

## Post Construction Stormwater Management/Site Restoration Plans Narrative

### Atlantic Sunrise Project Phase 2

West Diamond Regulator Station  
Jackson & Sugarloaf Townships  
Columbia County  
Pennsylvania

Prepared For:



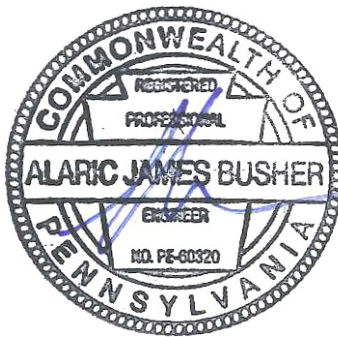
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BL Project No. 14C4909

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## CONTENTS

<u>Part</u>	<u>Description</u>	<u>Page</u>
<b>1.0</b>	<b>GENERAL INFORMATION</b>	<b>1</b>
1.1	Topographic Features	
	USGS Site Location Map	3
	Aerial Location Map	4
1.2	Soil Characteristics	5
1.3	Earth Disturbance Activity Characterization	7
1.4	Stormwater Management Calculation Methodology & Net Change in Volume and Rate of Runoff	9
1.5	Surface Water Classification	11
1.6	BMP Description Narrative	11
1.7	BMP Installation Sequence Narrative	12
1.8	Supporting Calculations	15
1.9	Plan Drawings	15
1.10	Long Term Operation and Maintenance Schedule	15
1.11	Material Recycling and Disposal	17
1.12	Soil Conditions and Geologic Formations	22
1.13	Thermal Impacts	22
1.14	Riparian Forest Buffer Management Plan	23
1.15	Antidegradation Requirements	23
1.16	Preparedness Prevention and Contingency Plan	23

## APPENDICES

<u>Part</u>	<u>Description</u>
Appendix A	West Diamond Regulator Station Supporting Calculations
	A.1 Pre-Development Calculations
	A.2 Post Development Calculations
	A.3 Conveyance Calculations
	A.4 PCSM BMP Calculations
	A.5 Water Quality Worksheets
	A.6 Site Characterization Assessment
	A.7 Supporting Documentation
Appendix B	Preparer Qualifications

## Appendix C

### United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Custom Soil Resource Report



## **1.0 GENERAL INFORMATION**

The following narrative was prepared as a supplement to the Transcontinental Gas Pipe Line Company, LLC.'s (Transco's) Environmental Construction Plan (ECP) provided in Section 4 of the Erosion and Sediment Control General Permit 2 (ESCGP-2) Notice of Intent (NOI), which was prepared for the Atlantic Sunrise Project ("Project"). This PCSM/SR narrative is intended to describe the post construction stormwater management/site restoration (PCSM/SR) design for the West Diamond Regulator Station ("Site") to be constructed as part of the Project, within Jackson/Sugarloaf Township, Columbia County, Pennsylvania. Similar narratives were prepared, under separate cover, for facilities in other affected counties, as well as for the pipeline construction.

The facility proposed to be constructed as part of Phase 2 of the Atlantic Sunrise Project in Columbia County is the following:

Facility Name	Facility Description	Facility Coordinates
West Diamond Regulator Station	Regulator Station	N41°16'24.28", W76°24'25.32"

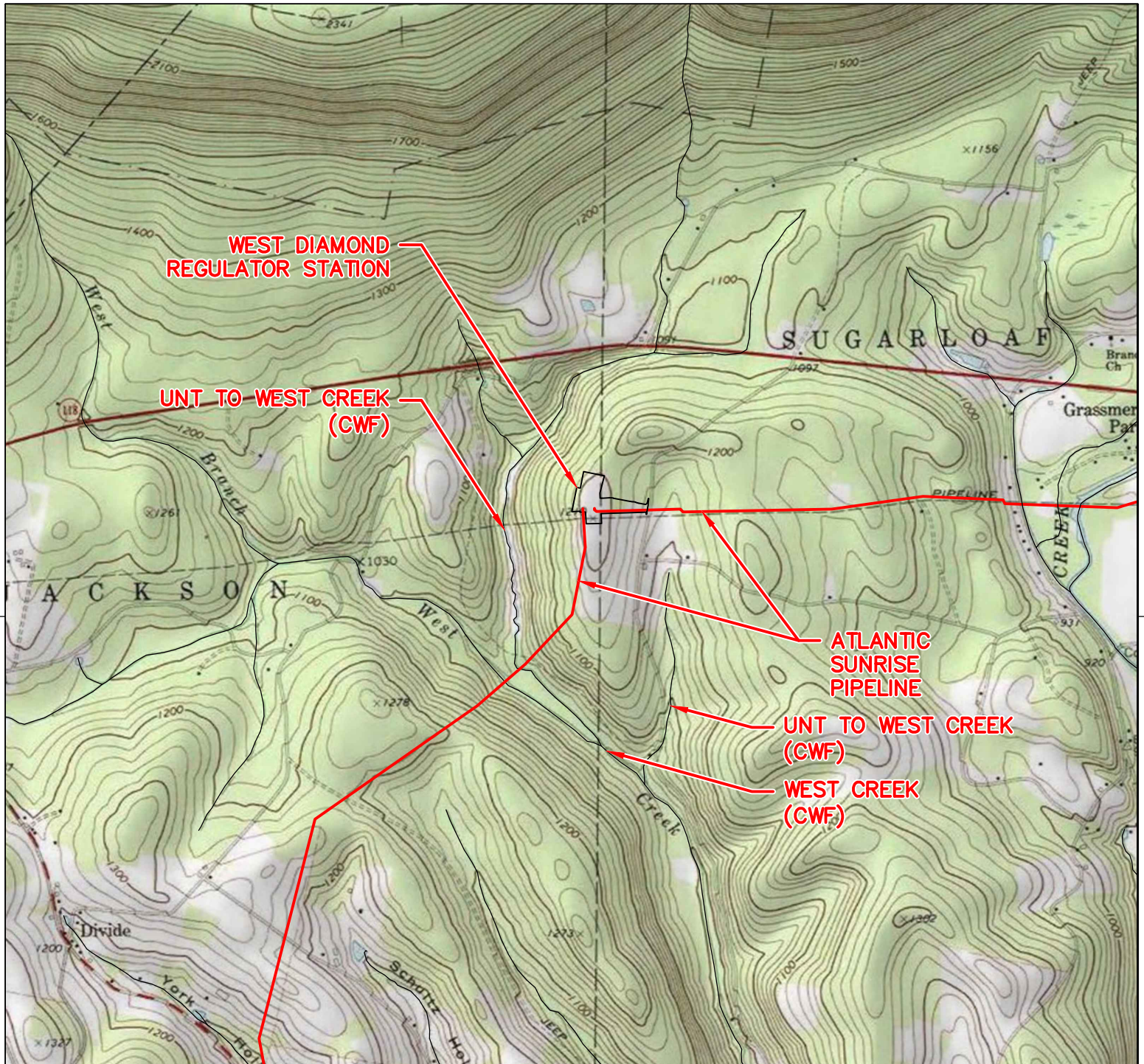
The West Diamond Regulator Station will be approximately 7.14 acres in area including a 706 linear foot permanent gravel access road, 51,522 square feet (1.18 acre) of gravel pad and 561 square feet (0.01 acers) of building that total 67,002 square feet (1.54 acres) of impervious area. The Site will utilize existing public and private roads for access to the Site during and after construction. PCSM/SR Best Management Practices (BMPs), in accordance with the standards and specifications in the Pennsylvania Department of Environmental Protection's (PADEP's) "Erosion and Sediment Pollution Control (E&S) Program Manual," Technical Guidance No. 363-2134-008, as amended and updated (E&S Manual) will be implemented to minimize and/or avoid potential adverse environmental impacts due to the construction, operation and maintenance activities associated with the Site. The proposed practices are designed to maximize volume reduction technologies, eliminate or minimize point source discharges to surface waters, preserve the integrity of stream channels, and protect the physical, biological, and chemical qualities of the receiving surface water. The intent is to keep the post construction runoff volume and flow rate no greater than the pre-construction conditions while maintaining water quality. Impervious areas, land clearing and soil compaction are minimized and natural drainage features and vegetation are protected wherever possible. Heavy equipment will be restricted from infiltration areas. E&SC and PCSM BMP measures will be installed and maintained as needed to control stormwater movement in the Site area.

Refer to the ECP (**Section 4 of the ESCGP-2 NOI**) for overall Project information.

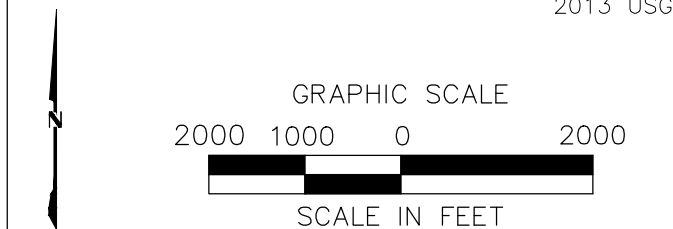
There are no impacts to regulated wetlands associated with this proposed Site. Refer to the Wetland Delineation Report provided in **Section 5 of the ESCGP-2 NOI** for information supporting wetland mapping as shown on the Erosion and Sediment Control (E&SC) Plans (**Section 2 of the ESCGP-2 NOI**).



## 1.1 Topographic Features



2013 USGS ELK GROVE QUADRANGLE



### ATLANTIC SUNRISE PROJECT WEST DIAMOND REGULATOR STATION

USGS LOCATION MAP

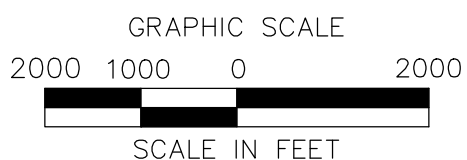
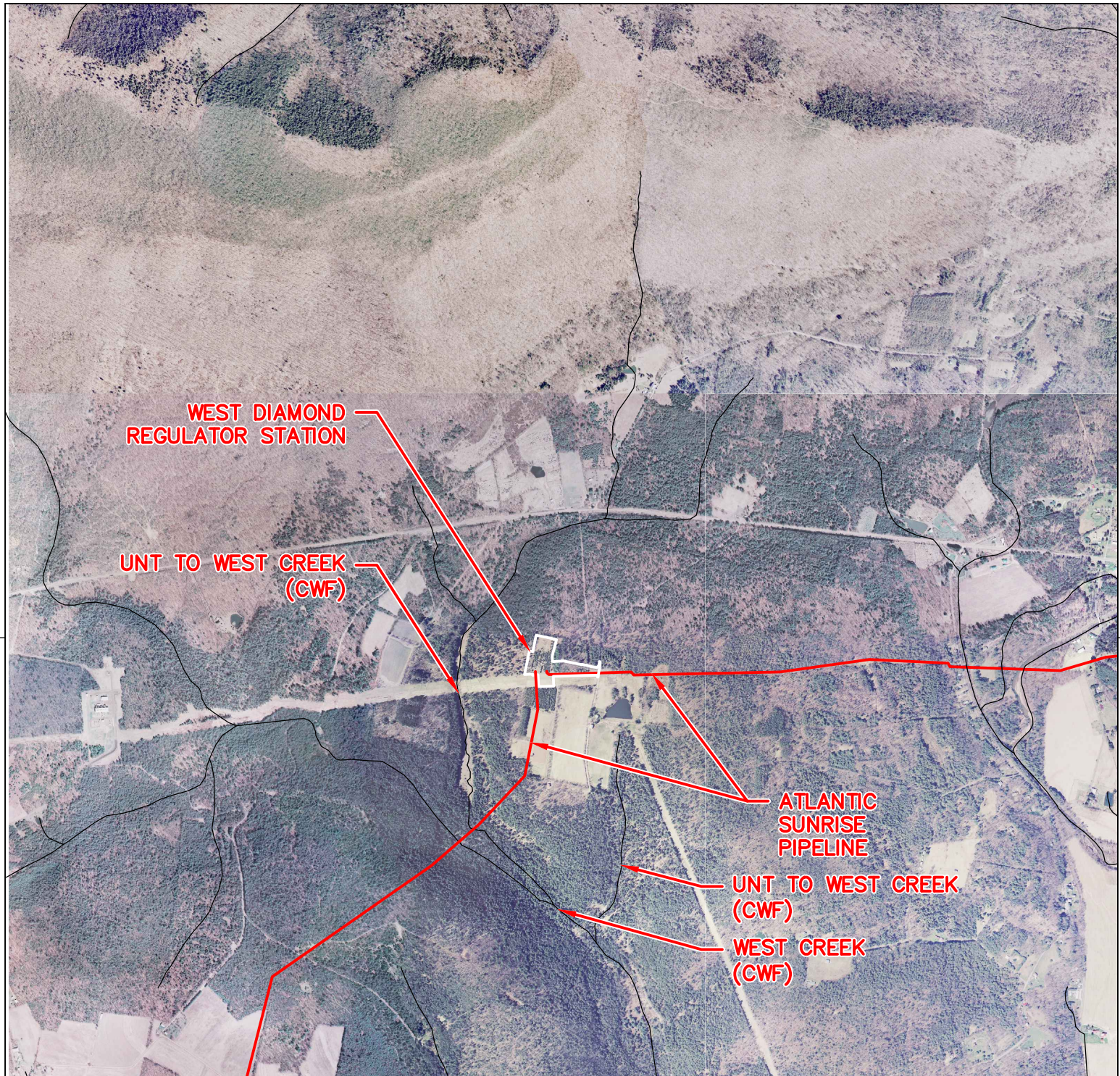
JACKSON/SUGARLOAF TOWNSHIP  
COLUMBIA COUNTY, PENNSYLVANIA



NO.	DATE	BY	REVISION DESCRIPTION	W.O. NO.	CHK.	APP.	DRAWN BY:	JEC	DATE:	04/03/15	ISSUED FOR BID:	SCALE: 1"=2,000'
01	08-28-15 12-02-15	BL BL	ISSUED FOR PADEP PERMIT SUBMITTAL ISSUED FOR PADEP RESUBMITTAL	1161501 1161501	SMK AJB		CHECKED BY:	AOE	DATE:	04/03/15	ISSUED FOR CONSTRUCTION:	
							APPROVED BY:	AJB	DATE:	04/03/15	DRAWING NUMBER:	WEST DIAMOND RS LOCATION
							WO:	1161501				SHEET 1 OF 1







**ATLANTIC SUNRISE PROJECT**  
**WEST DIAMOND REGULATOR STATION**  
AERIAL LOCATION MAP  
JACKSON/SUGARLOAF TOWNSHIP  
COLUMBIA COUNTY, PENNSYLVANIA



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							WO:	1161501				SHEET 1 OF 1





## 1.2 Soil Characteristics

In addition to the below use limitations and resolutions, refer to Appendix C for the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Custom Soil Resource Report for the Site.

**Soil Type and Use Limitations**

Map Symbol	Soil Name	Slope	Cut Banks Cave	Corrosive to Concrete or Steel	Droughty	Easily Erodeable	Flooding	High Water Table	Hydric/Hydric Inclusions	Low Strength	Slow Percolation	Piping	Poor Source of Topsoil	Frost Action	Shrink-Swell	Potential Sinkhole	Ponding	Wetness
OsB	Oquaga very stony silt loam	0-12%	X	C	X	X			X		X			X				
OcB2	Oquaga channery silt loam, moderately eroded	2-12%	X	C	X	X			X		X			X				
OcC2	Oquaga channery silt loam, moderately eroded	12-20%	X	C	X	X			X		X			X				
OsD	Oquaga very stony silt loam	12-35%	X	C	X	X			X		X			X				

Source: Appendix E, Table E-1, PADEP, *Erosion and Sediment Pollution Control (E&S) Program Manual* Technical Guidance Number 363-2134-008.

### Soil Use Limitations Resolutions

Limitation	Resolution
Cut Banks Cave	Excavations will be properly supported by sheeting and shoring to prevent caves.
Corrosive to Concrete or Steel	No concrete or steel piping is proposed without appropriate coatings and protection.
Droughty	Existing suitable topsoil and soil amendments will be used during construction.
Easily Erodible	Temporary and permanent erosion control BMPs will be employed throughout the Site.
Flooding	Ensure that the Site has proper drainage.
High Water Table	A geotechnical investigation was conducted to minimize conflicts with saturated zones.
Hydric/Hydric Inclusions	A wetland investigation was completed to determine no wetlands are present in the development area.
Low Strength	A maximum of 3:1 slopes are proposed.
Slow Percolation	A field investigation of percolation rates at the infiltration areas was performed to verify the soils percolation capacity.
Piping	Watertight pipe, antiseep collars, clay cores through basin berms, and concrete endwalls will be used to minimize the danger of piping.
Poor Source of Topsoil	Existing topsoil, which has proven to be suitable, will be reused on the Site.
Frost Action	Pavement subbase will be provided to minimize frost effects.
Shrink-Swell	Stone base will be provided to prevent shrink-swell from effecting pavement.
Potential Sinkhole	Geotechnical engineer of record recommendations will be followed for any potential occurrences.
Ponding	Surface grading and drainage facilities will be provided to minimize ponding affects.
Wetness	Wet weather construction recommendations, per the geotechnical engineer's recommendations, will be employed to minimize the effects of wetness during construction, surface grading. Surface grading and drainage will be provided to minimize wetness affects after construction.



### 1.3 Earth Disturbance Activity

#### Proposed Improvements and Land Use

The proposed West Diamond Regulator Station will be constructed in Lehman Township, Luzerne County. West Diamond Regulator Station will include construction of a regulator station and associated access road. The earthmoving activity will involve the stripping and stockpiling of top soil, Site grading, Site excavation, placement of fill, trenching and backfill, construction of equipment with gravel pad/parking lot, construction of a gravel access drive, construction of a stormwater management system, finish grading, and stabilization of disturbed surfaces. Approximately 67,002 square feet (1.54 acres) of additional gravel area will result on-site.

#### Present/Past Land Use

This section identifies the land requirements for construction and operation of the proposed CPL North, CPL South, and Associated Facilities. Table 1.3.1 summarizes the land requirements for the proposed West Diamond Regulator Station associated with the CPL North and CPL South mainlines.

The characterization of land use within the proposed CPL North, CPL South, and Associated Facilities project areas is based on interpretation of aerial photographs taken in the spring of 2014 and information gathered from field surveys conducted during 2014 and 2015. Transco classified land uses within the proposed CPL North, CPL South, and Associated Facilities project areas into the following eight broad types:

- Agricultural Land – land associated with active cultivation of row and field crops; areas of grasses planted for livestock grazing or for the production of hay crops; orchards; and specialty crops, including vineyards, Christmas trees, and fruits and vegetables.
- Upland Forest/Woodland – includes upland deciduous forest, evergreen forest, and mixed (deciduous and evergreen) forest, but does not include forested wetlands.
- Industrial/Commercial Land – land used for mines or quarries and associated processing plants; manufacturing or other industrial facilities; and land developed for commercial or retail uses, including malls, strip plazas, business parks, and medical facilities.
- Transportation Land – land used for transportation purposes, including interstate highways; state, county, and local highways and roads; and railroad lines.

- Residential Land – residential areas, including yards of individual residences.
- Open Land – non-forested and undeveloped land not classified for another use, including land maintained as utility ROWs for overhead and underground electric transmission, natural gas transmission, and oil transmission facilities.
- Wetlands – includes wetlands covered with emergent, scrub-shrub, and forested vegetation.
- Open Water – include rivers, streams, creeks, canals, and other linear waterbodies, as well as lakes, ponds, and other non-flowing waterbodies.

New MLVs will be wholly located within the permanent ROWs for the proposed CPL North and CPL South mainlines. Construction will primarily occur within the proposed CPL North and CPL South construction ROWs. Land uses appear to have remained similar for the past 50 years.

**Table 1.3.1**  
**Land Requirements for the New Aboveground Facilities<sup>a</sup>**

Facility	Milepost	County	Agricultural Land (acres)		Upland Forest / Woodland (acres)		Open Land (acres)		Total (acres)	
			Cons	Op	Cons	Op	Cons	Op	Cons	Op
West Diamond Regulator Station with pig launcher and receiver	L114.0	Columbia	0.0	0.0	3.0	3.0	1.8	1.4	4.8	4.4
<b>Columbia County Subtotal</b>			<b>32.8</b>	<b>32.8</b>	<b>0.7</b>	<b>0.7</b>	<b>1.8</b>	<b>1.4</b>	<b>38.3</b>	<b>37.9</b>
Notes: <sup>a</sup> Land use acreages for construction and operation are provided for reference only. Acreages provided were calculated by using kmz files and prepared as part of the June 8, 2015 FERC Supplement. Refer to plans and ESCGP-2 NOI for actual site conditions.  Key: Cons = Construction L = Leidy Line system milepost Op = Operation										

Please refer to the PCSM/SR Plans and Detail Sheets, as provided in **Section 3 of the ESCGP-2 NOI**, and Section 1.2 and Appendix C of this PCSM/SR Narrative for information on the Site soils.

#### **1.4 Stormwater Management Calculation Methodology & Net Change in Volume and Rate of Runoff**

Runoff volume and rate calculations have been performed for the Site are included in Appendix A.

Pre-development and Post Development runoff hydrographs were developed for the 1-, 2-, 10-, 25-, 50-, and 100-year storm events using the Soil Conservation Service's TR-55 Method. The PCSM/SR BMPs will meet the volume reduction and water quality requirements of Control Guideline 1 (CG 1). Water Quality Worksheet #4 was used to complete the CG 1 volume analysis for the 2-year storm event. Stormwater models were created using the HydroCAD Version 7.10 computer program produced by HydroCAD Software Solutions, LLC. Stormwater conveyance calculations were performed using Worksheet 11 of the Pennsylvania Erosion and Sediment Pollution Control (E&S) Program Manual. (Analysis of rates and flows at each point of interest (POI) were completed to meet CG 1 Requirements.) National Oceanic Atmospheric Administration (NOAA) Atlas 14 rainfall intensities were used in the calculations. See Appendix A for calculations and results.

##### POI Summary:

***POI A: Subarea of POI 1 (Improvements associated with pad area and basins) (UNT to West Creek)***

***POI B: Subarea of POI 1 (Improvements associated with permanent access road and roadside swale) (UNT to West Creek)***

***POI 1: Where POI A and POI B combine (downstream at West Creek)***

***Overall Site: West Creek***

### Volume Summary Table

VOLUME SUMMARY					
	2- YR PRE (FT <sup>3</sup> )	2- YR POST (FT <sup>3</sup> )	2- YR VOLUME INCREASE (FT <sup>3</sup> )	2- YR STRUCTURAL AND NONSTRUCTURAL CREDITS (FT <sup>3</sup> )	DIFFERENCE (FT <sup>3</sup> )
<b>POI A</b>	11,197	17,135	5,938	9,050	3,111
<b>POI B</b>	<b>7,548</b>	<b>8,564</b>	<b>1,016</b>	<b>1,602</b>	<b>584</b>
<b>POI 1</b>	<b>18,745</b>	<b>25,699</b>	<b>6,954</b>	<b>10,652</b>	<b>3,695</b>

\*See Appendix A.5 for calculations.

### Runoff Rate Summary Table

STORM EVENT	POINT OF INTEREST A			POINT OF INTEREST B			POINT OF INTEREST 1		
	PRE (CFS)	POST (CFS)	REDUCTION (CFS)	PRE (CFS)	POST (CFS)	REDUCTION (CFS)	PRE (CFS)	POST (CFS)	REDUCTION (CFS)
1-yr	1.39	1.16	0.23	1.06	0.87	0.19	2.42	2.01	0.41
2-yr	2.51	1.94	0.57	1.89	1.50	0.39	4.32	3.43	0.89
5-yr	4.20	3.07	1.13	3.27	2.56	0.71	7.21	5.55	1.66
10-yr	5.63	3.98	1.65	4.39	3.39	1.00	9.64	7.28	2.36
25-yr	7.74	5.32	2.42	6.05	4.62	1.43	13.24	9.83	3.41
50-yr	9.48	6.41	3.07	7.41	5.62	1.79	16.21	11.97	4.24
100-yr	11.31	9.71	1.60	8.84	6.72	2.12	19.33	16.42	2.91

\*See Appendix A.1 for Pre-Development Calculations with Mapping and Appendix A.2 for Post Development Calculations with Mapping.

### Act 167 Summary

The Site is not located within a current, PADEP approved Act 167 Stormwater Management Watershed Plan. Therefore, the Site was designed to meet CG 1 requirements.

## 1.5 Surface Water Classification

The PCSM/SR drawings in **Section 3 of the ESCGP-2 NOI** depict the locations of the streams and wetlands in and near the LOD for the Site. The Site area surface water runoff drain to two different UNT to West Creek, which are not High Quality (HQ) or Exceptional Value (EV) streams. The receiving waters are designated as Cold Water Fishery (CWF) under PA Code 25 Chapter 93. The Site's watersheds are not listed as impaired in the PADEP Chapter 93 Integrated List.

## 1.6 BMP Description Narrative

The structural PCSM BMPs listed below are to be used for this Site. The calculations used to design the PCSM BMPs are included in Appendix A. The locations of the PCSM BMPs are shown on the PCSM/SR Plans and Detail Sheets (**Section 3 of the ESCGP-2 NOI**).

Vegetated Swales with **Earthen** Check Dams: A vegetated swale with earthen check dams will be utilized to manage post construction stormwater runoff.

Rain Garden: Infiltration will occur within Rain Garden #1 will be utilized to infiltrate post construction stormwater runoff and provide runoff rate and volume control.

Stormwater Management Basin: Connected to the infiltration area of Basin #1, a stormwater area will be utilized to provide runoff rate control, only.

Minimize Total Disturbed Areas – Grading: The extent of proposed earthwork on the Project Site will be minimized in order to avoid special value/sensitive areas and reduce disturbed areas. Orange construction fence will be used to protect special value/sensitive areas during construction.

Minimize Soil Compaction in Disturbed Areas: Soil compaction within the limit of disturbance will be minimized to the extent practicable in order to protect soil quality, preserve permeability and protect the soil from damage where possible. Minimum compaction areas will be surrounded by orange construction fence for the duration of construction activities to ensure minimum compaction.

Disconnection from Storm Sewers: In order to enhance infiltration and pollutant removal, reduce stormwater runoff volume, slow runoff velocities, and reduce peak discharge rates, stormwater runoff from impervious areas will be directed to infiltration areas and vegetated swales. This will also reduce or eliminate the need for curbs, gutters, inlets and storm sewers.

Soil Amendment and Restoration: Soil amendments shall be added to Basin areas after construction in order to restore soil porosity and enhance long term infiltration.

Reduce parking impervious area: Impervious parking areas will be minimized to the maximum extent practicable. All roads and pads will be gravel areas.

### **1.7 BMP Installation Sequence Narrative**

1. At least 7 days prior to starting any earth disturbance activities, including clearing and grubbing, the owner and/or operator shall invite all contractors, Environmental Inspectors, the landowner, appropriate municipal officials, the E&S plan preparer, the PCSM plan preparer, the licensed professional responsible for oversight of critical stages of implementation of the PCSM plan, and a representative from the local conservation district to an on-site preconstruction meeting.
2. At least 3 days prior to starting any earth disturbance activities, or expanding into an area previously unmarked, the Pennsylvania One Call System Inc. shall be notified at 1-800-242-1776 for the location of existing underground utilities.
3. Install orange construction fence around areas to be protected.
4. Locate staging areas and access points including construction entrances. Field locate limits of disturbance.
5. Install rock construction entrance (RCE) at temporary access road.
6. Remove brush to effectively install perimeter controls, level side cuts to grant access for vehicles and workers to safely perform the installation of sediment barriers on the Site as shown on the construction drawings.
7. The Compliance Manager shall provide PADEP and CCD at least three days' notice prior to bulk earth disturbance and upon completed installation of perimeter erosion controls.
8. Install temporary access road. Construction of temporary access road shall be fully completed and stabilized prior to any additional disturbance occurs on site.
9. Install waterbars. Any E&SC BMPs associated with the construction of the pipeline should remain in place until construction of pipeline and facility is completed and the areas are stabilized.

10. \* **Install Sediment Trap with temporary riser orifice configuration, including clay core, antiseep collars, slope liners, cleanout stake, and associated improvements. Install orange construction fence at perimeter of trap to prevent compaction of soils.**
11. Proceed with major clearing and grubbing.
12. Begin construction staking for grading.
13. Begin grading and strip and stockpile topsoil within the regulator station area and install sediment barriers around stockpiles.
14. Upon temporary cessation of an earth disturbance activity or any stage of an activity where the cessation of earth disturbance activities will exceed four days, the Site shall be immediately seeded, mulched, or otherwise protected from accelerated erosion and sedimentation pending future earth disturbance activities. For an earth disturbance activity or any stage of an activity to be considered temporarily stabilized, the disturbed areas shall be covered with one of the following: A minimum uniform coverage of mulch and seed, with a density capable of resisting accelerated erosion and sedimentation, or an acceptable BMP which temporarily minimizes accelerated erosion and sedimentation. Temporary stabilization will not occur on active vehicular travel ways within the ROW. The on-site environmental inspector will log daily activity within the LOD and notify the Contractor of areas requiring temporary stabilization (i.e., areas where work has ceased for at least four days).
15. Rough grade Site.
16. Grade the regulator station pad as shown on the E&SC and PCSM/SR Plans **(Sections 2 and 3 of the ESCGP-2 NOI)**.
17. Immediately stabilize side slopes with erosion control matting when slopes are 3:1 or greater. See PCSM/SR Plans and Detail Sheets, as provided in **Section 3 of the ESCGP-2 NOI**, (patterns differ by slope category). Install rip rap slope stabilization where shown on the PCSM/SR Plans.
18. Establish final grade.
19. Surface Stabilization, apply permanent stabilization measures immediately to any disturbed areas where work has reached final grade.

20. Construct remainder of stormwater management Basin 1 area. All earth moving associated with this work shall be completed prior to converting temporary riser to the permanent riser configuration. Any excess excavation material that will not be used onsite shall be hauled offsite.
21. Upon completion of all earthwork activities and permanent stabilization of all disturbed areas, the Owner and/or Operators shall contact the local CCD for an inspection prior to the removal/conversion of the E&SC BMPs.
22. **\* Convert trap to permanent Basin 1 configuration by removing all accumulated sediments, removing baffles and amending soils on basin bottom. Immediately seed and stabilize basin, install erosion control blanket on basin slopes, and install CFS on interior toe of slope. Haul off site any excess material not used and left over from the conversion of the basin.**
23. **\* Reconfigure temporary riser to permanent outlet structure by permanently sealing the 1" orifices. Install emergency spillway.**
24. **\* Once construction for the regulator station and the pipeline is complete and the areas are stabilized, install permanent access road and associated BMPs (vegetated roadside swales with earthen check dams and riprap outlet protection). Any waterbars associated with the pipeline construction that are impacted by the construction of the permanent access road should be removed.**
25. Remove temporary access road. Restore temporary access road area to pre-development grades. Immediately seed and stabilize area disturbed during removal of access road.
26. After finish grading and topsoil placement is completed, disturbed areas shall be fertilized, seeded, and mulched. Seed mixtures, fertilizer and mulch applications rates and dates shall conform to the tables provided on the PCSM/SR Plans and Detail Sheets (**Section 3 of the ESCGP-2 NOI**), land owner agreements and/or the **ECP (Section 4 of the ESCGP-2 NOI)**.
27. After seeding, fertilizing and mulching is complete, install ECBs as required or ordered or on slopes of 3:1 or greater.
28. After the Site is permanently stabilized and upon PADEP or local CCD and Owner approval of stabilization and re-vegetation, remove temporary erosion and sediment control measures and stabilize areas disturbed by removal.



29. **\* Complete Site stabilization, including soil amendment, seed application, ECB installation in basins, and mulching.**
30. Upon completion of all earth disturbance activities, the Owner and/or Operators shall contact the local CCD for a final inspection.
31. Maintain E&SC BMPs until site work is complete and uniform 70% perennial vegetative cover is established.
32. Remove and properly dispose/recycle E&SC BMPs. Remove orange construction fence. Repair and permanently stabilize areas disturbed during E&SC BMP removal upon establishment of uniform 70% vegetative cover.

**\* indicates a critical stage of PCSM installation to be observed by a licensed professional or designee. Contractor to provide three working days' notice to Design Engineer.**

## **1.8 Supporting Calculations**

Supporting calculations are included in Appendix A.

## **1.9 Plan Drawings**

PCSM/SR Plans, including sensitive resource mapping, are included in **Section 3 of the ESCGP-2 NOI**.

## **1.10 Long Term Operation and Maintenance Schedule**

### **Monitoring**

Transco's personnel (Operations) will perform visual inspections on an annual basis after permit closure, by qualified personnel, trained and experienced in PCSM/SR, to ascertain that the BMPs are functioning and operating effectively to ensure West Diamond Regulator Station are causing no undue burden on the property owner or adjacent owners. Repairs of deficiencies will be initiated within ten business days of discovery.

### **Maintenance**

The Contractor will be responsible for the maintenance of the system during construction. After construction, the stormwater management facilities will be owned and maintained by Transco.

Where maintenance of the storm system after acceptance by the Owner will primarily consist of routine cleaning of accumulated sediment and debris by facility staff or private contractors, the specific maintenance steps and schedule are listed below:

1. Stormwater/Infiltration Basins

Inspect stormwater/infiltration facilities annually and inspect soil, repair eroded areas and remove litter and debris as needed. Inspect twice a year for sediment buildup, erosion and vegetative conditions. Remove and replace dead and diseased vegetation. Any litter, debris, sediment, vegetation, or other items removed during maintenance activities will be disposed of in a manner consistent with the ESCGP-2 requirements. ***Compaction of the basin bottom shall be prevented.***

2. Vegetated Swales with ***Earthen*** Check Dams

***Vegetated swales with Earthen Check Dams are to be inspected annually for sediment, build-up, erosion debris, and damage due to traffic. Ditches should be maintained to ensure that the specified design dimensions and vegetative lining are available at all times. No more than one-third of the shoot (grass leaf) shall be removed in any mowing. Grass height shall be maintained between 3 and 6 inches unless otherwise specified. Excess vegetation shall be removed from permanent channels to ensure sufficient channel capacity. Any litter, debris, sediment, vegetation, or other items removed during maintenance activities will be disposed of in a manner consistent with the ESCGP-2 requirements.***

3. Minimize Soil Compaction

- ***Protected areas – restrict vehicle access, do not clear vegetation. Avoid earth disturbance.***
- ***Minimum disturbance areas – Restrict vehicle access.***

4. Disconnection from Storm Sewers

Disconnected impervious areas shall continue to be directed to infiltration areas and vegetated swales as shown on the PCSM/SR Plans (**Section 3 of the ESCGP-2 NOI**). Infiltration areas and vegetated swales shall be maintained as indicated on the PCSM/SR Plans (**Section 3 of the ESCGP-2 NOI**).

## 5. Soil Amendments and Restoration

Restrict vehicle access. Monitor water drawdown time in infiltration areas and replace amended soils if dewatering time increases to more than three days. Maintain Infiltration areas and vegetated swales as indicated on the PCSM/SR Plans.

## 6. Reduce Parking Area/Street Area Imperviousness

Gravel areas will be maintained in good condition and will not be paved without obtaining prior approval from the PADEP or the County Conservation District.

## 7. Level Spreader

***Inspect area below the level spreader on a quarterly basis for the first two years after installation and annually thereafter. Remove sediment and debris from the level spreader when it interferes with proper function. Regrade and reseed any channelized or eroded areas that develop below the level spreader. Regrade any newly occurring areas where water stands for longer than 72 hours. Inspect vegetation for the first growing season. Conduct health, diversity and density inspection twice a year after the first growing season. Maintain vegetative cover at 85%.***

## 8. Annual Records of Maintenance Procedures

The facility shall maintain a checklist whenever the storm system is inspected and cleaned. An annual list of inspections and major cleaning operations and repairs (pumping, sweeping parking lots, cleaning catch basin, etc.) shall be maintained. The local CCD or enforcement officials shall have access to those records.

## 9. ESCGP-2

The facility Owner and Operator shall ensure compliance with ESCGP-2 requirements by meeting all ongoing record, keeping maintenance, and other applicable ESCGP-2 and PADEP permit conditions.

### 1.11 Material Recycling and Disposal

The restoration of the temporary gravel will require the removal of the temporary materials. The temporary materials include, but may not be limited to, stone surface and

associated geotextiles. The contractors are required to dispose of materials at suitable disposals or recycling sites and in compliance with local, state and federal regulations.

Transco has prepared a Spill Plan for Oil and Hazardous Materials to assist in prevention of any spills that may occur at the Site and to respond to any spills that do occur. The Contractor will be required to become familiar with the Spill Plan for Oil and Hazardous Materials and its contents prior to commencing any construction-related activities. The Spill Plan for Oil and Hazardous Materials is included as **Attachment 9 to the ECP** provided as **Section 4 of the ESCGP-2 NOI**.

Contractors are required to inventory and manage their construction site materials. The goal is to be aware of the materials on-site; ensure they are properly maintained, used, and disposed of; and to make sure the materials are not exposed to stormwater.

#### ***Materials Covered***

The following materials or substances are expected to be present on-site during construction (**Note: this list is not an all-inclusive list and the Materials Management Practices can be modified to address additional materials used on-site**):

- Acids
- Detergents
- Fertilizers (nitrogen/phosphorus)
- Hydroseeding mixtures
- Petroleum based products
- Sanitary wastes
- Soil stabilization additives
- Solder
- Solvents
- Other

These materials must be stored as appropriate and shall not contact storm or non-stormwater discharges. Contractor shall provide a weather proof container to store chemicals or erodible substances that must be kept on the Site. Contractor is responsible for reading, maintaining, and making employees and subcontractors aware of safety data sheets (SDSs).

#### ***Material Management Practices***

The following are material management practices that will be used to reduce the risk of spills or other accidental exposure of materials and substances to stormwater runoff.

## 1. Good Housekeeping Practices

The following good housekeeping practices will be followed on Site during construction:

- Store only enough material required to do the job.
- Store materials in a neat, orderly manner.
- Store chemicals in watertight containers or in a storage shed, under a roof, completely enclosed, with appropriate secondary containment to prevent spill or leakage. Drip pans shall be provided under dispensers.
- Substances will not be mixed with one another unless recommended by the Manufacturer.
- Manufacturer's recommendations for proper use and disposal will be followed.
- Inspections will be performed to ensure proper use and disposal of materials.
- Cover and berm loose stockpiled construction materials that are not actively being used (i.e. Soil, spoils, aggregate, etc.).
- Minimize exposure of construction materials to precipitation.
- Minimize the potential for off-site tracking of loose construction and landscape materials.

## 2. Hazardous Products

These practices will be used to reduce the risks associated with hazardous materials. SDSs for each substance with hazardous properties that is used on the job site(s) will be obtained and used for the proper management of potential wastes that may result from these products. A SDS will be posted in the immediate area where such product is stored and/or used and another copy of each SDS will be maintained in a file at the job site construction trailer office. Each employee, who must handle a substance with hazardous properties, will be instructed on the use of SDS and the specific information in the applicable SDS for the product he/she is using, particularly regarding spill control techniques.

- Products will be kept in original containers with the original labels in legible condition.
- Original labels and SDSs will be produced and used for each material.
- If surplus product must be disposed of, manufacturers or local/state/federal recommended methods for proper disposal will be followed.

### 3. Hazardous Wastes

All hazardous waste materials will be disposed of by the Contractor in the manner specified by local, state, and/or federal regulations and by the manufacturer of such products. Site personnel will be instructed.

### 4. Concrete and Other Wash Waters

Prevent disposal of rinse, wash waters, or materials on impervious or pervious surfaces, into streams, wetlands or other water bodies.

Concrete trucks will be allowed to wash out or discharge surplus concrete or drum wash water on the Site, but only in either (1) specifically designated diked areas which have been prepared to prevent contact between the concrete and/or washout and soil and stormwater having the potential to be discharged from the Site; or (2) in locations where waste concrete can be poured into forms to make riprap or other useful concrete products.

The hardened residue from the concrete washout diked areas will be disposed of in the same manner as other non-hazardous construction waste materials or may be broken up and used on the Site as deemed appropriate by the Contractor and Owner or Owner's representative. The Contractor will be responsible for seeing that these procedures are followed.

All concrete washout areas will be located in an area where the likelihood of the area contributing to stormwater discharge is negligible. If required, additional E&SC BMPs must be implemented to prevent concrete wastes from contributing to stormwater discharges. The location of the concrete washout area(s) must be identified, by the Contractor/Job Site Superintendent, on the job site copy of the E&SC Plans (**Section 2 of the ESCGP-2 NOI**) and in the E&SC Narrative.

## 5. Sanitary Wastes

All sanitary waste units will be located in an area where the likelihood of the unit contributing to stormwater discharges is negligible. Additional E&SC BMPs must be implemented, such as containment trays (provided by the rental company) or special containment created with 2" x 4" lumber, impervious plastic, and gravel. The location of the sanitary waste units must be identified on the job site copy of the E&SC Plans (**Section 2 of the ESCGP-2 NOI**), in the E&SC Narrative, by the Contractor/Job Site Superintendent.

## 6. Solid and Construction Wastes

All waste materials will be collected and stored in a securely lidded metal dumpster. The dumpster will comply with all local and state solid waste management regulations. The dumpster/container lids shall be closed at the end of every business day and during rain events. Appropriate measures shall be taken to prevent discharges from waste disposal containers to the receiving water.

## 7. Construction Access

A stabilized construction exit will be provided to help reduce vehicle tracking of sediments. The paved roads adjacent to the Site entrance will be inspected daily and swept as necessary to remove any excess mud, dirt, or rock tracked from the Site. Dump trucks hauling material from the construction site will be covered with a tarpaulin as necessary.

## 8. Petroleum Products

On-site vehicles will be monitored for leaks and receive regular preventative maintenance. Petroleum products will be stored in tightly sealed containers which are clearly labeled. Petroleum storage tanks on-site will have a dike or berm containment structure constructed around it to contain spills which may occur (containment volume to be 110% of volume stored). The dike or bermed area shall be lined with an impervious material such as a heavy duty plastic sheet. Drip pans shall be provided for all dispensers. Any asphalt substances used on the Site will be applied according to the manufacturer's recommendations.

## 9. Fertilizers and Landscape Materials

Fertilizers will be applied only in the minimum amounts recommended by the manufacturer. Once applied, fertilizer will be worked into the soil to minimize the potential for exposure to stormwater. Storage will be under cover. The contents of

any partially used bags of fertilizer will be transferred to a sealable plastic bin to minimize the potential for spills. The bin shall be labeled appropriately.

Contain stockpiled materials, such as but not limited to, mulches, top soil, rocks and gravel, and decomposed granite, when they are not actively being used.

Apply erodible landscape material at quantities and application rates according to the manufacturer's recommendations or based on written specifications by knowledgeable and experienced field personnel. Discontinue the application of any erodible landscape material within two days prior to a forecasted rain event or during periods of precipitation.

#### 10. Paints, Paint Solvents and Cleaning Solvents

Containers will be tightly sealed and stored when not in use. Excess paint and solvents will be properly disposed of according to the manufacturer's recommendations or local, state, and/or federal regulations.

#### 11. Contaminated Soils

Any contaminated soils (resulting from spills of materials with hazardous properties) which may result from construction activities will be contained and cleaned up immediately in accordance with applicable local, state and federal regulations.

### 1.12 Soil Conditions and Geologic Formations

There are no naturally occurring geologic formations or soils on-site are expected that may have the potential to cause pollution during earth disturbance activities. See E&SC Detail Sheets (**Section 2 of the ESCGP-2 NOI**) for Acid-Producing Soils and Bedrock Control Plan should any unexpected acid runoff producing soils be encountered.

### 1.13 Thermal Impacts

Thermal impacts associated with CPL North, CPL South, and Associated Facilities will be avoided to the maximum extent practicable. The following provisions related to thermal impacts are included in the **E&SC Plan** within **Section 2 of the ESCGP-2 NOI**:

- The minimum permanent changes in land cover, necessary to construct the required facilities are being proposed.
- Runoff from the permanent impervious areas will be collected as part of the Post Construction Stormwater Management/Site Restoration (PCSM/SR) Plan and



routed to PCSM/SR BMPs. In addition, impervious areas will be gravel instead of asphalt wherever practical.

- PCSM/SR BMPs incorporate the use of infiltration facilities such as basins and vegetated swales with **Earthen** Check Dams.
- The removal of vegetation, especially tree cover, will be limited to only that necessary for construction.
- The amount of impervious surfaces will be limited to only that necessary to support the construction of CPL North, CPL South, and Associated Facilities and/or operation of the pipeline.
- The impacts to existing riparian corridors will be limited to only that necessary for construction.

#### **1.14 Riparian Forest Buffer Management Plan**

There are no regulated riparian buffers within the Site area.

#### **1.15 Antidegradation Requirements**

The Site is not located in a special protection or siltation impaired watershed; therefore, no antidegradation analysis is necessary.

#### **1.16 Preparedness Prevention and Contingency Plan**

See Attachment 9 of the **ECP** within **Section 4 of the ESCGP-2 NOI** for the Preparedness Prevention and Contingency Plan provided.



## **APPENDICES**

Appendix A	West Diamond Regulator Station Supporting Calculations
	A.1 Pre-Development Calculations
	A.2 Post Development Calculations
	A.3 Conveyance Calculations
	A.4 PCSM BMP Calculations
	A.5 Water Quality Worksheets
	A.6 Site Characterization Assessment
	A.7 Supporting Documentation
Appendix B	Preparer Qualifications
Appendix C	United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Custom Soil Resource Report



## **APPENDIX A**

### **West Diamond Regulator Station Supporting Calculations**

- A.1 Pre-Development Calculations
- A.2 Post Development Calculations
- A.3 Conveyance Calculations
- A.4 PCSM BMP Calculations
- A.5 Water Quality Worksheets
- A.6 Site Characterization Assessment
- A.7 Supporting Documentation

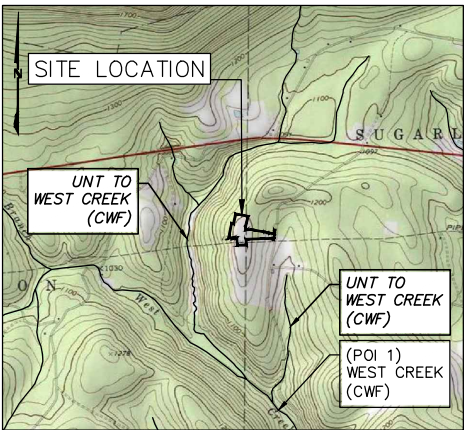
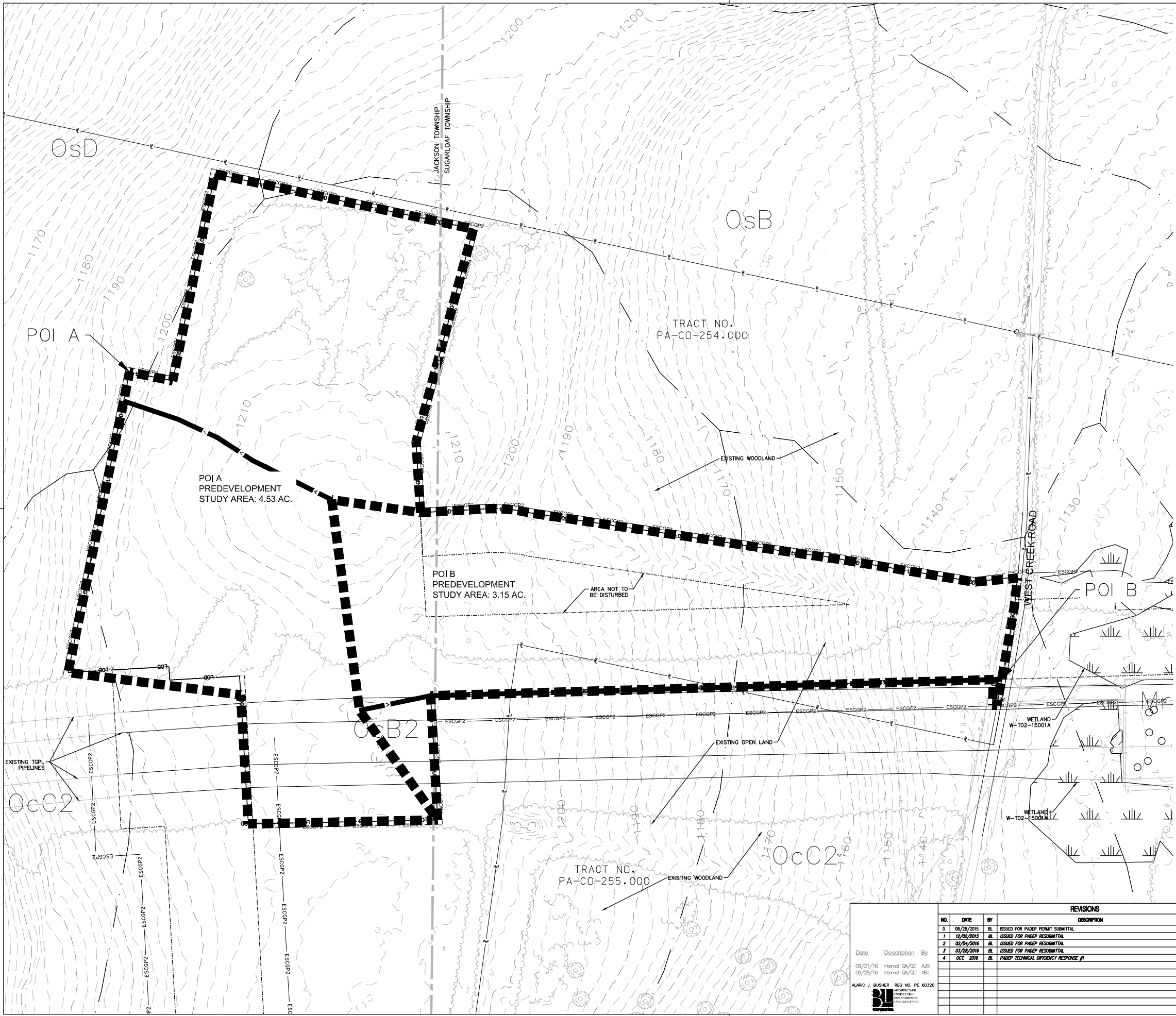


## **A.1      Pre-Development Calculations**



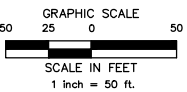


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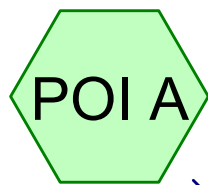
### LEGEND

- PROPERTY BOUNDARY LINE (APPROXIMATE)
- EXISTING MAJOR CONTOUR (10' INTERVAL)
- EXISTING MINOR CONTOUR (2' INTERVAL)
- FENCE
- STONE ROW
- SOIL BOUNDARY
- TREELINE
- CENTERLINE STREAM/EDGE WATERBODY
- DELINEATED WETLANDS
- SPOT ELEVATION
- TREE OR BUSH
- UTILITY POLE AND UTILITY LINE
- GUY POLE
- GUY POLE OR ANCHOR
- POST
- SIGN
- WATER WELL
- UTILITY BOX
- MONUMENT (PROPERTY BOUNDARY MARKER)
- IRON PIPE OR PIN (PROPERTY BOUNDARY MARKER)
- SOIL TYPE DESIGNATION
- ESCGP2 - ESCGP2 PERMIT BOUNDARY
- LOD - LIMIT OF DISTURBANCE (WEST DIAMOND REGULATOR STATION)
- LIMIT OF WORKSPACE (OVERALL PIPELINE PROJECT)
- EXISTING ROAD
- ROW
- TOWNSHIP LINE
- STUDY DRAINAGE AREA BOUNDARIES
- TIME OF CONCENTRATION FLOW PATH

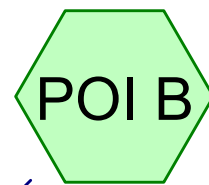


REVISIONS				TRANSCONTINENTAL GAS PIPELINE COMPANY LLC			
NO.	DATE	BY	DESCRIPTION	W.D. NO.	CHK.	APP.	
0	08/28/2015	BL	ISSUED FOR PADEP PERMIT SUBMITTAL	W01161501	DAK	AJB	
1	12/02/2015	BL	ISSUED FOR PADEP RESUBMITTAL	W01161501	DAK	AJB	
2	02/04/2016	BL	ISSUED FOR PADEP RESUBMITTAL	W01161501	DAK	AJB	
3	03/28/2016	BL	ISSUED FOR PADEP RESUBMITTAL	W01161501	AB	AJB	
4	OCT. 2016	BL	PADEP TECHNICAL DEFICIENCY RESPONSE #1	W01161501	AB	AJB	
Date Description By				ATLANTIC SUNRISE PROJECT- PROPOSED 30"/42" NATURAL GAS PIPELINE			
09/21/16 Internal QA/QC AJB				POST CONSTRUCTION STORMWATER MANAGEMENT PLANS FOR WEST			
09/28/16 Internal QA/QC ABU				DIAMOND REGULATOR STATION & ASSOCIATED PERMANENT ACCESS ROADS			
ALANIC J. BUSHER REG NO. PE 60320				JACKSON/SUGARLOAF TOWNSHIPS, COLUMBIA COUNTY, PENNSYLVANIA			
				PRE-DEVELOPMENT DRAINAGE AREA MAP			
DRAWN BY: JEC		DATE: 04/03/15		ISSUED FOR BID:		SCALE: AS NOTED	
CHECKED BY: AJB		DATE: 04/03/15		ISSUED FOR CONSTRUCTION:		REVISION: 4	
APPROVED BY: AJB		DATE: 07/17/15		DRAWING NUMBER: (36-7943)MF-1A-9		SHEET 1	
W.D. 1161501						OF 1	

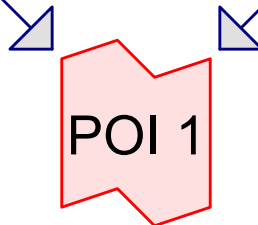




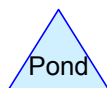
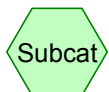
PREDEVELOPMENT



PREDEVELOPMENT



POI 1 - PRE



**Routing Diagram for C-DAT-14C4909-WDIAMOND**

Prepared by {enter your company name here}, Printed 9/17/2016  
HydroCAD® 10.00-12 s/n 01334 © 2014 HydroCAD Software Solutions LLC

**Summary for Subcatchment POI A: PREDEVELOPMENT**

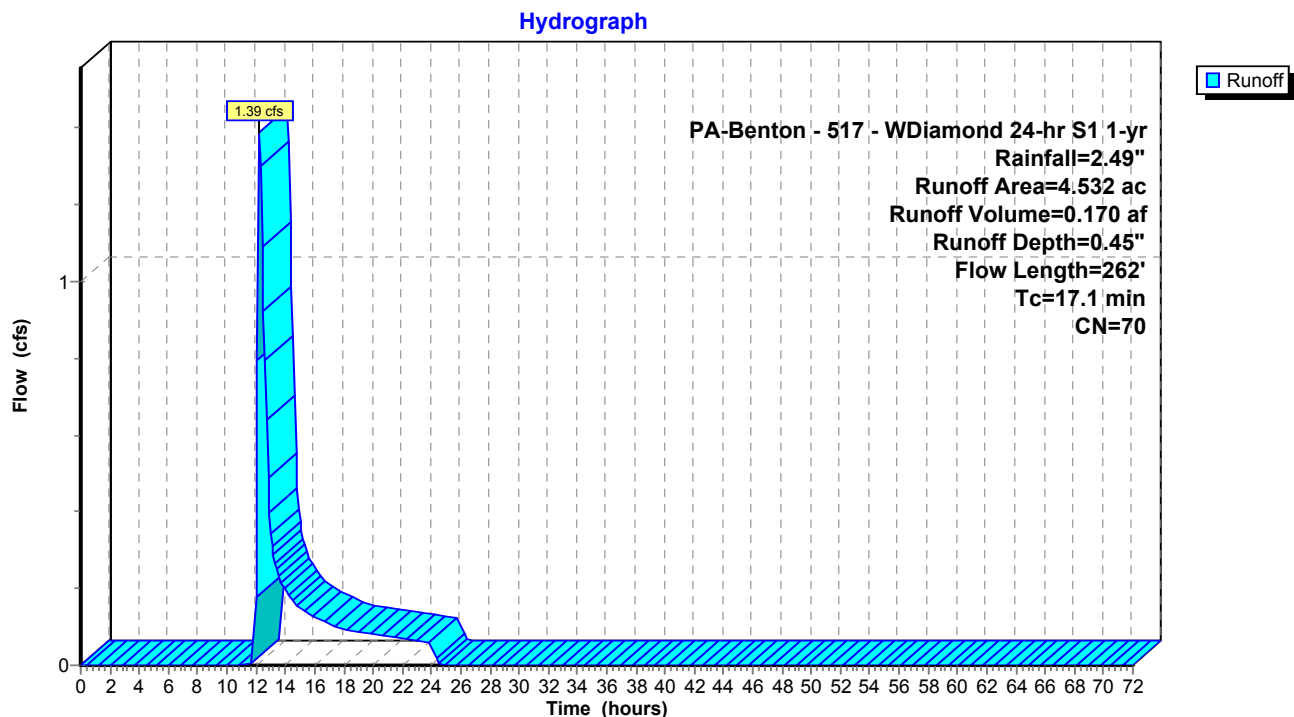
Runoff = 1.39 cfs @ 12.24 hrs, Volume= 0.170 af, Depth= 0.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs  
PA-Benton - 517 - WDiamond 24-hr S1 1-yr Rainfall=2.49"

Area (ac)	CN	Description
2.835	70	Woods, Good, HSG C
1.697	71	Meadow, non-grazed, HSG C
4.532	70	Weighted Average
4.532		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.4	100	0.0500	0.11		<b>Sheet Flow, SHT 1</b>
					Woods: Light underbrush n= 0.400 P2= 2.98"
1.5	127	0.0787	1.40		<b>Shallow Concentrated Flow, SCF 1</b>
					Woodland Kv= 5.0 fps
0.2	35	0.2290	2.39		<b>Shallow Concentrated Flow, SCF 2</b>
					Woodland Kv= 5.0 fps
17.1	262	Total			

**Subcatchment POI A: PREDEVELOPMENT**

**Summary for Subcatchment POI A: PREDEVELOPMENT**

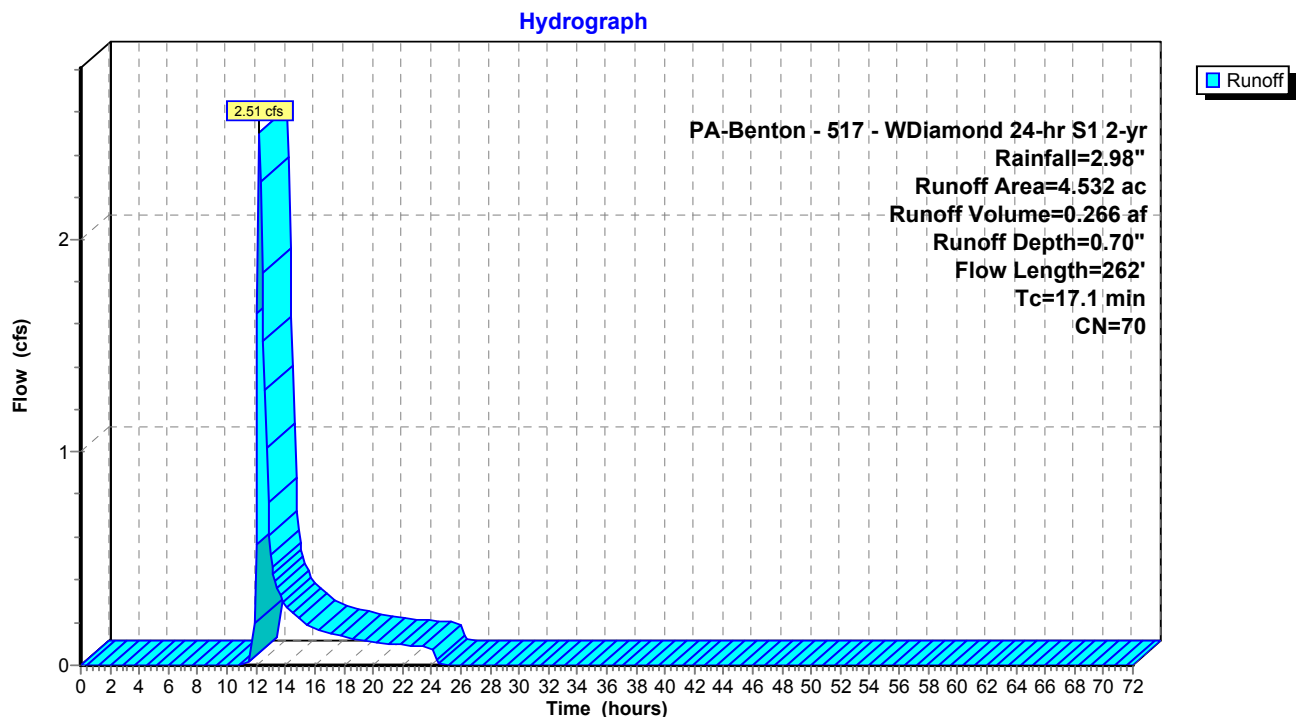
Runoff = 2.51 cfs @ 12.23 hrs, Volume= 0.266 af, Depth= 0.70"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs  
 PA-Benton - 517 - WDiamond 24-hr S1 2-yr Rainfall=2.98"

