Harnessing Technical Assistance and Tools to Access and Plan for Stormwater Funding

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Partners

- City of Dover Staff
- UNH Stormwater Center
- NH Department of Environmental Services
- Environmental Protection Agency

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Berry Brook Watershed Management Plan –Implementation Projects Phase III

Final Report to
The New Hampshire Department of Environmental Services
Submitted by

The City of Dover and the UNH Stormwater Center
December, 2017

https://www.unh.edu/unhsc/berry-brook-project

Typical Project Approach

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Develop a watershed management plan (a-i)

Optimize placement of BMPs for maximum gain

Implement

Model

Outreach and education on project results

Report

Typical Project Approach

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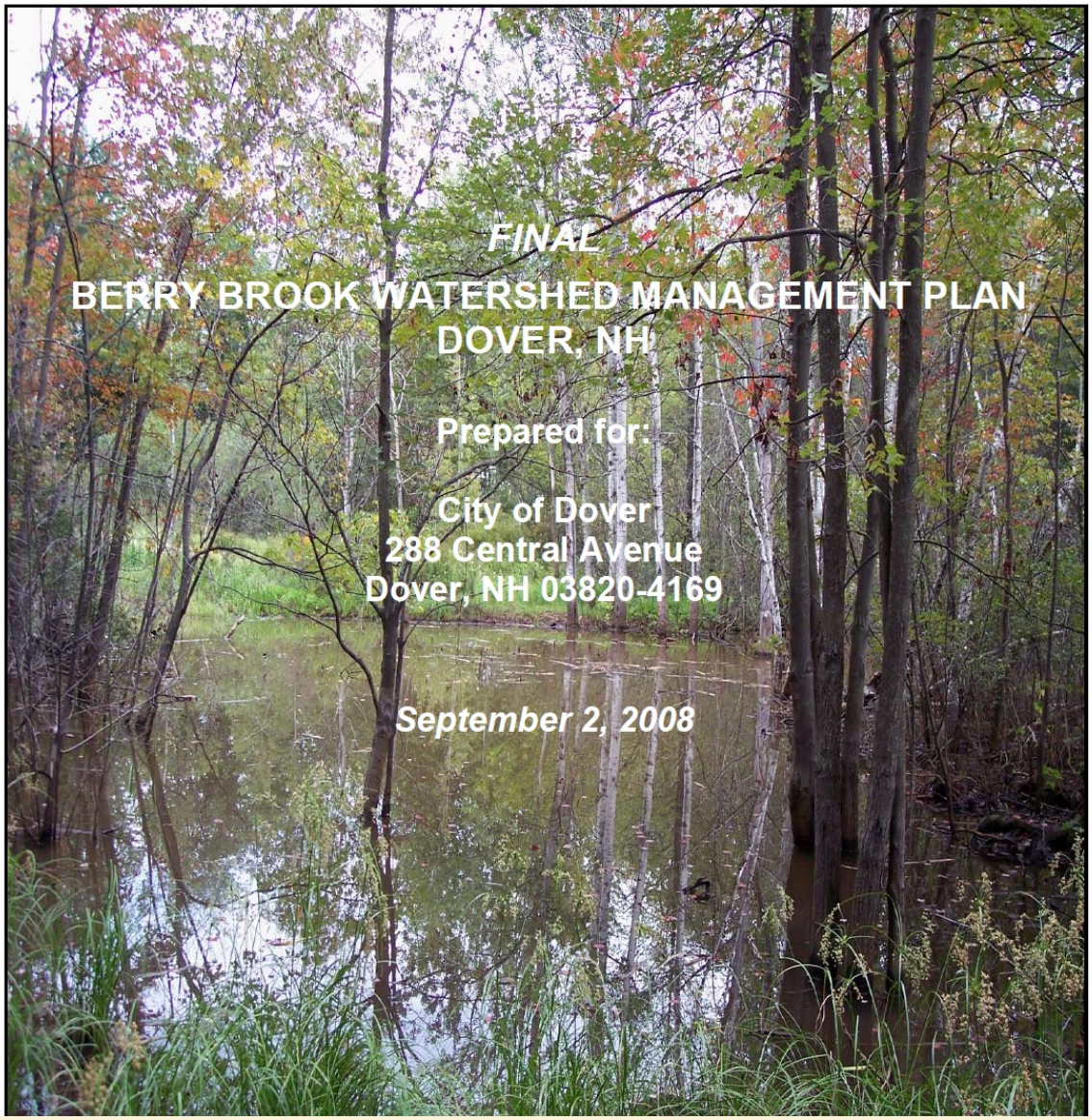

Optimize Again…

2011 Watershed Restoration Grants for
Impaired Waters

Section B: PRE-PROPOSAL APPLICATION FORM
Watershed Restoration Grants for Impaired Waters

I. Proposal Title

Berry Brook Watershed Restoration through Low Impact Development Retrofits in an Urban Environment

II. Contact Information

Primary contact person: Dean Peschel
Organization: Environmental Project Manager, City of Dover DPW
Street address: 288 Central Avenue
City, State, ZIP: Dover, NH, 03820-4169
Day phone: (603) 516-6094 Fax: ( ) Email: dean.peschel@ci.dover.nh.us

Secondary contact person: Robert M. Roseen, Ph.D., D.WRE, P.E.
Organization: Director, The UNH Stormwater Center
Street address: 35 Colovos Road
City, State, ZIP: Durham, NH, 03824
Day phone: (603)862-4024 Fax: (603)862-3957 Email: robert.roseen@unh.edu

Signature of Applicant: _____

Date of signature: 9/2/10

III. Project Summary

Berry Brook is a highly urbanized 1st order stream located in Dover, NH, that is classified as Class B waters. . The Brook is located in a built-out, 164-acre watershed with 25% impervious cover (IC) and includes medium-density housing with commercial and industrial uses. The stream has been placed on the NHDES 2006 Section 303(d) list and is impaired for primary recreation and for aquatic life. The source of this impairment includes urbanization resulting in an increase of pollutant mass and runoff volumes from stormwater.

