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1. INTRODUCTION

Elements Engineering, Inc. and Evans, Mechwart, Hambleton and Tilton Engineering (EMH&T) has completed a drainage analysis for the theoretical site located in the downtown urban environment of the City of Indianapolis, Marion County, Indiana. The intent of this design example is to provide a comparison of drainage between conventional design methods with those integrating green site and building components as related to stormwater runoff. The design team utilized an existing approximate 1-acre site for the drainage comparison of existing use, conventional and green design conditions.

The existing, conventional and green site designs were performed to meet the City of Indianapolis drainage standards for water quality volume and discharge allowances. Each site design also meets current City of Indianapolis zoning and landscaping requirements. For this exercise, offsite drainage facilities are found within the Combined Sewer system and are assumed to be readily available, such that all design techniques are to be evaluated only for onsite drainage improvements. It is assumed that the building footprints are identical for useable space and the parking provided is equivalent. The soil conditions are assumed to be type B with a water table that is 4' or greater below the surface. Costs for actual building construction is not being considered within the cost impact comparison, assuming similar conditions for both design alternatives.

2. DESIGN CONDITIONS

Existing Site:

The existing site is assumed to be completely developed, being utilized for warehousing and office activities. The existing site is considered to be almost completely impervious surface with a combination of building, parking and minimal landscaping or green space. For this re-development condition, it is assumed that the existing site will be completely demolished and no existing above ground features will remain.

Proposed Site:

A) CONVENTIONAL DESIGN

The conventional design will use a single-story commercial office building with impervious parking surfaces and minimal landscaping or lawn areas. Due to need to maximize above ground land use and in consideration of the value/cost of land, there is no recognized economically viable space for above ground detention. Typical site piping will direct storm runoff from the building roof, parking area, driveways and remaining site to an underground detention. An underground mechanical Post Construction water quality Best Management Practice (BMP) will

be used. BMPs of this type are typically vortex solids removal mechanical equipment.

B) GREEN INTEGRATED DESIGN

The green integrated design will use a two-story commercial office building with permeable pavement while maximizing the integration of Post Construction Water Quality BMPs into the landscaping. The two-story building will have the same leasable space as the conventional design alternative, but will provide a smaller building footprint upon the overall redevelopment site. The building layout and alignment will be such that the energy consumption for the building will be optimized. Primary green site features include unpaved green space, porous pavement and bioretention via rain gardens.

It should be noted that the exercise evaluated the use of a green roof technology for the Green Integrated Design option in order to evaluate the benefit-cost impacts for the site's storm runoff management. The green roof evaluated incorporated an average depth of 6" over 75% of the roof surface. The results indicate that for stormwater benefits only, the cost of the greenroof was not economically viable or needed to meet the current City of Indianapolis water management requirements. This result was directly related to the green integrated design efficiency in utilizing a smaller building footprint and subsequent green site space utilization. Essentially, the green space around the building was less expensive and very efficient in water quality and quantity management then green roof alternatives. Ironically, the green roof technology seems best suited for the conventional design condition (low percentage green space around building) as a hybrid site development technique. Further evaluation of this type of hybrid site development was outside the intent of this study and was not performed.

3. RESULTS

The comparison of the existing, conventional and integrated green site design is tabulated in Table 1, below. Of greatest interest are the values of observed Combined Sewer System. The existing and conventional site do not retain, store, infiltrate or appreciably reduce the peak runoff for the majority of the storm events. The existing and conventional site layouts and designs provide a continual discharge rate up to 2.1 cubic feet per second (cfs) until all water is drained into the Combined Sewer system.

The Green Integrated site design stores, treats and/or delays the storm runoff prior to discharge to the Combined Sewer system. The distributed storage of the bioretention (rain gardens) provides a positive removal volume from the combined sewer system. The temporary storage and conveyance of stormwater runoff through the porous paved parking areas in combination with the use of green space for breaking up impervious

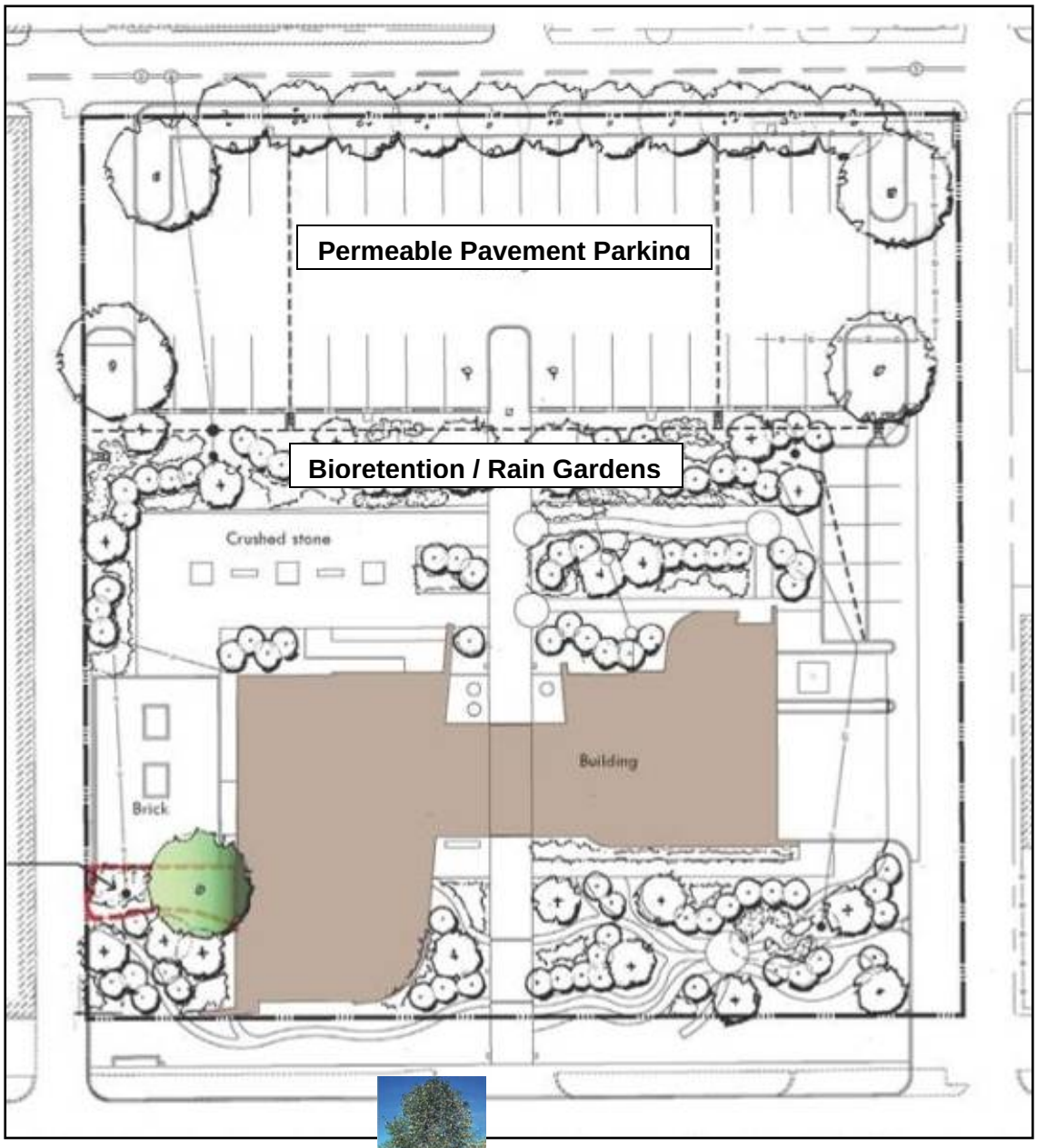
area runoff significantly reduces the discharge rate of the site's runoff (1.1 cfs) as compared to the conventional site design.

Given the capital cost of combined sewer peak flow storage and the annual cost for transporting and treating all captured Combined Sewer flow, the green integrated site design has the potential to provide direct economic benefit to the City of Indianapolis. The green integrated design also provides direct environmental benefit to the water quality of the streams and/or rivers due to the treated volume that can be removed from the combined sewer system by infiltration and/or evapotranspiration. Additional potential benefits through the use of stormwater re-direction out of the combined sewer system were not evaluated for this exercise. However, it can be directly implied that for every gallon removed and treated from the combined sewer system, a direct economic and environmental benefit can be observed.