Area (ac)	CN	Description
2.835	70	Woods, Good, HSG C
1.697	71	Meadow, non-grazed, HSG C
4.532	70	Weighted Average
4.532		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.4	100	0.0500	0.11		<b>Sheet Flow, SHT 1</b>
					Woods: Light underbrush n= 0.400 P2= 2.98"
1.5	127	0.0787	1.40		<b>Shallow Concentrated Flow, SCF 1</b>
					Woodland Kv= 5.0 fps
0.2	35	0.2290	2.39		<b>Shallow Concentrated Flow, SCF 2</b>
					Woodland Kv= 5.0 fps
17.1	262	Total			

**Subcatchment POI A: PREDEVELOPMENT**

**Summary for Subcatchment POI A: PREDEVELOPMENT**

Runoff = 4.20 cfs @ 12.22 hrs, Volume= 0.423 af, Depth= 1.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs  
 PA-Benton - 517 - WDiamond 24-hr S1 5-yr Rainfall=3.68"

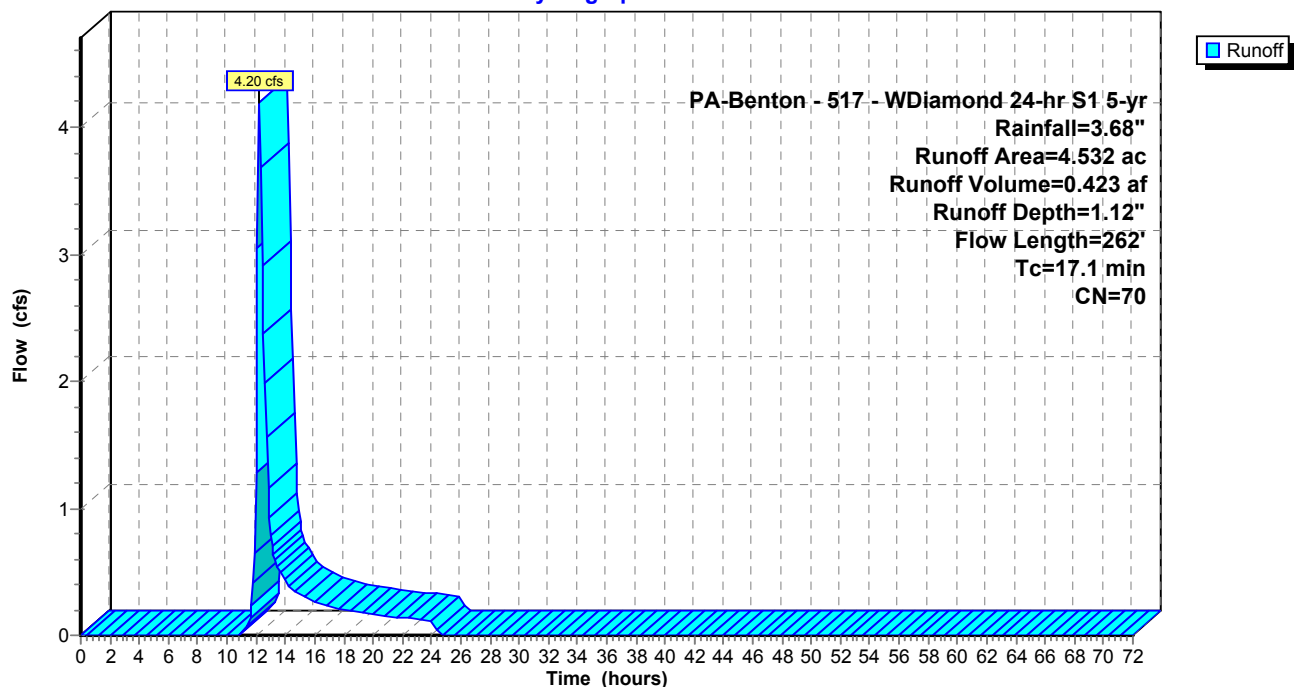
Area (ac)	CN	Description
2.835	70	Woods, Good, HSG C
1.697	71	Meadow, non-grazed, HSG C
4.532	70	Weighted Average
4.532		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.4	100	0.0500	0.11		<b>Sheet Flow, SHT 1</b>
					Woods: Light underbrush n= 0.400 P2= 2.98"
1.5	127	0.0787	1.40		<b>Shallow Concentrated Flow, SCF 1</b>
					Woodland Kv= 5.0 fps
0.2	35	0.2290	2.39		<b>Shallow Concentrated Flow, SCF 2</b>
					Woodland Kv= 5.0 fps
17.1	262	Total			

**Subcatchment POI A: PREDEVELOPMENT**

Hydrograph



**Summary for Subcatchment POI A: PREDEVELOPMENT**

Runoff = 5.63 cfs @ 12.22 hrs, Volume= 0.577 af, Depth= 1.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs  
PA-Benton - 517 - WDiamond 24-hr S1 10-yr Rainfall=4.29"

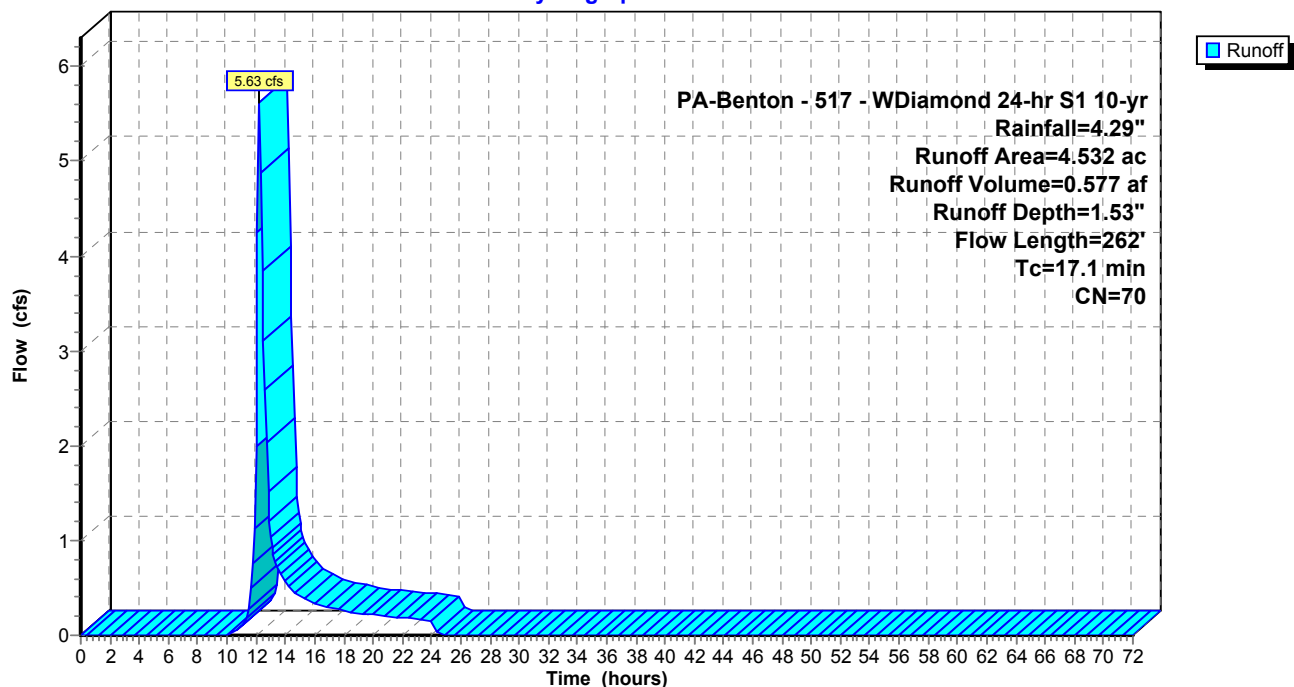
Area (ac)	CN	Description
2.835	70	Woods, Good, HSG C
1.697	71	Meadow, non-grazed, HSG C
4.532	70	Weighted Average
4.532		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.4	100	0.0500	0.11		<b>Sheet Flow, SHT 1</b>
					Woods: Light underbrush n= 0.400 P2= 2.98"
1.5	127	0.0787	1.40		<b>Shallow Concentrated Flow, SCF 1</b>
					Woodland Kv= 5.0 fps
0.2	35	0.2290	2.39		<b>Shallow Concentrated Flow, SCF 2</b>
					Woodland Kv= 5.0 fps
17.1	262	Total			

**Subcatchment POI A: PREDEVELOPMENT**

Hydrograph





**Summary for Subcatchment POI A: PREDEVELOPMENT**

Runoff = 7.74 cfs @ 12.21 hrs, Volume= 0.828 af, Depth= 2.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs  
 PA-Benton - 517 - WDiamond 24-hr S1 25-yr Rainfall=5.21"

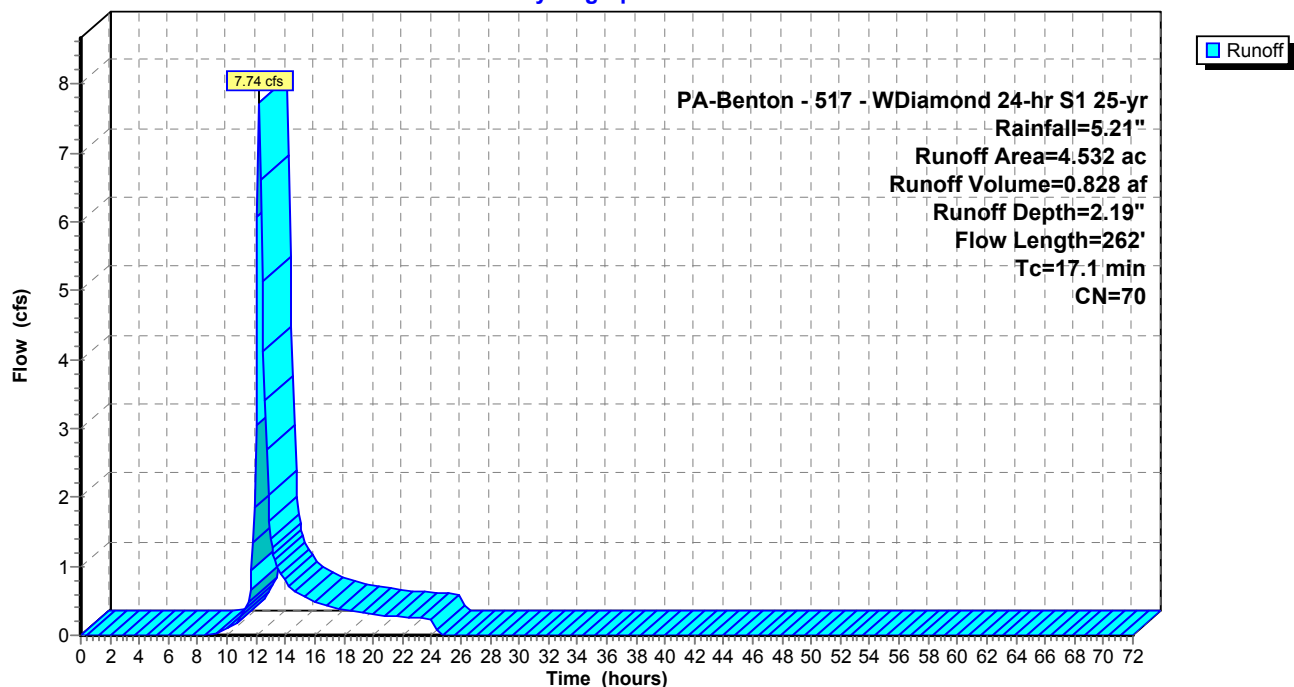
Area (ac)	CN	Description
2.835	70	Woods, Good, HSG C
1.697	71	Meadow, non-grazed, HSG C
4.532	70	Weighted Average
4.532		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.4	100	0.0500	0.11		<b>Sheet Flow, SHT 1</b>
					Woods: Light underbrush n= 0.400 P2= 2.98"
1.5	127	0.0787	1.40		<b>Shallow Concentrated Flow, SCF 1</b>
					Woodland Kv= 5.0 fps
0.2	35	0.2290	2.39		<b>Shallow Concentrated Flow, SCF 2</b>
					Woodland Kv= 5.0 fps
17.1	262	Total			

**Subcatchment POI A: PREDEVELOPMENT**

Hydrograph





**Summary for Subcatchment POI A: PREDEVELOPMENT**

Runoff = 9.48 cfs @ 12.21 hrs, Volume= 1.071 af, Depth= 2.84"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs  
PA-Benton - 517 - WDiamond 24-hr S1 50-yr Rainfall=6.04"

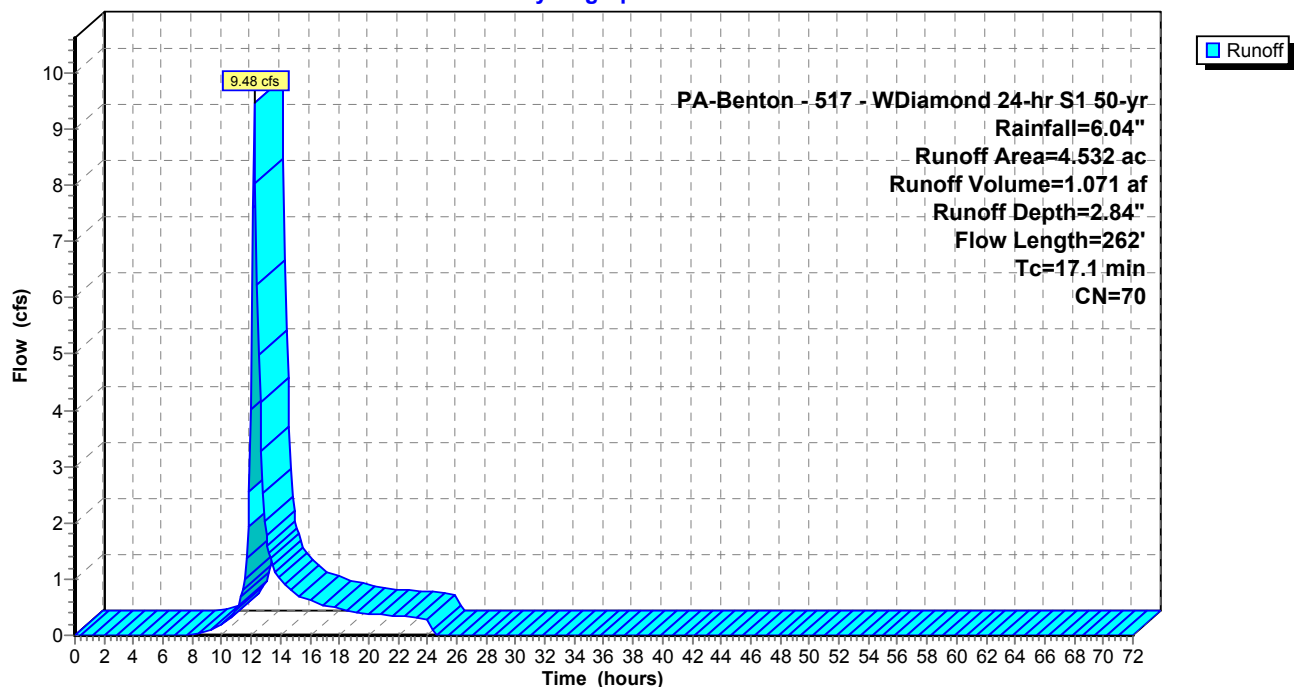
Area (ac)	CN	Description
2.835	70	Woods, Good, HSG C
1.697	71	Meadow, non-grazed, HSG C
4.532	70	Weighted Average
4.532		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.4	100	0.0500	0.11		<b>Sheet Flow, SHT 1</b>
					Woods: Light underbrush n= 0.400 P2= 2.98"
1.5	127	0.0787	1.40		<b>Shallow Concentrated Flow, SCF 1</b>
					Woodland Kv= 5.0 fps
0.2	35	0.2290	2.39		<b>Shallow Concentrated Flow, SCF 2</b>
					Woodland Kv= 5.0 fps
17.1	262	Total			

**Subcatchment POI A: PREDEVELOPMENT**

Hydrograph



### Summary for Subcatchment POI A: PREDEVELOPMENT

Runoff = 11.31 cfs @ 12.20 hrs, Volume= 1.367 af, Depth= 3.62"

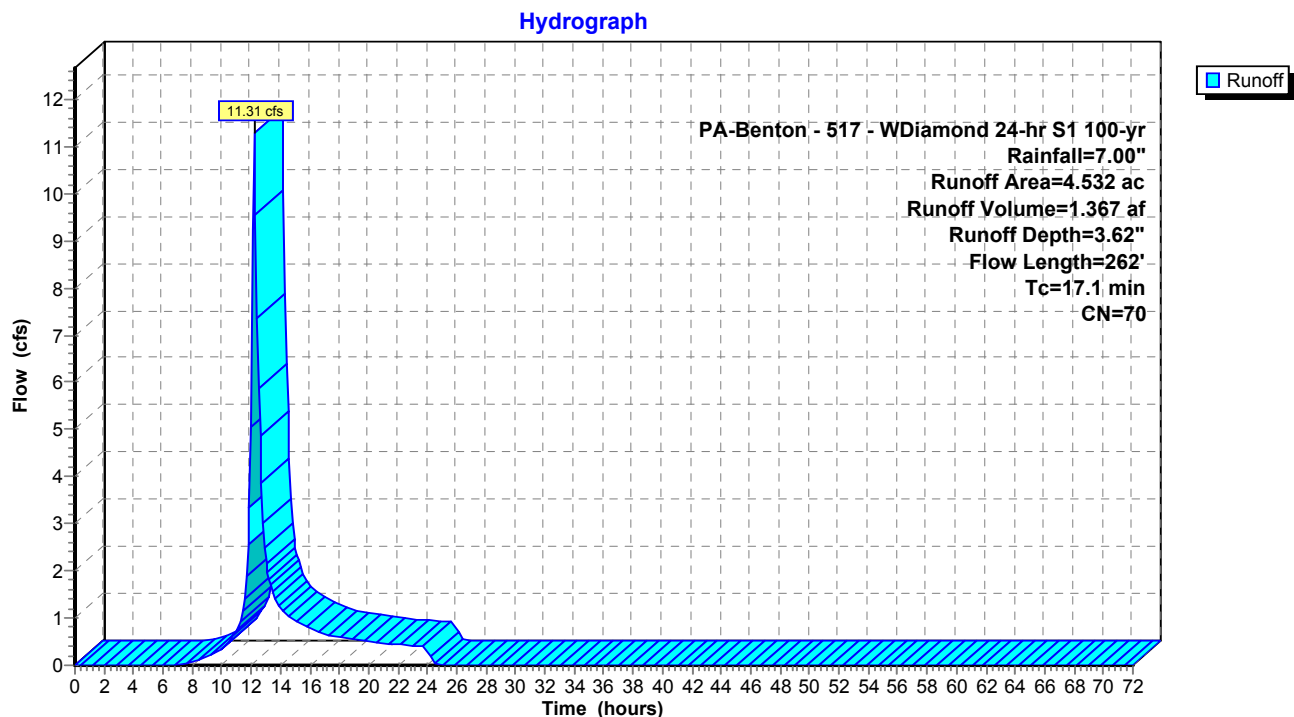
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs  
 PA-Benton - 517 - WDiamond 24-hr S1 100-yr Rainfall=7.00"

Area (ac)	CN	Description
2.835	70	Woods, Good, HSG C
1.697	71	Meadow, non-grazed, HSG C
4.532	70	Weighted Average
4.532		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.4	100	0.0500	0.11		<b>Sheet Flow, SHT 1</b>
					Woods: Light underbrush n= 0.400 P2= 2.98"
1.5	127	0.0787	1.40		<b>Shallow Concentrated Flow, SCF 1</b>
					Woodland Kv= 5.0 fps
0.2	35	0.2290	2.39		<b>Shallow Concentrated Flow, SCF 2</b>
					Woodland Kv= 5.0 fps
17.1	262	Total			

### Subcatchment POI A: PREDEVELOPMENT



**Summary for Subcatchment POI B: PREDEVELOPMENT**

Runoff = 1.06 cfs @ 12.19 hrs, Volume= 0.118 af, Depth= 0.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs  
PA-Benton - 517 - WDiamond 24-hr S1 1-yr Rainfall=2.49"

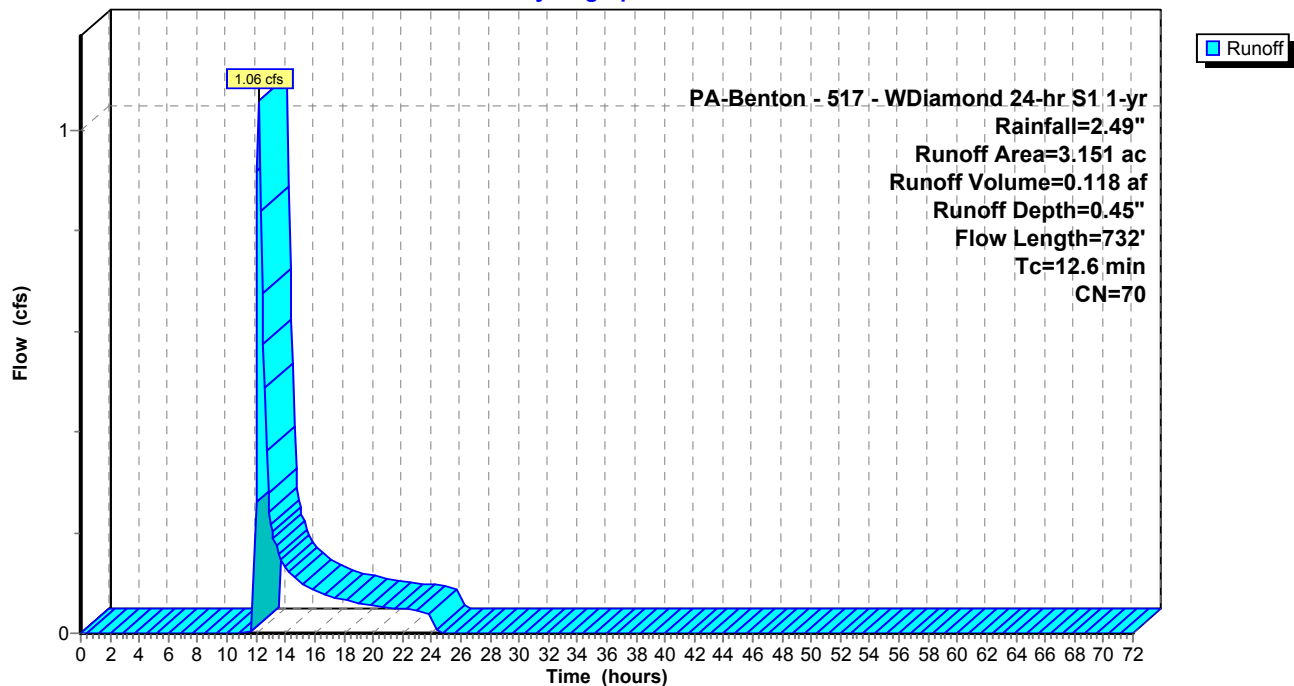
Area (ac)	CN	Description
2.091	70	Woods, Good, HSG C
1.060	71	Meadow, non-grazed, HSG C
3.151	70	Weighted Average
3.151		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.3	100	0.0250	0.20		<b>Sheet Flow, SHT 1</b>
					Range n= 0.130 P2= 2.98"
4.3	632	0.1200	2.42		<b>Shallow Concentrated Flow, SCF 1</b>
					Short Grass Pasture Kv= 7.0 fps
12.6	732	Total			

**Subcatchment POI B: PREDEVELOPMENT**

Hydrograph



**Summary for Subcatchment POI B: PREDEVELOPMENT**

Runoff = 1.89 cfs @ 12.17 hrs, Volume= 0.185 af, Depth= 0.70"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs  
PA-Benton - 517 - WDiamond 24-hr S1 2-yr Rainfall=2.98"

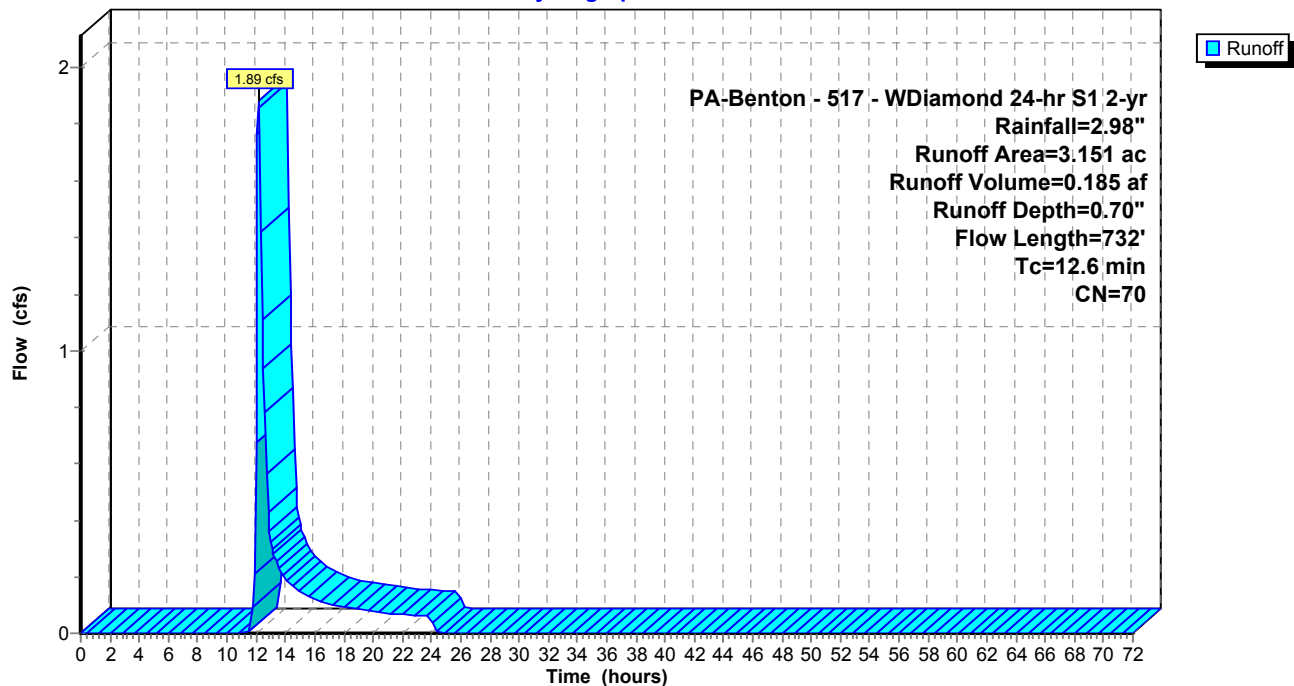
Area (ac)	CN	Description
2.091	70	Woods, Good, HSG C
1.060	71	Meadow, non-grazed, HSG C
3.151	70	Weighted Average
3.151		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.3	100	0.0250	0.20		<b>Sheet Flow, SHT 1</b>
					Range n= 0.130 P2= 2.98"
4.3	632	0.1200	2.42		<b>Shallow Concentrated Flow, SCF 1</b>
					Short Grass Pasture Kv= 7.0 fps
12.6	732	Total			

**Subcatchment POI B: PREDEVELOPMENT**

Hydrograph



**Summary for Subcatchment POI B: PREDEVELOPMENT**

Runoff = 3.27 cfs @ 12.15 hrs, Volume= 0.294 af, Depth= 1.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs  
PA-Benton - 517 - WDiamond 24-hr S1 5-yr Rainfall=3.68"

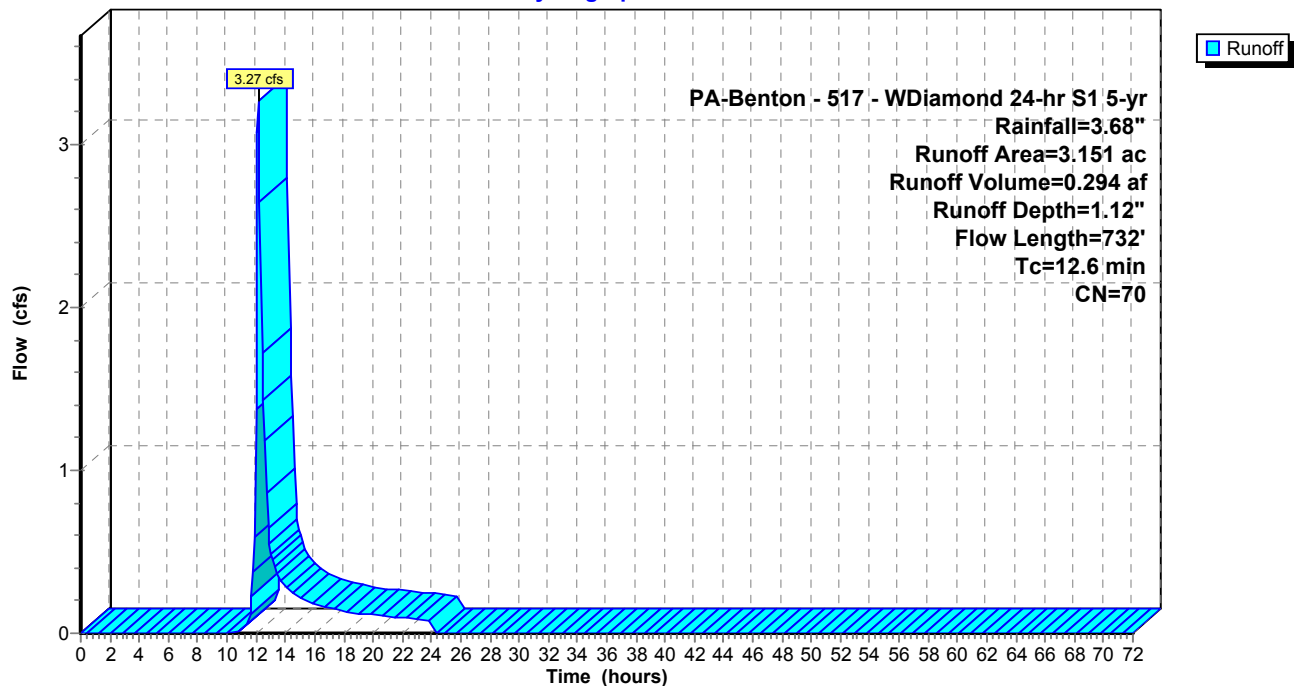
Area (ac)	CN	Description
2.091	70	Woods, Good, HSG C
1.060	71	Meadow, non-grazed, HSG C
3.151	70	Weighted Average
3.151		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.3	100	0.0250	0.20		<b>Sheet Flow, SHT 1</b>
					Range n= 0.130 P2= 2.98"
4.3	632	0.1200	2.42		<b>Shallow Concentrated Flow, SCF 1</b>
					Short Grass Pasture Kv= 7.0 fps
12.6	732	Total			

**Subcatchment POI B: PREDEVELOPMENT**

Hydrograph



**Summary for Subcatchment POI B: PREDEVELOPMENT**

Runoff = 4.39 cfs @ 12.14 hrs, Volume= 0.401 af, Depth= 1.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs  
PA-Benton - 517 - WDiamond 24-hr S1 10-yr Rainfall=4.29"

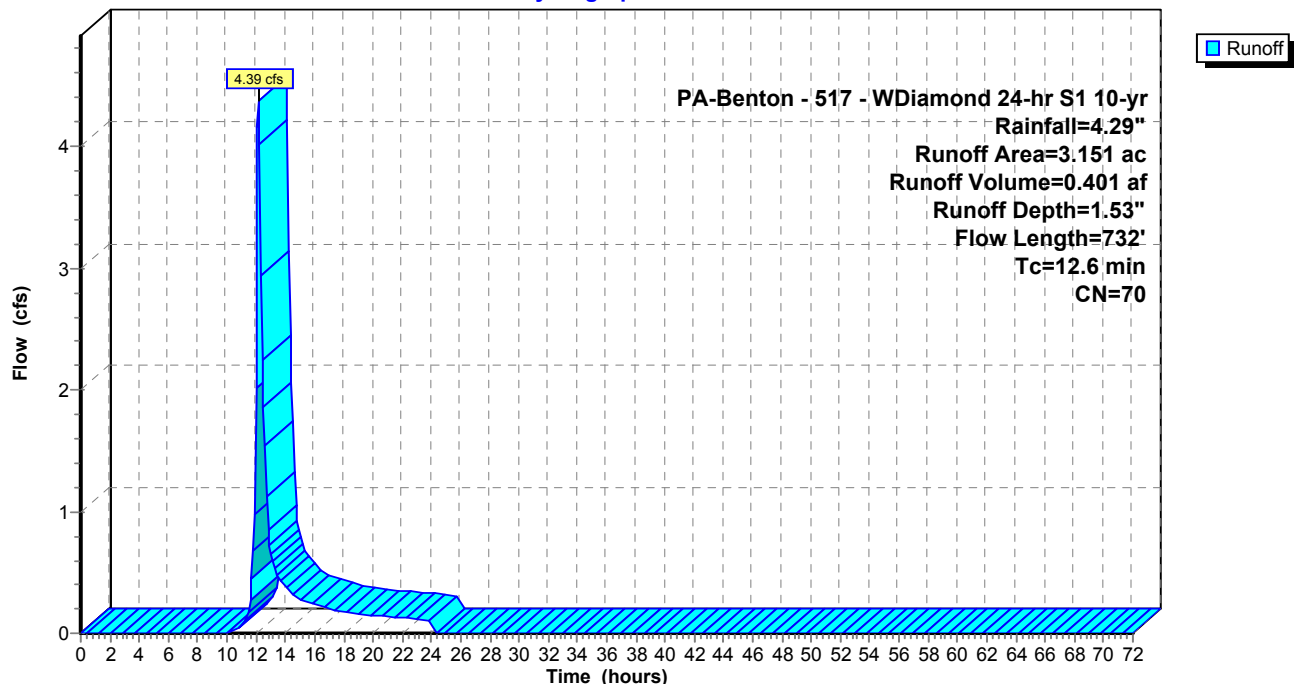
Area (ac)	CN	Description
2.091	70	Woods, Good, HSG C
1.060	71	Meadow, non-grazed, HSG C
3.151	70	Weighted Average
3.151		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.3	100	0.0250	0.20		<b>Sheet Flow, SHT 1</b>
					Range n= 0.130 P2= 2.98"
4.3	632	0.1200	2.42		<b>Shallow Concentrated Flow, SCF 1</b>
					Short Grass Pasture Kv= 7.0 fps
12.6	732	Total			

**Subcatchment POI B: PREDEVELOPMENT**

Hydrograph



## Summary for Subcatchment POI B: PREDEVELOPMENT

Runoff = 6.05 cfs @ 12.14 hrs, Volume= 0.576 af, Depth= 2.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs  
PA-Benton - 517 - WDiamond 24-hr S1 25-yr Rainfall=5.21"

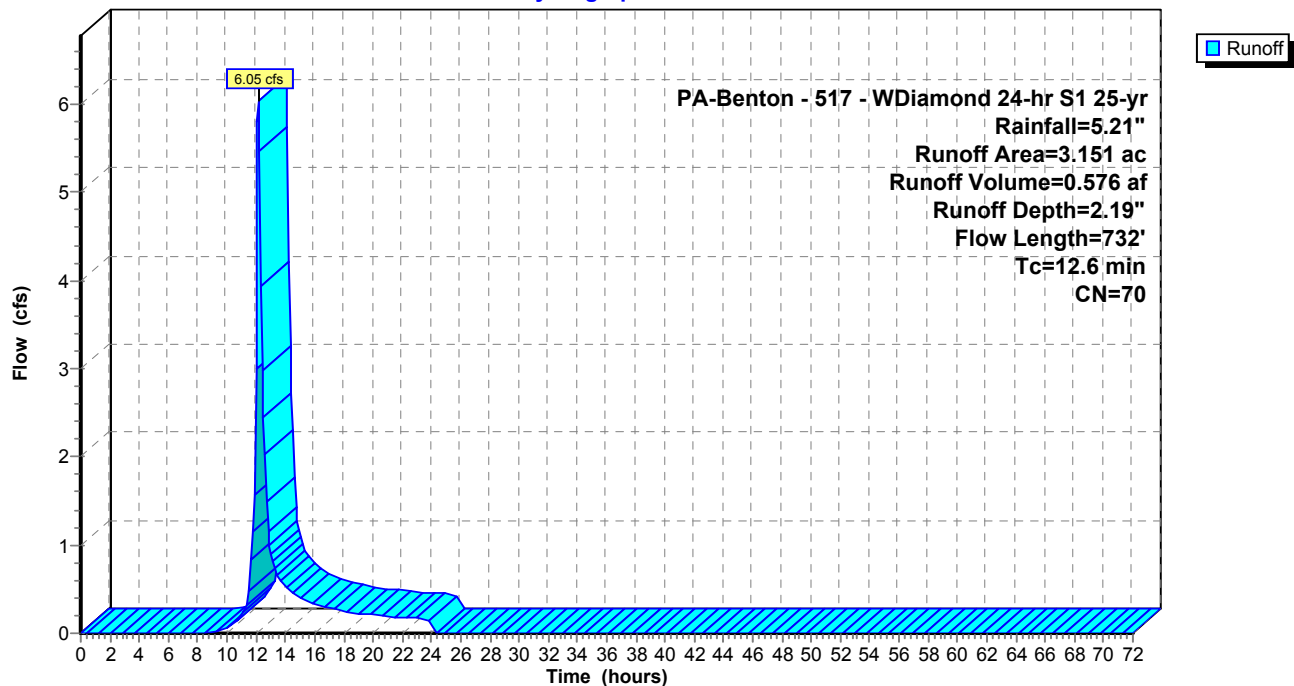
Area (ac)	CN	Description
2.091	70	Woods, Good, HSG C
1.060	71	Meadow, non-grazed, HSG C
3.151	70	Weighted Average
3.151		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.3	100	0.0250	0.20		<b>Sheet Flow, SHT 1</b>
					Range n= 0.130 P2= 2.98"
4.3	632	0.1200	2.42		<b>Shallow Concentrated Flow, SCF 1</b>
					Short Grass Pasture Kv= 7.0 fps
12.6	732	Total			

## Subcatchment POI B: PREDEVELOPMENT

Hydrograph



**Summary for Subcatchment POI B: PREDEVELOPMENT**

Runoff = 7.41 cfs @ 12.14 hrs, Volume= 0.745 af, Depth= 2.84"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs  
PA-Benton - 517 - WDiamond 24-hr S1 50-yr Rainfall=6.04"

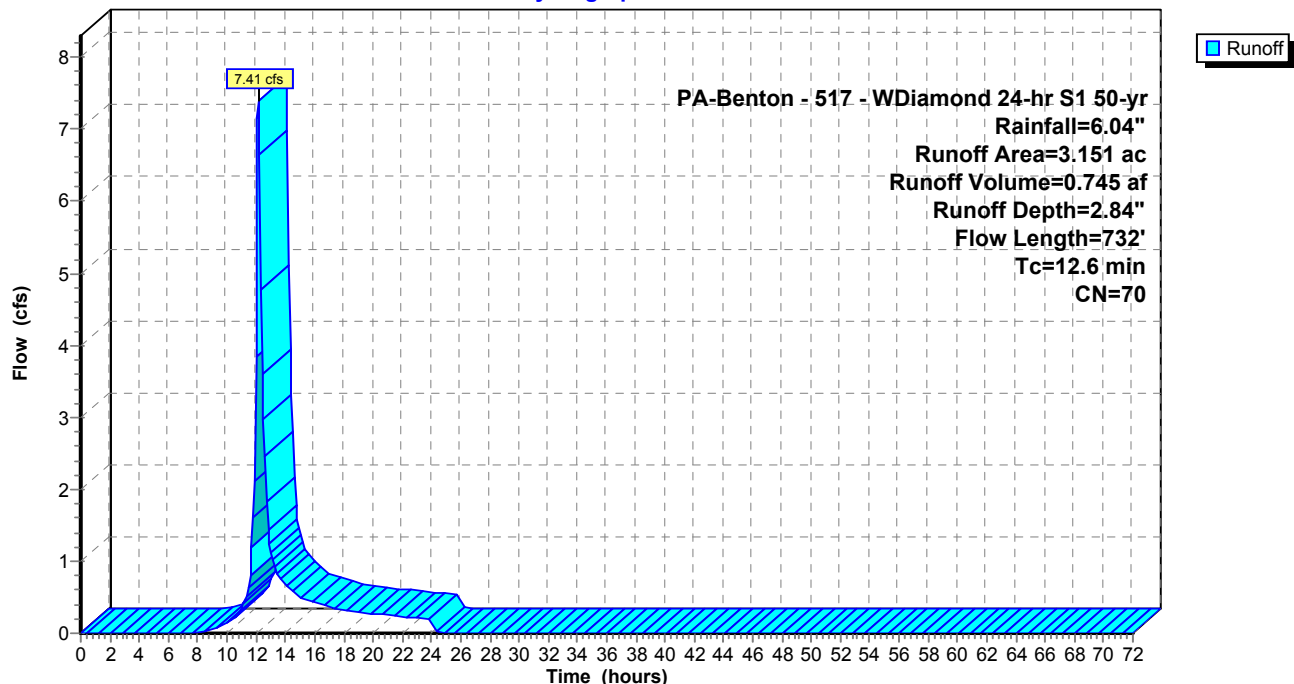
Area (ac)	CN	Description
2.091	70	Woods, Good, HSG C
1.060	71	Meadow, non-grazed, HSG C
3.151	70	Weighted Average
3.151		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.3	100	0.0250	0.20		<b>Sheet Flow, SHT 1</b>
					Range n= 0.130 P2= 2.98"
4.3	632	0.1200	2.42		<b>Shallow Concentrated Flow, SCF 1</b>
					Short Grass Pasture Kv= 7.0 fps
12.6	732	Total			

**Subcatchment POI B: PREDEVELOPMENT**

Hydrograph





### Summary for Subcatchment POI B: PREDEVELOPMENT

Runoff = 8.84 cfs @ 12.13 hrs, Volume= 0.950 af, Depth= 3.62"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs  
 PA-Benton - 517 - WDiamond 24-hr S1 100-yr Rainfall=7.00"

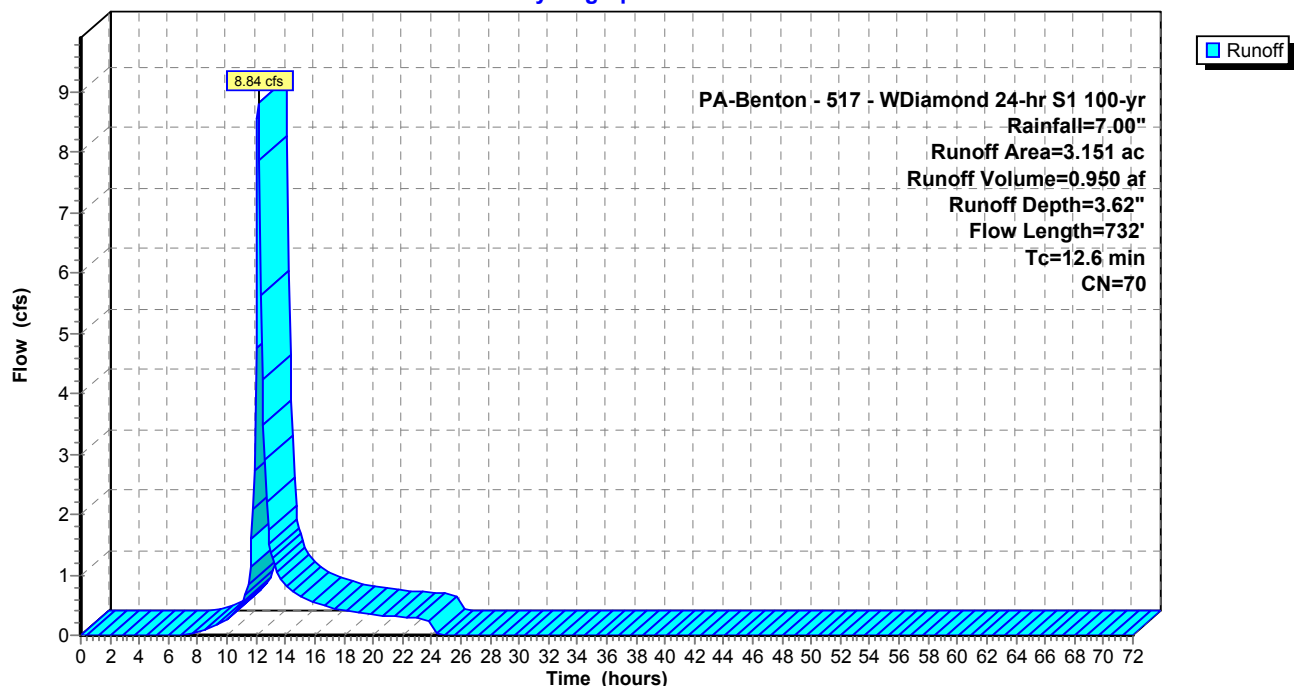
Area (ac)	CN	Description
2.091	70	Woods, Good, HSG C
1.060	71	Meadow, non-grazed, HSG C
3.151	70	Weighted Average
3.151		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.3	100	0.0250	0.20		<b>Sheet Flow, SHT 1</b>
					Range n= 0.130 P2= 2.98"
4.3	632	0.1200	2.42		<b>Shallow Concentrated Flow, SCF 1</b>
					Short Grass Pasture Kv= 7.0 fps
12.6	732	Total			

### Subcatchment POI B: PREDEVELOPMENT

Hydrograph



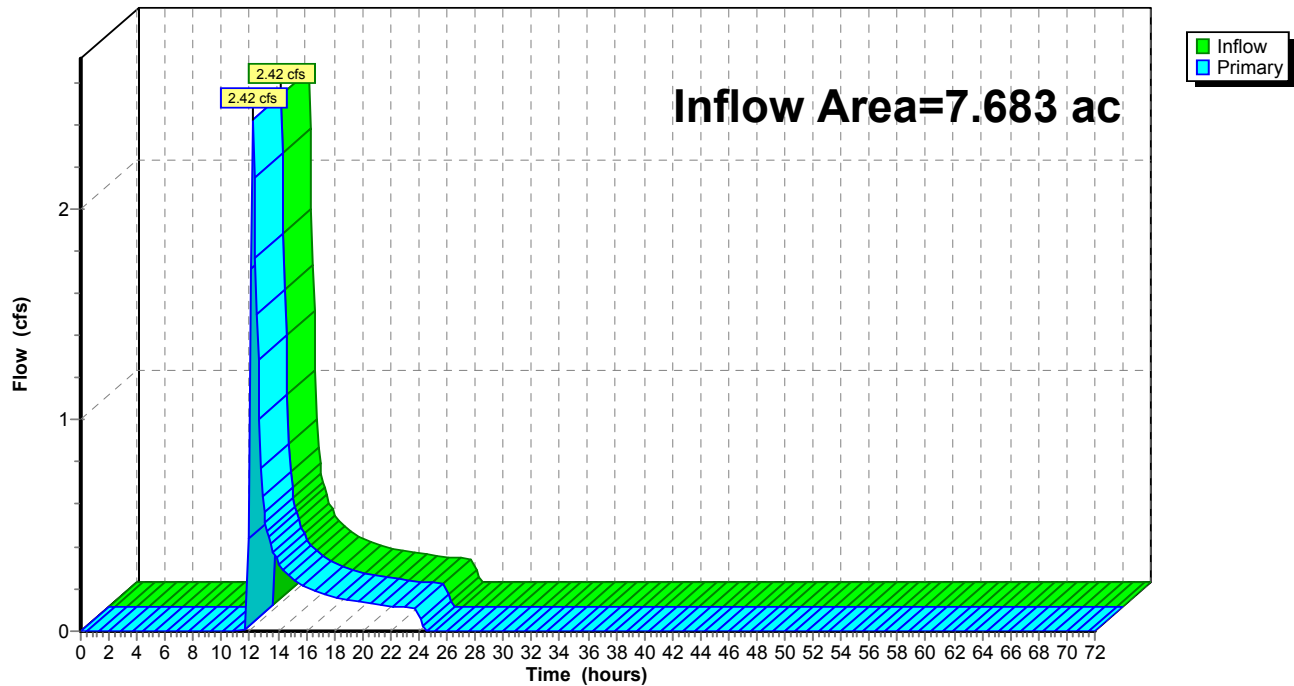
**Summary for Link POI 1: POI 1 - PRE**

Inflow Area = 7.683 ac, 0.00% Impervious, Inflow Depth = 0.45" for 1-yr event  
Inflow = 2.42 cfs @ 12.22 hrs, Volume= 0.288 af  
Primary = 2.42 cfs @ 12.22 hrs, Volume= 0.288 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs

**Link POI 1: POI 1 - PRE**

Hydrograph



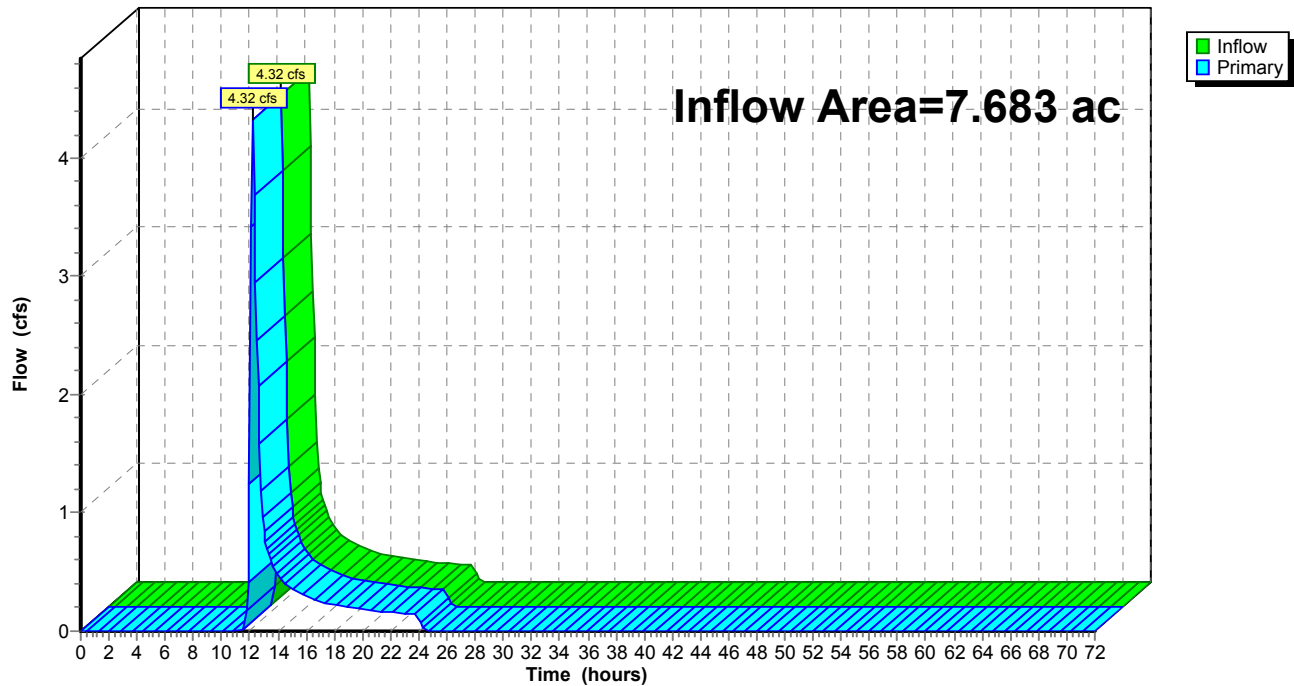
**Summary for Link POI 1: POI 1 - PRE**

Inflow Area = 7.683 ac, 0.00% Impervious, Inflow Depth = 0.70" for 2-yr event  
Inflow = 4.32 cfs @ 12.21 hrs, Volume= 0.450 af  
Primary = 4.32 cfs @ 12.21 hrs, Volume= 0.450 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs

**Link POI 1: POI 1 - PRE**

Hydrograph



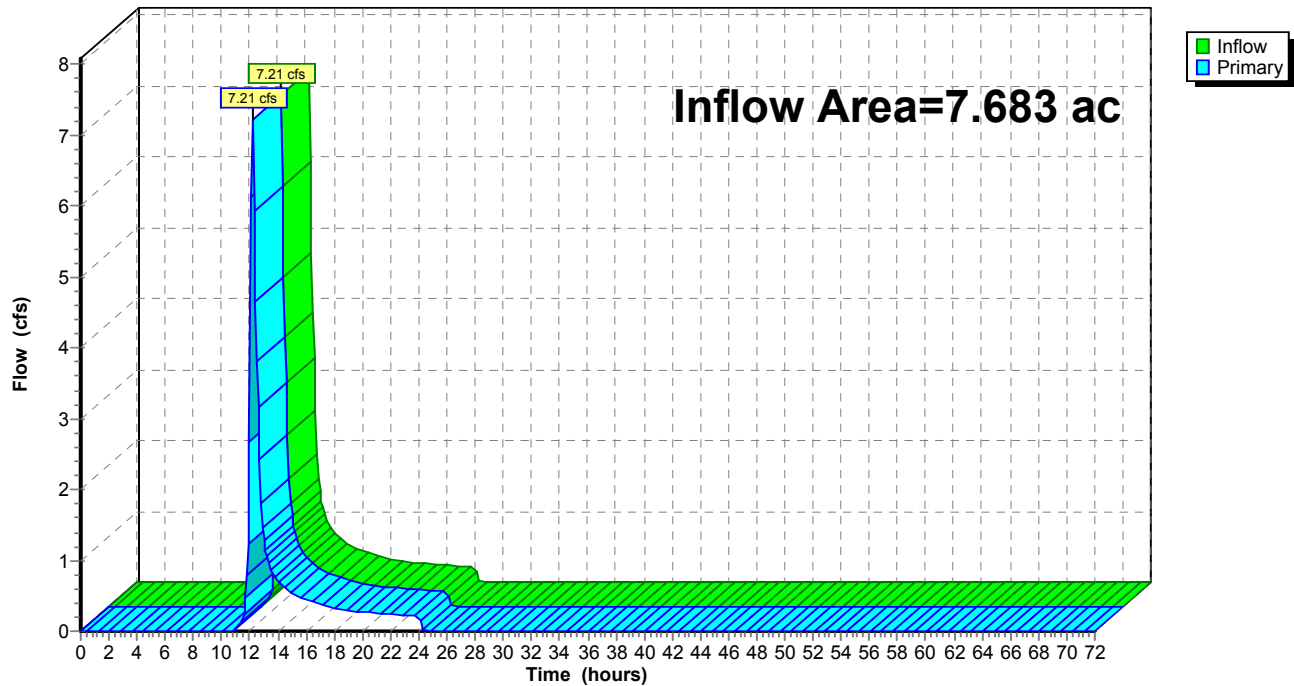
**Summary for Link POI 1: POI 1 - PRE**

Inflow Area = 7.683 ac, 0.00% Impervious, Inflow Depth = 1.12" for 5-yr event  
Inflow = 7.21 cfs @ 12.20 hrs, Volume= 0.718 af  
Primary = 7.21 cfs @ 12.20 hrs, Volume= 0.718 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs

**Link POI 1: POI 1 - PRE**

Hydrograph



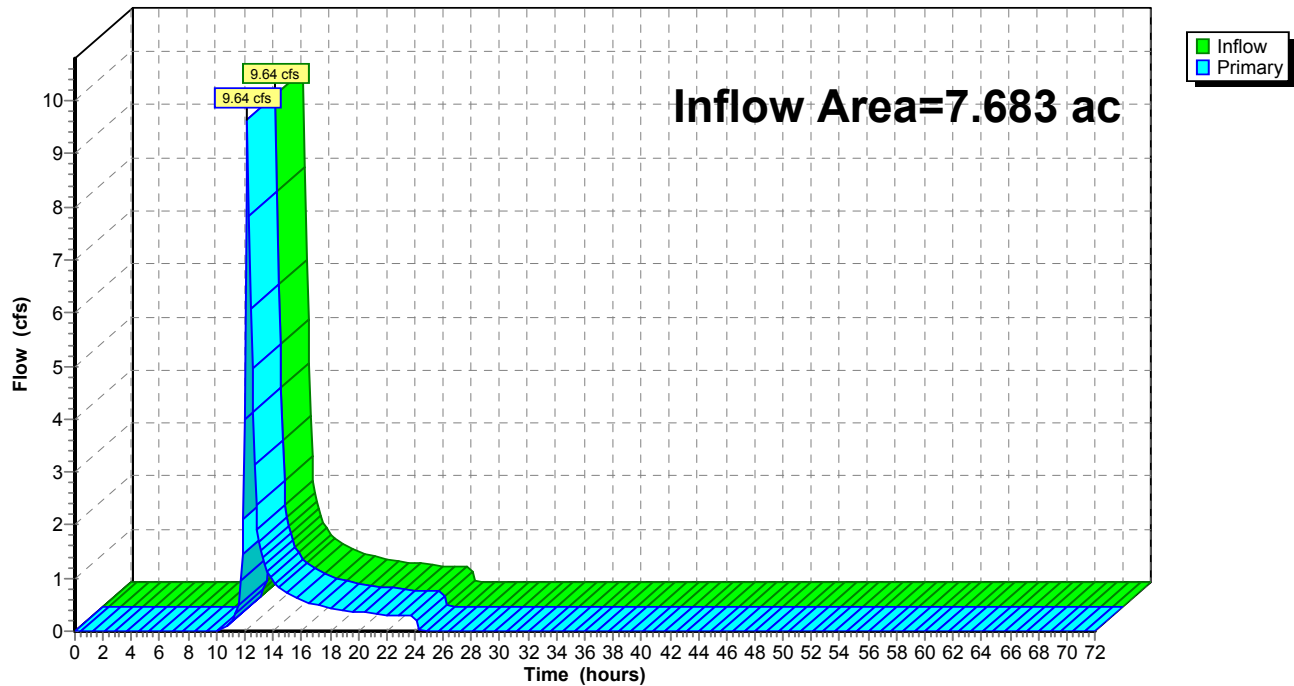
**Summary for Link POI 1: POI 1 - PRE**

Inflow Area = 7.683 ac, 0.00% Impervious, Inflow Depth = 1.53" for 10-yr event  
Inflow = 9.64 cfs @ 12.19 hrs, Volume= 0.978 af  
Primary = 9.64 cfs @ 12.19 hrs, Volume= 0.978 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs

**Link POI 1: POI 1 - PRE**

Hydrograph



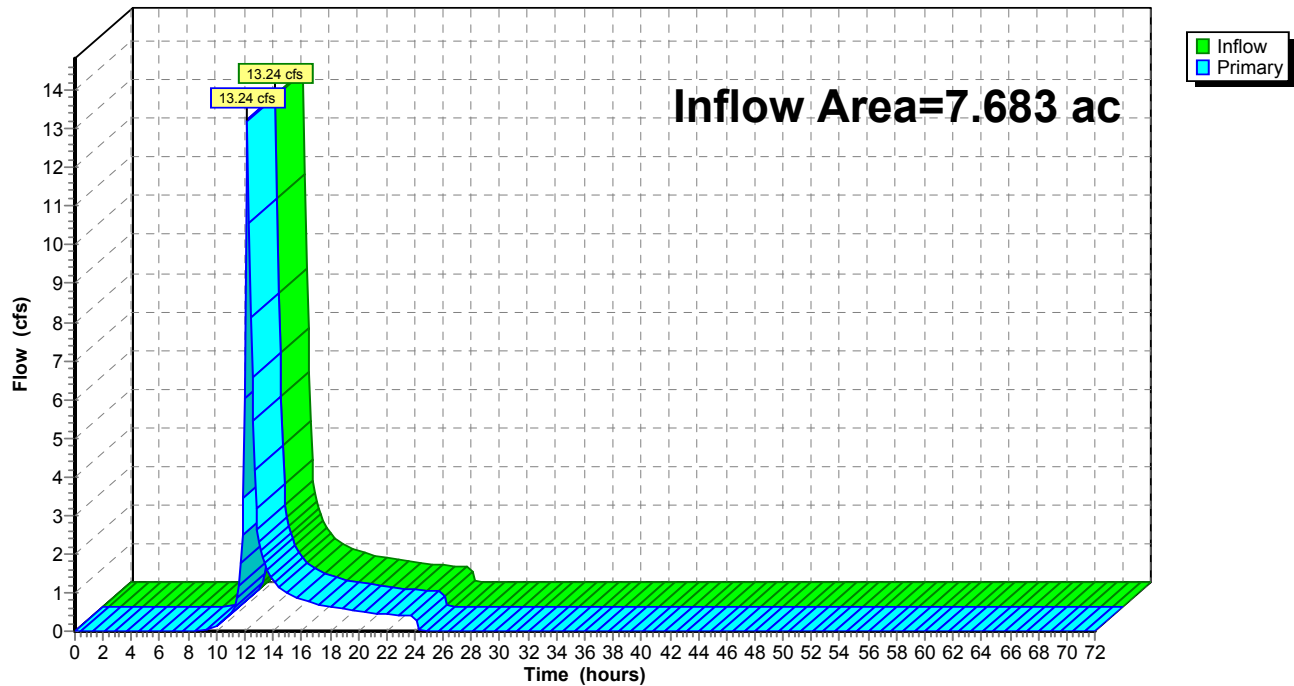
**Summary for Link POI 1: POI 1 - PRE**

Inflow Area = 7.683 ac, 0.00% Impervious, Inflow Depth = 2.19" for 25-yr event  
Inflow = 13.24 cfs @ 12.18 hrs, Volume= 1.404 af  
Primary = 13.24 cfs @ 12.18 hrs, Volume= 1.404 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs

**Link POI 1: POI 1 - PRE**

Hydrograph



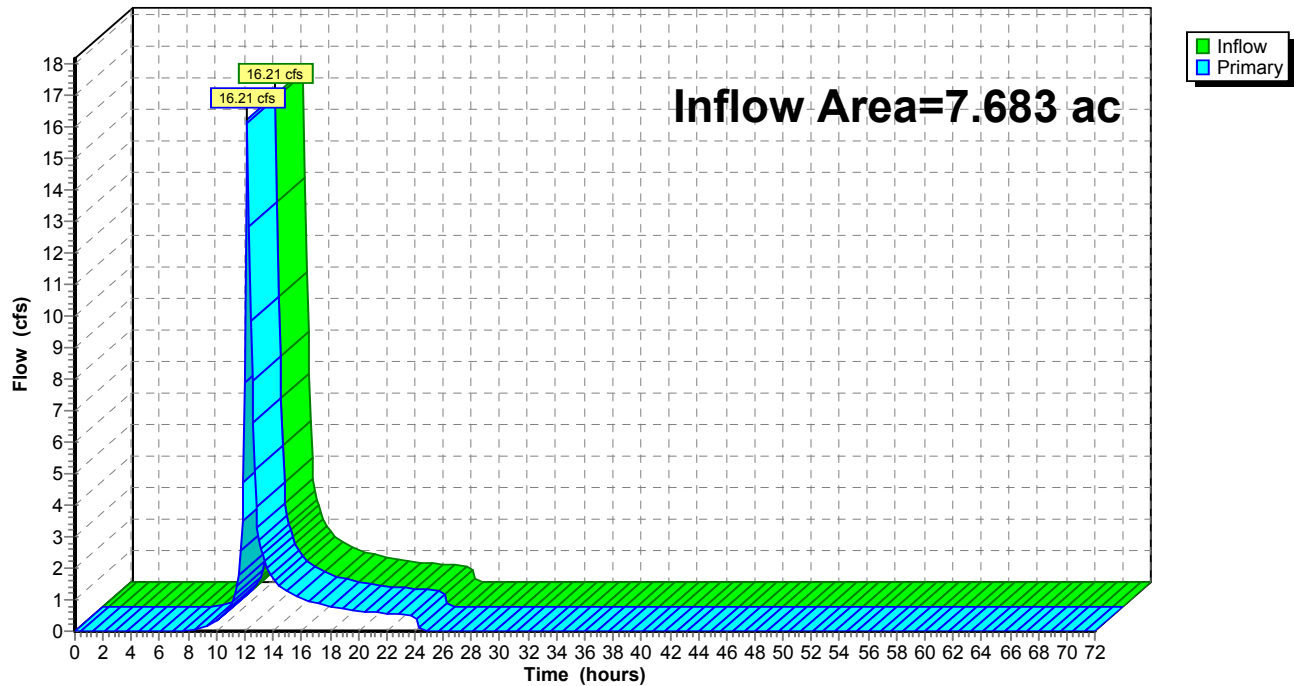
**Summary for Link POI 1: POI 1 - PRE**

Inflow Area = 7.683 ac, 0.00% Impervious, Inflow Depth = 2.84" for 50-yr event  
Inflow = 16.21 cfs @ 12.18 hrs, Volume= 1.816 af  
Primary = 16.21 cfs @ 12.18 hrs, Volume= 1.816 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs

**Link POI 1: POI 1 - PRE**

Hydrograph



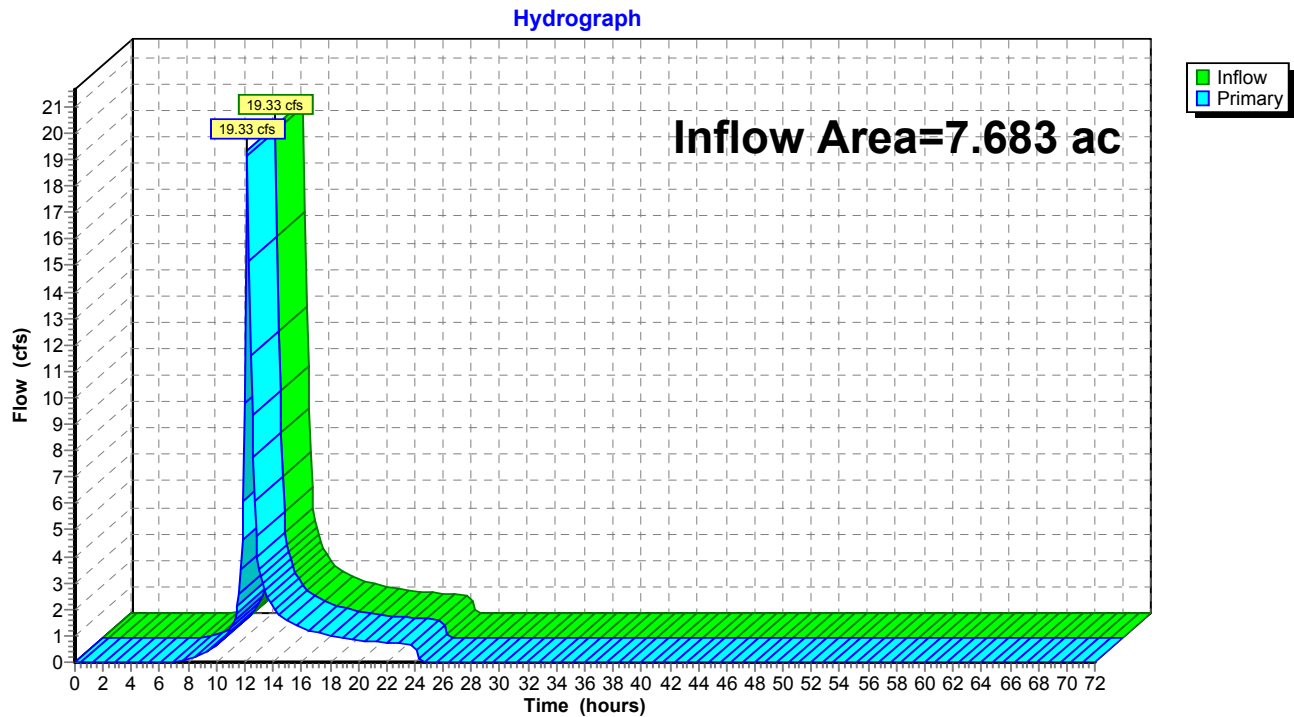


### Summary for Link POI 1: POI 1 - PRE

Inflow Area =      7.683 ac,    0.00% Impervious,    Inflow Depth =    3.62"    for 100-yr event  
Inflow      =      19.33 cfs @    12.18 hrs,    Volume=      2.317 af  
Primary      =      19.33 cfs @    12.18 hrs,    Volume=      2.317 af,    Atten= 0%,    Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs

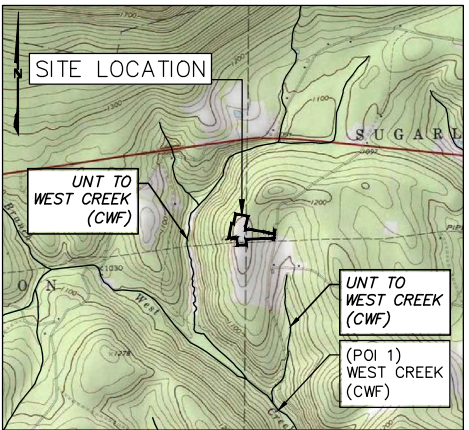
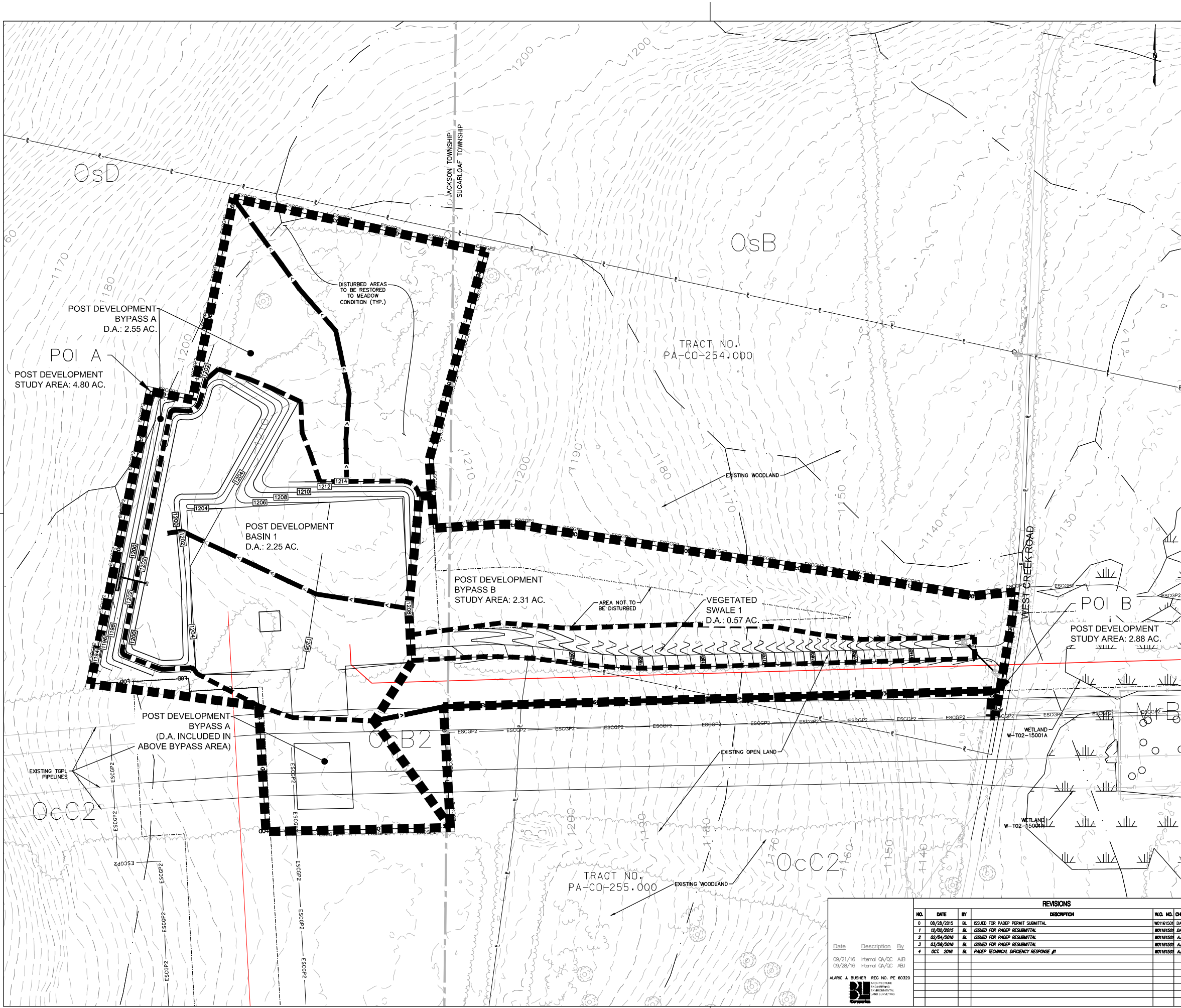
### Link POI 1: POI 1 - PRE



## **A.2 Post Development Calculations**



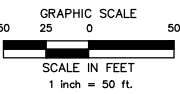
Drawn By & Date/Time: EPerides Oct 06, 2016 - 6:27pm  
Drawing Location & Name: G:\JOBS\14\14C\14C4909\DWG\010-CPIN FRN\_PCSN14C4909\10\_WDAMOND.dwg



LOCATION MAP  
USGS ELK GROVE QUADRANGLE  
SCALE: 1"=2,000'

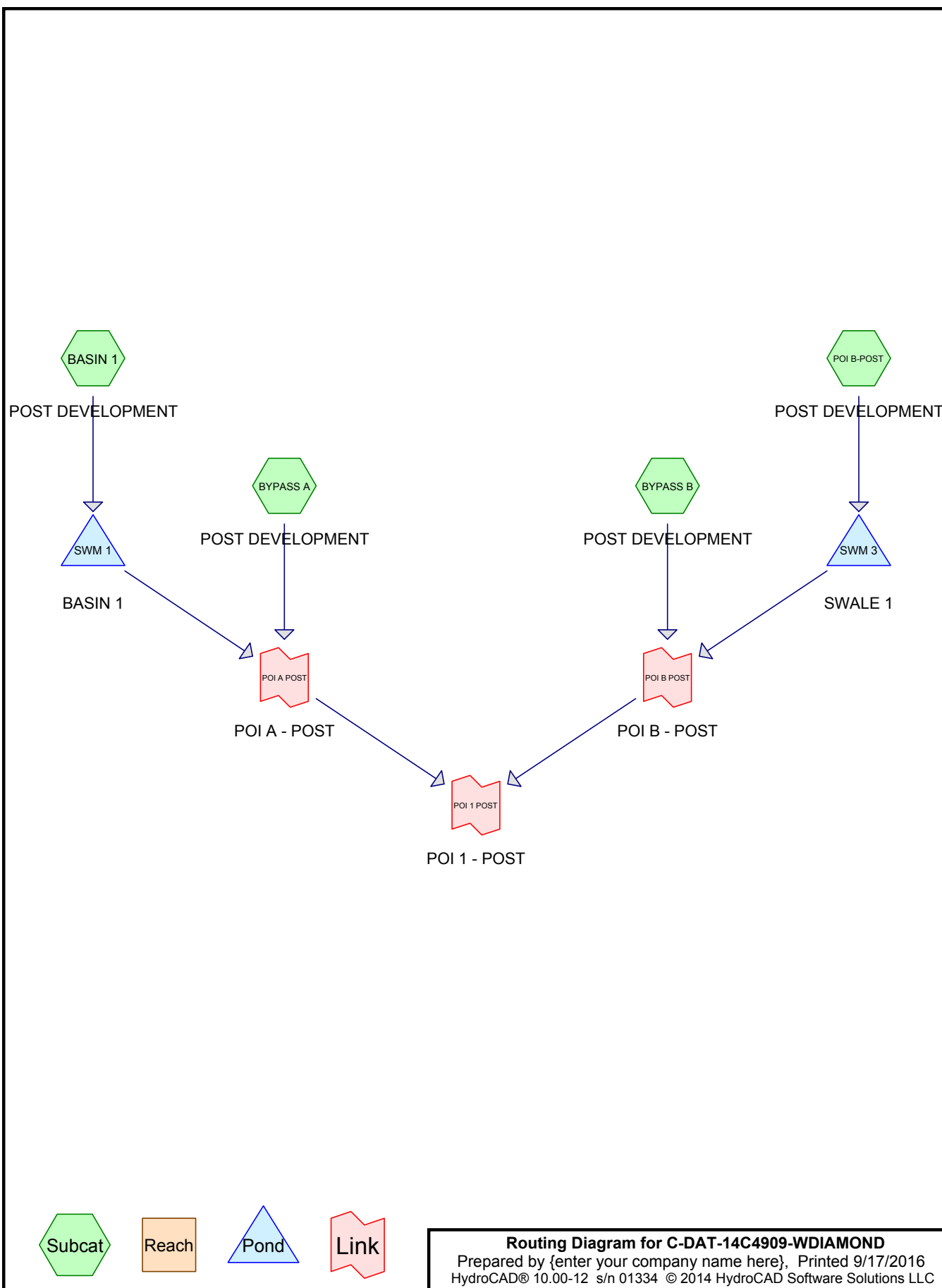
LEGEND

- PROPERTY BOUNDARY (1/4"=1/4"=1/4")
- EXISTING MAJOR CONTOUR (10' INTERVAL)
- EXISTING MINOR CONTOUR (2' INTERVAL)
- FENCE
- STONE ROW
- SOIL BOUNDARY
- TREELINE
- CENTERLINE STREAM/EDGE WATERBODY
- DELINEATED WETLANDS
- SPOT ELEVATION
- TREE OR BUSH
- UTILITY POLE AND UTILITY LINE
- GUY POLE
- GUY POLE OR ANCHOR
- POST
- SIGN
- WATER WELL
- UTILITY BOX
- MONUMENT (PROPERTY BOUNDARY MARKER)
- IRON PIPE OR PIN (PROPERTY BOUNDARY MARKER)
- SOIL TYPE DESIGNATION
- EXISTING ROAD
- ROW
- PROPOSED MAJOR CONTOUR (10' INTERVAL)
- PROPOSED MINOR CONTOUR (2' INTERVAL)
- PROPOSED MINOR CONTOUR (1' INTERVAL)
- LOD
- ESCGP-2 PERMIT BOUNDARY
- CENTERLINE GAS PIPELINE
- LIMIT OF WORKSPACE (OVERALL PIPELINE PROJECT)
- PROPOSED ACCESS ROAD
- DRAINAGE AREA BOUNDARIES
- TIME OF CONCENTRATION FLOW PATH



REVISIONS				TRANSCONTINENTAL GAS PIPELINE COMPANY LLC			
NO.	DATE	BY	DESCRIPTION	W.D. NO.	CHK.	APP.	
0	08/28/2015	BL	ISSUED FOR PADEP PERMIT SUBMITTAL	W01161501	DAK	AJB	
1	12/02/2015	BL	ISSUED FOR PADEP RESUBMITTAL	W01161501	DAK	AJB	
2	02/04/2016	BL	ISSUED FOR PADEP RESUBMITTAL	W01161501	AJB	AJB	
3	03/28/2016	BL	ISSUED FOR PADEP RESUBMITTAL	W01161501	AJB	AJB	
4	OCT. 2016	BL	PADEP TECHNICAL DEFICIENCY RESPONSE #1	W01161501	AJB	AJB	
Date Description By				ATLANTIC SUNRISE PROJECT- PROPOSED 30"/42" NATURAL GAS PIPELINE			
09/21/16 Internal QA/QC AJB				POST CONSTRUCTION STORMWATER MANAGEMENT PLANS FOR WEST			
09/28/16 Internal QA/QC ABU				DIAMOND REGULATOR STATION & ASSOCIATED PERMANENT ACCESS ROADS			
ALAN J. BUSHER REG. NO. PE 60320				JACKSON/SUGARLOAF TOWNSHIPS, COLUMBIA COUNTY, PENNSYLVANIA			
				POST DEVELOPMENT DRAINAGE AREA MAP			
DRAWN BY: JEC		DATE: 04/03/15		ISSUED FOR BID:		SCALE: AS NOTED	
CHECKED BY: AJB		DATE: 04/03/15		ISSUED FOR CONSTRUCTION:		REVISION: 4	
APPROVED BY: AJB		DATE: 07/17/15		DRAWING NUMBER: (36-7943)MF-1A-9		SHEET 1	
W.D. 1161501						OF 1	





**Summary for Subcatchment BASIN 1: POST DEVELOPMENT**

Runoff = 2.69 cfs @ 12.03 hrs, Volume= 0.175 af, Depth= 0.94"

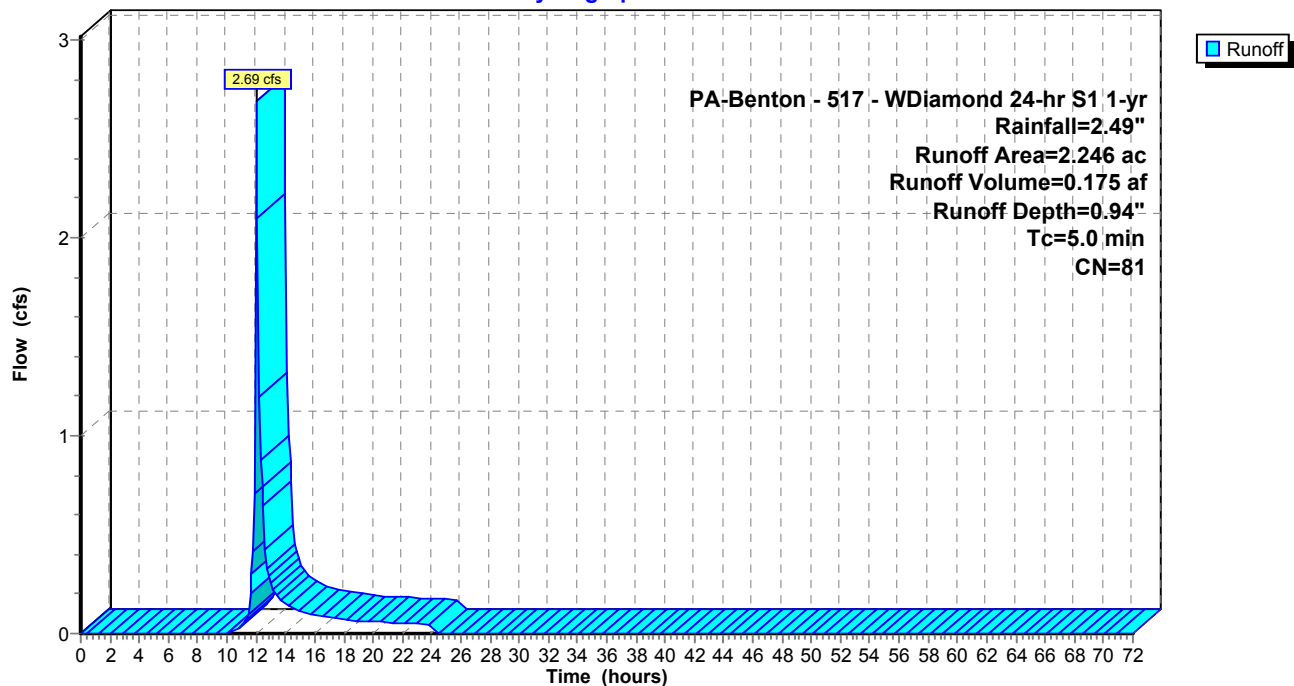
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs  
PA-Benton - 517 - WDiamond 24-hr S1 1-yr Rainfall=2.49"

Area (ac)	CN	Description
0.000	70	Woods, Good, HSG C
1.050	71	Meadow, non-grazed, HSG C
* 1.186	89	Gravel areas, HSG C
* 0.010	98	Impervious areas, HSG C
2.246	81	Weighted Average
2.236		99.55% Pervious Area
0.010		0.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry,

**Subcatchment BASIN 1: POST DEVELOPMENT**

Hydrograph





**Summary for Subcatchment BASIN 1: POST DEVELOPMENT**

Runoff = 3.81 cfs @ 12.03 hrs, Volume= 0.243 af, Depth= 1.30"

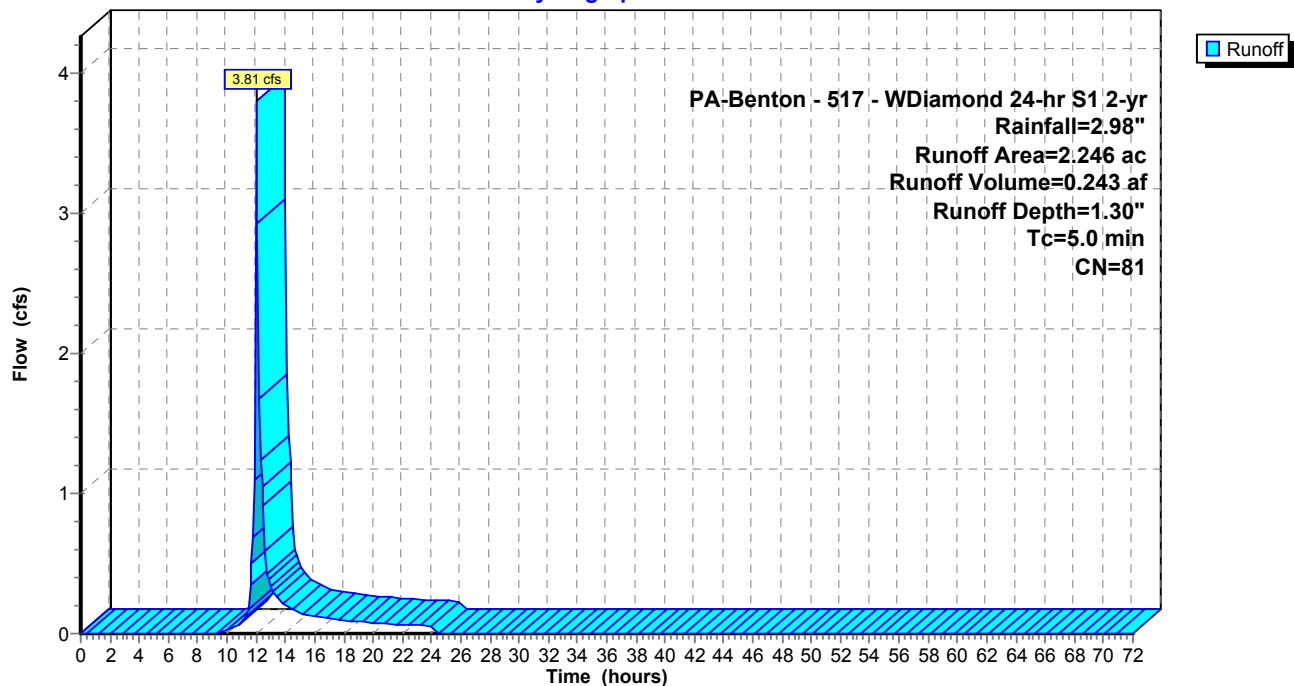
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs  
PA-Benton - 517 - WDiamond 24-hr S1 2-yr Rainfall=2.98"

Area (ac)	CN	Description
0.000	70	Woods, Good, HSG C
1.050	71	Meadow, non-grazed, HSG C
* 1.186	89	Gravel areas, HSG C
* 0.010	98	Impervious areas, HSG C
2.246	81	Weighted Average
2.236		99.55% Pervious Area
0.010		0.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry,

**Subcatchment BASIN 1: POST DEVELOPMENT**

Hydrograph



**Summary for Subcatchment BASIN 1: POST DEVELOPMENT**

Runoff = 5.32 cfs @ 12.03 hrs, Volume= 0.347 af, Depth= 1.86"

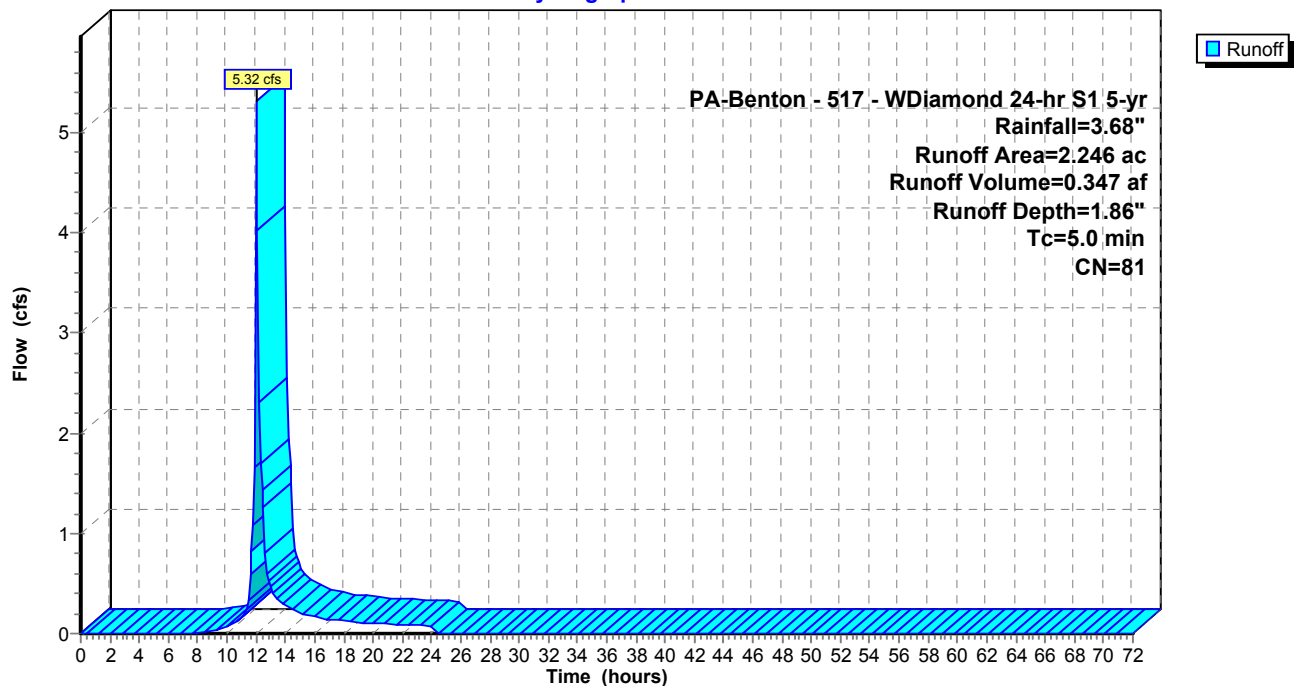
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs  
PA-Benton - 517 - WDiamond 24-hr S1 5-yr Rainfall=3.68"

Area (ac)	CN	Description
0.000	70	Woods, Good, HSG C
1.050	71	Meadow, non-grazed, HSG C
* 1.186	89	Gravel areas, HSG C
* 0.010	98	Impervious areas, HSG C
2.246	81	Weighted Average
2.236		99.55% Pervious Area
0.010		0.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry,

**Subcatchment BASIN 1: POST DEVELOPMENT**

Hydrograph



## Summary for Subcatchment BASIN 1: POST DEVELOPMENT

Runoff = 6.43 cfs @ 12.02 hrs, Volume= 0.443 af, Depth= 2.37"

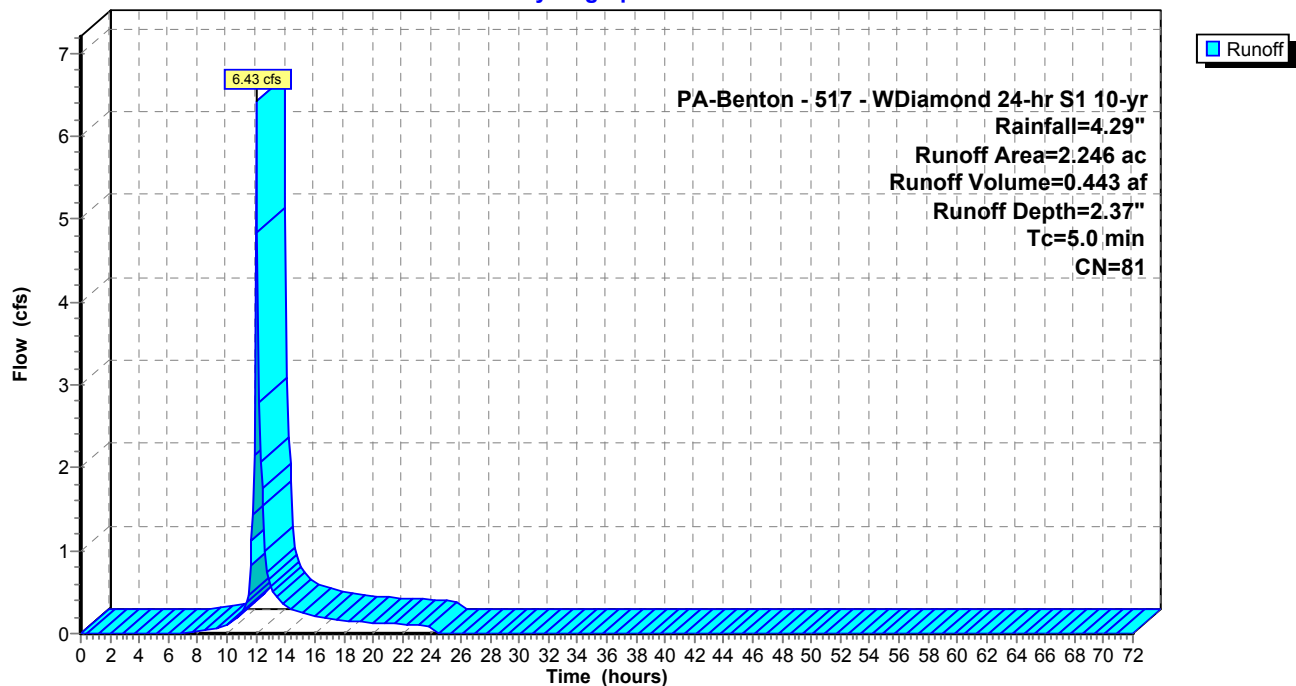
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs  
PA-Benton - 517 - WDiamond 24-hr S1 10-yr Rainfall=4.29"

Area (ac)	CN	Description
0.000	70	Woods, Good, HSG C
1.050	71	Meadow, non-grazed, HSG C
* 1.186	89	Gravel areas, HSG C
* 0.010	98	Impervious areas, HSG C
2.246	81	Weighted Average
2.236		99.55% Pervious Area
0.010		0.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry,

## Subcatchment BASIN 1: POST DEVELOPMENT

Hydrograph



**Summary for Subcatchment BASIN 1: POST DEVELOPMENT**

Runoff = 8.01 cfs @ 12.02 hrs, Volume= 0.594 af, Depth= 3.17"

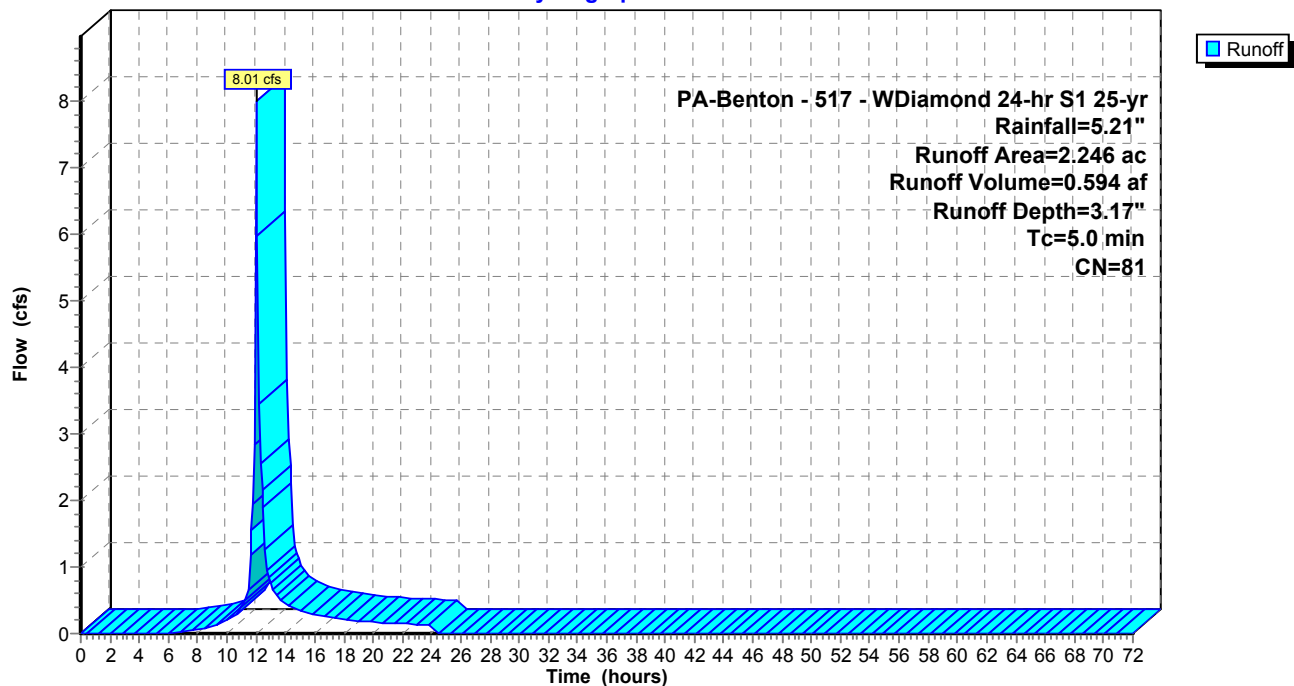
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs  
PA-Benton - 517 - WDiamond 24-hr S1 25-yr Rainfall=5.21"

Area (ac)	CN	Description
0.000	70	Woods, Good, HSG C
1.050	71	Meadow, non-grazed, HSG C
* 1.186	89	Gravel areas, HSG C
* 0.010	98	Impervious areas, HSG C
2.246	81	Weighted Average
2.236		99.55% Pervious Area
0.010		0.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry,

**Subcatchment BASIN 1: POST DEVELOPMENT**

Hydrograph



**Summary for Subcatchment BASIN 1: POST DEVELOPMENT**

Runoff = 9.19 cfs @ 12.02 hrs, Volume= 0.734 af, Depth= 3.92"

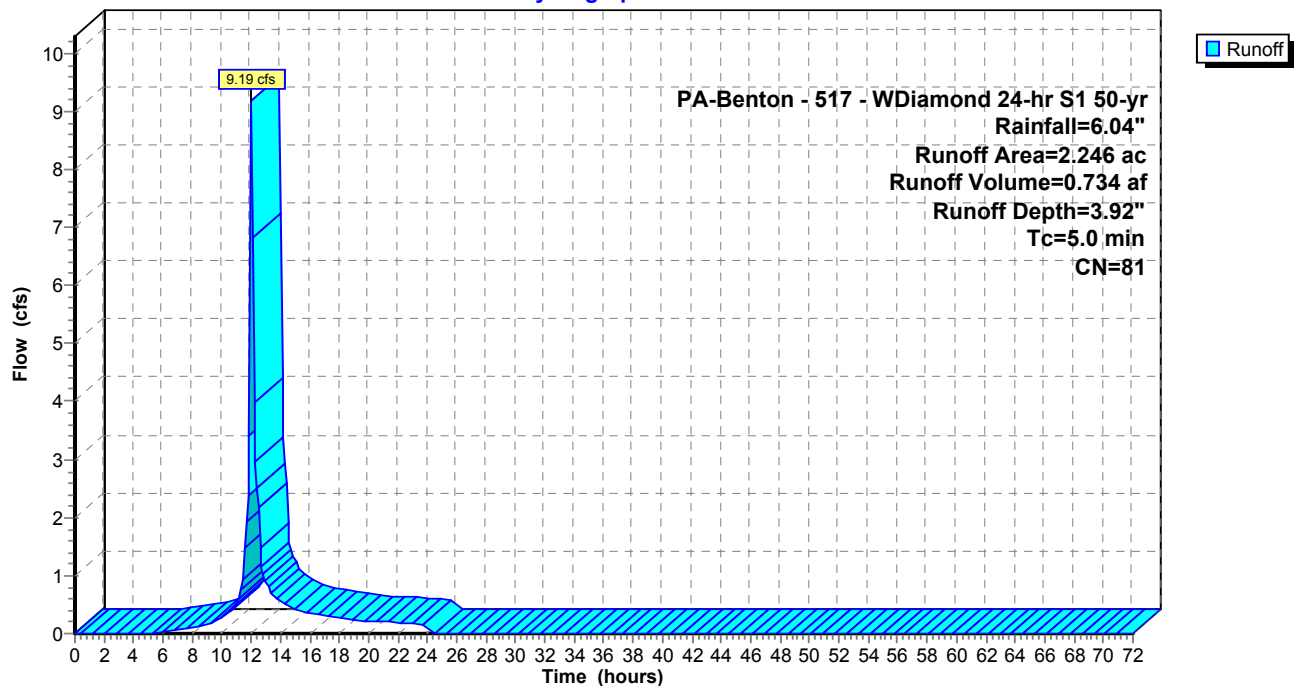
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs  
PA-Benton - 517 - WDiamond 24-hr S1 50-yr Rainfall=6.04"

Area (ac)	CN	Description
0.000	70	Woods, Good, HSG C
1.050	71	Meadow, non-grazed, HSG C
* 1.186	89	Gravel areas, HSG C
* 0.010	98	Impervious areas, HSG C
2.246	81	Weighted Average
2.236		99.55% Pervious Area
0.010		0.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry,

**Subcatchment BASIN 1: POST DEVELOPMENT**

Hydrograph



### Summary for Subcatchment BASIN 1: POST DEVELOPMENT

Runoff = 10.37 cfs @ 12.02 hrs, Volume= 0.899 af, Depth= 4.81"

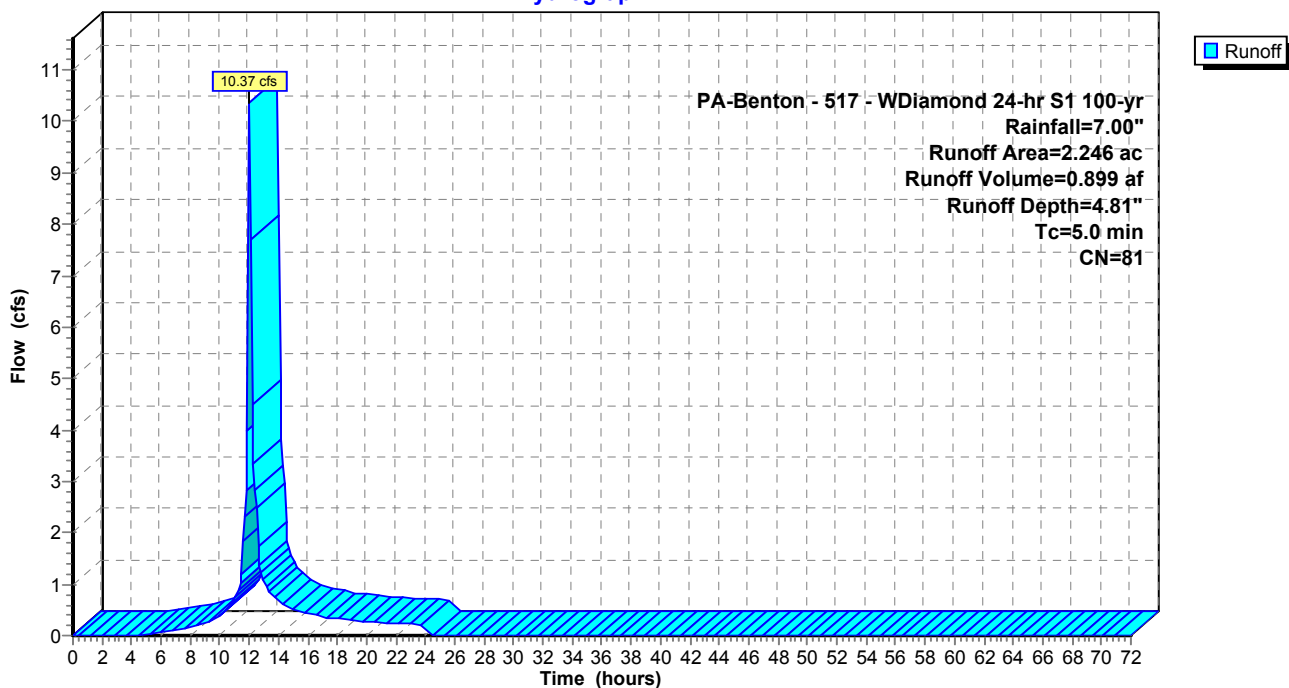
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs  
 PA-Benton - 517 - WDiamond 24-hr S1 100-yr Rainfall=7.00"

Area (ac)	CN	Description
0.000	70	Woods, Good, HSG C
1.050	71	Meadow, non-grazed, HSG C
* 1.186	89	Gravel areas, HSG C
* 0.010	98	Impervious areas, HSG C
2.246	81	Weighted Average
2.236		99.55% Pervious Area
0.010		0.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry,

### Subcatchment BASIN 1: POST DEVELOPMENT

Hydrograph



**Summary for Pond SWM 1: BASIN 1**

Inflow Area = 2.246 ac, 0.45% Impervious, Inflow Depth = 0.94" for 1-yr event  
 Inflow = 2.69 cfs @ 12.03 hrs, Volume= 0.175 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= 0.00-72.00 hrs, dt= 0.10 hrs  
 Peak Elev= 1,200.45' @ 24.40 hrs Surf.Area= 17,365 sf Storage= 7,625 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	1,200.00'	37,481 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,200.00	16,221	0	0
1,202.00	21,260	37,481	37,481

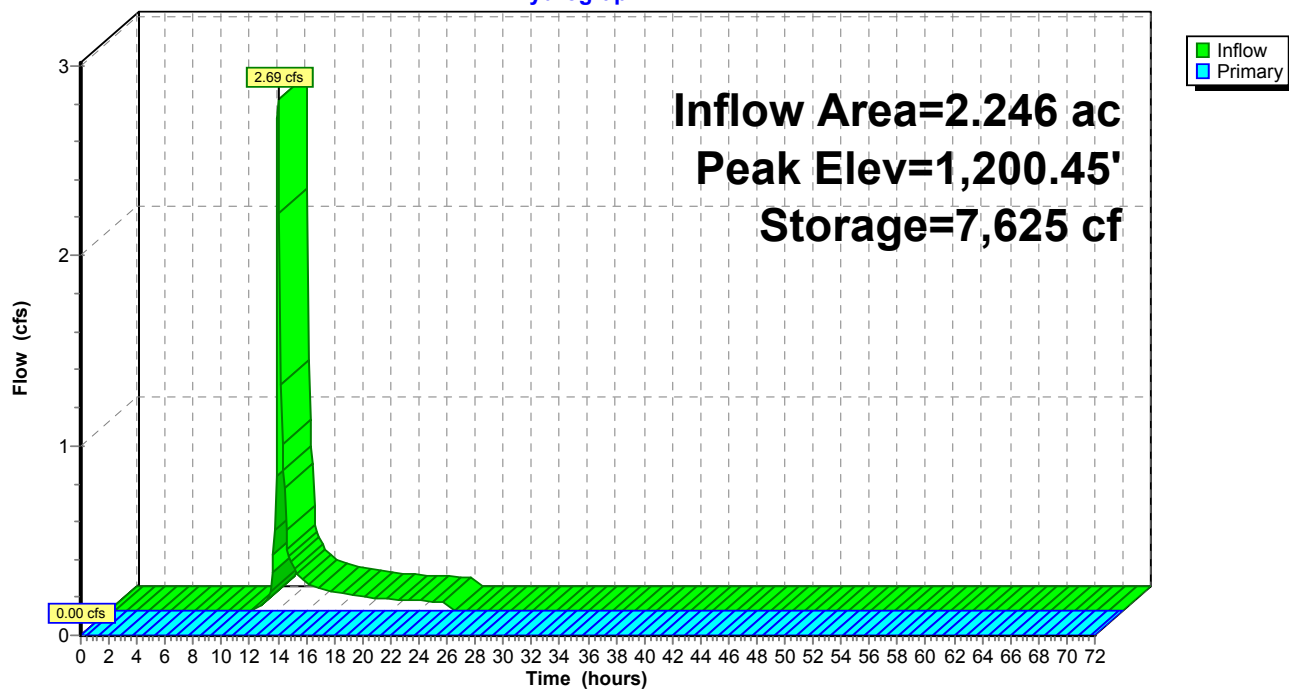
Device	Routing	Invert	Outlet Devices
#1	Primary	1,198.00'	<b>12.0" Round Culvert</b> L= 29.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 1,198.00' / 1,195.00' S= 0.1034 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Device 1	1,200.75'	<b>24.0" x 48.0" Horiz. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#3	Primary	1,201.00'	<b>15.0' long x 14.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.64 2.67 2.70 2.65 2.64 2.65 2.65 2.63

**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=1,200.00' (Free Discharge)

1=Culvert (Passes 0.00 cfs of 4.63 cfs potential flow)  
 2=Orifice/Grate ( Controls 0.00 cfs)  
 3=Broad-Crested Rectangular Weir ( Controls 0.00 cfs)

## Pond SWM 1: BASIN 1

Hydrograph





**Stage-Discharge for Pond SWM 1: BASIN 1**

Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)
1,200.00	0.00	1,200.52	0.00	1,201.04	6.34	1,201.56	23.55
1,200.01	0.00	1,200.53	0.00	1,201.05	6.48	1,201.57	24.03
1,200.02	0.00	1,200.54	0.00	1,201.06	6.63	1,201.58	24.51
1,200.03	0.00	1,200.55	0.00	1,201.07	6.80	1,201.59	24.99
1,200.04	0.00	1,200.56	0.00	1,201.08	6.97	1,201.60	25.48
1,200.05	0.00	1,200.57	0.00	1,201.09	7.16	1,201.61	25.95
1,200.06	0.00	1,200.58	0.00	1,201.10	7.35	1,201.62	26.41
1,200.07	0.00	1,200.59	0.00	1,201.11	7.55	1,201.63	26.89
1,200.08	0.00	1,200.60	0.00	1,201.12	7.77	1,201.64	27.36
1,200.09	0.00	1,200.61	0.00	1,201.13	7.99	1,201.65	27.84
1,200.10	0.00	1,200.62	0.00	1,201.14	8.22	1,201.66	28.32
1,200.11	0.00	1,200.63	0.00	1,201.15	8.46	1,201.67	28.80
1,200.12	0.00	1,200.64	0.00	1,201.16	8.70	1,201.68	29.29
1,200.13	0.00	1,200.65	0.00	1,201.17	8.95	1,201.69	29.77
1,200.14	0.00	1,200.66	0.00	1,201.18	9.22	1,201.70	30.26
1,200.15	0.00	1,200.67	0.00	1,201.19	9.48	1,201.71	30.76
1,200.16	0.00	1,200.68	0.00	1,201.20	9.76	1,201.72	31.25
1,200.17	0.00	1,200.69	0.00	1,201.21	10.04	1,201.73	31.75
1,200.18	0.00	1,200.70	0.00	1,201.22	10.33	1,201.74	32.25
1,200.19	0.00	1,200.71	0.00	1,201.23	10.62	1,201.75	32.76
1,200.20	0.00	1,200.72	0.00	1,201.24	10.93	1,201.76	33.26
1,200.21	0.00	1,200.73	0.00	1,201.25	11.24	1,201.77	33.77
1,200.22	0.00	1,200.74	0.00	1,201.26	11.55	1,201.78	34.28
1,200.23	0.00	1,200.75	0.00	1,201.27	11.87	1,201.79	34.80
1,200.24	0.00	1,200.76	0.04	1,201.28	12.20	1,201.80	35.31
1,200.25	0.00	1,200.77	0.11	1,201.29	12.53	1,201.81	35.85
1,200.26	0.00	1,200.78	0.20	1,201.30	12.87	1,201.82	36.40
1,200.27	0.00	1,200.79	0.31	1,201.31	13.22	1,201.83	36.94
1,200.28	0.00	1,200.80	0.44	1,201.32	13.57	1,201.84	37.49
1,200.29	0.00	1,200.81	0.58	1,201.33	13.92	1,201.85	38.04
1,200.30	0.00	1,200.82	0.73	1,201.34	14.29	1,201.86	38.60
1,200.31	0.00	1,200.83	0.89	1,201.35	14.65	1,201.87	39.16
1,200.32	0.00	1,200.84	1.06	1,201.36	15.03	1,201.88	39.72
1,200.33	0.00	1,200.85	1.24	1,201.37	15.41	1,201.89	40.28
1,200.34	0.00	1,200.86	1.43	1,201.38	15.79	1,201.90	40.85
1,200.35	0.00	1,200.87	1.63	1,201.39	16.18	1,201.91	41.42
1,200.36	0.00	1,200.88	1.84	1,201.40	16.57	1,201.92	41.99
1,200.37	0.00	1,200.89	2.06	1,201.41	16.97	1,201.93	42.57
1,200.38	0.00	1,200.90	2.28	1,201.42	17.38	1,201.94	43.14
1,200.39	0.00	1,200.91	2.51	1,201.43	17.79	1,201.95	43.73
1,200.40	0.00	1,200.92	2.75	1,201.44	18.20	1,201.96	44.31
1,200.41	0.00	1,200.93	3.00	1,201.45	18.62	1,201.97	44.90
1,200.42	0.00	1,200.94	3.25	1,201.46	19.04	1,201.98	45.49
1,200.43	0.00	1,200.95	3.51	1,201.47	19.47	1,201.99	46.08
1,200.44	0.00	1,200.96	3.78	1,201.48	19.91	1,202.00	<b>46.67</b>
1,200.45	0.00	1,200.97	4.05	1,201.49	20.35		
1,200.46	0.00	1,200.98	4.33	1,201.50	20.79		
1,200.47	0.00	1,200.99	4.61	1,201.51	21.24		
1,200.48	0.00	1,201.00	4.91	1,201.52	21.69		
1,200.49	0.00	1,201.01	5.24	1,201.53	22.15		
1,200.50	0.00	1,201.02	5.62	1,201.54	22.61		
1,200.51	0.00	1,201.03	6.02	1,201.55	23.08		

**Stage-Area-Storage for Pond SWM 1: BASIN 1**

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
1,200.00	16,221	0	1,201.04	18,841	18,232
1,200.02	16,271	325	1,201.06	18,892	18,610
1,200.04	16,322	651	1,201.08	18,942	18,988
1,200.06	16,372	978	1,201.10	18,992	19,367
1,200.08	16,423	1,306	1,201.12	19,043	19,748
1,200.10	16,473	1,635	1,201.14	19,093	20,129
1,200.12	16,523	1,965	1,201.16	19,144	20,511
1,200.14	16,574	2,296	1,201.18	19,194	20,895
1,200.16	16,624	2,628	1,201.20	19,244	21,279
1,200.18	16,675	2,961	1,201.22	19,295	21,665
1,200.20	16,725	3,295	1,201.24	19,345	22,051
1,200.22	16,775	3,630	1,201.26	19,396	22,438
1,200.24	16,826	3,966	1,201.28	19,446	22,827
1,200.26	16,876	4,303	1,201.30	19,496	23,216
1,200.28	16,926	4,641	1,201.32	19,547	23,607
1,200.30	16,977	4,980	1,201.34	19,597	23,998
1,200.32	17,027	5,320	1,201.36	19,648	24,391
1,200.34	17,078	5,661	1,201.38	19,698	24,784
1,200.36	17,128	6,003	1,201.40	19,748	25,179
1,200.38	17,178	6,346	1,201.42	19,799	25,574
1,200.40	17,229	6,690	1,201.44	19,849	25,970
1,200.42	17,279	7,035	1,201.46	19,899	26,368
1,200.44	17,330	7,381	1,201.48	19,950	26,766
1,200.46	17,380	7,728	1,201.50	20,000	27,166
1,200.48	17,430	8,076	1,201.52	20,051	27,566
1,200.50	17,481	8,425	1,201.54	20,101	27,968
1,200.52	17,531	8,776	1,201.56	20,151	28,370
1,200.54	17,582	9,127	1,201.58	20,202	28,774
1,200.56	17,632	9,479	1,201.60	20,252	29,179
1,200.58	17,682	9,832	1,201.62	20,303	29,584
1,200.60	17,733	10,186	1,201.64	20,353	29,991
1,200.62	17,783	10,541	1,201.66	20,403	30,398
1,200.64	17,833	10,897	1,201.68	20,454	30,807
1,200.66	17,884	11,255	1,201.70	20,504	31,216
1,200.68	17,934	11,613	1,201.72	20,555	31,627
1,200.70	17,985	11,972	1,201.74	20,605	32,039
1,200.72	18,035	12,332	1,201.76	20,655	32,451
1,200.74	18,085	12,693	1,201.78	20,706	32,865
1,200.76	18,136	13,056	1,201.80	20,756	33,279
1,200.78	18,186	13,419	1,201.82	20,806	33,695
1,200.80	18,237	13,783	1,201.84	20,857	34,112
1,200.82	18,287	14,148	1,201.86	20,907	34,529
1,200.84	18,337	14,515	1,201.88	20,958	34,948
1,200.86	18,388	14,882	1,201.90	21,008	35,368
1,200.88	18,438	15,250	1,201.92	21,058	35,788
1,200.90	18,489	15,619	1,201.94	21,109	36,210
1,200.92	18,539	15,990	1,201.96	21,159	36,633
1,200.94	18,589	16,361	1,201.98	21,210	37,056
1,200.96	18,640	16,733	1,202.00	<b>21,260</b>	<b>37,481</b>
1,200.98	18,690	17,106			
1,201.00	18,741	17,481			
1,201.02	18,791	17,856			

**Summary for Pond SWM 1: BASIN 1**

Inflow Area = 2.246 ac, 0.45% Impervious, Inflow Depth = 1.30" for 2-yr event  
 Inflow = 3.81 cfs @ 12.03 hrs, Volume= 0.243 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= 0.00-72.00 hrs, dt= 0.10 hrs  
 Peak Elev= 1,200.62' @ 24.40 hrs Surf.Area= 17,789 sf Storage= 10,584 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	1,200.00'	37,481 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,200.00	16,221	0	0
1,202.00	21,260	37,481	37,481

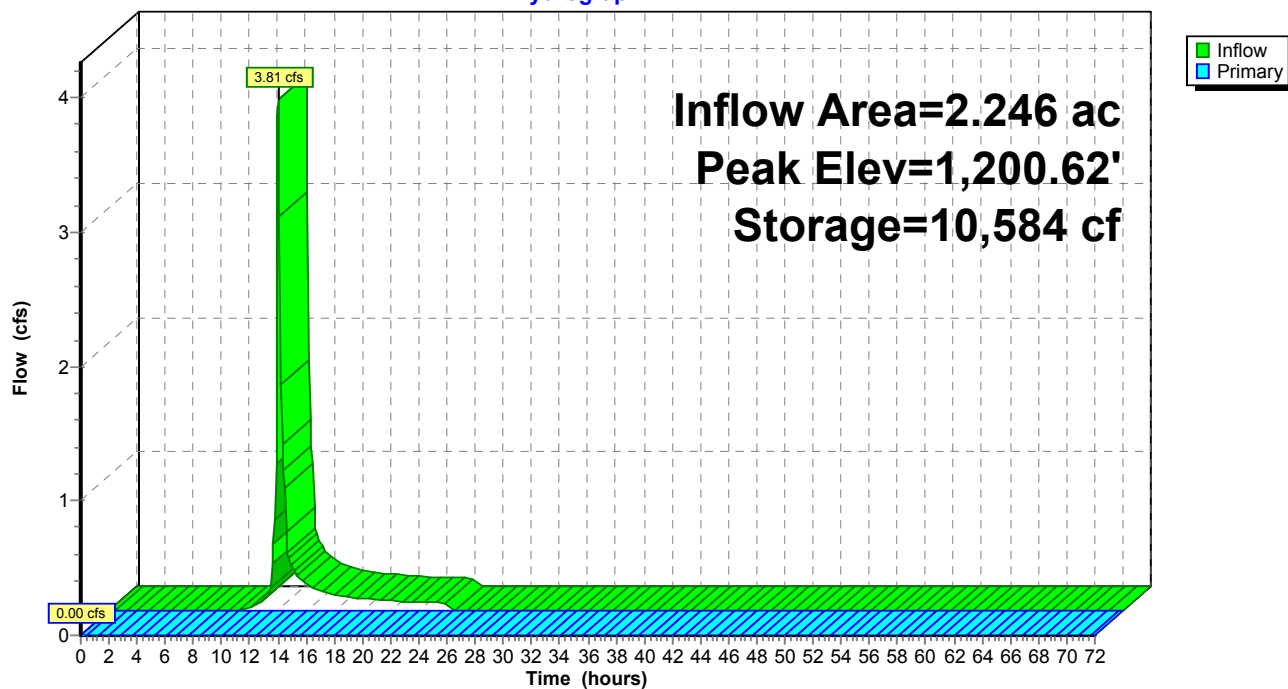
Device	Routing	Invert	Outlet Devices
#1	Primary	1,198.00'	<b>12.0" Round Culvert</b> L= 29.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 1,198.00' / 1,195.00' S= 0.1034 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Device 1	1,200.75'	<b>24.0" x 48.0" Horiz. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#3	Primary	1,201.00'	<b>15.0' long x 14.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.64 2.67 2.70 2.65 2.64 2.65 2.65 2.63

**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=1,200.00' (Free Discharge)

1=Culvert (Passes 0.00 cfs of 4.63 cfs potential flow)  
 2=Orifice/Grate ( Controls 0.00 cfs)  
 3=Broad-Crested Rectangular Weir ( Controls 0.00 cfs)

## Pond SWM 1: BASIN 1

Hydrograph



**Summary for Pond SWM 1: BASIN 1**

Inflow Area = 2.246 ac, 0.45% Impervious, Inflow Depth = 1.86" for 5-yr event  
 Inflow = 5.32 cfs @ 12.03 hrs, Volume= 0.347 af  
 Outflow = 0.11 cfs @ 19.89 hrs, Volume= 0.052 af, Atten= 98%, Lag= 471.7 min  
 Primary = 0.11 cfs @ 19.89 hrs, Volume= 0.052 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs  
 Peak Elev= 1,200.77' @ 19.89 hrs Surf.Area= 18,156 sf Storage= 13,202 cf

Plug-Flow detention time= 620.4 min calculated for 0.052 af (15% of inflow)  
 Center-of-Mass det. time= 456.0 min ( 1,296.4 - 840.4 )

Volume	Invert	Avail.Storage	Storage Description
#1	1,200.00'	37,481 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,200.00	16,221	0	0
1,202.00	21,260	37,481	37,481

