

**South Main
403 South Main**

**Rolesville, NC
Wake County**

STORMWATER MANAGEMENT ANALYSIS

**September 29, 2022
Revised: January 9, 2023**



Prepared for:

**Toy Storage, LLC
2700 Gresham lake Rd.
Raleigh, NC 27615**

South Main

Stormwater Management Analysis

Project Name: South Main

Project Address: 403 South Main Street
Rolesville, NC

Pins: 1758784708

Latitude: N 35.916120
Longitude: W -78.468430

Zoning: GC

River Basin: Neuse

Watershed: Lower Neuse

HUC: 0302020107

Developer: Toy Storage, LLC
2700 Gresham Lake Rd.
Raleigh, NC 27615

Telephone: (919) 604-0505

Email: Storit@AOL.com

Site Description

The project consists of a single parcel located at the intersection of Wall Creek Drive and South Main Street in downtown Rolesville. The lot is approximately 1.80 acres (78,408 sq feet) and a portion of the lot on the south property line will be used for the BMP (approximately 0.23 acres from parcel 1758.08-78-5571). The parcel is vacant with grassy vegetation with approximately 4195 sq ft of impervious area. The project will consist of a commercial / residential building. The impervious area post development will be 1.19 acres.

The site is in the Neuse River Basin, Milburnie Lake Watershed and subject to those rules regarding nutrient management and post storm water runoff.

The parcel is not located within a flood zone as noted per FEMA map 3720175800K, Dated July 19, 2022.

Based on the Wake County SCS soils map (attached) the onsite soils are primarily Durham Series (DuB), soil group B, throughout the tract. The Durham Series soil type is considered to be well drained soils and based on information in the Soil Survey.

Seasonal High Water Table (SHWT)

A soils investigation was done to determine the SHWT and the results attached in the report from Protocol Sampling Services, Inc.

Proposed Development

The stormwater analysis considers a proposed development that will include one commercial building on the site.

The proposed stormwater facility for the project will consist of one Bioretention device. Drainage from the majority of the property will be collected within the storm pipe system, surface drainage and routed towards the BMP. The device is designed in accordance with NCDENR DWR's BMP Manual, and will manage the 2, 10, and 100 year, 24-hour storm events as noted below. The post development runoff from the noted storm events is less than the pre-development rates for the site. **As a result, per the Town of Rolesville UDO 7.5.4, a Downstream Impact Analysis is not required since the post development runoff rate is less than pre-development.**

The proposed BMP will capture the runoff from the majority of impervious area from the lot. However, a small portion of the site and impervious does not drain towards the device; however, the device has been designed to treat all the impervious area as a part of the WQV. The total impervious associated with the development has been accounted for treatment within the Bioretention device.

Methodology (Peak Flow and Nutrient Management)

The project is located within the Town of Rolesville's / Wake County permitting authority, and within the Neuse River / Milburnie Lake watershed and the project is subjected to those rules listed in the LDO, Appendix B, Section 1.2 Stormwater Management, Adopted 6-1-2021.

Under the Town's LDO stormwater requirements as noted below. The project is considered a High-Density project.

Development Standards for High-Density

Projects High-Density Projects shall implement stormwater control measures that comply with each of the following standards, in addition to the General Standards found in subsection B of this section:

- a. The measures shall control and treat runoff from the first inch of rain. Runoff volume drawdown time shall be a minimum of 48 hours, but not more than 120 hours.*
- b. All structural stormwater treatment systems used to meet these requirements shall be designed to have a minimum of 85 percent average annual removal for Total Suspended Solids (TSS).*
- c. All Development and Redevelopment projects required to manage storm water shall provide permanent on-site BMPs to lower the nitrogen export amounts as part of the storm water management plan. BMPs are to be in accordance with and as specified in the Design Manual*
- d. Structural and Non-structural BMPs shall be used to ensure there is no net increase in peak flow leaving the site from the pre-Development conditions for the one-year, 24-hour storm. Runoff volume drawdown time shall be a minimum of 48 hours, but not more than 120 hours.*
- e. General engineering design criteria for all projects shall be in accordance with 15A NCAC 2H .1008(c), as explained in the Design Manual*

Peak flow – The methodology used to determine the runoff is the Rational Method.

Time of Concentration used in the analysis is 5 minutes.

The POI (point of interest) for the project is at the southwest corner of the site

Based on the proposed stormwater management for the project no adverse impact is anticipated on adjacent parcels. The BMP system and drainage point from the project does encroach on another property with new development and grading operations. The impacted property is owned by the same company involved with this projected.

Using the Rational Method, the modeling of the BMP at the POI provides the following results in peak flow management.

Total site peak runoff in cfs (noted in the attached Hydraflow report) is as follows.

Storm Event	Pre	Post
Q2	3.11	.27
Q10	3.90	.34
Q100	5.25	.46

Nutrient Management

The BMP provides treatment for drainage area within the project and also provides the TSS removal of 85%.

O&M Manual

A copy of the project's O&M manual is attached for the Bioretention device.

Flood Hazard Area (Soils)

There are no Flood Hazard Soils on site (see attached GIS map).

Q100 Backwater Effect at BMP (13. Z Wake County Checklist)

There is no storm pipe from the ROW that discharges to the BMP and as a result Q100 backwater review not needed.

Downstream Impact Analysis (DIA)

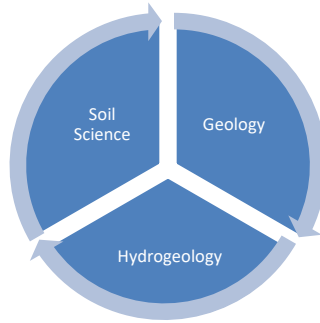
The Town of Rolesville requires a DIA to be performed with the 10% rule. As a result of the proposed BMP the post runoff from the development of the project will reduce the peak stormwater runoff to below the predevelopment standards. As a result, the post stormwater runoff increase is less than 10% on adjacent properties.

Adjacent Property Evaluation

Approximately .23 acres (PIN: 1758.08-78-5571) will be included with the proposed project for the location of the BMP. The impact on the host parcel is summarized as follows.

The StorageMax site Bioretention device has a WQV availability of 9467 cubic feet (1 foot of storage). Based on the revised area to impervious ratio the WQV needed is 6746 cubic feet. See attached summary of the existing BMP for the noted site.

Attachments.



4114 Laurel Ridge Drive
Raleigh, North Carolina 27612

Protocol Sampling Service, Inc.
“Experts in Environmental Compliance”

(919) 210-6547

Protocolsampling@yahoo.com
Environmentalservicesnc.com

August 8, 2022

Mr. Keith P. Gettle, P.E.
Gettle Engineering & Design, PLLC
3616 Waxwing Court
Wake Forest, North Carolina 27587

Re: Storm Water Management Soil Investigation
503 South Main Street
Rolesville, Wake County, North Carolina
Protocol Project #22-126

Dear Mr. Gettle:

The following Soil Investigation is submitted to assist in a site assessment for storm water management improvements at 503 South Main Street in Rolesville, Wake County, North Carolina.

SITE HISTORY AND PHYSICAL CHARACTERISTICS

The subject property was formerly occupied by a residential structure. Commercial and residential development surround the subject property. Protocol Sampling Service, Inc. of Raleigh, North Carolina was hired to perform an investigation to identify the depth to seasonal high-water table in the location of the proposed BMP structure.

SOIL INVESTIGATION

The field survey was conducted on Friday July 29, 2022. One (1) soil boring was advanced in the center of the proposed BMP to a depth of 72-inches below land surface (bls) with a hand auger (GoogleEarth™ Map – attached). Soil color was determined with a Munsell Soil Color Chart. The presence of fill or other disturbances, the depth to the seasonal high-water table, soil structure and consistence were noted. The boring was also checked for reduced colors, an anaerobic smell or obvious soil wetness.

FINDINGS - Soil

- The proposed BMP structure located on the southern section of the project was found to have an apparent depth to seasonal high-water table (perched) of 15 to 18-inches bls due to the presence of a drainageway that carries stormwater from higher properties through this portion of the subject property .

- Competent granite bedrock was not encountered to a depth of 72-inches bls in the proposed BMP. No ground water was encountered in the soil boring.
- The depth to the perched SHWT at 15-18-inches bls is considered to be temporary and will be removed when the BMP structure is built.
- A seasonal high-water table of 4-feet bls should be considered the true SHWT elevation.

The findings presented herein are based on the site conditions observed during performance of the field survey on July 29, 2022.

Please call me at (919) 210-6547 if you have any questions or need further assistance.

Sincerely,
Protocol Sampling Service, Inc.



David E. Meyer, N.C.L.S.S.
President








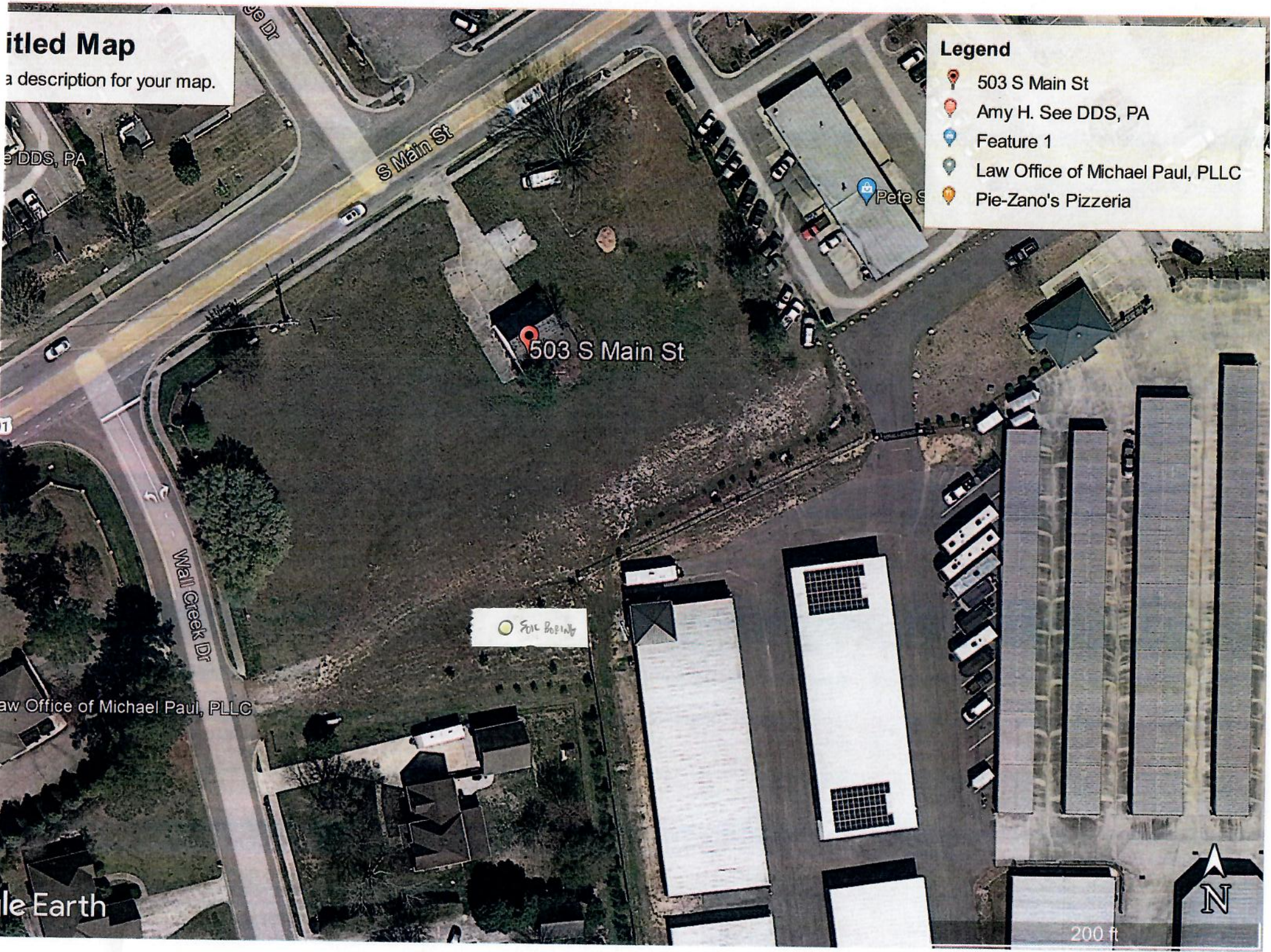
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Untitled Map

A description for your map.

Legend

-  503 S Main St
-  Amy H. See DDS, PA
-  Feature 1
-  Law Office of Michael Paul, PLLC
-  Pie-Zano's Pizzeria



503 S Main St

Full Body

200 ft



DDS, PA

Wall Creek Dr

S Main St

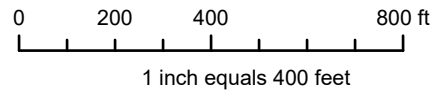
Pete S

Law Office of Michael Paul, PLLC

Google Earth



Site Map

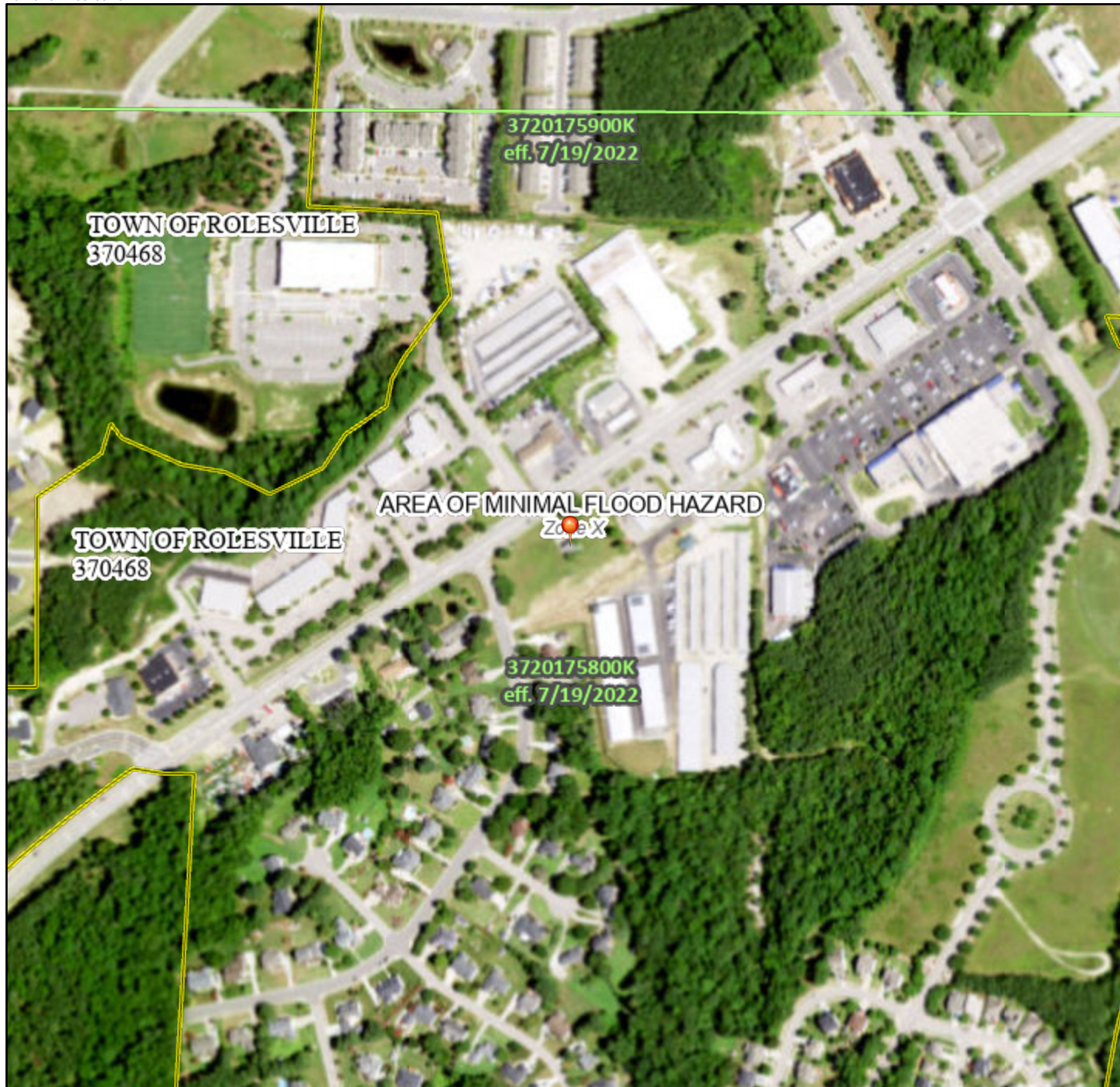


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National Flood Hazard Layer FIRMette



78°28'25"W 35°55'13"N



Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

78°27'47"W 35°54'44"N

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS		Without Base Flood Elevation (BFE) <i>Zone A, V, A99</i>
		With BFE or Depth <i>Zone AE, AO, AH, VE, AR</i>
		Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD		0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile <i>Zone X</i>
		Future Conditions 1% Annual Chance Flood Hazard <i>Zone X</i>
		Area with Reduced Flood Risk due to Levee. See Notes. <i>Zone X</i>
		Area with Flood Risk due to Levee <i>Zone D</i>
OTHER AREAS		NO SCREEN Area of Minimal Flood Hazard <i>Zone X</i>
		Effective LOMRs
GENERAL STRUCTURES		Area of Undetermined Flood Hazard <i>Zone D</i>
		Channel, Culvert, or Storm Sewer
		Levee, Dike, or Floodwall
OTHER FEATURES		20.2 Cross Sections with 1% Annual Chance
		17.5 Water Surface Elevation
		Coastal Transect
		Base Flood Elevation Line (BFE)
		Limit of Study
MAP PANELS		Digital Data Available
		No Digital Data Available
		Unmapped
		The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.



This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on **7/22/2022 at 4:32 PM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

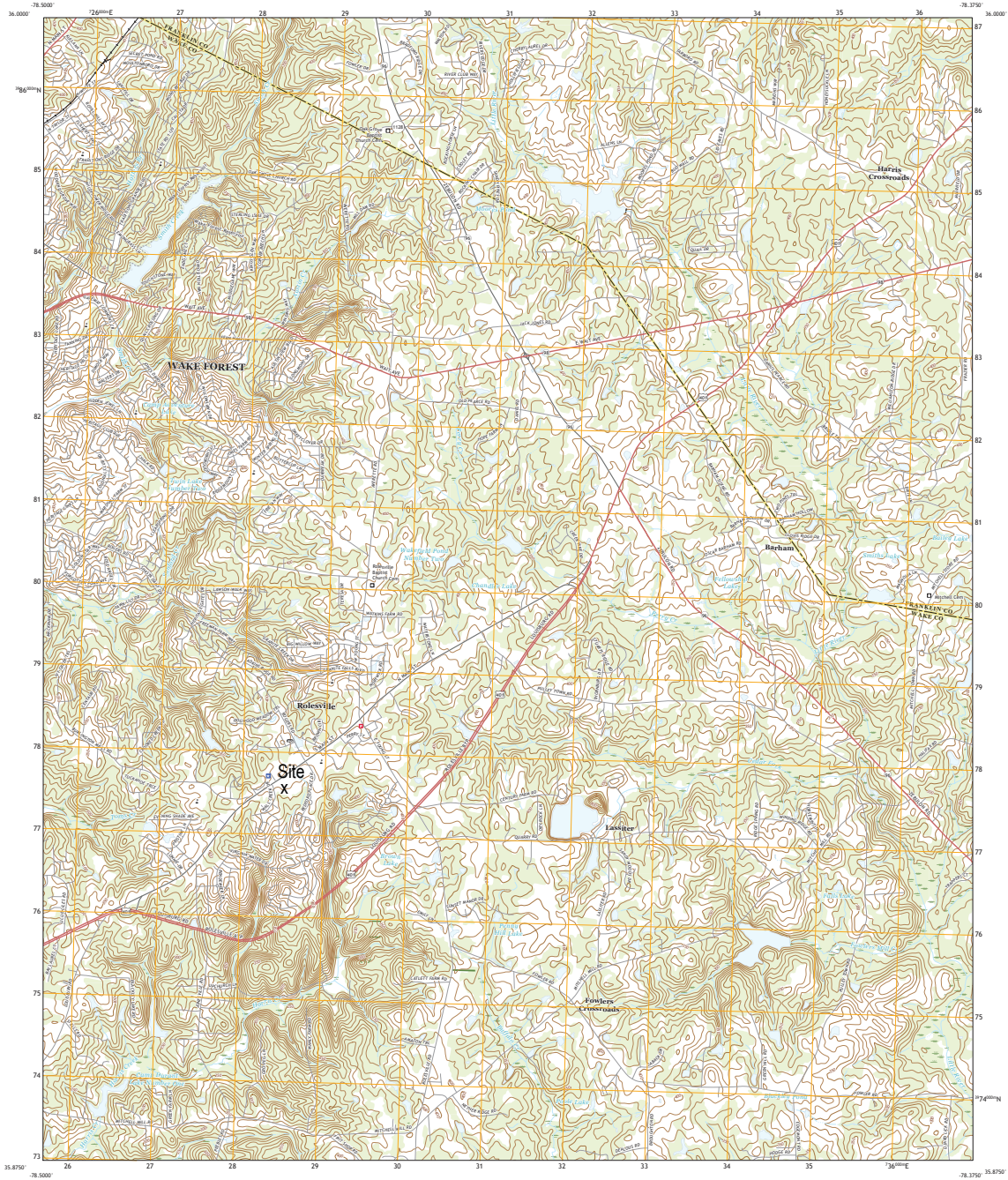
This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.



