Stormwater Management Report

Fort Monmouth Mod Substation

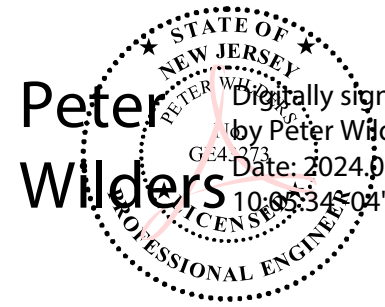
Oceanport Borough
Monmouth County, New Jersey

Prepared for:

Jersey Central Power & Light

Prepared by:

MasTec
Professional Services



Peter Wilders
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December 2023

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MasTec WO# 4435

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1.0 INTRODUCTION

1.1 PROJECT DESCRIPTION

The proposed Fort Monmouth substation is located on a 2.64-acre site in Oceanport Borough, Monmouth County New Jersey. The site is located on a portion of Block 110 Lot 4. Existing site development includes an abandoned military building and associated parking and driveway. This project will include a new Electrical Substation with control house, transformers, grounding grid and underground conduits/cables. Proposed new impervious surface is 0.68 acres, and total disturbance amounts to approximately 1.2 acres; therefore, the Project is subject to NJDEP Stormwater Management Rules (NJAC 7:8).

The NJDEP Stormwater Management Rules require that the following performance standards be met:

1. Maintain pre-development hydrology (Rate and Volume control)
2. Provide Water Quality Control for new impervious surfaces and
3. Maintain the annual pre-development Groundwater Recharge

The purpose of this report is to demonstrate that the Project conforms to the requirements of NJAC 7:8. This Stormwater Management report will summarize the pre and post development drainage areas and land cover conditions.

1.2 EXISTING CONDITIONS

The topography of the project site generally consists of slopes ranging from 1.5% to 25%. Drainage from the site generally flows from southeast to northwest by overland flow and discharges offsite near the northwest corner of the property. All the runoff from the site eventually enters a swale area to the north/northwest and runs to a headwall with 12" and 24" culverts running from the headwall to the west below Murphy Drive.

MasTec has reviewed the Natural Resources Conservation Service (NRCS) soil survey and determined that the soils on the Project site consist of Freehold Sandy Loam (HSG B), Udorthents (HSG D) and Freehold Urban Land (HSG B). A summary of the soil composition is shown in Table

1-1. (Appendix A). The Freehold Urban Land (FrrC) soils are not affected by this project as they are located at the very eastern edge of the property which is not being disturbed.

Table 1-1
Soil Analysis Summary

Soil Name	Range of Slopes	Hydrologic Soil Group (HSG)
Freehold Sandy Loam (FrkB)	2%-5%	B
Udorthents (UdauB)	0%-8%	D
Freehold Urban Land (FrrC)	0%-10%	B

The geotechnical borings completed for the design were analyzed to verify the NRCS hydrologic soil group rating.

The basin is located on the western side of the site within the HSG D soils, and this soil was consistent with geotechnical findings. The infiltration rate was found to be 0 inches/hr. based on two double ring infiltrometer tests that were performed in the stormwater management area. In order to meet groundwater recharge and green infrastructure standards, soil replacement to the seasonal high-water table is proposed for a portion of the proposed infiltration basin. The soil will be replaced below the 6" sand trench as the bottom of the infiltration basin. Soil boring data and infiltration results have been included in Appendix E.

2.0 DESIGN CRITERIA

The following design criteria have been established for the project, in accordance with the New Jersey Department of Environmental Protection.

MasTec proposes to utilize the unified approach for sizing stormwater management practices to meet sediment and pollutant removal goals, reduce channel erosion and prevent overbank flooding. The following technical criteria will be met in accordance with State of New Jersey Regulations N.J.A.C 7:8:

Performance Standard #1: Maintenance of Pre-Development Hydrology (Rate and Volume control)

As per NJAC 7:8-5.6, the stormwater management system may satisfy the performance standard by demonstrating one (1) of three (3) criteria which are applicable to this particular site plan. These are:

a. "That the post-construction runoff hydrographs for the 2, 10, and 100-year storm events do not exceed, at any point in time, the pre-construction runoff hydrographs for the same storm events"
b. "That there is no increase, as compared to the pre-construction condition, in the peak runoff rates of stormwater leaving the site for the 2, 10, and 100-year storm events, and that the increased volume or change in timing of stormwater runoff will not increase flood damage at or downstream of the site."
c. "That the post-construction peak runoff rates for the 2, 10, and 100-year storm events are 50, 75 and 80 percent, respectively, of the pre-construction peak runoff rates."

Performance Standard #2: Water Quality Control for New Impervious Surfaces

To satisfy the standards for stormwater quality, the design engineer is required to show a load reduction of total suspended solids (TSS) in stormwater runoff. Specifically, the water quality design storm is 1.25 inches/2 hours. As per NJAC 7:8-5.5, post-construction loads of total suspended solids (TSS) must be reduced by 80% from runoff from the site for this specified design storm. The chosen BMP must also be designed to reduce to the maximum extent possible the nutrient loads (phosphorous & nitrogen) from the post developed site.

Performance Standard #3: Groundwater Recharge

In order to satisfy the performance standard for groundwater recharge, the applicant must demonstrate one (1) of the two (2) following criteria as per NJAC 7:8-5.7:

a. "…that the site and stormwater management measures maintain 100% of the average annual pre-construction ground water recharge volume for the site…"
b. "…that the increase of stormwater runoff volume from pre-construction to post-construction for the two-year storm is infiltrated."

3.0 STORMWATER QUANTITY COMPLIANCE

MasTec has utilized unit hydrograph analysis to demonstrate that NJAC 7:8 Performance Standard 1c, "That the post-construction peak runoff rates for the 2, 10, and 100-year storm events are 50, 75 and 80 percent, respectively, of the pre-construction peak runoff rates", is met.

Runoff curve numbers and times of concentration were computed using standard NRCS TR-55 methodology. Because the site is in the coastal plains physiographic region and this site is characterized by generally flat slopes (less than 5%) the Delmarva Unit Hydrogrpah was used to model the pre and post condition runoff routings.

The proposed condition hydrographs were generated for the site, using a Region D rainfall distribution. Rainfall amounts were referenced from the NOAA Atlas 14 Point Frequency Estimates. The rainfall amounts were developed for both the current precipitation values along with the future precipitation values. The future precipitation values are associated with an increased adjustment factor including 19% for both the 2- & 10-year storm events and 26% for the 100-year storm event. The 24-hour rainfall amounts for the 2-, 10- and 100-year design storms in Monmouth County are summarized in the table below for both the current and future precipitation values. Refer to Appendix B.

TABLE 3-1: Precipitation Values and Factors

	2-year design storm	10-year design storm	100-year design storm
NOAA Atlas 14 Rainfall Depth	3.38"	5.23"	8.94"
Current Precipitation Adjustment Factor	1.00	1.01	1.02
Adjusted Current Rainfall Depth	3.38"	5.28"	9.12"
Future Precipitation Adjustment Factor	1.19	1.19	1.26
Future Projected Rainfall Depth	4.02"	6.22"	11.26"

The substation consists of two small concrete pads that the electrical equipment will sit on, and the remainder of the site will be a gravel access road and yard. The gravel area will extend to 5' outside of the fenced in substation. The time of concentration flow path for the existing condition includes overland sheet flow, shallow concentrated flow and channel flow. The high point starts near the southeast corner of the site and then runs northwest toward design point 1. The flow is ultimately

collected in a swale area offsite to the north of the property and discharges thru 12" & 24" storm sewers which runs west below Murphy Drive.

The existing curve number was generated from a combination of Building, paved parking, driveway, woods and meadow areas.

The proposed analysis was divided up into two areas, with one being the developed area of the site which will drain to the proposed stormwater management basin. The other area will be the undeveloped (bypass) area consisting mostly of offsite area to the north of the property which drains to design point 1.

The curve number (Cn) for the developed area is a combination of concrete pads, gravel substation surface, woods, grass and meadow areas. The curve number for the undeveloped (bypass) area includes meadow, grass, woods and small gravel and pavement areas. The time of concentration flow path for the developed area consists of overland (sheet) flow to the basin from the high point near the southwest corner of the site. The time of concentration flow path for the bypass area consists of overland flow and channel flow and starts at the northeast corner of the site and runs west to the design point.

The hydraulic summary presented below captures the Q_2, Q_{10} & Q_{100} for the existing and proposed conditions:

The existing site drains to one location (DP-1).

- DP-1: Drainage Area (1) consists of the entire disturbed area and some offsite area draining to the same design point. The drainage flows overland in a southeast to northwest direction and is collected just offsite to the north/northwest in a swale area. This swale area ultimately discharges to existing 12" & 24" culverts which runs west below Murphy Drive. Refer to the attached drainage area maps in Appendix C.

Only portions of the existing drainage area will be developed as part of this project. Refer to the table below for development analysis.

Table 3-2
Development Analysis

Condition	Design Point	Total Area (ac)	Developed Area (ac)	Un-Developed Area (ac)	% of Total Area Disturbed
POST	DP-1	2.13	1.20	0.93	56.3%

The NJAC 7:8-5.6(b)3 states that "the (rate reduction) percentages only apply to the post construction stormwater runoff that is attributable to the portion of the site on which the proposed development or project is to be constructed. The below therefore summarizes the allowable peak runoff with rate reductions applied to the portion of the site that will be disturbed.

Table 3-3A
NJAC Adjustment (Current Precipitation)

Condition	2-yr storm (3.38")	10-yr storm (5.28")	100-yr storm (9.12")
Existing condition Peak Runoff	1.39 cfs	3.12 cfs	7.07 cfs
Undisturbed/Disturbed Portion Existing Condition Peak Runoff	0.61 cfs/0.78 cfs	1.36 cfs/1.76 cfs	3.09 cfs/3.98 cfs
Rate Reductions – Applied to Disturbed Areas	50%	75%	80%
Total Allowable Peak Runoff	1.00 cfs	2.68 cfs	6.27 cfs
Total Actual Peak Runoff	1.00 cfs	2.39 cfs	6.20 cfs

Actual Runoff <= Allowable	Yes	Yes	Yes

Table 3-3B
NJAC Adjustment (Future Precipitation)

Condition	2-yr storm (4.02")	10-yr storm (6.22")	100-yr storm (11.26")
Existing condition Peak Runoff	2.01 cfs	4.22 cfs	9.75 cfs
Undisturbed/Disturbed Portion Existing Condition Peak Runoff	0.88 cfs/ 1.13 cfs	1.84 cfs/2.38 cfs	4.26 cfs/ 5.49 cfs
Rate Reductions – Applied to Disturbed Areas	50%	75%	80%
Total Allowable Peak Runoff	1.45 cfs	3.63 cfs	8.65 cfs
Total Actual Peak Runoff	1.42 cfs	3.62 cfs	8.00 cfs
Actual Runoff <= Allowable	Yes	Yes	Yes

The pre-development condition to Design Pt 1 was analyzed to verify compliance with the NJAC adjusted requirements. Refer to the hydraulic analysis summary below:

Table 3-4A
Hydraulic Analysis Summary DP-1 (Current Precipitation)

Condition	Design Point	Area (ac)	T_c (min)	Curve Number	Peak Flow Rate (cfs)		
					2-yr	10-yr	100-yr
POST	Undeveloped Bypass	0.97	11.2	78	0.96	2.03	4.36
POST	Developed	1.16	8.7	80	1.41	2.86	6.01
POST	Combined (DP-1)				1.00	2.39	6.20
			Allowable Post Peak Flow (cfs)		1.00	2.68	6.27
			Meets NJAC Requirement (Y/N)		Y	Y	Y

Table 3-4B
Hydraulic Analysis Summary DP-1 (Future Precipitation)

Condition	Design Point	Area (ac)	T_c (min)	Curve Number	Peak Flow Rate (cfs)		
					2-yr	10-yr	100-yr
POST	Undeveloped Bypass	0.97	10.6	78	1.34	2.65	5.80
POST	Developed	1.16	8.22	80	1.96	3.75	7.97
POST	Combined (DP-1)				1.42	3.62	8.00
			Allowable Post Peak Flow (cfs)		1.45	3.63	8.65

Meets NJAC Requirement (Y/N)	Y	Y	Y

In order to determine the best option for a stormwater BMP, a geotechnical analysis was performed in the designated stormwater management area to determine the feasibility of using infiltration to provide for water quality/quantity mitigation. Refer to Appendix E for geotechnical findings. The soils in the stormwater basin area are HSG D type soils so infiltration would be expected to be a challenge. Upon receipt of the geotechnical analysis, it was determined that the infiltration rate was essentially 0 in/hr. as such infiltration would not be option. It is therefore proposed that sand replacement to the seasonal high-water table be provided for a portion of the infiltration basin.

Upon further review of the geotechnical findings, the seasonal high groundwater table was determined to be approximately 6.5' to 7' down. Rock was not found during the geotechnical investigation. As required by the New Jersey BMP manual, there is more than 2' of separation between the seasonal high-water table and the proposed bottom of the 6" sand layer at the bottom of the infiltration basin.

Based on the geotechnical analysis/findings and site elevations it was determined that a small-scale infiltration basin was the best option to provide water quality, quantity and groundwater recharge mitigation. The basin will be utilizing a 6" sand bed within the basin. A setting was used in Hydrocad that routes impervious and pervious surfaces separately, then automatically combines the hydrographs (SBUH Routing Method), as required by NJAC 7:8-5.7(a)4.

The post-development runoff generally flows overland and via a swale to the proposed stormwater infiltration BMP. It is captured there, and runoff is controlled thru a combination of a 2.5" diameter orifice and a 12" wide by 5" high rectangular orifice.

There will be no increase in peak flow rate from the existing to developed condition for the 2-yr, 10-yr & 100-yr storms for both the current and future precipitation runoff values. Refer to the Appendix C for detailed calculations of the pre/post development hydraulic conditions.

4.0 STORMWATER QUALITY COMPLIANCE

Typical source of non-point stormwater pollution are parking areas and roofs. While all impervious surfaces collect airborne dust, conveyance by vehicles generally results in larger concentrations in parking lots and drive aisles. Additionally, these areas collect other pollutants, such as vehicular fluid drippings, brake dust and rubber residue and refuse. Pervious surfaces collect a much lower concentration of pollutants. Overland flow, infiltration and biological activities can significantly reduce pollutant loading on pervious and vegetated surfaces.

The runoff from the substation is collected and conveyed through the gravel surface area. It will run overland before discharging to the proposed stormwater facility. Dust and fine particulates are partially captured within the gravel area. Additionally, the decrease in velocity through dynamic stone base allows for some deposition of suspended solids.

The proposed infiltration basin will provide for water quality treatment which meets the NJDEP requirements. The infiltration facility provides for 80% TSS removal. An infiltration facility also provides for a total phosphorous removal rate of 60% and total nitrogen removal rate of 30%. This substation site will be comprised mostly of gravel. The areas outside of the gravel areas will be mostly meadow so lawn areas will be limited to the swales located east and south of the project area. These areas are minimal so there won't be much if any fertilizer needed on site once vegetation is established.

5.0 GROUNDWATER RECHARGE COMPLIANCE

This site is located in the Coastal Metropolitan Planning Area (PA1) which is a planning area within an urban redevelopment area. However, because tree clearing in an "undeveloped" portion of the site is required, groundwater recharge standards need to be met. An annual groundwater recharge analysis based on the GSR-32 spreadsheet provided in the New Jersey BMP manual was performed. A post developed annual recharge deficit of 8,509 c.f. was calculated from the change in ground cover for the developed site. The designated 500 s.f. of infiltration area in the basin bottom will provide for 11,252 c.f. of annual BMP recharge volume, which exceeds the recharge deficit.

6.0 SOIL EROSION & SEDIMENT CONTROL DURING CONSTRUCTION

Stormwater discharges from construction activities are regulated under the *Freehold Soil Conservation District*. The discharges authorized under this act shall neither cause nor contribute to a violation of water quality standards. Proposed erosion and sediment control measures for this project will be implemented in such a way as to reduce the risk of soil loss from disturbed areas and to prevent the siltation of existing drainage channels. Measures taken during all phases of construction will be in accordance with the guidelines provided in the New Jersey Soil Conservation Commission "Standards for Soil Erosion & Sediment Control" 7th Edition January 2014 revised July 2017.

The erosion and sediment control measures will be implemented in accordance with the Contract Specifications and Drawings.

7.0 OPERATIONS & MAINTENANCE

The Operation and Maintenance plan (O&M Plan) that follows is to ensure that the stormwater management policy criteria are met during both the construction phase and post developed phase of the project. Since the substation will be owned and maintained by the Jersey Central Power & Light, no easements or right of ways on site are proposed or required to ensure the operation and maintenance of the proposed facilities. There will be a utility easement running offsite for the pipe draining the outfall structure of the basin.

7.1 CONSTRUCTION PHASE

The General Contractor hired by Jersey Central Power & Light for the construction of the Ft Monmouth Substation shall be responsible for the implementation of the soil and erosion and sediment control plans, and the stabilization of the construction site after completion of the work.

The Contractor shall maintain all soil erosion and sediment control / stormwater system features

during construction in accordance with the Stormwater Pollution Prevention Plan.

7.2 POST CONSTRUCTION

Upon completion of construction and a final stabilization of disturbed areas, the following Best Management Practices (BMPs) shall be implemented to ensure that permanent controls continue to function as designed and intended. The BMPs will be the responsibility of Jersey Central Power & Light. See Appendix D for post construction operation and maintenance.

8.0 SUMMARY AND CONCLUSIONS

The stormwater management plan for the Ft. Monmouth Substation Project and its associated facilities includes stormwater management practices that treat runoff from the proposed development. These practices include mitigation of water quantity, water quality, groundwater recharge and temporary and permanent erosion and sediment control measures. The proposed facilities mitigate the impacts of the site development on the quantity stormwater runoff. As such, the proposed mitigation systems have been designed in accordance with the policies, guidelines and regulations established by the Oceanport Borough, Freehold Soil Conservation District and the New Jersey Department of Environmental Protection.

Appendix A

Soil Map—Monmouth County, New Jersey
(Fort Monmouth Soils)

Map Scale: 1:2,140 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 30 60 120 180

Feet
0 100 200 400 600

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Monmouth County, New Jersey
Survey Area Data: Version 16, Aug 30, 2022

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Sep 25, 2020—Oct 15, 2020

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
FrkB	Freehold sandy loam, 2 to 5 percent slopes	4.4	25.5%
FrrC	Freehold-Urban land complex, 0 to 10 percent slopes	4.3	25.0%
UdauB	Udorthents-Urban land complex, 0 to 8 percent slopes	8.5	49.5%
Totals for Area of Interest		**17.1**	**100.0%**

Appendix B

Table 5-1: County-Specific, New Jersey 24-Hour Rainfall Frequency Data

NEW JERSEY 24 HOUR RAINFALL FREQUENCY DATA

Rainfall amounts in Inches

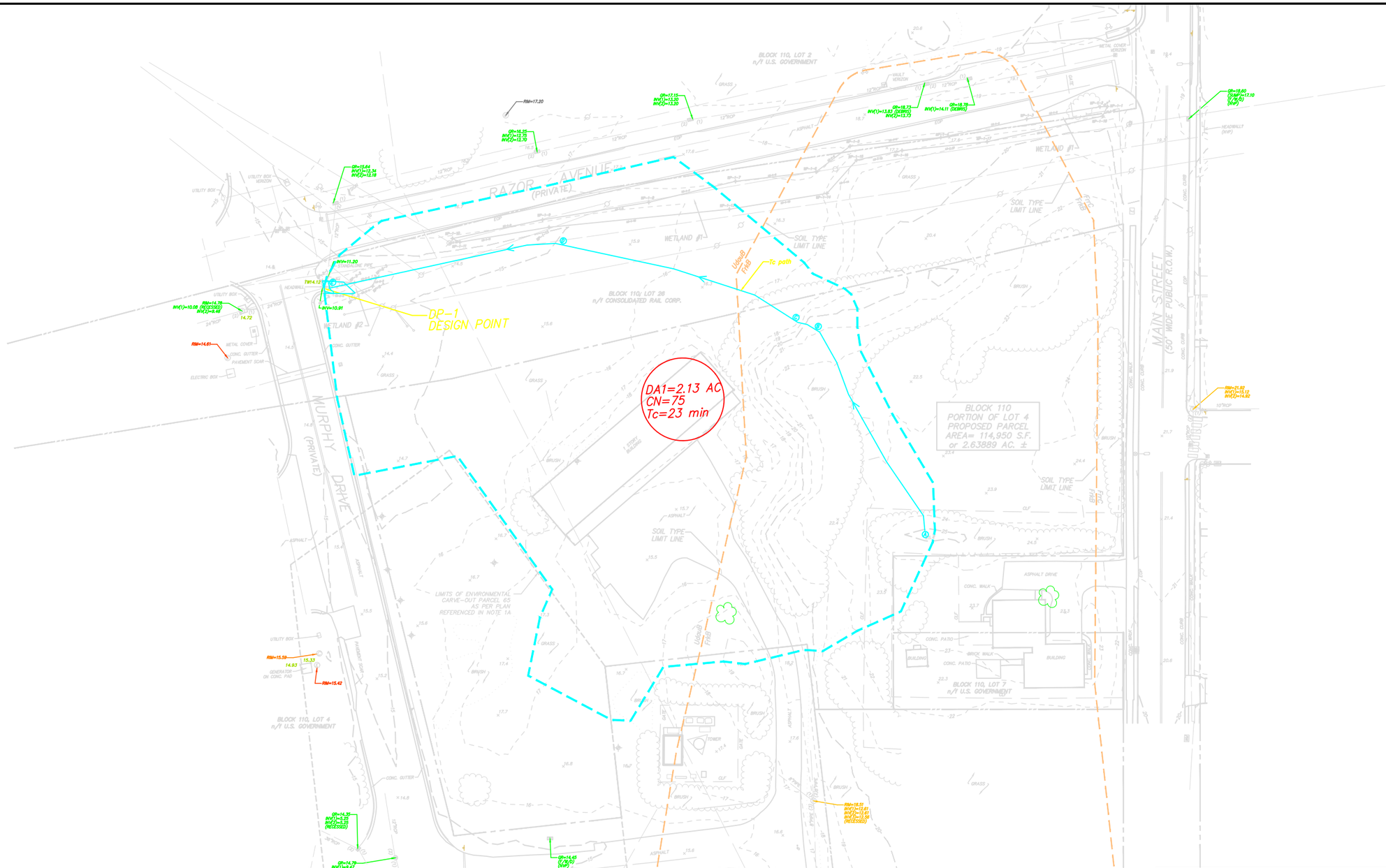
County	1 year	2 year	5 year	10 year	25 year	50 year	100 year
Atlantic	2.72	3.31	4.30	5.16	6.46	7.61	8.90
Bergen	2.75	3.34	4.27	5.07	6.28	7.32	8.47
Burlington	2.77	3.36	4.34	5.18	6.45	7.56	8.81
Camden	2.73	3.31	4.25	5.06	6.28	7.34	8.52
Cape May	2.67	3.25	4.22	5.07	6.34	7.47	8.73
Cumberland	2.69	3.27	4.25	5.09	6.37	7.49	8.76
Essex	2.85	3.44	4.40	5.22	6.44	7.49	8.66
Gloucester	2.71	3.29	4.24	5.05	6.29	7.36	8.55
Hudson	2.73	3.31	4.23	5.02	6.19	7.20	8.31
Hunterdon	2.80	3.38	4.26	5.00	6.09	7.02	8.03
Mercer	2.74	3.31	4.23	5.01	6.19	7.20	8.33
Middlesex	2.76	3.35	4.30	5.12	6.36	7.43	8.63
Monmouth	2.79	3.38	4.38	5.23	6.53	7.66	8.94
Morris	2.94	3.54	4.47	5.24	6.37	7.32	8.35
Ocean	2.81	3.42	4.45	5.33	6.68	7.87	9.20
Passaic	2.87	3.47	4.42	5.23	6.43	7.47	8.62
Salem	2.69	3.26	4.20	5.00	6.22	7.28	8.45
Somerset	2.76	3.34	4.25	5.01	6.15	7.13	8.21
Sussex	2.68	3.22	4.02	4.70	5.72	6.60	7.58
Union	2.80	3.39	4.35	5.17	6.42	7.49	8.69
Warren	2.78	3.34	4.18	4.89	5.93	6.83	7.82

Notes: The average point rainfall amounts listed above were developed from data contained in NOAA Atlas 14 Volume 2.

Point rainfall estimates for specific locations may be obtained from the Precipitation Frequency Data Server located at http://www.nws.noaa.gov/ohd/hdsc/

For most hydrologic design procedures, the rainfall amounts listed above may be rounded to the nearest tenth of an inch.

Appendix C



REV	DATE	DESCRIPTION	DRWN	CHK'D	APP'D
					PW

MasTec
Professional Services
450 DAVIS DRIVE
PLYMOUTH MEETING, PA 19462
OFFICE NUMBER: 484-344-2161

PROJECT#: 55003885

Jersey Central Power & Light
A FirstEnergy Company

JCP&L – FORT MONMOUTH MOD SUBSTATION
EXISTING CONDITIONS DRAINAGE AREA MAP

DRAWN BY: CP	SCALE: NTS	DATE: 12/8/21	
DESIGN BY: PW	DWG NO.: EX-DA		REV.
CHECKED BY: DF			
APPROVED BY:			

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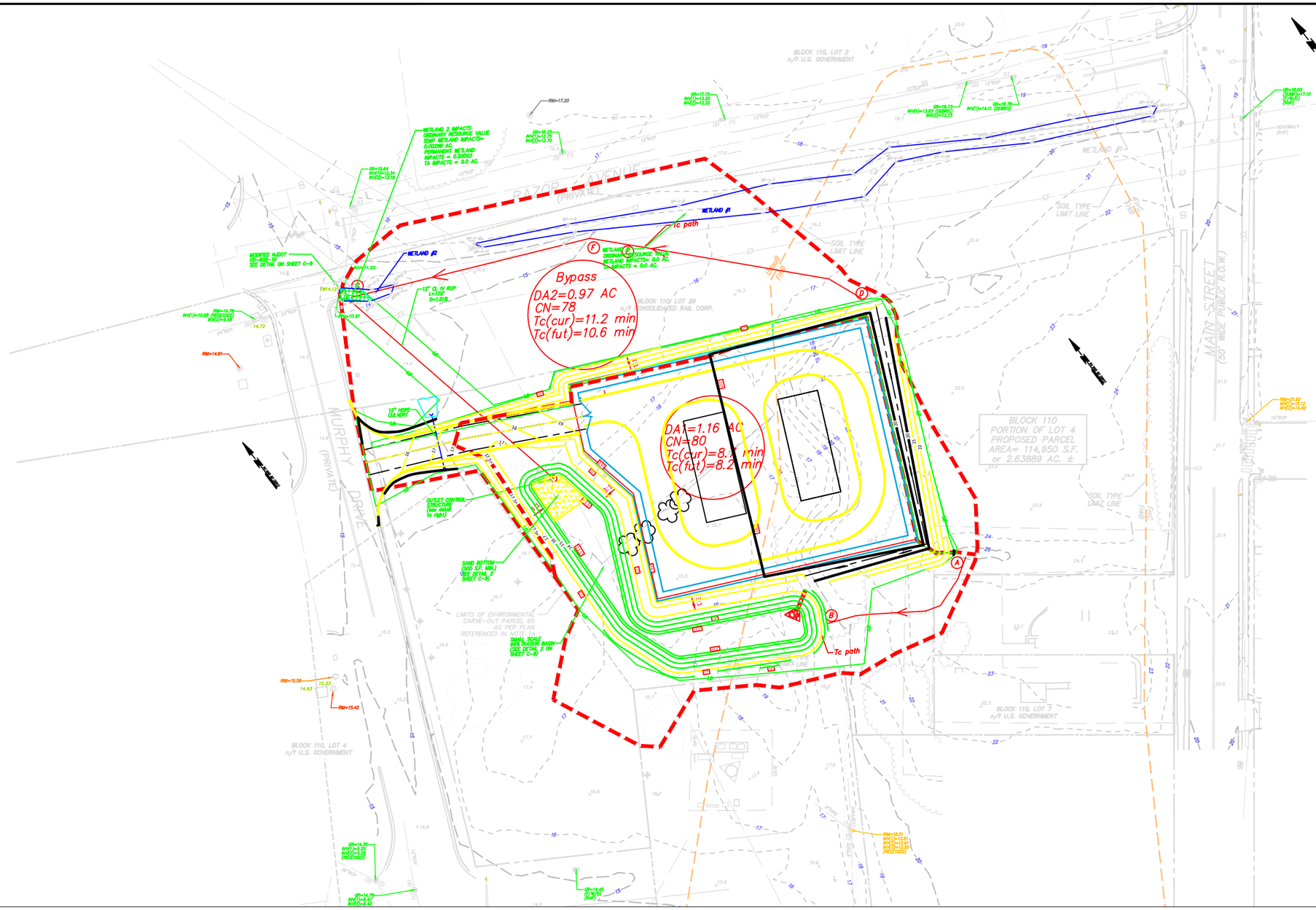

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Jersey Central Power & Light
A FirstEnergy Company

MasTec
Professional Services
450 DAVIS DRIVE, PLYMOUTH MEETING, PA 19462
OFFICE NUMBER: 484-344-2161

PROJECT#: 55003885

JCP&L – FORT MONMOUTH MOD SUBSTATION
PROPOSED CONDITION DRAINAGE AREA MAP

DRAWN BY: CP	SCALE: NTS	DATE: 12/8/21	
DESIGN BY: PW	DWG NO.: PR-DA		REV.
CHECKED BY: DF			
APPROVED BY:			

MasTec Professional Services

Worksheet 3: Time of Concentration (Tc)

Project:	Fort Monmouth Substation	Job No.		By	PW	Date	10/11/2023
Location:	Oceanport, NJ			Checked		Date	

Existing

Subarea: Existing Tc1 (current rainfall)

1. Sheet Flow

		Segment ID	A-B			
1. Surface Description (table 3-1)			dense grass			
2. Manning's roughness coeff., 'n' (table 3-1)			0.240			
3. Flow length, L (total L ≤ 150 ft		ft	100			
4. Two-year 24-hour rainfall, P_2		in	3.4			
5. Land Slope, s		ft/ft	0.018			
6. T_t =	$\frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	hr	0.241	0.000	0.000	0.241

2. Shallow Concentrated Flow

		Segment ID	B-C	C-D	D-E	
7. Surface description (Paved or Unpaved)			U	U	U	
8. Flow length, L		ft	50	14	166	
9. Watercourse slope, s		ft/ft	0.018	0.200	0.018	
10. Average velocity, V (figure 3-1)		ft/s	2.165	7.216	2.165	
11. T_t =	$\frac{L}{3600\,V}$	hr	0.006	0.001	0.021	0.028

3. Channel Flow

		Segment ID	E-F			
12. Cross sectional flow area, a		ft^2	2.37			
13. Wetted perimeter, p_w		ft	16.2			
14. Hydraulic radius, $r = a/p_w$		ft	0.15	0.00	0.00	
15. Channel slope, s		ft/ft	0.014			
16. Manning's roughness coefficient, n			0.025			
17. V =	$\frac{1.49\,r^{2/3}\,s^{1/2}}{n}$	ft/s	1.956	0.000	0.000	
18. Flow Length, L		ft	153			
19. T_t =	$\frac{L}{3600\,V}$	hr	0.022	0.000	0.000	0.022

20. Total Tc For Watershed or Subarea (Add Steps 6, 11, and 19)

hr = 0.29

min = 17.46

MasTec Professional Services

Worksheet 3: Time of Concentration (Tc)

Project: Fort Monmouth Substation | Job No. | By: PW | Date: 10/11/2023
Location: Oceanport, NJ | Checked | Date

Existing | Subarea: Existing Tc1 (future rainfall)

1. Sheet Flow

		Segment ID	A-B			
1.	Surface Description (table 3-1)		dense grass			
2.	Manning's roughness coeff., 'n' (table 3-1)		0.240			
3.	Flow length, L (total L ≤ 150 ft	ft	100			
4.	Two-year 24-hour rainfall, P_2	in	4.0			
5.	Land Slope, s	ft/ft	0.018			
6.	$T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\, s^{0.4}}$	hr	0.221	0.000	0.000	0.221

