

*First Southern Baptist Church of Bryant*

604 S REYNOLDS ROAD, BRYANT, AR 72022

*DRAINAGE REPORT*

*FOR*

*City of Bryant, Saline County, AR*

September 2024

Owner & Developer: Peter Cunningham.

By:

**HOPE**  
**CONSULTING**  
ENGINEERS - SURVEYORS

# TABLE OF CONTENTS

## ITEM DESCRIPTION

1. Narrative & Summary
2. Hydrograph Report

## **Narrative & Summary**

**PROJECT TITLE**

First Southern Baptist Church of Bryant

**PROJECT PROPERTY OWNER**

Peter Cunningham

**PROJECT LOCATION**

604 S Reynolds Road, Bryant, AR

**PROJECT DESCRIPTION**

The proposed development is on South Reynolds Road, Bryant, AR. Total development site area is 7.58 acres.

**DRAINAGE ANALYSIS**

**On Site Drainage-** Rational method was used to determine the existing and proposed flows from proposed site. There will be one retention pond to detain water from this development. Detailed drainage calculations considering the future expected development have been conducted to determine the required detention pond and culvert dimensions. Summary of the calculations are below:

**Retention Pond**

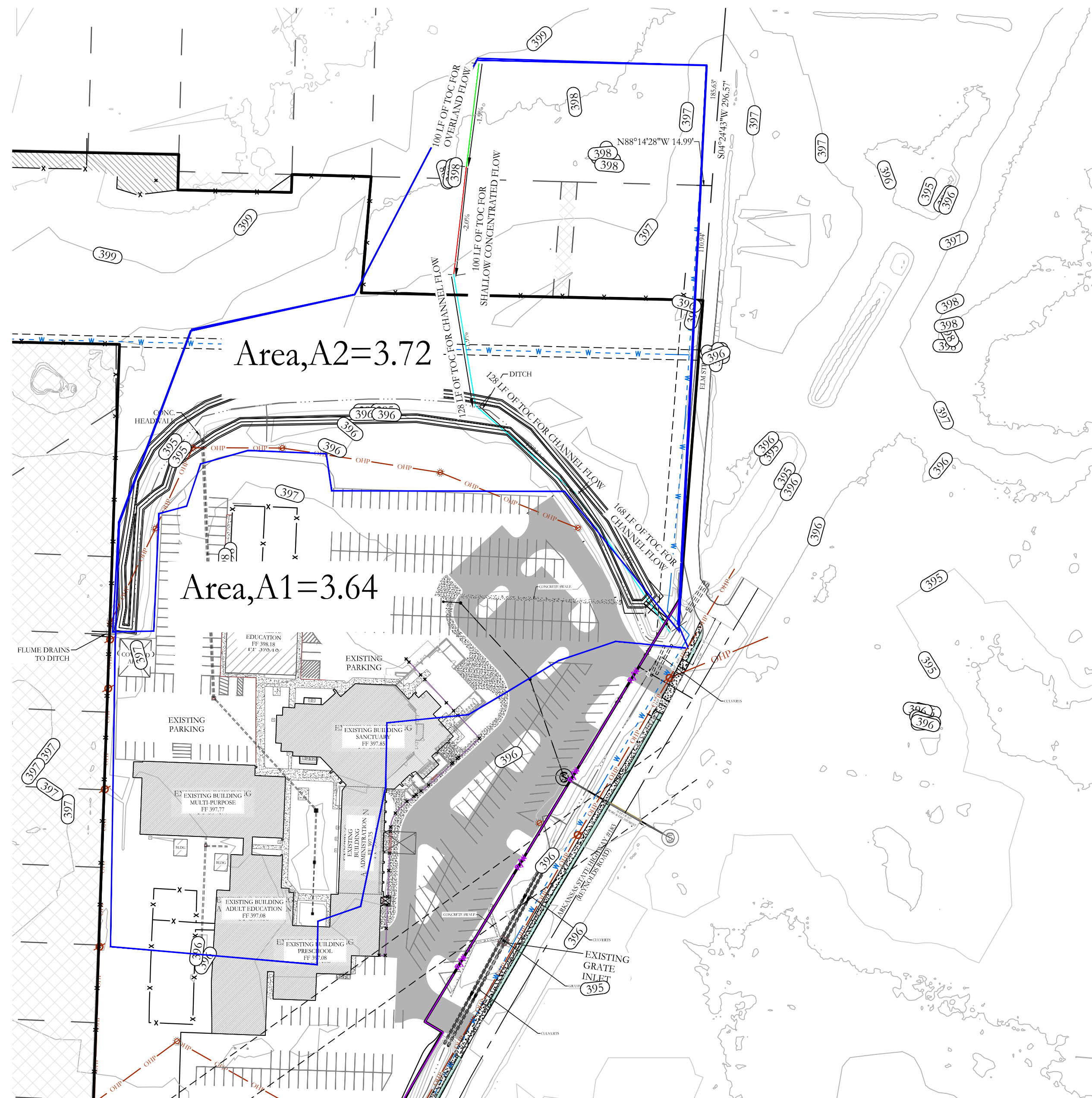
- Pond is situated on the north-east side of the property.
- Pre-development area 7.36 acres.
- Post-development area 7.34 acres.
- Pre-development runoff cumulative coefficient 0.65.
- Post-development runoff cumulative coefficient 0.72
- Pond has a bottom area of 16,570 sqft with bottom elevation of 393.4’.
- Two 8” RCPs with 0.52% slope is proposed for outflow pipes.

**Peak flows for Pre and post development phase of onsite area have been tabulated below-**

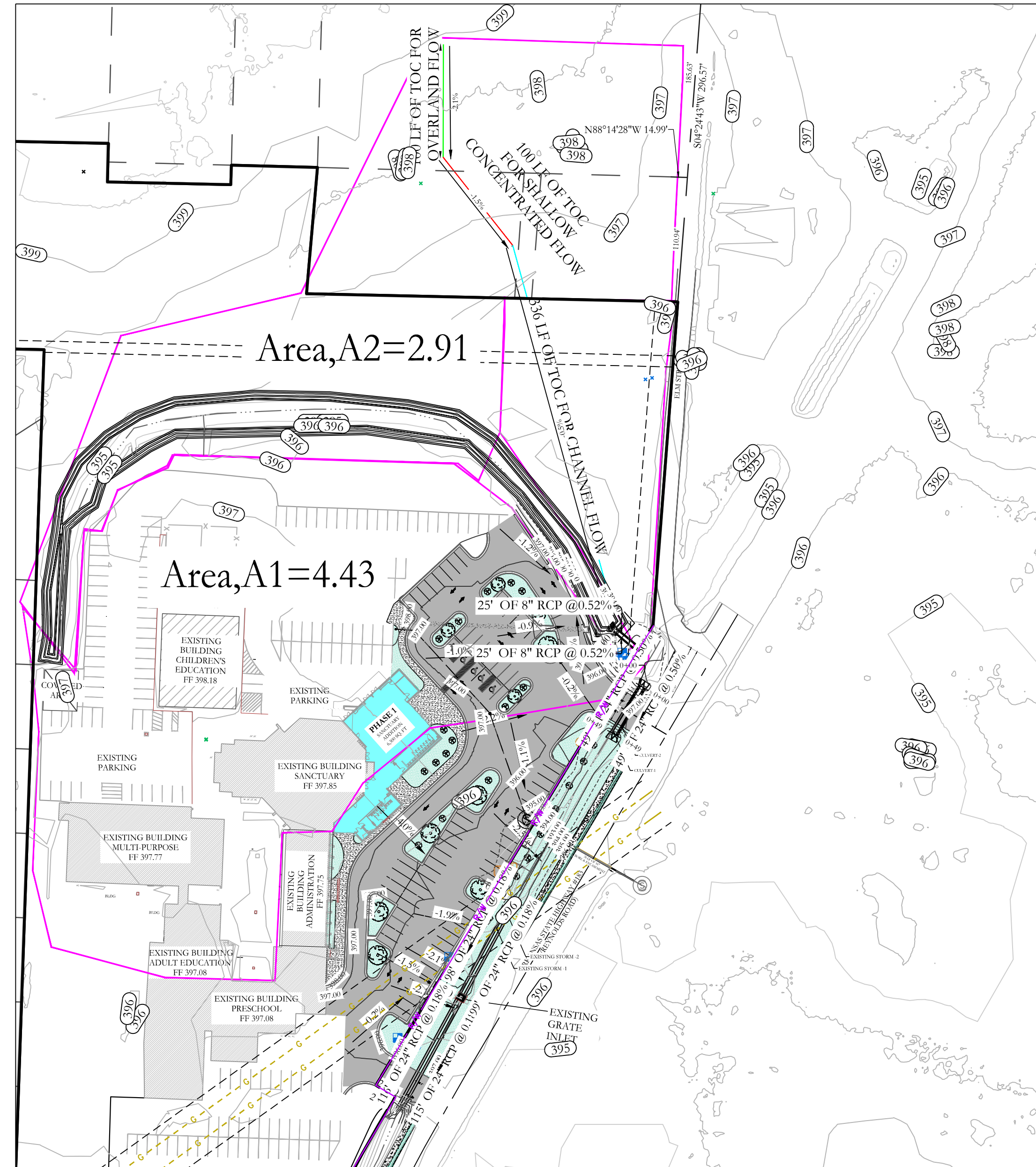
Period of time	Pre-development	Post-dev. Without detention	Post-dev. With detention
	Peak Flow (cfs)	Peak Flow (cfs)	Peak Flow (cfs)
2-Year	18.69	22.67	1.911
5-Year	20.65	25.15	2.677
10-Year	24.35	29.23	4.569
25-Year	27.93	33.44	6.883
50-Year	31.84	38.07	9.645
100-Year	33.86	40.40	11.06

