 1 GI Cost Estimates

| BMP (From Opti-Tool) | Cost (\$/ft ³) ¹ | Cost (\$/ft ³) – 2016 dollars ⁶ |
|---|---|--|
| Bioretention (Includes rain garden) | 13.37 ^{2,4} | 15.46 |
| Dry Pond or detention basin | 5.88 ^{2,4} | 6.80 |
| Enhanced Bioretention (aka-Bio-filtration Practice) | 13.5 ^{2,3} | 15.61 |
| Infiltration Basin (or other Surface Infiltration Practice) | 5.4 ^{2,3} | 6.24 |
| Infiltration Trench | 10.8 ^{2,3} | 12.49 |
| Porous Pavement - Porous Asphalt Pavement | 4.60 ^{2,4} | 5.32 |
| Porous Pavement - Pervious Concrete | 15.63 ^{2,4} | 18.07 |
| Sand Filter | 15.51 ^{2,4} | 17.94 |
| Gravel Wetland System (aka-subsurface gravel wetland) | 7.59 ^{2,4} | 8.78 |
| Wet Pond or wet detention basin | 5.88 ^{2,4} | 6.80 |
| Subsurface Infiltration/Detention System (aka-Infiltration Chamber) | 54.54 ⁵ | 67.85 |

¹ Footnote: Includes 35% add on for design engineering and contingencies

Fill in the Blanks

| BMP Type | DSV (cf) | Treated IC acres (sf) | Treated Runoff Depth | % Load Reduction | | |
|-------------------------------------|----------|-----------------------|----------------------|------------------|----|----|
| | | | | TSS | TP | TN |
| Bioretention/ Infiltration Basin | 200 | 1 (26,136) | 1.2 | 99 | 99 | 99 |
| | | | | | | |

| BMP Type | BMP Cost (\$/yr) | O&M Costs (hrs/yr) |
|----------------------------------|------------------|--------------------|
| Bioretention/ Infiltration Basin | | 12.42 |
| | | |

Assume Urban Environment

$$14.76 + 5.16 = 19.92 \times 200 = \$3,984$$

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Group Debrief & Discussion

Hand out case description of Daisy Field project: case should be designed to prompt/spark thinking about alternatives using GI/BMP approaches; Hold Discussion. 25 minutes



Daisy Field

- 47.4 Acre Ultra-urban environment at 65% IC
- Not a lot of space to put Bmps
- 62% TP reduction requirement as the discharge is to the Charles River

0 0.0250.05 0.1 0.15 0.2 Miles

University of New Hampshire Stormwater Center



Drawn By: JUH
Reviewed By: <Initials>
Date Prepared: 4-8-15

Drawing Title

Daisey Field
Boston, MA

Figure # 1



Daisy Field

| | |
|------------------------|-----------|
| P | 1 |
| A | 70.47 |
| I | 0.65 |
| Rv | 0.635 |
| WQV (acre-in) | 1.88 |
| WQV (ft ³) | 81,936.36 |
| S | 1.11 |
| Q (in) | 0.320325 |
| CN | 90 |
| la | 0.22 |
| la/P | 0.22 |
| TC (hr) | 0.12 |

What would you do?