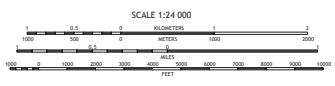
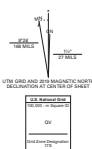
U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY



ROLESVILLE QUADRANGLE
NORTH CAROLINA
7.5-MINUTE SERIES



Produced by the United States Geological Survey
North American Datum of 1983 (NAD83)
World Geodetic System of 1984 (WGS84). Projection and
1:500-meter grid derived from the North American Datum 1983
This map is not a legal document. Accuracy may be
questioned for any scale. Please check with appropriate
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reusing private land.



QUADRANGLE CORRELATION

1	2	3	1 Green
4	5	6	2 Lenoir
7	8	9	3 Lenoir
10	11	12	4 Lenoir
13	14	15	5 Lenoir
16	17	18	6 Lenoir
19	20	21	7 Lenoir
22	23	24	8 Lenoir

ADJOINING QUADRANGLES

CONTOUR INTERVAL 10 FEET
NORTH AMERICAN VERTICAL DATUM OF 1983
This map was produced in conformance with the
National Geospatial Intelligence Agency (NGA) Standard, 2011.
A metadata file associated with this product is draft version 01.0.18

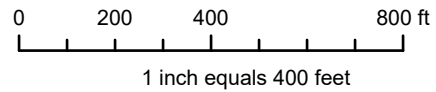


ROLESVILLE, NC
2019





Flood Prone Soils Map



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Table 3: HSGs for North Carolina Soil Types
(Malcom 1989)

Alaga	A	Dragston	D/C	Louisa	B	Ridgeland	C
Alamance	B	Dunbar	D/B	Louisburg	B	Rimini	C
Albany	C/A	Duplin	C/B	Lucy	A	Roanoke	D
Altavista	C/B	Durham	B	Lumbee	D/C	Rosman	B
Americus	A	Dykes	B	Lynchburg	C/B	Rumford	B
Appling	B	Edneyville	B	Lynn Haven	D/C	Ruston	B
Ashe	B	Elbert	D	Madison	B	Ruttege	D/B
Augusta	C	Elioak	B	Magnolia	B	Saluda	C/B
Avery	B	Elsinboro	B	Mantachie	C/B	Scranton	D/B
Aycock	B	Enon	C	Manteo	D	Seneca	C/B
Barclay	C	Eustis	A	Marlboro	B	Starr	B
Barth	C	Exum	C/B	Masada	B	State	B
Bayboro	D/C	Faceville	B	Maxton	B	Suncook	A
Bertie	C/B	Fannin	B	Mayodan	B	Surry	B
Bibb	D/B	Fletcher	B	McColl	D/C	Talladega	C
Bladen	D/C	Fuquay	B	Mecklenburg	C	Tallepoosa	C
Blaney	B	Georgeville	B	Meggett	D/C	Tate	B
Blanton	A	Gilead	C	Molena	A	Taturn	B
Bowie	B	Goldsboro	C/B	Musella	B	Thurmont	B
Braddock	B	Goldston	C	Myatt	D/C	Toccoa	B
Bradley	B	Granville	B	Nahunta	C/B	Toisnot	C/B
Brandywine	B	Grover	B	Nason	C	Torhuna	C/A
Brevard	B	Guin	A	Nixonton	B	Toxaway	D
Bucks	B	Gwinnett	B	Norfolk	B	Transylvania	B
Buncombe	A	Hartsells	B	Ochlockonee	B	Troup	A
Burton	B	Hatboro	D/C	Ocilla	C/B	Tuckerman	D/C
Byars	D	Hayesville	B	Olustee	D/C	Tusquitee	B
Cahaba	B	Haywood	B	Onslow	B	Unison	B
Cape Fear	D/B	Helena	C	Orange	D	Vance	C
Caroline	C	Herndon	B	Orangeburg	B	Varina	C
Cartecay	C	Hiwassee	B	Osier	D	Vaucluse	C
Cataula	C	Hoffman	C	Pacolet	B	Wadesboro	B
Cecil	B	Hulett	B	Pactolus	C/A	Wagram	A
Chandler	B	Hyde	D/C	Pamlico	D/C	Wahee	D/C
Chastain	D	Invershield	C	Pantego	D/C	Wake	D
Chester	B	Iredell	D	Pasquotank	D/B	Watauga	B
Chesterfield	B	Iuka	C	Pelham	D/C	Wedowee	B
Chewacla	C	Izagora	C	Pender	D		
Chipley	C/A	Johnston	D/B	Penn	C/B		
Clifton	B	Johus	C/B	Pinkston	C		



POINT PRECIPITATION FREQUENCY ESTIMATES

G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M. Yekta, and D. Riley

NOAA, National Weather Service, Silver Spring, Maryland

[PF tabular](#) | [PF graphical](#) | [Maps & aerials](#)

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)¹										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.403 (0.369-0.442)	0.469 (0.430-0.512)	0.534 (0.489-0.583)	0.600 (0.549-0.654)	0.666 (0.606-0.726)	0.719 (0.652-0.783)	0.766 (0.690-0.834)	0.807 (0.723-0.881)	0.854 (0.759-0.932)	0.896 (0.789-0.980)
10-min	0.644 (0.590-0.705)	0.750 (0.687-0.819)	0.855 (0.783-0.933)	0.960 (0.877-1.05)	1.06 (0.966-1.16)	1.15 (1.04-1.25)	1.22 (1.10-1.33)	1.28 (1.15-1.40)	1.35 (1.20-1.48)	1.41 (1.24-1.54)
15-min	0.806 (0.738-0.882)	0.942 (0.864-1.03)	1.08 (0.991-1.18)	1.21 (1.11-1.32)	1.35 (1.23-1.47)	1.45 (1.31-1.58)	1.54 (1.39-1.68)	1.62 (1.45-1.76)	1.70 (1.51-1.86)	1.77 (1.56-1.94)
30-min	1.10 (1.01-1.21)	1.30 (1.19-1.42)	1.54 (1.41-1.68)	1.76 (1.61-1.92)	1.99 (1.81-2.17)	2.18 (1.98-2.38)	2.36 (2.12-2.57)	2.51 (2.25-2.74)	2.70 (2.40-2.95)	2.87 (2.53-3.14)
60-min	1.38 (1.26-1.51)	1.63 (1.50-1.78)	1.97 (1.81-2.15)	2.29 (2.09-2.50)	2.65 (2.42-2.89)	2.96 (2.68-3.22)	3.24 (2.92-3.54)	3.53 (3.16-3.85)	3.88 (3.45-4.24)	4.18 (3.69-4.58)
2-hr	1.61 (1.46-1.78)	1.92 (1.75-2.10)	2.34 (2.13-2.57)	2.75 (2.49-3.01)	3.23 (2.91-3.54)	3.66 (3.29-4.00)	4.07 (3.63-4.45)	4.49 (3.98-4.91)	5.04 (4.42-5.51)	5.53 (4.81-6.06)
3-hr	1.71 (1.55-1.89)	2.03 (1.85-2.24)	2.49 (2.26-2.74)	2.95 (2.67-3.24)	3.50 (3.15-3.84)	4.00 (3.58-4.39)	4.49 (3.99-4.92)	5.01 (4.41-5.49)	5.70 (4.97-6.24)	6.33 (5.46-6.95)
6-hr	2.05 (1.87-2.26)	2.44 (2.23-2.68)	2.99 (2.72-3.28)	3.54 (3.22-3.89)	4.22 (3.82-4.62)	4.85 (4.35-5.30)	5.47 (4.87-5.97)	6.12 (5.39-6.67)	7.01 (6.10-7.64)	7.83 (6.72-8.55)
12-hr	2.41 (2.21-2.66)	2.87 (2.64-3.15)	3.54 (3.24-3.88)	4.22 (3.84-4.62)	5.07 (4.59-5.53)	5.85 (5.26-6.37)	6.64 (5.91-7.22)	7.50 (6.59-8.14)	8.67 (7.51-9.42)	9.77 (8.32-10.6)
24-hr	2.86 (2.66-3.08)	3.46 (3.22-3.73)	4.35 (4.04-4.69)	5.06 (4.69-5.45)	6.03 (5.58-6.50)	6.81 (6.28-7.33)	7.61 (6.99-8.20)	8.45 (7.73-9.11)	9.60 (8.73-10.4)	10.5 (9.52-11.4)
2-day	3.32 (3.08-3.57)	3.99 (3.72-4.30)	4.99 (4.64-5.37)	5.77 (5.36-6.21)	6.84 (6.33-7.37)	7.69 (7.09-8.29)	8.57 (7.88-9.24)	9.48 (8.68-10.2)	10.7 (9.77-11.6)	11.7 (10.6-12.7)
3-day	3.52 (3.28-3.77)	4.23 (3.94-4.54)	5.25 (4.89-5.63)	6.06 (5.64-6.50)	7.17 (6.65-7.70)	8.06 (7.45-8.65)	8.97 (8.26-9.63)	9.91 (9.09-10.7)	11.2 (10.2-12.1)	12.2 (11.1-13.2)
4-day	3.72 (3.47-3.98)	4.46 (4.17-4.77)	5.52 (5.15-5.90)	6.36 (5.92-6.79)	7.51 (6.97-8.02)	8.43 (7.80-9.01)	9.37 (8.64-10.0)	10.3 (9.50-11.1)	11.7 (10.7-12.5)	12.8 (11.6-13.7)
7-day	4.31 (4.04-4.61)	5.15 (4.82-5.50)	6.29 (5.89-6.72)	7.20 (6.72-7.68)	8.44 (7.86-9.01)	9.43 (8.76-10.1)	10.5 (9.67-11.2)	11.5 (10.6-12.3)	13.0 (11.9-13.9)	14.1 (12.9-15.1)
10-day	4.91 (4.61-5.24)	5.85 (5.49-6.23)	7.05 (6.61-7.51)	7.99 (7.48-8.51)	9.27 (8.64-9.87)	10.3 (9.56-11.0)	11.3 (10.5-12.1)	12.3 (11.4-13.2)	13.7 (12.7-14.7)	14.8 (13.6-15.9)
20-day	6.59 (6.20-7.02)	7.79 (7.33-8.29)	9.23 (8.67-9.82)	10.4 (9.73-11.0)	11.9 (11.1-12.7)	13.1 (12.3-14.0)	14.4 (13.4-15.3)	15.6 (14.5-16.6)	17.3 (16.0-18.5)	18.6 (17.1-20.0)
30-day	8.19 (7.72-8.69)	9.63 (9.08-10.2)	11.2 (10.6-11.9)	12.5 (11.7-13.3)	14.1 (13.2-15.0)	15.4 (14.4-16.3)	16.6 (15.5-17.7)	17.9 (16.7-19.1)	19.6 (18.2-20.9)	20.9 (19.3-22.3)
45-day	10.4 (9.89-11.0)	12.2 (11.6-12.9)	14.0 (13.3-14.8)	15.4 (14.6-16.2)	17.2 (16.3-18.2)	18.6 (17.5-19.6)	19.9 (18.8-21.1)	21.3 (20.0-22.5)	23.0 (21.5-24.4)	24.3 (22.7-25.8)
60-day	12.5 (11.9-13.1)	14.6 (13.9-15.4)	16.6 (15.7-17.4)	18.1 (17.1-19.0)	20.0 (19.0-21.1)	21.5 (20.3-22.6)	22.9 (21.6-24.1)	24.3 (22.9-25.6)	26.1 (24.5-27.6)	27.4 (25.7-29.0)

¹ Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS). Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values. Please refer to NOAA Atlas 14 document for more information.

[Back to Top](#)

PF graphical

Operation & Maintenance Agreement

Project Name: South Main
Project Location: Rolesville NC

Cover Page

Maintenance records shall be kept on the following SCM(s). This maintenance record shall be kept in a log in a known set location. Any deficient SCM elements noted in the inspection will be corrected, repaired, or replaced immediately. These deficiencies can affect the integrity of structures, safety of the public, and the pollutant removal efficiency of the SCM(s).

The SCM(s) on this project include (check all that apply & corresponding O&M sheets will be added automatically):

Infiltration Basin	Quantity:		Location(s):	
Infiltration Trench	Quantity:		Location(s):	
Bioretention Cell	Quantity:	1	Location(s):	Project Site
Wet Pond	Quantity:		Location(s):	
Stormwater Wetland	Quantity:		Location(s):	
Permeable Pavement	Quantity:		Location(s):	
Sand Filter	Quantity:		Location(s):	
Rainwater Harvesting	Quantity:		Location(s):	
Green Roof	Quantity:		Location(s):	
Level Spreader - Filter Strip	Quantity:		Location(s):	
Proprietary System	Quantity:		Location(s):	
Treatment Swale	Quantity:		Location(s):	
Dry Pond	Quantity:		Location(s):	
Disconnected Impervious Surface	Present:	No	Location(s):	
User Defined SCM	Present:	No	Location(s):	
Low Density	Present:	No	Type:	

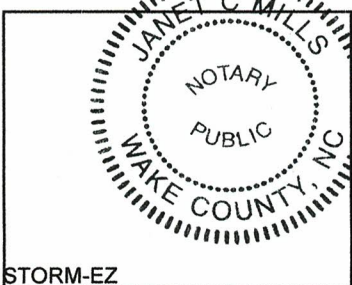
I acknowledge and agree by my signature below that I am responsible for the performance of the maintenance procedures listed for each SCM above, and attached O&M tables. I agree to notify NCDEQ of any problems with the system or prior to any changes to the system or responsible party.

Responsible Party: E. ALLEN MASSEY
 Title & Organization: Toy Storage LLC
 Street address: 2700 Gresham Lake Drive
 City, state, zip: Raleigh, NC 27615
 Phone number(s): 919-604-0505
 Email: Storit@AOL.com

Signature: *E. Allen Massey* Date: 11.29.22

I, JANET C. MILLS, a Notary Public for the State of NORTH CAROLINA
 County of WAKE, do hereby certify that E. ALLEN MASSEY
 personally appeared before me this 29 day of NOVEMBER 2022 and
 acknowledge the due execution of the Operations and Maintenance Agreement.

Witness my hand and official seal, *Janet Mills*



MY COMMISSION EXPIRES
 4.29.27

Bioretention Maintenance Requirements

Important operation and maintenance procedures:

- Immediately after the bioretention cell is established, the plants will be watered twice weekly if needed until the plants become established (commonly six weeks).
- Snow, mulch or any other material will NEVER be piled on the surface of the bioretention cell.
- Heavy equipment will NEVER be driven over the bioretention cell.
- Special care will be taken to prevent sediment from entering the bioretention cell.
- Once a year, a soil test of the soil media will be conducted.
- Remove top layer of fill media when the pool does not drain quickly. Based on the media specification, the pool should drain within 24 hours.

After the bioretention cell is established, it will be inspected **quarterly and within 24 hours after every storm event greater than 1.0 inches (or 1.5 inches if in a Coastal County)**. Records of operation and maintenance shall be kept in a known set location and shall be available upon request.

Inspection activities shall be performed as follows. Any problems that are found shall be repaired immediately.

SCM element:	Potential problem:	How to remediate the problem:
The entire bioretention cell	Trash/debris is present.	Remove the trash/debris.
The perimeter of the bioretention cell	Areas of bare soil and/or erosive gullies have formed.	Regrade the soil if necessary to remove the gully, plant ground cover and water until it is established. Provide lime and a one-time fertilizer application.
The flow diversion structure (if applicable)	The structure is clogged.	Unclog the structure and dispose of any sediment off-site.
	The structure is damaged.	Make any necessary repairs or replace if the damage is too much for repair.
The inlet device	The inlet pipe is clogged (if applicable).	Unclog the pipe and dispose of any sediment in a location where it will not cause impacts to streams or the SCM.
	The inlet pipe is cracked or otherwise damaged (if applicable).	Repair or replace the pipe.
	Erosion is occurring in the swale (if applicable).	Regrade the swale if necessary and provide erosion control devices such as reinforced turf matting or riprap to avoid future erosion problems.
	Stone verge is clogged or covered in sediment (if applicable).	Remove sediment and clogged stone and replace with clean stone.
The pretreatment area	Flow is bypassing pretreatment area and/or gullies have formed.	Regrade if necessary to route all flow to the pretreatment area. Restabilize the area after grading.
	Sediment has accumulated to a depth greater than three inches.	Search for the source of the sediment and remedy the problem if possible. Remove the sediment and dispose of it in a location where it will not cause impacts to streams or the SCM.

Erosion has occurred.

Provide additional erosion protection such as reinforced turf matting or riprap if needed to prevent future erosion problems.

Weeds are present.

Remove the weeds, preferably by hand. If pesticide is used, wipe it on the plants rather than spraying.

Bioretention Maintenance Requirements (continued)

SCM element:	Potential problem:	How to remediate the problem:
Bioretention cell vegetation	Best professional practices show that pruning is needed to maintain optimal plant health.	Prune according to best professional practices. Maintain lines of sight between 2'-6'.
	Plants are dead, diseased or dying.	Determine the source of the problem: soils, hydrology, disease, etc. Remedy the problem and replace plants. Provide a one-time fertilizer application to establish the ground cover if a soil test indicates it is necessary. If sod was used, check to see that it was not grown on clay or impermeable soils. Replace sod if necessary.
	Weeds are present.	Remove the weeds, preferably by hand. If pesticide is used, wipe it on the plants rather than spraying.
	Tree stakes/wires are present six months after planting.	Remove tree stake/wires (which can kill the tree if not removed).
Bioretention cell mulch and media	Mulch is breaking down or has floated away.	Spot mulch if there are only random void areas. Replace whole mulch layer if necessary. Remove the remaining mulch and replace with triple shredded hard wood mulch at a maximum depth of four inches.
	Soils and/or mulch are clogged with sediment.	Determine the extent of the clogging - remove and replace either just the top layers or the entire media as needed. Dispose of the spoil in an appropriate off-site location. Use triple shredded hard wood mulch at a maximum depth of four inches. Search for the source of the sediment and remedy the problem if possible.
	An annual soil test shows that pH has dropped or heavy metals have accumulated in the soil media.	Dolomitic lime shall be applied as recommended per the soil test and toxic soils shall be removed, disposed of properly and replaced with new planting media.
The underdrain, filter fabric element, and outlet system	Clogging has occurred.	Wash out the underdrain system.
	Clogging has occurred.	Clean out the drop inlet. Dispose of the sediment in a location where it will not cause impacts to streams or the SCM..
	The drop inlet is damaged	Repair or replace the drop inlet.
The receiving water	Erosion or other signs of damage have occurred at the outlet.	Repair the damage and improve the flow dissipation structure.
	Discharges from the bioretention cell are causing erosion or sedimentation in the receiving water.	Contact the local NCDEQ Regional Office.

