STORMWATER MANAGEMENT REPORT

PREPARED FOR

LINDO CONSTRUCTION, LLC

90 Maple Ave.
Montville, Conn.

BY

WENTWORTH CIVIL ENGINEERS, LLC
177 WEST TOWN STREET
LEBANON, CONNECTICUT 06249

DATE: 4-06-20

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STORMWATER MANAGEMENT REPORT

Project & Site

The site lies on the western side of Maple Avenue at the intersection of Pequot Road. This parcel consists of 20+ acres of land and is currently vacant. A multifamily development of 87 apartments in 11 buildings with associated access driveway and parking is proposed.

Drainage Evaluation, Methodology and References

Pre vs. Post development analysis and proposed detention basin were analyzed and designed using the NRCS TR-55 drainage design manual for 2, 10, 25, 50 & 100 year Type III storm events. The detention basin will also act as an infiltration basin and was sized and designed to treat the first 1" rainfall storm event (Water Quality Volume) as per CT DEEP 2004 Stormwater Quality Manual.

Current Drainage Patterns

The site slopes westward, up from Maple Avenue. Site drains to the road frontage via an intermittent watercourse that dissipates at the toe of slope and infiltrates most storm events into Hinckley sand & gravel near Maple Avenue. Larger storm events discharge into an existing catch basin located in the west side of Maple Avenue.

Proposed Drainage Patterns

Developed site will utilize the same drainage patterns as exist currently. The site will drain via a catch basin and pipe system to a proposed infiltration / detention basin located in the sand & gravel soils at the Maple Avenue road frontage.

The developed onsite storm water treatment design includes the following:

- Onsite detention of peak storm water flows for 2 through 100 year storm events.
- Treatment of 1" Water Quality Volume through infiltration / detention basin into groundwater.
- Maximize infiltration through infiltration into sand & gravel soils therefore maintaining storm volumes for storm events up to 25 years.

Developed Conditions

- Stormwater Quality:

  The site was designed to minimize impervious surfaces and maximize travel time and infiltration of developed storm water flows. All onsite parking and driveway areas drain into a combination infiltration / detention basin. Roof drains also discharge into basin for additional groundwater recharge. The basin has a sediment fore bay that discharges through a filter berm and into the main body of the basin. Travel distance is maximized through the basin to encourage pollutant and sediment treatment and infiltration time during smaller storm events.

  The basin has been sized to retain the first flush 1" storm event that compromise about 85 – 90% of annual storms (water quality volume or WQV). This volume will infiltrate through the bottom of the basin during all periods of the year.

- Pre vs. Post Development Analysis and Large Storm Peak Flow Attenuation:

  The site was analyzed for pre vs. post development conditions for 2, 10, 25, 50 & 100 year Type III storm events. The majority of the developed site stormwater will be intercepted and discharged to the proposed infiltration / water quality basin. The detention basin has been designed to keep post development peak flow rates approximately the same or reduced relative to existing conditions. The resulting peak flows are as follows:

		2yr	10 yr	25yr	100yr
Exist.	Point A	13.7 cfs	34.6 cfs	36.7 cfs	69.0 cfs
Dev.	Point A	9.9 cfs	26.0 cfs	27.4 cfs	53.8 cfs

Maintenance of Water Recharge Potential

Open space areas of 85% are being maintained on the site. Post developed landscape design include large portion of open space to remain wooded (62% wooded), lawn and landscaped. Infiltration basin will recharge groundwater for entire water quality volume and maximize rainwater infiltration for all storm events.

Erosion & Sedimentation Control

Design plans include site specific erosion and sedimentation control design measures. Site specific design plans and notes are provided to minimize short term impacts during construction of the project.

Maintenance and Operation

Maintenance and operation of notes for privately owned onsite drainage facilities have been included as part of design plans.

Basin Model

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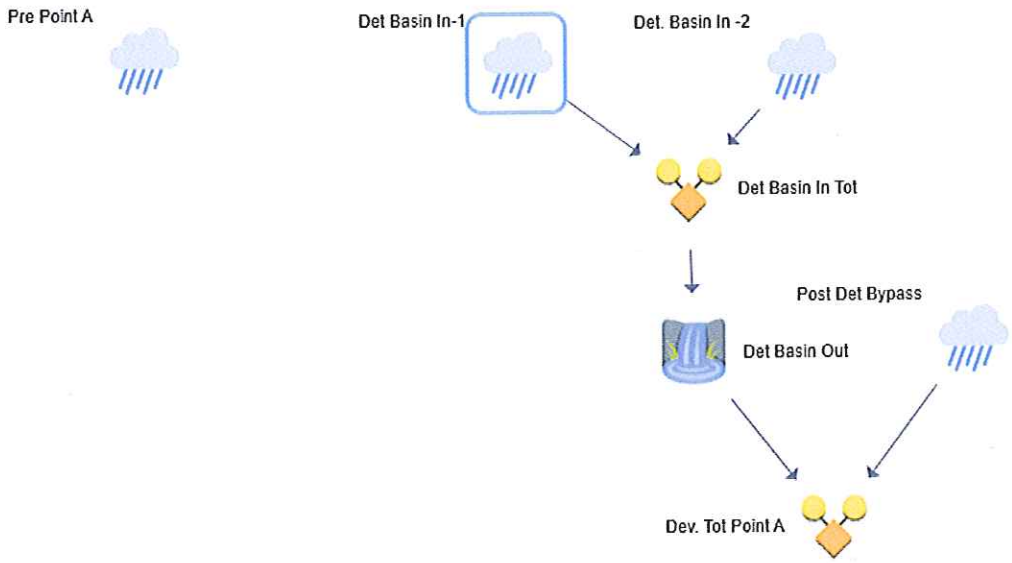

Hydrograph by Return Period

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Hyd. No.	Hydrograph Type	Hydrograph Name	Peak Outflow (cfs)							
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
1	NRCS Runoff	Pre Point A		13.74			34.63	36.74		68.96
2	NRCS Runoff	Det Basin In-1		9.636			17.84	19.53		29.86
3	NRCS Runoff	Det. Basin In -2		0.018			0.286	0.288		1.101
4	Junction	Det Basin In Tot		9.637			18.12	19.80		30.93
5	Pond Route	Det Basin Out		1.022			5.430	5.563		8.782
6	NRCS Runoff	Post Det Bypass		9.941			24.03	25.64		46.98
7	Junction	Dev. Tot Point A		9.941			26.04	27.36		53.76

Hydrograph 2-yr Summary

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Hyd. No.	Hydrograph Type	Hydrograph Name	Peak Flow (cfs)	Time to Peak (hrs)	Hydrograph Volume (cuft)	Inflow Hyd(s)	Maximum Elevation (ft)	Maximum Storage (cuft)
1	NRCS Runoff	Pre Point A	13.74	12.20	50,501	----		
2	NRCS Runoff	Det Basin In-1	9.636	12.17	29,397	----		
3	NRCS Runoff	Det. Basin In -2	0.018	12.47	313	----		
4	Junction	Det Basin In Tot	9.637	12.17	29,710	2, 3		
5	Pond Route	Det Basin Out	1.022	13.03	13,978	4	111.07	14,929
6	NRCS Runoff	Post Det Bypass	9.941	12.20	35,460	----		
7	Junction	Dev. Tot Point A	9.941	12.20	49,438	5, 6		

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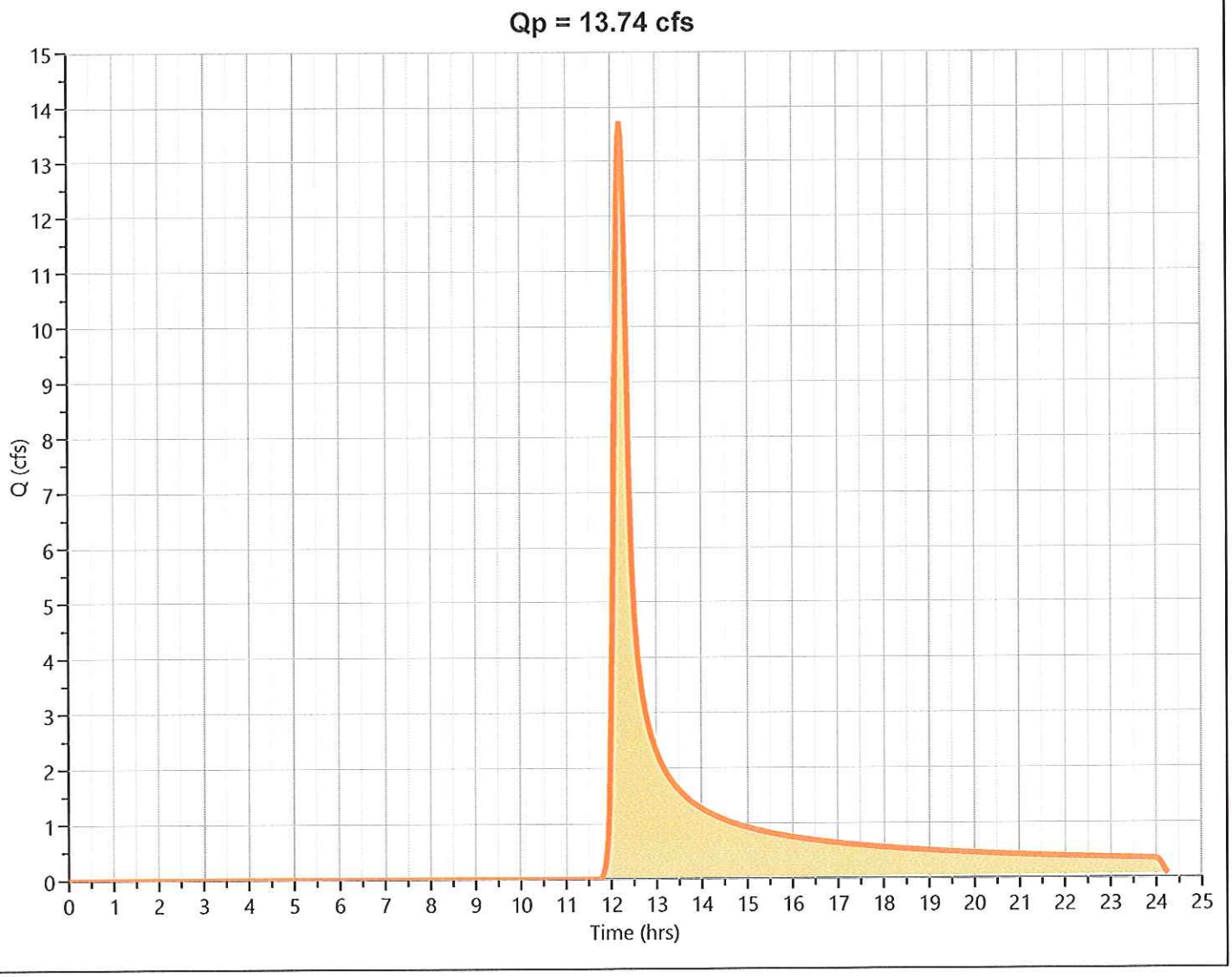
Pre Point A