TABLE 1 - Existing, Conventional and Green Integrated Site Design Comparison

	Existing Site	Conventional	Green Integrated
Total Site (sq. ft.)	42,889		
Impervious (sq. ft.)	41,901	38,177	23,615
Pervious (sq. ft.)	988	4,712	19,274
% Green (pervious) Space	2%	11%	45%
Average Curve Number	97.1	93.9	77.7
Cost ($)/ Sq. Ft.	n/a	$ 3.03	$ 3.86
Discharge Rate (cfs)	2.11	2.10	1.10
Volume of Stormwater Removed from Combined Sewer System*			
1" Storm (gal.)	0	0	26,703
Annual Total (gal)	0	0	650,000
Potential Combined Sewer Cost Savings (per Acre)			
Annual Operation	$0	$0	$6,500
CSO Storage Reduction**	$0	$0	$18,692
*estimated from Indianapolis Rain Data, 2001-2005			
**estimated 20% total volume reduction for peak detention			

Green Integrated Design Condition
Landscape Plan




6. Iris species


4. Hibiscus species


1. River Birch


7. Golden Queen Globeflower


5. Kelsey Dogwood


2. Willow species


3. Knockout Rose


5. Lily varieties


6. Purple Coneflower


4. Golden Vicary Privet


2. Varder Valley Boxwood


1. Knockout Rose (yellow variety)

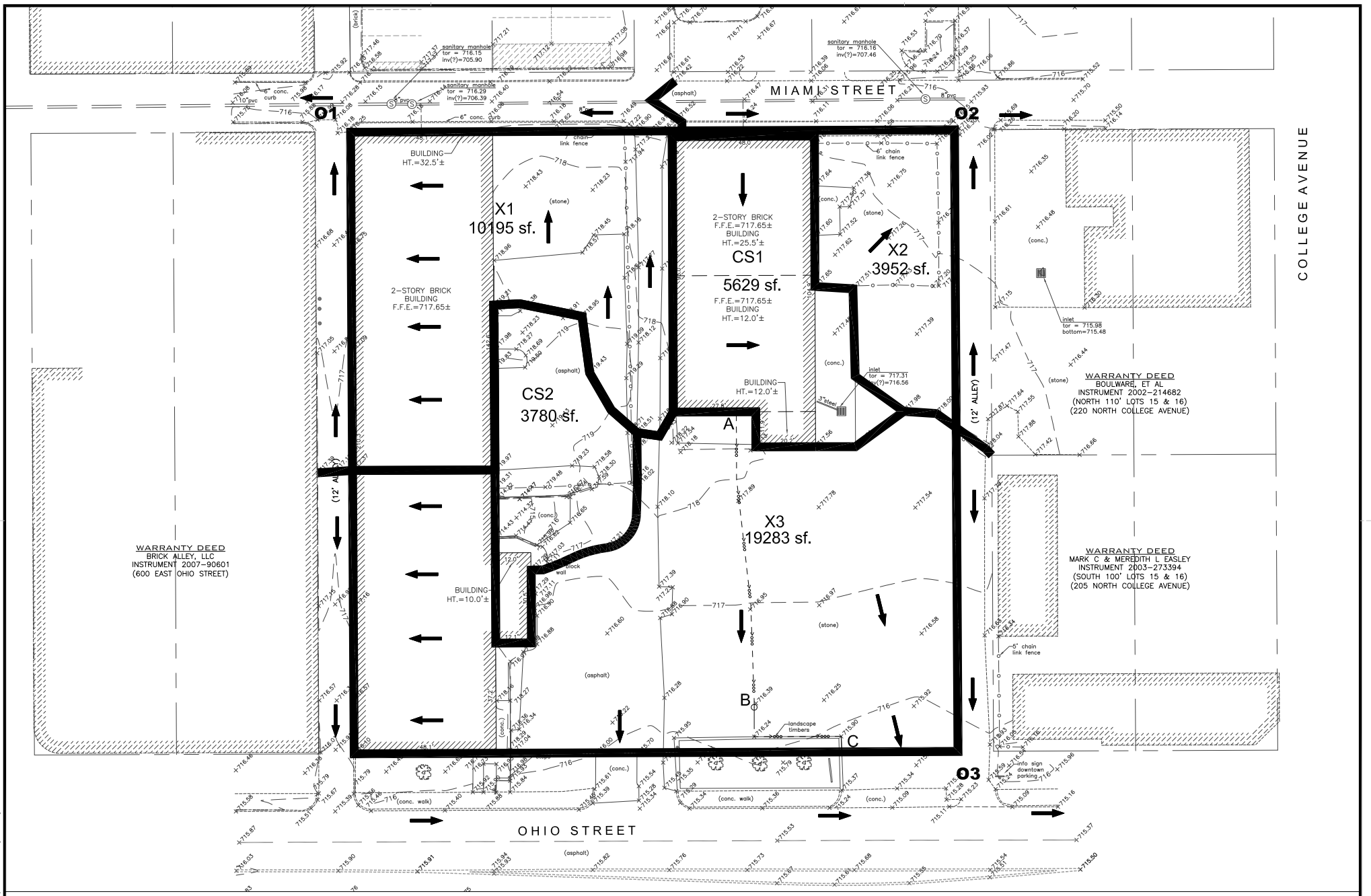
APPENDICES

APPENDIX A – Existing Conditions
- Site Plan Drainage
- Model Output

APPENDIX B – Conventional Design Conditions
- Site Plan Drainage
- Typical Landscape Design
- Model Output

APPENDIX C – Green Integrated Design Conditions
- Typical Cupped Landscape Design
- Without Green Roof
  - Site Plan Drainage
  - Model Output
- With Green Roof
  - Site Plan Drainage
  - Model Output

Appendix A
Existing Conditions



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M C M X X V I

LEGEND

ROOF	15,157 sf.
PAVEMENT	9,673 sf.
STONE	17,021 sf.
PERVIOUS	988 sf.
TOTAL PROJECT AREA	42,839 sf

PROJECT:

Green Design Example - Commercial Office Site
Indianapolis, Marion County Indiana

PRE-DEVELOPED
EXISTING DRAINAGE CONDITIONS

EMH&T JOB NO. 2008-0237

DATE: 06-11-2008

SCALE: 1" = 20'

SHEET No. **X2**

Jul 13, 2009 - 4:00pm - Q:\Project_2008\Projects\20080834\Dwg\Pre-D.dwg

Existing Conditions - Land Use

EXISTING CONDITION			
Surface	Area	CN	C
Roof	15157	98	0.90
Pavement	9673	98	0.85
Stone	17021	98	0.85
Pervious	988	61	0.25
Total =	**42839**	**97.1**	**0.85**

X1			
Surface	Area	CN	C
Roof	5488	98	0.90
Pavement	2138	98	0.85
Stone	2569	98	0.85
Pervious	0	61	0.25
Total =	**10195**	**98.0**	**0.88**

X2			
Surface	Area	CN	C
Roof	0	98	0.90
Pavement	165	98	0.85
Stone	3787	98	0.85
Pervious	0	61	0.25
Total =	**3952**	**98.0**	**0.85**

CS1			
Surface	Area	CN	C
Roof	4706	98	0.90
Pavement	729	98	0.85
Stone	194	98	0.85
Pervious	0	61	0.25
Total =	**5629**	**98.0**	**0.89**

X3			
Surface	Area	CN	C
Roof	4597	98	0.90
Pavement	3788	98	0.85
Stone	10420	98	0.85
Pervious	478	61	0.25
Total =	**19283**	**97.1**	**0.85**

CS2			
Surface	Area	CN	C
Roof	366	98	0.90
Pavement	2853	98	0.85
Stone	51	98	0.85
Pervious	510	61	0.25
Total =	**3780**	**93.0**	**0.77**

EXISTING CONDITION			
Surface	Area	CN	C
Roof	15157	98	0.90
Pavement	9673	98	0.85
Stone	17021	98	0.85
Pervious	988	61	0.25
Total =	**42839**	**97.1**	**0.85**

Existing Conditions - Peak Release

X1			
Event	2-year	10-year	100-year
30	**0.67**	**1.17**	1.70
1	0.47	0.79	1.19
2	0.31	0.52	0.78
3	0.24	0.39	0.59
6	0.14	0.24	0.34

X2			
Event	2-year	10-year	100-year
30	**0.26**	**0.45**	0.66
1	0.18	0.30	0.46
2	0.12	0.20	0.30
3	0.09	0.15	0.23
6	0.06	0.09	0.13

CS1			
Event	2-year	10-year	100-year
30	**0.37**	**0.65**	0.94
1	0.26	0.43	0.66
2	0.17	0.29	0.43
3	0.13	0.22	0.32
6	0.08	0.13	0.19

X3			
Event	2-year	10-year	100-year
30	**1.15**	**2.08**	3.09
1	0.80	1.40	2.18
2	0.54	0.93	1.43
3	0.41	0.71	1.08
6	0.26	0.43	0.64