And then you implement –
Inside a historic 40,000 sf slow sand filter

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Reality

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Redesign

Reconfigure

… and optimize Again…

BACB

And more implementation…

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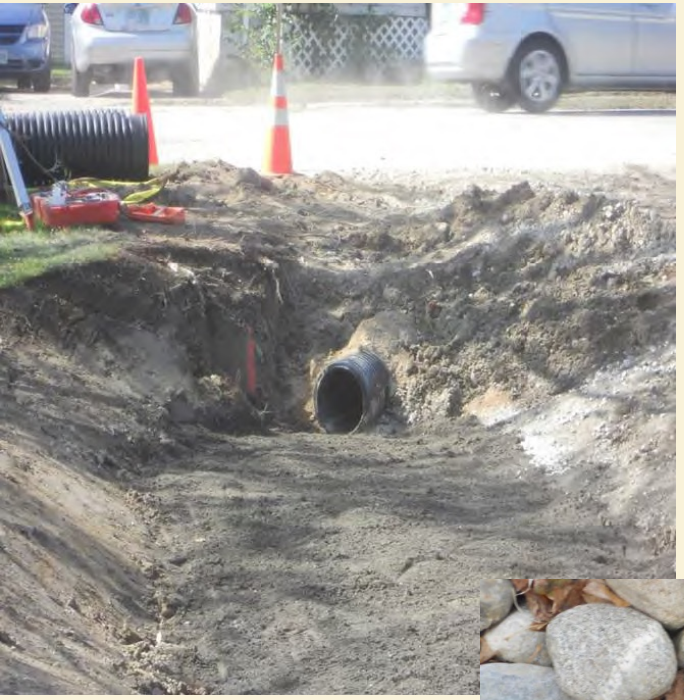

And more adaptation…NDP!

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Redesign

Reconfigure

… and optimize Again…

2013 Watershed Assistance Grants
PROPOSAL FORM

NEW HAMPSHIRE DEPARTMENT OF Environmental Services
CELEBRATING 25 YEARS 1987 2012

SUBMISSION DEADLINE
4:00pm
November 21, 2012

1. PROJECT TITLE

Getting to 10%: Watershed Restoration through Low Impact Development Retrofits in an Urban Environment

Berry Brook/Cocheco River Watershed Management Plan Implementation Phase III.

2. PROJECT LOCATION

A. Town(s): **Dover, NH**
Does project involve other states? **Yes** ☐ **No** ☒

B. What water body does it affect? **Berry Brook/Cocheco River/Great Bay**
12-digit hydrologic unit code (HUC): 010600030608

C. Attach a project location map showing the watershed and relevant project site locations (required).

HUC look-up: http://www2.des.nh.gov/SWQA/ or contact your DES project leader for assistance.

3. GRANT CATEGORY

Please check applicable water quality category:

a. High Quality Waters ☐

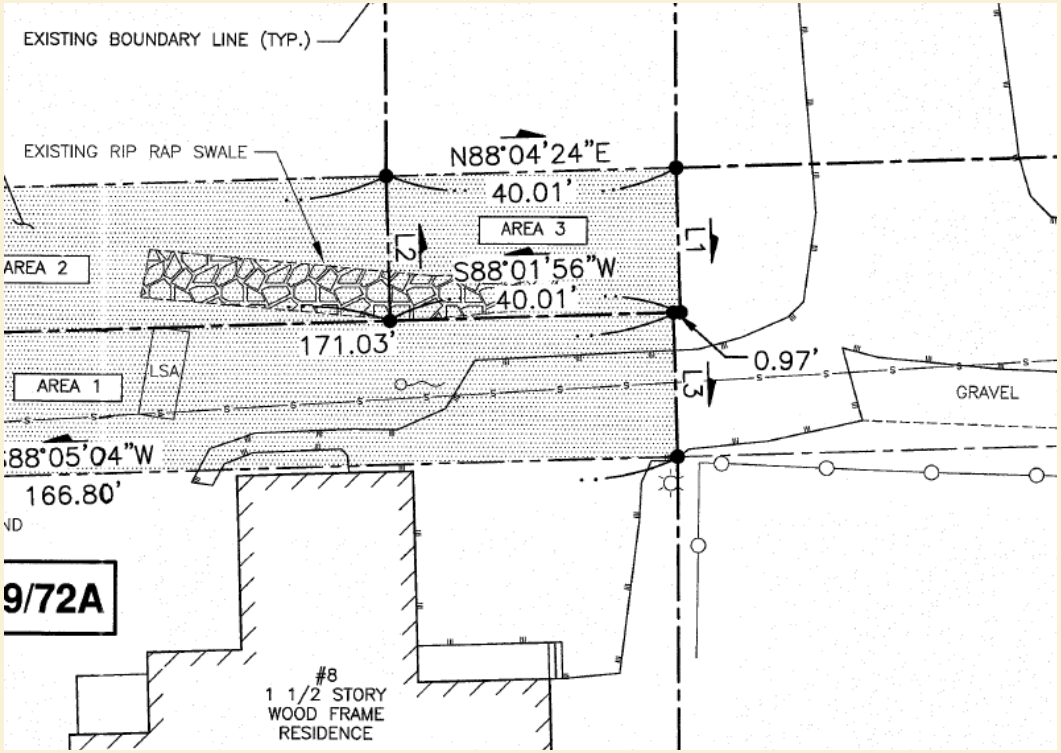
b. Impaired Waters ☒

Please list the designated uses that are impaired and the specific causes of impairments as identified on the *2010 305(b)/ 303(d) Surface Water Quality Assessment*. If the waterbody is not listed as impaired in the 2010 Surface Water Quality Assessment, then describe and attach documentation of the impairment.

***2010 Surface Water Quality Assessment*:** http://des.nh.gov/organization/divisions/water/wmb/swqa/2010/index.htm

Primary Contact Recreation (as a result of high bacteria concentrations) and for Aquatic Life Use due to an NHDES assessment of benthic macroinvertebrate monitoring.

And more implementation…



Results

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Not one single installation was installed as originally planned

The entire project required flexibility in relation to all BMPs installed

Overall goals of the project (disconnection of EIC) was considered paramount objective over actual implementation sites.

New Project Approach

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Desktop designs invariably change when in-depth site specific investigations begin.