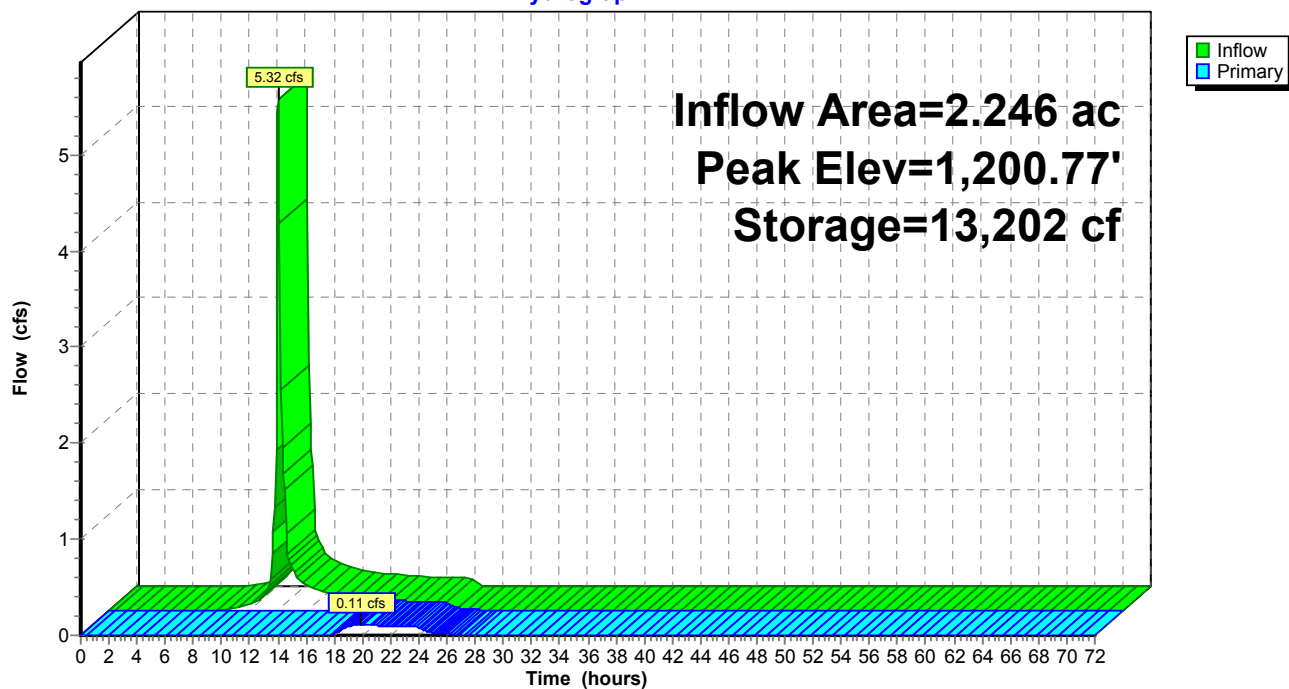
Device	Routing	Invert	Outlet Devices
#1	Primary	1,198.00'	<b>12.0" Round Culvert</b> L= 29.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 1,198.00' / 1,195.00' S= 0.1034 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Device 1	1,200.75'	<b>24.0" x 48.0" Horiz. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#3	Primary	1,201.00'	<b>15.0' long x 14.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.64 2.67 2.70 2.65 2.64 2.65 2.65 2.63

**Primary OutFlow** Max=0.10 cfs @ 19.89 hrs HW=1,200.77' (Free Discharge)

1=Culvert (Passes 0.10 cfs of 5.70 cfs potential flow)  
 2=Orifice/Grate (Weir Controls 0.10 cfs @ 0.44 fps)  
 3=Broad-Crested Rectangular Weir ( Controls 0.00 cfs)

## Pond SWM 1: BASIN 1

## Hydrograph



### Summary for Pond SWM 1: BASIN 1

Inflow Area = 2.246 ac, 0.45% Impervious, Inflow Depth = 2.37" for 10-yr event  
 Inflow = 6.43 cfs @ 12.02 hrs, Volume= 0.443 af  
 Outflow = 0.26 cfs @ 14.90 hrs, Volume= 0.148 af, Atten= 96%, Lag= 172.7 min  
 Primary = 0.26 cfs @ 14.90 hrs, Volume= 0.148 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs  
 Peak Elev= 1,200.79' @ 14.90 hrs Surf.Area= 18,199 sf Storage= 13,513 cf

Plug-Flow detention time= 420.1 min calculated for 0.148 af (33% of inflow)  
 Center-of-Mass det. time= 275.3 min ( 1,111.0 - 835.6 )

Volume	Invert	Avail.Storage	Storage Description
#1	1,200.00'	37,481 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,200.00	16,221	0	0
1,202.00	21,260	37,481	37,481

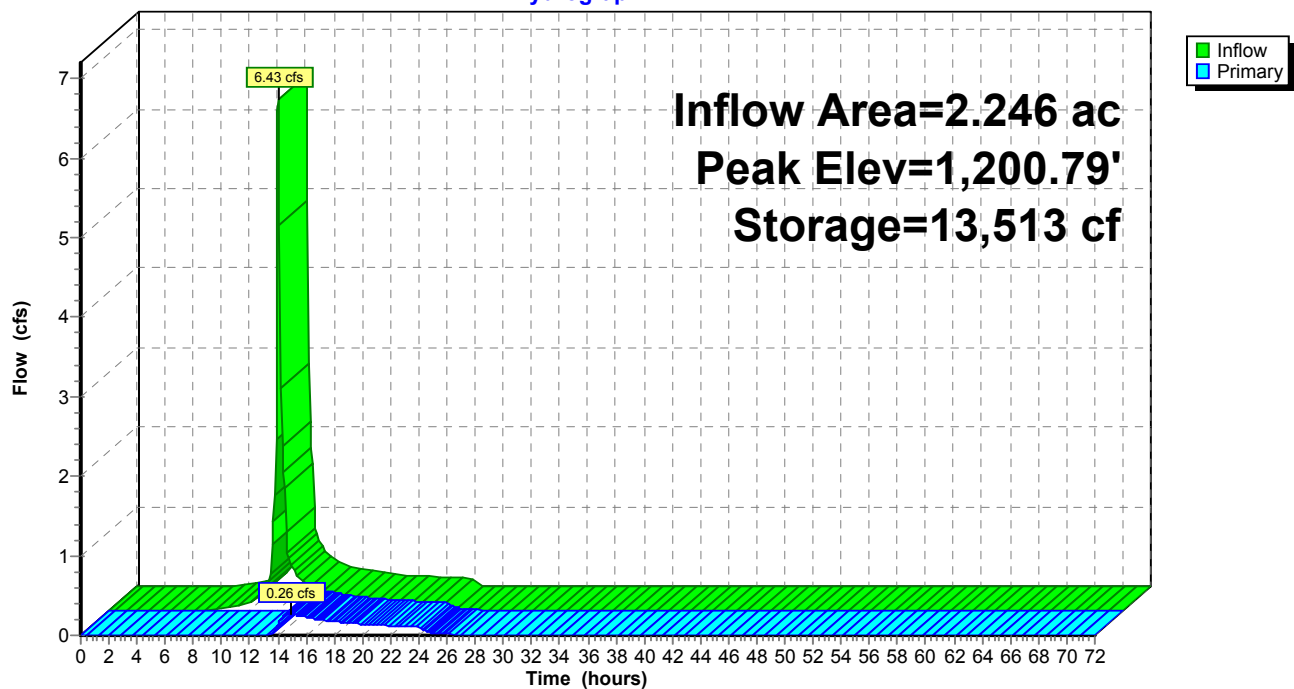
Device	Routing	Invert	Outlet Devices
#1	Primary	1,198.00'	<b>12.0" Round Culvert</b> L= 29.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 1,198.00' / 1,195.00' S= 0.1034 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Device 1	1,200.75'	<b>24.0" x 48.0" Horiz. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#3	Primary	1,201.00'	<b>15.0' long x 14.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.64 2.67 2.70 2.65 2.64 2.65 2.65 2.63

**Primary OutFlow** Max=0.26 cfs @ 14.90 hrs HW=1,200.79' (Free Discharge)

1=Culvert (Passes 0.26 cfs of 5.72 cfs potential flow)  
 2=Orifice/Grate (Weir Controls 0.26 cfs @ 0.61 fps)  
 3=Broad-Crested Rectangular Weir ( Controls 0.00 cfs)

## Pond SWM 1: BASIN 1

## Hydrograph





**Summary for Pond SWM 1: BASIN 1**

Inflow Area = 2.246 ac, 0.45% Impervious, Inflow Depth = 3.17" for 25-yr event  
 Inflow = 8.01 cfs @ 12.02 hrs, Volume= 0.594 af  
 Outflow = 0.89 cfs @ 12.77 hrs, Volume= 0.298 af, Atten= 89%, Lag= 44.9 min  
 Primary = 0.89 cfs @ 12.77 hrs, Volume= 0.298 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs  
 Peak Elev= 1,200.83' @ 12.77 hrs Surf.Area= 18,312 sf Storage= 14,328 cf

Plug-Flow detention time= 306.8 min calculated for 0.298 af (50% of inflow)  
 Center-of-Mass det. time= 172.7 min ( 1,003.1 - 830.3 )

Volume	Invert	Avail.Storage	Storage Description
#1	1,200.00'	37,481 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,200.00	16,221	0	0
1,202.00	21,260	37,481	37,481

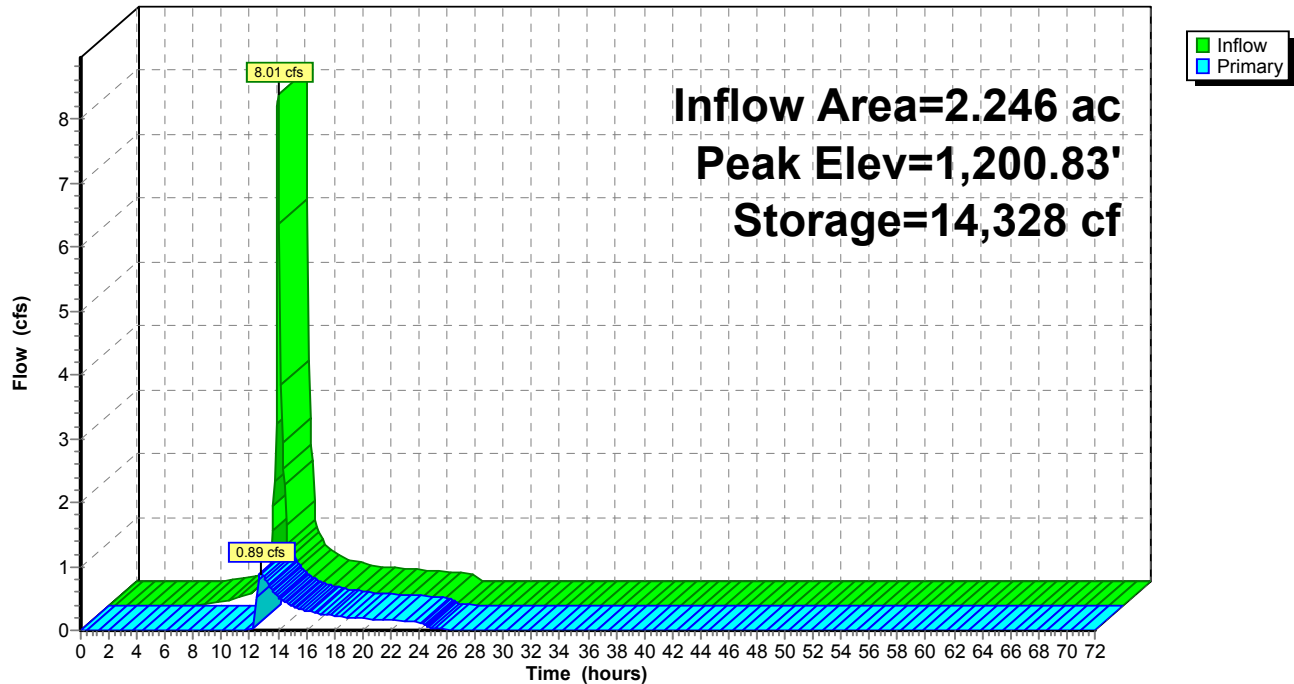
Device	Routing	Invert	Outlet Devices
#1	Primary	1,198.00'	<b>12.0" Round Culvert</b> L= 29.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 1,198.00' / 1,195.00' S= 0.1034 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Device 1	1,200.75'	<b>24.0" x 48.0" Horiz. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#3	Primary	1,201.00'	<b>15.0' long x 14.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.64 2.67 2.70 2.65 2.64 2.65 2.65 2.63

**Primary OutFlow** Max=0.88 cfs @ 12.77 hrs HW=1,200.83' (Free Discharge)

1=Culvert (Passes 0.88 cfs of 5.77 cfs potential flow)  
 2=Orifice/Grate (Weir Controls 0.88 cfs @ 0.92 fps)  
 3=Broad-Crested Rectangular Weir ( Controls 0.00 cfs)

## Pond SWM 1: BASIN 1

## Hydrograph



**Summary for Pond SWM 1: BASIN 1**

Inflow Area = 2.246 ac, 0.45% Impervious, Inflow Depth = 3.92" for 50-yr event  
 Inflow = 9.19 cfs @ 12.02 hrs, Volume= 0.734 af  
 Outflow = 2.11 cfs @ 12.51 hrs, Volume= 0.438 af, Atten= 77%, Lag= 29.0 min  
 Primary = 2.11 cfs @ 12.51 hrs, Volume= 0.438 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs  
 Peak Elev= 1,200.89' @ 12.51 hrs Surf.Area= 18,469 sf Storage= 15,479 cf

Plug-Flow detention time= 264.9 min calculated for 0.438 af (60% of inflow)  
 Center-of-Mass det. time= 136.0 min ( 962.1 - 826.1 )

Volume	Invert	Avail.Storage	Storage Description
#1	1,200.00'	37,481 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,200.00	16,221	0	0
1,202.00	21,260	37,481	37,481

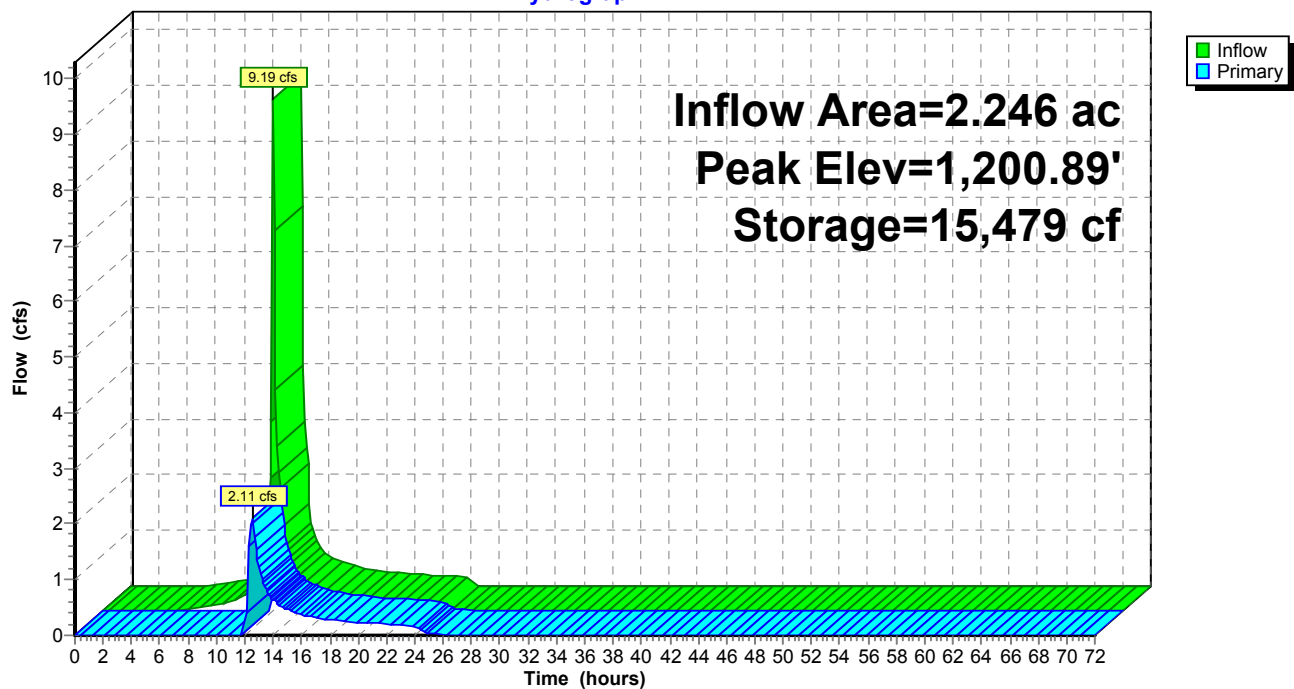
Device	Routing	Invert	Outlet Devices
#1	Primary	1,198.00'	<b>12.0" Round Culvert</b> L= 29.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 1,198.00' / 1,195.00' S= 0.1034 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Device 1	1,200.75'	<b>24.0" x 48.0" Horiz. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#3	Primary	1,201.00'	<b>15.0' long x 14.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.64 2.67 2.70 2.65 2.64 2.65 2.65 2.63

**Primary OutFlow** Max=2.10 cfs @ 12.51 hrs HW=1,200.89' (Free Discharge)

1=Culvert (Passes 2.10 cfs of 5.85 cfs potential flow)  
 2=Orifice/Grate (Weir Controls 2.10 cfs @ 1.23 fps)  
 3=Broad-Crested Rectangular Weir ( Controls 0.00 cfs)

## Pond SWM 1: BASIN 1

Hydrograph



### Summary for Pond SWM 1: BASIN 1

Inflow Area = 2.246 ac, 0.45% Impervious, Inflow Depth = 4.81" for 100-yr event  
 Inflow = 10.37 cfs @ 12.02 hrs, Volume= 0.899 af  
 Outflow = 3.69 cfs @ 12.29 hrs, Volume= 0.604 af, Atten= 64%, Lag= 16.1 min  
 Primary = 3.69 cfs @ 12.29 hrs, Volume= 0.604 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs  
 Peak Elev= 1,200.96' @ 12.29 hrs Surf.Area= 18,631 sf Storage= 16,670 cf

Plug-Flow detention time= 240.8 min calculated for 0.604 af (67% of inflow)  
 Center-of-Mass det. time= 115.8 min ( 937.9 - 822.0 )

Volume	Invert	Avail.Storage	Storage Description
#1	1,200.00'	37,481 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,200.00	16,221	0	0
1,202.00	21,260	37,481	37,481

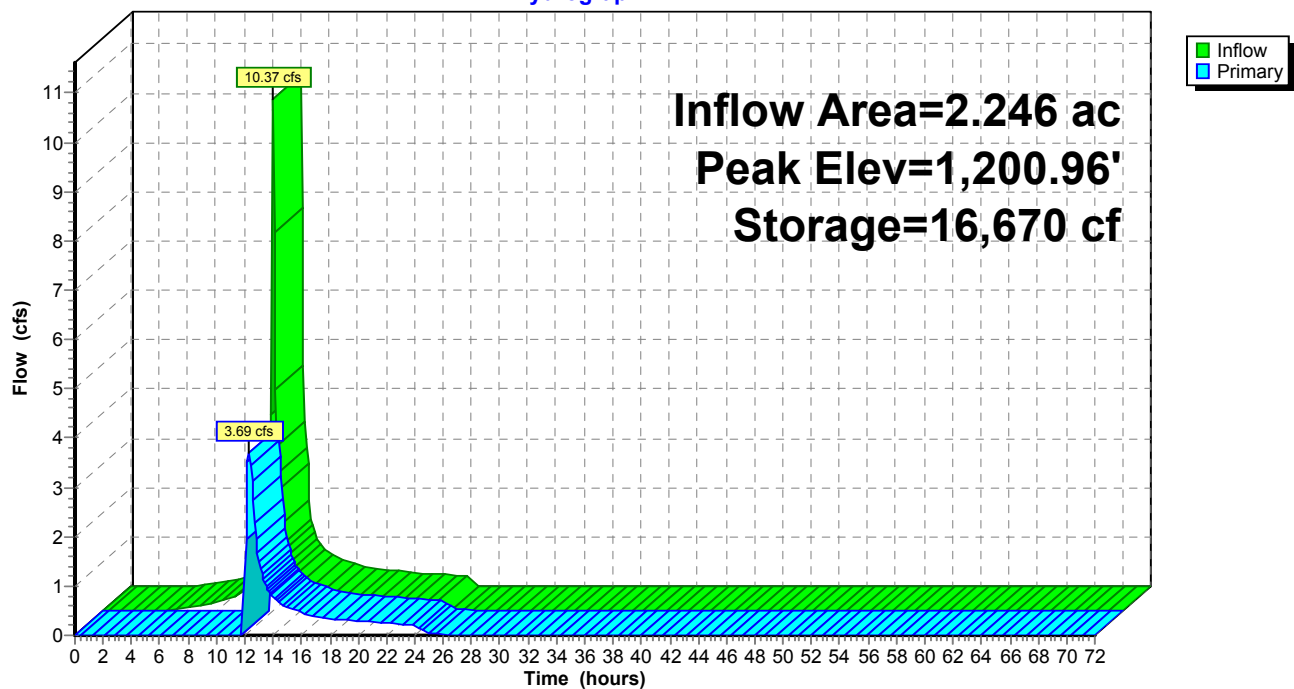
Device	Routing	Invert	Outlet Devices
#1	Primary	1,198.00'	<b>12.0" Round Culvert</b> L= 29.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 1,198.00' / 1,195.00' S= 0.1034 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Device 1	1,200.75'	<b>24.0" x 48.0" Horiz. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#3	Primary	1,201.00'	<b>15.0' long x 14.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.64 2.67 2.70 2.65 2.64 2.65 2.65 2.63

**Primary OutFlow** Max=3.67 cfs @ 12.29 hrs HW=1,200.96' (Free Discharge)

1=Culvert (Passes 3.67 cfs of 5.93 cfs potential flow)  
 2=Orifice/Grate (Weir Controls 3.67 cfs @ 1.48 fps)  
 3=Broad-Crested Rectangular Weir ( Controls 0.00 cfs)

## Pond SWM 1: BASIN 1

## Hydrograph



**Summary for Subcatchment BYPASS A: POST DEVELOPMENT**

Runoff = 1.16 cfs @ 12.12 hrs, Volume= 0.099 af, Depth= 0.52"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs  
PA-Benton - 517 - WDiamond 24-hr S1 1-yr Rainfall=2.49"

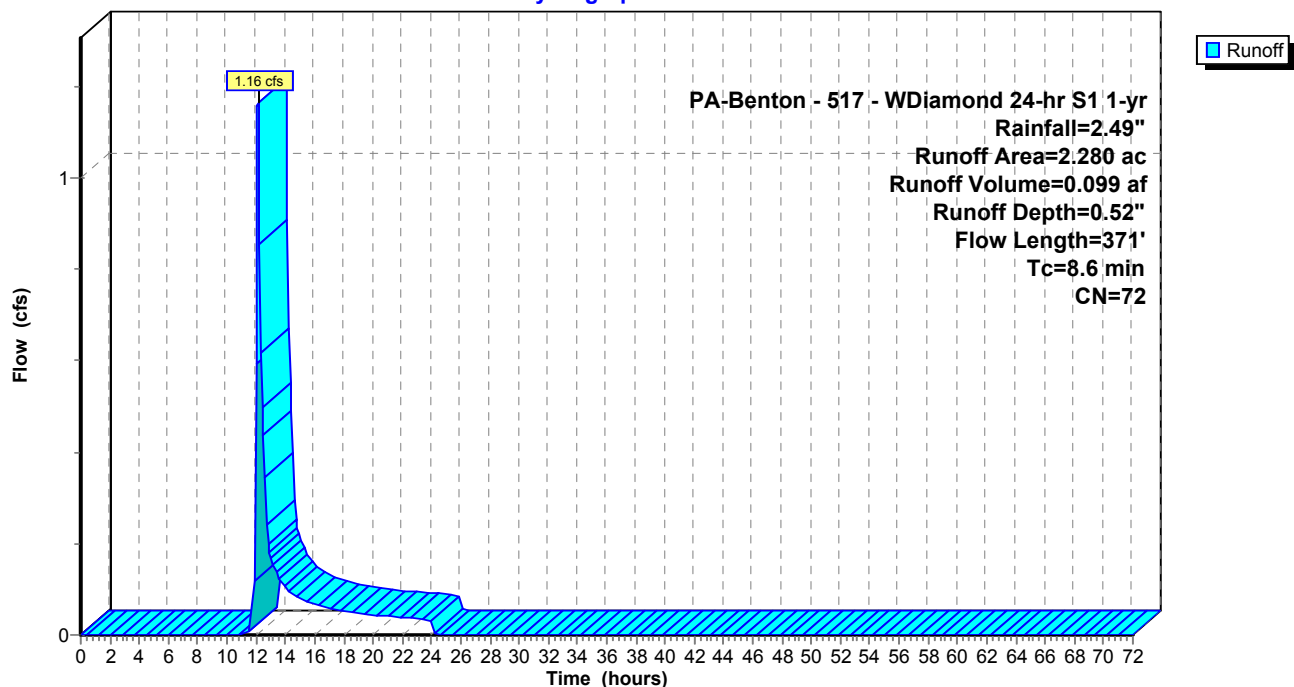
Area (ac)	CN	Description
0.010	70	Woods, Good, HSG C
2.155	71	Meadow, non-grazed, HSG C
* 0.115	89	Gravel areas, HSG C
* 0.000	98	Impervious areas, HSG C
2.280	72	Weighted Average
2.280		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	100	0.0600	0.29		<b>Sheet Flow, SHT</b>
					Range n= 0.130 P2= 2.98"
1.1	75	0.0267	1.14		<b>Shallow Concentrated Flow, SCF 1</b>
					Short Grass Pasture Kv= 7.0 fps
1.7	196	0.0714	1.87		<b>Shallow Concentrated Flow, SCF 2</b>
					Short Grass Pasture Kv= 7.0 fps
8.6	371	Total			

**Subcatchment BYPASS A: POST DEVELOPMENT**

Hydrograph



**Summary for Subcatchment BYPASS A: POST DEVELOPMENT**

Runoff = 1.94 cfs @ 12.11 hrs, Volume= 0.151 af, Depth= 0.80"

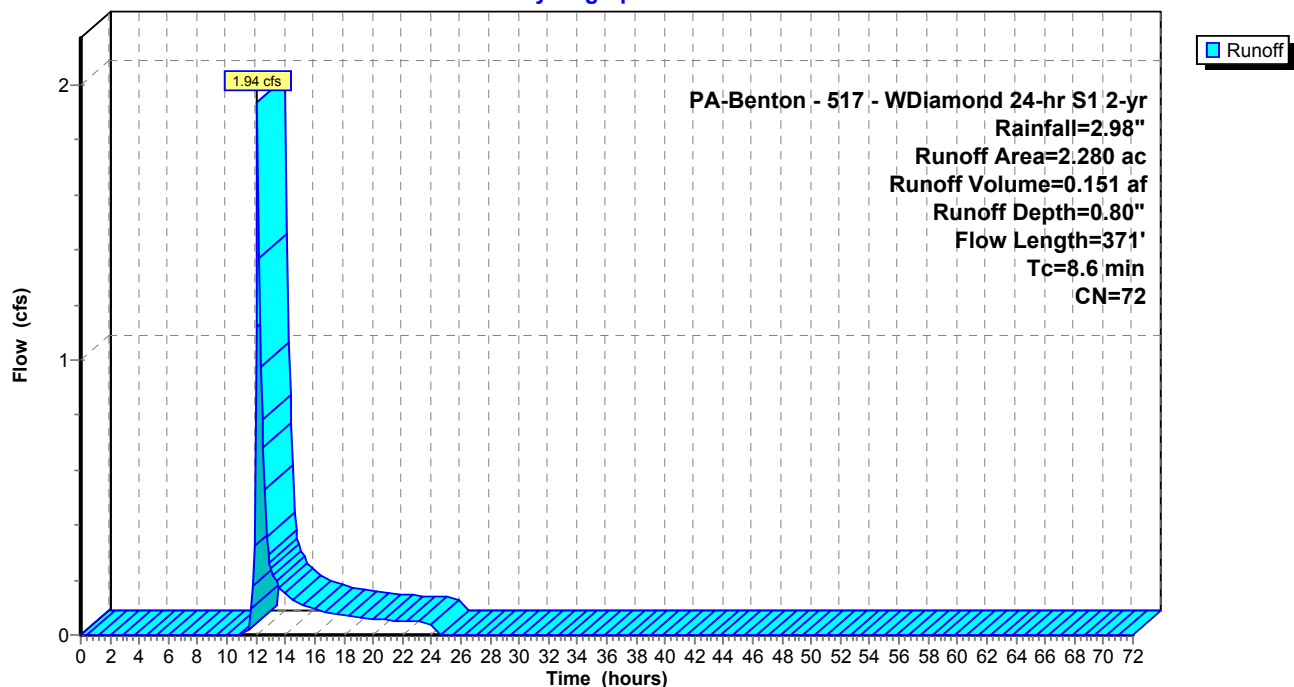
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs  
PA-Benton - 517 - WDiamond 24-hr S1 2-yr Rainfall=2.98"

Area (ac)	CN	Description
0.010	70	Woods, Good, HSG C
2.155	71	Meadow, non-grazed, HSG C
* 0.115	89	Gravel areas, HSG C
* 0.000	98	Impervious areas, HSG C
2.280	72	Weighted Average
2.280		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	100	0.0600	0.29		<b>Sheet Flow, SHT</b>
					Range n= 0.130 P2= 2.98"
1.1	75	0.0267	1.14		<b>Shallow Concentrated Flow, SCF 1</b>
					Short Grass Pasture Kv= 7.0 fps
1.7	196	0.0714	1.87		<b>Shallow Concentrated Flow, SCF 2</b>
					Short Grass Pasture Kv= 7.0 fps
8.6	371	Total			

**Subcatchment BYPASS A: POST DEVELOPMENT**

Hydrograph





**Summary for Subcatchment BYPASS A: POST DEVELOPMENT**

Runoff = 3.07 cfs @ 12.10 hrs, Volume= 0.236 af, Depth= 1.24"

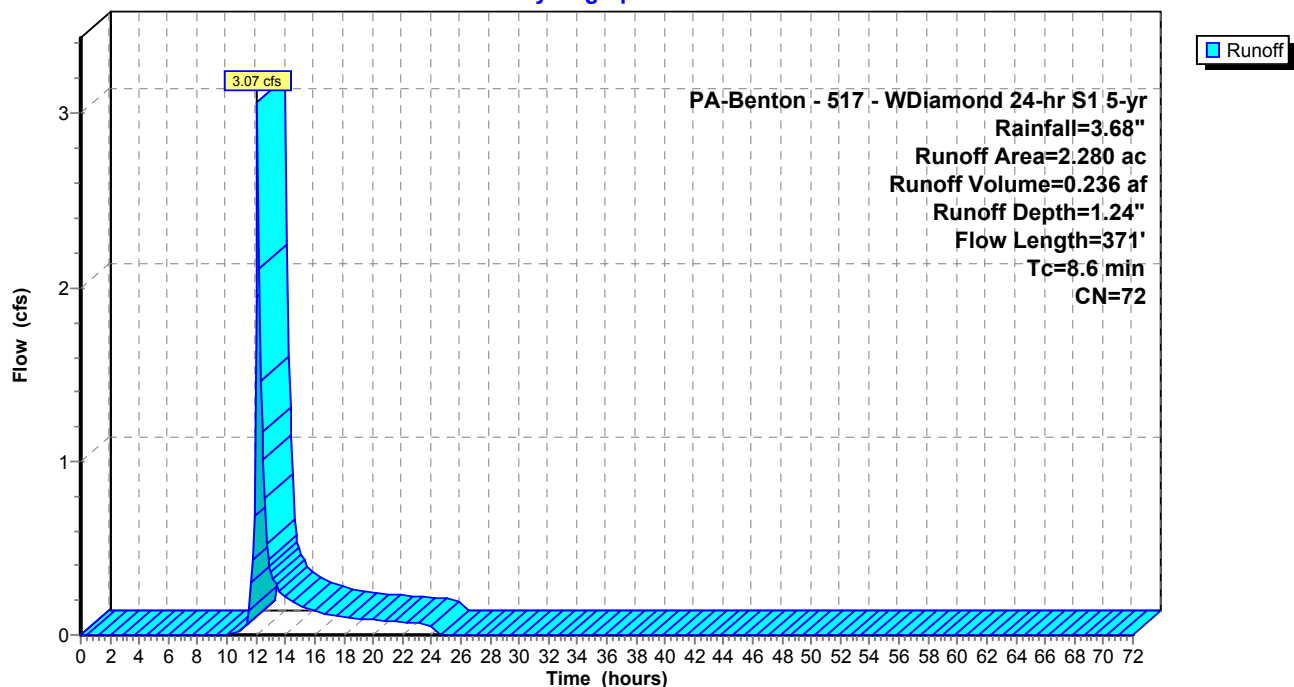
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs  
PA-Benton - 517 - WDiamond 24-hr S1 5-yr Rainfall=3.68"

Area (ac)	CN	Description
0.010	70	Woods, Good, HSG C
2.155	71	Meadow, non-grazed, HSG C
* 0.115	89	Gravel areas, HSG C
* 0.000	98	Impervious areas, HSG C
2.280	72	Weighted Average
2.280		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	100	0.0600	0.29		<b>Sheet Flow, SHT</b>
					Range n= 0.130 P2= 2.98"
1.1	75	0.0267	1.14		<b>Shallow Concentrated Flow, SCF 1</b>
					Short Grass Pasture Kv= 7.0 fps
1.7	196	0.0714	1.87		<b>Shallow Concentrated Flow, SCF 2</b>
					Short Grass Pasture Kv= 7.0 fps
8.6	371	Total			

**Subcatchment BYPASS A: POST DEVELOPMENT**

Hydrograph



**Summary for Subcatchment BYPASS A: POST DEVELOPMENT**

Runoff = 3.98 cfs @ 12.10 hrs, Volume= 0.317 af, Depth= 1.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs  
PA-Benton - 517 - WDiamond 24-hr S1 10-yr Rainfall=4.29"

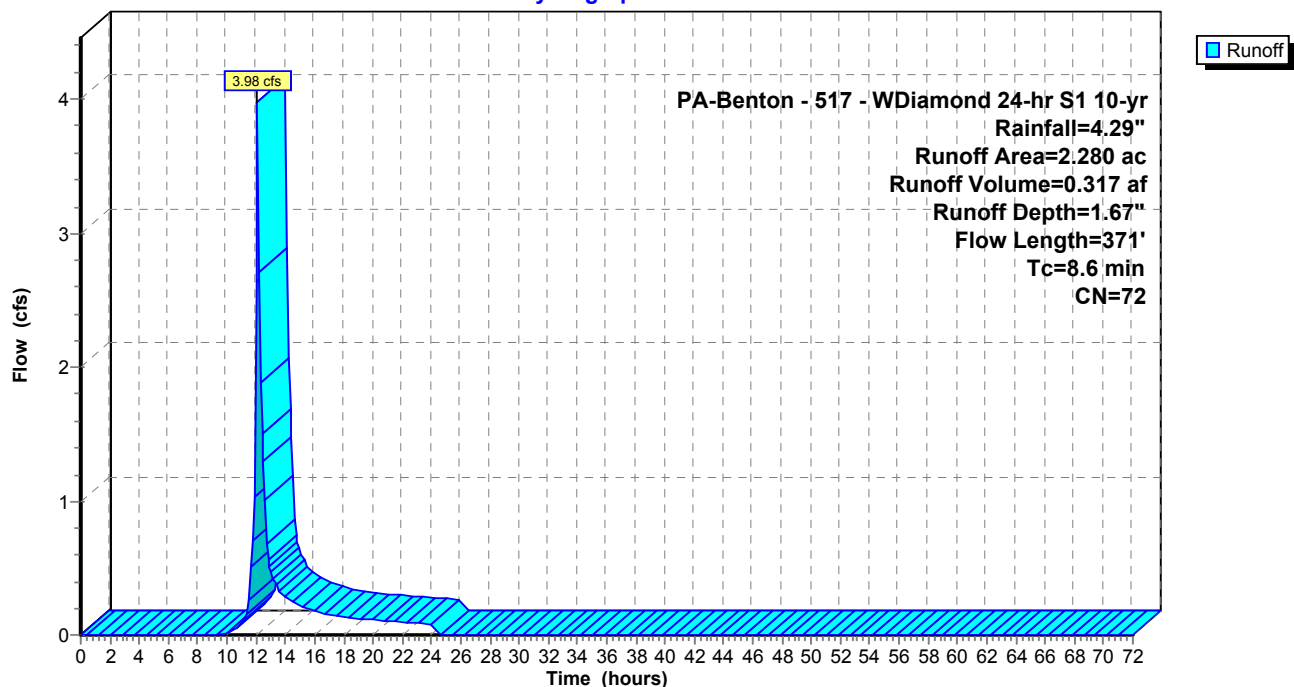
Area (ac)	CN	Description
0.010	70	Woods, Good, HSG C
2.155	71	Meadow, non-grazed, HSG C
* 0.115	89	Gravel areas, HSG C
* 0.000	98	Impervious areas, HSG C
2.280	72	Weighted Average
2.280		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	100	0.0600	0.29		<b>Sheet Flow, SHT</b>
					Range n= 0.130 P2= 2.98"
1.1	75	0.0267	1.14		<b>Shallow Concentrated Flow, SCF 1</b>
					Short Grass Pasture Kv= 7.0 fps
1.7	196	0.0714	1.87		<b>Shallow Concentrated Flow, SCF 2</b>
					Short Grass Pasture Kv= 7.0 fps
8.6	371	Total			

**Subcatchment BYPASS A: POST DEVELOPMENT**

Hydrograph



## Summary for Subcatchment BYPASS A: POST DEVELOPMENT

Runoff = 5.32 cfs @ 12.10 hrs, Volume= 0.449 af, Depth= 2.36"

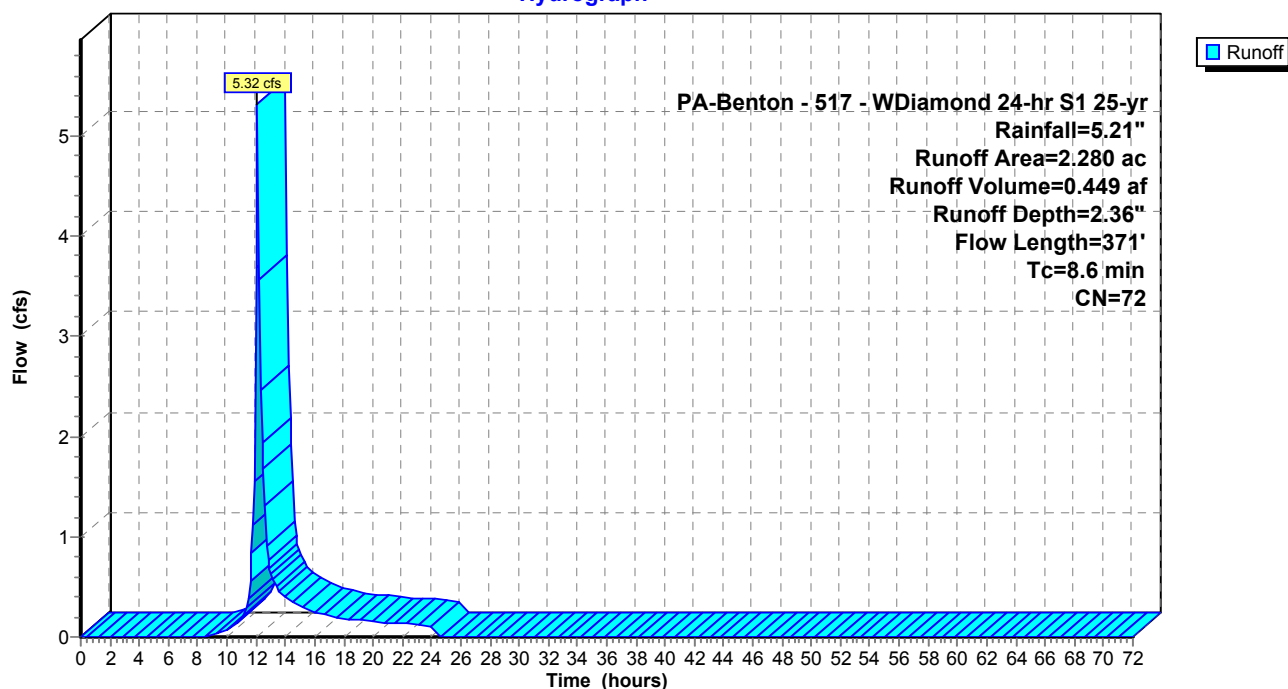
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs  
PA-Benton - 517 - WDiamond 24-hr S1 25-yr Rainfall=5.21"

Area (ac)	CN	Description
0.010	70	Woods, Good, HSG C
2.155	71	Meadow, non-grazed, HSG C
* 0.115	89	Gravel areas, HSG C
* 0.000	98	Impervious areas, HSG C
2.280	72	Weighted Average
2.280		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	100	0.0600	0.29		<b>Sheet Flow, SHT</b>
					Range n= 0.130 P2= 2.98"
1.1	75	0.0267	1.14		<b>Shallow Concentrated Flow, SCF 1</b>
					Short Grass Pasture Kv= 7.0 fps
1.7	196	0.0714	1.87		<b>Shallow Concentrated Flow, SCF 2</b>
					Short Grass Pasture Kv= 7.0 fps
8.6	371	Total			

## Subcatchment BYPASS A: POST DEVELOPMENT

Hydrograph



**Summary for Subcatchment BYPASS A: POST DEVELOPMENT**

Runoff = 6.40 cfs @ 12.10 hrs, Volume= 0.575 af, Depth= 3.03"

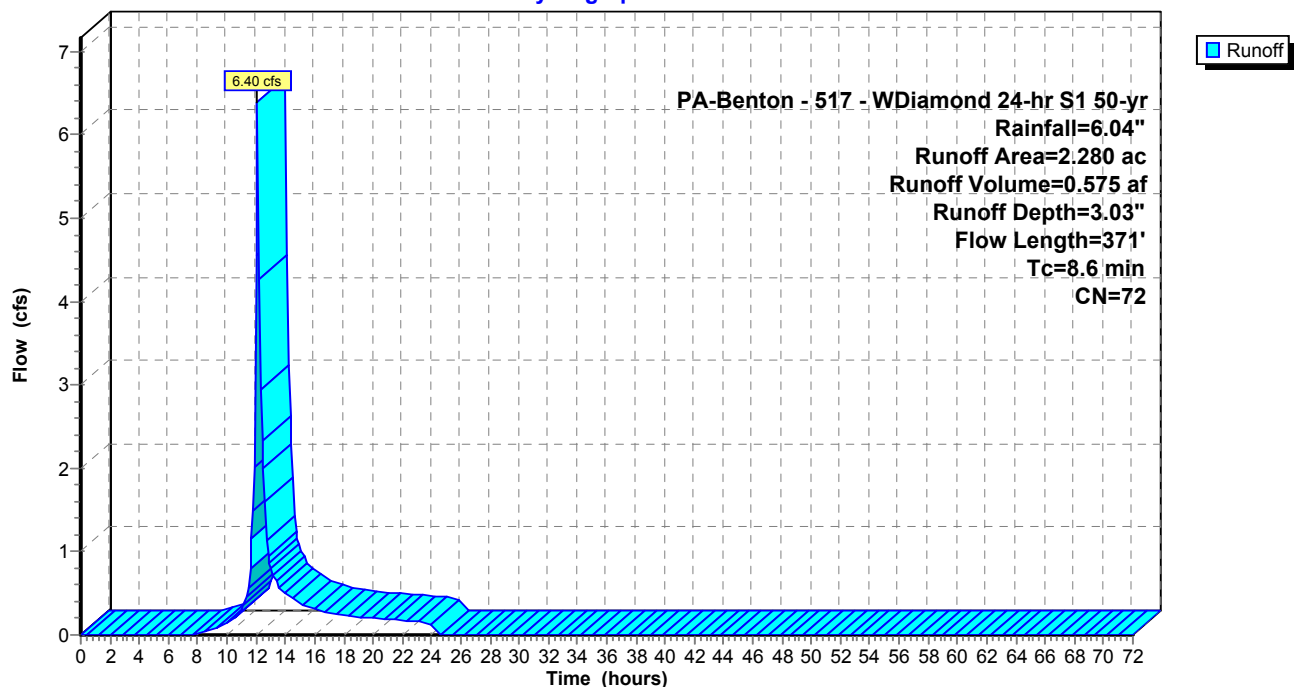
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs  
PA-Benton - 517 - WDiamond 24-hr S1 50-yr Rainfall=6.04"

Area (ac)	CN	Description
0.010	70	Woods, Good, HSG C
2.155	71	Meadow, non-grazed, HSG C
* 0.115	89	Gravel areas, HSG C
* 0.000	98	Impervious areas, HSG C
2.280	72	Weighted Average
2.280		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	100	0.0600	0.29		<b>Sheet Flow, SHT</b> Range n= 0.130 P2= 2.98"
1.1	75	0.0267	1.14		<b>Shallow Concentrated Flow, SCF 1</b> Short Grass Pasture Kv= 7.0 fps
1.7	196	0.0714	1.87		<b>Shallow Concentrated Flow, SCF 2</b> Short Grass Pasture Kv= 7.0 fps
8.6	371	Total			

**Subcatchment BYPASS A: POST DEVELOPMENT**

Hydrograph



### Summary for Subcatchment **BYPASS A: POST DEVELOPMENT**

Runoff = 7.51 cfs @ 12.09 hrs, Volume= 0.728 af, Depth= 3.83"

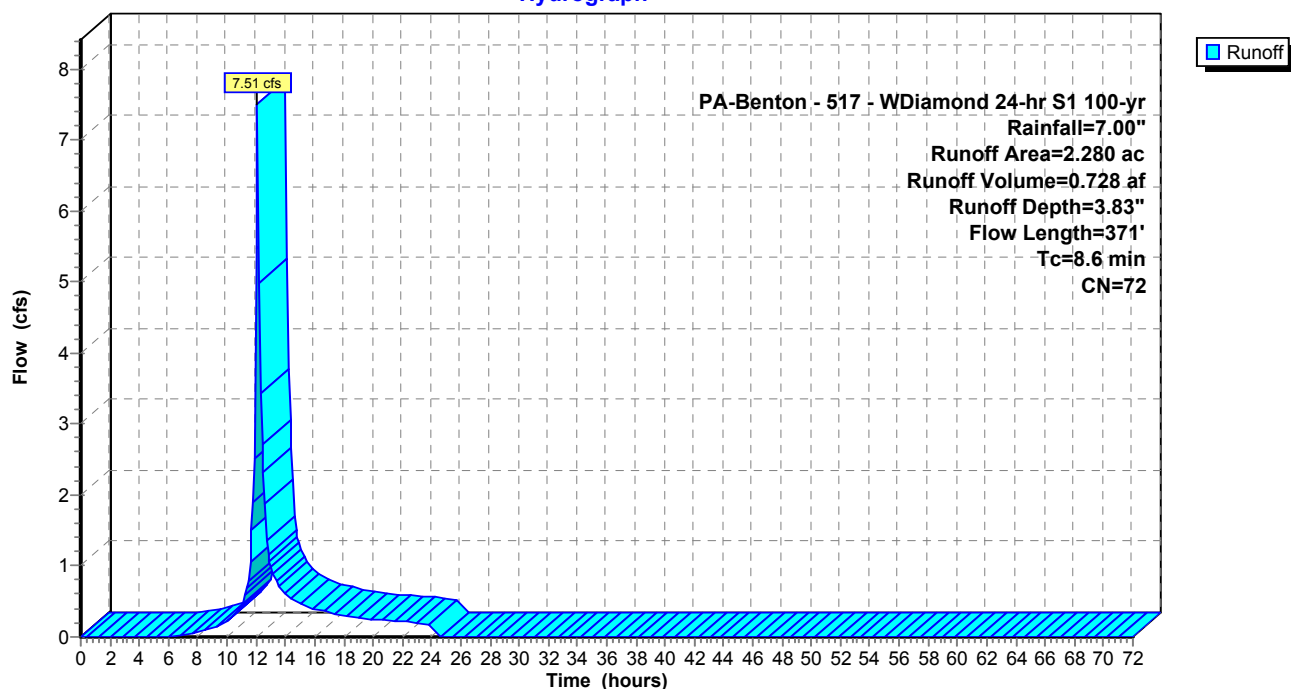
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs  
 PA-Benton - 517 - WDiamond 24-hr S1 100-yr Rainfall=7.00"

Area (ac)	CN	Description
0.010	70	Woods, Good, HSG C
2.155	71	Meadow, non-grazed, HSG C
* 0.115	89	Gravel areas, HSG C
* 0.000	98	Impervious areas, HSG C
2.280	72	Weighted Average
2.280		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	100	0.0600	0.29		<b>Sheet Flow, SHT</b>
					Range n= 0.130 P2= 2.98"
1.1	75	0.0267	1.14		<b>Shallow Concentrated Flow, SCF 1</b>
					Short Grass Pasture Kv= 7.0 fps
1.7	196	0.0714	1.87		<b>Shallow Concentrated Flow, SCF 2</b>
					Short Grass Pasture Kv= 7.0 fps
8.6	371	Total			

### Subcatchment **BYPASS A: POST DEVELOPMENT**

Hydrograph



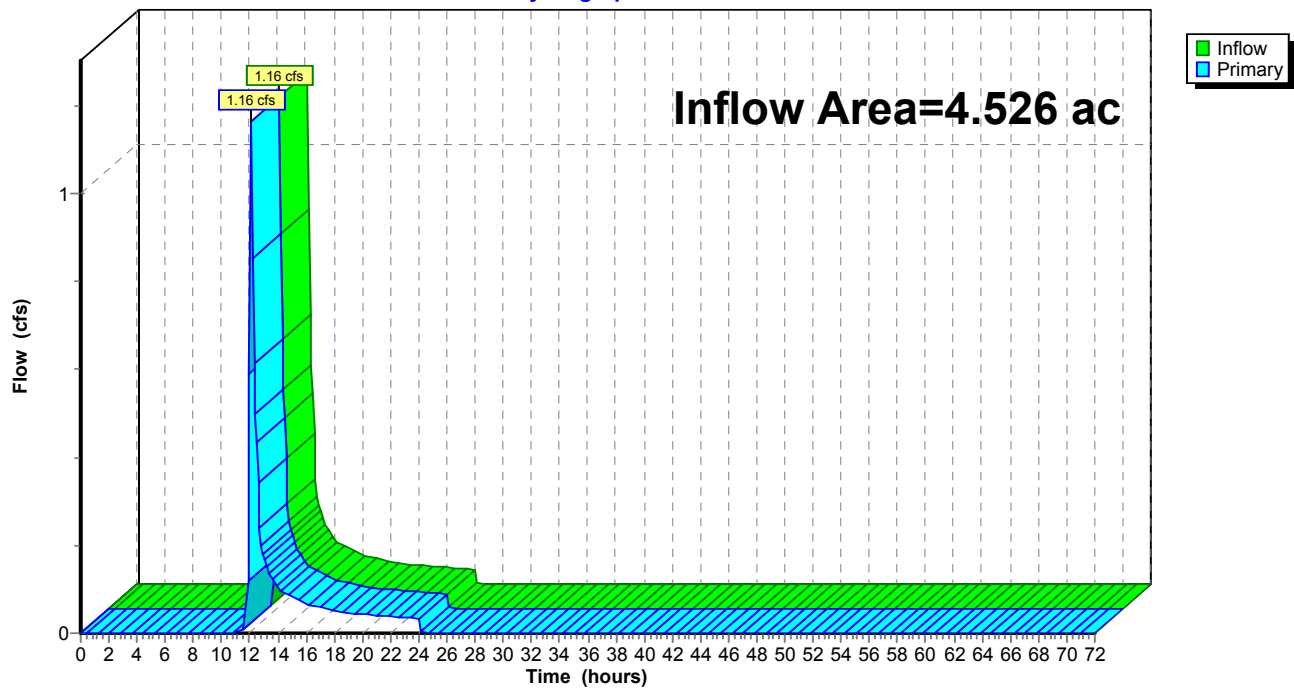
**Summary for Link POI A POST: POI A - POST**

Inflow Area = 4.526 ac, 0.22% Impervious, Inflow Depth = 0.26" for 1-yr event  
Inflow = 1.16 cfs @ 12.12 hrs, Volume= 0.099 af  
Primary = 1.16 cfs @ 12.12 hrs, Volume= 0.099 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs

**Link POI A POST: POI A - POST**

Hydrograph



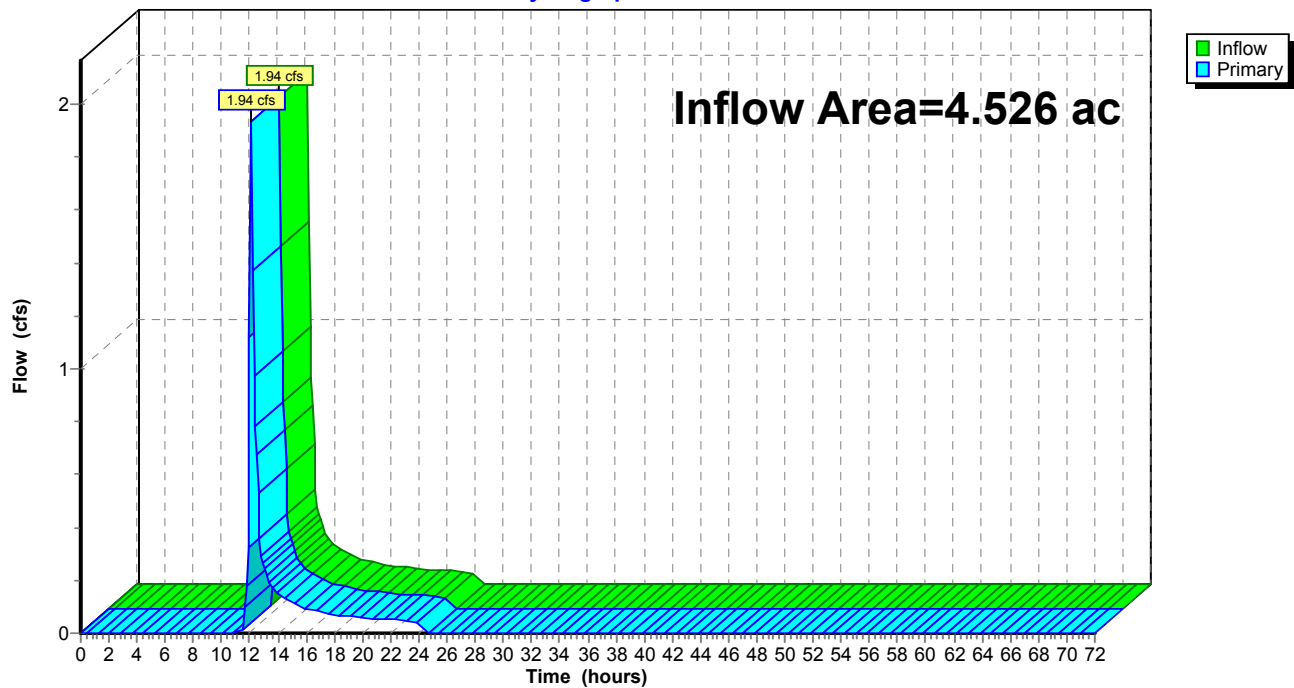
**Summary for Link POI A POST: POI A - POST**

Inflow Area = 4.526 ac, 0.22% Impervious, Inflow Depth = 0.40" for 2-yr event  
Inflow = 1.94 cfs @ 12.11 hrs, Volume= 0.151 af  
Primary = 1.94 cfs @ 12.11 hrs, Volume= 0.151 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs

**Link POI A POST: POI A - POST**

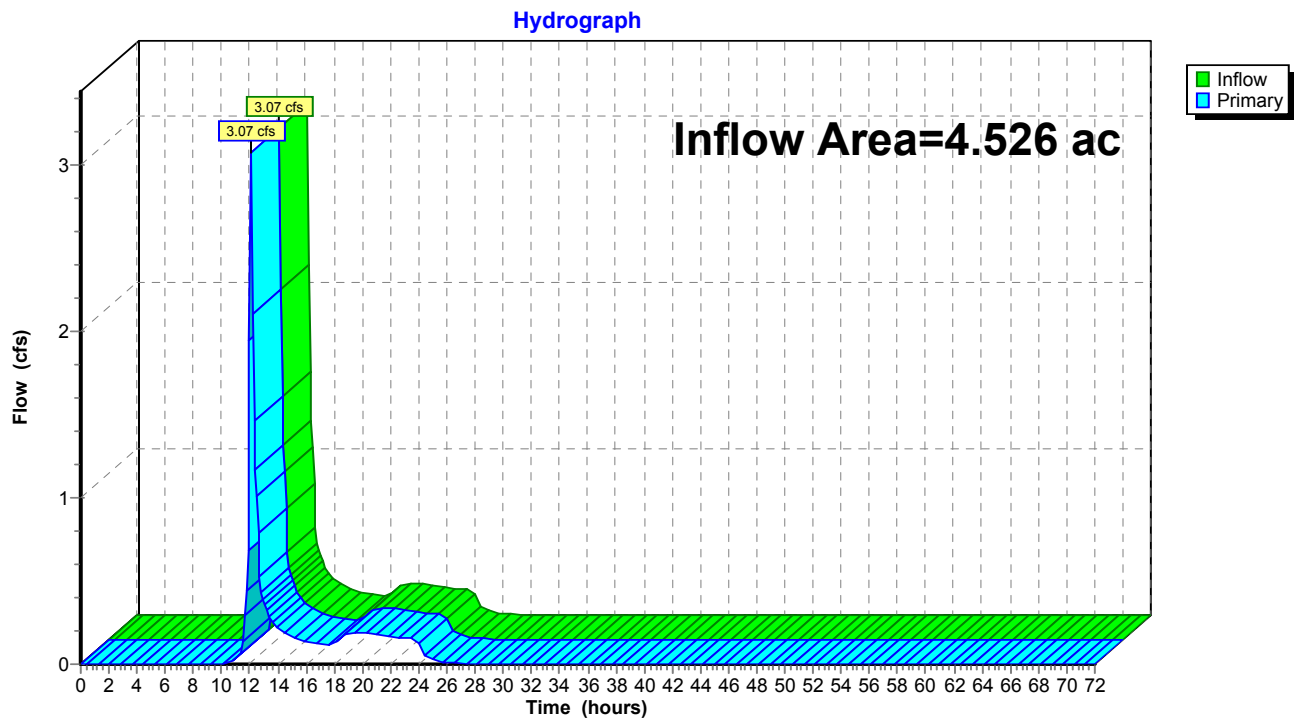
Hydrograph



**Summary for Link POI A POST: POI A - POST**

Inflow Area = 4.526 ac, 0.22% Impervious, Inflow Depth = 0.76" for 5-yr event  
Inflow = 3.07 cfs @ 12.10 hrs, Volume= 0.287 af  
Primary = 3.07 cfs @ 12.10 hrs, Volume= 0.287 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs

**Link POI A POST: POI A - POST**



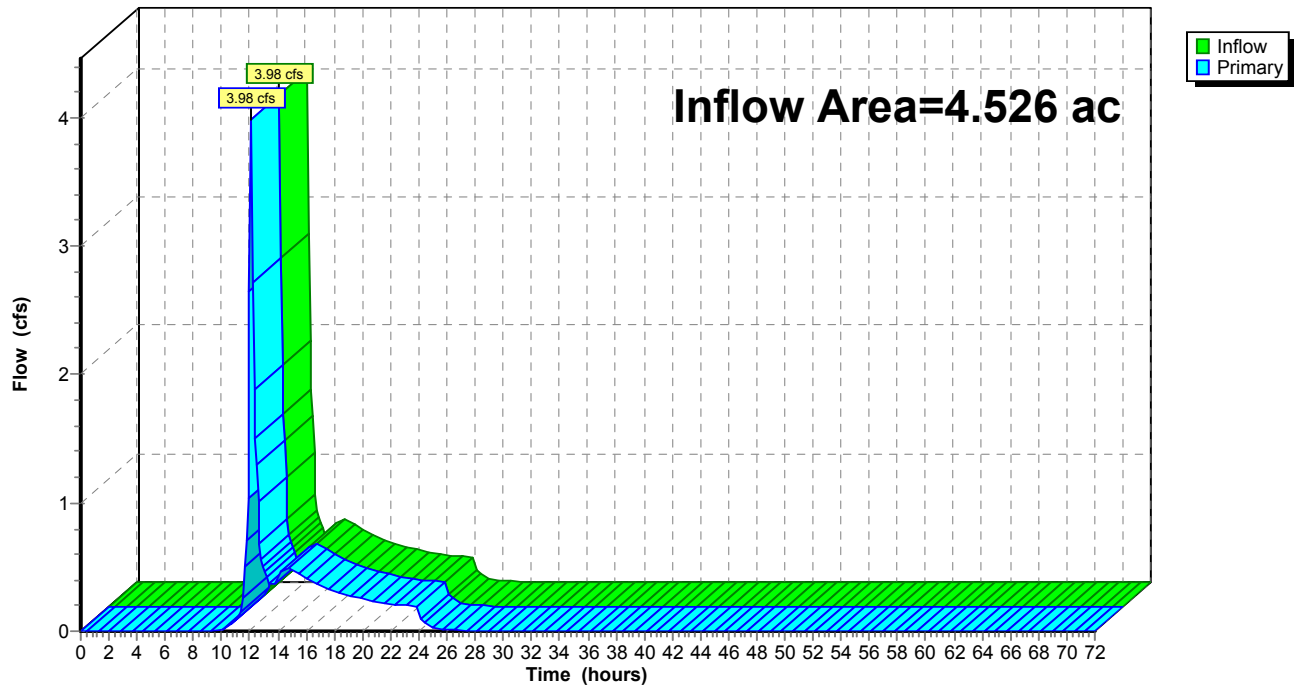
**Summary for Link POI A POST: POI A - POST**