STORMWATER CONTROL STRUCTURE
BIORETENTION MAINTENANCE AGREEMENT

PROJECT: SOUTH MAIN
RESPONSIBLE PARTY: TOY STORES LLC PHONE #: 919-604-0505
ADDRESS: 403 SOUTH MAIN
ROLESVILLE NC

- I. **Monthly** or after every runoff producing rainfall, whichever comes first:
- a. Remove debris from bioretention area.
 - b. Inspect for ponding, washed-out areas, and soil conditions.
 - c. Check for eroded areas of bioretention area and repair before next rainfall.
 - d. Check vegetation conditions within the bioretention area and replace if necessary any damaged plant materials.

II. **Quarterly**

- a. Inspect the collection system (i.e., catch basin, piping, grassed swales) for proper functioning.
- b. Clear accumulated trash from basin grates, and basin bottoms, and check piping for obstructions.
- c. Check bioretention inlet pipes for undercutting. Repair if necessary.
- d. Repair any broken pipes.
- e. Remulch any void areas by hand whenever needed.
- f. Replace rip rap at out let pipe that is choked with sediment.

III. **Semi-Annually**

- a. Reseed grass swale or border twice yearly.
- b. Apply new mulch twice yearly.

IV. **General**

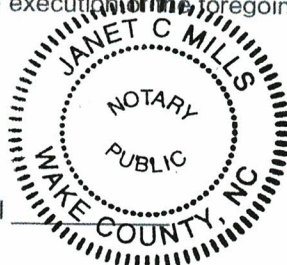
- a. All components of bioretention area to be kept in working order.
- b. This property and bioretention area is also subject to the Operations and Maintenance Manual filed in relation to this project.
- c. The maintenance of the stormwater device(s) shall be the sole responsibility of the Owner. The responsibility for the maintenance of the stormwater device shall pass in the chain of title to the Owner's successor in interest.

I, E. ALLEN MASSEY, hereby acknowledge that I am the financially responsible party for maintenance of this stormwater device.

I will perform the maintenance as outlined above, as part of the Certificate of Compliance with Stormwater Regulations received for this project.

Signature:  Date: 7.27.22

I, JANET C MILLS do hereby certify that E. ALLEN MASSEY personally appeared before me this 27 day of JULY, 2022 and acknowledge due execution of the foregoing instrument. Witness my hand and official seal,





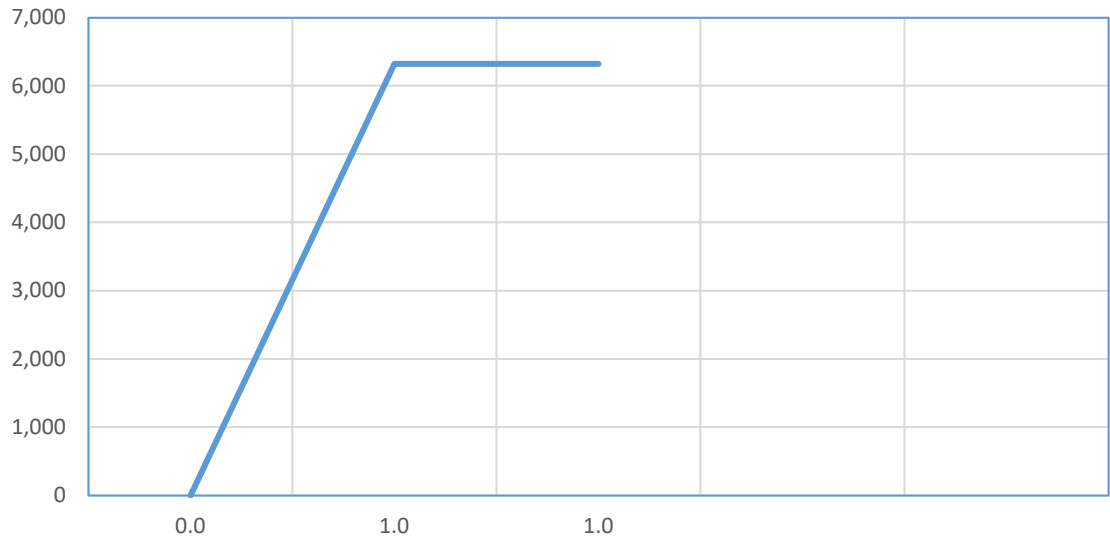
Seal

My commission expires: 4.29.27

Calculate Stage-Storage of Bioretention Basin

Stage	Contour	Contour Area (sf)	Incremental Volume (cf)	S, Accumulated Volume (cf)	0.5
Media Volume					
0.0	409	5,525	1,000	1,000	
-1.0	408	4,494	2,000	3,000	
-2.0	407	3,482	3,000	6,000	
Water Volume					
0.0	409	5,525	-	0	<i>Top of Media</i>
1.0	410	7,119	6,322	6,322	<i>1" storm volume pool elevation</i>
1.0	410	7,119	-	6,322	<i>Top of Riser</i>
				0	

S, Accumulated Volume (cf) by Stage



Calculate the runoff coefficient, Rv

Impervious portion of drainage area	1.19 acres
Drainage area	1.66 acres
IA	72%
Rv	0.70

$$I_A = \frac{\text{Impervious portion of drainage area (acre)}}{\text{Drainage area (acre)}}$$

$$R_v = 0.05 + 0.9 \times I_A$$

Calculate the volume of runoff to be controlled, V

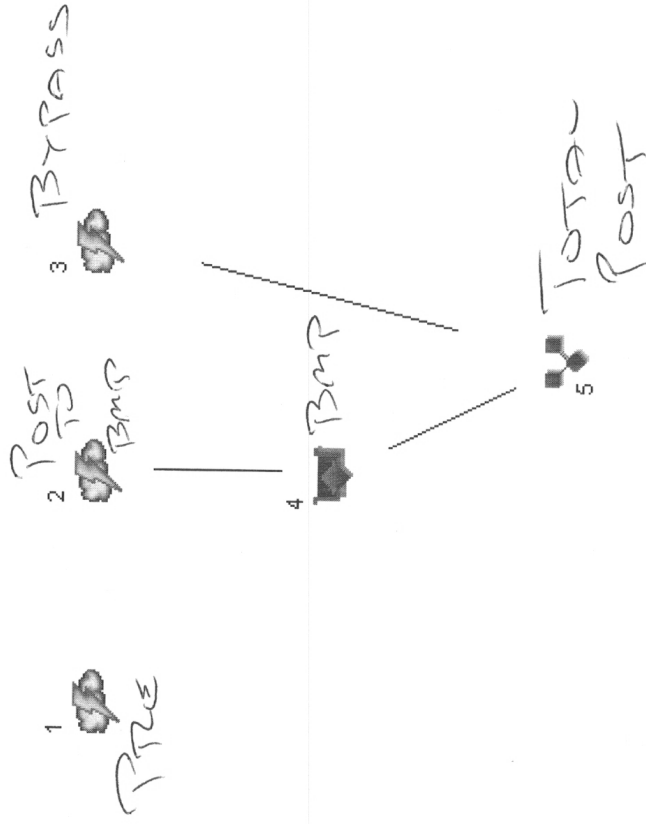
RD	1 inch
A	1.66 acres

Design storm rainfall depth
Watershed area

V required	4,189 cf
V provided	6,322 cf

$$V = 3630 \times R_D \times R_v \times A$$

SOUTH MAIN



Legend

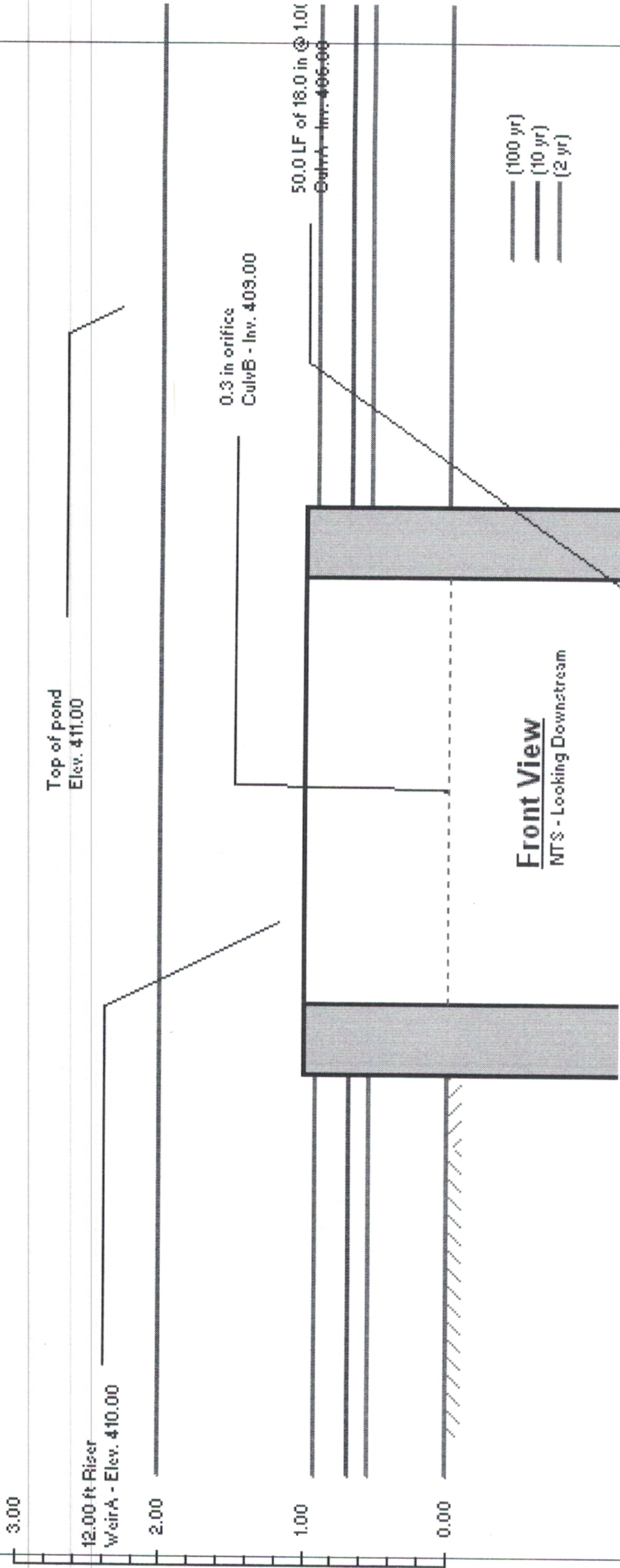
Hyd. Origin	Description
1	Pre Development
2	Post Development
3	Post Bypass
4	Reservoir pond
5	Post Runoff

Hydraflow Hydrographs Model

Project: Rolesville Massey.gpw

Monday, Jul 25 2022, 9:52 AM

Bioretention



Schematic only. Not for construction.

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Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

Friday, Sep 30 2022, 10:20 AM

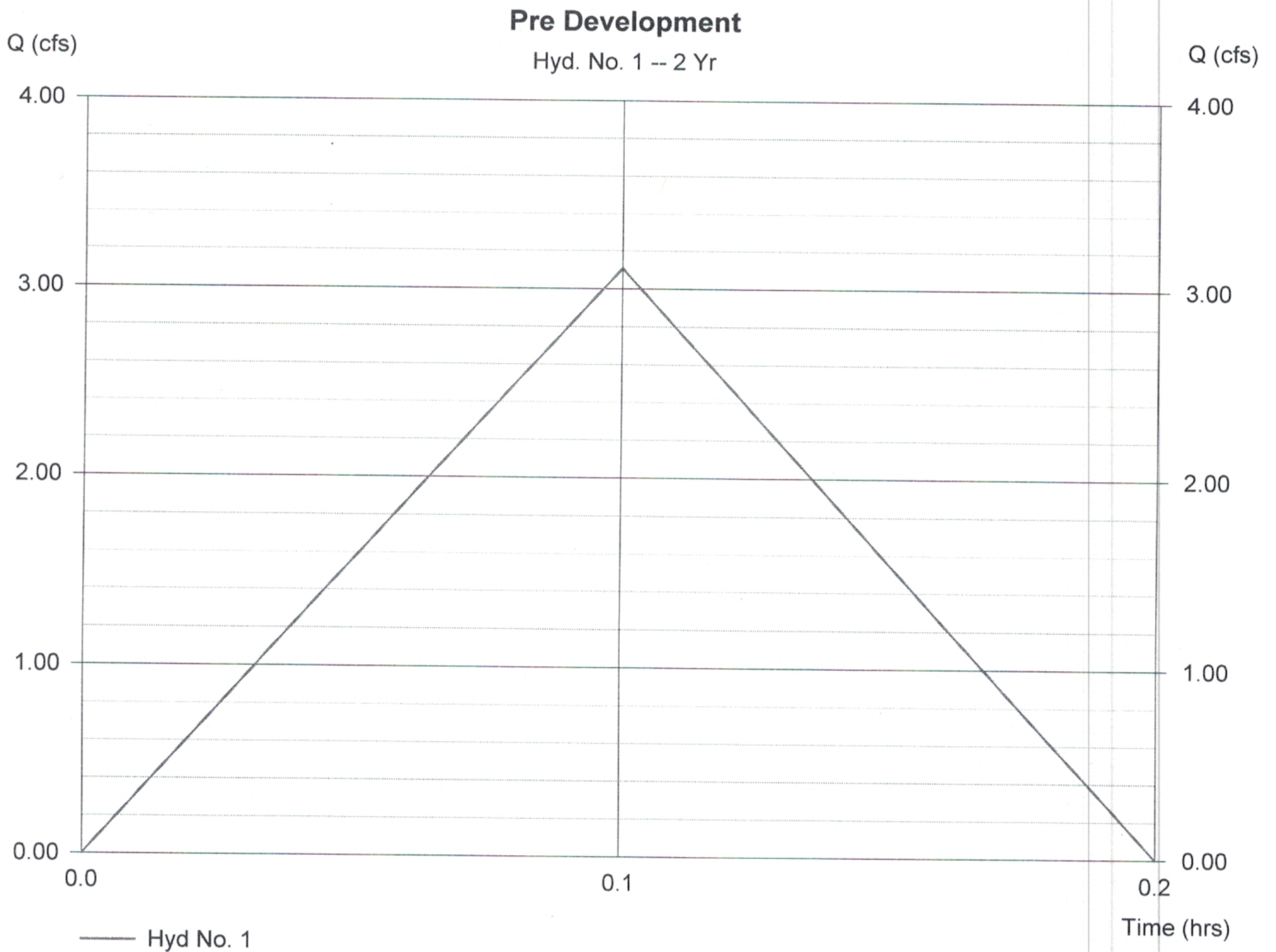
Hyd. No. 1

Pre Development

Hydrograph type = Rational
Storm frequency = 2 yrs
Drainage area = 1.8 ac
Intensity = 5.755 in/hr
IDF Curve = Raleigh-2002.IDF

Peak discharge = 3.11 cfs
Time interval = 1 min
Runoff coeff. = 0.3
Tc by User = 5 min
Asc/Rec limb fact = 1/1

Hydrograph Volume = 932 cuft



Hydrograph Plot

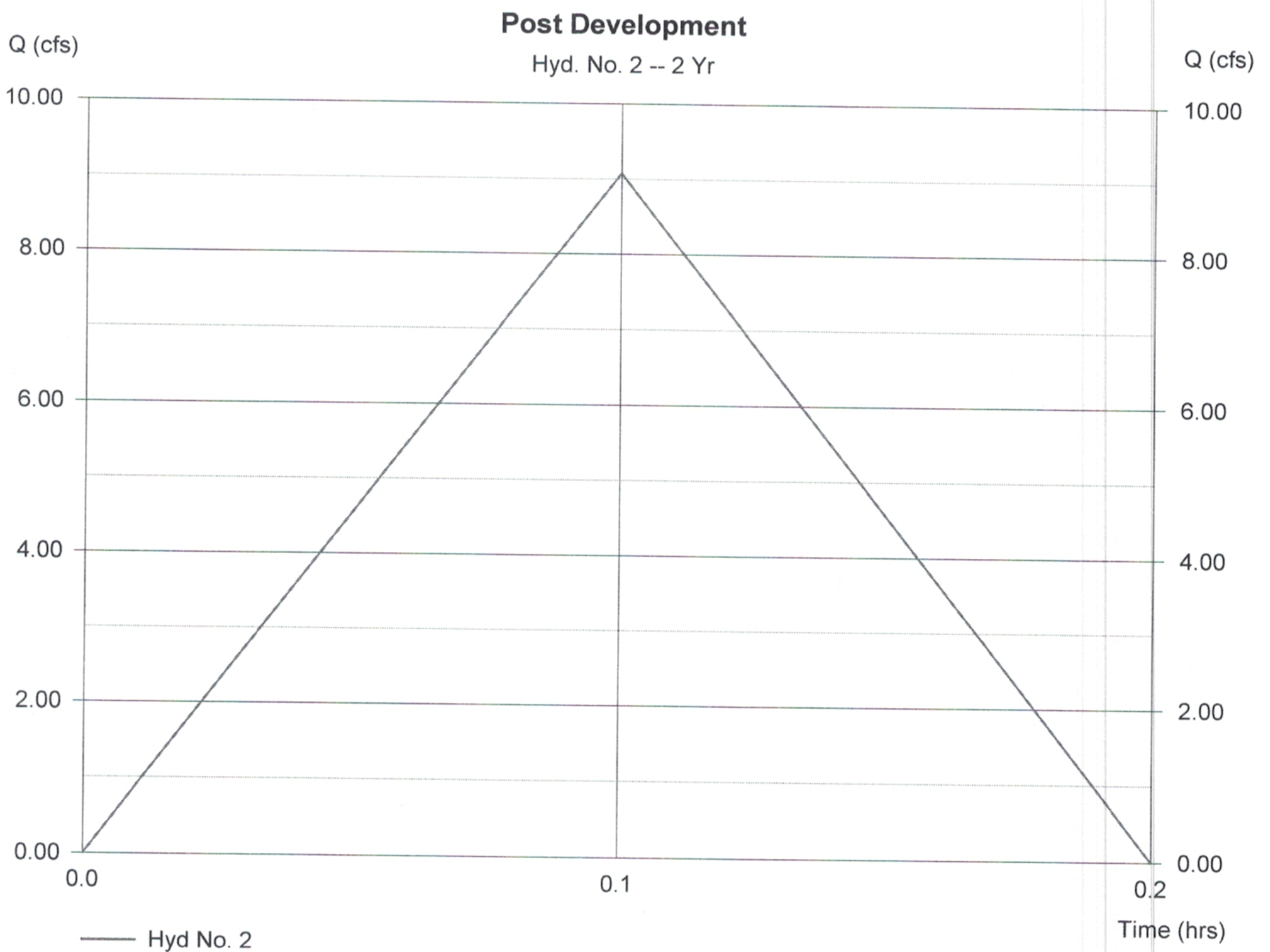
Hyd. No. 2

Post Development

Hydrograph type = Rational
Storm frequency = 2 yrs
Drainage area = 1.7 ac
Intensity = 5.755 in/hr
IDF Curve = Raleigh-2002.IDF