## **CONCLUSION**

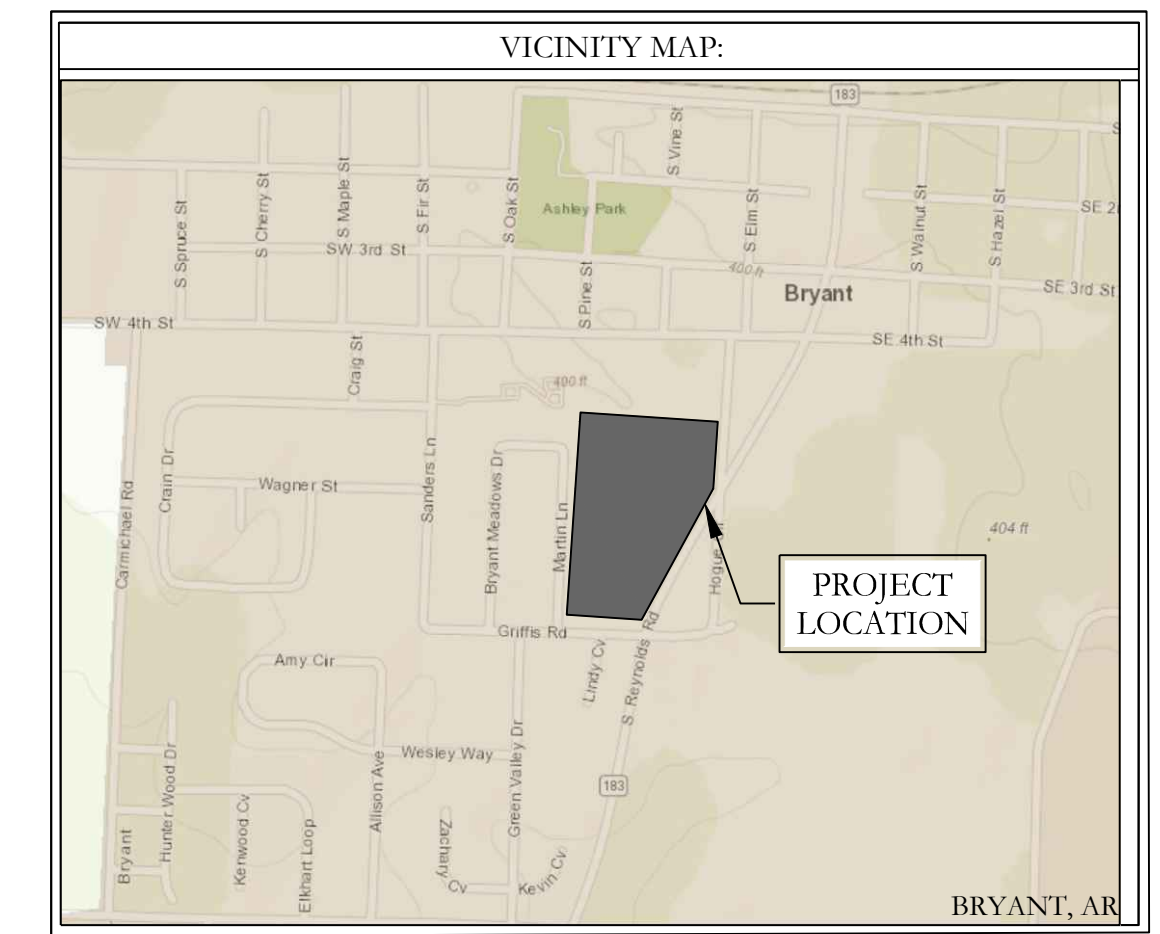
From the onsite drainage calculation, it is seen that there is decrease in flow for all storm events due to the proposed retention pond.



Pre Development



Post Development



- OVERLAND FLOW
- SHALLOW CONCENTRATED FLOW
- CHANNEL FLOW

RUNOFF CO-EFFICIENT CALCULATIONS:

FOR 100 YR,

FOR PRE-DEVELOPMENT:

FOR AREA , A1

RUNOFF CO-EFF. C1=0.95 (ASPHALT)

[PAGE-55, BRYANT STANDARD STORM DRAINAGE MANUAL]

FOR AREA , A2

C2=0.36 (>75% GRASS COVER)

CUMMULATIVE CO-EFF.  
= [(0.95\*3.64)+(3.72\*0.36)]/7.36  
=0.65

FOR POST-DEVELOPMENT:

FOR AREA , A1

RUNOFF CO-EFF. C1=0.95 (ASPHALT)

[PAGE-55, BRYANT STANDARD STORM DRAINAGE MANUAL]

FOR AREA , A2

C2=0.36 (>75% GRASS COVER)

CUMMULATIVE CO-EFF.  
= [(0.95\*4.43)+(2.91\*0.36)]/7.34  
=0.72

- LEGEND**
- - Found Aliquot Corner
  - - Found monument
  - ⊙ - Set 1/2" Rebar
  - △ - Computed point
  - (M) - Measured
  - (P) - Plat/Deed
  - - Fence

Drainage Calculations:

TOC Calculations for 100 yr:

Pre-Development:

Overland Flow:  $t_1 = 0.82 \left[ \frac{NL}{50S} \right]^{0.467}$  |  $N = 0.30$   
 $= 10.25 \text{ min}$  |  $L = 100'$   
 $S = 1.9\%$

Shallow Concentrated Flow:  $t_{sc} = \frac{L}{60V}$  |  $V = 16.1345 (S)^{0.5}$ ;  $S = 2.0\%$   
 $= 0.73 \text{ min}$  |  $L = 100'$   
 $S_1 = 1.9\%$ ;  $S_2 = 1.8\%$ ;  $S_3 = 1.1\%$   
 $n = 0.15$  ;  $R = 0.22$   
 $V = \frac{1.49}{n} R^{2/3} S^{1/2}$   
 $V_1 = 0.49$   
 $V_2 = 0.48$  ;  $V = 1.35$   
 $V_3 = 0.38$

Channel Flow:  $t_{cs} = \frac{L}{60V}$  |  $L = 420'$   
 $= 5.19 \text{ min}$  |  $L_1 = 128'$ ;  $L_2 = 128'$ ;  $L_3 = 164'$   
 $S_1 = 1.9\%$ ;  $S_2 = 1.8\%$ ;  $S_3 = 1.1\%$   
 $n = 0.15$  ;  $R = 0.22$   
 $V = \frac{1.49}{n} R^{2/3} S^{1/2}$   
 $V_1 = 0.49$   
 $V_2 = 0.48$  ;  $V = 1.35$   
 $V_3 = 0.38$

Total TOC = 16.16 min

∴ Rainfall Intensity,  $I = 7.4 \text{ in/hr}$

Area,  $A = 7.36 \text{ ac}$

Run-off Co-efficient (Cumulative) = 0.65 [  $C_1 = 0.95$ ,  $C_2 = 0.36$  ]

∴ Discharge,  $Q = CIA = 35.40 \text{ cfs}$

Post-Development: (Without Detention)

Overland Flow:  $t_1 = 10.015 \text{ min}$  |  $N = 0.30$   
 $L = 100'$ ;  $S = 2.1\%$

Shallow Concentrated Flow:  $t_{sc} = 0.84 \text{ min}$  |  $V = 16.1345 (S)^{0.5}$   
 $S = 1.5\%$   
 $L = 100'$

Channel Flow:  $t_{cs} = 1.89 \text{ min}$  |  $L = 336'$   
 $S = 0.5\%$   
 $V = \frac{1.49}{n} R^{2/3} S^{1/2}$ ;  $n = 0.13$   
 $V = 2.05$

∴ Total TOC = 12.78 min

∴ Rainfall Intensity,  $I = 7.8 \text{ in/hr}$

Area,  $A = 7.34 \text{ ac}$

∴ Cumulative Run-off coefficient = 0.72

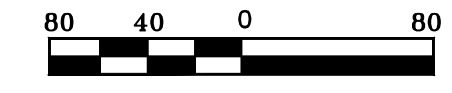
∴ Total Discharge,  $Q = CIA$   
 $∴ Q = 41.22 \text{ cfs}$

Peak flows for Pre and post development phase of onsite area have been tabulated below-

Period of time	Pre-development Peak Flow (cfs)	Post-dev. Without detention Peak Flow (cfs)	Post-dev. With detention Peak Flow (cfs)
2-Year	18.69	22.67	2.319
5-Year	20.65	25.15	3.152
10-Year	24.35	29.23	5.424
25-Year	27.93	33.44	8.087
50-Year	31.84	38.07	11.15
100-Year	33.86	40.40	12.73



BASE OF BEARING:  
GRID NORTH, ARKANSAS  
COORDINATE SYSTEM, SOUTH ZONE  
BY GPS OBSERVATION



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**FIRST SOUTHERN BAPTIST CHURCH OF BRYANT**

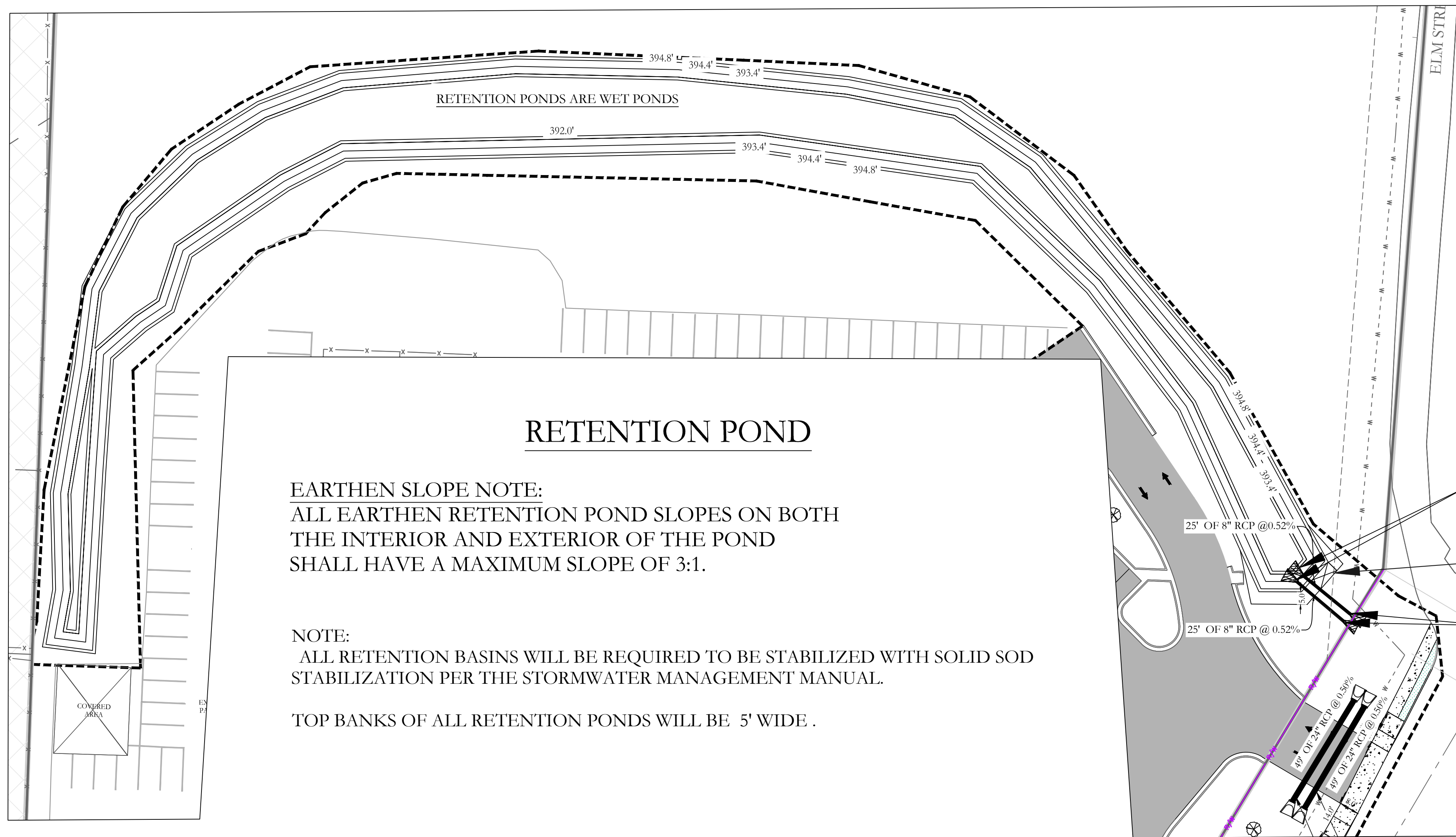
**FSCB EXPANSION & REMODEL PHASE 1**

DRAINAGE CALCULATIONS  
604 S REYNOLDS ROAD  
BRYANT, SALINE COUNTY, ARKANSAS

DATE: 10/3/2024	C.A.D. BY:	DRAWING NUMBER:
REVISED:	CHECKED BY:	24-0260
SHEET: C-5.0	SCALE:	