2. Shallow Concentrated Flow

		Segment ID	B-C	C-D	D-E	
7.	Surface description (Paved or Unpaved)		U	U	U	
8.	Flow length, L	ft	50	14	166	
9.	Watercourse slope, s	ft/ft	0.018	0.200	0.018	
10.	Average velocity, V (figure 3-1)	ft/s	2.165	7.216	2.165	
11.	$T_t = \frac{L}{3600\, V}$	hr	0.006	0.001	0.021	0.028

3. Channel Flow

		Segment ID	E-F			
12.	Cross sectional flow area, a	ft^2	2.37			
13.	Wetted perimeter, p_w	ft	16.2			
14.	Hydraulic radius, $r = a/p_w$	ft	0.15	0.00	0.00	
15.	Channel slope, s	ft/ft	0.014			
16.	Manning's roughness coefficient, n		0.025			
17.	$V = \frac{1.49\, r^{2/3}\, s^{1/2}}{n}$	ft/s	1.956	0.000	0.000	
18.	Flow Length, L	ft	153			
19.	$T_t = \frac{L}{3600\, V}$	hr	0.022	0.000	0.000	0.022

20. Total Tc For Watershed or Subarea (Add Steps 6, 11, and 19)

hr = 0.27

min = 16.28

MasTec Professional Services

Worksheet 3: Time of Concentration (Tc)

Project:	Fort Monmouth Substation	Job No.		By	PW	Date	10/16/2023
Location:	Oceanport, NJ			Checked		Date	

Proposed

Subarea: Proposed Tc DA1 (current rainfall)

1. Sheet Flow

		Segment ID	A-B			
1. Surface Description (table 3-1)			dense grass			
2. Manning's roughness coeff., 'n' (table 3-1)			0.240			
3. Flow length, L (total L ≤ 150 ft		ft	100			
4. Two-year 24-hour rainfall, P_2		in	3.4			
5. Land Slope, s		ft/ft	0.065			
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\, s^{0.4}}$		hr	0.144	0.000	0.000	0.144

2. Shallow Concentrated Flow

		Segment ID	B-C			
7. Surface description (Paved or Unpaved)			U			
8. Flow length, L		ft	6			
9. Watercourse slope, s		ft/ft	0.060			
10. Average velocity, V (figure 3-1)		ft/s	3.952	0.000	0.000	
11. $T_t = \frac{L}{3600\, V}$		hr	0.000	0.000	0.000	0.000

3. Channel Flow

		Segment ID	B-C			
12. Cross sectional flow area, a		ft^2	0.00			
13. Wetted perimeter, p_w		ft	0.0			
14. Hydraulic radius, $r = a/p_w$		ft	0.00	0.00	0.00	
15. Channel slope, s		ft/ft	0.000			
16. Manning's roughness coefficient, n			0.000			
17. $V = \frac{1.49\, r^{2/3}\, s^{1/2}}{n}$		ft/s	0.000	0.000	0.000	
18. Flow Length, L		ft	0			
19. $T_t = \frac{L}{3600\, V}$		hr	0.000	0.000	0.000	0.000

20. Total Tc For Watershed or Subarea (Add Steps 6, 11, and 19)

hr = 0.14

min = 8.7

MasTec Professional Services

Worksheet 3: Time of Concentration (Tc)

Project:	Fort Monmouth Substation	Job No.		By	PW	Date	10/11/2023
Location:	Oceanport, NJ			Checked		Date	

Proposed

Subarea: Proposed Tc DA1 (future rainfall)

1. Sheet Flow

		Segment ID	A-B			
1. Surface Description (table 3-1)			dense grass			
2. Manning's roughness coeff., 'n' (table 3-1)			0.240			
3. Flow length, L (total L ≤ 150 ft		ft	100			
4. Two-year 24-hour rainfall, P_2		in	4.0			
5. Land Slope, s		ft/ft	0.060			
6. T_t =	$\frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	hr	0.137	0.000	0.000	0.137

2. Shallow Concentrated Flow

		Segment ID	B-C			
7. Surface description (Paved or Unpaved)			U			
8. Flow length, L		ft	6			
9. Watercourse slope, s		ft/ft	0.060			
10. Average velocity, V (figure 3-1)		ft/s	3.952	0.000	0.000	
11. T_t =	$\frac{L}{3600\,V}$	hr	0.000	0.000	0.000	0.000

3. Channel Flow

		Segment ID				
12. Cross sectional flow area, a		ft^2	0.00			
13. Wetted perimeter, p_w		ft	0.0			
14. Hydraulic radius, $r = a/p_w$		ft	0.00	0.00	0.00	
15. Channel slope, s		ft/ft	0.000			
16. Manning's roughness coefficient, n			0.000			
17. V =	$\frac{1.49\,r^{2/3}\,s^{1/2}}{n}$	ft/s	0.000	0.000	0.000	
18. Flow Length, L		ft	0			
19. T_t =	$\frac{L}{3600\,V}$	hr	0.000	0.000	0.000	0.000

20. Total Tc For Watershed or Subarea (Add Steps 6, 11, and 19)

hr = 0.14

min = 8.22

MasTec Professional Services

Worksheet 3: Time of Concentration (Tc)

Project:	Fort Monmouth Substation	Job No.		By	PW	Date	10/16/2023
Location:	Oceanport, NJ			Checked		Date	

Proposed

Subarea: Proposed Tc DA2 (current rainfall)

1. Sheet Flow

		Segment ID	D-E			
1. Surface Description (table 3-1)			dense grass			
2. Manning's roughness coeff., 'n' (table 3-1)			0.240			
3. Flow length, L (total L ≤ 150 ft		ft	54			McCu
4. Two-year 24-hour rainfall, P_2		in	3.4			
5. Land Slope, s		ft/ft	0.018			
6. T_t =	$\frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	hr	0.149	0.000	0.000	0.149

2. Shallow Concentrated Flow

		Segment ID	E-F			
7. Surface description (Paved or Unpaved)			U			
8. Flow length, L		ft	120			
9. Watercourse slope, s		ft/ft	0.013			
10. Average velocity, V (figure 3-1)		ft/s	1.840	0.000	0.000	
11. T_t =	$\frac{L}{3600\,V}$	hr	0.018	0.000	0.000	0.018

3. Channel Flow

		Segment ID	F-G			
12. Cross sectional flow area, a		ft^2	0.68			
13. Wetted perimeter, p_w		ft	4.2			
14. Hydraulic radius, $r = a/p_w$		ft	0.16	0.00	0.00	
15. Channel slope, s		ft/ft	0.016			
16. Manning's roughness coefficient, n			0.025			
17. V =	$\frac{1.49\,r^{2/3}\,s^{1/2}}{n}$	ft/s	2.236	0.000	0.000	
18. Flow Length, L		ft	153			
19. T_t =	$\frac{L}{3600\,V}$	hr	0.019	0.000	0.000	0.019

20. Total Tc For Watershed or Subarea (Add Steps 6, 11, and 19)

hr = 0.19

min = 11.2

MasTec Professional Services

Worksheet 3: Time of Concentration (Tc)

Project:	Fort Monmouth Substation	Job No.		By	PW	Date	10/11/2023
Location:	Oceanport, NJ			Checked		Date	

Proposed

Subarea: Proposed Tc DA2 - future

1. Sheet Flow

		Segment ID	D-E			
1.	Surface Description (table 3-1)		dense grass			
2.	Manning's roughness coeff., 'n' (table 3-1)		0.240			
3.	Flow length, L (total L ≤ 150 ft	ft	54			McCuen-W
4.	Two-year 24-hour rainfall, P_2	in	4.0			
5.	Land Slope, s	ft/ft	0.017			
6.	$T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\, s^{0.4}}$	hr	0.138	0.000	0.000	0.138

2. Shallow Concentrated Flow

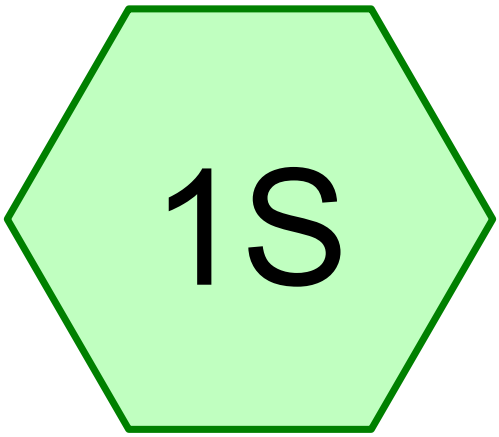
		Segment ID	E-F			
7.	Surface description (Paved or Unpaved)		U			
8.	Flow length, L	ft	126			
9.	Watercourse slope, s	ft/ft	0.013			
10.	Average velocity, V (figure 3-1)	ft/s	1.840	0.000	0.000	
11.	$T_t = \frac{L}{3600\, V}$	hr	0.019	0.000	0.000	0.019

3. Channel Flow

		Segment ID	F-G			
12.	Cross sectional flow area, a	ft^2	0.68			
13.	Wetted perimeter, p_w	ft	4.2			
14.	Hydraulic radius, $r = a/p_w$	ft	0.16	0.00	0.00	
15.	Channel slope, s	ft/ft	0.016			
16.	Manning's roughness coefficient, n		0.025			
17.	$V = \frac{1.49\, r^{2/3}\, s^{1/2}}{n}$	ft/s	2.236	0.000	0.000	
18.	Flow Length, L	ft	153			
19.	$T_t = \frac{L}{3600\, V}$	hr	0.019	0.000	0.000	0.019

20. Total Tc For Watershed or Subarea (Add Steps 6, 11, and 19)

hr =	**0.18**
min =	**10.57**



Exisiting Conditions (current)

Subcat Reach Pond Link

Routing Diagram for 231218 SWM Calcs
Prepared by ACT Engineers, Inc., Printed 12/20/2023

Summary for Subcatchment 1S: Exisiting Conditions (current)

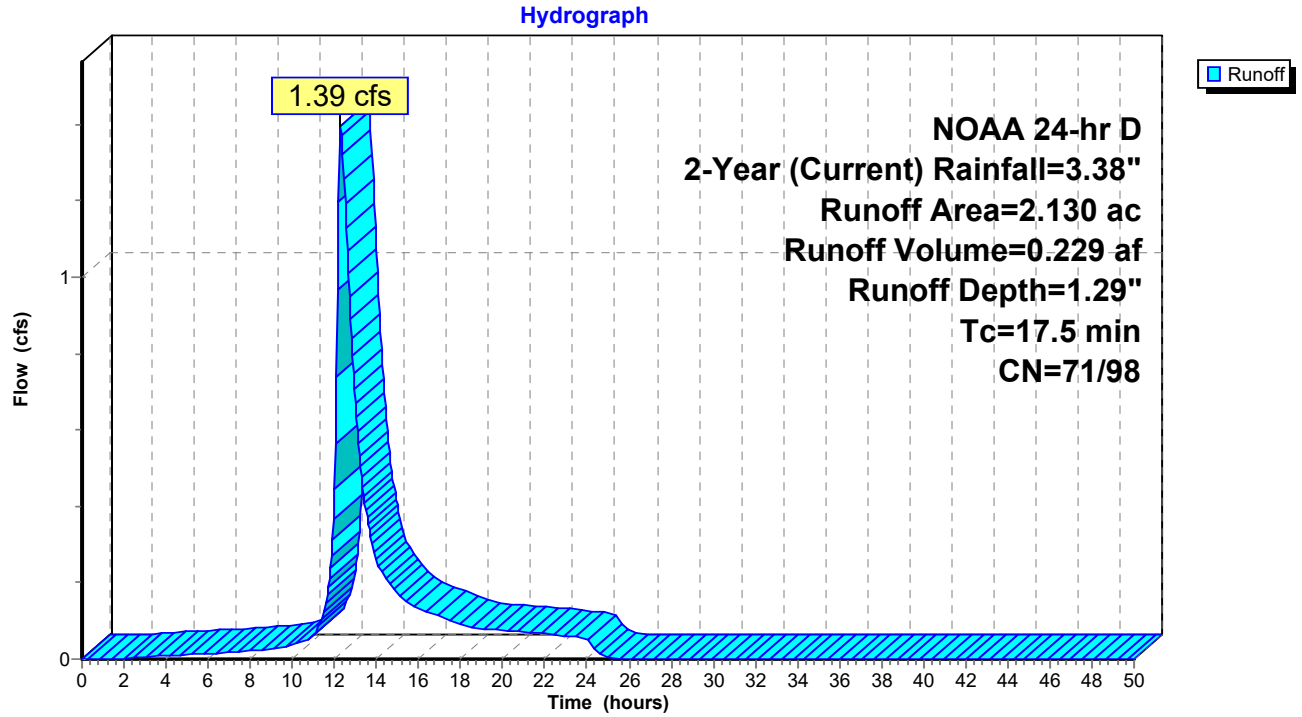
Runoff = 1.39 cfs @ 12.31 hrs, Volume= 0.229 af, Depth= 1.29"

Runoff by SCS TR-20 method, UH=Delmarva, Split Pervious/Imperv., Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
NOAA 24-hr D 2-Year (Current) Rainfall=3.38"

	Area (ac)	CN	Description
*	0.110	98	Building
*	0.190	98	Pavement
*	0.280	60	Woods, HSG B
*	1.190	78	Meadow, HSG D
*	0.360	58	Meadow, HSG B
	2.130	75	Weighted Average
	1.830	71	85.92% Pervious Area
	0.300	98	14.08% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.5					**Direct Entry, See Tc Calcs**

Subcatchment 1S: Exisiting Conditions (current)



Summary for Subcatchment 1S: Exisiting Conditions (current)

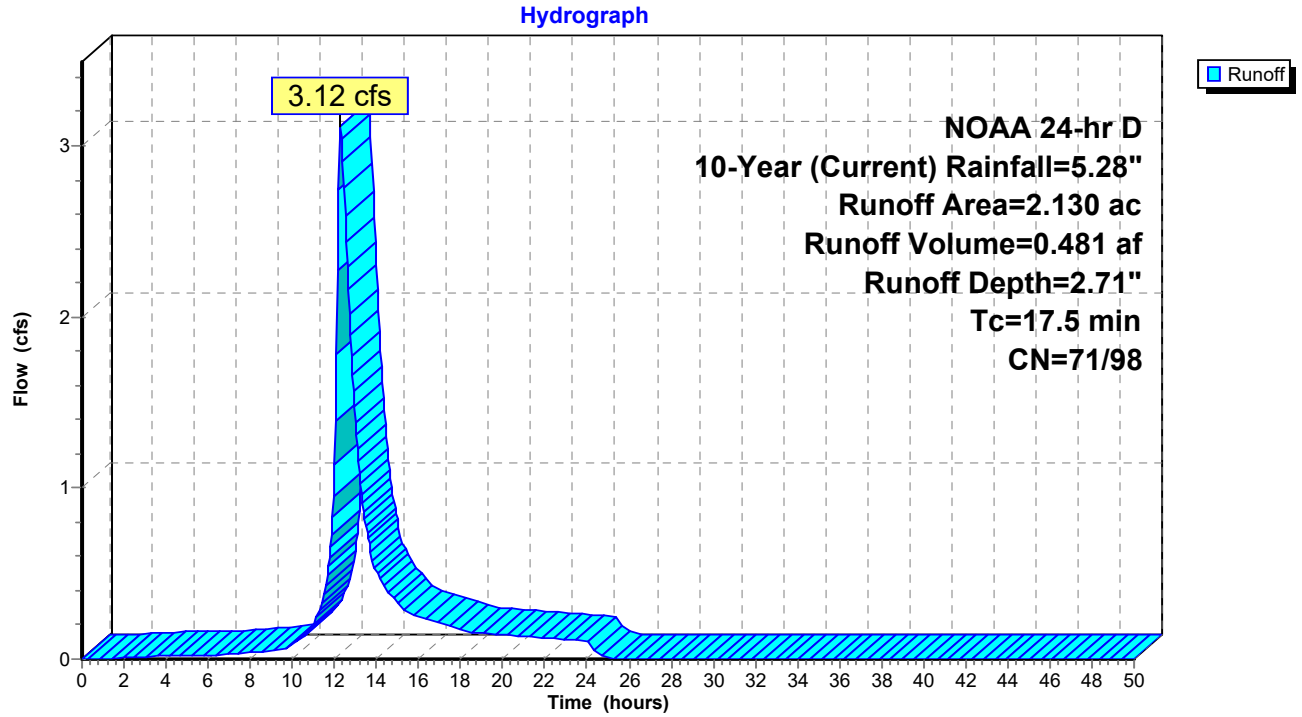
Runoff = 3.12 cfs @ 12.30 hrs, Volume= 0.481 af, Depth= 2.71"

Runoff by SCS TR-20 method, UH=Delmarva, Split Pervious/Imperv., Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
NOAA 24-hr D 10-Year (Current) Rainfall=5.28"

	Area (ac)	CN	Description
*	0.110	98	Building
*	0.190	98	Pavement
*	0.280	60	Woods, HSG B
*	1.190	78	Meadow, HSG D
*	0.360	58	Meadow, HSG B
	2.130	75	Weighted Average
	1.830	71	85.92% Pervious Area
	0.300	98	14.08% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.5					**Direct Entry, See Tc Calcs**

Subcatchment 1S: Exisiting Conditions (current)



Summary for Subcatchment 1S: Exisiting Conditions (current)

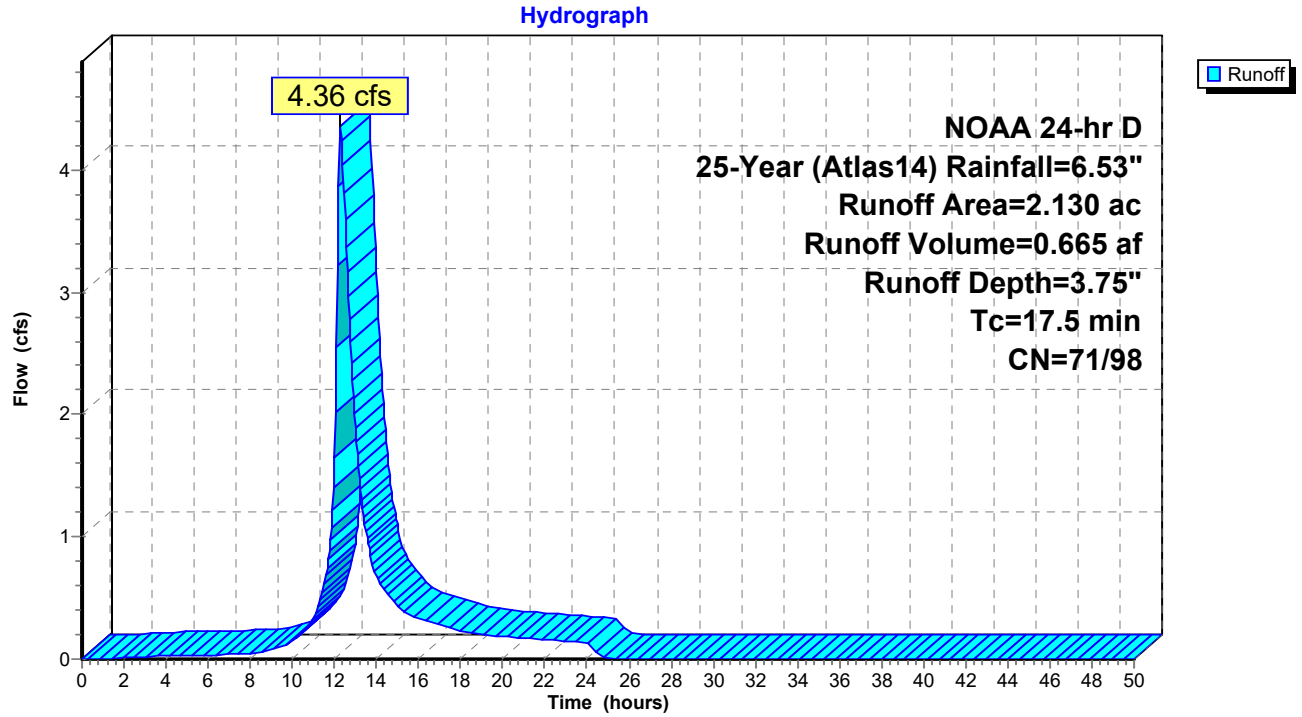
Runoff = 4.36 cfs @ 12.30 hrs, Volume= 0.665 af, Depth= 3.75"

Runoff by SCS TR-20 method, UH=Delmarva, Split Pervious/Imperv., Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
NOAA 24-hr D 25-Year (Atlas14) Rainfall=6.53"

	Area (ac)	CN	Description
*	0.110	98	Building
*	0.190	98	Pavement
*	0.280	60	Woods, HSG B
*	1.190	78	Meadow, HSG D
*	0.360	58	Meadow, HSG B
	2.130	75	Weighted Average
	1.830	71	85.92% Pervious Area
	0.300	98	14.08% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.5					**Direct Entry, See Tc Calcs**

Subcatchment 1S: Exisiting Conditions (current)



Summary for Subcatchment 1S: Exisiting Conditions (current)

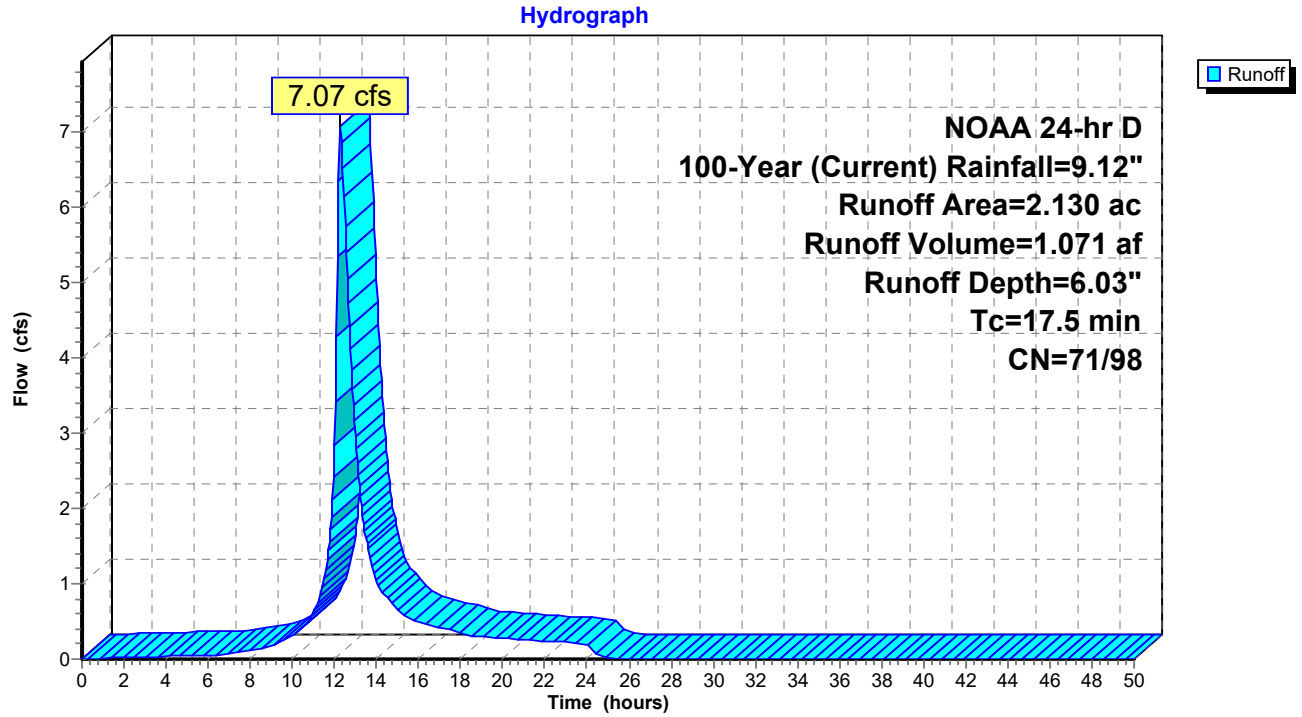
Runoff = 7.07 cfs @ 12.29 hrs, Volume= 1.071 af, Depth= 6.03"

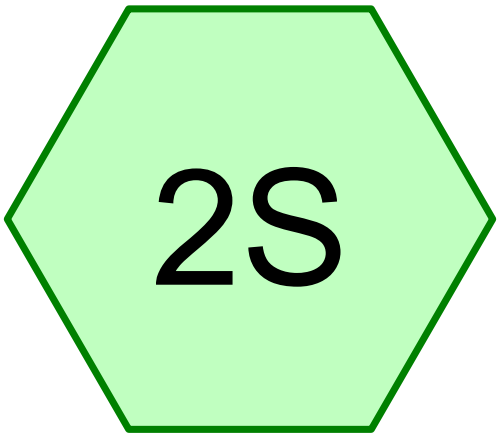
Runoff by SCS TR-20 method, UH=Delmarva, Split Pervious/Imperv., Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
NOAA 24-hr D 100-Year (Current) Rainfall=9.12"

	Area (ac)	CN	Description
*	0.110	98	Building
*	0.190	98	Pavement
*	0.280	60	Woods, HSG B
*	1.190	78	Meadow, HSG D
*	0.360	58	Meadow, HSG B
	2.130	75	Weighted Average
	1.830	71	85.92% Pervious Area
	0.300	98	14.08% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.5					**Direct Entry, See Tc Calcs**

Subcatchment 1S: Exisiting Conditions (current)





Exisiting Conditions (future)

Subcat Reach Pond Link

Routing Diagram for 231218 SWM Calcs
Prepared by ACT Engineers, Inc., Printed 12/20/2023

Summary for Subcatchment 2S: Exisiting Conditions (future)

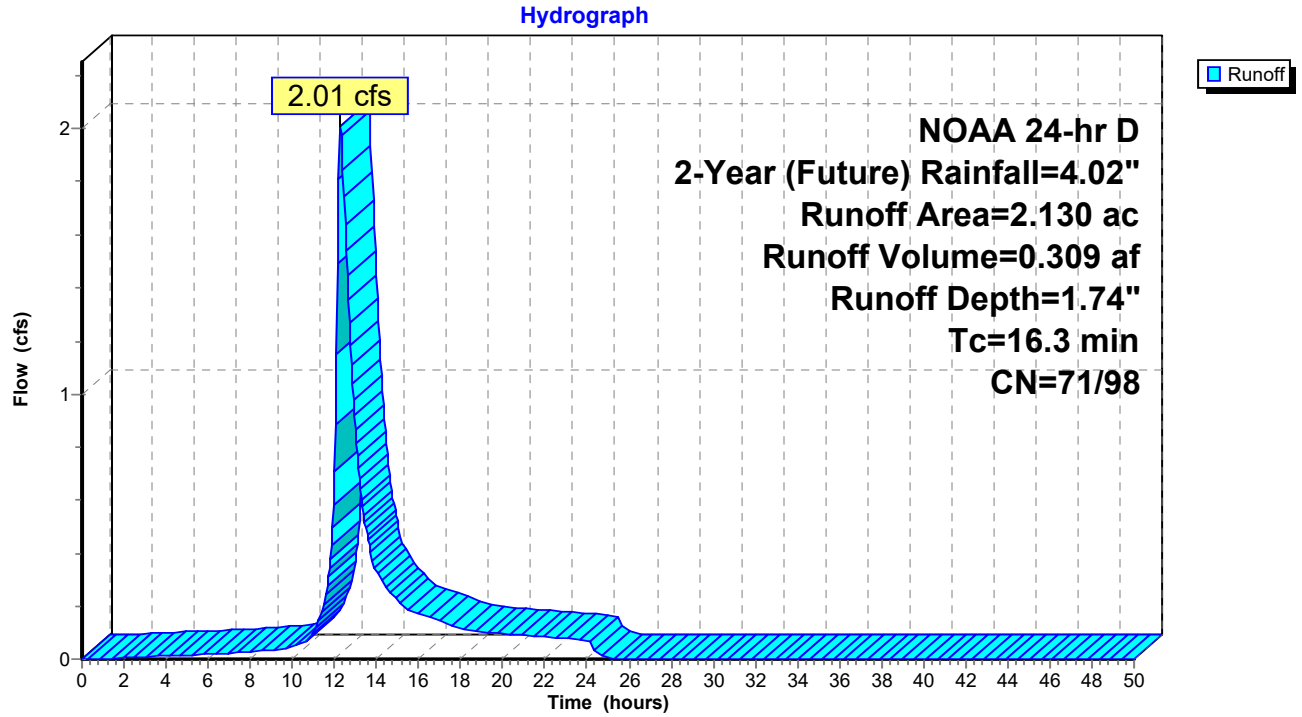
Runoff = 2.01 cfs @ 12.28 hrs, Volume= 0.309 af, Depth= 1.74"

Runoff by SCS TR-20 method, UH=Delmarva, Split Pervious/Imperv., Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
NOAA 24-hr D 2-Year (Future) Rainfall=4.02"

	Area (ac)	CN	Description
*	0.110	98	Building
*	0.190	98	Pavement
*	0.280	60	Woods, HSG B
*	1.190	78	Meadow, HSG D
*	0.360	58	Meadow, HSG B
	2.130	75	Weighted Average
	1.830	71	85.92% Pervious Area
	0.300	98	14.08% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.3					**Direct Entry, See Tc Calcs**

Subcatchment 2S: Exisiting Conditions (future)



Summary for Subcatchment 2S: Exisiting Conditions (future)

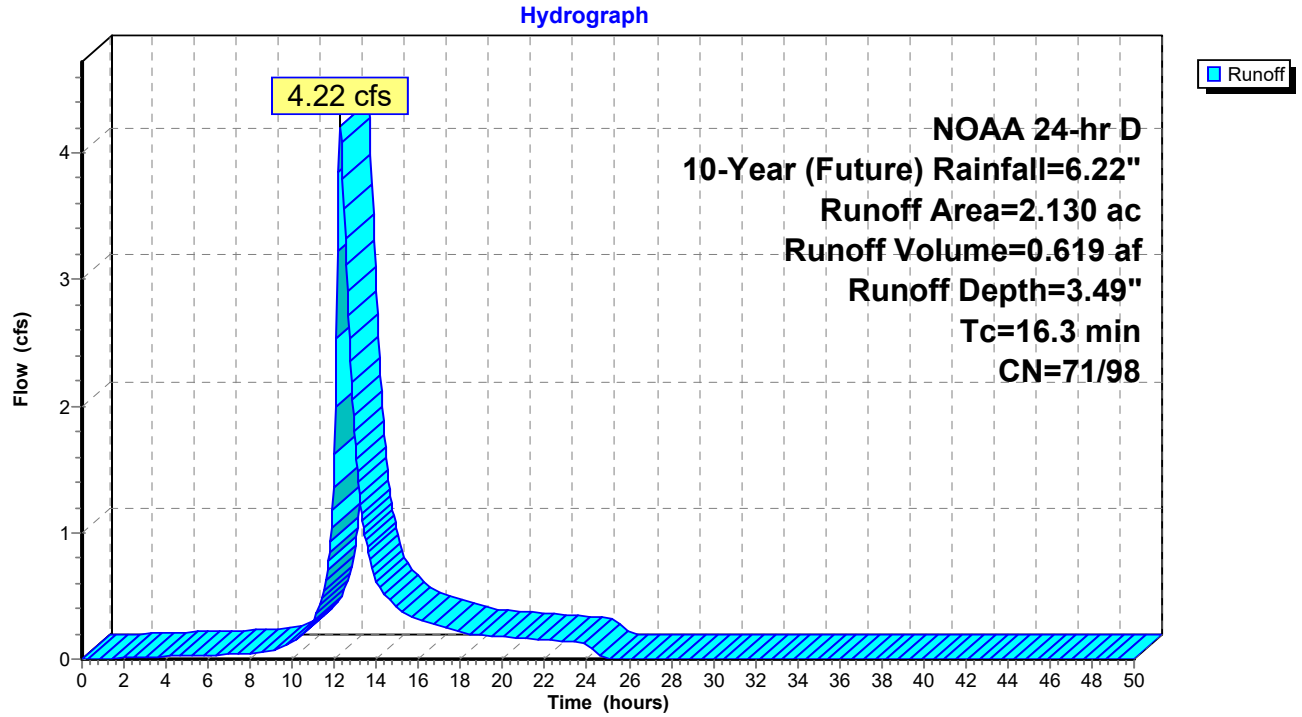
Runoff = 4.22 cfs @ 12.27 hrs, Volume= 0.619 af, Depth= 3.49"

Runoff by SCS TR-20 method, UH=Delmarva, Split Pervious/Imperv., Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
NOAA 24-hr D 10-Year (Future) Rainfall=6.22"

	Area (ac)	CN	Description
*	0.110	98	Building
*	0.190	98	Pavement
*	0.280	60	Woods, HSG B
*	1.190	78	Meadow, HSG D
*	0.360	58	Meadow, HSG B
	2.130	75	Weighted Average
	1.830	71	85.92% Pervious Area
	0.300	98	14.08% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.3					**Direct Entry, See Tc Calcs**