Better to quickly and coarsely develop a handful of candidate sites

Conduct inexpensive site queries of local areas of concern to further develop a practical mitigation approach.

Implement where and however much feasible

municipal implementation efforts adapt or innovate “text book” research-based designs with what is practical for a public works department working in an urban setting leading to lower costs and more effective systems.

New Project Approach

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Large Project approach vs. every day counts approach

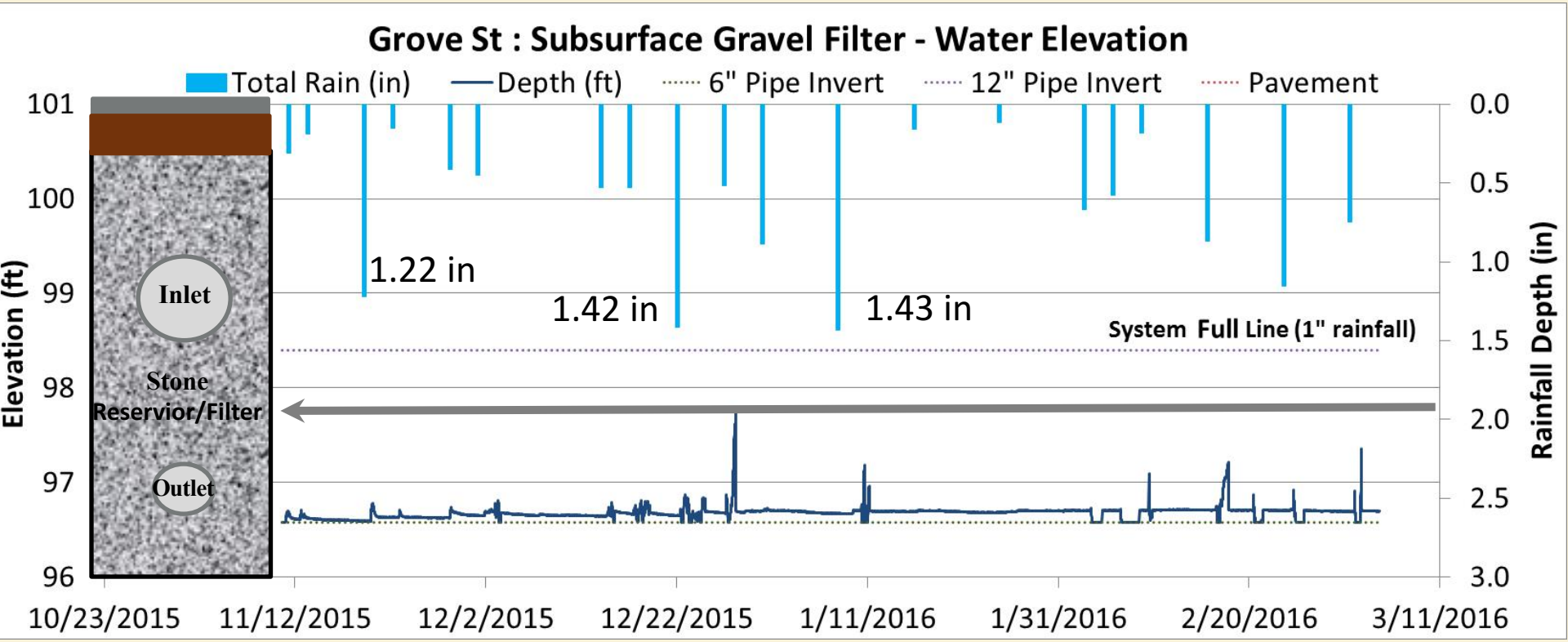
For the largest seacoast community there is:

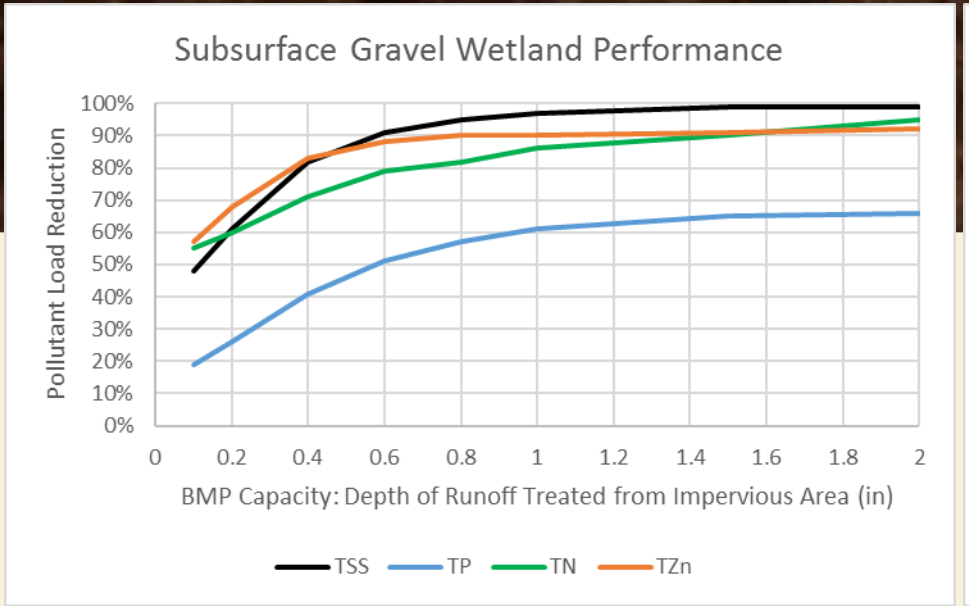
- Over 2800 catch basins
- 65 linear miles of pipes
- 200 outfall locations