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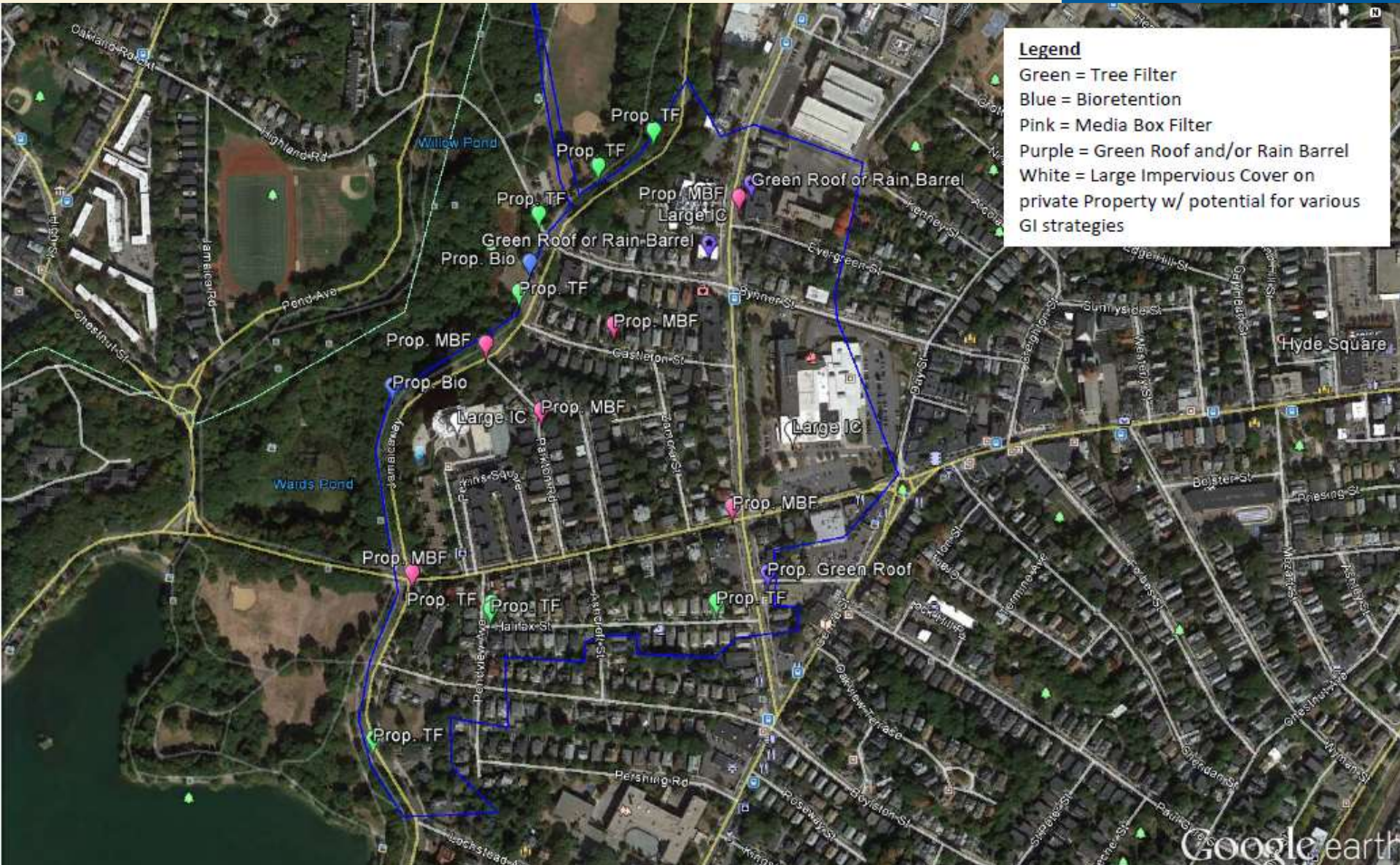
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Other Considerations