500 01S 14W 0 34 310 62 1664

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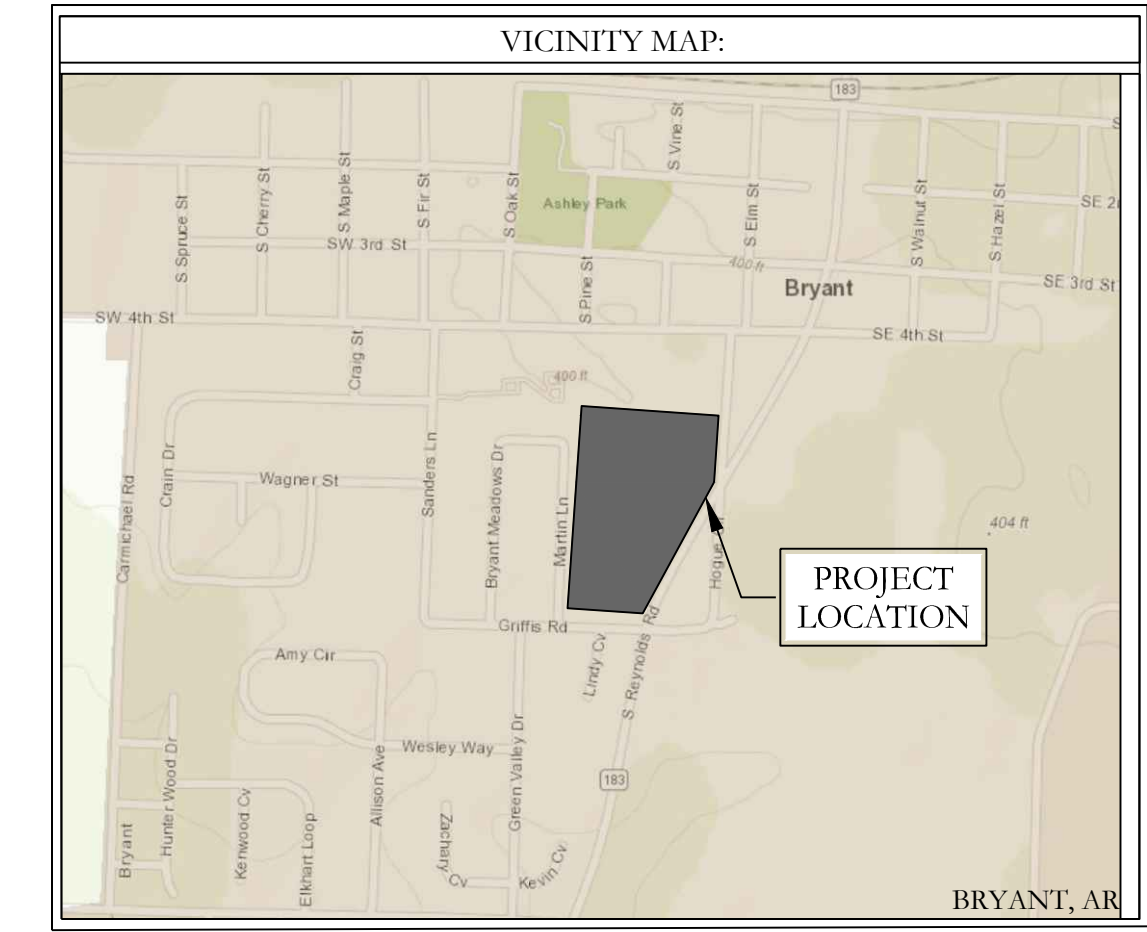
**RETENTION POND**

**EARTHEN SLOPE NOTE:**  
ALL EARTHEN RETENTION POND SLOPES ON BOTH THE INTERIOR AND EXTERIOR OF THE POND SHALL HAVE A MAXIMUM SLOPE OF 3:1.

**NOTE:**  
ALL RETENTION BASINS WILL BE REQUIRED TO BE STABILIZED WITH SOLID SOD STABILIZATION PER THE STORMWATER MANAGEMENT MANUAL.

TOP BANKS OF ALL RETENTION PONDS WILL BE 5' WIDE .

FLOW IN ELEV. 393.4'  
10' WIDE SPILLWAY  
FLOW OUT ELEV. 393.27'



**DETENTION POND MAINTENANCE PLAN**

**Background**

The Retention ponds are located on the periphery of the subdivision. They are designed to temporarily detain stormwater to meet water quantity criteria before discharging off the property.

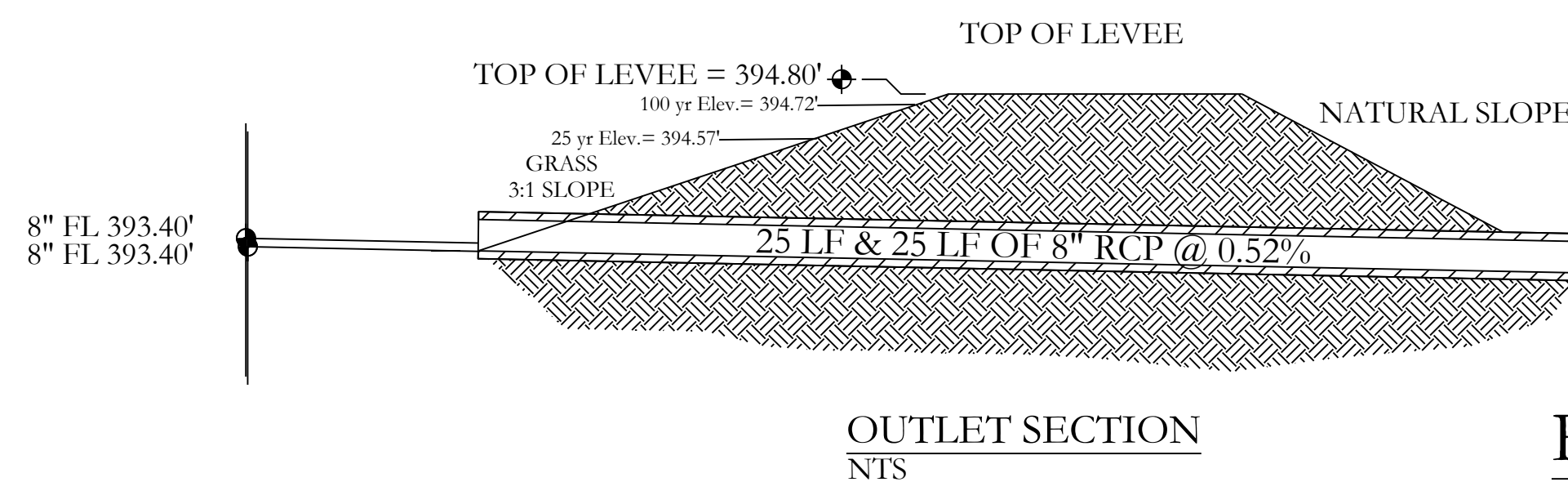
**Routine Maintenance:**

- The property owners association will maintain the drainage easements. Routine maintenance will include but not be limited to:
- Mowing of the bank slopes and area around the pond on a monthly basis during the growing season and as needed during the cooler months.
  - The outlet pipe from the pond and other areas will be inspected monthly for debris which could inhibit the proper flow of discharge. Any debris will be removed immediately and disposed of or placed in a location to prevent future maintenance and to not cause impact up or downstream of the structure.
  - Trash will be removed from around the pond to prevent entering the pond. Generally, the site should be kept free of loose trash which could be carried off site by wind or rain.
  - Inspect the pond and outlet pipe for non-routine maintenance need.

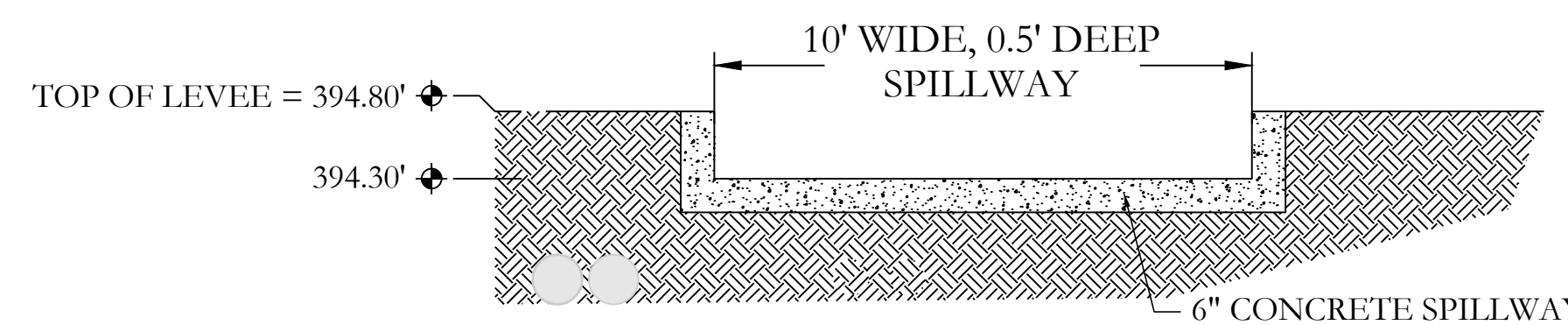
**Periodic or Non-Routine Maintenance**

The routine inspection of the ponds areas and discharge pipes will identify needed repairs and non-routine maintenance. These items may include but not be limited to:

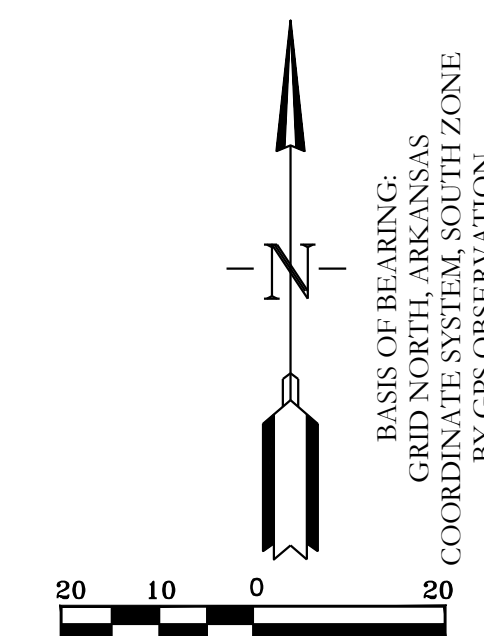
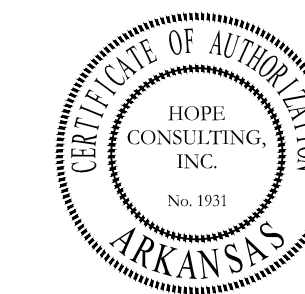
- Re-growth of trees on or around the pond bank. These should be cut and removed from the pond area.
- Sediment from the site may accumulate in the pond bottom and reduce the pond to below design volume requirements. The pond should be excavated if the pond bottom elevation reached a level that allows excessive aquatic growth or reduces the pond efficiency such, that the sediments are passing the discharge structure and release off site.
- Stabilization or re-grading of side slopes may be required periodically or after excessive rain events. Any disturbance of slopes should be reseeded or may require installation of erosion control materials until seeding can reestablish adequate grasses to prevent future erosion.
- Any other maintenance or repairs which would minimize other maintenance to the pond or outfall structures.



