Case Study

Barrier Island Study Center

LID Retrofit

Bald Head Island, North Carolina

Nick Lauretta, PE, LEED AP®

Owner: Bald Head Island Conservancy & Smith Island Trust

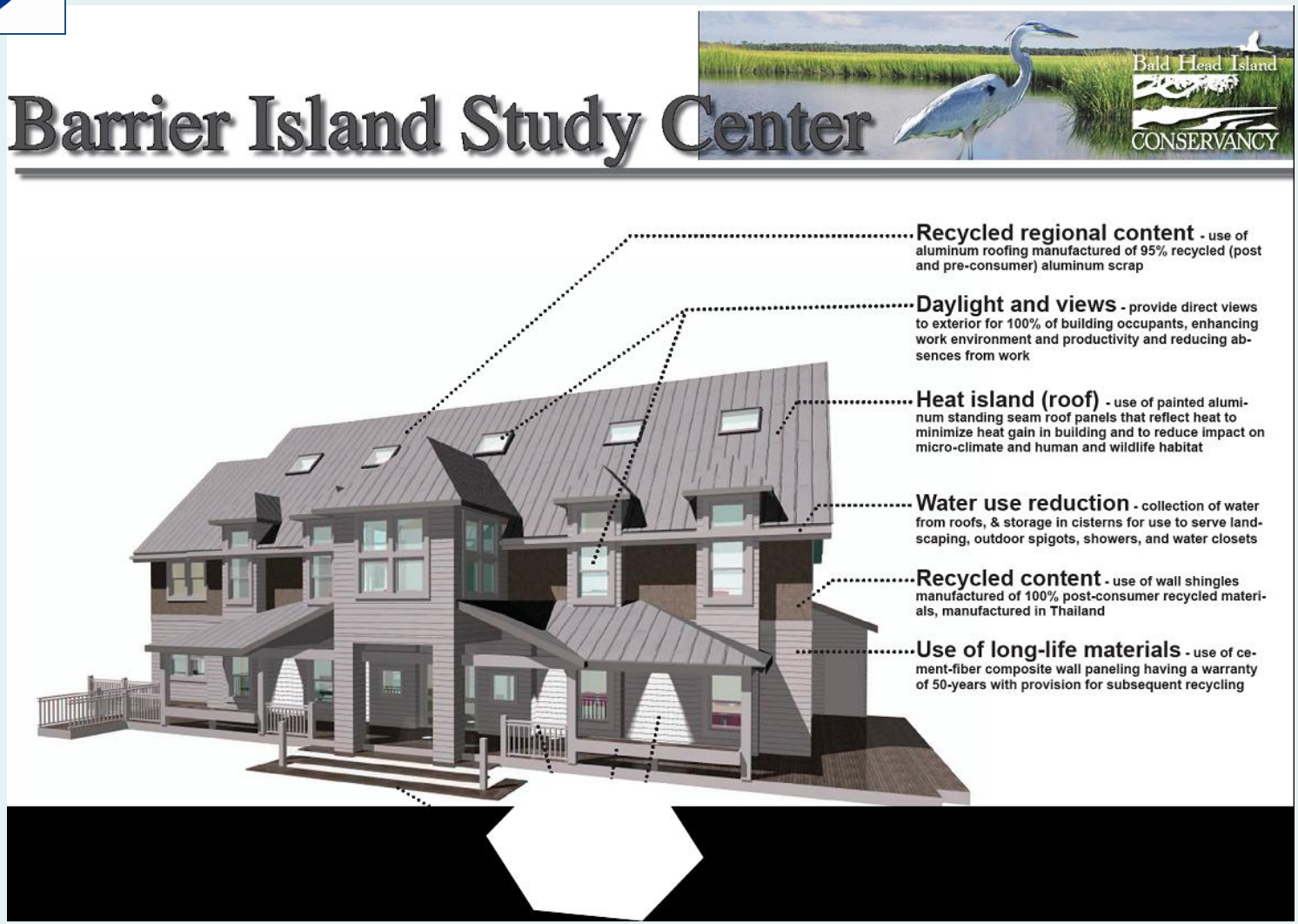
Architect: Jay DeChesere Architect

Engineer: McKim & Creed

Landscape Architect: B+O Design Studio

Contractor: Adams Southeastern Construction

Designed LEED Platinum



Introduction

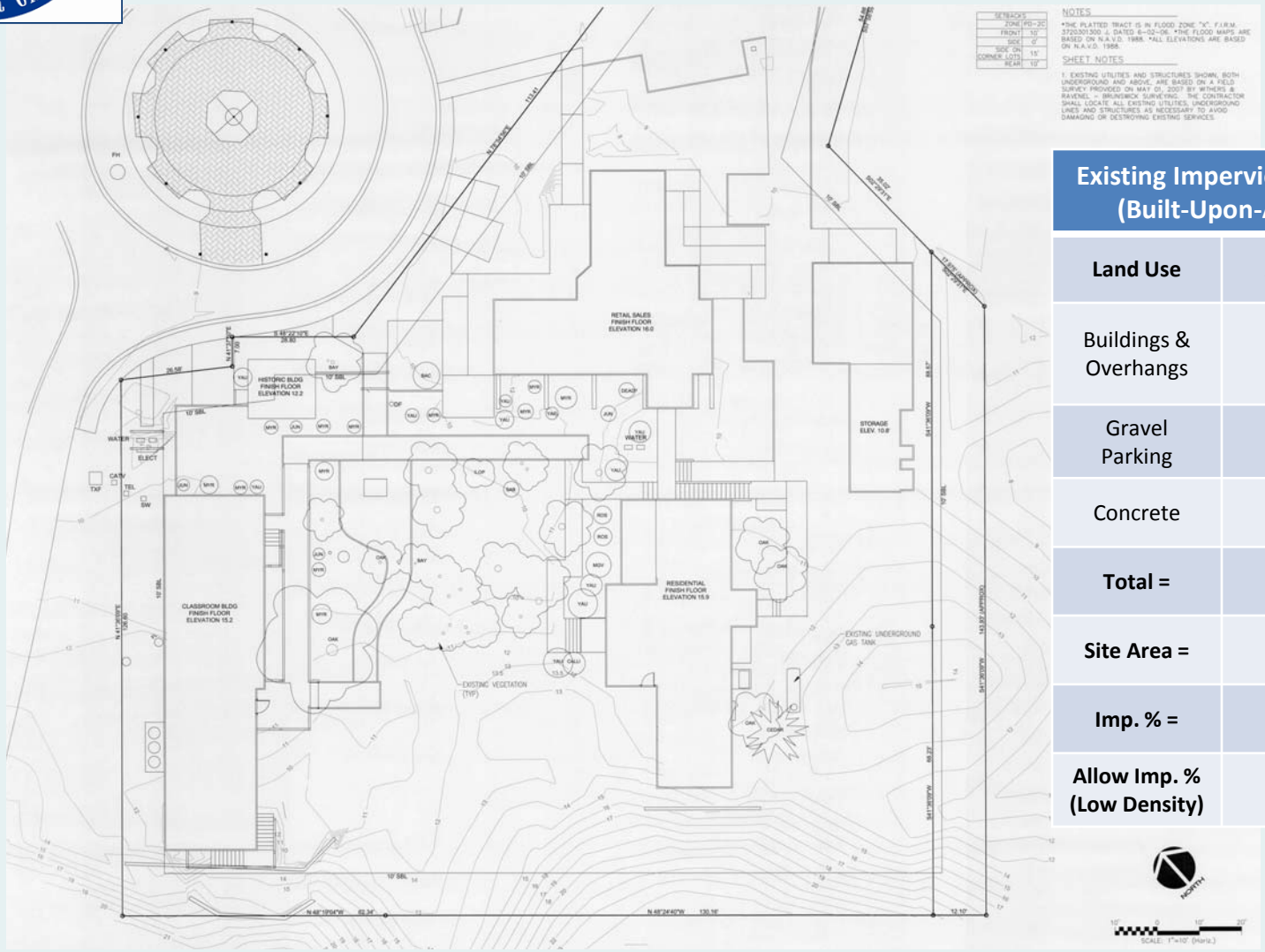
The Barrier Island Study Center represented the last phase of development of the Bald Head Island Conservancy site. The first phase of the project, which consisted of the core of three [of four] buildings, plus one existing small Generator Building, was constructed in the late 1990's.

A Low-Density Stormwater Permit (Permit SW8 950824), was issued on 18 September 1995 as part of the Major CAMA Permit to Bald Head Island Ltd. The Conservancy site was donated to them by Bald Head Island Ltd .

The Low-Density Stormwater Permit was not updated or modified during the first phase of the project, as the Conservancy and the Village of Bald Head Island were unaware of this permit or the need to update or modify it.

During the final review of the project, the Bald Head Architectural Review Committee brought the Stormwater Permit to the attention of the Conservancy's architect. The stormwater issue needed to be resolved before final approval and building permits could be obtained.

