DRAINAGE CALCULATIONS AND STORMWATER MANAGEMENT PLAN

For:

COMPREHENSIVE PERMIT PLAN
RIVER MARSH VILLAGE
PEMBROKE, MA

Located:

0 WATER STREET
(ASSESSOR'S MAP E-17, LOT 0 & E-17A, LOT 274)
PEMBROKE, MASSACHUSETTS

Submitted to:
TOWN OF PEMBROKE

Prepared For:
RIVER MARSH, LLC
293R WASHINGTON STREET
NORWELL, MA 02061

MCKENZIE
ENGINEERING GROUP

COMMONWEALTH OF MASSACHUSETTS
BRADLEY C
McKENZIE
CIVIL
No. 36917
REGISTERED
PROFESSIONAL ENGINEER

Professional Civil Engineering • Project Management • Land Planning
150 Longwater Drive, Suite 101, Norwell, Massachusetts 02061
Tel.: (781) 792-3900 Facsimile: (781) 792-0333
www.mckeng.com

November 27, 2018
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Revised June 7, 2021

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Drainage Calculations and Stormwater Management Plan
Comprehensive Permit Plan
River Marsh Village
Pembroke, Massachusetts

Project Summary

The project proponent River Marsh, LLC, proposes to develop an approximate 49.94-acre parcel of land located at 0 Water Street (Assessor's Map E-17, Lot 0 and E-17A, Lot 274) in Pembroke, Massachusetts. The development is being permitted under MGL Ch. 40B Comprehensive Permit and will consist of 56 condominium units comprised of 3, and 4-unit buildings. The proposed development will involve the construction of approximately 2,414 linear feet of bituminous roadways, residential buildings, driveways, stormwater management system, utilities and other related infrastructure.

The development will be comprised of two parcels which are shown on the Assessor's Map E-17, Lot 0 and E-17A, Lot 274. The site is located between the North River to the west and Water Street, at the intersection of Church Street (Route 139) to the east in Pembroke, Massachusetts. The entire site is located within the Residence "A" Zoning District and Business "B" Zoning District. Approximately 10,700 +/- square feet are in the Business "B" Zoning District. Access to the site will be provided by two (2) access points from Water Street. A double barrel entrance with 13-foot-wide travel lanes and an 8-foot-wide median and a 22-foot-wide roadway. Refer to Figure 1- USGS Locus Map for the location of the parcel.

The project will access utility infrastructure located on Water Street including electric, water, telephone and cable television. The lots will be served by a shared subsurface sewage disposal system with a pump chamber and connections to the municipal water system which will extend from Water Street throughout the proposed development. All stormwater management facilities will be designed provide renovation of stormwater and meet the requirements of the Department of Environment Protection's Stormwater Management Regulations. The existing and proposed site conditions are illustrated on the project *site plans* entitled "River March Village, Comprehensive Permit Plan, Water Street, Pembroke, Massachusetts", prepared by McKenzie Engineering Group, Inc. dated November 27, 2018, with a latest revision date of June 7, 2021.

This report contains stormwater runoff calculations for the pre-development and post-development conditions and includes the sizing of the drainage system and stormwater best management practices (BMPs).

Pre-Development Condition

The site is located primarily within the Residence "A" Zoning District and is comprised of 22.53 acres of upland and 27.41 acres of wetland. The Massachusetts Department of Environmental Protection (DEP) has confirmed the wetland resource area by issuance of a Superseding Order of Resource Area Delineation (ORAD). The wetland complex that extends from the North River is tidal in nature. The project is exempt from Standard 2 of the Massachusetts DEP Stormwater Management Regulations for land subject to coastal storm flowage as defined in 310 CMR 10.04.

One single family home currently exists on parcel Map E-17A Lot 274, which is to be retained. The project site is partially wooded and partially cleared with grass cover and wetlands toward the west side of the site approaching the North River. No improvements have been made to the land. The topography of the site is varied with elevations ranging from 30 feet (NAVD88) along the eastern boundary of the parcel to 5 feet (NAVD88) at the natural riverbank of the North River. Slopes vary from gentle to somewhat steeper grades sloping toward the wetlands on the west side of the site.

Review of available environmental databases such as MassGIS reveals that the site is not located within a mapped Natural Heritage Area, a Zone II or Zone III Groundwater Recharge Area, an Interim Wellhead Protection Area (IWPA), or a Contributing Watershed to Outstanding Resource Water (ORW). Review of the Town of Pembroke's Zoning Map reveals that the site is not located within any other protection area.

The site is within Zone AE (Elevation 8-NAVD88) and Zone X of the Flood Insurance Rate Map, as shown on the current FEMA Flood Insurance Rate Map Panel Nos. 25023C0206J and 25023C0207J with an effective date of July 17, 2012. Refer to Figure 2 – FEMA Flood Map.

The Natural Resources Conservation Service (NRCS) has identified the soil on the site as Scarboro, Ipswich, Squamscott, Eldridge, Hinckley, Merrimac, Windsor and Deerfield soils. The soils range in hydrological soil group classifications from 'A' to 'D'. Soil testing conducted by McKenzie Engineering Group, Inc. (MEG) on March 16, 2021 and May 17 and 18, 2021, identified the soils to be sandy loam. Refer to Figure 3 – Soil Map.

The existing watershed analyzed in this report is comprised of approximately 32.4 acres consisting of the subject parcel to be developed and offsite tributary areas. The watershed consists of four (4) sub-catchments. Refer to the Pre-Development Watershed Plan WS-1 in Appendix A for a delineation of drainage subcatchments for the pre-development design condition.

The SCS Technical Release 20 (TR-20) and Technical Release 55 (TR-55) method-based program "HydroCAD" was employed to develop pre- and post-development peak flows. Drainage calculations were prepared for the pre-development condition for the 2, 10, 25 and 100-year, Type III storm events. Refer to Appendix A for computer results, soil characteristics, cover descriptions and times of concentrations for all subareas.

Post-Development Condition

The proposed development will consist of 56 condominium units comprised of 3, and 4-unit buildings with bituminous concrete access roadways, parking areas and associated infrastructure. Visitor parking will be dispersed throughout the site. Access to the site will be provided by a private 22 ft. wide roadway with two access points from Water Street.

Watershed areas were analyzed in the post-development condition to design stormwater management facilities to mitigate impacts resulting from developing the property. The objective in designing the proposed drainage facilities for the project was to maintain existing drainage patterns to the extent practicable and to ensure that the post-development rates of runoff are less than pre-development rates at the design points.

Refer to the Post-Development Watershed Plan WS-2 in Appendix B for a delineation of post-development drainage subareas. The design points for the post-development design conditions correspond to those analyzed for the pre-development design condition.

Drainage calculations were prepared by employing the SCS TR-20 Methods for the 2, 10, 25 and 100-year, type III storm events. Refer to Appendix B for computer results. The subsurface infiltration chambers were designed to accommodate peak flows generated by all storms up to and including the 100-year storm event. Refer to site plans for the drainage system design.

The project is exempt from Standard 2 of the Massachusetts DEP Stormwater Management Regulations for land subject to coastal storm flowage as defined in 310 CMR 10.04.

Stormwater Best Management Practices (BMP's)

The treatment stream shall consist of deep sump hooded catch basins, a sediment forebay and an infiltration basin to achieve the required removal of a least 80% of the total suspended solids (TSS) and mitigate the anticipated pollutant loading.

Refer to the TSS Removal Worksheets in Appendix D for TSS removal rates.

Erosion and Sedimentation Controls

Compost filter tube (Silt sock) erosion control barriers will be placed at the limit of work prior to the commencement of any construction activity. The integrity of the silt sock will be maintained by periodic inspection and replacement as necessary. The silt sock will remain in place until the first course of pavement has been placed and all side slopes have been loamed and seeded and vegetation has been established. Refer to the Erosion Control details on the Site Development Plans and BMP Operation and Maintenance Plan for proposed erosion control measures to be employed for the project.

Compliance with Stormwater Management Standards

Standard 1 – No New Untreated Discharges

The proposed redevelopment will not introduce any new untreated discharges to a wetland area or waters of the Commonwealth of Massachusetts. All discharges from the site will be treated through proposed stormwater quality controls such as deep sump hooded catch basin, propriety pre-treatment units, subsurface infiltration chambers, sediment forebay and extended dry detention basin including the establishment of proper maintenance procedures.

Standard 2 – Peak Rate Attenuation

In the pre-development and post-development stormwater analysis, the watershed area analyzed was approximately 32.4 acres consisting of the subject parcel to be developed and offsite tributary areas. Refer to Existing Watershed Delineation Plan WS-1 for a delineation of drainage subareas for the pre-development design condition and refer to Post-Development Watershed Delineation Plan WS-2 for a delineation of drainage subareas for the post-development design condition.

Drainage calculations were performed by employing SCS TR-20 methods for the 1, 2, 10, 25, and 100-year Type III storm events. Refer to Appendix A and B for computer results. All drainage structures will be designed employing the Rational Method and the Mass. DPW Design Manual to accommodate peak flows generated by a minimum of a 25-year storm event or a 100-year storm event where applicable. The stormwater management systems were designed to accommodate peak flows generated by a 100-year storm event.

The peak rates of runoff and elevations for this condition are as follows:

Table 1 – Pre-Development Results				
	Design Storm (flow in cfs)			
	2-Year Storm	10-Year Storm	25-Year Storm	100-Year Storm
Design Point	Flow (CFS)	Flow (CFS)	Flow (CFS)	Flow (CFS)
DP-1	1.53	10.20	18.26	30.86
DP-2	0.24	1.79	3.68	7.53
DP-3	0.00	0.03	0.15	0.66
DP-4	0.20	0.40	0.56	0.059

	Design Storm (volume in ac-ft)			
	2-Year Storm	10-Year Storm	25-Year Storm	100-Year Storm
Design Point	Volume (AC-FT)	Volume (AC-FT)	Volume (AC-FT)	Volume (AC-FT)
DP-1	0.664	1.623	2.444	3.919
DP-2	0.091	0.304	0.504	0.882
DP-3	0.000	0.02	0.051	0.121
DP-4	0.015	0.029	0.040	0.059

The peak rates of runoff and elevations for this condition are as follows:

Table 2 – Post-Development Results				
	Design Storm (flow in cfs)			
	2-Year Storm	10-Year Storm	25-Year Storm	100-Year Storm
Design Point	Flow (CFS)	Flow (CFS)	Flow (CFS)	Flow (CFS)
DP-1	1.51	9.08	15.56	27.67
DP-2	0.17	1.53	3.61	6.77
DP-3	0.00	0.00	0.00	0.00
DP-4	0.00	0.00	0.00	0.00

	Design Storm (volume in ac-ft)			
	2-Year Storm	10-Year Storm	25-Year Storm	100-Year Storm
Design Point	Volume (AC-FT)	Volume (AC-FT)	Volume (AC-FT)	Volume (AC-FT)
DP-1	0.782	2.039	3.034	4.757
DP-2	0.229	0.576	0.879	1.425
DP-3	0.000	0.000	0.000	0.000
DP-4	0.000	0.000	0.000	0.000

Although the project is exempt from Standard 2 of the Massachusetts DEP Stormwater Management Regulations for land subject to coastal storm flowage as defined in 310 CMR 10.04, a comparison of the pre-development and post-development peak rates of runoff indicate that the peak rates of runoff for the post-development condition at all Design Points will be less than the pre-development condition for all storm events.

Pre-Development vs. Post-Development Peak Surface Elevations

Design Point	2 Year Storm		10 Year Storm		25 Year Storm		100 Year Storm	
	Exist. (Ft)	**Prop. (Ft)**	**Exist. (Ft)**	**Prop. (Ft)**	**Exist. (Ft)**	**Prop. (Ft)**	**Exist. (Ft)**	**Prop. (Ft)**
E-P1	*18.04*	18.04	*18.06*	18.06	*18.07*	18.07	*18.09*	18.09
E-P2	*13.03*	13.03	*13.21*	13.30	*13.30*	13.47	*13.38*	13.70

Standard 3 – Groundwater Recharge

Runoff will be infiltrated by the subsurface infiltration chambers, which will meet the Stormwater Guidelines for infiltration:

- The subsurface infiltration chambers will be four (4) feet above seasonal high groundwater.
- Utilize the "Simple Dynamic" method for sizing the storage volume, which takes into account the fact that stormwater is exfiltrating from the infiltration basin at the same time that the basin is filling.
- Hydraulic conductivity is based on soil data from the test pits and values developed from Rawls, Brakensiek and Saxton, 1982, Estimation of Soil Water Properties, *Transactions of the American Society of Agricultural Engineers*, vol.25, no. 5.
- Refer to Appendix D for infiltration and drawdown calculations and Appendix E for soil data.

Groundwater Recharge Volume

Infiltration Chambers	**Soil Type**	**Target Depth Factor (F) (in)**	**Total Impervious Area (sf)**	**Required Recharge Volume (cf)[1]**	**Provided Recharge Volume (cf)[2]**
	A	0.60	85,595	4,280	

	C	0.25	130,281	2,714	
2P					
				6,994 (9,999 ADJ.)	**10,406**

[Simple dynamic method]

1. Required Recharge Volume = Target Depth Factor x Impervious Area / (d+Kt) (Refer to supplemental calculations in Appendix D)
2. Provided Recharge Volume = Volume provided below lowest invert elevation. .

Per Standard 3, if stormwater runoff from less than 100% of the site's impervious cover is directed to the BMP intended to infiltrate the Required Recharge Volume, then the storage capacity of the infiltration BMP needs to be increased so that the BMP can capture more of the runoff from the impervious surfaces located with the contributing drainage area. The impervious cover directed towards the infiltration system is 69.58%; therefore, a capture area adjustment was made. Refer to Appendix D for Capture Area Adjustment calculations.

The proposed infiltration basin has been designed to completely drain within 72 hours. The drawdown analysis is based on the required recharge volume exfiltrating at the Rawls Rates based on the soil textural analysis conducted at the proposed exfiltration location. Refer to Appendix D for calculations.

<u>Standard 4 – Water Quality</u>

The Long-Term Pollution Prevention Plan has been incorporated into the Post-Development Operation and Maintenance Plan. Refer to Appendix F for BMP Operation and Maintenance Plans.