**RETENTION POND**  
NTS

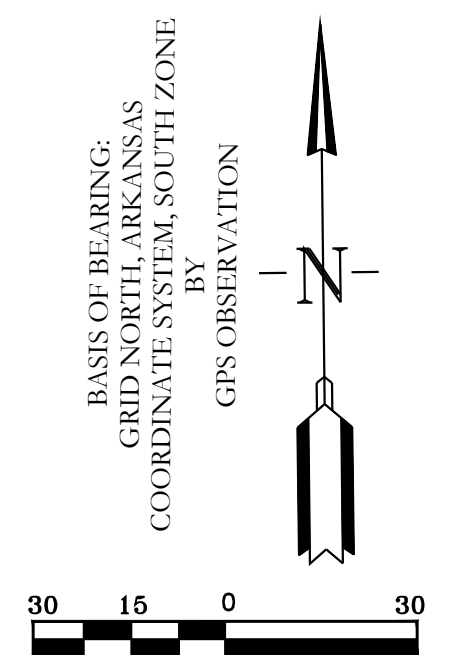
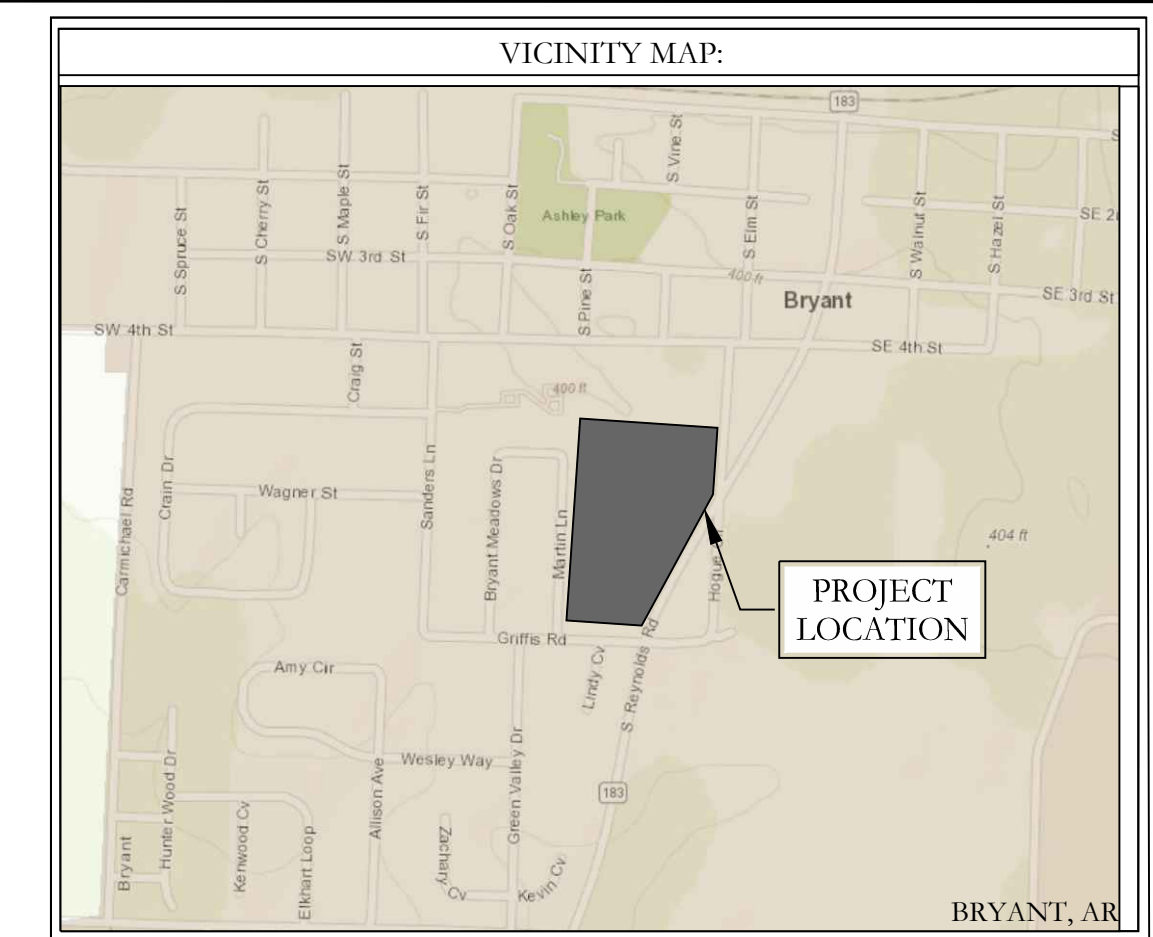
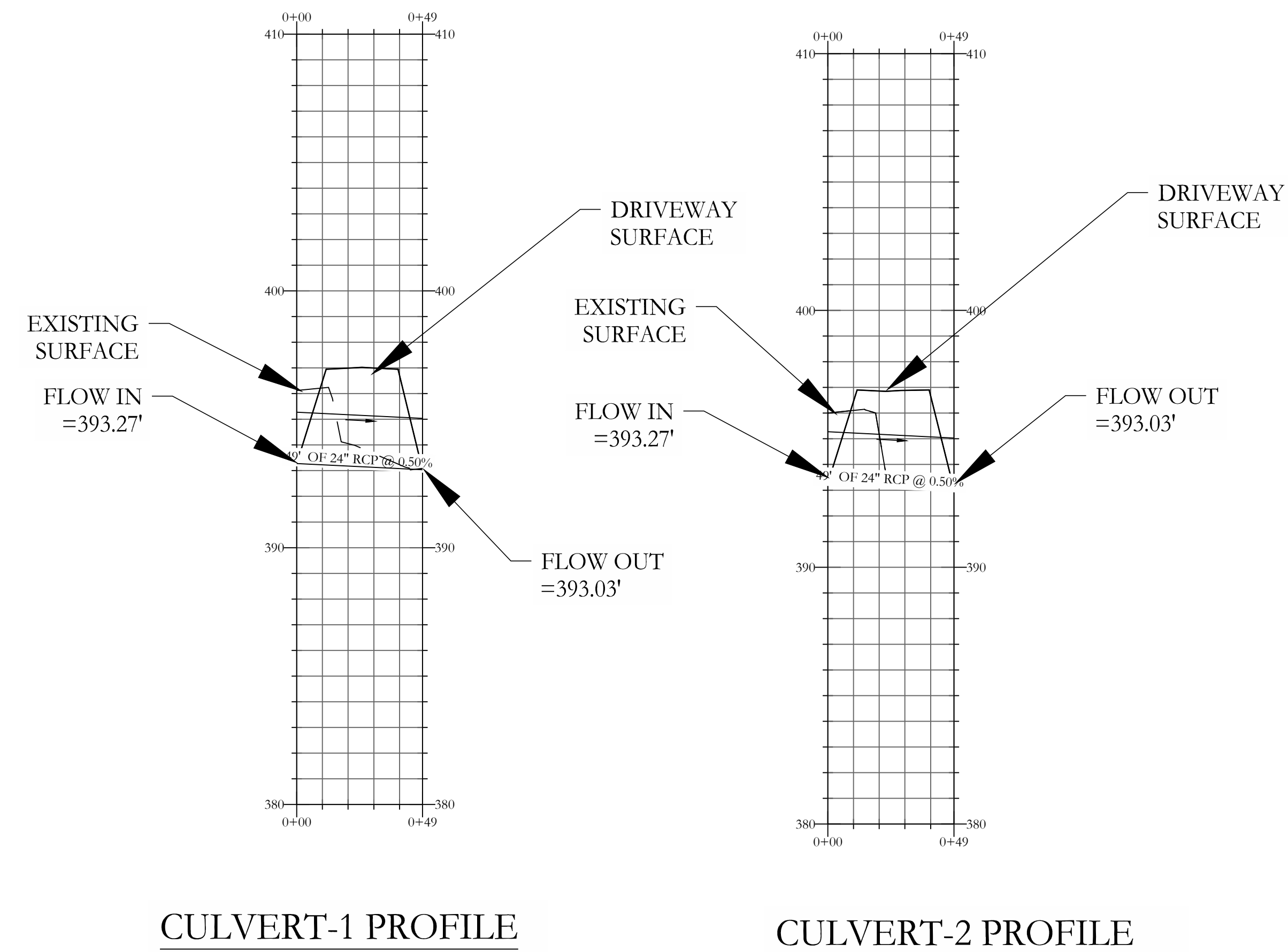
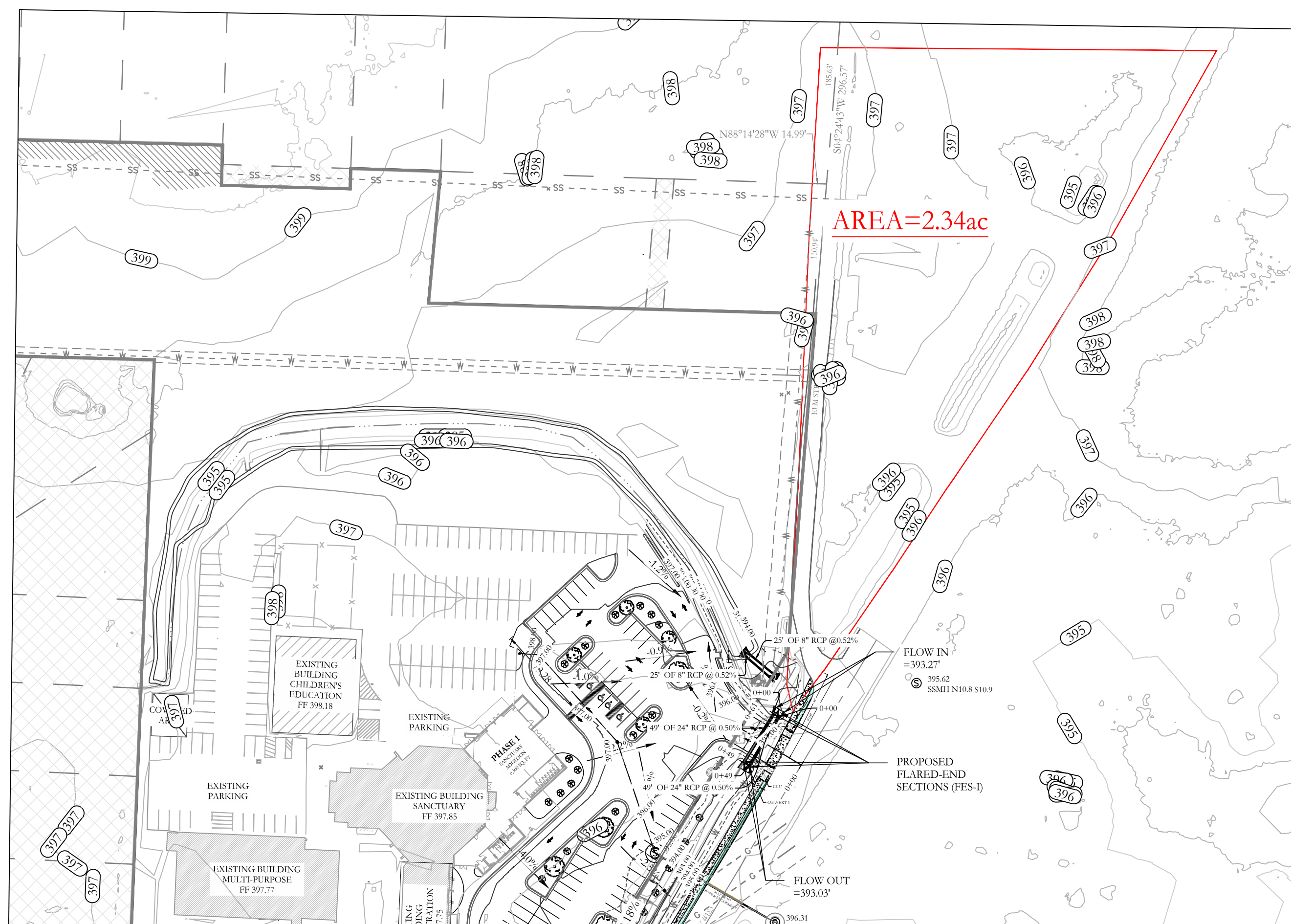