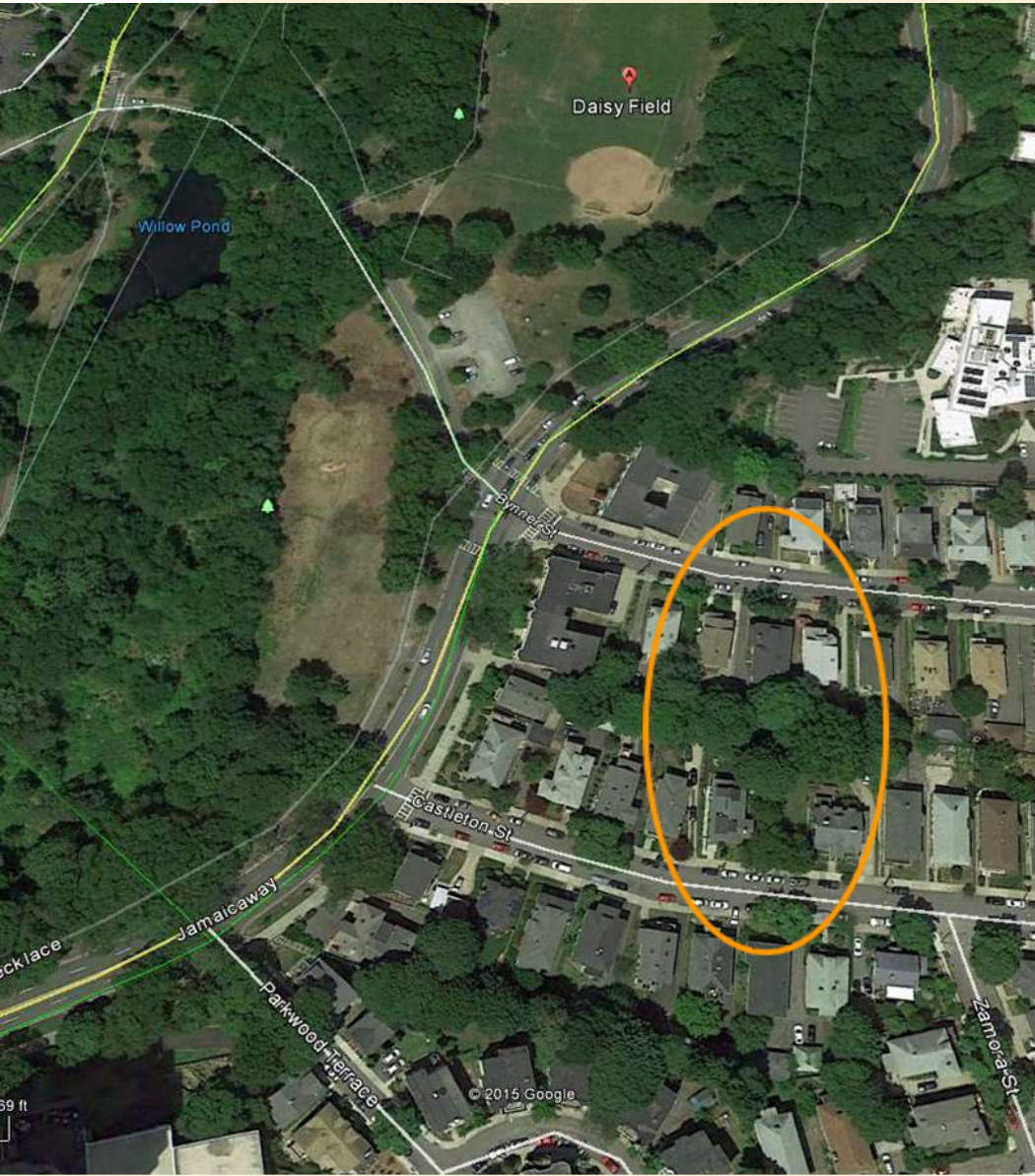


Legend

- Green = Tree Filter
- Blue = Bioretention
- Pink = Media Box Filter
- Purple = Green Roof and/or Rain Barrel
- White = Large Impervious Cover on private Property w/ potential for various GI strategies



| Location | Best Management Practice | Rationale |
|---|--|---|
| Along west side of Jamaica Way | Tree Filters (5) | Existing storm drain line and several catch basins. There are also some recently planted trees that could be transplanted into tree filter units. These would provide some treatment through filtration, infiltration, rhizosphere, and flow attenuation. Media amendments would be added to remove phosphorus. |
| Halifax St and Pondview Ave | Tree Filters (2) | There is an existing storm drain line and catch basins on each side of the Halifax St. The existing street scape includes trees. |
| Halifax St near S. Huntington St | Tree Filter | There is an existing storm drain line and a catch basin that could be converted to a tree filter. |
| <ul style="list-style-type: none"> • Parkwood Terrace and Jamaica Way • Perkins St and Jamaica Way | Media Box Filters | Existing storm drain line and catch basin. Large vegetated strip between road and sidewalk that is likely in City right-of-way. Large trees are in this proximity so an MBF would be a better fit. |
| <ul style="list-style-type: none"> • North end of Parkton Rd • Perkins St and S. Huntington • Castleton St • Evergreen St and S. Huntington | Media Box Filters | Existing storm drain line and catch basins on each side of Perkins St. No vegetated area but an MBF might fit under the road depending on other utilities. |
| Just south of Highland Rd and Jamaica Way intersection | Bioretention | Existing storm drain line and room for a bioretention cell that could treat surface runoff and then be piped into existing line. |
| West of Jamaica Way near Wards Pond | Bioretention | Plenty of area for a bioretention cell but some trees may need to be removed. Effluent could discharge cool treated water to Wards Pond. |
| <ul style="list-style-type: none"> • El Mundo Newspaper • Intersection of Bynner St and South Huntington • Intersection of Evergreen St and South Huntington | Green Roof and Rain Barrel installations | These are flat roof buildings with concrete block or brick exteriors, which may be strong enough for green roof systems. There are several other buildings in the drainage area that could be identified if this is a viable strategy. |
| <ul style="list-style-type: none"> • MSPCA, Animal Care & Adoption Center • Perkins Square – Sagamore Advisors • Mt. Pleasant Home | Tree Filters, Bioretention(s), media box filters | Three of the largest, privately owned impervious cover areas in the watershed. There are media strips, large parking areas, and large roof tops that could all be managed using various GI strategies. |



“Hi, Tim and I were just chatting about siting systems. Is there any reason why we could not put a system where the orange oval is in the pic below?”

“I’m going to say almost definitely no. It’s private property and we have no way to get those property owners to work with us. Additionally, my understanding is that we want a visible area for public education (a park in this tributary area).”

We need to avoid the ball fields for now. In the future, Parks may choose to redo the fields and we will propose an Underground Gravel Filter at that time.

What are we trying to treat?

We are trying to treat the first 1" of water across the whole catchment

If that cannot be done, then aim for the 62% reduction of phosphorus

Who owns what?

