PLD Piedmont Land Design, LLP
8522-204 Six Forks Road • Raleigh, NC 27615 • (919) 845-7600 • Fax: (919) 845-7703

Stormwater Management Report

For

Riverstone Subdivision

US Highway 64
Pittsboro, North Carolina

NORTH CAROLINA PROFESSIONAL SEAL 030856 ENGINEER MICHAEL L. SCHNEIDER
5/5/15

Issued:

May 5, 2015

Prepared for:

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Cary, NC 27513

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Narrative

The proposed Riverstone subdivision is located on a 97.31 acre parcel, located along US Highway 64 in Pittsboro, North Carolina. The project consists of the construction of 33 single family lots with associated roadways. The site is located in the Cape Fear river basin. The site will utilize two dry extended detention basins in order to provide the required detention requirements.

Stormwater Runoff Analysis

Hydrograph software by Intelisolve was used to prepare the runoff, time of concentration and routing calculations. The Town of Pittsboro stormwater requirements require that there be no net increase in peak flow leaving the site from pre-developed conditions for the one-year, 24-hour storm. Additionally, nitrogen and phosphorus leaving the site shall not exceed 3.8 lbs/ac/yr and 1.43 lbs/ac/yr respectively. The nitrogen and phosphorus leaving the site are below these thresholds without treatment being provided.

This site is predominantly Pittsboro Iredell soils which have a hydrological soil group type "D". There are some Nanford and Badin soils present which have a hydrological soil group type "C". Refer to the NRCS Soil Map in Appendix A.

PRE-DEVELOPED PEAK FLOW CALCULATIONS

Discharge Point #1

Drainage Area – 39.0 acres
Pre-development Curve Number Calculations
7.9 acres of Wooded Area (good condition) – "C" Soils CN 70
31.1 acres of Wooded Area (good condition) – "D" Soils CN 77

Use CN = 76
Q(1) = 42.71 cfs

Discharge Point #2

Drainage Area – 10.0 acres
Pre-development Curve Number Calculations
4.3 acres of Wooded Area (good condition) – "C" Soils CN 70
5.7 acres of Wooded Area (good condition) – "D" Soils CN 77

Use CN = 74
Q(1) = 10.54 cfs

Discharge Point #3 (Bypass)

Drainage Area – 48.3 acres
Pre-development Curve Number Calculations
15.5 acres of Wooded Area (good condition) – "C" Soils CN 70
32.8 acres of Wooded Area (good condition) – "D" Soils CN 77

Use CN = 75
Q(1) = 54.38 cfs

*** Total Pre-developed One-year peak flow = 42.71 cfs + 10.54 cfs + 54.38 cfs = 107.63 cfs**

POST-DEVELOPED PEAK FLOW CALCULATIONS

BMP #1 – Dry Detention Pond
Post-developed Condition

Drainage Area – 39.0 acres

Post-development Curve Number Calculations

2.8 acres of Wooded Area (good condition) – "C" Soils	CN 70
22.6 acres of Wooded Area (good condition) – "D" Soils	CN 77
0.6 acres of Lawn/Open Space (good condition) – "C" Soils	CN 74
8.9 acres of Lawn/Open Space (good condition) – "D" Soils	CN 80
4.1 acres of Impervious Area	CN 98

Use CN = 79
Q(1-without BMP) = 51.15 cfs
Q(1 – with BMP) = 39.70 cfs

BMP #2 – Dry Detention Pond
Post-developed Condition

Drainage Area – 10.0 acres

Post-development Curve Number Calculations

1.0 acres of Wooded Area (good condition) – "C" Soils	CN 70
5.9 acres of Wooded Area (good condition) – "D" Soils	CN 77
1.0 acres of Lawn/Open Space (good condition) – "C" Soils	CN 74
1.0 acres of Lawn/Open Space (good condition) – "D" Soils	CN 80
1.1 acres of Impervious Area	CN 98

Use CN = 79
Q(1-without BMP) = 14.35 cfs
Q(1 – with BMP) = 8.73 cfs

Bypass Area
Post-developed Condition

Drainage Area – 48.3 acres

Post-development Curve Number Calculations

15.5 acres of Wooded Area (good condition) – "C" Soils	CN 70
25.4 acres of Wooded Area (good condition) – "D" Soils	CN 77
1.5 acres of Lawn/Open Space (good condition) – "C" Soils	CN 74
3.5 acres of Lawn/Open Space (good condition) – "D" Soils	CN 80
2.4 acres of Impervious Area	CN 98

Use CN = 76
Q(1) = 57.94 cfs

*** Total Post-developed One-year peak flow = 39.70 cfs + 8.73 cfs + 57.94 cfs = 106.37 cfs**

PLD

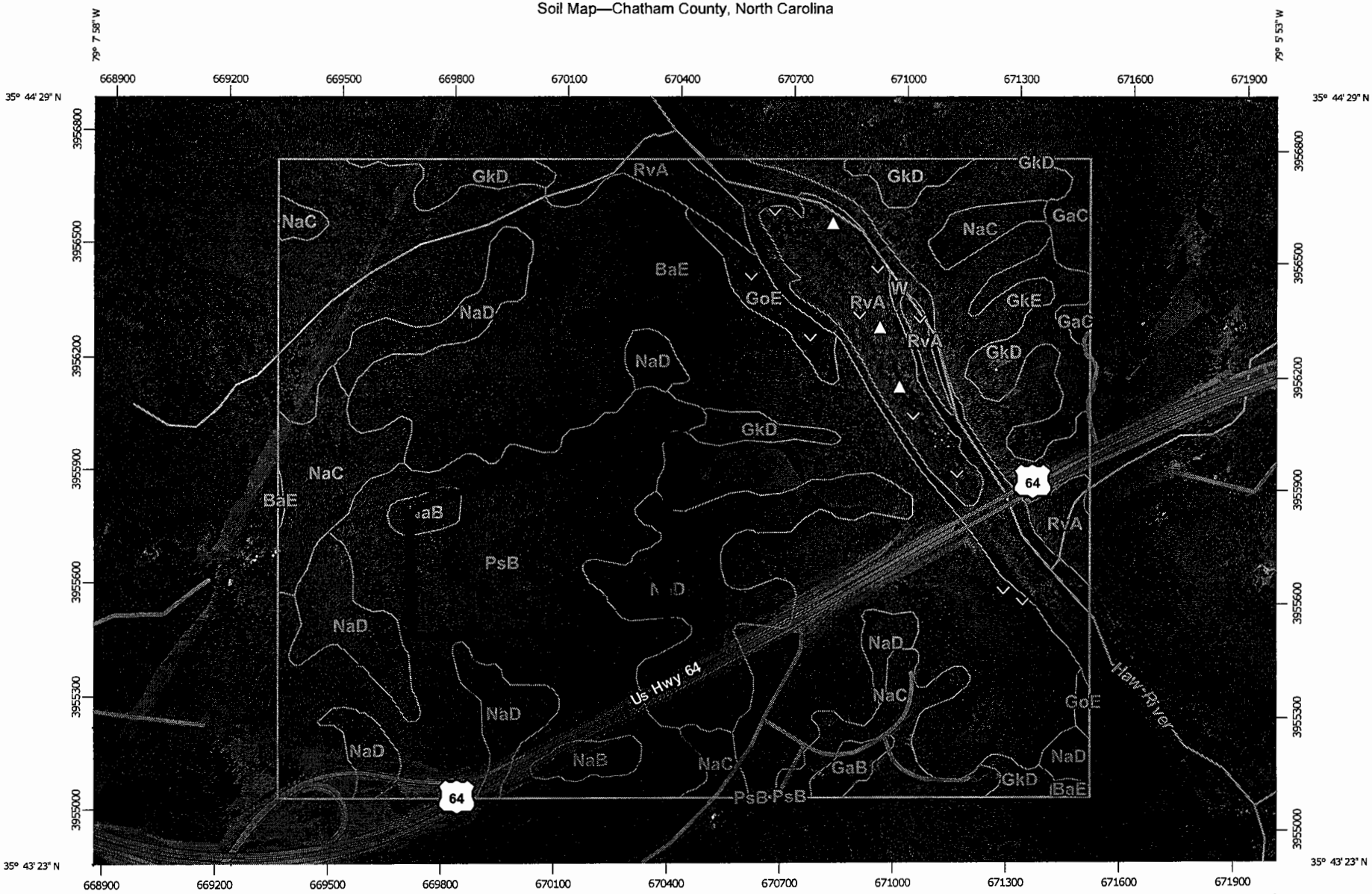
Flow Summary

	Pre-Developed Peak Flow (cfs)	Post-Developed Peak Flow without BMP's (cfs)	Post-Developed Peak Flow with BMP's (cfs)
BMP #1	42.71	51.15	39.70
BMP #2	10.54	14.35	8.73
Bypass	54.38	57.94	57.94
Totals	107.63	123.44	106.37

Appendix A

Soils Map

Soil Map—Chatham County, North Carolina



Map Scale: 1:14,300 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 200 400 800 1200

Feet: 0 500 1000 2000 3000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 17N WGS84

Appendix B

Stormwater Peak Runoff Calculations

Hydrograph Return Period Recap

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2013 by Autodesk, Inc. v10

Hyd. No.	Hydrograph type (origin)	Inflow hyd(s)	Peak Outflow (cfs)								Hydrograph Description
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
1	SCS Runoff	------	42.71	62.57	-------	-------	-------	-------	-------	0.000	BMP #1 - PRE-DEVELOPED
2	SCS Runoff	------	51.15	72.66	-------	-------	-------	-------	-------	233.36	BMP #1 - POST-DEVELOPED
3	SCS Runoff	------	10.54	15.78	-------	-------	-------	-------	-------	0.000	BMP #2 PRE-DEVELOPED
4	SCS Runoff	------	14.35	20.34	-------	-------	-------	-------	-------	64.81	BMP #2 POST-DEVELOPED
5	SCS Runoff	------	54.38	80.45	-------	-------	-------	-------	-------	0.000	BYPASS - PRE-DEVELOPED
6	SCS Runoff	------	57.94	84.80	-------	-------	-------	-------	-------	0.000	BYPASS - POST-DEVELOPED
7	Reservoir	2	39.70	61.59	-------	-------	-------	-------	-------	227.43	BMP #1 ROUTING
8	Reservoir	4	8.732	16.85	-------	-------	-------	-------	-------	51.70	BMP #2 ROUTING

Hydrograph Report

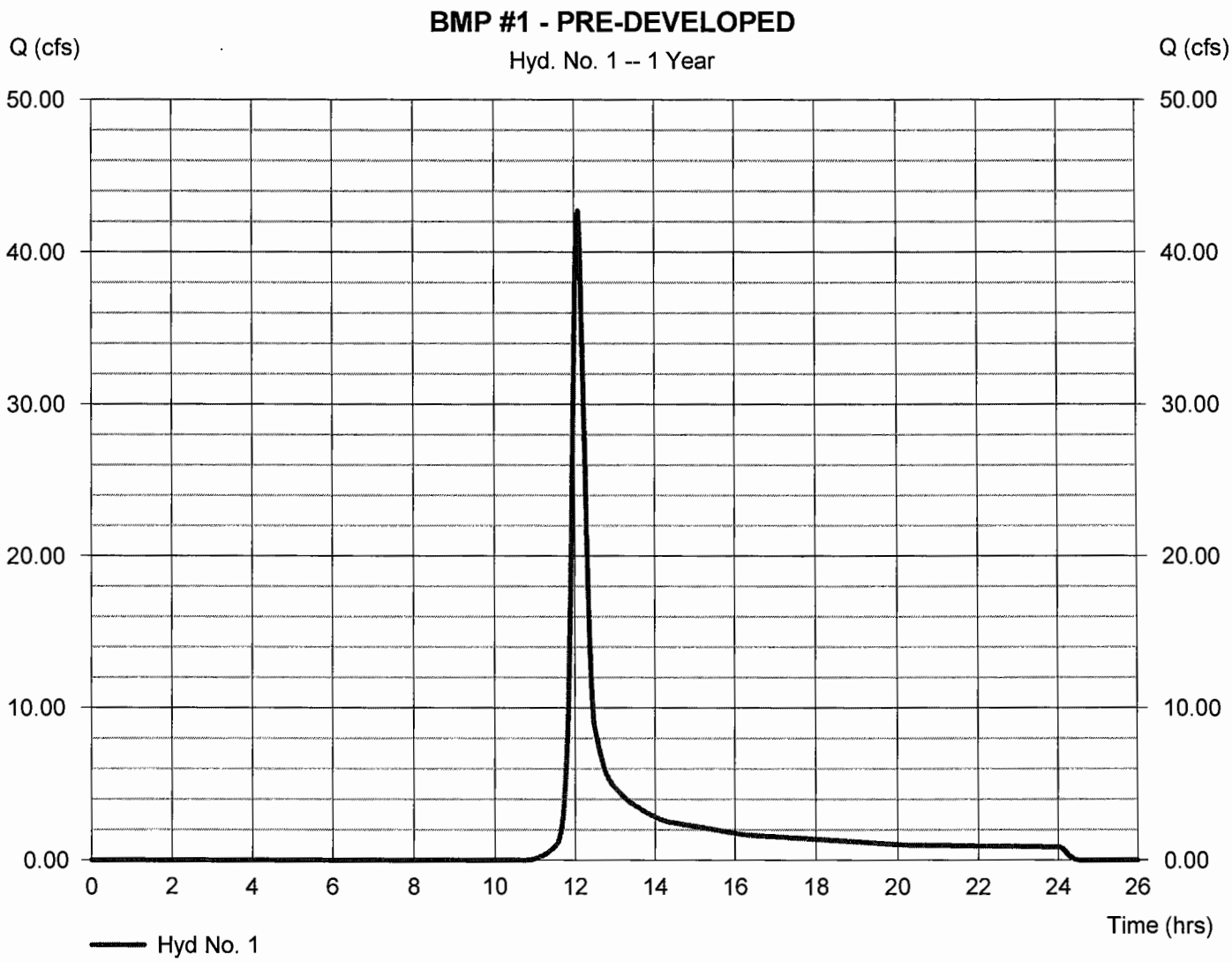
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2013 by Autodesk, Inc. v10 Monday, 04 / 27 / 2015

Hyd. No. 1

BMP #1 - PRE-DEVELOPED

Hydrograph type	= SCS Runoff	Peak discharge	= 42.71 cfs
Storm frequency	= 1 yrs	Time to peak	= 12.10 hrs
Time interval	= 2 min	Hyd. volume	= 139,899 cuft
Drainage area	= 39.000 ac	Curve number	= 76*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 20.00 min
Total precip.	= 2.96 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(7.900 x 70) + (31.100 x 77)] / 39.000



TR55 Tc Worksheet

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2013 by Autodesk, Inc. v10

Hyd. No. 1

BMP #1 - PRE-DEVELOPED

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.400		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.57		0.00		0.00		
Land slope (%)	= 5.00		0.00		0.00		
Travel Time (min)	**= 14.09**	**+**	**0.00**	**+**	**0.00**	**=**	**14.09**
Shallow Concentrated Flow							
Flow length (ft)	= 543.00		0.00		0.00		
Watercourse slope (%)	= 5.60		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=3.82		0.00		0.00		
Travel Time (min)	**= 2.37**	**+**	**0.00**	**+**	**0.00**	**=**	**2.37**
Channel Flow							
X sectional flow area (sqft)	= 3.00		0.00		0.00		
Wetted perimeter (ft)	= 16.00		0.00		0.00		
Channel slope (%)	= 4.70		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=7.02						
			0.00				
					0.00		
Flow length (ft)	({0})1500.0		0.0		0.0		
Travel Time (min)	**= 3.56**	**+**	**0.00**	**+**	**0.00**	**=**	**3.56**