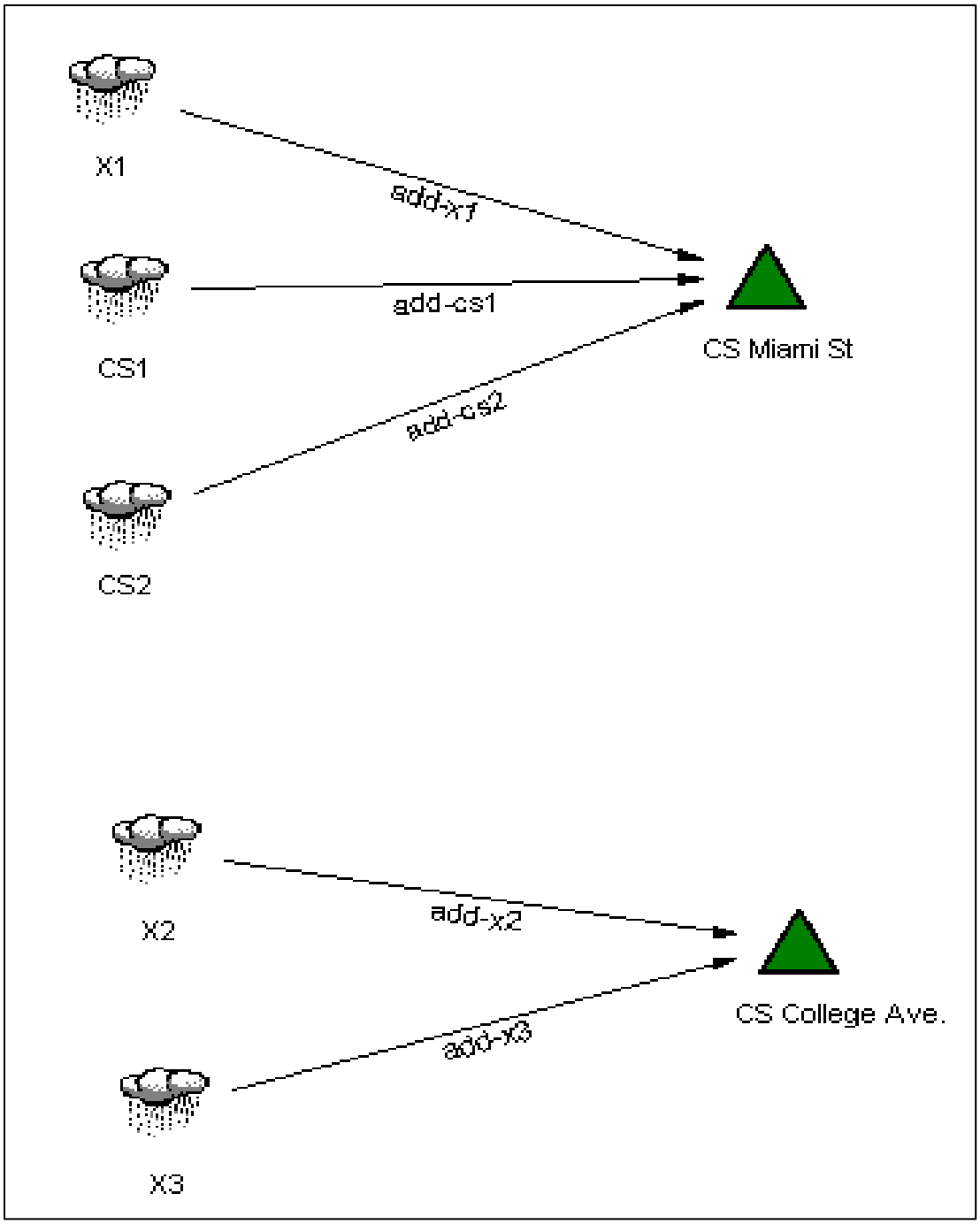
CS2			
Event	2-year	10-year	100-year
30	**0.14**	**0.30**	0.50
1	0.11	0.22	0.36
2	0.08	0.14	0.24
3	0.06	0.11	0.19
6	0.04	0.07	0.11

CS - Miami Street			
30	2-year	10-year	100-year
1	**1.18**	**2.11**	3.13
2	0.82	1.42	2.20
3	0.55	0.95	1.44
6	0.42	0.72	1.09
Total =	0.26	0.44	0.65

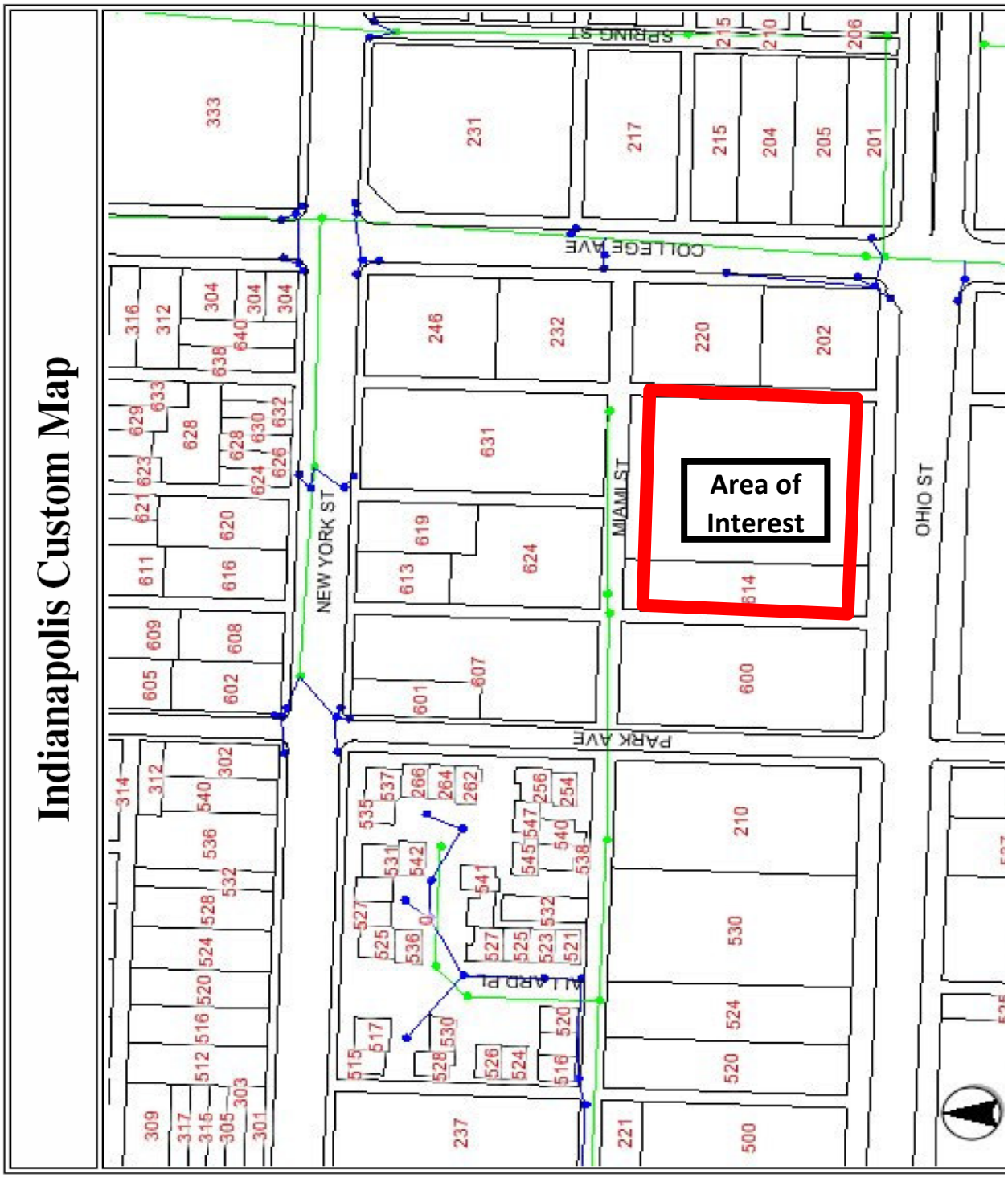
CS - College Avenue			
30	2-year	10-year	100-year
1	**1.41**	**2.53**	3.74
2	0.98	1.70	2.64
3	0.66	1.13	1.73
6	0.51	0.86	1.31
Total =	0.31	0.52	0.77

	CS Miami	**CS College**
Post-D 0-10-year Allowable Release	**1.18**	**1.41**
Post-D 11-100-year Allowable Release	**2.11**	**2.53**