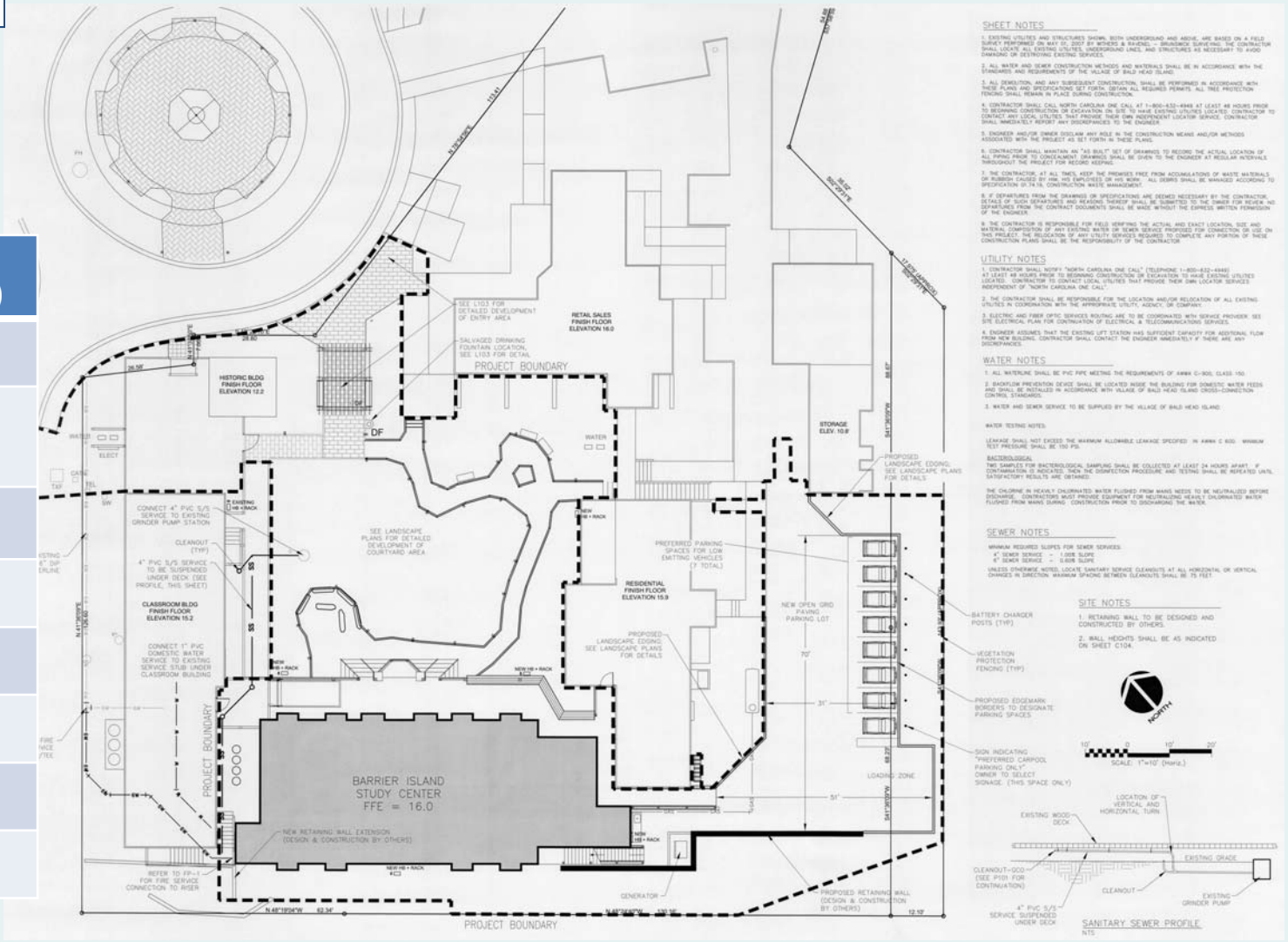
Existing Conditions



Existing Impervious Area (Built-Upon-Area)	
Land Use	**Area (sf)**
Buildings & Overhangs	8,141
Gravel Parking	3,012
Concrete	1392
Total =	**12,545**
Site Area =	**37,739**
Imp. % =	**33.2%**
Allow Imp. % (Low Density)	**30%**

Proposed Development

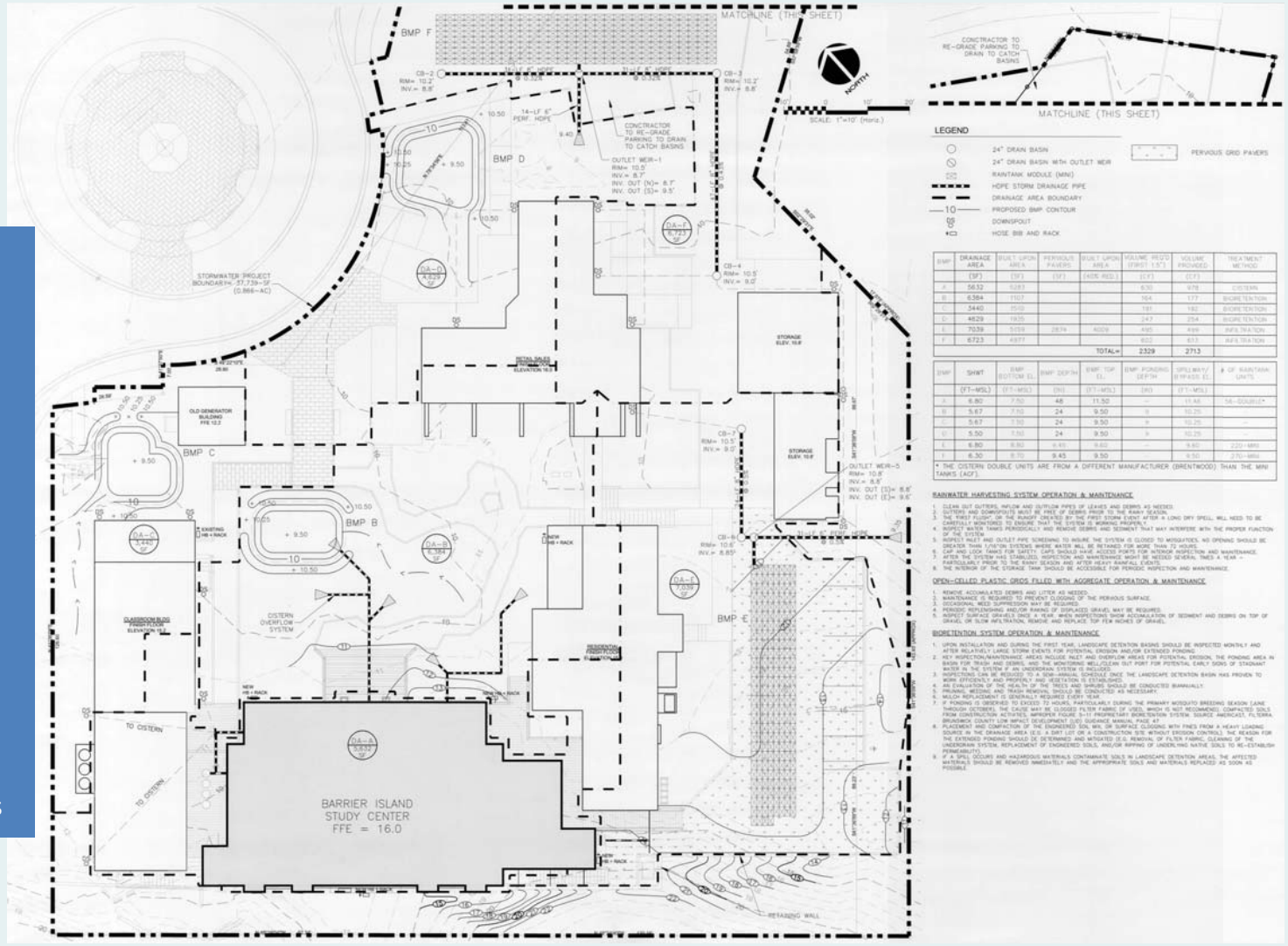
Proposed Impervious Area (Built-Upon-Area)	
Land Use	**Area (sf)**
Buildings & Overhangs	11,782
Gravel Parking	3,012
Concrete	2,328
Pavers	2,872
Total =	**19,994**
Site Area =	**37,739**
Imp. % =	**53.0%**