Total Travel Time, Tc ..... 20.00 min

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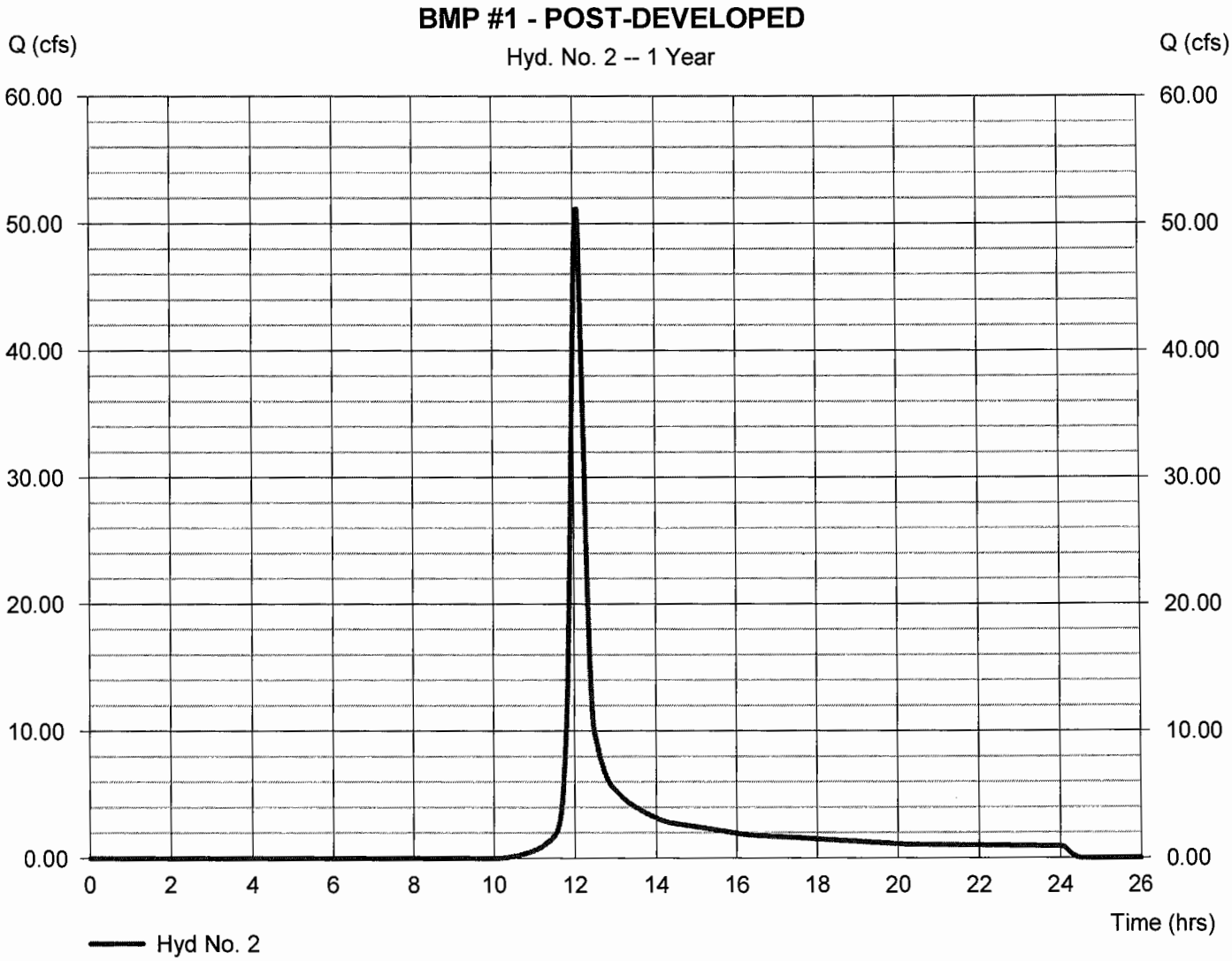
Hyd. No. 2

BMP #1 - POST-DEVELOPED

Hydrograph type	= SCS Runoff	Peak discharge	= 51.15 cfs
Storm frequency	= 1 yrs	Time to peak	= 12.10 hrs
Time interval	= 2 min	Hyd. volume	= 164,123 cuft
Drainage area	= 39.000 ac	Curve number	= 79*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 20.00 min
Total precip.	= 2.96 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(2.800 x 70) + (22.600 x 77) + (0.600 x 74) + (8.900 x 80) + (4.100 x 98)] / 39.000



TR55 Tc Worksheet

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2013 by Autodesk, Inc. v10

Hyd. No. 2

BMP #1 - POST-DEVELOPED

Description	A	B	C	Totals
Sheet Flow				
Manning's n-value	= 0.400	0.011	0.011	
Flow length (ft)	= 100.0	0.0	0.0	
Two-year 24-hr precip. (in)	= 3.57	0.00	0.00	
Land slope (%)	= 5.00	0.00	0.00	
Travel Time (min)	**= 14.09 +**	**0.00 +**	**0.00 =**	**14.09**
Shallow Concentrated Flow				
Flow length (ft)	= 543.00	0.00	0.00	
Watercourse slope (%)	= 5.60	0.00	0.00	
Surface description	= Unpaved	Paved	Paved	
Average velocity (ft/s)	=3.82	0.00	0.00	
Travel Time (min)	**= 2.37 +**	**0.00 +**	**0.00 =**	**2.37**
Channel Flow				
X sectional flow area (sqft)	= 3.00	0.00	0.00	
Wetted perimeter (ft)	= 16.00	0.00	0.00	
Channel slope (%)	= 4.70	0.00	0.00	
Manning's n-value	= 0.015	0.015	0.015	
Velocity (ft/s)	=7.02			
		0.00		
			0.00	
Flow length (ft)	({0})1500.0	0.0	0.0	
Travel Time (min)	**= 3.56 +**	**0.00 +**	**0.00 =**	**3.56**

Total Travel Time, Tc ..... 20.00 min

Hydrograph Report

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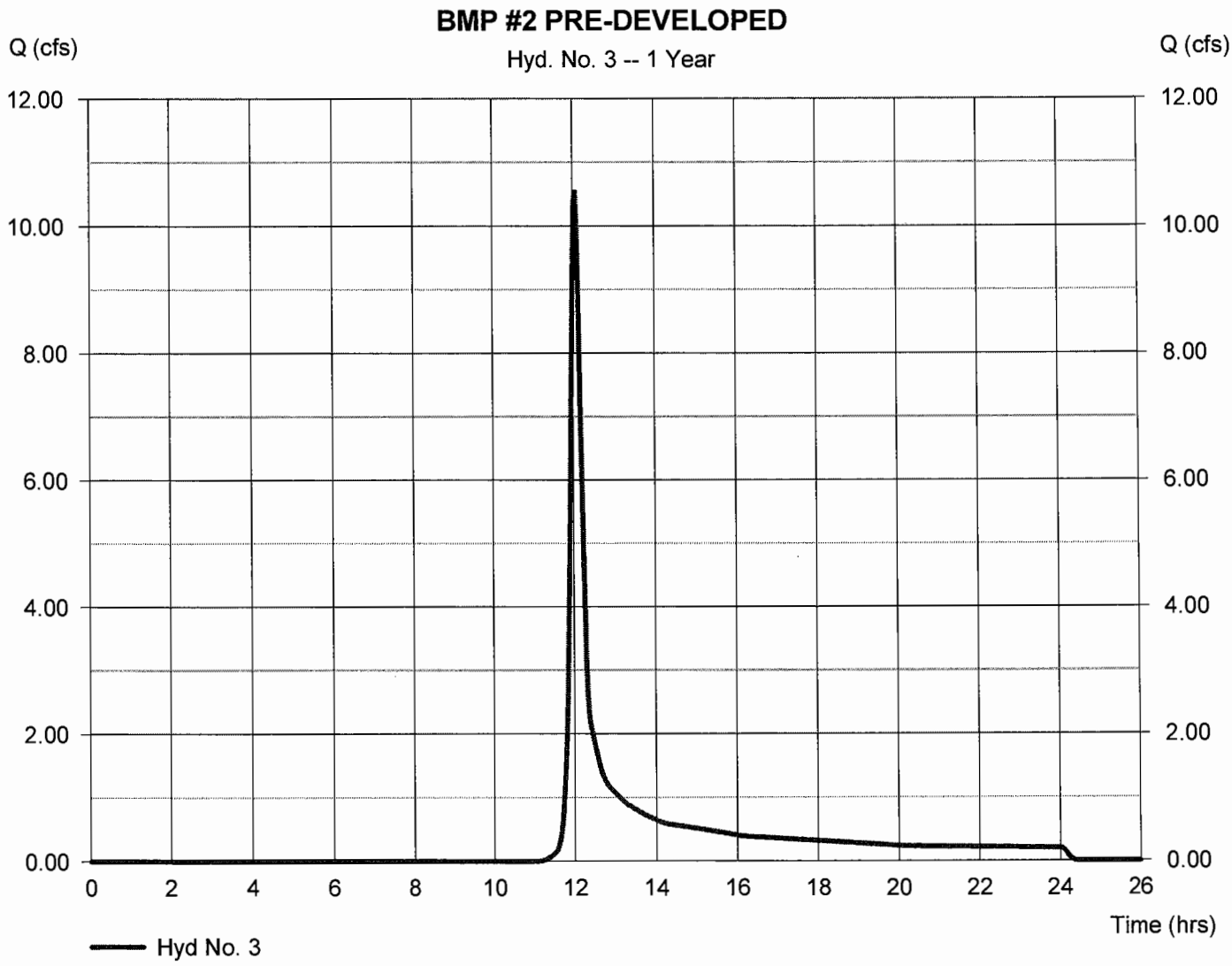
Hyd. No. 3

BMP #2 PRE-DEVELOPED

Hydrograph type	= SCS Runoff	Peak discharge	= 10.54 cfs
Storm frequency	= 1 yrs	Time to peak	= 12.07 hrs
Time interval	= 2 min	Hyd. volume	= 31,250 cuft
Drainage area	= 10.000 ac	Curve number	= 74*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 15.70 min
Total precip.	= 2.96 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(4.300 x 70) + (5.700 x 77)] / 10.000



TR55 Tc Worksheet

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Hyd. No. 3

BMP #2 PRE-DEVELOPED

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.400		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.57		0.00		0.00		
Land slope (%)	= 6.70		0.00		0.00		
Travel Time (min)	**= 12.54**	**+**	**0.00**	**+**	**0.00**	**=**	**12.54**
Shallow Concentrated Flow							
Flow length (ft)	= 700.00		0.00		0.00		
Watercourse slope (%)	= 9.00		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=4.84		0.00		0.00		
Travel Time (min)	**= 2.41**	**+**	**0.00**	**+**	**0.00**	**=**	**2.41**
Channel Flow							
X sectional flow area (sqft)	= 3.00		0.00		0.00		
Wetted perimeter (ft)	= 16.00		0.00		0.00		
Channel slope (%)	= 9.50		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=9.97						
			0.00				
					0.00		
Flow length (ft)	({0})460.0		0.0		0.0		
Travel Time (min)	**= 0.77**	**+**	**0.00**	**+**	**0.00**	**=**	**0.77**

Total Travel Time, Tc ..... 15.70 min

Hydrograph Report

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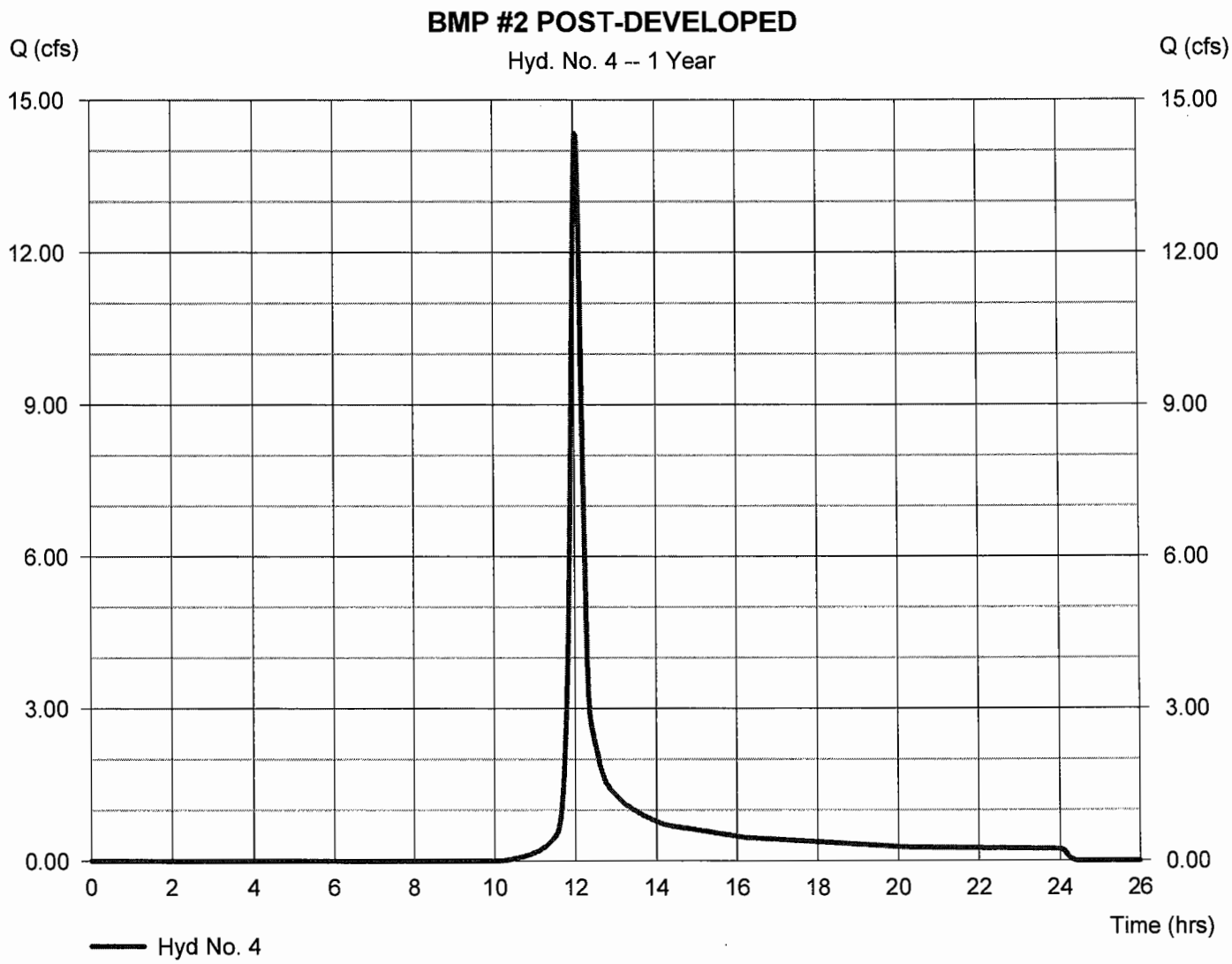
Hyd. No. 4

BMP #2 POST-DEVELOPED

Hydrograph type	= SCS Runoff	Peak discharge	= 14.35 cfs
Storm frequency	= 1 yrs	Time to peak	= 12.03 hrs
Time interval	= 2 min	Hyd. volume	= 41,031 cuft
Drainage area	= 10.000 ac	Curve number	= 79*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 15.70 min
Total precip.	= 2.96 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.000 x 70) + (5.880 x 77) + (1.000 x 74) + (1.000 x 80) + (1.120 x 98)] / 10.000



TR55 Tc Worksheet

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Hyd. No. 4

BMP #2 POST-DEVELOPED

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.400		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.57		0.00		0.00		
Land slope (%)	= 6.70		0.00		0.00		
Travel Time (min)	**= 12.54**	**+**	**0.00**	**+**	**0.00**	**=**	**12.54**
Shallow Concentrated Flow							
Flow length (ft)	= 700.00		0.00		0.00		
Watercourse slope (%)	= 9.00		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=4.84		0.00		0.00		
Travel Time (min)	**= 2.41**	**+**	**0.00**	**+**	**0.00**	**=**	**2.41**
Channel Flow							
X sectional flow area (sqft)	= 3.00		0.00		0.00		
Wetted perimeter (ft)	= 16.00		0.00		0.00		
Channel slope (%)	= 9.50		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=9.97						
			0.00				
					0.00		
Flow length (ft)	({0})460.0		0.0		0.0		
Travel Time (min)	**= 0.77**	**+**	**0.00**	**+**	**0.00**	**=**	**0.77**