Inflow Area = 4.526 ac, 0.22% Impervious, Inflow Depth = 1.23" for 10-yr event  
Inflow = 3.98 cfs @ 12.10 hrs, Volume= 0.464 af  
Primary = 3.98 cfs @ 12.10 hrs, Volume= 0.464 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs

**Link POI A POST: POI A - POST**

Hydrograph



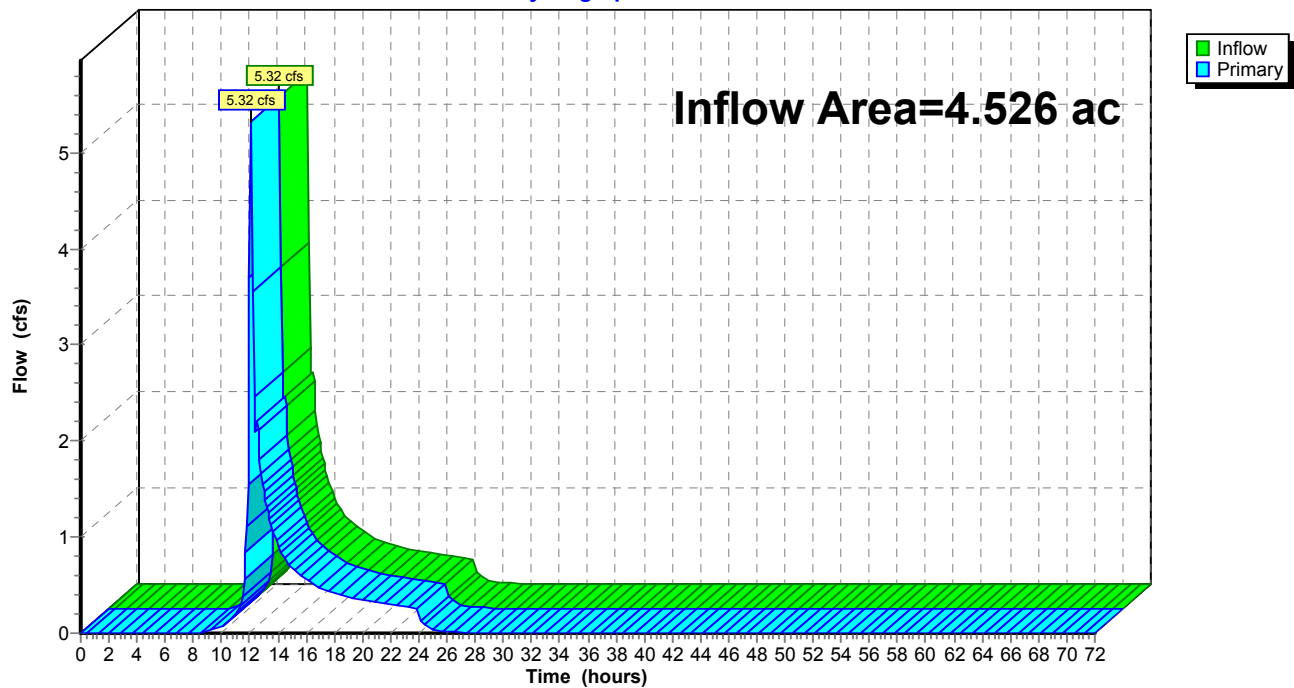
**Summary for Link POI A POST: POI A - POST**

Inflow Area = 4.526 ac, 0.22% Impervious, Inflow Depth = 1.98" for 25-yr event  
Inflow = 5.32 cfs @ 12.10 hrs, Volume= 0.747 af  
Primary = 5.32 cfs @ 12.10 hrs, Volume= 0.747 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs

**Link POI A POST: POI A - POST**

Hydrograph



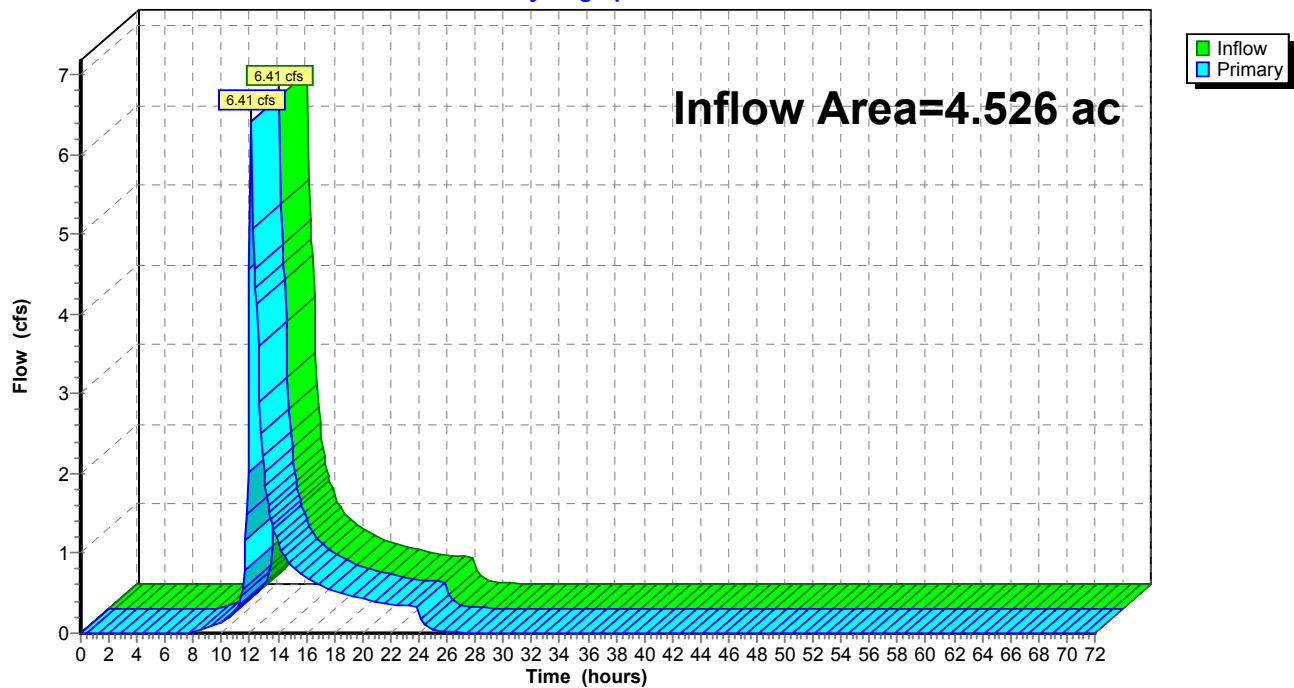
**Summary for Link POI A POST: POI A - POST**

Inflow Area = 4.526 ac, 0.22% Impervious, Inflow Depth = 2.69" for 50-yr event  
Inflow = 6.41 cfs @ 12.11 hrs, Volume= 1.013 af  
Primary = 6.41 cfs @ 12.11 hrs, Volume= 1.013 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs

**Link POI A POST: POI A - POST**

Hydrograph

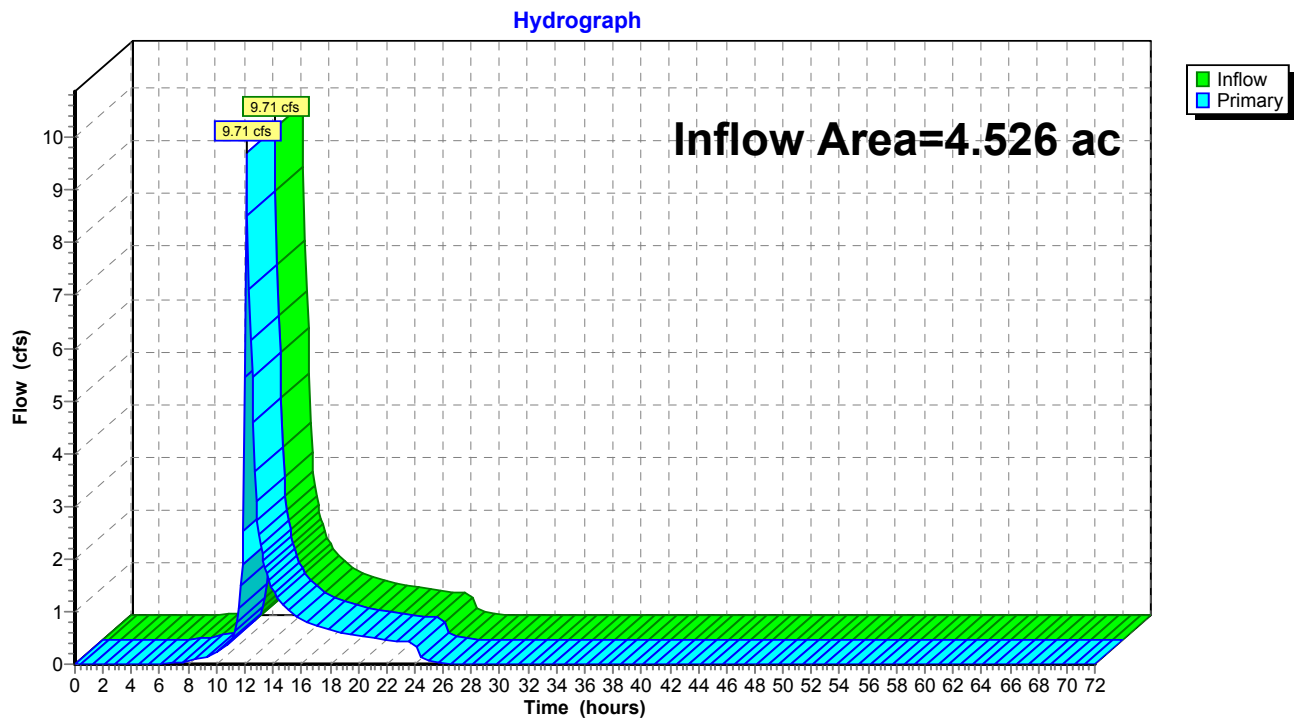


### Summary for Link POI A POST: POI A - POST

Inflow Area =      4.526 ac,   0.22% Impervious,   Inflow Depth =   3.53"   for 100-yr event  
Inflow        =      9.71 cfs @   12.13 hrs,   Volume=            1.331 af  
Primary       =      9.71 cfs @   12.13 hrs,   Volume=            1.331 af,   Atten= 0%,   Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs

### Link POI A POST: POI A - POST



**Summary for Subcatchment POI B-POST: POST DEVELOPMENT**

Runoff = 0.43 cfs @ 12.15 hrs, Volume= 0.037 af, Depth= 0.78"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs  
PA-Benton - 517 - WDiamond 24-hr S1 1-yr Rainfall=2.49"

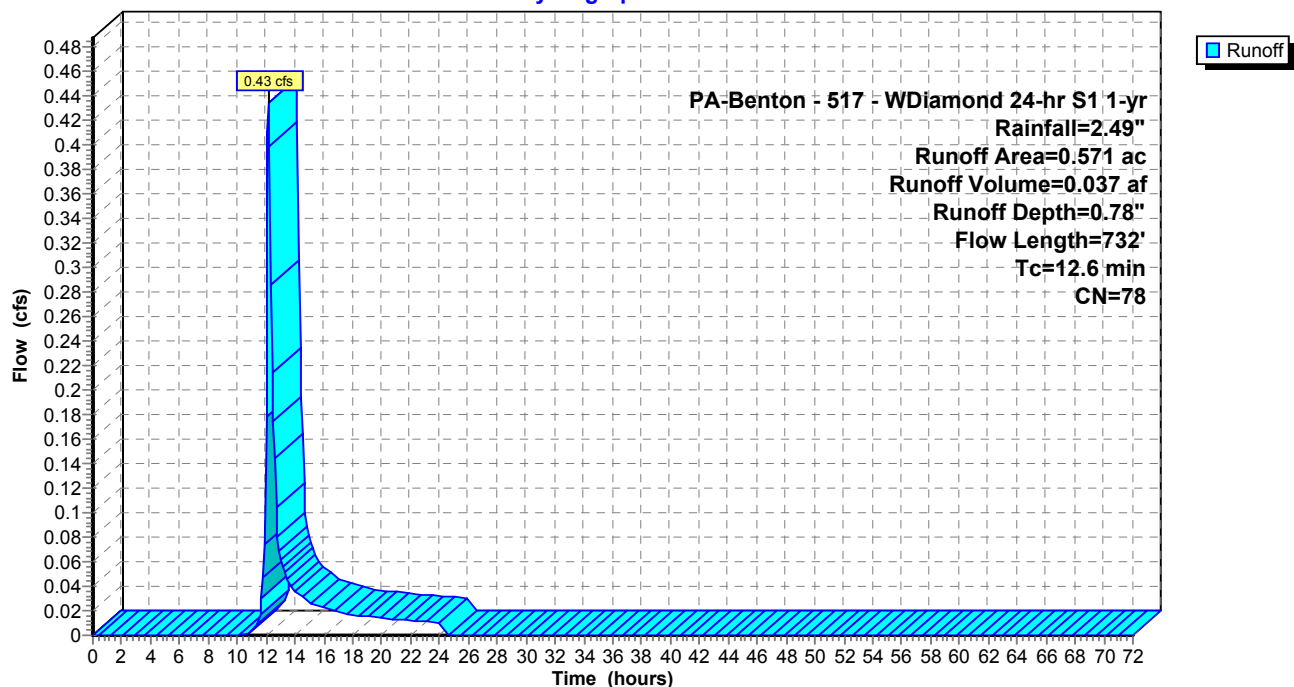
Area (ac)	CN	Description
0.007	70	Woods, Good, HSG C
0.353	71	Meadow, non-grazed, HSG C
* 0.211	89	Gravel areas, HSG C
* 0.000	98	Impervious areas, HSG C
0.571	78	Weighted Average
0.571		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.3	100	0.0250	0.20		<b>Sheet Flow, SHT 1</b>
					Range n= 0.130 P2= 2.98"
4.3	632	0.1200	2.42		<b>Shallow Concentrated Flow, SCF 1</b>
					Short Grass Pasture Kv= 7.0 fps
12.6	732	Total			

**Subcatchment POI B-POST: POST DEVELOPMENT**

Hydrograph



**Summary for Subcatchment POI B-POST: POST DEVELOPMENT**

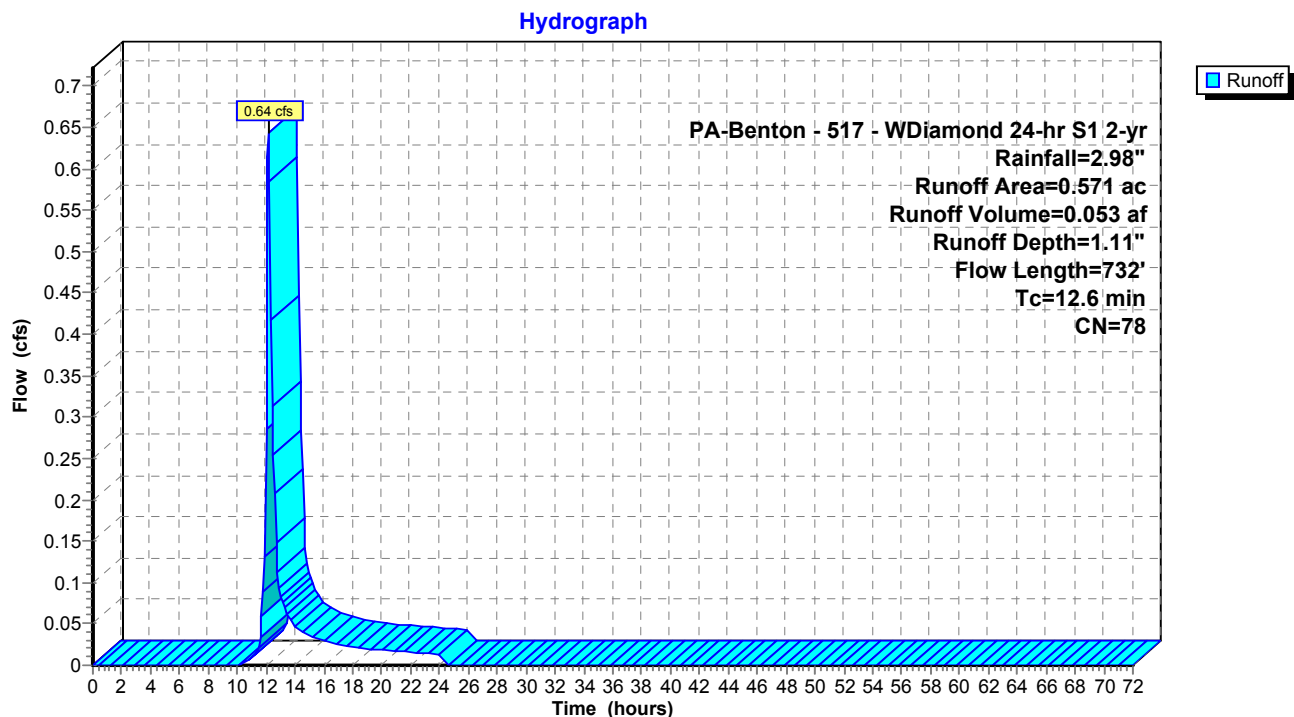
Runoff = 0.64 cfs @ 12.14 hrs, Volume= 0.053 af, Depth= 1.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs  
PA-Benton - 517 - WDiamond 24-hr S1 2-yr Rainfall=2.98"

Area (ac)	CN	Description
0.007	70	Woods, Good, HSG C
0.353	71	Meadow, non-grazed, HSG C
* 0.211	89	Gravel areas, HSG C
* 0.000	98	Impervious areas, HSG C
0.571	78	Weighted Average
0.571		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.3	100	0.0250	0.20		<b>Sheet Flow, SHT 1</b>
					Range n= 0.130 P2= 2.98"
4.3	632	0.1200	2.42		<b>Shallow Concentrated Flow, SCF 1</b>
					Short Grass Pasture Kv= 7.0 fps
12.6	732	Total			

**Subcatchment POI B-POST: POST DEVELOPMENT**

**Summary for Subcatchment POI B-POST: POST DEVELOPMENT**

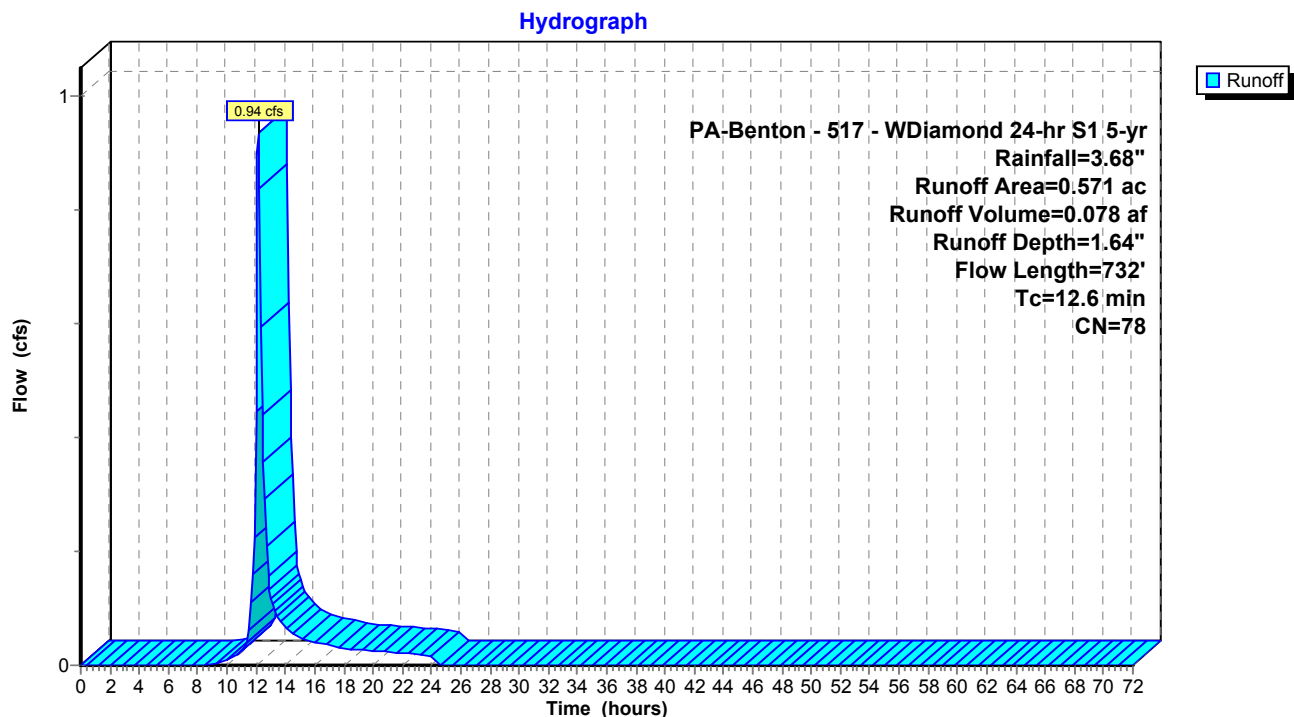
Runoff = 0.94 cfs @ 12.14 hrs, Volume= 0.078 af, Depth= 1.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs  
PA-Benton - 517 - WDiamond 24-hr S1 5-yr Rainfall=3.68"

Area (ac)	CN	Description
0.007	70	Woods, Good, HSG C
0.353	71	Meadow, non-grazed, HSG C
* 0.211	89	Gravel areas, HSG C
* 0.000	98	Impervious areas, HSG C
0.571	78	Weighted Average
0.571		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.3	100	0.0250	0.20		<b>Sheet Flow, SHT 1</b>
					Range n= 0.130 P2= 2.98"
4.3	632	0.1200	2.42		<b>Shallow Concentrated Flow, SCF 1</b>
					Short Grass Pasture Kv= 7.0 fps
12.6	732	Total			

**Subcatchment POI B-POST: POST DEVELOPMENT**

**Summary for Subcatchment POI B-POST: POST DEVELOPMENT**

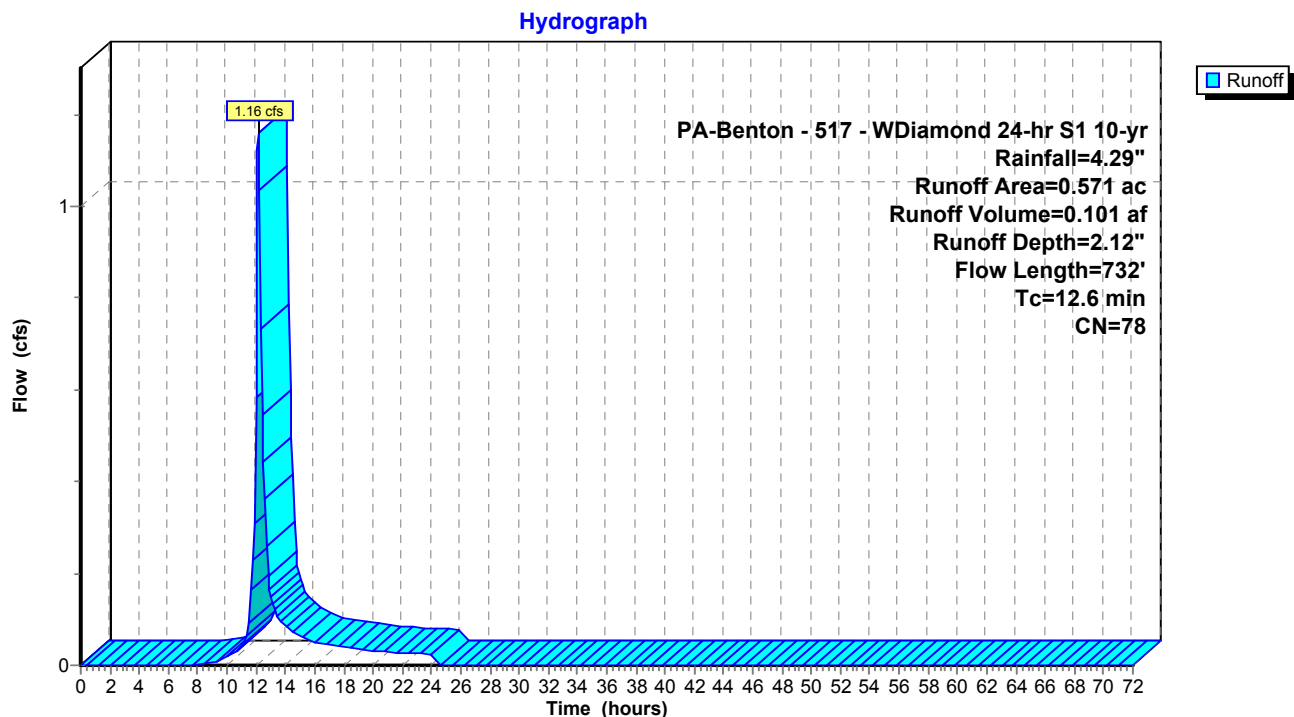
Runoff = 1.16 cfs @ 12.14 hrs, Volume= 0.101 af, Depth= 2.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs  
PA-Benton - 517 - WDiamond 24-hr S1 10-yr Rainfall=4.29"

Area (ac)	CN	Description
0.007	70	Woods, Good, HSG C
0.353	71	Meadow, non-grazed, HSG C
* 0.211	89	Gravel areas, HSG C
* 0.000	98	Impervious areas, HSG C
0.571	78	Weighted Average
0.571		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.3	100	0.0250	0.20		<b>Sheet Flow, SHT 1</b>
					Range n= 0.130 P2= 2.98"
4.3	632	0.1200	2.42		<b>Shallow Concentrated Flow, SCF 1</b>
					Short Grass Pasture Kv= 7.0 fps
12.6	732	Total			

**Subcatchment POI B-POST: POST DEVELOPMENT**



**Summary for Subcatchment POI B-POST: POST DEVELOPMENT**

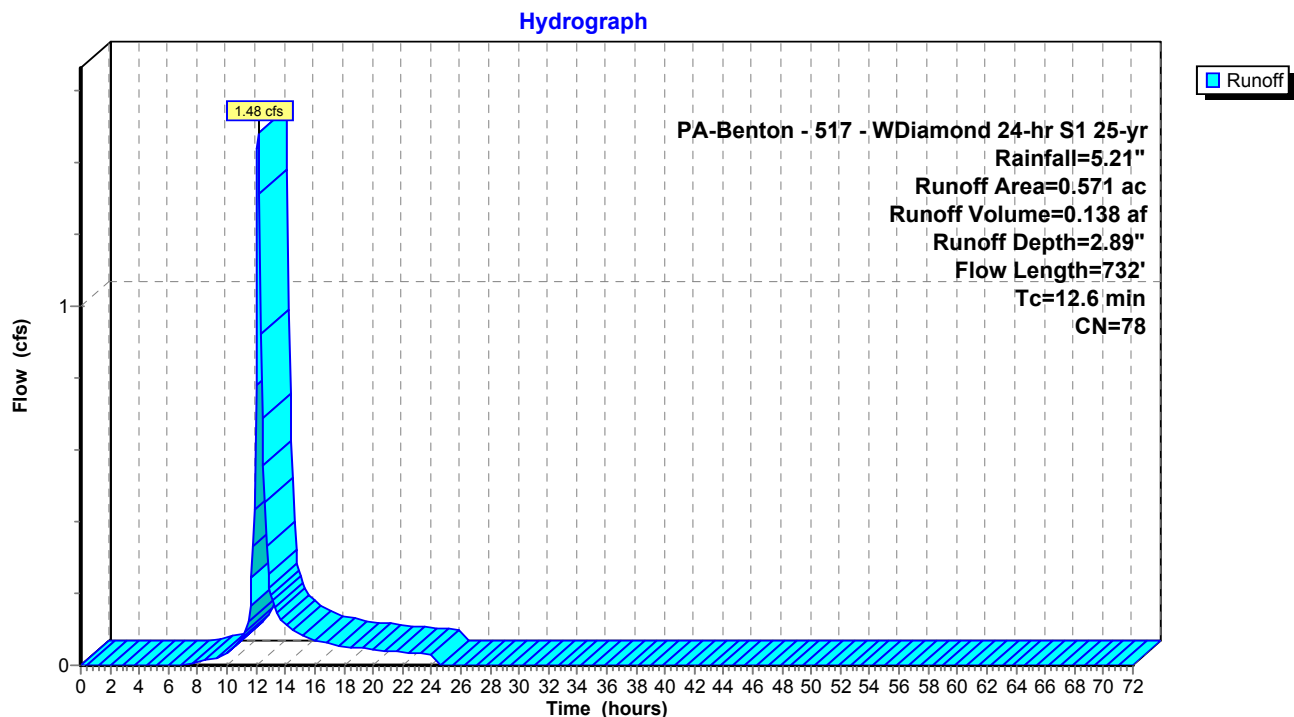
Runoff = 1.48 cfs @ 12.13 hrs, Volume= 0.138 af, Depth= 2.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs  
PA-Benton - 517 - WDiamond 24-hr S1 25-yr Rainfall=5.21"

Area (ac)	CN	Description
0.007	70	Woods, Good, HSG C
0.353	71	Meadow, non-grazed, HSG C
* 0.211	89	Gravel areas, HSG C
* 0.000	98	Impervious areas, HSG C
0.571	78	Weighted Average
0.571		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.3	100	0.0250	0.20		<b>Sheet Flow, SHT 1</b>
					Range n= 0.130 P2= 2.98"
4.3	632	0.1200	2.42		<b>Shallow Concentrated Flow, SCF 1</b>
					Short Grass Pasture Kv= 7.0 fps
12.6	732	Total			

**Subcatchment POI B-POST: POST DEVELOPMENT**

**Summary for Subcatchment POI B-POST: POST DEVELOPMENT**

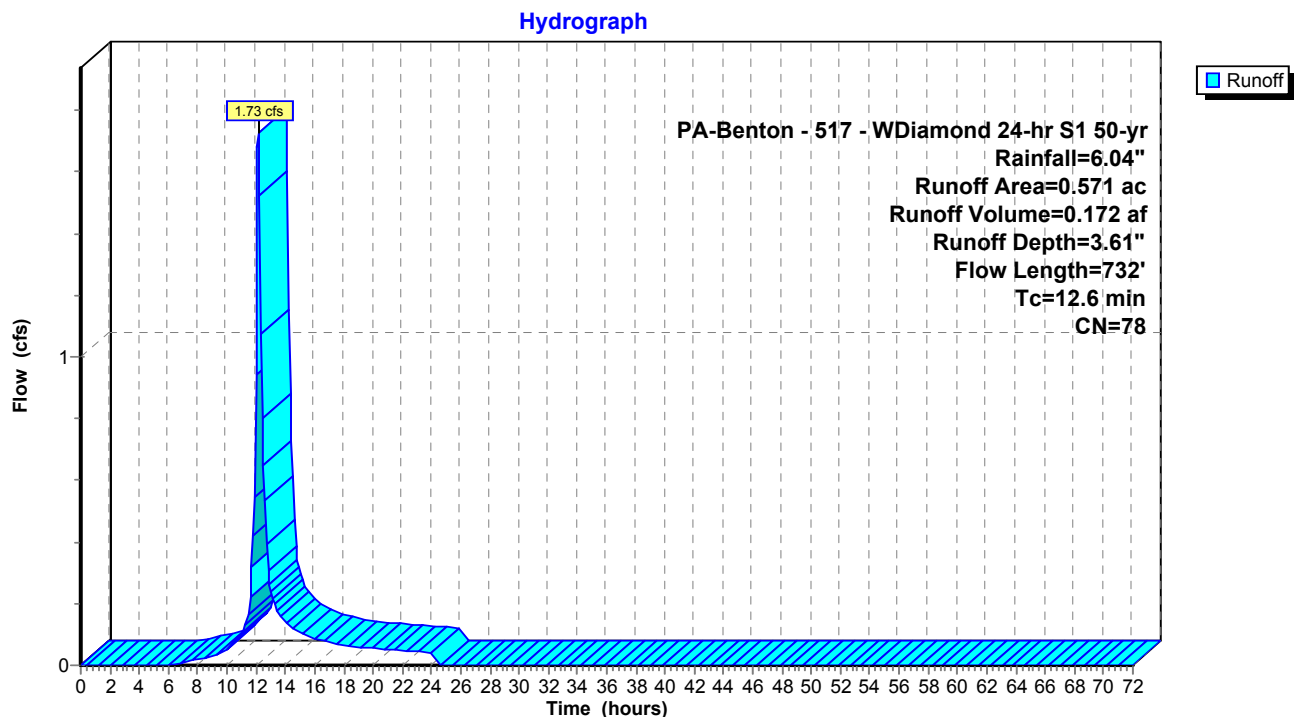
Runoff = 1.73 cfs @ 12.13 hrs, Volume= 0.172 af, Depth= 3.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs  
PA-Benton - 517 - WDiamond 24-hr S1 50-yr Rainfall=6.04"

Area (ac)	CN	Description
0.007	70	Woods, Good, HSG C
0.353	71	Meadow, non-grazed, HSG C
* 0.211	89	Gravel areas, HSG C
* 0.000	98	Impervious areas, HSG C
0.571	78	Weighted Average
0.571		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.3	100	0.0250	0.20		<b>Sheet Flow, SHT 1</b>
					Range n= 0.130 P2= 2.98"
4.3	632	0.1200	2.42		<b>Shallow Concentrated Flow, SCF 1</b>
					Short Grass Pasture Kv= 7.0 fps
12.6	732	Total			

**Subcatchment POI B-POST: POST DEVELOPMENT**

### Summary for Subcatchment POI B-POST: POST DEVELOPMENT

Runoff = 1.99 cfs @ 12.13 hrs, Volume= 0.213 af, Depth= 4.47"

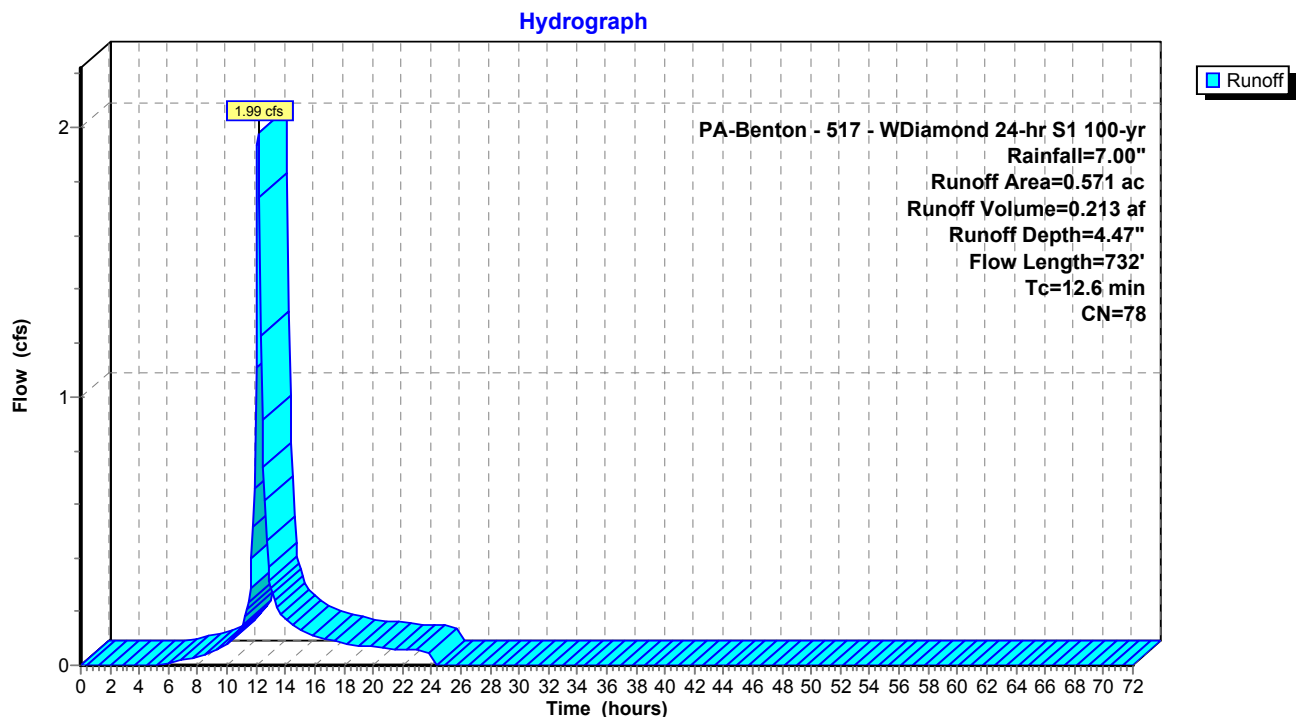
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs  
 PA-Benton - 517 - WDiamond 24-hr S1 100-yr Rainfall=7.00"

Area (ac)	CN	Description
0.007	70	Woods, Good, HSG C
0.353	71	Meadow, non-grazed, HSG C
* 0.211	89	Gravel areas, HSG C
* 0.000	98	Impervious areas, HSG C
0.571	78	Weighted Average
0.571		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.3	100	0.0250	0.20		<b>Sheet Flow, SHT 1</b>
					Range n= 0.130 P2= 2.98"
4.3	632	0.1200	2.42		<b>Shallow Concentrated Flow, SCF 1</b>
					Short Grass Pasture Kv= 7.0 fps
12.6	732	Total			

### Subcatchment POI B-POST: POST DEVELOPMENT



**Summary for Pond SWM 3: SWALE 1**

Inflow Area = 0.571 ac, 0.00% Impervious, Inflow Depth = 0.78" for 1-yr event  
 Inflow = 0.43 cfs @ 12.15 hrs, Volume= 0.037 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= 0.00-72.00 hrs, dt= 0.10 hrs  
 Peak Elev= 1,132.66' @ 24.80 hrs Surf.Area= 3,686 sf Storage= 1,620 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	1,132.00'	9,920 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)

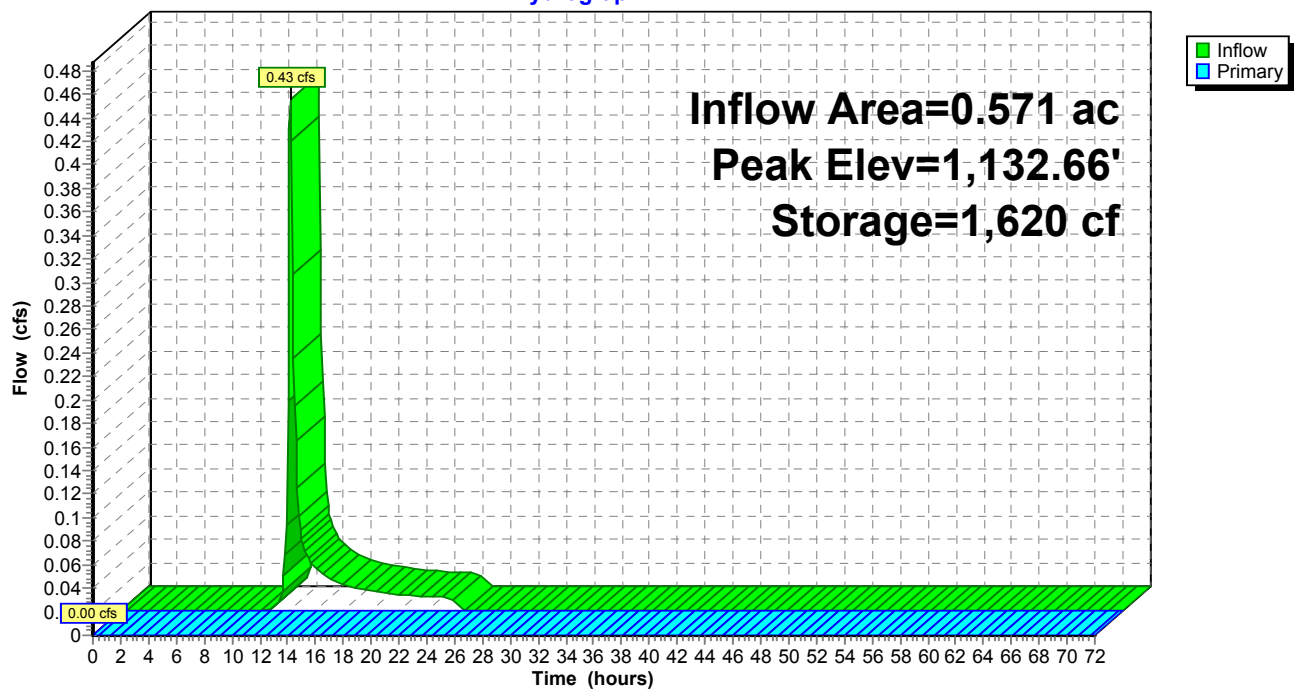
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,132.00	1,240	0	0
1,133.00	4,960	3,100	3,100
1,134.00	8,680	6,820	9,920

Device	Routing	Invert	Outlet Devices
#1	Primary	1,133.00'	<b>8.0' long x 1.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=1,132.00' (Free Discharge)  
 ↑1=**Broad-Crested Rectangular Weir**( Controls 0.00 cfs)

**Pond SWM 3: SWALE 1**

Hydrograph



**Stage-Discharge for Pond SWM 3: SWALE 1**

Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)
1,132.00	0.00	1,132.52	0.00	1,133.04	0.17	1,133.56	9.20
1,132.01	0.00	1,132.53	0.00	1,133.05	0.24	1,133.57	9.45
1,132.02	0.00	1,132.54	0.00	1,133.06	0.32	1,133.58	9.71
1,132.03	0.00	1,132.55	0.00	1,133.07	0.40	1,133.59	9.96
1,132.04	0.00	1,132.56	0.00	1,133.08	0.49	1,133.60	10.22
1,132.05	0.00	1,132.57	0.00	1,133.09	0.58	1,133.61	10.50
1,132.06	0.00	1,132.58	0.00	1,133.10	0.68	1,133.62	10.78
1,132.07	0.00	1,132.59	0.00	1,133.11	0.79	1,133.63	11.06
1,132.08	0.00	1,132.60	0.00	1,133.12	0.89	1,133.64	11.35
1,132.09	0.00	1,132.61	0.00	1,133.13	1.01	1,133.65	11.63
1,132.10	0.00	1,132.62	0.00	1,133.14	1.13	1,133.66	11.92
1,132.11	0.00	1,132.63	0.00	1,133.15	1.25	1,133.67	12.22
1,132.12	0.00	1,132.64	0.00	1,133.16	1.38	1,133.68	12.52
1,132.13	0.00	1,132.65	0.00	1,133.17	1.51	1,133.69	12.82
1,132.14	0.00	1,132.66	0.00	1,133.18	1.64	1,133.70	13.12
1,132.15	0.00	1,132.67	0.00	1,133.19	1.78	1,133.71	13.42
1,132.16	0.00	1,132.68	0.00	1,133.20	1.92	1,133.72	13.73
1,132.17	0.00	1,132.69	0.00	1,133.21	2.07	1,133.73	14.05
1,132.18	0.00	1,132.70	0.00	1,133.22	2.22	1,133.74	14.36
1,132.19	0.00	1,132.71	0.00	1,133.23	2.38	1,133.75	14.68
1,132.20	0.00	1,132.72	0.00	1,133.24	2.54	1,133.76	15.00
1,132.21	0.00	1,132.73	0.00	1,133.25	2.70	1,133.77	15.32
1,132.22	0.00	1,132.74	0.00	1,133.26	2.86	1,133.78	15.65
1,132.23	0.00	1,132.75	0.00	1,133.27	3.03	1,133.79	15.98
1,132.24	0.00	1,132.76	0.00	1,133.28	3.20	1,133.80	16.31
1,132.25	0.00	1,132.77	0.00	1,133.29	3.38	1,133.81	16.66
1,132.26	0.00	1,132.78	0.00	1,133.30	3.56	1,133.82	17.01
1,132.27	0.00	1,132.79	0.00	1,133.31	3.74	1,133.83	17.36
1,132.28	0.00	1,132.80	0.00	1,133.32	3.92	1,133.84	17.71
1,132.29	0.00	1,132.81	0.00	1,133.33	4.11	1,133.85	18.07
1,132.30	0.00	1,132.82	0.00	1,133.34	4.30	1,133.86	18.43
1,132.31	0.00	1,132.83	0.00	1,133.35	4.49	1,133.87	18.80
1,132.32	0.00	1,132.84	0.00	1,133.36	4.69	1,133.88	19.17
1,132.33	0.00	1,132.85	0.00	1,133.37	4.89	1,133.89	19.54
1,132.34	0.00	1,132.86	0.00	1,133.38	5.09	1,133.90	19.91
1,132.35	0.00	1,132.87	0.00	1,133.39	5.30	1,133.91	20.29
1,132.36	0.00	1,132.88	0.00	1,133.40	5.50	1,133.92	20.67
1,132.37	0.00	1,132.89	0.00	1,133.41	5.72	1,133.93	21.05
1,132.38	0.00	1,132.90	0.00	1,133.42	5.93	1,133.94	21.44
1,132.39	0.00	1,132.91	0.00	1,133.43	6.15	1,133.95	21.83
1,132.40	0.00	1,132.92	0.00	1,133.44	6.36	1,133.96	22.23
1,132.41	0.00	1,132.93	0.00	1,133.45	6.59	1,133.97	22.63
1,132.42	0.00	1,132.94	0.00	1,133.46	6.81	1,133.98	23.03
1,132.43	0.00	1,132.95	0.00	1,133.47	7.04	1,133.99	23.43
1,132.44	0.00	1,132.96	0.00	1,133.48	7.27	1,134.00	<b>23.84</b>
1,132.45	0.00	1,132.97	0.00	1,133.49	7.50		
1,132.46	0.00	1,132.98	0.00	1,133.50	7.74		
1,132.47	0.00	1,132.99	0.00	1,133.51	7.97		
1,132.48	0.00	1,133.00	0.00	1,133.52	8.21		
1,132.49	0.00	1,133.01	0.02	1,133.53	8.46		
1,132.50	0.00	1,133.02	0.06	1,133.54	8.70		
1,132.51	0.00	1,133.03	0.11	1,133.55	8.95		

**Stage-Area-Storage for Pond SWM 3: SWALE 1**

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
1,132.00	1,240	0	1,133.04	5,109	3,301
1,132.02	1,314	26	1,133.06	5,183	3,404
1,132.04	1,389	53	1,133.08	5,258	3,509
1,132.06	1,463	81	1,133.10	5,332	3,615
1,132.08	1,538	111	1,133.12	5,406	3,722
1,132.10	1,612	143	1,133.14	5,481	3,831
1,132.12	1,686	176	1,133.16	5,555	3,941
1,132.14	1,761	210	1,133.18	5,630	4,053
1,132.16	1,835	246	1,133.20	5,704	4,166
1,132.18	1,910	283	1,133.22	5,778	4,281
1,132.20	1,984	322	1,133.24	5,853	4,398
1,132.22	2,058	363	1,133.26	5,927	4,515
1,132.24	2,133	405	1,133.28	6,002	4,635
1,132.26	2,207	448	1,133.30	6,076	4,755
1,132.28	2,282	493	1,133.32	6,150	4,878
1,132.30	2,356	539	1,133.34	6,225	5,001
1,132.32	2,430	587	1,133.36	6,299	5,127
1,132.34	2,505	637	1,133.38	6,374	5,253
1,132.36	2,579	687	1,133.40	6,448	5,382
1,132.38	2,654	740	1,133.42	6,522	5,511
1,132.40	2,728	794	1,133.44	6,597	5,642
1,132.42	2,802	849	1,133.46	6,671	5,775
1,132.44	2,877	906	1,133.48	6,746	5,909
1,132.46	2,951	964	1,133.50	6,820	6,045
1,132.48	3,026	1,024	1,133.52	6,894	6,182
1,132.50	3,100	1,085	1,133.54	6,969	6,321
1,132.52	3,174	1,148	1,133.56	7,043	6,461
1,132.54	3,249	1,212	1,133.58	7,118	6,603
1,132.56	3,323	1,278	1,133.60	7,192	6,746
1,132.58	3,398	1,345	1,133.62	7,266	6,890
1,132.60	3,472	1,414	1,133.64	7,341	7,036
1,132.62	3,546	1,484	1,133.66	7,415	7,184
1,132.64	3,621	1,555	1,133.68	7,490	7,333
1,132.66	3,695	1,629	1,133.70	7,564	7,483
1,132.68	3,770	1,703	1,133.72	7,638	7,635
1,132.70	3,844	1,779	1,133.74	7,713	7,789
1,132.72	3,918	1,857	1,133.76	7,787	7,944
1,132.74	3,993	1,936	1,133.78	7,862	8,100
1,132.76	4,067	2,017	1,133.80	7,936	8,258
1,132.78	4,142	2,099	1,133.82	8,010	8,418
1,132.80	4,216	2,182	1,133.84	8,085	8,579
1,132.82	4,290	2,267	1,133.86	8,159	8,741
1,132.84	4,365	2,354	1,133.88	8,234	8,905
1,132.86	4,439	2,442	1,133.90	8,308	9,071
1,132.88	4,514	2,532	1,133.92	8,382	9,238
1,132.90	4,588	2,623	1,133.94	8,457	9,406
1,132.92	4,662	2,715	1,133.96	8,531	9,576
1,132.94	4,737	2,809	1,133.98	8,606	9,747
1,132.96	4,811	2,905	1,134.00	<b>8,680</b>	<b>9,920</b>
1,132.98	4,886	3,002			
1,133.00	4,960	3,100			
1,133.02	5,034	3,200			

**Summary for Pond SWM 3: SWALE 1**

Inflow Area = 0.571 ac, 0.00% Impervious, Inflow Depth = 1.11" for 2-yr event  
 Inflow = 0.64 cfs @ 12.14 hrs, Volume= 0.053 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= 0.00-72.00 hrs, dt= 0.10 hrs  
 Peak Elev= 1,132.83' @ 24.80 hrs Surf.Area= 4,327 sf Storage= 2,310 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	1,132.00'	9,920 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,132.00	1,240	0	0
1,133.00	4,960	3,100	3,100
1,134.00	8,680	6,820	9,920

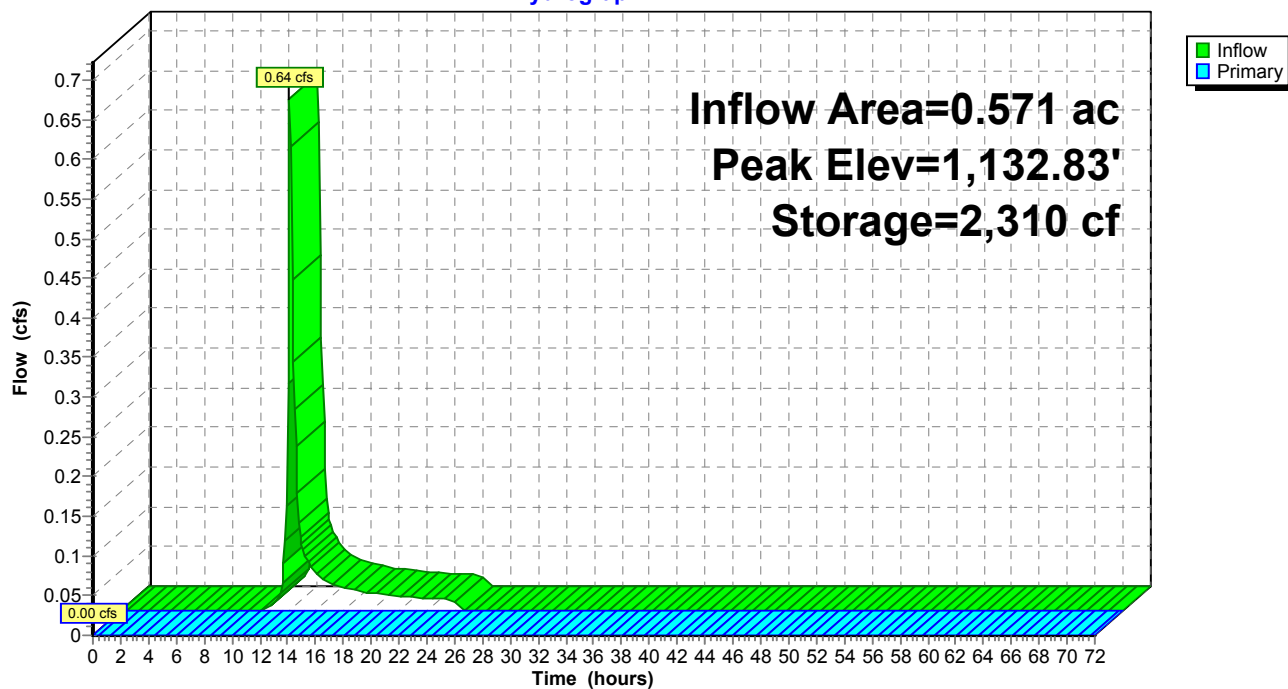
Device	Routing	Invert	Outlet Devices
#1	Primary	1,133.00'	<b>8.0' long x 1.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=1,132.00' (Free Discharge)  
 ↑1=**Broad-Crested Rectangular Weir**( Controls 0.00 cfs)



**Pond SWM 3: SWALE 1**

Hydrograph



**Summary for Pond SWM 3: SWALE 1**

Inflow Area = 0.571 ac, 0.00% Impervious, Inflow Depth = 1.64" for 5-yr event  
 Inflow = 0.94 cfs @ 12.14 hrs, Volume= 0.078 af  
 Outflow = 0.02 cfs @ 22.03 hrs, Volume= 0.007 af, Atten= 98%, Lag= 593.5 min  
 Primary = 0.02 cfs @ 22.03 hrs, Volume= 0.007 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs  
 Peak Elev= 1,133.01' @ 22.03 hrs Surf.Area= 4,986 sf Storage= 3,135 cf

Plug-Flow detention time= 681.1 min calculated for 0.007 af (9% of inflow)  
 Center-of-Mass det. time= 503.7 min ( 1,360.9 - 857.2 )

Volume	Invert	Avail.Storage	Storage Description
#1	1,132.00'	9,920 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)

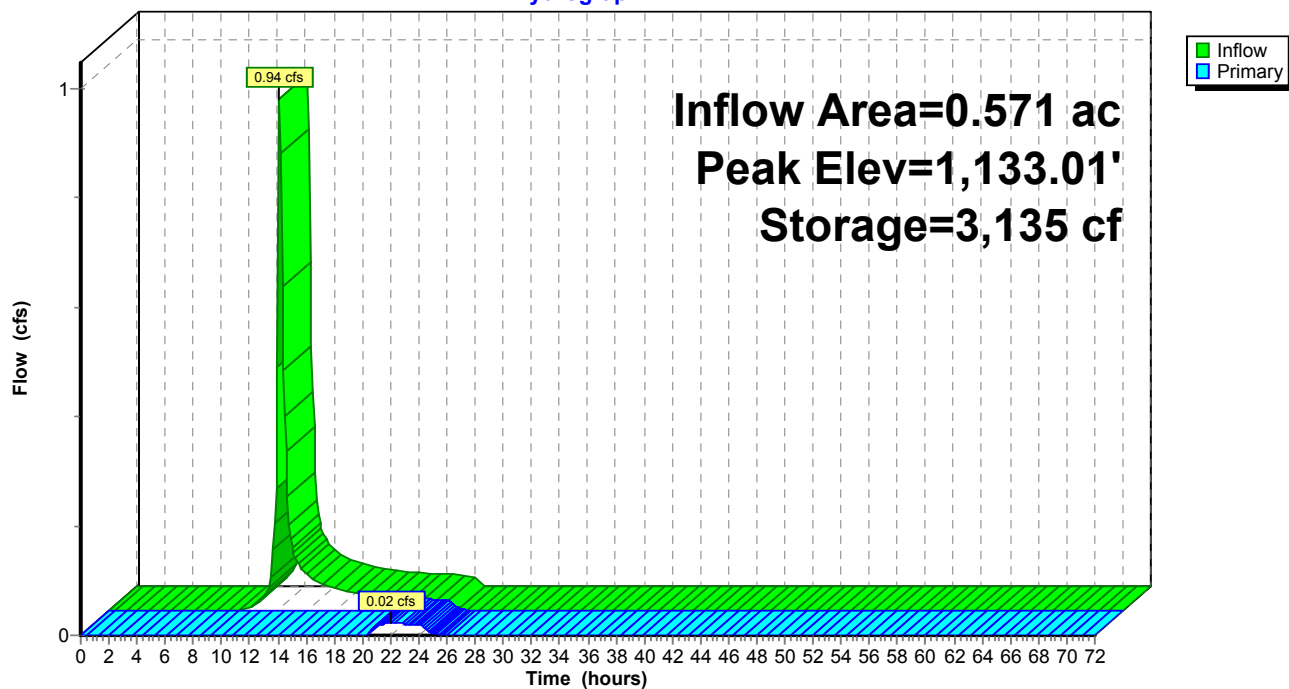
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,132.00	1,240	0	0
1,133.00	4,960	3,100	3,100
1,134.00	8,680	6,820	9,920

Device	Routing	Invert	Outlet Devices
#1	Primary	1,133.00'	<b>8.0' long x 1.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

**Primary OutFlow** Max=0.01 cfs @ 22.03 hrs HW=1,133.01' (Free Discharge)  
 ↑1=**Broad-Crested Rectangular Weir**(Weir Controls 0.01 cfs @ 0.23 fps)

**Pond SWM 3: SWALE 1**

Hydrograph



**Summary for Pond SWM 3: SWALE 1**

Inflow Area = 0.571 ac, 0.00% Impervious, Inflow Depth = 2.12" for 10-yr event  
 Inflow = 1.16 cfs @ 12.14 hrs, Volume= 0.101 af  
 Outflow = 0.05 cfs @ 15.79 hrs, Volume= 0.030 af, Atten= 95%, Lag= 219.2 min  
 Primary = 0.05 cfs @ 15.79 hrs, Volume= 0.030 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs  
 Peak Elev= 1,133.02' @ 15.79 hrs Surf.Area= 5,026 sf Storage= 3,188 cf

Plug-Flow detention time= 437.2 min calculated for 0.030 af (29% of inflow)  
 Center-of-Mass det. time= 289.7 min ( 1,141.9 - 852.3 )

Volume	Invert	Avail.Storage	Storage Description
#1	1,132.00'	9,920 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)

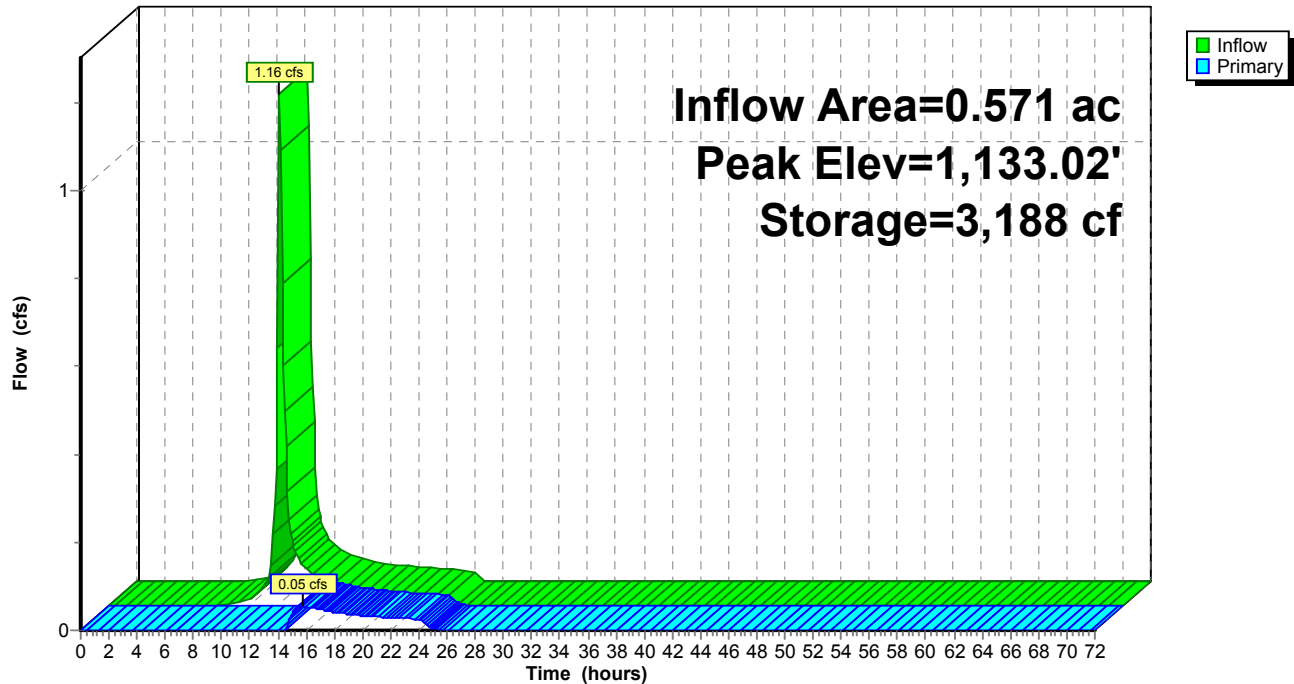
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,132.00	1,240	0	0
1,133.00	4,960	3,100	3,100
1,134.00	8,680	6,820	9,920