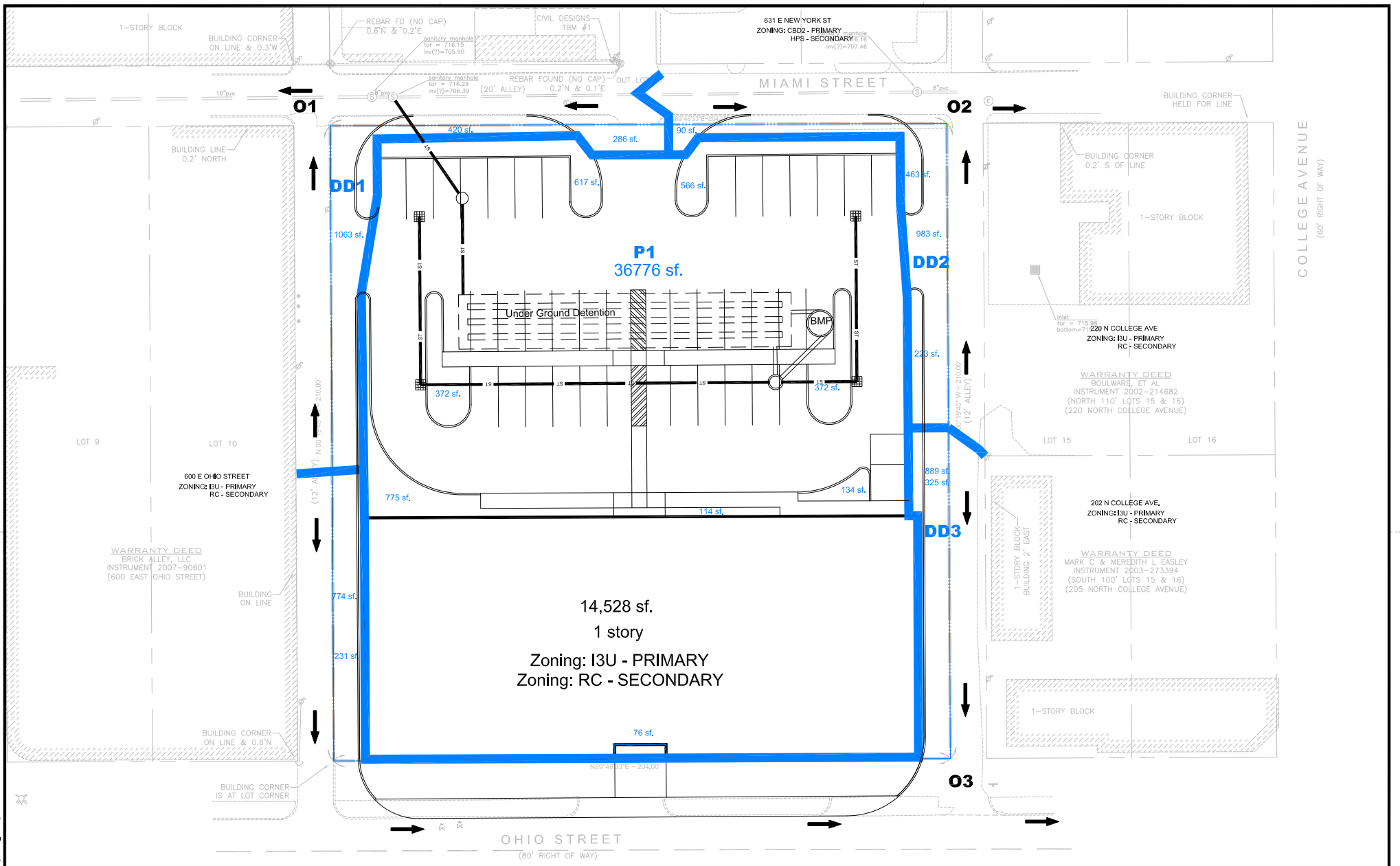
Existing Conditions - Model Diagram



Existing Conditions - Area of Interest Map



Appendix B
Conventional Design Conditions



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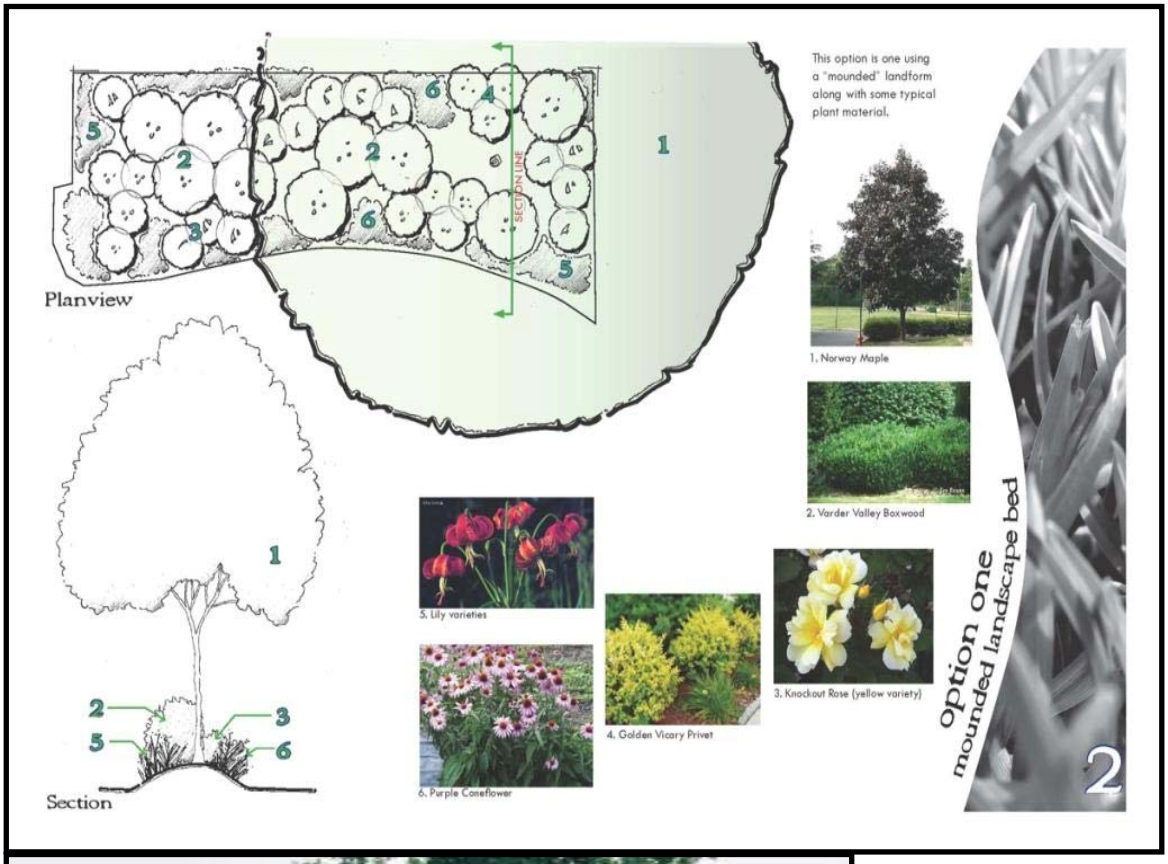
PROJECT:
Green Design Example - Commercial Office Site
Indianapolis, Marion County Indiana

POST-DEVELOPED CONVENTIONAL DRAINAGE CONDITIONS

EMH&T JOB NO. 2008-0237
DATE: 06-11-2008
SCALE: 1" = 20'
SHEET No. C1

Jul 14, 2008 - 2:14pm - Q:\Project_2008\Projects\20080834\Dwg\Urban_NC.dwg

Conventional Site Design Condition
Mounding Landscape Design Typical



Conventional Conditions - Land Use

CONVENTIONAL CONDITIONS			
Surface	Area	CN	C
Roof	14604	98	0.90
Pavement	23523	98	0.85
Pervious	4712	61	0.25
Total =	**42839**	**93.9**	**0.80**

COMPARISON		
Condition	CN	c
Existing	97.1	0.85
Conventional	93.9	0.80

reduction due to Landscape Requirements

CN % Reduction	C % Reduction
3.31	6.18

P1			
Surface	Area	CN	C
Roof	14604	98	0.90
Pavement	19222	98	0.85
Pervious	2950	61	0.25
Total =	**36776**	**95.0**	**0.82**

DD3			
Surface	Area	CN	C
Roof	0	0	0.00
Pavement	1721	98	0.85
Pervious	556	61	0.25
Total =	**2277**	**89.0**	**0.70**

DD1			
Surface	Area	CN	C
Roof	0	0	0.00
Pavement	1407	98	0.85
Pervious	520	61	0.25
Total =	**1927**	**88.0**	**0.69**