**SPILLWAY END VIEW**  
NTS



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<b>FSCB EXPANSION &amp; REMODEL PHASE 1</b>			
RETENTION POND 604 S REYNOLDS ROAD BRYANT, SALINE COUNTY, ARKANSAS			
DATE: 10/3/2024	C.A.D. BY:	DRAWING NUMBER:	
REVISIONS:	CHECKED BY:	<b>24-0260</b>	
SHEET: C-6.0	SCALE:		
500	01S	14W	0 34 310 62 1664

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Edge of pavement elev. =397.45'  
 Proposed Driveway Surface elev. =397.00'  
 10 yr Storm Discharge Elevation=394.97'  
 50 yr Storm Discharge Elevation =395.28'

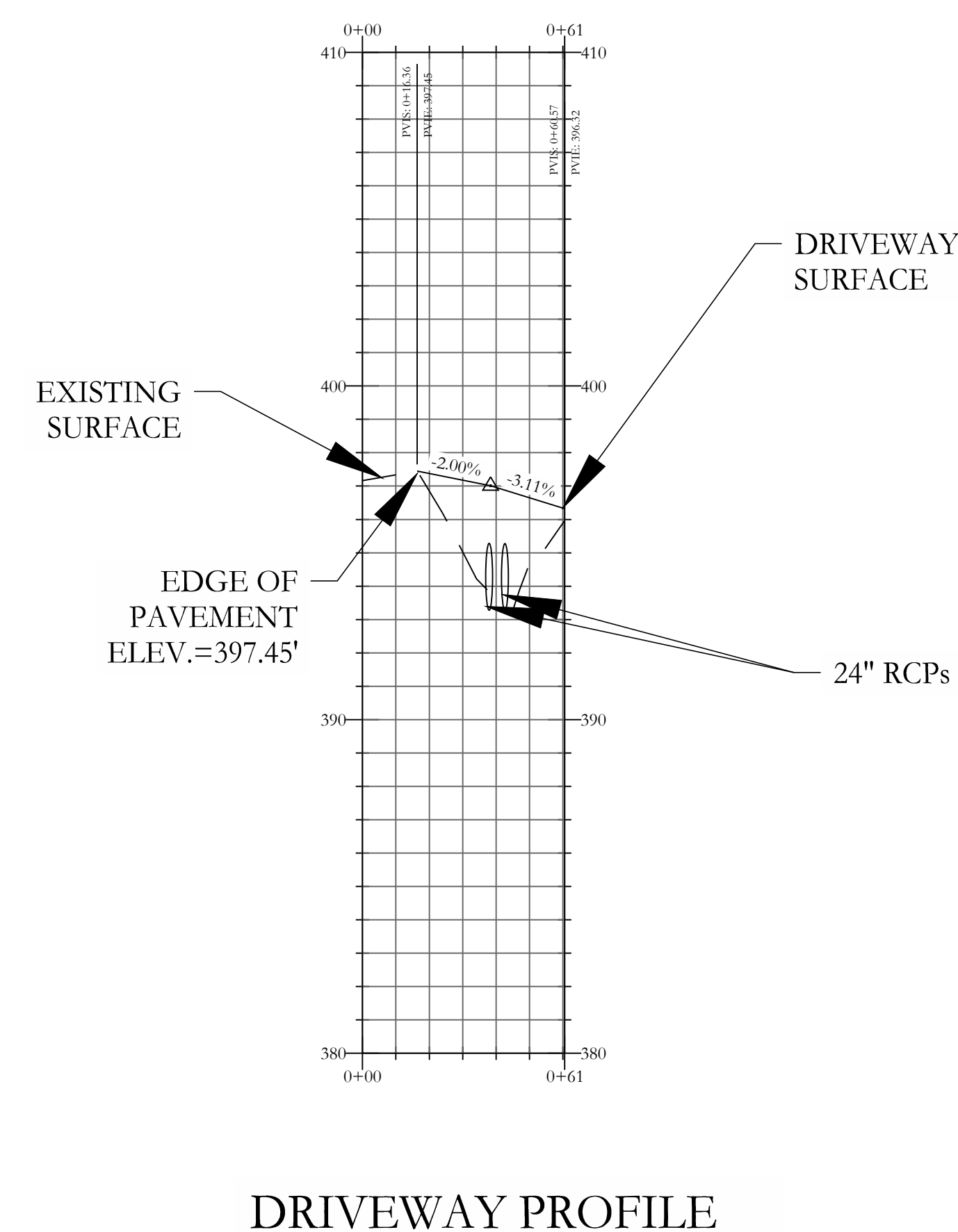
**DRAINAGE CALCULATION**

Discharge,  $Q_{10} = 0.83 * 6.3 * 2.34 = 12.24$  cfs  
 Discharge,  $Q_{50} = 0.92 * 7.9 * 2.34 = 17.00$  cfs

Discharge from Detention Outlets:  
 Discharge,  $Q_{10} = 4.569$  cfs  
 Discharge,  $Q_{50} = 9.645$  cfs

Total Discharge,  $Q_{10} = 16.81$  cfs  
 $Q_{50} = 26.65$  cfs

For 24" RCP pipes,  
 10 yr Storm Discharge Elevation,  $d_{10} = 394.97'$   
 50 yr Storm Discharge Elevation,  $d_{50} = 395.28'$



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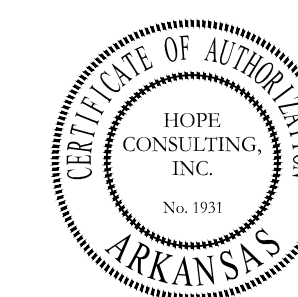
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**FSCB EXPANSION & REMODEL PHASE 1**  
 DRAINAGE EXHIBIT  
 604 S REYNOLDS ROAD  
 BRYANT, SALINE COUNTY, ARKANSAS

DATE: 08-28-2024	C.A.D. BY:	DRAWING NUMBER:
REVISION: 10-03-2024	CHECKED BY:	24-0260
SHEET: No. 20876	SCALE:	

500 01S 14W 0 12 310 62 1664



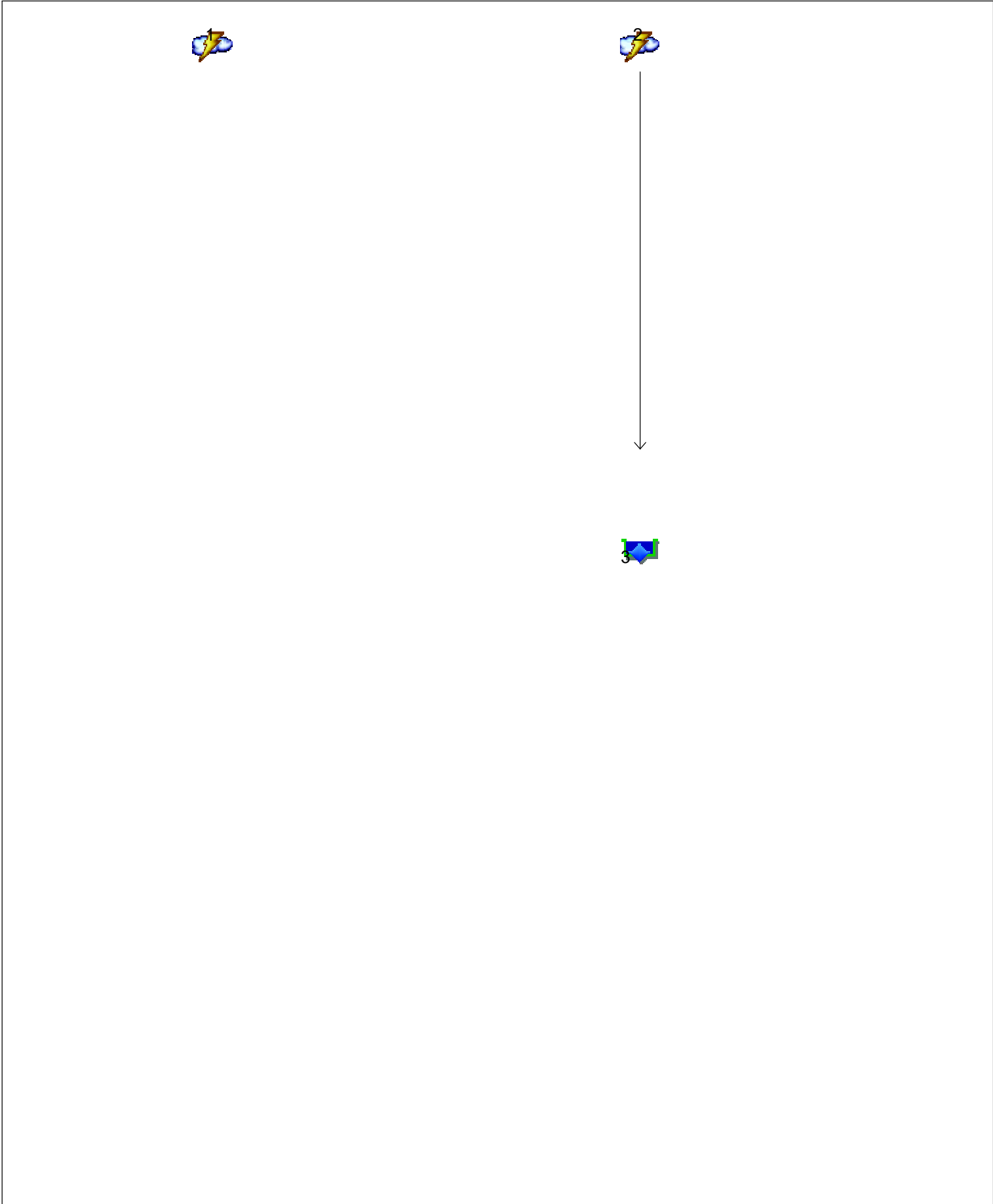
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# **Hydrograph Summary Report**