Device	Routing	Invert	Outlet Devices
#1	Primary	1,133.00'	<b>8.0' long x 1.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

**Primary OutFlow** Max=0.05 cfs @ 15.79 hrs HW=1,133.02' (Free Discharge)  
 ↑1=**Broad-Crested Rectangular Weir** (Weir Controls 0.05 cfs @ 0.36 fps)

**Pond SWM 3: SWALE 1**

Hydrograph



**Summary for Pond SWM 3: SWALE 1**

Inflow Area = 0.571 ac, 0.00% Impervious, Inflow Depth = 2.89" for 25-yr event  
 Inflow = 1.48 cfs @ 12.13 hrs, Volume= 0.138 af  
 Outflow = 0.19 cfs @ 13.04 hrs, Volume= 0.066 af, Atten= 87%, Lag= 54.2 min  
 Primary = 0.19 cfs @ 13.04 hrs, Volume= 0.066 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs  
 Peak Elev= 1,133.04' @ 13.04 hrs Surf.Area= 5,119 sf Storage= 3,315 cf

Plug-Flow detention time= 307.8 min calculated for 0.066 af (48% of inflow)  
 Center-of-Mass det. time= 169.9 min ( 1,016.9 - 847.0 )

Volume	Invert	Avail.Storage	Storage Description
#1	1,132.00'	9,920 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)

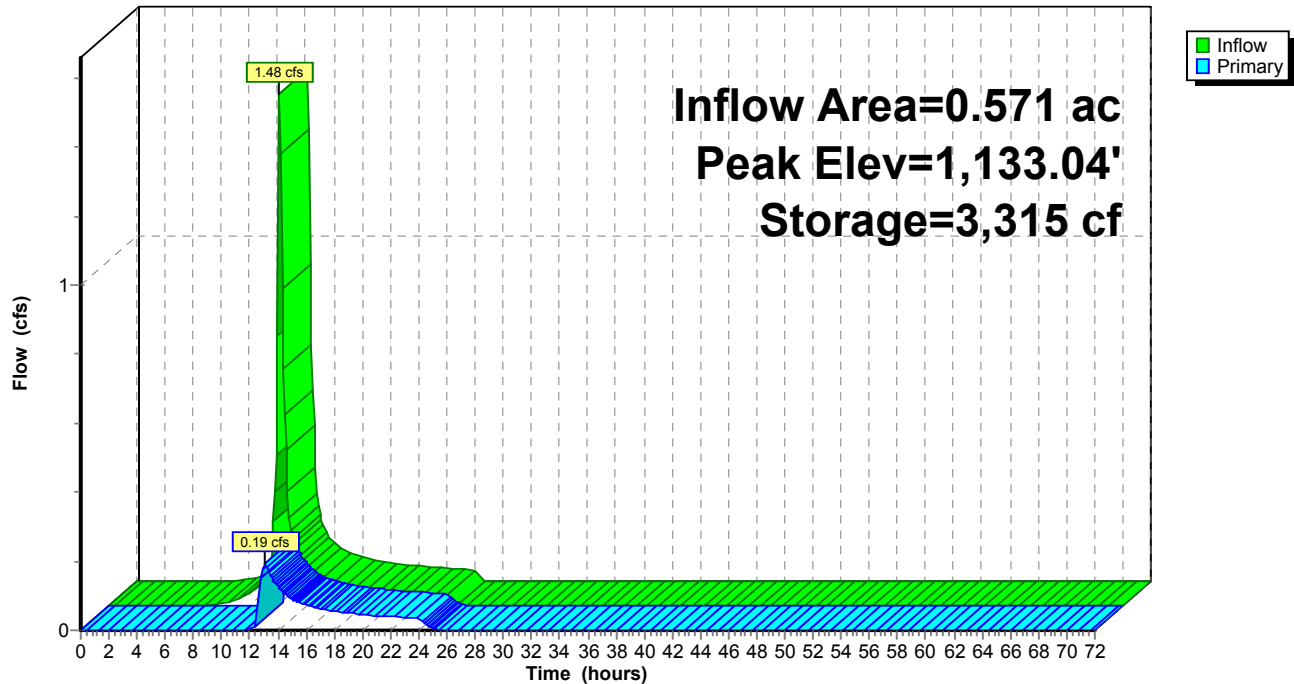
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,132.00	1,240	0	0
1,133.00	4,960	3,100	3,100
1,134.00	8,680	6,820	9,920

Device	Routing	Invert	Outlet Devices
#1	Primary	1,133.00'	<b>8.0' long x 1.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

**Primary OutFlow** Max=0.19 cfs @ 13.04 hrs HW=1,133.04' (Free Discharge)  
 ↑1=**Broad-Crested Rectangular Weir** (Weir Controls 0.19 cfs @ 0.55 fps)

**Pond SWM 3: SWALE 1**

Hydrograph



### Summary for Pond SWM 3: SWALE 1

Inflow Area = 0.571 ac, 0.00% Impervious, Inflow Depth = 3.61" for 50-yr event  
 Inflow = 1.73 cfs @ 12.13 hrs, Volume= 0.172 af  
 Outflow = 0.53 cfs @ 12.61 hrs, Volume= 0.101 af, Atten= 69%, Lag= 28.9 min  
 Primary = 0.53 cfs @ 12.61 hrs, Volume= 0.101 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs  
 Peak Elev= 1,133.08' @ 12.61 hrs Surf.Area= 5,275 sf Storage= 3,533 cf

Plug-Flow detention time= 260.0 min calculated for 0.101 af (59% of inflow)  
 Center-of-Mass det. time= 128.1 min ( 970.9 - 842.8 )

Volume	Invert	Avail.Storage	Storage Description
#1	1,132.00'	9,920 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,132.00	1,240	0	0
1,133.00	4,960	3,100	3,100
1,134.00	8,680	6,820	9,920

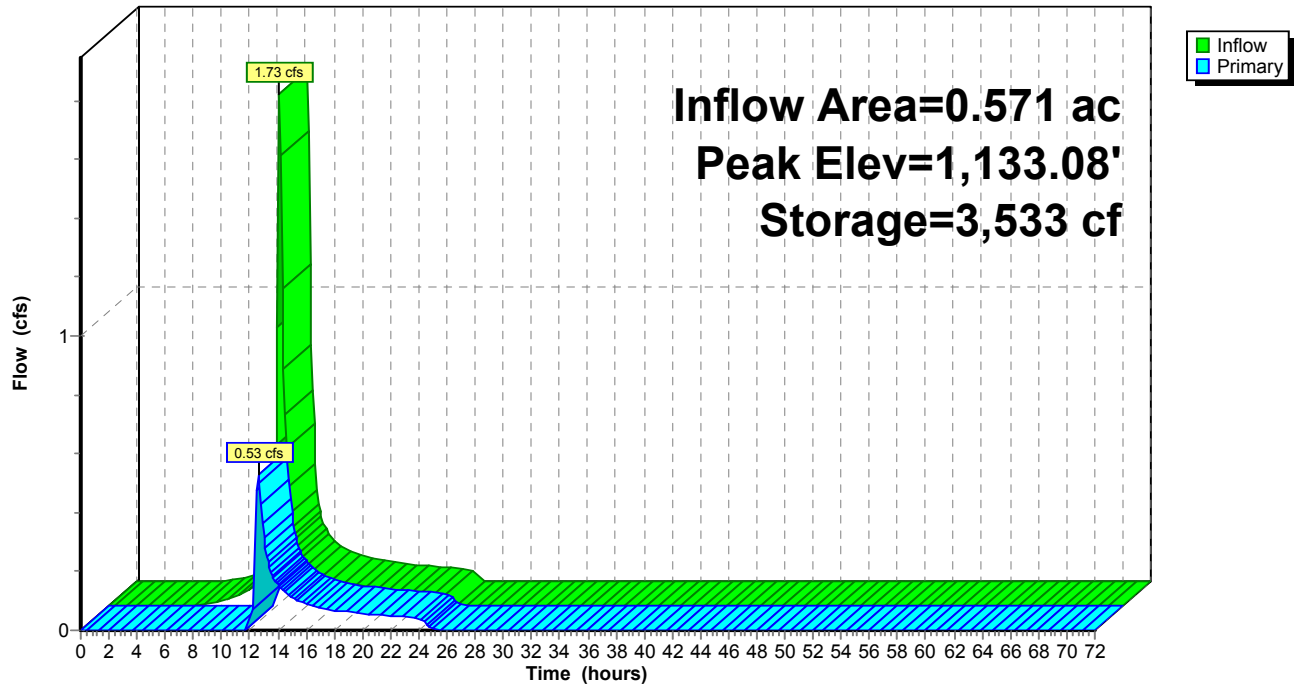
Device	Routing	Invert	Outlet Devices
#1	Primary	1,133.00'	<b>8.0' long x 1.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

**Primary OutFlow** Max=0.52 cfs @ 12.61 hrs HW=1,133.08' (Free Discharge)  
 ↑1=**Broad-Crested Rectangular Weir**(Weir Controls 0.52 cfs @ 0.78 fps)



**Pond SWM 3: SWALE 1**

Hydrograph



### Summary for Pond SWM 3: SWALE 1

Inflow Area = 0.571 ac, 0.00% Impervious, Inflow Depth = 4.47" for 100-yr event  
 Inflow = 1.99 cfs @ 12.13 hrs, Volume= 0.213 af  
 Outflow = 0.96 cfs @ 12.42 hrs, Volume= 0.142 af, Atten= 52%, Lag= 17.1 min  
 Primary = 0.96 cfs @ 12.42 hrs, Volume= 0.142 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs  
 Peak Elev= 1,133.13' @ 12.42 hrs Surf.Area= 5,427 sf Storage= 3,752 cf

Plug-Flow detention time= 232.2 min calculated for 0.142 af (67% of inflow)  
 Center-of-Mass det. time= 105.8 min ( 944.6 - 838.8 )

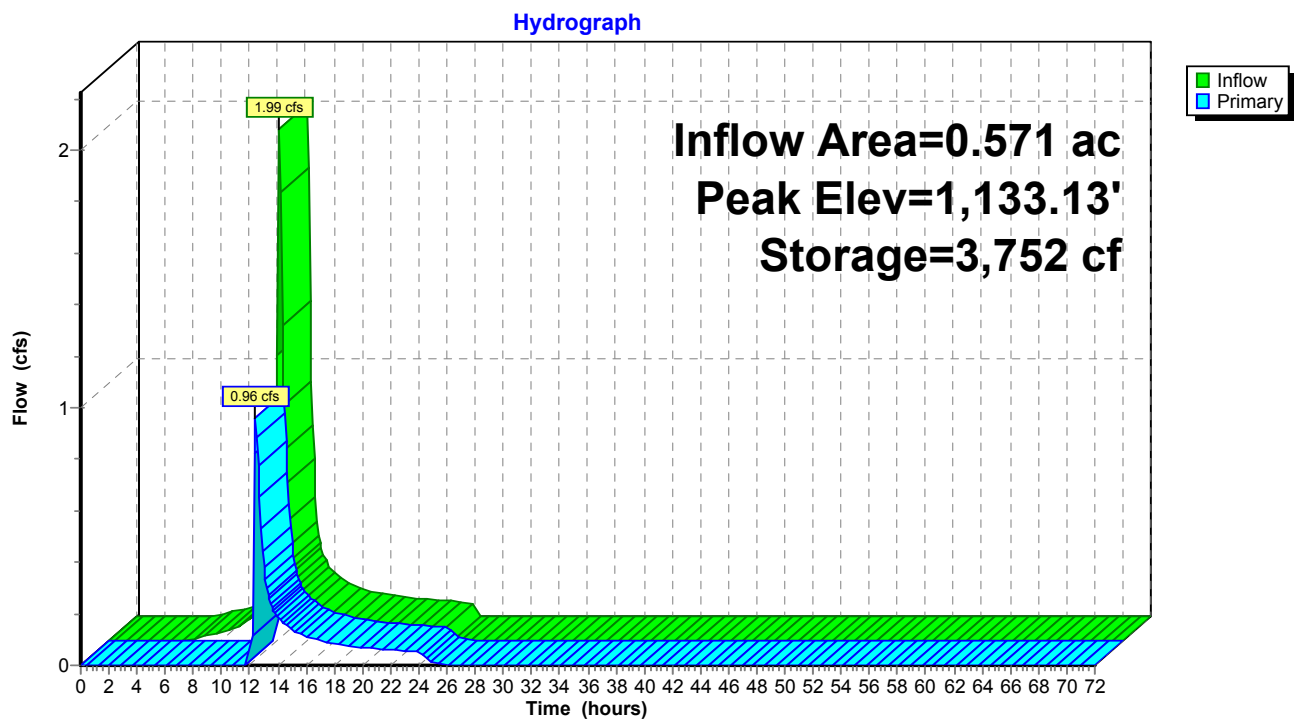
Volume	Invert	Avail.Storage	Storage Description
#1	1,132.00'	9,920 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,132.00	1,240	0	0
1,133.00	4,960	3,100	3,100
1,134.00	8,680	6,820	9,920

Device	Routing	Invert	Outlet Devices
#1	Primary	1,133.00'	<b>8.0' long x 1.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

**Primary OutFlow** Max=0.94 cfs @ 12.42 hrs HW=1,133.12' (Free Discharge)  
 ↑1=**Broad-Crested Rectangular Weir**(Weir Controls 0.94 cfs @ 0.95 fps)

### Pond SWM 3: SWALE 1



**Summary for Subcatchment BYPASS B: POST DEVELOPMENT**

Runoff = 0.87 cfs @ 12.18 hrs, Volume= 0.093 af, Depth= 0.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs  
PA-Benton - 517 - WDiamond 24-hr S1 1-yr Rainfall=2.49"

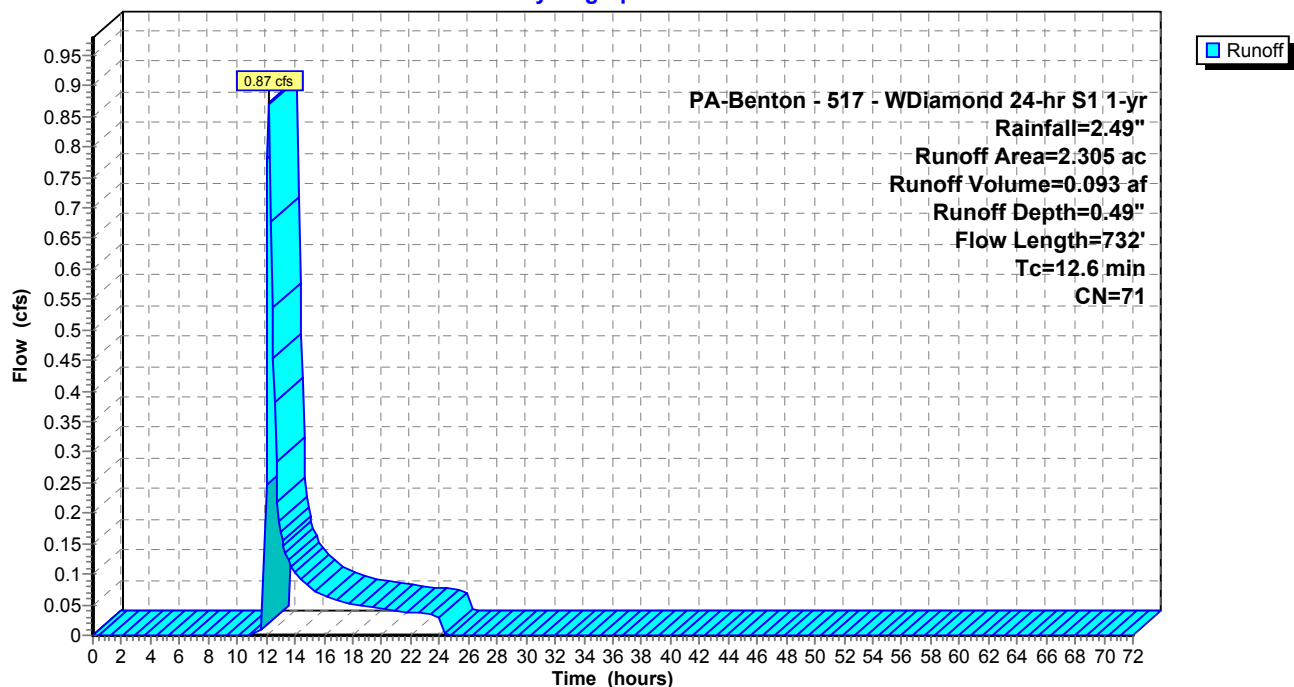
Area (ac)	CN	Description
0.459	70	Woods, Good, HSG C
1.830	71	Meadow, non-grazed, HSG C
* 0.016	89	Gravel areas, HSG C
* 0.000	98	Impervious areas, HSG C
2.305	71	Weighted Average
2.305		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.3	100	0.0250	0.20		<b>Sheet Flow, SHT 1</b>
					Range n= 0.130 P2= 2.98"
4.3	632	0.1200	2.42		<b>Shallow Concentrated Flow, SCF 1</b>
					Short Grass Pasture Kv= 7.0 fps
12.6	732	Total			

**Subcatchment BYPASS B: POST DEVELOPMENT**

Hydrograph



**Summary for Subcatchment BYPASS B: POST DEVELOPMENT**

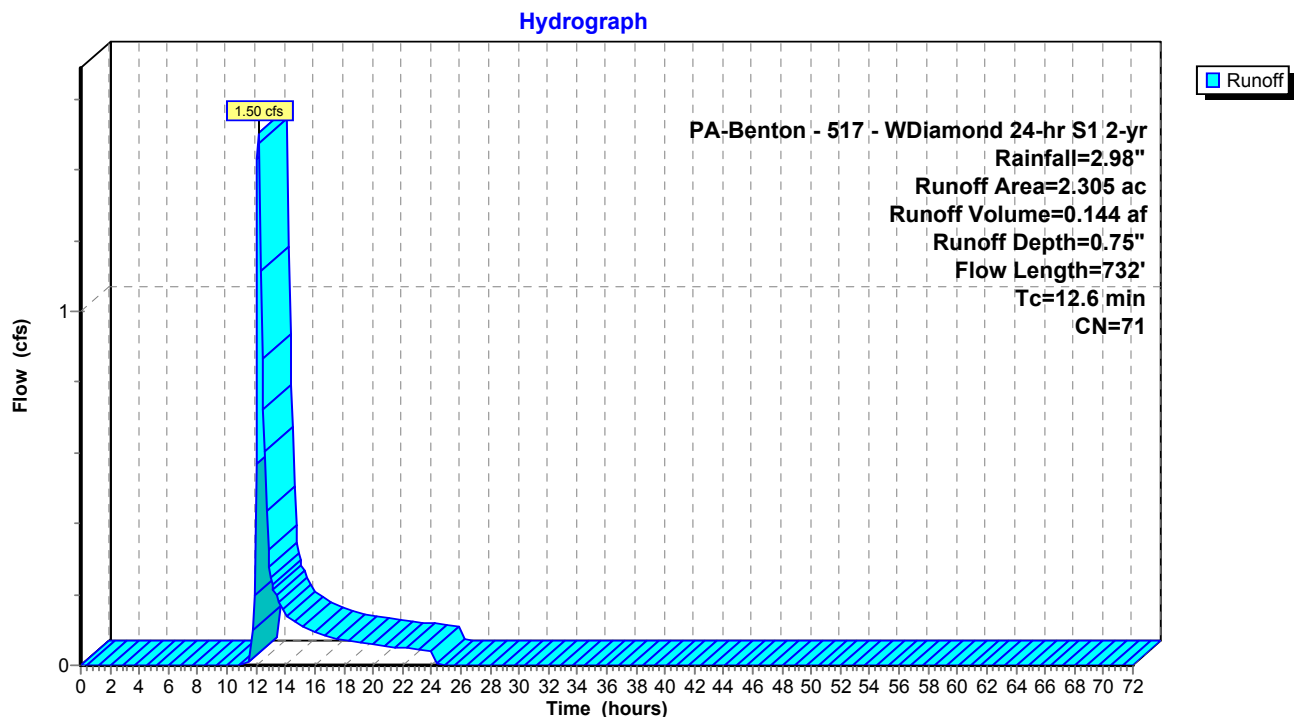
Runoff = 1.50 cfs @ 12.16 hrs, Volume= 0.144 af, Depth= 0.75"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs  
PA-Benton - 517 - WDiamond 24-hr S1 2-yr Rainfall=2.98"

Area (ac)	CN	Description
0.459	70	Woods, Good, HSG C
1.830	71	Meadow, non-grazed, HSG C
* 0.016	89	Gravel areas, HSG C
* 0.000	98	Impervious areas, HSG C
2.305	71	Weighted Average
2.305		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.3	100	0.0250	0.20		<b>Sheet Flow, SHT 1</b>
					Range n= 0.130 P2= 2.98"
4.3	632	0.1200	2.42		<b>Shallow Concentrated Flow, SCF 1</b>
					Short Grass Pasture Kv= 7.0 fps
12.6	732	Total			

**Subcatchment BYPASS B: POST DEVELOPMENT**

**Summary for Subcatchment BYPASS B: POST DEVELOPMENT**

Runoff = 2.56 cfs @ 12.15 hrs, Volume= 0.227 af, Depth= 1.18"

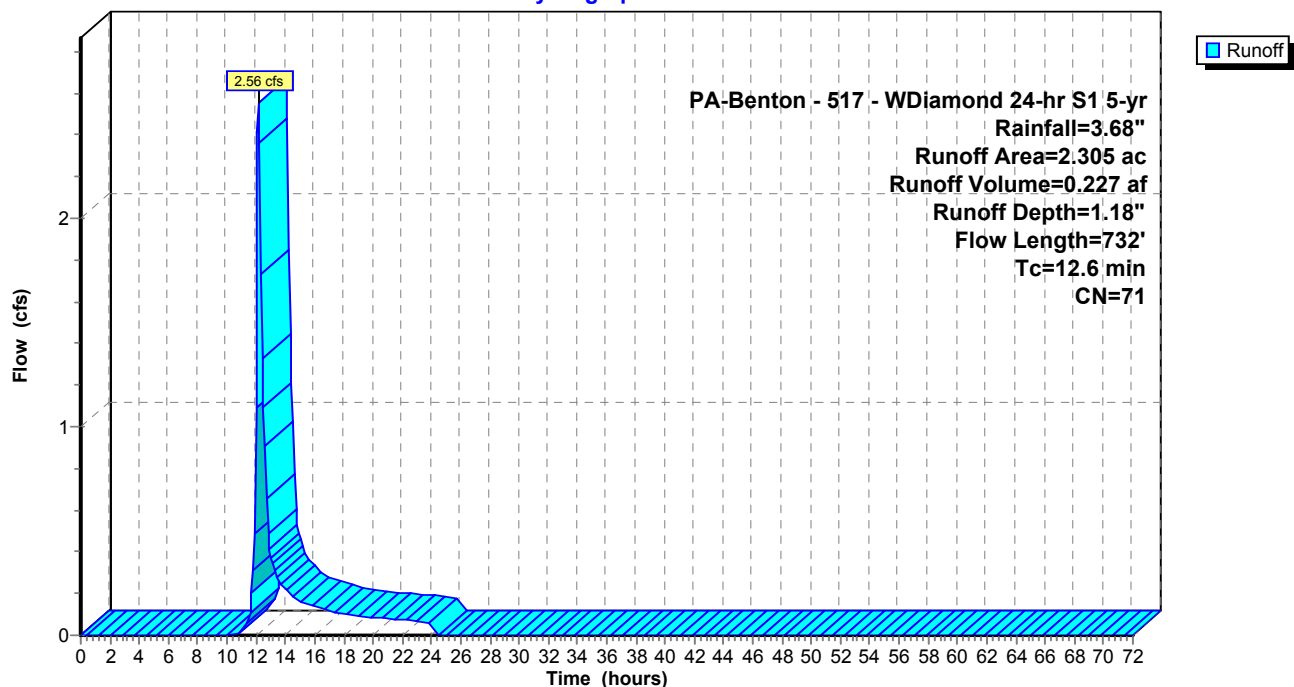
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs  
PA-Benton - 517 - WDiamond 24-hr S1 5-yr Rainfall=3.68"

Area (ac)	CN	Description
0.459	70	Woods, Good, HSG C
1.830	71	Meadow, non-grazed, HSG C
* 0.016	89	Gravel areas, HSG C
* 0.000	98	Impervious areas, HSG C
2.305	71	Weighted Average
2.305		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.3	100	0.0250	0.20		<b>Sheet Flow, SHT 1</b>
					Range n= 0.130 P2= 2.98"
4.3	632	0.1200	2.42		<b>Shallow Concentrated Flow, SCF 1</b>
					Short Grass Pasture Kv= 7.0 fps
12.6	732	Total			

**Subcatchment BYPASS B: POST DEVELOPMENT**

Hydrograph



**Summary for Subcatchment BYPASS B: POST DEVELOPMENT**

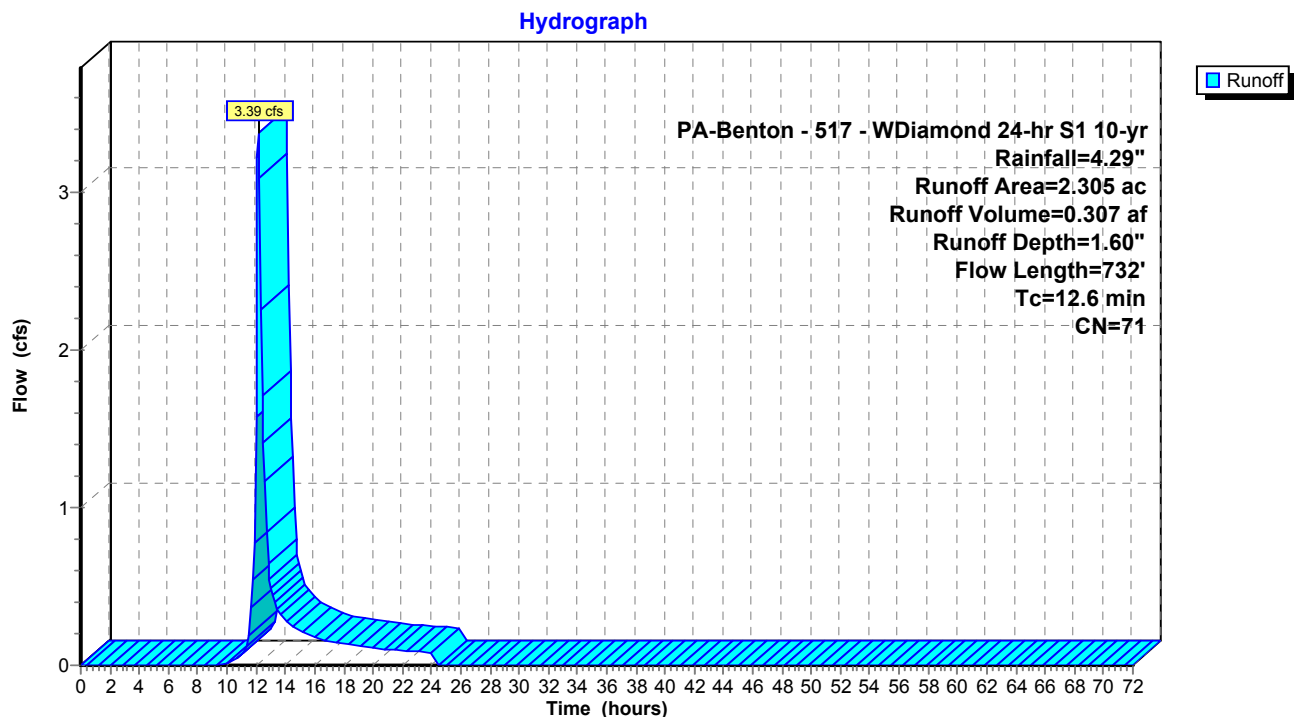
Runoff = 3.39 cfs @ 12.14 hrs, Volume= 0.307 af, Depth= 1.60"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs  
PA-Benton - 517 - WDiamond 24-hr S1 10-yr Rainfall=4.29"

Area (ac)	CN	Description
0.459	70	Woods, Good, HSG C
1.830	71	Meadow, non-grazed, HSG C
* 0.016	89	Gravel areas, HSG C
* 0.000	98	Impervious areas, HSG C
2.305	71	Weighted Average
2.305		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.3	100	0.0250	0.20		<b>Sheet Flow, SHT 1</b>
					Range n= 0.130 P2= 2.98"
4.3	632	0.1200	2.42		<b>Shallow Concentrated Flow, SCF 1</b>
					Short Grass Pasture Kv= 7.0 fps
12.6	732	Total			

**Subcatchment BYPASS B: POST DEVELOPMENT**

### Summary for Subcatchment BYPASS B: POST DEVELOPMENT

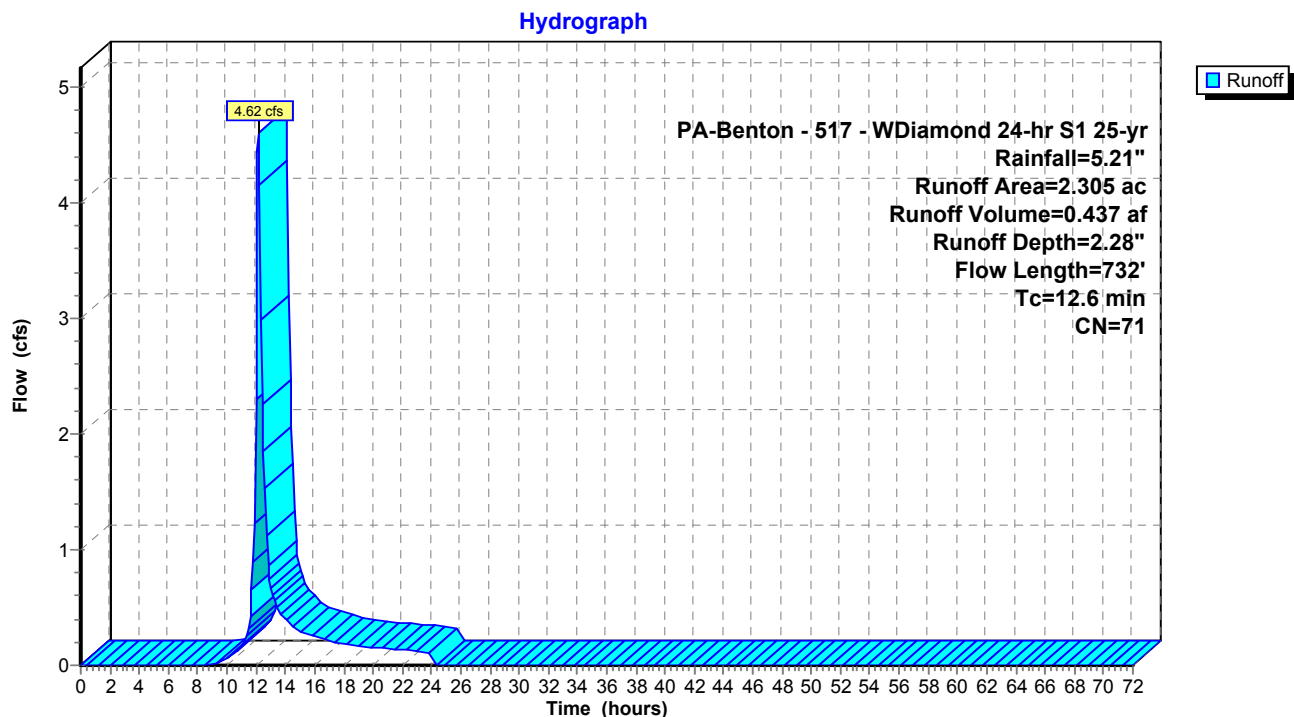
Runoff = 4.62 cfs @ 12.14 hrs, Volume= 0.437 af, Depth= 2.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs  
PA-Benton - 517 - WDiamond 24-hr S1 25-yr Rainfall=5.21"

Area (ac)	CN	Description
0.459	70	Woods, Good, HSG C
1.830	71	Meadow, non-grazed, HSG C
* 0.016	89	Gravel areas, HSG C
* 0.000	98	Impervious areas, HSG C
2.305	71	Weighted Average
2.305		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.3	100	0.0250	0.20		<b>Sheet Flow, SHT 1</b>
					Range n= 0.130 P2= 2.98"
4.3	632	0.1200	2.42		<b>Shallow Concentrated Flow, SCF 1</b>
					Short Grass Pasture Kv= 7.0 fps
12.6	732	Total			

### Subcatchment BYPASS B: POST DEVELOPMENT





### Summary for Subcatchment **BYPASS B: POST DEVELOPMENT**

Runoff = 5.62 cfs @ 12.14 hrs, Volume= 0.563 af, Depth= 2.93"

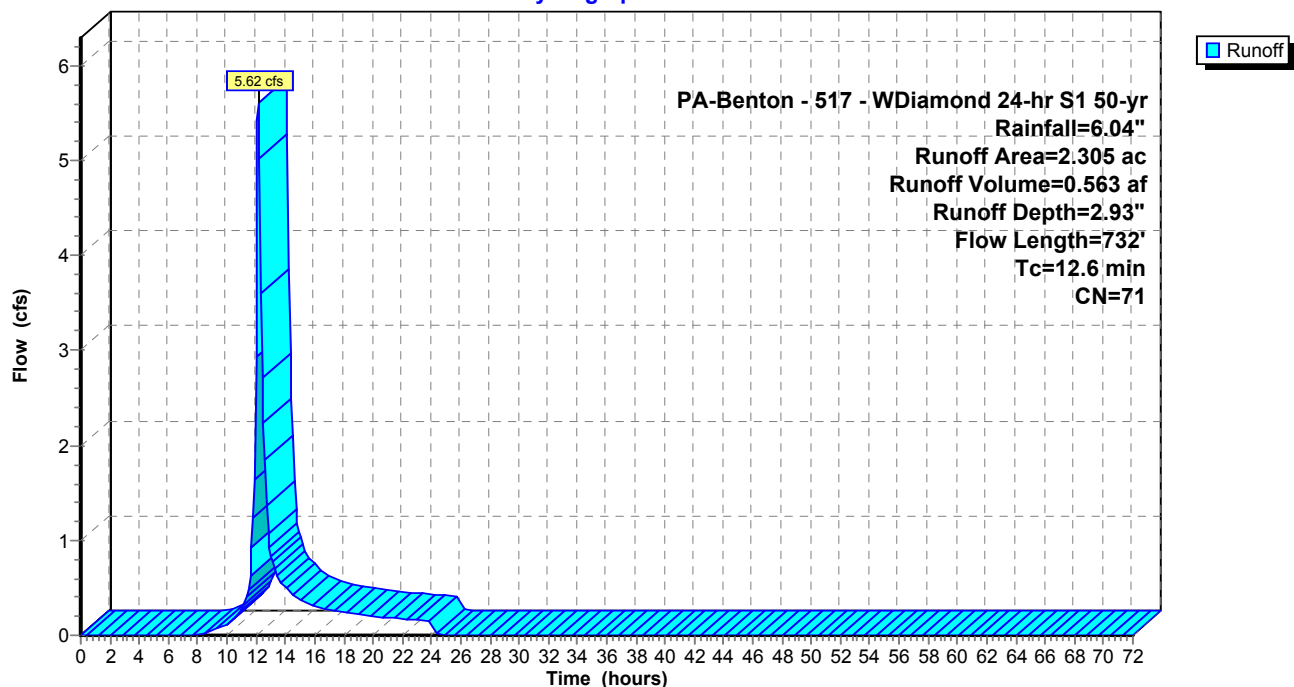
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs  
PA-Benton - 517 - WDiamond 24-hr S1 50-yr Rainfall=6.04"

Area (ac)	CN	Description
0.459	70	Woods, Good, HSG C
1.830	71	Meadow, non-grazed, HSG C
* 0.016	89	Gravel areas, HSG C
* 0.000	98	Impervious areas, HSG C
2.305	71	Weighted Average
2.305		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.3	100	0.0250	0.20		<b>Sheet Flow, SHT 1</b>
					Range n= 0.130 P2= 2.98"
4.3	632	0.1200	2.42		<b>Shallow Concentrated Flow, SCF 1</b>
					Short Grass Pasture Kv= 7.0 fps
12.6	732	Total			

### Subcatchment **BYPASS B: POST DEVELOPMENT**

Hydrograph



### Summary for Subcatchment **BYPASS B: POST DEVELOPMENT**

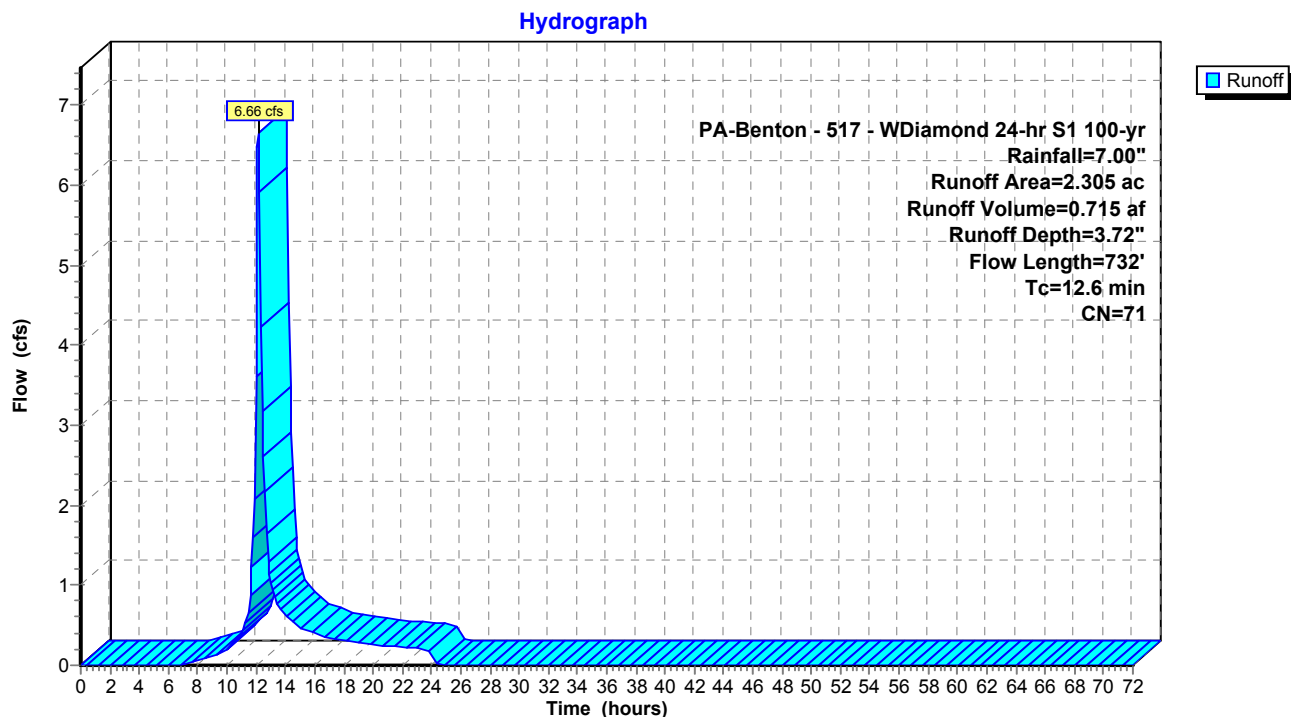
Runoff = 6.66 cfs @ 12.13 hrs, Volume= 0.715 af, Depth= 3.72"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs  
 PA-Benton - 517 - WDiamond 24-hr S1 100-yr Rainfall=7.00"

Area (ac)	CN	Description
0.459	70	Woods, Good, HSG C
1.830	71	Meadow, non-grazed, HSG C
* 0.016	89	Gravel areas, HSG C
* 0.000	98	Impervious areas, HSG C
2.305	71	Weighted Average
2.305		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.3	100	0.0250	0.20		<b>Sheet Flow, SHT 1</b>
					Range n= 0.130 P2= 2.98"
4.3	632	0.1200	2.42		<b>Shallow Concentrated Flow, SCF 1</b>
					Short Grass Pasture Kv= 7.0 fps
12.6	732	Total			

### Subcatchment **BYPASS B: POST DEVELOPMENT**



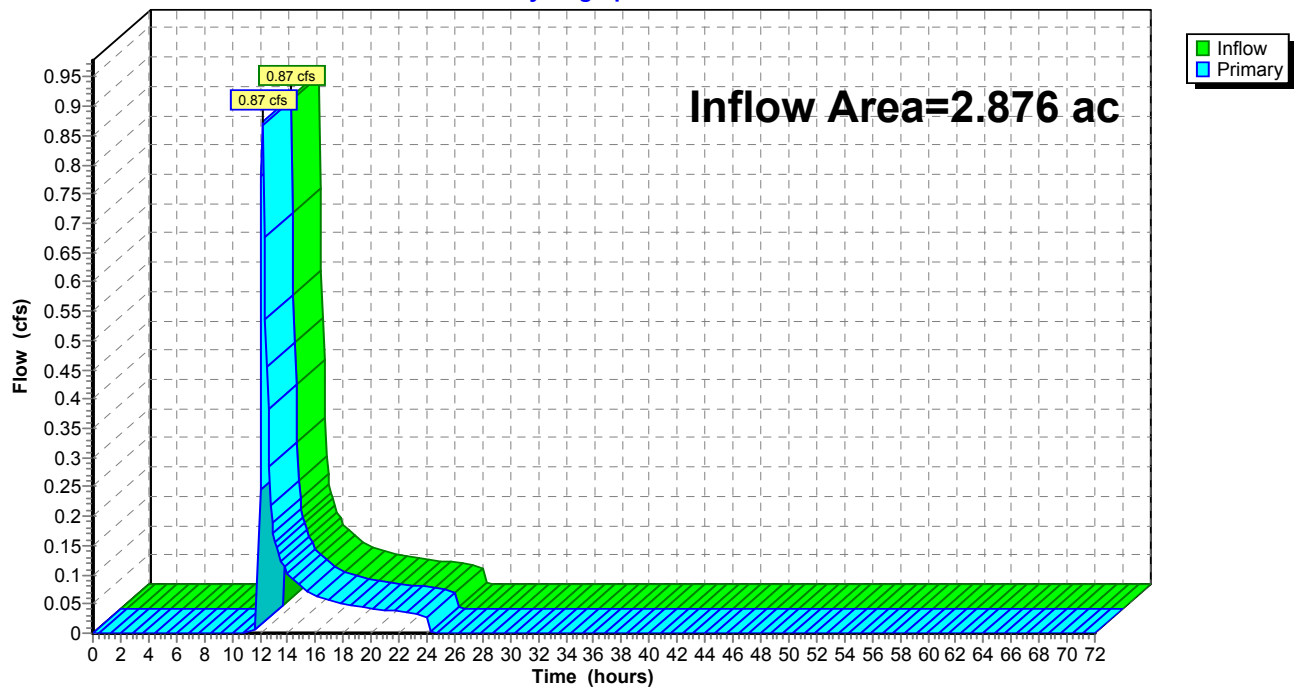
**Summary for Link POI B POST: POI B - POST**

Inflow Area = 2.876 ac, 0.00% Impervious, Inflow Depth = 0.39" for 1-yr event  
Inflow = 0.87 cfs @ 12.18 hrs, Volume= 0.093 af  
Primary = 0.87 cfs @ 12.18 hrs, Volume= 0.093 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs

**Link POI B POST: POI B - POST**

Hydrograph



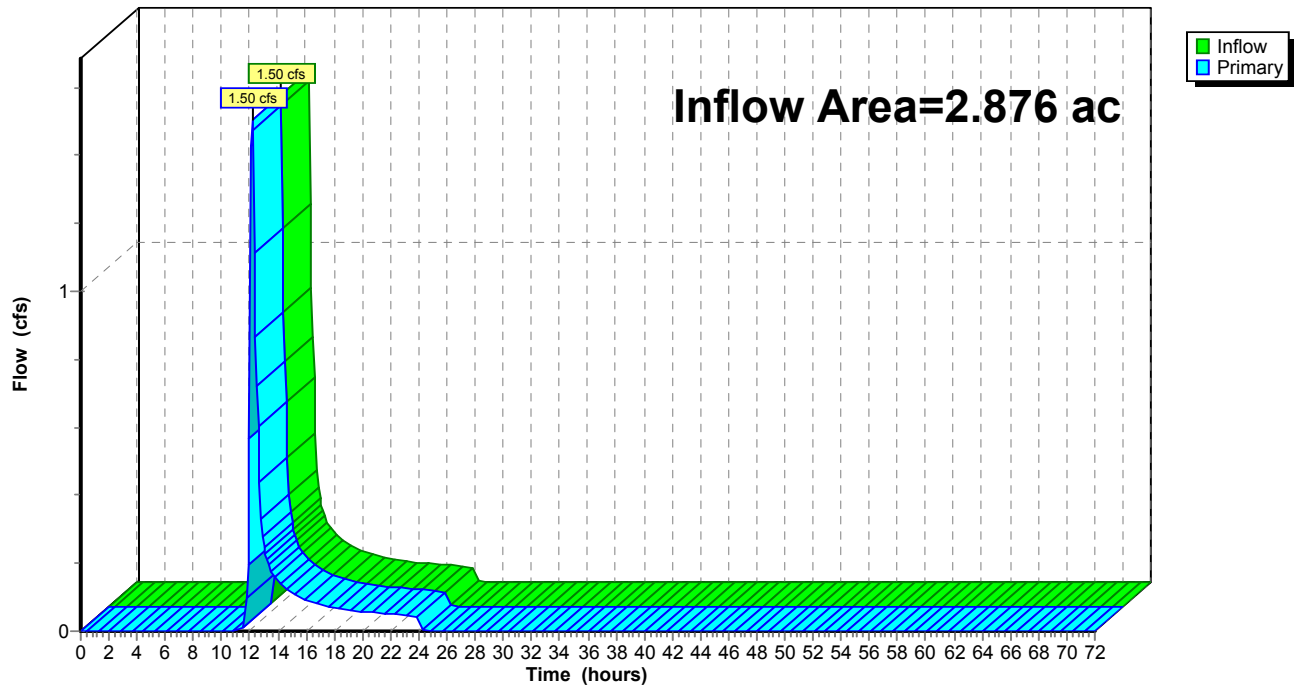
**Summary for Link POI B POST: POI B - POST**

Inflow Area = 2.876 ac, 0.00% Impervious, Inflow Depth = 0.60" for 2-yr event  
Inflow = 1.50 cfs @ 12.16 hrs, Volume= 0.144 af  
Primary = 1.50 cfs @ 12.16 hrs, Volume= 0.144 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs

**Link POI B POST: POI B - POST**

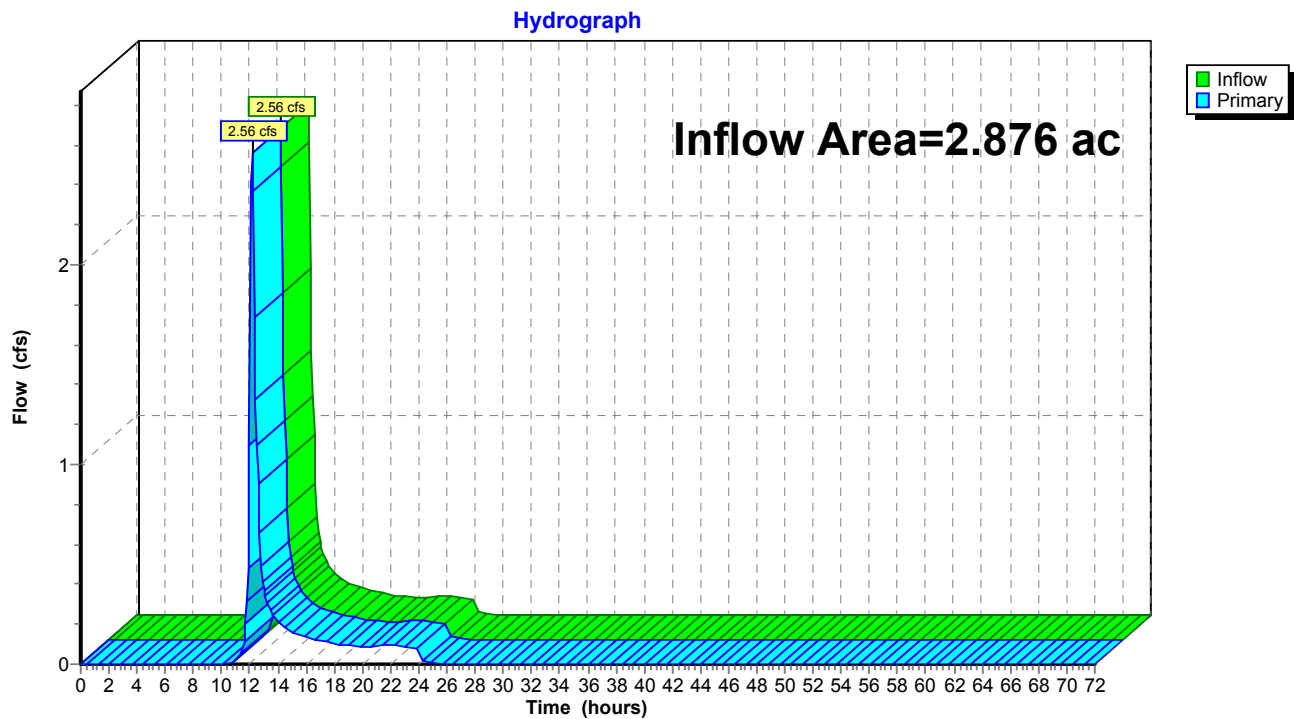
Hydrograph



**Summary for Link POI B POST: POI B - POST**

Inflow Area = 2.876 ac, 0.00% Impervious, Inflow Depth = 0.97" for 5-yr event  
Inflow = 2.56 cfs @ 12.15 hrs, Volume= 0.233 af  
Primary = 2.56 cfs @ 12.15 hrs, Volume= 0.233 af, Atten= 0%, Lag= 0.0 min

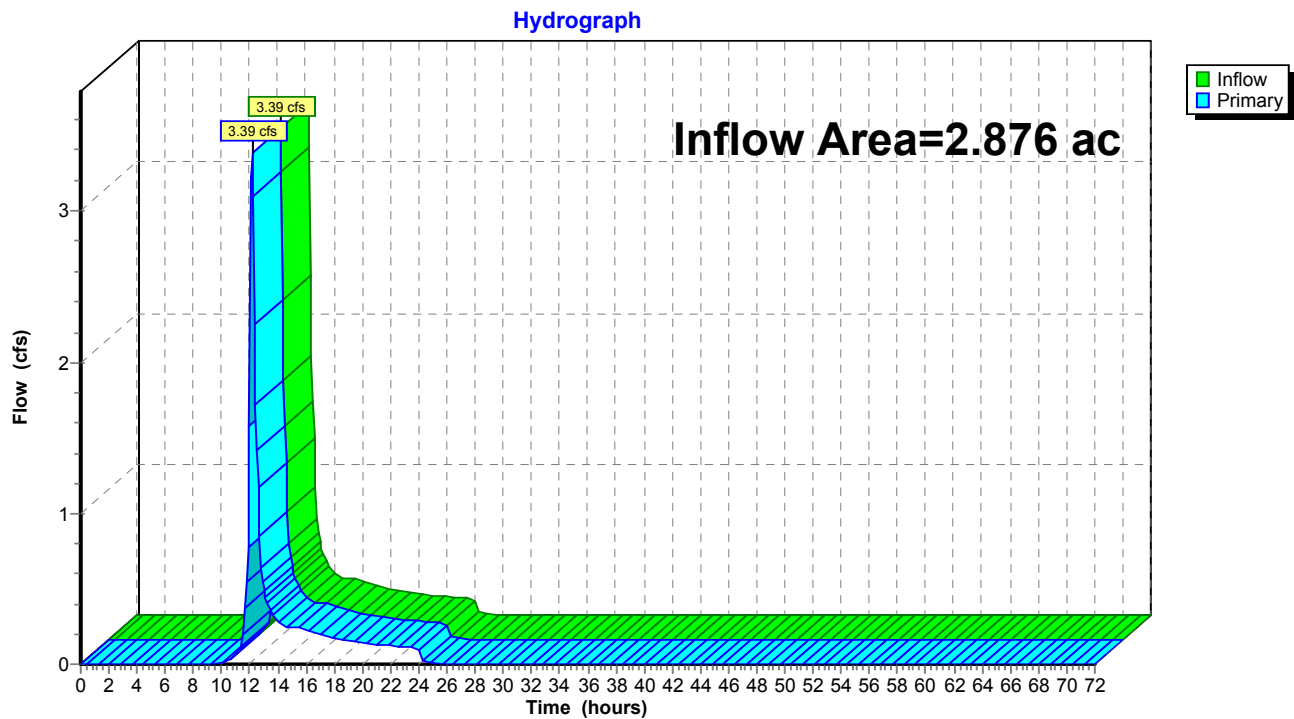
Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs

**Link POI B POST: POI B - POST**

**Summary for Link POI B POST: POI B - POST**

Inflow Area = 2.876 ac, 0.00% Impervious, Inflow Depth = 1.40" for 10-yr event  
Inflow = 3.39 cfs @ 12.14 hrs, Volume= 0.336 af  
Primary = 3.39 cfs @ 12.14 hrs, Volume= 0.336 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs

**Link POI B POST: POI B - POST**

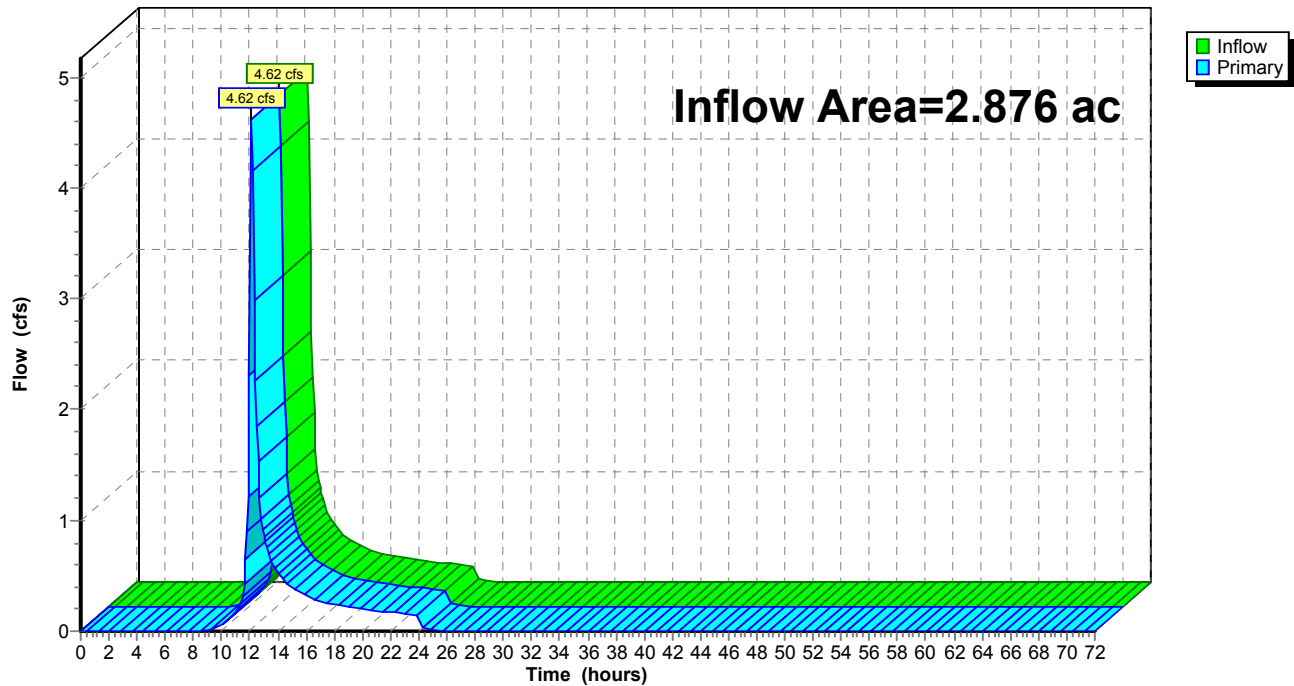
**Summary for Link POI B POST: POI B - POST**

Inflow Area = 2.876 ac, 0.00% Impervious, Inflow Depth = 2.10" for 25-yr event  
Inflow = 4.62 cfs @ 12.14 hrs, Volume= 0.504 af  
Primary = 4.62 cfs @ 12.14 hrs, Volume= 0.504 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs

**Link POI B POST: POI B - POST**

Hydrograph



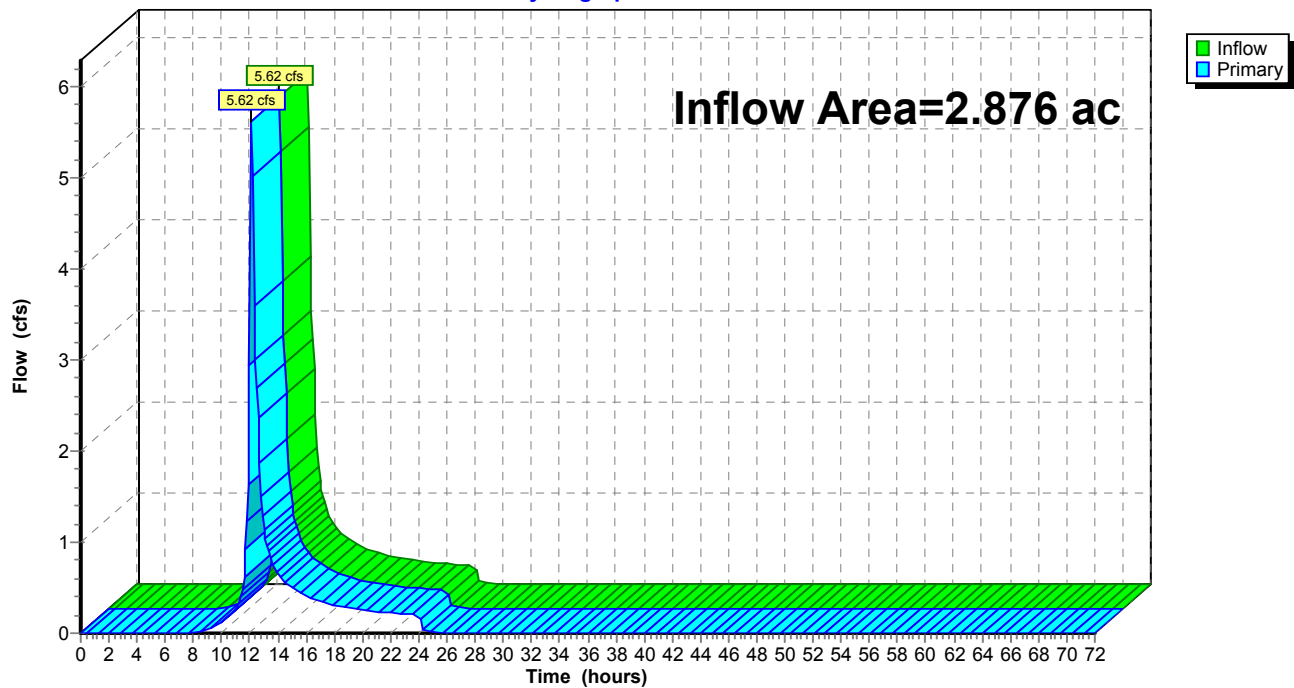
**Summary for Link POI B POST: POI B - POST**

Inflow Area = 2.876 ac, 0.00% Impervious, Inflow Depth = 2.77" for 50-yr event  
Inflow = 5.62 cfs @ 12.14 hrs, Volume= 0.664 af  
Primary = 5.62 cfs @ 12.14 hrs, Volume= 0.664 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs

**Link POI B POST: POI B - POST**

Hydrograph



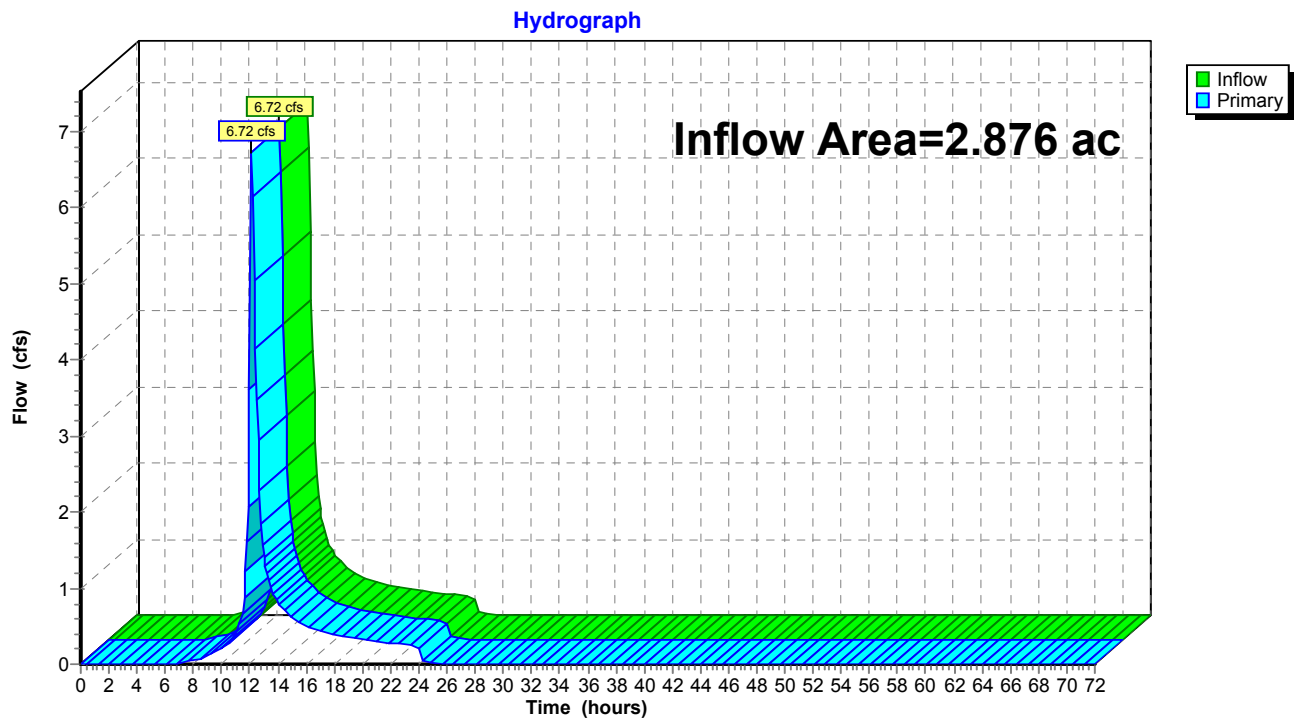


### Summary for Link POI B POST: POI B - POST

Inflow Area =      2.876 ac,   0.00% Impervious, Inflow Depth =   3.58"   for 100-yr event  
Inflow        =      6.72 cfs @   12.14 hrs, Volume=                0.857 af  
Primary       =      6.72 cfs @   12.14 hrs, Volume=                0.857 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs

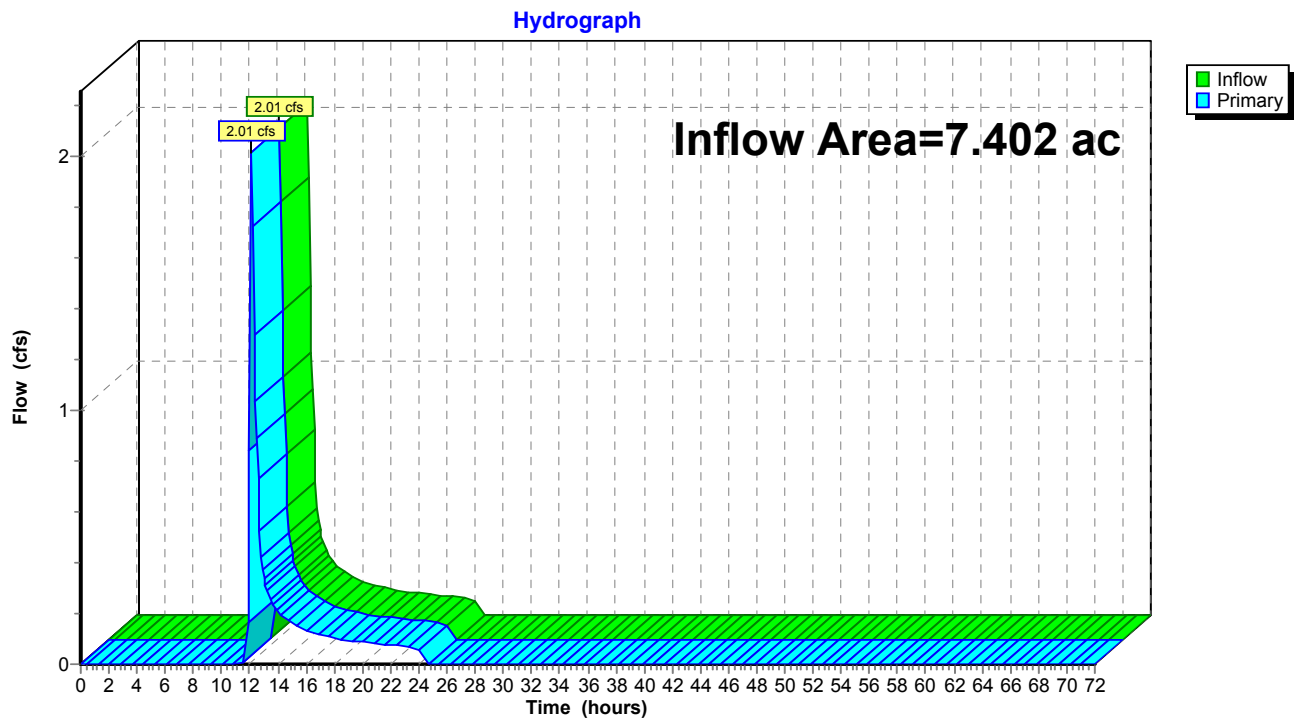
### Link POI B POST: POI B - POST



**Summary for Link POI 1 POST: POI 1 - POST**

Inflow Area = 7.402 ac, 0.14% Impervious, Inflow Depth = 0.31" for 1-yr event  
Inflow = 2.01 cfs @ 12.13 hrs, Volume= 0.193 af  
Primary = 2.01 cfs @ 12.13 hrs, Volume= 0.193 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs

**Link POI 1 POST: POI 1 - POST**

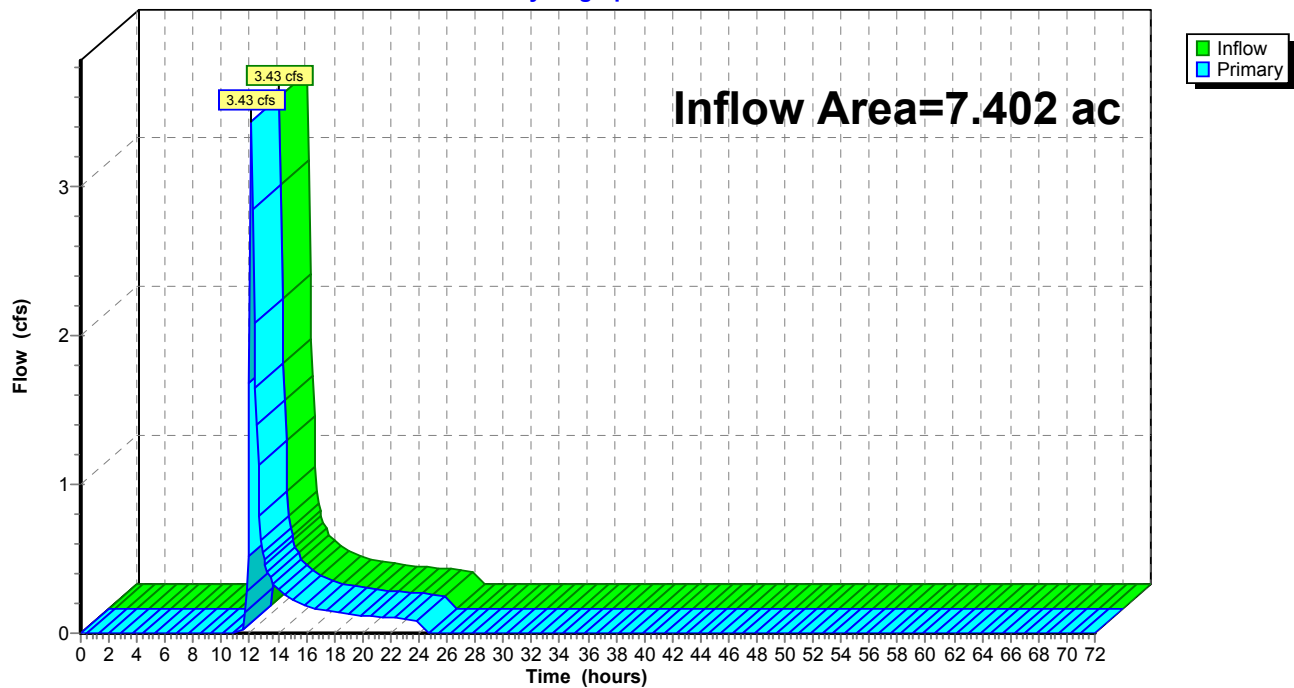
**Summary for Link POI 1 POST: POI 1 - POST**

Inflow Area = 7.402 ac, 0.14% Impervious, Inflow Depth = 0.48" for 2-yr event  
Inflow = 3.43 cfs @ 12.13 hrs, Volume= 0.295 af  
Primary = 3.43 cfs @ 12.13 hrs, Volume= 0.295 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs

**Link POI 1 POST: POI 1 - POST**

Hydrograph



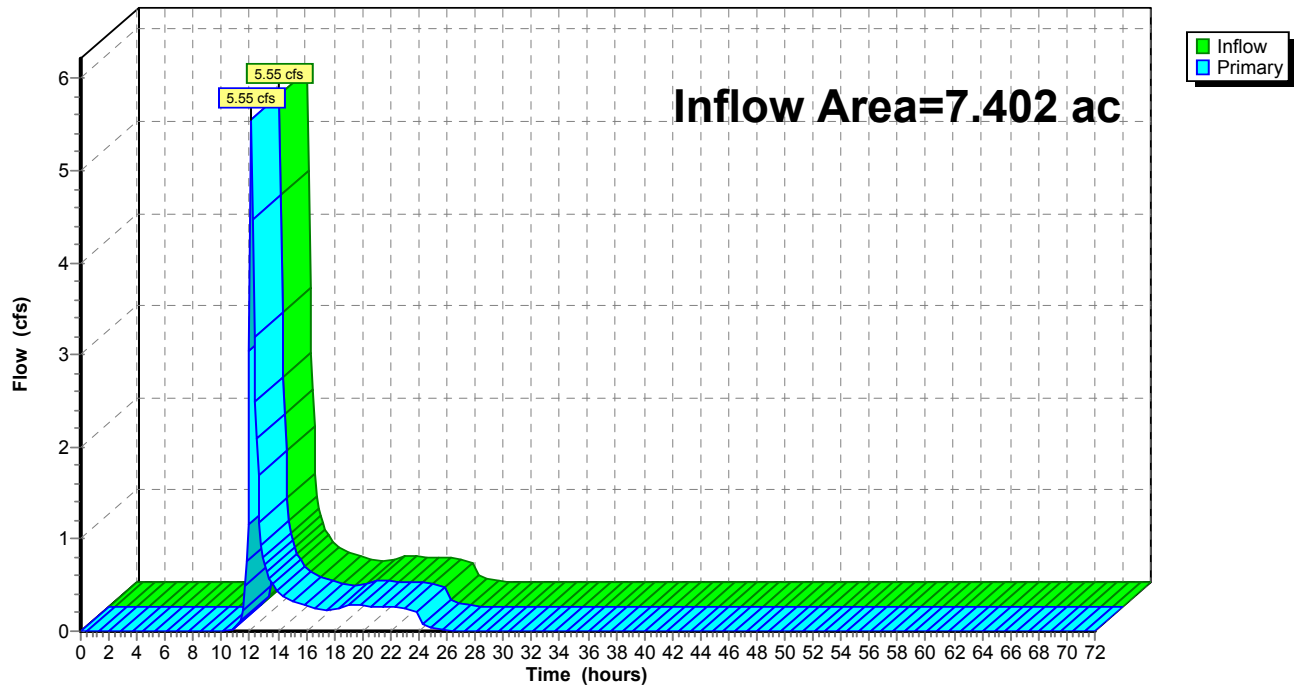
**Summary for Link POI 1 POST: POI 1 - POST**

Inflow Area = 7.402 ac, 0.14% Impervious, Inflow Depth = 0.84" for 5-yr event  
Inflow = 5.55 cfs @ 12.12 hrs, Volume= 0.521 af  
Primary = 5.55 cfs @ 12.12 hrs, Volume= 0.521 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs

**Link POI 1 POST: POI 1 - POST**

Hydrograph



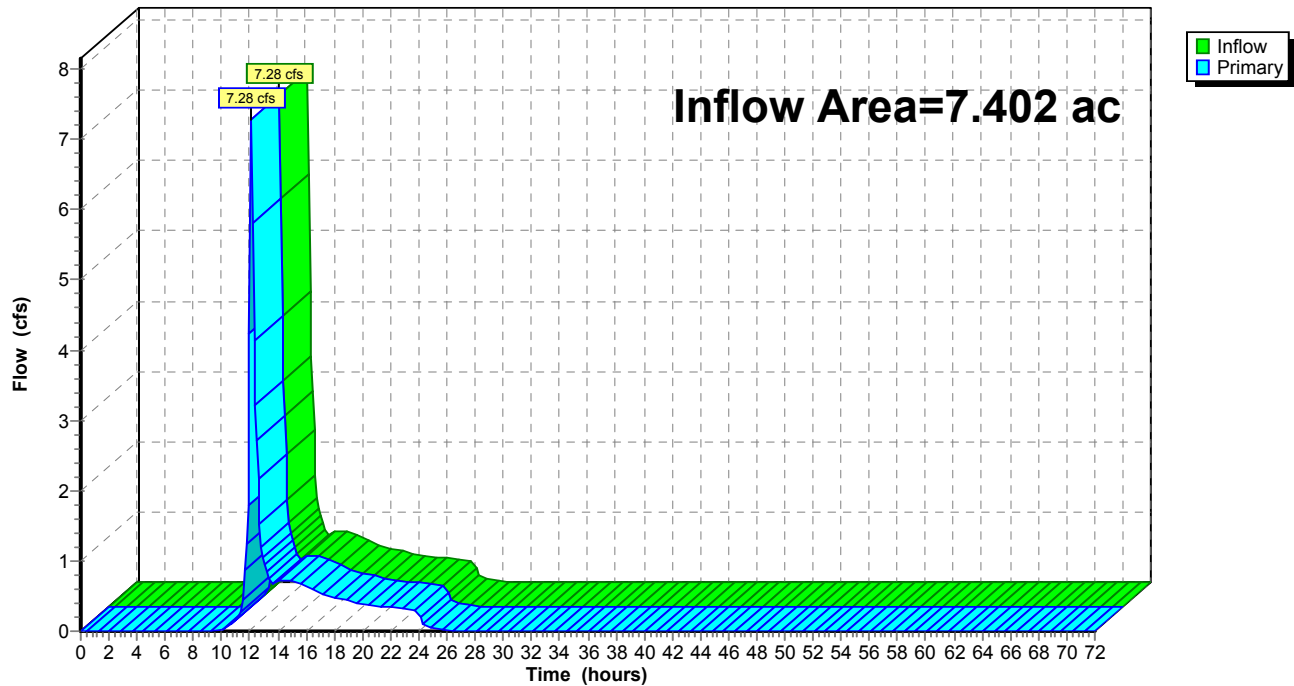
**Summary for Link POI 1 POST: POI 1 - POST**

Inflow Area = 7.402 ac, 0.14% Impervious, Inflow Depth = 1.30" for 10-yr event  
Inflow = 7.28 cfs @ 12.12 hrs, Volume= 0.801 af  
Primary = 7.28 cfs @ 12.12 hrs, Volume= 0.801 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs

**Link POI 1 POST: POI 1 - POST**

Hydrograph



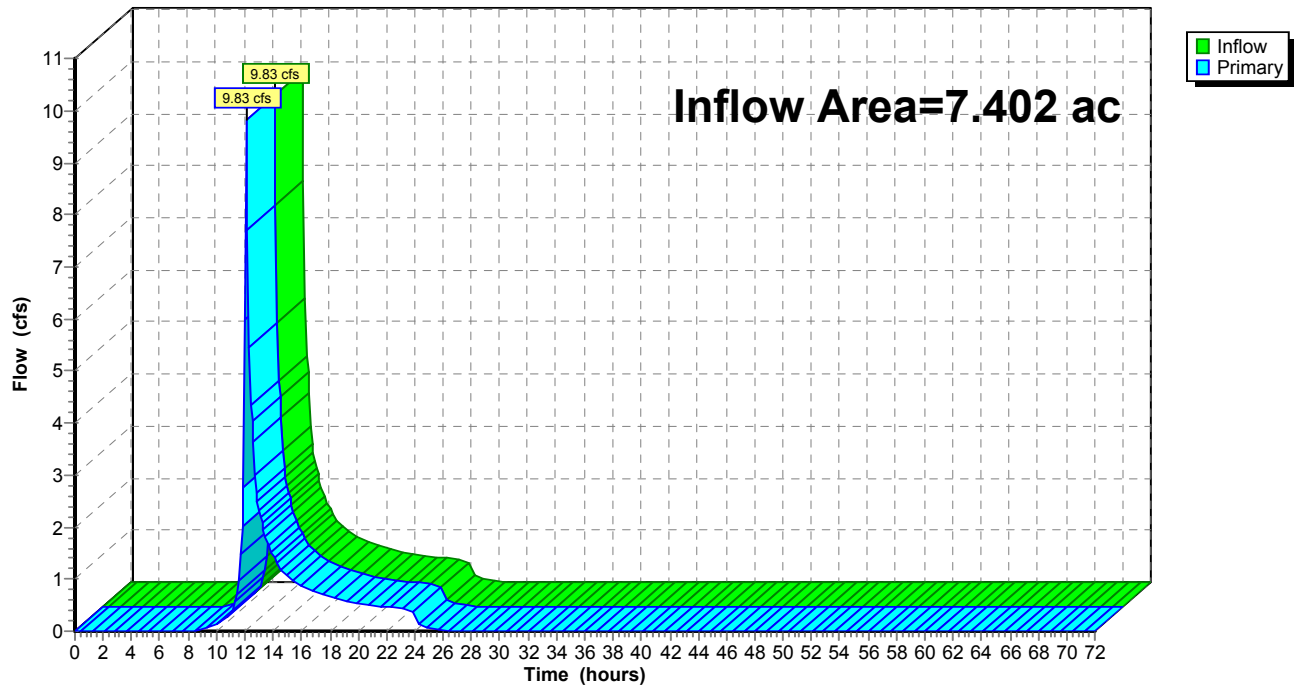
**Summary for Link POI 1 POST: POI 1 - POST**

Inflow Area = 7.402 ac, 0.14% Impervious, Inflow Depth = 2.03" for 25-yr event  
Inflow = 9.83 cfs @ 12.11 hrs, Volume= 1.250 af  
Primary = 9.83 cfs @ 12.11 hrs, Volume= 1.250 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs

**Link POI 1 POST: POI 1 - POST**

Hydrograph



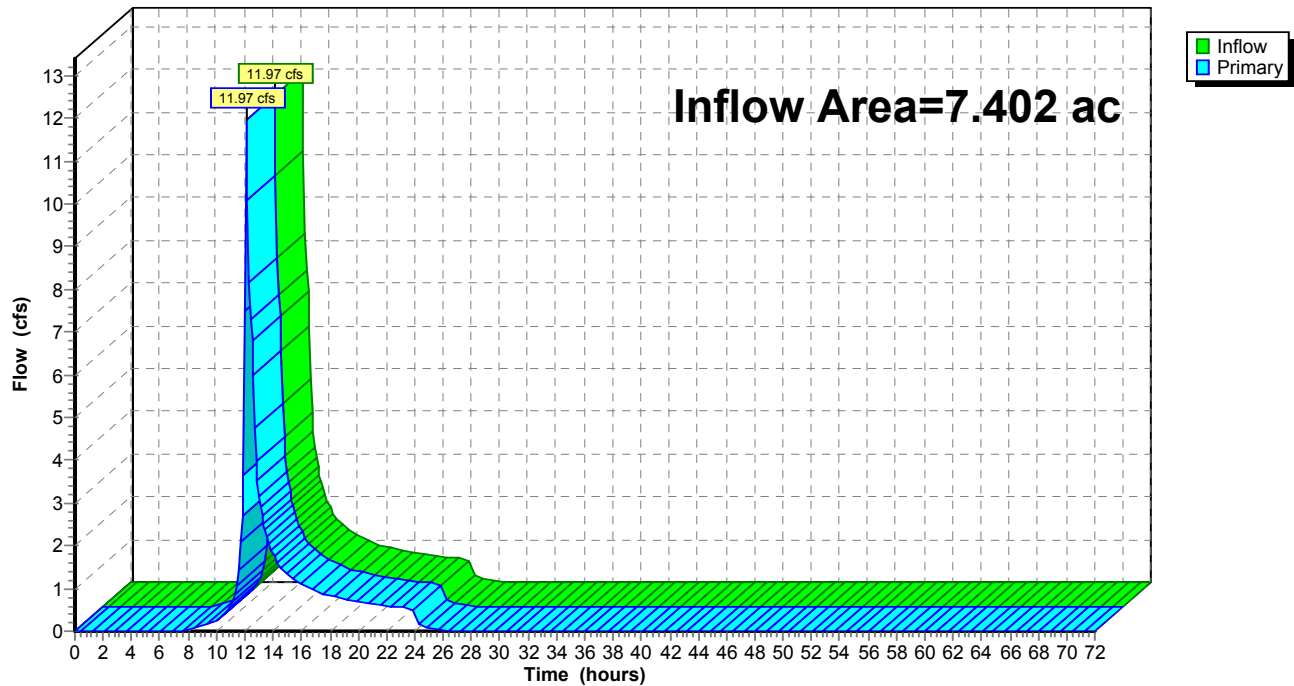
**Summary for Link POI 1 POST: POI 1 - POST**

Inflow Area = 7.402 ac, 0.14% Impervious, Inflow Depth = 2.72" for 50-yr event  
Inflow = 11.97 cfs @ 12.12 hrs, Volume= 1.677 af  
Primary = 11.97 cfs @ 12.12 hrs, Volume= 1.677 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs

**Link POI 1 POST: POI 1 - POST**

Hydrograph

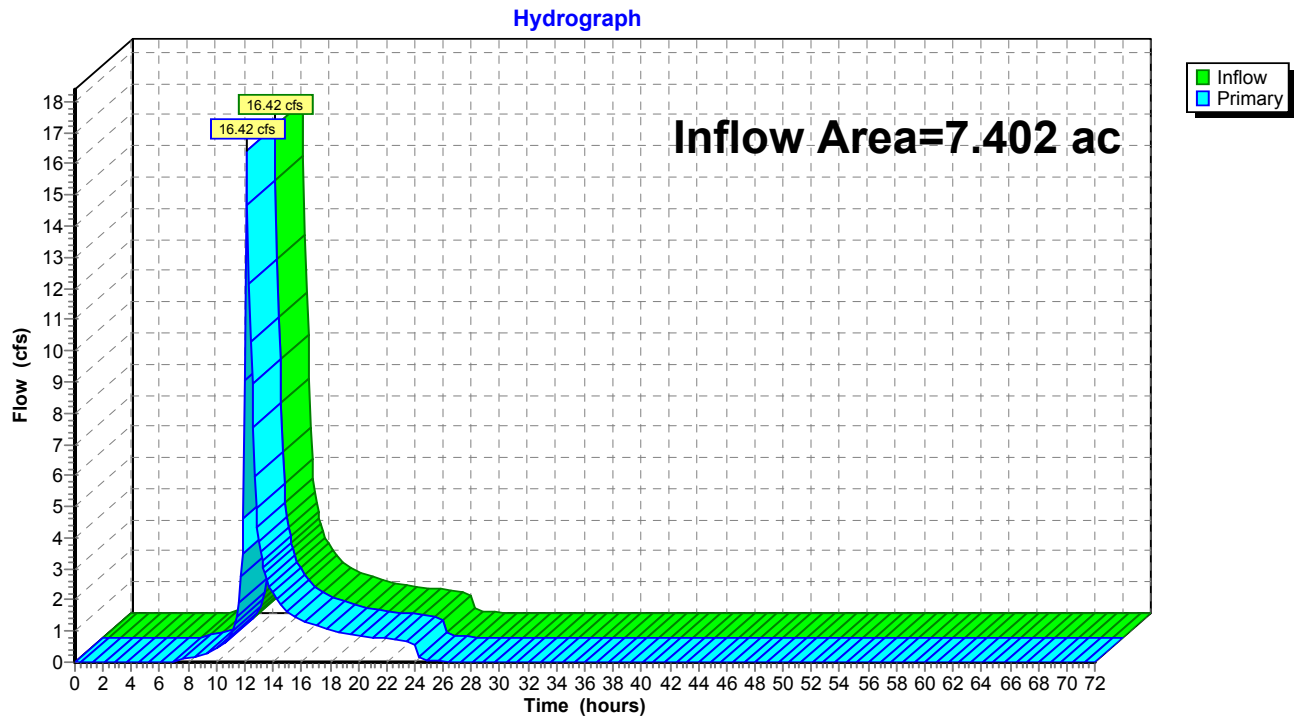


### Summary for Link POI 1 POST: POI 1 - POST

Inflow Area =      7.402 ac,   0.14% Impervious, Inflow Depth =   3.55"   for 100-yr event  
Inflow        =      16.42 cfs @   12.13 hrs, Volume=            2.188 af  
Primary       =      16.42 cfs @   12.13 hrs, Volume=            2.188 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs

### Link POI 1 POST: POI 1 - POST





## **A.3 Conveyance Calculations**



## E&S WORKSHEET # 11

### Channel Design Data

PROJECT NAME: ATLANTIC SUNRISE PROJECT - WEST DIAMOND REGULATOR STATION

LOCATION: JACKSON/SUGARLOAF TOWNSHIPS, COLUMBIA COUNTY, PENNSYLVANIA

PREPARED BY: JEC DATE: 04/03/2015

CHECKED BY: AJB DATE: 04/03/2015

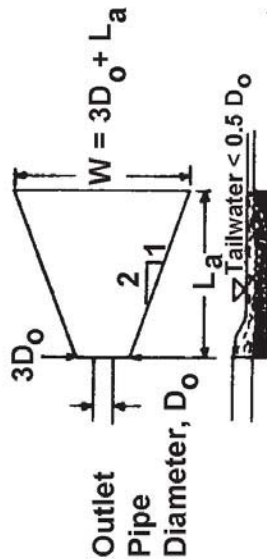
CHANNEL OR CHANNEL SECTION	VEGETATED SWALE 1 LINING	VEGETATED SWALE 1 GRASS		
TEMPORARY OR PERMANENT? (T OR P)	P	P		
DESIGN STORM (2, 5, OR 10 YR)	10	10		
ACRES (AC)	0.57	0.57		
MULTIPLIER <sup>1</sup> (1.6, 2.25, or 2.75) <sup>1</sup>	2.75	2.75		
Q <sub>r</sub> (REQUIRED CAPACITY) (CFS)	1.57	1.57		
Q (CALCULATED AT FLOW DEPTH d) (CFS)	1.58	1.58		
PROTECTIVE LINING <sup>2</sup>	SC250	GRASS/ SC250		
n (MANNING'S COEFFICIENT) <sup>2</sup>	0.040	0.128		
V <sub>a</sub> (ALLOWABLE VELOCITY) (FPS)	N/A	N/A		
V (CALCULATED AT FLOW DEPTH d) (FPS)	4.19	1.88		
τ <sub>a</sub> (MAX ALLOWABLE SHEAR STRESS) (LB/FT <sup>2</sup> )	2.50	8.00		
τ <sub>d</sub> (CALC'D SHEAR STRESS AT FLOW DEPTH d) (LB/FT <sup>2</sup> )	1.91	3.64		
CHANNEL BOTTOM WIDTH (FT)	2	2		
CHANNEL SIDE SLOPES (H:V)	3	3		
D (TOTAL DEPTH) (FT)	2.0	2.0		
CHANNEL TOP WIDTH @ D (FT)	14	14		
d (CALCULATED FLOW DEPTH) (FT)	0.15	0.29		
CHANNEL TOP WIDTH @ FLOW DEPTH d (FT)	2.92	3.75		
BOTTOM WIDTH: FLOW DEPTH RATIO (12:1 MAX)	13.07	6.85		
d <sub>50</sub> STONE SIZE (IN)	N/A	N/A		
A (CROSS-SECTIONAL AREA) (SQ. FT.)	0.38	0.84		
R (HYDRAULIC RADIUS)	0.13	0.22		
S (BED SLOPE) <sup>3</sup> (FT/FT)	0.2	0.2		
S <sub>c</sub> (CRITICAL SLOPE) (FT/FT)	0.047	0.406		
.7S <sub>c</sub> (FT/FT)	0.033	0.284		
1.3S <sub>c</sub> (FT/FT)	0.061	0.528		
STABLE FLOW? (Y/N)	Y	Y		
FREEBOARD BASED ON UNSTABLE FLOW (FT)	0.05	0.0		
FREEBOARD BASED ON STABLE FLOW (FT)	0.50	0.5		
MINIMUM REQUIRED FREEBOARD <sup>4</sup> (FT)	0.50	0.5		
DESIGN METHOD FOR PROTECTIVE LINING <sup>5</sup> PERMISSIBLE VELOCITY (V) OR SHEAR STRESS (S)	S	S		

1. Use 1.6 for Temporary Channels; 2.25 for Temporary Channels in Special Protection (HQ or EV) Watersheds; 2.75 for Permanent Channels. For Rational Method, enter "N/A" and attach E&S Worksheets 9 and 10. For TR-55 enter "N/A" and attach appropriate Worksheets.
2. Adjust "n" value for changes in channel liner and flow depth. For vegetated channels, provide data for manufactured linings without vegetation and with vegetation in separate columns.
3. Slopes may not be averaged.
4. Minimum Freeboard is 0.5 ft. or ¼ Total Channel Depth, whichever is greater
5. Permissible velocity lining design method is not acceptable for channels with a bed slope of 10% or greater. Shear stress lining design method is required for channels with a bed slope of 10% or greater. Shear stress lining design method may be used for any channel bed slope.

**VEGETATED SWALE 1 - RIP RAP APRON DESIGN**

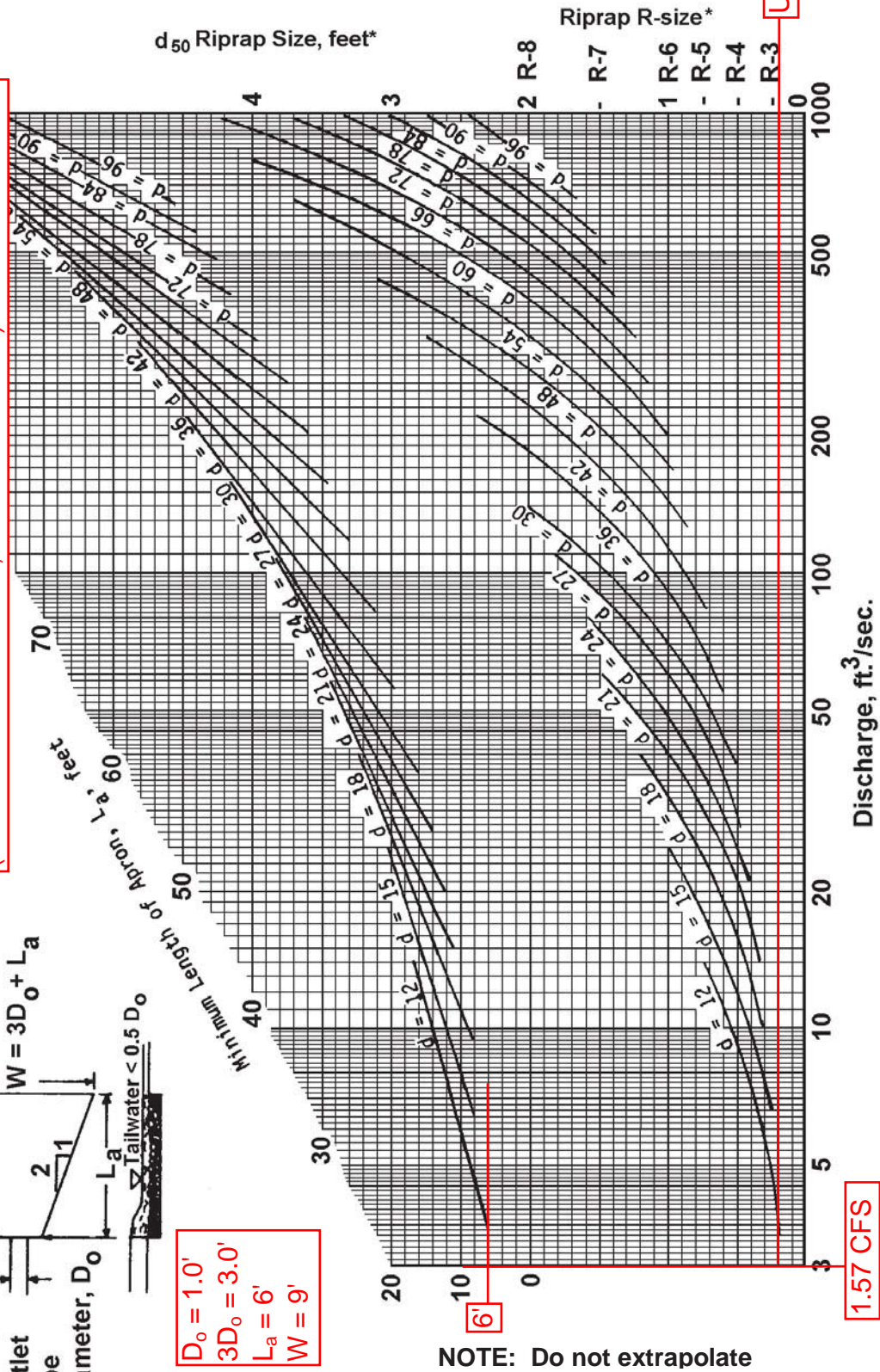
DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL  
MINIMUM TAILWATER CONDITION ( $T_w < 0.5$  DIAMETER)

MAX. ALLOWABLE VELOCITY FOR R-3 RIP RAP = **6.5 FPS**  
(E&S MANUAL, TABLE 6.6, ATTACHED HERETO IN APP. A.4)  
CALCULATED VELOCITY = **4.19 FPS**  
(VEGETATED SWALE 1, WORKSHEET 11)



$D_o = 1.0'$   
 $3D_o = 3.0'$   
 $L_a = 6'$   
 $W = 9'$

**FIGURE 9.3**  
**Riprap Apron Design, Minimum Tailwater Condition**



Use R-3

1.57 CFS

\* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d<sub>50</sub> stone size and/or provide velocity reduction device.

Not to be used for Box Culverts

# Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc.

Thursday, Oct 27 2016

## Culvert 1

Invert Elev Dn (ft) = 1131.80  
Pipe Length (ft) = 51.00  
Slope (%) = 0.51  
Invert Elev Up (ft) = 1132.06  
Rise (in) = 12.0  
Shape = Circular  
Span (in) = 12.0  
No. Barrels = 1  
n-Value = 0.012  
Culvert Type = Circular Concrete  
Culvert Entrance = Groove end projecting (C)  
Coeff. K,M,c,Y,k = 0.0045, 2, 0.0317, 0.69, 0.2

### Embankment

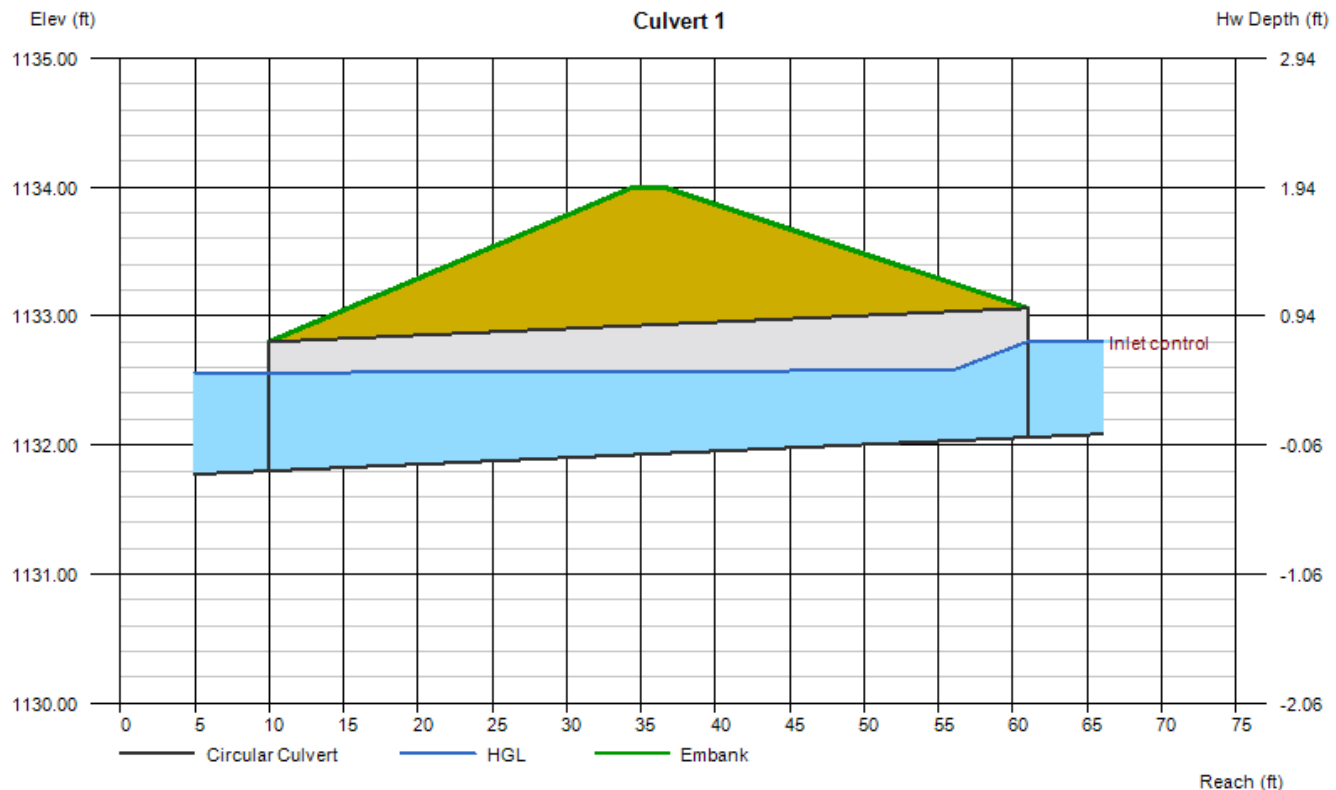
Top Elevation (ft) = 1134.00  
Top Width (ft) = 2.00  
Crest Width (ft) = 20.00

### Calculations

Qmin (cfs) = 1.51  
Qmax (cfs) = 6.00  
Tailwater Elev (ft) =  $(dc+D)/2$

### Highlighted

Qtotal (cfs) = 1.51  
Qpipe (cfs) = 1.51  
Qovertop (cfs) = 0.00  
Veloc Dn (ft/s) = 2.36  
Veloc Up (ft/s) = 3.63  
HGL Dn (ft) = 1132.56  
HGL Up (ft) = 1132.58  
Hw Elev (ft) = 1132.80  
Hw/D (ft) = 0.74  
Flow Regime = Inlet Control

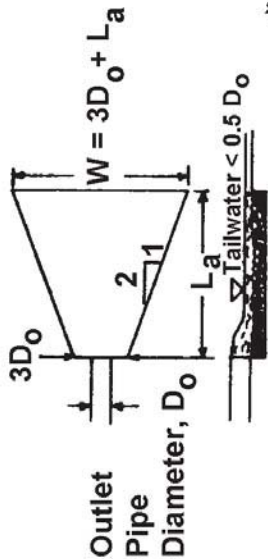




# CULVERT 1 - RIP RAP APRON DESIGN

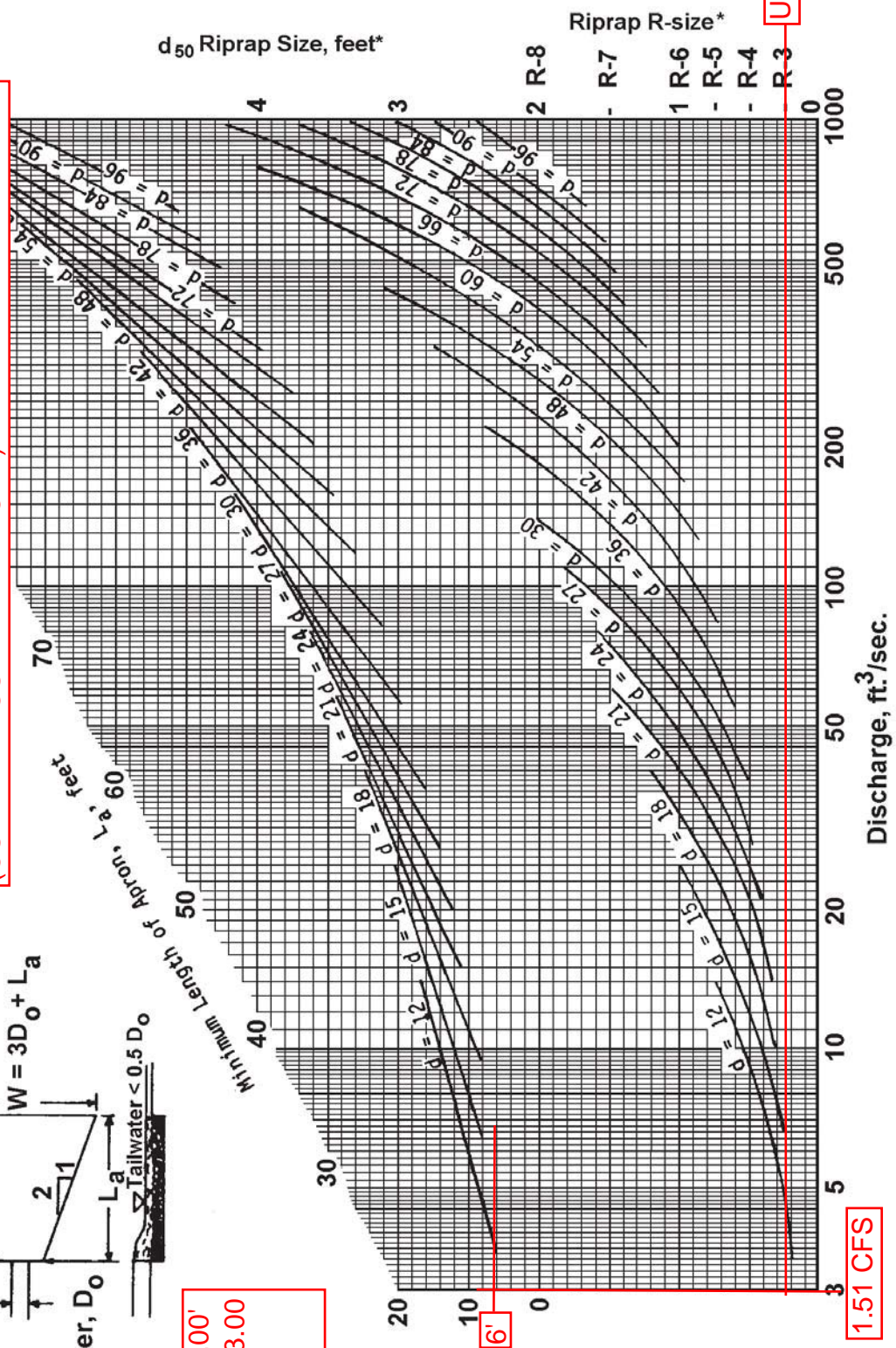
DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL  
MINIMUM TAILWATER CONDITION ( $T_w < 0.5$  DIAMETER)

MAX. ALLOWABLE VELOCITY FOR R-3 RIP RAP = **6.5 FPS**  
(E&S MANUAL, TABLE 6.6, ATTACHED HERETO IN APP. A.4)  
CALCULATED VELOCITY = **1.68 FPS**  
(CULVERT 1 CULVERT REPORT)



$D_o = 1.00'$   
 $3D_o = 3.00'$   
 $L_a = 6'$   
 $W = 9'$

FIGURE 9.3  
Riprap Apron Design, Minimum Tailwater Condition



NOTE: Do not extrapolate

\* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase  $d_{50}$  stone size and/or provide velocity reduction device.

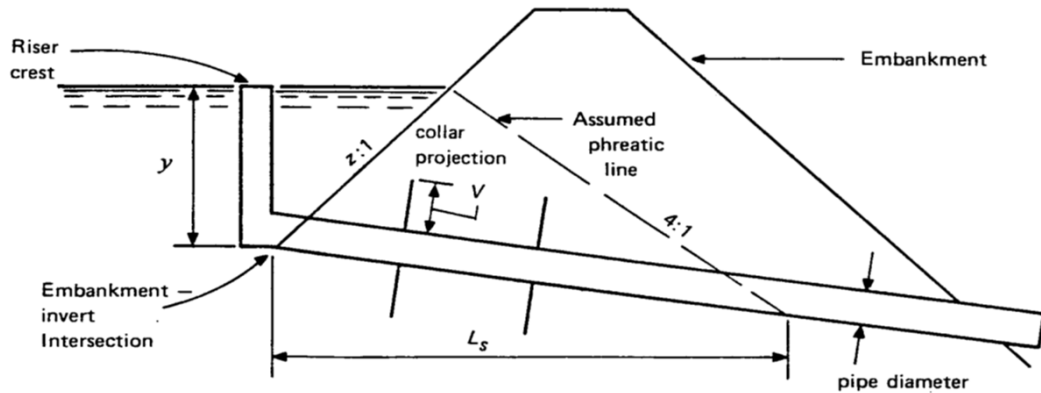
Not to be used for Box Culverts

## **A.4 PCSM BMP Calculations**





## Anti-seep Collar Design

[illegible]



## WEST DIAMOND REGULATOR STATION INFILTRATION BASIN OUTLET STRUCTURE FLOTATION CALCULATIONS

### Assumptions

24" X 48" concrete inlet box riser

Total area of 24" x 48" inlet box = 10 sf

6" concrete wall thickness

6" thick bottom

Density of water = 62.4 lb/cf

Density of concrete = 150 lb/cf

Area of concrete in a 2' X 4' inlet box with a 6" thick wall = 3.5 sf

Volume of concrete per vertical foot of inlet box = 1' X 3.5 sf = 3.5 cf.

Weight of concrete per vertical foot of inlet box = 3.5 cf X 150 lb/cf = 525 Lbs

Buoyant force from water per vertical foot of inlet box = 62.4lb/cf X 10 sf X 1 ft = 624 lb.

Volume of bottom of inlet = 10 sf X 0.5 ft = 5 cf

Weight of bottom of inlet = 150 lb/cf X 5 cf = 750 lb

Buoyant force on bottom of inlet = 62.4 lb/cf X 5 = 312 lb

West Diamond RS outlet structure height = 2.75 ft

Weight of outlet structure = 2.75 X 525 + 750 = 2,194 lb

Buoyant force = 312 + 624 X 2.75 = **2,028 lb**

Weight of outlet structure with 6 inches of concrete below invert:

$$2,194 + 10 \times 150 = 3,694 \text{ lb} \quad \text{OK}$$

**ATLANTIC SUNRISE PROJECT**  
**WEST DIAMOND REGULATOR STATION LEVEL SPREADER DESIGN**

9/19/2016

**LEVEL SPREADER DESIGN CALCULATIONS**

Required Perforated Pipe Length

$$Q = C * A * (2 * G * H)^{0.5} \quad (\text{Weir Equation})$$

where: Q = 100 year year storm, cfs  
C = weir coefficient (0.60)  
A = cross sectional area of orifice in sf  
G = acceleration of gravity, 32.2  
H = head from 100 year pond elevation to top of perforated pipe

Pipe perforation information taken from ADS Technical Note TN 1.02 for Single wall HDPE perforated patterns for 12" pipe with type C perforated pattern

100 year Q:	3.69	cfs
Head:	4.96	ft
Perforation Dia.:	0.313	in. per each hole
Perforation Area:	0.0005	sq. ft
Flow per Perforation:	0.005727	cfs
Holes required:	644.3	
Length of pipe:	33.03	lf (TN 1.02 lists a minimum inlet area of 1.5 sq. in./ft.)

**Summary:**

To pass the 100 year storm through the level spreader, 33 lf. 12" perforated HDPE pipe is needed.

**ATLANTIC SUNRISE PROJECT**  
**W. DIAMOND REGULATOR STATION VEGETATED SWALE STORAGE VOLUME**

10/27/2016

**TOTAL REACH VOLUME = 1616 CF**

Width ( $W_B$ ): 2 FT.

Depth (H): 1 FT.

**VEGETATED SWALE 1**

**Input data**

S = 0.138 ft/ft  
H = 1 ft  
 $W_B$  = 2  
 $z_1$  = 3  
 $z_2$  = 3

**Input data**

S = 0.065 ft/ft  
H = 1 ft  
 $W_B$  = 2  
 $z_1$  = 3  
 $z_2$  = 3

**Input data**

S = 0.200 ft/ft  
H = 1 ft  
 $W_B$  = 2  
 $z_1$  = 3  
 $z_2$  = 3

**Output data**

L = 7 ft  
 $W_T$  = 8 ft  
 $W_T + W_B$  = 10 ft  
V = 18 cf  
No. of **check dams** = 39  
Subreach Volume = 709 CF

**Output data**

L = 15 ft  
 $W_T$  = 8 ft  
 $W_T + W_B$  = 10 ft  
V = 38 cf  
No. of **check dams** = 20  
Subreach Volume = 769 CF

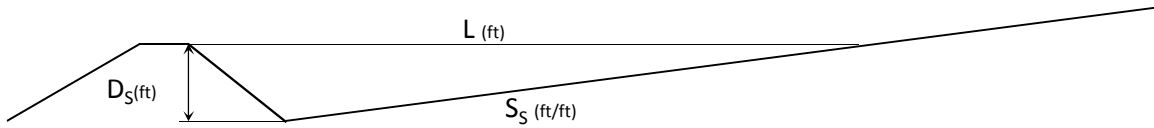
**Output data**

L = 5 ft  
 $W_T$  = 8 ft  
 $W_T + W_B$  = 10 ft  
V = 13 cf  
No. of **check dams** = 11  
Subreach Volume = 138 CF

# ATLANTIC SUNRISE PIPELINE PROJECT

## W. DIAMOND REGULATOR STATION VEGETATED SWALE INFILTRATION VOLUME ROCK FILTER VOLUME AND SPACING

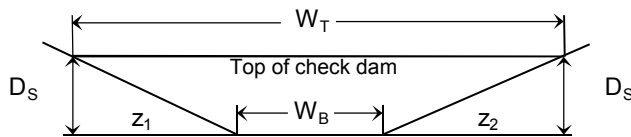
Per the Pennsylvania Stormwater BMP Manual (pg 94), the minimum spacing of check dam is determined by the length of the storage volume (L). The length of the storage volume is calculated by dividing the height of the check dam ( $D_S$ ) by the slope of the channel ( $S_S$ ):



$$L = D_S / S_S$$

Where:  $L$  = Storage Length  
 $S_S$  = Channel slope  
 $D_S$  = Height of the check dam

The volume of runoff that will be stored upstream of a check dam is dependent on the height of the check dam, the slope of the upstream channel and the dimensions of the upstream channel. The storage volume ( $V_S$ ) can be calculated with:



$$V_S = 0.25 \times L \times D_S \times (W_T + W_B)$$

Where:  $L$  = Storage Length  
 $D_S$  = Height of check dam  
 $W_T$  = check dam top width  
 $W_B$  = check dam bottom width

The check dam top width ( $W_T$ ) is given by:

$$W_T = W_B + z_1 + z_2$$

Where:  $W_B$  = check dam bottom width  
 $z_1$  = side slope  
 $z_2$  = side slope

**ATLANTIC SUNRISE PROJECT  
WEST DIAMOND REGULATOR STATION RAIN GARDEN 1 VOLUME**

9/17/2016

**BASIN 1**

<b>Elevation</b>	<b>Surface Area (S.F.)</b>	<b>Inc. Storage (C.F.)</b>	<b>Cumulative Storage (C.F.)</b>
1200	16221	0	0
1202	21260	37481	37481

**ATLANTIC SUNRISE PROJECT  
WEST DIAMOND REGULATOR STATION RAIN GARDEN VOLUME CREDIT**

10/3/2016

**RAIN GARDEN 1**

1) Surface Volume (cf) = Bed Area (sf) x Average Depth

$$16,211 \times 0.75 = \mathbf{12,165 \text{ cf}}$$

2a) Infiltration Volume = Bed Bottom Area (sf) x infiltration design rate (in/hr) x infiltration period x 1/12

$$16,211 \times 0 \times 24\text{hr} \times 1/12 = \mathbf{0 \text{ cf}}$$

2b) Volume = Bed Bottom Area (sf) x soil mix bed depth x void space

$$16,221 \times 1 \times 0.2 = \mathbf{3,214 \text{ CF}}$$

**Volume Reduction = sum of 1 and the smaller of 2a or 2b**

$$12,165 + 0 = \mathbf{12,165 \text{ cf}}$$

**Amended Soil Volume Credit**

Amended Area (sf) x 0.50in x 1/12 = Volume (cf)

$$\text{POI A: } 5,607 \times 0.50 \times 1/12 = \mathbf{233.63 \text{ cf}}$$

$$\text{POI B: } 19,492 \times 0.50 \times 1/12 = \mathbf{812.17 \text{ cf}}$$



### Criteria and Credits for BMP 5.6.1 Minimize Total Disturbed Area - Grading

To receive credit, areas of Minimized Disturbance/Grading must meet the following criteria:

- ☒ Area shall not be subject to grading or movement of existing soils.
- ☒ Existing native vegetation in a healthy condition may not be removed.
- ☐ Invasive non-native vegetation may be removed. N/A
- ☐ Pruning or other required maintenance of vegetation is permitted. Additional planting is permitted. N/A
- ☒ Area shall be protected by having the limits of disturbance clearly shown on all construction drawings and delineated in the field.
- ☒ The area not subject to grading shall be clearly delineated on the Stormwater Management Plan. If future grading or disturbance of this area occurs, subsequent stormwater management must be provided to address disturbance.
- ☒ Shall be located on the development project.

### CREDITS

#### Volume and Quality

Protected Area is not to be included in Runoff Volume calculation or Water Quality volume

Mitigation Area = (Total Area – Protected Area)

#### Peak Rate and Channel Protection

Runoff from the Protected Area (area not subject to grading) may be excluded from Peak Rate calculations and Channel Protection calculations for rate control, provided that the runoff from the protected area is not conveyed to and/or through stormwater management control structures. If necessary, runoff from Protected Areas should be directed around BMPs and stormwater pipes and inlets by means of vegetated swales or low berms that direct flow to natural drainage ways.

## Criteria and Credits for BMP 5.8.2 Disconnection from Storm Sewers

To receive credit, the following must be met:

- ☒ Runoff from the non-rooftop impervious cover shall be directed to pervious areas where it is infiltrated into the soil.
- ☒ May include Vegetated Swales as outlined in BMP 6.8.
- ☒ May include check dams, low berms, native vegetation, and limited grading to improve natural drainage features.
- ☒ Shall be designed such that flows after development are non-erosive.
- ☐ Shall be protected from compaction or unintended disturbance during construction by having the limits of disturbance clearly shown on all construction drawings and delineated in the field.
- ☐ Shall be noted on stormwater management plans as part of stormwater management system and included in any municipal easement requirements for stormwater systems.
- ☒ Shall be located on the development project.
- ☒ Runoff cannot originate from a designated hotspot.
- ☒ The maximum contributing impervious flow path length shall be 75 feet.
- ☒ The disconnection shall drain continuously through a vegetated swale or filter strip, or planted area to the property line or BMP.
- ☐ The length of the disconnection area must be at the least the length of the contributing area.
- ☐ The entire vegetated "disconnection" area shall have a maximum slope of 5%.
- ☒ The contributing impervious area to any one discharge point shall not exceed 1000 ft<sup>2</sup>.
- ☐ Disconnections are encouraged on relatively well-draining soils (HSG A & B).
- ☐ If the site cannot meet the required disconnect length, a level-spreading device, recharge garden, infiltration trench, or other storage device may be needed for compensation.

### CREDITS

#### Volume and Quality

Volume Reduction (ft<sup>3</sup>) = Contributing Impervious Area (ft<sup>2</sup>) x 1/4" / 12

*Note: A greater volume credit may be requested by the applicant if calculations support a greater numerical value to Minimizing Soil Compaction.*

#### Peak Rate and Channel Protection

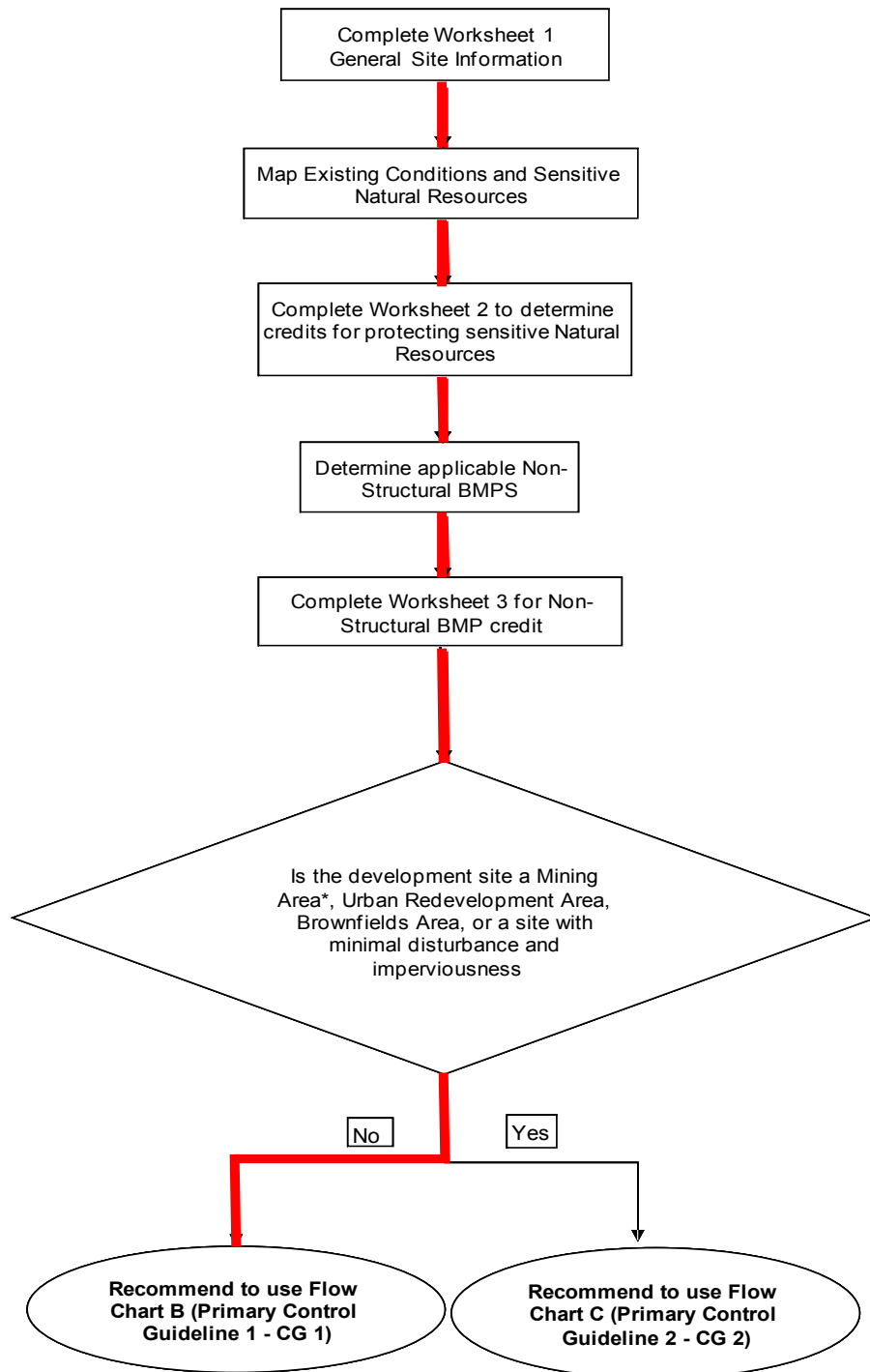
The Peak Rate for flood protection and channel protection will be reduced by the reduction in runoff volume provided above.

## **A.5 Water Quality Worksheets**



# FLOW CHART A

## Stormwater Calculation Process





## Worksheet 1. General Site Information

INSTRUCTIONS: Fill out Worksheet 1 for each watershed

Date: 13-Aug-15

Project Name: Atlantic Sunrise Project - West Diamond Regulator Station

Municipality: Jackson/Sugarloaf Township

County: Columbia County

Total Area (acres): 7.14 (POI A = 4.30; POI B = 2.84)

Major River Basin: Susquehanna River

<http://www.dep.state.pa.us/dep/depupdate/watermgt/wc/default.htm#newtopics>

Watershed: West Creek

Sub-Basin: UNT to West Creek; UNT to West Creek

Nearest Surface Water(s) to Receive Runoff: UNT; UNT

Chapter 93 - Designated Water Use: CWF; CWF

<http://www.pacode.com/secure/data/025/chapter93/chap93toc.html>

Impaired according to Chapter 303(d) List? Yes ☐

<http://www.dep.state.pa.us/dep/deputate/watermgt/wqp/wqstandards/303d-Report.htm> No ☒

List Causes of Impairment:

*Is project subject to, or part of:*

Municipal Separate Storm Sewer System (MS4) Requirements? Yes ☐

<http://www.dep.state.pa.us/dep/deputate/watermgt/wc/Subjects/StormwaterManagement/GeneralPermits/default.htm> No ☒

Existing or planned drinking water supply? Yes ☐

No ☒

If yes, distance from proposed discharge (miles):

Approved Act 167 Plan? Yes ☒

[http://www.dep.state.pa.us/dep/deputate/watermgt/wc/Subjects/StormwaterManagement/Approved\\_1.html](http://www.dep.state.pa.us/dep/deputate/watermgt/wc/Subjects/StormwaterManagement/Approved_1.html) No ☐

Existing River Conservation Plan? Yes ☐

<http://www.dcnr.state.pa.us/brc/rivers/riversconservation/planningprojects/> No ☒

## Worksheet 2. Sensitive Natural Resources

### INSTRUCTIONS:

1. Provide Sensitive Resources Map according to non-structural BMP 5.4.1 in Chapter 5. This map should identify wetlands, woodlands, natural drainage ways, steep slopes, and other sensitive natural areas.