Peak discharge = 9.08 cfs
Time interval = 1 min
Runoff coeff. = 0.95
Tc by User = 5 min
Asc/Rec limb fact = 1/1

Hydrograph Volume = 2,723 cuft



Hydrograph Plot

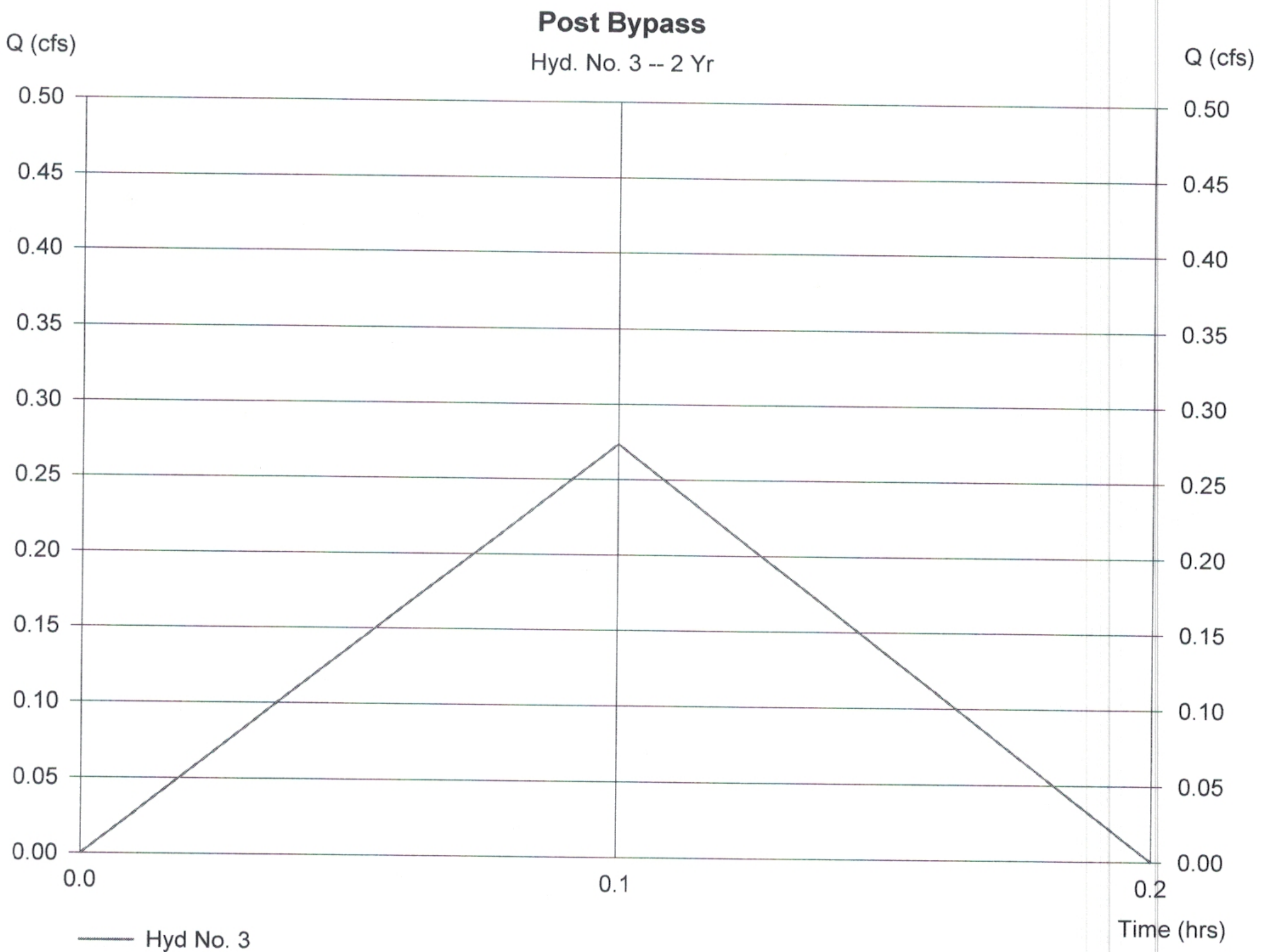
Hyd. No. 3

Post Bypass

Hydrograph type = Rational
Storm frequency = 2 yrs
Drainage area = 0.1 ac
Intensity = 5.755 in/hr
IDF Curve = Raleigh-2002.IDF

Peak discharge = 0.27 cfs
Time interval = 1 min
Runoff coeff. = 0.95
Tc by User = 5 min
Asc/Rec limb fact = 1/1

Hydrograph Volume = 82 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

Friday, Sep 30 2022, 10:20 AM

Hyd. No. 4

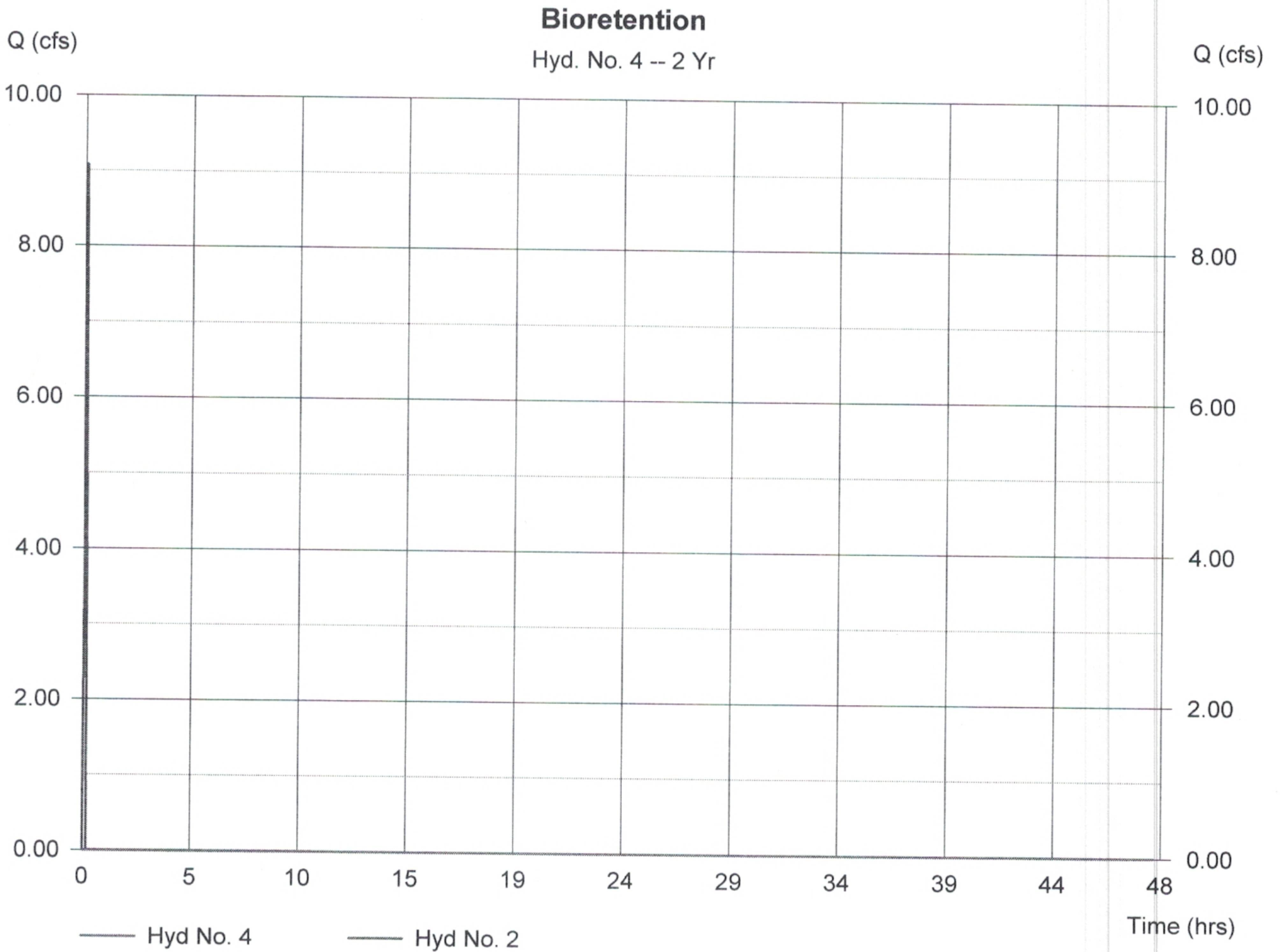
Bioretention

Hydrograph type = Reservoir
Storm frequency = 2 yrs
Inflow hyd. No. = 2
Reservoir name = Bioretention

Peak discharge = 0.00 cfs
Time interval = 1 min
Max. Elevation = 409.54 ft
Max. Storage = 2,723 cuft

Storage Indication method used.

Hydrograph Volume = 202 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

Friday, Sep 30 2022, 10:20 AM

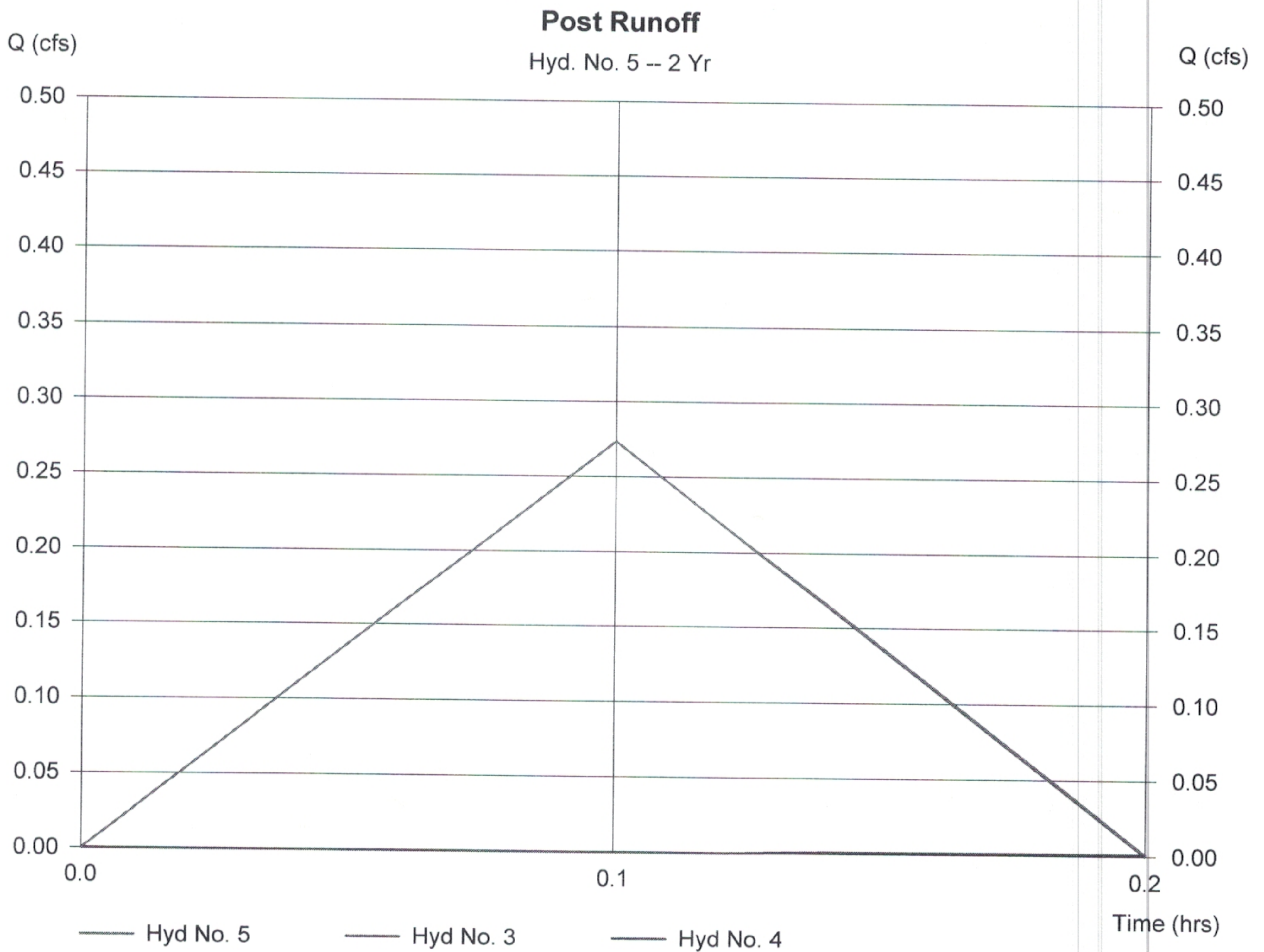
Hyd. No. 5

Post Runoff

Hydrograph type = Combine
Storm frequency = 2 yrs
Inflow hyds. = 3, 4

Peak discharge = 0.27 cfs
Time interval = 1 min

Hydrograph Volume = 284 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

Friday, Sep 30 2022, 10:20 AM

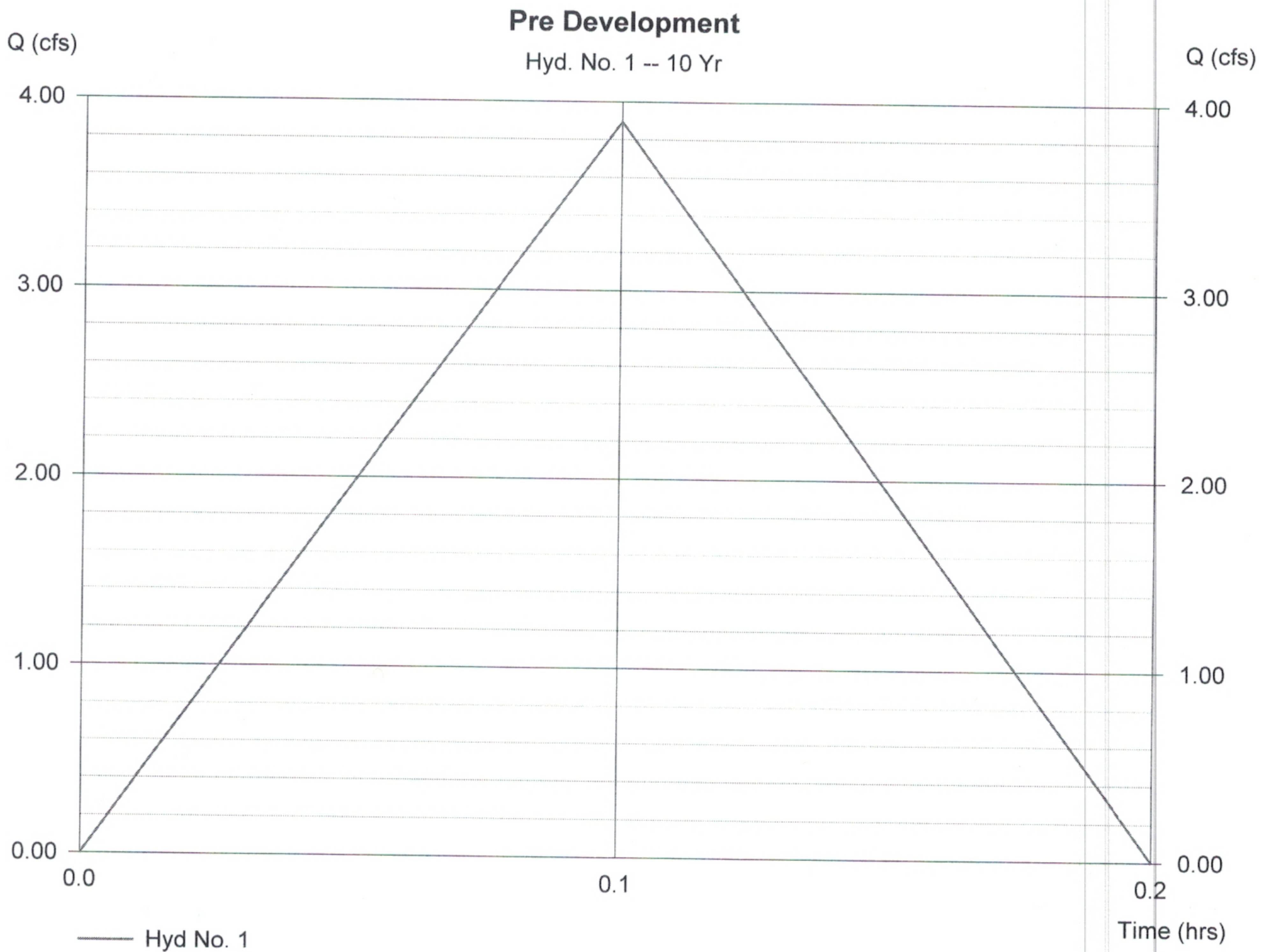
Hyd. No. 1

Pre Development

Hydrograph type = Rational
Storm frequency = 10 yrs
Drainage area = 1.8 ac
Intensity = 7.217 in/hr
IDF Curve = Raleigh-2002.IDF

Peak discharge = 3.90 cfs
Time interval = 1 min
Runoff coeff. = 0.3
Tc by User = 5 min
Asc/Rec limb fact = 1/1

Hydrograph Volume = 1,169 cuft



Hydrograph Plot

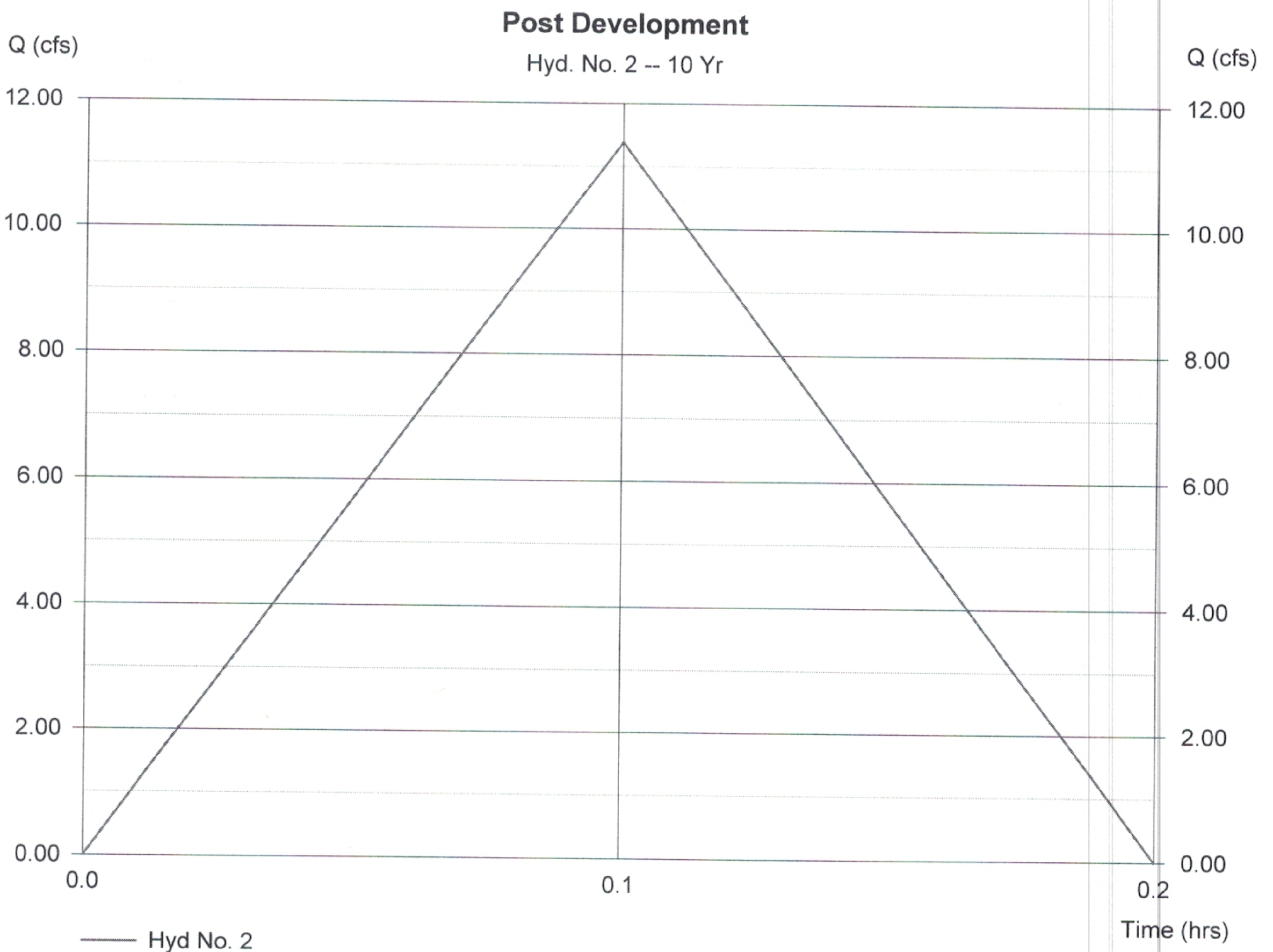
Hyd. No. 2

Post Development

Hydrograph type = Rational
Storm frequency = 10 yrs
Drainage area = 1.7 ac
Intensity = 7.217 in/hr
IDF Curve = Raleigh-2002.IDF