# Watershed Model Schematic

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2025



# Multi-Hydrograph Plot

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2025

## Hyd. No. 1

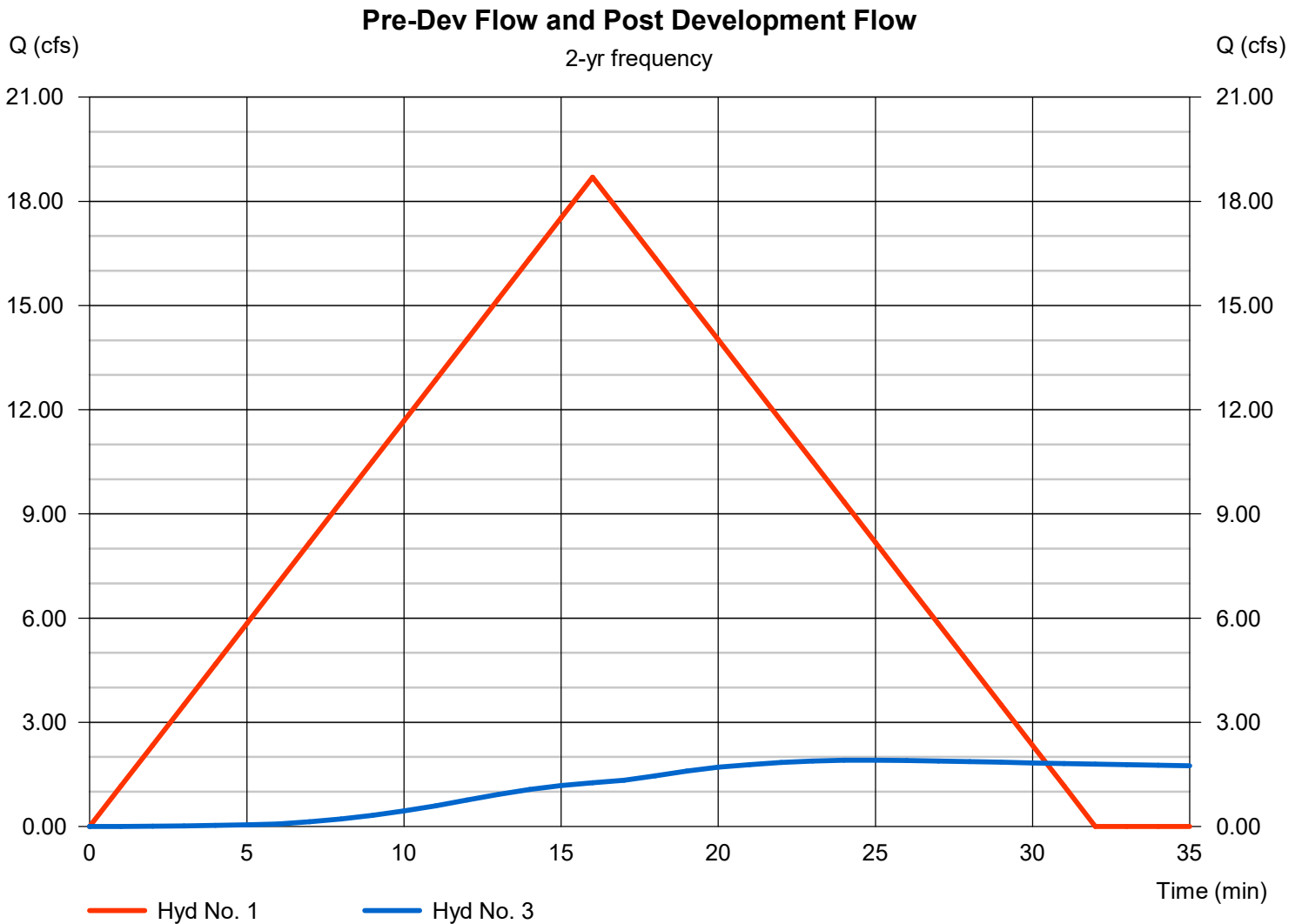
Pre-Dev Flow

Hydrograph type = Rational  
Peak discharge = 18.69 cfs  
Time to peak = 16 min  
Hyd. Volume = 17,943 cuft

## Hyd. No. 3

Post Development Flow

Hydrograph type = Reservoir  
Peak discharge = 1.91 cfs  
Time to peak = 25 min  
Hyd. Volume = 17,652 cuft



# Multi-Hydrograph Plot

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2025

## Hyd. No. 1

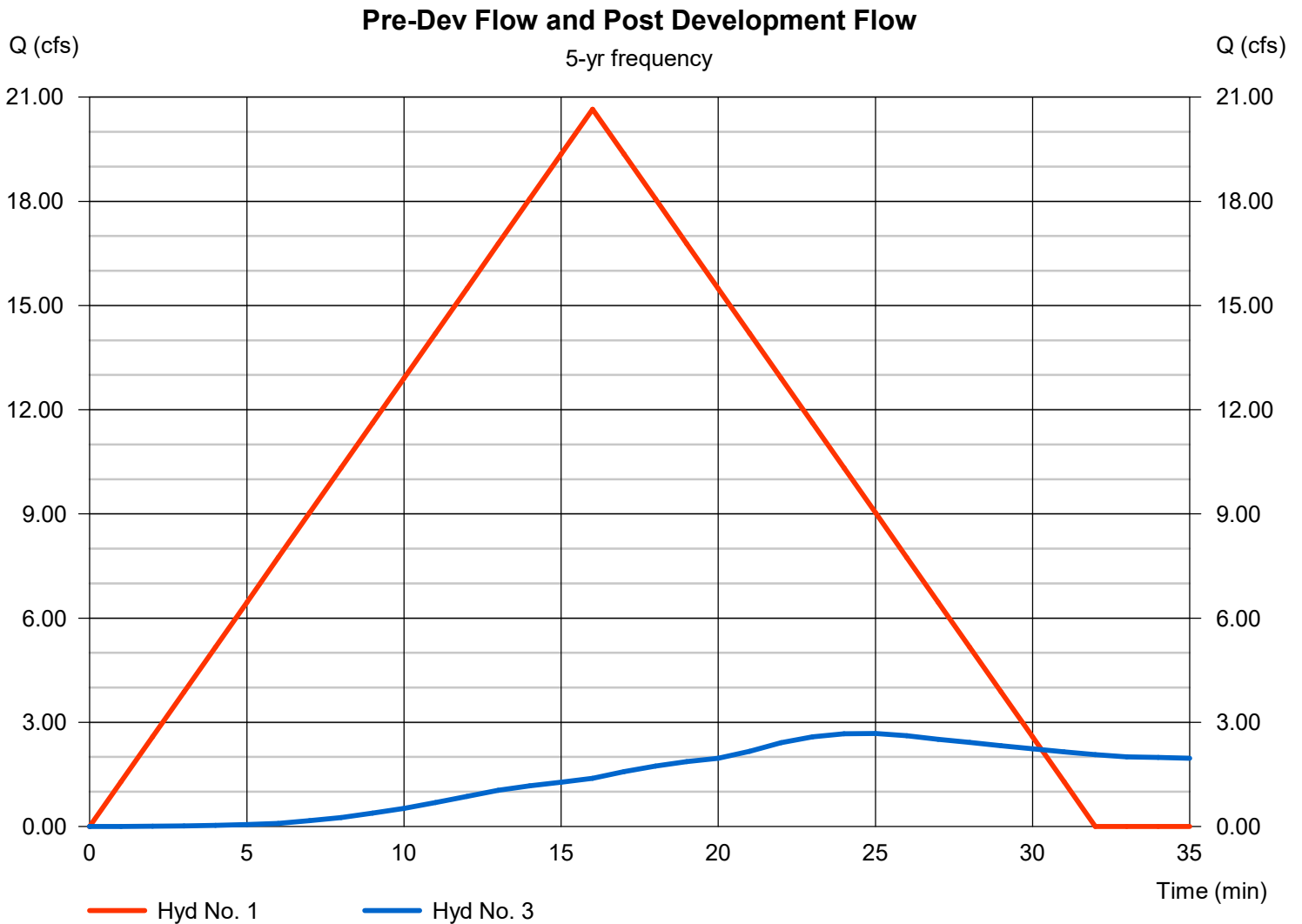
Pre-Dev Flow

Hydrograph type = Rational  
Peak discharge = 20.65 cfs  
Time to peak = 16 min  
Hyd. Volume = 19,826 cuft

## Hyd. No. 3

Post Development Flow

Hydrograph type = Reservoir  
Peak discharge = 2.68 cfs  
Time to peak = 25 min  
Hyd. Volume = 19,588 cuft



# Multi-Hydrograph Plot

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2025

## Hyd. No. 1

Pre-Dev Flow

Hydrograph type = Rational  
Peak discharge = 24.35 cfs  
Time to peak = 16 min  
Hyd. Volume = 23,373 cuft