DD2			
Surface	Area	CN	C
Roof	0	0	0.00
Pavement	1173	98	0.85
Pervious	686	61	0.25
Total =	**1859**	**84.3**	**0.63**

Conventional Conditions - Peak Release

P1			
Event	2-year	10-year	100-year
30		1.14	2.01
1		1.09	1.97
2		0.99	1.75
3		0.89	1.49
6		0.66	0.95
		0.43	0.62

DD2			
Event	2-year	10-year	100-year
30		0.07	0.15
1		0.06	0.12
2		0.05	0.09
3		0.04	0.07
6		0.02	0.04

DD1			
Event	2-year	10-year	100-year
30		0.10	0.19
1		0.08	0.15
2		0.06	0.10
3		0.04	0.08
6		0.03	0.05

DD3			
Event	2-year	10-year	100-year
30		0.13	0.24
1		0.10	0.19
2		0.07	0.12
3		0.05	0.09
6		0.04	0.06

CS - Miami Street			
Event	**2-year**	**10-year**	**100-year**
30		**1.18**	**2.10**
1		1.14	2.06
2		1.03	1.83
3		0.93	1.56
6		0.69	0.99
Total =		0.44	0.64
Hydrograph addition			
CS Miami - Allowable		**1.18**	**2.11**

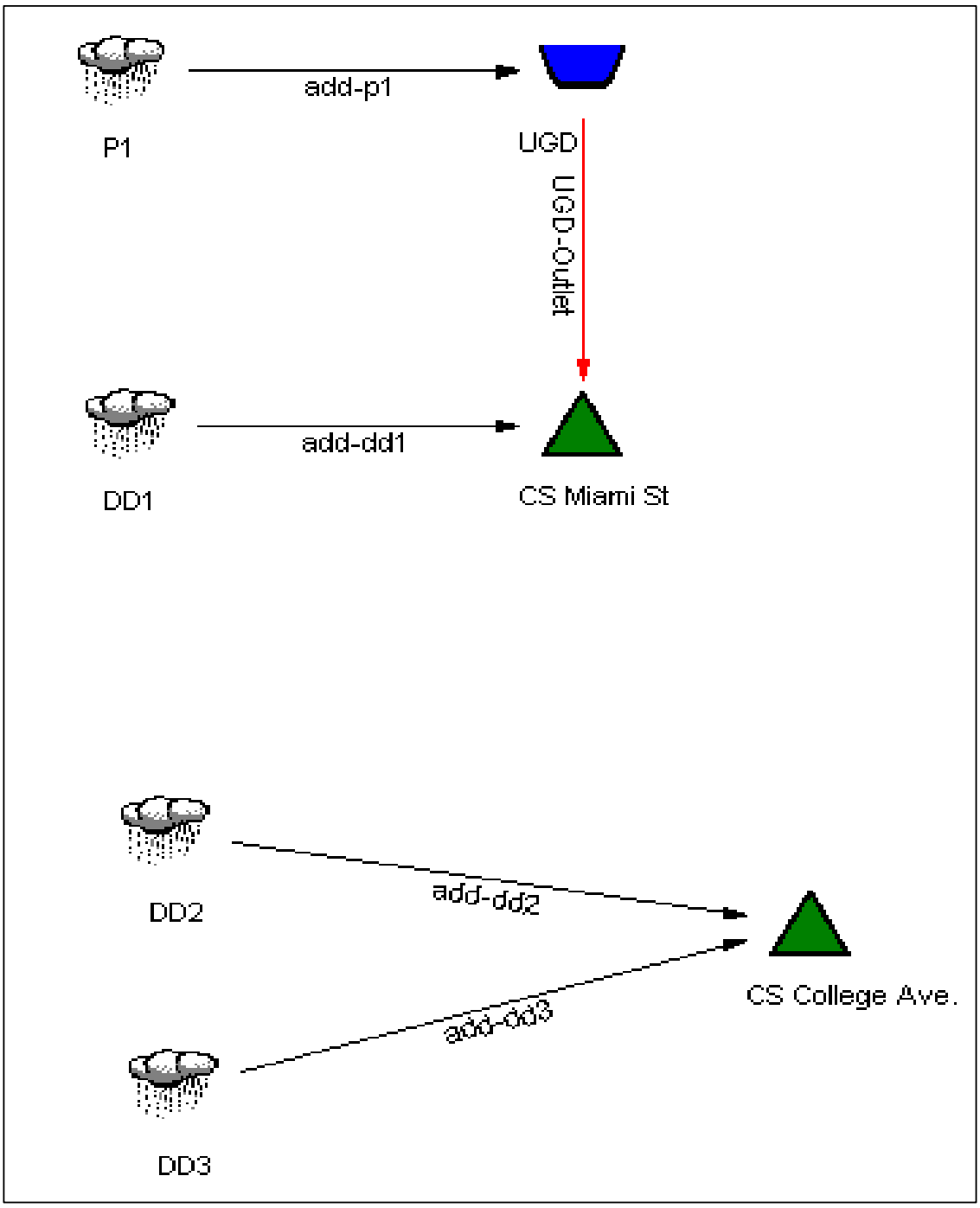
CS - College Avenue			
Event	**2-year**	**10-year**	**100-year**
30		**0.21**	**0.39**
1		0.17	0.31
2		0.12	0.21
3		0.09	0.16
6		0.06	0.10
Total =		0.04	0.06
Hydrograph addition			
CS College - Allowable		**1.41**	**2.53**

Under Ground Detention System			
P1 to CS Miami Street			
Event	**cfs**	**stage**	**volume**
10-year	**1.14**	**801.70**	**1951**
100-year	**2.08**	**802.65**	**2986**

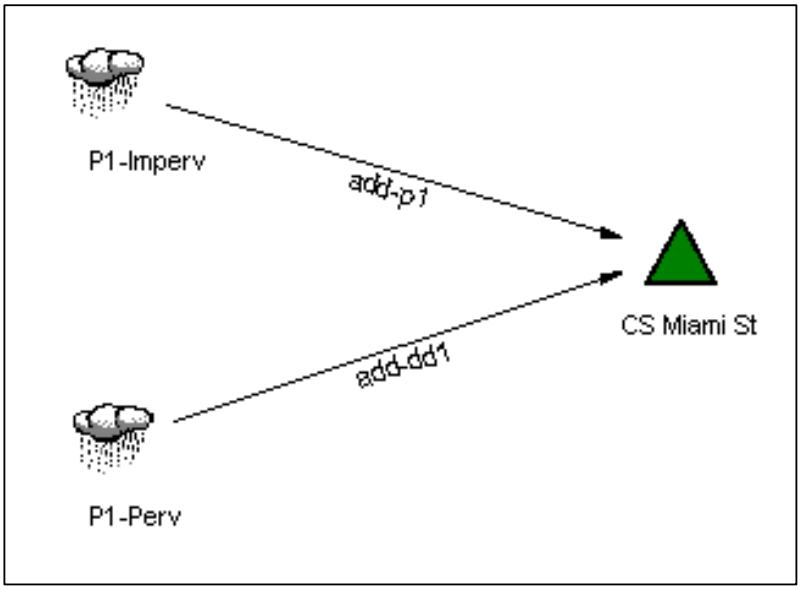
4 x 36" Barrels x 110 feet in length **3110-cft**

Outlet: **1 x 6" dia. Orifice**
1 x 5" dia.Orifice
1 x 12" dia. Conduit

Water Quality Treatment Unit		
Event	**cfs**	**Aqua-Swirl**
huff 1 Qrt.	**1.47**	**AS-6**


add-p1
P1
UGD
UGD-Outlet
add-dd1
DD1
CS Miami St
DD2
add-dd2
CS College Ave.
add-dd3
DD3