The total required water quality treatment volume was calculated to be 17,990 cubic feet. The one-inch rule has been applied to the water quality volume calculations. The water quality treatment volume will be provided within the storm water management facilities as follows:

Water Quality Treatment Volume

Catchment Area	Required WQ Volume (cf)	Proposed WQ Volume (cf)	
P4a	3,094		FD-4HC (see below)
P4b	295		FD-4HC (see below)
P4c	5,499	5,499	Extended Dry Detention Basin with Sediment Forebay
P4d	0	0	
Roofs Only	8,744	10,406	Subsurface Infiltration Chambers – Cultec R-902HD
P2	1,504	0	
P4	1,306	0	
P5	1,486	0	
	17,990	**15,905**	

Proprietary treatment units – First Defense High-Capacity treatment units will pre-treat and treat the required water quality volume. MassDEP has adopted a standard method to convert required water quality volume to a discharge rate for sizing flow based on manufactured proprietary stormwater treatment practices. The one inch rule has been applied to the water quality flow rate calculations. Refer to Appendix D for supporting calculations. The water quality treatment flow rate is provided within the storm water management facilities is as follows:

Pre-Treatment Water Quality Volume

Required WQ Flow Rate (cfs)	Proposed WQ Flow Rate (cfs)	
1.832	3.8	First Defense Unit - FD-6HC
0.098	1.2	First Defense Unit - FD-4HC
1.031	1.2	First Defense Unit - FD-4HC
2.961	6.20	

The stormwater management system design calls for the installation of 4-foot-deep sump catch basins with hooded outlets to collect runoff from the proposed roadway, propriety pre-treatment and treatment units, subsurface infiltration chambers, sediment forebay and extended dry detention basin. Removal rates for all paved surfaces are:

Deep Sump Catch Basins	25%
Extended dry detention basin w/ Sediment Forebay	50%

Sediment Forebay Sizing Requirements

Extended Dry Detention Basin	Contributing Impervious Area (ft^2)	Required Volume[1] (ft^3)	Provided Volume (ft^3)
1P	65,988	550	636

1. Required Volume = Contributing Impervious Area (sq.ft.) x (1 ft./12 in.) x (0.1 in./acre)

The stormwater management system was designed to be in full compliance with the DEP Stormwater Management Policy. A treatment stream consisting of deep sump catch basins with hooded outlets, proprietary pre-treatment and treatment units, subsurface infiltration chambers will be employed in the design of drainage facilities for the project to achieve the required removal of 80% total suspended solids. The proposed treatment streams will renovate the stormwater and improve the water quality by promoting the settlement of sediments and pollutants before runoff is released into down gradient wetlands. Refer to the TSS Removal Worksheets in Appendix D for TSS removal rates.

The drainage system is designed to comply with the Standards of the DEP Stormwater Management Policy. A treatment stream consisting of deep sump catch basins with hooded outlets and a sediment forebay will ensure that the 44% TSS removal (total suspended solids) is removed prior to discharge to the infiltration chambers and to ensure that 80% TSS removal is accomplished. The proposed treatment stream will renovate the stormwater and improve the water quality by promoting the settlement of sediments and pollutants before runoff is released into the existing drainage system. Refer to Appendix D for TSS Removal Calculation Worksheets.

Standard 5 – Land Use with Higher Potential Pollutant Loads (LUHPPL)

The proposed project does not include land uses with higher potential pollutant loads. Not Applicable.

Standard 6 – Critical Areas

The proposed project does not discharge to any critical areas. Not Applicable.

Standard 7 - Redevelopments and Other Projects Subject to the Standards only to the maximum extent practicable

The proposed project is not a redevelopment project. Not Applicable.

Standard 8 – Construction Period Pollution Prevention and Erosion and Sedimentation Control

The project will require a NPDES Construction General Permit, but the Stormwater Pollution Prevention Plan (SWPPP) has not been submitted. The SWPPP will be submitted prior to any proposed construction. A Construction Phase BMP Operation and Maintenance Plan will be provided as a basis for the SWPPP during final design.

Standard 9 – Operation and Maintenance Plan

The Long-Term Pollution Prevention Plan has been incorporated into the Post-Development Operation and Maintenance Plan. Refer to Appendix F for BMP Operation and Maintenance Plans.

Standard 10 – Prohibition of Illicit Discharges

No illicit discharges are anticipated on site. An Illicit Discharge Compliance Statement will be submitted prior to the discharge of any stormwater to the post-construction best management practices. Measures to prevent illicit discharges will be included in the Long-Term Pollution Prevention Plan.

FIGURE - 1

0 1000' 2000' 2500'

U.S. GEOLOGICAL SURVEY
7.5 X 15 MINUTE SERIES

MCKENZIE ENGINEERING GROUP
Assinippi Office Park
150 Longwater Drive, Suite 101
Norwell, MA 02061
P: 781.792.3900
F: 781.792.0333
www.mckeng.com

USGS LOCUS MAP

WATER STREET
PEMBROKE, MASSACHUSETTS

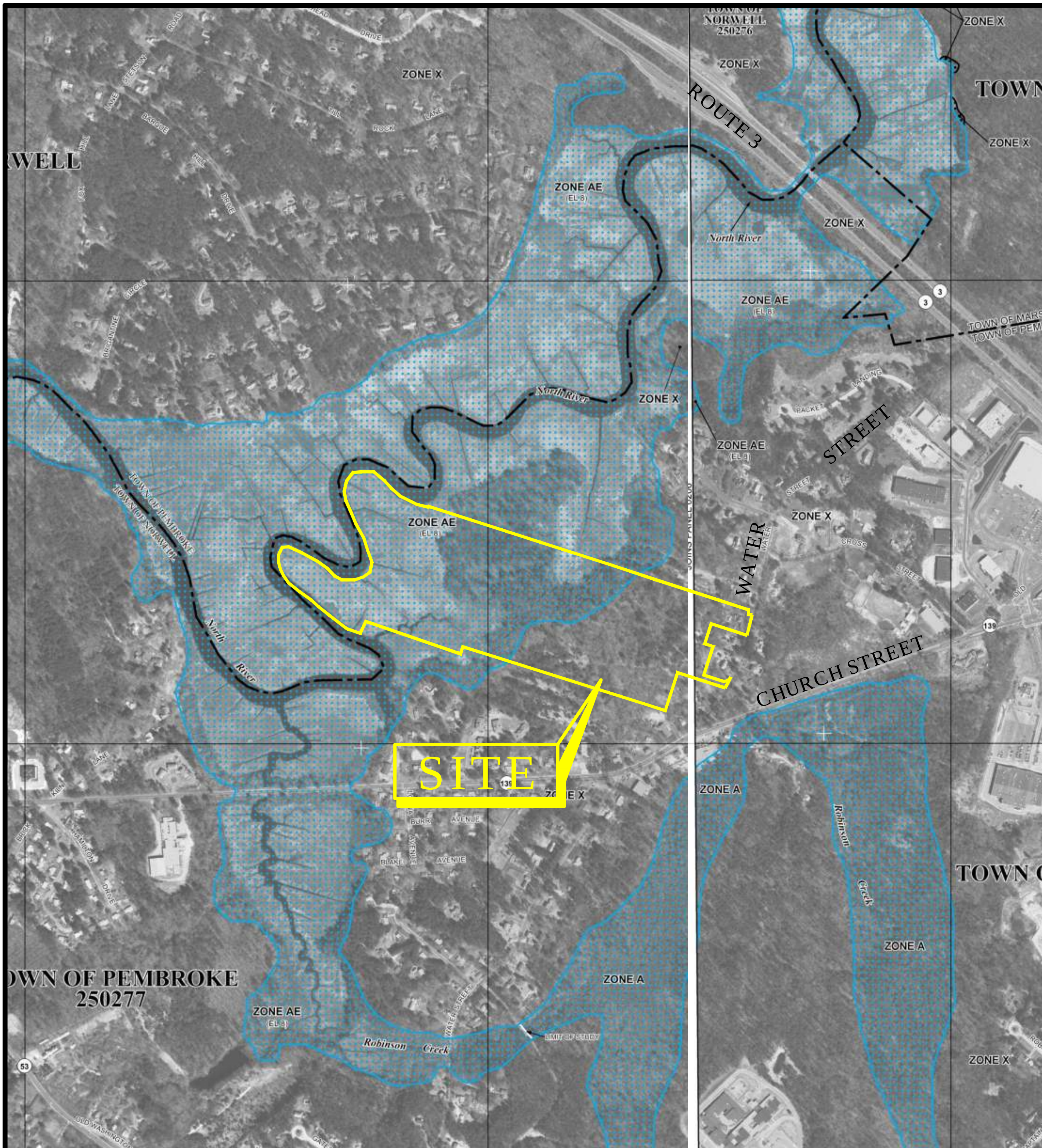

FIGURE - 2

0 1000' 2000' 2500'

COMMUNITY PANELS NO: 25023C0206J, 25023C0207J

EFFECTIVE DATE: JULY 17, 2012

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Assinippi Office Park
150 Longwater Drive, Suite 101
Norwell, MA 02061
P: 781.792.3900
F: 781.792.0333
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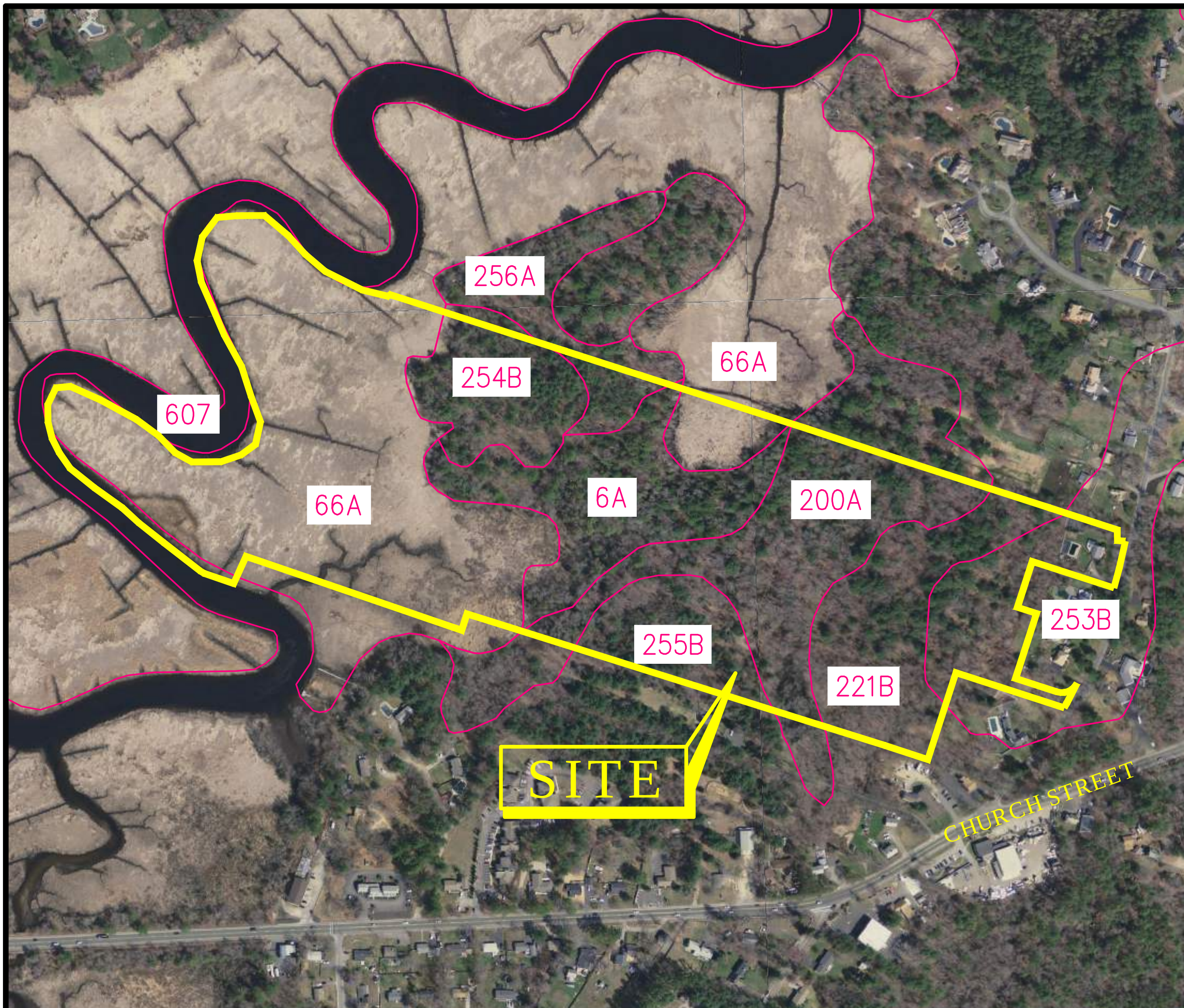
FEMA FLOOD MAP

WATER STREET

PEMBROKE, MASSACHUSETTS



LEGEND	NAME	HSG HYDROLOGIC
6A	SCARBORO MUCK, COASTAL LOWLAND	D
66A	IPSWICH–PAWCATUCK–MATUNUCK COMPLEX	D
200A	SQUAMSCOTT FINE SANDY LOAM	A/D
221B	ELDRIDGE FINE SANDY LOAM	C/D
253B	HINCKLEY LOAMY SAND	A
254B	MERRIMAC FINE SANDY LOAM	A
255B	WINDSOR LOAMY SAND	A
256A	DEERFIELD FINE SAND	B
607	WATER, SALINE	

FIGURE - 3

0 500' 1000' 1500'

PLYMOUTH COUNTY, MASSACHUSETTS
SOIL SURVEY

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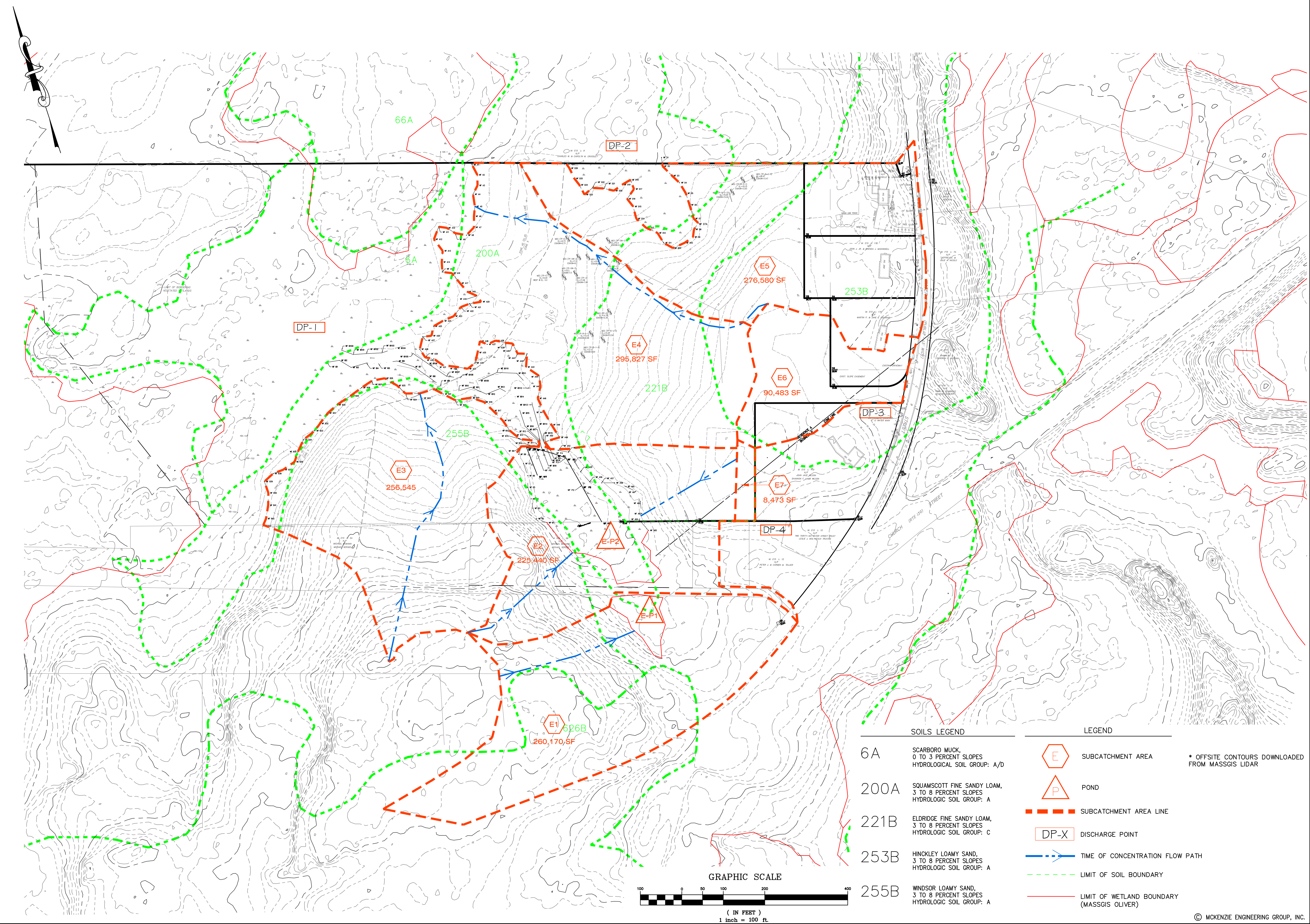
Assinippi Office Park
150 Longwater Drive, Suite 101
Norwell, MA 02061
P: 781.792.3900
F: 781.792.0333
www.mckeng.com