- a. Parks owns the pipe that runs under Daisy Field, starting from 18GMH252 and continuing to the outfall
 - i. However, BWSC owns 18GMH252
 - b. Parks also owns the outfall into Leverett Pond

Other Considerations

In the “TOPOGRAPHY” layer there are several sub-layers that seem to be paired for identical points on the map. They consistently differ by 6.5’. Which surface elevation layer is correct or relative to the Pipe Invert Elevation layers? For example:

| Sub-Layer Name | Elevation | Elevation | Elevation | General Location of Point |
|-----------------------|-----------|-----------|-----------|---|
| Topo DETBCB Elevation | 29.0 | 34.8 | 28.3 | East of Jamaica Way / Willow Pond Rd intersection. |
| Topo DET Elevation | 22.5 | 28.3 | 21.8 | Same as above |
| Difference | 6.5 | 6.5 | 6.5 | |
| Topo INDBCB Elevation | 26.5 | | | On contour line southeast of Jamaica Way / Willow Pond Rd. int. |
| Topo INDD Elevation | 20 | | | Same as above |
| Difference | 6.5 | | | |
| Topo BCB Elevation | 33.0 | 31.8 | 34.2 | In vicinity of Jamaica Way / Willow Pond Rd. intersection |
| TOP GEN Elevation | 26.5 | 25.3 | 27.7 | Same as above |
| Difference | 6.5 | 6.5 | 6.5 | |

Here are the updated 90% Concept Designs for Daisy Field Stormwater Infrastructure

Bio-2 is probably too close to the heritage oaks for comfort, but we can leave it there for now.

Bio-4 is located in the primary walking path from the parking lot to the softball diamonds and is unlikely to be acceptable to Parks.

The current location of the Subsurface Gravel Wetland is **not an option** and will need to be moved.

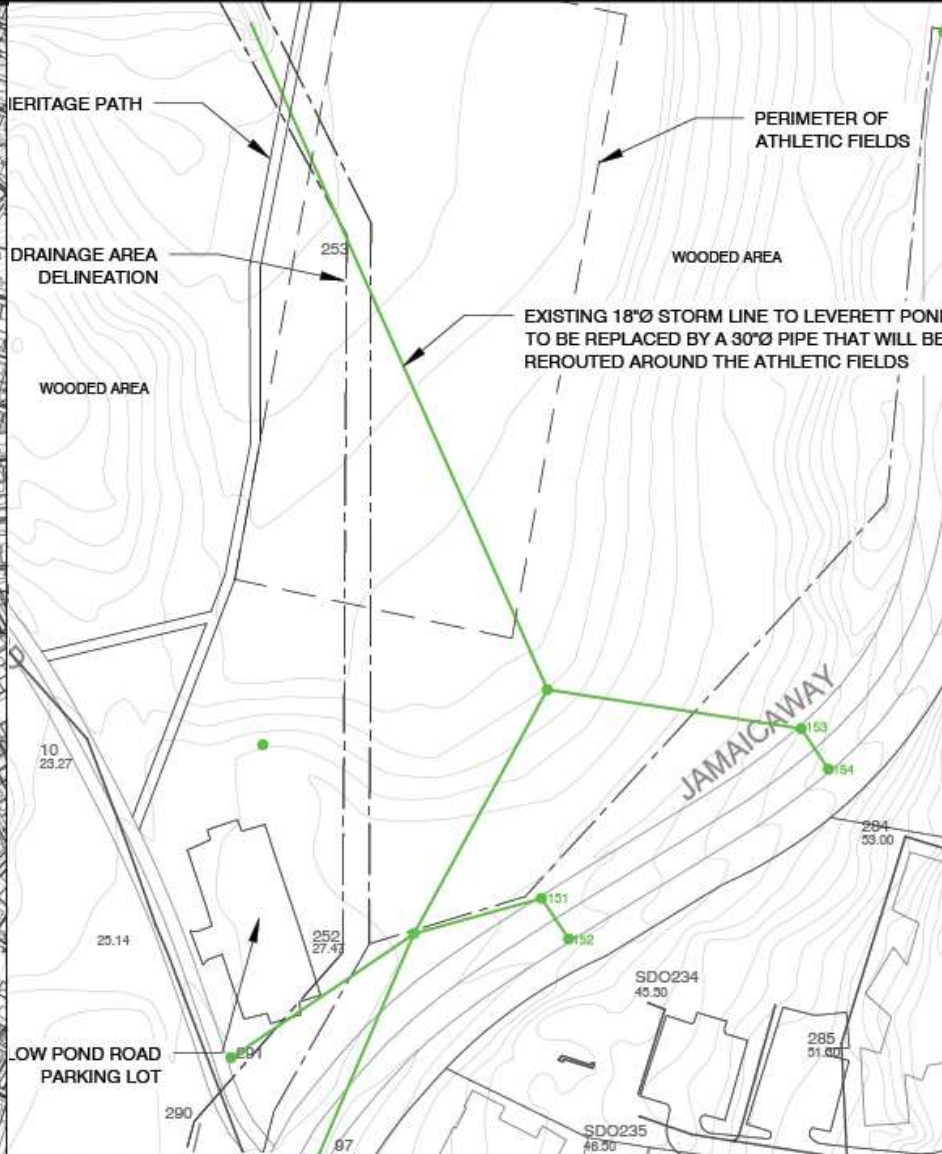
Well, lo and behold, after our initial meeting and site walk with Parks, if some scheduling and budgeting concerns can be addressed with Parks' long planned Daisy Field renovation, we might be able to do something under the athletic fields (assuming that grass and not artificial turf can be used).

