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Stormwater Management Report

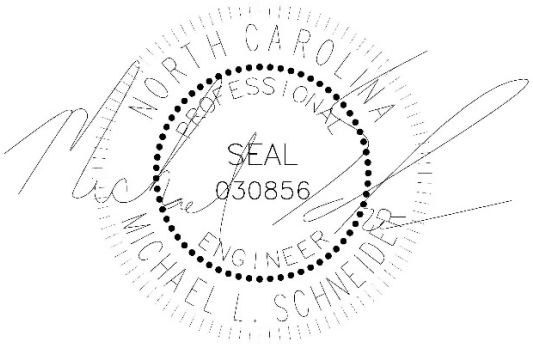
And

Erosion Control Calculations

for

Mack Todd Road Apartments

Zebulon North Carolina



05-05-25

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Project Narrative

The proposed residential project is located on a 2.3 acre vacant, mostly wooded lot. The proposed development includes construction of 13 townhomes. The site is located in Zebulon, NC, and is located in the Neuse River watershed basin. The proposed development provides a wet detention pond for water quantity and quality treatment. The USGS map shows an existing pond on the site that no longer exists. Available historical photography as far back as 1985 do not show the pond.

Stormwater Runoff Analysis

CIVIL 3D 2019 software Hydrograph extensions were utilized to model the runoff, time of concentration and routing calculations. The calculations for the 1-year storms for pre-developed and post-development drainage areas for each stormwater discharge location are provided in this report. (See Appendix B, C, and D for details.)

This site consists of soils predominantly hydrological soil group type "C". Refer to the USDA Soil Map in Appendix A for reference.

The site is subject to the Wake County Stormwater rules for the Town of Zebulon.

Following are the stormwater requirements:

- Post-developed peak flows cannot exceed pre-developed flows for the 1 year storm.
- Control the first 1" runoff volume and drawn down per SCM requirements.
- Provide 85% TSS removal.
- Ensure the specified volume, as determined by the Stormwater Municipal Tool, is controlled and released in 2-5 days.

Stormwater Runoff Summary

See the Wake County Stormwater Municipal Tool spreadsheet provided in Appendix B for complete SCM design data. The results of pre and post-development peak flows for Discharge Point #1-#5 are shown in the tables below.

Discharge Point #1

Stormwater Runoff Results

Storm Event	Pre-Development	Post-Development
1-Year	0.61 cfs	0.36 cfs

Discharge Point #2

Stormwater Runoff Results

Storm Event	Pre-Development	Post-Development with Detention
1-Year	2.03 cfs	1.28 cfs

SCM Drainage Area calculations:

Discharge Point #1

Pre-developed
Drainage Area = 0.52 acres
0.50 ac Woods
0.02 ac Open Space (existing easement)

Post-developed
Drainage area = 0.21 acres
0.03 ac Impervious
0.10 ac Woods
0.08 ac Open Space

Discharge Point #2

Pre-developed
Drainage Area = 1.65 acres
1.20 ac Woods
0.40 ac Open Space (existing easement)

Post-developed to SCM:
Drainage area = 1.0 acres
0.32 ac Open Space
0.68 ac Impervious

Post-Developed Bypass:
Drainage area = 0.93 acres
0.46 ac Woods
0.47 ac Open Space

Required Surface Area for SCM's:

SCM #1

Project Name:

Table 1 Surface Area to Drainage Area Ratio for Permanent Pool Sizing
Piedmont and Mountain

% Impervious Cover	Permanent Pool Depth (feet)						
	3.0	4.0	5.0	6.0	7.0	8.0	9.0
10	0.51	0.43					
20	0.84	0.69					
30	1.17	0.94					
40	1.51	1.24					
50	1.79	1.51					
60	2.09	1.77					
70	2.51	2.09					
80	2.92	2.41					
90	3.25	2.64					

Source: NCDEQ Stormw ater Design Manual, pg. 7, 11-23-2020

STORMWATER SCM - WET DETENTION POND

Land Use	Area (ac)	% IA	Imp. Area (ac)
Impervious	0.68	100	0.68
Open Space	0.32	0	0.00
Totals	**1.00**		**0.68**

Total % Impervious Surface Area = 68.0 %

Surface Area of Permanent Pool:

Assumed depth = 3 feet

SA/DA ratio = **2.43** % *From Table 1.1*

Minimum pond surface area (SA) = (DA * SA/DA ratio)/100

SA = 0.024 acres

1059 sq. ft.

1-Inch Runoff Volume Calculation

Using the runoff volume calculations in the "Simple Method" as described by Schueler (1987)

Rv = 0.05 + 0.009(I) where, Rv = Runoff coefficient, in./in.

I = Percent impervious

Rv = 0.66 in./in.

Total runoff volume from 1-inch precipitation:

Runoff volume, S = (Design rainfall) (Rv) (Drainage Area)

S = 0.055 acre-ft

2403 cu. ft.

* Required Volume to be controlled as determined by the Wake County Spreadsheet
Required Volume to be controlled = 2,572 cf

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Anti-Floatation Calculations									
			Box	Box	Submerged				
			Width (ft)	Depth (ft)	Height (ft)				
Water Displacement		=	(5.0)	(5.0)	(3.0)	=	75.0	cf	
Bouyant Force		=	75.0	cf x 62.4 pcf		=	4,680	lbs	
						Weight of			
			Box	Box	Depth of	Concrete			
			Width (ft)	Depth (ft)	Concrete (	(pcf)			
Structure Weight		=	(5.0)	(5.0)	(2.0)	150	=	7,500	lbs
**Structure Weight = quantity of concrete provided at bottom of structure									

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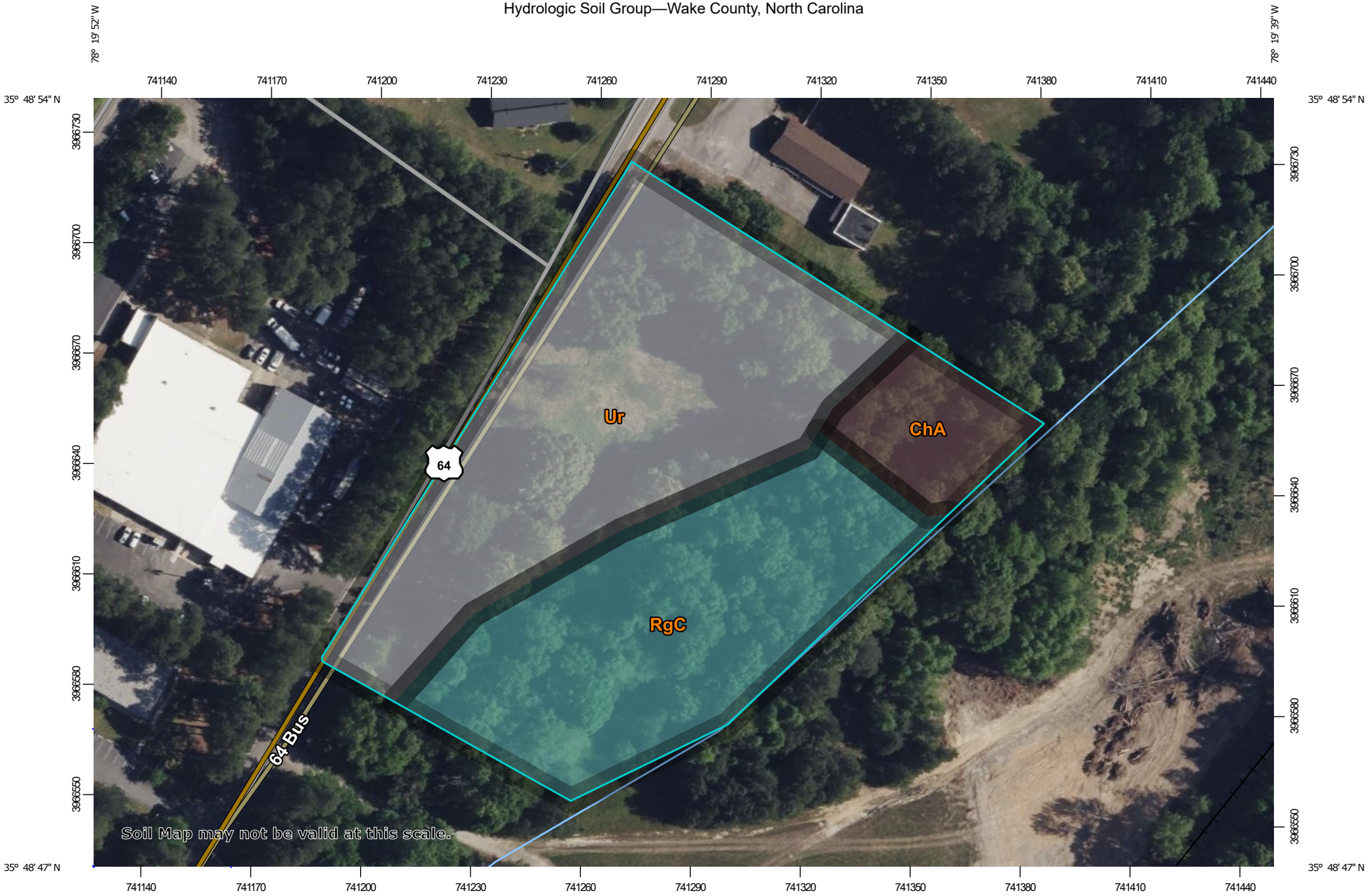
Appendix A
USDA Soils and USGS Map

PLD



Map Scale: 1:1,470 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 20 40 80 120

Feet: 0 50 100 200 300

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
ChA	Chewacla and Wehadkee soils, 0 to 2 percent slopes, frequently flooded	B/D	0.4	9.1%
RgC	Rawlings-Rion complex, 6 to 10 percent slopes	C	1.7	39.9%
Ur	Urban land		2.2	51.1%
Totals for Area of Interest			**4.3**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

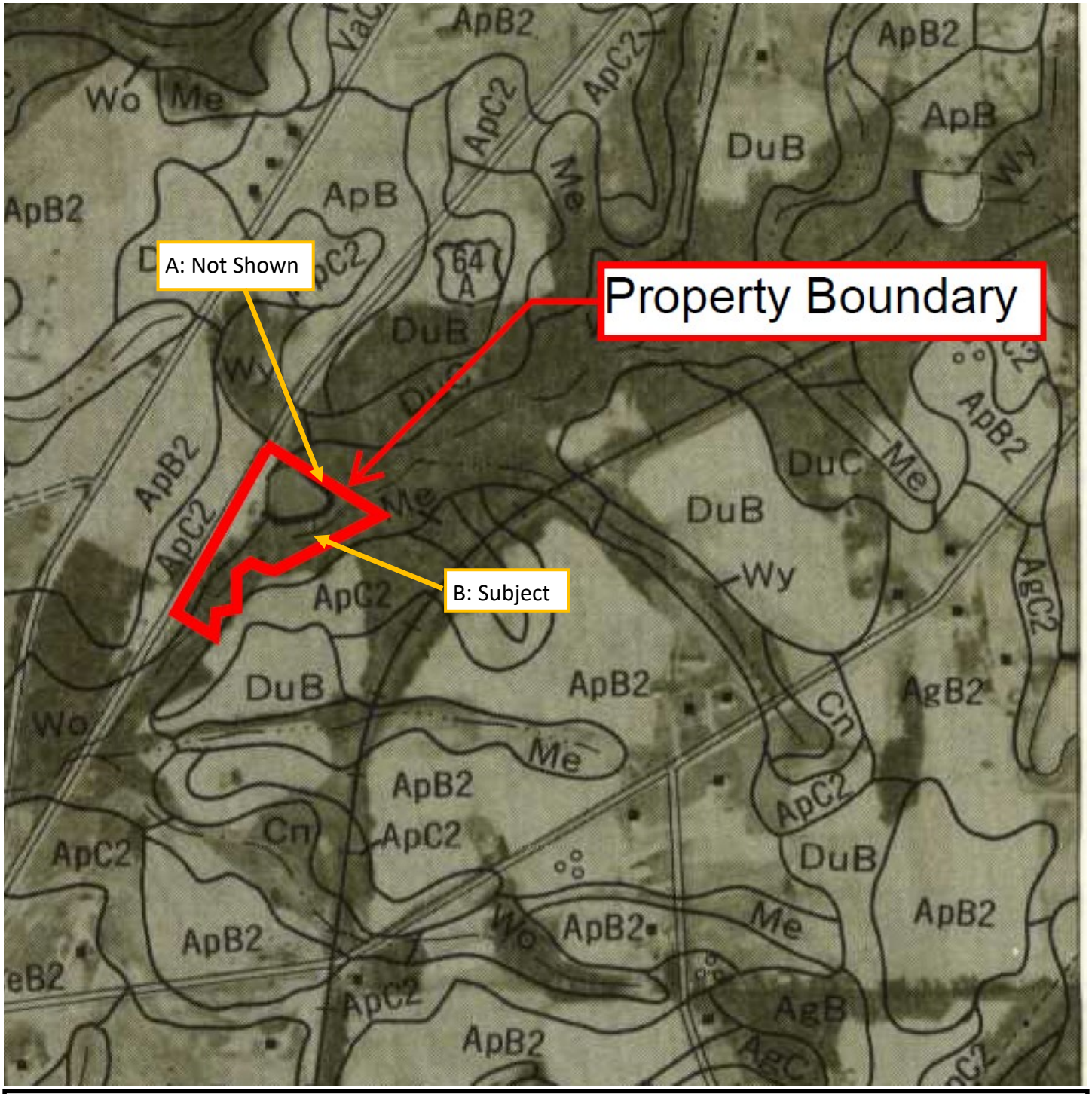
Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

901 Mack Todd Rd.

Wake County, NC-DWR Project # 21-235



NRCS Soil Survey Sheet 53

Wake Co., NC 1970

Legend:

-project boundary

Base map provided by Mitchell Environmental

:: Locations are approximate and are provided for reference only ::

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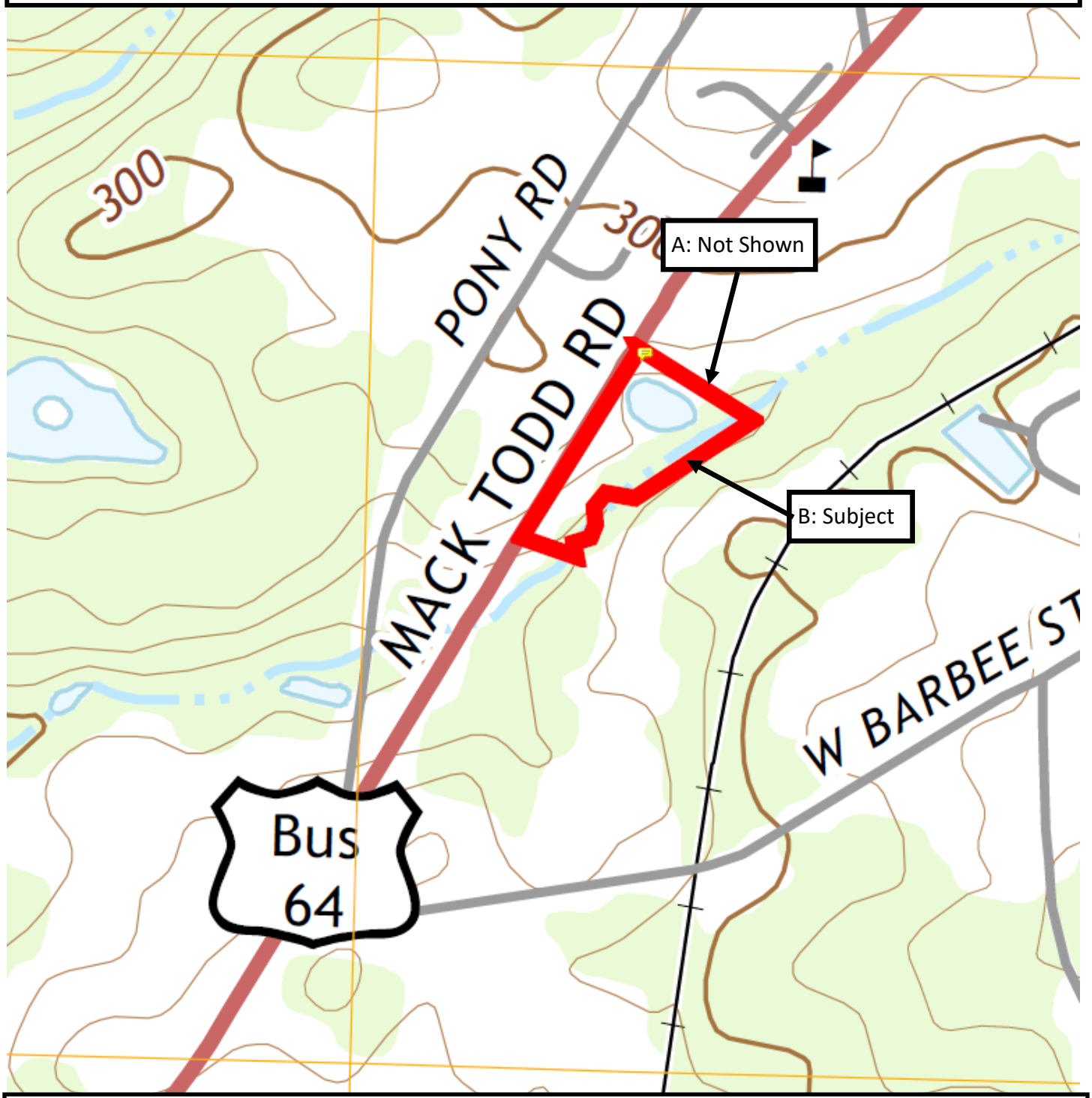
901 Mack Todd Rd.

Wake County, NC-DWR Project #21-235



USGS Topographical Map

Zebulon Quadrangle 2019

Legend:

-Project boundary

Base map provided by Mitchell Environmental

:: Locations are approximate and are provided for reference only ::

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Appendix B
Wake County Stormwater Municipal Tool

PLD

Project Name: Mack Todd Road Townhomes

DRAINAGE AREA 1
BMP CALCULATIONS

DRAINAGE AREA 1 - BMP DEVICES AND ADJUSTMENTS				
DA1 Site Acreage=	0.21			
DA1 Off-Site Acreage=				
Total Required Storage Volume for Site TCN Requirement (ft^3)=	N/A			
Total Required Storage Volume for DA1 1" Rainfall for High Density (ft^3)=	136			
Will site use underground detention/cistern?	No	Enter % of the year water will be reused=	0%	Note: Supporting information/details should be submitted to demonstrate water usage.

ENTER ACREAGE FOR ALL SUB-DRAINAGE AREAS IN DA

HSG	Sub-DA1(a) (Ac)		Sub-DA1(b) (Ac)		Sub-DA1(c) (Ac)		Sub-DA1(d) (Ac)		Sub-DA1(e) (Ac)	
	Site	Off-site	Site	Off-site	Site	Off-site	Site	Off-site	Site	Off-site
Pasture										
Woods, Poor Condition										
Woods, Fair Condition										
Woods, Good Condition										
Open Space, Poor Condition										
Open Space, Fair Condition										
Open Space, Good Condition										
Reforestation (in dedicated OS)										
Impervious										

Sub-DA1(a) BMP(s)

Device Name (As Shown on Plan)	Device Type	Water Quality Volume for Sub-DA (ft^3)	Provided Volume that will drawdown 2-5 days (ft^3)	Nitrogen Removal Efficiency	Sub-DA Nitrogen (lbs)	Nitrogen Removed (lbs)	Drawdown Time (hours)
				0%	0.00	0.00	96
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
Total Nitrogen remaining leaving the subbasin (lbs):							

Sub-DA1(b) BMP(s)

If Sub-DA1(b) is connected to upstream subbasin(s), enter the nitrogen leaving the most upstream subbasin(lbs):							
Device Name (As Shown on Plan)	Device Type	Water Quality Volume for Sub-DA (ft^3)	Provided Volume that will drawdown 2-5 days (ft^3)	Nitrogen Removal Efficiency	Sub-DA Nitrogen (lbs)	Nitrogen Removed (lbs)	Drawdown Time (hours)
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
Total Nitrogen remaining leaving the subbasin (lbs):							

Sub-DA1 (c) BMP(s)

If Sub-DA1(c) is connected to upstream subbasin(s), enter the nitrogen leaving the most upstream subbasin(lbs):							
Device Name (As Shown on Plan)	Device Type	Water Quality Volume for Sub-DA (ft^3)	Provided Volume that will drawdown 2-5 days (ft^3)	Nitrogen Removal Efficiency	Sub-DA Nitrogen (lbs)	Nitrogen Removed (lbs)	Drawdown Time (hours)
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
Total Nitrogen remaining leaving the subbasin (lbs):							

Project Name: Mack Todd Road Townhomes

DRAINAGE AREA 1
BMP CALCULATIONS

Sub-DA1(d) BMP(s)							
If Sub-DA1(d) is connected to upstream subbasin(s), enter the nitrogen leaving the most upstream subbasin(lbs):							
Device Name (As Shown on Plan)	Device Type	Water Quality Volume for Sub-DA (ft^3)	Provided Volume that will drawdown 2-5 days (ft^3)	Nitrogen Removal Efficiency	Sub-DA Nitrogen (lbs)	Nitrogen Removed (lbs)	Drawdown Time (hours)
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
Total Nitrogen remaining leaving the subbasin (lbs):							

Sub-DA1(e) BMP(s)							
If Sub-DA1(e) is connected to upstream subbasin(s), enter the nitrogen leaving the most upstream subbasin(lbs):							
Device Name (As Shown on Plan)	Device Type	Water Quality Volume for Sub-DA (ft^3)	Provided Volume that will drawdown 2-5 days (ft^3)	Nitrogen Removal Efficiency	Sub-DA Nitrogen (lbs)	Nitrogen Removed (lbs)	Drawdown Time (hours)
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
Total Nitrogen remaining leaving the subbasin (lbs):							

DA1 BMP SUMMARY	
Total Volume Treated (ft^3)=	
Nitrogen Mitigated(lbs)=	
1-year, 24-hour storm	
Post BMP Volume of Runoff (ft^3)$_{(1\text{-year})}$=	678
Post BMP Runoff (inches) = $Q^*_{(1\text{-year})}$=	0.89
Post BMP $CN_{(1\text{-year})}$=	75
Post BMP Peak Discharge (cfs)= $Q_{1\text{-year}}$=	0.360
2-year, 24-hour storm (LID)	
Post BMP Volume of Runoff (ft3)$_{(2\text{-year})}$=	990
Post BMP Runoff (inches) = $Q^*_{(2\text{-year})}$=	1.30
Post BMP $CN_{(2\text{-year})}$=	75
Post BMP Peak Discharge (cfs)= $Q_{(2\text{-year})}$=	
10-year, 24-hour storm (DIA)	
Post BMP Volume of Runoff (ft^3)$_{(10\text{-year})}$=	4,876
Post BMP Runoff (inches) = $Q^*_{(10\text{-year})}$=	6.40
Post BMP $CN_{(10\text{-year})}$=	98
Post BMP Peak Discharge (cfs)= $Q_{(10\text{-year})}$=	