SOIL MAP

WATER STREET
PEMBROKE, MASSACHUSETTS

A P P E N D I X A

Pre-Development Condition



SOILS LEGEND

6A	SCARBORO MUCK, 0 TO 3 PERCENT SLOPES, HYDROLOGICAL SOIL GROUP: A/D
200A	SQUAMSCOTT FINE SANDY LOAM, 3 TO 8 PERCENT SLOPES, HYDROLOGIC SOIL GROUP: A
221B	ELDRIDGE FINE SANDY LOAM, 3 TO 8 PERCENT SLOPES, HYDROLOGIC SOIL GROUP: C
253B	HINCKLEY LOAMY SAND, 3 TO 8 PERCENT SLOPES, HYDROLOGIC SOIL GROUP: A
255B	WINDSOR LOAMY SAND, 3 TO 8 PERCENT SLOPES, HYDROLOGIC SOIL GROUP: A

LEGEND

- E — SUBCATCHMENT AREA
- P — POND
- SUBCATCHMENT AREA LINE
- DP-X — DISCHARGE POINT
- TIME OF CONCENTRATION FLOW PATH
- LIMIT OF SOIL BOUNDARY
- LIMIT OF WETLAND BOUNDARY (MASSGIS OLIVER)

* OFFSITE CONTOURS DOWNLOADED FROM MASSGIS LIDAR

REV	DATE	DESCRIPTION	BY	APP
1	4/5/2021	MERRILL ENGINEERS PEER REVIEW COMMENTS	SBS	BCM
2	6/7/2021	RECONFIGURED WTTP, STORMWATER SYSTEM AND BUILDINGS	SBS	BCM

PREPARED BY:

MCKENZIE ENGINEERING GROUP
Assinippi Office Park
150 Longwater Drive, Suite 101
Norwell, MA 02061
P: 781.792.3900
F: 781.792.0333
www.mckeng.com

RIVER MARSH VILLAGE COMPREHENSIVE PERMIT PLAN

(ASSESSOR'S MAP E-17, LOT 0 AND E-17A, LOT 274)

WATER STREET
PEMBROKE, MASSACHUSETTS

PROFESSIONAL ENGINEER:

OWNER/APPLICANT:
RIVER MARSH, LLC
293R WASHINGTON STREET
NORWELL, MA 02061

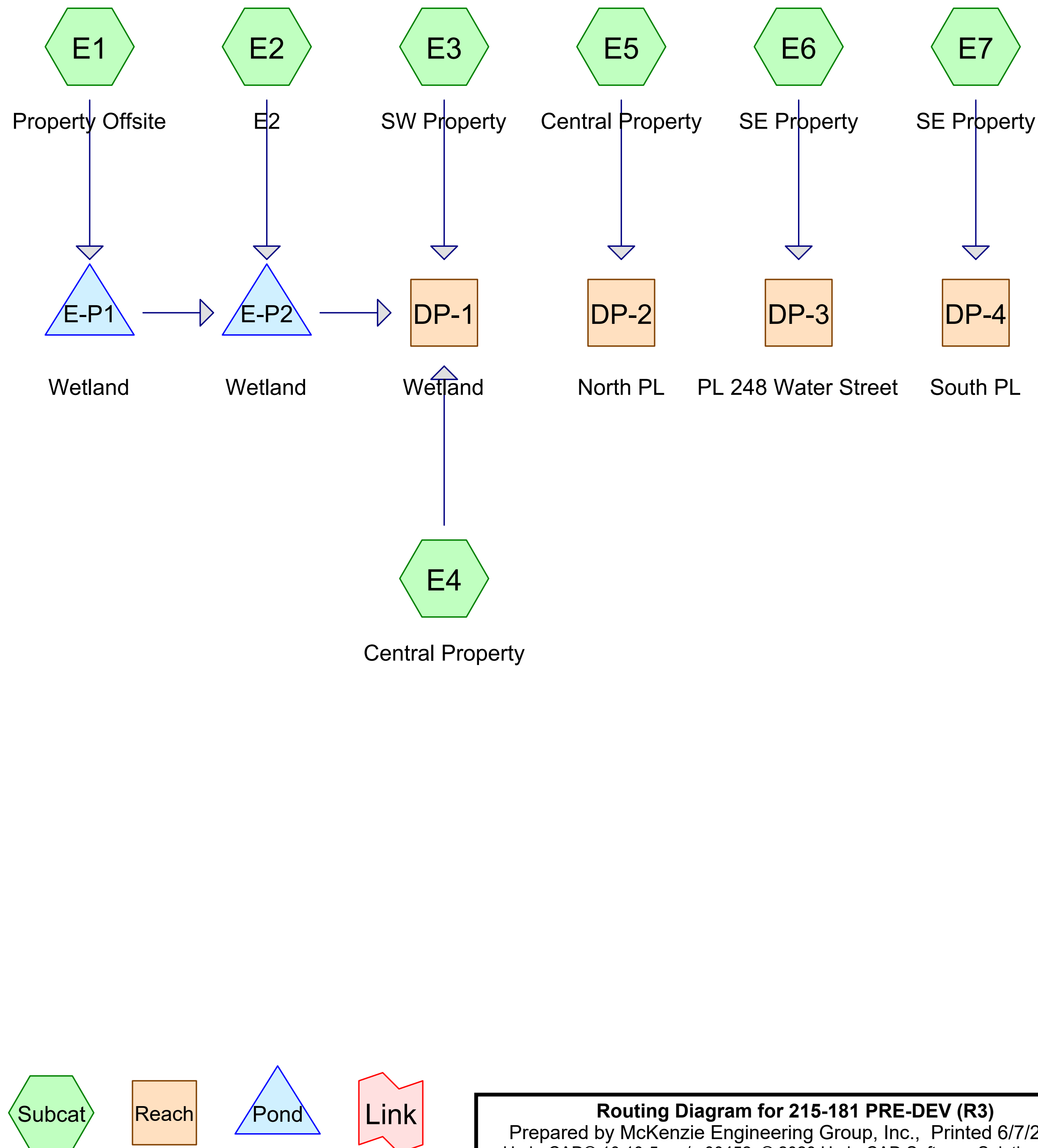
PERMITTING

DRAWN BY:	AJC
DESIGNED BY:	SBS
CHECKED BY:	SBS
APPROVED BY:	BCM
DATE:	AUGUST 1, 2018
SCALE:	1"=100'
PROJECT NO.:	215-181

DWG. TITLE:
PRE-DEVELOPMENT WATERSHED PLAN

DWG. NO.:
WS-1

M: \MEG\2015 PROJECTS\215-181\DWGS\CUT SHEETS\ZBA APPLICATION\SUBMISSION (R3)\215-181 WATERSHED (R3).DWG



Routing Diagram for 215-181 PRE-DEV (R3)
Prepared by McKenzie Engineering Group, Inc., Printed 6/7/2021
HydroCAD® 10.10-5a s/n 00452 © 2020 HydroCAD Software Solutions LLC

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-yr	Type III 24-hr		Default	24.00	1	3.40	2
2	10-yr	Type III 24-hr		Default	24.00	1	4.70	2
3	25-yr	Type III 24-hr		Default	24.00	1	5.60	2
4	100-yr	Type III 24-hr		Default	24.00	1	7.00	2

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.270	49	50-75% Grass cover, Fair, HSG A (E6)
1.370	39	>75% Grass cover, Good, HSG A (OFFSITE) (E5, E6)
0.627	74	>75% Grass cover, Good, HSG C (E5)
0.295	98	Impervious, HSG A (OFFSITE) (E3, E5)
0.018	98	Paved parking, HSG A (E6)
0.273	98	Paved parking, HSG A (OFFSITE) (E2, E6)
0.106	98	Paved parking, HSG C (OFFSITE) (E2)
0.062	98	Pavement, HSG A (E5)
0.086	98	Pavement, HSG A (OFFSITE) (E5)
0.046	98	Roofs, HSG A (E5)
3.277	89	Urban commercial, 85% imp, HSG A (OFFSITE) (E1)
1.124	94	Urban commercial, 85% imp, HSG C (OFFSITE) (E1)
0.657	78	Wetlands/woods, HSG A (E2)
0.199	78	Wetlands/woods, HSG A (OFFSITE) (E1)
0.136	78	Wetlands/woods, HSG C (E2)
0.133	78	Wetlands/woods, HSG C (OFFSITE) (E1, E2)
0.463	78	Wetlands/woods. HSG A (OFFSITE) (E2)
2.175	30	Woods, Fair, HSG A (OFFSITE) (E3)
11.731	30	Woods, Good, HSG A (E2, E3, E4, E5, E6)
2.648	30	Woods, Good, HSG A (OFFSITE) (E1, E2, E5, E6)
6.054	70	Woods, Good, HSG C (E2, E4, E5, E6, E7)
0.702	70	Woods, Good, HSG C (OFFSITE) (E1, E2, E6)
32.450	**52**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
23.569	HSG A	E1, E2, E3, E4, E5, E6
0.000	HSG B	
8.881	HSG C	E1, E2, E4, E5, E6, E7
0.000	HSG D	
0.000	Other	
32.450		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.270	0.000	0.000	0.000	0.000	0.270	50-75% Grass cover, Fair	E6
1.370	0.000	0.627	0.000	0.000	1.997	>75% Grass cover, Good	E5, E6
0.295	0.000	0.000	0.000	0.000	0.295	Impervious	E3, E5
0.291	0.000	0.106	0.000	0.000	0.397	Paved parking	E2, E6
0.148	0.000	0.000	0.000	0.000	0.148	Pavement	E5
0.046	0.000	0.000	0.000	0.000	0.046	Roofs	E5
3.277	0.000	1.124	0.000	0.000	4.401	Urban commercial, 85% imp	E1
0.856	0.000	0.269	0.000	0.000	1.126	Wetlands/woods	E1, E2
0.463	0.000	0.000	0.000	0.000	0.463	Wetlands/woods.	E2
2.175	0.000	0.000	0.000	0.000	2.175	Woods, Fair	E3
14.379	0.000	6.755	0.000	0.000	21.134	Woods, Good	E1, E2, E3, E4, E5, E6, E7
23.569	**0.000**	**8.881**	**0.000**	**0.000**	**32.450**	**TOTAL AREA**	

Time span=0.00-72.00 hrs, dt=0.02 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment E1: Property Offsite	Runoff Area=260,170 sf 62.63% Impervious Runoff Depth=1.56" Flow Length=343' Tc=31.4 min CN=80 Runoff=5.98 cfs 0.775 af
Subcatchment E2: E2	Runoff Area=225,440 sf 6.06% Impervious Runoff Depth=0.57" Flow Length=319' Tc=21.2 min CN=62 Runoff=1.68 cfs 0.246 af
Subcatchment E3: SW Property	Runoff Area=256,545 sf 1.84% Impervious Runoff Depth=0.00" Flow Length=683' Tc=13.5 min CN=31 Runoff=0.00 cfs 0.000 af
Subcatchment E4: Central Property	Runoff Area=295,827 sf 0.00% Impervious Runoff Depth=0.05" Flow Length=808' Tc=17.9 min CN=44 Runoff=0.05 cfs 0.030 af
Subcatchment E5: Central Property	Runoff Area=276,580 sf 5.99% Impervious Runoff Depth=0.17" Flow Length=808' Tc=17.9 min CN=50 Runoff=0.24 cfs 0.091 af
Subcatchment E6: SE Property	Runoff Area=90,483 sf 4.01% Impervious Runoff Depth=0.00" Flow Length=290' Tc=13.3 min CN=38 Runoff=0.00 cfs 0.000 af
Subcatchment E7: SE Property	Runoff Area=8,473 sf 0.00% Impervious Runoff Depth=0.95" Tc=6.0 min CN=70 Runoff=0.20 cfs 0.015 af
Reach DP-1: Wetland	Inflow=1.53 cfs 0.644 af Outflow=1.53 cfs 0.644 af
Reach DP-2: North PL	Inflow=0.24 cfs 0.091 af Outflow=0.24 cfs 0.091 af
Reach DP-3: PL 248 Water Street	Inflow=0.00 cfs 0.000 af Outflow=0.00 cfs 0.000 af
Reach DP-4: South PL	Inflow=0.20 cfs 0.015 af Outflow=0.20 cfs 0.015 af
Pond E-P1: Wetland	Peak Elev=18.04' Storage=7,800 cf Inflow=5.98 cfs 0.775 af Outflow=5.93 cfs 0.607 af
Pond E-P2: Wetland	Peak Elev=13.02' Storage=15,036 cf Inflow=7.51 cfs 0.853 af Outflow=1.51 cfs 0.614 af

Total Runoff Area = 32.450 ac Runoff Volume = 1.158 af Average Runoff Depth = 0.43"
85.74% Pervious = 27.824 ac 14.26% Impervious = 4.626 ac

Summary for Subcatchment E1: Property Offsite

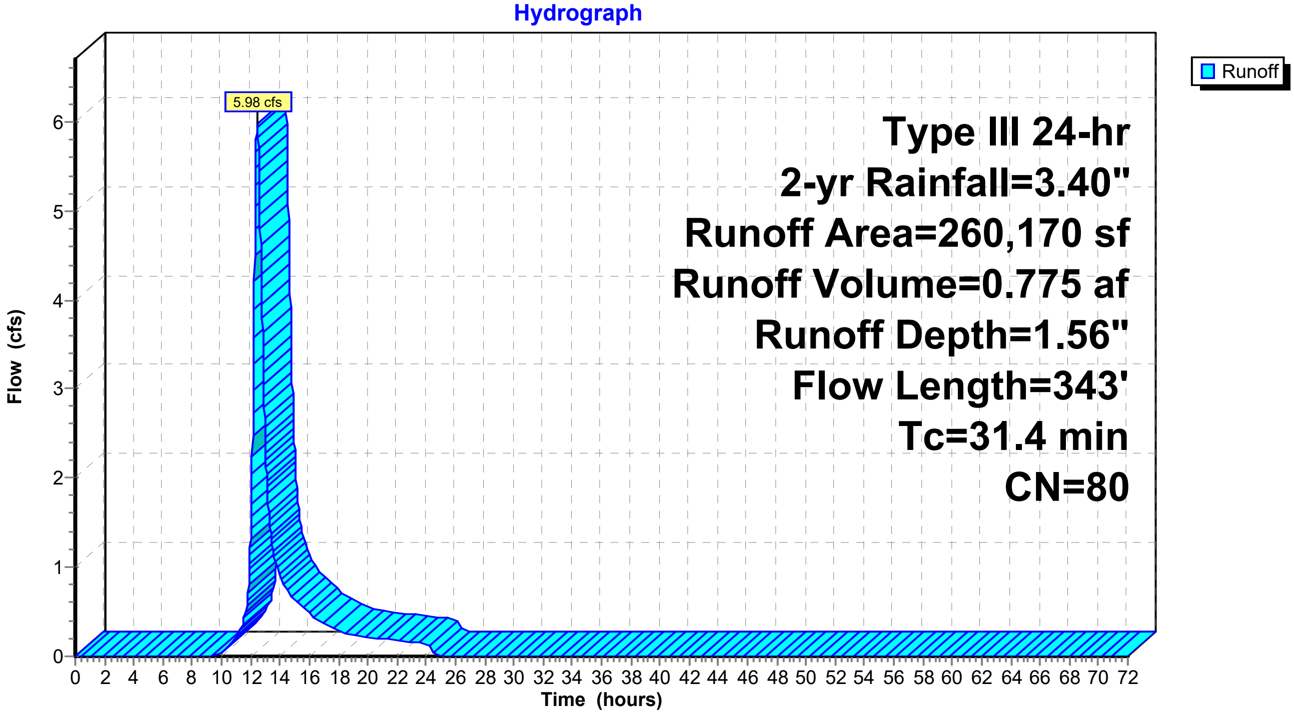
Runoff = 5.98 cfs @ 12.45 hrs, Volume= 0.775 af, Depth= 1.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-yr Rainfall=3.40"