Subcatchment 2S: Exisiting Conditions (future)



Summary for Subcatchment 2S: Exisiting Conditions (future)

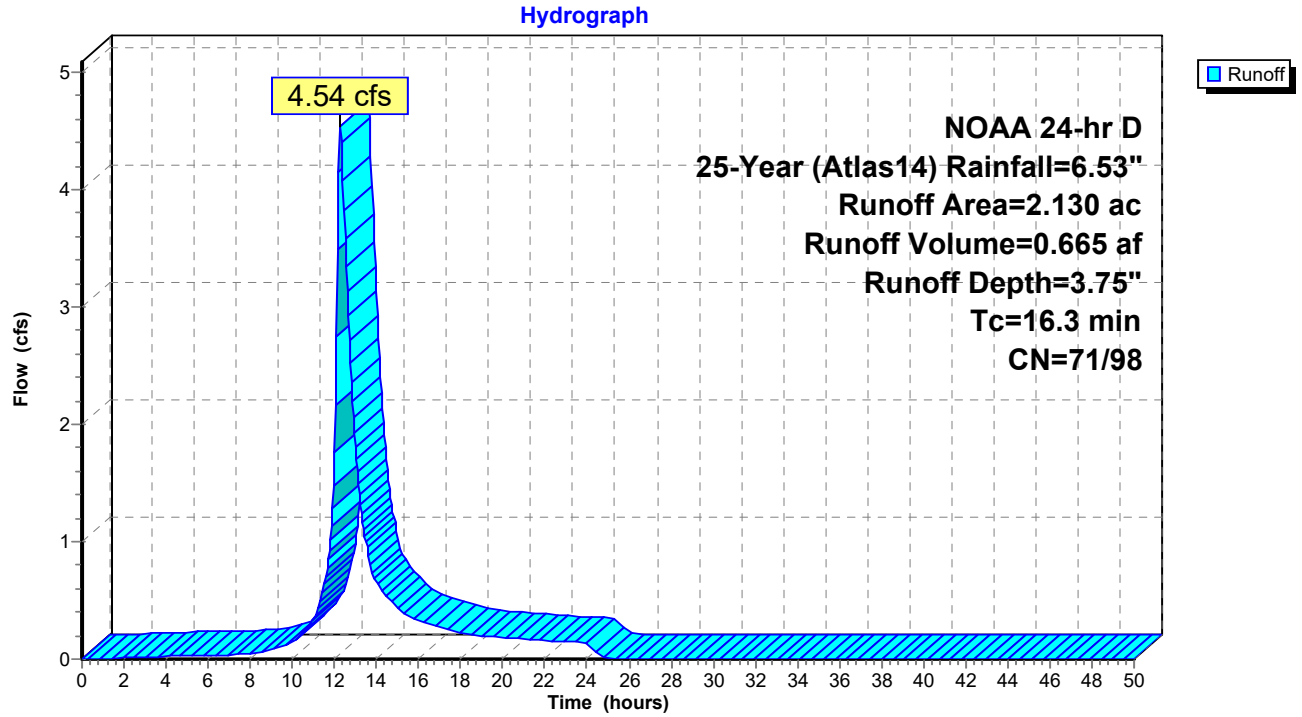
Runoff = 4.54 cfs @ 12.27 hrs, Volume= 0.665 af, Depth= 3.75"

Runoff by SCS TR-20 method, UH=Delmarva, Split Pervious/Imperv., Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
NOAA 24-hr D 25-Year (Atlas14) Rainfall=6.53"

	Area (ac)	CN	Description
*	0.110	98	Building
*	0.190	98	Pavement
*	0.280	60	Woods, HSG B
*	1.190	78	Meadow, HSG D
*	0.360	58	Meadow, HSG B
	2.130	75	Weighted Average
	1.830	71	85.92% Pervious Area
	0.300	98	14.08% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.3					**Direct Entry, See Tc Calcs**

Subcatchment 2S: Exisiting Conditions (future)



Summary for Subcatchment 2S: Exisiting Conditions (future)

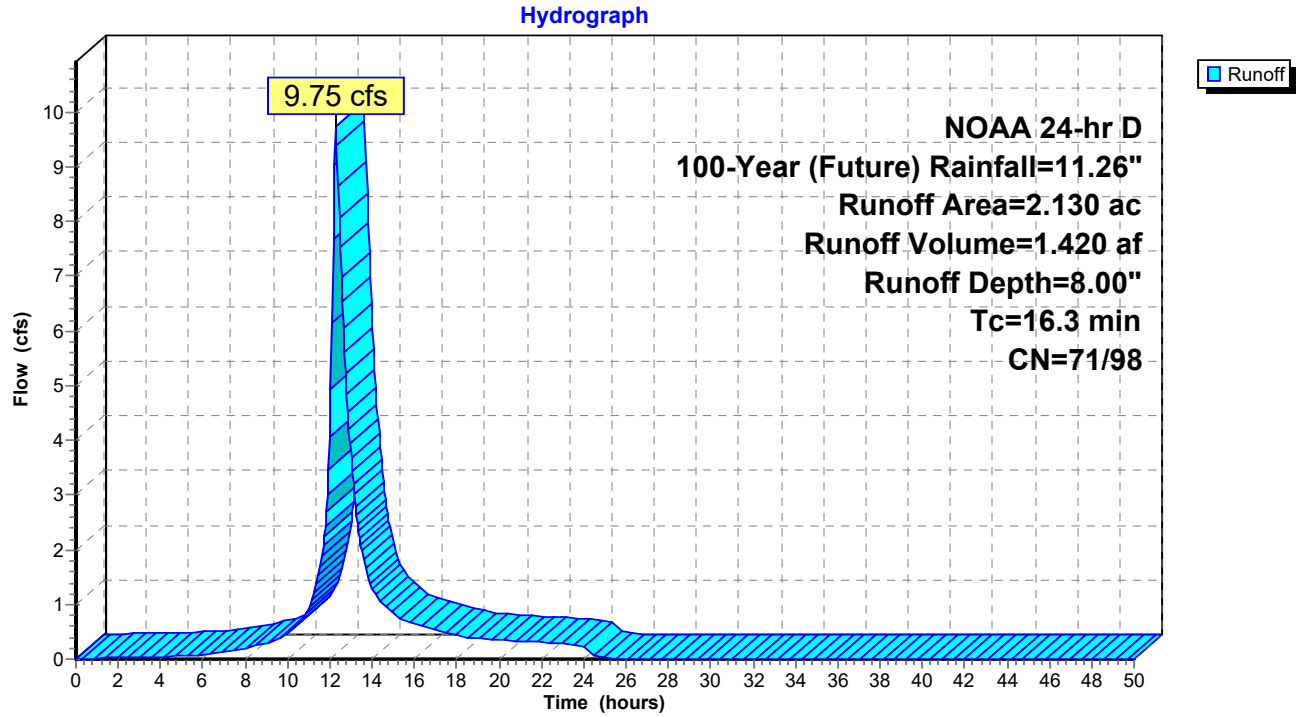
Runoff = 9.75 cfs @ 12.27 hrs, Volume= 1.420 af, Depth= 8.00"

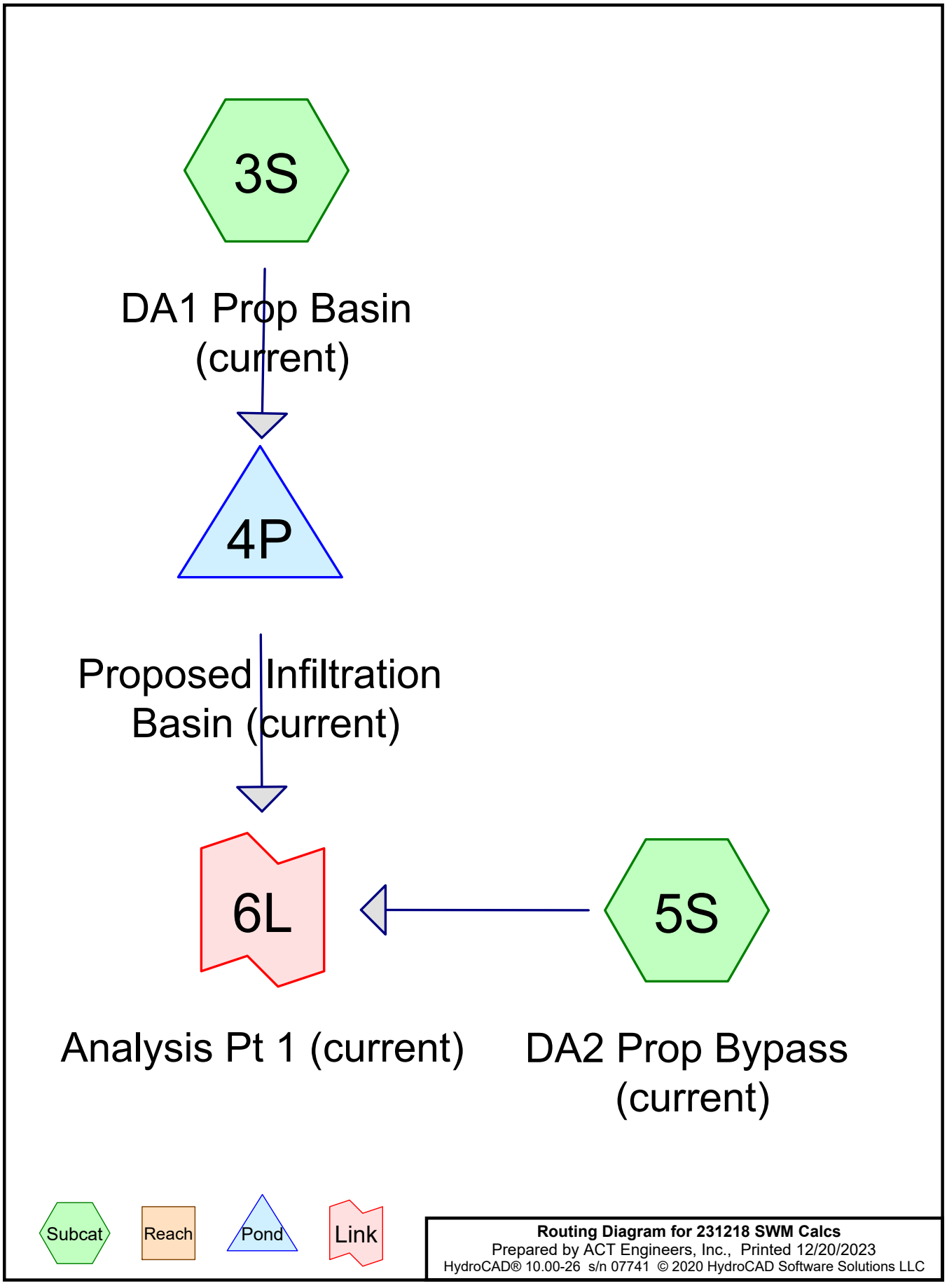
Runoff by SCS TR-20 method, UH=Delmarva, Split Pervious/Imperv., Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
NOAA 24-hr D 100-Year (Future) Rainfall=11.26"

	Area (ac)	CN	Description
*	0.110	98	Building
*	0.190	98	Pavement
*	0.280	60	Woods, HSG B
*	1.190	78	Meadow, HSG D
*	0.360	58	Meadow, HSG B
	2.130	75	Weighted Average
	1.830	71	85.92% Pervious Area
	0.300	98	14.08% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.3					**Direct Entry, See Tc Calcs**

Subcatchment 2S: Exisiting Conditions (future)





Routing Diagram for 231218 SWM Calcs
Prepared by ACT Engineers, Inc., Printed 12/20/2023

Summary for Subcatchment 3S: DA1 Prop Basin (current)

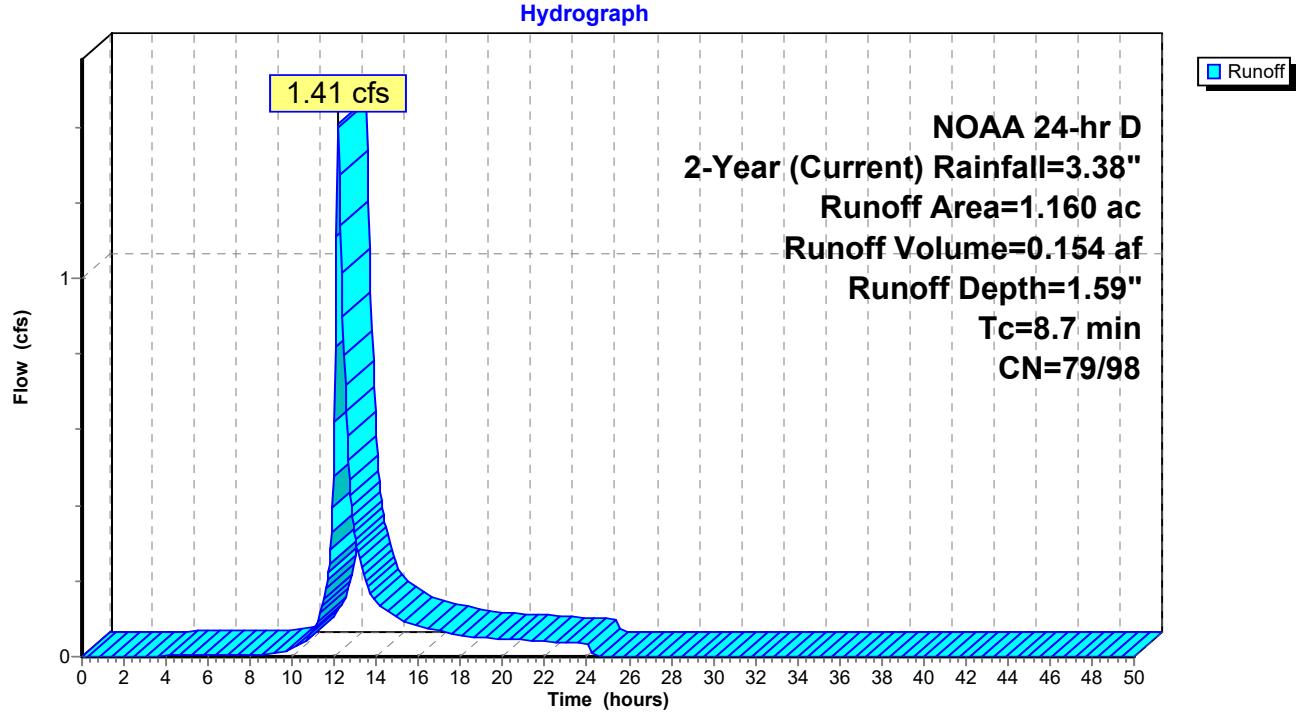
Runoff = 1.41 cfs @ 12.18 hrs, Volume= 0.154 af, Depth= 1.59"

Runoff by SCS TR-20 method, UH=Delmarva, Split Pervious/Imperv., Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
NOAA 24-hr D 2-Year (Current) Rainfall=3.38"

	Area (ac)	CN	Description
*	0.080	98	Concrete Pads, HSG B/D
*	0.300	85	Gravel, HSG B
*	0.200	91	Gravel, HSG D
*	0.050	55	Woods (Good), HSG B
*	0.160	78	Meadow, HSG D
*	0.060	61	Grass (Good), HSG B
*	0.220	80	Grass (Good), HSG D
*	0.090	58	Meadow, HSG B
	1.160	80	Weighted Average
	1.080	79	93.10% Pervious Area
	0.080	98	6.90% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.7					**Direct Entry, See Tc Calcs**

Subcatchment 3S: DA1 Prop Basin (current)



Summary for Subcatchment 5S: DA2 Prop Bypass (current)

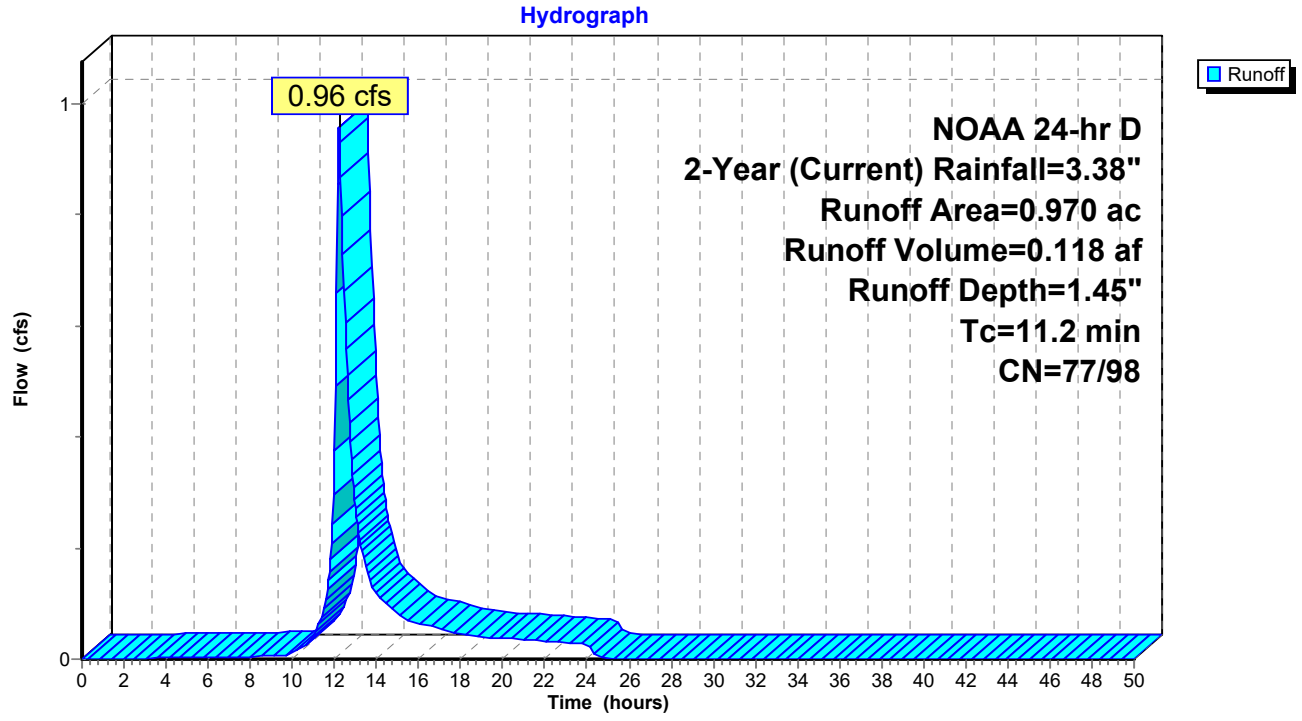
Runoff = 0.96 cfs @ 12.22 hrs, Volume= 0.118 af, Depth= 1.45"

Runoff by SCS TR-20 method, UH=Delmarva, Split Pervious/Imperv., Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
NOAA 24-hr D 2-Year (Current) Rainfall=3.38"

	Area (ac)	CN	Description
*	0.030	58	Meadow, HSG B
*	0.690	78	Meadow, HSG D
*	0.020	77	Woods (Good), HSG D
*	0.040	91	Gravel, HSG D
*	0.060	98	Pavement, HSG B/D
*	0.080	61	Grass (Good), HSG B
*	0.050	80	Grass (Good), HSG D
	0.970	78	Weighted Average
	0.910	77	93.81% Pervious Area
	0.060	98	6.19% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.2					**Direct Entry, See Tc Calcs**

Subcatchment 5S: DA2 Prop Bypass (current)



Summary for Pond 4P: Proposed Infiltration Basin (current)

Inflow Area = 1.160 ac, 6.90% Impervious, Inflow Depth = 1.59" for 2-Year (Current) event
Inflow = 1.41 cfs @ 12.18 hrs, Volume= 0.154 af
Outflow = 0.14 cfs @ 14.14 hrs, Volume= 0.125 af, Atten= 90%, Lag= 117.5 min
Primary = 0.14 cfs @ 14.14 hrs, Volume= 0.125 af

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 14.37' @ 14.14 hrs Surf.Area= 4,749 sf Storage= 3,755 cf

Plug-Flow detention time= 436.8 min calculated for 0.125 af (81% of inflow)
Center-of-Mass det. time= 354.3 min (1,203.1 - 848.9)

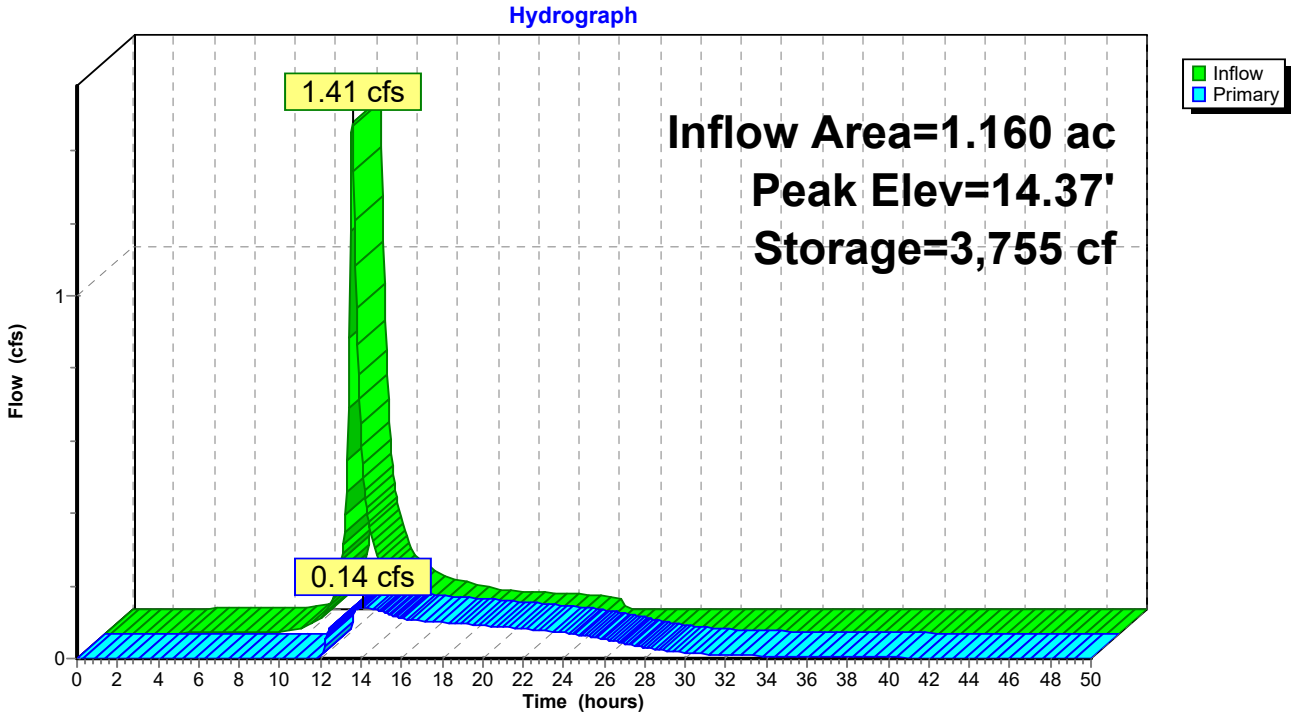
Volume	Invert	Avail.Storage	Storage Description
#1	13.50'	21,315 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
13.50	3,483	0	0
14.00	4,201	1,921	1,921
15.00	5,678	4,940	6,861
16.00	7,213	6,446	13,306
17.00	8,804	8,009	21,315

Device	Routing	Invert	Outlet Devices
#1	Primary	13.50'	**12.0" Round Culvert** L= 165.0' Ke= 0.500 Inlet / Outlet Invert= 13.50' / 10.91' S= 0.0157 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	13.81'	**2.5" Vert. Orifice/Grate** C= 0.600
#3	Device 1	14.33'	**12.0" W x 5.0" H Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.14 cfs @ 14.14 hrs HW=14.37' (Free Discharge)
└**1=Culvert** (Passes 0.14 cfs of 2.31 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.11 cfs @ 3.26 fps)
  └**3=Orifice/Grate** (Orifice Controls 0.03 cfs @ 0.65 fps)

Pond 4P: Proposed Infiltration Basin (current)

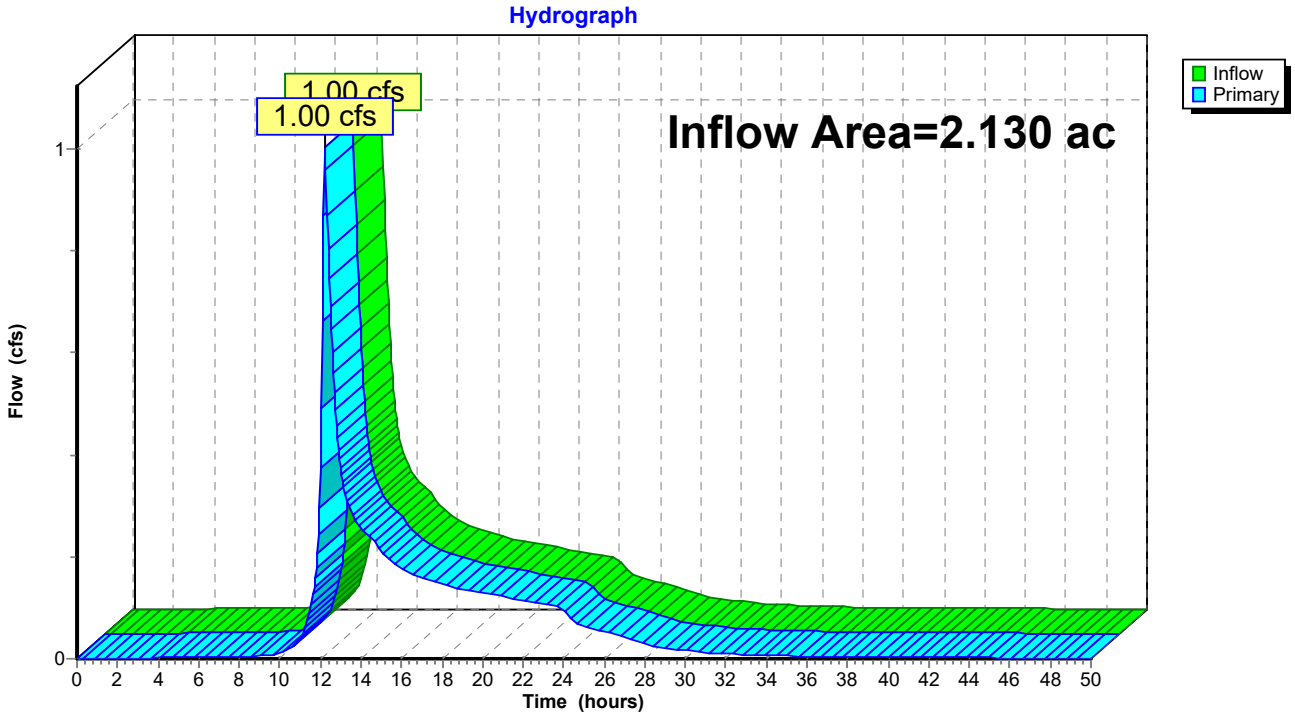


Summary for Link 6L: Analysis Pt 1 (current)

Inflow Area = 2.130 ac, 6.57% Impervious, Inflow Depth > 1.36" for 2-Year (Current) event
Inflow = 1.00 cfs @ 12.22 hrs, Volume= 0.242 af
Primary = 1.00 cfs @ 12.22 hrs, Volume= 0.242 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs

Link 6L: Analysis Pt 1 (current)



Summary for Subcatchment 3S: DA1 Prop Basin (current)

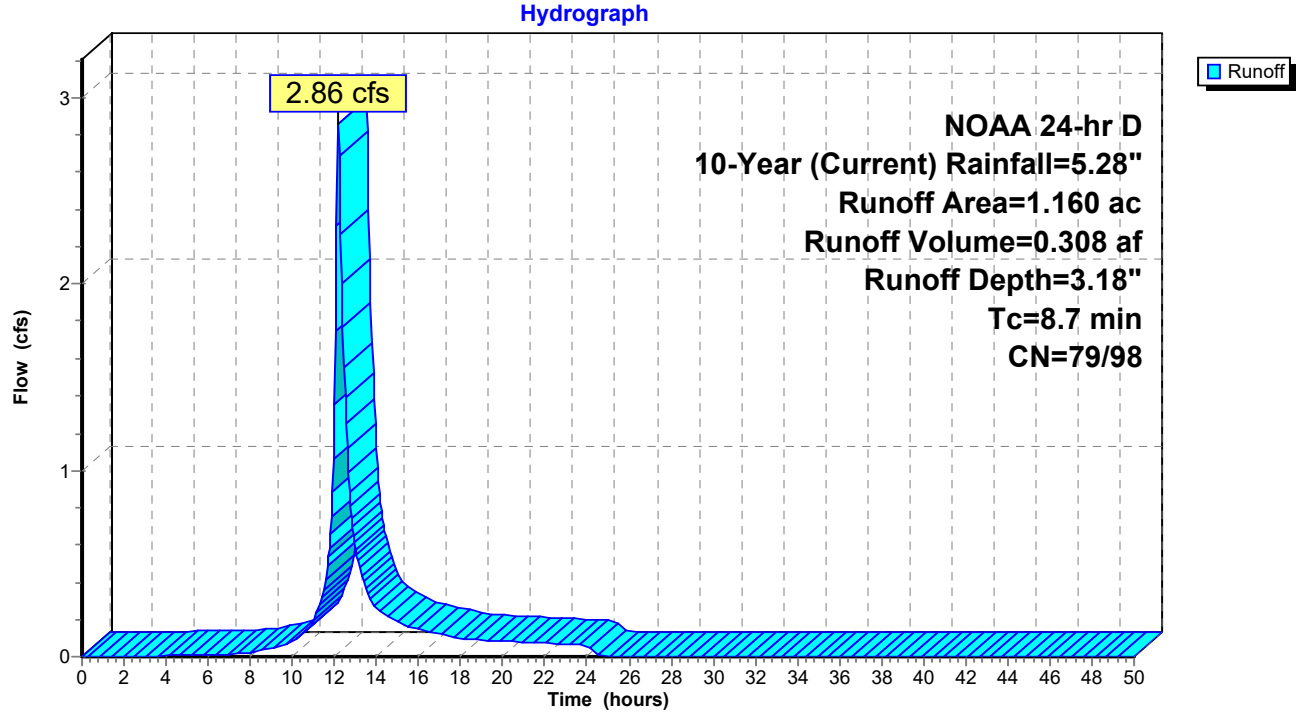
Runoff = 2.86 cfs @ 12.18 hrs, Volume= 0.308 af, Depth= 3.18"

Runoff by SCS TR-20 method, UH=Delmarva, Split Pervious/Imperv., Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
NOAA 24-hr D 10-Year (Current) Rainfall=5.28"

	Area (ac)	CN	Description
*	0.080	98	Concrete Pads, HSG B/D
*	0.300	85	Gravel, HSG B
*	0.200	91	Gravel, HSG D
*	0.050	55	Woods (Good), HSG B
*	0.160	78	Meadow, HSG D
*	0.060	61	Grass (Good), HSG B
*	0.220	80	Grass (Good), HSG D
*	0.090	58	Meadow, HSG B
	1.160	80	Weighted Average
	1.080	79	93.10% Pervious Area
	0.080	98	6.90% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.7					**Direct Entry, See Tc Calcs**

Subcatchment 3S: DA1 Prop Basin (current)



Summary for Subcatchment 5S: DA2 Prop Bypass (current)