We are still waiting for a letter from Parks with the official feedback, but based on what I heard during the meeting and the walk, we need to start putting together final pollutant removal and cost estimates for a feature under the fields

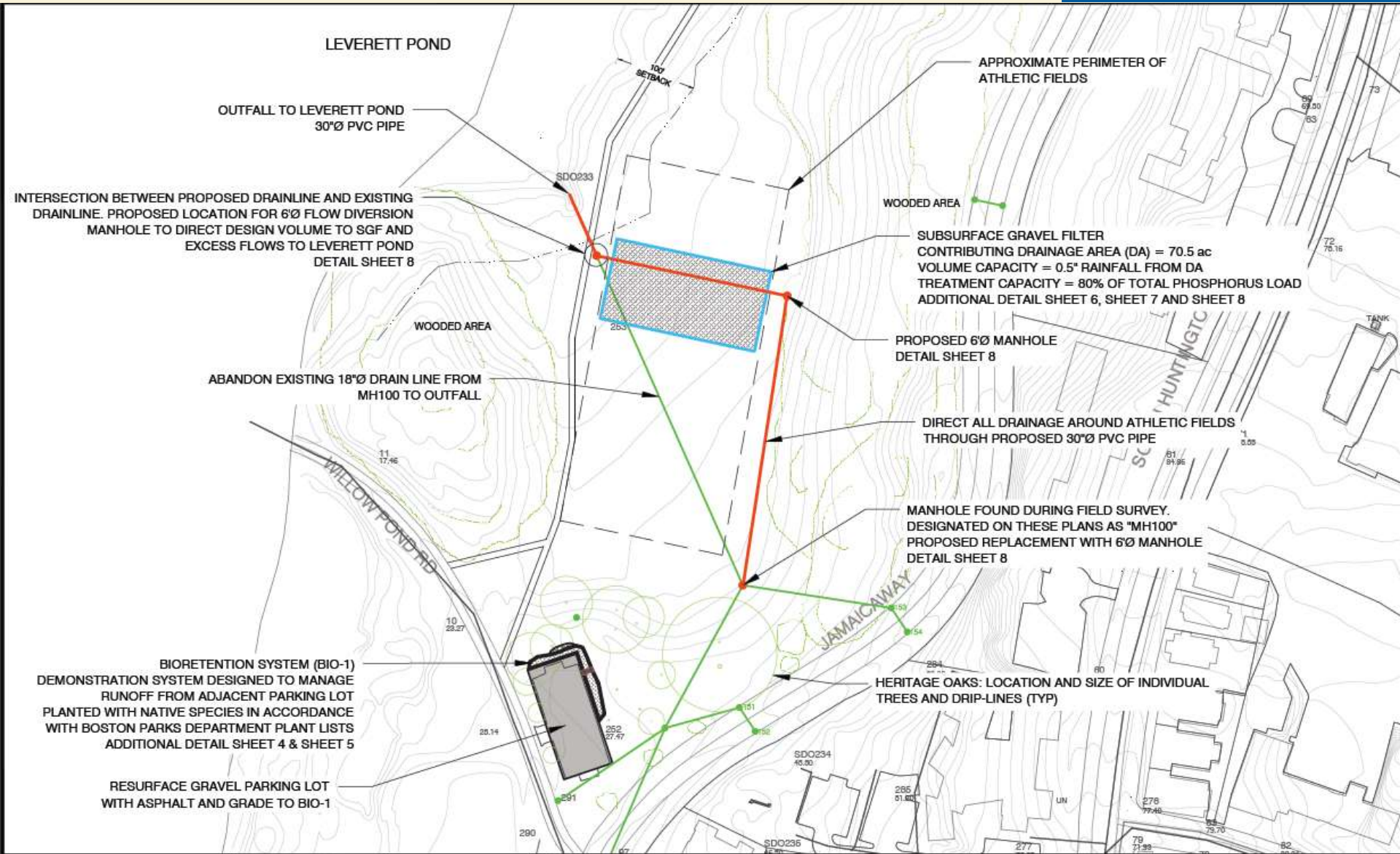
What we did...