	Area (sf)	CN	Description
*	142,754	89	Urban commercial, 85% imp, HSG A (OFFSITE)
*	31,587	30	Woods, Good, HSG A (OFFSITE)
*	48,943	94	Urban commercial, 85% imp, HSG C (OFFSITE)
*	8,690	78	Wetlands/woods, HSG A (OFFSITE)
*	25,996	70	Woods, Good, HSG C (OFFSITE)
*	2,200	78	Wetlands/woods, HSG C (OFFSITE)
	260,170	80	Weighted Average
	97,228		37.37% Pervious Area
	162,942		62.63% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.8	50	0.0040	0.04		**Sheet Flow, Start** Woods: Light underbrush n= 0.400 P2= 3.40"
6.6	126	0.0040	0.32		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
2.0	167	0.0800	1.41		**Shallow Concentrated Flow, C-WETLAND** Woodland Kv= 5.0 fps
31.4	343	Total			

Subcatchment E1: Property Offsite



Summary for Subcatchment E2: E2

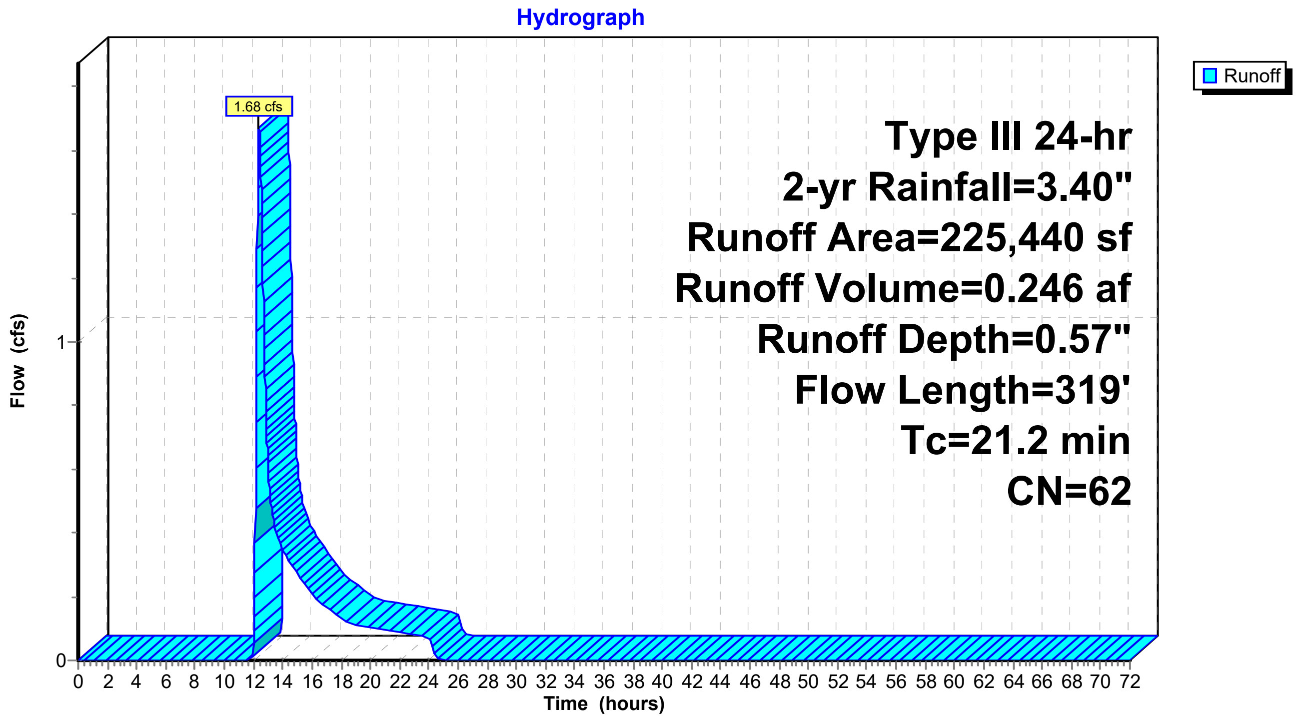
Runoff = 1.68 cfs @ 12.38 hrs, Volume= 0.246 af, Depth= 0.57"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-yr Rainfall=3.40"

	Area (sf)	CN	Description
*	9,050	98	Paved parking, HSG A (OFFSITE)
*	49,865	30	Woods, Good, HSG A (OFFSITE)
*	20,149	78	Wetlands/woods. HSG A (OFFSITE)
*	4,604	98	Paved parking, HSG C (OFFSITE)
*	4,156	70	Woods, Good, HSG C (OFFSITE)
*	3,605	78	Wetlands/woods, HSG C (OFFSITE)
	83,652	70	Woods, Good, HSG C
*	5,924	78	Wetlands/woods, HSG C
*	28,611	78	Wetlands/woods, HSG A
	15,824	30	Woods, Good, HSG A
	225,440	62	Weighted Average
	211,786		93.94% Pervious Area
	13,654		6.06% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.8	50	0.0100	0.05		**Sheet Flow, START** Woods: Light underbrush n= 0.400 P2= 3.40"
3.2	95	0.0100	0.50		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
2.2	174	0.0710	1.33		**Shallow Concentrated Flow, c-WETLAND** Woodland Kv= 5.0 fps
21.2	319	Total			

Subcatchment E2: E2



Summary for Subcatchment E3: SW Property

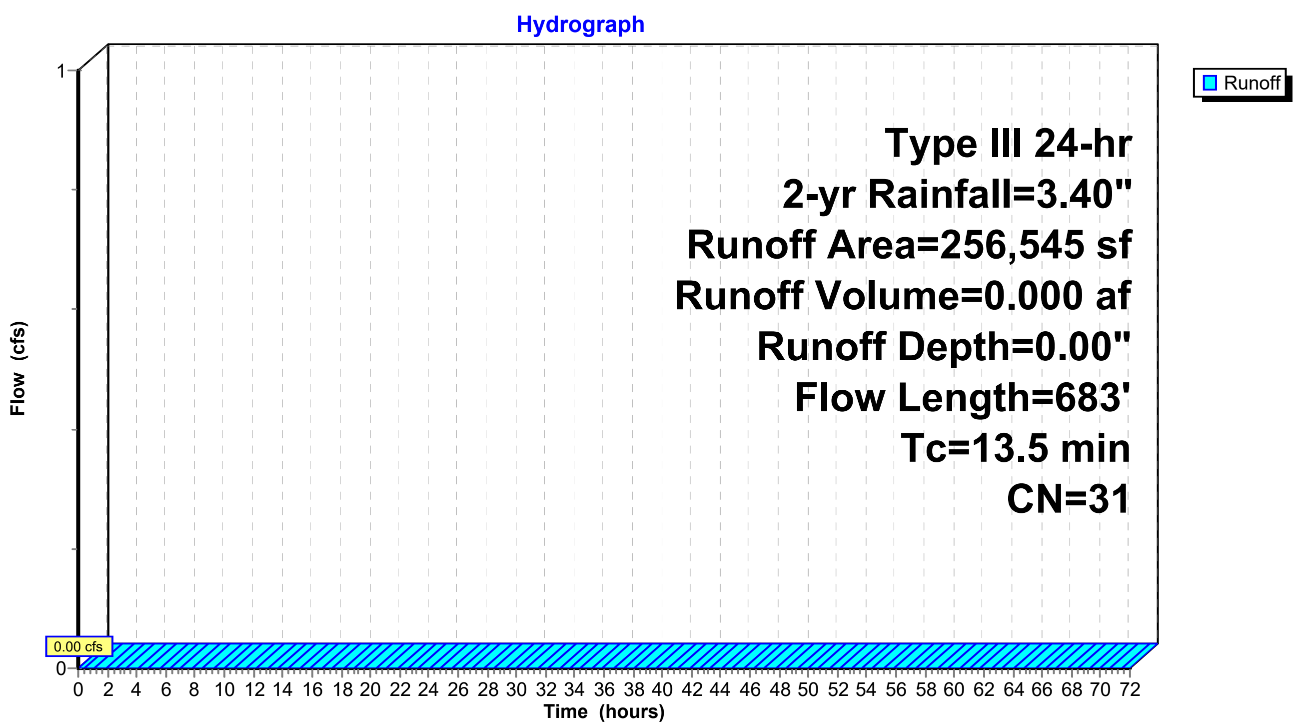
Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-yr Rainfall=3.40"

	Area (sf)	CN	Description
	157,110	30	Woods, Good, HSG A
*	94,725	30	Woods, Fair, HSG A (OFFSITE)
*	4,710	98	Impervious, HSG A (OFFSITE)
	256,545	31	Weighted Average
	251,835		98.16% Pervious Area
	4,710		1.84% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.2	50	0.0300	0.08		**Sheet Flow, Start Off Property** Woods: Light underbrush n= 0.400 P2= 3.40"
3.3	633	0.0400	3.22		**Shallow Concentrated Flow, To Wetland** Unpaved Kv= 16.1 fps
13.5	683	Total			

Subcatchment E3: SW Property



Summary for Subcatchment E4: Central Property

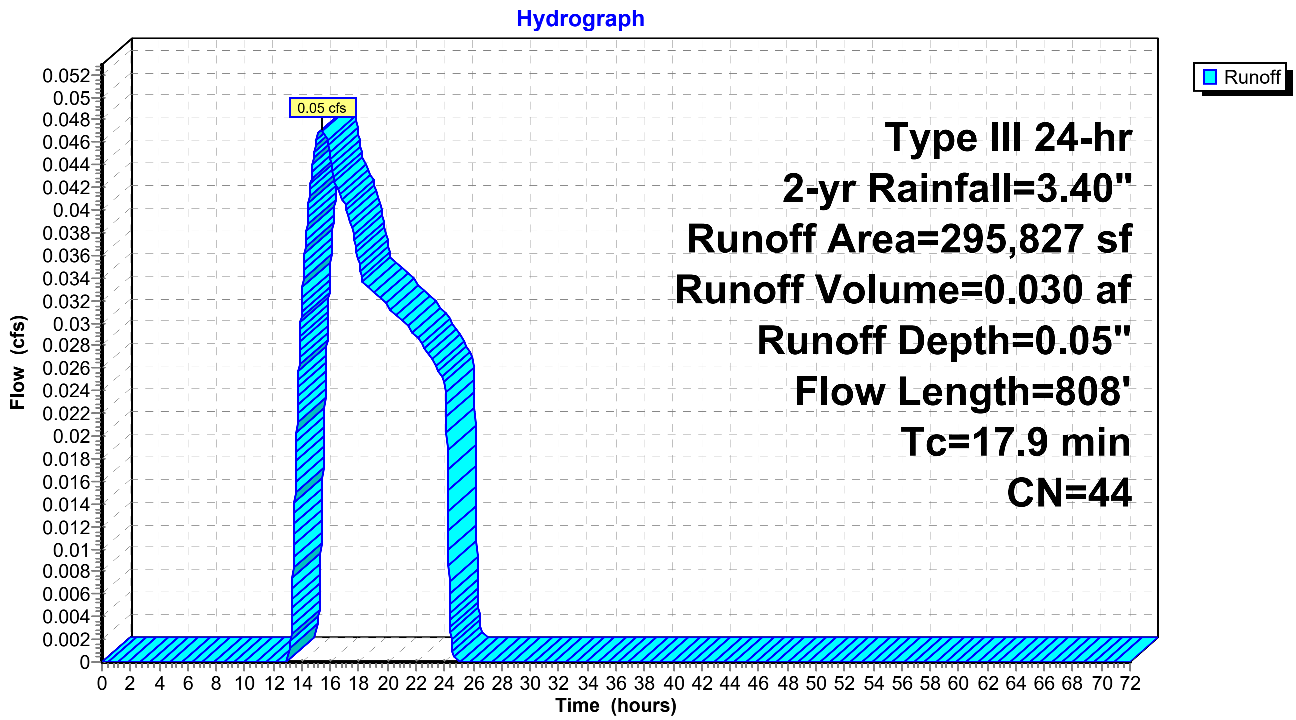
Runoff = 0.05 cfs @ 15.38 hrs, Volume= 0.030 af, Depth= 0.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-yr Rainfall=3.40"

Area (sf)	CN	Description
195,082	30	Woods, Good, HSG A
100,745	70	Woods, Good, HSG C
295,827	44	Weighted Average
295,827		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.4	50	0.0150	0.06		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.40"
4.5	758	0.0310	2.83		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
17.9	808	Total			

Subcatchment E4: Central Property



Summary for Subcatchment E5: Central Property

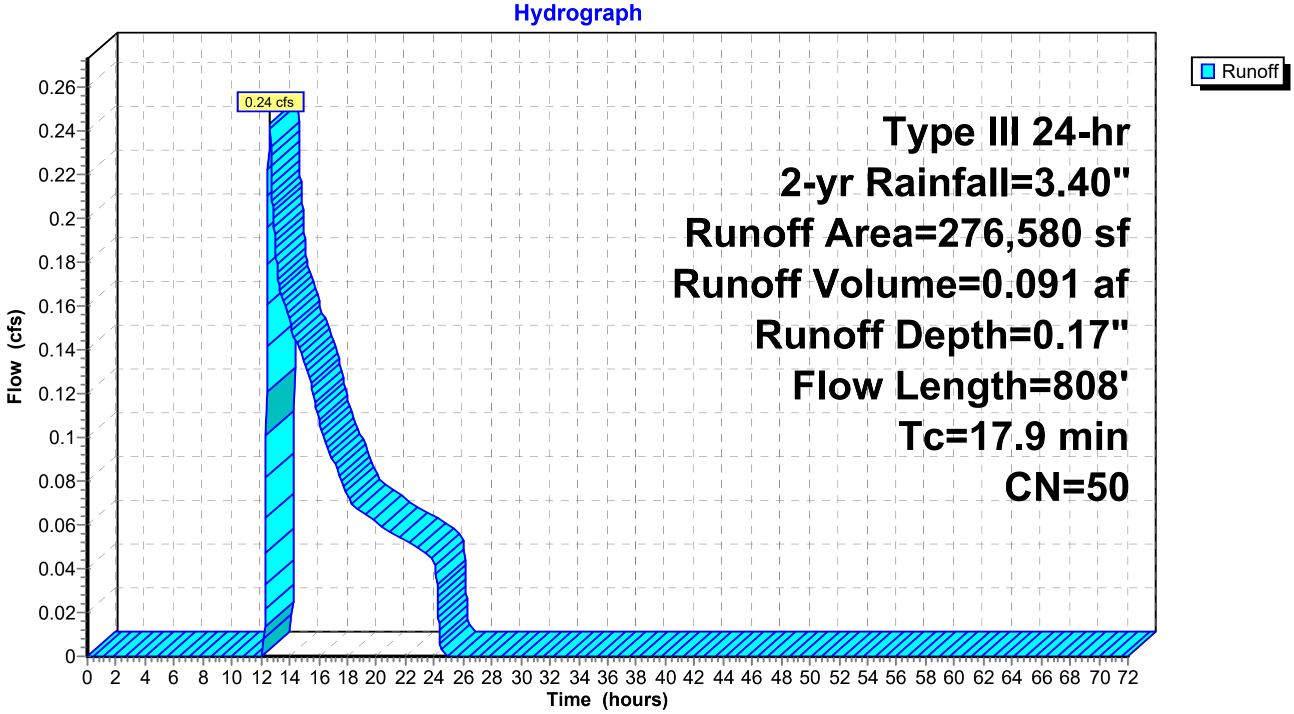
Runoff = 0.24 cfs @ 12.61 hrs, Volume= 0.091 af, Depth= 0.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-yr Rainfall=3.40"