Hyd. No. 1

Hydrograph Type	= NRCS Runoff	Peak Flow	= 13.74 cfs
Storm Frequency	= 2-yr	Time to Peak	= 12.20 hrs
Time Interval	= 2 min	Runoff Volume	= 50,501 cuft
Drainage Area	= 25.48 ac	Curve Number	= 70*
Tc Method	= TR55 (See Worksheet)	Time of Conc. (Tc)	= 15.97 min
Total Rainfall	= 2.71 in	Design Storm	= Synthetic
Storm Duration	= 24 hrs	Shape Factor	= 484

*** Composite CN Worksheet**

AREA (ac)	CN	DESCRIPTION
0.21	98	Bit / Roofs / Drives
0.47	74	Lawn - Soil C
0.42	30	Brush - Soil A
24.38	70	Woods - Soil C
25.48	**70**	Weighted CN Method Employed



Tc by TR55 Worksheet

Project Name:

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Point A

Hyd. No. 1

NRCS Runoff

Description	Segments			Tc (min)
	A	B	C	
Sheet Flow				
Description				
Manning's n	0.150	0.013	0.013	
Flow Length (ft)	100			
2-yr, 24-hr Precip. (in)	2.280000	2.280000	2.280000	
Land Slope (%)	3.6			
Travel Time (min)	**9.18**	**0.00**	**0.00**	**9.18**
Shallow Concentrated Flow				
Flow Length (ft)	970			
Watercourse Slope (%)	5.9			
Surface Description	Unpaved	Paved	Paved	
Average Velocity (ft/s)	3.92			
Travel Time (min)	**4.13**	**0.00**	**0.00**	**4.13**
Channel Flow				
X-sectional Flow Area (sqft)	3			
Wetted Perimiter (ft)	5			
Channel Slope (%)	7.9			
Manning's n	0.050	0.013	0.013	
Velocity (ft/s)	5.95			
Flow Length (ft)	950			
Travel Time (min)	**2.66**	**0.00**	**0.00**	**2.66**
Total Travel Time				**15.97 min**

Hydrograph Report

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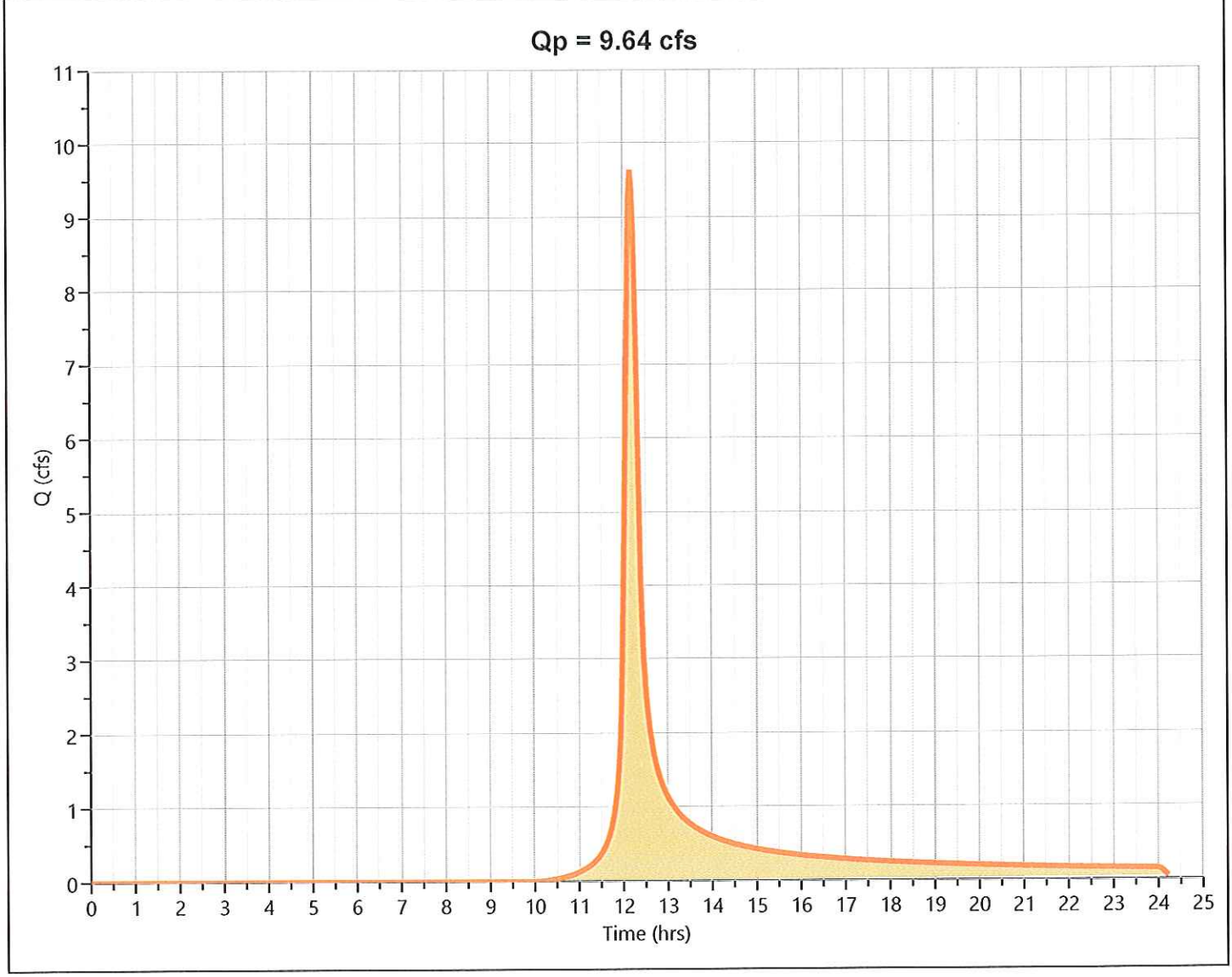
Det Basin In-1

Hyd. No. 2

Hydrograph Type	= NRCS Runoff	Peak Flow	= 9.636 cfs
Storm Frequency	= 2-yr	Time to Peak	= 12.17 hrs
Time Interval	= 2 min	Runoff Volume	= 29,397 cuft
Drainage Area	= 7.62 ac	Curve Number	= 80.9*
Tc Method	= TR55 (See Worksheet)	Time of Conc. (Tc)	= 14.07 min
Total Rainfall	= 2.71 in	Design Storm	= Synthetic
Storm Duration	= 24 hrs	Shape Factor	= 484

*** Composite CN Worksheet**

AREA (ac)	CN	DESCRIPTION
2.95	98	Bit / Roofs / Walks
0.42	39	Lawn - Soil A
3.36	74	Lawn - Soil C
0.89	70	Woods - Soil C
7.62	**81**	Weighted CN Method Employed



Tc by TR55 Worksheet

Project Name:

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Det Basin In-1
NRCS Runoff

Hyd. No. 2

Description	Segments			Tc (min)
	A	B	C	
Sheet Flow				
Description				
Manning's n	0.150	0.013	0.013	
Flow Length (ft)	100			
2-yr, 24-hr Precip. (in)	2.280000	2.280000	2.280000	
Land Slope (%)	3			
Travel Time (min)	**9.87**	**0.00**	**0.00**	**9.87**
Shallow Concentrated Flow				
Flow Length (ft)	310			
Watercourse Slope (%)	1.3			
Surface Description	Unpaved	Paved	Paved	
Average Velocity (ft/s)	1.84			
Travel Time (min)	**2.81**	**0.00**	**0.00**	**2.81**
Channel Flow				
X-sectional Flow Area (sqft)	1.7			
Wetted Perimiter (ft)	4.7			
Channel Slope (%)	6.7			
Manning's n	0.013	0.013	0.013	
Velocity (ft/s)	15.01			
Flow Length (ft)	1250			
Travel Time (min)	**1.39**	**0.00**	**0.00**	**1.39**
Total Travel Time				**14.07 min**