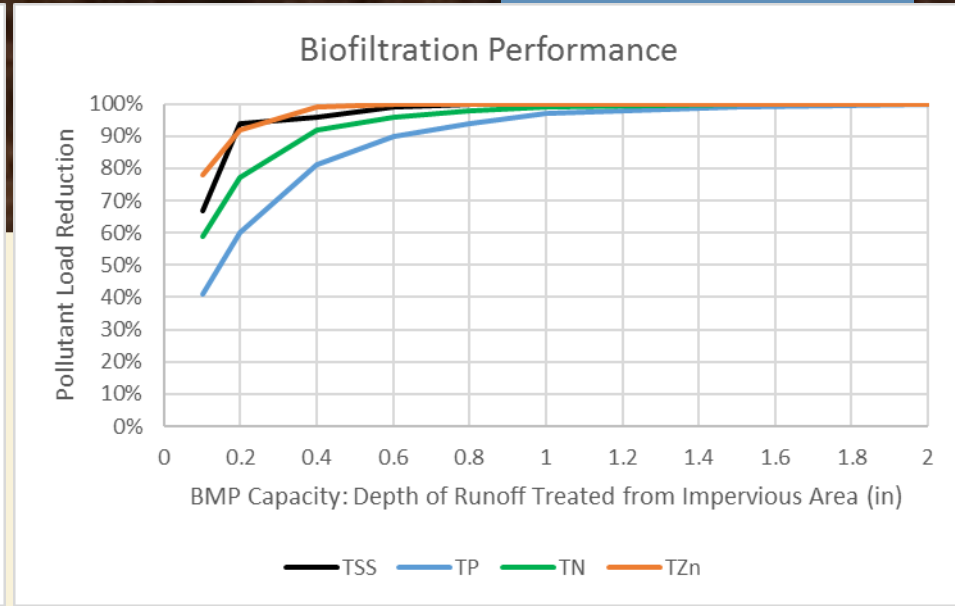
When all this infrastructure was originally designed the approach was very different.

Correction is not going to happen overnight!

Boulangenator Performance







Design Storage Volume (DSV) - runoff depth from IA (in)

Analyte	Depth txt	Modeled RE	Measured RE
TSS	0.1	48	75
TZn	0.1	57	75
TN	0.1	55	23
TP	0.1	19	53

Analyte	Depth txt	Modeled RE	Measured RE
TSS	0.23	70	81
TZn	0.23	88	86
TN	0.23	60	27
TP	0.23	35	45

Funding and Results

Funding: 3 watershed assistance grants and 1 aquatic resource mitigation grant with match from the city.

Berry Brook Project: Getting to 10%	
Cost	$1,322,000
Grant Funds	$793,000
Match (min estimate)	529,000
BMPs	26
DCIA Reduced	37 acres
TSS Reductions (lb./yr.)	57,223
TP Reductions (lb./yr.)	201
TN Reductions (lb./yr.)	1,127

Modeled Performance

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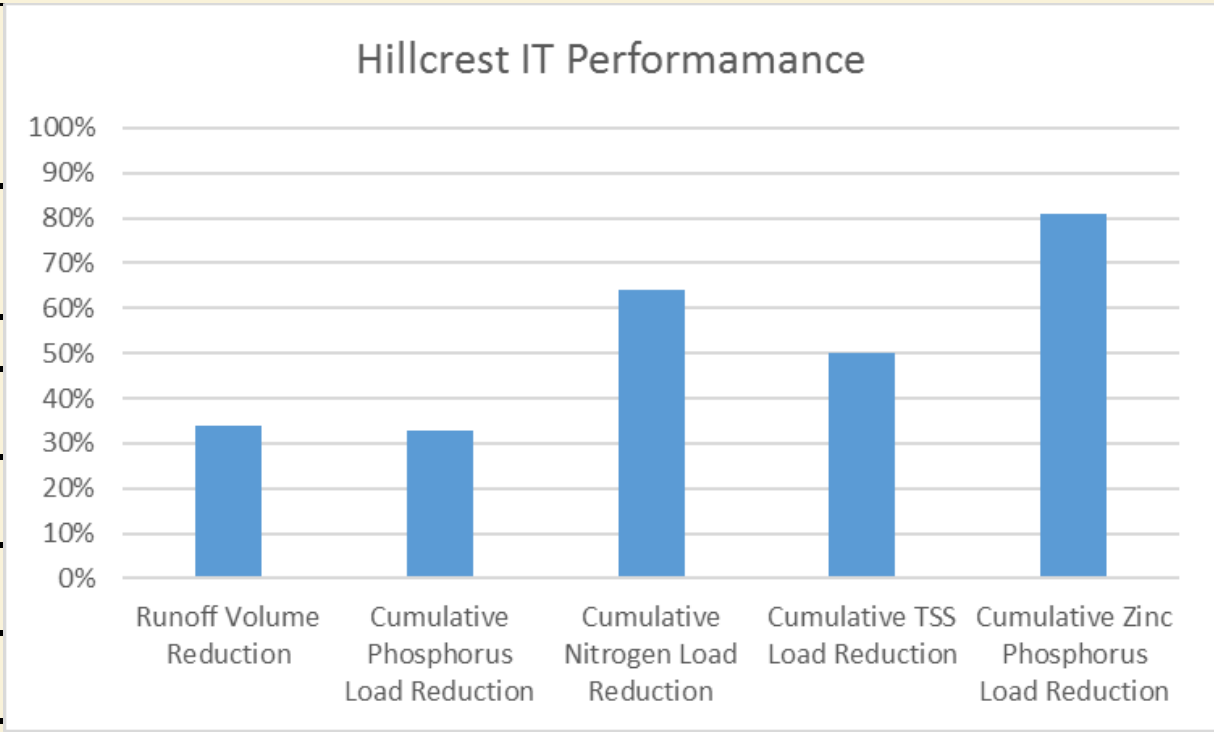
Infiltration Trench (2.41 in/hr) BMP Performance Table	
BMP Capacity: Depth of Runoff Treated from Impervious Area (inches)	0.1
Runoff Volume Reduction	34%
Cumulative Phosphorus Load Reduction	33%
Cumulative Nitrogen Load Reduction	64%
Cumulative TSS Load Reduction	50%
Cumulative Zinc Phosphorus Load Reduction	81%



Region 1 GI Cost Estimates

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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**

GI Implementation Cost Comparisons

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Costs per disconnected acre of IC			
	PA	NY	NH
Actual	$250,000.00	$320,000.00	$30,000.00

SGWS Costs

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Site Characteristics and System Treatment Capacity						Annual Removals (lbs/yr)		
Project	Impervious Area (sf)	Impervious Area (acres)	Best Management Practice	Hydrologic Soil Group	Depth of Runoff Treated from Impervious Area (in)	Total Suspended Sediment	Total Phosphorus	Total Nitrogen
Hillcrest IT	39,640	0.91	Infiltration Trench	B	0.10	97	0.35	8.8