Project Name: Mack Todd Road Townhomes

DRAINAGE AREA 1
STORMWATER PRE-POST CALCULATIONS

LAND USE & SITE DATA	PRE-DEVELOPMENT				POST-DEVELOPMENT			
Drainage Area (Acres)=	0.52				0.21			
Site Acreage within Drainage=	0.52				0.21			
One-year, 24-hour rainfall (in)=	2.85							
Two-year, 24-hour rainfall (in)=	3.45							
Ten-year, 24-hour storm (in)=	5.11							
Total Lake/Pond Area (Acres)=								
Lake/Pond Area not in the Tc flow path (Acres)=								
Site Land Use (acres):	A	B	C	D	A	B	C	D
Pasture								
Woods, Poor Condition								
Woods, Fair Condition								
Woods, Good Condition			0.50				0.10	
Open Space, Poor Condition								
Open Space, Fair condition								
Open Space, Good Condition			0.02				0.08	
Reforestation (in dedicated OS)								
Connected Impervious								
Disconnected Impervious							0.03	

SITE FLOW	PRE-DEVELOPMENT T_c	POST-DEVELOPMENT Tc
Sheet Flow		
Length (ft)=	10.00	10.00
Slope (ft/ft)=	0.020	0.020
Surface Cover:	Woods	Paved, Gravel, or Bare Soil
n-value=	0.400	0.011
T_t (hrs)=	0.060	0.003
Shallow Flow		
Length (ft)=	140.00	280.00
Slope (ft/ft)=	0.020	0.020
Surface Cover:	Unpaved	Unpaved
Average Velocity (ft/sec)=	2.28	2.28
T_t (hrs)=	0.02	0.03
Channel Flow 1		
Length (ft)=	120.00	
Slope (ft/ft)=	0.050	
Cross Sectional Flow Area (ft^2)=	3.00	
Wetted Perimeter (ft)=	3.00	
Channel Lining:	Weeds	
n-value=	0.040	
Hydraulic Radius (ft)=	1.00	
Average Velocity (ft/sec)=	8.33	
T_t (hrs)=	0.00	
Channel Flow 2		
Length (ft)=		
Slope (ft/ft)=		
Cross Sectional Flow Area (ft^2)=		
Wetted Perimeter (ft)=		
Channel Lining:		
n-value=		
Hydraulic Radius (ft)=		
Average Velocity (ft/sec)=		
T_t (hrs)=		
Channel Flow 3		
Length (ft)=		
Slope (ft/ft)=		
Cross Sectional Flow Area (ft^2)=		
Wetted Perimeter (ft)=		
Channel Lining:		
n-value=		
Hydraulic Radius (ft)=		
Average Velocity (ft/sec)=		
T_t (hrs)=		
Tc (hrs)=	0.08	0.04

RESULTS	PRE-DEVELOPMENT	POST-DEVELOPMENT
Composite Curve Number=	70	76
Disconnected Impervious Adjustment		
Disconnected impervious area (acre) =	0.03	
$CN_{adjusted\ (1\text{-}year)}$=	**76**	
High Density Only		
Volume of runoff from 1" rainfall for DA HIGH DENSITY REQUIREMENT = (ft^3) =	136	
1-year, 24-hour storm (Peak Flow)		
Runoff (inches) = $Q^*_{1\text{-year}}$=	0.64	0.89
Volume of runoff (ft^3) =	1,206	678
Volume change (ft^3) =		
Peak Discharge (cfs)= $Q_{1\text{-year}}$=	0.526	0.382
2-year, 24-hour storm (LID)		
Runoff (inches) = $Q^*_{2\text{-year}}$=	0.99	1.30
Volume of runoff (ft^3) =	1,860	990
Peak Discharge (cfs)= $Q_{2\text{-year}}$=	0.811	0.557
10-year, 24-hour storm (DIA)		
Runoff (inches) = $Q^*_{10\text{-year}}$=	2.13	2.58
Volume of runoff (ft^3) =	4,021	4,876
Peak Discharge (cfs)= $Q_{10\text{-year}}$=	1.754	1.108

Project Name: Mack Todd Road Townhomes

DRAINAGE AREA 2
STORMWATER PRE-POST CALCULATIONS

LAND USE & SITE DATA	PRE-DEVELOPMENT				POST-DEVELOPMENT				LINKS/COMMENTS
Drainage Area (Acres)=	1.65				1.93				Note: Includes offsite drainage
Site Acreage within Drainage=	1.65				1.93				
One-year, 24-hour rainfall (in)=	2.85								
Two-year, 24-hour rainfall (in)=	3.45								From Site Data
Ten-year, 24-hour storm (in)=	5.11								
Total Lake/Pond Area (Acres)=									
Lake/Pond Area not in the Tc flow path (Acres)=									
Site Land Use (acres):	A	B	C	D	A	B	C	D	
Pasture									
Woods, Poor Condition									
Woods, Fair Condition									
Woods, Good Condition			1.20				0.46		See Weighted Curve Number
Open Space, Poor Condition									
Open Space, Fair condition									
Open Space, Good Condition			0.40				0.79		
Reforestation (in dedicated OS)									
Connected Impervious							0.68		
Disconnected Impervious									

SITE FLOW	PRE-DEVELOPMENT T_c	POST-DEVELOPMENT Tc	LINKS/COMMENTS
Sheet Flow			
Length (ft)=	10.00	10.00	
Slope (ft/ft)=	0.020	0.020	
Surface Cover:	Woods	Paved, Gravel, or Bare Soil	
n-value=	0.400	0.011	See Sheet Flow Calculations
T_t (hrs)=	0.060	0.003	
Shallow Flow			
Length (ft)=	360.00	70.00	
Slope (ft/ft)=	0.080	0.020	
Surface Cover:	Unpaved	Paved	
Average Velocity (ft/sec)=	4.56	2.87	
T_t (hrs)=	0.02	0.01	See Shallow Flow Calculations
Channel Flow 1			
Length (ft)=	45.00	320.00	
Slope (ft/ft)=	0.020	0.050	
Cross Sectional Flow Area (ft^2)=	3.00	3.00	
Wetted Perimeter (ft)=	3.00	3.00	
Channel Lining:	Weeds	Concrete, finished	
n-value=	0.040	0.012	
Hydraulic Radius (ft)=	1.00	1.00	
Average Velocity (ft/sec)=	5.27	27.76	See Open Channel Flow
T_t (hrs)=	0.00	0.00	
Channel Flow 2			
Length (ft)=			
Slope (ft/ft)=			
Cross Sectional Flow Area (ft^2)=			
Wetted Perimeter (ft)=			
Channel Lining:			
n-value=			
Hydraulic Radius (ft)=			
Average Velocity (ft/sec)=			See Open Channel Flow
T_t (hrs)=			
Channel Flow 3			
Length (ft)=			
Slope (ft/ft)=			
Cross Sectional Flow Area (ft^2)=			
Wetted Perimeter (ft)=			
Channel Lining:			
n-value=			
Hydraulic Radius (ft)=			
Average Velocity (ft/sec)=			See Open Channel Flow
T_t (hrs)=			
Tc (hrs)=	0.08	0.01	See Tc

RESULTS	PRE-DEVELOPMENT	POST-DEVELOPMENT	LINKS/COMMENTS
Composite Curve Number=	71	82	See Weighted Curve Number
Disconnected Impervious Adjustment			
Disconnected impervious area (acre) =			See Disconnected Impervious Calculation
$CN_{adjusted\ (1\text{-}year)}$=	**82**		
High Density Only			
Volume of runoff from 1" rainfall for DA HIGH DENSITY REQUIREMENT = (ft^3) =	2,572		See Discrete Runoff Method
1-year, 24-hour storm (Peak Flow)			
Runoff (inches) = $Q^*_{1\text{-}year}$=	0.68	1.23	See SCS Runoff Method
Volume of runoff (ft^3) =	4,047	8,620	
Volume change (ft^3) =	4,573		
Peak Discharge (cfs)= $Q_{1\text{-}year}$=	1.740	5.004	See Peak Flow Calculations
2-year, 24-hour storm (LID)			
Runoff (inches) = $Q^*_{2\text{-}year}$=	1.03	1.70	See SCS Runoff Method
Volume of runoff (ft^3) =	6,182	11,942	
Peak Discharge (cfs)= $Q_{2\text{-}year}$=	2.657	6.933	See Peak Flow Calculations
10-year, 24-hour storm (DIA)			
Runoff (inches) = $Q^*_{10\text{-}year}$=	2.20	3.13	See SCS Runoff Method
Volume of runoff (ft^3) =	13,177	18,747	
Peak Discharge (cfs)= $Q_{10\text{-}year}$=	5.664	12.730	

CLICK TO ADD ANOTHER DRAINAGE AREA

Project Name: Mack Todd Road Townhomes

DA SITE SUMMARY
STORMWATER PRE-POST CALCULATIONS

SITE SUMMARY

DRAINAGE AREA SUMMARIES

DRAINAGE AREA:	DA1	DA2	DA3	DA4	DA5	DA6	DA7	DA8	DA9	DA10
Pre-Development (1-year, 24-hour storm)										
Runoff (in) = $Q_{pre,1\text{-}year}$ =	0.64	0.68								
Peak Flow (cfs)=$Q_{1\text{-}year}$ =	0.526	1.740								
Post-Development (1-year, 24-hour storm)										
Proposed Impervious Surface (acre) =	0.03	0.68								
Runoff (in)=$Q_{1\text{-}year}$ =	0.89	1.23								
Peak Flow (cfs)=$Q_{1\text{-}year}$ =	0.382	5.004								
Increase in volume per DA (ft^3)_1-yr storm=		4,573								
Minimum Volume to be Managed for DA HIGH DENSITY REQUIREMENT = (ft^3) =	136	2,572								

TARGET CURVE NUMBER (TCN)

Site Data

SITE \SOIL COMPOSITION

HYDROLOGIC SOIL GROUP	Site Area	%	Target CN
A	0.00	0%	N/A
B	0.00	0%	N/A
C	2.14	100%	N/A
D	0.00	0%	N/A

Total Site Area (acres) =	2.14
Percent BUA (Includes Existing Lakes/Pond Areas) =	33%
Project Density =	High
Target Curve Number (TCN) =	N/A
$CN_{adjusted\ (1\text{-}year)}$=	81
Minimum Volume to be Managed (Total Site) Per TCN Requirement= ft^3 =	N/A

Site Nitrogen Loading Data

HSG	TN export coefficient (lbs/ac/yr)	Site Acreage	N Export
Pasture	1.2	0.00	0.00
Woods, Poor Condition	1.6	0.00	0.00
Woods, Fair Condition	1.2	0.00	0.00
Woods, Good Condition	0.8	0.56	0.45
Open Space, Poor Condition	1.0	0.00	0.00
Open Space, Fair Condition	0.8	0.00	0.00
Open Space, Good Condition	0.6	0.87	0.52
Reforestation (in dedicated OS)	0.6	0.00	0.00
Impervious	21.2	0.71	15.05

SITE NITROGEN LOADING RATE (lbs/ac/yr)=	7.49
Nitrogen Load (lbs/yr)=	16.02
TOTAL SITE NITROGEN TO MITIGATE (lbs/yr)_Wendell Only=	8.32

Site Nitrogen Loading Data For Expansions Only

	Existing	New
Impervious(acres)=	NA	NA
"Expansion Area" (acres=)		
Nitrogen Load (lbs/yr)=	NA	NA
SITE NITROGEN LOADING RATE (lbs/ac/yr)=	NA	NA
Total Site loading rate (lbs/ac/yr)		
TOTAL SITE NITROGEN TO MITIGATE (lbs/yr)=	NA	

WAKE COUNTY
NORTH CAROLINA

Project Name: Mack Todd Road Townhomes

DRAINAGE AREA 2
BMP CALCULATIONS

DRAINAGE AREA 1 - BMP DEVICES AND ADJUSTMENTS

DA2 Site Acreage=	1.93			
DA2 Off-Site Acreage=				
Total Required Storage Volume TCN Requirement (ft^3)=	N/A			
Total Required Storage Volume for DA2 1" Rainfall for High Density (ft3)=	2,572			
Will site use underground detention/cistern?	No	Enter % of the year water will be reused=	0%	Note: Supporting information/details should be submitted to demonstrate water usage.

ENTER ACREAGE FOR ALL SUB-DRAINAGE AREAS IN DA

HSG	Sub-DA2(a) (Ac)		Sub-DA2(b) (Ac)		Sub-DA2(c) (Ac)		Sub-DA2(d) (Ac)		Sub-DA2(e) (Ac)	
	Site	Off-site	Site	Off-site	Site	Off-site	Site	Off-site	Site	Off-site
Pasture										
Woods, Poor Condition										
Woods, Fair Condition										
Woods, Good Condition			0.46							
Open Space, Poor Condition										
Open Space, Fair Condition										
Open Space, Good Condition	0.32		0.47							
Reforestation (in dedicated OS)										
Impervious	0.68									

Sub-DA1(a) BMP(s)

Device Name (As Shown on Plan)	Device Type	Water Quality Volume for Sub-DA (ft^3)	Provided Volume that will drawdown 2-5 days (ft^3)	Nitrogen Removal Efficiency	Sub-DA Nitrogen (lbs)	Nitrogen Removed (lbs)	Drawdown Time (hours)
SCM 1	Wet Detention Basin	1,333	2,752	25%	14.61	3.65	96
				0%	10.96	0.00	
				0%	10.96	0.00	
				0%	10.96	0.00	
				0%	10.96	0.00	
Total Nitrogen remaining leaving the subbasin (lbs):			**10.96**				

Sub-DA1(b) BMP(s)

If Sub-DA1(b) is connected to upstream subbasin(s), enter the nitrogen leaving the most upstream subbasin(lbs):

Device Name (As Shown on Plan)	Device Type	Water Quality Volume for Sub-DA (ft^3)	Provided Volume that will drawdown 2-5 days (ft^3)	Nitrogen Removal Efficiency	Sub-DA Nitrogen (lbs)	Nitrogen Removed (lbs)	Drawdown Time (hours)
		169		0%	0.65	0.00	
				0%	0.65	0.00	
				0%	0.65	0.00	
				0%	0.65	0.00	
				0%	0.65	0.00	
Total Nitrogen remaining leaving the subbasin (lbs):			**0.65**				

Sub-DA1 (c) BMP(s)

If Sub-DA1(c) is connected to upstream subbasin(s), enter the nitrogen leaving the most upstream subbasin(lbs):

Device Name (As Shown on Plan)	Device Type	Water Quality Volume for Sub-DA (ft^3)	Provided Volume that will drawdown 2-5 days (ft^3)	Nitrogen Removal Efficiency	Sub-DA Nitrogen (lbs)	Nitrogen Removed (lbs)	Drawdown Time (hours)
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
Total Nitrogen remaining leaving the subbasin (lbs):							

Sub-DA1(d) BMP(s)

If Sub-DA1(d) is connected to upstream subbasin(s), enter the nitrogen leaving the most upstream subbasin(lbs):

Device Name (As Shown on Plan)	Device Type	Water Quality Volume for Sub-DA (ft^3)	Provided Volume that will drawdown 2-5 days (ft^3)	Nitrogen Removal Efficiency	Sub-DA Nitrogen (lbs)	Nitrogen Removed (lbs)	Drawdown Time (hours)
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
Total Nitrogen remaining leaving the subbasin (lbs):							

Sub-DA1(e) BMP(s)

If Sub-DA1(e) is connected to upstream subbasin(s), enter the nitrogen leaving the most upstream subbasin(lbs):

Device Name (As Shown on Plan)	Device Type	Water Quality Volume for Sub-DA (ft^3)	Provided Volume that will drawdown 2-5 days (ft^3)	Nitrogen Removal Efficiency	Sub-DA Nitrogen (lbs)	Nitrogen Removed (lbs)	Drawdown Time (hours)
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
				0%	0.00	0.00	
Total Nitrogen remaining leaving the subbasin (lbs):							

DA2 BMP SUMMARY

Total Volume Treated (ft^3)=	2,752
Nitrogen Mitigated(lbs)=	3.65
1-year, 24-hour storm	
Post BMP Volume of Runoff (ft^3)$_{(1\text{-year})}$=	5,868
Post BMP Runoff (inches) = $Q^*_{(1\text{-year})}$=	0.84
Post BMP CN$_{(1\text{-year})}$=	74
Post BMP Peak Discharge (cfs)= $Q_{(1\text{-year})}$=	0.630
2-year, 24-hour storm (LID)	
Post BMP Volume of Runoff (ft3)$_{(2\text{-year})}$=	9,190
Post BMP Runoff (inches) = $Q^*_{(2\text{-year})}$=	1.31
Post BMP CN$_{(2\text{-year})}$=	75
Post BMP Peak Discharge (cfs)= $Q_{(2\text{-year})}$=	
10-year, 24-hour storm (DIA)	
Post BMP Volume of Runoff (ft^3)$_{(10\text{-year})}$=	15,995
Post BMP Runoff (inches) = $Q^*_{(10\text{-year})}$=	2.28
Post BMP CN$_{(10\text{-year})}$=	88
Post BMP Peak Discharge (cfs)= $Q_{(10\text{-year})}$=	

CLICK TO ADD BMPS TO ANOTHER DRAINAGE AREA

Project Name: Mack Todd Road Townhomes

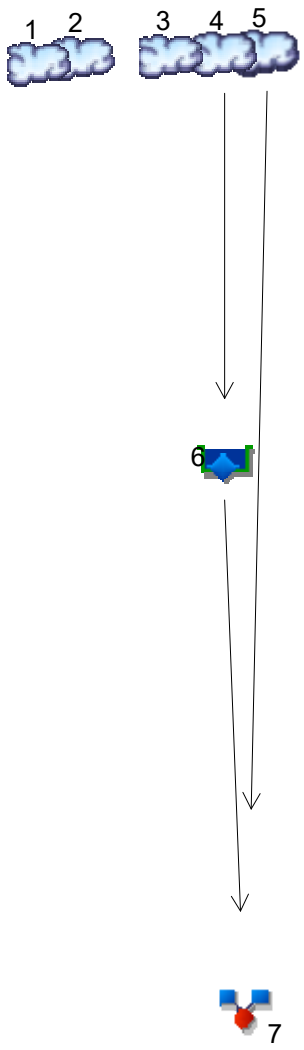
DA SITE SUMMARY
BMP CALCULATIONS

BMP SUMMARY										
DRAINAGE AREA SUMMARIES										
DRAINAGE AREA:	DA1	DA2	DA3	DA4	DA5	DA6	DA7	DA8	DA9	DA10
Pre-Development (1-year, 24-hour storm)										
Runoff (in)=$Q^*_{1\text{-year}}$ =	0.64	0.68								
Peak Flow (cfs)=$Q_{1\text{-year}}$ =	0.526	1.740								
Post-Development (1-year, 24-hour storm)										
Target Curve Number (TCN) =	NA									
Post BMP Runoff (inches) = $Q^*_{(1\text{-year})}$=	0.89	0.84								
Post BMP Peak Discharge (cfs)= $Q_{1\text{-year}}$=	0.360	0.630								
Post BMP $CN_{(1\text{-year})}$=	74									
Post-BMP Nitrogen Loading										
TOTAL SITE NITROGEN MITIGATED (lbs)=	3.65									
SITE NITROGEN LOADING RATE (lbs/ac/yr)=	5.78									
TOTAL SITE NITROGEN LEFT TO MITIGATE_Wendell Only (lbs)=	**4.67**									

Appendix C
Stormwater Routing Calculations

PLD

Watershed Model Schematic



Pond Report

Pond No. 1 - SCM

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 279.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	279.00	1,492	0	0
1.00	280.00	1,950	1,716	1,716
1.50	280.50	2,200	1,037	2,752
2.00	281.00	2,308	1,127	3,879
3.00	282.00	2,561	2,433	6,312
4.00	283.00	2,795	2,677	8,989

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 18.00	0.80	Inactive	0.00
Span (in)	= 18.00	0.80	0.00	0.00
No. Barrels	= 1	1	1	0
Invert El. (ft)	= 278.00	279.00	0.00	0.00
Length (ft)	= 40.00	0.00	0.00	0.00
Slope (%)	= 2.50	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	Yes	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 16.00	0.00	0.00	0.00
Crest El. (ft)	= 280.80	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	---	---	---
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).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	279.00	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
1.00	1,716	280.00	4.28 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.017
1.50	2,752	280.50	4.28 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.020
2.00	3,879	281.00	4.80 ic	0.02 ic	---	---	4.77	---	---	---	---	---	4.789
3.00	6,312	282.00	15.30 ic	0.00 ic	---	---	15.27 s	---	---	---	---	---	15.27
4.00	8,989	283.00	17.53 ic	0.00 ic	---	---	17.44 s	---	---	---	---	---	17.44