LID Stormwater Plan

LID Process:

- Verify with Brunswick County Stormwater that project qualifies for LID
- Conduct soils analysis, infiltration and SHWT determination
- Delineate drainage areas and quantify BUA in each drainage area
- Use LID-EZ to determine required storage volume for First Flush
- Site and detail LID Best Management Practices
- Develop planting plans
- Submit permit documents



LID-EZ

Stormwater Management Plan
Coastal Learning Center
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Project #: 5098-0001
Date: 11/30/09
Designer: auretta, PE

PRE-DEVELOPMENT CALCULATIONS

CURVE NUMBER:

HSG	Land-use	CN	Area (acres)	%
A	Woods, Good Cond.	30	0.289	33.37%
A	Pasture or Open Space, Good Cond.	39	0.289	33.37%
A	Impervious	98	0.288	33.26%
		98		0.00%
		98		0.00%
		98		0.00%
		98		0.00%
		98		0.00%
		98		0.00%
		98		0.00%
		98		0.00%
		98		0.00%

Warning: Impervious surface may not be counted in the pre-development condition without permission from Stormwater staff.

	CN	Area (ac.)	% Imp	
User Defined				0.00%
User Defined				0.00%
Sub-Total:		0.866		100.00%

Land Excluded from CN Calculations:

Lakes & Non-Coastal Wetlands :		acres
Coastal Wetlands :		acres
Total Area:	**0.866**	**acres**

Pre-development CN = 56

Runoff Volume for First Flush:	0.37	acre-inches	1338	cf
Runoff Volume for 1-yr Storm:	0.39	acre-inches	1426	cf

TIME OF CONCENTRATION:

	Length (ft)	Slope (ft/ft)	Surface Cover	T_t (hrs)
Sheet Flow:	100	0.01	Woods	0.40
Sheet Flow:				
Shallow Flow:	200	0.01	Unpaved	0.03
Shallow Flow:				

	Length (ft)	Slope (ft/ft)	n-value	Flow Area (ft^2)	Wetted Perimeter (ft)	T_t (hrs)
Channel Flow:						
Channel Flow:						

Pre-development T_c = 25.96 min *(Minimum 5 minutes)*

Stormwater Management Plan
Coastal Learning Center
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POST-DEVELOPMENT CALCULATIONS

CURVE NUMBER:

Residential Lot Data: (If Applicable)		
Total Area of Lots *(Excluding R/W and Open Space)*		acres
Number of Lots:		
Allowable Impervious Area per Lot:		sf
Percent of Impervious on Lots:		%
Preserved Woods per Lot:		sf
Percent of Lot Impervious that is Disconnected:		%

Pervious Pavement Data: (If Applicable)		
Type of Pavement:	Flexible pavement with +4" of gravel base	
HSG	A	
Soil Permeability	6	in/hr

CN=83, 40% Pervious

HSG	Land-use	CN	Area (acres)	%
A	Woods (Preserved Open Space)	30	0.118	13.63%
A	Open Space (Managed Open Space)	39	0.289	33.37%
A	Impervious (Connected)	98	0.167	19.28%
A	Impervious (Disconnected)	98	0.226	26.10%
A	Pervious Pavement	83	0.066	7.62%
		0		0.00%
		0		0.00%
		0		0.00%
		0		0.00%
		0		0.00%
		0		0.00%
		0		0.00%
		0		0.00%
		0		0.00%
Sub-Total:			0.866	100.00%

Lakes & Non-Coastal Wetlands :	0	acres
Coastal Wetlands:	0	acres
Total Area:	**0.866**	**acres**

Post-Development CN = 60

Runoff Volume for First Flush:	0.26	acre-inches	960	cf
Runoff Volume for 1-yr Storm:	0.54	acre-inches	1949	cf

TIME OF CONCENTRATION:

	Length (ft)	Slope (ft/ft)	Surface Cover	T_t (hrs)
Sheet Flow:	100	0.01	Woods	0.40
Sheet Flow:				
Shallow Flow:	200	0.01	Paved	0.03
Shallow Flow:				

	Length (ft)	Slope (ft/ft)	n-value	Flow Area (ft^2)	Wetted Perimeter (ft)	T_t (hrs)
Channel Flow:						
Channel Flow:						

Post-development T_c = 25.53 min *(Minimum 5 minutes)*

LID-EZ

Stormwater Management Plan

Project #: 5098-0001
Date: 11/30/09
Designer: Nick Lauretta, PE

PROPOSED STORAGE DEVICES

Enter only runoff volume below that will be infiltrated or drawn down over 2 to 5 days. Additional volume provided in devices should not be entered in this worksheet. Drawdown time requirement applies to all storm events.