Water Quality Volume	Hillcrest IT
Drainage Area (ft^2)	39,640
% Impervious Cover	100%
Impervious Area (ft^2)	39,640
Conv WQV (ft^3) (@ P = 1.0in)	3,303
System Treatment	
System Area (ft^2)	10
Reservior Storage (ft^3)	400
System Storage (ft^3)	320
Rainfall Depth Treated (in)	0.10

Marginal Extra Materials	Marginal Cost Difference
700 cf stone	$10,000

Maintenance Basics

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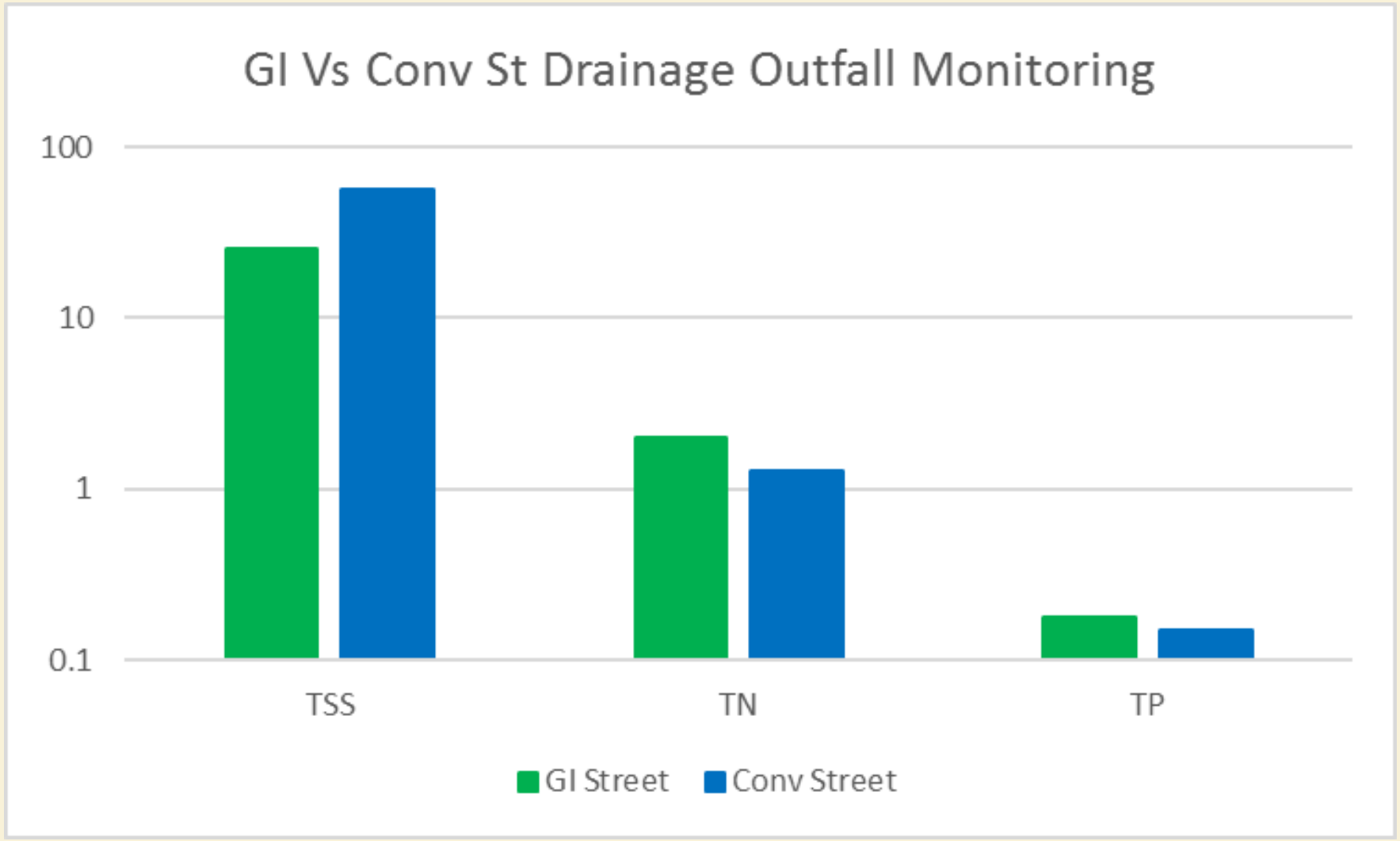

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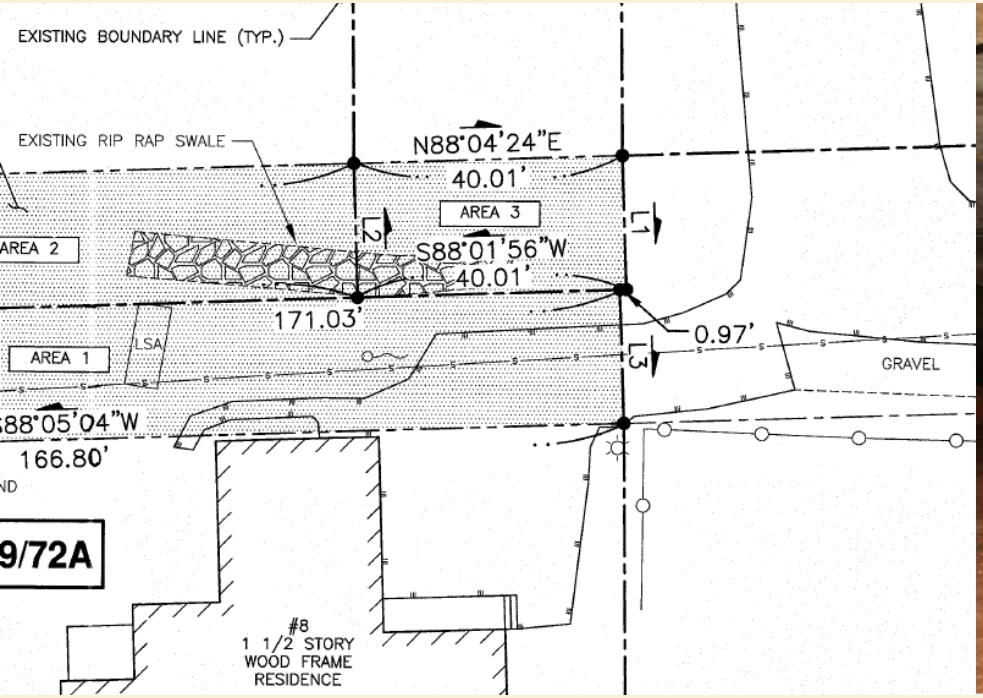
INTERNATIONAL
S66
7400
PUBLIC WORKS
WATER / SEWER DIVISION