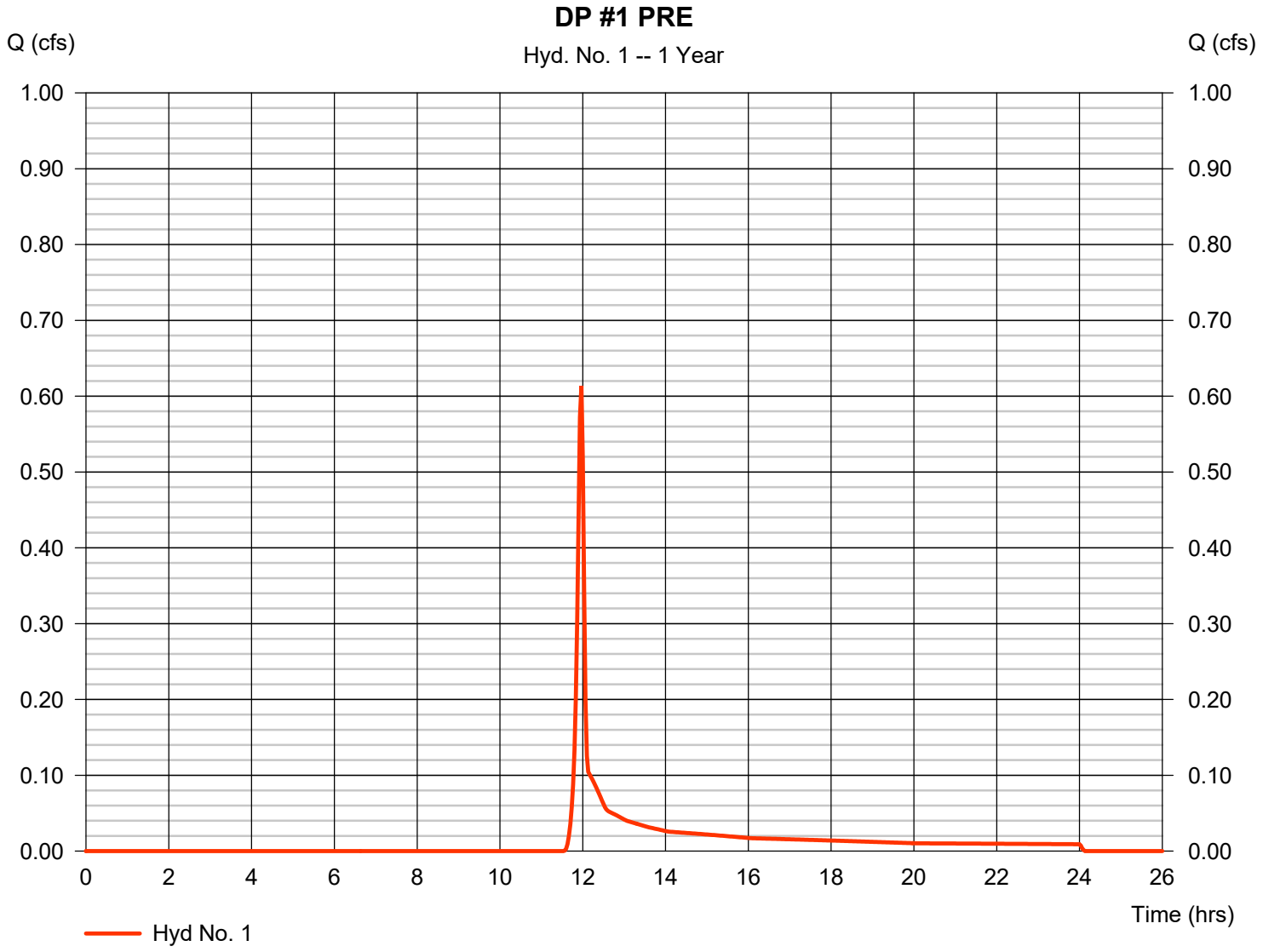
Hydrograph Report

Hyd. No. 1

DP #1 PRE

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.613 cfs
Storm frequency	=	1 yrs	Time to peak	=	11.97 hrs
Time interval	=	2 min	Hyd. volume	=	1,264 cuft
Drainage area	=	0.520 ac	Curve number	=	70*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	3.00 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.500 x 70) + (0.020 x 74)] / 0.520



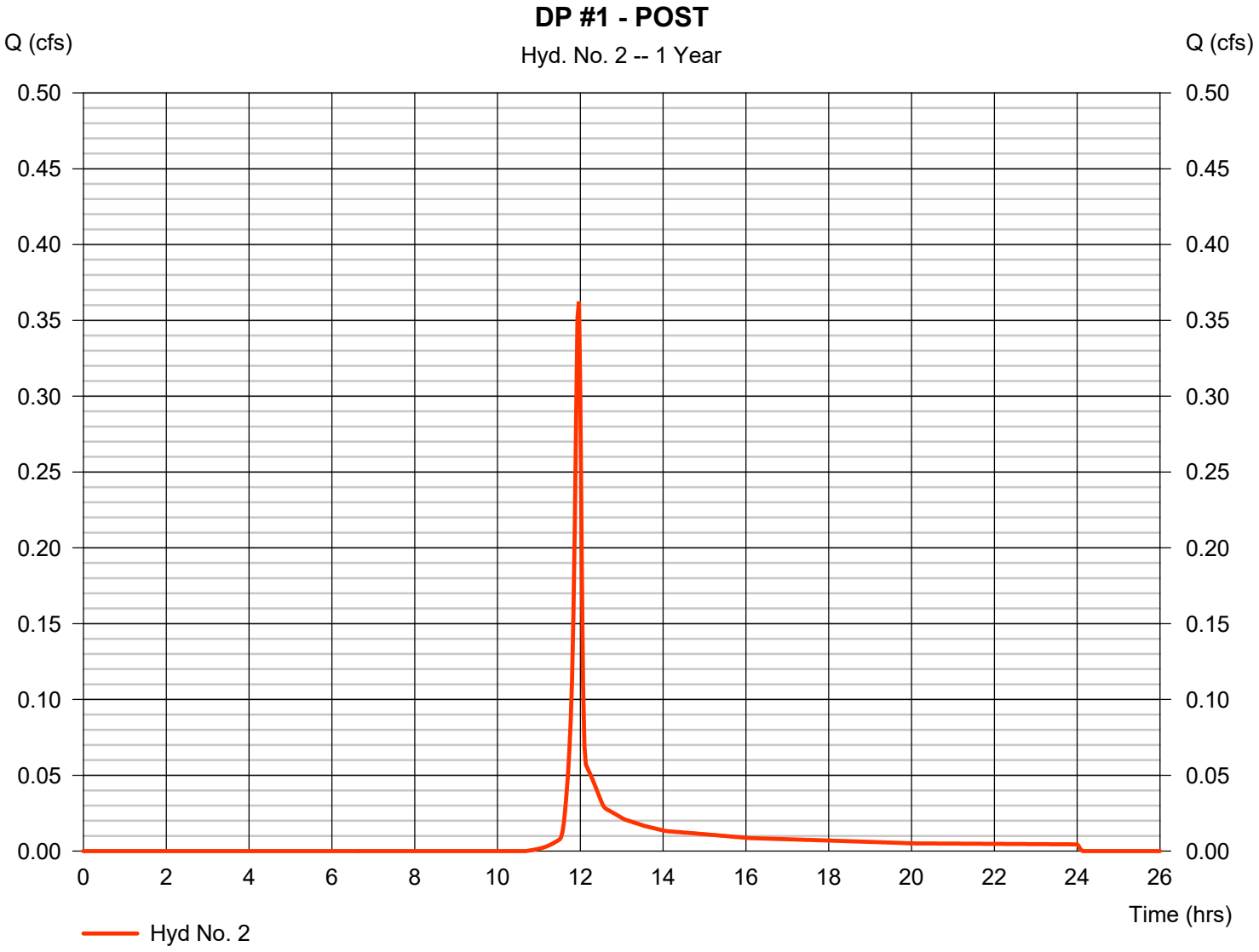
Hydrograph Report

Hyd. No. 2

DP #1 - POST

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.362 cfs
Storm frequency	=	1 yrs	Time to peak	=	11.97 hrs
Time interval	=	2 min	Hyd. volume	=	725 cuft
Drainage area	=	0.210 ac	Curve number	=	76*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	3.00 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.030 x 98) + (0.100 x 70) + (0.080 x 74)] / 0.210



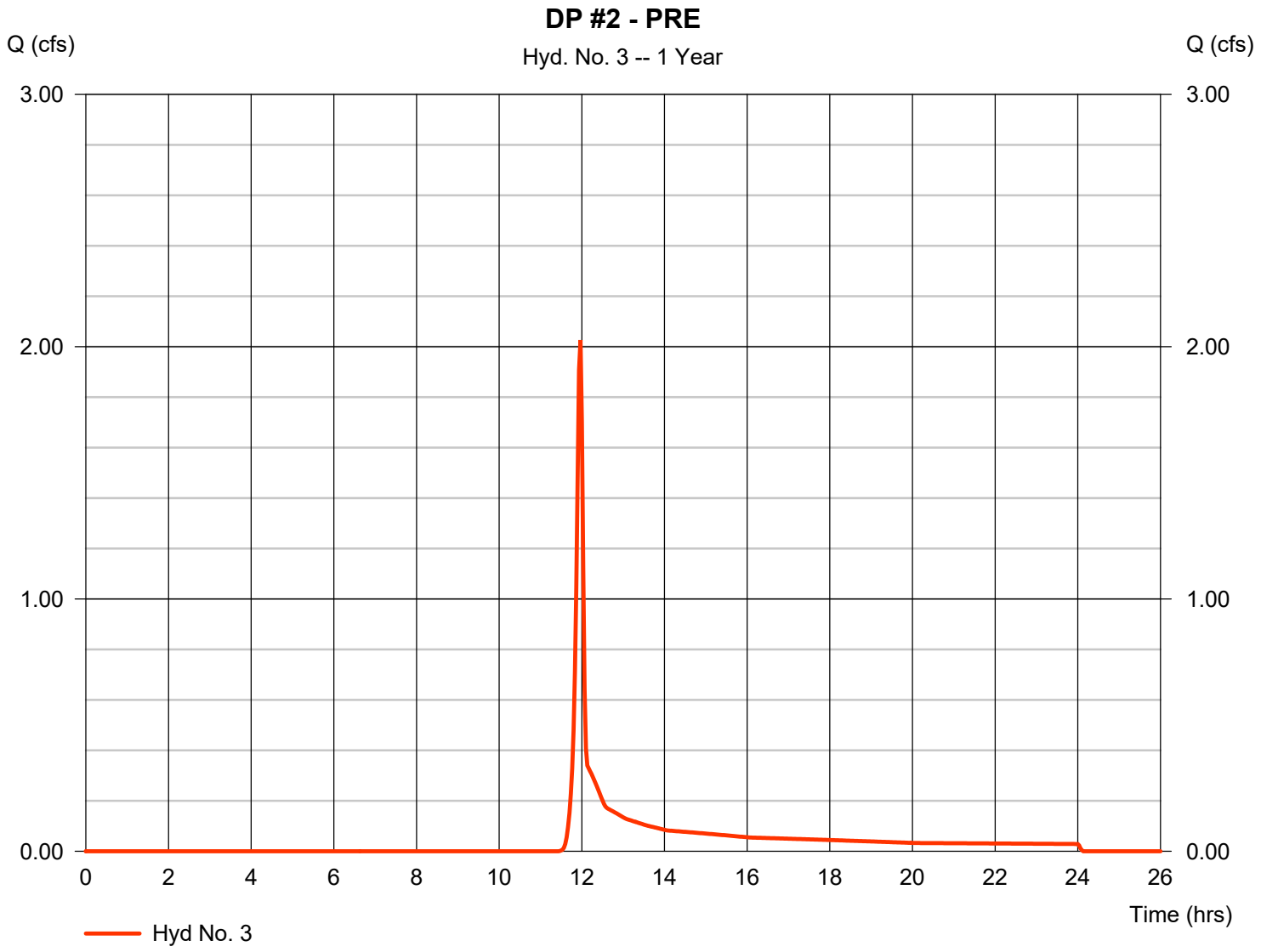
Hydrograph Report

Hyd. No. 3

DP #2 - PRE

Hydrograph type	=	SCS Runoff	Peak discharge	=	2.026 cfs
Storm frequency	=	1 yrs	Time to peak	=	11.97 hrs
Time interval	=	2 min	Hyd. volume	=	4,140 cuft
Drainage area	=	1.600 ac	Curve number	=	71*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	3.00 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.200 x 70) + (0.400 x 74)] / 1.600



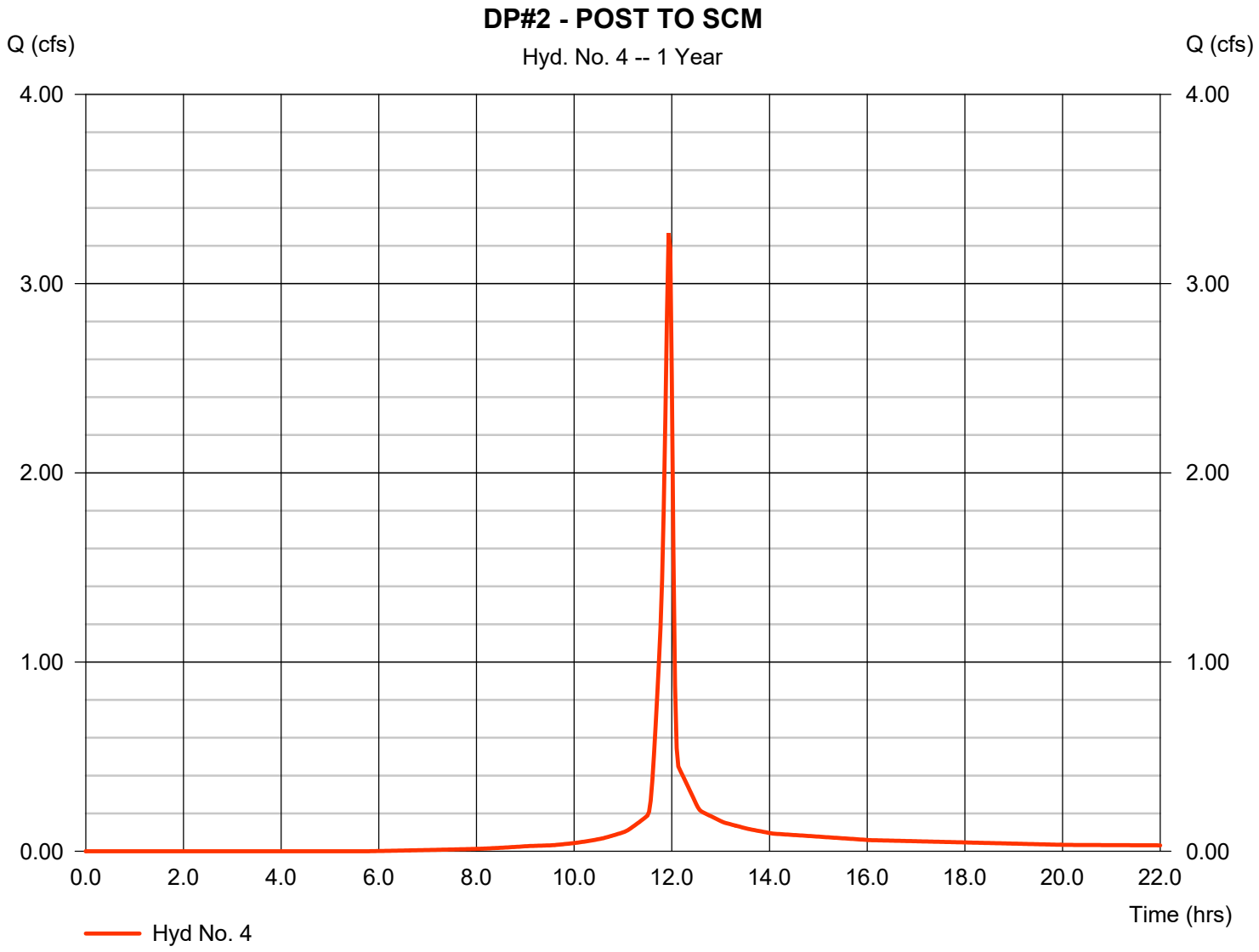
Hydrograph Report

Hyd. No. 4

DP#2 - POST TO SCM

Hydrograph type	=	SCS Runoff	Peak discharge	=	3.267 cfs
Storm frequency	=	1 yrs	Time to peak	=	11.93 hrs
Time interval	=	2 min	Hyd. volume	=	6,752 cuft
Drainage area	=	1.000 ac	Curve number	=	90*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	3.00 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.680 x 98) + (0.320 x 74)] / 1.000



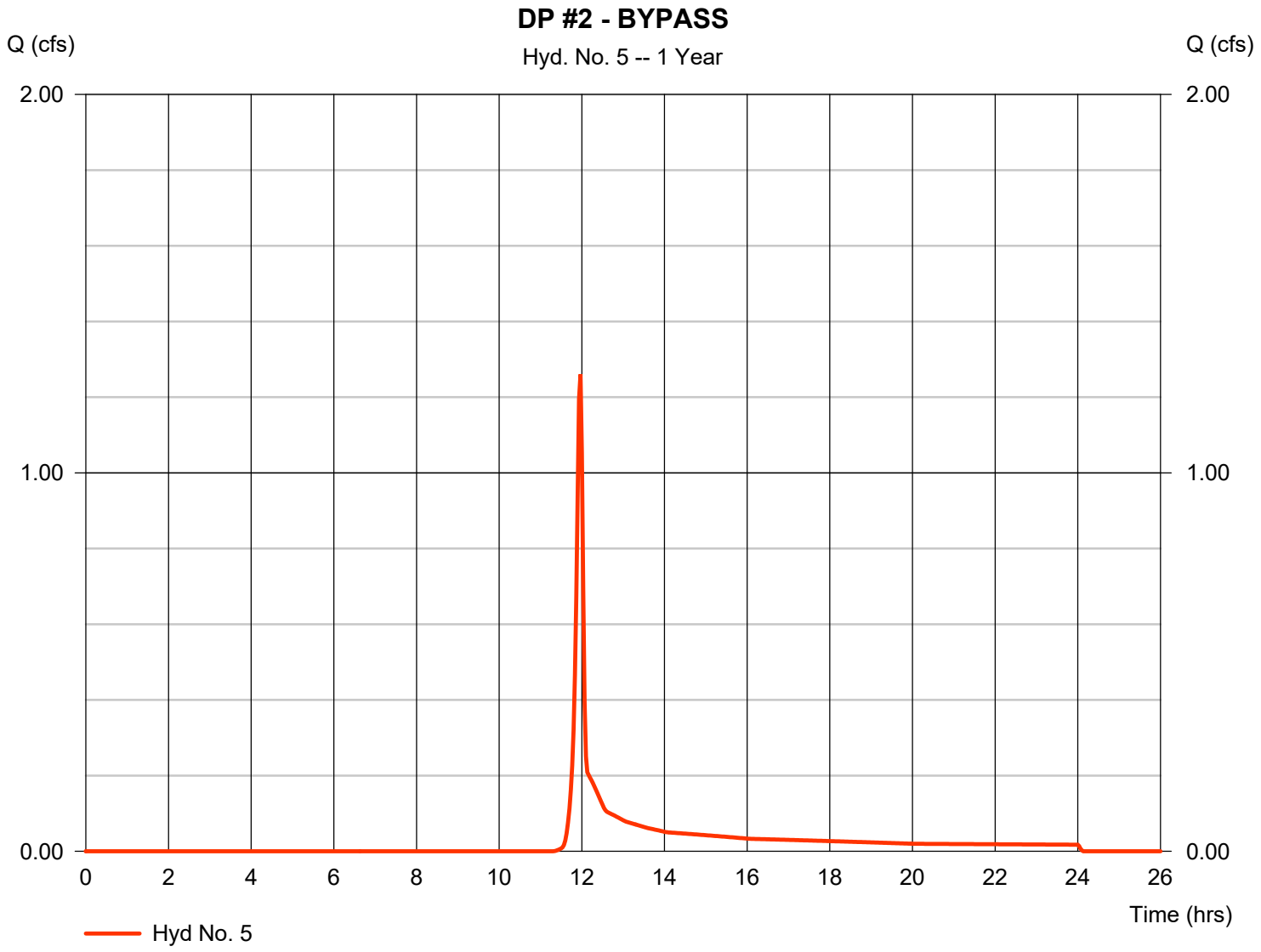
Hydrograph Report

Hyd. No. 5

DP #2 - BYPASS

Hydrograph type	=	SCS Runoff	Peak discharge	=	1.260 cfs
Storm frequency	=	1 yrs	Time to peak	=	11.97 hrs
Time interval	=	2 min	Hyd. volume	=	2,557 cuft
Drainage area	=	0.930 ac	Curve number	=	72*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	3.00 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.460 x 70) + (0.470 x 74)] / 0.930



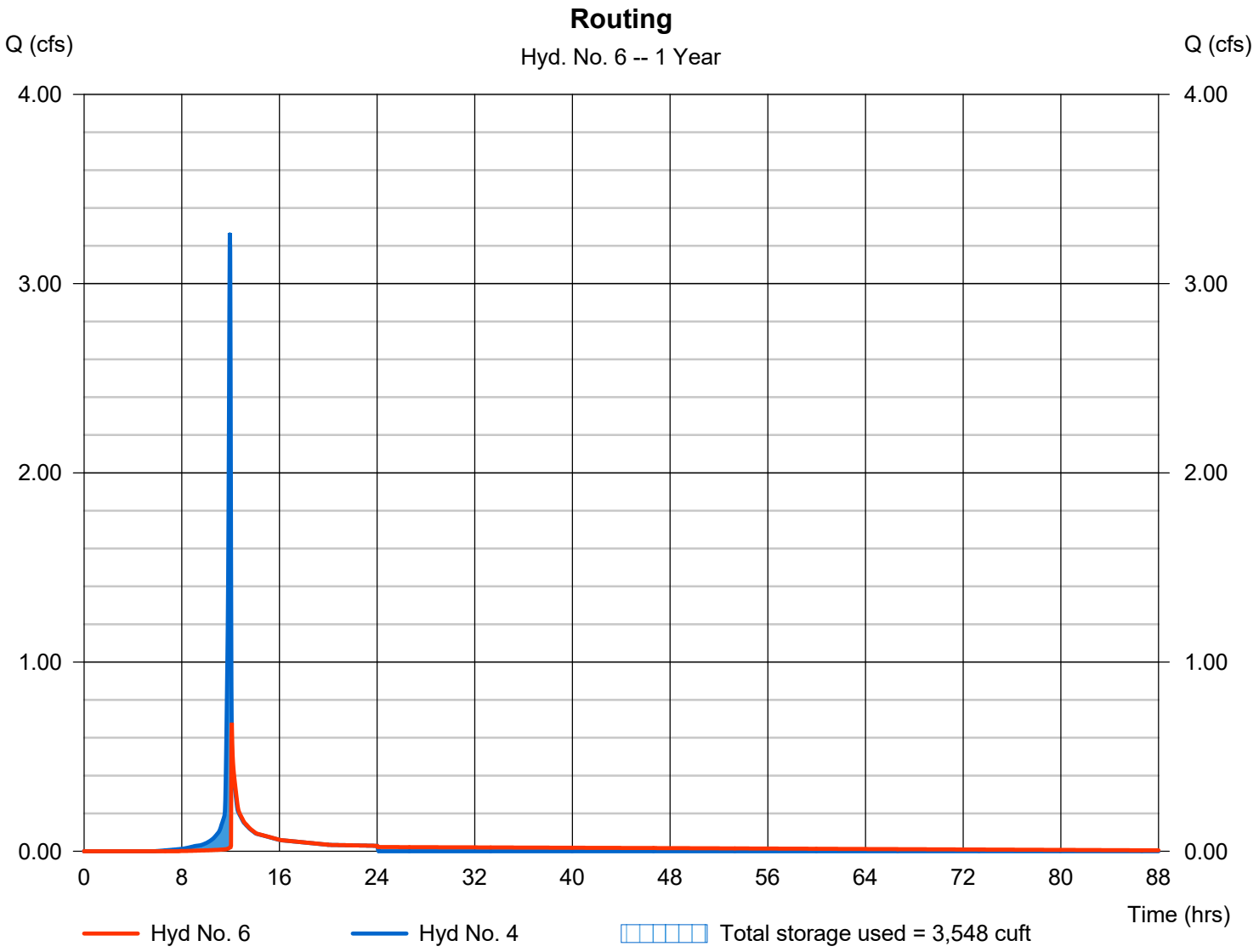
Hydrograph Report

Hyd. No. 6

Routing

Hydrograph type	=	Reservoir	Peak discharge	=	0.678 cfs
Storm frequency	=	1 yrs	Time to peak	=	12.10 hrs
Time interval	=	2 min	Hyd. volume	=	6,655 cuft
Inflow hyd. No.	=	4 - DP#2 - POST TO SCM	Max. Elevation	=	280.85 ft
Reservoir name	=	SCM	Max. Storage	=	3,548 cuft

Storage Indication method used.