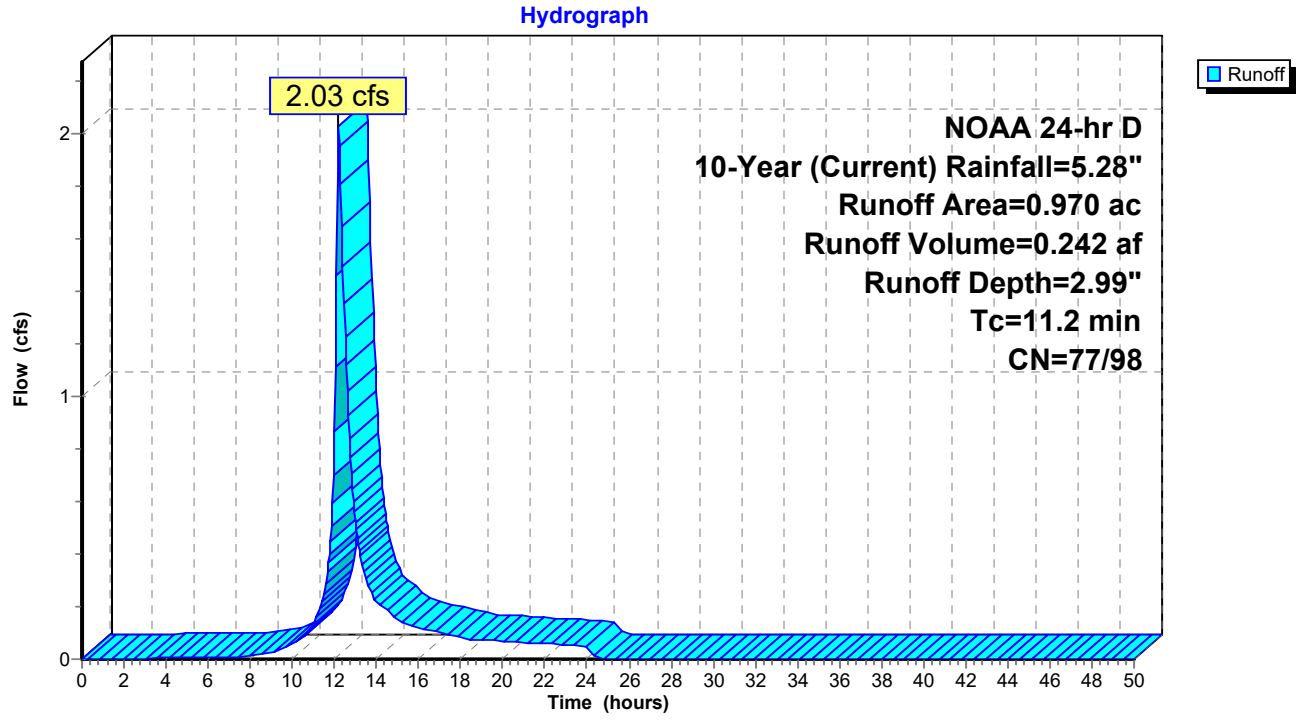
Runoff = 2.03 cfs @ 12.21 hrs, Volume= 0.242 af, Depth= 2.99"

Runoff by SCS TR-20 method, UH=Delmarva, Split Pervious/Imperv., Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
NOAA 24-hr D 10-Year (Current) Rainfall=5.28"

	Area (ac)	CN	Description
*	0.030	58	Meadow, HSG B
*	0.690	78	Meadow, HSG D
*	0.020	77	Woods (Good), HSG D
*	0.040	91	Gravel, HSG D
*	0.060	98	Pavement, HSG B/D
*	0.080	61	Grass (Good), HSG B
*	0.050	80	Grass (Good), HSG D
	0.970	78	Weighted Average
	0.910	77	93.81% Pervious Area
	0.060	98	6.19% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.2					**Direct Entry, See Tc Calcs**

Subcatchment 5S: DA2 Prop Bypass (current)



Summary for Pond 4P: Proposed Infiltration Basin (current)

Inflow Area = 1.160 ac, 6.90% Impervious, Inflow Depth = 3.18" for 10-Year (Current) event
Inflow = 2.86 cfs @ 12.18 hrs, Volume= 0.308 af
Outflow = 1.04 cfs @ 12.63 hrs, Volume= 0.278 af, Atten= 64%, Lag= 27.3 min
Primary = 1.04 cfs @ 12.63 hrs, Volume= 0.278 af

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 14.76' @ 12.63 hrs Surf.Area= 5,318 sf Storage= 5,657 cf

Plug-Flow detention time= 274.8 min calculated for 0.278 af (91% of inflow)
Center-of-Mass det. time= 226.0 min (1,055.9 - 829.9)

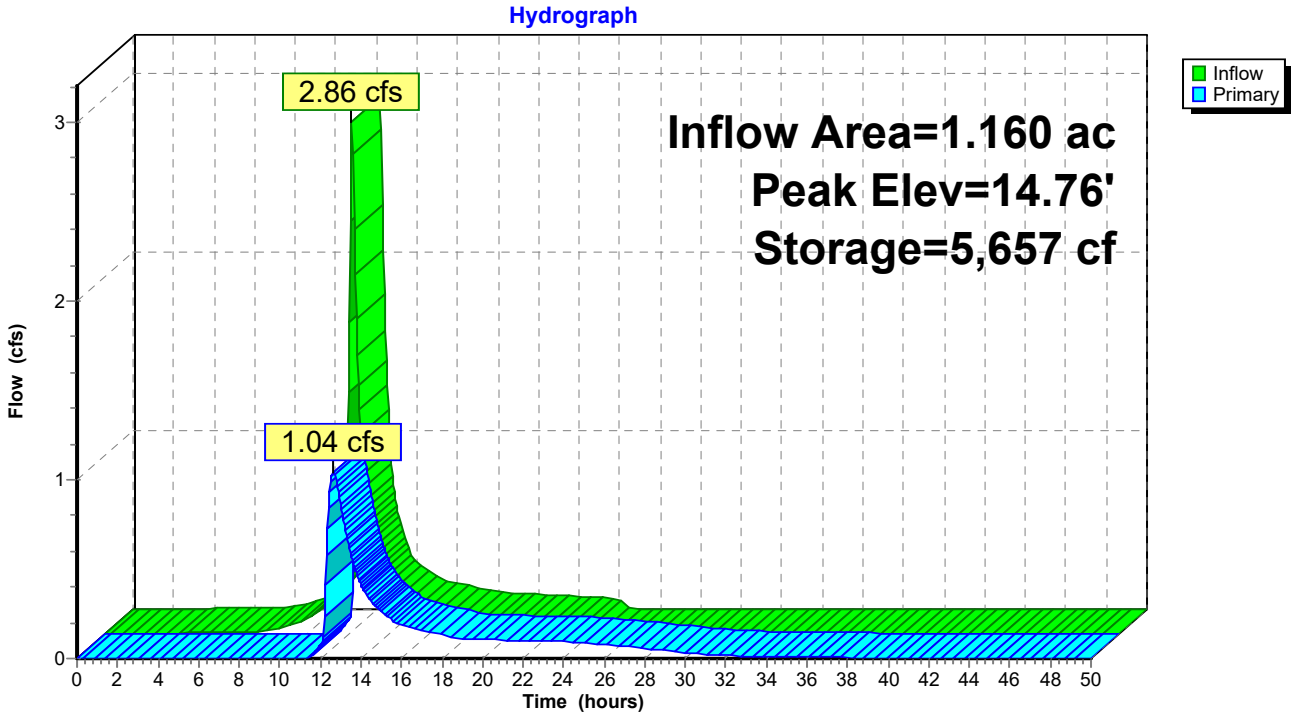
Volume	Invert	Avail.Storage	Storage Description
#1	13.50'	21,315 cf	**Custom Stage Data (Prismatic)**Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
13.50	3,483	0	0
14.00	4,201	1,921	1,921
15.00	5,678	4,940	6,861
16.00	7,213	6,446	13,306
17.00	8,804	8,009	21,315

Device	Routing	Invert	Outlet Devices
#1	Primary	13.50'	**12.0" Round Culvert** L= 165.0' Ke= 0.500 Inlet / Outlet Invert= 13.50' / 10.91' S= 0.0157 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	13.81'	**2.5" Vert. Orifice/Grate** C= 0.600
#3	Device 1	14.33'	**12.0" W x 5.0" H Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=1.04 cfs @ 12.63 hrs HW=14.76' (Free Discharge)
└**1=Culvert** (Passes 1.04 cfs of 3.29 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.15 cfs @ 4.42 fps)
  └**3=Orifice/Grate** (Orifice Controls 0.89 cfs @ 2.13 fps)

Pond 4P: Proposed Infiltration Basin (current)

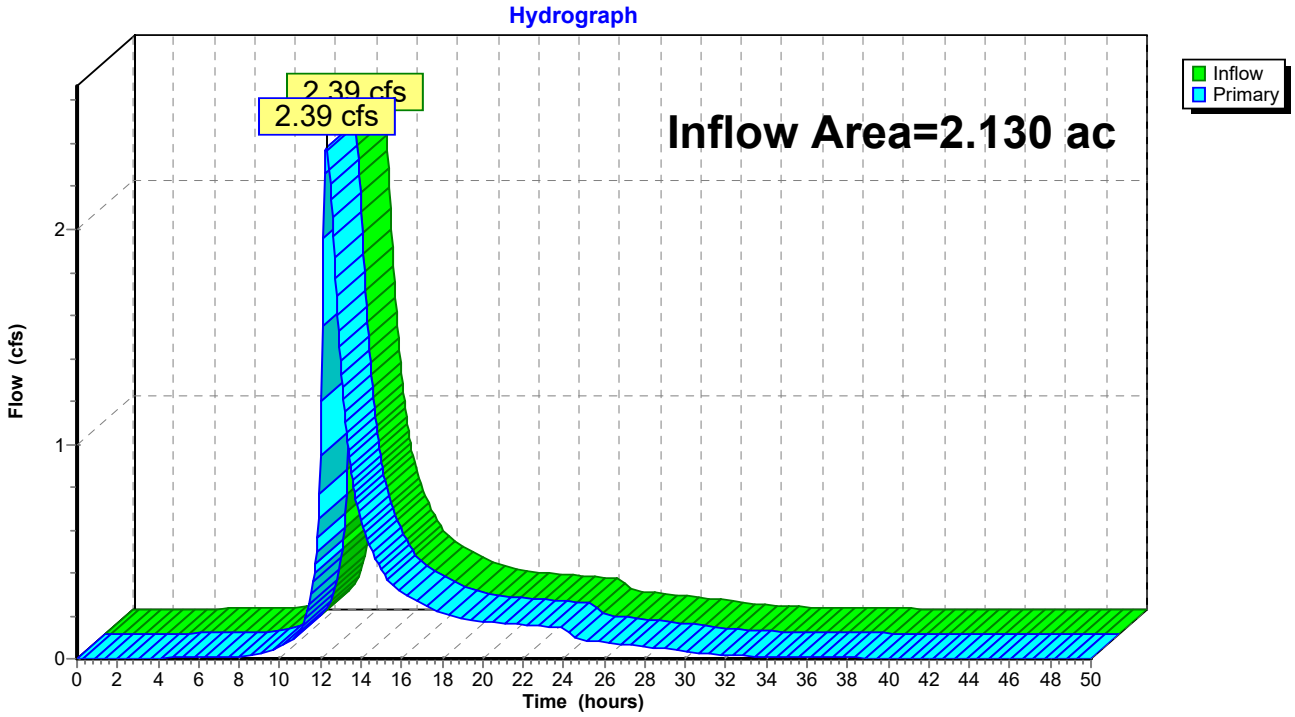


Summary for Link 6L: Analysis Pt 1 (current)

Inflow Area = 2.130 ac, 6.57% Impervious, Inflow Depth > 2.93" for 10-Year (Current) event
Inflow = 2.39 cfs @ 12.31 hrs, Volume= 0.520 af
Primary = 2.39 cfs @ 12.31 hrs, Volume= 0.520 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs

Link 6L: Analysis Pt 1 (current)



Summary for Subcatchment 3S: DA1 Prop Basin (current)

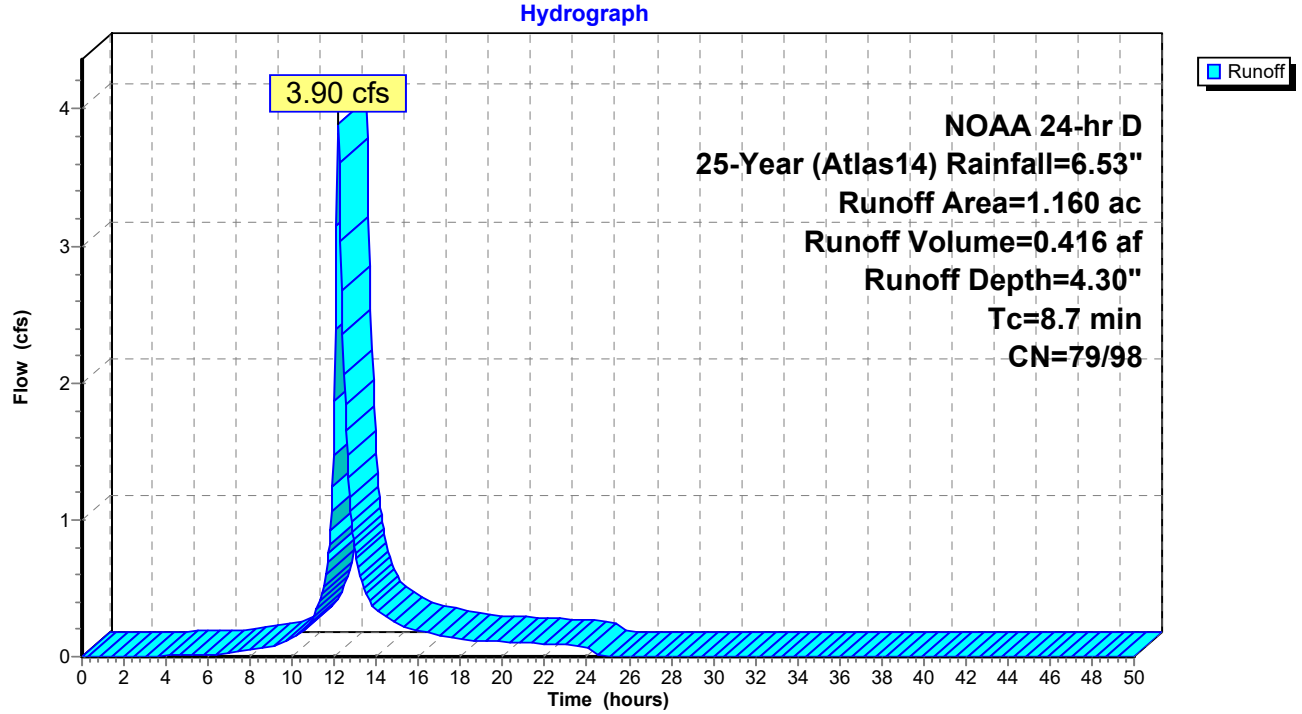
Runoff = 3.90 cfs @ 12.17 hrs, Volume= 0.416 af, Depth= 4.30"

Runoff by SCS TR-20 method, UH=Delmarva, Split Pervious/Imperv., Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
NOAA 24-hr D 25-Year (Atlas14) Rainfall=6.53"

	Area (ac)	CN	Description
*	0.080	98	Concrete Pads, HSG B/D
*	0.300	85	Gravel, HSG B
*	0.200	91	Gravel, HSG D
*	0.050	55	Woods (Good), HSG B
*	0.160	78	Meadow, HSG D
*	0.060	61	Grass (Good), HSG B
*	0.220	80	Grass (Good), HSG D
*	0.090	58	Meadow, HSG B
	1.160	80	Weighted Average
	1.080	79	93.10% Pervious Area
	0.080	98	6.90% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.7					**Direct Entry, See Tc Calcs**

Subcatchment 3S: DA1 Prop Basin (current)



Summary for Subcatchment 5S: DA2 Prop Bypass (current)

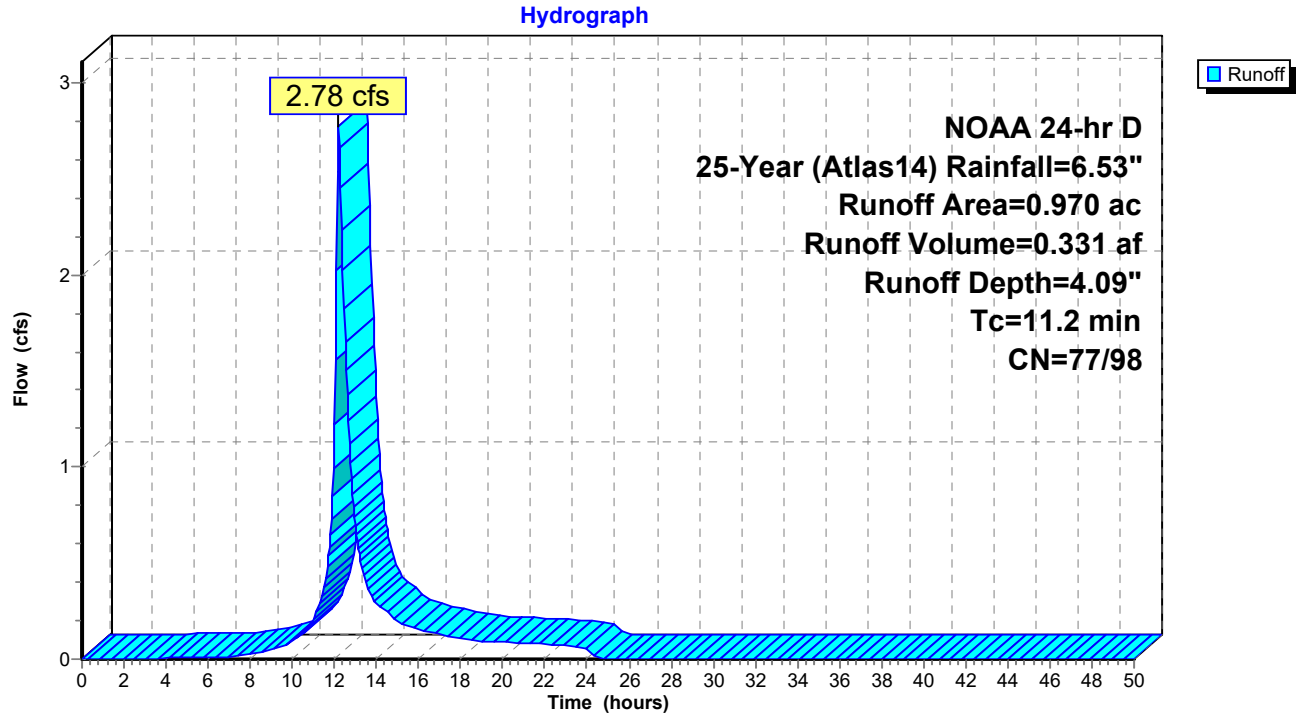
Runoff = 2.78 cfs @ 12.21 hrs, Volume= 0.331 af, Depth= 4.09"

Runoff by SCS TR-20 method, UH=Delmarva, Split Pervious/Imperv., Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
NOAA 24-hr D 25-Year (Atlas14) Rainfall=6.53"

	Area (ac)	CN	Description
*	0.030	58	Meadow, HSG B
*	0.690	78	Meadow, HSG D
*	0.020	77	Woods (Good), HSG D
*	0.040	91	Gravel, HSG D
*	0.060	98	Pavement, HSG B/D
*	0.080	61	Grass (Good), HSG B
*	0.050	80	Grass (Good), HSG D
	0.970	78	Weighted Average
	0.910	77	93.81% Pervious Area
	0.060	98	6.19% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.2					**Direct Entry, See Tc Calcs**

Subcatchment 5S: DA2 Prop Bypass (current)



Summary for Pond 4P: Proposed Infiltration Basin (current)

Inflow Area = 1.160 ac, 6.90% Impervious, Inflow Depth = 4.30" for 25-Year (Atlas14) event
Inflow = 3.90 cfs @ 12.17 hrs, Volume= 0.416 af
Outflow = 1.57 cfs @ 12.57 hrs, Volume= 0.387 af, Atten= 60%, Lag= 23.9 min
Primary = 1.57 cfs @ 12.57 hrs, Volume= 0.387 af

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 15.03' @ 12.57 hrs Surf.Area= 5,727 sf Storage= 7,068 cf

Plug-Flow detention time= 226.2 min calculated for 0.387 af (93% of inflow)
Center-of-Mass det. time= 188.0 min (1,009.4 - 821.4)

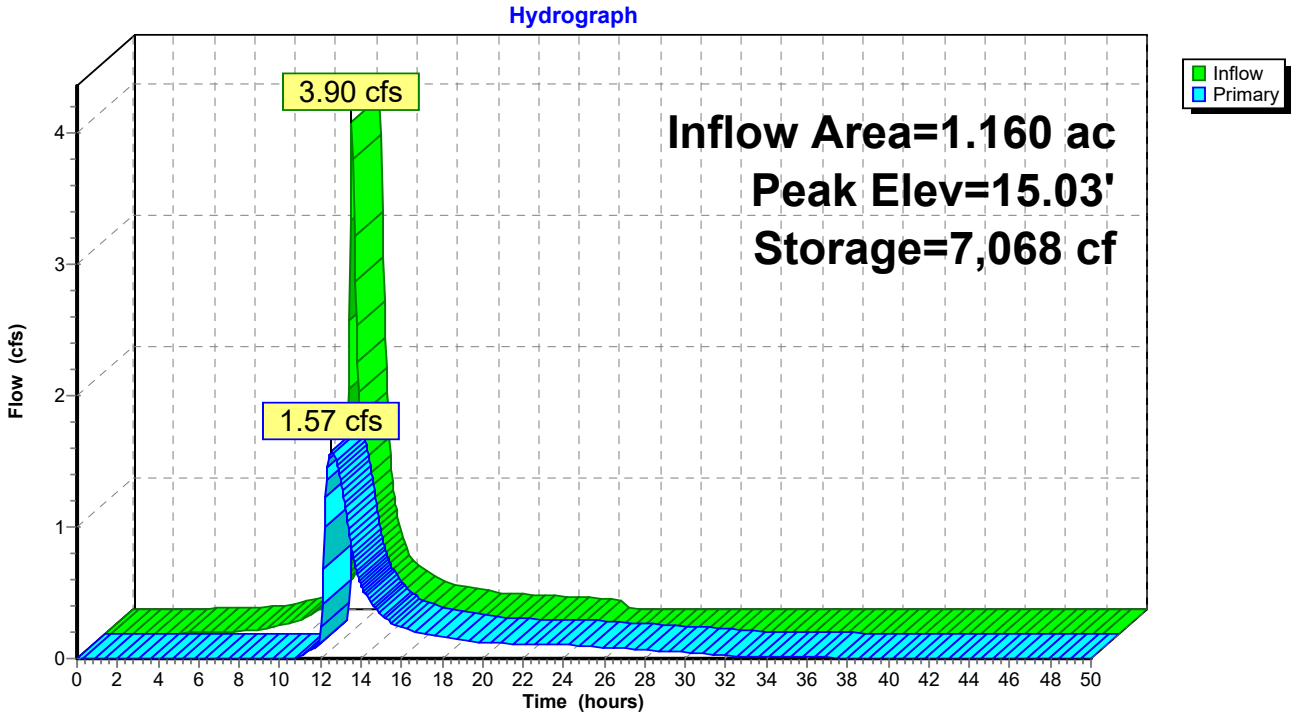
Volume	Invert	Avail.Storage	Storage Description
#1	13.50'	21,315 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
13.50	3,483	0	0
14.00	4,201	1,921	1,921
15.00	5,678	4,940	6,861
16.00	7,213	6,446	13,306
17.00	8,804	8,009	21,315

Device	Routing	Invert	Outlet Devices
#1	Primary	13.50'	**12.0" Round Culvert** L= 165.0' Ke= 0.500 Inlet / Outlet Invert= 13.50' / 10.91' S= 0.0157 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	13.81'	**2.5" Vert. Orifice/Grate** C= 0.600
#3	Device 1	14.33'	**12.0" W x 5.0" H Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=1.57 cfs @ 12.57 hrs HW=15.03' (Free Discharge)
└**1=Culvert** (Passes 1.57 cfs of 3.84 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.17 cfs @ 5.09 fps)
  └**3=Orifice/Grate** (Orifice Controls 1.40 cfs @ 3.36 fps)

Pond 4P: Proposed Infiltration Basin (current)

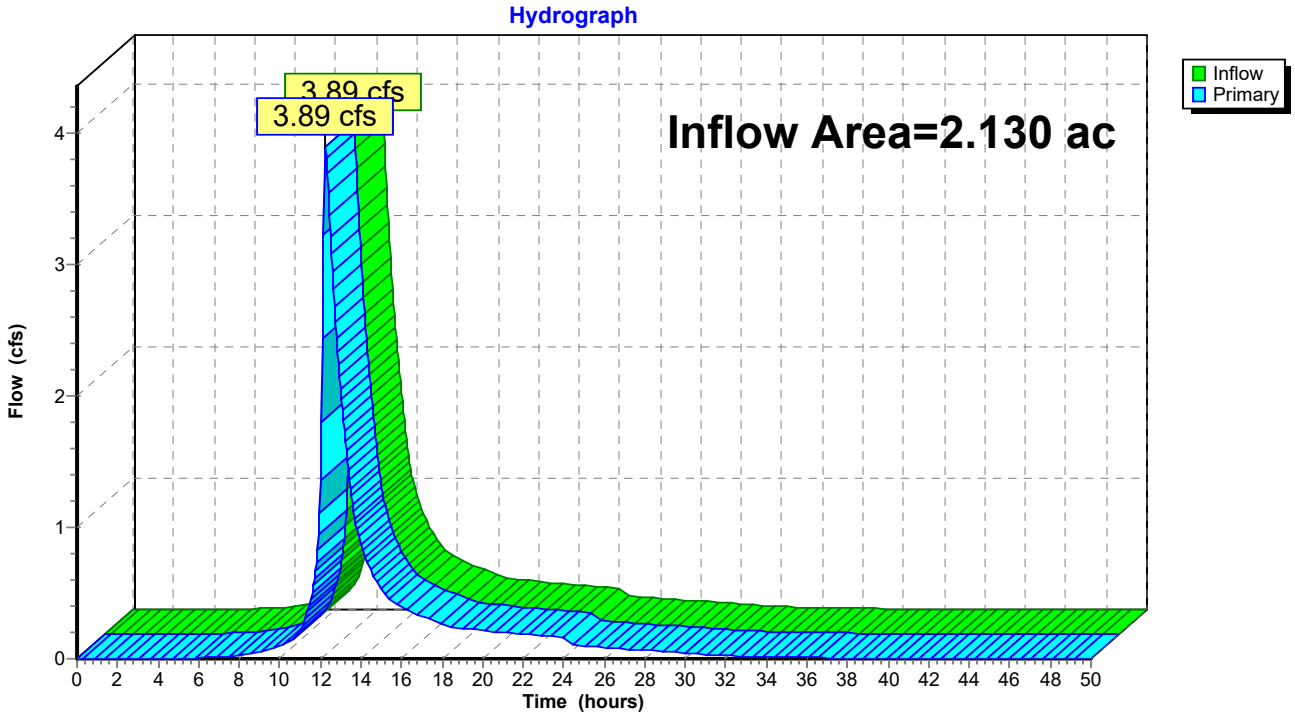


Summary for Link 6L: Analysis Pt 1 (current)

Inflow Area = 2.130 ac, 6.57% Impervious, Inflow Depth > 4.04" for 25-Year (Atlas14) event
Inflow = 3.89 cfs @ 12.26 hrs, Volume= 0.717 af
Primary = 3.89 cfs @ 12.26 hrs, Volume= 0.717 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs

Link 6L: Analysis Pt 1 (current)



Summary for Subcatchment 3S: DA1 Prop Basin (current)

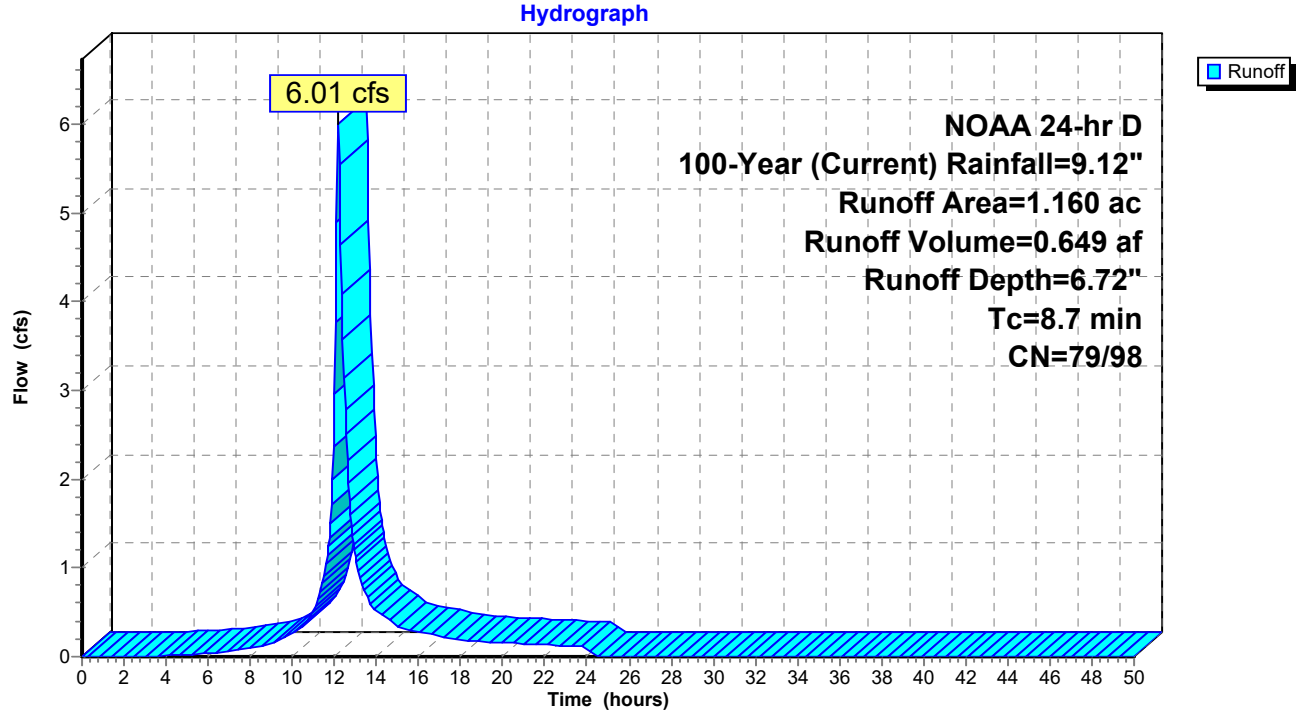
Runoff = 6.01 cfs @ 12.17 hrs, Volume= 0.649 af, Depth= 6.72"

Runoff by SCS TR-20 method, UH=Delmarva, Split Pervious/Imperv., Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
NOAA 24-hr D 100-Year (Current) Rainfall=9.12"

	Area (ac)	CN	Description
*	0.080	98	Concrete Pads, HSG B/D
*	0.300	85	Gravel, HSG B
*	0.200	91	Gravel, HSG D
*	0.050	55	Woods (Good), HSG B
*	0.160	78	Meadow, HSG D
*	0.060	61	Grass (Good), HSG B
*	0.220	80	Grass (Good), HSG D
*	0.090	58	Meadow, HSG B
	1.160	80	Weighted Average
	1.080	79	93.10% Pervious Area
	0.080	98	6.90% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.7					**Direct Entry, See Tc Calcs**

Subcatchment 3S: DA1 Prop Basin (current)



Summary for Subcatchment 5S: DA2 Prop Bypass (current)

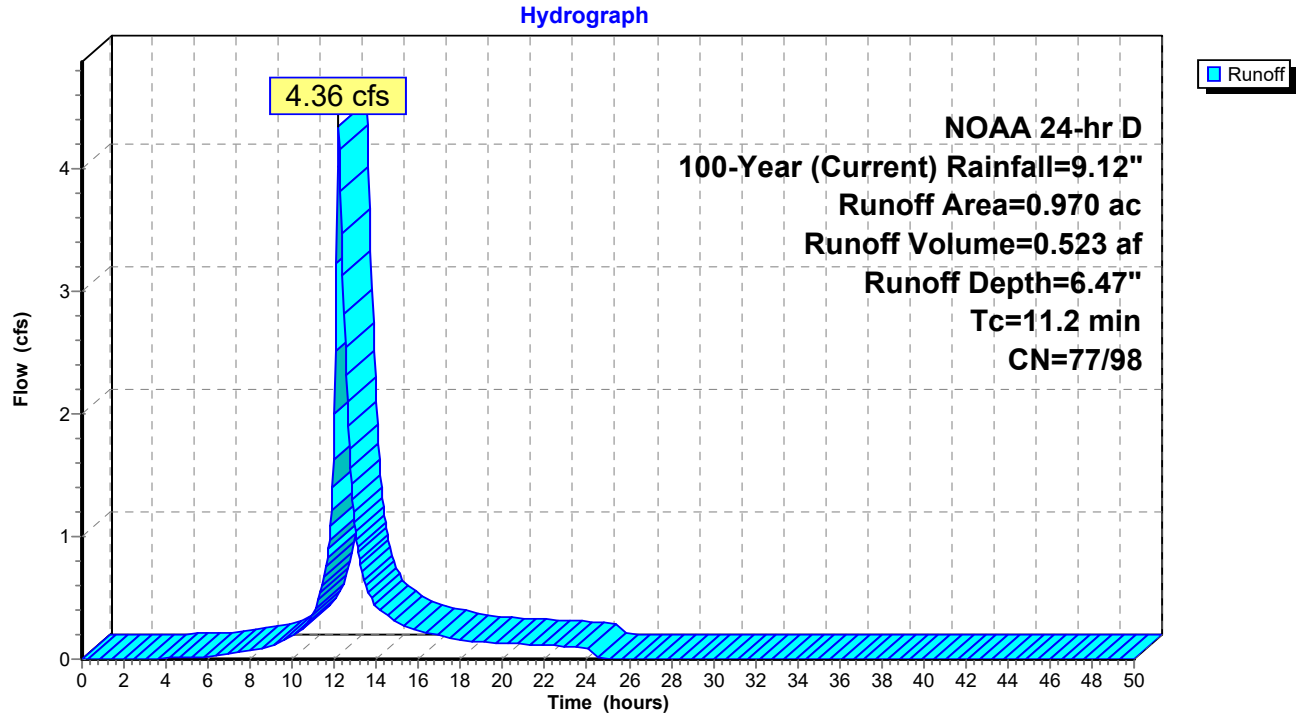
Runoff = 4.36 cfs @ 12.21 hrs, Volume= 0.523 af, Depth= 6.47"