#	Name	Location	Type of Device	Storage Volume Provided (ft^3)	Impervious Area (ac.)	D.S BMP #	% of Total Imp. Area	Required Storage (cf)	% of Storage Provided
1	BMP A		Cistern	978	0.121		28.14%	978.00	100%
2	BMP B		Bioretention	177	0.025		5.81%	164.00	108%
3	BMP C		Bioretention	192	0.035		8.14%	191.00	101%
4	BMP D		Bioretention	254	0.044		10.23%	247.00	103%
5	BMP E		Infiltration Trench	499	0.092		21.40%	495.00	101%
6	BMP F		Infiltration Trench	613	0.114		26.51%	602.00	102%
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									

PEAK FLOW CALCULATIONS

	Pre-Dev	Post-Dev	Increase
$Q_{1\text{-year}}$ =	0.18 cfs	0.00 cfs	-100.0%
$Q_{2\text{-year}}$ =	0.37 cfs	0.05 cfs	-87.6%
$Q_{10\text{-year}}$ =	1.15 cfs	0.92 cfs	-20.1%
$Q_{25\text{-year}}$ =	1.81 cfs	1.29 cfs	-28.7%
$Q_{50\text{-year}}$ =	2.26 cfs	2.05 cfs	-9.3%
$Q_{100\text{-year}}$ =	2.73 cfs	2.59 cfs	-5.3%