	Area (sf)	CN	Description
*	3,765	98	Pavement, HSG A (OFFSITE)
*	8,121	98	Impervious, HSG A (OFFSITE)
*	17,970	30	Woods, Good, HSG A (OFFSITE)
*	41,632	39	>75% Grass cover, Good, HSG A (OFFSITE)
	69,621	70	Woods, Good, HSG C
	103,483	30	Woods, Good, HSG A
*	2,694	98	Pavement, HSG A
*	1,985	98	Roofs, HSG A
	27,309	74	>75% Grass cover, Good, HSG C
	276,580	50	Weighted Average
	260,015		94.01% Pervious Area
	16,565		5.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.4	50	0.0150	0.06		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.40"
4.5	758	0.0310	2.83		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
17.9	808	Total			

Subcatchment E5: Central Property



Summary for Subcatchment E6: SE Property

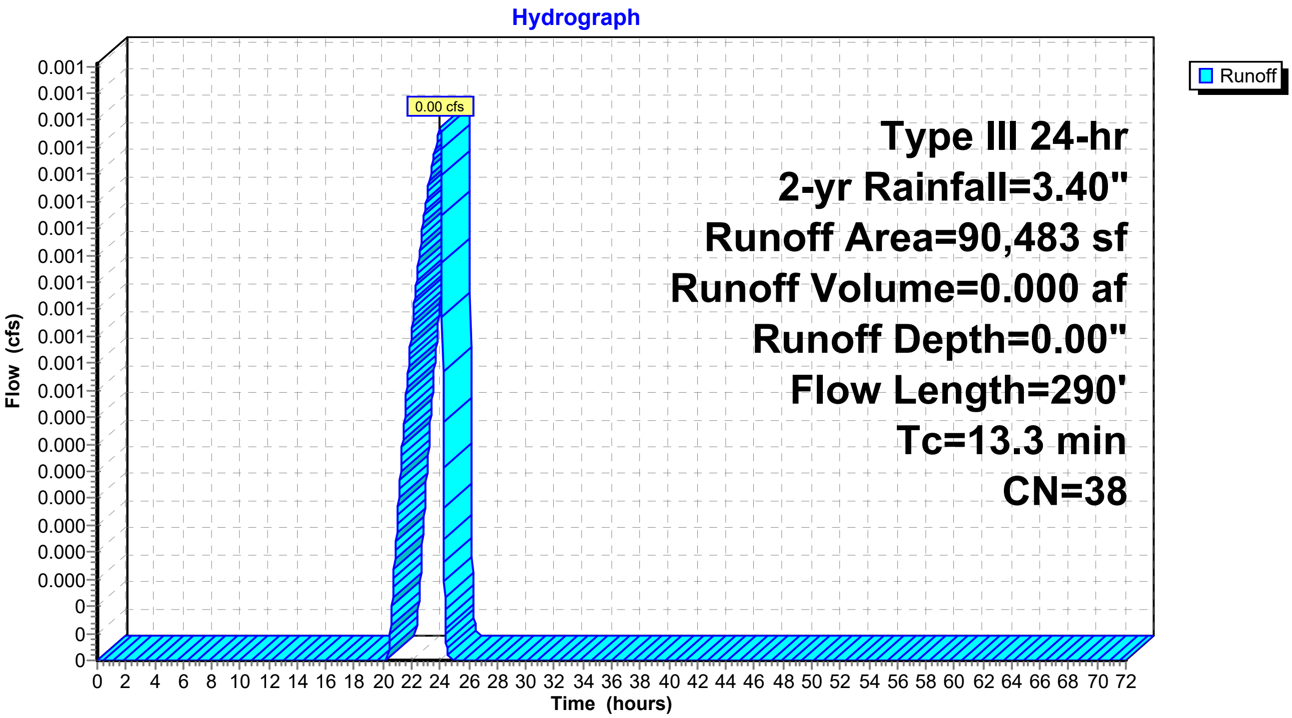
Runoff = 0.00 cfs @ 24.02 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-yr Rainfall=3.40"

	Area (sf)	CN	Description
	39,519	30	Woods, Good, HSG A
	1,209	70	Woods, Good, HSG C
	11,750	49	50-75% Grass cover, Fair, HSG A
	770	98	Paved parking, HSG A
*	15,917	30	Woods, Good, HSG A (OFFSITE)
*	406	70	Woods, Good, HSG C (OFFSITE)
*	18,054	39	>75% Grass cover, Good, HSG A (OFFSITE)
*	2,858	98	Paved parking, HSG A (OFFSITE)
	90,483	38	Weighted Average
	86,855		95.99% Pervious Area
	3,628		4.01% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.5	50	0.0220	0.07		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.40"
1.8	240	0.0200	2.28		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
13.3	290	Total			

Subcatchment E6: SE Property



Summary for Subcatchment E7: SE Property

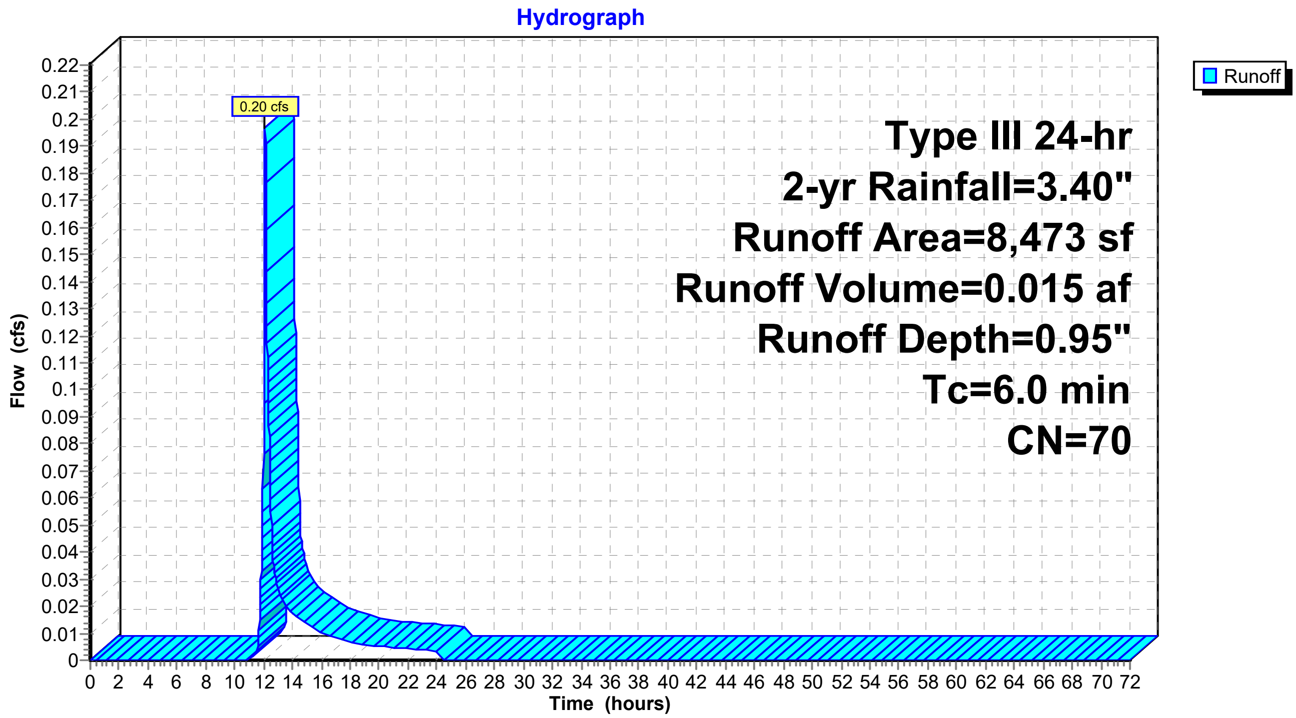
Runoff = 0.20 cfs @ 12.10 hrs, Volume= 0.015 af, Depth= 0.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-yr Rainfall=3.40"

Area (sf)	CN	Description
8,473	70	Woods, Good, HSG C
8,473		100.00% Pervious Area

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

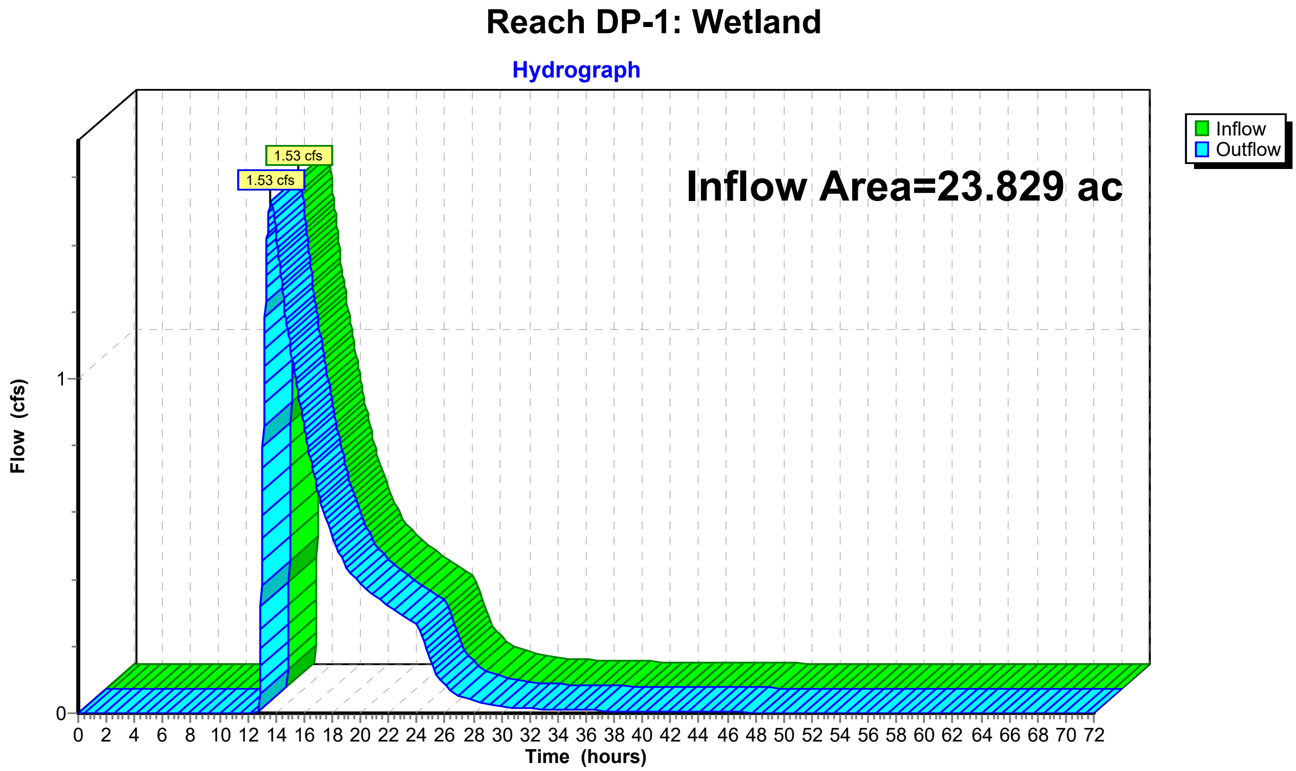
Subcatchment E7: SE Property



Summary for Reach DP-1: Wetland

Inflow Area = 23.829 ac, 17.47% Impervious, Inflow Depth > 0.32" for 2-yr event
Inflow = 1.53 cfs @ 13.64 hrs, Volume= 0.644 af
Outflow = 1.53 cfs @ 13.64 hrs, Volume= 0.644 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs

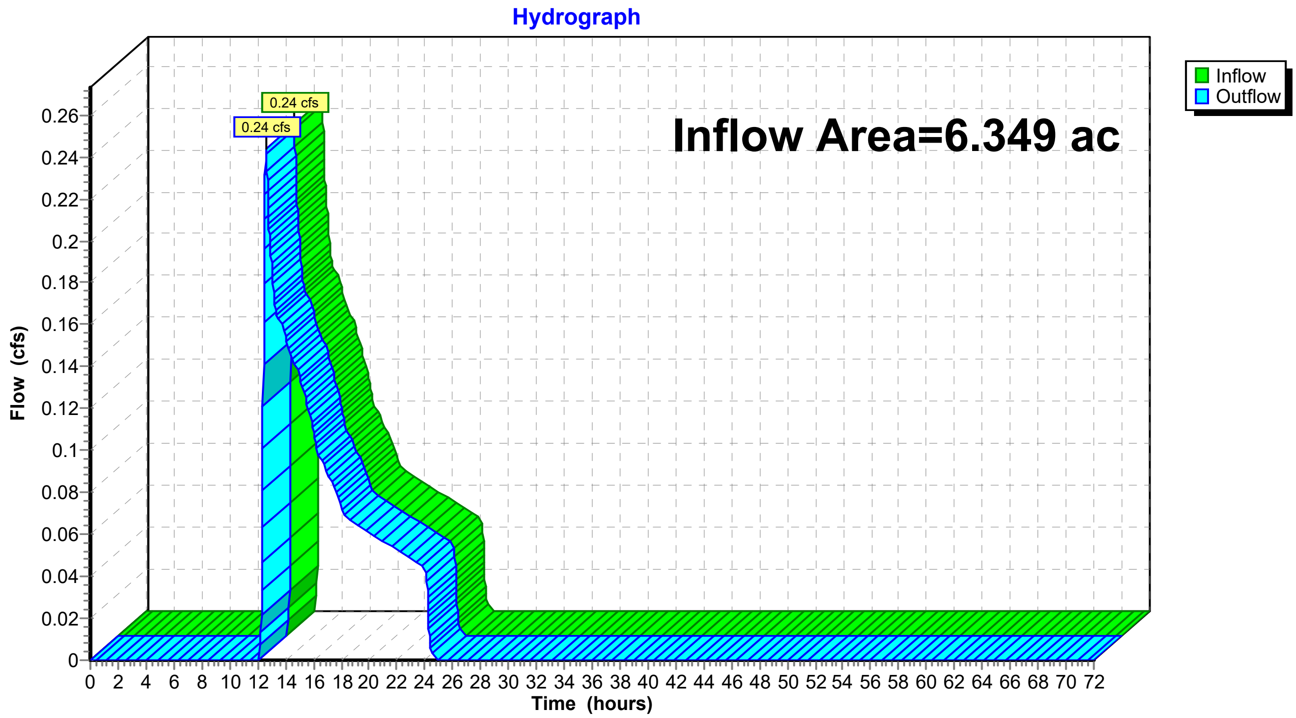


Summary for Reach DP-2: North PL

Inflow Area =	6.349 ac,	5.99% Impervious, Inflow Depth = 0.17"	for 2-yr event	
Inflow =	0.24 cfs @	12.61 hrs, Volume=	0.091 af	
Outflow =	0.24 cfs @	12.61 hrs, Volume=	0.091 af,	Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs

Reach DP-2: North PL

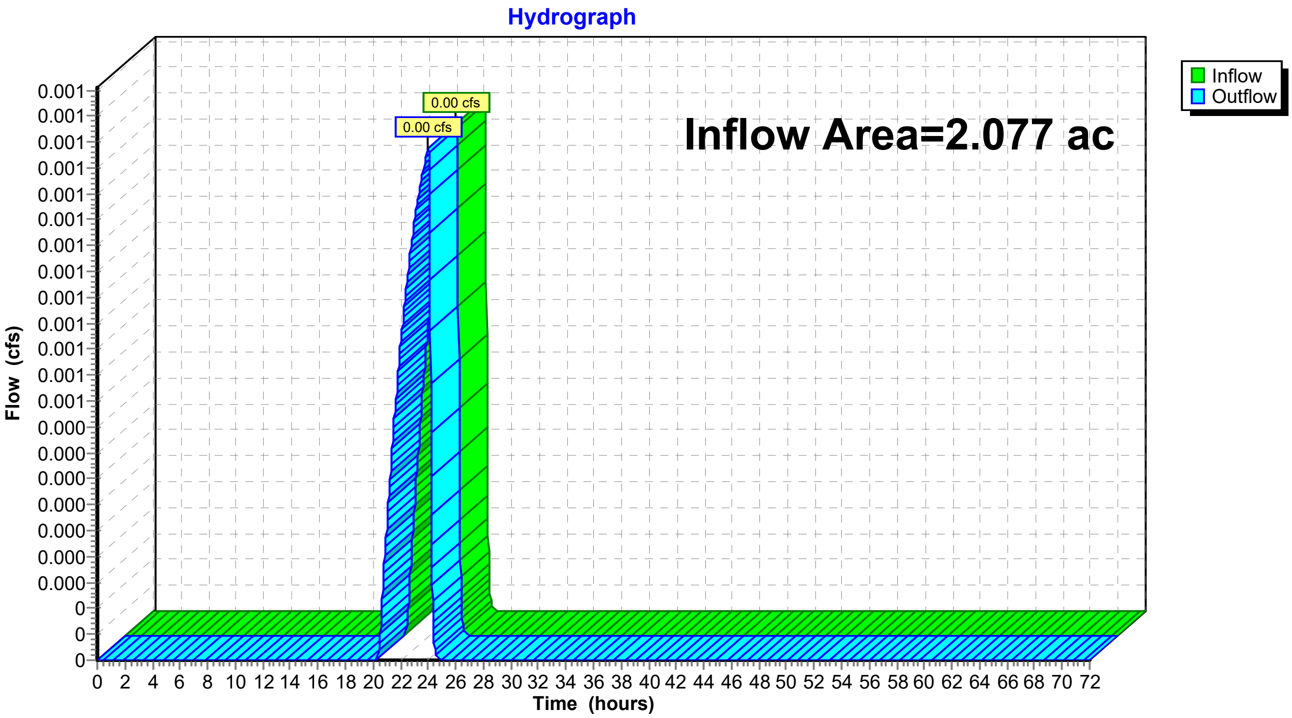


Summary for Reach DP-3: PL 248 Water Street

Inflow Area = 2.077 ac, 4.01% Impervious, Inflow Depth = 0.00" for 2-yr event
Inflow = 0.00 cfs @ 24.02 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 24.02 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs

Reach DP-3: PL 248 Water Street

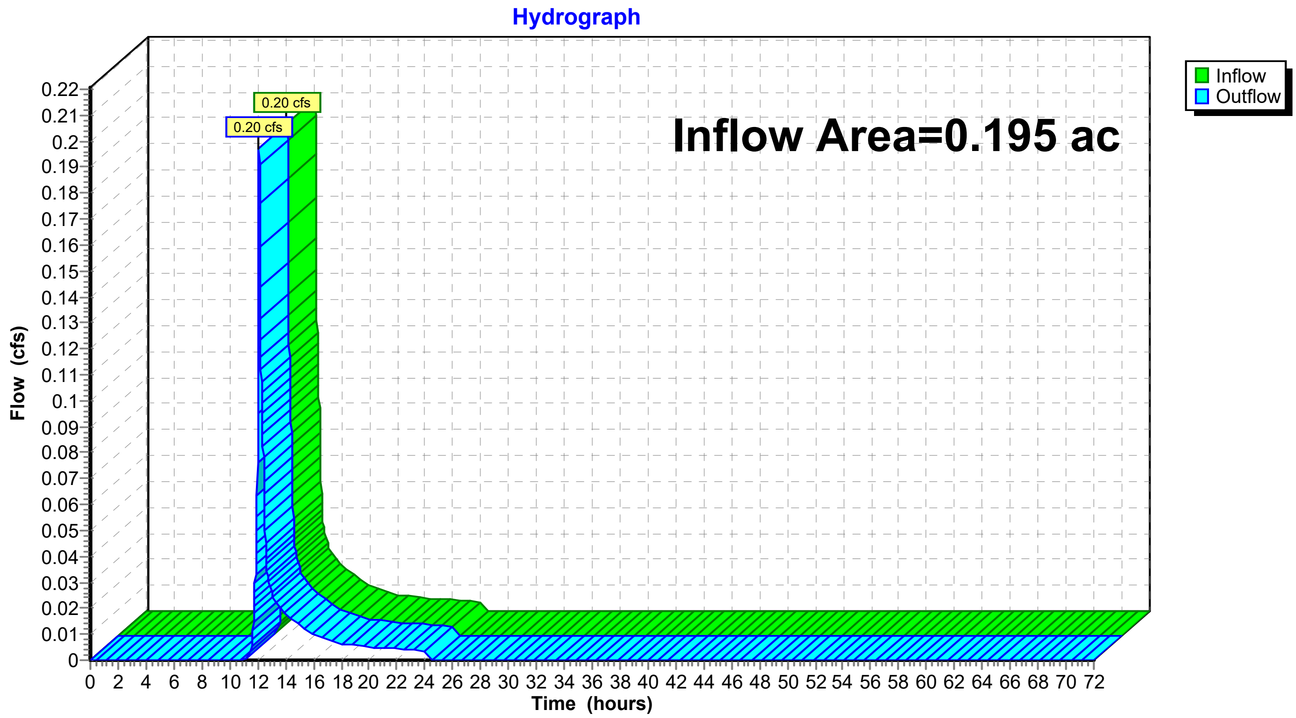


Summary for Reach DP-4: South PL

Inflow Area =	0.195 ac,	0.00% Impervious, Inflow Depth = 0.95"	for 2-yr event	
Inflow =	0.20 cfs @	12.10 hrs, Volume=	0.015 af	
Outflow =	0.20 cfs @	12.10 hrs, Volume=	0.015 af,	Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs

Reach DP-4: South PL



Summary for Pond E-P1: Wetland

Inflow Area = 5.973 ac, 62.63% Impervious, Inflow Depth = 1.56" for 2-yr event
Inflow = 5.98 cfs @ 12.45 hrs, Volume= 0.775 af
Outflow = 5.93 cfs @ 12.49 hrs, Volume= 0.607 af, Atten= 1%, Lag= 2.0 min
Primary = 5.93 cfs @ 12.49 hrs, Volume= 0.607 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 18.04' @ 12.49 hrs Surf.Area= 12,886 sf Storage= 7,800 cf

Plug-Flow detention time= 125.2 min calculated for 0.607 af (78% of inflow)
Center-of-Mass det. time= 41.8 min (905.0 - 863.2)

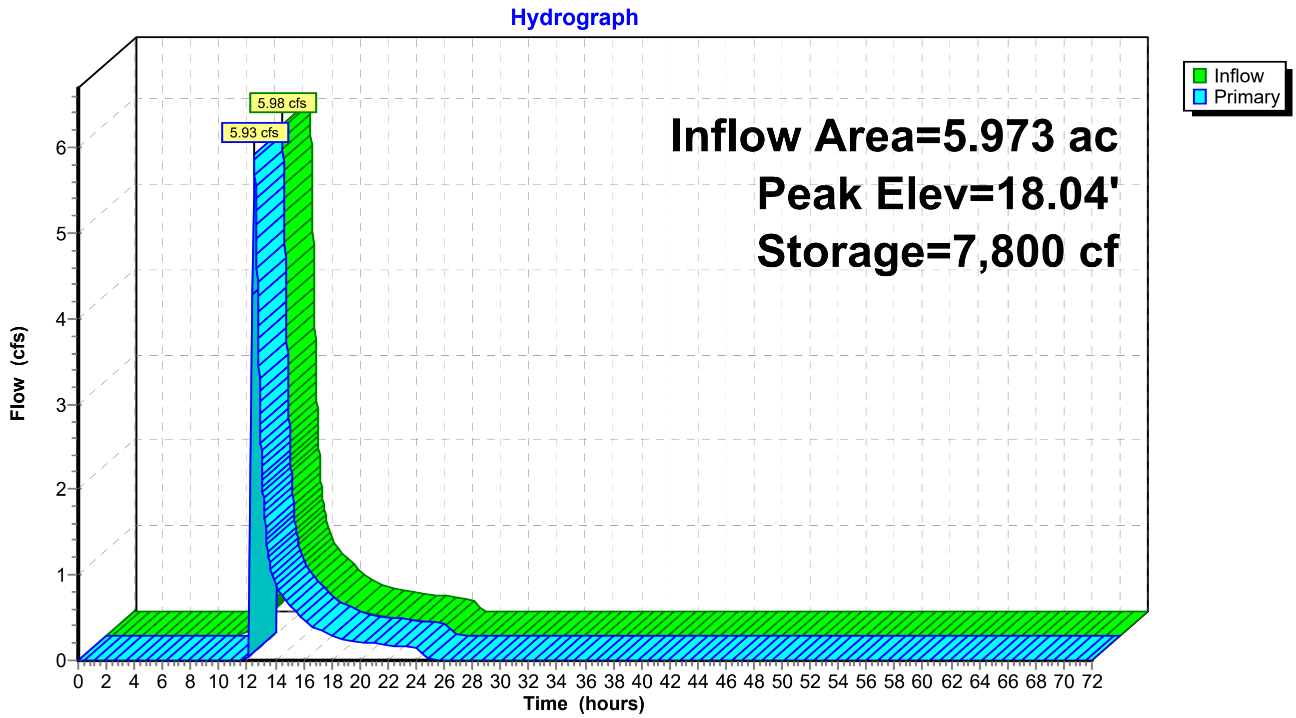
Volume	Invert	Avail.Storage	Storage Description
#1	17.00'	236,253 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
17.00	2,349	0	0
18.00	12,281	7,315	7,315
19.00	27,986	20,134	27,449
20.00	37,607	32,797	60,245
21.00	49,582	43,595	103,840
22.00	66,971	58,277	162,116
23.00	81,302	74,137	236,253

Device	Routing	Invert	Outlet Devices
#1	Primary	18.00'	**Asymmetrical Weir, C= 3.27** Offset (feet) 0.00 10.80 18.43 23.94 57.50 86.92 287.08 357.73 427.57 483.95 528.04 555.94 Elev. (feet) 23.00 22.00 21.00 20.00 19.00 18.00 18.00 19.00 20.00 21.00 22.00 23.00

Primary OutFlow Max=4.98 cfs @ 12.49 hrs HW=18.04' (Free Discharge)
└─**1=Asymmetrical Weir** (Weir Controls 4.98 cfs @ 0.63 fps)

Pond E-P1: Wetland



Summary for Pond E-P2: Wetland

Inflow Area = 11.148 ac, 36.37% Impervious, Inflow Depth = 0.92" for 2-yr event
Inflow = 7.51 cfs @ 12.48 hrs, Volume= 0.853 af
Outflow = 1.51 cfs @ 13.62 hrs, Volume= 0.614 af, Atten= 80%, Lag= 68.4 min
Primary = 1.51 cfs @ 13.62 hrs, Volume= 0.614 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Peak Elev= 13.02' @ 13.62 hrs Surf.Area= 27,403 sf Storage= 15,036 cf

Plug-Flow detention time= 264.1 min calculated for 0.614 af (72% of inflow)
Center-of-Mass det. time= 161.3 min (1,069.7 - 908.3)

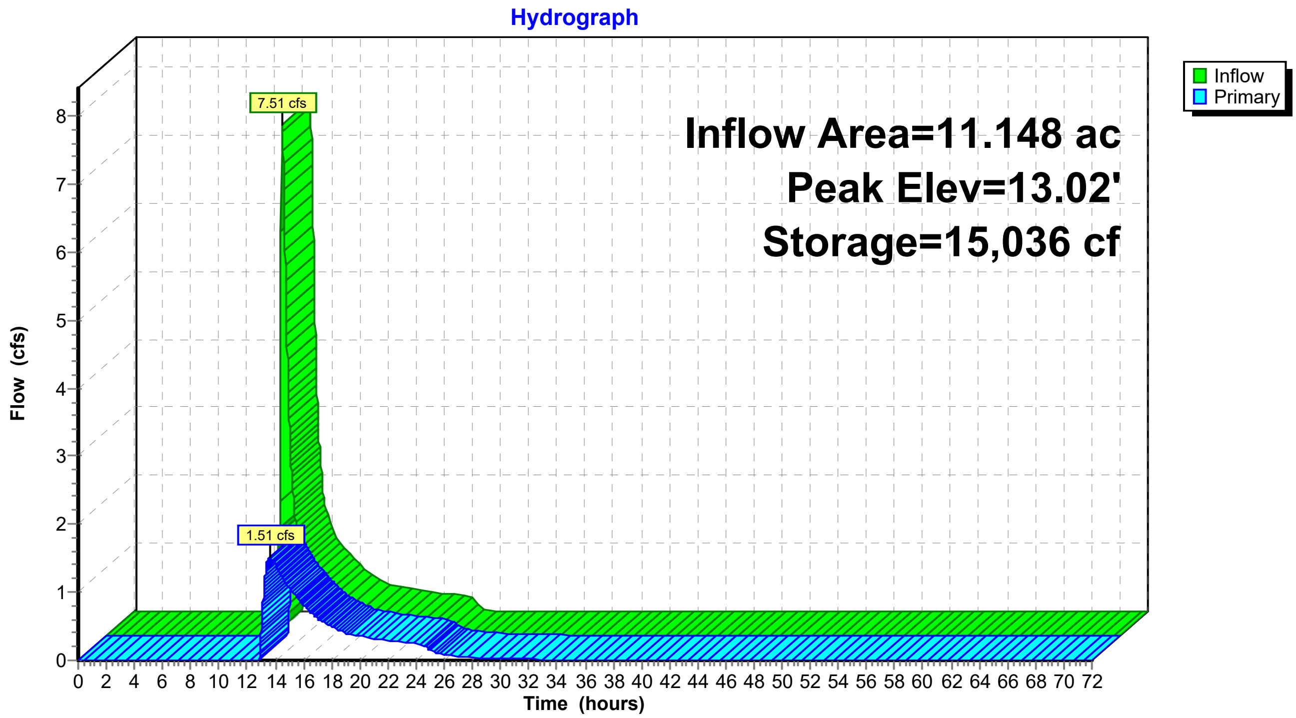
Volume	Invert	Avail.Storage	Storage Description
#1	12.00'	47,617 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
12.00	1,826	0	0
13.00	27,167	14,497	14,497
14.00	39,073	33,120	47,617