Out of space


EXISTING BOUNDARY LINE (TYP.)
EXISTING RIP RAP SWALE
N88°04'24"E
40.01'
AREA 3
L2
L1
AREA 2
S88°01'56"W
40.01'
171.03'
0.97'
AREA 1
LSA
L3
GRAVEL
88°05'04"W
166.80'
ND
9/72A
#8
1 1/2 STORY
WOOD FRAME
RESIDENCE

New Definitions to Learn:

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BMP – Best Management Practice

LID – Low Impact Development

OMDB – Over My Dead Body

RG – Rain Garden

NDP – No Damn Plants

More Definitions…

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GW – Gravel Wetland

MHA – Must Have Access

MS4 – More Sh#@ 4 me

BACB – Big Ass Catch Basin

SWMP – Stormwater Management Plan

RMP – Right Maintenance Plan

Still More Definitions…

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TMDL – Too Much Damn Litigation

IDDE - ????

PEDDI – Public Excrement Dumping Directly In

NOI – Never Own It

Need for Innovation

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- "Boulanginator" (subsurface gravel filter) mimics performance of PA with regular pavement.
- The hydraulic inlet and outlets are controlled through perforated pipes and underdrains.
- treat runoff from 1.96 acres and 0.61 acres DCIA

Need for Innovation

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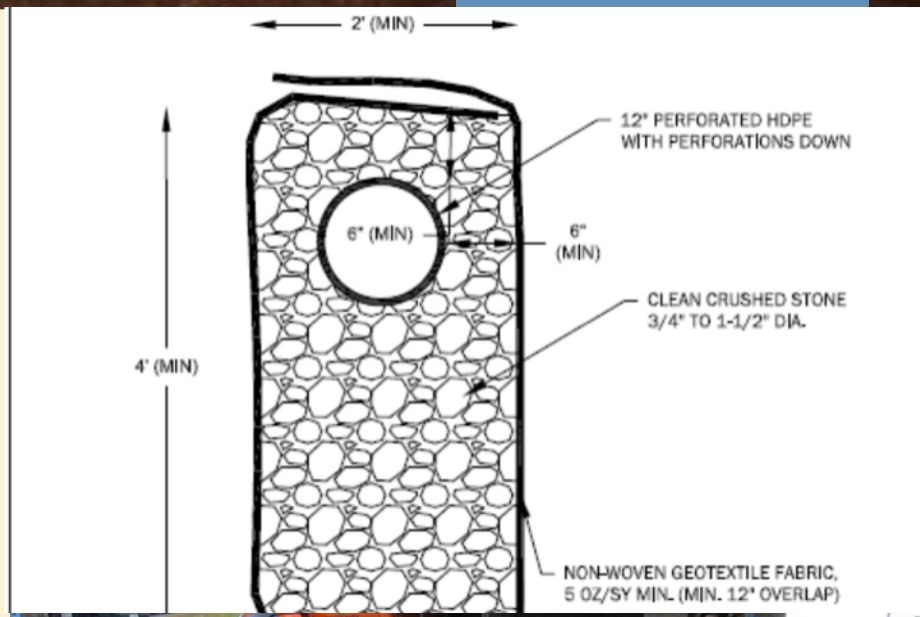
- In HSG A installed an infiltration trench between two conv CBs
- A simple but effective adaptation instead of solid pipe.
- Treats runoff from 3.36 acres and 1.04 acres DCIA



Need for Innovation

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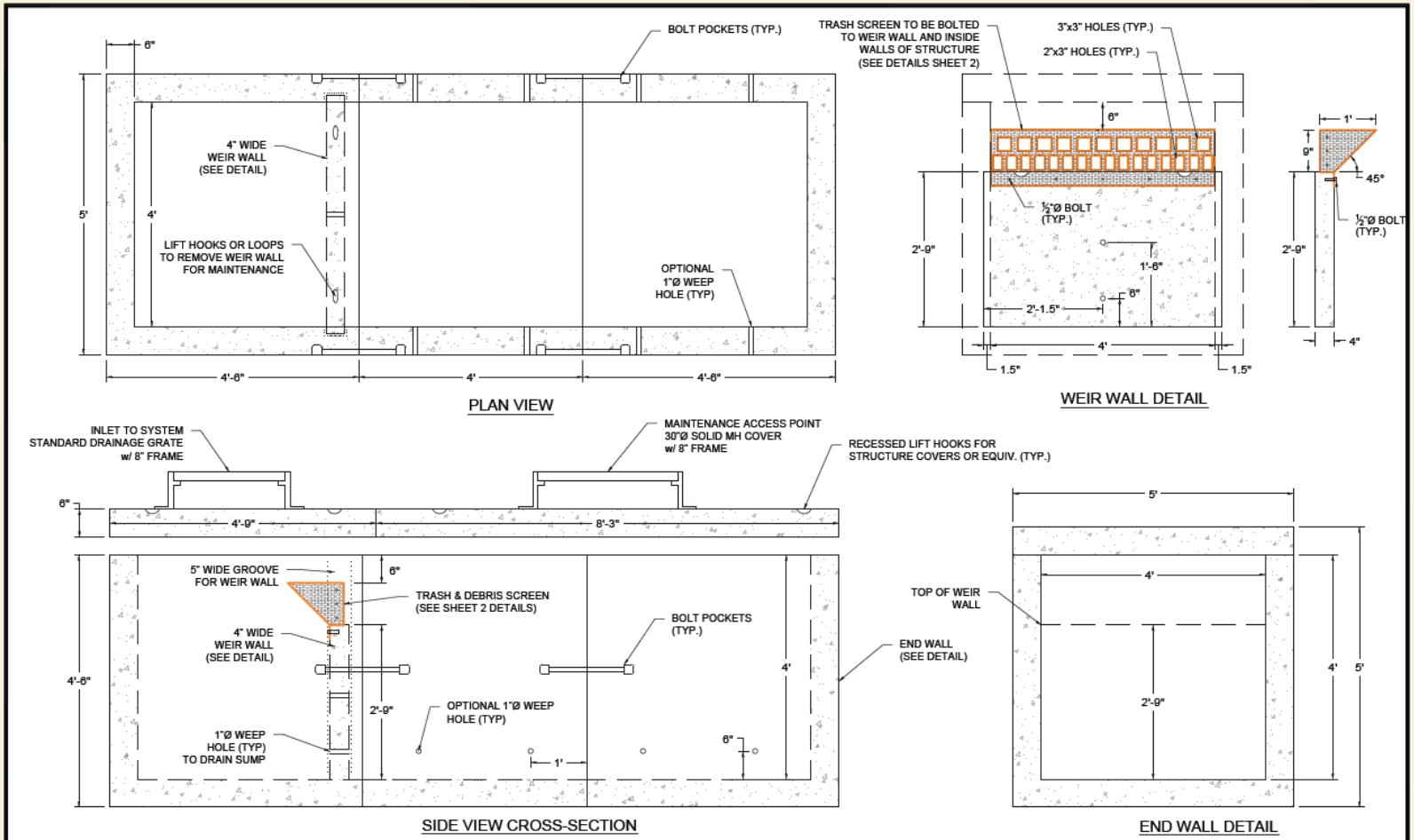
Sectional Media Box Filter Design – version 3