Eff. WQ Treatment Volume Provided: 2,713 ft^3

Total Impervious Treated: 100.00%

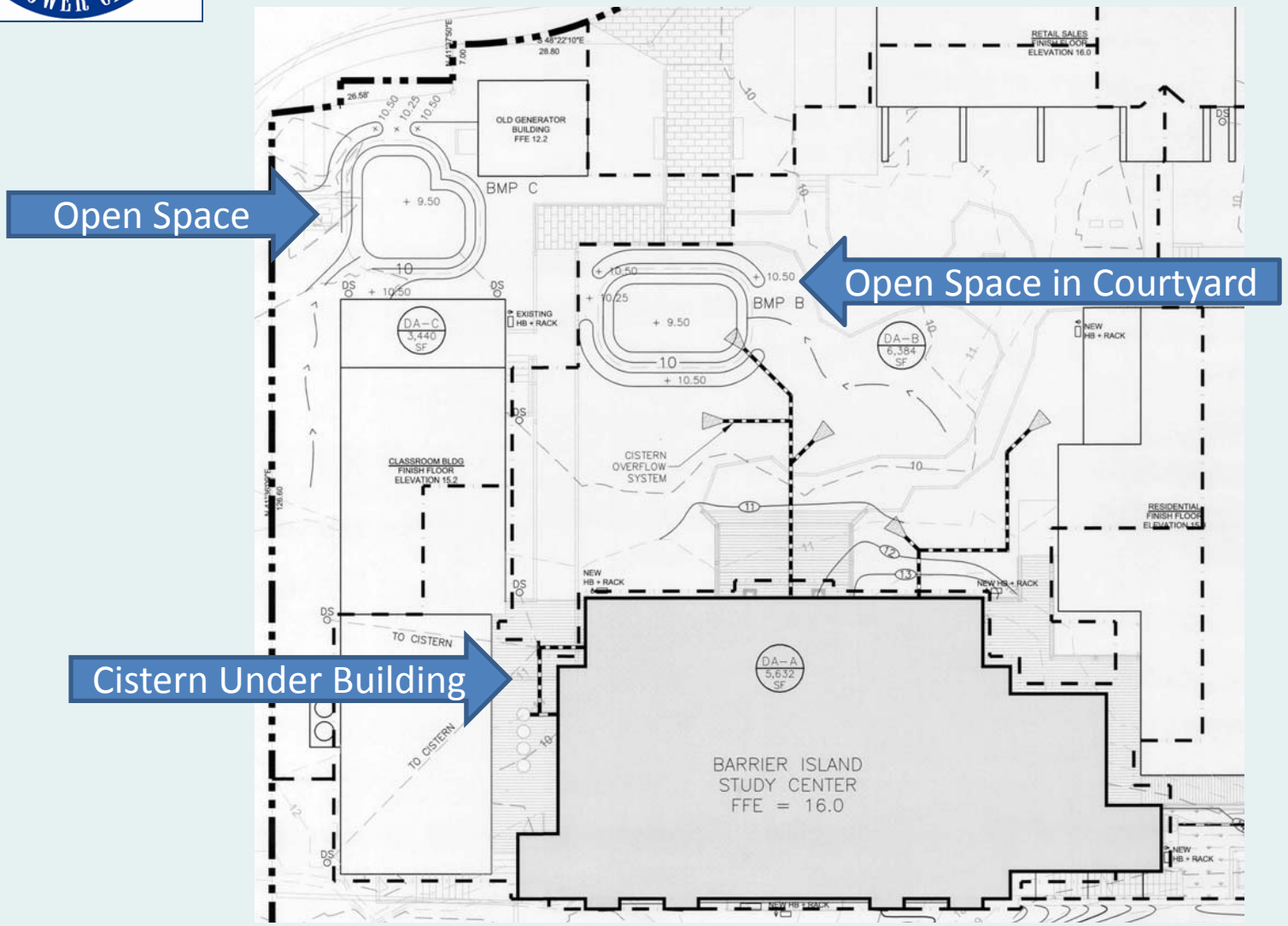
Calculate Removal

Minimum Required Volume for First Flush: 960 ft^3

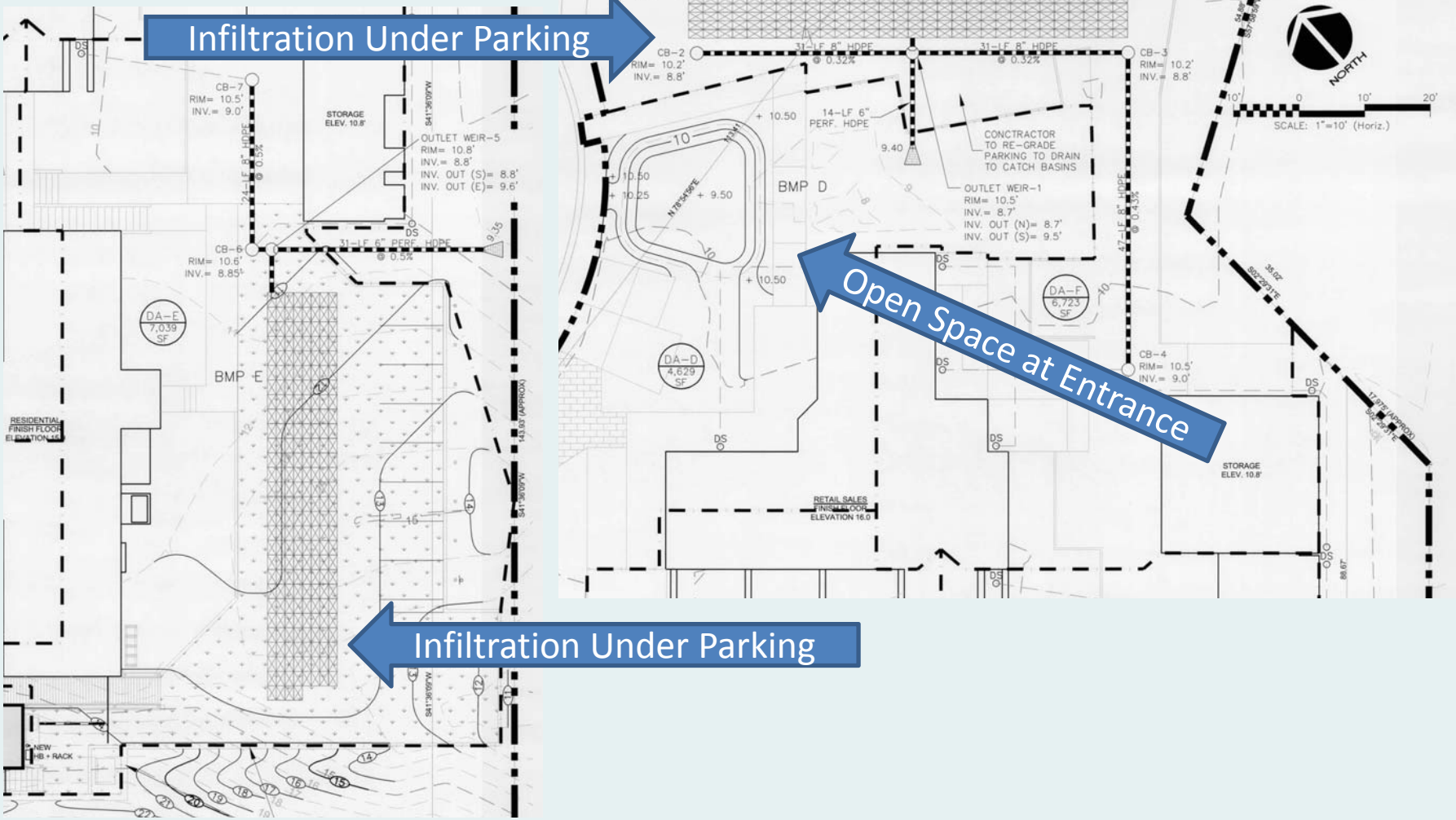
Minimum Volume Required to Meet Δ 1-yr Runoff Volume Requirements: 523 ft^3

Net Pollutant Removal (%)		Target %
TSS	64.2	
TN	25.3	
TP	31.8	
Fecal	Med	
Temp Concern	Low	