Total Travel Time, Tc ..... 15.70 min

Hydrograph Report

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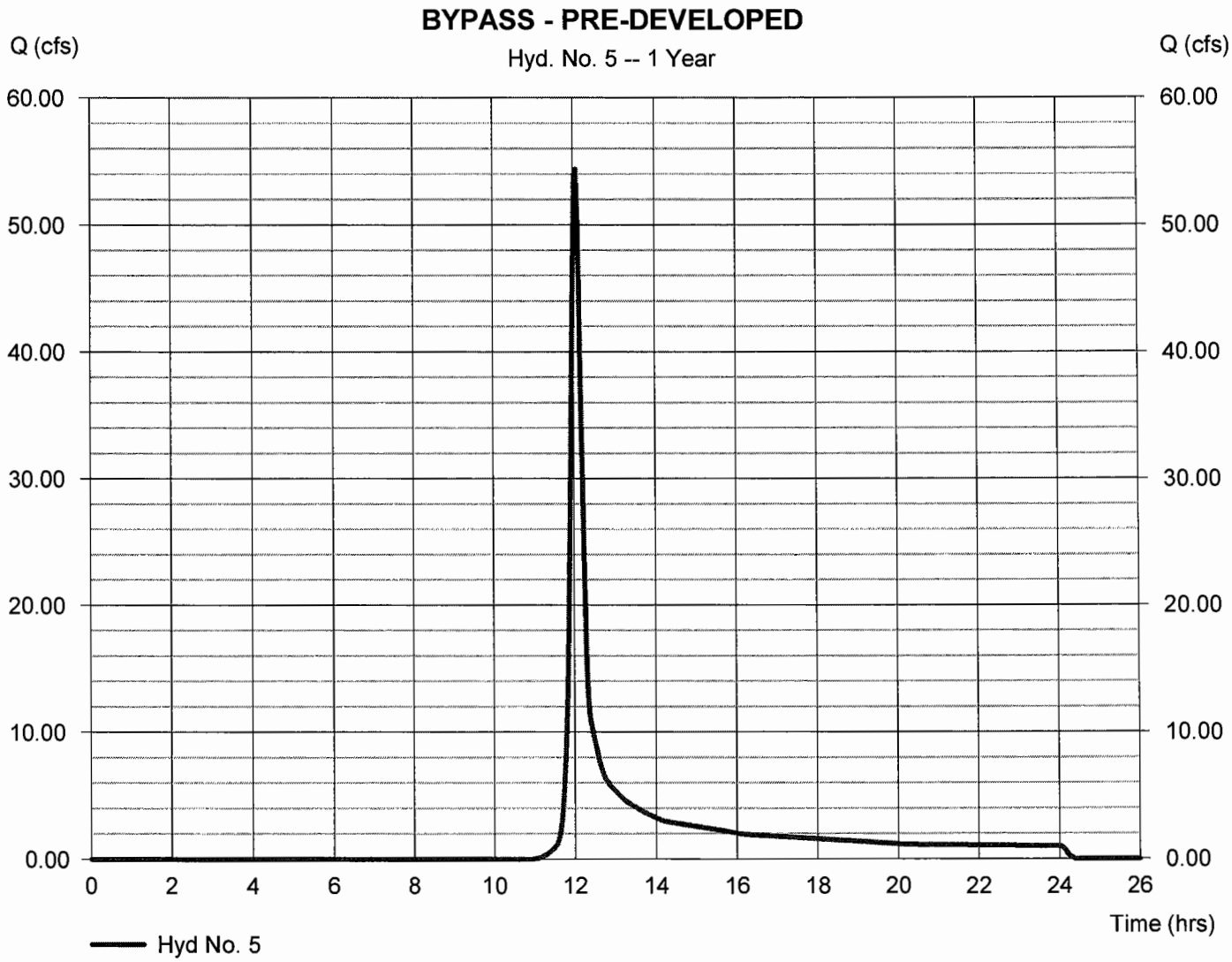
Hyd. No. 5

BYPASS - PRE-DEVELOPED

Hydrograph type	= SCS Runoff	Peak discharge	= 54.38 cfs
Storm frequency	= 1 yrs	Time to peak	= 12.07 hrs
Time interval	= 2 min	Hyd. volume	= 159,820 cuft
Drainage area	= 48.310 ac	Curve number	= 75*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 15.00 min
Total precip.	= 2.96 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(15.500 x 70) + (32.810 x 77)] / 48.310



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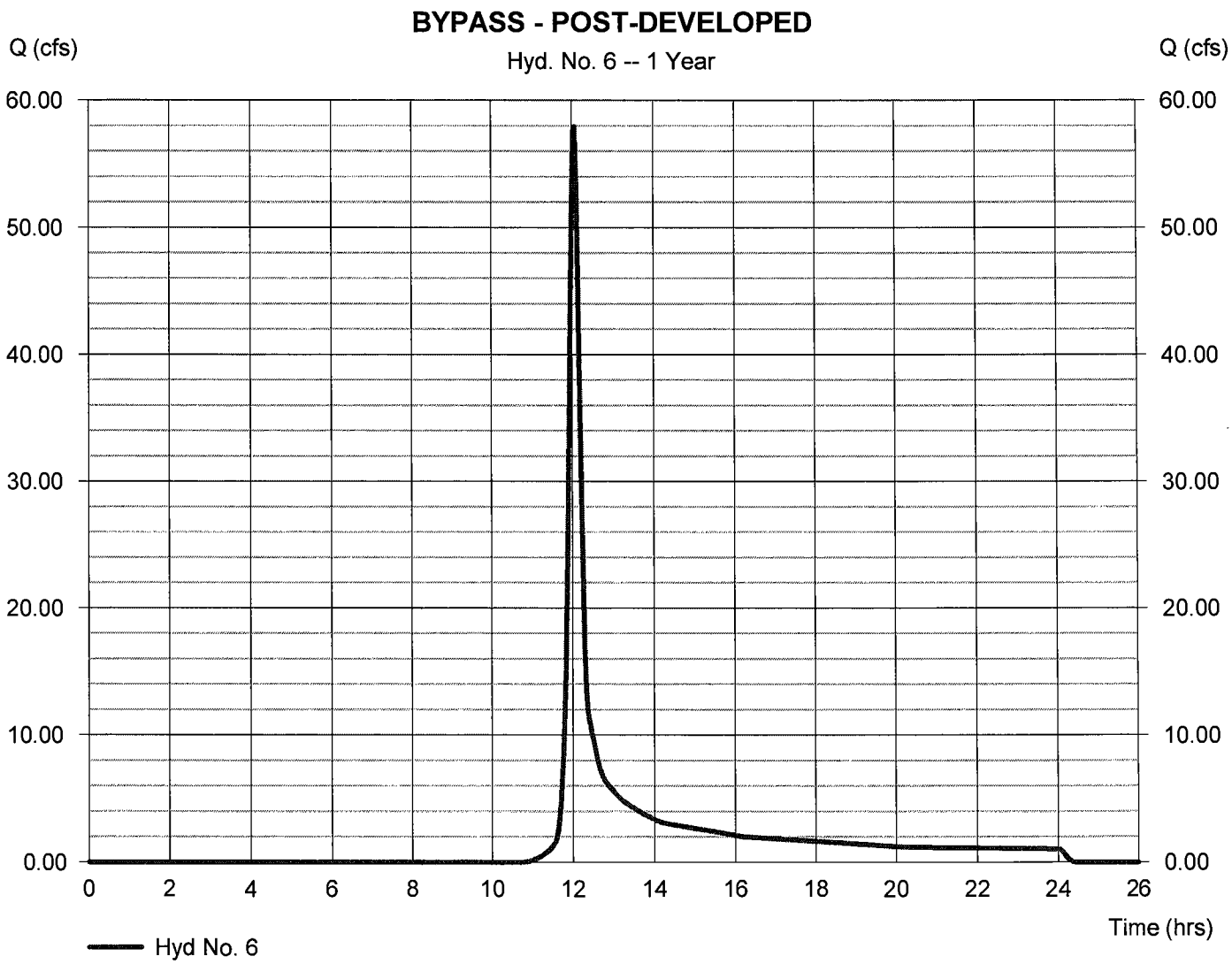
Hyd. No. 6

BYPASS - POST-DEVELOPED

Hydrograph type	= SCS Runoff	Peak discharge	= 57.94 cfs
Storm frequency	= 1 yrs	Time to peak	= 12.07 hrs
Time interval	= 2 min	Hyd. volume	= 168,963 cuft
Drainage area	= 48.310 ac	Curve number	= 76*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 15.00 min
Total precip.	= 2.96 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(15.500 x 70) + (25.410 x 77) + (1.500 x 74) + (3.500 x 80) + (2.400 x 98)] / 48.310



Pond Report

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Pond No. 1 - BMP #1

BMP#1

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 393.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	393.00	7,260	0	0
1.00	394.00	9,463	8,336	8,336
2.00	395.00	11,791	10,605	18,941
3.00	396.00	14,230	12,990	31,931
4.00	397.00	16,754	15,473	47,404
5.00	398.00	18,692	17,712	65,117
6.00	399.00	20,686	19,679	84,795
7.00	400.00	22,738	21,702	106,497

Culvert / Orifice Structures

	[A]	[B] PRIMARY	[C] SECONDARY	[PrfRsr]
Rise (in)	= 48.00	12.00	12.00	0.00
Span (in)	= 48.00	40.00	40.00	0.00
No. Barrels	= 1	2	3	0
Invert El. (ft)	= 392.00	393.00	395.10	0.00
Length (ft)	= 32.00	0.00	0.00	0.00
Slope (%)	= 0.62	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

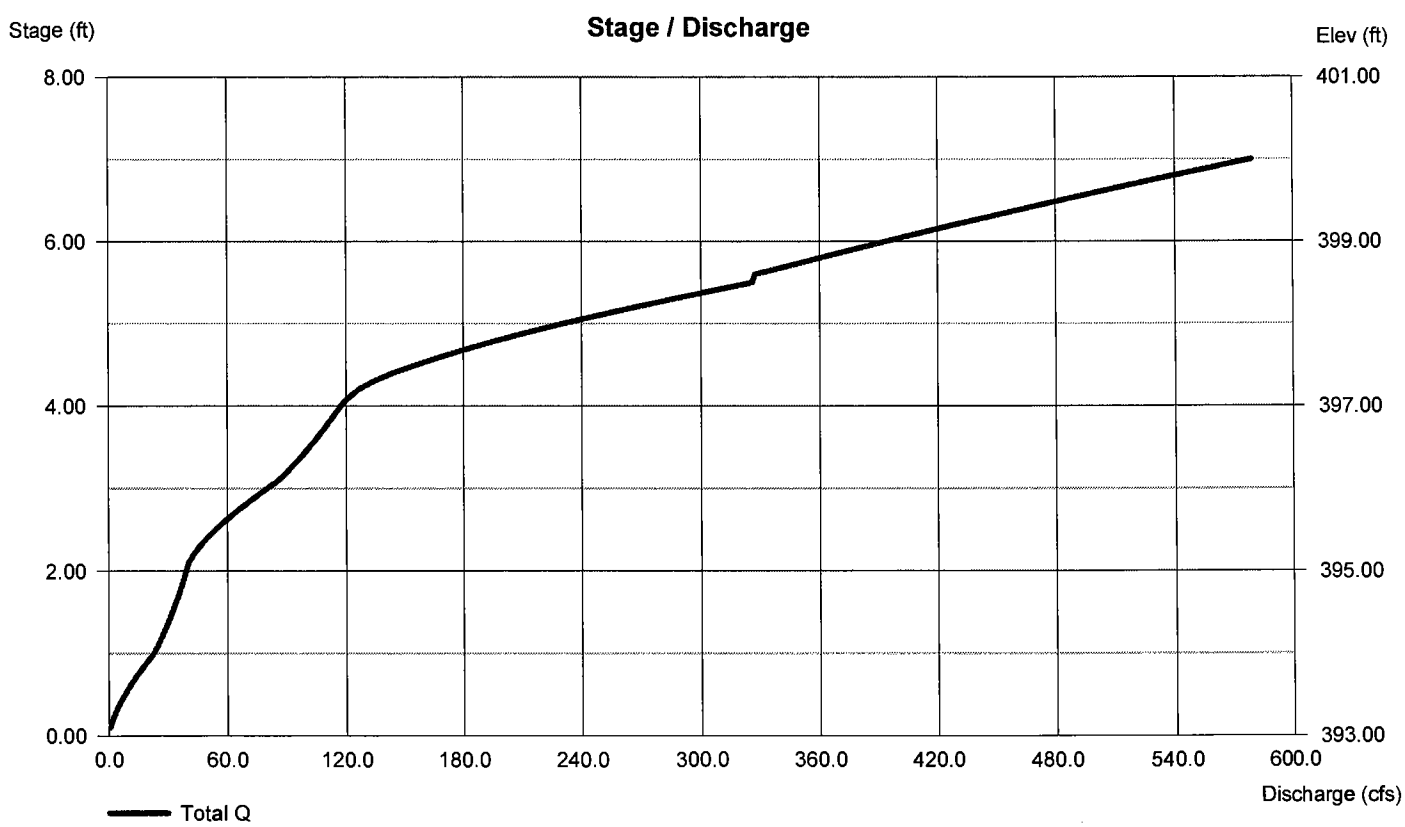
Weir Structures

	[A] RISER	[B] EM. SPILLWAY	[C]	[D]
Crest Len (ft)	= 12.00	20.00	0.00	0.00
Crest El. (ft)	= 397.00	397.20	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	Rect	---	---
Multi-Stage	= Yes	No	No	No

Exfil.(in/hr) = 0.000 (by Contour)

TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).



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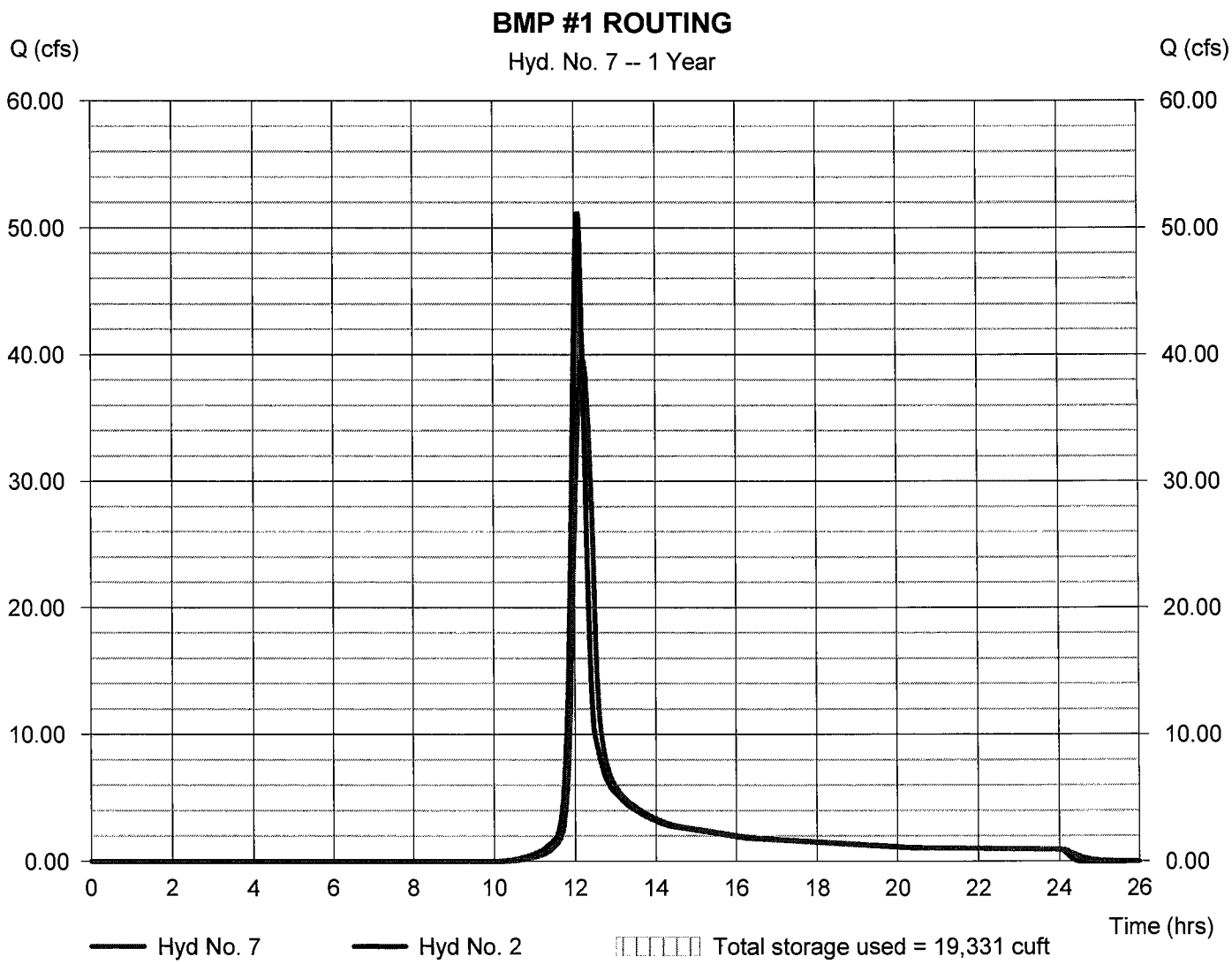
Hyd. No. 7

BMP #1 ROUTING

Hydrograph type	= Reservoir	Peak discharge	= 39.70 cfs
Storm frequency	= 1 yrs	Time to peak	= 12.20 hrs
Time interval	= 2 min	Hyd. volume	= 164,122 cuft
Inflow hyd. No.	= 2 - BMP #1 - POST-DEVELOPED	Max. Elevation	= 395.03 ft
Reservoir name	= BMP #1	Max. Storage	= 19,331 cuft

Storage Indication method used.