Hydrograph Report

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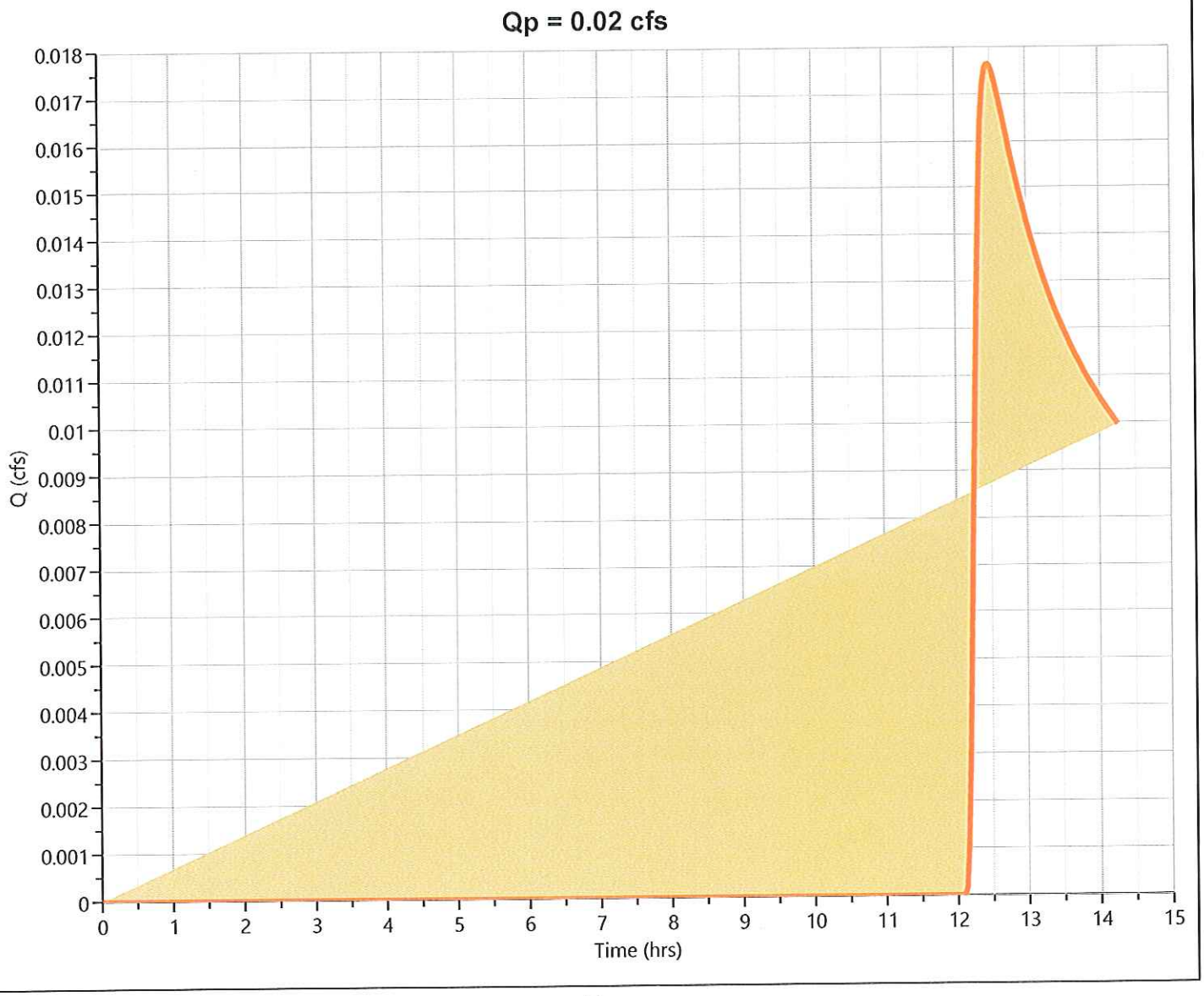
Det. Basin In -2

Hyd. No. 3

Hydrograph Type	= NRCS Runoff	Peak Flow	= 0.018 cfs
Storm Frequency	= 2-yr	Time to Peak	= 12.47 hrs
Time Interval	= 2 min	Runoff Volume	= 313 cuft
Drainage Area	= 0.81 ac	Curve Number	= 54*
Tc Method	= TR55 (See Worksheet)	Time of Conc. (Tc)	= 8.69 min
Total Rainfall	= 2.71 in	Design Storm	= Synthetic
Storm Duration	= 24 hrs	Shape Factor	= 484

*** Composite CN Worksheet**

AREA (ac)	CN	DESCRIPTION
0.42	39	Lawn - Soil A
0.39	70	Woods - Soil C
0.81	54	Weighted CN Method Employed



Tc by TR55 Worksheet

Project Name:

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Det. Basin In -2
NRCS Runoff

Hyd. No. 3

Description	Segments			Tc (min)
	A	B	C	
Sheet Flow				
Description				
Manning's n	0.400	0.013	0.013	
Flow Length (ft)	50			
2-yr, 24-hr Precip. (in)	2.280000	2.280000	2.280000	
Land Slope (%)	8			
Travel Time (min)	**8.39**	**0.00**	**0.00**	**8.39**
Shallow Concentrated Flow				
Flow Length (ft)	100			
Watercourse Slope (%)	12			
Surface Description	Unpaved	Paved	Paved	
Average Velocity (ft/s)	5.59			
Travel Time (min)	**0.30**	**0.00**	**0.00**	**0.30**
Channel Flow				
X-sectional Flow Area (sqft)				
Wetted Perimiter (ft)				
Channel Slope (%)				
Manning's n	0.013	0.013	0.013	
Velocity (ft/s)				
Flow Length (ft)				
Travel Time (min)	**0.00**	**0.00**	**0.00**	**0.00**
Total Travel Time				**8.69 min**

Hydrograph Report

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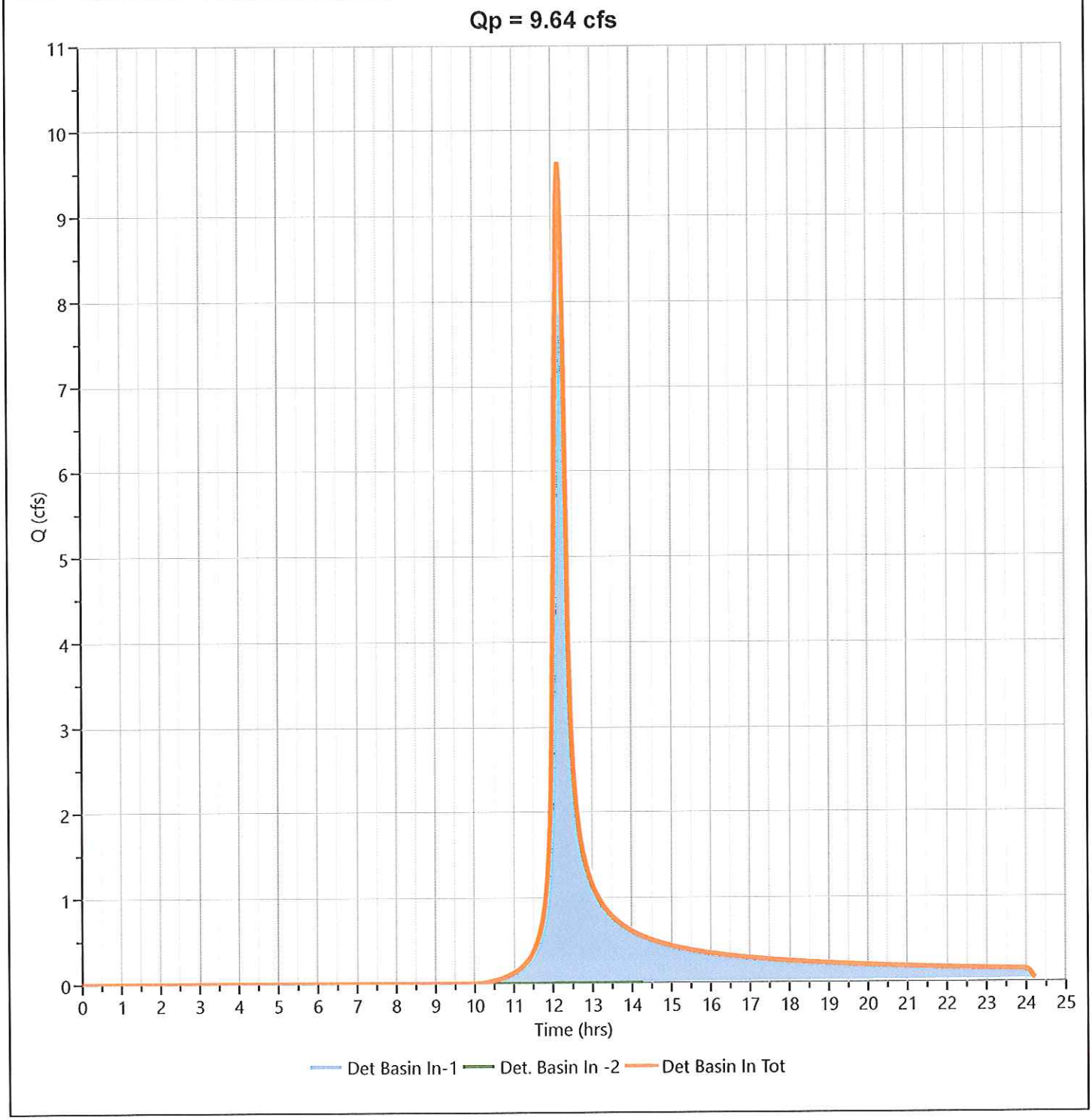
Det Basin In Tot

Hyd. No. 4

Hydrograph Type	= Junction	Peak Flow	= 9.637 cfs
Storm Frequency	= 2-yr	Time to Peak	= 12.17 hrs
Time Interval	= 2 min	Hydrograph Volume	= 29,710 cuft
Inflow Hydrographs	= 2, 3	Total Contrib. Area	= 8.43 ac



Hydrograph Report

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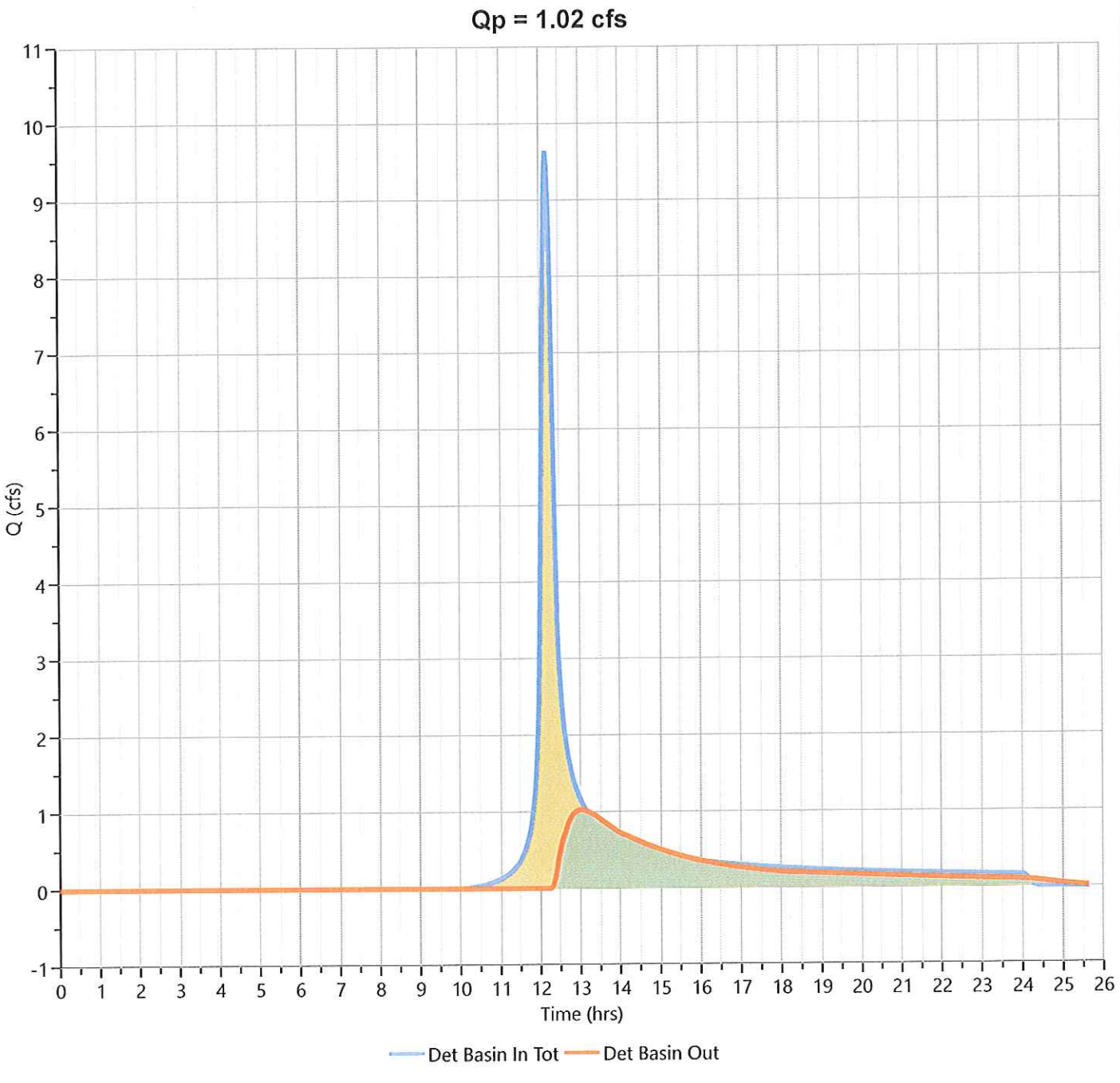
Det Basin Out