2. Summarize the existing extent of each sensitive resource in the Existing Sensitive Resources Table (below, using Acres). If none present, insert 0.

3. Summarize Total Protected Area as defined under BMPs in Chapter 5.

4. Do not count any area twice. For example, an area that is both a floodplain and a wetland may only be considered once.

EXISTING NATURAL SENSITIVE RESOURCE	MAPPED? yes/no/n/a	TOTAL AREA (Ac.)	PROTECTED AREA (Ac.)
Waterbodies	N/A	0.00	0.00
Floodplains	N/A	0.00	0.00
Riparian Areas	N/A	0.00	0.00
Wetlands	N/A	0.00	0.00
Woodlands	N/A	3.35	0.00
Natural Drainage Ways	N/A	0.00	0.00
Steep Slopes, 15% - 25%	N/A	0.00	0.00
Steep Slopes, over 25%	N/A	0.00	0.00
Other:			
Other:			
<b>TOTAL EXISTING:</b>		3.35	0.00



### Worksheet 3. Nonstructural BMP Credits

**POI A**

#### PROTECTED AREA

1.1 Area of Protected Sensitive/Special Value Features (see WS 2) - Ac.

1.2 Area of Riparian Forest Buffer Protection - Ac.

3.1 Area of Minimum Disturbance/Reduced Grading - Ac.

TOTAL - Ac.

Site Area	minus	Protected Area	=	Stormwater Management Area
4.30	-	-	=	4.30
<i>This is the area that requires stormwater management</i>				

#### VOLUME CREDITS

##### 3.1 Minimum Soil Compaction

Lawn  ft<sup>2</sup> x 1/4" x 1/12 =  - ft<sup>3</sup>

Meadow  ft<sup>2</sup> x 1/3" x 1/12 =  - ft<sup>3</sup>

##### 3.3 Protect Existing Trees

*For Trees within 100 feet of impervious area: DISCONNECTED NON-ROOF*

Tree Canopy  ft<sup>2</sup> x 1/2" x 1/12 =  - ft<sup>3</sup>

*For Trees within 20 feet of impervious area:*

Tree Canopy  x 1/12 =  - ft<sup>3</sup>

##### 5.1 Disconnect Roof Leaders to Vegetated Areas

*For Runoff directed to areas protected under 5.8.1 and 5.8.2*

Roof Area  ft<sup>2</sup> x 1/12 =  - ft<sup>3</sup>

*For all other disconnected roof areas*

Roof Area  ft<sup>2</sup> x 1/4" x 1/12 =  - ft<sup>3</sup>

##### 5.2 Disconnect Non-Roof impervious to Vegetated Areas

*For Runoff directed to areas protected under 5.8.1 and 5.8.2*

Impervious Area  ft<sup>2</sup> x 1/3" x 1/12 =  - ft<sup>3</sup>

*For all other disconnected roof areas*

Impervious Area  ft<sup>2</sup> x 1/4" x 1/12 =  - ft<sup>3</sup>

**TOTAL NON-STRUCTURAL VOLUME CREDIT\***  - ft<sup>3</sup>

\* For use on Worksheet 5

### Worksheet 3. Nonstructural BMP Credits

*POI B*

#### PROTECTED AREA

1.1 Area of Protected Sensitive/Special Value Features (see WS 2) - Ac.

1.2 Area of Riparian Forest Buffer Protection - Ac.

3.1 Area of Minimum Disturbance/Reduced Grading - Ac.

TOTAL - Ac.

Site Area	minus	Protected Area	=	Stormwater Management Area
2.84	-	-	=	2.84
<i>This is the area that requires stormwater management</i>				

#### VOLUME CREDITS

##### 3.1 Minimum Soil Compaction

Lawn   ft<sup>2</sup> x 1/4" x 1/12 =  - ft<sup>3</sup>

Meadow   ft<sup>2</sup> x 1/3" x 1/12 =  - ft<sup>3</sup>

##### 3.3 Protect Existing Trees

*For Trees within 100 feet of impervious area:*

Tree Canopy   ft<sup>2</sup> x 1/2" x 1/12 =  - ft<sup>3</sup>

*For Trees within 20 feet of impervious area:*

Tree Canopy   x 1/12 =  - ft<sup>3</sup>

##### 5.1 Disconnect Roof Leaders to Vegetated Areas

*For Runoff directed to areas protected under 5.8.1 and 5.8.2*

Roof Area   ft<sup>2</sup> x 1/12 =  - ft<sup>3</sup>

*For all other disconnected roof areas*

Roof Area   ft<sup>2</sup> x 1/4" x 1/12 =  - ft<sup>3</sup>

##### 5.2 Disconnect Non-Roof impervious to Vegetated Areas

*For Runoff directed to areas protected under 5.8.1 and 5.8.2*

Impervious Area 9,887 ft<sup>2</sup> x 1/3" x 1/12 =  **275** ft<sup>3</sup>

*For all other disconnected roof areas*

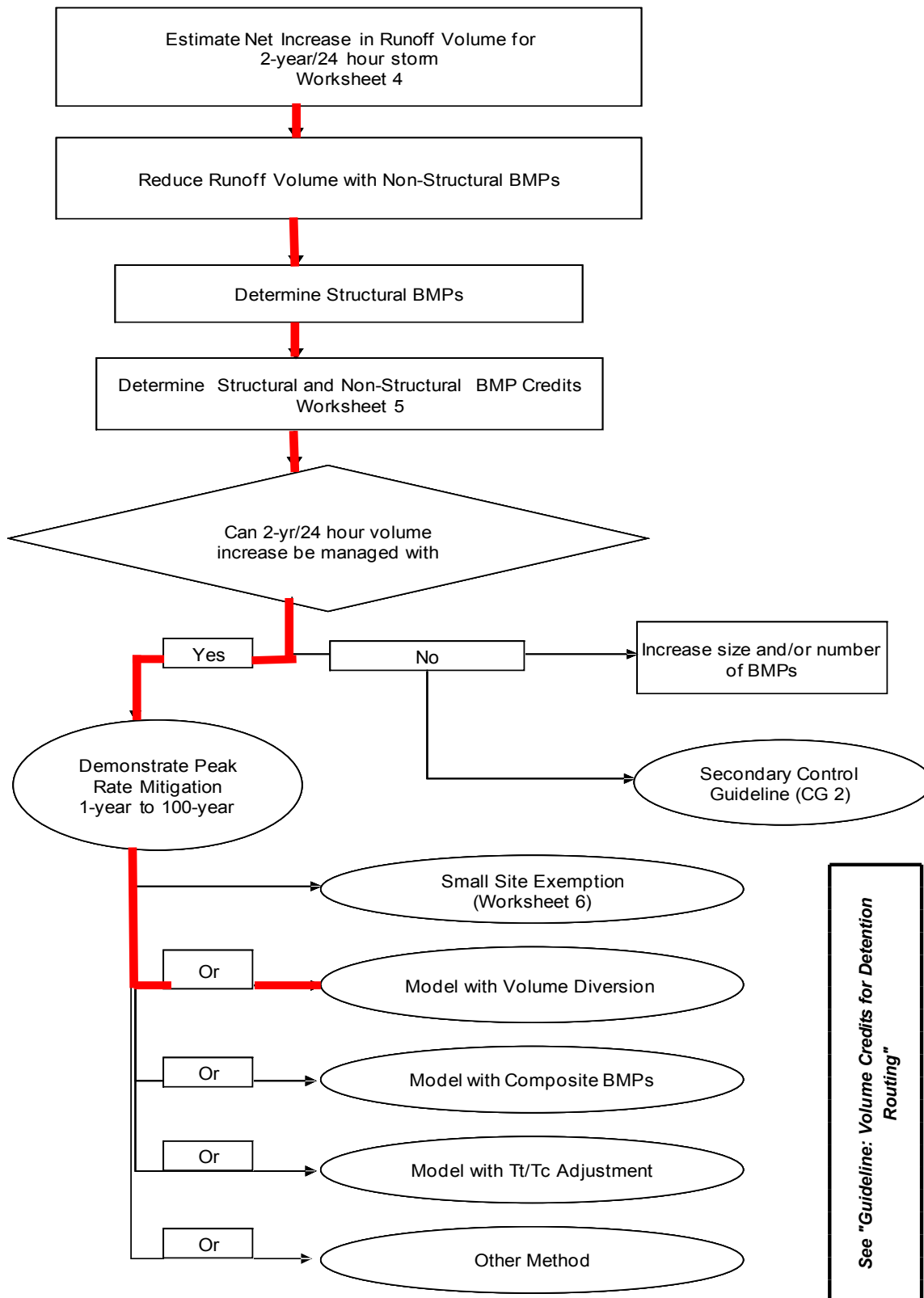
Impervious Area   ft<sup>2</sup> x 1/4" x 1/12 =  - ft<sup>3</sup>

**TOTAL NON-STRUCTURAL VOLUME CREDIT\*** 275 ft<sup>3</sup>

\* For use on Worksheet 5

## FLOW CHART B

### Control Guideline 1 Process



# **WORKSHEET 4 . CHANGE IN RUNOFF VOLUME FOR 2-YR STORM EVENT**

**PROJECT:** Atlantic Sunrise Project - West Diamond Regulator Station

**DA:** POI A

**2-Year Rainfall:** 2.98 in

**Total Site Area:** 4.30 acres

**Protected Site Area:**            acres

**Managed Area** 4.30 acres

## **Existing Conditions:**

Cover Type/ Condition	Soil Type	Area (sf)	Area (ac)	CN	S	Ia (0.2*S)	Q Runoff <sup>1</sup> (in)	Runoff Volume <sup>2</sup> (ft³)
Meadow	C	54,792.00	1.26	71	4.08	0.82	0.75	3,420
Woods	C	132,723.00	3.05	70	4.29	0.86	0.70	7,778
Dirt Road	C	-	0.00	87	1.49	0.30	1.72	-
<b>TOTAL:</b>		<b>187,515.00</b>	<b>4.30</b>					<b>11,197</b>

## **Developed Conditions:**

Cover Type/ Condition	Soil Type	Area (sf)	Area (ac)	CN	S	Ia (0.2*S)	Q Runoff <sup>1</sup> (in)	Runoff Volume <sup>2</sup> (ft³)
Meadow	C	130,400.00	2.99	71	4.08	0.82	0.75	8,138
Woods	C	-	0.00	70	4.29	0.86	0.70	-
Gravel Road	C	56,554.00	1.30	89	1.24	0.25	1.88	8,868
Impervious	C	561.00	0.01	98	0.20	0.04	2.75	128
<b>TOTAL:</b>		<b>187,515.00</b>	<b>4.30</b>					<b>17,135</b>

**2-Year Volume Increase (ft³)** 5,938

**2-Year Volume Increase = Developed Conditions Runoff Volume - Existing Conditions Runoff Volume**

1. Runoff (in) =  $Q = (P - 0.2S)^2 / (P + 0.8S)$  where

P = 2-Year Rainfall (in)

S =  $(1000 / CN) - 10$

2. Runoff Volume (CF) =  $Q \times \text{Area} \times 1/12$

Q = Runoff (in)

Area = Land use area (sq. ft.)

**Note: Runoff Volume must be calculated for EACH land use type/condition and HSGI.  
The use of a weighted CN value for volume calculations is not acceptable.**

# **WORKSHEET 4 . CHANGE IN RUNOFF VOLUME FOR 2-YR STORM EVENT**

**PROJECT:** Atlantic Sunrise Project - West Diamond Regulator Station  
**DA:** POI B  
**2-Year Rainfall:** 2.98 in

**Total Site Area:** 2.84 acres  
**Protected Site Area:**            acres  
**Managed Area** 2.84 acres

## **Existing Conditions:**

Cover Type/ Condition	Soil Type	Area (sf)	Area (ac)	CN	S	Ia (0.2*S)	Q Runoff <sup>1</sup> (in)	Runoff Volume <sup>2</sup> (ft <sup>3</sup> )
Meadow	C	81,396.00	1.87	71	4.08	0.82	0.75	5,080
Woods	C	<b>42,109.00</b>	<b>0.97</b>	70	4.29	0.86	0.70	2,468
Dirt Road	C	-	0.00	87	1.49	0.30	1.72	-
<b>TOTAL:</b>		<b>123,505.00</b>	<b>2.84</b>					<b>7,548</b>

## **Developed Conditions:**

Cover Type/ Condition	Soil Type	Area (sf)	Area (ac)	CN	S	Ia (0.2*S)	Q Runoff <sup>1</sup> (in)	Runoff Volume <sup>2</sup> (ft <sup>3</sup> )
Meadow	C	<b>93,284.00</b>	<b>2.14</b>	71	4.08	0.82	0.75	5,822
Woods	C	20,334.00	0.47	70	4.29	0.86	0.70	1,192
Gravel Road	C	9,887.00	0.23	89	1.24	0.25	1.88	1,550
<b>TOTAL:</b>		<b>123,505.00</b>	<b>2.84</b>					<b>8,564</b>

**2-Year Volume Increase (ft<sup>3</sup>)** 1,016

**2-Year Volume Increase = Developed Conditions Runoff Volume - Existing Conditions Runoff Volume**

1. Runoff (in) = Q = (P - 0.2S)<sup>2</sup> / (P+ 0.8S) where

P = 2-Year Rainfall (in)

S = (1000/ CN)-10

2. Runoff Volume (CF) = Q x Area x 1/12

Q = Runoff (in)

Area = Land use area (sq. ft.)

**Note: Runoff Volume must be calculated for EACH land use type/condition and HSGI.  
The use of a weighted CN value for volume calculations is not acceptable.**

## WORKSHEET 5. STRUCTURAL BMP VOLUME CREDITS

**POI A**

**PROJECT:** Atlantic Sunrise Project - West Diamond Regulator Station

**SUB-BASIN:**

Required Control Volume (ft<sup>3</sup>) - from Worksheet 4:

5,938

Non-structural Volume Credit (ft<sup>3</sup>) - from Worksheet 3:

- 0

Structural Volume Reqmt (ft<sup>3</sup>)

5,938

(Required Control Volume minus Non-structural Credit)

Proposed BMP	Area (ft <sup>2</sup> )	Volume Reduction Permanently Removed (ft <sup>3</sup> )
6.4.1 Porous Pavement		
6.4.2 Infiltration Basin		
6.4.3 Infiltration Bed		
6.4.4 Infiltration Trench		
6.4.5 Rain Garden/Bioretenion	16,221	12,165
6.4.6 Dry Well / Seepage Pit		
6.4.7 Constructed Filter		
6.4.8 Vegetated Swale		
6.4.9 Vegetated Filter Strip		
6.4.10 Berm		
6.5.1 Vegetated Roof		
6.5.2 Capture and Re-use		
6.6.1 Constructed Wetlands		
6.6.2 Wet Pond / Retention Basin		
6.7.1 Riparian Buffer/Riparian Forest Buffer Restoration		
6.7.2 Landscape Restoration / Reforestation		
6.7.3 Soil Amendment	5,607	234
6.8.1 Level Spreader		
6.8.2 Special Storage Areas		
Other Check Dams in Vegetated Swales		

Total Structural Volume (ft<sup>3</sup>): 12,399

Structural Volume Requirement (ft<sup>3</sup>): 5,938

DIFFERENCE 6,461

## WORKSHEET 5. STRUCTURAL BMP VOLUME CREDITS

**POI B**

**PROJECT:** Atlantic Sunrise Project - West Diamond Regulator Station

**SUB-BASIN:**

Required Control Volume (ft <sup>3</sup> ) - from Worksheet 4:	-	1,016
Non-structural Volume Credit (ft <sup>3</sup> ) - from Worksheet 3:	-	254
Structural Volume Reqmt (ft <sup>3</sup> )		762
(Required Control Volume minus Non-structural Credit)		

Proposed BMP	Area (ft <sup>2</sup> )	Volume Reduction Permanently Removed (ft <sup>3</sup> )
6.4.1 Porous Pavement		
6.4.2 Infiltration Basin		
6.4.3 Infiltration Bed		
6.4.4 Infiltration Trench		
6.4.5 Rain Garden/Bioretenention		
6.4.6 Dry Well / Seepage Pit		
6.4.7 Constructed Filter		
6.4.8 Vegetated Swale		
6.4.9 Vegetated Filter Strip		
6.4.10 Berm		
6.5.1 Vegetated Roof		
6.5.2 Capture and Re-use		
6.6.1 Constructed Wetlands		
6.6.2 Wet Pond / Retention Basin		
6.7.1 Riparian Buffer/Riparian Forest Buffer Restoration		
6.7.2 Landscape Restoration / Reforestation		
6.7.3 Soil Amendment	19,492	812
6.8.1 Level Spreader		
6.8.2 Special Storage Areas		
Other Check Dams in Vegetated Swales		

Total Structural Volume (ft <sup>3</sup> ):	-	812
Structural Volume Requirement (ft <sup>3</sup> ):	-	762
DIFFERENCE	-	50

## WORKSHEET 10. WATER QUALITY COMPLIANCE FOR NITRATE

Does the site design incorporate the following BMPs to address nitrate pollution? A summary "yes" rating is achieved if at least 2 Primary BMPs for nitrate are provided across the site or 4 secondary BMPs for nitrate are provided across the site (or the

POI A

### PRIMARY BMPs FOR NITRATE:

	YES	NO
NS BMP 5.4.2 - Protect / Conserve / Enhance Riparian Buffers	<input type="checkbox"/>	<input type="checkbox"/>
NS BMP 5.5.4 - Cluster Uses at Each Site	<input type="checkbox"/>	<input type="checkbox"/>
NS BMP 5.6.1 - Minimize Total Disturbed Area	<input checked="" type="checkbox"/>	<input type="checkbox"/>
NS BMP 5.6.3 - Re-Vegetate / Re-Forest Disturbed Areas (Native	<input type="checkbox"/>	<input type="checkbox"/>
NS BMP 5.9.1 - Street Sweeping / Vacuuming	<input type="checkbox"/>	<input type="checkbox"/>
Structural BMP 6.7.1 - Riparian Buffer Restoration	<input type="checkbox"/>	<input type="checkbox"/>
Structural BMP 6.7.2 - Landscape Restoration	<input type="checkbox"/>	<input type="checkbox"/>

### SECONDARY BMPs FOR NITRATE:

NS BMP 5.4.1 - Protect Sensitive / Special Value Features	<input type="checkbox"/>	<input type="checkbox"/>
NS BMP 5.4.3 - Protect / Utilize Natural Drainage Features	<input type="checkbox"/>	<input type="checkbox"/>
NS BMP 5.6.2 - Minimize Soil Compaction	<input type="checkbox"/>	<input type="checkbox"/>
Structural BMP 6.4.5 - Rain Garden / Bioretention	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Structural BMP 6.4.8 - Vegetated Swale	<input type="checkbox"/>	<input type="checkbox"/>
Structural BMP 6.4.9 - Vegetated Filter Strip	<input type="checkbox"/>	<input type="checkbox"/>
Structural BMP 6.6.1 - Constructed Wetland	<input type="checkbox"/>	<input type="checkbox"/>
Structural BMP 6.7.1 - Riparian Buffer Restoration	<input type="checkbox"/>	<input type="checkbox"/>
Structural BMP 6.7.2 - Landscape Restoration	<input type="checkbox"/>	<input type="checkbox"/>
Structural BMP 6.7.3 - Soils Amendment/Restoration	<input checked="" type="checkbox"/>	<input type="checkbox"/>



## WORKSHEET 10. WATER QUALITY COMPLIANCE FOR NITRATE

Does the site design incorporate the following BMPs to address nitrate pollution? A summary "yes" rating is achieved if at least 2 Primary BMPs for nitrate are provided across the site or 4 secondary BMPs for nitrate are provided across the site (or the

POI B

### PRIMARY BMPs FOR NITRATE:

	YES	NO
NS BMP 5.4.2 - Protect / Conserve / Enhance Riparian Buffers	<input type="checkbox"/>	<input type="checkbox"/>
NS BMP 5.5.4 - Cluster Uses at Each Site	<input type="checkbox"/>	<input type="checkbox"/>
NS BMP 5.6.1 - Minimize Total Disturbed Area	<input checked="" type="checkbox"/>	<input type="checkbox"/>
NS BMP 5.6.3 - Re-Vegetate / Re-Forest Disturbed Areas (Native	<input type="checkbox"/>	<input type="checkbox"/>
NS BMP 5.9.1 - Street Sweeping / Vacuuming	<input type="checkbox"/>	<input type="checkbox"/>
Structural BMP 6.7.1 - Riparian Buffer Restoration	<input type="checkbox"/>	<input type="checkbox"/>
Structural BMP 6.7.2 - Landscape Restoration	<input type="checkbox"/>	<input type="checkbox"/>

### SECONDARY BMPs FOR NITRATE:

NS BMP 5.4.1 - Protect Sensitive / Special Value Features	<input type="checkbox"/>	<input type="checkbox"/>
NS BMP 5.4.3 - Protect / Utilize Natural Drainage Features	<input type="checkbox"/>	<input type="checkbox"/>
NS BMP 5.6.2 - Minimize Soil Compaction	<input type="checkbox"/>	<input type="checkbox"/>
Structural BMP 6.4.5 - Rain Garden / Bioretention	<input type="checkbox"/>	<input type="checkbox"/>
Structural BMP 6.4.8 - Vegetated Swale	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Structural BMP 6.4.9 - Vegetated Filter Strip	<input type="checkbox"/>	<input type="checkbox"/>
Structural BMP 6.6.1 - Constructed Wetland	<input type="checkbox"/>	<input type="checkbox"/>
Structural BMP 6.7.1 - Riparian Buffer Restoration	<input type="checkbox"/>	<input type="checkbox"/>
Structural BMP 6.7.2 - Landscape Restoration	<input type="checkbox"/>	<input type="checkbox"/>
Structural BMP 6.7.3 - Soils Amendment/Restoration	<input checked="" type="checkbox"/>	<input type="checkbox"/>



## **A.6 Site Characterization Assessment**





# Field Observation Report

Project Number: 14C4909

Project Name: Atlantic Sunrise Project – West Diamond Regulator Station

Date of Field Visit: March 11, 2015

Weather Conditions: Sunny Temperature: Approximately 40-52°F

Prepared By: Krystal Bealing, APSS and Joseph Kempf

Copies of Report Have Been Sent To: ☒ Client ☐ Contractor ☐ Other

Client:

Transcontinental Gas Pipe Line  
Company, LLC  
2800 Post Oak Blvd  
Houston, TX 77251

Contractor:

BL Companies  
4242 Carlisle Pike, Suite 260  
Camp Hill, PA 17011

Six soil pits were excavated by backhoe and described to varying depths. Additionally, infiltration tests using the double ring infiltrometer method were conducted at each pit location, at depths ranging from the surface to 22 inches.

The test pit location map, soil profile descriptions, infiltration worksheet and photographs are attached. Determined limiting layer depths are listed below:

Pit #1: 17 inches deep, Limiting Layer observed at 17 inches  
Infiltration conducted at the surface, Infiltration Rate = 3.321 inches/hour

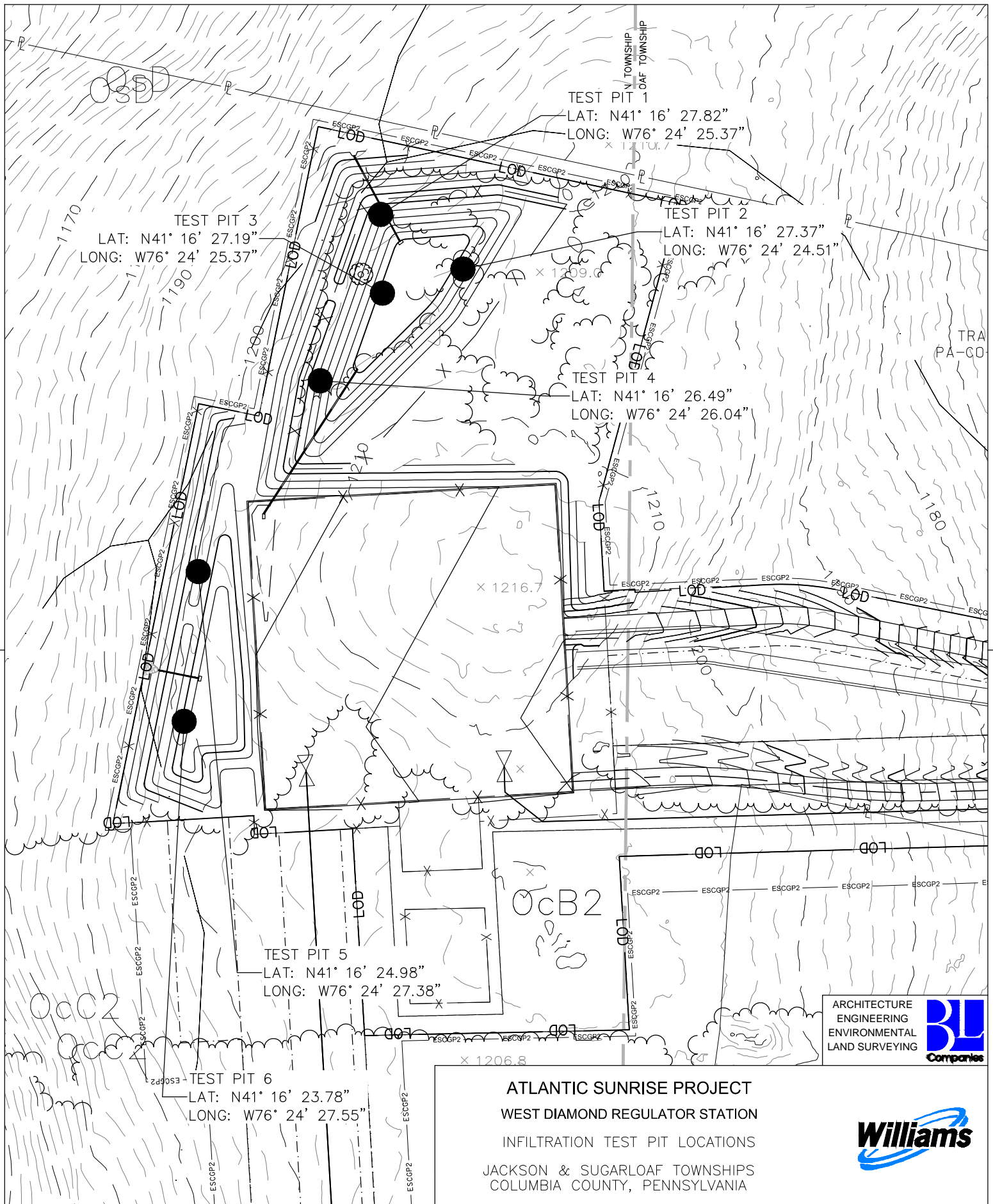
Pit #2: 12 inches deep, Limiting Layer observed at 12 inches  
Infiltration conducted at the surface, Infiltration Rate = 0.094 inches/hour

Pit #3: 59 inches deep, Limiting Layer observed at 22 inches  
Infiltration conducted at 22 inches, Infiltration Rate = 1.000 inches/hour

Pit #4: 43 inches deep, Limiting Layer observed at 18 inches  
Infiltration conducted at 18 inches, Infiltration Rate = 1.250 inches/hour

Pit #5: 40 inches deep, Limiting Layer observed at 40 inches  
Infiltration conducted at 16 inches, Infiltration Rate = 2.250 inches/hour

Pit #6: 17 inches deep, Limiting Layer observed at 17 inches  
Infiltration conducted at the surface, Infiltration Rate = 0.000 inches/hour



ARCHITECTURE  
ENGINEERING  
ENVIRONMENTAL  
LAND SURVEYING



**ATLANTIC SUNRISE PROJECT**  
**WEST DIAMOND REGULATOR STATION**  
 INFILTRATION TEST PIT LOCATIONS  
 JACKSON & SUGARLOAF TOWNSHIPS  
 COLUMBIA COUNTY, PENNSYLVANIA

NO.	DATE	BY	REVISION DESCRIPTION	W.O. NO.	CHK.	APP.	DRAWN BY:	AOE	DATE:	3/27/15	ISSUED FOR BID:	SCALE: 1"=100'
							CHECKED BY:	AJB	DATE:	3/27/15	ISSUED FOR CONSTRUCTION:	
							APPROVED BY:	AJB	DATE:	3/27/15	DRAWING NUMBER:	WEST DIAMOND RS TEST PITS
							WO:				SHEET 1 OF 1	

# Soil Profile Log

<b>Project</b>	14C4909-A Atlantic Sunrise Project -West Diamond Regulator Station	<b>Elevation</b>	1201 AMSL
<b>Test Pit #</b>	1	<b>Soil Type</b>	Oquaga channery silt loam, 3-12% slopes
<b>Name</b>	Krystal Beaing, APSS	<b>Geology</b>	Catskill Formation
<b>Date</b>	March 11, 2015	<b>Landscape Position/Slope</b>	Summit, 2-5%
<b>Weather</b>	40-52°F; Sunny	<b>Land Use</b>	Wooded
<b>Equipment</b>	Mini Excavator	<b>Additional Comments</b>	Approximately 12" snow

Horizon	Upper Boundary (inches)	Lower Boundary (inches)	Soil Textural Class	Type, Size, Coarse Fragments, etc.	Soil Matrix Color	Color Patterns	Pores, Roots, Structure	Depth to Bedrock	Depth to Water	Comments
A	0	9	SiL	15-35% Channery	5YR 3/3	-	Weak, Granular	-	-	-
Bw	9	17	SiL	35-60% Channery	5YR 4/3	-	Weak, Subangular Blocky	17	-	Limiting Layer - Bedrock

Note: Unless stated otherwise, horizon strike and dip was not observed to have a significant impact on water flow within the profile.

Soil Profile Log

Project	14C4909-A Atlantic Sunrise Project -West Diamond Regulator Station
Test Pit #	2
Name	Krystal Beaing, APSS
Date	March 11, 2015
Weather	40-52°F; Sunny
Equipment	Mini Excavator

Elevation	1208 AMSL
Soil Type	Oquaga channery silt loam, 3-12% slopes
Geology	Catskill Formation
Landscape Position/Slope	Summit, 2-5%
Land Use	Wooded
Additional Comments	Approximately 12" snow

Horizon	Upper Boundary (inches)	Lower Boundary (inches)	Soil Textural Class	Type, Size, Coarse Fragments, etc.	Soil Matrix Color	Color Patterns	Pores, Roots, Structure	Depth to Bedrock	Depth to Water	Comments
A	0	9	SiL	15-35% Channery	5YR 3/3	-	Weak, Granular	-	-	-
Bw	9	12	SiL	35-60% Channery	5YR 4/3	-	Weak, Subangular Blocky	12	-	Limiting Layer - Bedrock

Note: Unless stated otherwise, horizon strike and dip was not observed to have a significant impact on water flow within the profile.



# Soil Profile Log

Project 14C4909-A Atlantic Sunrise Project -West Diamond Regulator Station

Test Pit # 3

Name Krystal Beaing, APSS

Date March 11, 2015

Weather 40-52°F; Sunny

Equipment Mini Excavator

Elevation 1205 AMSL

Soil Type Oquaga channery silt loam, 3-12% slopes

Geology Catskill Formation

Landscape Position/Slope Summit, 2-5%

Land Use Wooded

Additional Comments Approximately 12" snow

Horizon	Upper Boundary (inches)	Lower Boundary (inches)	Soil Textural Class	Type, Size, Coarse Fragments, etc.	Soil Matrix Color	Color Patterns	Pores, Roots, Structure	Depth to Bedrock	Depth to Water	Comments
A	0	9	SiL	15-35% Channery	5YR 3/3	-	Roots present; Weak, Granular	-	-	-
Bw1	9	22	SiL	15-35% Channery	5YR 4/3	-	Weak, Granular	-	-	-
Bw2	22	28	SiL	15-35% Channery	5YR 4/4	15% 5YR 5/8	Weak, Granular	-	-	Limiting Layer - Season High Water Table
Bw3	28	44	SiL	15-35% Channery	5YR 5/2	40% 5YR 5/8	Weak, Subangular Blocky	-	-	Limiting Layer - Season High Water Table
BC	44	56	L	35-60% Channery	2.5YR 4/4	10% 5YR 4/6	Weak, Subangular Blocky	-	-	Limiting Layer - Season High Water Table
C	56	59+	SL	35-60% Channery	5YR 3/4	5% 5YR 5/6	Weak, Granular	-	-	Limiting Layer - Season High Water Table

Note: Unless stated otherwise, horizon strike and dip was not observed to have a significant impact on water flow within the profile.

# Soil Profile Log

<b>Project</b>	14C4909-A Atlantic Sunrise Project -West Diamond Regulator Station
<b>Test Pit #</b>	4
<b>Name</b>	Krystal Beaing, APSS
<b>Date</b>	March 11, 2015
<b>Weather</b>	40-52°F; Sunny
<b>Equipment</b>	Mini Excavator

<b>Elevation</b>	1206 AMSL
<b>Soil Type</b>	Oquaga channery silt loam, 3-12% slopes
<b>Geology</b>	Catskill Formation
<b>Landscape Position/Slope</b>	Summit, 2-5%
<b>Land Use</b>	Wooded
<b>Additional Comments</b>	Approximately 12" snow

Horizon	Upper Boundary (inches)	Lower Boundary (inches)	Soil Textural Class	Type, Size, Coarse Fragments, etc.	Soil Matrix Color	Color Patterns	Pores, Roots, Structure	Depth to Bedrock	Depth to Water	Comments
A	0	7	SiL	15-35% Channery	5YR 3/3	-	Roots present; Weak, Granular	-	-	-
Bw1	7	18	SiL	15-35% Channery	5YR 4/3	-	Weak, Subangular Blocky	-	-	-
Bw2	18	24	SiL	15-35% Channery	5YR 4/4	10% 5YR 5/8	Weak, Subangular Blocky	-	-	Limiting Layer - Seasonal High Water Table
Bw3	24	34	SiL	15-35% Channery	5YR 5/2	40% 5YR 5/8	Weak, Subangular Blocky	-	-	Limiting Layer - Seasonal High Water Table
BC	34	43	L	35-60% Channery	2.5YR 4/4	15% 5YR 4/6	Weak, Subangular Blocky	43	-	Limiting Layer - Seasonal High Water Table; Bedrock

Note: Unless stated otherwise, horizon strike and dip was not observed to have a significant impact on water flow within the profile.

Soil Profile Log

Project	14C4909-A Atlantic Sunrise Project -West Diamond Regulator Station
Test Pit #	5
Name	Krystal Beaing, APSS
Date	March 11, 2015
Weather	40-52°F; Sunny
Equipment	Mini Excavator

Elevation	1202 AMSL
Soil Type	Oquaga channery silt loam, 3-12% slopes
Geology	Catskill Formation
Landscape Position/Slope	Summit, 2-5%
Land Use	Wooded
Additional Comments	Approximately 12" snow

Horizon	Upper Boundary (inches)	Lower Boundary (inches)	Soil Textural Class	Type, Size, Coarse Fragments, etc.	Soil Matrix Color	Color Patterns	Pores, Roots, Structure	Depth to Bedrock	Depth to Water	Comments
A	0	11	SIL	15-35% Channery	5YR 3/3	-	Roots present; Weak, Granular	-	-	-
Bw	11	40	SIL	15-35% Channery	5YR 4/4	-	Weak, Subangular Blocky	40	-	Limiting Layer - Bedrock

Note: Unless stated otherwise, horizon strike and dip was not observed to have a significant impact on water flow within the profile.

Soil Profile Log

Project	14C4909-A Atlantic Sunrise Project -West Diamond Regulator Station	Elevation	1203 AMSL
Test Pit #	6	Soil Type	Oquaga channery silt loam, 3-12% slopes
Name	Krystal Beaing, APSS	Geology	Catskill Formation
Date	March 11, 2015	Landscape Position/Slope	Summit, 2-5%
Weather	40-52°F; Sunny	Land Use	Wooded
Equipment	Mini Excavator	Additional Comments	Approximately 12" snow

Horizon	Upper Boundary (inches)	Lower Boundary (inches)	Soil Textural Class	Type, Size, Coarse Fragments, etc.	Soil Matrix Color	Color Patterns	Pores, Roots, Structure	Depth to Bedrock	Depth to Water	Comments
A	0	11	SiL	15-35% Channery	5YR 3/3	-	Roots present; Weak, Granular	-	-	-
Bw	11	17	SiL	15-35% Channery	5YR 4/4	-	Weak, Subangular Blocky	17	-	Limiting Layer - Bedrock

Note: Unless stated otherwise, horizon strike and dip was not observed to have a significant impact on water flow within the profile.







View of Pit #1.



View of Pit #2.



View of Pit #3.



View of Pit #4.





View of Pit #5.



View of Pit #6.



## **WEST DIAMOND REGULATOR STATION INFILTRATION RATE/DEWATERING TIME**

Note: the infiltration tests were performed with a double ring infiltrometer. Therefore, no reduction factors were applied.

The limiting layer was found to be approximately 17 inches to 40 inches below existing grade ( $\pm 1200.00$ ). Therefore, the infiltration areas would be shallow or at existing grade. Therefore, infiltration facilities are not feasible for this site

### **BASIN 1**

#### Infiltration Rate

Test pit 4	1.25	in/hr
Test pit 5	2.25	in/hr
Test pit 6	0.00	in/hr
Average	1.75	in/hr
Safety factor	3.00	
Adjusted rate	0.58	in/hr



## **A.7 Supporting Documentation**



**TABLE 6.6**  
**Riprap Gradation, Filter Blanket Requirements, Maximum Velocities**

Percent Passing (Square Openings)						
Class, Size NO.	R-8	R-7	R-6	R-5	R-4	R-3
Rock Size (Inches)						
42	100					
30		100				
24	15-50		100			
18		15-50		100		
15	0-15					
12		0-15	15-50		100	
9				15-50		
6			0-15		15-50	100
4				0-15		
3					0-15	15-50
2						0-15
Nominal Placement Thickness (inches)	63	45	36	27	18	9
Filter Stone <sup>1</sup>	AASHTO #1	AASHTO #1	AASHTO #1	AASHTO #3	AASHTO #3	AASHTO #57
V <sub>max</sub> (ft/sec)	17.0	14.5	13.0	11.5	9.0	6.5

Adapted from PennDOT Pub. 408, Section 703.2(c), Table C

- 1 This is a general standard. Soil conditions at each site should be analyzed to determine actual filter size. A suitable woven or non-woven geotextile underlayment, used according to the manufacturer's recommendations, may be substituted for the filter stone for gradients < 10%.

**TABLE 6.7**  
**Comparison of Various Gradations of Coarse Aggregates**

Total Percent Passing															
AASHTO NUMBER	6 ½"	4"	3 ½"	2 ½"	2"	1 ½"	1"	¾"	½"	⅜"	#4	#8	#16	#30	#100
1		100	90-100	25-60		0-15		0-5							
3				100	90-100	35-70	0-15		0-5						
5						100	90-100	20-55	0-10	0-5					
57						100	90-100		25-60		0-10	0-5			
67							100	90-100		20-55	0-10	0-5			
7								100	90-100	40-70	0-15	0-5			
8									100	85-100	10-30	0-10	0-5		
10										100	75-100				10-30

PennDOT Publication 408, Section 703.2(c), Table C

Tables 6.6 and 6.7 should be placed on the plan drawings of all sites where riprap channel linings are proposed.



**NOAA Atlas 14, Volume 2, Version 3**  
**Location name: Benton, Pennsylvania, US\***  
**Latitude: 41.2734°, Longitude: -76.4070°**  
**Elevation: 1210 ft\***  
 \* source: Google Maps



## POINT PRECIPITATION FREQUENCY ESTIMATES

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

NOAA, National Weather Service, Silver Spring, Maryland

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

### PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches) <sup>1</sup>										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.336 (0.305-0.371)	0.400 (0.362-0.441)	0.464 (0.420-0.512)	0.509 (0.461-0.561)	0.564 (0.508-0.621)	0.605 (0.544-0.667)	0.644 (0.576-0.711)	0.685 (0.609-0.757)	0.740 (0.653-0.822)	0.781 (0.684-0.871)
10-min	0.523 (0.473-0.576)	0.624 (0.566-0.688)	0.721 (0.652-0.795)	0.786 (0.712-0.866)	0.862 (0.777-0.950)	0.917 (0.824-1.01)	0.970 (0.867-1.07)	1.02 (0.909-1.13)	1.09 (0.960-1.21)	1.14 (0.996-1.27)
15-min	0.641 (0.580-0.706)	0.764 (0.692-0.842)	0.885 (0.801-0.977)	0.967 (0.876-1.07)	1.06 (0.960-1.17)	1.14 (1.02-1.25)	1.21 (1.08-1.33)	1.27 (1.13-1.41)	1.36 (1.20-1.51)	1.42 (1.25-1.59)
30-min	0.848 (0.767-0.934)	1.02 (0.926-1.13)	1.21 (1.10-1.34)	1.34 (1.22-1.48)	1.50 (1.36-1.66)	1.62 (1.46-1.79)	1.74 (1.56-1.92)	1.86 (1.65-2.05)	2.01 (1.77-2.24)	2.13 (1.87-2.38)
60-min	1.03 (0.937-1.14)	1.25 (1.14-1.38)	1.52 (1.38-1.68)	1.71 (1.55-1.88)	1.95 (1.76-2.15)	2.14 (1.92-2.36)	2.33 (2.08-2.57)	2.52 (2.24-2.78)	2.78 (2.45-3.09)	2.99 (2.62-3.34)
2-hr	1.20 (1.08-1.33)	1.44 (1.30-1.60)	1.76 (1.59-1.96)	2.02 (1.81-2.24)	2.38 (2.13-2.64)	2.68 (2.38-2.97)	3.01 (2.66-3.35)	3.37 (2.96-3.75)	3.91 (3.38-4.38)	4.37 (3.74-4.92)
3-hr	1.30 (1.17-1.45)	1.56 (1.41-1.75)	1.92 (1.73-2.15)	2.21 (1.98-2.46)	2.63 (2.34-2.93)	2.99 (2.65-3.34)	3.39 (2.97-3.79)	3.83 (3.32-4.29)	4.50 (3.85-5.07)	5.09 (4.30-5.76)
6-hr	1.63 (1.46-1.84)	1.96 (1.76-2.22)	2.40 (2.15-2.70)	2.76 (2.46-3.10)	3.28 (2.90-3.68)	3.73 (3.28-4.19)	4.22 (3.68-4.75)	4.78 (4.12-5.38)	5.63 (4.77-6.37)	6.37 (5.33-7.24)
12-hr	2.03 (1.82-2.29)	2.44 (2.19-2.74)	2.99 (2.68-3.36)	3.45 (3.08-3.87)	4.13 (3.66-4.62)	4.72 (4.16-5.29)	5.38 (4.69-6.03)	6.13 (5.28-6.89)	7.28 (6.16-8.22)	8.31 (6.92-9.43)
24-hr	2.45 (2.24-2.71)	2.94 (2.69-3.25)	3.63 (3.31-4.01)	4.22 (3.84-4.66)	5.13 (4.63-5.64)	5.95 (5.33-6.51)	6.89 (6.12-7.53)	8.00 (7.04-8.71)	9.75 (8.45-10.6)	11.4 (9.70-12.3)
2-day	2.88 (2.61-3.23)	3.45 (3.13-3.87)	4.26 (3.85-4.77)	4.95 (4.46-5.54)	6.02 (5.38-6.70)	6.98 (6.20-7.76)	8.10 (7.13-8.98)	9.39 (8.19-10.4)	11.5 (9.84-12.7)	13.4 (11.3-14.7)
3-day	3.06 (2.78-3.41)	3.65 (3.33-4.08)	4.48 (4.07-4.99)	5.19 (4.70-5.77)	6.28 (5.65-6.96)	7.26 (6.49-8.03)	8.39 (7.44-9.26)	9.71 (8.53-10.7)	11.8 (10.2-13.0)	13.7 (11.7-15.0)
4-day	3.23 (2.95-3.58)	3.85 (3.52-4.28)	4.70 (4.29-5.22)	5.43 (4.94-6.01)	6.54 (5.92-7.22)	7.54 (6.78-8.30)	8.69 (7.76-9.54)	10.0 (8.87-11.0)	12.1 (10.6-13.3)	14.0 (12.1-15.3)
7-day	3.82 (3.52-4.20)	4.55 (4.19-5.01)	5.49 (5.04-6.04)	6.29 (5.75-6.90)	7.49 (6.82-8.21)	8.56 (7.75-9.36)	9.77 (8.79-10.7)	11.2 (9.97-12.2)	13.4 (11.8-14.5)	15.3 (13.3-16.7)
10-day	4.40 (4.07-4.81)	5.22 (4.83-5.71)	6.24 (5.76-6.82)	7.10 (6.53-7.75)	8.38 (7.67-9.12)	9.49 (8.65-10.3)	10.7 (9.73-11.7)	12.2 (10.9-13.2)	14.4 (12.8-15.6)	16.3 (14.4-17.6)
20-day	5.98 (5.60-6.41)	7.04 (6.60-7.55)	8.20 (7.67-8.78)	9.17 (8.56-9.82)	10.6 (9.85-11.3)	11.8 (10.9-12.6)	13.1 (12.1-14.0)	14.6 (13.4-15.6)	16.8 (15.3-17.9)	18.7 (16.9-19.9)
30-day	7.44 (7.00-7.96)	8.72 (8.21-9.32)	10.0 (9.41-10.7)	11.1 (10.4-11.8)	12.6 (11.8-13.5)	13.9 (13.0-14.8)	15.3 (14.2-16.3)	16.7 (15.5-17.9)	18.9 (17.4-20.2)	20.8 (19.0-22.2)
45-day	9.40 (8.88-9.99)	11.0 (10.4-11.7)	12.4 (11.7-13.2)	13.6 (12.8-14.4)	15.2 (14.4-16.2)	16.6 (15.6-17.6)	18.0 (16.9-19.2)	19.6 (18.3-20.8)	21.7 (20.2-23.1)	23.5 (21.8-25.0)
60-day	11.3 (10.8-12.0)	13.2 (12.5-13.9)	14.8 (14.0-15.7)	16.1 (15.3-17.1)	18.0 (17.0-19.0)	19.5 (18.4-20.6)	21.1 (19.9-22.3)	22.8 (21.4-24.1)	25.2 (23.6-26.7)	27.2 (25.3-28.8)

<sup>1</sup> Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

[Back to Top](#)

### PF graphical



## **APPENDIX B**

### **Preparer Qualifications**



**STANDARD E&S WORKSHEET # 22**  
**PLAN PREPARER RECORD OF TRAINING AND EXPERIENCE IN EROSION AND**  
**SEDIMENT POLLUTION CONTROL METHODS AND TECHNIQUES**

**NAME OF PLAN PREPARER:** Alaric J. Busher, PE, CPESC

**FORMAL EDUCATION:**

**Name of College or Technical Institute:** The Pennsylvania State University

**Curriculum or Program:** Civil Engineering

**Dates of Attendance:**     **From:** 9/1995                     **To:** 5/1999

**Degree Received** Bachelor of Science - Civil Engineering

**OTHER TRAINING:**

<b>Name of Training:</b>	<u>Annual Oil and Gas Training</u>	<u>Chapter 102 Update Training for the Regulated Community</u>
<b>Presented By:</b>	<u>PADEP</u>	<u>PADEP</u>
<b>Date:</b>	<u>7/10/2013</u>	<u>11/12/2010</u>

**EMPLOYMENT HISTORY:**

**Current Employer:** BL Companies

**Telephone:** 717-651-9850

**Former Employer:** N/A

**Telephone:** \_\_\_\_\_

**RECENT E&S PLANS PREPARED:**

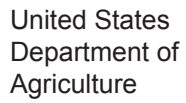
<b>Name of Project:</b>	<u>Constitution Pipeline, Access Roads and Meter Station (ES, PCSM)</u>	<u>Reynolds Alford Pipeline (E&amp;S, PCSM)</u>	<u>Annville Medical Office (E&amp;S, PCSM)</u>
<b>County:</b>	<u>Susquehanna</u>	<u>Susquehanna</u>	<u>Lebanon</u>
<b>Municipality:</b>	<u>Multiple</u>	<u>Brooklyn, Harford</u>	<u>Annville Twp</u>
<b>Permit Number:</b>	<u>ESG0011540002</u>	<u>ESX13-115-0152(01)</u>	<u>PAG-02-0038-15-010</u>
<b>Approving Agency:</b>	<u>Susquehanna CCD</u>	<u>PADEP (O&amp;G)</u>	<u>Lebanon CCD</u>



## **APPENDIX C**

### **United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Custom Soil Resource Report**



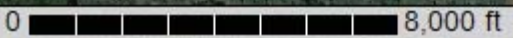


Natural  
Resources  
Conservation  
Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

# Custom Soil Resource Report for Columbia County, Pennsylvania

## West Diamond Regulator Station



July 6, 2015





# Preface

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Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (<http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/>) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (<http://offices.sc.egov.usda.gov/locator/app?agency=nrcs>) or your NRCS State Soil Scientist ([http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2\\_053951](http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951)).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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# Contents

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<b>Preface</b> .....	2
<b>How Soil Surveys Are Made</b> .....	5
<b>Soil Map</b> .....	7
Soil Map.....	8
Legend.....	9
Map Unit Legend.....	10
Map Unit Descriptions.....	10
Columbia County, Pennsylvania.....	12
OcB2—Oquaga channery silt loam, 3 to 12 percent slopes, moderately eroded.....	12
OcC2—Oquaga channery silt loam, 12 to 20 percent slopes, moderately eroded.....	13
OsB—Oquaga very stony silt loam, 0 to 12 percent slopes.....	14
OsD—Oquaga very stony silt loam, 12 to 35 percent slopes.....	15
<b>References</b> .....	16

# How Soil Surveys Are Made

---

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the

individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

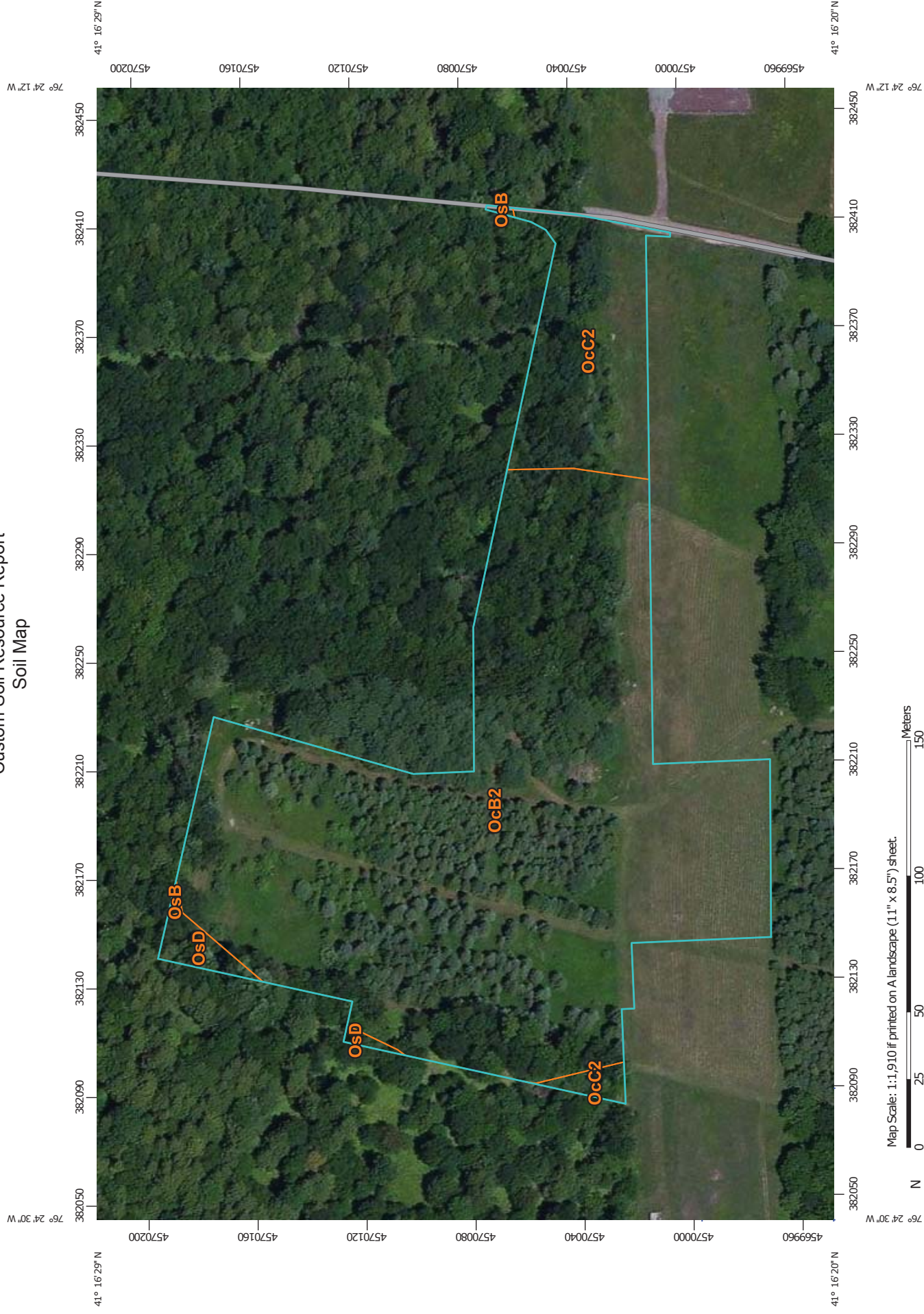
# Soil Map

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The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.



# Custom Soil Resource Report Soil Map







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

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

Special Line Features

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

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: <http://websoilsurvey.nrcs.usda.gov>  
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: Columbia County, Pennsylvania  
Survey Area Data: Version 7, Sep 15, 2014

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

Date(s) aerial images were photographed: Apr 14, 2011—Sep 18, 2011

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

Columbia County, Pennsylvania (PA037)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
OcB2	Oquaga channery silt loam, 3 to 12 percent slopes, moderately eroded	6.6	84.7%
OcC2	Oquaga channery silt loam, 12 to 20 percent slopes, moderately eroded	1.1	13.6%
OsB	Oquaga very stony silt loam, 0 to 12 percent slopes	0.0	0.2%
OsD	Oquaga very stony silt loam, 12 to 35 percent slopes	0.1	1.6%
<b>Totals for Area of Interest</b>		<b>7.8</b>	<b>100.0%</b>

## Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

## Columbia County, Pennsylvania

### OcB2—Oquaga channery silt loam, 3 to 12 percent slopes, moderately eroded

#### Map Unit Setting

*National map unit symbol:* 13fk  
*Elevation:* 600 to 1,800 feet  
*Mean annual precipitation:* 35 to 50 inches  
*Mean annual air temperature:* 46 to 52 degrees F  
*Frost-free period:* 120 to 180 days  
*Farmland classification:* Farmland of statewide importance

#### Map Unit Composition

*Oquaga and similar soils:* 100 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

#### Description of Oquaga

##### Setting

*Landform:* Hillslopes  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Side slope  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Parent material:* Reddish ablation till derived from sandstone and siltstone

##### Typical profile

*H1 - 0 to 7 inches:* channery silt loam  
*H2 - 7 to 22 inches:* very channery loam  
*H3 - 22 to 26 inches:* unweathered bedrock

##### Properties and qualities

*Slope:* 3 to 12 percent  
*Depth to restrictive feature:* 20 to 40 inches to lithic bedrock  
*Natural drainage class:* Well drained  
*Runoff class:* Medium  
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high to high (0.60 to 2.00 in/hr)  
*Depth to water table:* More than 80 inches  
*Frequency of flooding:* None  
*Frequency of ponding:* None  
*Available water storage in profile:* Very low (about 2.1 inches)

##### Interpretive groups

*Land capability classification (irrigated):* None specified  
*Land capability classification (nonirrigated):* 2e  
*Hydrologic Soil Group:* C

**OcC2—Oquaga channery silt loam, 12 to 20 percent slopes, moderately eroded**

**Map Unit Setting**

*National map unit symbol:* 13fl

*Elevation:* 600 to 1,800 feet

*Mean annual precipitation:* 35 to 50 inches

*Mean annual air temperature:* 46 to 52 degrees F

*Frost-free period:* 120 to 180 days

*Farmland classification:* Farmland of statewide importance

**Map Unit Composition**

*Oquaga and similar soils:* 100 percent

*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Oquaga**

**Setting**

*Landform:* Hillslopes

*Landform position (two-dimensional):* Shoulder

*Landform position (three-dimensional):* Side slope

*Down-slope shape:* Linear

*Across-slope shape:* Linear

*Parent material:* Reddish ablation till derived from sandstone and siltstone

**Typical profile**

*H1 - 0 to 7 inches:* channery silt loam

*H2 - 7 to 22 inches:* very channery loam

*H3 - 22 to 26 inches:* unweathered bedrock

**Properties and qualities**

*Slope:* 12 to 20 percent

*Depth to restrictive feature:* 20 to 40 inches to lithic bedrock

*Natural drainage class:* Well drained

*Runoff class:* Medium

*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high to high  
(0.60 to 2.00 in/hr)

*Depth to water table:* More than 80 inches

*Frequency of flooding:* None

*Frequency of ponding:* None

*Available water storage in profile:* Very low (about 2.1 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified

*Land capability classification (nonirrigated):* 3e

*Hydrologic Soil Group:* C

## **OsB—Oquaga very stony silt loam, 0 to 12 percent slopes**

### **Map Unit Setting**

*National map unit symbol:* l3fn  
*Elevation:* 700 to 1,800 feet  
*Mean annual precipitation:* 35 to 50 inches  
*Mean annual air temperature:* 46 to 52 degrees F  
*Frost-free period:* 110 to 180 days  
*Farmland classification:* Not prime farmland

### **Map Unit Composition**

*Oquaga and similar soils:* 100 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

### **Description of Oquaga**

#### **Setting**

*Landform:* Hillslopes  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Side slope  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Parent material:* Reddish ablation till derived from sandstone and siltstone

#### **Typical profile**

*H1 - 0 to 7 inches:* channery silt loam  
*H2 - 7 to 22 inches:* very channery silt loam  
*H3 - 22 to 26 inches:* unweathered bedrock

#### **Properties and qualities**

*Slope:* 0 to 12 percent  
*Percent of area covered with surface fragments:* 1.6 percent  
*Depth to restrictive feature:* 20 to 40 inches to lithic bedrock  
*Natural drainage class:* Well drained  
*Runoff class:* Medium  
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high to high  
(0.60 to 2.00 in/hr)  
*Depth to water table:* More than 80 inches  
*Frequency of flooding:* None  
*Frequency of ponding:* None  
*Available water storage in profile:* Very low (about 2.1 inches)

#### **Interpretive groups**

*Land capability classification (irrigated):* None specified  
*Land capability classification (nonirrigated):* 6s  
*Hydrologic Soil Group:* C

## **OsD—Oquaga very stony silt loam, 12 to 35 percent slopes**

### **Map Unit Setting**

*National map unit symbol:* l3fp  
*Elevation:* 700 to 1,800 feet  
*Mean annual precipitation:* 35 to 50 inches  
*Mean annual air temperature:* 46 to 52 degrees F  
*Frost-free period:* 110 to 180 days  
*Farmland classification:* Not prime farmland

### **Map Unit Composition**

*Oquaga and similar soils:* 100 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

### **Description of Oquaga**

#### **Setting**

*Landform:* Hillslopes  
*Landform position (two-dimensional):* Shoulder  
*Landform position (three-dimensional):* Side slope  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Parent material:* Reddish ablation till derived from sandstone and siltstone

#### **Typical profile**

*H1 - 0 to 7 inches:* channery silt loam  
*H2 - 7 to 22 inches:* very channery silt loam  
*H3 - 22 to 26 inches:* unweathered bedrock

#### **Properties and qualities**

*Slope:* 12 to 35 percent  
*Percent of area covered with surface fragments:* 1.6 percent  
*Depth to restrictive feature:* 20 to 40 inches to lithic bedrock  
*Natural drainage class:* Well drained  
*Runoff class:* High  
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high to high  
(0.60 to 2.00 in/hr)  
*Depth to water table:* More than 80 inches  
*Frequency of flooding:* None  
*Frequency of ponding:* None  
*Available water storage in profile:* Very low (about 2.1 inches)

#### **Interpretive groups**

*Land capability classification (irrigated):* None specified  
*Land capability classification (nonirrigated):* 6s  
*Hydrologic Soil Group:* C



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