Hydrograph Report

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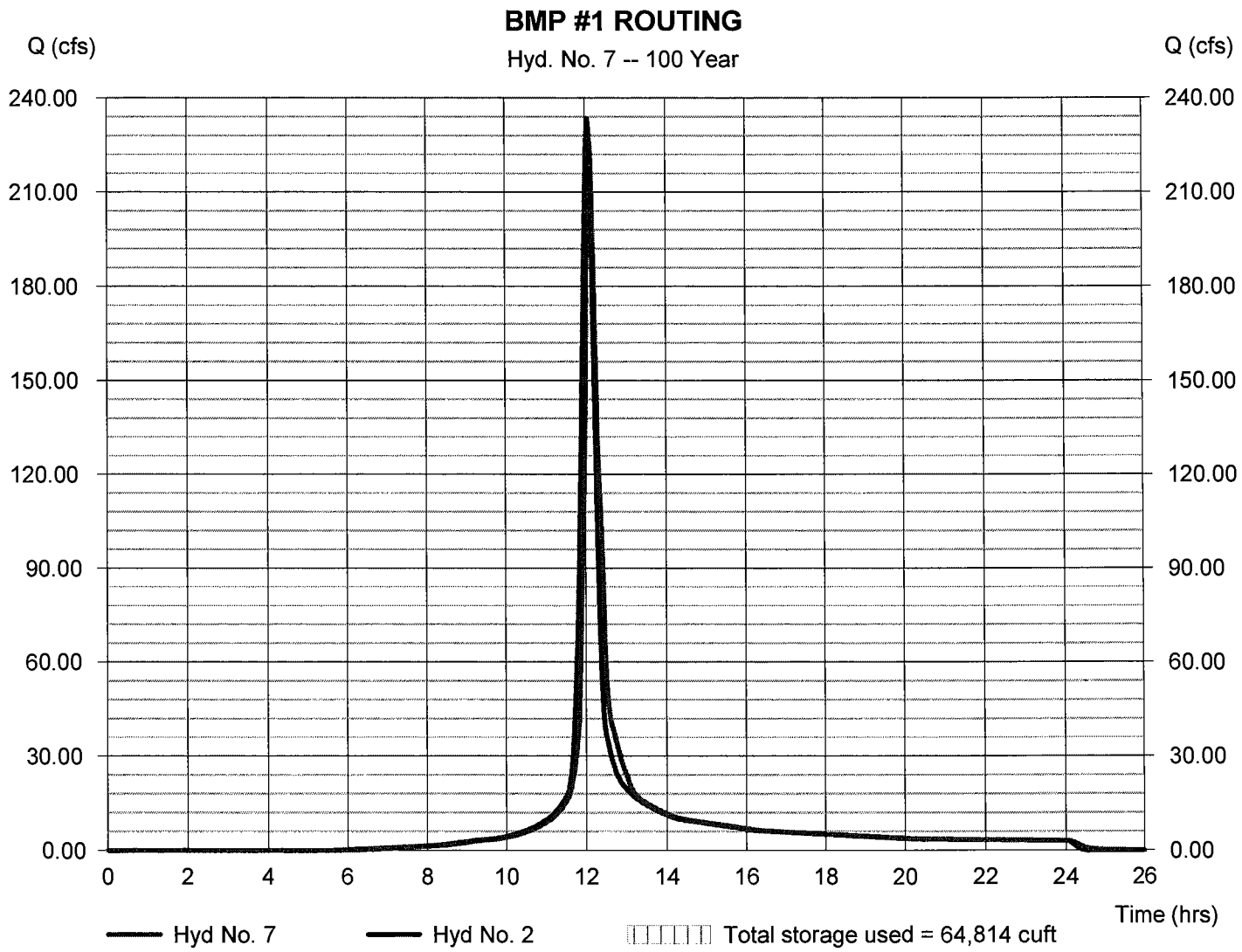
Hyd. No. 7

BMP #1 ROUTING

Hydrograph type	= Reservoir	Peak discharge	= 227.43 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.10 hrs
Time interval	= 2 min	Hyd. volume	= 736,364 cuft
Inflow hyd. No.	= 2 - BMP #1 - POST-DEVELOPED	Max. Elevation	= 397.99 ft
Reservoir name	= BMP #1	Max. Storage	= 64,814 cuft

Storage Indication method used.



Pond Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2013 by Autodesk, Inc. v10 Tuesday, 04 / 28 / 2015

Pond No. 2 - BMP #2

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 378.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	378.00	4,878	0	0
1.00	379.00	5,994	5,426	5,426
2.00	380.00	7,224	6,599	12,025
3.00	381.00	8,567	7,885	19,910
4.00	382.00	10,211	9,376	29,286
5.00	383.00	11,392	10,795	40,081

Culvert / Orifice Structures

PRIMARY

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	11.00	0.00	0.00
Span (in)	= 24.00	11.00	0.00	0.00
No. Barrels	= 1	1	1	0
Invert El. (ft)	= 375.00	378.00	0.00	0.00
Length (ft)	= 39.00	0.00	0.00	0.00
Slope (%)	= 3.87	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

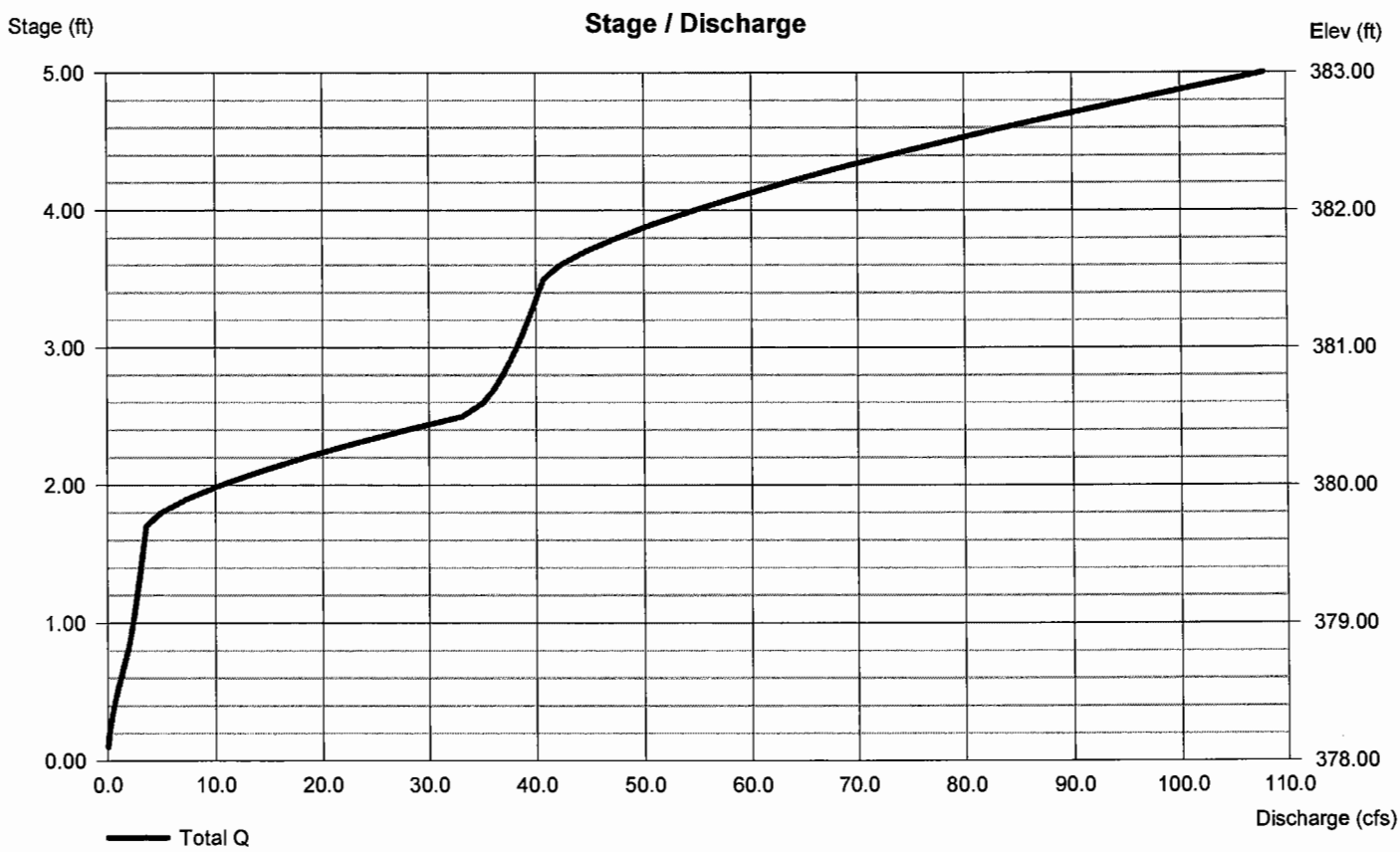
RISER EM. SPILLWAY

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 12.00	10.00	0.00	0.00
Crest El. (ft)	= 379.70	381.50	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	Rect	---	---
Multi-Stage	= Yes	No	No	No

Exfil.(in/hr) = 0.000 (by Contour)

TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).



Hydrograph Report

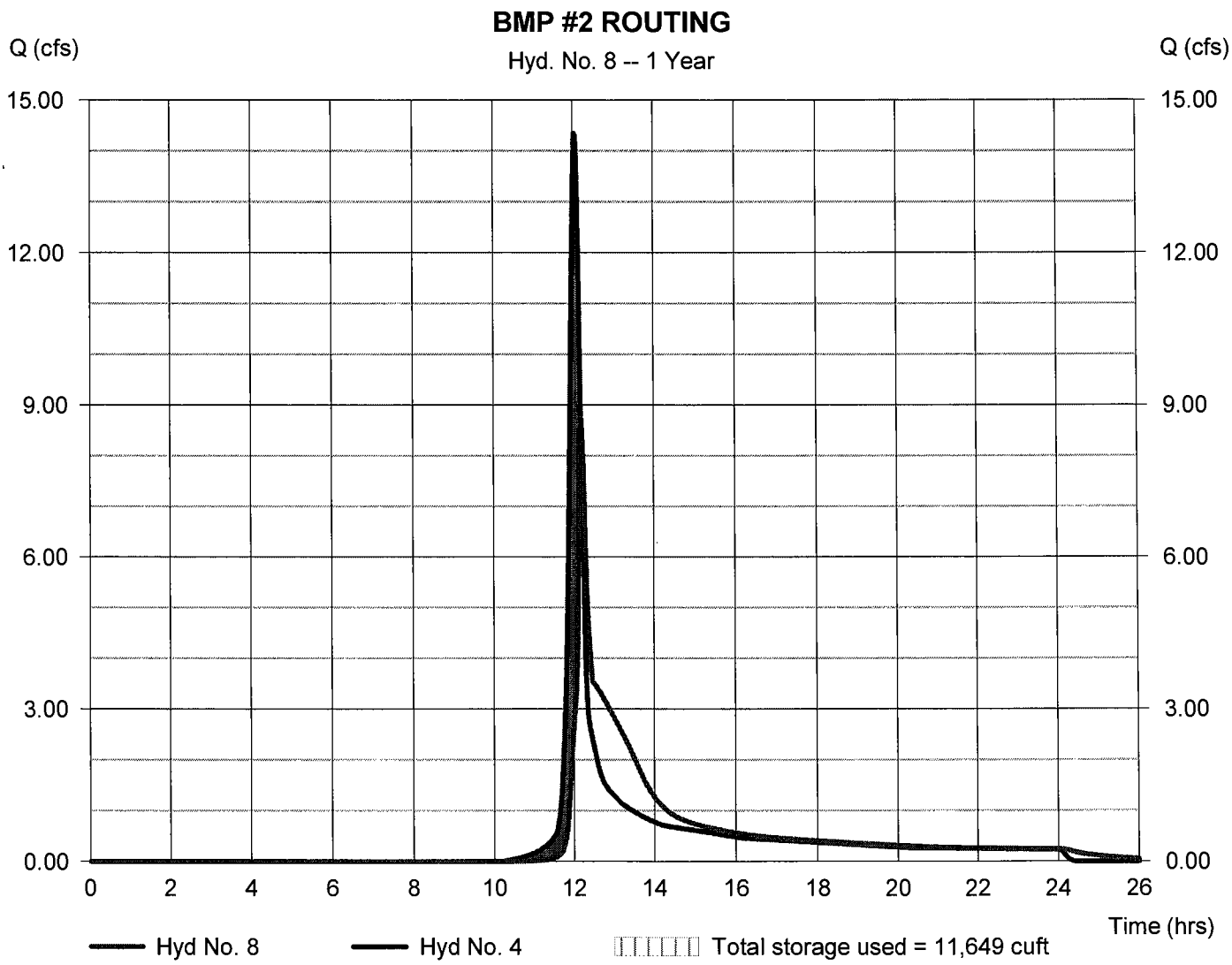
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2013 by Autodesk, Inc. v10 Monday, 04 / 27 / 2015

Hyd. No. 8

BMP #2 ROUTING

Hydrograph type	= Reservoir	Peak discharge	= 8.732 cfs
Storm frequency	= 1 yrs	Time to peak	= 12.20 hrs
Time interval	= 2 min	Hyd. volume	= 41,018 cuft
Inflow hyd. No.	= 4 - BMP #2 POST-DEVELOPED	Max. Elevation	= 379.95 ft
Reservoir name	= BMP #2	Max. Storage	= 11,649 cuft

Storage Indication method used.