Conventional Design Conditions - DRAINAGE SCHEMATIC - Water Quality



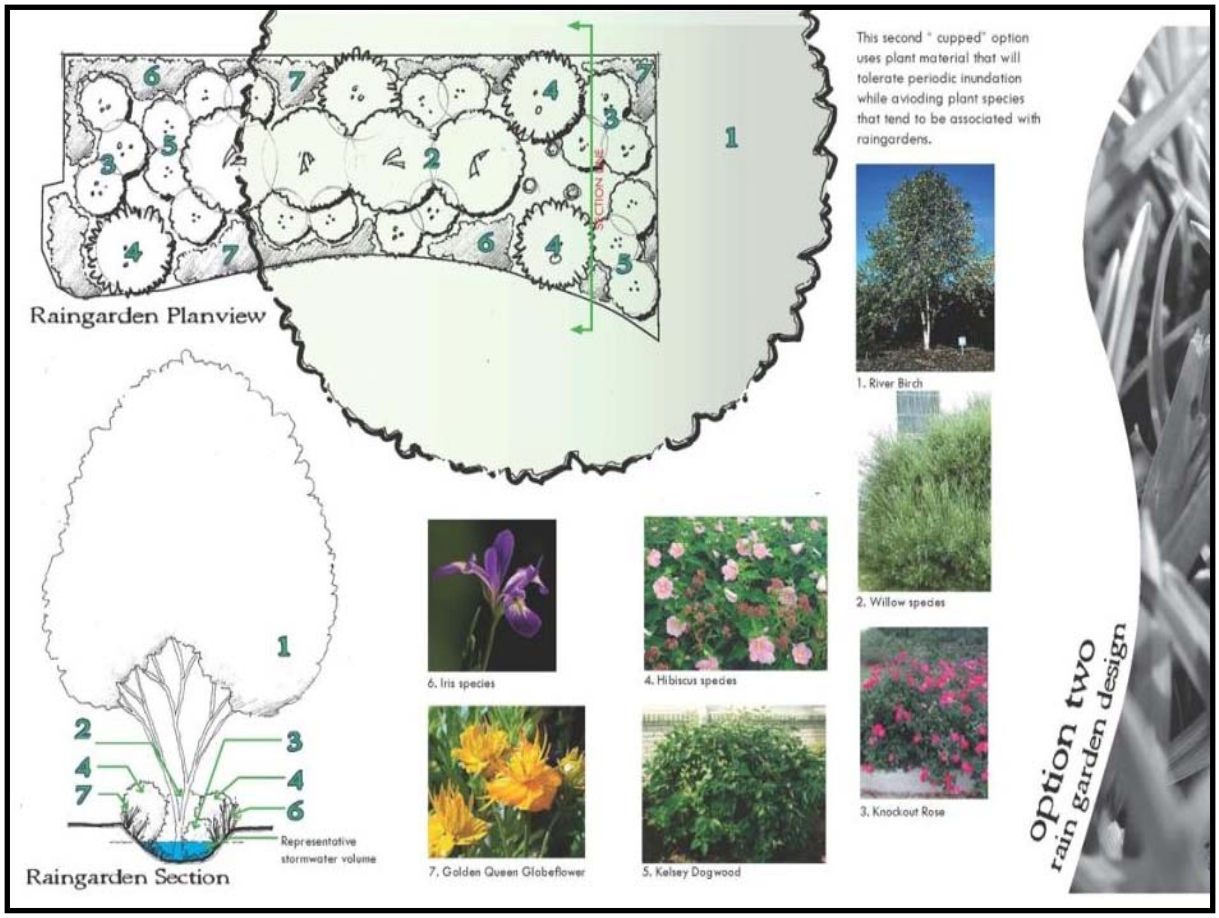
Water Quality Treatment Unit		
Event	cfs	Aqua-Swirl
huff 1 Qrt.	1.47	AS-6

Aqua-Swirl™ 2	AS-2	0.29
	AS-3	0.50
	AS-4	0.75
	AS-5	1.20
	AS-6	1.70
	AS-7	2.30
	AS-8	3.00
	AS-9	3.80
	AS-10	4.70
	AS-12	6.80

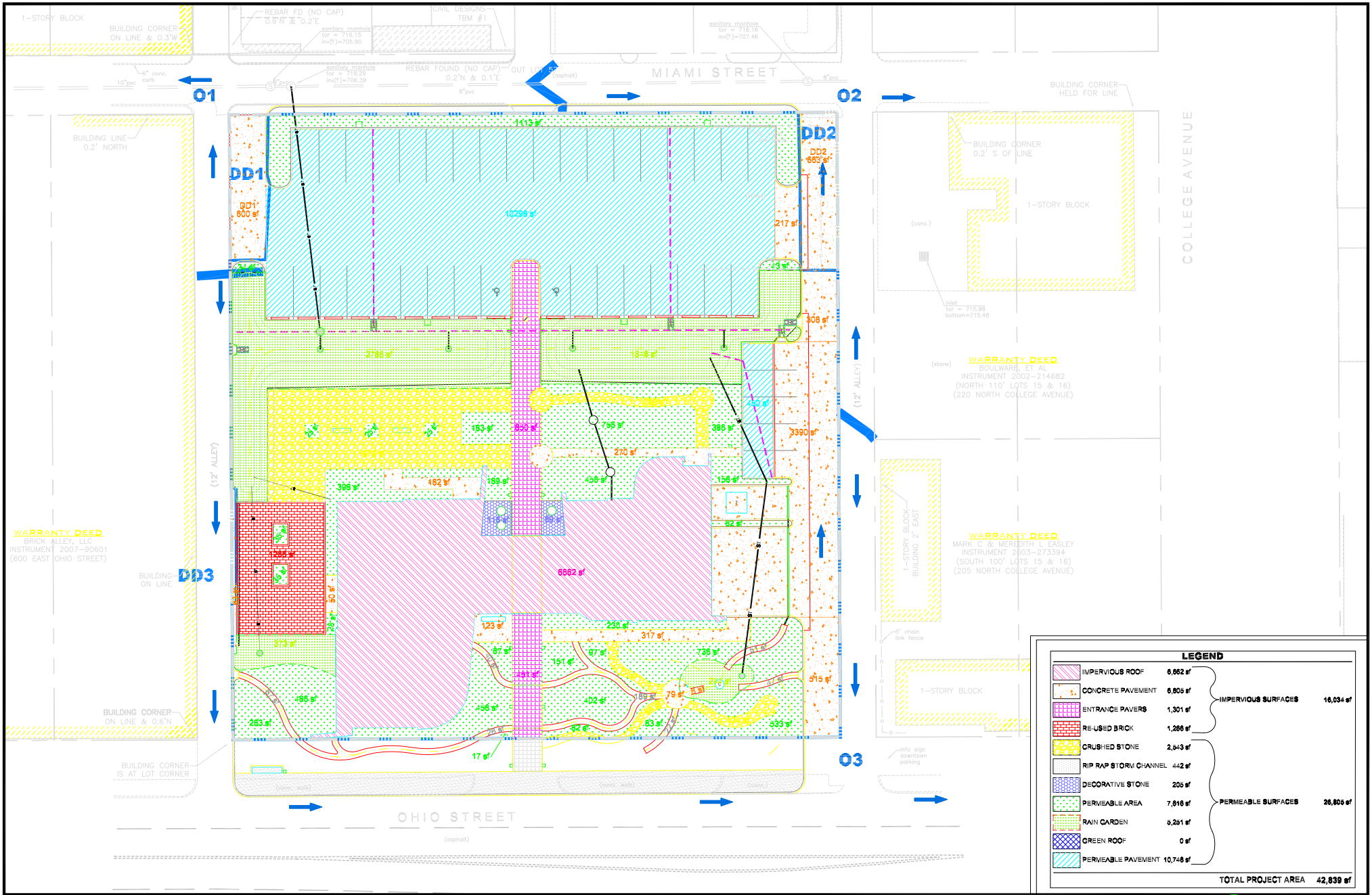
Appendix C

Green Integrated Design Conditions

Green Integrated Site Design Condition
Cupping Landscape Design Typical



Without Green Roof



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Nature Conservancy Headquarters
Indianapolis, Marion County Indiana

POST-DEVELOPED - INTEGRATED SITE DESIGN OPTION 1
PROPOSED SURFACE CONDITIONS

ELEMENTS JOB NO.
08-29-001

DATE:
07-27-2008

SCALE:
1" = 20'

SHEET No.
P1

Green Integrated Design Conditions - Without Green Roof

INTEGRATED CONDITIONS - OVERALL			
Surface	Area	CN	C
Roof	6662	98	0.90
Imp. Pavement	5459	98	0.85
Porous Pavement	10748	85	0.80
Crushed stone	2543	85	0.80
Paver stones	1301	85	0.80
Rip rap channel	442	85	0.80
Brick pavers	1266	98	0.90
Dec. stone	205	85	0.80
Rain Garden	5251	61	0.25
Pervious	7616	61	0.25
DD1 Imp. Pav't	600	98	0.85
DD2 Imp. Pav't	663	98	0.85
DD3 Imp. Pav't	83	98	0.85
Total =	**42839**	**82.3**	**0.66**
Total pervious =	12867		
Total Impervious =	29972		

COMPARISON		
Condition	CN	c
Existing	97.1	0.85
Integrated "A"	82.3	0.66
	CN	C
	% Reduction	% Reduction
	15.32	22.56

Water Quality Volume:		
I=	69.96 %	
Rv=	0.68	
A=	0.983	ac
WQv=	0.0557	ac-ft

Rain Garden Stage Storage:		
Stage	Volume	
806	0.0438	ac-ft
806.16	0.056	ac-ft
807	0.1198	ac-ft