Device	Routing	Invert	Outlet Devices
#1	Primary	12.83'	**Asymmetrical Weir, C= 3.27** Offset (feet) 0.00 13.92 43.45 57.57 61.89 74.87 84.88 105.86 131.31 Elev. (feet) 14.00 13.56 13.12 13.03 12.83 13.08 13.85 13.88 14.00

Primary OutFlow Max=1.51 cfs @ 13.62 hrs HW=13.02' (Free Discharge)
└─**1=Asymmetrical Weir** (Weir Controls 1.51 cfs @ 0.57 fps)

Pond E-P2: Wetland



Time span=0.00-72.00 hrs, dt=0.02 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentE1: Property Offsite Runoff Area=260,170 sf 62.63% Impervious Runoff Depth=2.63"
Flow Length=343' Tc=31.4 min CN=80 Runoff=10.20 cfs 1.310 af

SubcatchmentE2: E2 Runoff Area=225,440 sf 6.06% Impervious Runoff Depth=1.26"
Flow Length=319' Tc=21.2 min CN=62 Runoff=4.50 cfs 0.542 af

SubcatchmentE3: SW Property Runoff Area=256,545 sf 1.84% Impervious Runoff Depth=0.00"
Flow Length=683' Tc=13.5 min CN=31 Runoff=0.01 cfs 0.001 af

SubcatchmentE4: Central Property Runoff Area=295,827 sf 0.00% Impervious Runoff Depth=0.31"
Flow Length=808' Tc=17.9 min CN=44 Runoff=0.66 cfs 0.177 af

SubcatchmentE5: Central Property Runoff Area=276,580 sf 5.99% Impervious Runoff Depth=0.57"
Flow Length=808' Tc=17.9 min CN=50 Runoff=1.79 cfs 0.304 af

SubcatchmentE6: SE Property Runoff Area=90,483 sf 4.01% Impervious Runoff Depth=0.12"
Flow Length=290' Tc=13.3 min CN=38 Runoff=0.03 cfs 0.020 af

SubcatchmentE7: SE Property Runoff Area=8,473 sf 0.00% Impervious Runoff Depth=1.82"
Tc=6.0 min CN=70 Runoff=0.40 cfs 0.029 af

Reach DP-1: Wetland Inflow=10.20 cfs 1.623 af
Outflow=10.20 cfs 1.623 af

Reach DP-2: North PL Inflow=1.79 cfs 0.304 af
Outflow=1.79 cfs 0.304 af

Reach DP-3: PL 248 Water Street Inflow=0.03 cfs 0.020 af
Outflow=0.03 cfs 0.020 af

Reach DP-4: South PL Inflow=0.40 cfs 0.029 af
Outflow=0.40 cfs 0.029 af

Pond E-P1: Wetland Peak Elev=18.06' Storage=8,052 cf Inflow=10.20 cfs 1.310 af
Outflow=10.18 cfs 1.143 af

Pond E-P2: Wetland Peak Elev=13.20' Storage=20,172 cf Inflow=14.31 cfs 1.685 af
Outflow=9.66 cfs 1.445 af

Total Runoff Area = 32.450 ac Runoff Volume = 2.384 af Average Runoff Depth = 0.88"
85.74% Pervious = 27.824 ac 14.26% Impervious = 4.626 ac

Summary for Subcatchment E1: Property Offsite

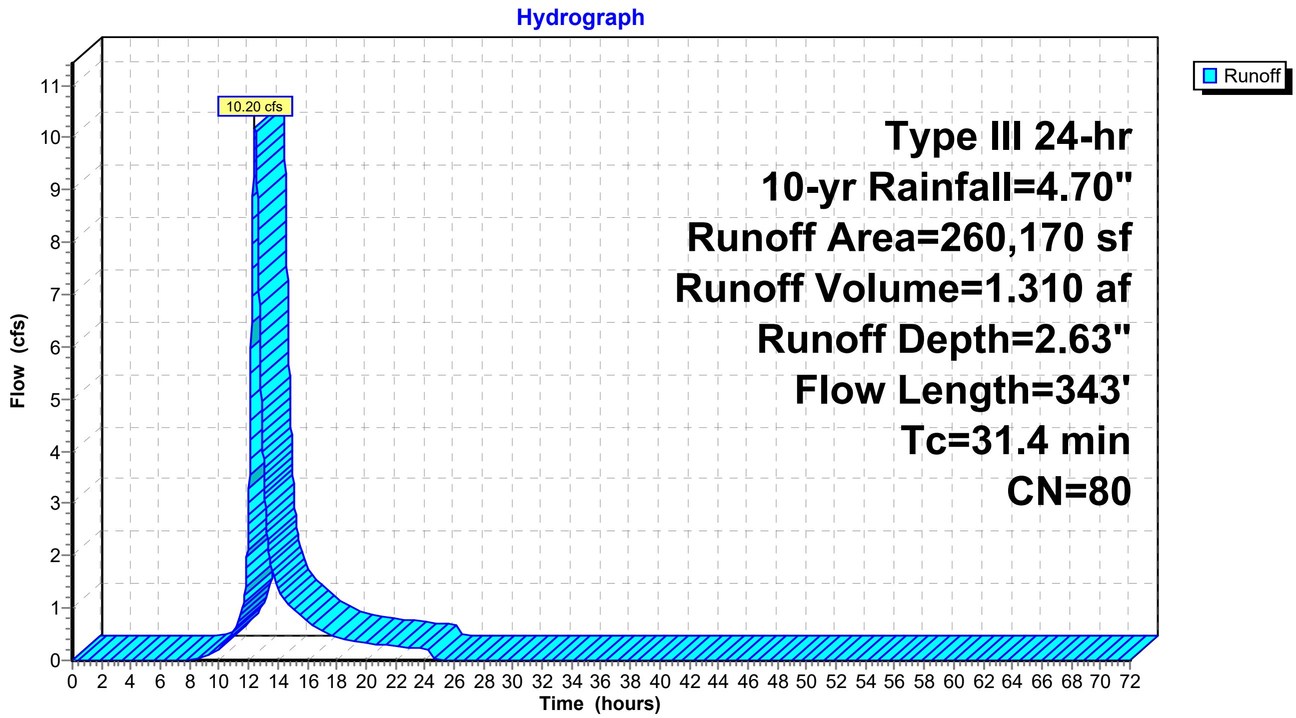
Runoff = 10.20 cfs @ 12.44 hrs, Volume= 1.310 af, Depth= 2.63"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-yr Rainfall=4.70"

	Area (sf)	CN	Description
*	142,754	89	Urban commercial, 85% imp, HSG A (OFFSITE)
*	31,587	30	Woods, Good, HSG A (OFFSITE)
*	48,943	94	Urban commercial, 85% imp, HSG C (OFFSITE)
*	8,690	78	Wetlands/woods, HSG A (OFFSITE)
*	25,996	70	Woods, Good, HSG C (OFFSITE)
*	2,200	78	Wetlands/woods, HSG C (OFFSITE)
	260,170	80	Weighted Average
	97,228		37.37% Pervious Area
	162,942		62.63% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.8	50	0.0040	0.04		**Sheet Flow, Start** Woods: Light underbrush n= 0.400 P2= 3.40"
6.6	126	0.0040	0.32		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
2.0	167	0.0800	1.41		**Shallow Concentrated Flow, C-WETLAND** Woodland Kv= 5.0 fps
31.4	343	Total			

Subcatchment E1: Property Offsite



Summary for Subcatchment E2: E2

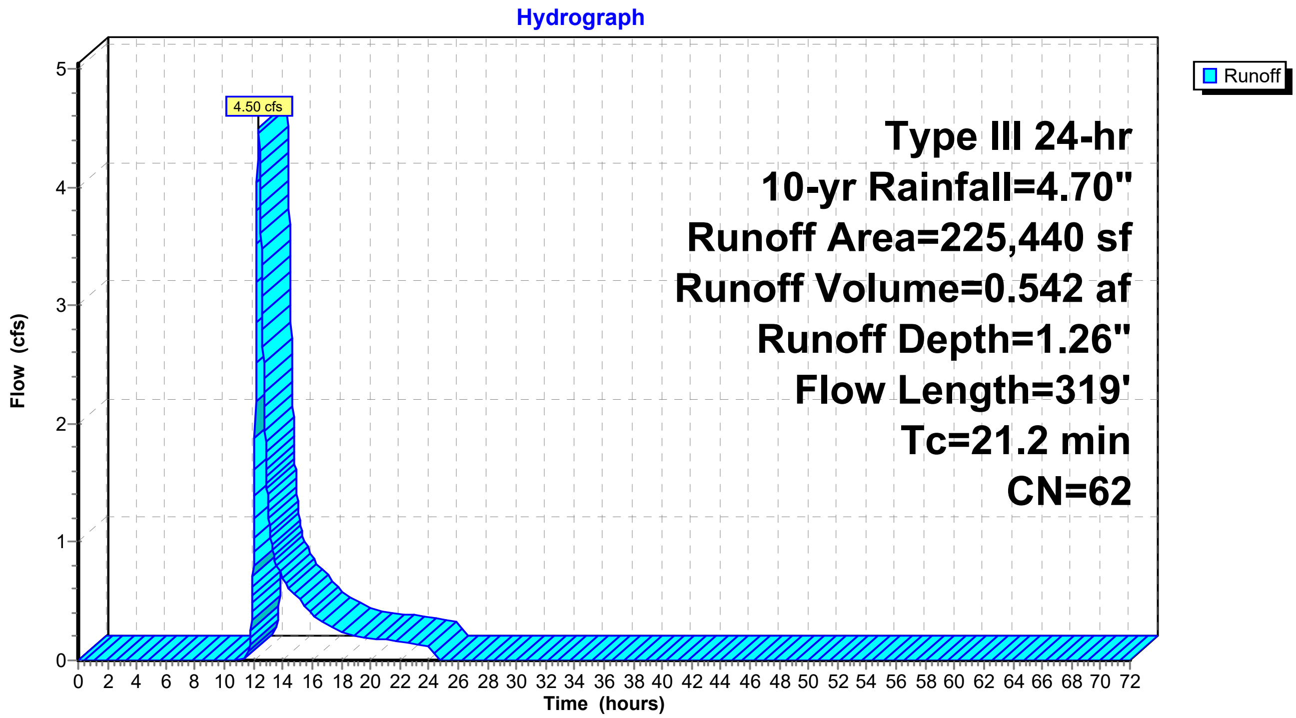
Runoff = 4.50 cfs @ 12.33 hrs, Volume= 0.542 af, Depth= 1.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-yr Rainfall=4.70"

	Area (sf)	CN	Description
*	9,050	98	Paved parking, HSG A (OFFSITE)
*	49,865	30	Woods, Good, HSG A (OFFSITE)
*	20,149	78	Wetlands/woods. HSG A (OFFSITE)
*	4,604	98	Paved parking, HSG C (OFFSITE)
*	4,156	70	Woods, Good, HSG C (OFFSITE)
*	3,605	78	Wetlands/woods, HSG C (OFFSITE)
	83,652	70	Woods, Good, HSG C
*	5,924	78	Wetlands/woods, HSG C
*	28,611	78	Wetlands/woods, HSG A
	15,824	30	Woods, Good, HSG A
	225,440	62	Weighted Average
	211,786		93.94% Pervious Area
	13,654		6.06% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.8	50	0.0100	0.05		**Sheet Flow, START** Woods: Light underbrush n= 0.400 P2= 3.40"
3.2	95	0.0100	0.50		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
2.2	174	0.0710	1.33		**Shallow Concentrated Flow, c-WETLAND** Woodland Kv= 5.0 fps
21.2	319	Total			

Subcatchment E2: E2



Summary for Subcatchment E3: SW Property

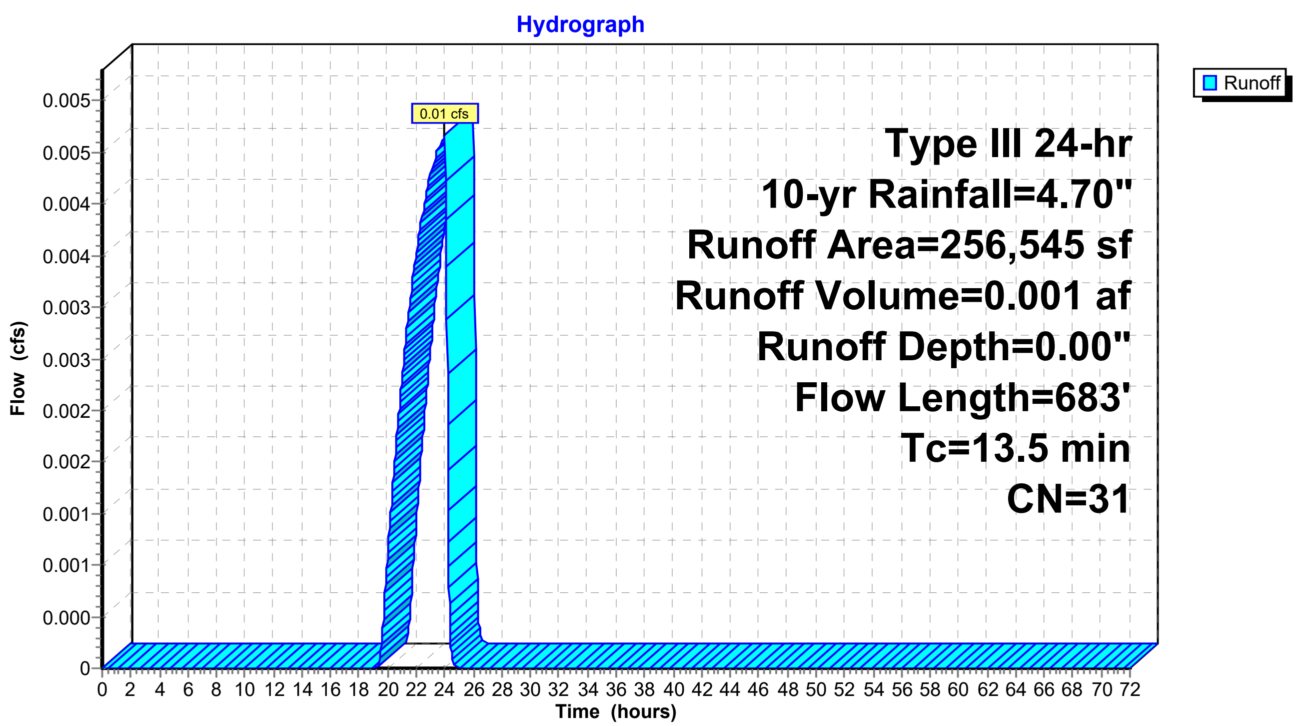
Runoff = 0.01 cfs @ 24.02 hrs, Volume= 0.001 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-yr Rainfall=4.70"