Hydrograph Report

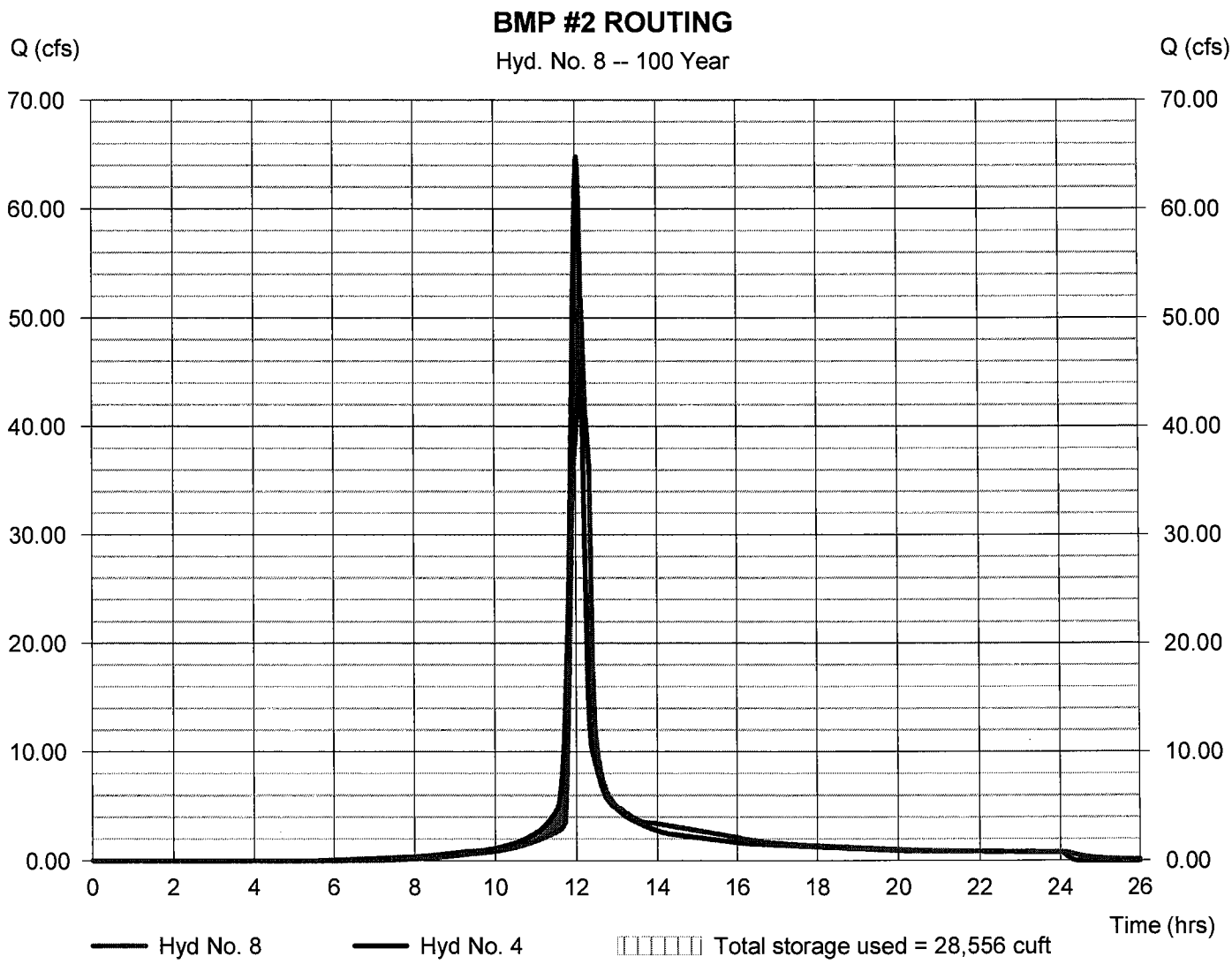
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2013 by Autodesk, Inc. v10 Monday, 04 / 27 / 2015

Hyd. No. 8

BMP #2 ROUTING

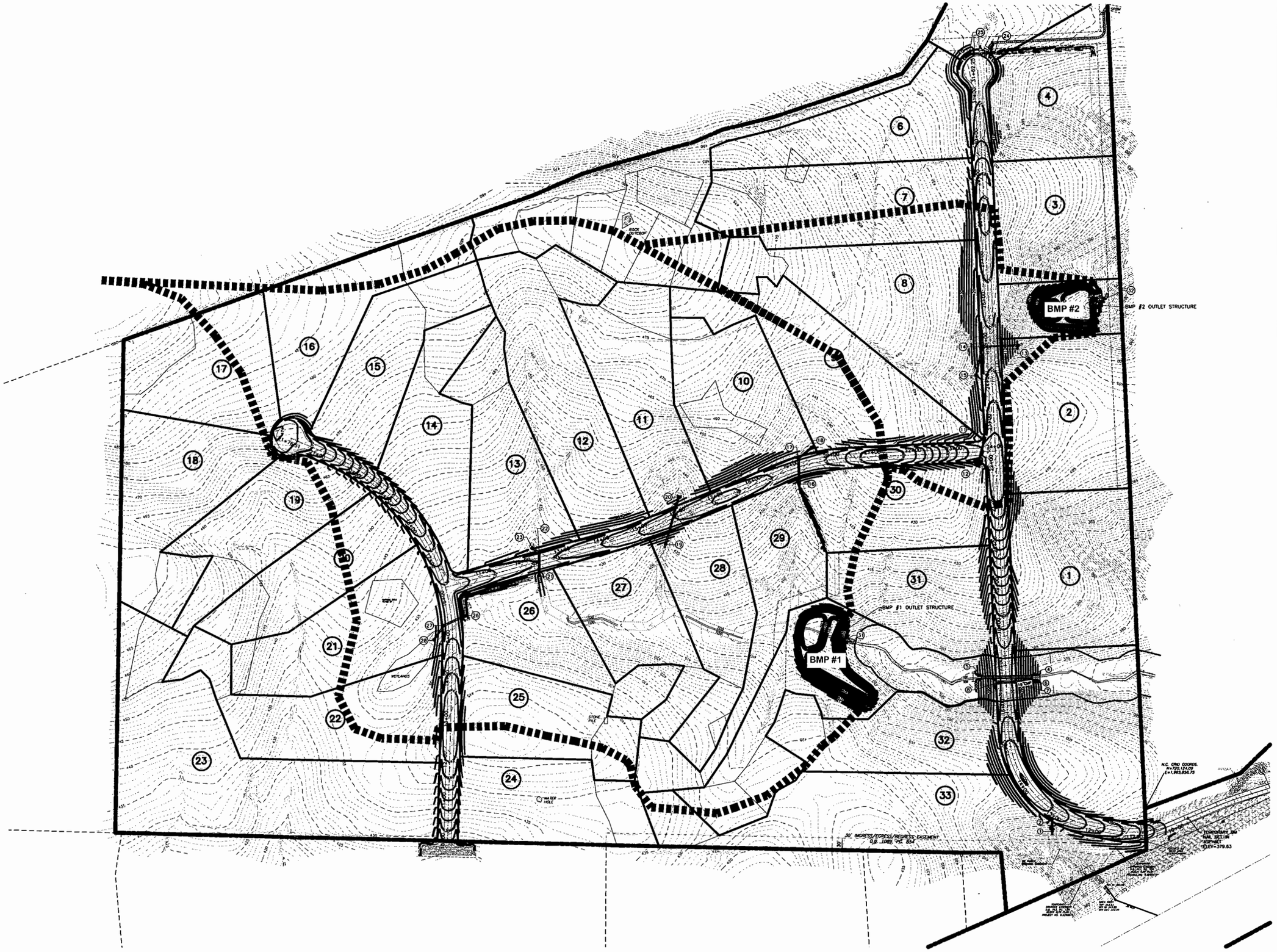
Hydrograph type	= Reservoir	Peak discharge	= 51.70 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 184,078 cuft
Inflow hyd. No.	= 4 - BMP #2 POST-DEVELOPED	Max. Elevation	= 381.94 ft
Reservoir name	= BMP #2	Max. Storage	= 28,556 cuft

Storage Indication method used.



Appendix C

BMP Drainage Area Maps



PLD

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RIVERSTONE SUBDIVISION

HIGHWAY 64
PITTSBORO, NORTH CAROLINA

ISSUED: PROGRESS

REVISIONS:

DRAWN BY: MLS
CHECKED BY: JDL

PROJECT: FPRSP

BMP
DRAINAGE AREA
MAP

DWG. NO. EX 1.0

F:\Projects\FPRSP\Stormwater\FPRSP Drainage Area Maps.dwg - EX 1 - BMP May 05, '15 - 10:01am

Appendix D

Storm Sewer System Calculations

STORM DRAINAGE DESIGN DATA SHEET

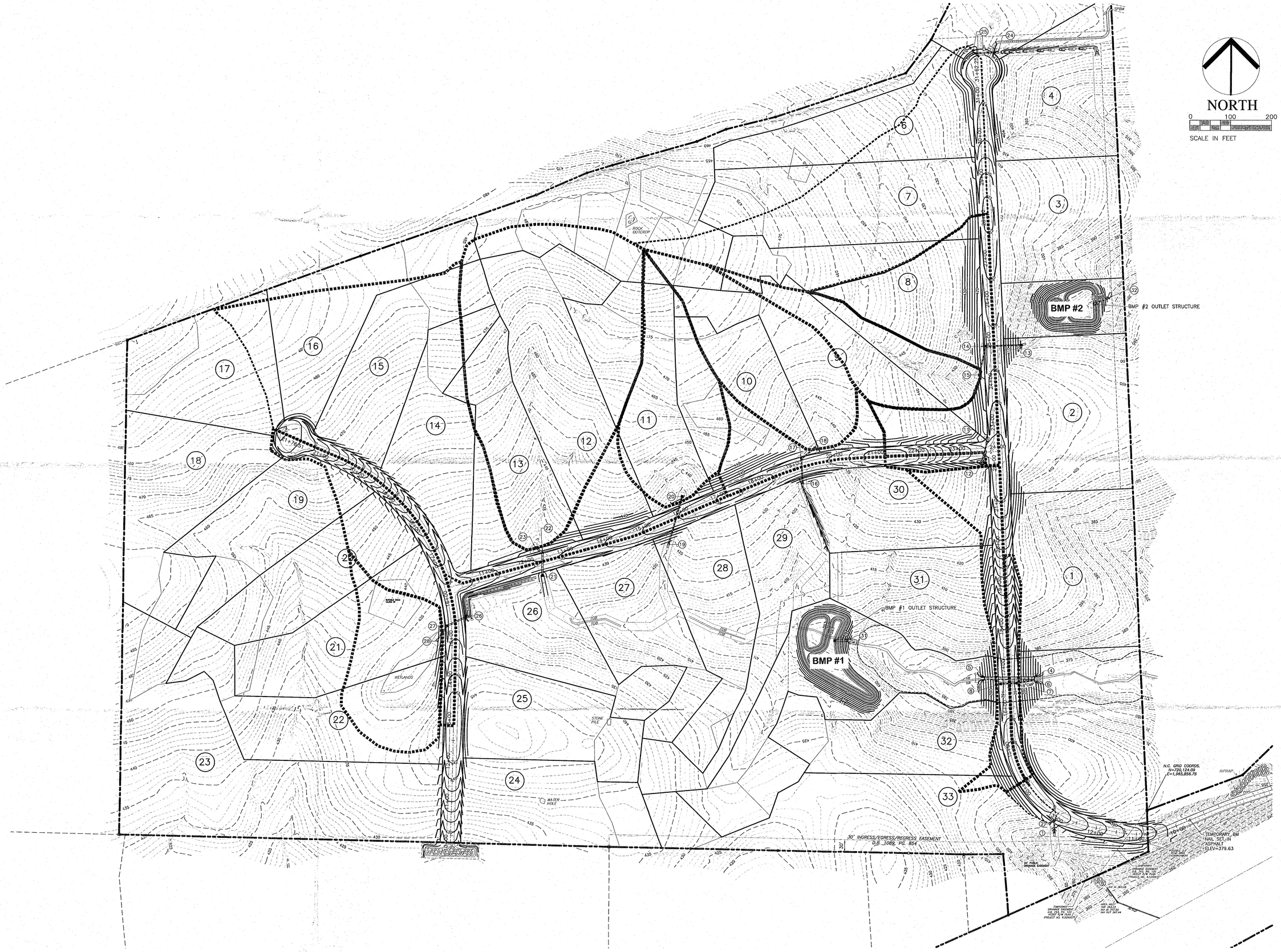
5/5/2015

Project Number:		Designed By:	
Project:	FPRSP	Checked By:	
Storm Frequency:	10 Year	Pipe Type:	RCP

1	2	3	4	8	9	10		11	12	13	14
Location		Area						PIPE DATA			
From	To	Sub Total (acres)	Total (acres)	I-10 Intensity (in./hr.)	C Runoff Coef.	Q (inlet) (cfs)	Q (Total) (cfs)	Slope (ft./ft.)	Min. Pipe Size (in.)	Size (in.)	V full (fps)
2	1	0.13	0.13	7.08	0.55	0.51	0.51	0.007	6.2	15	4.3
											0.0
8	7	1.24	1.24	7.08	0.55	4.83	4.83	0.005	15.3	18	4.2
7	6	0.33	1.57	7.08	0.55	1.29	6.11	0.105	9.4	18	19.2
12	11	0.46	0.46	7.08	0.55	1.79	1.79	0.006	10.2	15	4.1
15	14	1.59	1.59	7.08	0.35	3.94	3.94	0.028	10.3	15	8.8
14	13	2.50	4.09	7.08	0.35	6.20	10.14	0.089	11.8	15	15.7
18	17	2.62	2.62	7.08	0.35	6.49	6.49	0.007	16.1	18	5.0
17	16	0.99	3.61	7.08	0.35	2.45	8.95	0.026	14.2	18	9.5
20	19	2.31	2.31	7.08	0.35	5.72	5.72	0.050	10.6	15	11.7
23	22	6.22	6.22	7.08	0.35	15.41	15.41	0.010	20.9	24	7.0
22	21	7.50	13.72	7.08	0.35	18.59	34.00	0.005	31.8	36	6.7
25	24	4.50	4.50	7.08	0.35	11.15	11.15	0.006	20.4	24	5.5
28	27	1.92	1.92	7.08	0.35	4.76	4.76	0.044	10.1	15	11.1
27	26	1.55	3.47	7.08	0.35	3.84	8.60	0.005	18.9	24	5.2
30	29	0.12	0.12	7.08	0.55	0.47	0.47	0.006	6.1	15	4.1

Appendix E

Storm Sewer Drainage Area Map



NORTH

0 100 200

SCALE IN FEET

PLD

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RIVERSTONE SUBDIVISION

HIGHWAY 64
PITTSBORO, NORTH CAROLINA

ISSUED: **PROGRESS**

REVISIONS:

DRAWN BY: **MLS**
CHECKED BY: **JDL**

PROJECT: **FPRSP**

STORM SYSTEM DRAINAGE AREA MAP

DWG. NO. **EX 2.0**

F:\Projects\FPRSP\Stormwater\FPRSP Drainage Area Maps.dwg - EX 2 - STORM May 05, '15 - 10:11am

Appendix F

Permanent Channel Calculations

Hydraulic Analysis Report

Channel Analysis: Channel Analysis

CHANNEL "A"

Input Parameters

Channel Type: Trapezoidal

Side Slope 1 (Z1): 3.0000 (ft/ft)

Side Slope 2 (Z2): 3.0000 (ft/ft)

Channel Width: 4.0000 (ft)

Longitudinal Slope: 0.0600 (ft/ft)

Manning's n: 0.0690

Flow: 9.2400 (cfs)

Result Parameters

Depth: 0.5537 (ft)

Area of Flow: 3.1345 (ft^2)

Wetted Perimeter: 7.5019 (ft)

Hydraulic Radius: 0.4178 (ft)

Average Velocity: 2.9478 (ft/s)

Top Width: 7.3222 (ft)

Froude Number: 0.7940

Critical Depth: 0.4836 (ft)

Critical Velocity: 3.5056 (ft/s)

Critical Slope: 0.0985 (ft/ft)

Critical Top Width: 6.9014 (ft)

Calculated Max Shear Stress: 2.0730 (lb/ft^2)

Calculated Avg Shear Stress: 1.5644 (lb/ft^2) < 2.0 PSF ALLOWED FOR CL. B RIP RAP

USE CLASS B RIP RAP

Hydraulic Analysis Report

Channel Analysis: Channel Analysis

CHANNEL "B"

Input Parameters

Channel Type: Trapezoidal

Side Slope 1 (Z1): 3.0000 (ft/ft)

Side Slope 2 (Z2): 3.0000 (ft/ft)

Channel Width: 4.0000 (ft)

Longitudinal Slope: 0.0400 (ft/ft)

Manning's n: 0.0210

Flow: 9.2400 (cfs)

Result Parameters

Depth: 0.3201 (ft)

Area of Flow: 1.5878 (ft^2)

Wetted Perimeter: 6.0245 (ft)

Hydraulic Radius: 0.2636 (ft)

Average Velocity: 5.8192 (ft/s) < 6.0 ALLOWED FOR NAG S150

Top Width: 5.9207 (ft)

Froude Number: 1.9802

Critical Depth: 0.4837 (ft)