Rain Garden Overflow Elevation

SE RG LAWN			
Surface	Area	CN	C
Roof	0	98	0.90
Imp. Pavement	1042	98	0.85
Porous Pavement	0	85	0.80
Crushed stone	282	85	0.80
Paver stones	451	85	0.80
Rip rap channel	375	85	0.80
Brick pavers	0	98	0.90
Dec. stone	0	85	0.80
Rain Garden	244	61	0.25
Pervious	2876	61	0.25
Total =	**5270**	**73.4**	**0.5**

PCPC SIDE			
Surface	Area	CN	C
Imp. Pavement	3698	98	0.85
Porous Pavement	450	85	0.80
Pervious	240	61	0.25
Total =	**4388**	**94.6**	**0.8**

PCPC PAVEMENT			
Surface	Area	CN	C
Imp. Pavement	217	98	0.85
Porous Pavement	10298	85	0.80
Pervious	1113	61	0.25
Total =	**11628**	**82.9**	**0.7**

SW RG LAWN			
Surface	Area	CN	C
Roof	0	98	0.90
Imp. Pavement	50	98	0.85
Porous Pavement	0	85	0.80
Crushed stone	0	85	0.80
Paver stones	0	85	0.80
Rip rap channel	67	85	0.80
Brick pavers	0	98	0.90
Dec. stone	0	85	0.80
Rain Garden	373	61	0.25
Pervious	797	61	0.25
Total =	**1287**	**63.7**	**0.3**

BLDG ROOF			
Surface	Area	CN	C
Roof	6662	98	0.90
Green Roof 6" depth	0	92	0.84
Pervious	0	61	0.25
Total =	**6662**	**98.0**	**0.9**

DD1			
Surface	Area	CN	C
Roof	0	0	0.00
Pavement	600	98	0.85
Pervious	0	61	0.25
Total =	**600**	**98.0**	**0.85**

REAR YARD			
Surface	Area	CN	C
Roof	0	98	0.90
Imp. Pavement	452	98	0.85
Porous Pavement	0	85	0.80
Crushed stone	2261	85	0.80
Paver stones	850	85	0.80
Rip rap channel	0	85	0.80
Brick pavers	1266	98	0.90
Dec. stone	205	85	0.80
Rain Garden	4634	61	0.25
Pervious	2590	61	0.25
Total =	**12258**	**72.7**	**0.5**

DD2			
Surface	Area	CN	C
Roof	0	0	0.00
Pavement	663	98	0.85
Pervious	0	61	0.25
Total =	**663**	**98.0**	**0.85**

DD3			
Surface	Area	CN	C
Roof	0	0	0.00
Pavement	83	98	0.85
Pervious	0	61	0.25
Total =	**83**	**98.0**	**0.85**

Green Integrated Design Conditions - Without Green Roof - Peak Release

BLDG ROOF (to Rain Garden)			
Event	2-year	10-year	100-year
30		0.74	1.11
1		0.51	0.78
2		0.34	0.51
3		0.26	0.38
6		0.15	0.23

REAR YARD (to Rain Garden)			
Event	2-year	10-year	100-year
30		0.14	0.37
1		0.14	0.40
2		0.15	0.34
3		0.13	0.28
6		0.10	0.19

SE LAWN RG (to Rain Garden)			
Event	2-year	10-year	100-year
30		0.07	0.17
1		0.07	0.18
2		0.07	0.15
3		0.06	0.13
6		0.04	0.09

SW LAWN RG (to Rain Garden)			
Event	2-year	10-year	100-year
30		0.01	0.02
1		0.01	0.02
2		0.01	0.02
3		0.01	0.02
6		0.01	0.01

PCPC PAVEMENT (to Rain Garden)			
Event	2-year	10-year	100-year
30		0.39	0.86
1		0.37	0.73
2		0.28	0.52
3		0.22	0.40
6		0.15	0.25

PCPC SIDE (to Rain Garden)			
Event	2-year	10-year	100-year
30		0.40	0.64
1		0.28	0.46
2		0.19	0.30
3		0.15	0.23
6		0.09	0.14

DD1			
Event	2-year	10-year	100-year
30		0.07	0.10
1		0.05	0.07
2		0.03	0.05
3		0.02	0.04
6		0.01	0.02

DD2			
Event	2-year	10-year	100-year
30		0.07	0.11
1		0.05	0.08
2		0.03	0.05
3		0.03	0.04
6		0.02	0.02

DD3			
Event	2-year	10-year	100-year
30		0.13	0.24
1		0.10	0.19
2		0.07	0.12
3		0.05	0.09
6		0.04	0.06

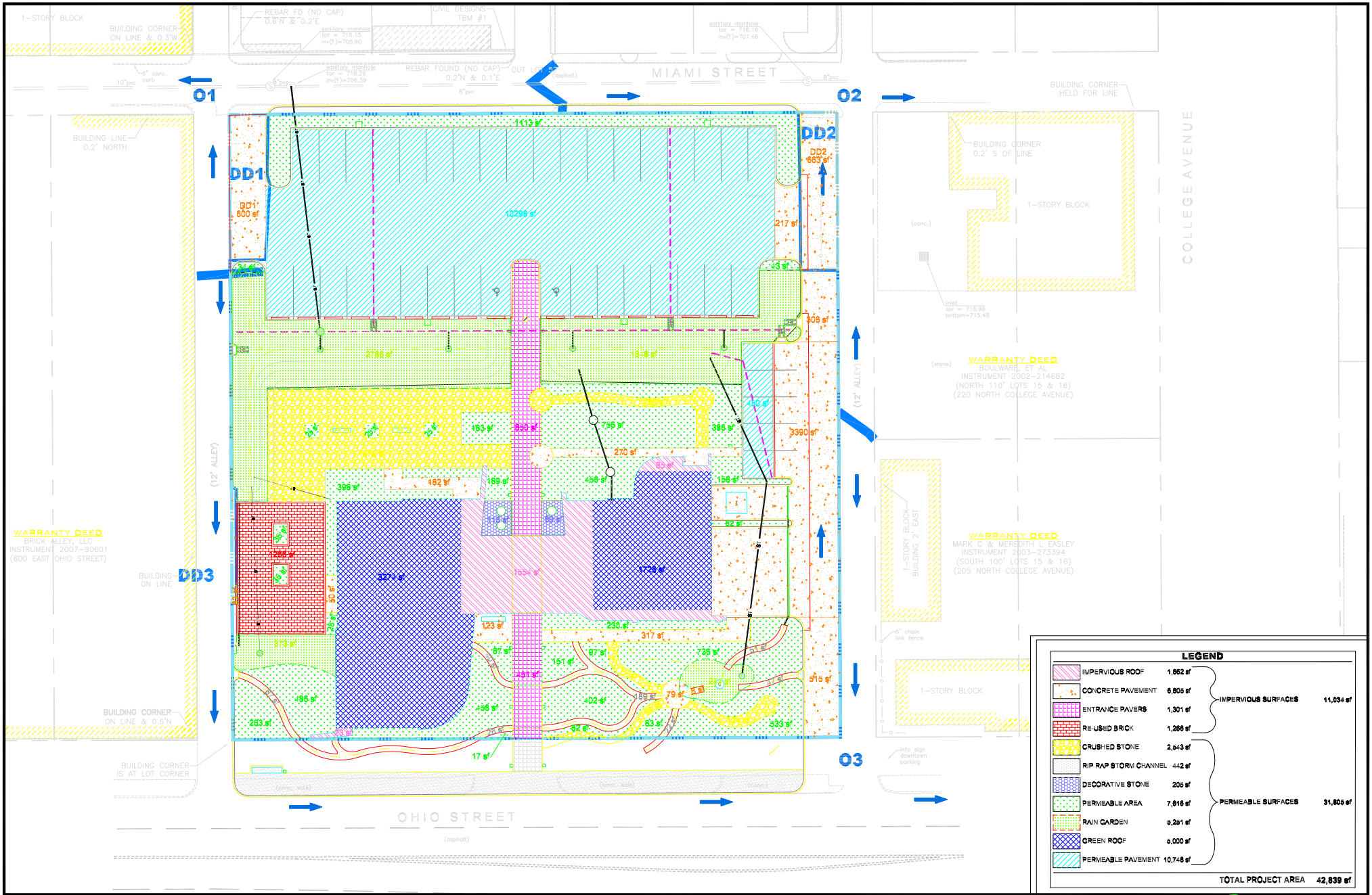
Outfall - Miami Street			
Event	**2-year**	**10-year**	**100-year**
30		0.07	0.96
1		0.24	**1.09**
2		**0.94**	1.05
3		0.94	1.03
6		0.94	0.95
Hydrograph addition			
CS Miami - Allowable		**1.18**	**2.11**