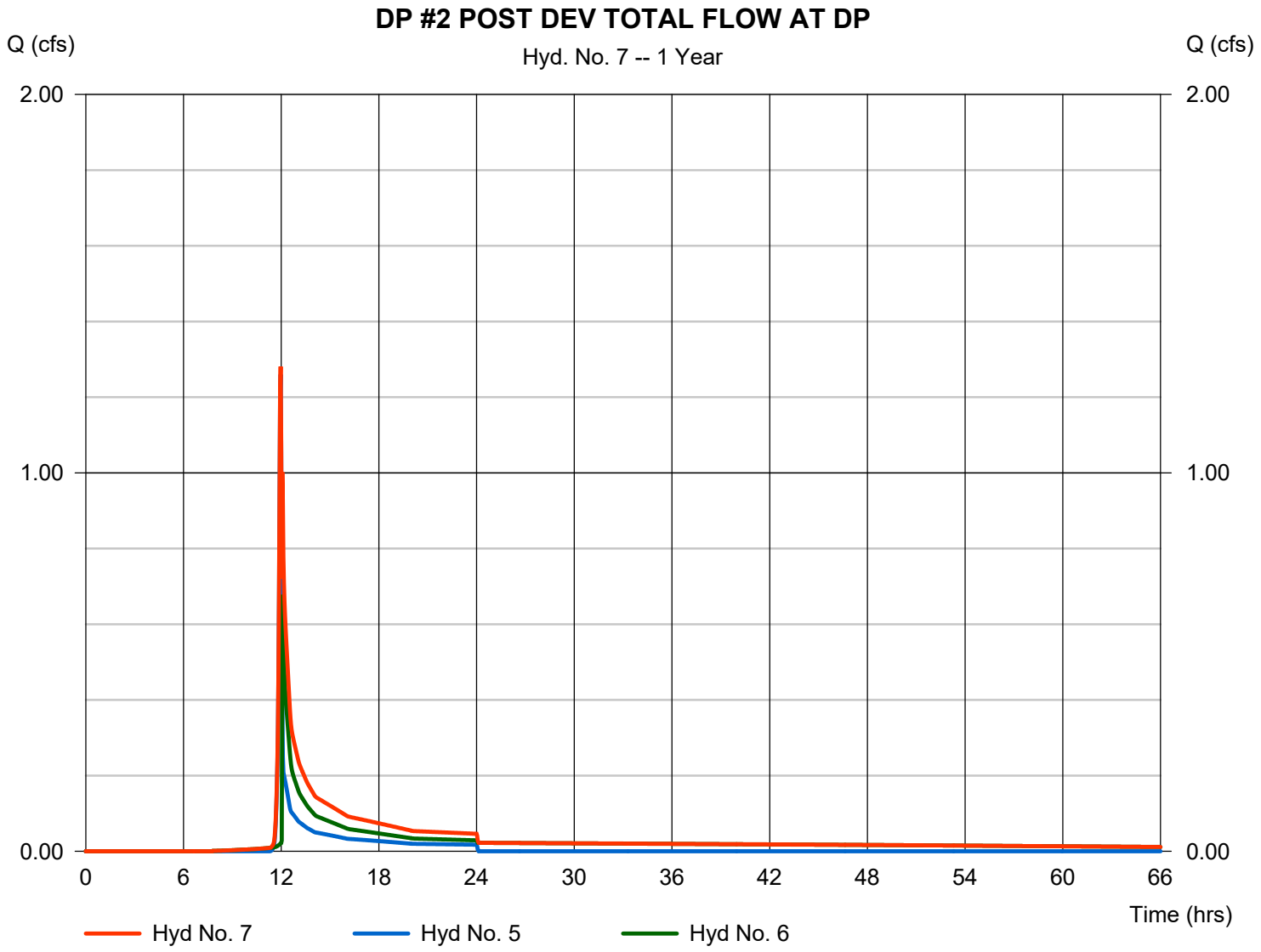


Hydrograph Report

Hyd. No. 7

DP #2 POST DEV TOTAL FLOW AT DP

Hydrograph type	= Combine	Peak discharge	= 1.281 cfs
Storm frequency	= 1 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 9,212 cuft
Inflow hyds.	= 5, 6	Contrib. drain. area	= 0.930 ac



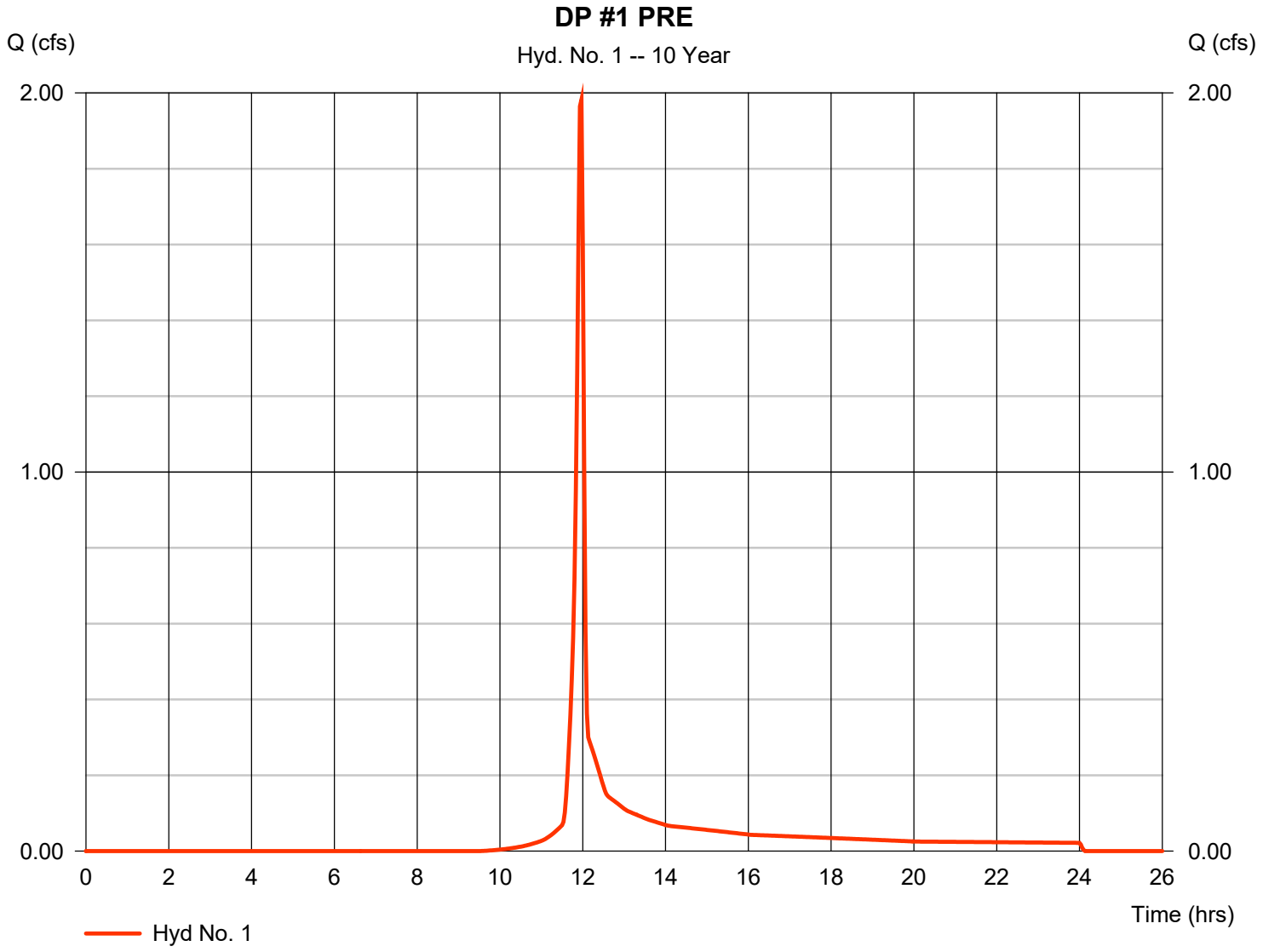
Hydrograph Report

Hyd. No. 1

DP #1 PRE

Hydrograph type	=	SCS Runoff	Peak discharge	=	1.982 cfs
Storm frequency	=	10 yrs	Time to peak	=	11.97 hrs
Time interval	=	2 min	Hyd. volume	=	3,975 cuft
Drainage area	=	0.520 ac	Curve number	=	70*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	5.28 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.500 x 70) + (0.020 x 74)] / 0.520



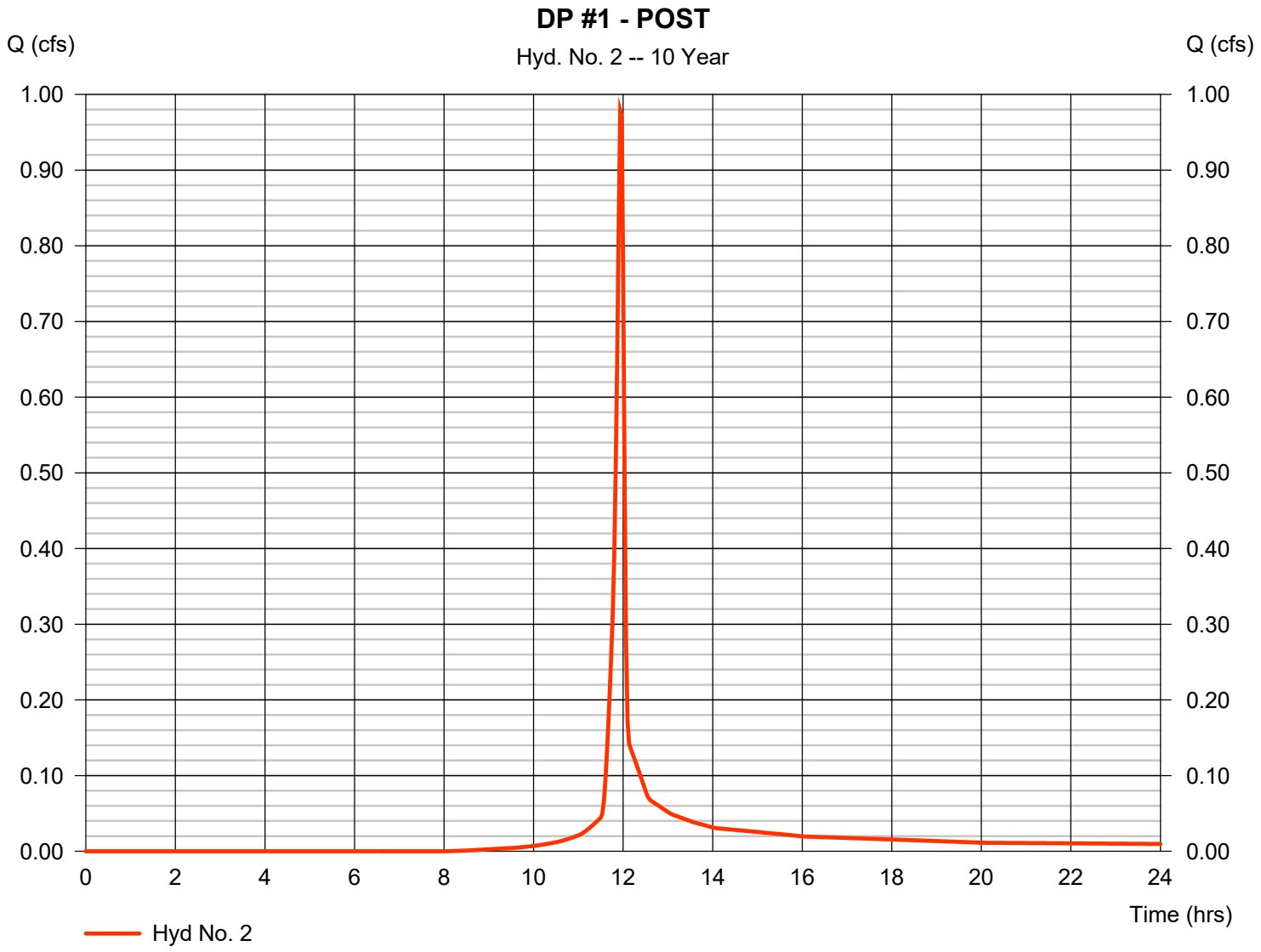
Hydrograph Report

Hyd. No. 2

DP #1 - POST

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.978 cfs
Storm frequency	=	10 yrs	Time to peak	=	11.93 hrs
Time interval	=	2 min	Hyd. volume	=	1,978 cuft
Drainage area	=	0.210 ac	Curve number	=	76*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	5.28 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.030 x 98) + (0.100 x 70) + (0.080 x 74)] / 0.210



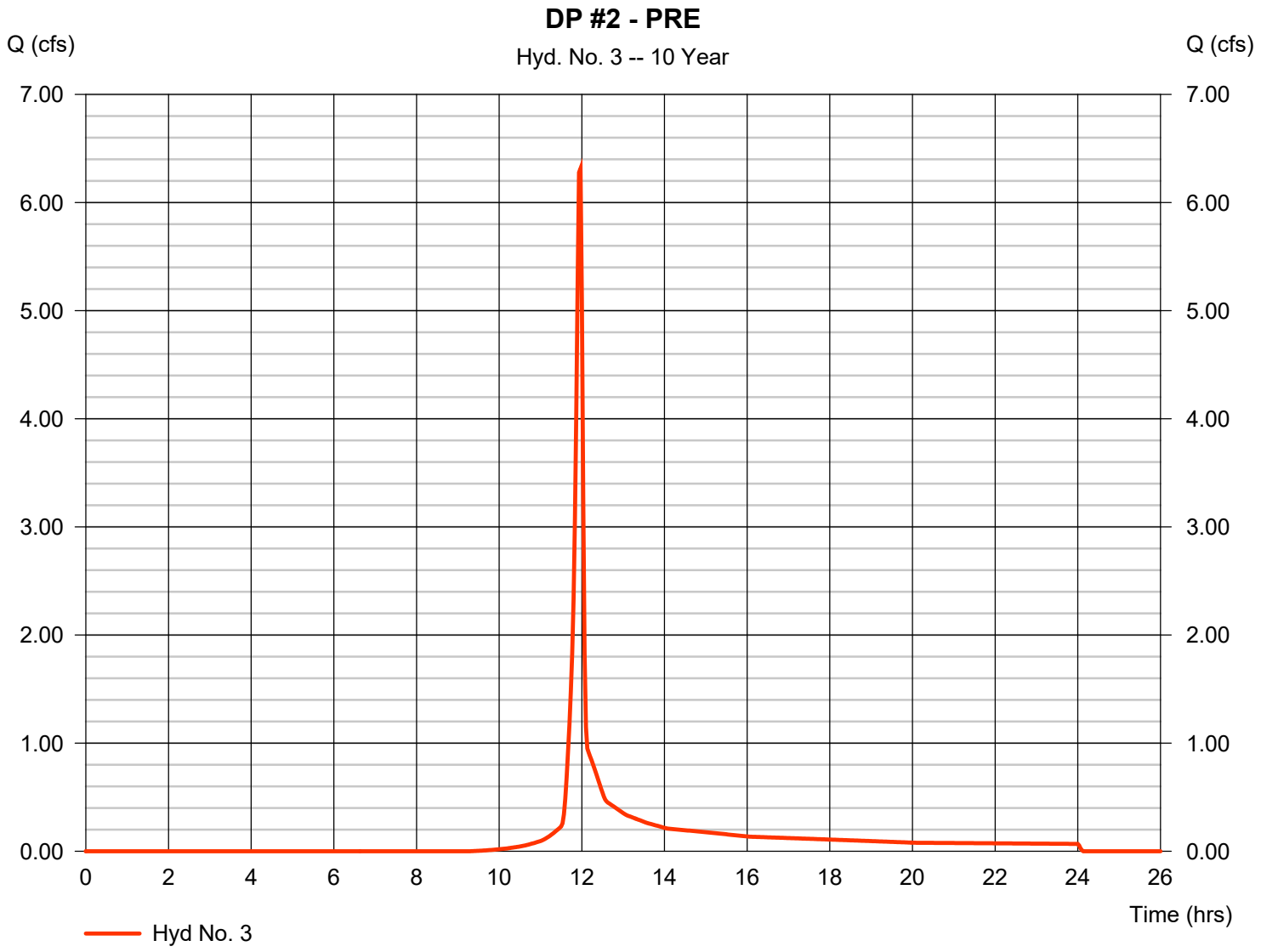
Hydrograph Report

Hyd. No. 3

DP #2 - PRE

Hydrograph type	=	SCS Runoff	Peak discharge	=	6.315 cfs
Storm frequency	=	10 yrs	Time to peak	=	11.97 hrs
Time interval	=	2 min	Hyd. volume	=	12,689 cuft
Drainage area	=	1.600 ac	Curve number	=	71*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	5.28 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.200 x 70) + (0.400 x 74)] / 1.600



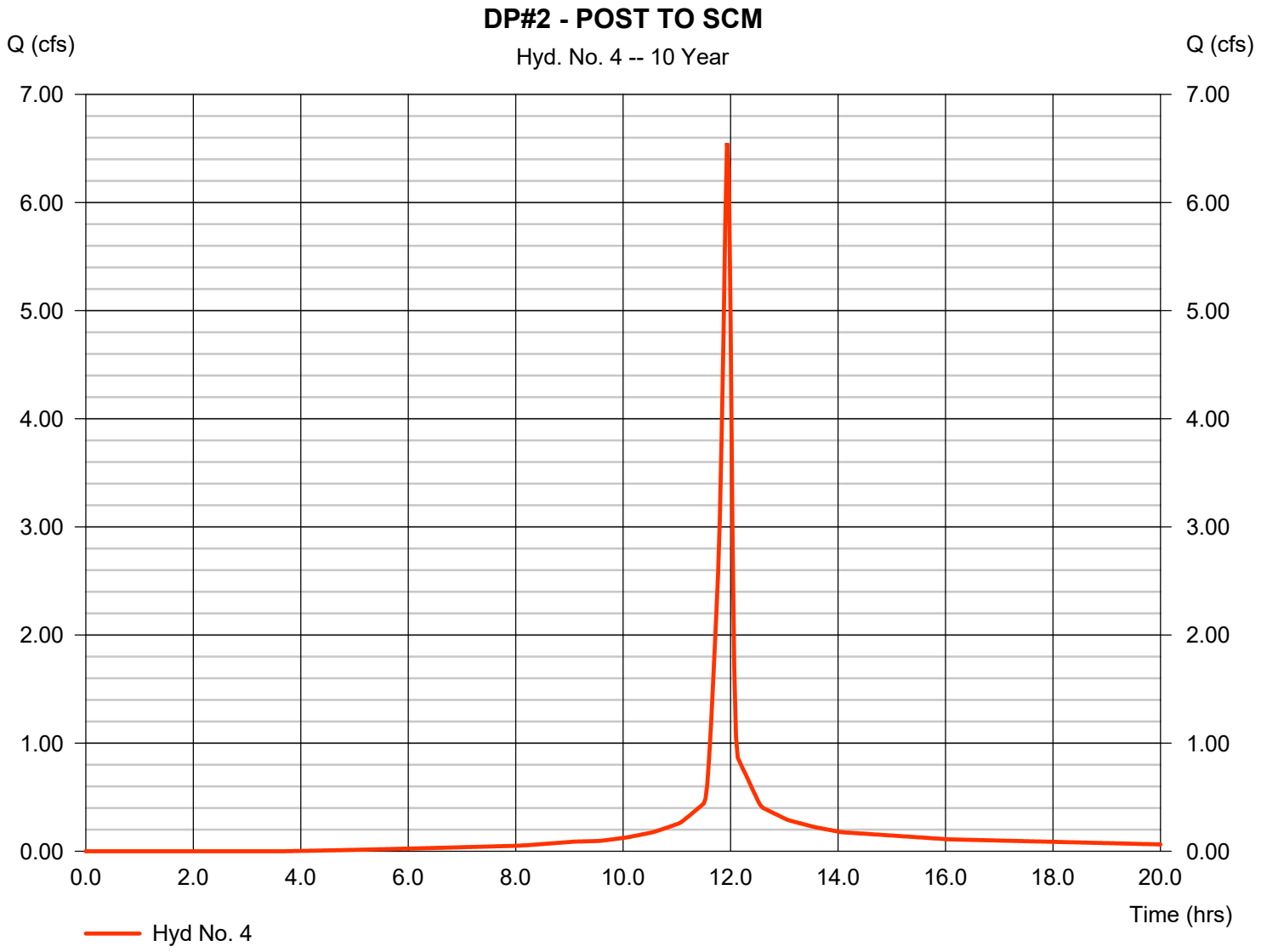
Hydrograph Report

Hyd. No. 4

DP#2 - POST TO SCM

Hydrograph type	=	SCS Runoff	Peak discharge	=	6.550 cfs
Storm frequency	=	10 yrs	Time to peak	=	11.93 hrs
Time interval	=	2 min	Hyd. volume	=	14,112 cuft
Drainage area	=	1.000 ac	Curve number	=	90*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	5.28 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.680 x 98) + (0.320 x 74)] / 1.000