Critical Velocity: 3.5040 (ft/s)

Critical Slope: 0.0091 (ft/ft)

Critical Top Width: 6.9024 (ft)

Calculated Max Shear Stress: 0.7990 (lb/ft^2)

Calculated Avg Shear Stress: 0.6579 (lb/ft^2) < 1.75 PSF ALLOWED FOR NAG S150

Hydraulic Analysis Report

Channel Analysis: Channel Analysis

CHANNEL "C"

Input Parameters

Channel Type: Trapezoidal

Side Slope 1 (Z1): 3.0000 (ft/ft)

Side Slope 2 (Z2): 3.0000 (ft/ft)

Channel Width: 3.0000 (ft)

Longitudinal Slope: 0.1000 (ft/ft)

Manning's n: 0.0780

Flow: 11.8000 (cfs)

Result Parameters

Depth: 0.6608 (ft)

Area of Flow: 3.2922 (ft^2)

Wetted Perimeter: 7.1792 (ft)

Hydraulic Radius: 0.4586 (ft)

Average Velocity: 3.5842 (ft/s)

Top Width: 6.9647 (ft)

Froude Number: 0.9187

Critical Depth: 0.6307 (ft)

Critical Velocity: 3.8247 (ft/s)

Critical Slope: 0.1199 (ft/ft)

Critical Top Width: 6.7840 (ft)

Calculated Max Shear Stress: 4.1233 (lb/ft^2)

Calculated Avg Shear Stress: 2.8616 (lb/ft^2) <4.0 ALLOWED FOR CL I RIPRAP

Hydraulic Analysis Report

Channel Analysis: Channel Analysis

CHANNEL "D"

Input Parameters

Channel Type: Trapezoidal

Side Slope 1 (Z1): 3.0000 (ft/ft)

Side Slope 2 (Z2): 3.0000 (ft/ft)

Channel Width: 3.0000 (ft)

Longitudinal Slope: 0.0500 (ft/ft)

Manning's n: 0.0550

Flow: 11.8000 (cfs)

Result Parameters

Depth: 0.6597 (ft)

Area of Flow: 3.2848 (ft^2)

Wetted Perimeter: 7.1724 (ft)

Hydraulic Radius: 0.4580 (ft)

Average Velocity: 3.5923 (ft/s) < 8.0 ALLOWED FOR NAG SC150

Top Width: 6.9583 (ft)

Froude Number: 0.9214

Critical Depth: 0.6307 (ft)

Critical Velocity: 3.8244 (ft/s)

Critical Slope: 0.0596 (ft/ft)

Critical Top Width: 6.7842 (ft)

Calculated Max Shear Stress: 2.0583 (lb/ft^2)

Calculated Avg Shear Stress: 1.4289 (lb/ft^2) < 2.0 ALLOWED FOR NAG SC150

Hydraulic Analysis Report

Channel Analysis: Channel Analysis

Channel "E"

Input Parameters

Channel Type: Trapezoidal

Side Slope 1 (Z1): 3.0000 (ft/ft)

Side Slope 2 (Z2): 3.0000 (ft/ft)

Channel Width: 2.0000 (ft)

Longitudinal Slope: 0.0100 (ft/ft)

Manning's n: 0.0400

Flow: 10.7000 (cfs)

Result Parameters

Depth: 0.9059 (ft)

Area of Flow: 4.2738 (ft^2)

Wetted Perimeter: 7.7295 (ft)

Hydraulic Radius: 0.5529 (ft)

Average Velocity: 2.5036 (ft/s) < 6.0 ALLOWED FOR NAG SISD

Top Width: 7.4355 (ft)

Froude Number: 0.5819

Critical Depth: 0.6875 (ft)

Critical Velocity: 3.8313 (ft/s)

Critical Slope: 0.0318 (ft/ft)

Critical Top Width: 6.1248 (ft)

Calculated Max Shear Stress: 0.5653 (lb/ft^2)

Calculated Avg Shear Stress: 0.3450 (lb/ft^2) <1.75 ALLOWED FOR NAG SISD

Table 8.05g
Permissible Shear Stresses for Riprap and Temporary Liners

Lining Category	Permissible Unit Shear Stress, T_d Lining Type	(lb/ft^2)
Temporary	Woven Paper Net	0.15
	Jute Net	0.45
	Fiberglass Roving:	
	Single	0.60
	Double	0.85
	Straw with Net	1.45
	Curled Wood mat	1.55
	Synthetic Mat	2.00
	d_{50} Stone Size (inches)	
Gravel Riprap	1	0.33
	2	0.67
Rock Riprap	6	2.00
	9	3.00
	12	4.00
	15	5.00
	18	6.00
	21	7.80
	24	8.00

Adapted From: FHWA, HEC-15, April 1983, pgs. 17 & 37.

Design Procedure-Temporary Liners

The following is a step-by-step procedure for designing a temporary liner for a channel. Because temporary liners have a short period of service, the design Q may be reduced. For liners that are needed for six months or less, the 2-yr frequency storm is recommended.

Step 1. Select a liner material suitable for site conditions and application. Determine roughness coefficient from manufacturer's specifications or Table 8.05e, pg. 8.05.10.

Step 2. Calculate the normal flow depth using Manning's equation (Figure 8.05d). Check to see that depth is consistent with that assumed for selection of Manning's *n* in Figure 8.05d, pg. 8.05.11. For smaller runoffs Figure 8.05d is not as clearly defined. Recommended solutions can be determined by using the Manning equation.

Step 3. Calculate shear stress at normal depth.

Step 4. Compare computed shear stress with the permissible shear stress for the liner.

Step 5. If computed shear is greater than permissible shear, adjust channel dimensions to reduce shear or select a more resistant lining and repeat steps 1 through 4.

Design of a channel with temporary lining is illustrated in Sample Problem 8.05b, pg. 8.05.14.

ROLLMAX™
ROLLED EROSION CONTROL

Specification Sheet – EroNet™ S150® Erosion Control Blanket

DESCRIPTION

The short-term double net erosion control blanket shall be a machine-produced mat of 100% agricultural straw with a functional longevity of up to 12 months. (*NOTE: functional longevity may vary depending upon climatic conditions, soil, geographical location, and elevation).* The blanket shall be of consistent thickness with the straw evenly distributed over the entire area of the mat. The blanket shall be covered on the top and bottom sides with a lightweight photodegradable polypropylene netting having an approximate 0.50 x 0.50 in. (1.27 x 1.27 cm) mesh. The blanket shall be sewn together on 1.50 inch (3.81 cm) centers with degradable thread. The blanket shall be manufactured with a colored thread stitched along both outer edges (approximately 2-5 inches [5-12.5 cm] from the edge) as an overlap guide for adjacent mats.

The S150 shall meet Type 2.D specification requirements established by the Erosion Control Technology Council (ECTC) and Federal Highway Administration's (FHWA) FP-03 Section 713.17

Material Content		
Matrix	100% Straw Fiber	0.5 lbs/sq yd (0.27 kg/sm)
Netting	Top and bottom nets: lightweight photodegradable	1.5 lbs/1000 sq ft (0.73 kg/100 sm)
Thread	Degradable	

Standard Roll Sizes			
Width	6.67 ft (2.03 m)	8 ft (2.4 m)	16.0 ft (4.87 m)
Length	108 ft (32.92 m)	112 ft (34.14 m)	108 ft (32.92 m)
Weight ± 10%	40 lbs (18.14 kg)	50 lbs (22.68 kg)	96 lbs (43.54 kg)
Area	80 sq yd (66.9 sm)	100 sq yd (83.61 sm)	192 sq yd (165.6 sm)

Roughness Coefficients – Unveg.	
Flow Depth	Manning's n
≤ 0.50 ft (0.15 m)	0.055
0.50 – 2.0 ft	0.055-0.021
≥ 2.0 ft (0.60 m)	0.021

Index Property	Test Method	Typical
Thickness	ASTM D6525	0.32 in. (8.13 mm)
Resiliency	ECTC Guidelines	80.5%
Water Absorbency	ASTM D1117	370%
Mass/Unit Area	ASTM D6475	8.15 oz/sy (277.1 g/sm)
Swell	ECTC Guidelines	15%
Smolder Resistance	ECTC Guidelines	Yes
Stiffness	ASTM D1388	6.06 oz-in
Light Penetration	ASTM D6567	12.4%
Tensile Strength - MD	ASTM D6818	159.6 lbs/ft (2.37 kN/m)
Elongation - MD	ASTM D6818	31.7%
Tensile Strength - TD	ASTM D6818	93.6 lbs/ft (1.39 kN/m)
Elongation - TD	ASTM D6818	26.7%
Biomass Improvement	ASTM D7322	371%

Design Permissible Shear Stress	
Unvegetated Shear Stress	1.75 psf (84 Pa)
Unvegetated Velocity	6.0 fps (1.83 m/s)

NTPEP ASTM D6460 Large-Scale Channel	
Unvegetated Shear Stress	2.42 psf (115.9 Pa)
Unvegetated Velocity	9.0 fps (2.75 m/s)

Slope Design Data: C Factors			
	Slope Gradients (S)		
Slope Length (L)	≤ 3:1	3:1 – 2:1	≥ 2:1
≤ 20 ft (6 m)	0.004	0.106	N/A
20-50 ft	0.062	0.118	N/A
≥ 50 ft (15.2 m)	0.12	0.180	N/A

NTPEP Large-scale Slope
ASTM D6459 - C-factor = 0.029

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ROLLMAX™
ROLLED EROSION CONTROL

Specification Sheet – EroNet™ SC150® Erosion Control Blanket

DESCRIPTION

The extended-term double net erosion control blanket shall be a machine-produced mat of 70% agricultural straw and 30% coconut fiber with a functional longevity of up to 24 months. (NOTE: functional longevity may vary depending upon climatic conditions, soil, geographical location, and elevation). The blanket shall be of consistent thickness with the straw and coconut evenly distributed over the entire area of the mat. The blanket shall be covered on the top side with a heavyweight photodegradable polypropylene netting having ultraviolet additives to delay breakdown and an approximate 0.63 x 0.63 in (1.59 x 1.59 cm) mesh, and on the bottom side with a lightweight photodegradable polypropylene netting with an approximate 0.50 x 0.50 (1.27 x 1.27 cm) mesh. The blanket shall be sewn together on 1.50 inch (3.81 cm) centers with degradable thread. The blanket shall be manufactured with a colored thread stitched along both outer edges (approximately 2-5 inches [5-12.5 cm] from the edge) as an overlap guide for adjacent mats.

The SC150 shall meet Type 3.B specification requirements established by the Erosion Control Technology Council (ECTC) and Federal Highway Administration's (FHWA) FP-03 Section 713.17

Material Content		
Matrix	70% Straw Fiber 30% Coconut Fiber	0.35 lbs/sq yd (0.19 kg/sm) 0.15 lbs/sq yd (0.08 kg/sm)
Netting	Top: Heavyweight photodegradable with UV additives	3 lbs/1000 sq ft (1.47 kg/100 sm)
	Bottom: lighweight photodegradable	1.5 lb/1000 sq ft (0.73 kg/100 sm)
Thread	Degradable	

Standard Roll Sizes			
Width	6.67 ft (2.03 m)	8 ft (2.4 m)	16.0 ft (4.87 m)
Length	108 ft (32.92 m)	112 ft (34.14 m)	108 ft (32.92 m)
Weight ± 10%	44 lbs (19.95 kg)	55 lbs (24.95 kg)	105.6 lbs (47.9 kg)
Area	80 sq yd (66.9 sm)	100 sq yd (83.61 sm)	192 sq yd (165.6 sm)

Index Property	Test Method	Typical
Thickness	ASTM D6525	0.35 in. (8.89 mm)
Resiliency	ECTC Guidelines	75%
Water Absorbency	ASTM D1117	342%
Mass/Unit Area	ASTM D6475	7.87 oz/sy (267.6 g/sm)
Swell	ECTC Guidelines	30%
Smolder Resistance	ECTC Guidelines	Yes
Stiffness	ASTM D1388	1.11 oz-in
Light Penetration	ASTM D6567	6.2%
Tensile Strength - MD	ASTM D6818	362.4 lbs/ft (5.37 kN/m)
Elongation - MD	ASTM D6818	29.4%
Tensile Strength - TD	ASTM D6818	136.8 lbs/ft (2.03 kN/m)
Elongation - TD	ASTM D6818	27.6%
Biomass Improvement	ASTM D7322	481%

Design Permissible Shear Stress	
Unvegetated Shear Stress	2.00 psf (96 Pa)
Unvegetated Velocity	8.0 fps (2.44 m/s)

Slope Design Data: C Factors			
	Slope Gradients (S)		
Slope Length (L)	≤ 3:1	3:1 – 2:1	≥ 2:1
≤ 20 ft (6 m)	0.001	0.048	0.100
20-50 ft	0.051	0.079	0.145
≥ 50 ft (15.2 m)	0.10	0.110	0.190

NTPEP Large-Scale Slope
ASTM D6459 - C-factor = 0.031

Roughness Coefficients – Unveg.	
Flow Depth	Manning's n
≤ 0.50 ft (0.15 m)	0.050
0.50 – 2.0 ft	0.050-0.018
≥ 2.0 ft (0.60 m)	0.018

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Tensar International Corporation warrants that at the time of delivery the product furnished hereunder shall conform to the specification stated herein. Any other warranty including merchantability and fitness for a particular purpose, are hereby executed. If the product does not meet specifications on this page and Tensar is notified prior to installation, Tensar will replace the product at no cost to the customer. **This product specification supersedes all prior specifications for the product described above and is not applicable to any products shipped prior to January 1, 2012.**

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ROLLMAX™
ROLLED EROSION CONTROL

Specification Sheet – VMax® C350® Turf Reinforcement Mat

DESCRIPTION

The composite turf reinforcement mat (C-TRM) shall be a machine-produced mat of 100% coconut fiber matrix incorporated into permanent three-dimensional turf reinforcement matting. The matrix shall be evenly distributed across the entire width of the matting and stitch bonded between super heavy duty UV-stabilized nettings with 0.50 x 0.50 in. (1.27 x 1.27 cm) openings, an ultra heavy duty UV-stabilized, dramatically corrugated (crimped) intermediate netting with 0.5 x 0.5 in. (1.27 x 1.27 cm) openings, and covered by a super heavy duty UV-stabilized nettings with 0.50 x 0.50 in. (1.27 x 1.27 cm) openings. The middle corrugated netting shall form prominent closely spaced ridges across the entire width of the mat. The three nettings shall be stitched together on 1.50 in. (3.81 cm) centers with UV-stabilized polypropylene thread to form permanent three-dimensional turf reinforcement matting. All mats shall be manufactured with colored thread stitched along both outer edges as an overlap guide for adjacent mats.

The C350 shall meet Type 5A, B and C specification requirements established by the Erosion Control Technology Council (ECTC) and Federal Highway Administration's (FHWA) *FP-03 Section 713.18*.

Material Content		
Matrix	100% Coconut Fiber	0.5 lb/sy (0.27 kg/sm)
Netting	Top and Bottom, UV-Stabilized Polypropylene	8 lb/1000 sf (3.91 kg/100 sm)
	Middle, Corrugated UV-Stabilized Polypropylene	24 lb/1000 sf (11.7 kg/100 sm)
Thread	Polypropylene, UV Stable	

Standard Roll Sizes	
Width	6.5 ft (2.0 m)
Length	55.5 ft (16.9 m)
Weight ± 10%	37 lbs (16.8 kg)
Thread	40 sy (33.4 sm)

Index Property	Test Method	Typical
Thickness	ASTM D6525	0.73 in. (18.54 mm)
Resiliency	ASTM D6524	90%
Density	ASTM D792	0.917 g/cm³
Mass/Unit Area	ASTM D6566	18.36 oz/sy (624 g/sm)
UV Stability	ASTM D4355/ 1000 HR	86%
Porosity	ECTC Guidelines	99%
Stiffness	ASTM D1388	0.24 in.-lb (275990 mg-cm)
Light Penetration	ASTM D6567	7.2%
Tensile Strength – MD	ASTM D6818	585.8 lbs/ft (8.70 kN/m)
Elongation – MD	ASTM D6818	45.3%
Tensile Strength – TD	ASTM D6818	687.6 lbs/ft (10.20 kN/m)
Elongation – TD	ASTM D6818	19.5%
Biomass Improvement	ASTM D7322	380%

Design Permissible Shear Stress	Short Duration	Long Duration
Phase 1 Unvegetated	3.2 psf (153 Pa)	3.0 psf (144 Pa)
Phase 2 Partially Veg.	10.0 psf (480 Pa)	10.0 psf (480 Pa)
Phase 3 Fully Veg.	12.0 psf (576 Pa)	10.0 psf (480 Pa)
Unvegetated Velocity	10.5 fps (3.2 m/s)	
Vegetated Velocity	20 fps (6.0 m/s)	

Slope Design Data: C Factors

	Slope Gradients (S)		
Slope Length (L)	≤ 3:1	3:1 – 2:1	≥ 2:1
≤ 20 ft (6 m)	0.0005	0.015	0.043
20-50 ft	0.018	0.031	0.050
≥ 50 ft (15.2 m)	0.035	0.047	0.057

Roughness Coefficients – Unveg.