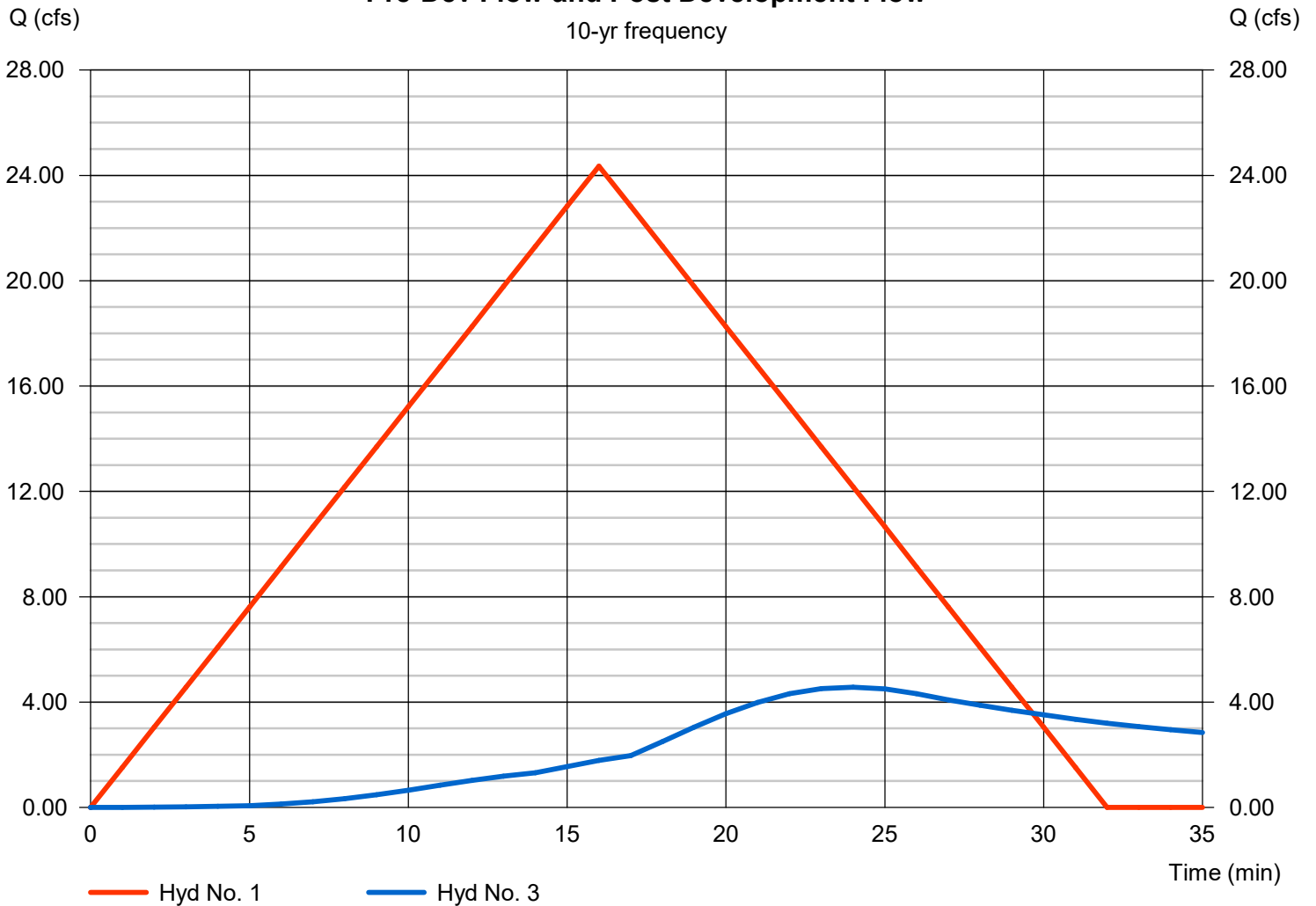
## Hyd. No. 3

Post Development Flow

Hydrograph type = Reservoir  
Peak discharge = 4.57 cfs  
Time to peak = 24 min  
Hyd. Volume = 22,771 cuft

Pre-Dev Flow and Post Development Flow

10-yr frequency



# Multi-Hydrograph Plot

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2025

## Hyd. No. 1

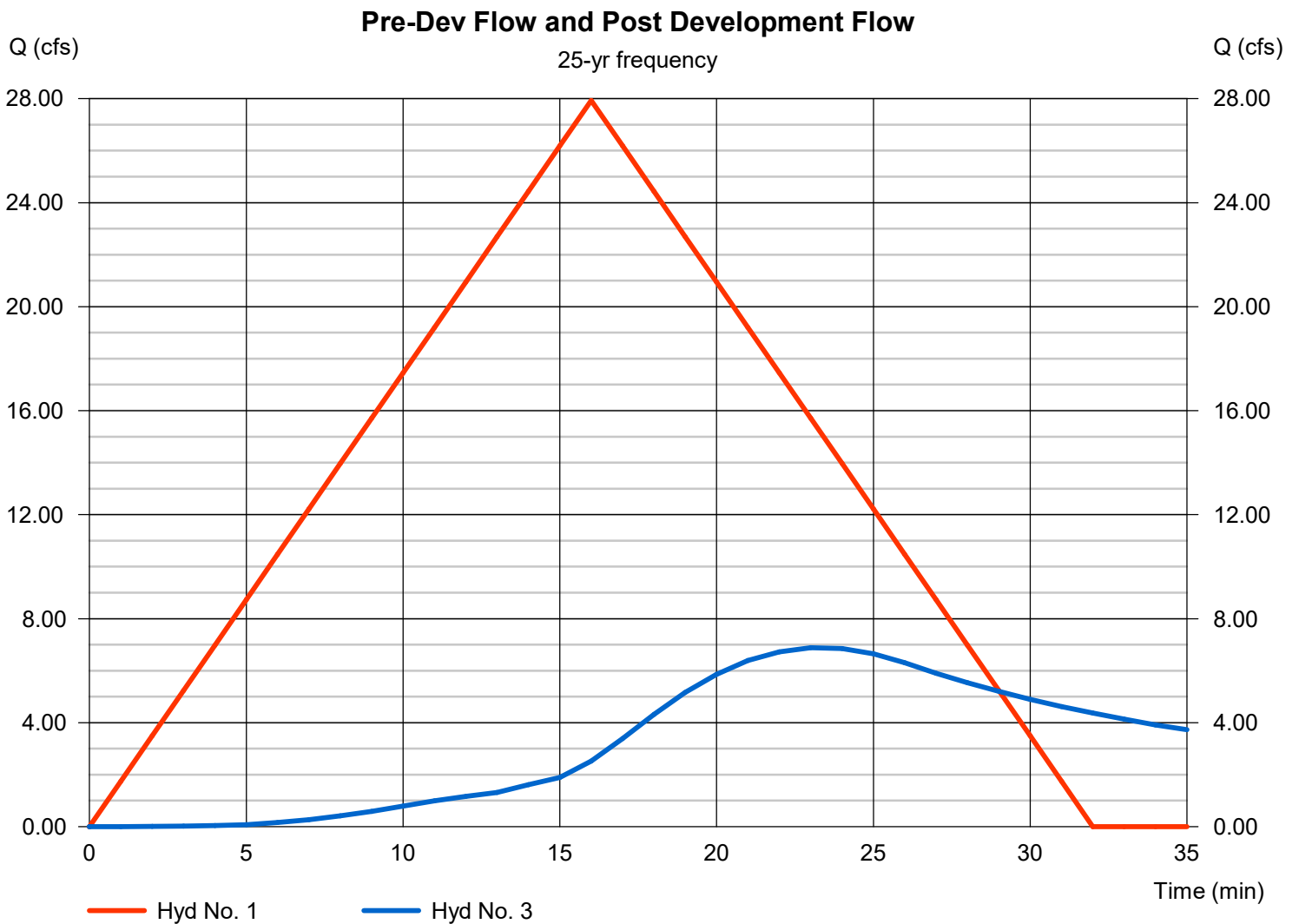
Pre-Dev Flow

Hydrograph type = Rational  
Peak discharge = 27.93 cfs  
Time to peak = 16 min  
Hyd. Volume = 26,812 cuft

## Hyd. No. 3

Post Development Flow

Hydrograph type = Reservoir  
Peak discharge = 6.88 cfs  
Time to peak = 23 min  
Hyd. Volume = 26,060 cuft



# Multi-Hydrograph Plot

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2025

## Hyd. No. 1

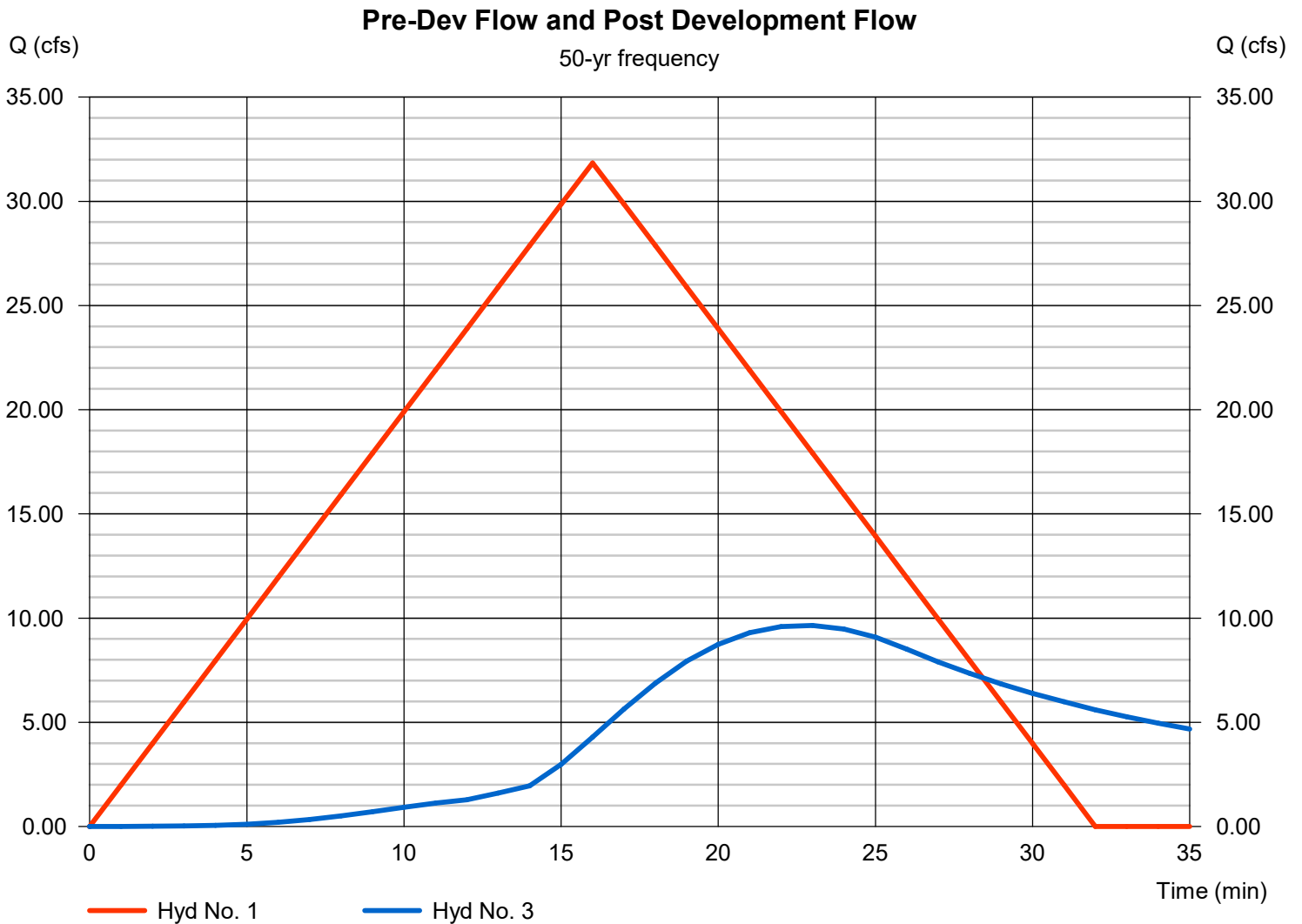
Pre-Dev Flow

Hydrograph type = Rational  
Peak discharge = 31.84 cfs  
Time to peak = 16 min  
Hyd. Volume = 30,570 cuft

## Hyd. No. 3

Post Development Flow

Hydrograph type = Reservoir  
Peak discharge = 9.64 cfs  
Time to peak = 23 min  
Hyd. Volume = 29,672 cuft