Runoff by SCS TR-20 method, UH=Delmarva, Split Pervious/Imperv., Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
NOAA 24-hr D 100-Year (Current) Rainfall=9.12"

	Area (ac)	CN	Description
*	0.030	58	Meadow, HSG B
*	0.690	78	Meadow, HSG D
*	0.020	77	Woods (Good), HSG D
*	0.040	91	Gravel, HSG D
*	0.060	98	Pavement, HSG B/D
*	0.080	61	Grass (Good), HSG B
*	0.050	80	Grass (Good), HSG D
	0.970	78	Weighted Average
	0.910	77	93.81% Pervious Area
	0.060	98	6.19% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.2					**Direct Entry, See Tc Calcs**

Subcatchment 5S: DA2 Prop Bypass (current)



Summary for Pond 4P: Proposed Infiltration Basin (current)

Inflow Area = 1.160 ac, 6.90% Impervious, Inflow Depth = 6.72" for 100-Year (Current) event
Inflow = 6.01 cfs @ 12.17 hrs, Volume= 0.649 af
Outflow = 2.23 cfs @ 12.60 hrs, Volume= 0.620 af, Atten= 63%, Lag= 25.5 min
Primary = 2.23 cfs @ 12.60 hrs, Volume= 0.620 af

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 15.56' @ 12.60 hrs Surf.Area= 6,535 sf Storage= 10,457 cf

Plug-Flow detention time= 173.2 min calculated for 0.620 af (95% of inflow)
Center-of-Mass det. time= 148.5 min (957.1 - 808.7)

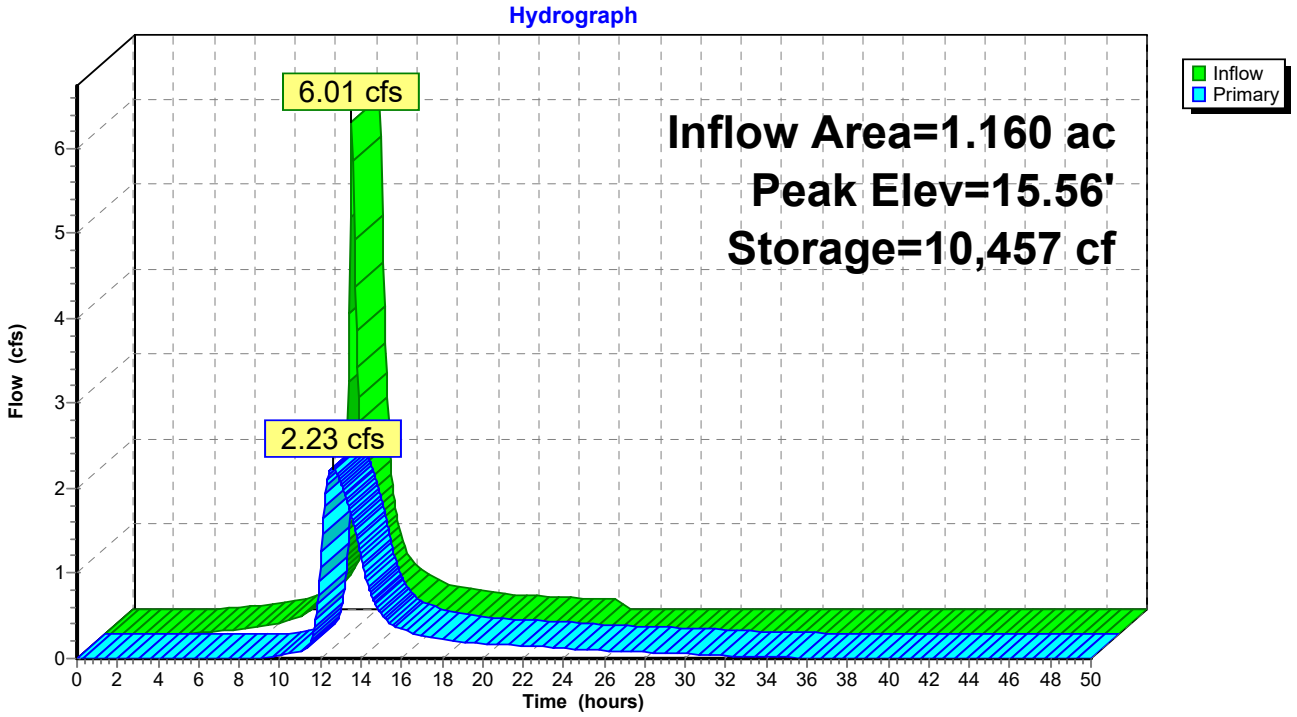
Volume	Invert	Avail.Storage	Storage Description
#1	13.50'	21,315 cf	**Custom Stage Data (Prismatic)**Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
13.50	3,483	0	0
14.00	4,201	1,921	1,921
15.00	5,678	4,940	6,861
16.00	7,213	6,446	13,306
17.00	8,804	8,009	21,315

Device	Routing	Invert	Outlet Devices
#1	Primary	13.50'	**12.0" Round Culvert** L= 165.0' Ke= 0.500 Inlet / Outlet Invert= 13.50' / 10.91' S= 0.0157 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	13.81'	**2.5" Vert. Orifice/Grate** C= 0.600
#3	Device 1	14.33'	**12.0" W x 5.0" H Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=2.23 cfs @ 12.60 hrs HW=15.56' (Free Discharge)
└**1=Culvert** (Passes 2.23 cfs of 4.66 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.21 cfs @ 6.17 fps)
  └**3=Orifice/Grate** (Orifice Controls 2.02 cfs @ 4.85 fps)

Pond 4P: Proposed Infiltration Basin (current)

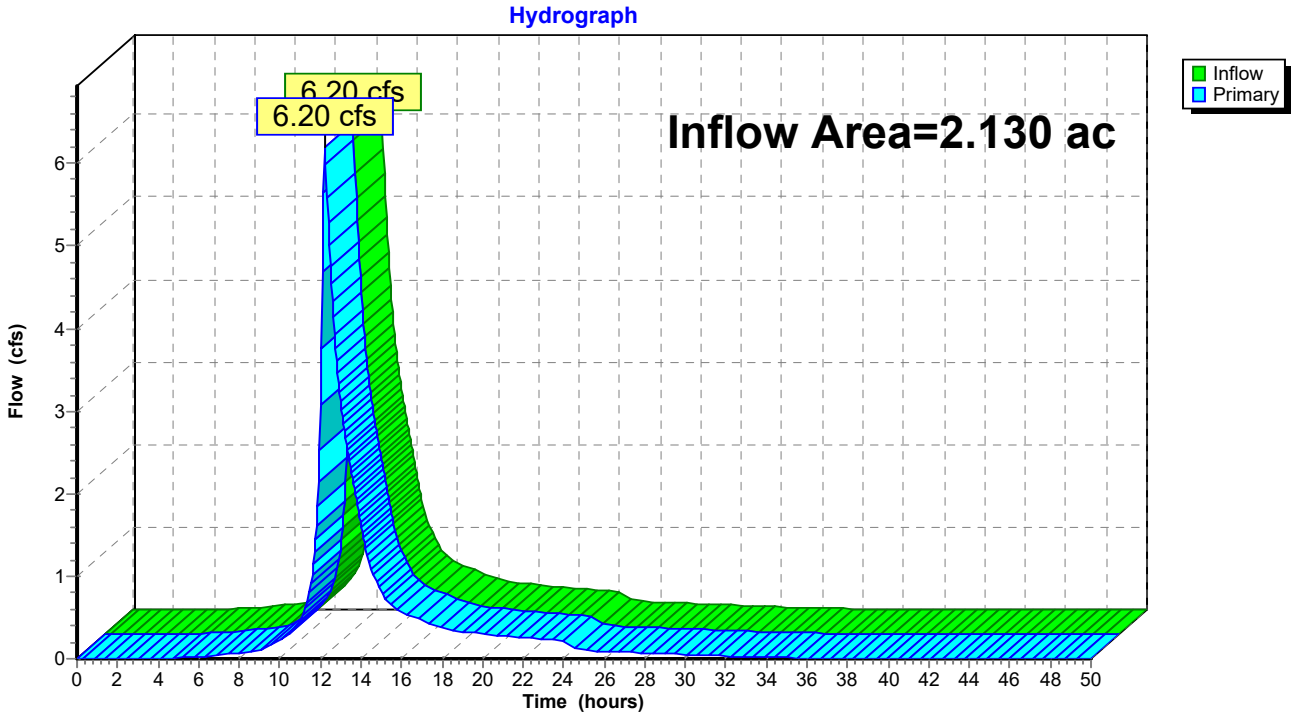


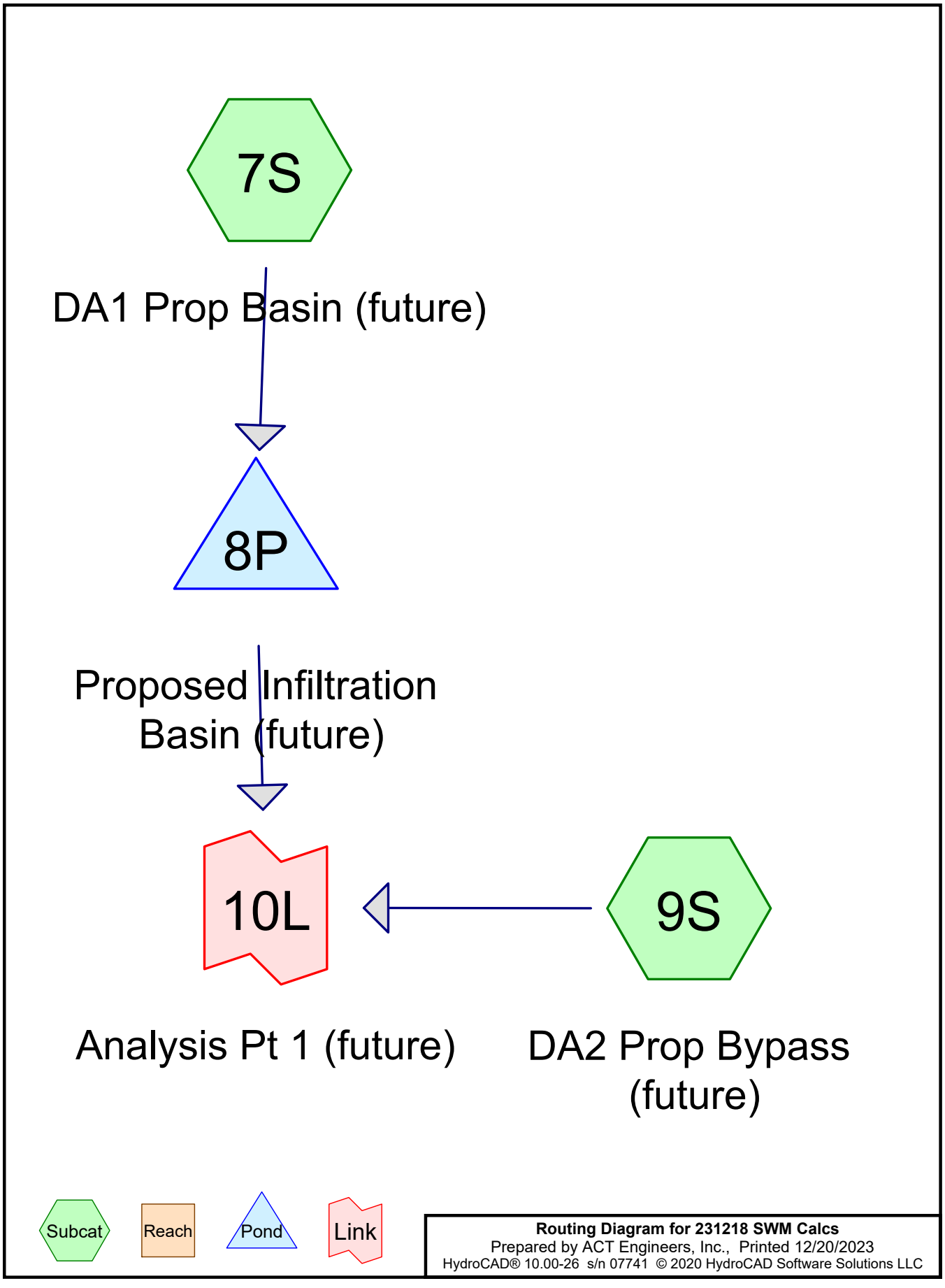
Summary for Link 6L: Analysis Pt 1 (current)

Inflow Area = 2.130 ac, 6.57% Impervious, Inflow Depth > 6.44" for 100-Year (Current) event
Inflow = 6.20 cfs @ 12.22 hrs, Volume= 1.143 af
Primary = 6.20 cfs @ 12.22 hrs, Volume= 1.143 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs

Link 6L: Analysis Pt 1 (current)





Routing Diagram for 231218 SWM Calcs
Prepared by ACT Engineers, Inc., Printed 12/20/2023

Summary for Subcatchment 7S: DA1 Prop Basin (future)

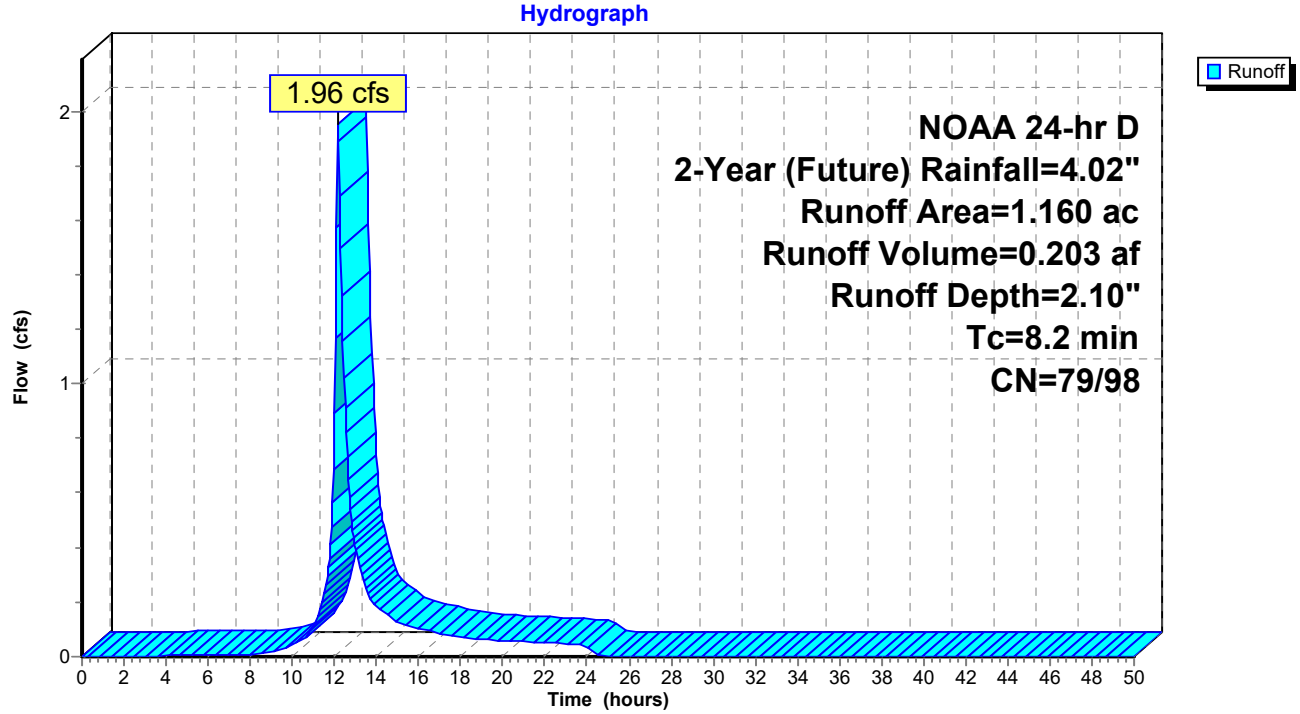
Runoff = 1.96 cfs @ 12.17 hrs, Volume= 0.203 af, Depth= 2.10"

Runoff by SCS TR-20 method, UH=Delmarva, Split Pervious/Imperv., Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
NOAA 24-hr D 2-Year (Future) Rainfall=4.02"

	Area (ac)	CN	Description
*	0.080	98	Concrete Pads, HSG B/D
*	0.300	85	Gravel, HSG B
*	0.200	91	Gravel, HSG D
*	0.050	55	Woods (Good), HSG B
*	0.160	78	Meadow, HSG D
*	0.060	61	Grass (Good), HSG B
*	0.220	80	Grass (Good), HSG D
*	0.090	58	Meadow, HSG B
	1.160	80	Weighted Average
	1.080	79	93.10% Pervious Area
	0.080	98	6.90% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2					**Direct Entry, See Tc Calcs**

Subcatchment 7S: DA1 Prop Basin (future)



Summary for Subcatchment 9S: DA2 Prop Bypass (future)

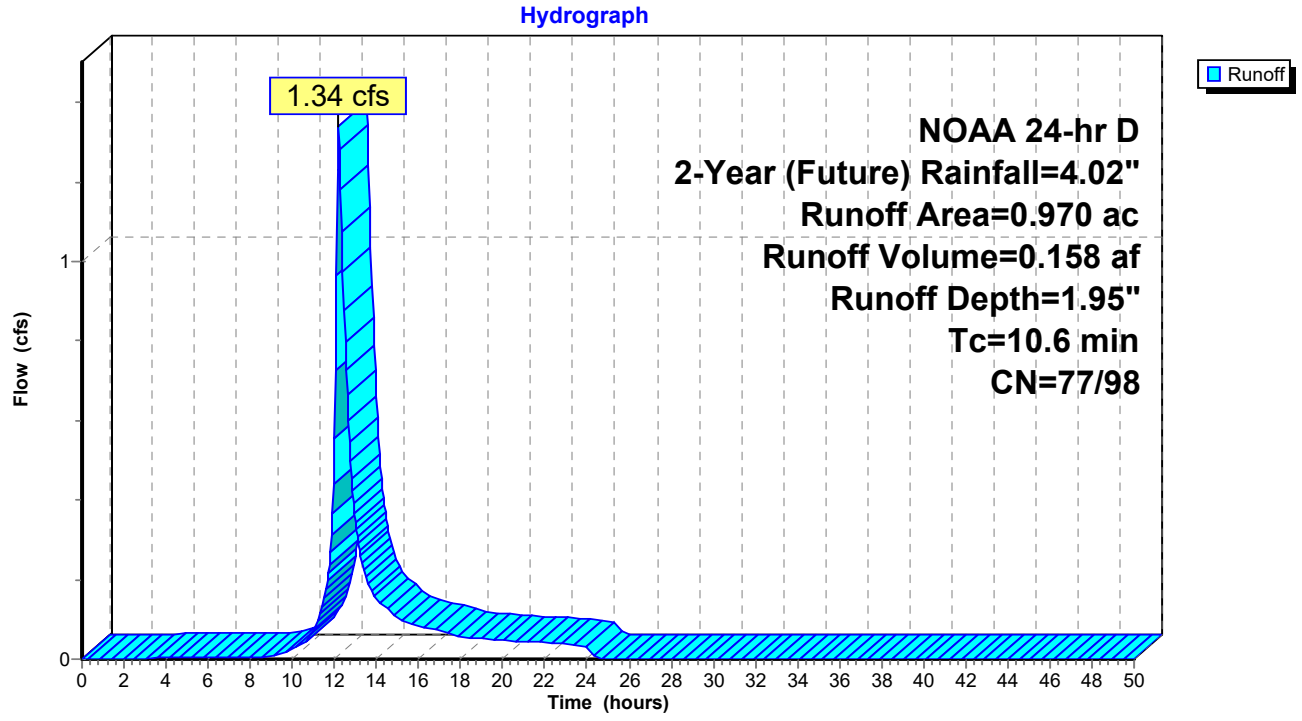
Runoff = 1.34 cfs @ 12.21 hrs, Volume= 0.158 af, Depth= 1.95"

Runoff by SCS TR-20 method, UH=Delmarva, Split Pervious/Imperv., Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
NOAA 24-hr D 2-Year (Future) Rainfall=4.02"

	Area (ac)	CN	Description
*	0.030	58	Meadow, HSG B
*	0.690	78	Meadow, HSG D
*	0.020	77	Woods (Good), HSG D
*	0.040	91	Gravel, HSG D
*	0.060	98	Pavement, HSG B/D
*	0.080	61	Grass (Good), HSG B
*	0.050	80	Grass (Good), HSG D
	0.970	78	Weighted Average
	0.910	77	93.81% Pervious Area
	0.060	98	6.19% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.6					**Direct Entry, See Tc Calcs**

Subcatchment 9S: DA2 Prop Bypass (future)



Summary for Pond 8P: Proposed Infiltration Basin (future)

Inflow Area = 1.160 ac, 6.90% Impervious, Inflow Depth = 2.10" for 2-Year (Future) event
Inflow = 1.96 cfs @ 12.17 hrs, Volume= 0.203 af
Outflow = 0.36 cfs @ 13.07 hrs, Volume= 0.174 af, Atten= 82%, Lag= 54.2 min
Primary = 0.36 cfs @ 13.07 hrs, Volume= 0.174 af

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 14.50' @ 13.07 hrs Surf.Area= 4,946 sf Storage= 4,414 cf

Plug-Flow detention time= 362.5 min calculated for 0.174 af (86% of inflow)
Center-of-Mass det. time= 296.7 min (1,137.2 - 840.5)

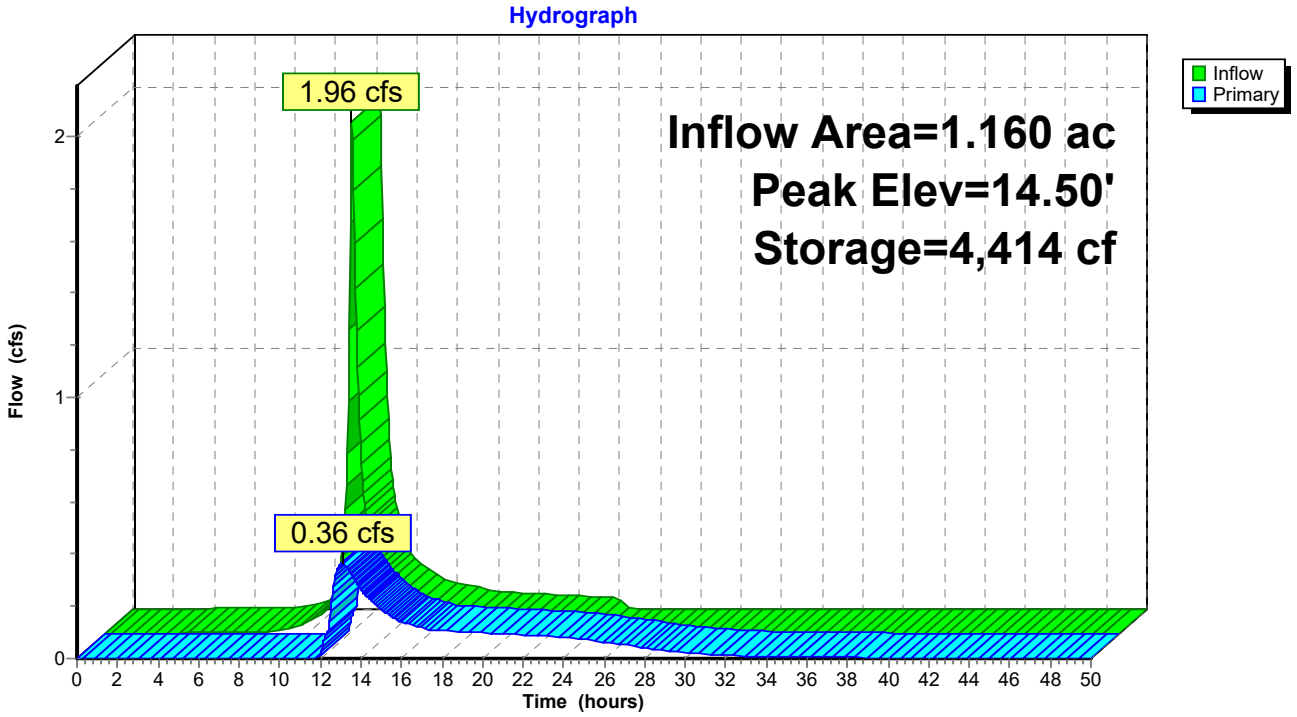
Volume	Invert	Avail.Storage	Storage Description
#1	13.50'	21,315 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
13.50	3,483	0	0
14.00	4,201	1,921	1,921
15.00	5,678	4,940	6,861
16.00	7,213	6,446	13,306
17.00	8,804	8,009	21,315

Device	Routing	Invert	Outlet Devices
#1	Primary	13.50'	**12.0" Round Culvert** L= 165.0' Ke= 0.500 Inlet / Outlet Invert= 13.50' / 10.91' S= 0.0157 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	13.81'	**2.5" Vert. Orifice/Grate** C= 0.600
#3	Device 1	14.33'	**12.0" W x 5.0" H Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.36 cfs @ 13.07 hrs HW=14.50' (Free Discharge)
└**1=Culvert** (Passes 0.36 cfs of 2.69 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.13 cfs @ 3.70 fps)
  └**3=Orifice/Grate** (Orifice Controls 0.23 cfs @ 1.34 fps)

Pond 8P: Proposed Infiltration Basin (future)

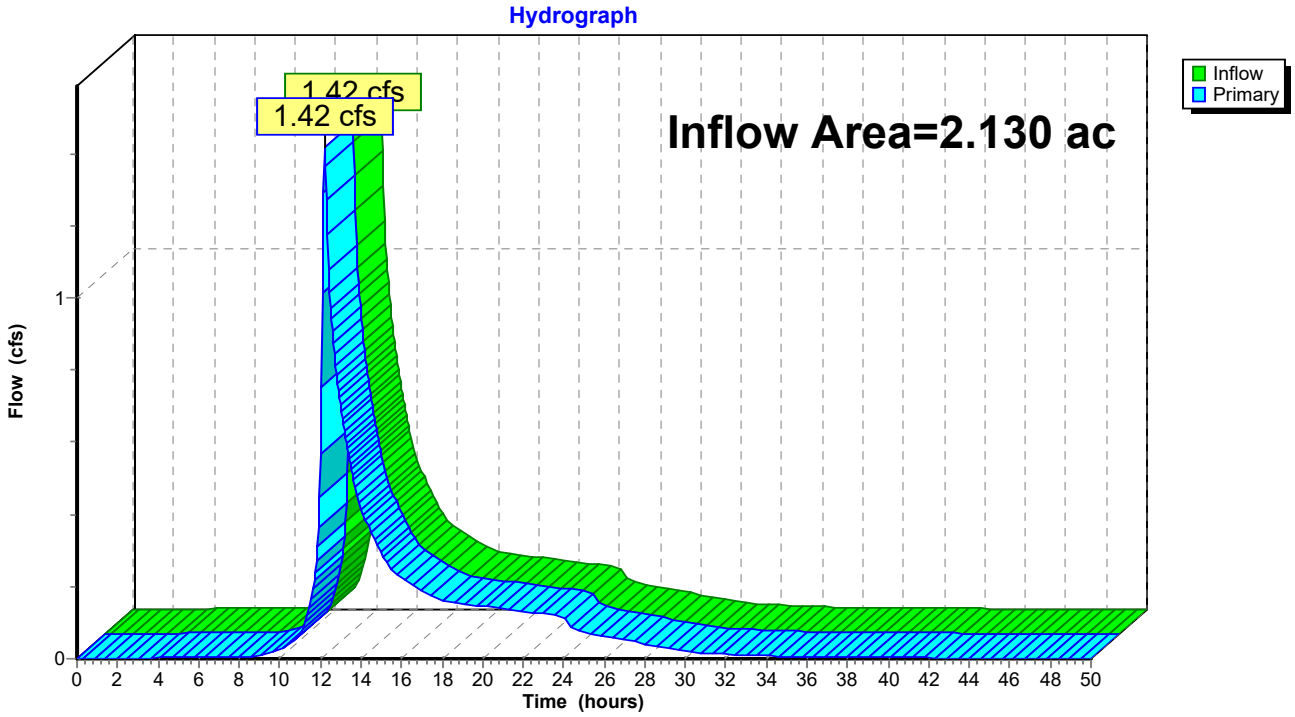


Summary for Link 10L: Analysis Pt 1 (future)

Inflow Area = 2.130 ac, 6.57% Impervious, Inflow Depth > 1.87" for 2-Year (Future) event
Inflow = 1.42 cfs @ 12.21 hrs, Volume= 0.332 af
Primary = 1.42 cfs @ 12.21 hrs, Volume= 0.332 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs

Link 10L: Analysis Pt 1 (future)



Summary for Subcatchment 7S: DA1 Prop Basin (future)

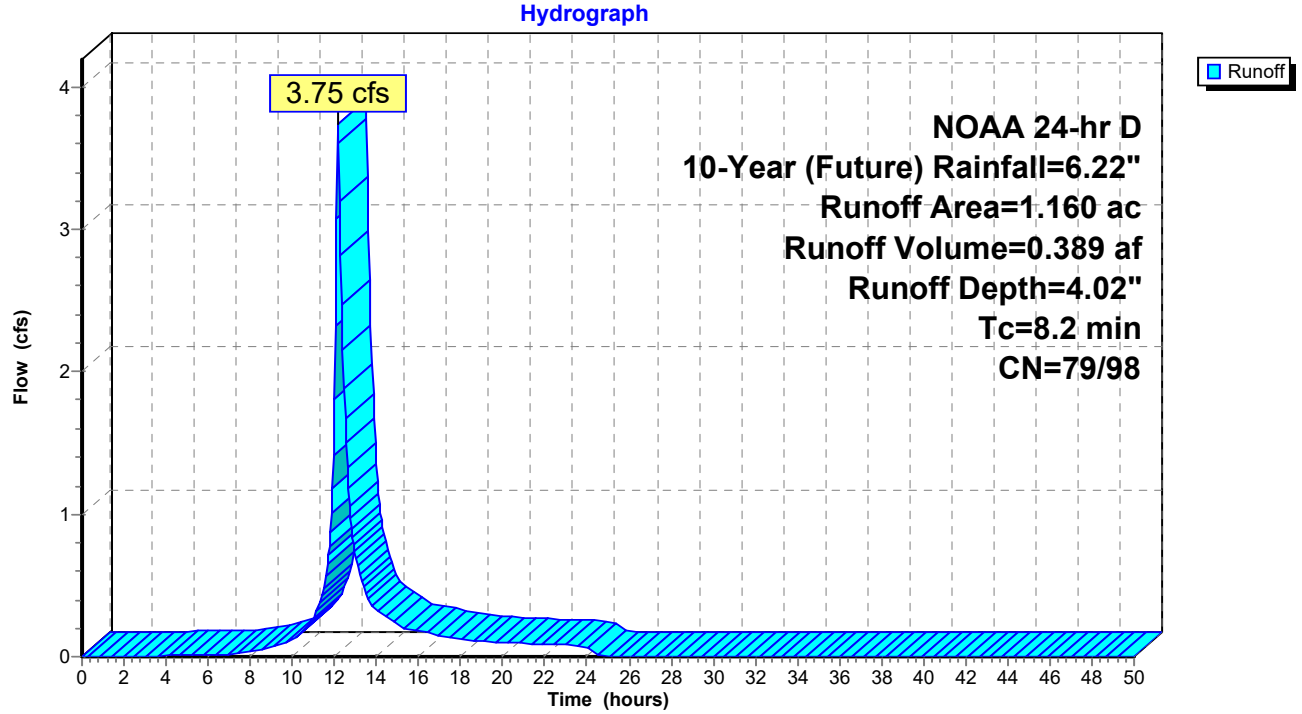
Runoff = 3.75 cfs @ 12.17 hrs, Volume= 0.389 af, Depth= 4.02"