Hyd. No. 5

Hydrograph Type	= Pond Route	Peak Flow	= 1.022 cfs
Storm Frequency	= 2-yr	Time to Peak	= 13.03 hrs
Time Interval	= 2 min	Hydrograph Volume	= 13,978 cuft
Inflow Hydrograph	= 4 - Det Basin In Tot	Max. Elevation	= 111.07 ft
Pond Name	= Basin A	Max. Storage	= 14,929 cuft

Pond Routing by Storage Indication Method

Center of mass detention time = 1.86 hrs



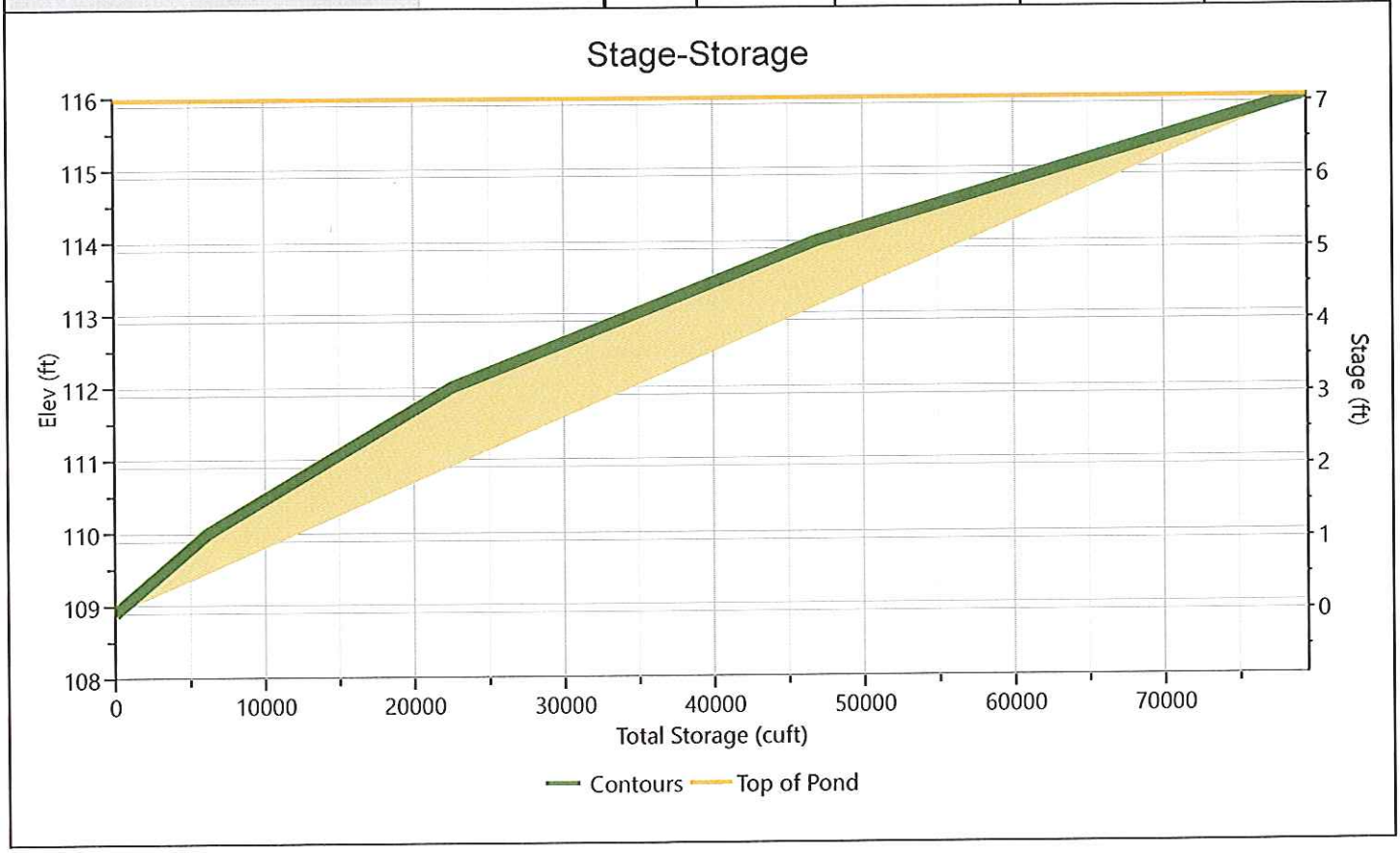
Basin A

Stage-Storage

User Defined Contours	
Description	Input
Bottom Elevation, ft	108.90
Voids (%)	100.00
Volume Calc	None

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour Area (sqft)	Incr. Storage (cuft)	Total Storage (cuft)
0.00	108.90	5,000	0.000	0.000
1.10	110.00	6,200	6,160	6,160
3.10	112.00	10,200	16,400	22,560
5.10	114.00	14,200	24,400	46,960
7.10	116.00	18,300	32,500	79,460



Pond Report

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Basin A

Stage-Discharge

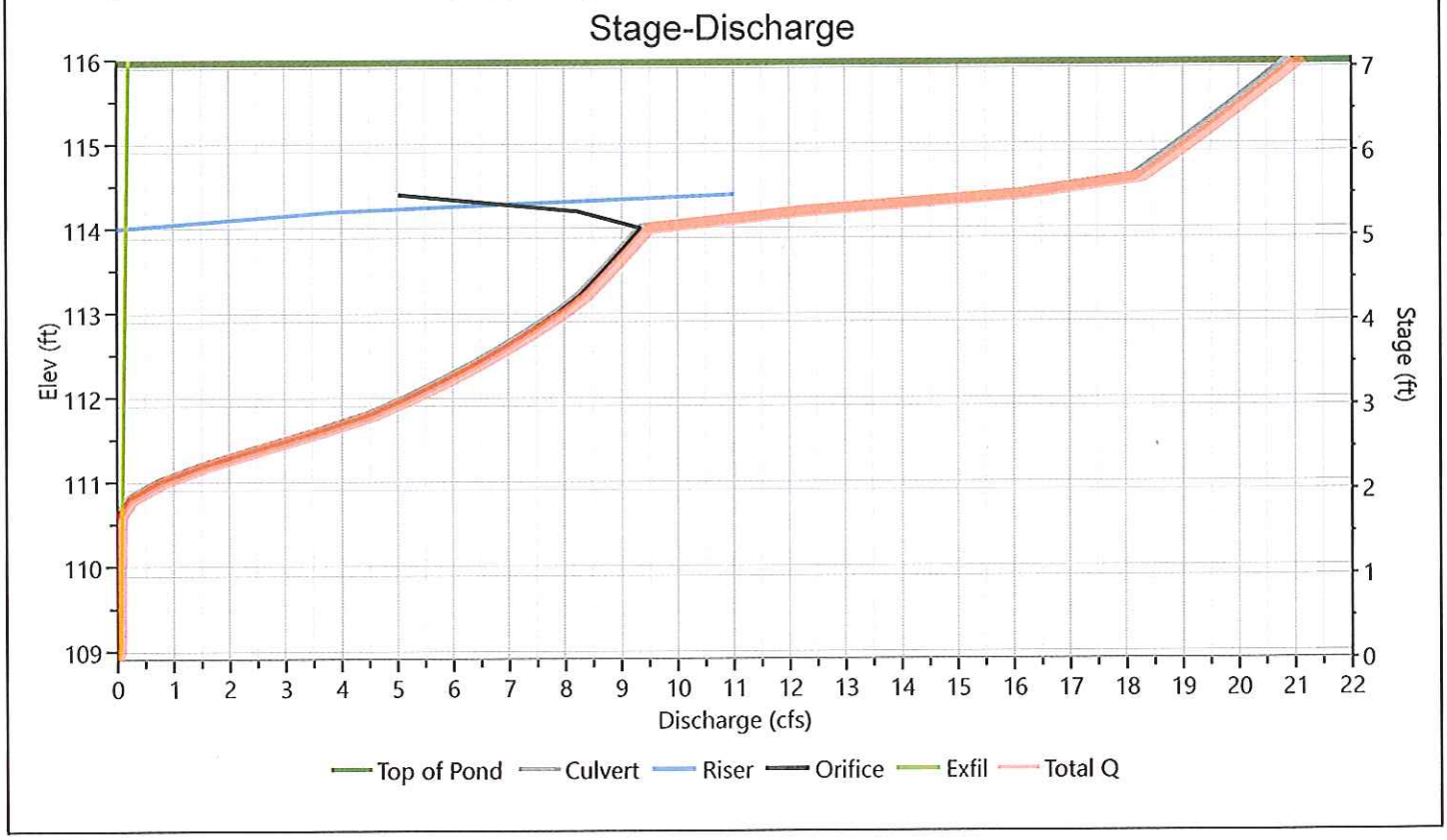
Culvert / Orifices	Culvert	Orifices		
		1*	2	3
Rise, in	18	15		
Span, in	18	15		
No. Barrels	1	1		
Invert Elevation, ft	108.90	110.60		
Orifice Coefficient, Co	0.60	0.60		
Length, ft	60			
Barrel Slope, %	.05			
N-Value, n	0.013			

Weirs	Riser*	Weirs		
		1	2	3
Shape / Type	Box			
Crest Elevation, ft	114			
Crest Length, ft	13.2			
Angle, deg				
Weir Coefficient, Cw	3.3			

Orifice Plate	
Orifice Dia, in	
No. Orifices	
Invert Elevation, ft	
Height, ft	
Orifice Coefficient, Co	

Ancillary	
Exfiltration, in/hr	0.50**

*Routes through Culvert. **Exfiltration extracted from outflow hydrograph. Rate applied to contours.