Peak discharge = 11.38 cfs
Time interval = 1 min
Runoff coeff. = 0.95
Tc by User = 5 min
Asc/Rec limb fact = 1/1

Hydrograph Volume = 3,414 cuft



Hydrograph Plot

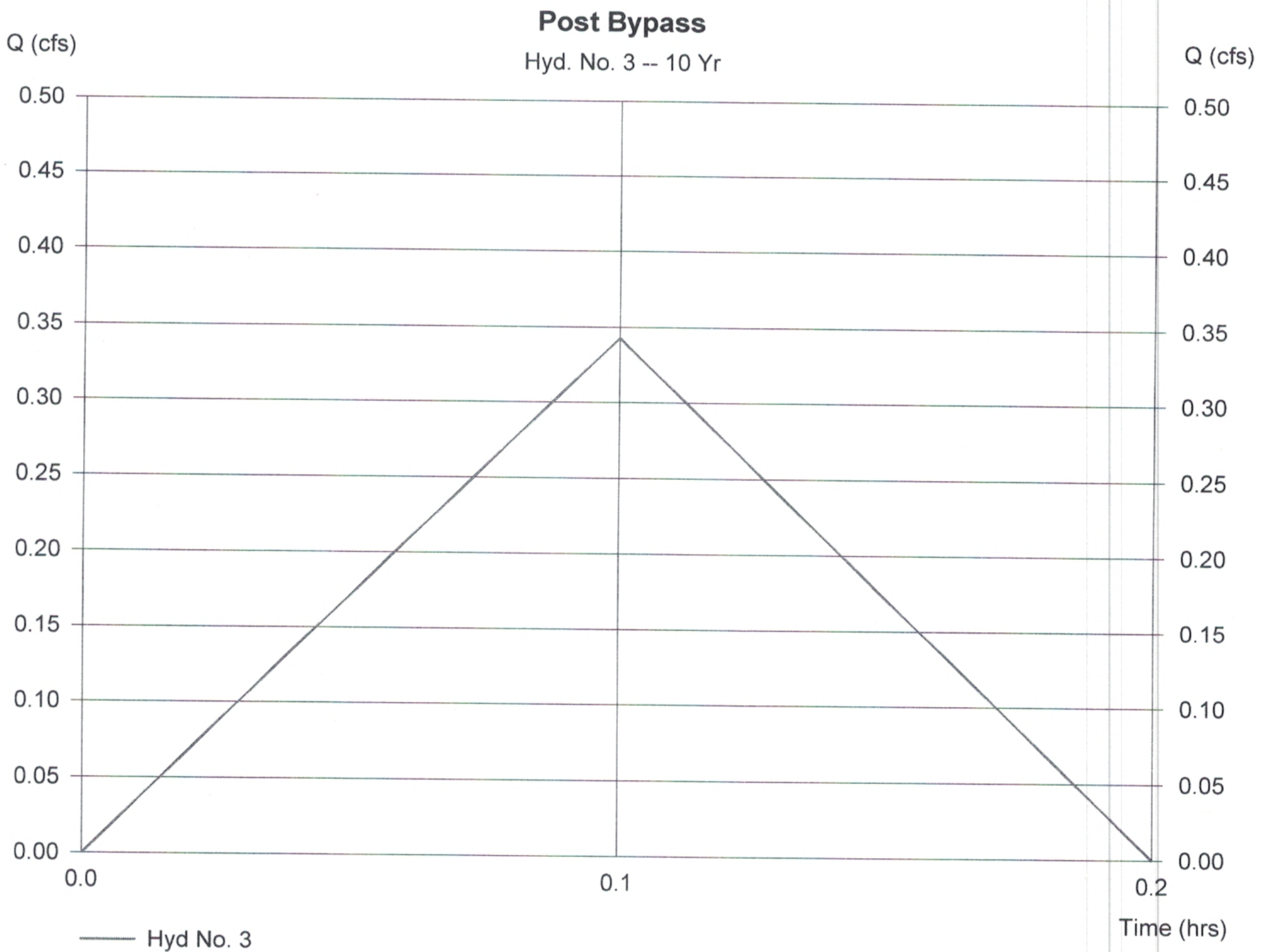
Hyd. No. 3

Post Bypass

Hydrograph type = Rational
Storm frequency = 10 yrs
Drainage area = 0.1 ac
Intensity = 7.217 in/hr
IDF Curve = Raleigh-2002.IDF

Peak discharge = 0.34 cfs
Time interval = 1 min
Runoff coeff. = 0.95
Tc by User = 5 min
Asc/Rec limb fact = 1/1

Hydrograph Volume = 103 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

Friday, Sep 30 2022, 10:20 AM

Hyd. No. 4

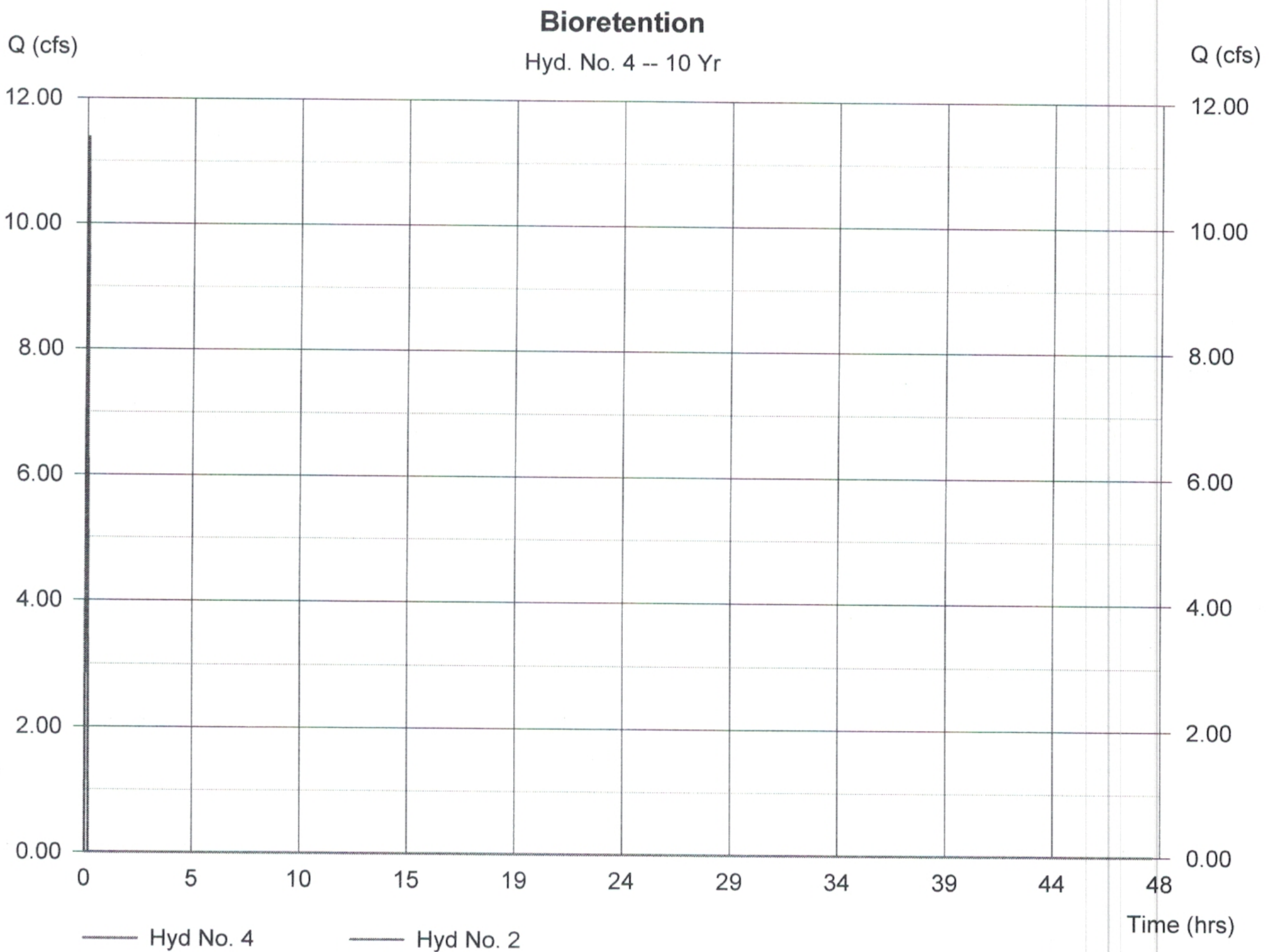
Bioretention

Hydrograph type = Reservoir
Storm frequency = 10 yrs
Inflow hyd. No. = 2
Reservoir name = Bioretention

Peak discharge = 0.00 cfs
Time interval = 1 min
Max. Elevation = 409.68 ft
Max. Storage = 3,414 cuft

Storage Indication method used.

Hydrograph Volume = 227 cuft



Pond Report

Hydraflow Hydrographs by Intelisolve

Friday, Sep 30 2022, 10:20 AM

Pond No. 1 - Bioretention

Pond Data

Pond storage is based on known contour areas. Average end area method used.

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	409.00	4,195	0	0
1.00	410.00	5,911	5,053	5,053
2.00	410.00	7,900	6,906	11,959

Culvert / Orifice Structures

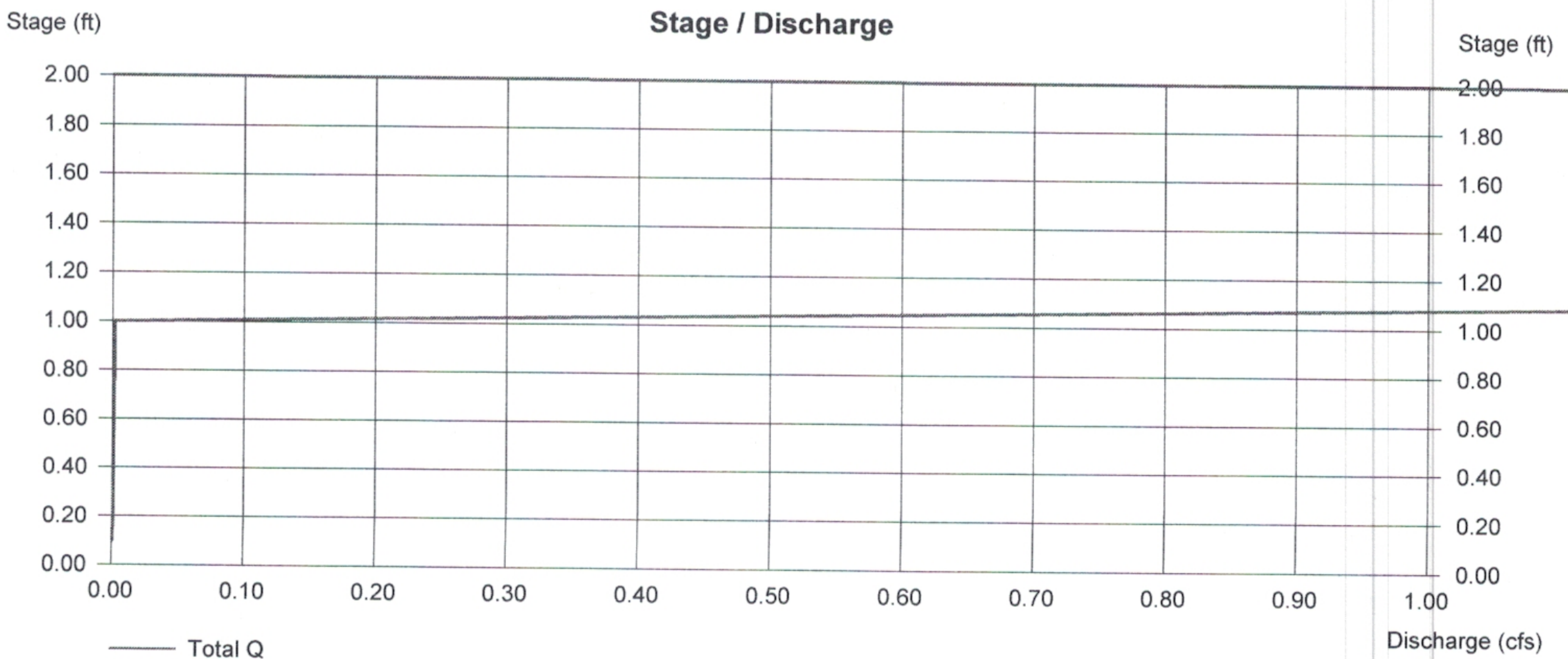
	[A]	[B]	[C]	[D]
Rise (in)	= 18.00	0.25	0.00	0.00
Span (in)	= 18.00	0.25	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 406.00	409.00	0.00	0.00
Length (ft)	= 50.00	0.50	0.00	0.00
Slope (%)	= 1.00	0.50	0.00	0.00
N-Value	= .013	.013	.000	.000
Orif. Coeff.	= 0.60	0.60	0.00	0.00
Multi-Stage	= n/a	Yes	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 12.00	0.00	0.00	0.00
Crest El. (ft)	= 410.00	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	0.00	0.00
Weir Type	= Riser	---	---	---
Multi-Stage	= Yes	No	No	No

Exfiltration = 0.000 in/hr (Contour) Tailwater Elev. = 0.00 ft

Note: Culvert/Orifice outflows have been analyzed under inlet and outlet control.



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

Friday, Sep 30 2022, 10:20 AM

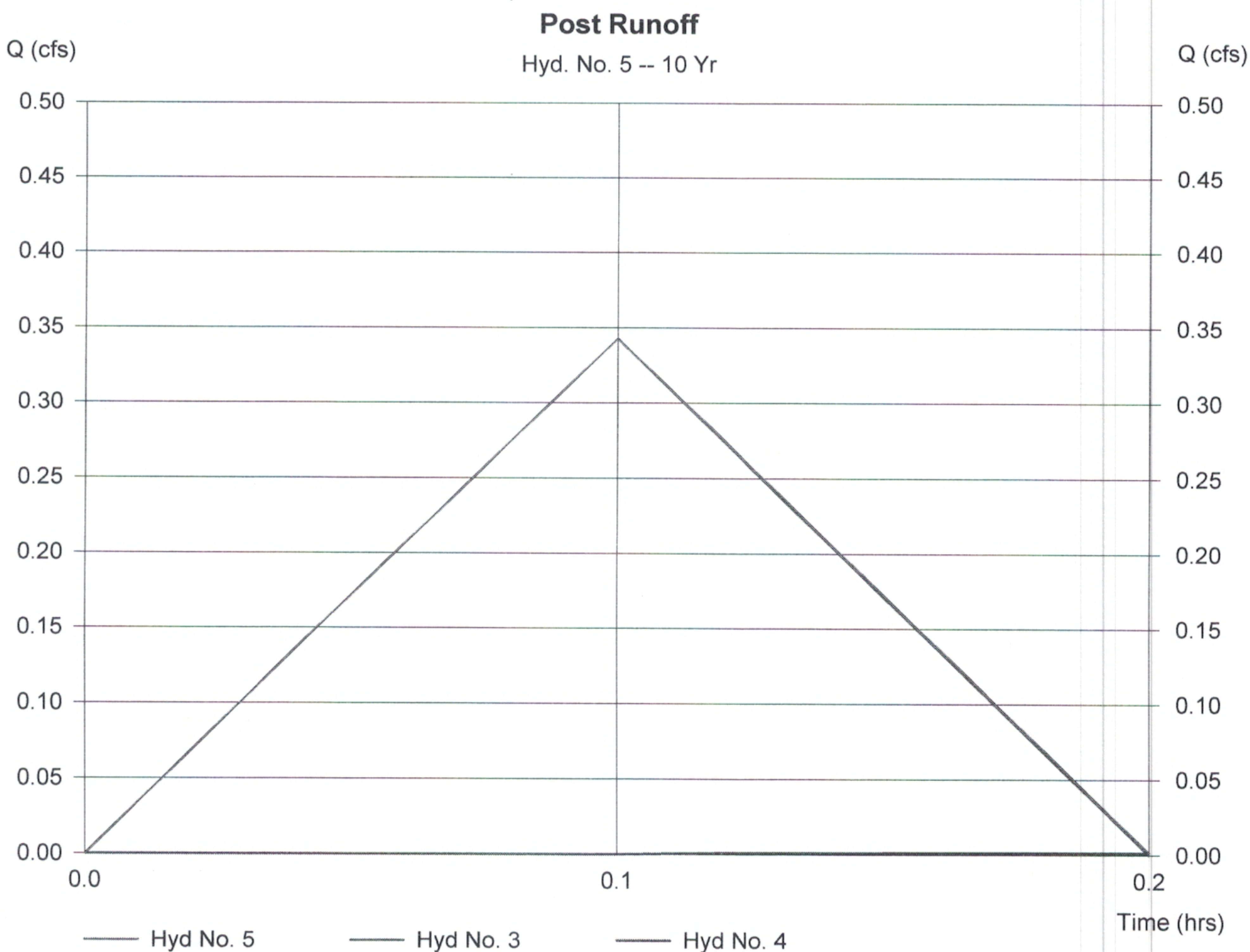
Hyd. No. 5

Post Runoff

Hydrograph type = Combine
Storm frequency = 10 yrs
Inflow hyds. = 3, 4

Peak discharge = 0.34 cfs
Time interval = 1 min

Hydrograph Volume = 330 cuft



Hydrograph Plot

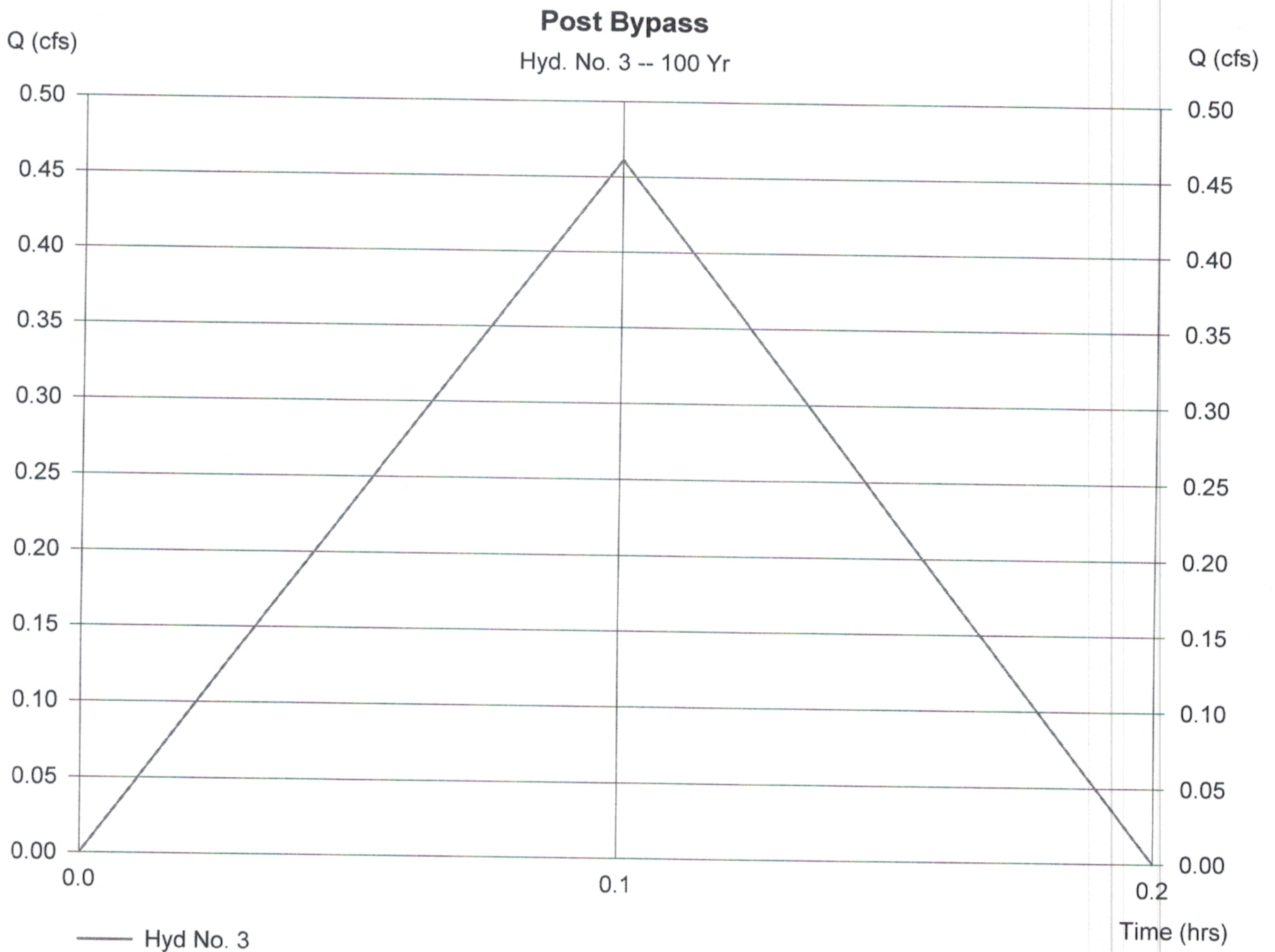
Hyd. No. 3

Post Bypass

Hydrograph type = Rational
Storm frequency = 100 yrs
Drainage area = 0.1 ac
Intensity = 9.713 in/hr
IDF Curve = Raleigh-2002.IDF