Runoff by SCS TR-20 method, UH=Delmarva, Split Pervious/Imperv., Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
NOAA 24-hr D 10-Year (Future) Rainfall=6.22"

	Area (ac)	CN	Description
*	0.080	98	Concrete Pads, HSG B/D
*	0.300	85	Gravel, HSG B
*	0.200	91	Gravel, HSG D
*	0.050	55	Woods (Good), HSG B
*	0.160	78	Meadow, HSG D
*	0.060	61	Grass (Good), HSG B
*	0.220	80	Grass (Good), HSG D
*	0.090	58	Meadow, HSG B
	1.160	80	Weighted Average
	1.080	79	93.10% Pervious Area
	0.080	98	6.90% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2					**Direct Entry, See Tc Calcs**

Subcatchment 7S: DA1 Prop Basin (future)



Summary for Subcatchment 9S: DA2 Prop Bypass (future)

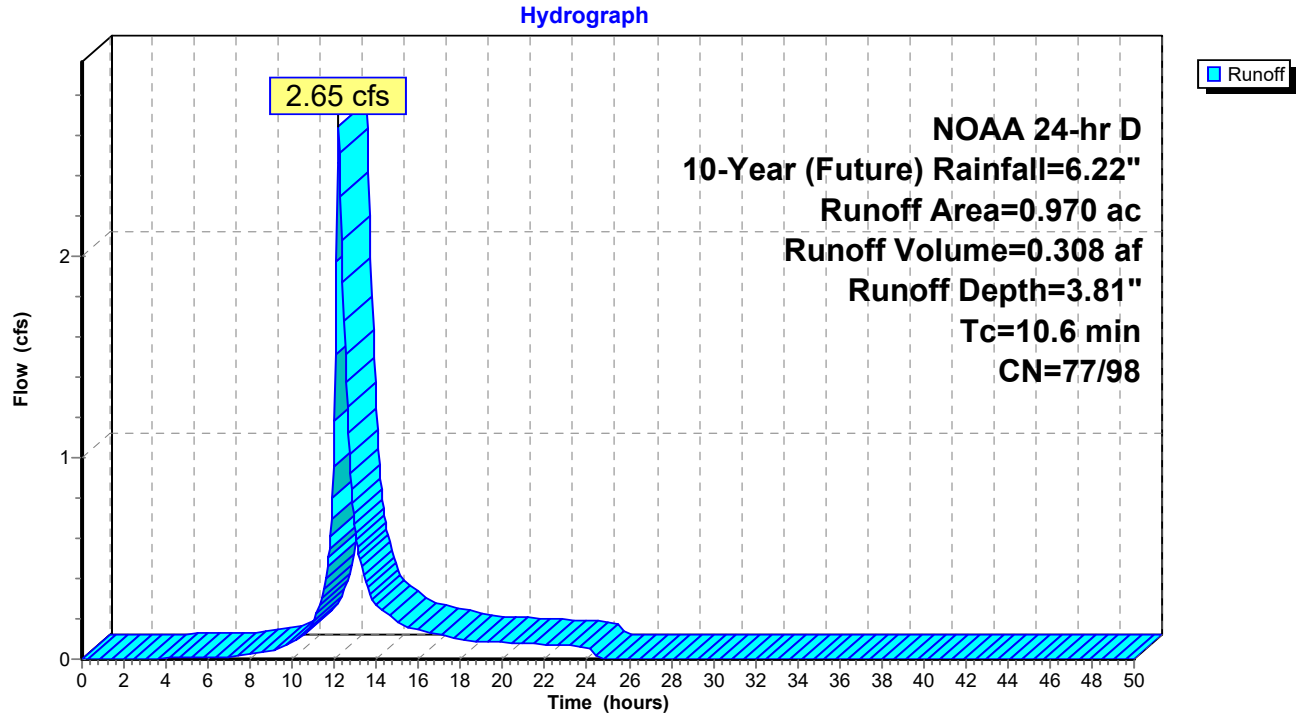
Runoff = 2.65 cfs @ 12.20 hrs, Volume= 0.308 af, Depth= 3.81"

Runoff by SCS TR-20 method, UH=Delmarva, Split Pervious/Imperv., Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
NOAA 24-hr D 10-Year (Future) Rainfall=6.22"

	Area (ac)	CN	Description
*	0.030	58	Meadow, HSG B
*	0.690	78	Meadow, HSG D
*	0.020	77	Woods (Good), HSG D
*	0.040	91	Gravel, HSG D
*	0.060	98	Pavement, HSG B/D
*	0.080	61	Grass (Good), HSG B
*	0.050	80	Grass (Good), HSG D
	0.970	78	Weighted Average
	0.910	77	93.81% Pervious Area
	0.060	98	6.19% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.6					**Direct Entry, See Tc Calcs**

Subcatchment 9S: DA2 Prop Bypass (future)



Summary for Pond 8P: Proposed Infiltration Basin (future)

Inflow Area = 1.160 ac, 6.90% Impervious, Inflow Depth = 4.02" for 10-Year (Future) event
Inflow = 3.75 cfs @ 12.17 hrs, Volume= 0.389 af
Outflow = 1.47 cfs @ 12.56 hrs, Volume= 0.360 af, Atten= 61%, Lag= 23.4 min
Primary = 1.47 cfs @ 12.56 hrs, Volume= 0.360 af

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 14.97' @ 12.56 hrs Surf.Area= 5,634 sf Storage= 6,714 cf

Plug-Flow detention time= 234.5 min calculated for 0.359 af (92% of inflow)
Center-of-Mass det. time= 195.6 min (1,018.2 - 822.5)

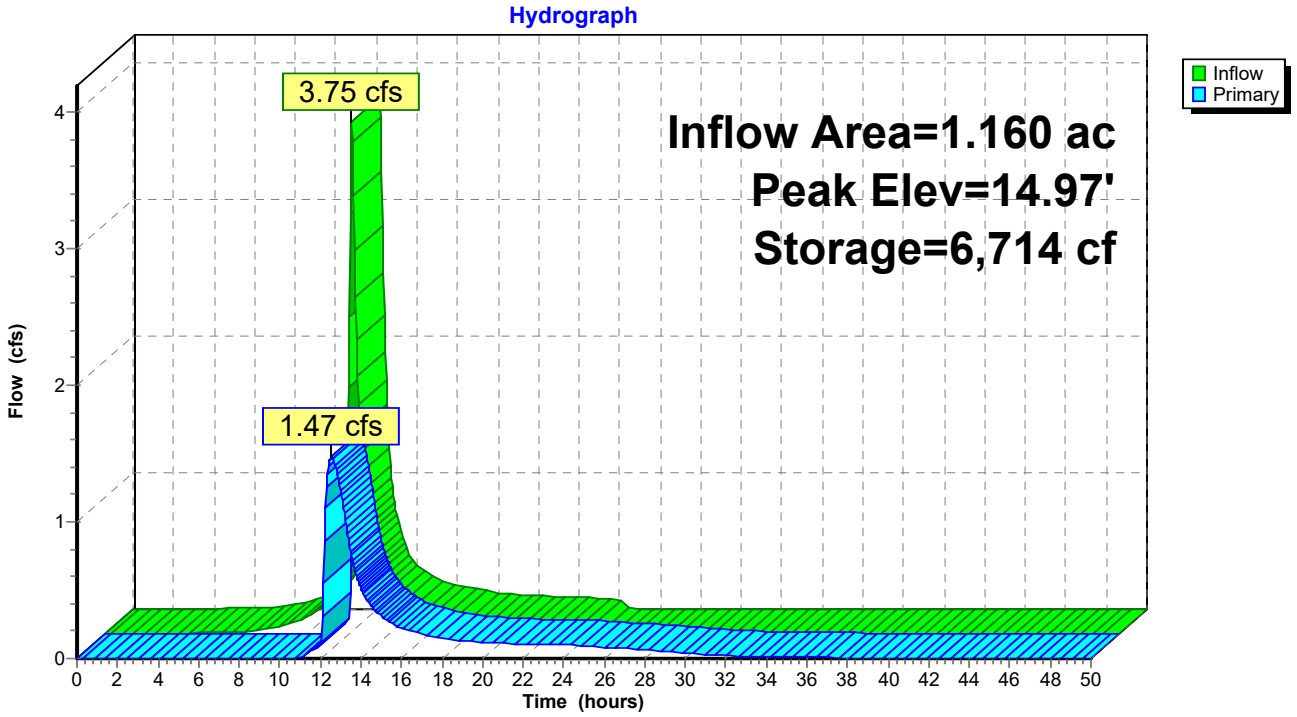
Volume	Invert	Avail.Storage	Storage Description
#1	13.50'	21,315 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
13.50	3,483	0	0
14.00	4,201	1,921	1,921
15.00	5,678	4,940	6,861
16.00	7,213	6,446	13,306
17.00	8,804	8,009	21,315

Device	Routing	Invert	Outlet Devices
#1	Primary	13.50'	**12.0" Round Culvert** L= 165.0' Ke= 0.500 Inlet / Outlet Invert= 13.50' / 10.91' S= 0.0157 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	13.81'	**2.5" Vert. Orifice/Grate** C= 0.600
#3	Device 1	14.33'	**12.0" W x 5.0" H Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=1.47 cfs @ 12.56 hrs HW=14.97' (Free Discharge)
└**1=Culvert** (Passes 1.47 cfs of 3.72 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.17 cfs @ 4.95 fps)
  └**3=Orifice/Grate** (Orifice Controls 1.30 cfs @ 3.13 fps)

Pond 8P: Proposed Infiltration Basin (future)

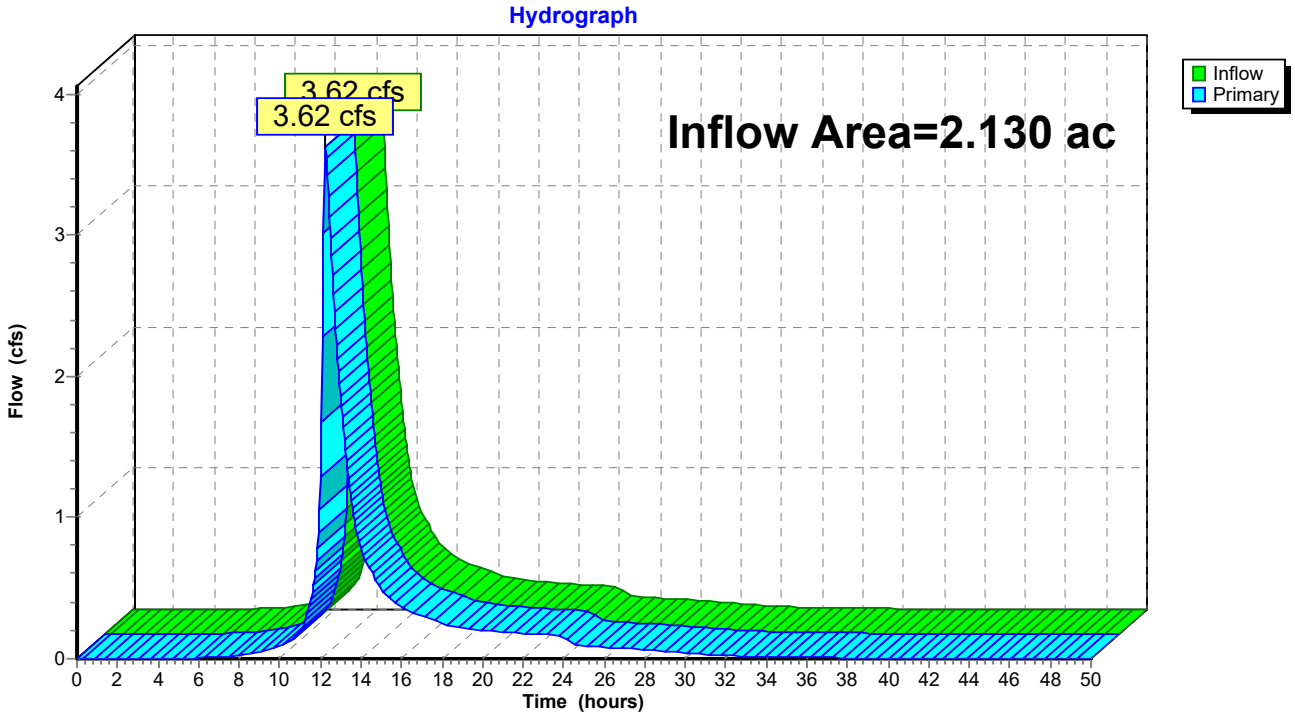


Summary for Link 10L: Analysis Pt 1 (future)

Inflow Area = 2.130 ac, 6.57% Impervious, Inflow Depth > 3.76" for 10-Year (Future) event
Inflow = 3.62 cfs @ 12.26 hrs, Volume= 0.668 af
Primary = 3.62 cfs @ 12.26 hrs, Volume= 0.668 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs

Link 10L: Analysis Pt 1 (future)



Summary for Subcatchment 7S: DA1 Prop Basin (future)

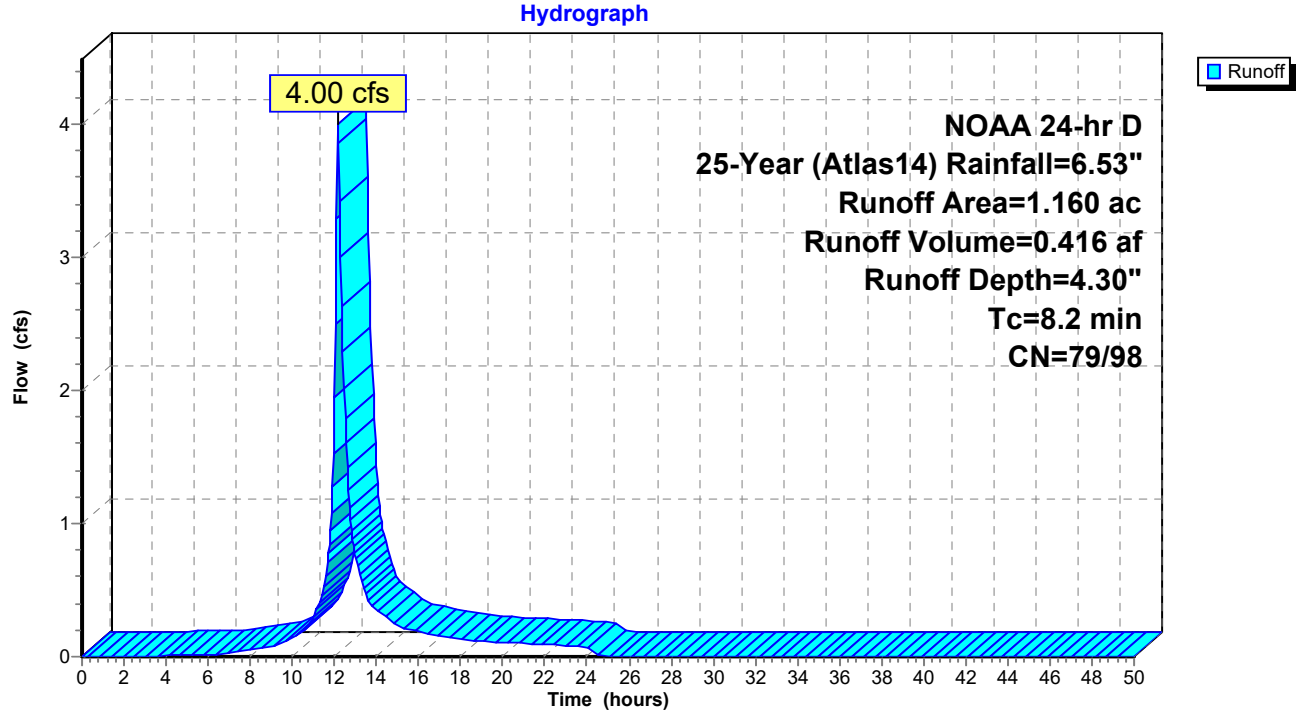
Runoff = 4.00 cfs @ 12.17 hrs, Volume= 0.416 af, Depth= 4.30"

Runoff by SCS TR-20 method, UH=Delmarva, Split Pervious/Imperv., Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
NOAA 24-hr D 25-Year (Atlas14) Rainfall=6.53"

	Area (ac)	CN	Description
*	0.080	98	Concrete Pads, HSG B/D
*	0.300	85	Gravel, HSG B
*	0.200	91	Gravel, HSG D
*	0.050	55	Woods (Good), HSG B
*	0.160	78	Meadow, HSG D
*	0.060	61	Grass (Good), HSG B
*	0.220	80	Grass (Good), HSG D
*	0.090	58	Meadow, HSG B
	1.160	80	Weighted Average
	1.080	79	93.10% Pervious Area
	0.080	98	6.90% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2					**Direct Entry, See Tc Calcs**

Subcatchment 7S: DA1 Prop Basin (future)



Summary for Subcatchment 9S: DA2 Prop Bypass (future)

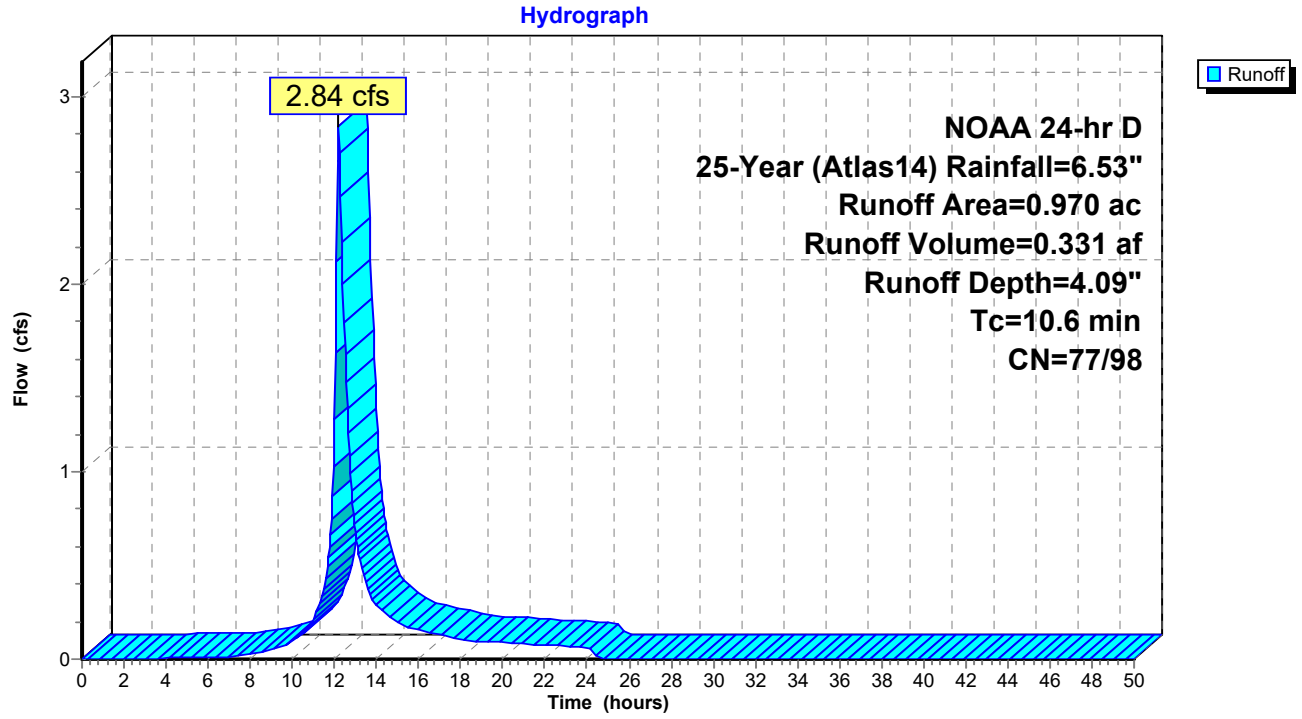
Runoff = 2.84 cfs @ 12.20 hrs, Volume= 0.331 af, Depth= 4.09"

Runoff by SCS TR-20 method, UH=Delmarva, Split Pervious/Imperv., Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
NOAA 24-hr D 25-Year (Atlas14) Rainfall=6.53"

	Area (ac)	CN	Description
*	0.030	58	Meadow, HSG B
*	0.690	78	Meadow, HSG D
*	0.020	77	Woods (Good), HSG D
*	0.040	91	Gravel, HSG D
*	0.060	98	Pavement, HSG B/D
*	0.080	61	Grass (Good), HSG B
*	0.050	80	Grass (Good), HSG D
	0.970	78	Weighted Average
	0.910	77	93.81% Pervious Area
	0.060	98	6.19% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.6					**Direct Entry, See Tc Calcs**

Subcatchment 9S: DA2 Prop Bypass (future)



Summary for Pond 8P: Proposed Infiltration Basin (future)

Inflow Area = 1.160 ac, 6.90% Impervious, Inflow Depth = 4.30" for 25-Year (Atlas14) event
Inflow = 4.00 cfs @ 12.17 hrs, Volume= 0.416 af
Outflow = 1.58 cfs @ 12.56 hrs, Volume= 0.387 af, Atten= 61%, Lag= 23.3 min
Primary = 1.58 cfs @ 12.56 hrs, Volume= 0.387 af

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 15.04' @ 12.56 hrs Surf.Area= 5,734 sf Storage= 7,096 cf

Plug-Flow detention time= 224.7 min calculated for 0.386 af (93% of inflow)
Center-of-Mass det. time= 188.0 min (1,008.6 - 820.6)

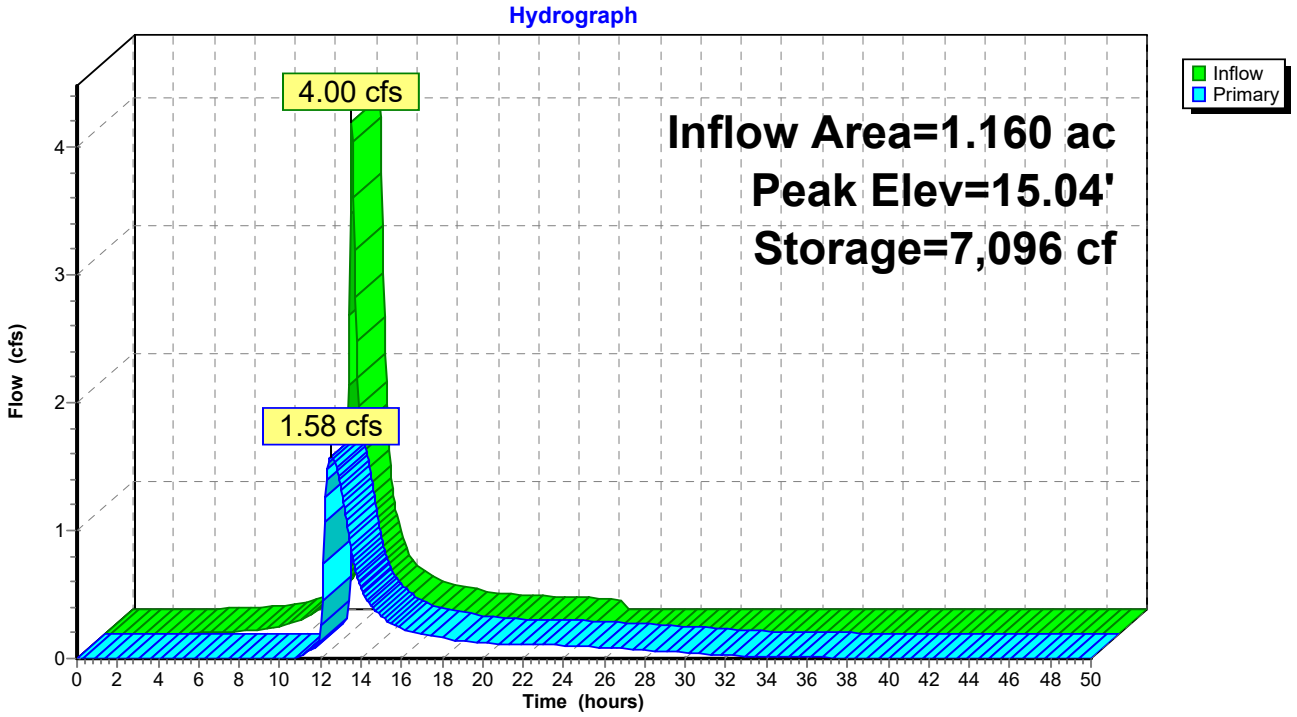
Volume	Invert	Avail.Storage	Storage Description
#1	13.50'	21,315 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
13.50	3,483	0	0
14.00	4,201	1,921	1,921
15.00	5,678	4,940	6,861
16.00	7,213	6,446	13,306
17.00	8,804	8,009	21,315

Device	Routing	Invert	Outlet Devices
#1	Primary	13.50'	**12.0" Round Culvert** L= 165.0' Ke= 0.500 Inlet / Outlet Invert= 13.50' / 10.91' S= 0.0157 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	13.81'	**2.5" Vert. Orifice/Grate** C= 0.600
#3	Device 1	14.33'	**12.0" W x 5.0" H Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=1.58 cfs @ 12.56 hrs HW=15.04' (Free Discharge)
└**1=Culvert** (Passes 1.58 cfs of 3.85 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.17 cfs @ 5.10 fps)
  └**3=Orifice/Grate** (Orifice Controls 1.40 cfs @ 3.37 fps)

Pond 8P: Proposed Infiltration Basin (future)

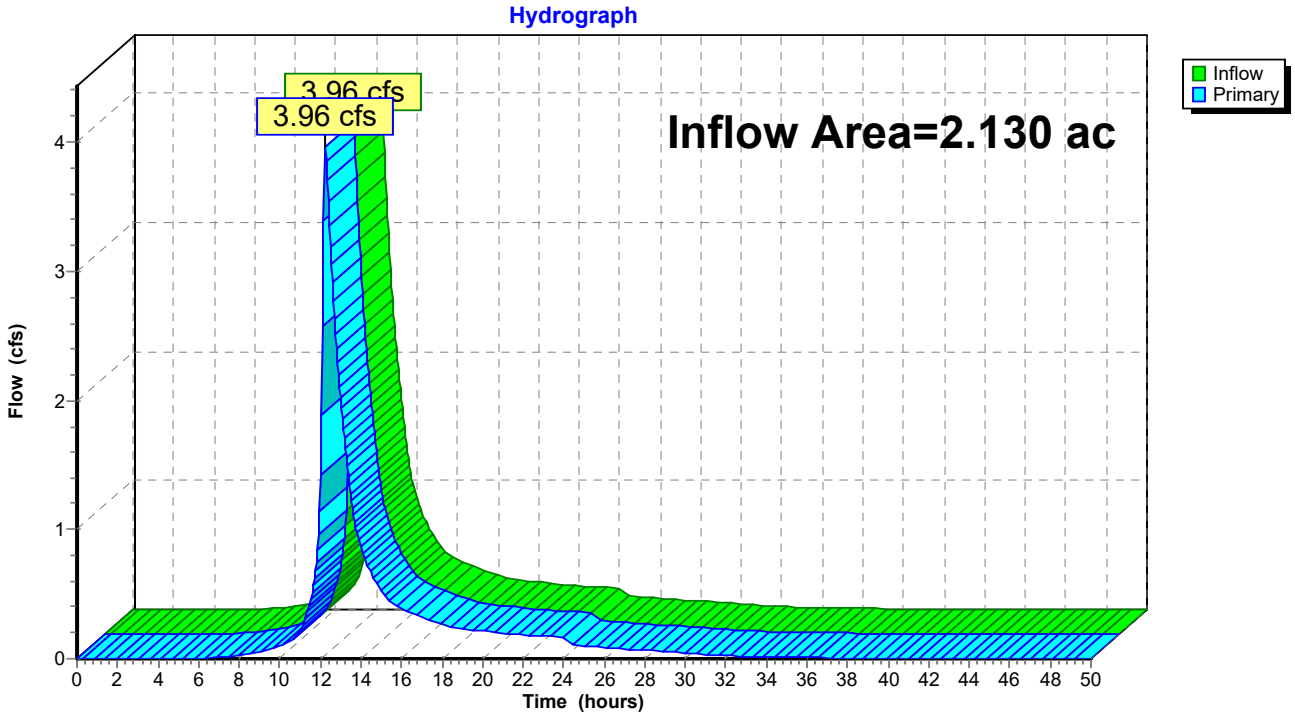


Summary for Link 10L: Analysis Pt 1 (future)

Inflow Area = 2.130 ac, 6.57% Impervious, Inflow Depth > 4.04" for 25-Year (Atlas14) event
Inflow = 3.96 cfs @ 12.24 hrs, Volume= 0.717 af
Primary = 3.96 cfs @ 12.24 hrs, Volume= 0.717 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs

Link 10L: Analysis Pt 1 (future)



Summary for Subcatchment 7S: DA1 Prop Basin (future)

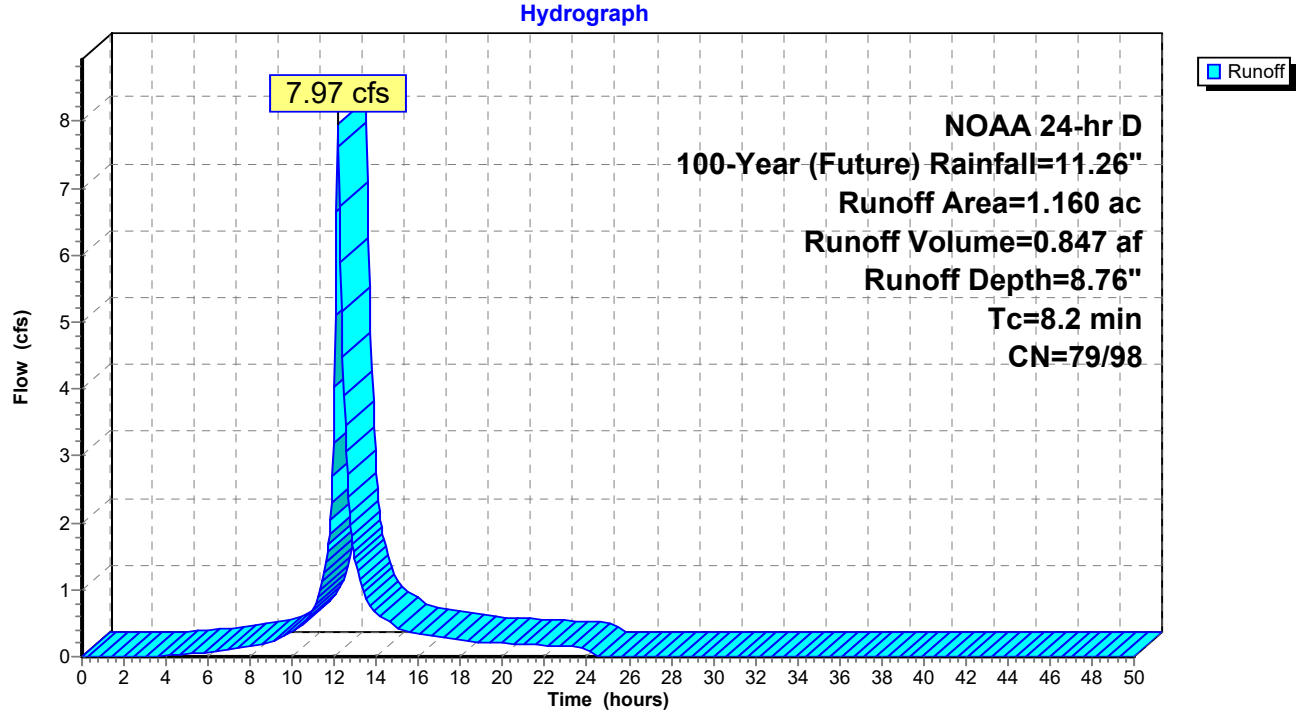
Runoff = 7.97 cfs @ 12.17 hrs, Volume= 0.847 af, Depth= 8.76"