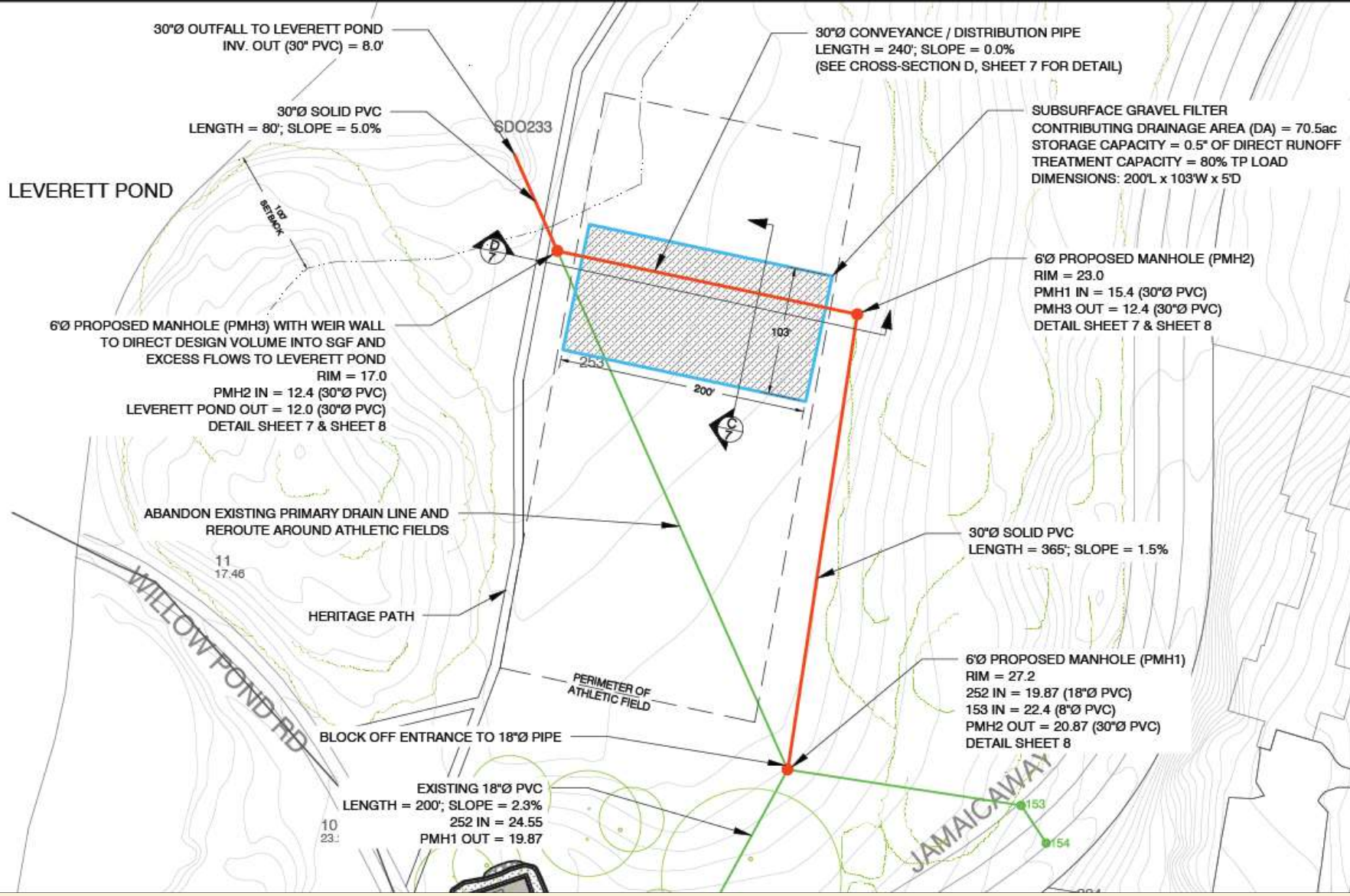
SCALE: 1" = 500'