Basin A

Stage-Storage-Discharge Summary

Stage (ft)	Elev. (ft)	Storage (cuft)	Culvert (cfs)	Orifices, cfs			Riser (cfs)	Weirs, cfs			Pf Riser (cfs)	Exfil (cfs)	User (cfs)	Total (cfs)
				1	2	3		1	2	3				
0.00	108.90	0.000	0.000	0.000			0.000					0.000		0.000
1.10	110.00	6,160	0.000	0.000			0.000					0.072		0.072
3.10	112.00	22,560	5.201 oc	5.201			0.000					0.118		5.319
5.10	114.00	46,960	9.352 oc	9.352			0.000					0.164		9.517
7.10	116.00	79,460	20.93 oc	0.000			0.000					0.212		21.14

Suffix key: ic = inlet control, oc = outlet control, s = submerged weir

Pond Report

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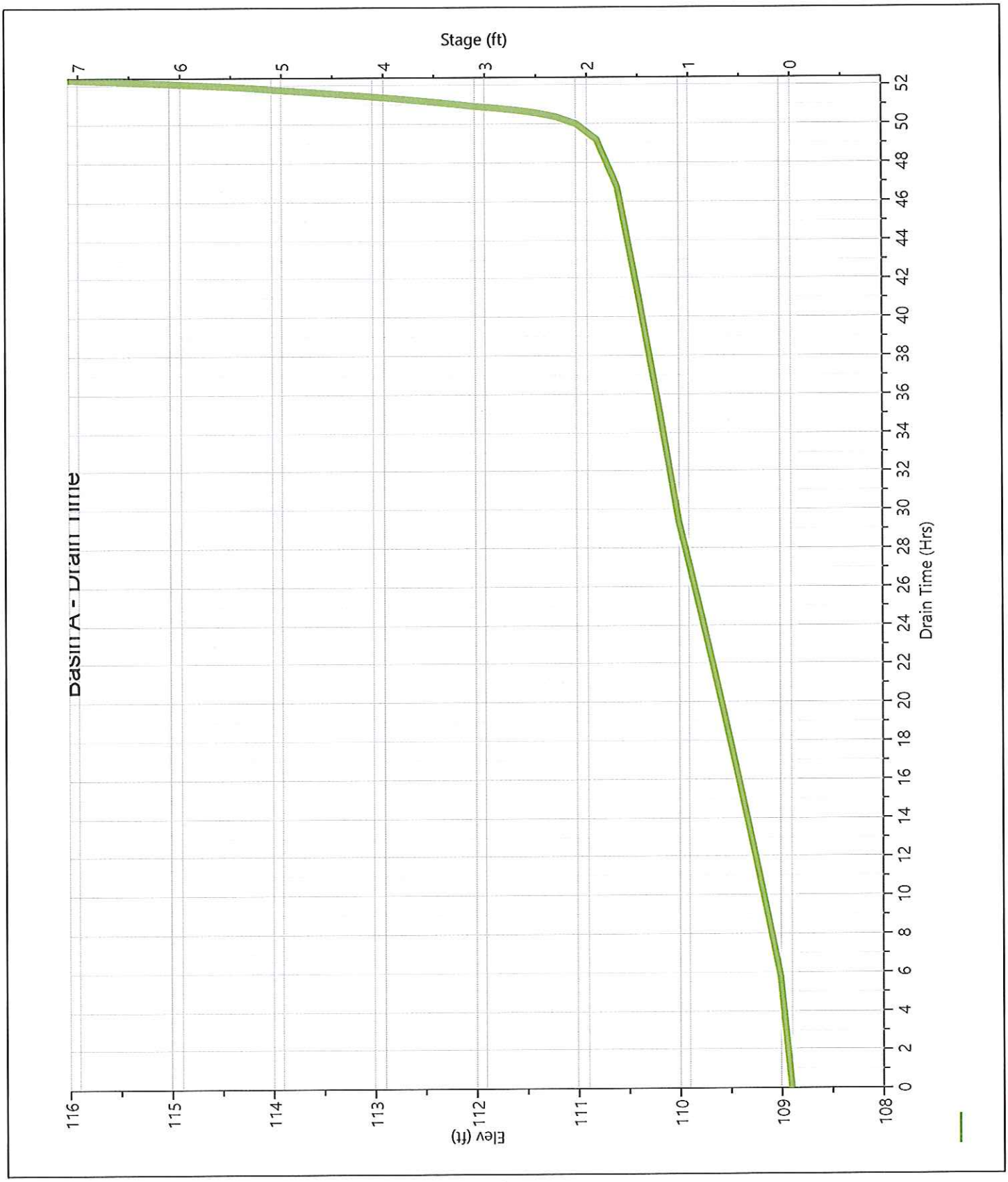
Basin A

Pond Drawdown



Hydrograph Report

Project Name:

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05-20-2020

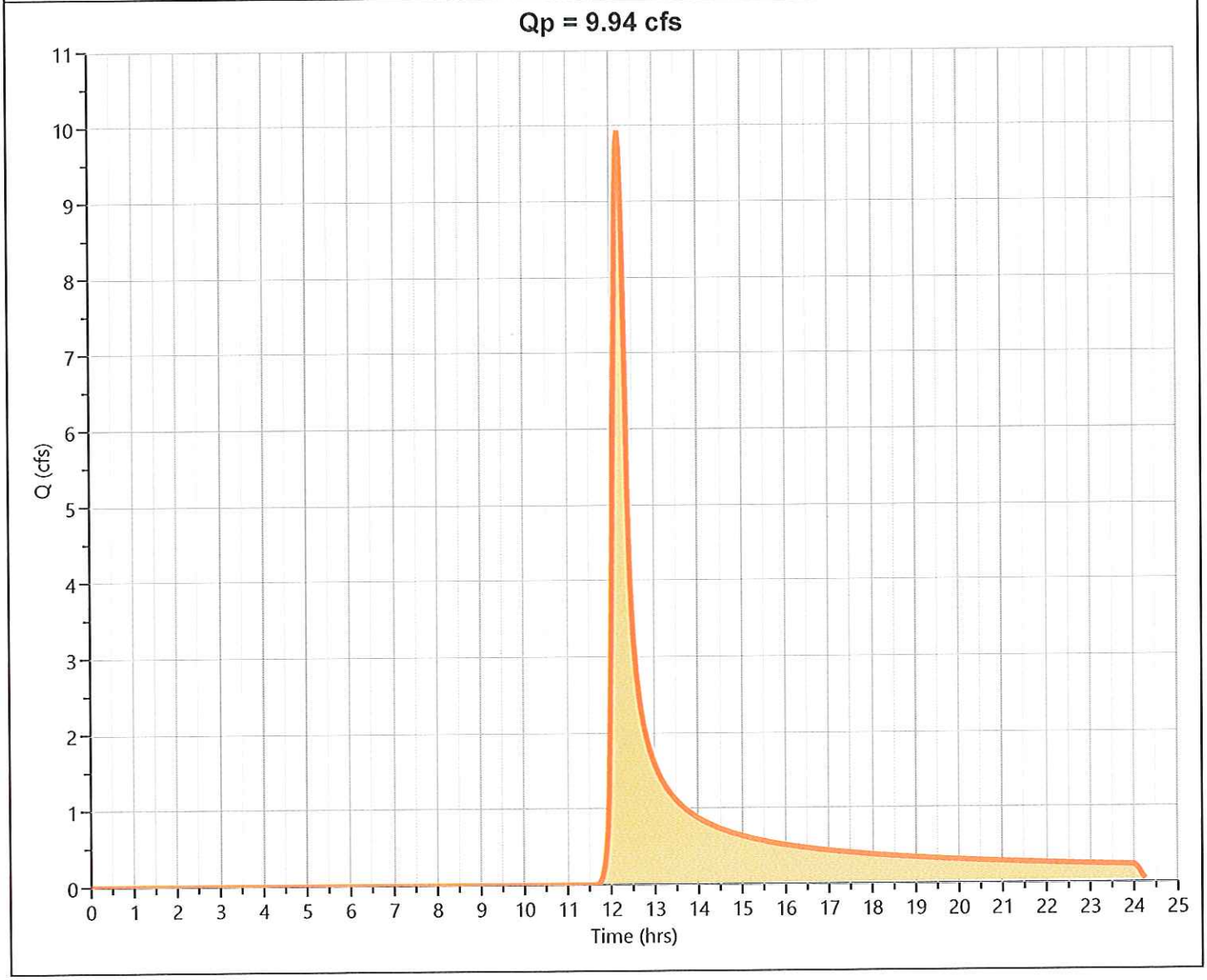
Post Det Bypass

Hyd. No. 6

Hydrograph Type	= NRCS Runoff	Peak Flow	= 9.941 cfs
Storm Frequency	= 2-yr	Time to Peak	= 12.20 hrs
Time Interval	= 2 min	Runoff Volume	= 35,460 cuft
Drainage Area	= 16.69 ac	Curve Number	= 71*
Tc Method	= TR55 (See Worksheet)	Time of Conc. (Tc)	= 15.97 min
Total Rainfall	= 2.71 in	Design Storm	= Synthetic
Storm Duration	= 24 hrs	Shape Factor	= 484

*** Composite CN Worksheet**

AREA (ac)	CN	DESCRIPTION
0.35	98	Bit/Roofs/Drives
0.92	74	Lawn - Soil C
15.42	70	Woods - Soil C
16.69	**71**	Weighted CN Method Employed