Runoff by SCS TR-20 method, UH=Delmarva, Split Pervious/Imperv., Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
NOAA 24-hr D 100-Year (Future) Rainfall=11.26"

	Area (ac)	CN	Description
*	0.080	98	Concrete Pads, HSG B/D
*	0.300	85	Gravel, HSG B
*	0.200	91	Gravel, HSG D
*	0.050	55	Woods (Good), HSG B
*	0.160	78	Meadow, HSG D
*	0.060	61	Grass (Good), HSG B
*	0.220	80	Grass (Good), HSG D
*	0.090	58	Meadow, HSG B
	1.160	80	Weighted Average
	1.080	79	93.10% Pervious Area
	0.080	98	6.90% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2					**Direct Entry, See Tc Calcs**

Subcatchment 7S: DA1 Prop Basin (future)



Summary for Subcatchment 9S: DA2 Prop Bypass (future)

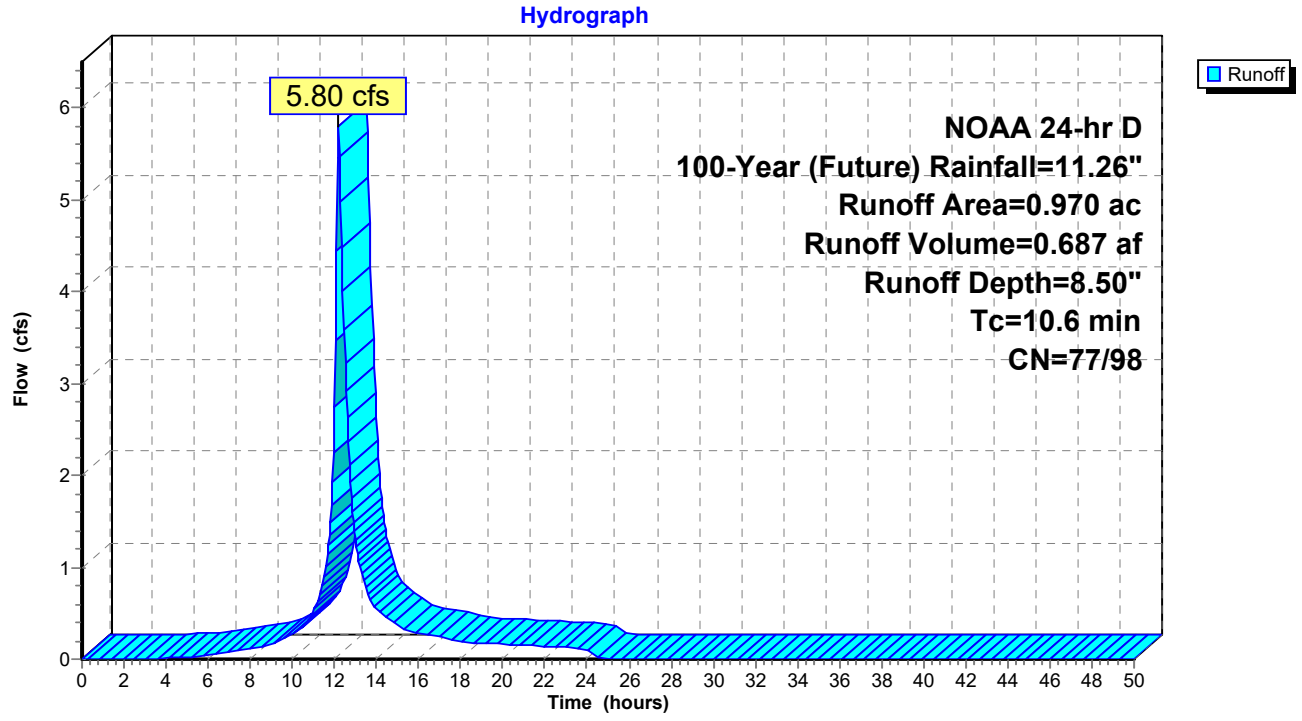
Runoff = 5.80 cfs @ 12.20 hrs, Volume= 0.687 af, Depth= 8.50"

Runoff by SCS TR-20 method, UH=Delmarva, Split Pervious/Imperv., Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
NOAA 24-hr D 100-Year (Future) Rainfall=11.26"

	Area (ac)	CN	Description
*	0.030	58	Meadow, HSG B
*	0.690	78	Meadow, HSG D
*	0.020	77	Woods (Good), HSG D
*	0.040	91	Gravel, HSG D
*	0.060	98	Pavement, HSG B/D
*	0.080	61	Grass (Good), HSG B
*	0.050	80	Grass (Good), HSG D
	0.970	78	Weighted Average
	0.910	77	93.81% Pervious Area
	0.060	98	6.19% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.6					**Direct Entry, See Tc Calcs**

Subcatchment 9S: DA2 Prop Bypass (future)



Summary for Pond 8P: Proposed Infiltration Basin (future)

Inflow Area = 1.160 ac, 6.90% Impervious, Inflow Depth = 8.76" for 100-Year (Future) event
Inflow = 7.97 cfs @ 12.17 hrs, Volume= 0.847 af
Outflow = 2.66 cfs @ 12.61 hrs, Volume= 0.818 af, Atten= 67%, Lag= 26.6 min
Primary = 2.66 cfs @ 12.61 hrs, Volume= 0.818 af

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 16.00' @ 12.61 hrs Surf.Area= 7,212 sf Storage= 13,301 cf

Plug-Flow detention time= 153.2 min calculated for 0.818 af (97% of inflow)
Center-of-Mass det. time= 132.5 min (932.9 - 800.3)

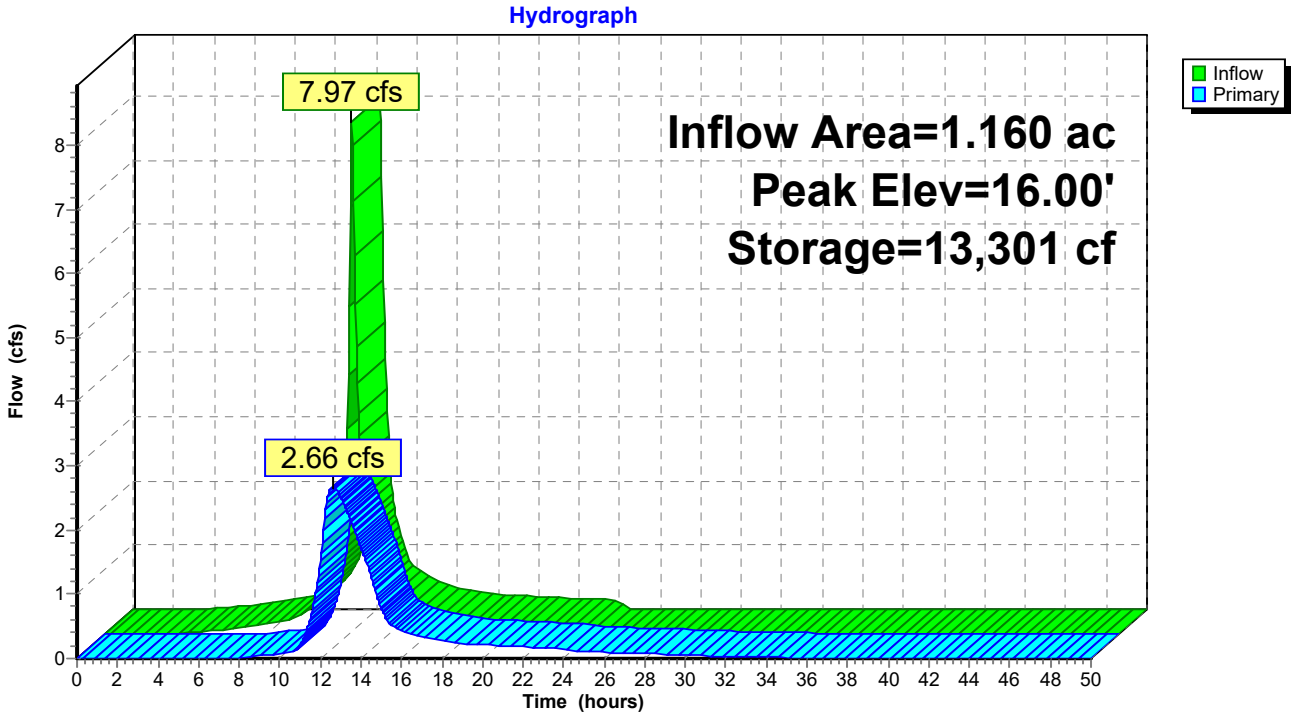
Volume	Invert	Avail.Storage	Storage Description
#1	13.50'	21,315 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
13.50	3,483	0	0
14.00	4,201	1,921	1,921
15.00	5,678	4,940	6,861
16.00	7,213	6,446	13,306
17.00	8,804	8,009	21,315

Device	Routing	Invert	Outlet Devices
#1	Primary	13.50'	**12.0" Round Culvert** L= 165.0' Ke= 0.500 Inlet / Outlet Invert= 13.50' / 10.91' S= 0.0157 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	13.81'	**2.5" Vert. Orifice/Grate** C= 0.600
#3	Device 1	14.33'	**12.0" W x 5.0" H Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=2.66 cfs @ 12.61 hrs HW=16.00' (Free Discharge)
└**1=Culvert** (Passes 2.66 cfs of 4.93 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.24 cfs @ 6.95 fps)
  └**3=Orifice/Grate** (Orifice Controls 2.42 cfs @ 5.81 fps)

Pond 8P: Proposed Infiltration Basin (future)

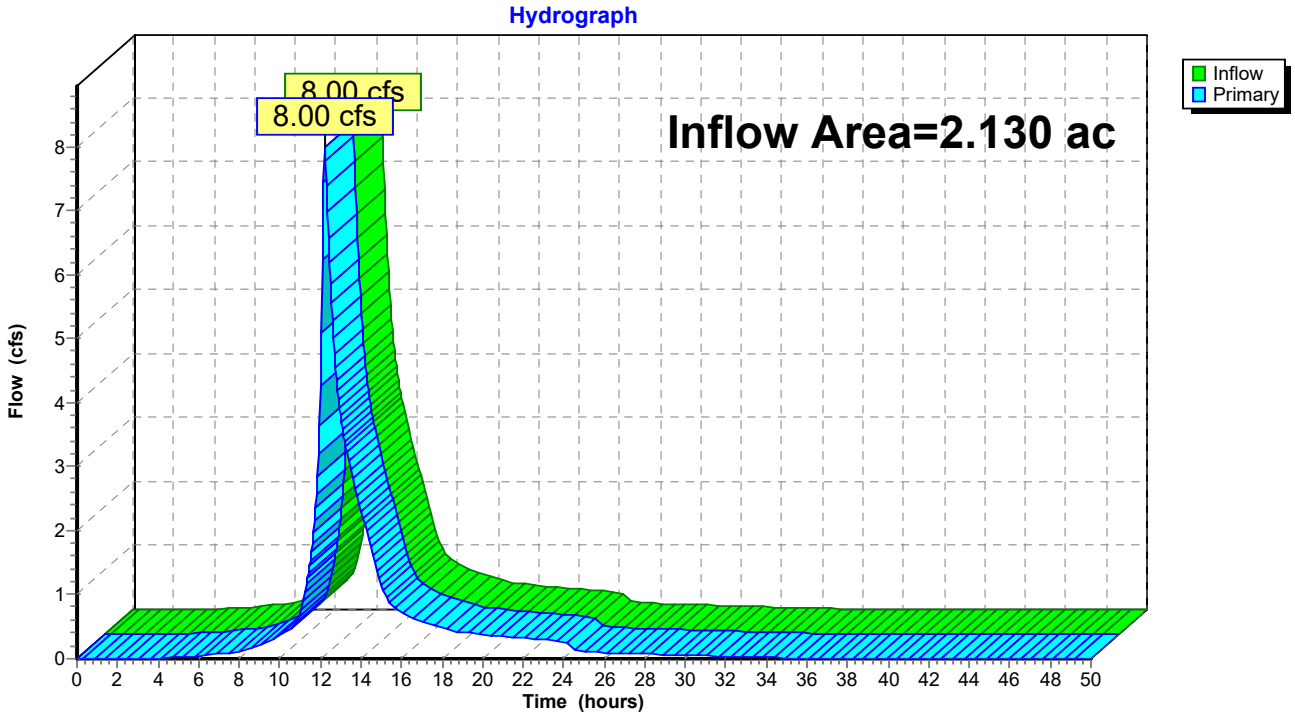


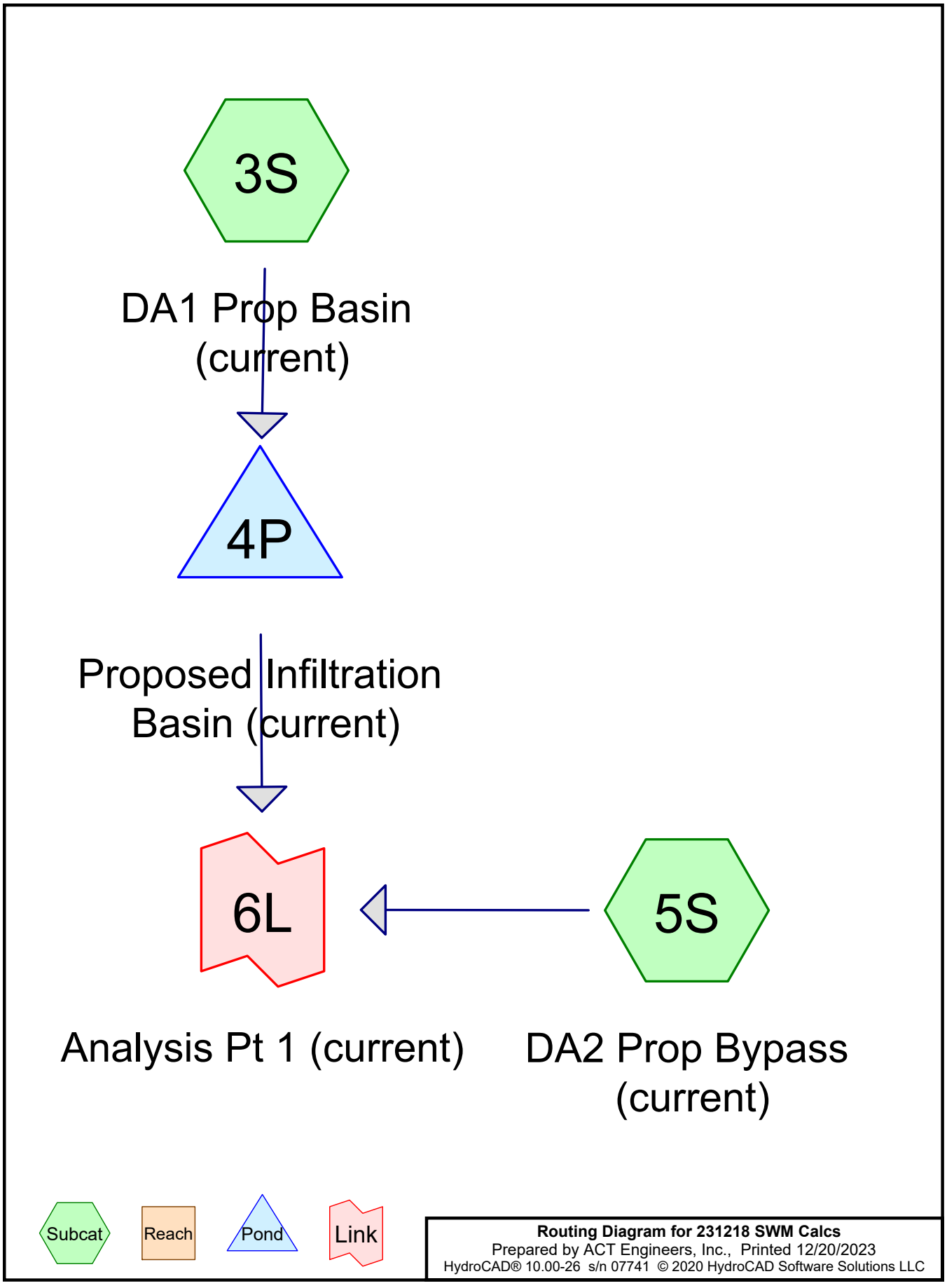
Summary for Link 10L: Analysis Pt 1 (future)

Inflow Area = 2.130 ac, 6.57% Impervious, Inflow Depth > 8.48" for 100-Year (Future) event
Inflow = 8.00 cfs @ 12.21 hrs, Volume= 1.505 af
Primary = 8.00 cfs @ 12.21 hrs, Volume= 1.505 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs

Link 10L: Analysis Pt 1 (future)





Routing Diagram for 231218 SWM Calcs
Prepared by ACT Engineers, Inc., Printed 12/20/2023

Summary for Subcatchment 3S: DA1 Prop Basin (current)

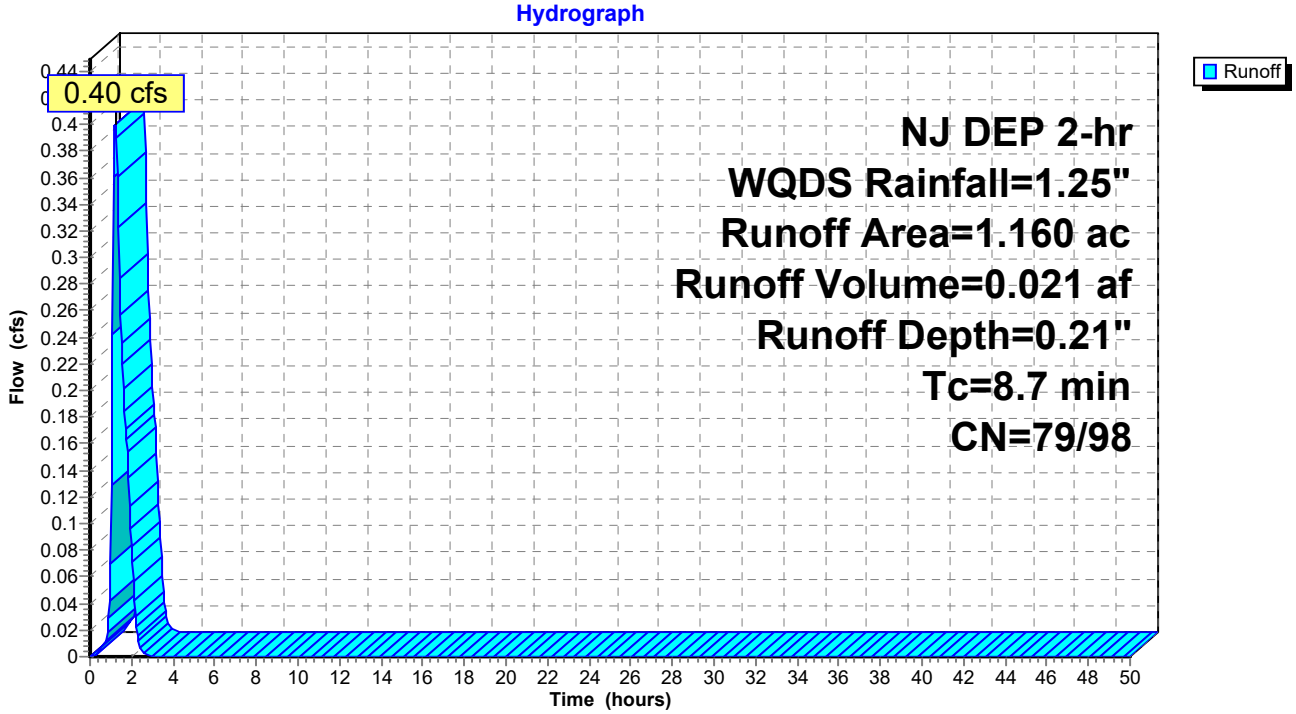
Runoff = 0.40 cfs @ 1.22 hrs, Volume= 0.021 af, Depth= 0.21"

Runoff by SCS TR-20 method, UH=Delmarva, Split Pervious/Imperv., Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
NJ DEP 2-hr WQDS Rainfall=1.25"

	Area (ac)	CN	Description
*	0.080	98	Concrete Pads, HSG B/D
*	0.300	85	Gravel, HSG B
*	0.200	91	Gravel, HSG D
*	0.050	55	Woods (Good), HSG B
*	0.160	78	Meadow, HSG D
*	0.060	61	Grass (Good), HSG B
*	0.220	80	Grass (Good), HSG D
*	0.090	58	Meadow, HSG B
	1.160	80	Weighted Average
	1.080	79	93.10% Pervious Area
	0.080	98	6.90% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.7					**Direct Entry, See Tc Calcs**

Subcatchment 3S: DA1 Prop Basin (current)



Summary for Subcatchment 5S: DA2 Prop Bypass (current)

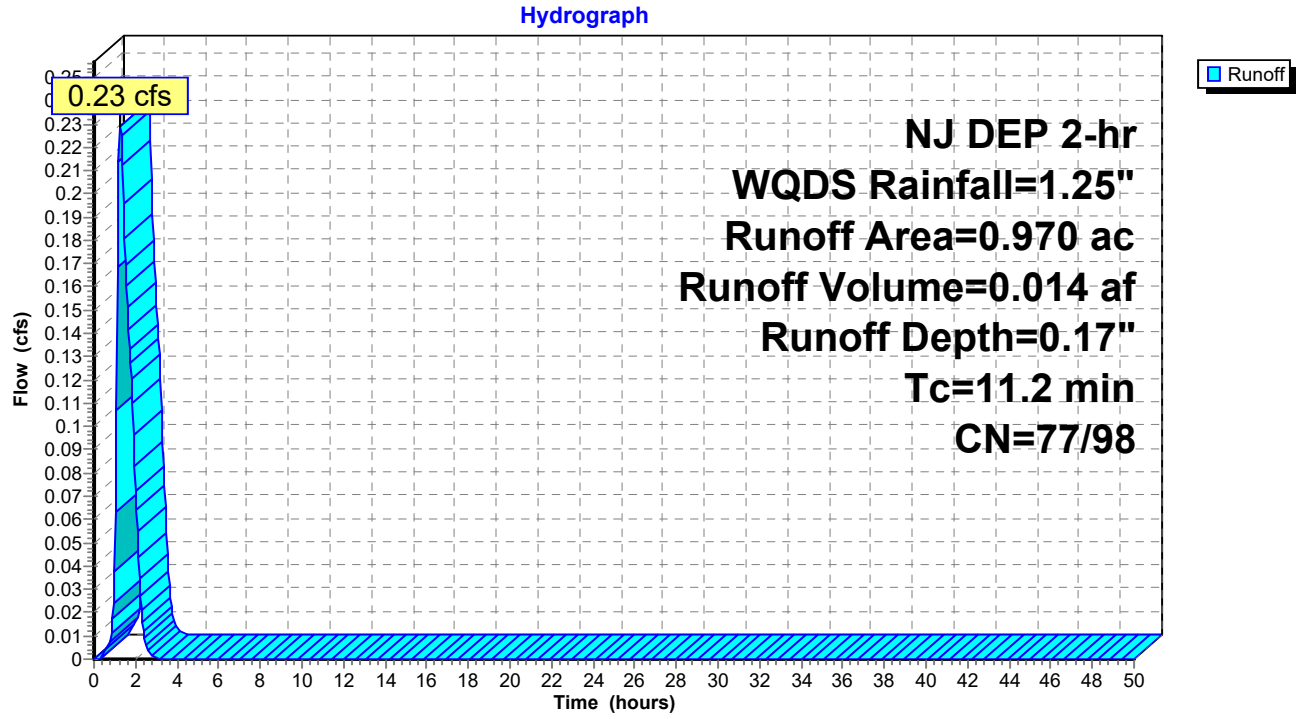
Runoff = 0.23 cfs @ 1.27 hrs, Volume= 0.014 af, Depth= 0.17"

Runoff by SCS TR-20 method, UH=Delmarva, Split Pervious/Imperv., Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
NJ DEP 2-hr WQDS Rainfall=1.25"

	Area (ac)	CN	Description
*	0.030	58	Meadow, HSG B
*	0.690	78	Meadow, HSG D
*	0.020	77	Woods (Good), HSG D
*	0.040	91	Gravel, HSG D
*	0.060	98	Pavement, HSG B/D
*	0.080	61	Grass (Good), HSG B
*	0.050	80	Grass (Good), HSG D
	0.970	78	Weighted Average
	0.910	77	93.81% Pervious Area
	0.060	98	6.19% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.2					**Direct Entry, See Tc Calcs**

Subcatchment 5S: DA2 Prop Bypass (current)



Summary for Pond 4P: Proposed Infiltration Basin (current)

Inflow Area = 1.160 ac, 6.90% Impervious, Inflow Depth = 0.21" for WQDS event
Inflow = 0.40 cfs @ 1.22 hrs, Volume= 0.021 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs
Peak Elev= 13.73' @ 3.00 hrs Surf.Area= 3,819 sf Storage= 900 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

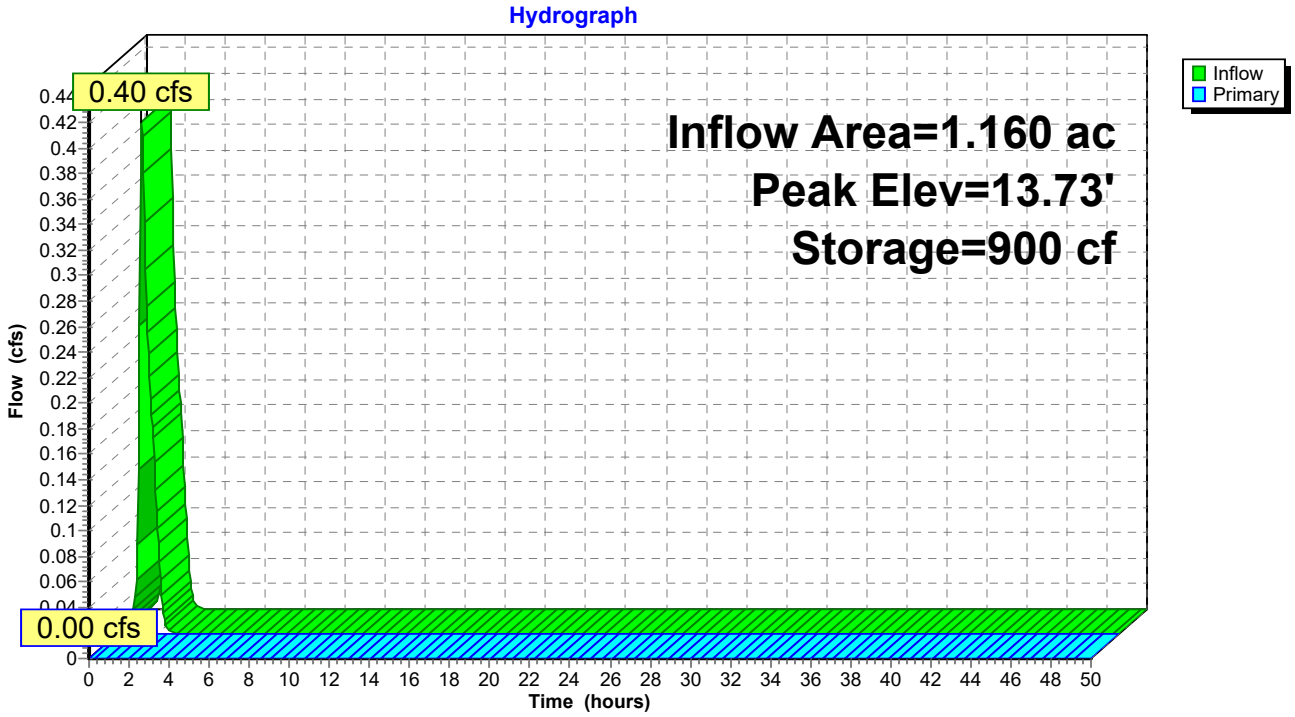
Volume	Invert	Avail.Storage	Storage Description
#1	13.50'	21,315 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
13.50	3,483	0	0
14.00	4,201	1,921	1,921
15.00	5,678	4,940	6,861
16.00	7,213	6,446	13,306
17.00	8,804	8,009	21,315

Device	Routing	Invert	Outlet Devices
#1	Primary	13.50'	**12.0" Round Culvert** L= 165.0' Ke= 0.500 Inlet / Outlet Invert= 13.50' / 10.91' S= 0.0157 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	13.81'	**2.5" Vert. Orifice/Grate** C= 0.600
#3	Device 1	14.33'	**12.0" W x 5.0" H Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=13.50' (Free Discharge)
└**1=Culvert** (Controls 0.00 cfs)
  └**2=Orifice/Grate** (Controls 0.00 cfs)
  └**3=Orifice/Grate** (Controls 0.00 cfs)

Pond 4P: Proposed Infiltration Basin (current)

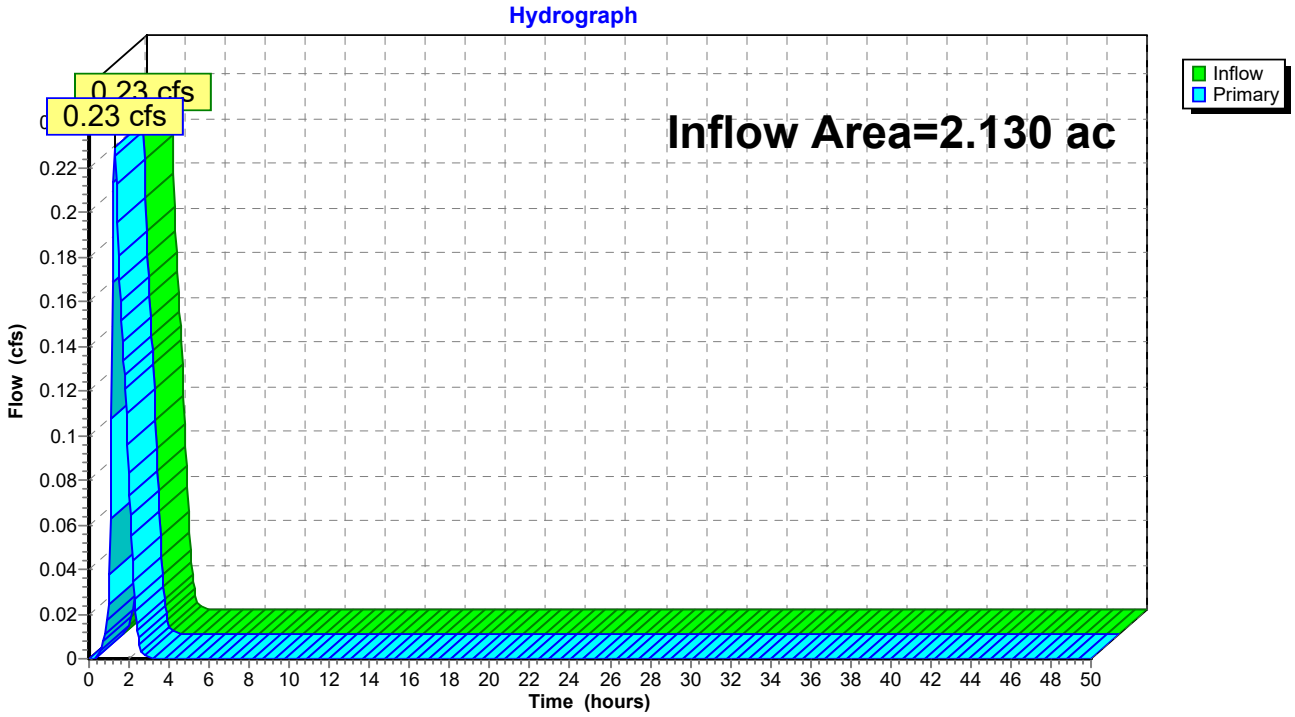


Summary for Link 6L: Analysis Pt 1 (current)

Inflow Area = 2.130 ac, 6.57% Impervious, Inflow Depth = 0.08" for WQDS event
Inflow = 0.23 cfs @ 1.27 hrs, Volume= 0.014 af
Primary = 0.23 cfs @ 1.27 hrs, Volume= 0.014 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-50.00 hrs, dt= 0.05 hrs

Link 6L: Analysis Pt 1 (current)



New Jersey Department of Agriculture

Hydrologic Modeling Database – Data Entry Form

Basin Outlet Structure(s)

ID. PROPOSED INFILTRATION BASIN

End of Pipe Location: Northing: 538,444 Easting: 621,134

Discharge Type (weir, orifice, etc)	Dimensions (diameter, length)	Elevation (USGS)	Discharge Coefficient	Equation Used
ORIFICE	2.5" DIA.	13.81	0.6	ORIFICE EQ
ORIFICE	12"W x 5"H	14.33	0.6	ORIFICE EQ

Basin Stage-Discharge Rating Table[12]

Elevation (USGS Feet)	Storage (Acre-Ft)	Total Outlet Structure Discharge (cfs)
13.50 (BASIN BOT)	0.000	0.00
14.00	0.044	0.05
14.50	0.101	0.35
15.00	0.158	1.52
15.50	0.231	2.17
16.00	0.305	2.66
16.50	0.397	3.07
17.00	0.489	3.44

New Jersey Groundwater Recharge Spreadsheet Version 2.0 November 2003

Annual Groundwater Recharge Analysis (based on GSR-32)

Select Township ↓	Average Annual P (in)	Climatic Factor
MONMOUTH CO., OCEANPORT BORO	47.4	1.55

Project Name:	MasTec - Ft Monmouth Substatio
Description:	230222-00
Analysis Date:	12/20/23

Pre-Developed Conditions

Land Segment	Area (acres)	TR-55 Land Cover	Soil	Annual Recharge (in)	Annual Recharge (cu.ft)
1	0.3	Impervious areas	Freehold	0.0	-
2	0.28	Woods	Freehold	15.9	16,206
3	1.19	Meadow, Pasture, Grassland or range	Udorthents	0.0	-
4	0.36	Meadow, Pasture, Grassland or range	Freehold	15.8	20,645
5	0				
6	0				
7	0				
8	0				
9	0				
10	0				
11	0				
12	0				
13	0				
14	0				
15	0				
Total =	2.1			Total Annual Recharge (in)	Total Annual Recharge (cu-ft)
				4.8	36,851

Post-Developed Conditions

Land Segment	Area (acres)	TR-55 Land Cover	Soil	Annual Recharge (in)	Annual Recharge (cu.ft)
1	0.3	Gravel, dirt	Freehold	9.8	10,640
2	0.24	Gravel, dirt	Udorthents	0.0	-
3	0.05	Woods	Freehold	15.9	2,894
4	0.85	adow, Pasture, Grassland or ra	Udorthents	0.0	-
5	0.14	Open space	Freehold	15.6	7,926
6	0.27	Open space	Udorthents	0.0	-
7	0.12	adow, Pasture, Grassland or ra	Freehold	15.8	6,882
8	0.02	Woods	Udorthents	0.0	-
9	0.14	Impervious areas	Udorthents	0.0	-
10	0				
11	0				
12	0				
13	0				
14	0				
15	0				
Total =	2.1			Total Annual Recharge (in)	Total Annual Recharge (cu.ft)
				3.7	28,342

Annual Recharge Requirements Calculation ↓

% of Pre-Developed Annual Recharge to Preserve =	100%	Total Impervious Area (sq.ft) 6,098
Post-Development Annual Recharge Deficit=	*8,509*	(cubic feet)

Recharge Efficiency Parameters Calculations (area averages)

RWC= 1.35	(in)	DRWC= 0.12	(in)
ERWC = 0.30	(in)	EDRWC= 0.03	(in)

Procedure to fill the Pre-Development and Post-Development Conditions Tables

For each land segment, first enter the area, then select TR-55 Land Cover, then select Soil. Start from the top of the table and proceed downward. Don't leave blank rows (with A=0) in between your segment entries. Rows with A=0 will not be displayed or used in calculations. For impervious areas outside of standard lots select "Impervious Areas" as the Land Cover. Soil type for impervious areas are only required if an infiltration facility will be built within these areas.