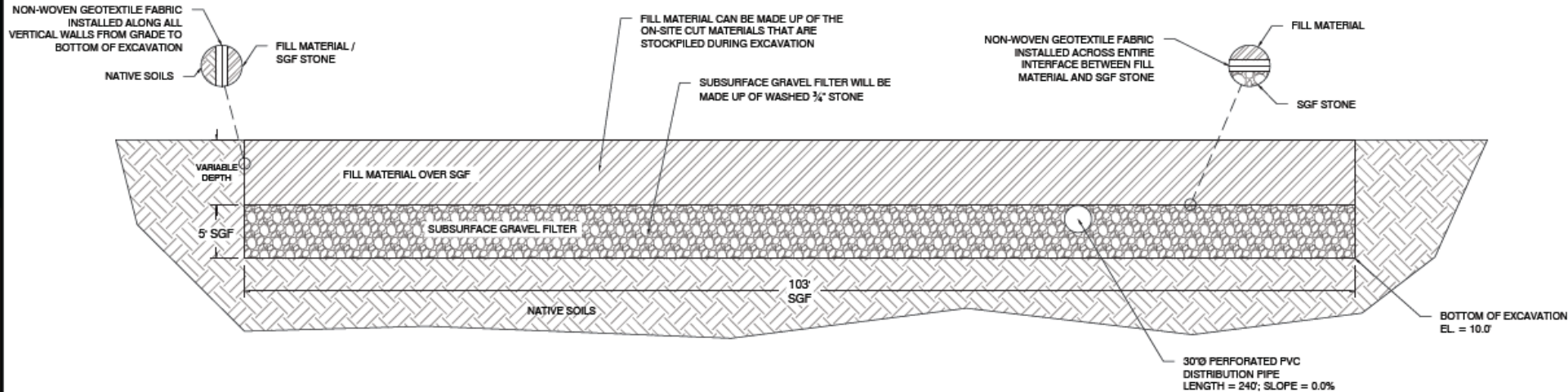
SCALE: 1" = 100'



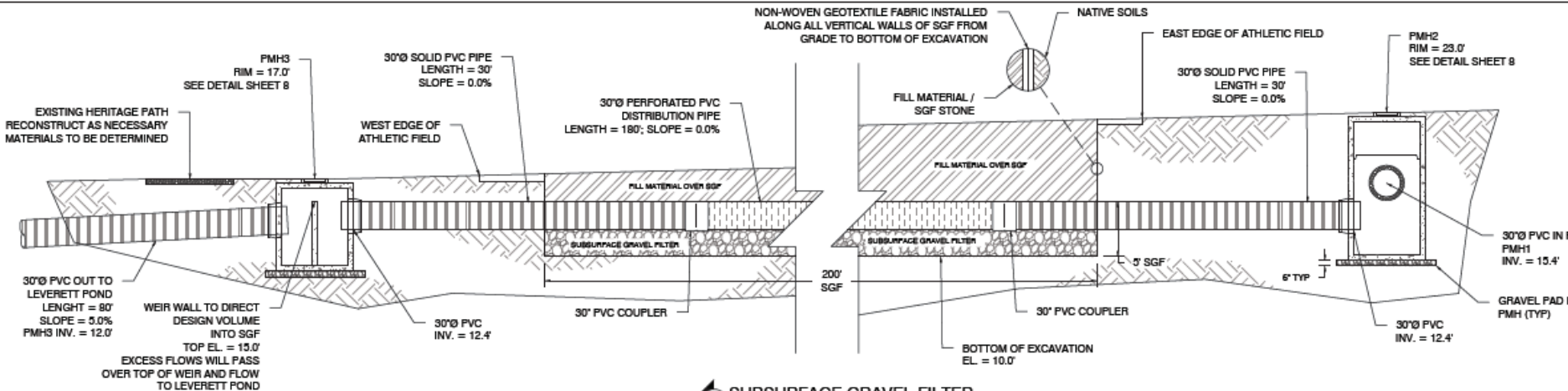
Final Design cont...



Final Design cont...