Need for Innovation

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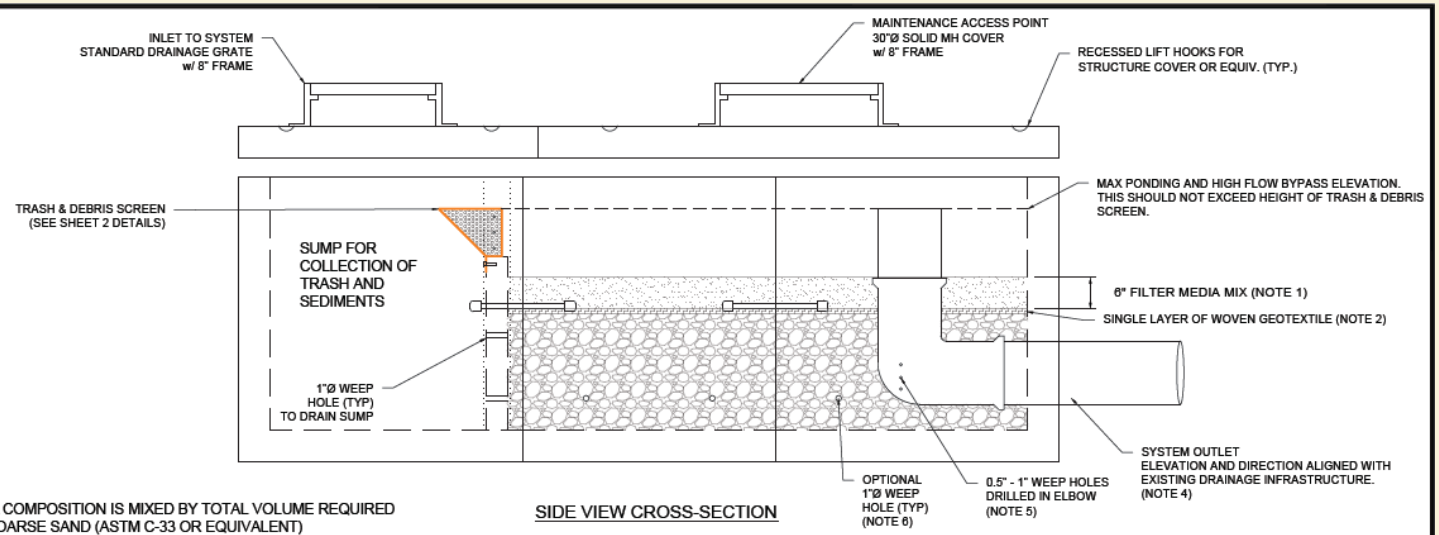
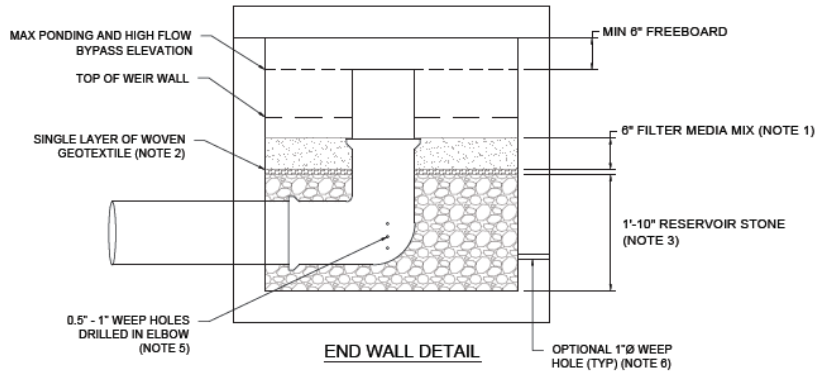
Sectional Media Box Filter Design – version 3



SIDE VIEW CROSS-SECTION

NOTES:

1. FILTER MEDIA COMPOSITION IS MIXED BY TOTAL VOLUME REQUIRED
   - 1.1. 75-85% COARSE SAND (ASTM C-33 OR EQUIVALENT)
   - 1.2. 15-25% LOAM OR TOP SOIL
   - 1.3. 0-5% WATER TREATMENT RESIDUALS OR IRON FILINGS. THIS IS AN AMENDMENT USED FOR ENHANCED PHOSPHORUS ADSORPTION
2. WOVEN GEOTEXTILE LAYER OR SILT FENCE MATERIAL. THIS LAYER IS TO REMOVE ALL SILT SIZE PARTICLES AND LARGER AND PROTECT THE RESERVOIR STONE FROM FILLING WITH FINES. THIS IS ALSO THE DEPTH OF ROUTINE MAINTENANCE, WHICH INVOLVES REMOVING FILTER MEDIA AND GEOTEXTILE AND REPLACING WITH NEW.
3. RESERVOIR STONE CAN CONSIST OF A WIDE RANGE OF STONE SIZES. PREFERABLY A WASHED STONE OF CONSISTENT GRADATION, e.g. ¾" OR No. 57 STONE.
4. SYSTEM OUTLET CONFIGURATION CONSISTS OF A 90° ELBOW AND SHORT STUB PIECES OF HDPE DOUBLE WALLED OR SDR 35. THE ELEVATION AND DIRECTION THAT THE OUTLET EXITS THE SYSTEM WILL BE DETERMINED BY THE RESIDENT ENGINEER. THE OUTLET CAN BE PLUMBED TO BEST FIT THE EXISTING INFRASTRUCTURE.THE OUTLET PIPE SHALL BE SIZED TO PASS THE PREFERRED DESIGN STORM.
5. DRAINAGE HOLES SHOULD BE DRILLED IN THE OUTLET ELBOW TO DRAIN THE WATER DURING AND BETWEEN STORMS. THE HOLES SHALL BE IN A VERTICAL PLACEMENT TO PROVIDE ADDITIONAL CAPACITY AS THE SYSTEM FILLS. THE HOLES SHOULD BE SMALL ENOUGH TO PREVENT RESERVOIR STONE FROM DRAINING THROUGH. NUMBER AND SIZE OF HOLES CAN BE DETERMINE BY RESIDENT ENGINEER.
6. OPTIONAL 1" WEEP HOLES IN EXTERIOR WALLS OF BOX STRUCTURE CAN BE REMOVED FROM PRODUCTION OR PLUGGED IF PREFERRED. BENEFITS INCLUDE: SYSTEM DRAIN DOWN BETWEEN STORMS, GROUNDWATER RECHARGE, AND VOLUME REDUCTION.



END WALL DETAIL

The Contractor shall verify and be responsible for all dimensions. DO NOT scale the drawing - any errors or omissions shall be reported to UNHSC without delay. The Copyrights to all designs and drawings are the property of UNHSC. Reproduction or use for any purpose other than that authorized by UNHSC is forbidden.

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University of New Hampshire
35 Colovos Road
Durham, NH 03824
Phone (603) 862-2618
Fax (603) 862-3957
http://www.unh.edu/unhsc

No.	Date	Revision

Designed: TAP | Checked: JJH | Approved:

GRAPHIC SCALE 0 20" 40"

Original Drawing Size = 11 x 17 in.

N

Project: Sectional Media Box Filter Typical Installation Detail

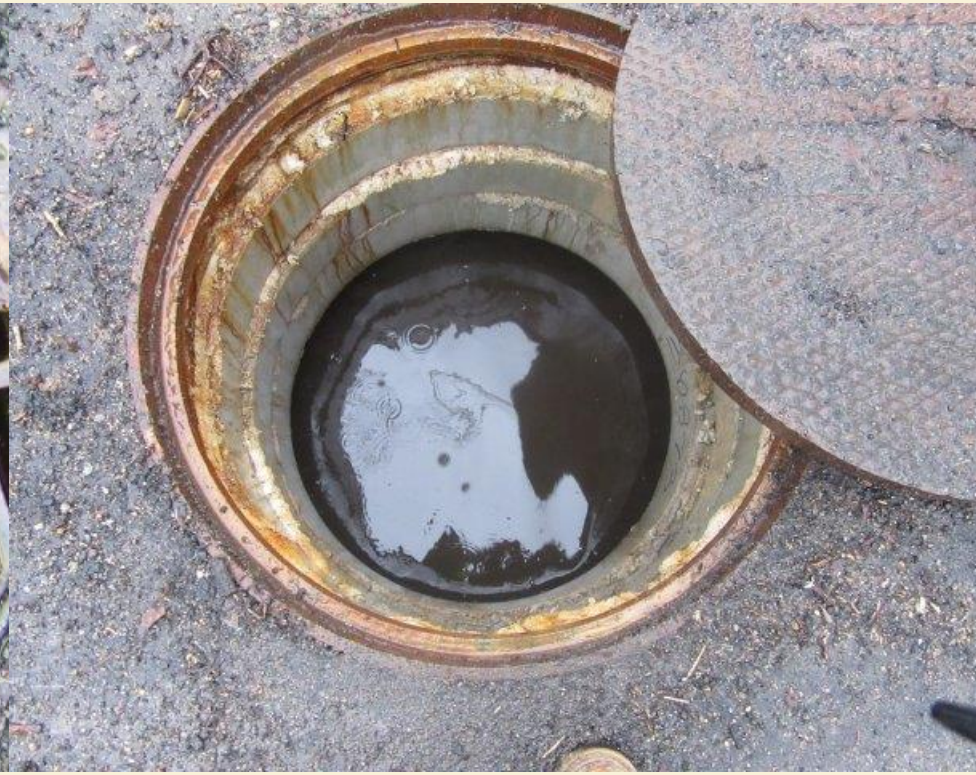
Date: February 22, 2017

Sheet No. 3 of 3

August 2017

- Filtering Catch Basin Designed to replace conv DSCB where applicable
- This system was the third iteration
- The City has purchased four additional filtering catch basins and will install them in other areas throughout the city.
- The system is designed to treat 0.5 acres (0.25 acres/section) of IC per section and costs 2,400 per

In Operation



Update May 2018

Update May 2018

Update May 2018

Conclusions

- Green infrastructure implementation was effective at reducing EIC with respect to hydrologic, water quality at the watershed scale.
- Modeling, stream gauging and water quality sampling results indicate that storm event hydrology and water quality parameters have improved in Berry Brook
- Having the community involved with decisions/design transferred ownership which led to innovations that decreased costs and improved system maintainability.
- Berry Brook project should help both regulators and municipalities adapt their mitigation and restoration efforts toward opportunistic implementation and resiliency planning.