# Multi-Hydrograph Plot

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2025

## Hyd. No. 1

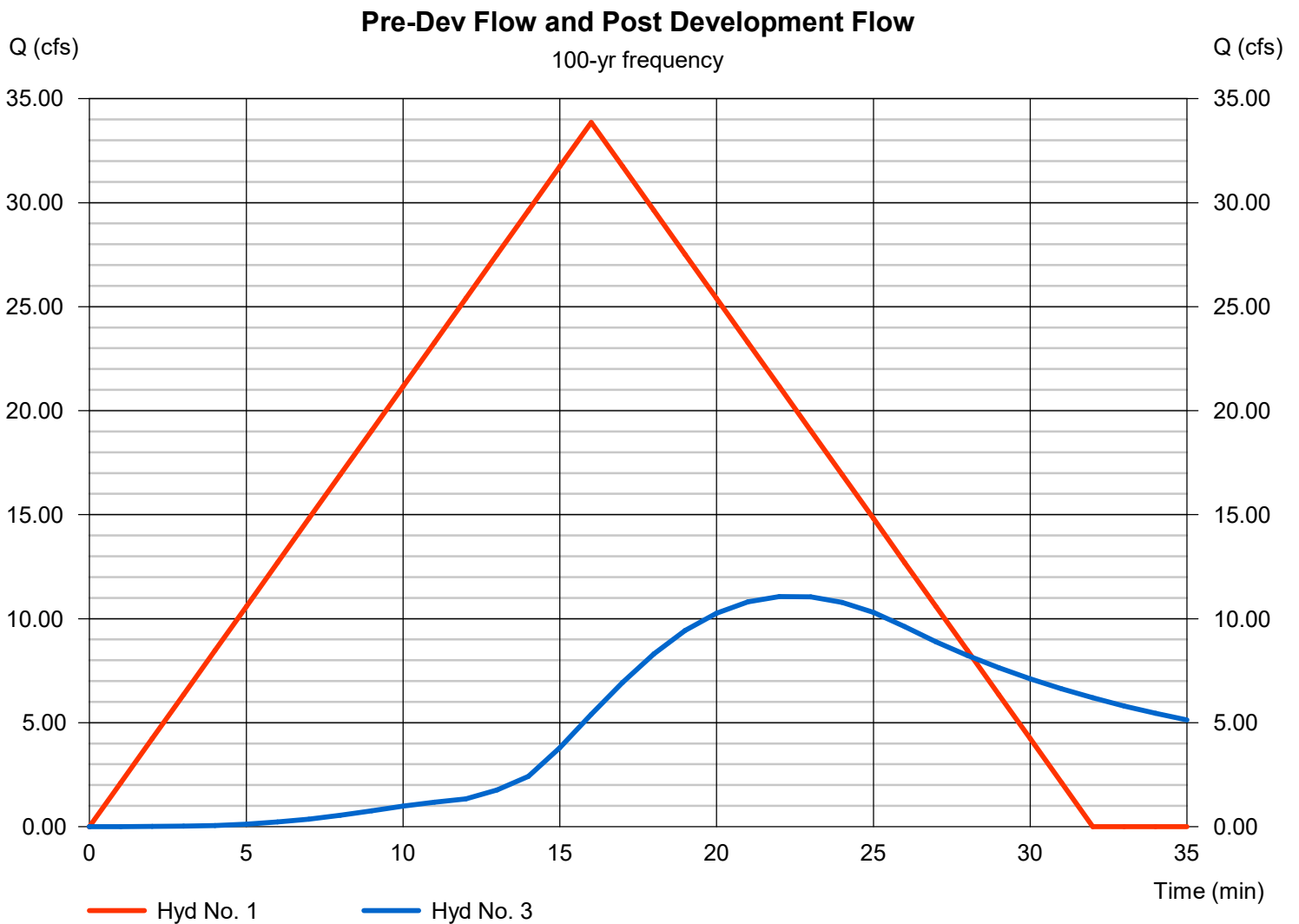
Pre-Dev Flow

Hydrograph type = Rational  
Peak discharge = 33.86 cfs  
Time to peak = 16 min  
Hyd. Volume = 32,504 cuft

## Hyd. No. 3

Post Development Flow

Hydrograph type = Reservoir  
Peak discharge = 11.06 cfs  
Time to peak = 22 min  
Hyd. Volume = 31,482 cuft





# Pond Report

## Pond No. 1 - Retention Pond

### Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 393.40 ft

### Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	393.40	16,570	0	0
1.00	394.40	21,182	18,827	18,827
1.40	394.80	23,045	8,842	27,669

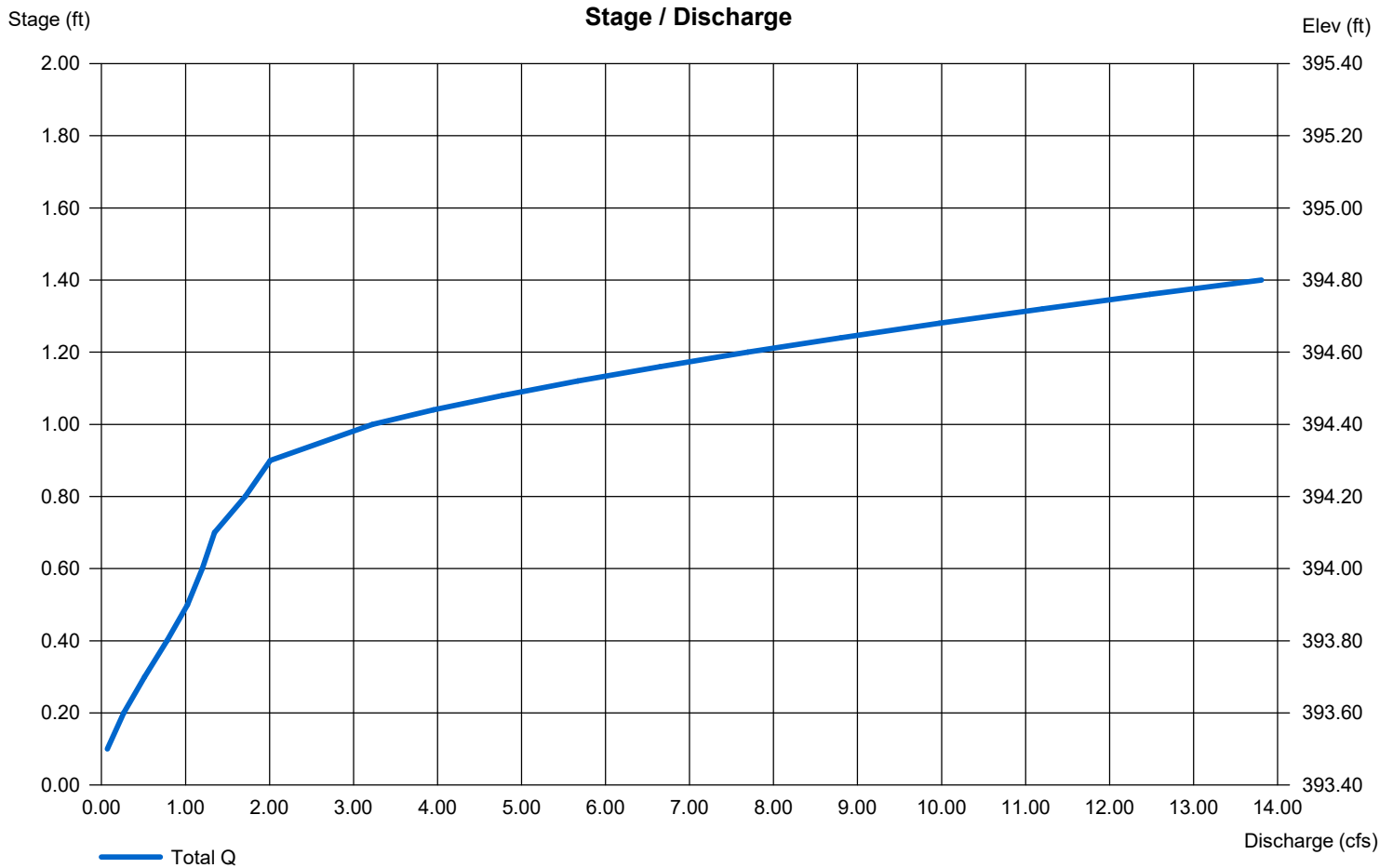
### Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 8.00	8.00	Inactive	Inactive
Span (in)	= 8.00	8.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 393.40	393.40	0.00	0.00
Length (ft)	= 25.00	25.00	0.00	0.00
Slope (%)	= 0.52	0.52	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

### Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 10.00	0.00	0.00	0.00
Crest El. (ft)	= 394.30	0.00	0.00	0.00
Weir Coeff.	= 3.03	3.33	3.33	3.33
Weir Type	= Rect	---	---	---
Multi-Stage	= No	No	No	No
Exfil.(in/hr)	= 0.000 (by Contour)			
TW Elev. (ft)	= 0.00			

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



# Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2025

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description	
1	Rational	18.69	1	16	17,943	-----	-----	-----	Pre-Dev Flow	
2	Rational	22.67	1	13	17,679	-----	-----	-----	Development Generated Flow	
3	Reservoir	1.911	1	25	17,652	2	394.27	16,333	Post Development Flow	
DETENTION-CONTOUR.gpw					Return Period: 2 Year			Wednesday, 09 / 4 / 2024		

# Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2025

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description	
1	Rational	20.65	1	16	19,826	-----	-----	-----	Pre-Dev Flow	
2	Rational	25.15	1	13	19,614	-----	-----	-----	Development Generated Flow	
3	Reservoir	2.677	1	25	19,588	2	394.35	17,979	Post Development Flow	
DETENTION-CONTOUR.gpw					Return Period: 5 Year			Wednesday, 09 / 4 / 2024		

# Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2025

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description	
1	Rational	24.35	1	16	23,373	-----	-----	-----	Pre-Dev Flow	
2	Rational	29.23	1	13	22,797	-----	-----	-----	Development Generated Flow	
3	Reservoir	4.569	1	24	22,771	2	394.47	20,378	Post Development Flow	
DETENTION-CONTOUR.gpw					Return Period: 10 Year			Wednesday, 09 / 4 / 2024		

# Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2025

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description	
1	Rational	27.93	1	16	26,812	-----	-----	-----	Pre-Dev Flow	
2	Rational	33.44	1	13	26,086	-----	-----	-----	Development Generated Flow	
3	Reservoir	6.883	1	23	26,060	2	394.57	22,563	Post Development Flow	
DETENTION-CONTOUR.gpw					Return Period: 25 Year			Wednesday, 09 / 4 / 2024		

# Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2025

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description	
1	Rational	31.84	1	16	30,570	-----	-----	-----	Pre-Dev Flow	
2	Rational	38.07	1	13	29,698	-----	-----	-----	Development Generated Flow	
3	Reservoir	9.645	1	23	29,672	2	394.67	24,768	Post Development Flow	
DETENTION-CONTOUR.gpw					Return Period: 50 Year			Wednesday, 09 / 4 / 2024		

# Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2025

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description	
1	Rational	33.86	1	16	32,504	-----	-----	-----	Pre-Dev Flow	
2	Rational	40.40	1	13	31,509	-----	-----	-----	Development Generated Flow	
3	Reservoir	11.06	1	22	31,482	2	394.72	25,801	Post Development Flow	
DETENTION-CONTOUR.gpw					Return Period: 100 Year			Wednesday, 09 / 4 / 2024		