⊙ SUBSURFACE GRAVEL FILTER
NORTH-SOUTH X-SECTION

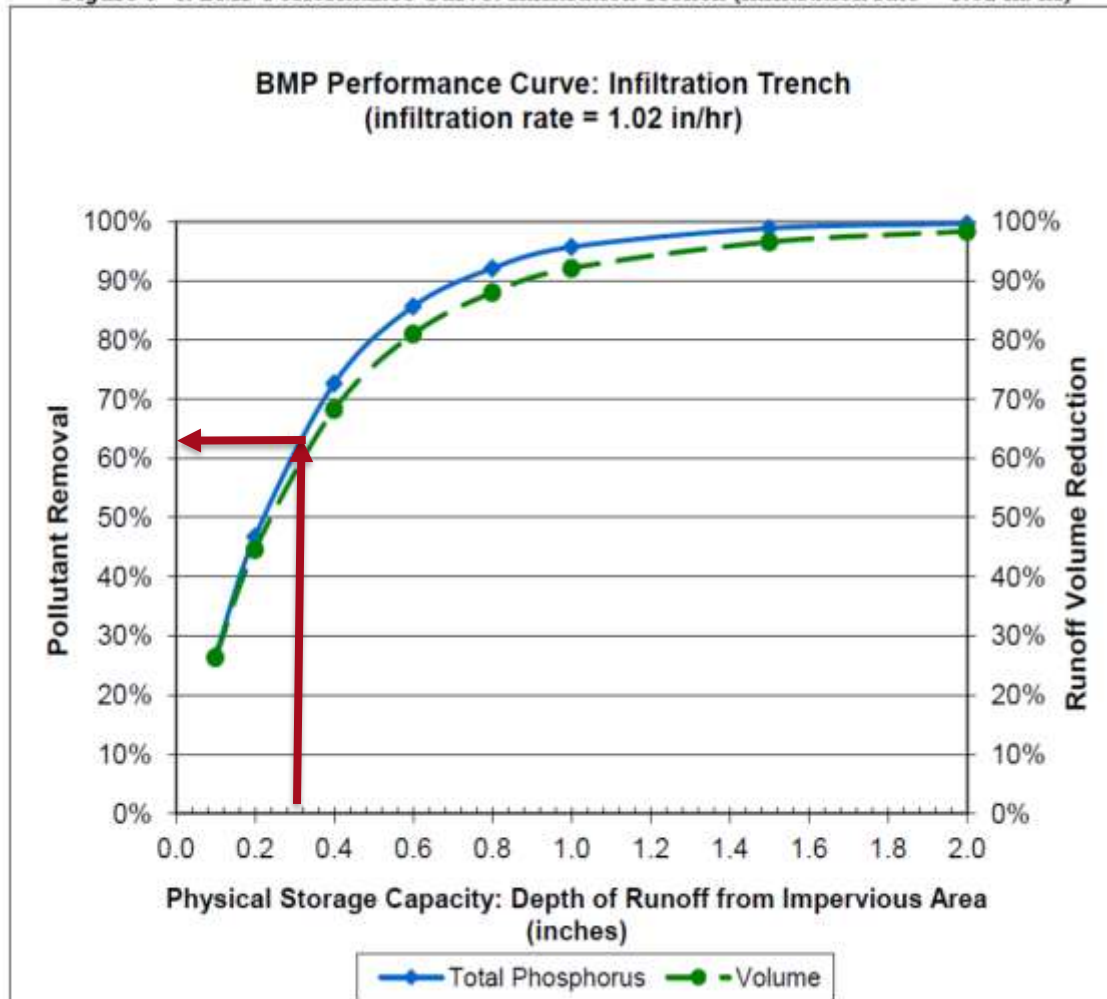


⊙ SUBSURFACE GRAVEL FILTER
EAST-WEST X-SECTION

Infiltration Trench (IR = 1.02 in/hr) BMP Performance Table: Long-Term Phosphorus Load Reduction

| BMP Capacity: Depth of Runoff Treated from Impervious Area (inches) | 0.1 | 0.2 | 0.4 | 0.6 | 0.8 | 1.0 | 1.5 | 2.0 |
|---|-------|-------|-------|-------|-------|-------|-------|-------|
| Runoff Volume Reduction | 26.3% | 44.6% | 68.2% | 81.0% | 88.0% | 92.1% | 96.5% | 98.0% |
| Cumulative Phosphorus Load Reduction | 27% | 47% | 73% | 86% | 92% | 96% | 99% | 100% |

Figure 3- 4: BMP Performance Curve: Infiltration Trench (infiltration rate = 1.02 in/hr)



| Stormwater Management Design - 70.5 acre Ultra-Urban Drainage Area | | | |
|---|---|--|---|
| Sizing Comparison of Capital Costs and Relative Phosphorus Load Removal Efficiency | | | |
| Best Management Practice Size | Depth of Runoff Treated from Impervious Area (in) | *Storage Volume Cost (\$/ft ³) | **Total Phosphorus Removal Efficiency (%) |
| Subsurface Gravel Filter - Minimum Size | 0.35 | \$1,016,912 | 62% |
| Subsurface Gravel Filter - Moderate Size | 0.5 | \$1,452,732 | 80% |
| Subsurface Gravel Filter - Full Size | 1.0 | \$2,905,463 | 96% |

*Storage Volume Cost estimates provided by EPA-Region 1 for Opti-Tool methodology, 2015-Draft

**Total Phosphorus %RE based on Appendix F Massachusetts MS4 Permit

Introduction

Unit Operations & Processes (UOPs)

Review of BMPs

Review of BMP Worksheets and Cross-walks

Costs

Effective SWM Case Study

Site Design Assessment

Group Debrief & Discussion

Next Steps

Group discussion of best use of UNHSC data sheets, who could benefit from workshop 2 on Opti-Tool and automation/optimization approach.

Input to further design of Workshop 1 as well as prospectively for Workshop 2.

Questions?