Flow Depth	Manning's n
≤ 0.50 ft (0.15 m)	0.041
0.50 – 2.0 ft	0.040-0.013
≥ 2.0 ft (0.60 m)	0.012

Tensar
NORTH AMERICAN GREEN

Tensar International Corporation
2500 Northwinds Parkway
Suite 500
Alpharetta, GA 30009
800-TENSAR-1
tensarcorp.com

Tensar International Corporation warrants that at the time of delivery the product furnished hereunder shall conform to the specification stated herein. Any other warranty including merchantability and fitness for a particular purpose, are hereby executed. If the product does not meet specifications on this page and Tensar is notified prior to installation, Tensar will replace the product at no cost to the customer. **This product specification supersedes all prior specifications for the product described above and is not applicable to any products shipped prior to January 1, 2012.**

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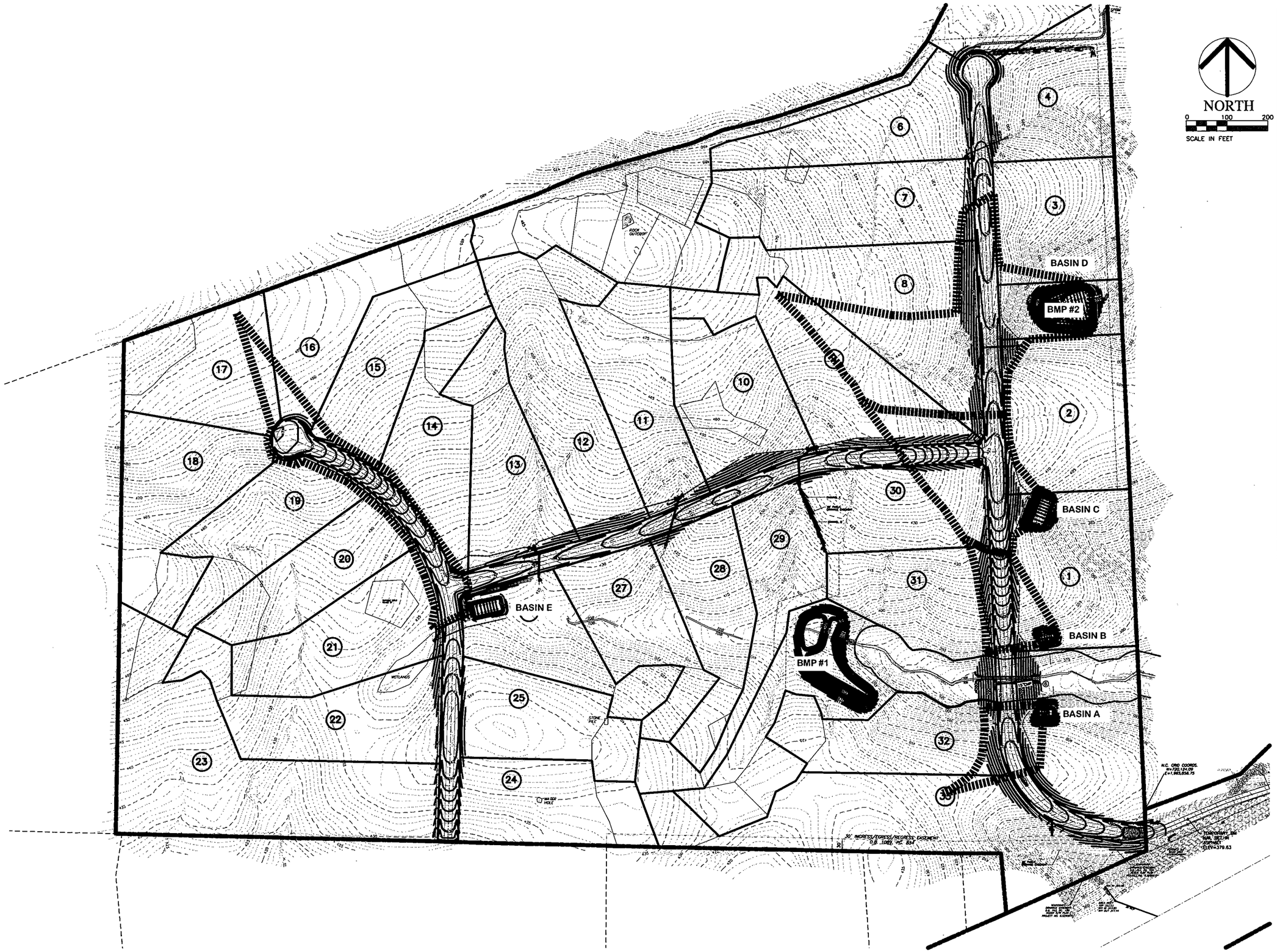
Appendix G

Sediment Basin Drainage Area Map



PLD
PIEDMONT LAND DESIGN, LLP
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PRELIMINARY
NOT FOR CONSTRUCTION

RIVERSTONE SUBDIVISION
HIGHWAY 64
PITTSBORO, NORTH CAROLINA

ISSUED: PROGRESS

REVISIONS:

DRAWN BY: MLS
CHECKED BY: JDL

PROJECT: FPRSP

SEDIMENT BASIN DRAINAGE AREA MAP

DWG. NO. EX 3.0

F:\Projects\FPRSP\Stormwater\FPRSP Drainage Area Maps.dwg - EX 3 - SED BASINS Apr 27, '15 - 2:31pm

Appendix H

Sediment Basin Skimmer Sizing Calculations

* FOR SED BASIN D

Calculate Skimmer Size

Basin Volume in Cubic Feet	40,081	Cu.Ft	**Skimmer Size**	**4.0** Inch
Days to Drain*	2	Days	Orifice Radius	**2.0** Inch[es]
			Orifice Diameter	**4.0** Inch[es]

*In NC assume 3 days to drain

Estimate Volume of Basin

	Length	Width			
Top of water surface in feet			Feet	**VOLUME**	**0 Cu. Ft.**
Bottom dimensions in feet			Feet		
Depth in feet			Feet		

Appendix I

Jordan/Falls Lake Stormwater Nutrient Load Accounting Tool

Watershed Characteristics Ver2.0

Clear All Values | Return to Instructions | Proceed to BMP Characteristics | Skip to Development Summary

Instructions

1. Select your physiographic/geologic region. (see map on 'instructions' page)
2. Enter the area of the entire development in square feet (ft^2).
3. Select the location that is most representative of the site's precipitation characteristics. (see map on 'instructions' page)
4. For each applicable land use, enter the total area of that land use that lies within the development under pre-development conditions.
5. For each applicable land use, enter the total area of that land use that lies within the development under post-development conditions, before BMP implementation.
6. Ensure that the sum of pre- and post-development areas entered equal the orginal development area.
7. Continue to "BMP Characteristics" tab.

Additional Guidelines

- For non-residential watersheds, indicate acreages of each land use type in Column 1 for both pre- and post-development conditions.
- For residential watersheds, complete the required information in Column 2 for both pre- and post-development conditions.
- If a given land use is not present in the given watershed, leave the cell blank or enter a zero.
- Ensure that land use areas entered for both pre- and post-development conditions match the total development area entered in cell O21.
- Residential areas may be entered by average lot size (column, part A), or may be separated into individual land uses (column 2, part B) – do NOT list out individual land uses within an area already described by lot size.
- Unless runoff flowing onto the development from offsite is routed separately around or through the site, the offsite catchment area draining in must be included in the acreage values of the appropriate land use(s) and treated.

Physiographic/Geologic Region:	**Piedmont**
Soil Hydrologic Group	**D**
Precipitation location:	**Siler City**

Total Development Area (ft^2):	**4,238,824**
Development Name:	River Stone
Model Prepared By:	MLS

COLUMN 1 -- NON-RESIDENTIAL LAND USES

	TN EMC (mg/L)	TP EMC (mg/L)	Pre-Development (ft^2)	Post-Development (ft^2)
COMMERCIAL				
Parking lot	1.44	0.16		
Roof	1.08	0.15		
Open/Landscaped	2.24	0.44		
INDUSTRIAL				
Parking lot	1.44	0.39		
Roof	1.08	0.15		
Open/Landscaped	2.24	0.44		
TRANSPORTATION				
High Density (interstate, main)	3.67	0.43		
Low Density (secondary, feeder)	1.4	0.52		
Rural	1.14	0.47		
Sidewalk	1.4	1.16		
PERVIOUS				
Managed pervious	3.06	0.59		
Unmanaged (pasture)	3.61	1.56		
Forest	1.47	0.25		
JURISDICTIONAL LANDS*				
Natural wetland	--	--		
Riparian buffer	--	--		
Open water	--	--		
LAND TAKEN UP BY BMPs	1.08	0.15		

*Jurisdictional land uses are not included in nutrient/flow calculations.

COLUMN 2 -- RESIDENTIAL LAND USES

	Custom Lot Size (ac)	Age (yrs)	TN EMC (mg/L)	TP EMC (mg/L)	Pre-Development (ft^2)	Post-Development (ft^2)
PART A						
⅛-ac lots	--		--	--		
¼-ac lots	--		--	--		
½-ac lots	--		--	--		
1-ac lots	--		--	--		
2-ac lots	--		--	--		
Multi-family	--		--	--		
Townhomes	--		--	--		
Custom Lot Size			--	--		
PART B						
Roadway		--	1.4	0.52		104,108
Driveway		1.0	1.44	0.39		33,000
Parking lot		--	1.44	0.39		
Roof		--	1.08	0.15		165,000
Sidewalk/Patio		--	1.4	1.16		33,000
Lawn		--	2.24	0.44		118,740
Managed pervious		--	3.06	0.59		
Forest		--	1.47	0.25	4,153,362	3,056,928
Natural wetland*		--	--	--	9,062	8,072
Riparian buffer*		--	--	--	76,400	59,976
Open water*		--	--	--		
LAND TAKEN UP BY BMPs		--	1.08	0.15		60,000

LAND USE AREA CHECK	
Total Development Area Entered (ft^2):	4,238,824
Total Pre-Development Calculated Area (ft^2):	4,238,824
Total Post-Development Calculated Area (ft^2):	4,238,824

BMP Characteristics Ver2.0

Clear All Values | Return to Instructions | Return to Watershed Characteristics | Proceed to Development Summary

Instructions

1. Select the type of BMP for each catchment.
2. Enter the area of each land use type in the contributing drainage area for each BMP.
3. Continue to "Development Summary" tab.

Additional Guidelines

- This spreadsheet allows the development to be divided into as many as 6 smaller catchments.
- BMPs 1, 2, and 3 for a given catchment are assumed to operate in series, with the outflow from 1 serving as the inflow to 2, etc.
- If the outflow from an entire catchment (including outflow from selected BMPs) drains to another BMP, indicate this in the drop down menu below the BMP type and leave all cells for individual land uses blank.
- Not all BMP or catchments must be utilized. Simply leave fields blank in the columns not needed.
- Leave cells blank or insert zeroes if a land use is not present in the area draining to the BMP.
- For water harvesting BMPs, be sure to enter the percent volume reduction that will be achieved by your system. Volume detention (catch-and-release mechanisms) will not be considered - only proven volume reductions are valid inputs.
- The BMP undersizing option should only be used for existing development or retrofit sites.
- Volume reduction efficiencies for undersized BMPs are calculated based on a 1:1 ratio (a BMP that is 60% smaller than the required design size is assigned a removal efficiency equal to 60% of the standard efficiency value). Effluent concentrations remain the same as full-sized BMPs.
- IMPORTANT: for the land area calculation checks to occur, you MUST press enter after entering a value for area to be treated by a BMP (not just click on the next cell).
- See User's Manual for instructions on modeling oversized BMPs.

BMP DETAILS

BMP	Volume Reduction (%)	TN Effluent Concen. (mg/L)	TP Effluent Concen. (mg/L)
Bioretention with IWS	50%	0.85	0.12
Bioretention without IWS	35%	1.00	0.12
Dry Detention Pond	0%	1.20	0.20
Grassed Swale	0%	1.21	0.26
Green Roof	50%	1.06	0.15
Level Spreader, Filter Strip	40%	1.20	0.15
Permeable Pavement*	0%	1.44	0.39
Sand Filter	5%	0.92	0.14
Water Harvesting	user defined	1.00	0.15
Wet Detention Pond	10%	1.01	0.11
Wetland	20%	1.08	0.13

*If treating commercial parking lot, TP effluent concentration = 0.16 mg/L

	CATCHMENT 1			CATCHMENT 2			CATCHMENT 3			CATCHMENT 4			CATCHMENT 5			CATCHMENT 6		
	BMP #1	BMP #2	BMP #3	BMP #1	BMP #2	BMP #3	BMP #1	BMP #2	BMP #3	BMP #1	BMP #2	BMP #3	BMP #1	BMP #2	BMP #3	BMP #1	BMP #2	BMP #3
Type of BMP	Dry Detention Pond			Dry Detention Pond														
If BMP is undersized, indicate the BMP size relative to the design that would be required to meet the designated water quality capture (i.e. 0.5 = BMP is 50% of required design size)																		
If a BMP is receiving runoff from other upstream catchments, indicate the BMP number																		
(1) Does BMP accept the outflow from another catchment? (yes, no, blank if not applicable) (2) Land use that utilized water are in addition to the watershed area treated by each draining catchment (%)																		
Catchment 1:	–	–	–	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no
Catchment 2:	no	no	no	–	–	–	no	no	no	no	no	no	no	no	no	no	no	no
Catchment 3:	no	no	no	no	no	no	–	–	–	no	no	no	no	no	no	no	no	no
Catchment 4:	no	no	no	no	no	no	no	no	no	–	–	–	no	no	no	no	no	no
Catchment 5:	no	no	no	no	no	no	no	no	no	no	no	no	–	–	–	no	no	no
Catchment 6:	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	–	–	–
Drainage Area Land Use	Area Treated by BMP (ft^2)	Area treated by BMP #2 that is not treated by BMP #1 (ft^2)	Area treated by BMP #3 that is not treated by BMPs #1 or #2 (ft^2)	Area Treated by BMP (ft^2)	Area treated by BMP #2 that is not treated by BMP #1 (ft^2)	Area treated by BMP #3 that is not treated by BMPs #1 or #2 (ft^2)	Area Treated by BMP (ft^2)	Area treated by BMP #2 that is not treated by BMP #1 (ft^2)	Area treated by BMP #3 that is not treated by BMPs #1 or #2 (ft^2)	Area Treated by BMP (ft^2)	Area treated by BMP #2 that is not treated by BMP #1 (ft^2)	Area treated by BMP #3 that is not treated by BMPs #1 or #2 (ft^2)	Area Treated by BMP (ft^2)	Area treated by BMP #2 that is not treated by BMP #1 (ft^2)	Area treated by BMP #3 that is not treated by BMPs #1 or #2 (ft^2)	Area Treated by BMP (ft^2)	Area treated by BMP #2 that is not treated by BMP #1 (ft^2)	Area treated by BMP #3 that is not treated by BMPs #1 or #2 (ft^2)	Total Land Use Area Treated By All BMPs (ft^2)	Allowable Total Land Use Area to be Treated Based on Post-Dev. Areas (ft^2)
COMMERCIAL																				
Parking lot																			0	0
Roof																			0	0
Open/Landscaped																			0	0
INDUSTRIAL																				
Parking lot																			0	0
Roof																			0	0
Open/Landscaped																			0	0
TRANSPORTATION																				
High Density (Interstate, main)																			0	0
Low Density (secondary, feeder)																			0	0
Rural																			0	0
Sidewalk																			0	0
MISC. PERVIOUS																				
Managed pervious																			0	0
Unmanaged (pasture)																			0	0
Forest																			0	0
RESIDENTIAL																				
2-ac lots (New)																			0	0
2-ac lots (Built after 1995)																			0	0
2-ac lots (Built before 1995)																			0	0
1-ac lots (New)																			0	0
1-ac lots (Built after 1995)																			0	0
1-ac lots (Built before 1995)																			0	0
½-ac lots (New)																			0	0
½-ac lots (Built after 1995)																			0	0
½-ac lots (Built before 1995)																			0	0
¼-ac lots (New)																			0	0
¼-ac lots (Built after 1995)																			0	0
¼-ac lots (Built before 1995)																			0	0
⅛-ac lots (New)																			0	0
⅛-ac lots (Built after 1995)																			0	0
⅛-ac lots (Built before 1995)																			0	0
Townhomes (New)																			0	0
Townhomes (Built after 1995)																			0	0
Townhomes (Built before 1995)																			0	0
Multi-family (New)																			0	0
Multi-family (Built after 1995)																			0	0
Multi-family (Built before 1995)																			0	0
Custom Lot Size (New)																			0	0
Custom Lot Size (Built after 1995)																			0	0
Custom Lot Size (Built before 1995)																			0	0
Roadway	48,352			10,909															69,261	104,108
Driveway	19,000			4,800															23,000	33,000
Parking lot																			0	0
Roof	90,000			20,000															115,000	165,000
Sidewalk	19,000			4,000															23,000	33,000
Lawn	413,810			87,120															500,930	718,750
Managed pervious																			0	0
Forest	1,093,908			299,571															1,393,479	2,056,928
LAND TAKEN UP BY BMP	40,000																		40,000	60,000
TOTAL AREA TREATED BY BMP (ft^2):	1,698,780	0	0	435,600	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
TOTAL AREA TREATED BY SERIES (ft^2):	1,698,780			435,600			0			0			0			0				