Outfall - College Avenue			
Event	**2-year**	**10-year**	**100-year**
30		**0.08**	**0.12**
1		0.06	0.09
2		0.04	0.06
3		0.03	0.04
6		0.02	0.03
Hydrograph addition			
CS College - Allowable		**1.41**	**2.53**

Flow Reduction Comparison over Existing Conditions			
Miami Street	**2-Year**	**10-Year**	**100-Year**
Max flow-proposed	0.091	0.94	1.09
Max flow-existing	1.18	2.11	3.13
% flow reduction	**92.29**	**55.45**	**65.18**

Surface Detention & Water Quality in Rain Garden			
Rain Garden to Stone Detention Section			
Event	**cfs (out)**	**stage**	**volume**
10-year	**0.47**	**806.35**	
100-year	**1.26**	**806.48**	

With Green Roof



PREPARED BY:

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Nature Conservancy Headquarters
Indianapolis, Marion County Indiana

POST-DEVELOPED - INTEGRATED SITE DESIGN OPTION 2
PROPOSED SURFACE CONDITIONS

ELEMENTS JOB NO.
08-29-001

DATE:
07-27-2008

SCALE:
1" = 20'

SHEET No.
P2

Green Integrated Design Conditions - With Green Roof

INTEGRATED CONDITIONS - OVERALL			
Surface	Area	CN	C
Roof	1662	98	0.90
Imp. Pavement	5459	98	0.85
Roof-Green 6" depth	5000	92	0.84
Porous Pavement	10748	85	0.80
Crushed stone	2543	85	0.80
Paver stones	1301	85	0.80
Rip rap channel	442	85	0.80
Brick pavers	1266	98	0.90
Dec. stone	205	85	0.80
Rain Garden	5251	61	0.25
Pervious	7616	61	0.25
DD1 Imp. Pav't	600	98	0.85
DD2 Imp. Pav't	663	98	0.85
DD3 Imp. Pav't	83	98	0.85
Total =	**42839**	**70.8**	**0.56**
Total pervious =	17867		
Total Impervious =	24972		

COMPARISON		
Condition	CN	c
Existing	97.1	0.85
Integrated "B"	70.8	0.56
	CN	C
	% Reduction	% Reduction
	27.10	34.86

Water Quality Volume:		
I=	58.29 %	
Rv=	0.57	
A=	0.983	ac
WQv=	0.0471	ac-ft

Rain Garden Stage Storage:			
Stage	Volume		
806	0.0438	ac-ft	
806.04	0.0471	ac-ft	← **Rain Garden Overflow Elevation**
807	0.1198	ac-ft	

SE RG LAWN			
Surface	Area	CN	C
Roof	0	98	0.90
Imp. Pavement	1042	98	0.85
Porous Pavement	0	85	0.80
Crushed stone	282	85	0.80
Paver stones	451	85	0.80
Rip rap channel	375	85	0.80
Brick pavers	0	98	0.90
Dec. stone	0	85	0.80
Rain Garden	244	61	0.25
Pervious	2876	61	0.25
Total =	**5270**	**73.4**	**0.5**

PCPC SIDE			
Surface	Area	CN	C
Imp. Pavement	3698	98	0.85
Porous Pavement	450	85	0.80
Pervious	240	61	0.25
Total =	**4388**	**94.6**	**0.8**

PCPC PAVEMENT			
Surface	Area	CN	C
Imp. Pavement	217	98	0.85
Porous Pavement	10298	85	0.80
Pervious	1113	61	0.25
Total =	**11628**	**82.9**	**0.7**

SW RG LAWN			
Surface	Area	CN	C
Roof	0	98	0.90
Imp. Pavement	50	98	0.85
Porous Pavement	0	85	0.80
Crushed stone	0	85	0.80
Paver stones	0	85	0.80
Rip rap channel	67	85	0.80
Brick pavers	0	98	0.90
Dec. stone	0	85	0.80
Rain Garden	373	61	0.25
Pervious	797	61	0.25
Total =	**1287**	**63.7**	**0.3**

BLDG ROOF			
Surface	Area	CN	C
Roof	1662	98	0.90
Green Roof 6" depth	5000	98	0.85
Pervious	0	61	0.25
Total =	**6662**	**98.0**	**0.9**

DD1			
Surface	Area	CN	C
Roof	0	0	0.00
Pavement	600	98	0.85
Pervious	0	61	0.25
Total =	**600**	**98.0**	**0.85**

REAR YARD			
Surface	Area	CN	C
Roof	0	98	0.90
Imp. Pavement	452	98	0.85
Porous Pavement	0	85	0.80
Crushed stone	2261	85	0.80
Paver stones	850	85	0.80
Rip rap channel	0	85	0.80
Brick pavers	1266	98	0.90
Dec. stone	205	85	0.80
Rain Garden	4634	61	0.25
Pervious	2590	61	0.25
Total =	**12258**	**72.7**	**0.5**

DD2			
Surface	Area	CN	C
Roof	0	0	0.00
Pavement	663	98	0.85
Pervious	0	61	0.25
Total =	**663**	**98.0**	**0.85**

DD3			
Surface	Area	CN	C
Roof	0	0	0.00
Pavement	83	98	0.85
Pervious	0	61	0.25
Total =	**83**	**98.0**	**0.85**

Green Integrated Design Conditions - With Green Roof - Peak Release

BLDG ROOF (to Rain Garden)			
Event	2-year	10-year	100-year
30		0.18	0.28
1		0.13	0.20
2		0.09	0.13
3		0.06	0.10
6		0.04	0.06

REAR YARD (to Rain Garden)			
Event	2-year	10-year	100-year
30		0.14	0.37
1		0.14	0.40
2		0.15	0.34
3		0.13	0.28
6		0.10	0.19

SE LAWN RG (to Rain Garden)			
Event	2-year	10-year	100-year
30		0.07	0.17
1		0.07	0.18
2		0.07	0.15
3		0.06	0.13
6		0.04	0.09

SW LAWN RG (to Rain Garden)			
Event	2-year	10-year	100-year
30		0.01	0.02
1		0.01	0.02
2		0.01	0.02
3		0.01	0.02
6		0.01	0.01

PCPC PAVEMENT (to Rain Garden)			
Event	2-year	10-year	100-year
30		0.39	0.86
1		0.37	0.73
2		0.28	0.52
3		0.22	0.40
6		0.15	0.25

PCPC SIDE (to Rain Garden)			
Event	2-year	10-year	100-year
30		0.40	0.64
1		0.28	0.46
2		0.19	0.30
3		0.15	0.23
6		0.09	0.14

BLDG GREEN ROOF (to Rain Garden)			
Event	2-year	10-year	100-year
30		0.34	0.59
1		0.27	0.45
2		0.18	0.30
3		0.14	0.23
6		0.09	0.14

DD2			
Event	2-year	10-year	100-year
30		0.07	0.11
1		0.05	0.08
2		0.03	0.05
3		0.03	0.04
6		0.02	0.02

DD1			
Event	2-year	10-year	100-year
30		0.07	0.10
1		0.05	0.07
2		0.03	0.05
3		0.02	0.04
6		0.01	0.02

DD3			
Event	2-year	10-year	100-year
30		0.13	0.24
1		0.10	0.19
2		0.07	0.12
3		0.05	0.09
6		0.04	0.06

Outfall - Miami Street			
Event	**2-year**	**10-year**	**100-year**
30		0.07	0.96
1		0.32	**1.14**
2		**0.94**	1.09
3		0.94	1.05
6		0.94	0.95
Hydrograph addition			
CS Miami - Allowable		**1.18**	**2.11**

Outfall - College Avenue			
Event	**2-year**	**10-year**	**100-year**
30		**0.08**	**0.12**
1		0.06	0.09
2		0.04	0.06
3		0.03	0.04
6		0.02	0.03
Hydrograph addition			
CS College - Allowable		**1.41**	**2.53**

Flow Reduction Comparison over Existing Conditions			
Miami Street	**2-Year**	**10-Year**	**100-Year**
Max flow-proposed	0.1	0.94	1.14
Max flow-existing	1.18	2.11	3.13
% flow reduction	**91.53**	**55.50**	**63.61**

Surface Detention & Water Quality in Rain Garden			
Rain Garden to Stone Detention Section			
Event	**cfs (out)**	**stage**	**volume**
10-year (max stage)	**0.90**	**806.20**	
10-year (max Q)	**1.16**	**806.17**	
100-year (max stage)	**2.29**	**806.34**	
100-year (max Q)	**2.59**	**806.30**	