Tc by TR55 Worksheet

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05-20-2020

Post Det Bypass
NRCS Runoff

Hyd. No. 6

Description	Segments			Tc (min)
	A	B	C	
Sheet Flow				
Description				
Manning's n	0.150	0.013	0.013	
Flow Length (ft)	100			
2-yr, 24-hr Precip. (in)	2.280000	2.280000	2.280000	
Land Slope (%)	3.6			
Travel Time (min)	**9.18**	**0.00**	**0.00**	**9.18**
Shallow Concentrated Flow				
Flow Length (ft)	970			
Watercourse Slope (%)	5.9			
Surface Description	Unpaved	Paved	Paved	
Average Velocity (ft/s)	3.92			
Travel Time (min)	**4.13**	**0.00**	**0.00**	**4.13**
Channel Flow				
X-sectional Flow Area (sqft)	3			
Wetted Perimiter (ft)	5			
Channel Slope (%)	7.9			
Manning's n	0.050	0.013	0.013	
Velocity (ft/s)	5.95			
Flow Length (ft)	950			
Travel Time (min)	**2.66**	**0.00**	**0.00**	**2.66**
Total Travel Time				**15.97 min**

Hydrograph Report

Project Name:

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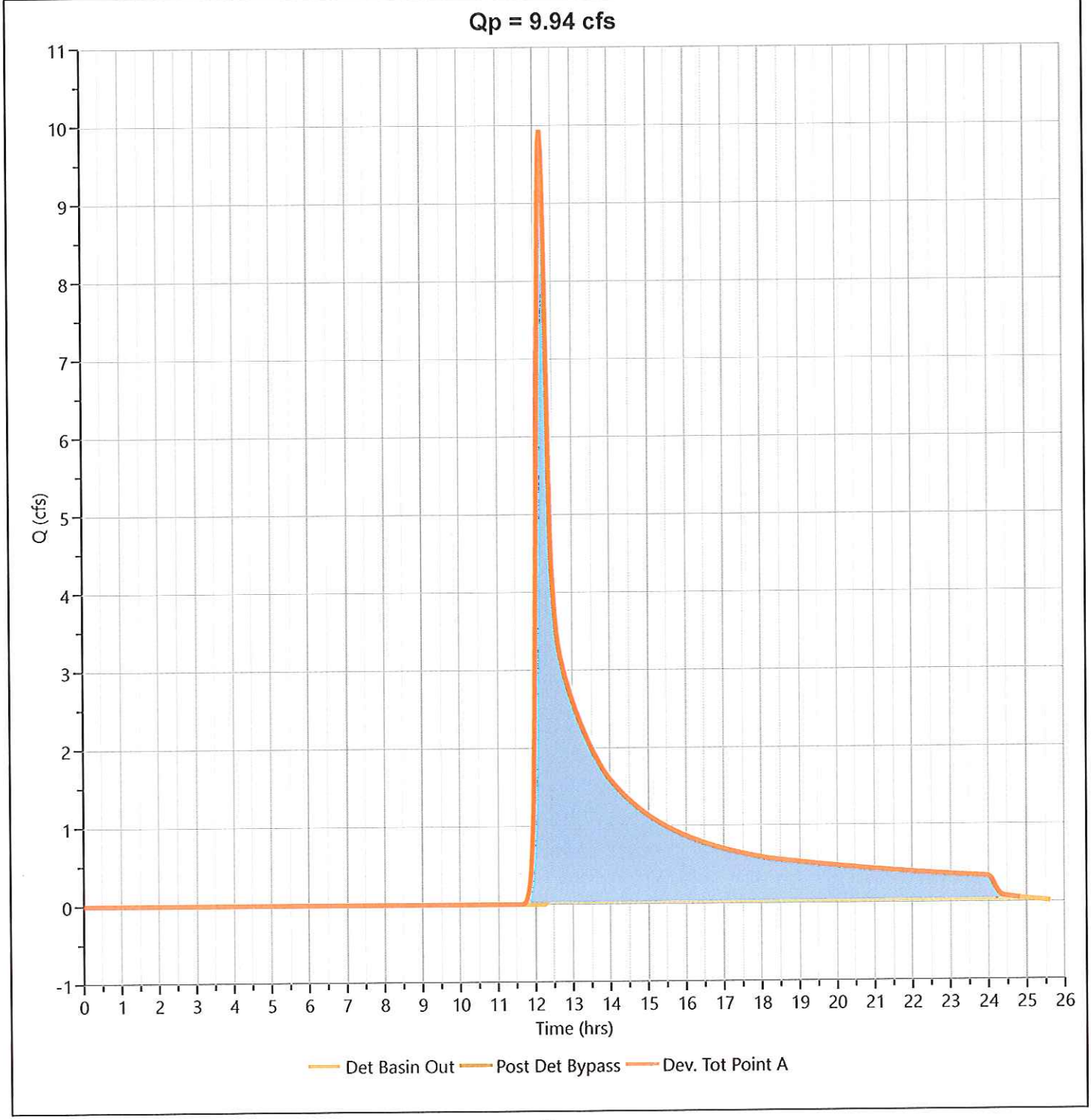
05-20-2020

Dev. Tot Point A

Hyd. No. 7

Hydrograph Type	= Junction	Peak Flow	= 9.941 cfs
Storm Frequency	= 2-yr	Time to Peak	= 12.20 hrs
Time Interval	= 2 min	Hydrograph Volume	= 49,438 cuft
Inflow Hydrographs	= 5, 6	Total Contrib. Area	= 16.69 ac



Design Storm Report

Custom Storm filename: WJW-2019-A.cds

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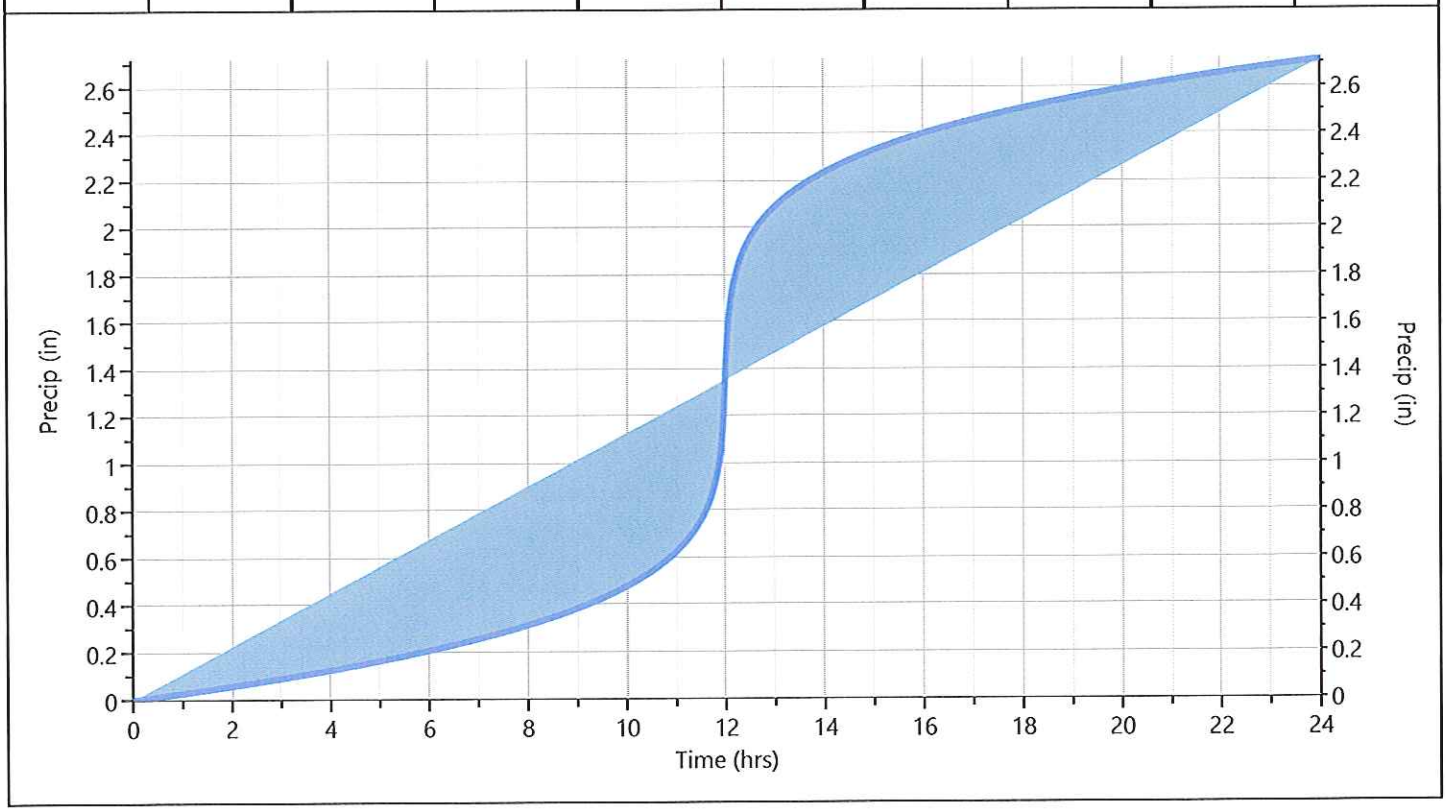
Storm Distribution: IDF Based - Synthetic

Storm Duration	Total Rainfall Volume (in)								
	1-yr	✔ 2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
24 hrs	0	2.71	0	2.84	3.84	3.56	4.56	5.38	

Incremental Rainfall Distribution, 2-yr									
Time (hrs)	Precip (in)	Time (hrs)	Precip (in)	Time (hrs)	Precip (in)	Time (hrs)	Precip (in)	Time (hrs)	Precip (in)
11.00	0.660753	11.37	0.984359	11.73	2.148765	12.10	5.790168	12.47	1.336384
11.03	0.680304	11.40	1.032746	11.77	2.424985	12.13	4.437953	12.50	1.253068
11.07	0.701201	11.43	1.086664	11.80	2.785379	12.17	3.588307	12.53	1.180232
11.10	0.723589	11.47	1.147139	11.83	3.273708	12.20	3.009748	12.57	1.116014
11.13	0.747645	11.50	1.215470	11.87	3.969002	12.23	2.592474	12.60	1.058948
11.17	0.773573	11.53	1.293278	11.90	5.028093	12.27	2.278274	12.63	1.007915
11.20	0.801575	11.57	1.382709	11.93	6.806308	12.30	2.033633	12.67	0.961983
11.23	0.831938	11.60	1.486576	11.97	10.284390	12.33	1.838005	12.70	0.920415
11.27	0.864983	11.63	1.608670	12.00	19.250550	12.37	1.678109	12.73	0.882638
11.30	0.901091	11.67	1.754224	12.03	13.541520	12.40	1.545060	12.77	0.848115
11.33	0.940704	11.70	1.930654	12.07	8.217419	12.43	1.432621	12.80	0.816441