Project Name	Description	Analysis Date	BMP or LID Type
MasTec - Ft Monmouth Su	230222-00	12/20/23	Infiltration Basin

Recharge BMP Input Parameters

Parameter	Symbol	Value	Unit
BMP Area	ABMP	500.0	sq.ft
BMP Effective Depth, this is the design variable	dBMP	3.5	in
Upper level of the BMP surface (negative if above ground)	dBMPu	38.5	in
Depth of lower surface of BMP, must be>=dBMPu	dEXC	42.0	in
Post-development Land Segment Location of BMP , Input Zero if Location is distributed or undetermined	SegBMP	6	unitless

Root Zone Water capacity Calculated Parameters

Parameter	Symbol	Value	Unit
Empty Portion of RWC under Post-D Natural Recharge	ERWC	0.00	in
ERWC Modified to consider dEXC	EDRWC	0.00	in
Empty Portion of RWC under Infilt. BMP	RERWC	0.00	in

Recharge Design Parameters

Parameter	Symbol	Value	Unit
Inches of Runoff to capture	Qdesign	0.07	in
Inches of Rainfall to capture	Pdesign	0.12	in
Recharge Provided Avg. over Imp. Area		5.3	in
Runoff Captured Avg. over imp. Area		5.3	in

BMP Calculated Size Parameters

ABMP/Aimp	Aratio	0.02	unitless
BMP Volume	VBMP	145	cu.ft

Parameters from Annual Recharge Worksheet

Post-D Deficit Recharge (or desired recharge volume)	Vdef	8,509	cu.ft
Post-D Impervious Area (or target Impervious Area)	Aimp	25,265	sq.ft
Root Zone Water Capacity	RWC	0.00	in
RWC Modified to consider dEXC	DRWC	0.00	in
Climatic Factor	C-factor	1.55	no units
Average Annual P	Pavg	47.4	in
Recharge Requirement over Imp. Area	dr	16.7	in

System Performance Calculated Parameters

Annual BMP Recharge Volume		11,252	cu.ft
Avg BMP Recharge Efficiency		100.0%	Represents % Infiltration Recharged
%Rainfall became Runoff		78.2%	%
%Runoff Infiltrated		14.4%	%
%Runoff Recharged		59.7%	%
%Rainfall Recharged		46.7%	%

CALCULATION CHECK MESSAGES

Volume Balance-> Solve Problem to satisfy Annual Recharge
dBMP Check---> OK
dEXC Check---> OK
BMP Location---> OK

OTHER NOTES

Pdesign is accurate only after BMP dimensions are updated to make rech volume= deficit volume. The portion of BMP infiltration prior to filling and the area occupied by BMP are ignored in these calculations. Results are sensetive to dBMP, make sure dBMP selected is small enough for BMP to empty in less than 3 days. For land Segment Location of BMP if you select "impervious areas" RWC will be minimal but not zero as determined by the soil type and a shallow root zone for this Land Cover allowing consideration of lateral flow and other losses.

How to solve for different recharge volumes: By default the spreadsheet assigns the values of total deficit recharge volume "Vdef" and total proposed impervious area "Aimp" from the "Annual Recharge" sheet to "Vdef" and "Aimp" on this page. This allows solution for a single BMP to handle the entire recharge requirement assuming the runoff from entire impervious area is available to the BMP.
To solve for a smaller BMP or a LID-IMP to recharge only part of the recharge requirement, set Vdef to your target value and Aimp to impervious area directly connected to your infiltration facility and then solve for ABMP or dBMP. To go back to the default configuration clik the "Default Vdef & Aimp" button.

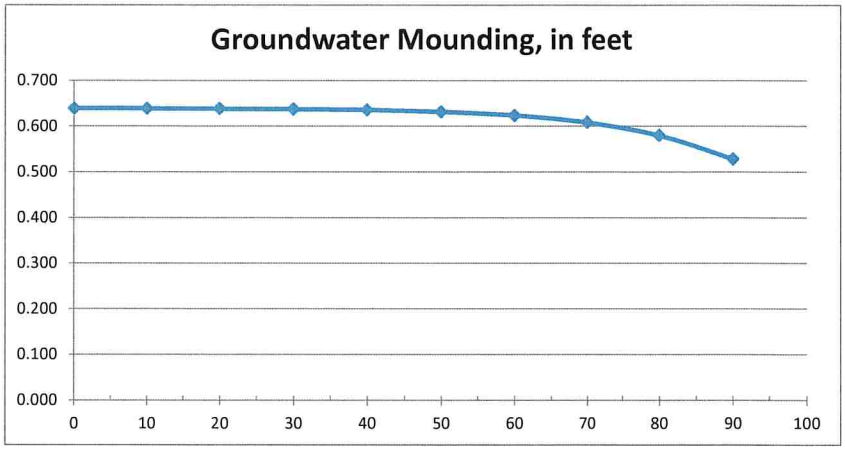
Fort Monmouth Mod Substation
Oceanport, NJ
Groundwater Mounding Calculations

Input Values		
5.00	*R*	Recharge rate (permeability rate) (in/hr)
0.150	Sy	Specific yield, Sy (dimensionless) default value is 0.15; max value is 0.2 provided that a lab test data is submitted
25.00	Kh	Horizontal hydraulic conductivity (in/hr) Kh = 5xRecharge Rate (R) in the costal plan; Kh=R outside the coastal plan
105.000	x	1/2 length of basin (x direction, in feet)
1.200	y	1/2 width of basin (y direction, in feet)
4.32	t	Duration of infiltration period (hours)
10.00	hi(0)	Initial thickness of saturated zone (feet)

10.639	h(max)	Maximum thickness of saturated zone (beneath center of basin at end of infiltration period)
0.639	Δh(max)	Maximum groundwater mounding (beneath center of basin at end of infiltration period)

Ground-water Mounding, in feet	Distance from center of basin in x direction, in feet
0.639	0
0.639	10
0.638	20
0.638	30
0.636	40
0.632	50
0.624	60
0.608	70
0.580	80
0.528	90

Re-Calculate Now



Disclaimer

This spreadsheet solving the Hantush (1967) equation for ground-water mounding beneath an infiltration basin is made available to the general public as a convenience for those wishing to replicate values documented in the USGS Scientific Investigations Report 2010-5102 "Groundwater mounding beneath hypothetical stormwater infiltration basins" or to calculate values based on user-specified site conditions. Any changes made to the spreadsheet (other than values identified as user-specified) after transmission from the USGS could have unintended, undesirable consequences. These consequences could include, but may not be limited to: erroneous output, numerical instabilities, and violations of underlying assumptions that are inherent in results presented in the accompanying USGS published report. The USGS assumes no responsibility for the consequences of any changes made to the spreadsheet. If changes are made to the spreadsheet, the user is responsible for documenting the changes and justifying the results and conclusions.

PERMEABILITY RATE: ASSUME 10"/HR (SAND REPLACEMENT)

R = 10"/HR / 2 = 5"/HR (SAFETY FACTOR OF 2)

Sy = 0.15 (DEFAULT)

K_h = 5"/HR x 5 = 25"/HR (COASTAL PLAINS REGION)

BASIN INFILTRATION AREA = 500 S.F. (APPROXIMATE DIMENSIONS 210' x 2.4'

X = 210 / 2 ±105' Y = 2.4 / 2 = 1.2'

WQ DESIGN STORM VOLUME = 900 C.F. (FROM HYDROGRAPH ROUTINGS)

$$t = \frac{12"/Ft \times 900\ C.F.}{500\ S.F. \times 5\ in/Hr} = 4.32\ hrs$$ LESS THAN 72 hrs SO OK ✓

RESULTS

Δh_{max} = 0.64'

BASIN BOTTOM = 13.5'
OBSERVED SHWT = 10.0'
MOUNDED SHWT = 10.64' SO OK ✓

Appendix D

Post Construction Operation & Maintenance Document

PART I - GENERAL PROJECT INFORMATION

Responsible Party (Permitee):

Company: Jersey Central Power & Light (JCP&L)
Address: 101 Crawfords Corner Rd Holmdel, NJ 07733
Phone Number: 732-212-4203
Email Address: kjamieson@firstenergycorp.com
Property: Portion of Block 110 Lot 4, Oceanport, NJ

Legal Instrument

- The legal instrument (for long term BMP O&M) must be recorded upon the deed of record for the property.
- The party may transfer responsibility for the stormwater maintenance plan to anyone who purchases the property. This transfer must include a copy of any ordinance or regulation that requires the owner to dedicate the stormwater management measures and maintenance. Any changes in the name, address and/or telephone number of the individual(s) responsible for the operation and maintenance of the infiltration basin shall be incorporated into this document.

Purpose

This document shall serve as the guideline for routine operation and maintenance of the small scale infiltration basin for the Fort Monmouth Substation. This manual applies only to the above referenced facility located on Block 110 Lot 4 (portion of) and any utility easements dedicated to Oceanport Township.

Basic Inspections and Maintenance

Inspections of the structural components of the facility shall occur a minimum of annually. Inspector shall inspect for cracking, spalling, trash, erosion and general deterioration. Inspections of components which receive and or trap sediment shall be occur a minimum of 4 times per year so once each quarter. Components shall be inspected for build up or clogging cause be sediment deposition.

Maintenance of the stormwater management facilities shall be performed as required based on the inspection results. Maintenance of the facility is essential to ensure basin is functioning as intended and providing the water quality and quantity mitigation for the substation site.

Grass should be mowed at least twice per month during the growing season with a hand mower, unless dry weather conditions allow for once per month. Equipment shall not be used to cut vegetation in order to prevent compaction of the basin. Vegetated areas must be inspected at least annually for erosion and scour. All unwanted underbrush and tree growth shall be removed a minimum of annually.

When establishing or restoring vegetation, bi-weekly inspections of vegetation growth should be performed during the first growing season or until the vegetation is established. Once established, inspections of vegetation health, density and diversity should be performed during the growing and non-growing seasons at least twice annually. The vegetative cover should be maintained at 85%. If vegetation has greater than 50% damage, the area should be re-established in accordance with the original specifications and the inspection requirements presented above.

Disposal of trash, debris, sediment and other waste material shall be done at approved disposal or recycling site in compliance with all local, county, state and federal regulations.

All use of fertilizers, mechanical treatments, pesticides and other means to assure optimum vegetation health must not compromise the intended purpose of the infiltration basin. All vegetation deficiencies should be addressed without the use of fertilizers and pesticides whenever possible..

The infiltration basin should be inspected at least twice annually. If water fails to infiltrate 72 hours after the end of the water quality design storm, corrective measures must be taken.

PART II - OPERATION AND MAINTENANCE

A detailed log of all maintenance activities performed on the infiltration basin shall be kept by JCP&L. The log shall include the date, maintenance activity performed and by whom. Below shows a typical table that should be provided:

Date	Maintenance Personnel	Activity Performed	Notes

The NJDEP Stormwater Management Rules require that the following procedures be followed:

1. Copies of the maintenance plan must be provided to the owner and operator of the stormwater management facility. Copies must also be submitted to all reviewing agencies as part of each agency's approval process. In addition, a copy should be provided to the local mosquito control or extermination commission upon request.
2. The title and date of the maintenance plan and the name, address and telephone number of the person with maintenance responsibility as specified in the plan must be recorded on the deed of the property on which the facility is located. Any change in this information (such as a change in property ownership) must also be recorded on the deed.
3. The person with maintenance responsibility must evaluate the maintenance plan for effectiveness at least annually and update as required.
4. A detailed written log of all preventative and corrective maintenance performed at the facility must be kept including a record of all inspections and copies of maintenance related work orders.
5. The person with maintenance responsibility must retain and, upon request, make available the maintenance plan and associated logs and other records for review by a public entity with administrative, health, environmental or safety authority over the site.

Designated Personnel

The following list represents the inspectors, contractor and professional engineers designated by JCP&L who will be involved with the inspection and maintenance of the small scale infiltration basin.

Personnel	*Contact Name*	*Contact Number*
Inspector	Kevin Jamieson	732-212-4203
Contractors		

Professional Engineer		
Owners Rep		

Plans & Documentation

Enclosed plans and documents should be reviewed prior to any inspection or maintenance activity taking place.

Plans are entitled ”Fort Monmouth Mod Substation dated 4/21/23.”

Stormwater Management Report entitled “Fort Monmouth Mod Substation dated December 2023.”

The plans and documents should be updated as needed based on changes to site operation, maintenance, inspections or expansion of the facility.

Tools and Equipment

- The following is a list of required inspection equipment for routine operation and maintenance procedures and inspections:
  1. Clipboard, pencil and inspection checklist provided within this document.
  2. Measurement wheel and or tape measure.
  3. Camera to document pre and post conditions.
  4. Shovel or rod to determine subsurface conditions penetrate soil.
  5. Hand mower and weed whacker.
- Possible heavy equipment noted below could be required, but not limited to, the following:
  1. Chain saw
  2. Stump grinder
  3. Wheelbarrow
  4. Backhoe
  5. Dump truck

6. Vacuum truck

- Safety equipment & PPE

1. Boots
2. Reflective Vest
3. Gloves
4. Safety glasses
5. Sunblock
6. Tick Repellent

- Maintenance staff to identify the following material sources if immediate use is warranted based on inspections.

1. Native, silty sand for filling erosion rills and gullies

   Company Name: Company Contact:

2. Large rip rap stone for emergency erosion repairs

   Company Name: Company Contact:

3. Synthetic geo-fabric netting and stakes to prevent blowing of seeding and topsoil

   Company Name: Company Contact:

4. Topsoil mixture, seed and fertilizer

   Company Name: Company Contact:

5. New Jersey P.E. (Contact MasTec @ 610-832-7332)

Specific Inspection & Maintenance

1 SMALL SCALE INFILTRATION BASIN

- During establishment of side slope vegetation pruning and weeding may be required.
- Detritus may need to be removed yearly.
- Perennial planting should be cut down at the end of each growing season.
- Mulch shall be re-spread over areas that have eroded and where mulch is thin.
- Inspection of bio retention areas should occur every 6 months looking for sediment deposition, erosion, trash and debris and vegetative health.

- Check sand layer at bottom of basin to ensure no fines have made their way into the sand thus reducing its permeability.
- Clean out contributing swales as needed to ensure BMP is functioning properly.
- Clean out outlet pipe as needed to allow for drainage of BMP.

2 LANDSCAPE RESTORATION

- During first 3 years inspections shall occur every 6 months and after every rainfall event of 2" or greater in a 24 hour period.
- In forest restoration areas planted with proper cover crop, mowing shall be required to control invasive species in the first 3 years.
- In forest restoration areas carefully selected herbicides shall be used around protective tree shelters/tubes and reinforced by cutting/manual removal if necessary in the first 3 years.
- In forest restoration areas once tree canopy begins to form and naturally inhibits weed growth, inspections are no longer required and forest becomes self maintaining.
- In meadow restoration areas, during the first year weeds must be controlled by cutting them down to 4" height once they reach 12" in height.
- In meadow restoration areas weeds shall be monitored in the second year and any rhizomatous weeds should be hand treated with herbicides. Weeds shall not be sprayed with any herbicides.
- In meadow restoration areas at the beginning of the third year, the meadow shall be burned off in mid spring. If burning is not possible then meadow shall be mowed as close to the ground as possible. Mowed material shall be removed from the site.

3 CULVERTS /OUTLET STORMSEWER

- Culverts to be inspected annually at a minimum and after major storm events causing flooding.
- Culverts should be cleaned annually at a minimum if inspections determine a need.
- For culverts, sediment should be removed when it has reached to within 25% of depth of the culvert.
- Culverts should be inspected for any trash or debris that has accumulated inside them.
- Jet cleaning shall be used for cleaning of the pipes and drainage structures with difficult blockages.

Inspection Access Points

- The outlet structure is a 4’ wide catch basin which can be entered in order to inspect both the structure itself and the underdrain which outfall into the catch basin.
- There is a clean out placed at the end of the underdrain in order to allow for inspection and maintenance of the underdrain.
- Confined space training will be necessary for any inspector entering the outlet structure of the bio-retention basin.

INSPECTION CHECKLIST

Facility Name: Fort Monmouth Mod Substation

Maintenance Personnel:_____Date:_____ Weather Conditions:

Directions: Mark an "X" in Yes or No column.

OBSERVED ITEM	YES	NO	N/A	DIMENSIONS, LOCATIONS, COMMENTS, ETC.
Infiltration Basin				
1. Outlet structure condition				
2. Emergency Spillway condition				
3. Grass height				
4. Settlement				
5. Erosion issues				
6. Bare spots				
7. Animal/human damage				
8. Embankment seepage				
9. Drawdown Time				
Maintenance Recommendations:				

MAINTENANCE CHECKLIST

Facility Name: Fort Monmouth Mod Substation

Maintenance Crew:_____	Date:_____
Weather Conditions:	

MAINTENANCE ITEM	DESCRIPTION OF WORK AND EQUIPMENT USED
Infiltration Basin	
Landscaping	
Outlet Pipe	
Activity Notes:	

YEARLY COST ESTIMATE FOR INSPECTION OF INFILTRATION FACILITY

ITEM	Quantity	Unit	RATE	TOTAL
Vegetation inspection	8	Month	$100	$800
Erosion/Seepage inspection	4	Month	$100	$400
Outlet Structure inspection	4	Month	$100	$400
Emergency spillway inspection	4	Month	$100	$400
Estimated Total				$2,000

YEARLY COST ESTIMATE FOR THE MAINTENANCE OF INFILTRATION FACILITY

ITEM	Quantity	Unit	RATE	TOTAL
Mowing & trimming of vegetation (twice a month for 8 months)	16	EA	$300	$4,800
Trash Removal	4	EA	$100	$400
Outlet Structure blockages (4 minimum plus 4 extra for storms)	8	EA	$150	$1200
New Vegetative Cover	6500	S.F	$0.25	$1625
Regrading of erosion gullies	2	EA	$450	$900
Estimated Total				$8,925

The above are rough estimates and could fluctuate yearly based on weather conditions and wage rate changes. Operator should track yearly averages and adjust the above tables accordingly from year to year to reflect actual conditions/costs more accurately.

Appendix E

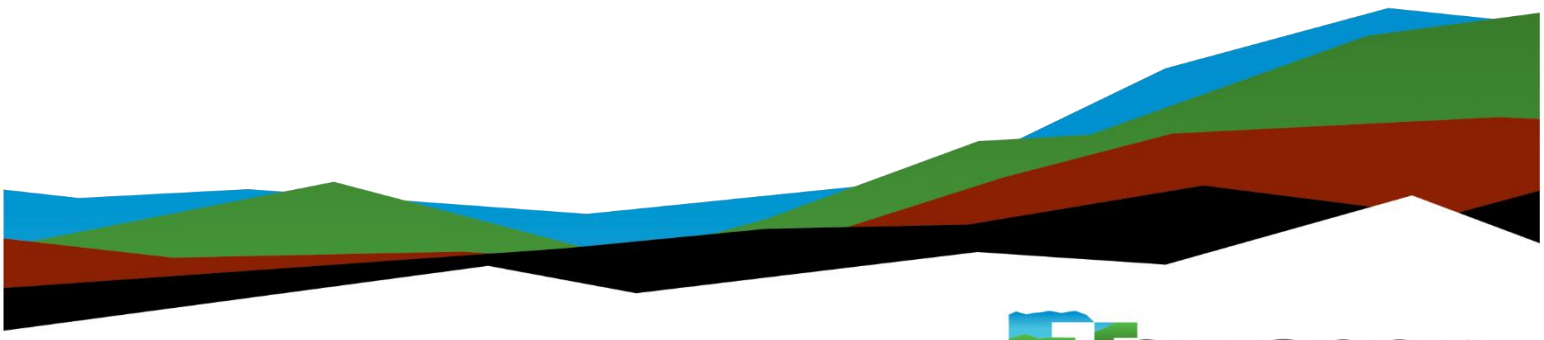
FMERA-MOB Substation

Stormwater Management Investigation

March 29, 2023 | Terracon Project No. J6225088

Prepared for:

Black & Veatch
3550 Green Court
Ann Arbor MI 48105



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4081 Hadley Road, Suite B
South Plainfield, NJ 07080
P (908) 546-6161
Terracon.com

March 29, 2023

Black & Veatch
3550 Green Court
Ann Arbor MI 48105

Attn: Mr. Tom Stroup, P.E.
P: 734-622-8862
E: strouptj@BV.com

Re: Stormwater Management Investigation
FMERA-MOB Substation
Oceanport, Monmouth County, New Jersey
Terracon Project No. J6225088

Dear Mr. Stroup:

We have completed the Stormwater Management Investigation services for the above referenced project in general accordance with Terracon Change Order No. 1 dated February 6, 2023. This report presents the findings of the subsurface exploration and provides results of the in-situ infiltration testing to assist HMI Services (HMI), the permitting consultant for the project, with the design of stormwater management systems for the proposed project.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report or if we may be of further service, please contact us.

Sincerely,

Terracon

Gregg Furson
Senior Project Manager

Erich Christiansen, P.E. (NJ)
Principal/Geotechnical Department Manager

Table of Contents

Attachments

Note: This report was originally delivered in a web-based format. **Blue Bold** text in the report indicates a referenced section heading. The PDF version also includes hyperlinks which direct the reader to that section and clicking on the Terracon logo will bring you back to this page. For more interactive features, please view your project online at **client.terracon.com**.

Refer to each individual Attachment for a listing of contents.

Introduction

This report presents the results of our subsurface exploration and Stormwater Management Investigation services performed for the proposed FMERA-MOB Substation that will be constructed within the former Fort Monmouth facility in Oceanport, Monmouth County, New Jersey. The purpose of these services was to provide information relative to:

- Subsurface soil conditions
- Groundwater conditions
- Results of infiltration testing

The Scope of Services for this project included the excavation of 2 test pits and the performance of 2 associated infiltration tests, which were performed on March 1, 2023.

Drawings showing the site and boring locations are shown on the **Site Location** and **Exploration Plan**, respectively.

Project Description

Our initial understanding of the project was provided in our proposal and was discussed during project planning. A period of collaboration has transpired since the project was initiated, and our final understanding of the project conditions is as follows:

Item	Description
Information Provided	Project information was provided via a subsurface investigation specification prepared by Black & Veatch (B&V) dated October 5, 2022.
Project Description	The project is the construction of a MOB substation. It is our understanding that a transformer, switchgear and breaker equipment will be installed. The equipment will be supported by a mat foundation. In addition, a deadend structure, as well as a possible static mast will be installed as part of the project. These structures would be supported by drilled shaft foundations.
Switchgear Load	Axial: 80 kips
Transformer Load	Axial: 200 kips
Breaker Loads	▪ Moment: 40 kip-ft

Item	Description
	▪ Axial: 10 kips
Deadend Load	Moment: 200 kip-ft
Static Mast Load	Moment: 150 kip-ft

It is our understanding that two underground stormwater management basins will be constructed on the west side of the site as part of the project.

Terracon should be notified if any of the above information is inconsistent with the planned construction.

Site Conditions

The following description of site conditions is derived from our site visit in association with the field exploration.

Item	Description
Parcel Information	The project is located in Oceanport, Monmouth County, New Jersey.
Existing Improvements	There is an existing one-story building.
Current Ground Cover	Vegetation, brush, grass and brush

Geotechnical Characterization

Two profile test pits numbered TP-1 and TP-2 were excavated to depths of approximately 9 and 8 feet below the existing ground surface, respectively. They were logged based on selected elements of the United States Department of Agriculture Soil Classification System, including soil texture, structure and consistency, as well as the Munsell color system, consistent with the guidelines promulgated in Chapter 12 of the NJDEP New Jersey Stormwater Best Management Practices Manual ("BMP Manual"), effective March 2021. The individual logs can be found in the **Exploration Results** section of this report.

Groundwater

Our representative also observed and recorded observations regarding groundwater levels and evidence of seasonal high (soil mottling) present at the time the test pits

were completed to provide a basis for our estimate of seasonal high-water levels, which are presented on the individual logs and summarized in the table below. If more accurate water level readings or seasonal high-water table are required, we recommend performing additional deeper explorations with groundwater observation wells to monitor the groundwater over a period of time.

Test Pit ID	Depth of Test Pit (feet)	Observed Water Level Immediately After Excavating (depth, in feet)	Estimated Seasonal High Level (depth, in feet)
TP-1	9	7	Not observed[1]
TP-2	8	6.5	Not observed[1]

1. Evidence of seasonal high water level (mottling) was not observed to the depths explored at these locations. Therefore, we recommend using the observed water level as seasonal high for design purposes since the test pit was performed during the NJ DEP recognized traditional wet period of the year from January to April, and direct observation can be used for design.

Infiltration Test Results

A total of two double-ring infiltrometer tests were performed in companion test pits in close proximity to the two profile test pits at the locations specified by HMI, at a depth of approximately 3.5 feet below the existing ground surface. The tests were performed in general accordance with the procedures outlined in Chapter 12, NJ BMP Manual, effective March 2021. The results of the infiltration tests are tabulated below.

Test Pit ID	Test Depth (feet)	Infiltration Rate (inches/hour)
TP-1	3.5	0
TP-2	3.5	0

General Comments

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Variations will occur between exploration point locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction.

Our Scope of Services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

Our services and any correspondence are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third-party beneficiaries intended. Any third-party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly affect excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety and cost estimating including excavation support and dewatering requirements/design are the responsibility of others. Construction and site development have the potential to affect adjacent properties. Such impacts can include damages due to vibration, modification of groundwater/surface water flow during construction, foundation movement due to undermining or subsidence from excavation, as well as noise or air quality concerns. Evaluation of these items on nearby properties are commonly associated with contractor means and methods and are not addressed in this report. The owner and contractor should consider a preconstruction/precondition survey of surrounding development.

Attachments

Exploration Procedures

Field Exploration

Number of Borings/Test Pits	Approximate Exploration Depth (feet)	Location
2 test pits	8 to 9	Stormwater management systems

Test Pit Layout and Elevations: Terracon personnel provided the boring and test pit layout using handheld GPS equipment (estimated horizontal accuracy of about ±10 feet) and referencing existing site features. If elevations and a more precise boring layout are desired, we recommend borings be surveyed.

Subsurface Exploration Procedures: The test pits were excavated with a small track excavator. We observed and recorded groundwater levels at the completion of excavation. For safety purposes, the test pits were backfilled with the excavated material.

Site Location and Exploration Plans

Contents:

Site Location
Exploration Plan

Note: All attachments are one page unless noted above.

Site Location

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES MAP PROVIDED BY MICROSOFT BING MAPS

Exploration Plan

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES MAP PROVIDED BY MICROSOFT BING MAPS

Exploration and Laboratory Results

Contents:

Test Pit Logs (TP-1 and TP-2)

Note: All attachments are one page unless noted above.

FMERA-MOB Substation
Main Street | Oceanport, NJ
Terracon Project No. J6225088

Terracon
4081 Hadley Rd, Ste B
South Plainfield, NJ

Test Pit Log No. TP-1

Location: See Exploration Plan

Latitude: 40.3103° Longitude: -74.0373°

Model Layer	Graphic Log	Depth (Ft.)		Depth (Ft.)	Water Level Observations	Sample Type
		0.5	**TOPSOIL**, 6"			
			FILL -, Dark olive brown (Munsell 2.5Y 3/3), sandy loam, 15% gravel, single grain, loose			
		3.0				
		3.5	**CLAYEY SAND (SC)**, Dark yellowish brown (Munsell 10YR 4/6), sandy clay loam, single grain, friable			
			SANDY SILT (ML), Yellowish brown (Munsell 10YR 5/6), silt loam, 1% gravel, single grain, firm	5		
		7.0				
			POORLY GRADED SAND WITH SILT (SP-SM), Light olive brown (Munsell 2.5Y 5/6), loamy sand, 5% gravel, single grain, loose wet at 7'			
		9.0				
			Test Pit Terminated at 9 Feet			

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Water Level Observations

While excavating

Cave In at 7'

Excavator
John Deere 75G

Operator
JT

Logged by
VP

Test Pit Started
03-01-2023

Test Pit Completed
03-01-2023

Notes

Advancement Method

Abandonment Method
Test Pits backfilled with excavated soil.

FMERA-MOB Substation
Main Street | Oceanport, NJ
Terracon Project No. J6225088

Terracon
4081 Hadley Rd, Ste B
South Plainfield, NJ

Test Pit Log No. TP-2

Location: See Exploration Plan

Latitude: 40.3101° Longitude: -74.0374°

Depth (Ft.)	Description
0.5	**TOPSOIL**, 6"
	FILL -, Olive Brown (Munsell 2.5Y 4/3), loamy sand, 7% gravel, single grain, loose
5.0	**CLAYEY SAND (SC)**, Olive Brown (Munsell 2.5Y 4/3), loamy sand, 3% gravel, single grain, friable
	wet at 6.5'
8.0	***Test Pit Terminated at 8 Feet***

Depth (Ft.): 5

Water Level Observations

Sample Type

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Water Level Observations

While excavating

Cave In at 6'

Excavator
John Deere 75G

Operator
JT

Logged by
VP

Test Pit Started
03-01-2023

Test Pit Completed
03-01-2023

Notes

Advancement Method

Abandonment Method
Test Pits backfilled with excavated soil.