Peak discharge = 0.46 cfs
Time interval = 1 min
Runoff coeff. = 0.95
Tc by User = 5 min
Asc/Rec limb fact = 1/1

Hydrograph Volume = 138 cuft



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

Friday, Sep 30 2022, 10:20 AM

Hyd. No. 4

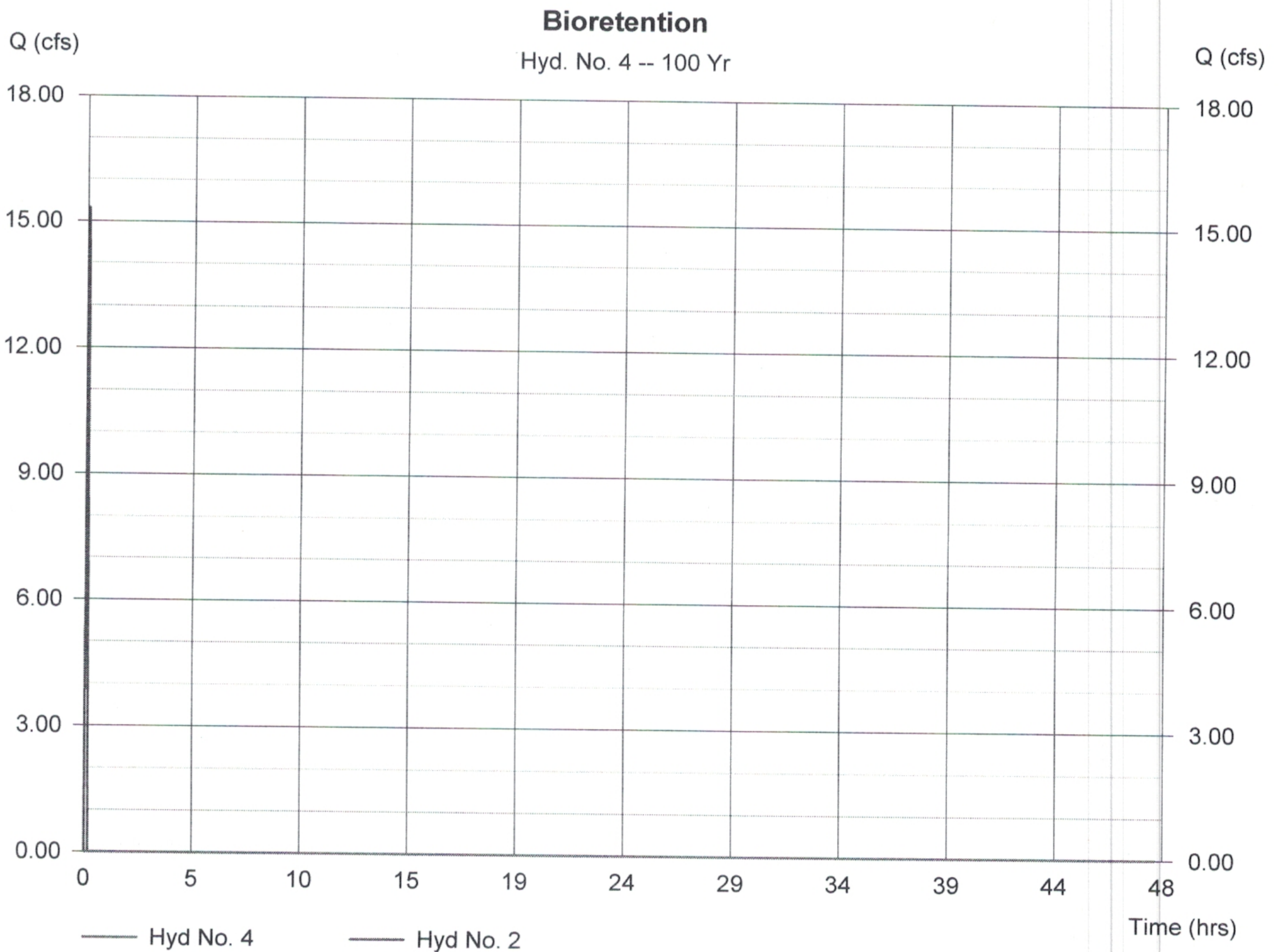
Bioretention

Hydrograph type = Reservoir
Storm frequency = 100 yrs
Inflow hyd. No. = 2
Reservoir name = Bioretention

Peak discharge = 0.00 cfs
Time interval = 1 min
Max. Elevation = 409.91 ft
Max. Storage = 4,595 cuft

Storage Indication method used.

Hydrograph Volume = 264 cuft



Hydrograph Plot

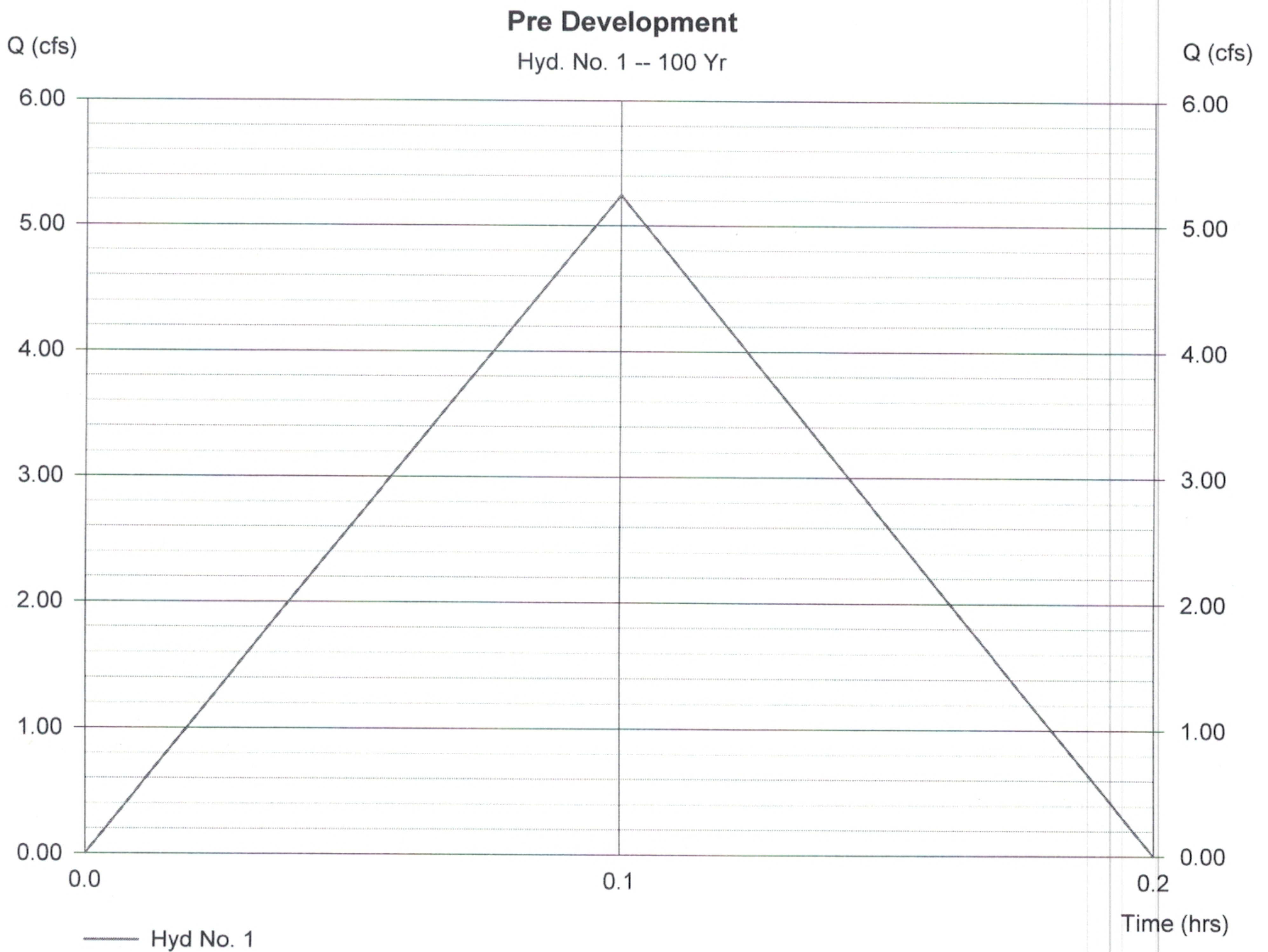
Hyd. No. 1

Pre Development

Hydrograph type = Rational
Storm frequency = 100 yrs
Drainage area = 1.8 ac
Intensity = 9.713 in/hr
IDF Curve = Raleigh-2002.IDF

Peak discharge = 5.25 cfs
Time interval = 1 min
Runoff coeff. = 0.3
Tc by User = 5 min
Asc/Rec limb fact = 1/1

Hydrograph Volume = 1,574 cuft



Hydrograph Plot

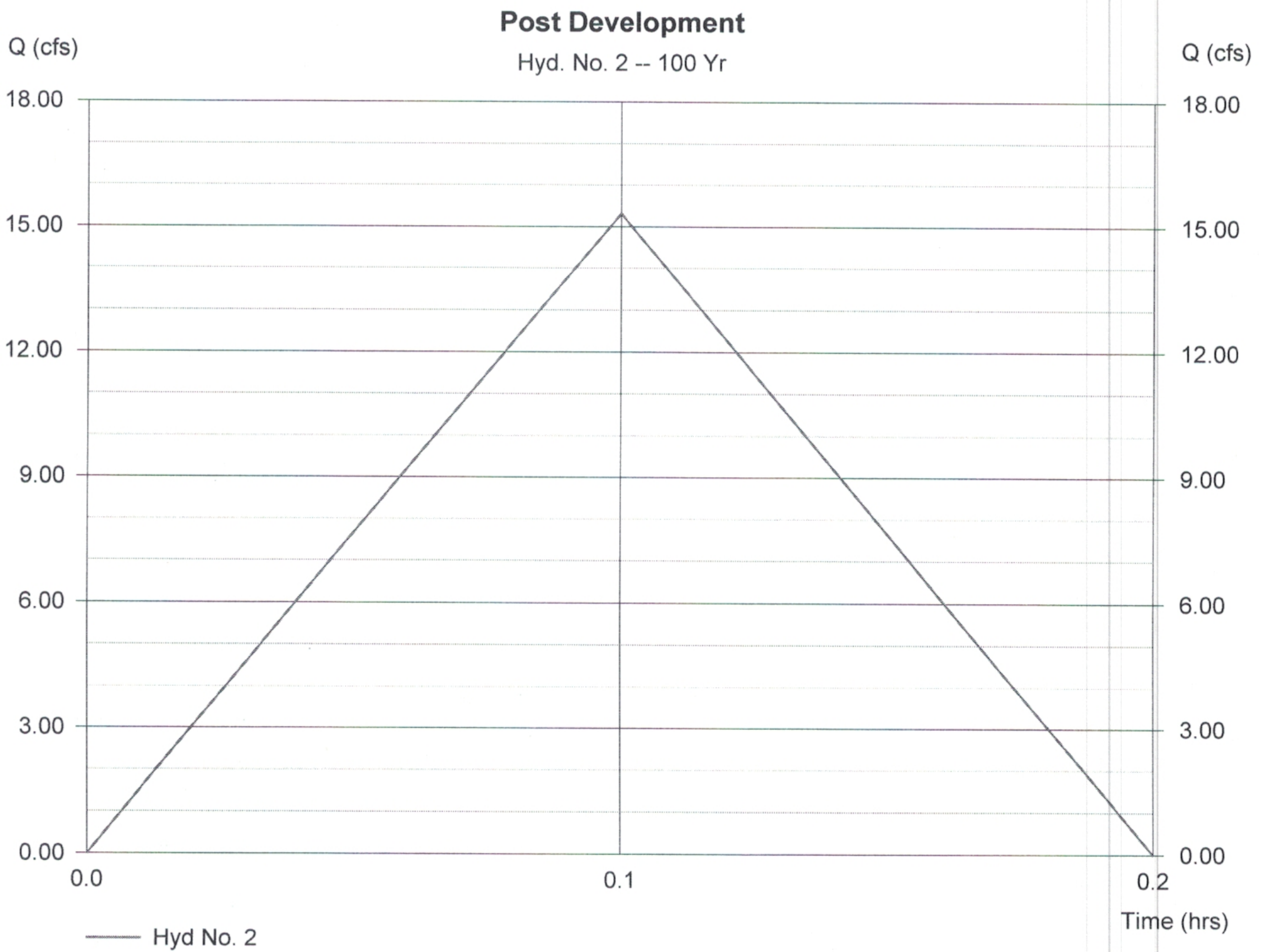
Hyd. No. 2

Post Development

Hydrograph type = Rational
Storm frequency = 100 yrs
Drainage area = 1.7 ac
Intensity = 9.713 in/hr
IDF Curve = Raleigh-2002.IDF

Peak discharge = 15.32 cfs
Time interval = 1 min
Runoff coeff. = 0.95
Tc by User = 5 min
Asc/Rec limb fact = 1/1

Hydrograph Volume = 4,595 cuft



Pond Report

Hydraflow Hydrographs by Intelisolve

Friday, Sep 30 2022, 10:20 AM

Pond No. 1 - Bioretention

Pond Data

Pond storage is based on known contour areas. Average end area method used.

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	409.00	4,195	0	0
1.00	410.00	5,911	5,053	5,053
2.00	410.00	7,900	6,906	11,959

Culvert / Orifice Structures

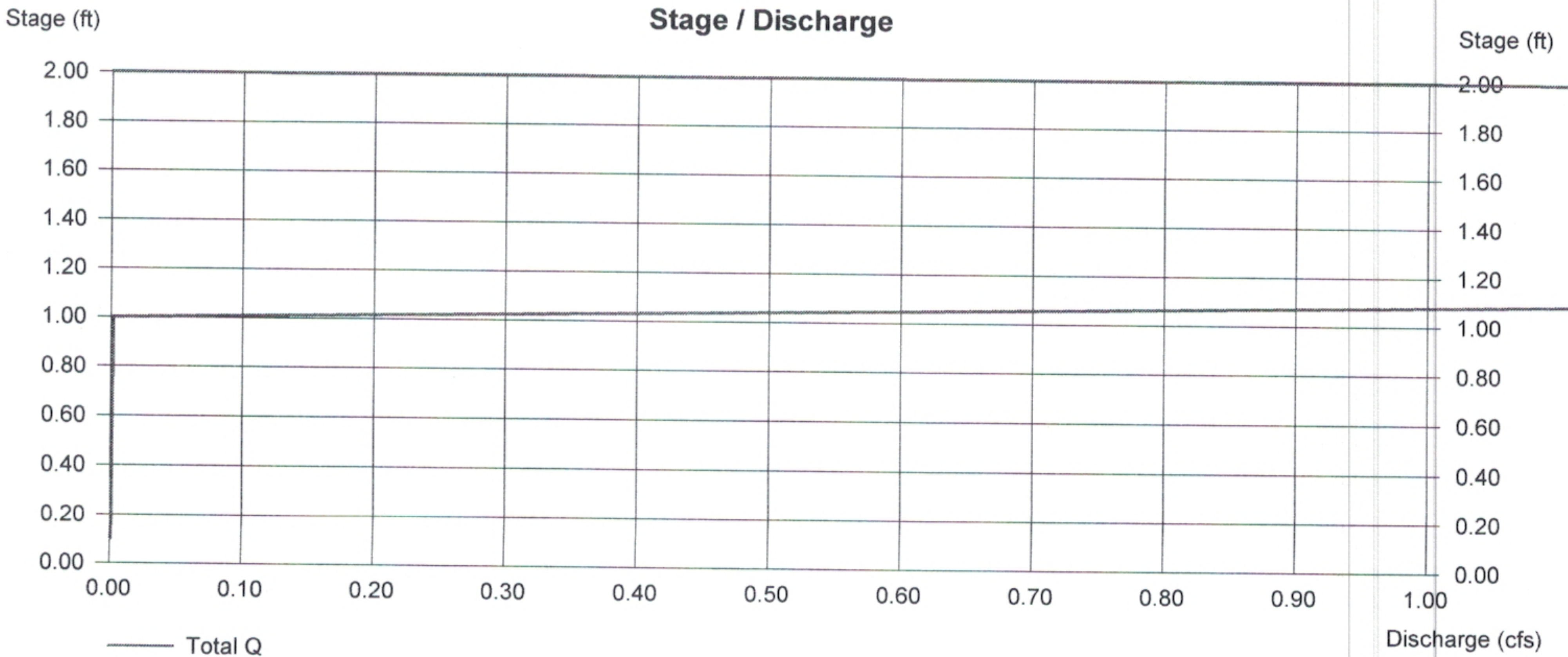
	[A]	[B]	[C]	[D]
Rise (in)	= 18.00	0.25	0.00	0.00
Span (in)	= 18.00	0.25	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 406.00	409.00	0.00	0.00
Length (ft)	= 50.00	0.50	0.00	0.00
Slope (%)	= 1.00	0.50	0.00	0.00
N-Value	= .013	.013	.000	.000
Orif. Coeff.	= 0.60	0.60	0.00	0.00
Multi-Stage	= n/a	Yes	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 12.00	0.00	0.00	0.00
Crest El. (ft)	= 410.00	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	0.00	0.00
Weir Type	= Riser	---	---	---
Multi-Stage	= Yes	No	No	No

Exfiltration = 0.000 in/hr (Contour) Tailwater Elev. = 0.00 ft

Note: Culvert/Orifice outflows have been analyzed under inlet and outlet control.



Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

Friday, Sep 30 2022, 10:20 AM

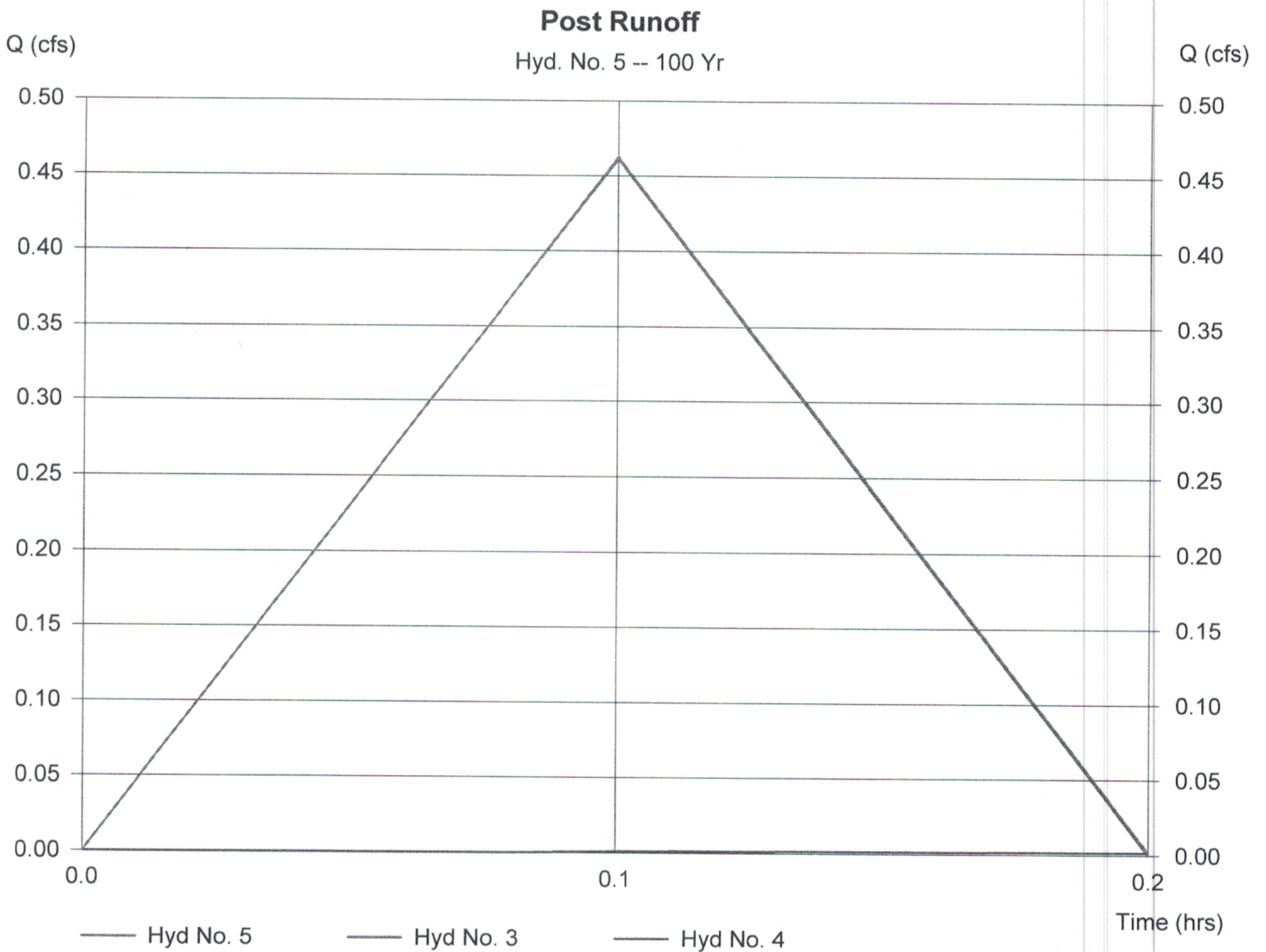
Hyd. No. 5

Post Runoff

Hydrograph type = Combine
Storm frequency = 100 yrs
Inflow hyds. = 3, 4

Peak discharge = 0.46 cfs
Time interval = 1 min

Hydrograph Volume = 403 cuft



STORAGE MAX ROLESVILLE

Calculate Stage-Storage of Bioretention Basin

Stage	Contour	Contour Area (sf)	Incremental Volume (cf)	S, Accumulated Volume (cf)	0.5
Media Volume					

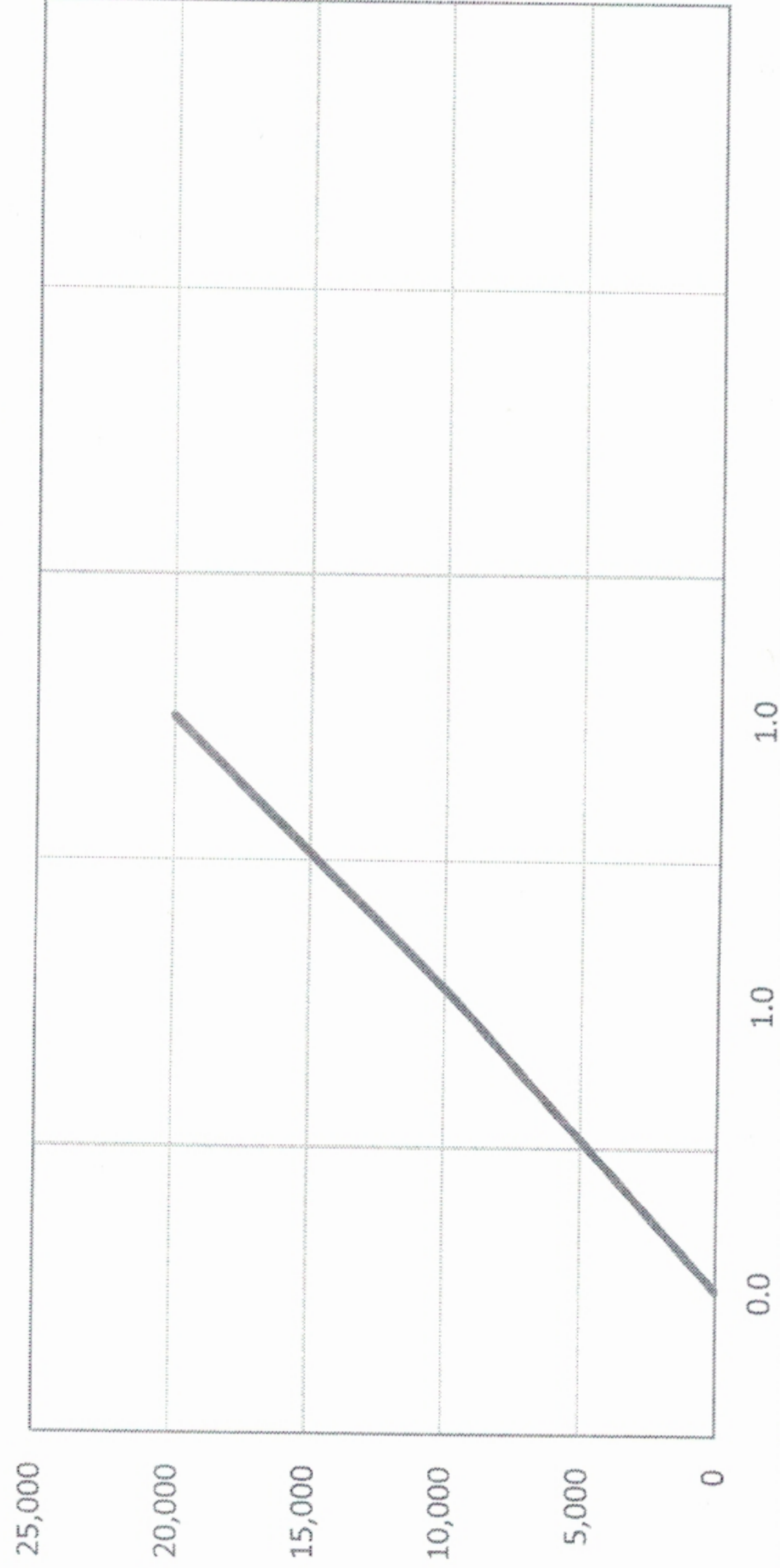
0.0

Water Volume

0.0	400	8,950	-	0	Top of Media
1.0	401	9,984	9,467	9,467	1" storm volume pool elevation
1.0	402	11,075	10,530	19,997	

0

S, Accumulated Volume (cf) by Stage



Calculate the runoff coefficient, Rv



SITE DATA

Project Information	
Project Name:	South Main
Permit No (if known):	
Applicant:	Toy Storage LLC
Applicant Contact Name:	Allen Massey
Applicant Contact Number:	919-604-0505
Contact Email:	Storit@AOL.com
Last Modified Date:	July 26 2022
Site Data:	
River Basin:	Neuse
Regulatory Watershed:	N/A
Physiographic/Geologic Region:	Piedmont
Type of Development (Select from Dropdown menu):	Non-Residential
Zoning:	General Business
Total Site Area (Ac):	2.03
Existing Lake/Pond Area (Ac):	0.00
Proposed Disturbed Area (Ac):	2.16
Proposed Impervious Surface Area from DA Sheets (acre):	1.19
Percent Built Upon Area (BUA):	59%
Is the proposed project a site expansion?	No
Number of Drainage Areas on Site (Points of Analysis):	1
Annual Rainfall (in):	45.41
One-year, 24-hour rainfall (in):	3.00
Two-year, 24-hour rainfall (in):	3.60
Proposed Residential Stormwater Details (if applicable):	
Site Square Footage:	88,427
Total Acreage in Lots:	2.03
Lot Square Footage:	88,427
Number of Lots:	1
Average Lot Size (SF):	78,408
Proposed Impervious Surface Area from DA sheets (SF):	51,836
Proposed Impervious Surface Area Devoted to Lots (SF):	
Total Impervious Surface Area Devoted to Roads (SF):	
Other Impervious Surface Area (SF):	
Stormwater Narrative (limit to 1,200 characters - attach additional pages with submittal if necessary):	



Project Name: South Main

**DRAINAGE AREA 1
STORMWATER PRE-POST CALCULATIONS**

LAND USE & SITE DATA	PRE-DEVELOPMENT								POST-DEVELOPMENT							
Drainage Area (Acres)=	2.03								2.03							
Site Acreage within Drainage=	2.03								2.03							
One-year, 24-hour rainfall (in)=	3.00															
Land Use (acres) by Soil Group:	A Soils		B Soils		C Soils		D Soils		A Soils		B Soils		C Soils		D Soils	
Commercial	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite
Parking lot			0.01								0.88					
Roof											0.31					
Open/Landscaped											0.41					
Industrial	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite
Parking lot																
Roof																
Open/Landscaped																
Transportation	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite
High Density (interstate, main)																
High Density (Grassed Right-of-ways)																
Low Density (secondary, feeder)																
Low Density (Grassed Right-of-ways)																
Rural																
Rural (Grassed Right-of-ways)																
Sidewalk																
Misc. Pervious	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite
Managed pervious (Open Space)			2.02								0.43					
Unmanaged (pasture)																
Woods (not on lots)																
Residential	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite
Roadway																
Grassed Right-of-ways																
Driveway																
Parking lot																
Roof																
Sidewalk (Includes Patios)																
Lawn																
Managed pervious (Open Space)																
Woods (on lots)																
Land Taken up by BMP																
JURISDICTIONAL LANDS	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite
Natural wetland																
Riparian buffer (Zone 1 only)																
Open water																
Totals (Ac)=	0.00	0.00	2.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.03	0.00	0.00	0.00	0.00	0.00

SITE FLOW	PRE-DEVELOPMENT T_c	POST-DEVELOPMENT T_c
Sheet Flow		
Length (ft)=	50.00	50.00
Slope (ft/ft)=	0.03	0.03
Surface Cover:	Grass	Paved, Gravel, or Bare Soil
n-value=	0.24	0.011
T_t (hrs)=	0.11	0.01
Shallow Flow		
Length (ft)=	370.00	211.00
Slope (ft/ft)=	0.03	0.03
Surface Cover:	Unpaved	Paved
Average Velocity (ft/sec)=	2.79	3.52
T_t (hrs)=	0.04	0.02
Channel Flow 1		
Length (ft)=	50.00	160.00
Slope (ft/ft)=	0.03	0.01
Cross Sectional Flow Area (ft ²)=	0.75	0.74
Wetted Perimeter (ft)=	2.50	3.16
Channel Lining:	Weeds	Concrete, finished
n-value=	0.04	0.012
Hydraulic Radius (ft)=	0.30	0.23
Average Velocity (ft/sec)=	2.89	4.72
T_t (hrs)=	0.00	0.01
T_c (hrs)=		
RESULTS		
	PRE-DEVELOPMENT	POST-DEVELOPMENT
Site Impervious Surface Area (Ac) =	0.01	1.19
Lot Impervious Surface Area (Ac) =	0.00	0.00
1-year, 24-hour storm (Peak Flow)		
Volume of runoff (ft ³) =	2,778	13,071
Volume change (ft ³) =	10,294	
Runoff (inches) = Q^* =	0.3770	1.7739
Peak Discharge (cfs) = Q =		
Composite Curve Number (DA)=	61	83
Composite Curve Number (Site only)=	61	83
DISCONNECTED IMPERVIOUS - Credit given only to residential development with drainage area with less than 30% impervious		
Percent Disconnected Impervious Credit (Residential Only) =	0%	
Disconnected impervious area (Ac) =	0.00	
Drainage Area $CN_{adjusted}$ =	83	
Site Only $CN_{adjusted}$ =	83	

Project Name: **South Main**

DA SITE SUMMARY
STORMWATER PRE-POST CALCULATIONS

SITE SUMMARY						
DRAINAGE AREA SUMMARIES						
DRAINAGE AREA:	DA1	DA2	DA3	DA4	DA5	DA6
Pre-Development (1-year, 24-hour storm)						
Runoff (in)=Q* =	0.377					
Peak Flow (cfs)=Q _{post} =						
Post-Development (1-year, 24-hour storm)						
Proposed Impervious Surface (acre) =	1.19					
Runoff (in)=Q* =	1.774					
Peak Flow (cfs)=Q _{post} =						
TARGET CURVE NUMBER (TCN) - Residential Only						
SITE \SOIL COMPOSITION						
HYDROLOGIC SOIL GROUP	<u>Site Area</u>	<u>%</u>	<u>Target CN</u>			
A	0.00	0%	N/A			
B	2.03	100%	N/A			
C	0.00	0%	N/A			
D	0.00	0%	N/A			
Total Site Area (acres) =	2.03					
Zoning =	General Business					
Target Curve Number (TCN) =	N/A					
% Impervious =	59%					
Post Development CN _{adjusted} =	83					
Required Volume to be Managed (TCN)= ft ³ =	N/A					
SITE NITROGEN AND PHOSPHORUS LOADING						
Nitrogen and Phosphorus Targets (Based on Regulatory Watershed)						
Target Nitrogen Load (lb/ac/yr)=	3.6					
Target Phosphorus Load (Falls and Jordan Lakes Only) (lb/ac/yr)=	N/A					
% N Loading Reduction Option for Expansions (Falls and Jordan Lakes Only) =	N/A					
% Loading Reduction Nitrogen Target (Falls and Jordan Lakes Only) (lb/ac/yr)=	N/A					
% P Loading Reduction Option for Expansions (Falls and Jordan Lakes Only) =	N/A					
% Loading Reduction Phosphorus Target (Falls and Jordan Lakes Only) (lb/ac/yr)=	N/A					
Pre Development Nitrogen and Phosphorus Load						
Total Nitrogen (lb/ac/yr)=	1.64					
Total Phosphorus (lb/ac/yr)=	N/A					
Post Development Nitrogen and Phosphorus Load						
Total Nitrogen (lb/ac/yr)=	8.28					
Total Phosphorus (lb/ac/yr)=	N/A					



Project Name: South Main

**DRAINAGE AREA 1
BMP CALCULATIONS**

DRAINAGE AREA 1 - BMP DEVICES AND ADJUSTMENTS			
DA1 Site Acreage=	2.03		
DA1 Off-Site Acreage=	0.00		
Total Required Storage Volume for Site TCN Requirement (ft ³)=			
Will site use underground water harvesting?		Enter % volume reduction in decimal form=	Note: Supporting information/details should be submitted to demonstrate water usage.