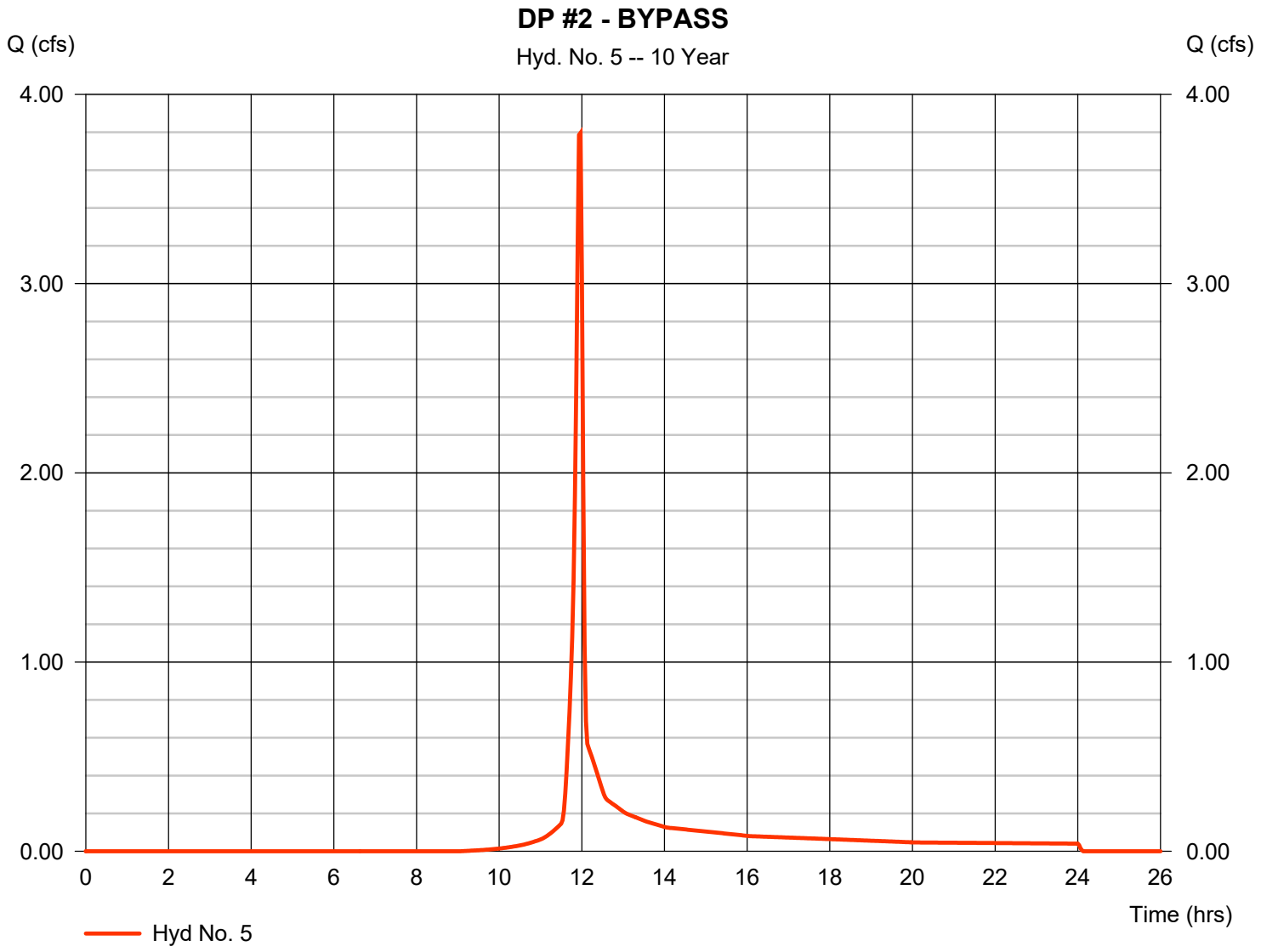
Hydrograph Report

Hyd. No. 5

DP #2 - BYPASS

Hydrograph type	=	SCS Runoff	Peak discharge	=	3.797 cfs
Storm frequency	=	10 yrs	Time to peak	=	11.97 hrs
Time interval	=	2 min	Hyd. volume	=	7,645 cuft
Drainage area	=	0.930 ac	Curve number	=	72*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	5.28 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.460 x 70) + (0.470 x 74)] / 0.930



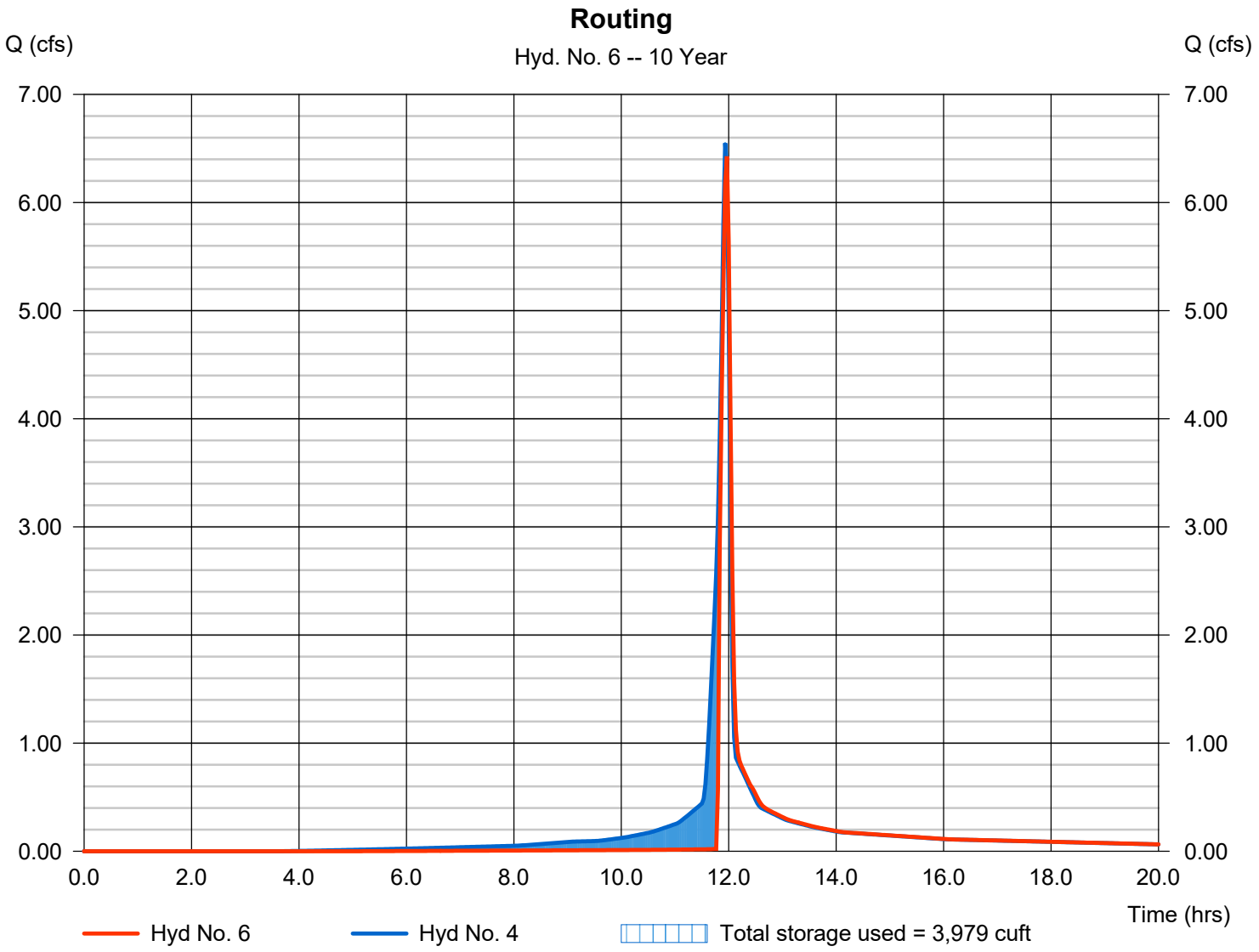
Hydrograph Report

Hyd. No. 6

Routing

Hydrograph type	=	Reservoir	Peak discharge	=	6.428 cfs
Storm frequency	=	10 yrs	Time to peak	=	11.97 hrs
Time interval	=	2 min	Hyd. volume	=	14,014 cuft
Inflow hyd. No.	=	4 - DP#2 - POST TO SCM	Max. Elevation	=	281.04 ft
Reservoir name	=	SCM	Max. Storage	=	3,979 cuft

Storage Indication method used.

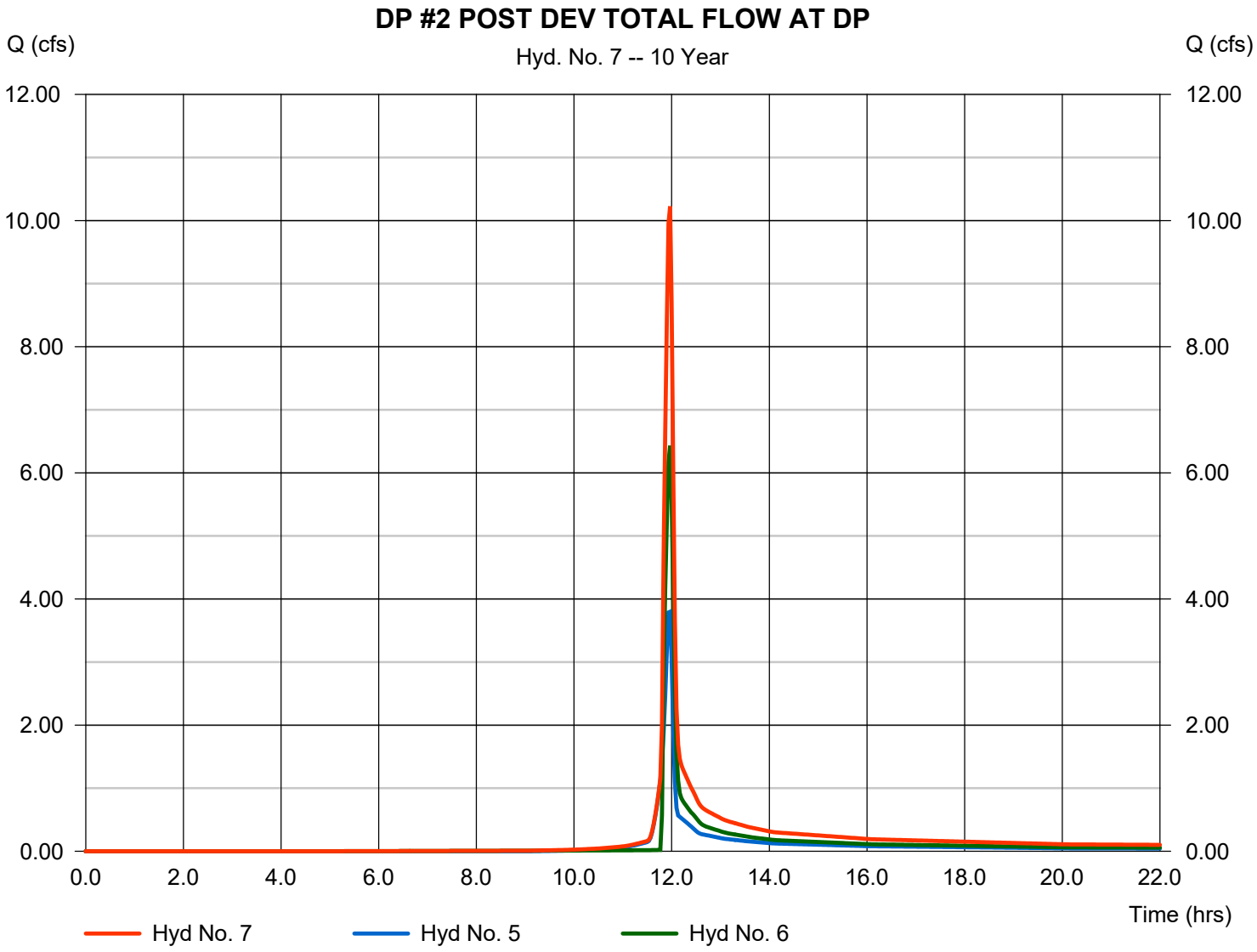


Hydrograph Report

Hyd. No. 7

DP #2 POST DEV TOTAL FLOW AT DP

Hydrograph type	= Combine	Peak discharge	= 10.22 cfs
Storm frequency	= 10 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 21,659 cuft
Inflow hyds.	= 5, 6	Contrib. drain. area	= 0.930 ac



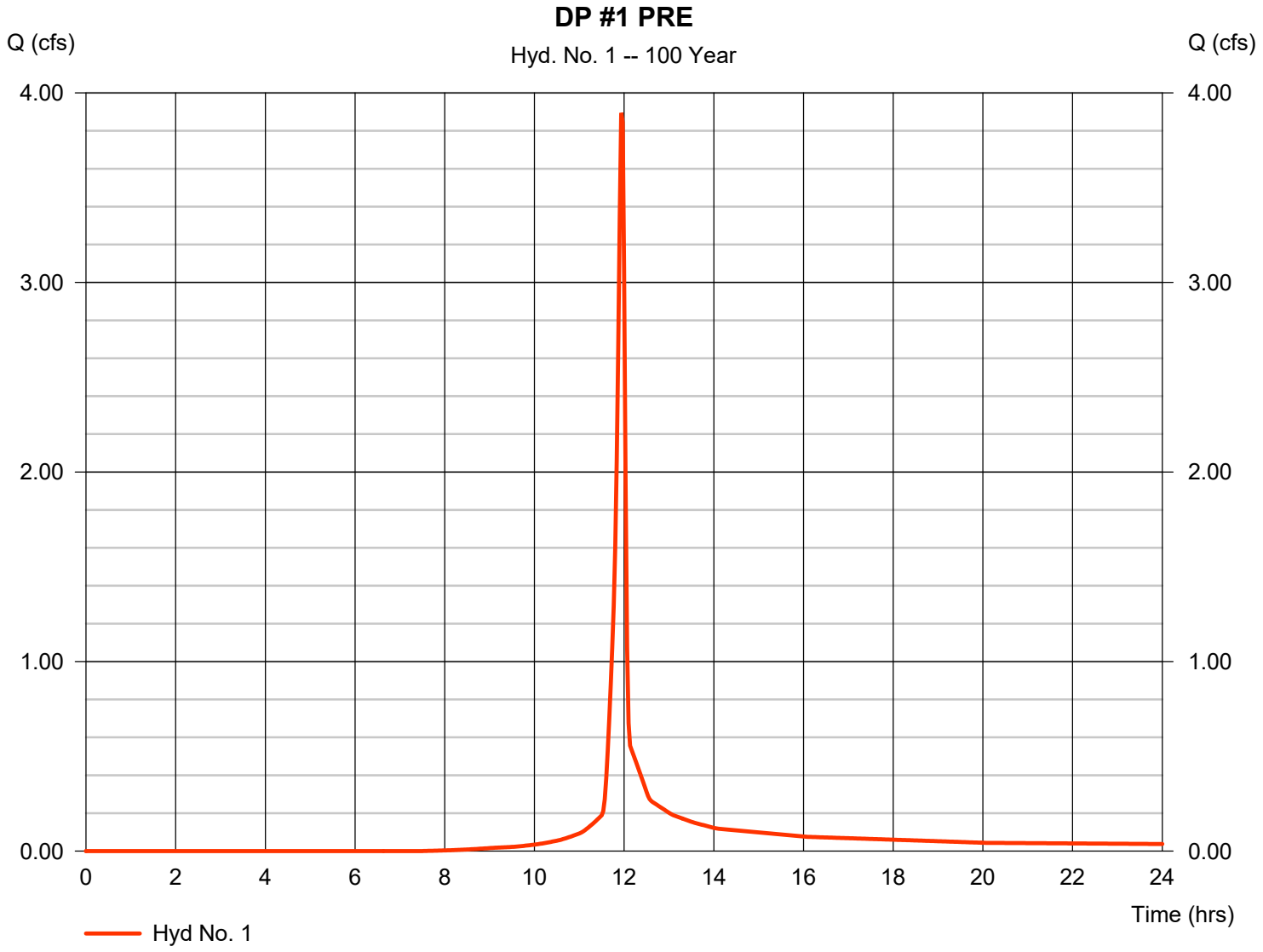
Hydrograph Report

Hyd. No. 1

DP #1 PRE

Hydrograph type	=	SCS Runoff	Peak discharge	=	3.894 cfs
Storm frequency	=	100 yrs	Time to peak	=	11.93 hrs
Time interval	=	2 min	Hyd. volume	=	7,900 cuft
Drainage area	=	0.520 ac	Curve number	=	70*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	8.00 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.500 x 70) + (0.020 x 74)] / 0.520



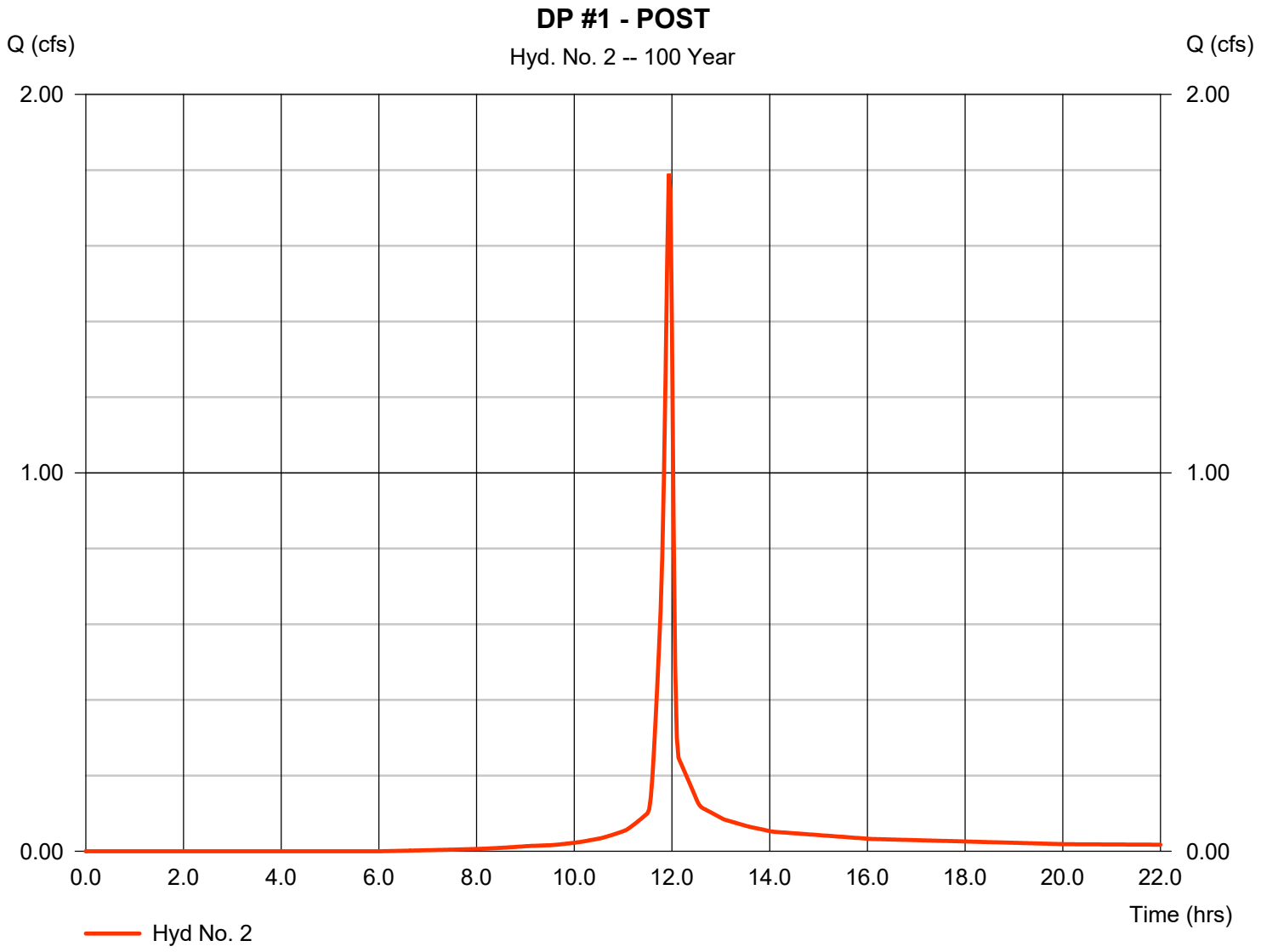
Hydrograph Report

Hyd. No. 2

DP #1 - POST

Hydrograph type	=	SCS Runoff	Peak discharge	=	1.790 cfs
Storm frequency	=	100 yrs	Time to peak	=	11.93 hrs
Time interval	=	2 min	Hyd. volume	=	3,686 cuft
Drainage area	=	0.210 ac	Curve number	=	76*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	8.00 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.030 x 98) + (0.100 x 70) + (0.080 x 74)] / 0.210



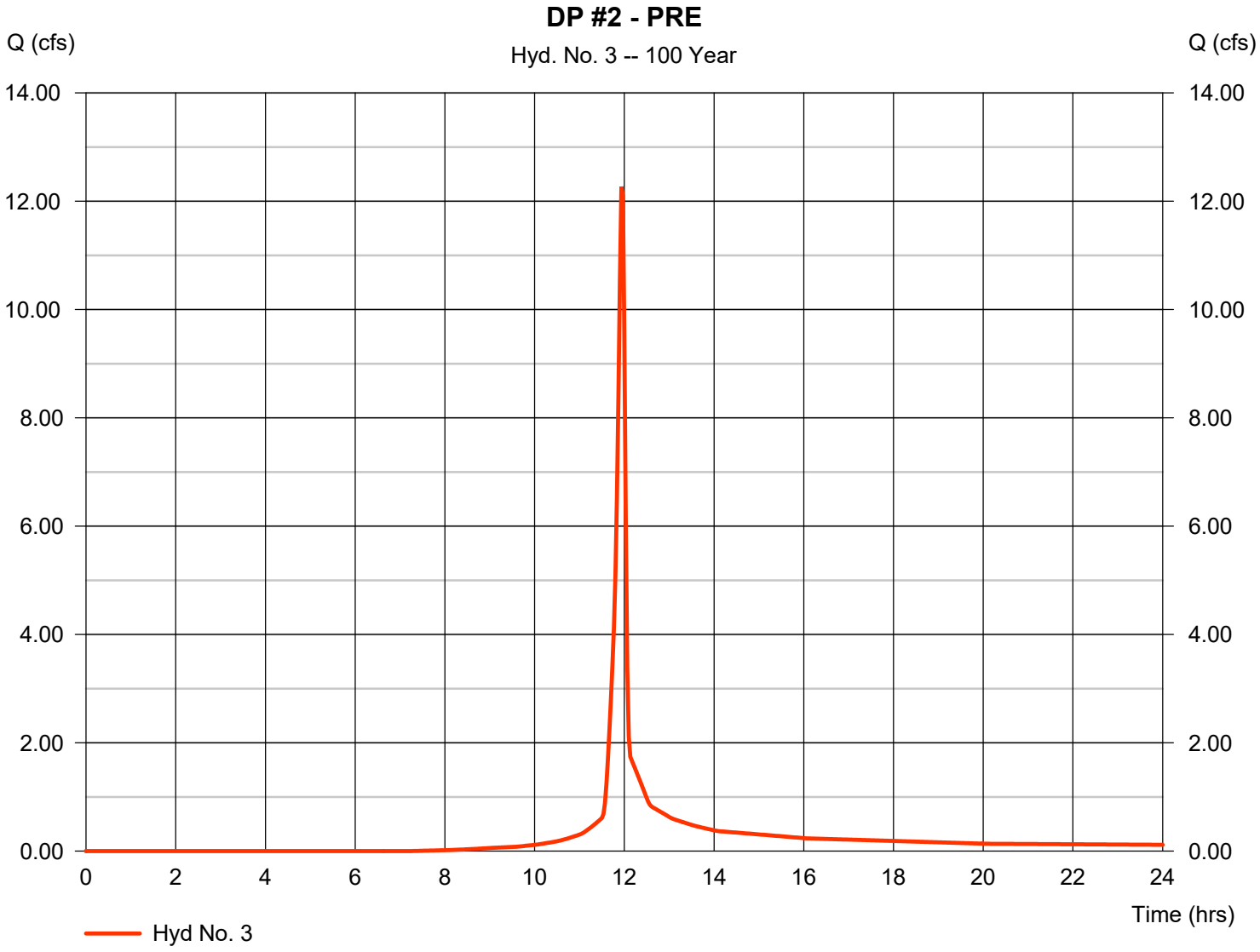
Hydrograph Report

Hyd. No. 3

DP #2 - PRE

Hydrograph type	=	SCS Runoff	Peak discharge	=	12.27 cfs
Storm frequency	=	100 yrs	Time to peak	=	11.93 hrs
Time interval	=	2 min	Hyd. volume	=	24,934 cuft
Drainage area	=	1.600 ac	Curve number	=	71*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	8.00 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.200 x 70) + (0.400 x 74)] / 1.600