Hydrograph 10-yr Summary

Project Name:

05-20-2020

Hydrology Studio v 3.0.0.14

Hyd. No.	Hydrograph Type	Hydrograph Name	Peak Flow (cfs)	Time to Peak (hrs)	Hydrograph Volume (cuft)	Inflow Hyd(s)	Maximum Elevation (ft)	Maximum Storage (cuft)
1	NRCS Runoff	Pre Point A	34.63	12.20	110,270	----		
2	NRCS Runoff	Det Basin In-1	17.84	12.17	53,350	----		
3	NRCS Runoff	Det. Basin In -2	0.286	12.17	1,257	----		
4	Junction	Det Basin In Tot	18.12	12.17	54,607	2, 3		
5	Pond Route	Det Basin Out	5.430	12.50	38,280	4	112.07	23,443
6	NRCS Runoff	Post Det Bypass	24.03	12.20	75,874	----		
7	Junction	Dev. Tot Point A	26.04	12.23	114,154	5, 6		

Hydrograph Report

Project Name:

Hydrology Studio v 3.0.0.14

05-20-2020

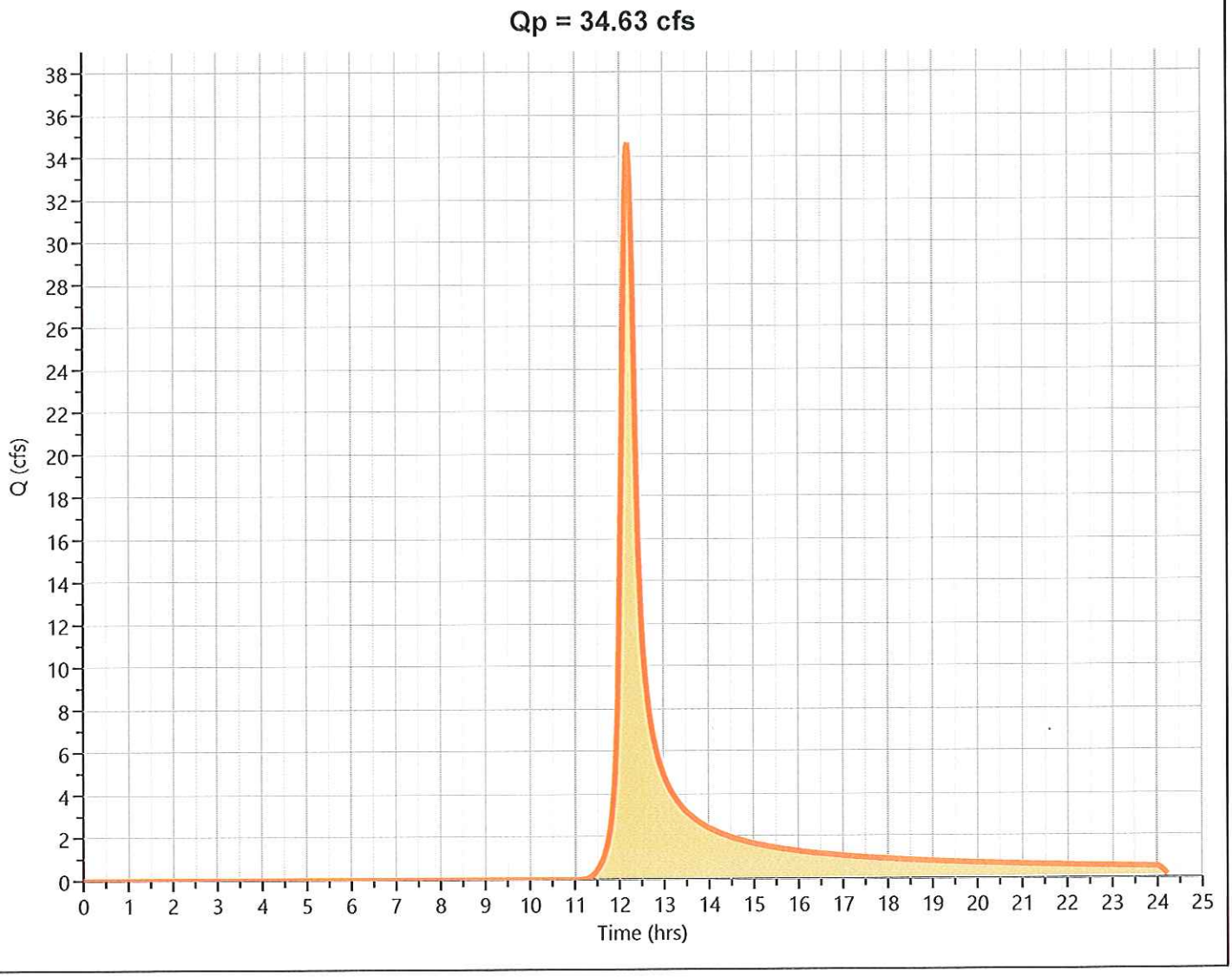
Pre Point A

Hyd. No. 1

Hydrograph Type	= NRCS Runoff	Peak Flow	= 34.63 cfs
Storm Frequency	= 10-yr	Time to Peak	= 12.20 hrs
Time Interval	= 2 min	Runoff Volume	= 110,270 cuft
Drainage Area	= 25.48 ac	Curve Number	= 70*
Tc Method	= TR55 (See Worksheet)	Time of Conc. (Tc)	= 15.97 min
Total Rainfall	= 3.84 in	Design Storm	= Synthetic
Storm Duration	= 24 hrs	Shape Factor	= 484

*** Composite CN Worksheet**

AREA (ac)	CN	DESCRIPTION
0.21	98	Bit / Roofs / Drives
0.47	74	Lawn - Soil C
0.42	30	Brush - Soil A
24.38	70	Woods - Soil C
25.48	**70**	Weighted CN Method Employed



Hydrograph Report

Project Name:

Hydrology Studio v 3.0.0.14

05-20-2020

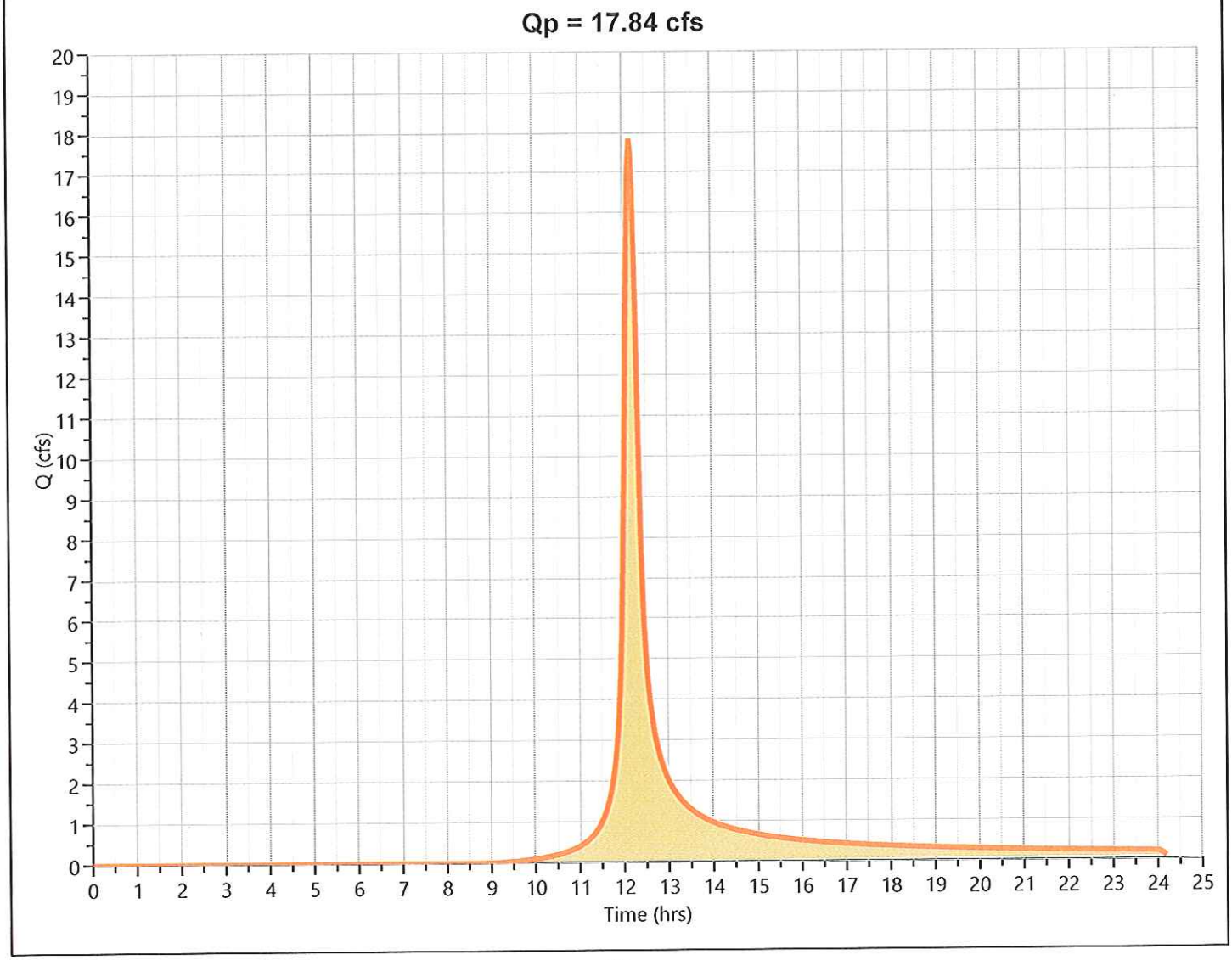
Det Basin In-1

Hyd. No. 2

Hydrograph Type	= NRCS Runoff	Peak Flow	= 17.84 cfs
Storm Frequency	= 10-yr	Time to Peak	= 12.17 hrs
Time Interval	= 2 min	Runoff Volume	= 53,350 cuft
Drainage Area	= 7.62 ac	Curve Number	= 80.9*
Tc Method	= TR55 (See Worksheet)	Time of Conc. (Tc)	= 14.07 min
Total Rainfall	= 3.84 in	Design Storm	= Synthetic
Storm Duration	= 24 hrs	Shape Factor	= 484