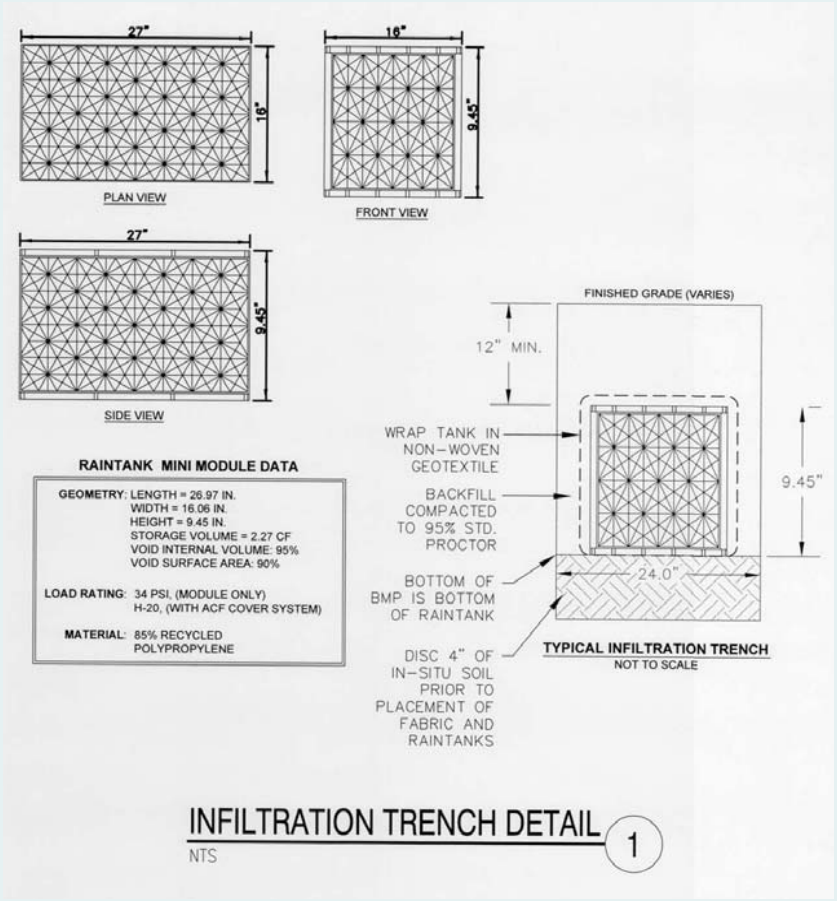
Siting LID BMPs

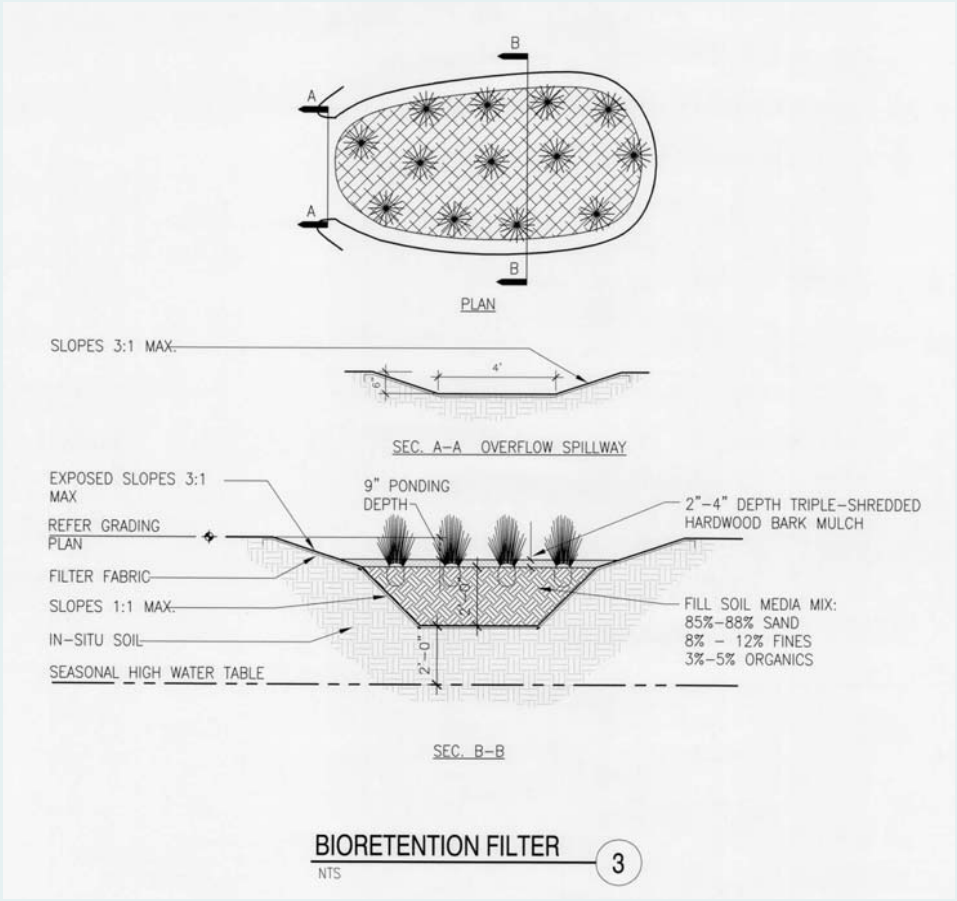


Siting LID BMPs

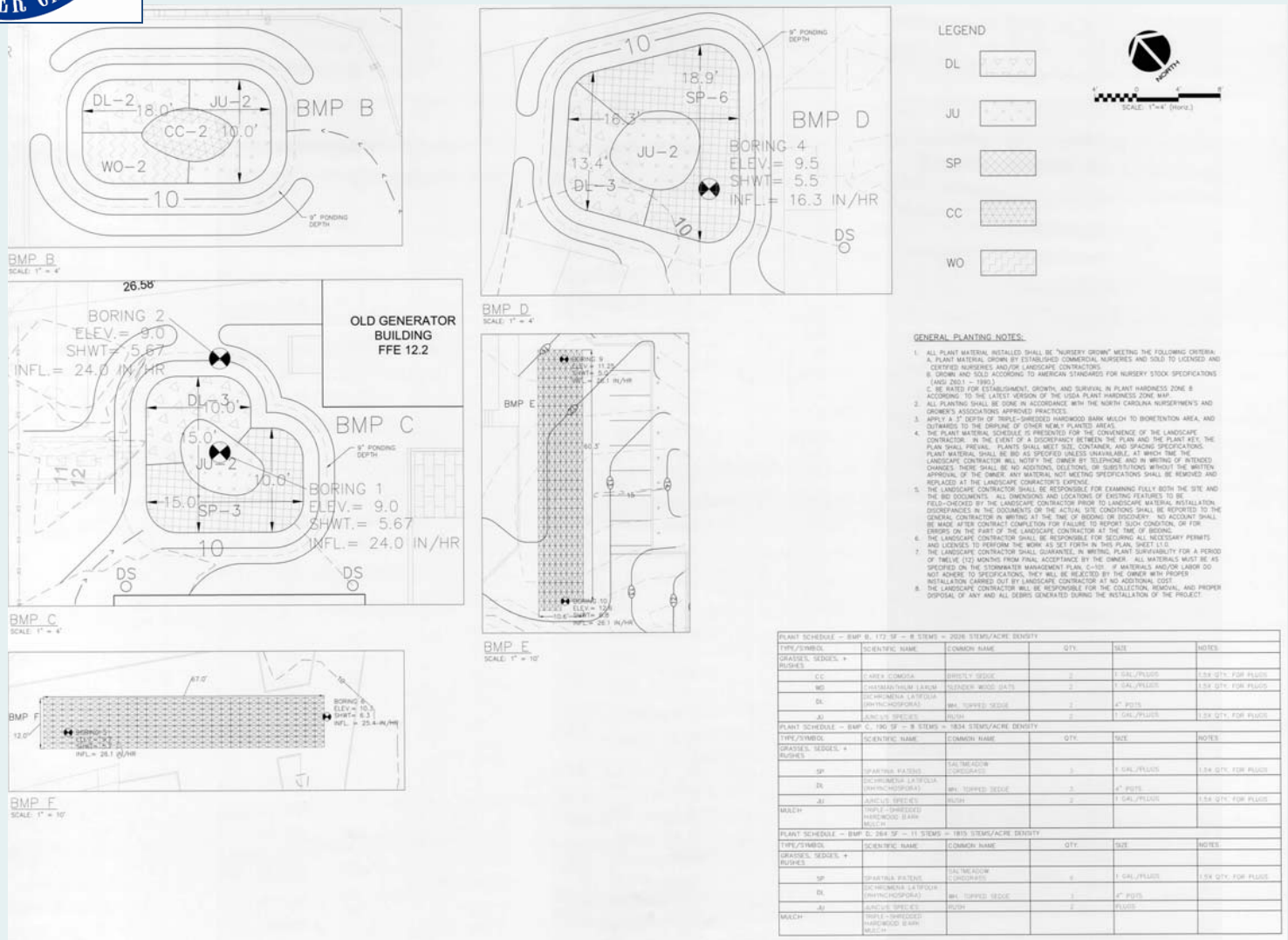


Details


27"
16"
PLAN VIEW
16"
9.45"
FRONT VIEW
27"
9.45"
SIDE VIEW
RAINTANK MINI MODULE DATA
GEOMETRY: LENGTH = 26.97 IN.
WIDTH = 16.06 IN.
HEIGHT = 9.45 IN.
STORAGE VOLUME = 2.27 CF
VOID INTERNAL VOLUME: 95%
VOID SURFACE AREA: 90%
LOAD RATING: 34 PSI, (MODULE ONLY)
H-20, (WITH ACF COVER SYSTEM)
MATERIAL: 85% RECYCLED POLYPROPYLENE
FINISHED GRADE (VARIES)
12" MIN.
WRAP TANK IN NON-WOVEN GEOTEXTILE
BACKFILL COMPACTED TO 95% STD. PROCTOR
BOTTOM OF BMP IS BOTTOM OF RAINTANK
DISC 4" OF IN-SITU SOIL PRIOR TO PLACEMENT OF FABRIC AND RAINTANKS
9.45"
24.0"
TYPICAL INFILTRATION TRENCH
NOT TO SCALE
INFILTRATION TRENCH DETAIL
NTS
1


B
A
A
B
PLAN
SLOPES 3:1 MAX.
4'
SEC. A-A OVERFLOW SPILLWAY
EXPOSED SLOPES 3:1 MAX
REFER GRADING PLAN
FILTER FABRIC
SLOPES 1:1 MAX.
IN-SITU SOIL
SEASONAL HIGH WATER TABLE
9" PONDING DEPTH
2"-4" DEPTH TRIPLE-SHREDDED HARDWOOD BARK MULCH
FILL SOIL MEDIA MIX:
85%-88% SAND
8% - 12% FINES
3%-5% ORGANICS
SEC. B-B
BIORETENTION FILTER
NTS
3

Landscaping



Construction Cost

LID Retrofit Costs	
Item	**Cost**
Cistern (BMP A)	$19,685.28 (Material and Labor) Including Valves and Piping
Bioretention B and C Infiltration E	$25,128.00 (Material and Labor)
Bioretention D Infiltration F	$34,895.00 (Material and Labor)
Total	**$79,708.28**
Cost/CF Storage (2,713 CF)	**$29.38/CF**