Development:	**River Stone**
Prepared By:	MLS
Date:	April 28, 2015

WATERSHED SUMMARY Ver2.0

REGION:	Piedmont
TOTAL DEVELOPMENT AREA (ft^2):	4,238,824

	Pre-Development Conditions	Post-Development Conditions	Post-Development w/ BMPs
Percent Impervious (%)	0.0%	9.5%	9.5%
Annual Runoff Volume (c.f.)	819,078	2,225,046	2,236,879
Total Nitrogen EMC (mg/L)	1.47	1.35	1.27
Total Nitrogen Loading (lb/ac/yr)	0.79	1.96	1.86
Total Phosphorus EMC (mg/L)	0.25	0.33	0.25
Total Phosphorus Loading (lb/ac/yr)	0.13	0.48	0.37

Percent Difference Between:

	Pre-Dev. & Post-Dev. without BMPs	Pre-Development & Post-Development with BMPs	Post-Dev without BMPs & Post-Dev with BMPs
Percent Impervious (%)	9%	9%	0%
Annual Runoff Volume (c.f.)	172%	173%	1%
Total Nitrogen EMC (mg/L)	-8%	-13%	-6%
Total Nitrogen Loading (lb/ac/yr)	149%	135%	-6%
Total Phosphorus EMC (mg/L)	32%	1%	-23%
Total Phosphorus Loading (lb/ac/yr)	257%	174%	-23%

*Negative percent difference values indicate a decrease in runoff volume, pollutant concentration or pollutant loading. Positive values indicate an increase.

BMP VOLUME REDUCTIONS/EFFLUENT CONCENTRATIONS

	Volume Reduction (%)	TN Effluent Concen. (mg/L)	TP Effluent Concen. (mg/L)
Bioretention with IWS	50%	0.95	0.12
Bioretention without IWS	35%	1.00	0.12
Dry Detention Pond	0%	1.20	0.20
Grassed Swale	0%	1.21	0.26
Green Roof	50%	1.08	0.15
Level Spdr, Filter Strip	40%	1.20	0.15
Permeable Pavement*	0%	1.44	0.39
Sand Filter	5%	0.92	0.14
Water Harvesting	user defined	1.08	0.15
Wet Detention Pond	10%	1.01	0.11
Wetland	20%	1.08	0.12

*If treating commercial parking lot, TP effluent concentration = 0.16 mg/L

Return to Instructions

Return to Watershed Characteristics

Return to BMP Characteristics

Print Summary

BMP SUMMARY Ver2.0

	CATCHMENT 1			CATCHMENT 2			CATCHMENT 3			CATCHMENT 4			CATCHMENT 5			CATCHMENT 6		
	BMP 1	BMP 2	BMP 3	BMP 1	BMP 2	BMP 3	BMP 1	BMP 2	BMP 3	BMP 1	BMP 2	BMP 3	BMP 1	BMP 2	BMP 3	BMP 1	BMP 2	BMP 3
	Dry Detention Pond	--	--	Dry Detention Pond	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Area Treated (ac)	39.00	--	--	10.00	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Inflow Volume (c.f.)	1,128,646	--	--	259,519	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Percent Volume Reduced (%)	0%	--	--	0%	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Inflow Nitrogen EMC (mg/L)	1.33	--	--	1.38	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Inflow Nitrogen (lb/ac/yr)	2.40	--	--	2.24	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Inflow Phosphorus EMC (mg/L)	0.328	--	--	0.376	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Inflow Phosphorus (lb/ac/yr)	0.59	--	--	0.61	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMP Outflow Nitrogen (lbs/ac/yr)	2.19	--	--	1.97	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BMP Outflow Phosphorus (lbs/ac/yr)	0.38	--	--	0.35	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Catchment Outflow Nitrogen EMC (mg/L)	1.21	1.22	--	--	--	--
Catchment Outflow Total Nitrogen (lb/ac/yr)	2.19	1.97	--	--	--	--
Percent Reduction in Nitrogen Load (%)	9%	12%	--	--	--	--
Catchment Outflow Phosphorus EMC (mg/L)	0.213	0.218	--	--	--	--
Catchment Outflow Total Phosphorus (lb/ac/yr)	0.384	0.352	--	--	--	--
Percent Reduction in Phosphorus Load (%)	35%	11%	--	--	--	--

Appendix J

Street "A" Culvert Calculations

HY-8 Culvert Analysis Report

DRAINAGE AREA TO CULVERT = 42.0 AC

$$t_c = \frac{(L^3/H)^{0.385}}{128} = \frac{(2556^3/225)^{0.385}}{128} = 8.4 \text{ MINUTES}$$

$I_{10} = 6.57$ "/HR

$I_{25} = 7.48$ "/HR

$I_{100} = 8.93$ "/HR

$Q_{10} = CIA = (0.35)(6.57 \text{"/HR})(42.0 \text{ AC}) = 97$ CFS

$Q_{25} =$ " " (7.48"/HR) " $= 110$ CFS

$Q_{100} =$ " " (8.93"/HR) " $= 132$ CFS

Headwater Elevation (ft)	Total Discharge (cfs)	Culvert 1 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
381.22	97.00	97.00	0.00	1
381.34	100.50	100.50	0.00	1
381.45	104.00	104.00	0.00	1
381.57	107.50	107.50	0.00	1
* 381.66	110.00=Q25	110.00	0.00	1
381.82	114.50	114.50	0.00	1
381.94	118.00	118.00	0.00	1
382.07	121.50	121.50	0.00	1
382.20	125.00	125.00	0.00	1
382.34	128.50	128.50	0.00	1
382.48	132.00	132.00	0.00	1
394.00	299.10	299.10	0.00	Overtopping

Table 1 - Summary of Culvert Flows at Crossing: STREET A CULVERT

****

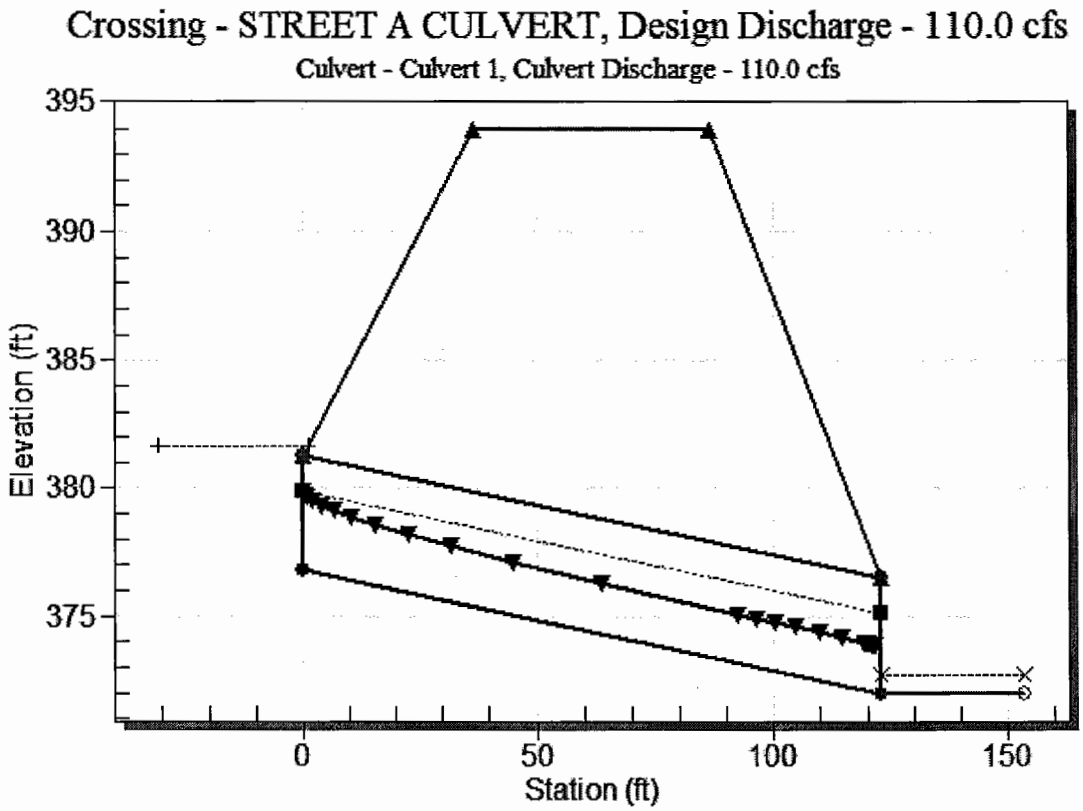
Inlet Elevation (invert): 376.80 ft, Outlet Elevation (invert): 372.00 ft

Culvert Length: 123.09 ft, Culvert Slope: 0.0390

****

$$HW/D \text{ @ } Q_{25} = \frac{381.66 - 376.80}{4.5'} = \underline{1.08}$$

Water Surface Profile Plot for Culvert: Culvert 1



Site Data - Culvert 1

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 376.80 ft

Outlet Station: 123.00 ft

Outlet Elevation: 372.00 ft

Number of Barrels: 1

Culvert Data Summary - Culvert 1

Barrel Shape: Circular

Barrel Diameter: 4.50 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0130

Inlet Type: Conventional

Inlet Edge Condition: Square Edge with Headwall

Inlet Depression: NONE

Tailwater Channel Data - STREET A CULVERT

Tailwater Channel Option: Trapezoidal Channel

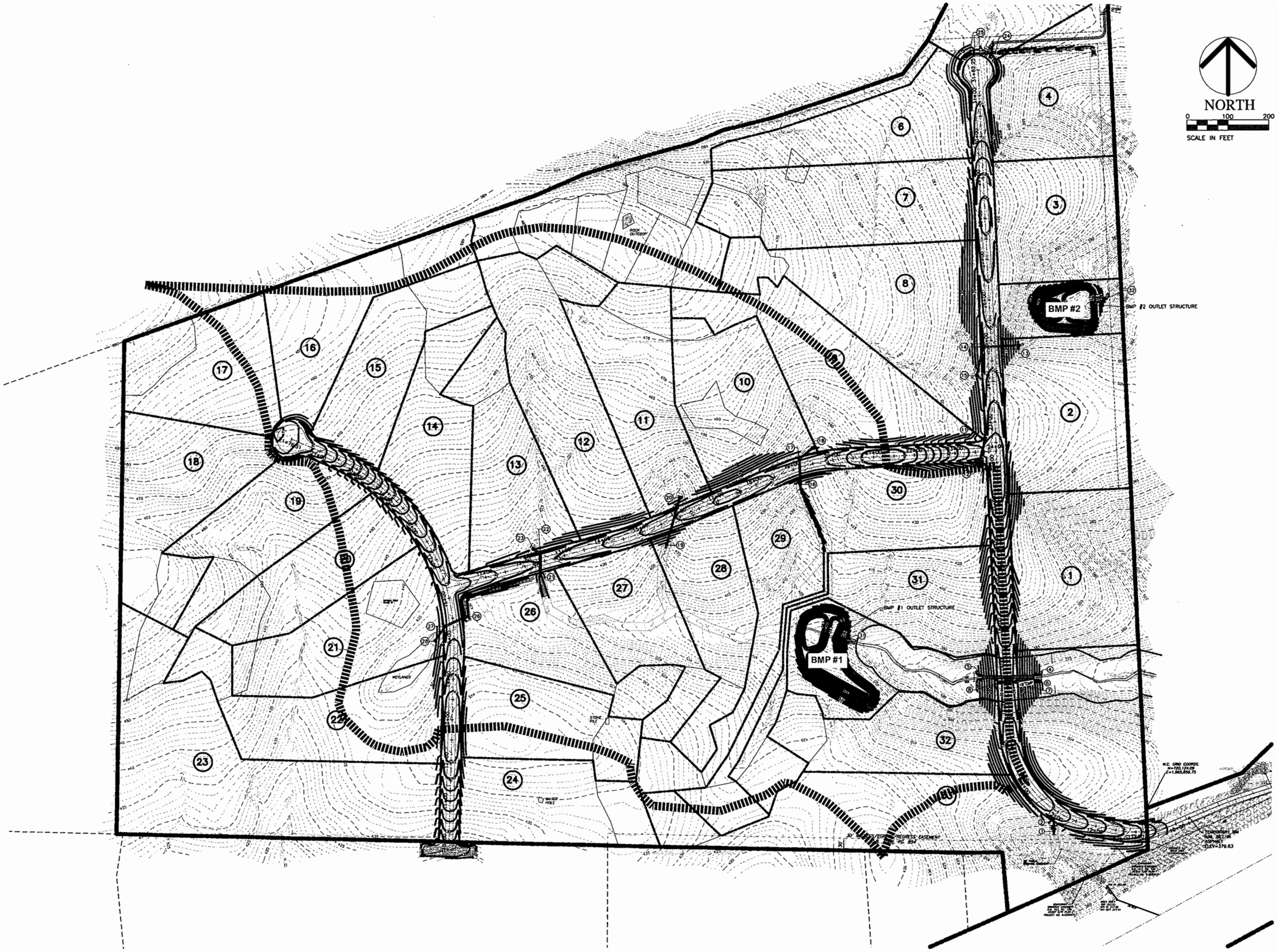
Bottom Width: 40.00 ft

Side Slope (H:V): 5.00 (_:1)

Channel Slope: 0.0230

Channel Manning's n: 0.0500

Channel Invert Elevation: 372.00 ft



F:\Projects\FPRSP\Stormwater\FPRSP Drainage Area Maps.dwg - EX 4 - CULVERT May 06, '15 - 7:40am

PLD

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PRELIMINARY
NOT FOR CONSTRUCTION

RIVERSTONE SUBDIVISION

HIGHWAY 64
PITTSBORO, NORTH CAROLINA

ISSUED: PROGRESS

REVISIONS:

DRAWN BY: MLS
CHECKED BY: JDL

PROJECT: FPRSP

CULVERT
DRAINAGE AREA
MAP

DWG. NO. EX 4.0