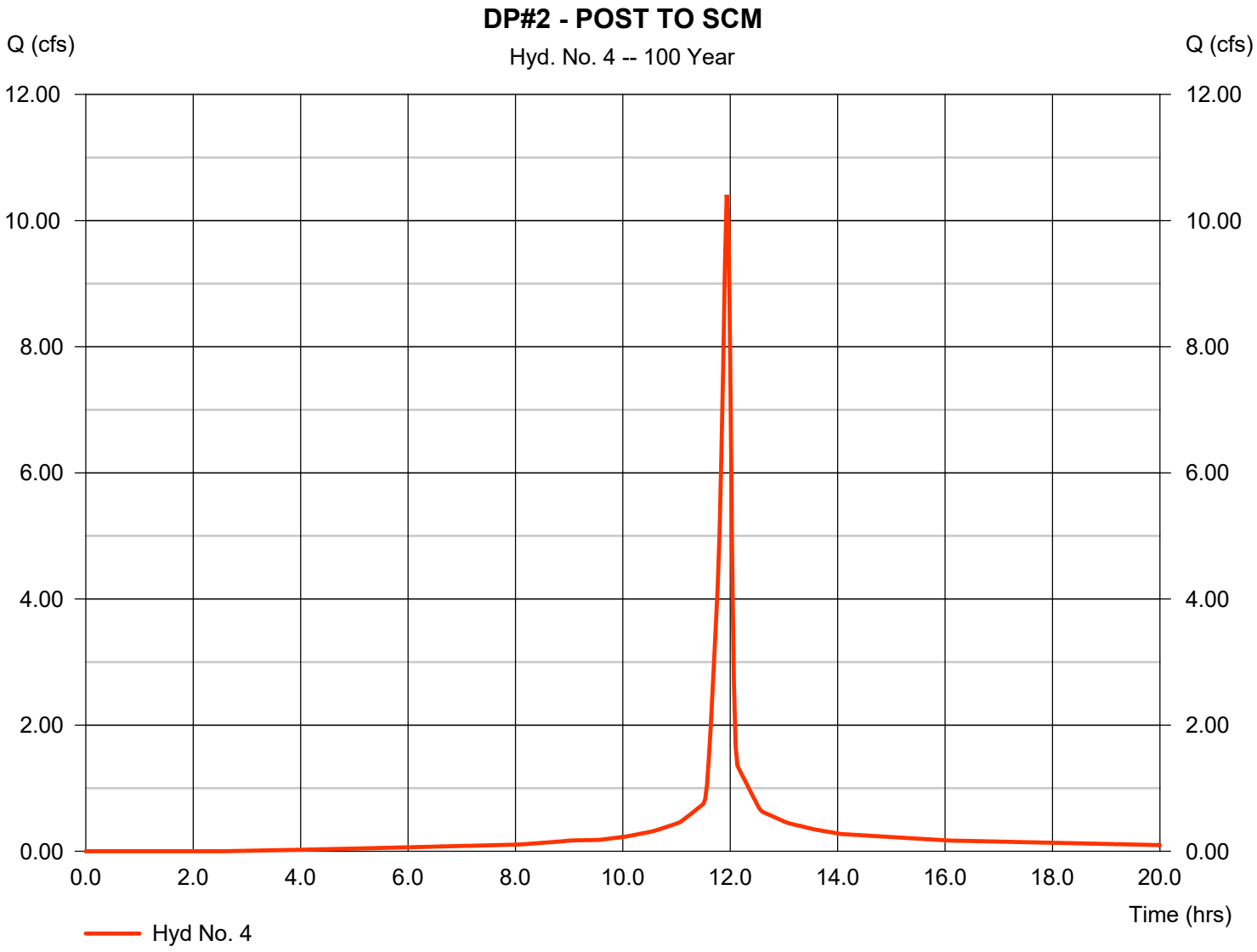
Hydrograph Report

Hyd. No. 4

DP#2 - POST TO SCM

Hydrograph type	=	SCS Runoff	Peak discharge	=	10.41 cfs
Storm frequency	=	100 yrs	Time to peak	=	11.93 hrs
Time interval	=	2 min	Hyd. volume	=	23,160 cuft
Drainage area	=	1.000 ac	Curve number	=	90*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	8.00 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.680 x 98) + (0.320 x 74)] / 1.000



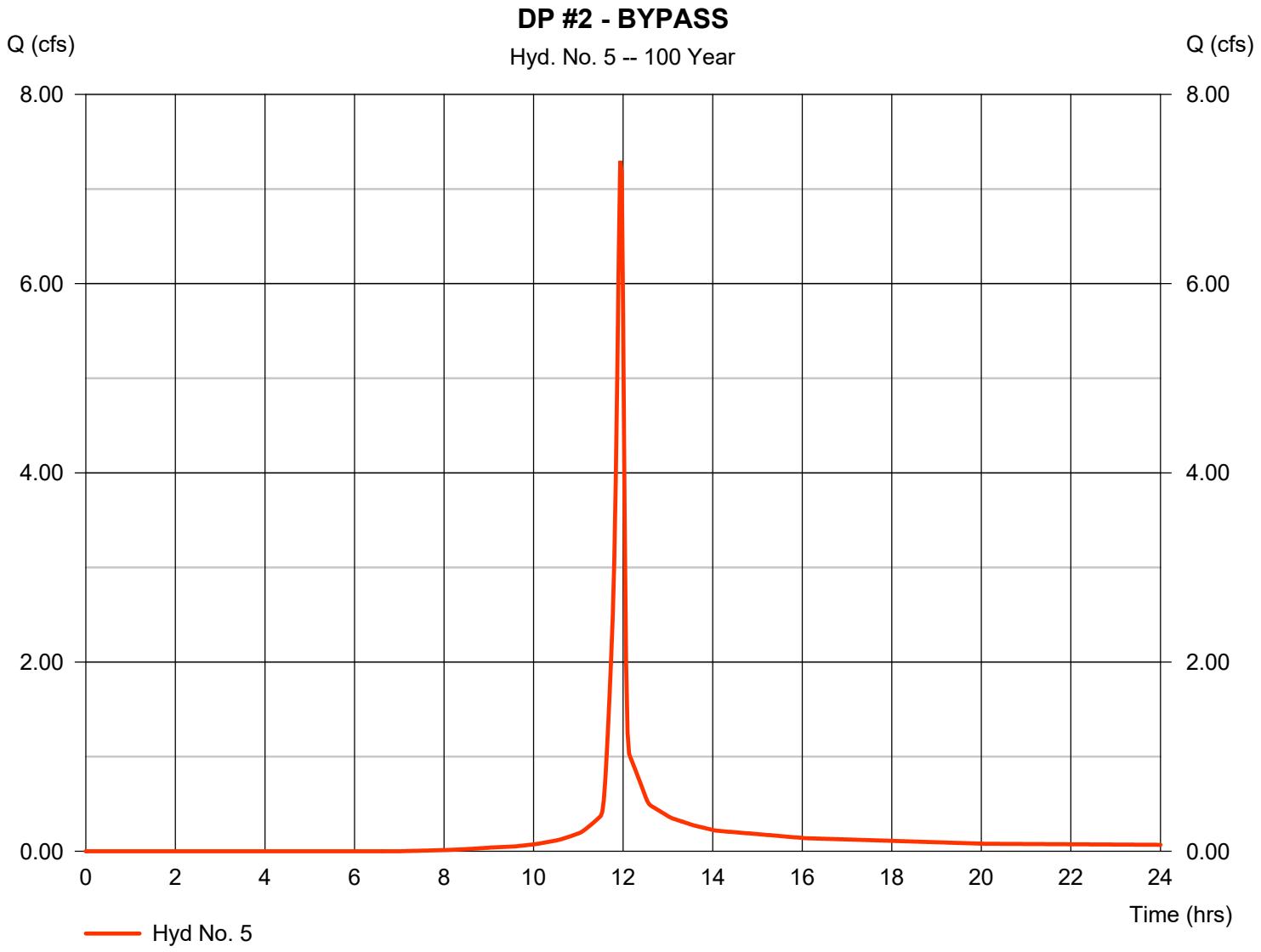
Hydrograph Report

Hyd. No. 5

DP #2 - BYPASS

Hydrograph type	=	SCS Runoff	Peak discharge	=	7.295 cfs
Storm frequency	=	100 yrs	Time to peak	=	11.93 hrs
Time interval	=	2 min	Hyd. volume	=	14,857 cuft
Drainage area	=	0.930 ac	Curve number	=	72*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	8.00 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.460 x 70) + (0.470 x 74)] / 0.930



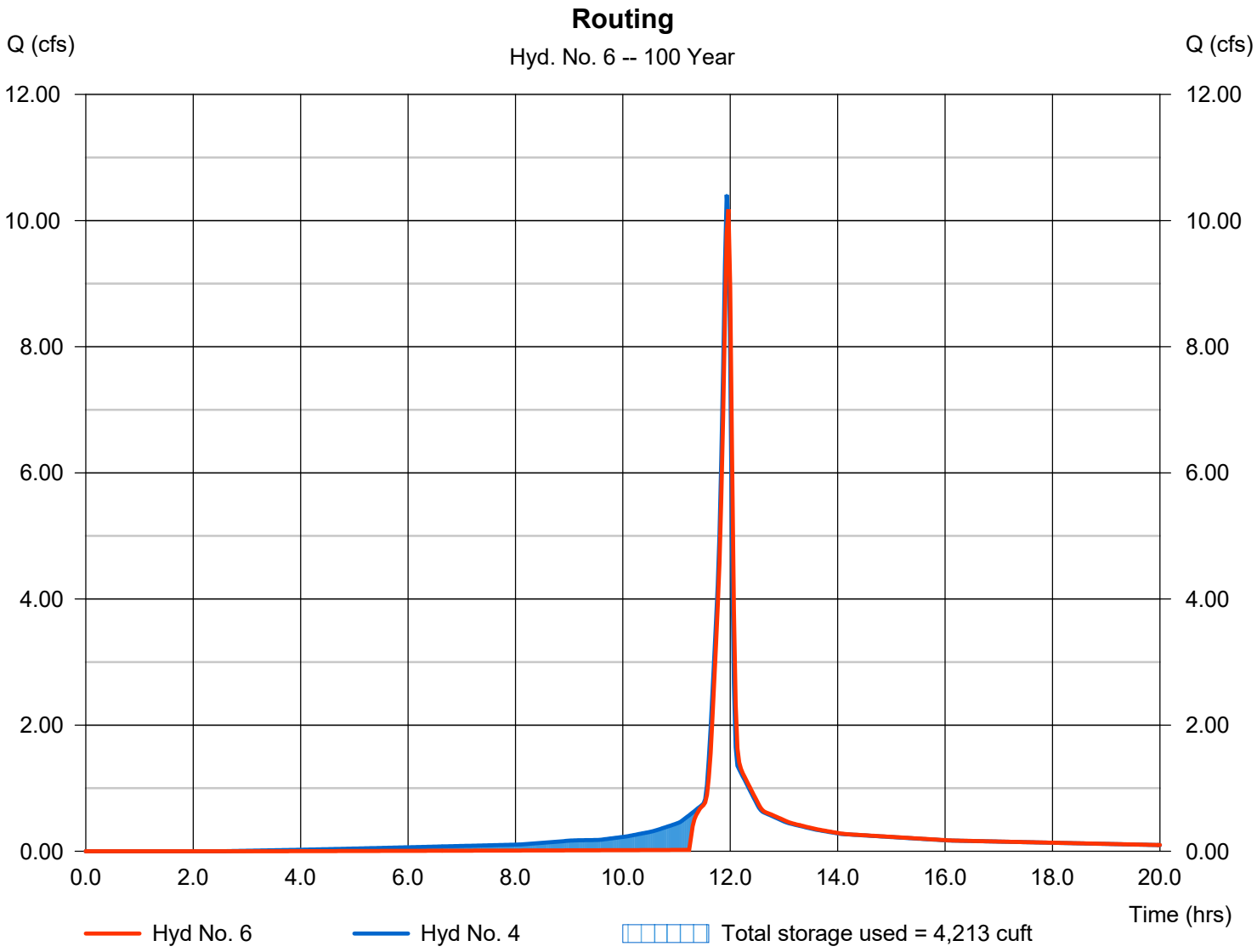
Hydrograph Report

Hyd. No. 6

Routing

Hydrograph type	=	Reservoir	Peak discharge	=	10.18 cfs
Storm frequency	=	100 yrs	Time to peak	=	11.97 hrs
Time interval	=	2 min	Hyd. volume	=	23,062 cuft
Inflow hyd. No.	=	4 - DP#2 - POST TO SCM	Max. Elevation	=	281.14 ft
Reservoir name	=	SCM	Max. Storage	=	4,213 cuft

Storage Indication method used.

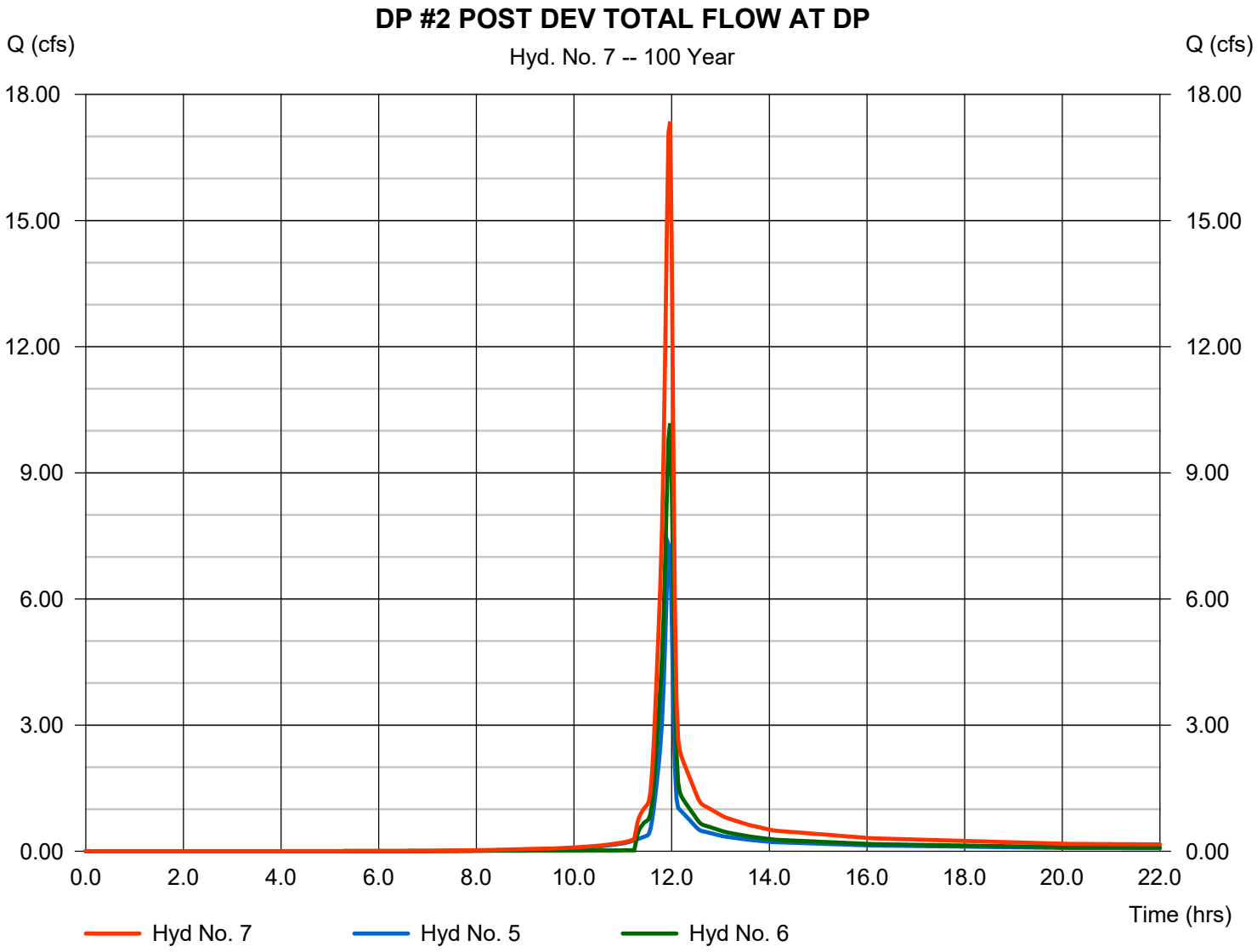


Hydrograph Report

Hyd. No. 7

DP #2 POST DEV TOTAL FLOW AT DP

Hydrograph type	= Combine	Peak discharge	= 17.36 cfs
Storm frequency	= 100 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 37,919 cuft
Inflow hyds.	= 5, 6	Contrib. drain. area	= 0.930 ac



Riser Drawdown Orifice Calculator

$$Q = C_D A\sqrt{2gH_o}$$

Where:
- Q = Discharge (cfs)
- C_D = Coefficient of discharge (dimensionless) – see Table 3-8
- A = Cross-sectional area of flow at the orifice entrance (sq ft)
- g = Acceleration of gravity (32.2 ft/sec^2)
- H_O = Driving head (ft), measured from the centroid of the orifice area

Cd=	0.6		
g =	32.2	ft/s^2	
Orifice Diameter	0.8	inches	
Orifice A =	0.003	sq. ft.	
WQV Elevation:	1.50	ft	(Distance from Orifice invert to WQV elevation)
Head:	1.47	ft	(Distance from Orifice centroid to WQV elevation)
Ho =	0.49	ft	Driving head / 3
Draw down time:	0.0117	cfs	
Water Quality Volume =	2,752	cf	
Drawdown Time =	**2.71**	**days**	

PLD

Appendix D
SCM Drainage Area Maps

PLD

DISCHARGE POINT #1

PROPERTY LINE IS APPROXIMATE CL OF STREAM

DISCHARGE POINT #2

DA=0.52 AC

DA=1.65 AC

25' PERIMETER SETBACK: NO LANDSCAPE BUFFER REQUIRED

EXISTING SOLID WHITE LINE TO REMAIN

EXISTING SOLID WHITE LINE TO REMAIN

EXISTING DOUBLE YELLOW LINE TO REMAIN (RESTRIPE IF REQUIRED)

EXISTING DOUBLE YELLOW LINE TO REMAIN (RESTRIPE IF REQUIRED)

MACK TODD RD. / US 64 BUSINESS

MACK TODD RD. / US 64 BUSINESS

0 20 40 60

SCALE IN FEET

PLD

PIEDMONT LAND DESIGN, PLLC

8522-204 SIX FORKS ROAD
RALEIGH, NORTH CAROLINA 27615
919.845.7600 PHONE
919.845.7703 FAX
ENGR. FIRM LICENSE NO. F-0843

PRELIMINARY
NOT FOR CONSTRUCTION

901 MACK TODD ROAD

**901 MACK TODD ROAD
ZEBULON, NORTH CAROLINA**

ISSUED: -

REVISIONS:

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

PROJECT: **CPMTRZ**

PRE-DEVELOPED DA MAP

DWG. NO. **DA 1.0**

F:\Projects\CPMTRZ\Drawings\Site\CPMTRZ_Base.dwg - da maps Feb 04, '25 - 1:40pm

DISCHARGE POINT #1

DISCHARGE POINT #2

DA=0.21 AC

DA TO SCM=1.00 AC

BYPASS DA=0.93 AC

25' PERIMETER SETBACK: NO LANDSCAPE BUFFER REQUIRED

MACK TODD RD. / US 64 BUSINESS

0 20 40 60

SCALE IN FEET

PLD

PIEDMONT LAND DESIGN, PLLC
8522-204 SIX FORKS ROAD
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901 MACK TODD ROAD

**901 MACK TODD ROAD
ZEBULON, NORTH CAROLINA**

ISSUED: -

REVISIONS:

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

PROJECT: **CPMTRZ**

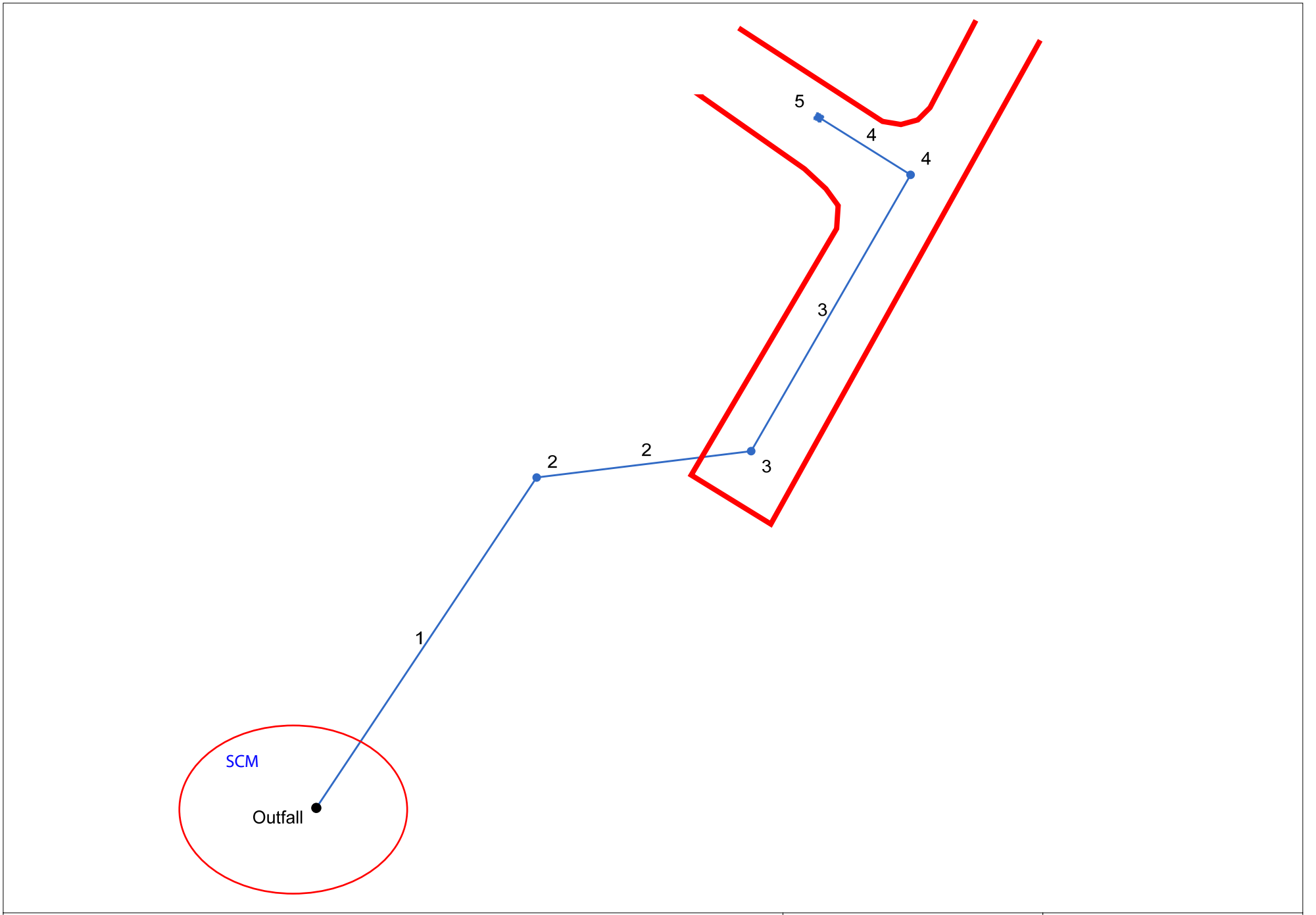
POST-DEVELOEPD DA MAP

DWG. NO. **DA 2.0**

Appendix E
Storm Sewer System Calculations

PLD

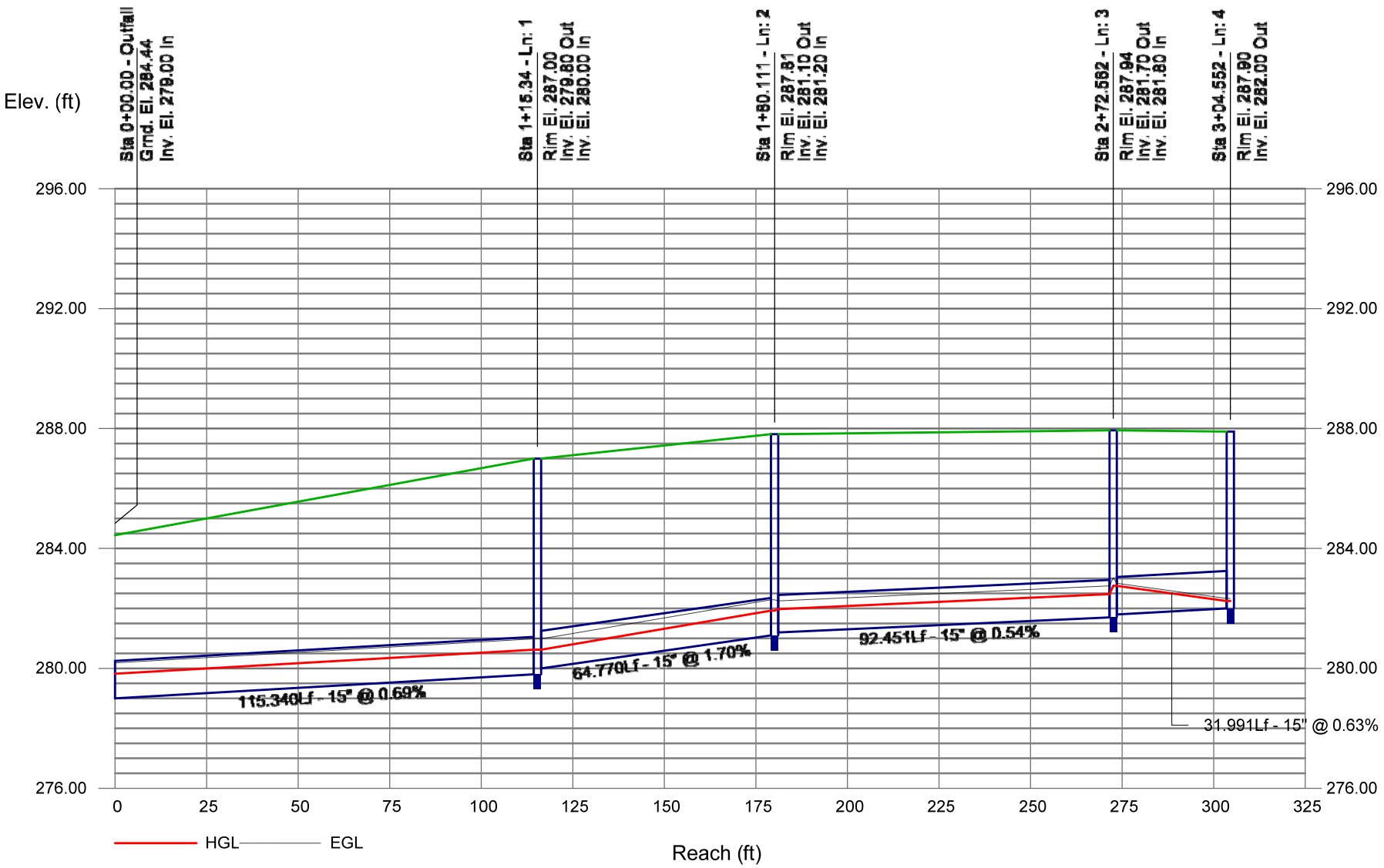
Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: Storm.stm	Number of lines: 4	Date: 1/31/2025

Storm Sewer Profile

Proj. file: Storm.stm



Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line Slope (%)	HGL Down (ft)	HGL Up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns Line No.	Junction Type
1	Pipe - (76)	4.08	15	Cir	115.340	279.00	279.80	0.694	279.82	280.62	0.28	280.62	End	Manhole
2	Pipe - (77)	4.11	15	Cir	64.770	280.00	281.10	1.698	280.62	281.92	n/a	281.92	1	Manhole
3	Pipe - (78)	3.31	15	Cir	92.451	281.20	281.70	0.541	281.97	282.47	0.27	282.74	2	Manhole
4	Pipe - (79)	0.58	15	Cir	31.991	281.80	282.00	0.625	282.74	282.30	n/a	282.30	3	Manhole

Project File: Storm.stm | Number of lines: 4 | Run Date: 1/31/2025

NOTES: Return period = 10 Yrs.

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	115.340	0.00	0.73	0.00	0.00	0.58	5.0	5.9	7.0	4.08	5.38	4.79	15	0.69	279.00	279.80	279.82	280.62	284.44	287.00	Pipe - (76)
2	1	64.770	0.15	0.73	0.80	0.12	0.58	5.0	5.7	7.0	4.11	8.42	5.81	15	1.70	280.00	281.10	280.62	281.92	287.00	287.81	Pipe - (77)
3	2	92.451	0.48	0.58	0.80	0.38	0.46	5.0	5.3	7.1	3.31	4.75	4.18	15	0.54	281.20	281.70	281.97	282.47	287.81	287.94	Pipe - (78)
4	3	31.991	0.10	0.10	0.80	0.08	0.08	5.0	5.0	7.2	0.58	5.11	1.59	15	0.63	281.80	282.00	282.74	282.30	287.94	287.90	Pipe - (79)

Project File: Storm.stm | Number of lines: 4 | Run Date: 1/31/2025

NOTES:Intensity = 88.24 / (Inlet time + 15.50) ^ 0.83; Return period =Yrs. 10 ; c = cir e = ellip b = box

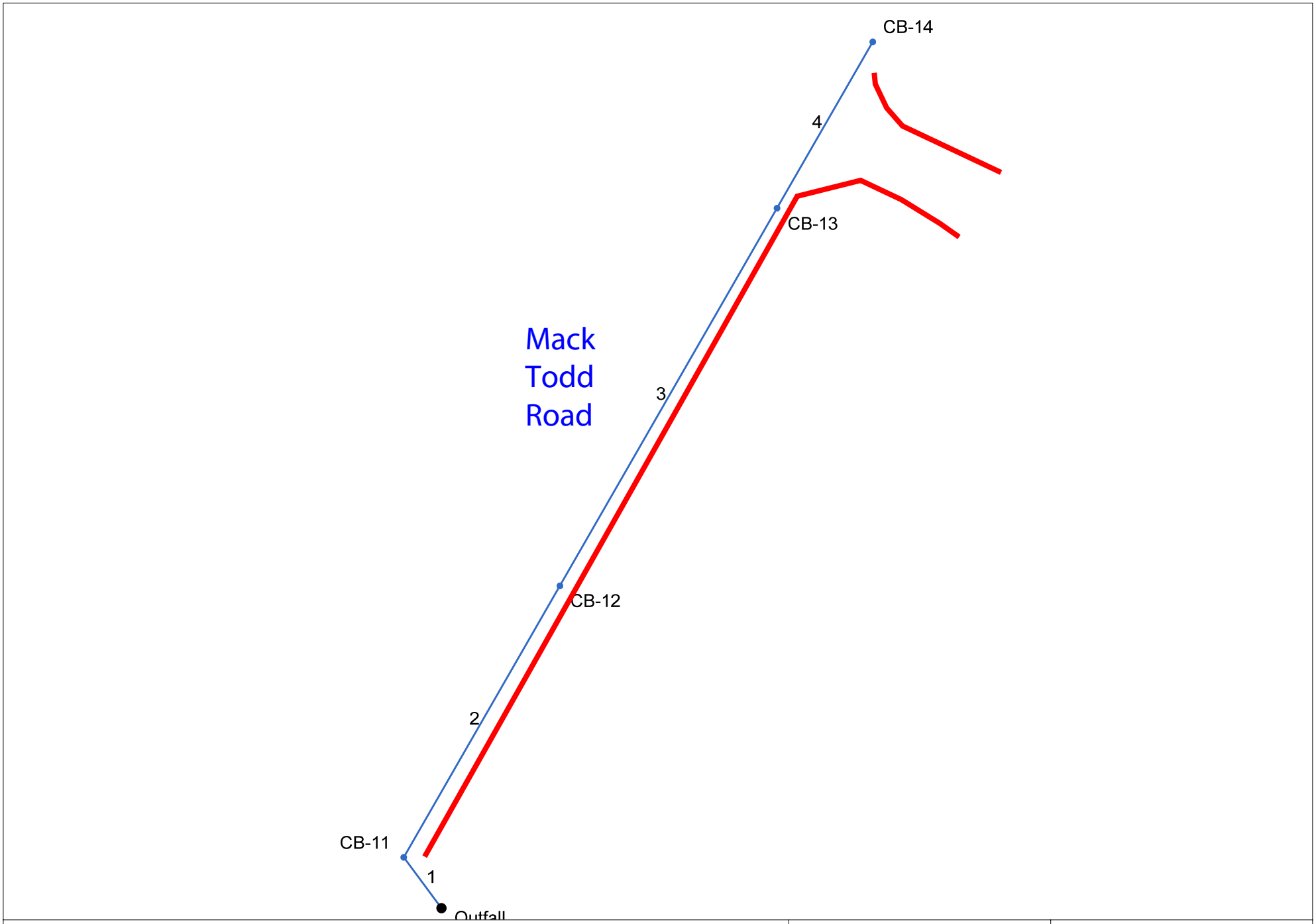
Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
			Invert elev	HGL elev	Depth	Area	Vel	Vel head	EGL elev	Sf		Invert elev	HGL elev	Depth	Area	Vel	Vel head	EGL elev	Sf	Ave Sf	Enrgy loss		
	(in)	(cfs)	(ft)	(ft)	(ft)	(sqft)	(ft/s)	(ft)	(ft)	(%)	(ft)	(ft)	(ft)	(ft)	(sqft)	(ft/s)	(ft)	(ft)	(%)	(%)	(ft)	(K)	(ft)
1	15	4.08	279.00	279.82	0.82	0.85	4.78	0.36	280.18	0.000	115.340	279.80	280.62	0.82**	0.85	4.80	0.36	280.98	0.000	0.000	n/a	0.79	0.28
2	15	4.11	280.00	280.62	0.62	0.60	6.81	0.36	280.98	0.000	64.770	281.10	281.92	0.82**	0.85	4.82	0.36	282.28	0.000	0.000	n/a	0.82	n/a
3	15	3.31	281.20	281.97	0.77*	0.79	4.18	0.27	282.24	0.541	92.451	281.70	282.47	0.77	0.79	4.18	0.27	282.74	0.539	0.540	0.499	1.00	0.27
4	15	0.58	281.80	282.74	0.94	0.22	0.58	0.10	282.85	0.000	31.991	282.00	282.30	0.30**	0.22	2.60	0.10	282.40	0.000	0.000	n/a	1.00	n/a

Project File: Storm.stm | Number of lines: 4 | Run Date: 1/31/2025

Notes: * depth assumed; ** Critical depth. ; c = cir e = ellip b = box

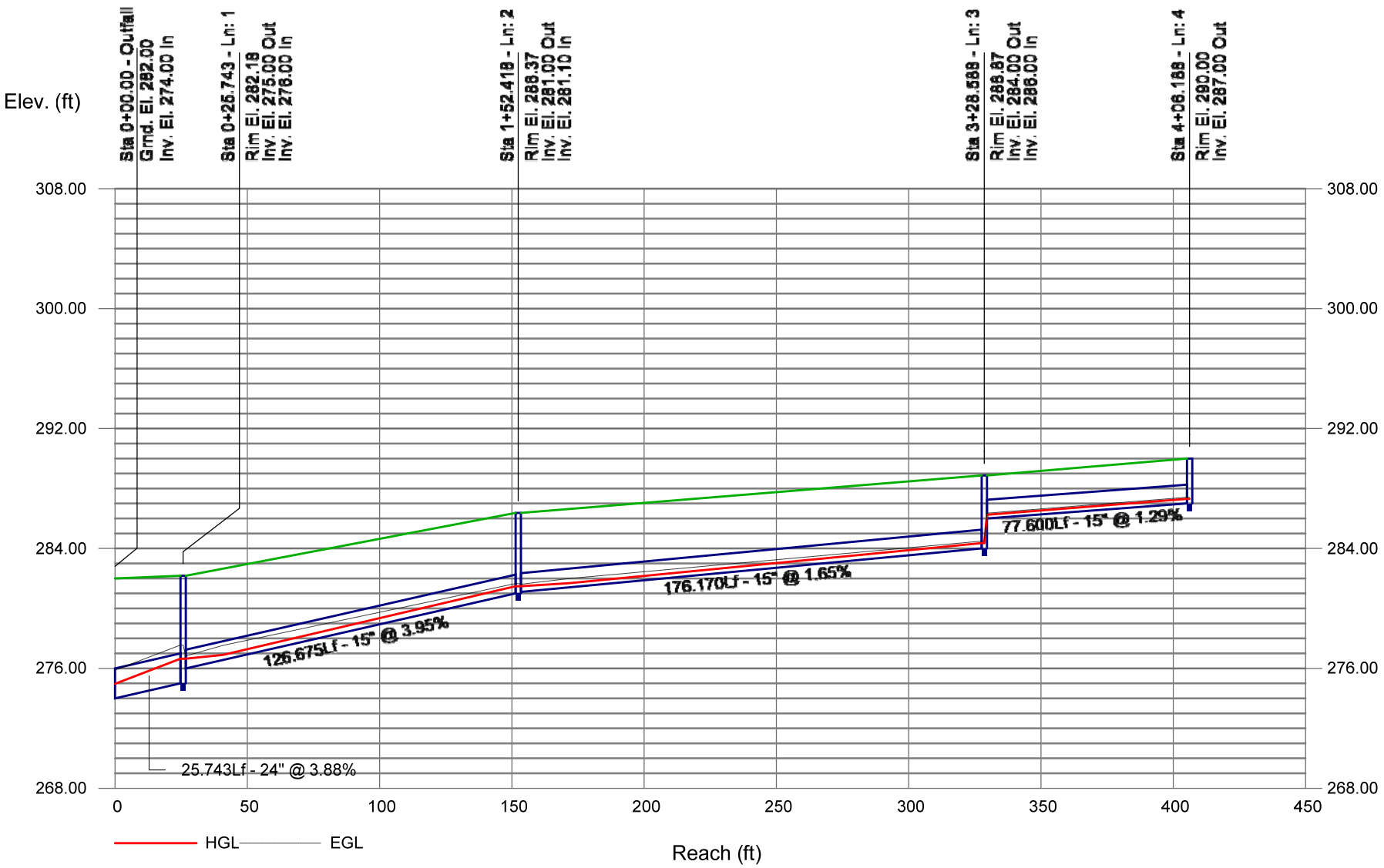
Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: Storm NCDOT.stm	Number of lines: 4	Date: 1/31/2025

Storm Sewer Profile

Proj. file: Storm NCDOT.stm



Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	25.743	0.09	0.40	0.70	0.06	0.28	5.0	7.2	6.7	21.16	44.58	10.83	24	3.88	274.00	275.00	274.97	276.65	282.00	282.18	CB-11
2	1	126.675	0.14	0.31	0.70	0.10	0.22	5.0	6.5	6.8	1.48	12.83	2.86	15	3.95	276.00	281.00	276.65	281.48	282.18	286.37	CB-12
3	2	176.170	0.05	0.17	0.70	0.04	0.12	5.0	5.4	7.1	0.85	8.29	2.78	15	1.65	281.10	284.00	281.48	284.36	286.37	288.87	CB-13
4	3	77.600	0.12	0.12	0.70	0.08	0.08	5.0	5.0	7.2	0.61	7.33	3.12	15	1.29	286.00	287.00	286.24	287.30	288.87	290.00	CB-14

Project File: Storm NCDOT.stm

Number of lines: 4

Run Date: 1/31/2025

NOTES:Intensity = 88.24 / (Inlet time + 15.50) ^ 0.83; Return period =Yrs. 10 ; c = cir e = ellip b = box

Inlet Report

Line No	Inlet ID	Q = CIA (cfs)	Q carry (cfs)	Q capt (cfs)	Q Byp (cfs)	Junc Type	Curb Inlet		Grate Inlet			Gutter							Inlet			Byp Line No
							Ht (in)	L (ft)	Area (sqft)	L (ft)	W (ft)	So (ft/ft)	W (ft)	Sw (ft/ft)	Sx (ft/ft)	n	Depth (ft)	Spread (ft)	Depth (ft)	Spread (ft)	Depr (in)	
1	CB-11	19.76*	0.00	19.76	0.00	Comb	4.0	48.68	97.36	48.68	2.00	Sag	2.00	0.050	0.020	0.013	0.30	12.01	0.30	12.01	0.0	Off
2	CB-12	0.71	0.00	0.71	0.00	Comb	4.0	0.13	0.26	0.13	2.00	Sag	2.00	0.050	0.020	0.000	0.16	5.23	0.16	5.23	0.0	Off
3	CB-13	0.25	0.00	0.25	0.00	Comb	4.0	0.05	0.09	0.05	2.00	Sag	2.00	0.050	0.020	0.013	0.12	2.96	0.12	2.96	0.0	Off
4	CB-14	0.61	0.00	0.61	0.00	Comb	4.0	0.11	0.23	0.11	2.00	Sag	2.00	0.050	0.020	0.013	0.15	4.44	0.15	4.44	0.0	Off

Project File: Storm NCDOT.stm

Number of lines: 4

Run Date: 1/31/2025

NOTES: Inlet N-Values = 0.016; Intensity = 88.24 / (Inlet time + 15.50) ^ 0.83; Return period = 10 Yrs. ; * Indicates Known Q added. All curb inlets are throat.

Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
			Invert elev	HGL elev	Depth	Area	Vel	Vel head	EGL elev	Sf		Invert elev	HGL elev	Depth	Area	Vel	Vel head	EGL elev	Sf	Ave Sf	Enrgy loss		
	(in)	(cfs)	(ft)	(ft)	(ft)	(sqft)	(ft/s)	(ft)	(ft)	(%)	(ft)	(ft)	(ft)	(ft)	(sqft)	(ft/s)	(ft)	(ft)	(%)	(%)	(ft)	(K)	(ft)
1	24	21.16	274.00	274.97	0.97	1.51	14.00	0.91	275.88	0.000	25.743	275.00	276.65	1.65**	2.77	7.65	0.91	277.56	0.000	0.000	n/a	1.42	n/a
2	15	1.48	276.00	276.65	0.65	0.44	2.32	0.18	276.83	0.000	126.675	281.00	281.48 j	0.48**	0.44	3.40	0.18	281.66	0.000	0.000	n/a	0.50	n/a
3	15	0.85	281.10	281.48	0.38	0.29	2.67	0.13	281.61	0.000	176.170	284.00	284.36 j	0.36**	0.29	2.89	0.13	284.49	0.000	0.000	n/a	0.50	n/a
4	15	0.61	286.00	286.24	0.24*	0.17	3.61	0.11	286.35	0.000	77.600	287.00	287.30	0.30**	0.23	2.63	0.11	287.41	0.000	0.000	n/a	1.00	n/a

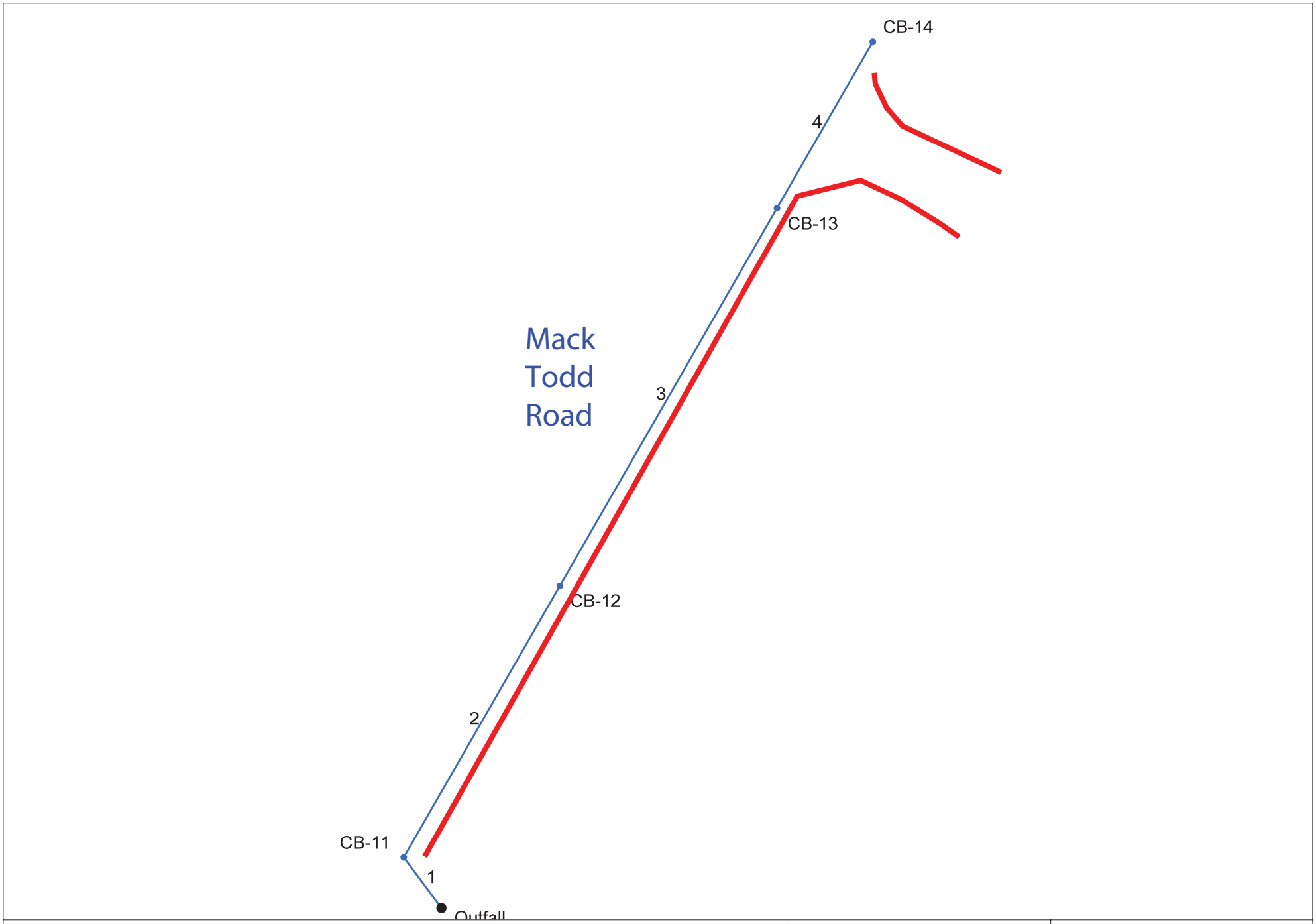
Project File: Storm NCDOT.stm | Number of lines: 4 | Run Date: 1/31/2025

Notes: * depth assumed; ** Critical depth.; j-Line contains hyd. jump ; c = cir e = ellip b = box

Appendix F
Gutter Spread Calculations

PLD

Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: Storm NCDOT.stm	Number of lines: 4	Date: 1/31/2025

Inlet Report

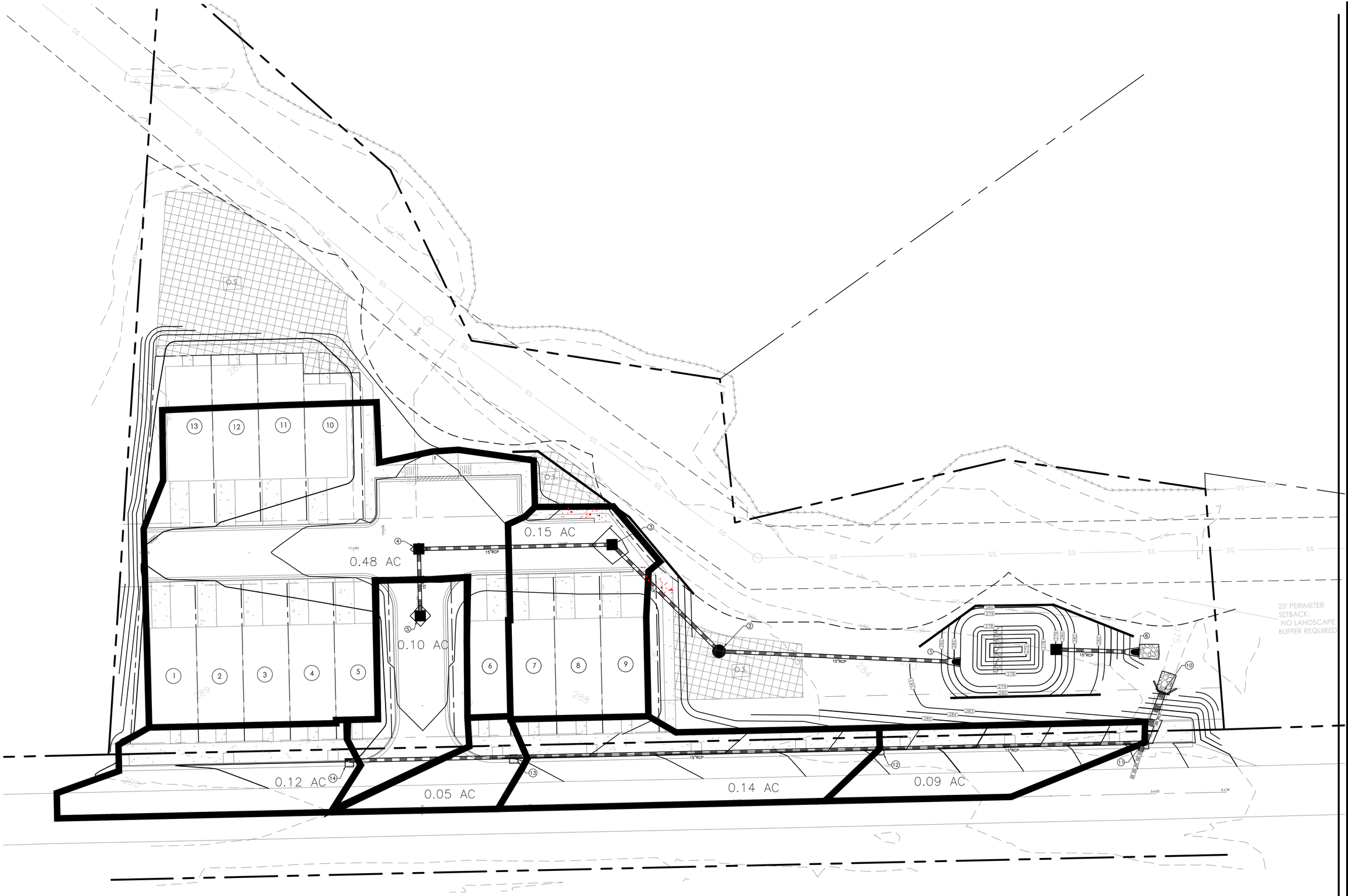
Line No	Inlet ID	Q = CIA (cfs)	Q carry (cfs)	Q capt (cfs)	Q Byp (cfs)	Junc Type	Curb Inlet		Grate Inlet			Gutter							Inlet			Byp Line No
							Ht (in)	L (ft)	Area (sqft)	L (ft)	W (ft)	So (ft/ft)	W (ft)	Sw (ft/ft)	Sx (ft/ft)	n	Depth (ft)	Spread (ft)	Depth (ft)	Spread (ft)	Depr (in)	
1	CB-11	0.25	0.01	0.26	0.00	Comb	6.0	48.68	0.00	3.00	2.00	0.022	2.00	0.042	0.020	0.013	0.09	2.41	0.00	0.00	0.0	Off
2	CB-12	0.39	0.00	0.38	0.01	Comb	6.0	0.13	0.00	3.00	2.00	0.020	2.00	0.042	0.020	0.013	0.11	3.21	0.03	0.69	0.0	1
3	CB-13	0.14	0.01	0.15	0.00	Comb	6.0	0.05	0.00	3.00	2.00	0.017	2.00	0.042	0.020	0.013	0.08	1.85	0.00	0.00	0.0	2
4	CB-14	0.34	0.00	0.33	0.01	Comb	6.0	0.11	0.00	3.00	2.00	0.016	2.00	0.042	0.020	0.013	0.11	3.13	0.03	0.62	0.0	3

Project File: Storm NCDOT spread.stm | Number of lines: 4 | Run Date: 1/31/2025

NOTES: Inlet N-Values = 0.016; Intensity = 4.59 / (Inlet time + 124.30) ^ 0.03; Return period = 2 Yrs. ; * Indicates Known Q added. All curb inlets are throat.

Appendix G
Storm Sewer System Drainage Area Map

PLD



PLD

PIEDMONT LAND DESIGN, PLLC
8522-204 SIX FORKS ROAD
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ENGR. FIRM LICENSE NO. F-0843

PRELIMINARY
NOT FOR CONSTRUCTION

901 MACK TODD ROAD
901 MACK TODD ROAD
ZEBULON, NORTH CAROLINA

ISSUED: **11 OCT 2024**

REVISIONS:

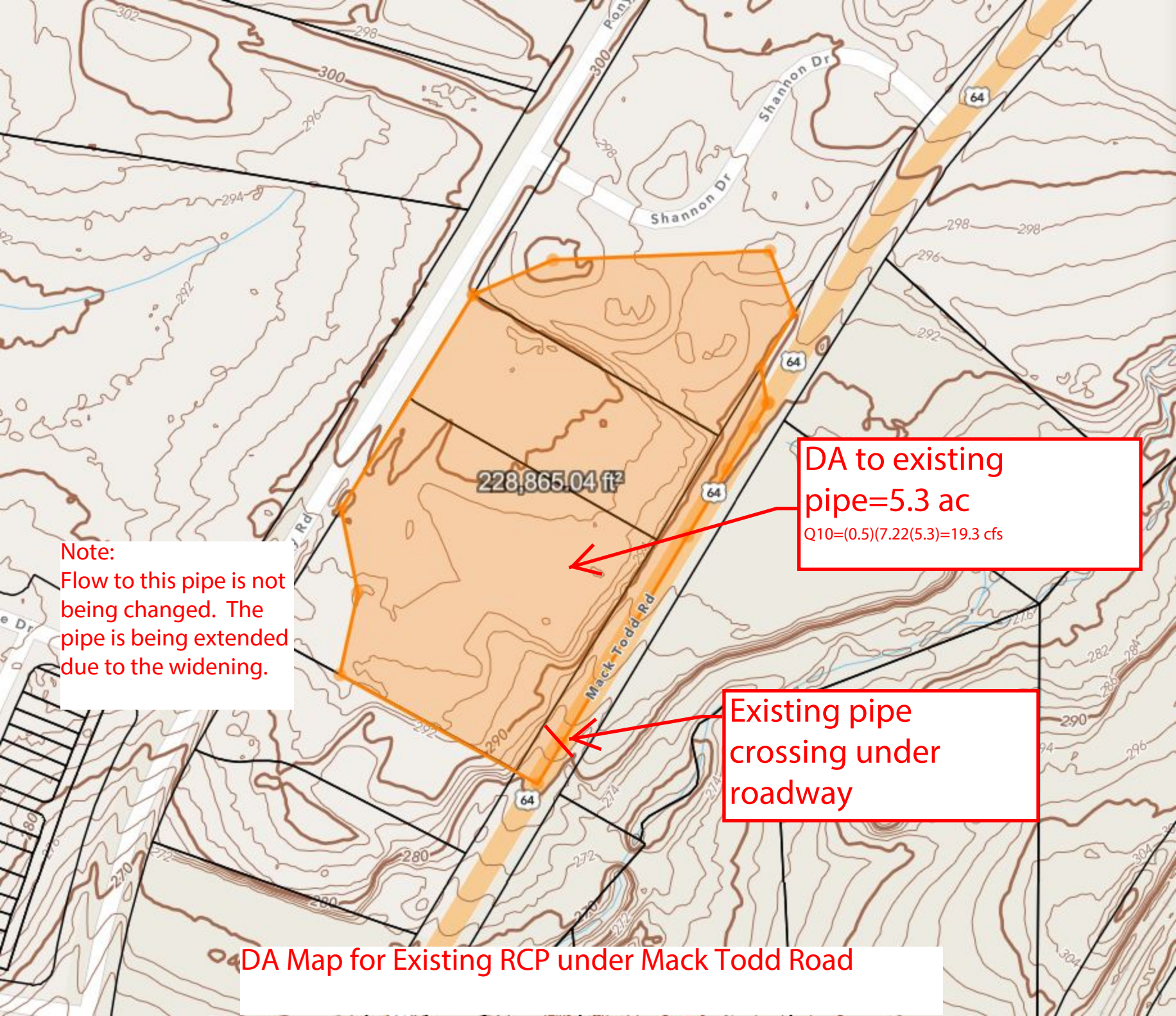
DRAWN BY: **MLS**
CHECKED BY: **MLS**

PROJECT: **CPMTRZ**

STORM SEWER DA MAP

DWG. NO. **DA 3.0**

F:\Projects\CPMTRZ\Drawings\Site\mls2.dwg - da maps Jan 31, '25 - 11:30am



DA Map for Existing RCP under Mack Todd Road

Appendix H
Sediment Basin Drainage Area Map

PLD

DA TO SEDIMENT
BASIN = 1.0 AC

DA TO DIVERSION
DITCH = 0.8 AC

RIPARIAN BUFFER ZONE 1 (30')

RIPARIAN BUFFER ZONE 2 (20')

BASIN DEWATERING BAG AND 20' LONG PAD LOCATION

25' PERIMETER SETBACK; NO LANDSCAPE BUFFER REQUIRED

MACK TODD RD. / US 64 BUSINESS

60' PUBLIC ROW

0 20 40 60

SCALE IN FEET

PLD

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ZEBULON, NORTH CAROLINA**

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PROJECT: **CPMTRZ**

SED BASIN DA MAP

DWG. NO. **DA 4.0**

F:\Projects\CPMTRZ\Drawings\Site\CPMTRZ_Base.dwg - do maps Apr 30, '25 - 4:00pm

Appendix I
Sediment Basin Calculations

PLD

Sediment Basin Design															
	PRE	POST	GOVERNING			REQUIRED	REQUIRED	MIN	MIN		PROVIDED	PROVIDED	WEIR	SKIMMER	ORIFICE
BASIN	DA	DA	DA	C	Q25	SA	VOLUME	L	W	D	SA	VOLUME	LENGTH	DIA	DIA
	(ac)	(ac)	(ac)		(cfs)	(sf)	(cf)	(ft)	(ft)	(ft)	(sf)	(cf)	(ft)	(in)	(in)
1	1.0	1.0	1.0	0.5	4.11	1,788	1,800	see plan		5	1,798@279	2,656@279	10	1.5	0.9

Calculate Skimmer Size

Basin Volume in Cubic Feet	1,800	Cu.Ft	**Skimmer Size**	**1.5** Inch
Days to Drain*	3	Days	Orifice Radius	**0.4** Inch[es]
			Orifice Diameter	**0.9** Inch[es]

*In NC assume 3 days to drain

Appendix J
Temporary Diversion Ditch/Slope Drain Calculations

PLD

Diversion Ditch Design

Diversion	DRAINAGE AREA (AC)	Total DA (CFS)	C	Q(10) (CFS)	SLOPE (FT/FT)	DEPTH (FT)	SHEAR STRESS (PSF)	ALLOWABLE SHEAR STRESS (PSF)	LINER
1	0.80	0.80	0.5	2.89	0.005	0.56	0.17	2.00	JUTE MAT

SLOPE DRAINS

Basin Slope Drain	DA (AC)	Q(10) (CFS)	REQUIRED AREA (SF)	MINIMUM DIA (FT)	MINIMUM DIA (INCHES)	USE (INCHES)
SCM #1-	1	3.61	0.61	0.88	10.59	12

PLD

Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Apr 30 2025

Temp. Diversion Ditch #1

Trapezoidal

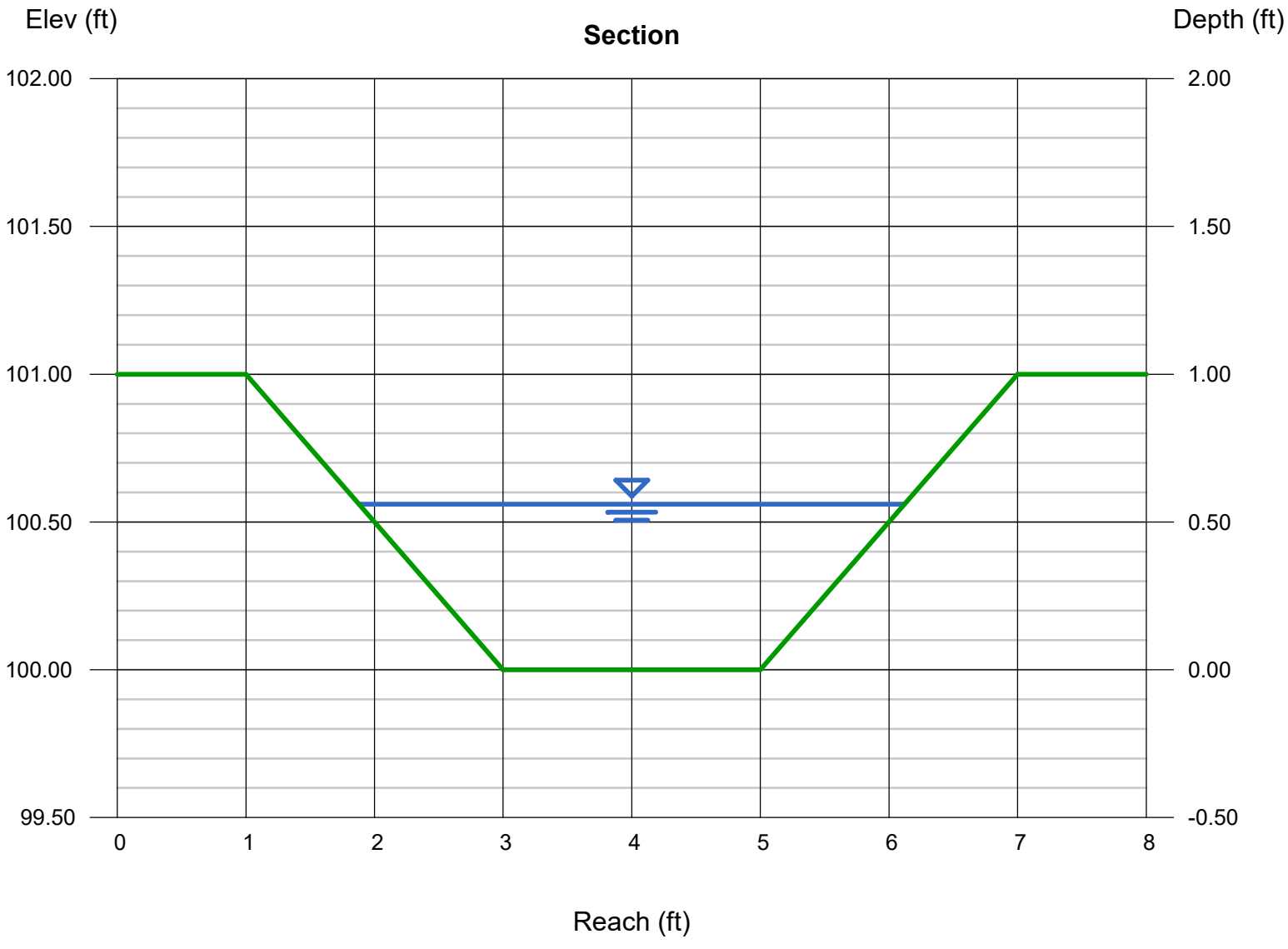
Bottom Width (ft)	= 2.00
Side Slopes (z:1)	= 2.00, 2.00
Total Depth (ft)	= 1.00
Invert Elev (ft)	= 100.00
Slope (%)	= 0.50
N-Value	= 0.033

Calculations

Compute by:	Known Q
Known Q (cfs)	= 2.89

Highlighted

Depth (ft)	= 0.56
Q (cfs)	= 2.890
Area (sqft)	= 1.75
Velocity (ft/s)	= 1.65
Wetted Perim (ft)	= 4.50
Crit Depth, Yc (ft)	= 0.36
Top Width (ft)	= 4.24
EGL (ft)	= 0.60



Appendix K
Energy Dissipater Calculations

PLD

Energy Dissipaters

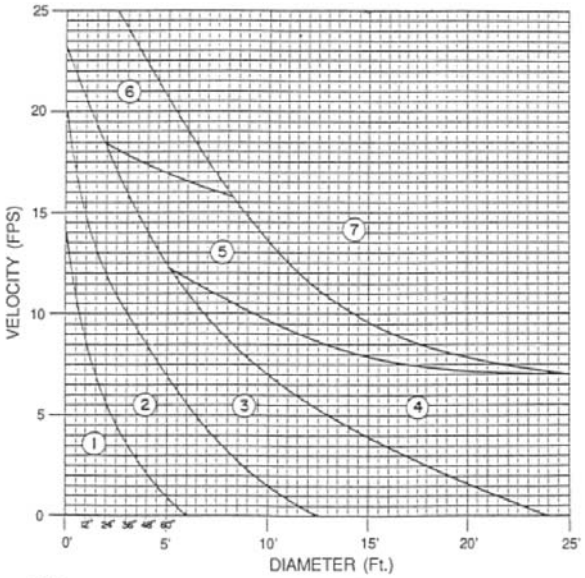


Figure 8.06c

ZONE	APRON MATERIAL	LENGTH OF APRON: TO PROTECT CULVERT L1	LENGTH OF APRON: TO PREVENT SCOUR HOLE USE L2 ALWAYS L2
1	STONE FILLING (FINE) CL. A	3 X D_o	4 x D_o
2	STONE FILLING (LIGHT) CL. B	3 X D_o	6 x D_o
3	STONE FILLING (MEDIUM) CL. 1	4 X D_o	8 x D_o
4	STONE FILLING (HEAVY) CL. 1	4 X D_o	8 x D_o
5	STONE FILLING (HEAVY) CL. 2	5 X D_o	10 x D_o
6	STONE FILLING (HEAVY) CL. 2	6 X D_o	10 x D_o
7	SPECIAL STUDY REQUIRED (ENERGY DISSIPATORS, STILLING BASIN OR LARGER SIZE STONE).		

Figure 8.06d

Width = 3 times pipe dia. (min.)

	Diameter (inches)	Manning's "n"	Min. thickness of lining	(inches)
Fine	3	0.031	9	12
Light	6	0.035	12	18
Medium	13	0.040	18	24
Heavy	23	0.044	30	36
			(Channels)	(Dissapators)

Required Energy Dissipater type/Dimensions

Outlet	Diameter (inches)	Velocity (fps)	Zone	APRON DIMENSIONS: Rip-Rap	Lengh (ft)	Width (ft)	Thickness (in)
1	15	4.39	1	Class B	9	5	18
6	18	9.42	2	Class B	9	5	18
10	24	14.23	2	Class B	12	6	18