*** Composite CN Worksheet**

AREA (ac)	CN	DESCRIPTION
2.95	98	Bit / Roofs / Walks
0.42	39	Lawn - Soil A
3.36	74	Lawn - Soil C
0.89	70	Woods - Soil C
7.62	**81**	Weighted CN Method Employed



Hydrograph Report

Project Name:

Hydrology Studio v 3.0.0.14

05-20-2020

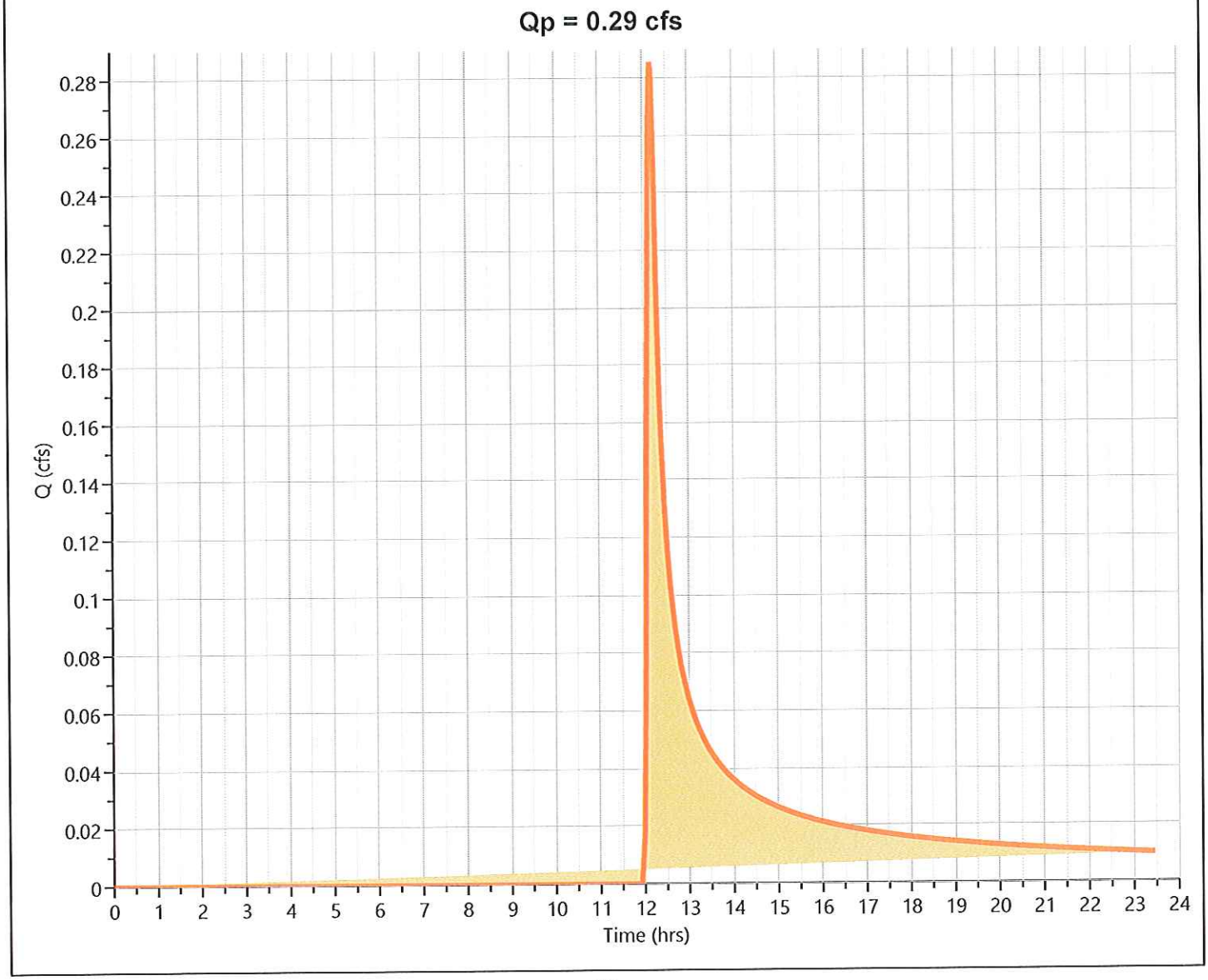
Det. Basin In -2

Hyd. No. 3

Hydrograph Type	= NRCS Runoff	Peak Flow	= 0.286 cfs
Storm Frequency	= 10-yr	Time to Peak	= 12.17 hrs
Time Interval	= 2 min	Runoff Volume	= 1,257 cuft
Drainage Area	= 0.81 ac	Curve Number	= 54*
Tc Method	= TR55 (See Worksheet)	Time of Conc. (Tc)	= 8.69 min
Total Rainfall	= 3.84 in	Design Storm	= Synthetic
Storm Duration	= 24 hrs	Shape Factor	= 484

*** Composite CN Worksheet**

AREA (ac)	CN	DESCRIPTION
0.42	39	Lawn - Soil A
0.39	70	Woods - Soil C
0.81	**54**	Weighted CN Method Employed



Hydrograph Report

Project Name:

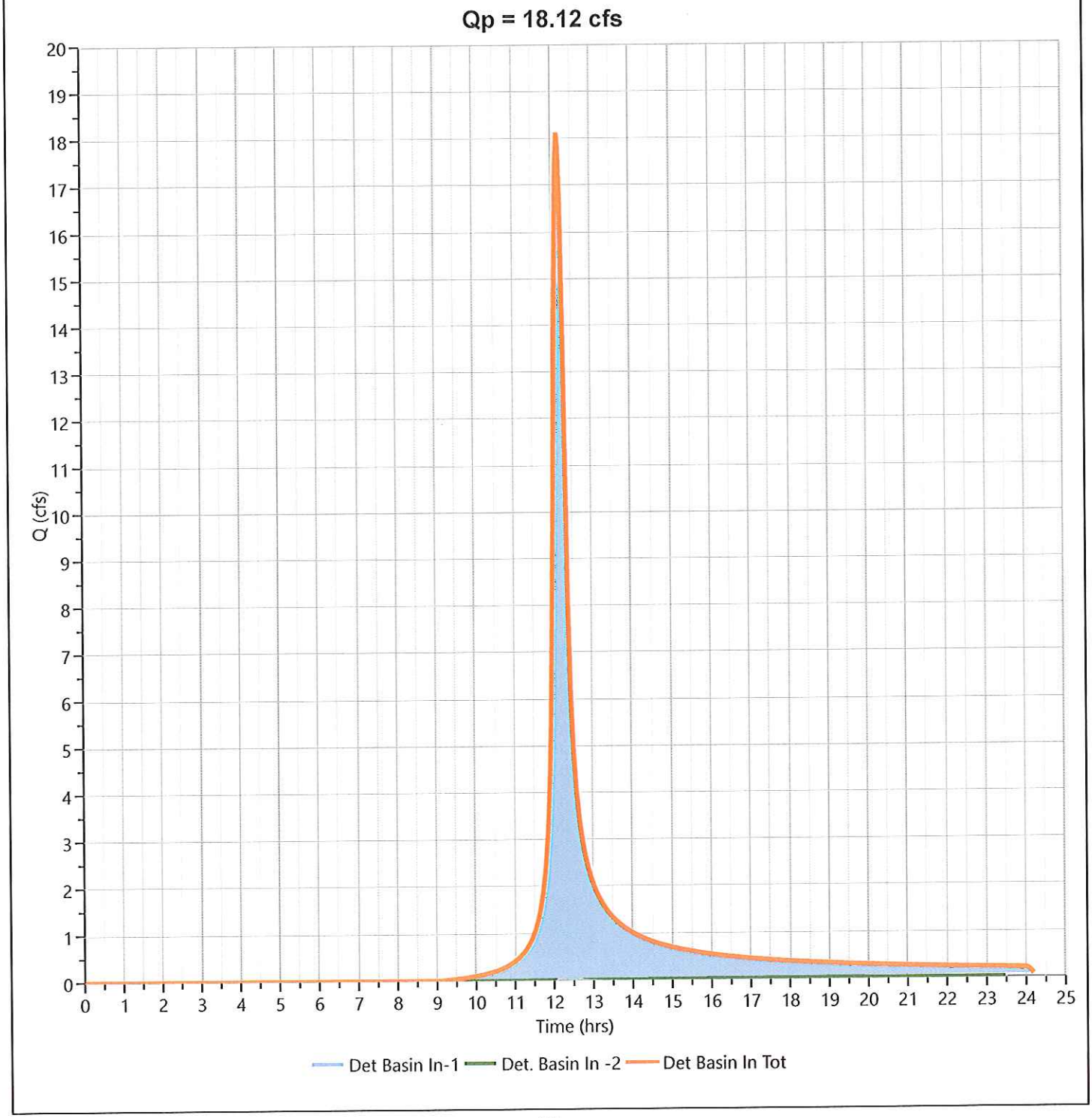
Hydrology Studio v 3.0.0.14

05-20-2020

Det Basin In Tot

Hyd. No. 4

Hydrograph Type	= Junction	Peak Flow	= 18.12 cfs
Storm Frequency	= 10-yr	Time to Peak	= 12.17 hrs
Time Interval	= 2 min	Hydrograph Volume	= 54,607 cuft
Inflow Hydrographs	= 2, 3	Total Contrib. Area	= 8.43 ac



Hydrograph Report

Project Name:

Hydrology Studio v 3.0.0.14

05-20-2020

Det Basin Out

Hyd. No. 5

Hydrograph Type	= Pond Route	Peak Flow	= 5.430 cfs
Storm Frequency	= 10-yr	Time to Peak	= 12.50 hrs
Time Interval	= 2 min	Hydrograph Volume	= 38,280 cuft
Inflow Hydrograph	= 4 - Det Basin In Tot	Max. Elevation	= 112.07 ft
Pond Name	= Basin A	Max. Storage	= 23,443 cuft

Pond Routing by Storage Indication Method

Center of mass detention time = 57 min