ENTER AREA TREATED BY BMP										
Land Use (acres)	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
Commercial										
Parking lot	0.88									
Roof	0.31									
Open/Landscaped	0.41									
Industrial										
Parking lot										
Roof										
Open/Landscaped										
Transportation										
High Density (interstate, main)										
High Density (Grassed Right-of-ways)										
Low Density (secondary, feeder)										
Low Density (Grassed Right-of-ways)										
Rural										
Rural (Grassed Right-of-ways)										
Sidewalk										
Misc. Pervious										
Managed pervious	0.43									
Unmanaged (pasture)										
Woods (not on lots)										
Residential										
Roadway										
Grassed Right-of-ways										
Driveway										
Parking lot										
Roof										
Sidewalk										
Lawn										
Managed pervious										
Woods (on lots)										
Land Taken up by BMP										
JURISDICTIONAL LANDS										
Natural wetland										
Riparian buffer (Zone 1 only)										
Totals (Ac)=										
	2.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Sub-DA1(a) BMP(s)											
Device Name (As Shown on Plan)	Device Type	Water Quality Volume (c.f.)	Inflow N EMC (mg/L)	Total Inflow N (lb/ac/yr)	Inflow P EMC (mg/L)	Total Inflow P (lb/ac/yr)	Outflow N EMC (mg/L)	Total Outflow N (lb/ac/yr)	Outflow P EMC (mg/L)	Total Outflow P (lb/ac/yr)	Provided Volume Managed (c.f.)
BMP 1	Bioretention with IWS	4,256	1.39	8.28	0.17	1.01	1.04	3.08	0.13	0.39	
Outflow Total Nitrogen (lb/ac/yr)=			3.08			Outflow Total Phosphorus (lb/ac/yr)=			0.39		

Sub-DA1(b) BMP(s)

If Sub-DA1(b) is connected to upstream sub-basin(s), select all contributing sub-basin(s) from dropdown menus:											
Device Name (As Shown on Plan)	Device Type	Water Quality Volume (c.f.)	Inflow N EMC (mg/L)	Total Inflow N (lb/ac/yr)	Inflow P EMC (mg/L)	Total Inflow P (lb/ac/yr)	Outflow N EMC (mg/L)	Total Outflow N (lb/ac/yr)	Outflow P EMC (mg/L)	Total Outflow P (lb/ac/yr)	Provided Volume Managed (c.f.)
Outflow Total Nitrogen (lb/ac/yr)=			Outflow Total Phosphorus (lb/ac/yr)=								
Sub-DA1 (c) BMP(s)											
If Sub-DA1(c) is connected to upstream sub-basin(s), select all contributing sub-basin(s):											
Device Name (As Shown on Plan)	Device Type	Water Quality Volume (c.f.)	Inflow N EMC (mg/L)	Total Inflow N (lb/ac/yr)	Inflow P EMC (mg/L)	Total Inflow P (lb/ac/yr)	Outflow N EMC (mg/L)	Total Outflow N (lb/ac/yr)	Outflow P EMC (mg/L)	Total Outflow P (lb/ac/yr)	Provided Volume Managed (c.f.)
Outflow Total Nitrogen (lb/ac/yr)=			Outflow Total Phosphorus (lb/ac/yr)=								
Sub-DA1 (d) BMP(s)											
If Sub-DA1(d) is connected to upstream sub-basin(s), select all contributing sub-basin(s):											
Device Name (As Shown on Plan)	Device Type	Water Quality Volume (c.f.)	Inflow N EMC (mg/L)	Total Inflow N (lb/ac/yr)	Inflow P EMC (mg/L)	Total Inflow P (lb/ac/yr)	Outflow N EMC (mg/L)	Total Outflow N (lb/ac/yr)	Outflow P EMC (mg/L)	Total Outflow P (lb/ac/yr)	Provided Volume Managed (c.f.)
Outflow Total Nitrogen (lb/ac/yr)=			Outflow Total Phosphorus (lb/ac/yr)=								
Sub-DA1 (e) BMP(s)											
If Sub-DA1(e) is connected to upstream sub-basin(s), select all contributing sub-basin(s):											
Device Name (As Shown on Plan)	Device Type	Water Quality Volume (c.f.)	Inflow N EMC (mg/L)	Total Inflow N (lb/ac/yr)	Inflow P EMC (mg/L)	Total Inflow P (lb/ac/yr)	Outflow N EMC (mg/L)	Total Outflow N (lb/ac/yr)	Outflow P EMC (mg/L)	Total Outflow P (lb/ac/yr)	Provided Volume Managed (c.f.)
Outflow Total Nitrogen (lb/ac/yr)=			Outflow Total Phosphorus (lb/ac/yr)=								
DA1 BMP SUMMARY											
Total Volume Treated (c.f.)=		0									
DA1 Outflow Total Nitrogen (lb/ac/yr)=		3.08									
DA1 Outflow Total Phosphorus (lb/ac/yr)=		0.39									
1-year, 24-hour storm											
Pre Development Peak Discharge (cfs)= Q _{1-year} =											
Post BMP Peak Discharge (cfs)= Q _{1-year} =											

Project Name: **South Main**

DA SITE SUMMARY
BMP CALCULATIONS

BMP SUMMARY						
DRAINAGE AREA SUMMARIES						
DRAINAGE AREA:	DA1	DA2	DA3	DA4	DA5	DA6
Post-Development (1-year, 24-hour storm)						
Peak Flow (cfs)= Q_{1-year} =						
Post-Development with BMPs (1-year, 24-hour storm)						
% Impervious =	59%					
Volume Managed (CF)=	0					
Post BMP Peak Discharge (cfs)= Q_{1-year} =						
Have Target Curve Number Requirements been met?	N/A					
Pre Development Nitrogen and Phosphorus Load						
Total Nitrogen (lb/ac/yr)=	1.64					
Total Phosphorus (lb/ac/yr)=	N/A					
Post Development Nitrogen and Phosphorus Load						
Total Nitrogen (lb/ac/yr)=	8.28					
Total Phosphorus (lb/ac/yr)=	N/A					
Post-BMP Nitrogen Loading						
Outflow Total Nitrogen (lb/ac/yr)=	3.08					
Outflow Total Phosphorus (lb/ac/yr)=	0.39					
Has site met the Target?	YES					
Has site met requirements for offsetting?	YES					

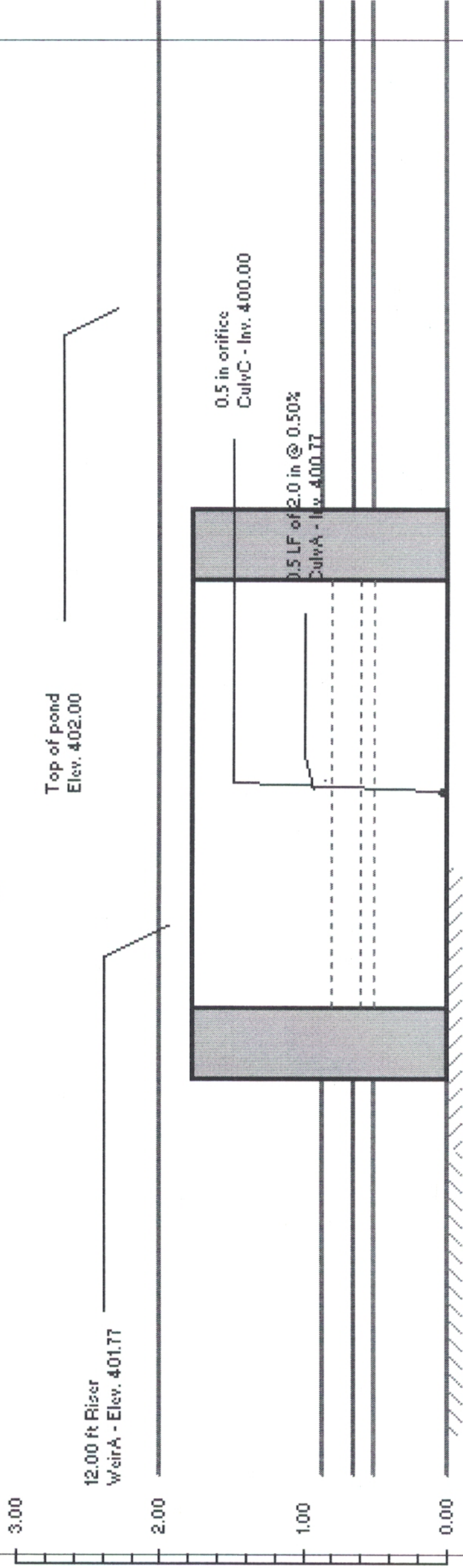
STORAGE MAX ROLESVILLE



Legend

<u>Hvd.</u>	<u>Origin</u>	<u>Description</u>
1	Rational	<no description>
2	Reservoir	Runoff

Storage Max Bioretention



Front View

NTS - Looking Downstream

Schematic only. Not for construction.

STORAGE MAX
ROLESVILLE

Impervious portion of drainage area 1.90 acres
 Drainage area 2.97 acres
 IA 64%
 RV 0.63

$$I_A = \frac{\text{Impervious portion of drainage area (acre)}}{\text{Drainage area (acre)}}$$

$$R_v = 0.05 + 0.9 \times I_A$$

Calculate the volume of runoff to be controlled, V

RD	1 inch	Design storm rainfall depth
A	2.97 acres	Watershed area
V required	6,746 cf	$V = 3630 \times R_D \times R_v \times A$
V provided	9,467 cf	

Hydrograph Summary Report

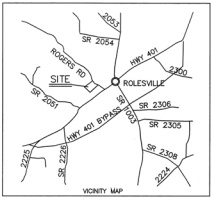
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Maximum storage (cuft)	Hydrograph description
1	Rational	16.24	1	5	4,872	----	-----	-----	<no description>
2	Reservoir	0.00	1	0	0	1	400.51	4,872	Runoff
StorageMax Rolesville.gpw					Return Period: 2 Year		Friday, Sep 30 2022, 1:10 PM		

Hydrograph Summary Report

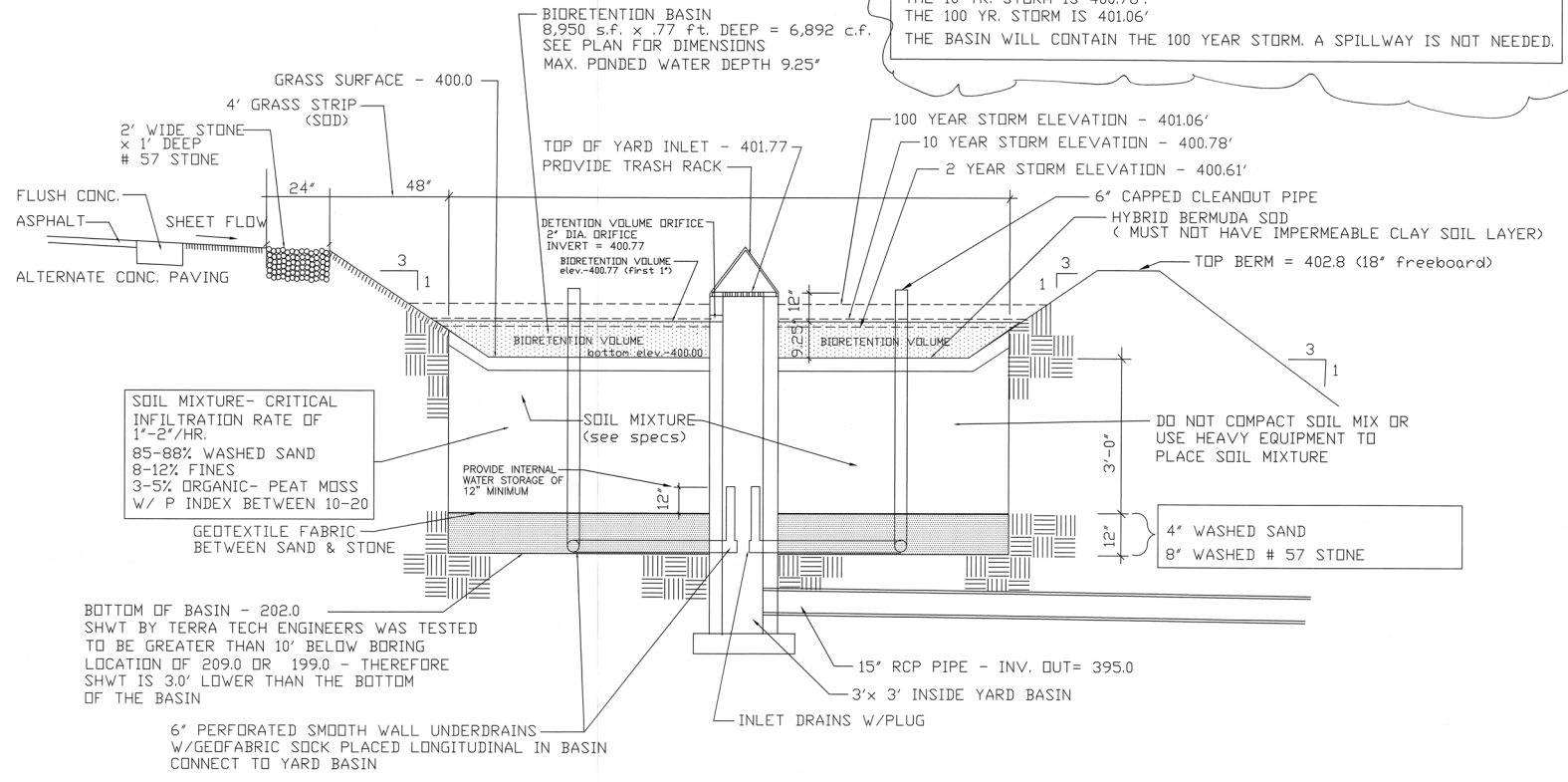
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Maximum storage (cuft)	Hydrograph description	
1	Rational	20.36	1	5	6,109	----	-----	-----	<no description>	
2	Reservoir	0.00	1	0	0	1	400.65	6,109	Runoff	
StorageMax Rolesville.gpw					Return Period: 10 Year		Friday, Sep 30 2022, 1:10 PM			

Hydrograph Summary Report

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Maximum storage (cuft)	Hydrograph description	
1	Rational	27.41	1	5	8,222	---	-----	-----	<no description>	
2	Reservoir	0.00	1	10	473	1	400.87	8,221	Runoff	
StorageMax Rolesville.gpw					Return Period: 100 Year		Friday, Sep 30 2022, 1:10 PM			



- LEGEND**
- LINES SURVEYED
 - - - LINES NOT SURVEYED
 - E.I.P. EXISTING IRON PIPE
 - I.P.S. IRON PIPE SET
 - C.M.S. CONCRETE MONUMENT SET
 - E.C.M. EXISTING CONCRETE MONUMENT
 - P.K.S. P.K. NAIL SET
 - E.P.K. EXISTING P.K. NAIL
 - R.W. RIGHT OF WAY
 - D.B. DEED BOOK
 - P.P. POWER POLE
 - O.H.P. OVER HEAD POWER
 - R.R.S. RAILROAD SPIKE
 - L.P. LAMP POLE
 - P.B. POWER BOX
 - M.H. MANHOLE
 - W.V. WATER VALVE
 - Y.I. YARD INLET
 - V. VAULT
 - C.V. CABLE TV
 - R.P.F. RAMP PARKING SPACES
 - C & G CURB AND GUTTER
 - R.C.P. REINFORCED CONCRETE PIPE
 - U.G. UNDER GROUND
 - TRANS. ELECTRICAL TRANSFORMER
 - D.I. DRAIN INLET
 - C.B. CATCH BASIN
 - B.E.I.P. BENT EXISTING IRON PIPE
 - E.R.R.S. EXISTING RAILROAD SPIKE
 - B.P.P. BACKFLOW PREVENTER
 - C.O. CLEAN OUT
 - W.V. WATER VALVE
 - F.O.M. FIBER OPTIC MARKER
 - G.V. GAS VALVE



NOTE:
 THE FIRST 1' IS CALCULATED AS THE BIORETENTION VOLUME USING THE BOTTOM OF THE BASIN AS 400.0'
 THE 2 YEAR STORM IS 400.61'
 THE 10 YR. STORM IS 400.78'
 THE 100 YR. STORM IS 401.06'
 THE BASIN WILL CONTAIN THE 100 YEAR STORM. A SPILLWAY IS NOT NEEDED.

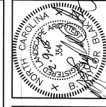
SOIL MIXTURE- CRITICAL
 INFILTRATION RATE OF
 1"-2"/HR.
 85-88% WASHED SAND
 8-12% FINES
 3-5% ORGANIC- PEAT MOSS
 W/ P INDEX BETWEEN 10-20

BOTTOM OF BASIN - 202.0
 SHWT BY TERRA TECH ENGINEERS WAS TESTED
 TO BE GREATER THAN 10' BELOW BORING
 LOCATION OF 209.0 OR 199.0 - THEREFORE
 SHWT IS 3.0' LOWER THAN THE BOTTOM
 OF THE BASIN

6" PERFORATED SMOOTH WALL UNDERDRAINS
 W/GEOTEXTILE SOCK PLACED LONGITUDINAL IN BASIN
 CONNECT TO YARD BASIN

**TYPICAL SECTION THRU GRASSED BIO-RETENTION BASIN
 WITH INTERNAL WATER STORAGE**

SCHMATIC NTS



BLAKEY DESIGN GROUP
 Landscape Architecture Site Planning
 700 Poppleton Road, Suite 105, Raleigh, North Carolina 27615
 Telephone: (919) 870-1888 Fax: (919) 870-0752
 E-Mail: info@blakdesigngroup.com

BIORETENTION PLAN
STORAGE MAX ROLESVILLE
 S. MAIN STREET, ROLESVILLE, N.C.

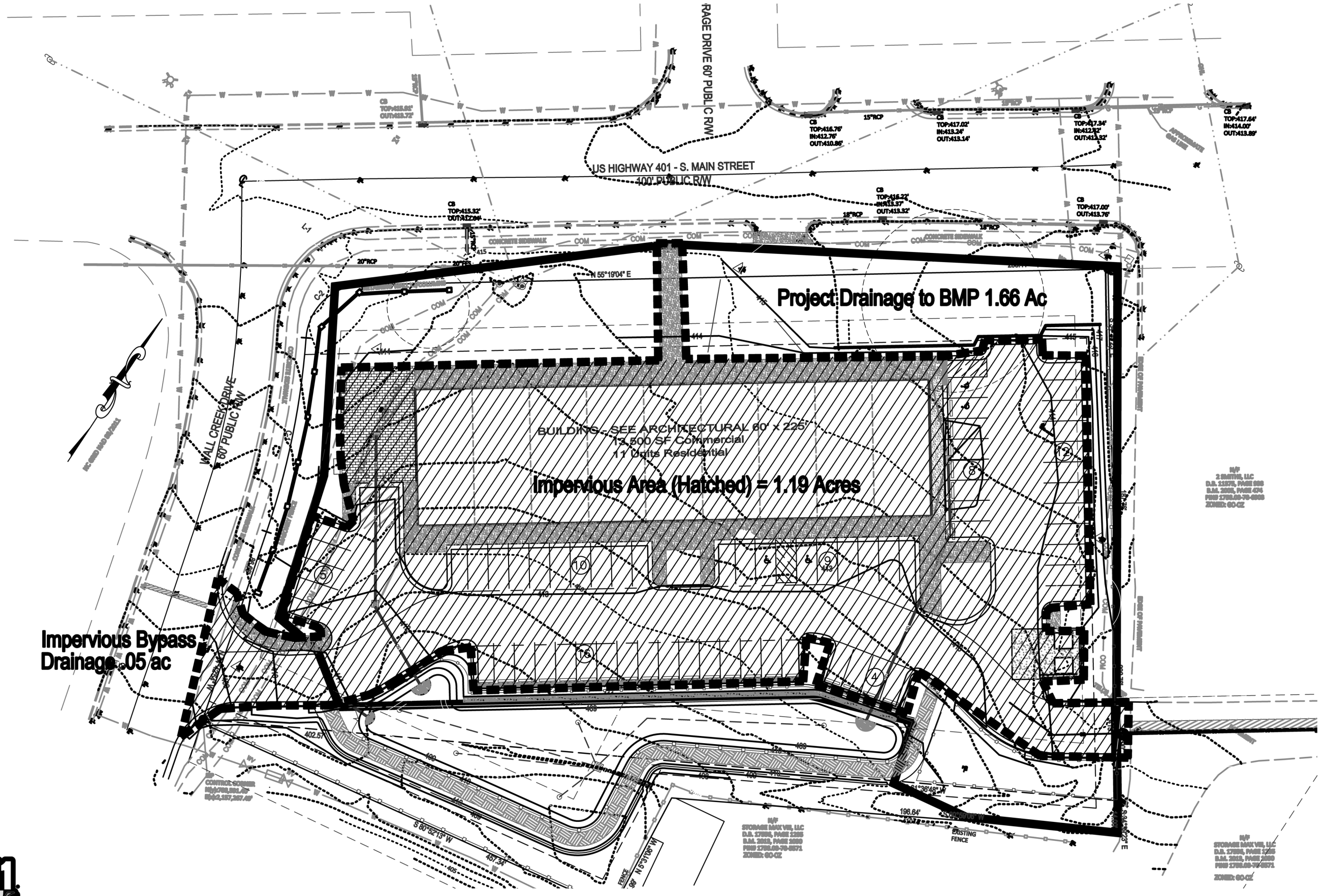
DATE AUG 1,17
 SCALE 1"=30'
 DRAWN BTB

JOB NO.
 REVISIONS

SHEET
C2.1



Know what's below.
Call before you dig.
(Or call 1-800-482-4849)



Project Drainage to BMP 1.66 Ac

Impervious Area (Hatched) = 1.19 Acres

Impervious Bypass Drainage .05 ac



Gettle Engineering and Design, PLLC

3616 Waxwing Court,
Wake Forest, North Carolina 27587
(919) 210-3934 Firm License P-2538

PRELIMINARY
DO NOT USE FOR
CONSTRUCTION

NO.	DATE	REVISION DESCRIPTION
1	07-20-2022	INITIAL SUBMITTAL
2		COMMENT
3		COMMENT
4		COMMENT
5		COMMENT
6		COMMENT
7		COMMENT
8		COMMENT

Drainage Map

South Main
503 South Main Street
Rolesville, Wake County, North Carolina

Project No. XXXXX

Dwg No.

EX1

MP
S SMITH, LLC
D.S. 2207, PAGE 000
S.M. 2002, PAGE 004
PWS 2700-00-70-0071
ZONE: 60-CZ

MP
S SMITH, LLC
D.S. 2207, PAGE 000
S.M. 2002, PAGE 000
PWS 2700-00-70-0071
ZONE: 60-CZ