	Area (sf)	CN	Description
	157,110	30	Woods, Good, HSG A
*	94,725	30	Woods, Fair, HSG A (OFFSITE)
*	4,710	98	Impervious, HSG A (OFFSITE)
	256,545	31	Weighted Average
	251,835		98.16% Pervious Area
	4,710		1.84% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.2	50	0.0300	0.08		**Sheet Flow, Start Off Property** Woods: Light underbrush n= 0.400 P2= 3.40"
3.3	633	0.0400	3.22		**Shallow Concentrated Flow, To Wetland** Unpaved Kv= 16.1 fps
13.5	683	Total			

Subcatchment E3: SW Property



Summary for Subcatchment E4: Central Property

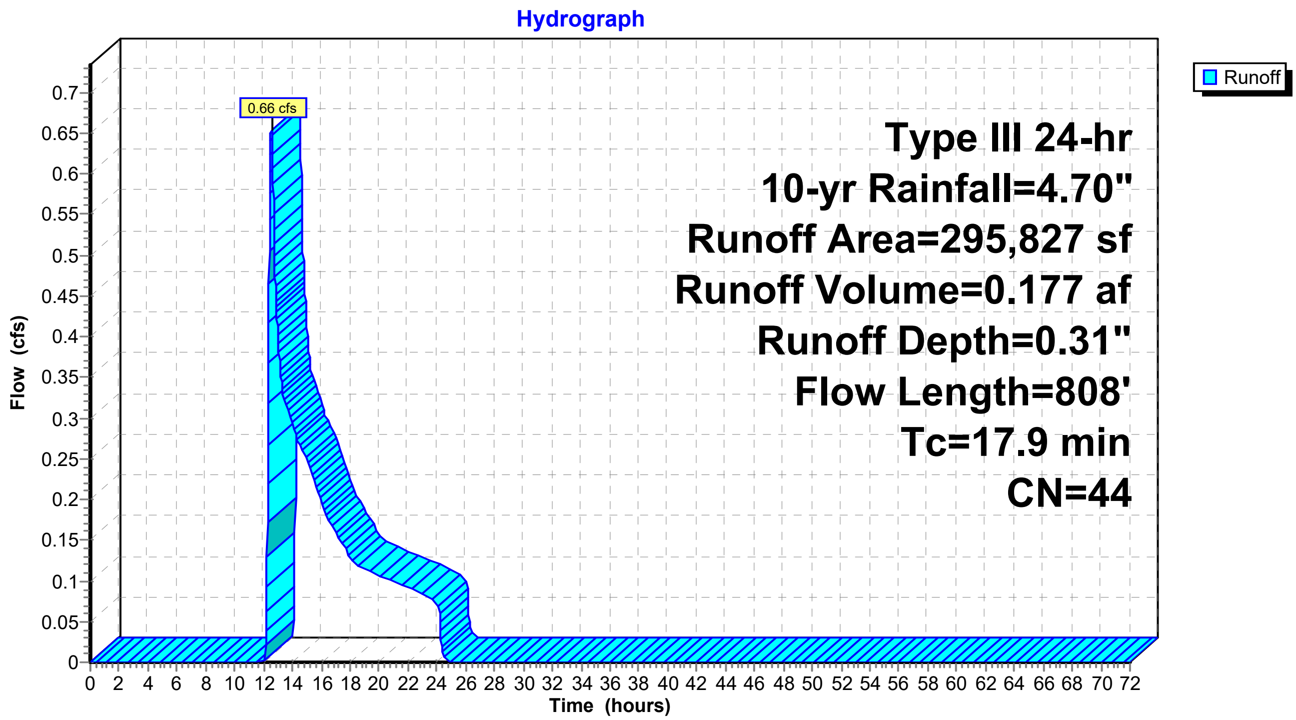
Runoff = 0.66 cfs @ 12.55 hrs, Volume= 0.177 af, Depth= 0.31"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-yr Rainfall=4.70"

Area (sf)	CN	Description
195,082	30	Woods, Good, HSG A
100,745	70	Woods, Good, HSG C
295,827	44	Weighted Average
295,827		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.4	50	0.0150	0.06		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.40"
4.5	758	0.0310	2.83		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
17.9	808	Total			

Subcatchment E4: Central Property



Summary for Subcatchment E5: Central Property

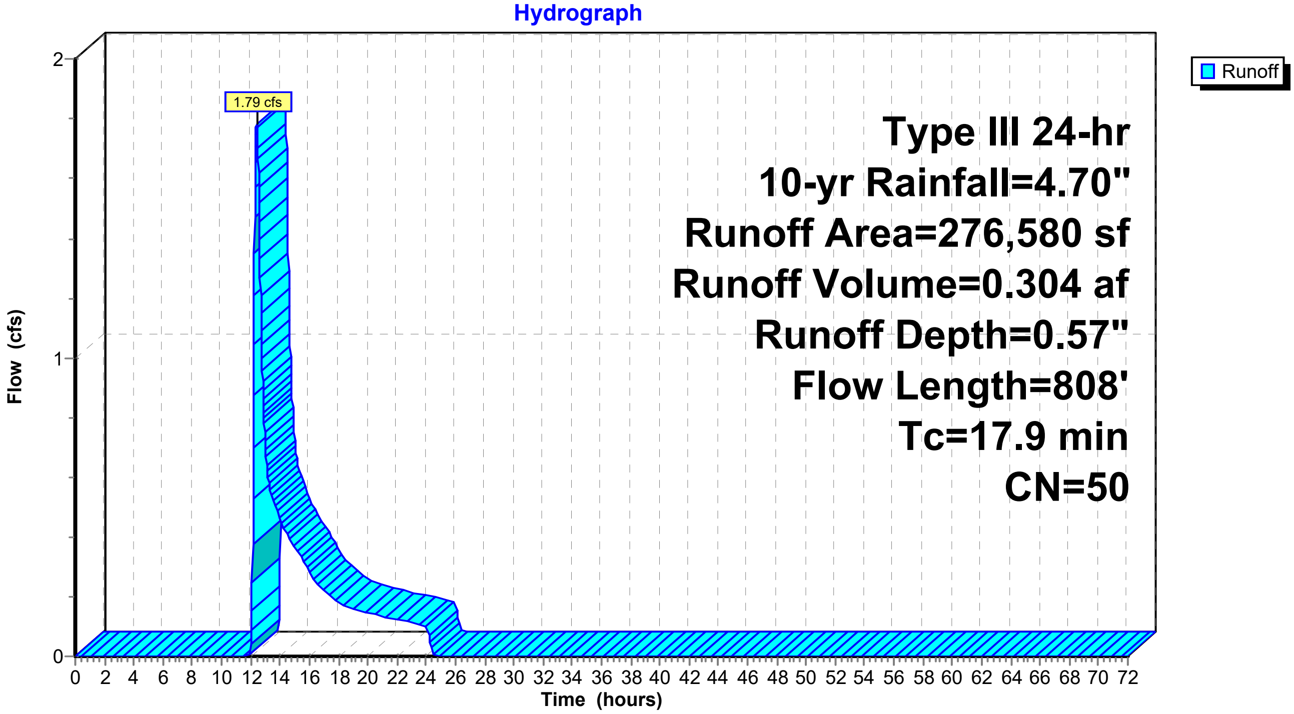
Runoff = 1.79 cfs @ 12.40 hrs, Volume= 0.304 af, Depth= 0.57"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-yr Rainfall=4.70"

	Area (sf)	CN	Description
*	3,765	98	Pavement, HSG A (OFFSITE)
*	8,121	98	Impervious, HSG A (OFFSITE)
*	17,970	30	Woods, Good, HSG A (OFFSITE)
*	41,632	39	>75% Grass cover, Good, HSG A (OFFSITE)
	69,621	70	Woods, Good, HSG C
	103,483	30	Woods, Good, HSG A
*	2,694	98	Pavement, HSG A
*	1,985	98	Roofs, HSG A
	27,309	74	>75% Grass cover, Good, HSG C
	276,580	50	Weighted Average
	260,015		94.01% Pervious Area
	16,565		5.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.4	50	0.0150	0.06		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.40"
4.5	758	0.0310	2.83		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
17.9	808	Total			

Subcatchment E5: Central Property



Summary for Subcatchment E6: SE Property

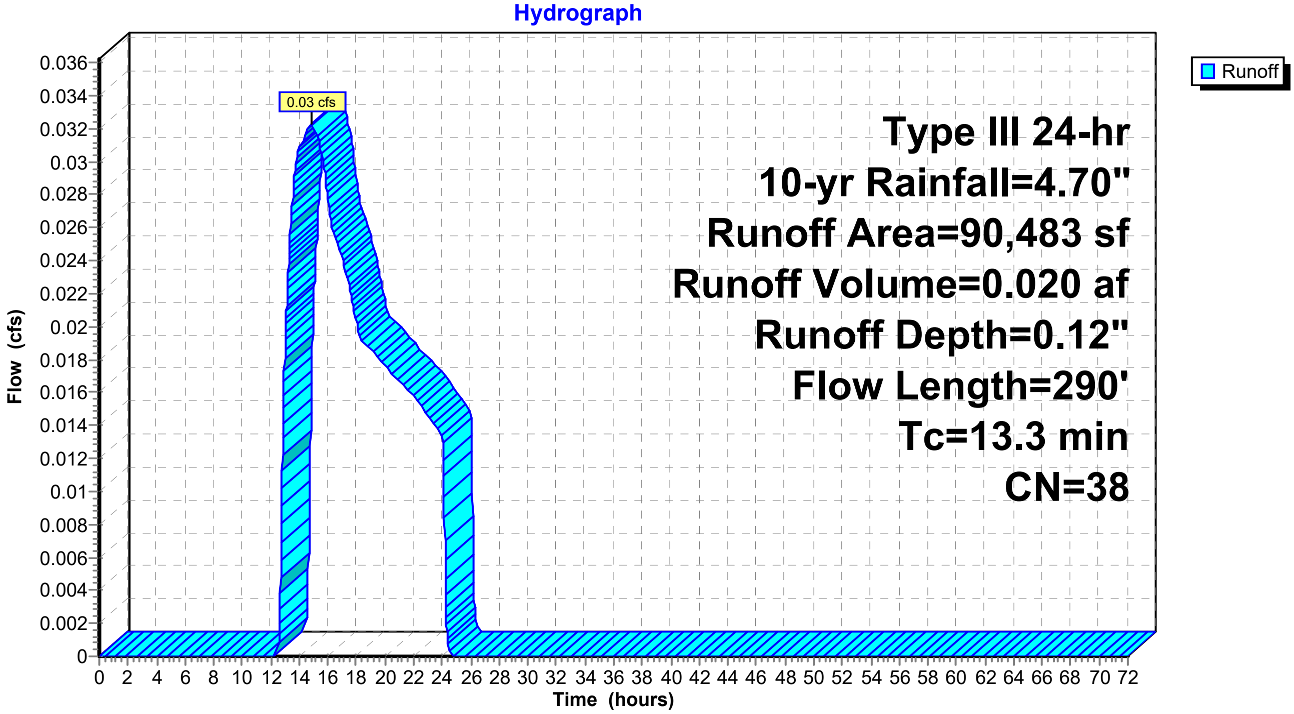
Runoff = 0.03 cfs @ 14.82 hrs, Volume= 0.020 af, Depth= 0.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-yr Rainfall=4.70"

	Area (sf)	CN	Description
	39,519	30	Woods, Good, HSG A
	1,209	70	Woods, Good, HSG C
	11,750	49	50-75% Grass cover, Fair, HSG A
	770	98	Paved parking, HSG A
*	15,917	30	Woods, Good, HSG A (OFFSITE)
*	406	70	Woods, Good, HSG C (OFFSITE)
*	18,054	39	>75% Grass cover, Good, HSG A (OFFSITE)
*	2,858	98	Paved parking, HSG A (OFFSITE)
	90,483	38	Weighted Average
	86,855		95.99% Pervious Area
	3,628		4.01% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.5	50	0.0220	0.07		**Sheet Flow, A-B**
					Woods: Light underbrush n= 0.400 P2= 3.40"
1.8	240	0.0200	2.28		**Shallow Concentrated Flow, B-C**
					Unpaved Kv= 16.1 fps
13.3	290	Total			

Subcatchment E6: SE Property



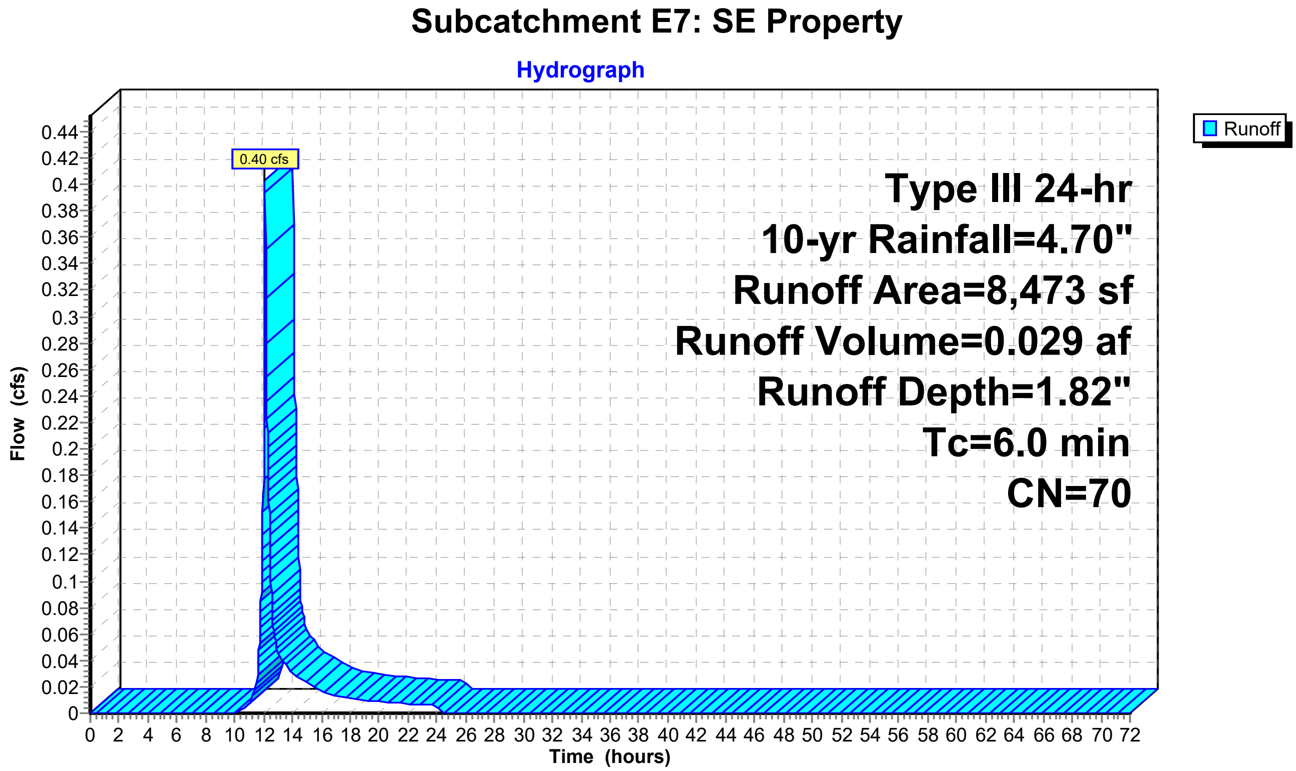
Summary for Subcatchment E7: SE Property

Runoff = 0.40 cfs @ 12.09 hrs, Volume= 0.029 af, Depth= 1.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-yr Rainfall=4.70"

Area (sf)	CN	Description
8,473	70	Woods, Good, HSG C
8,473		100.00% Pervious Area

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

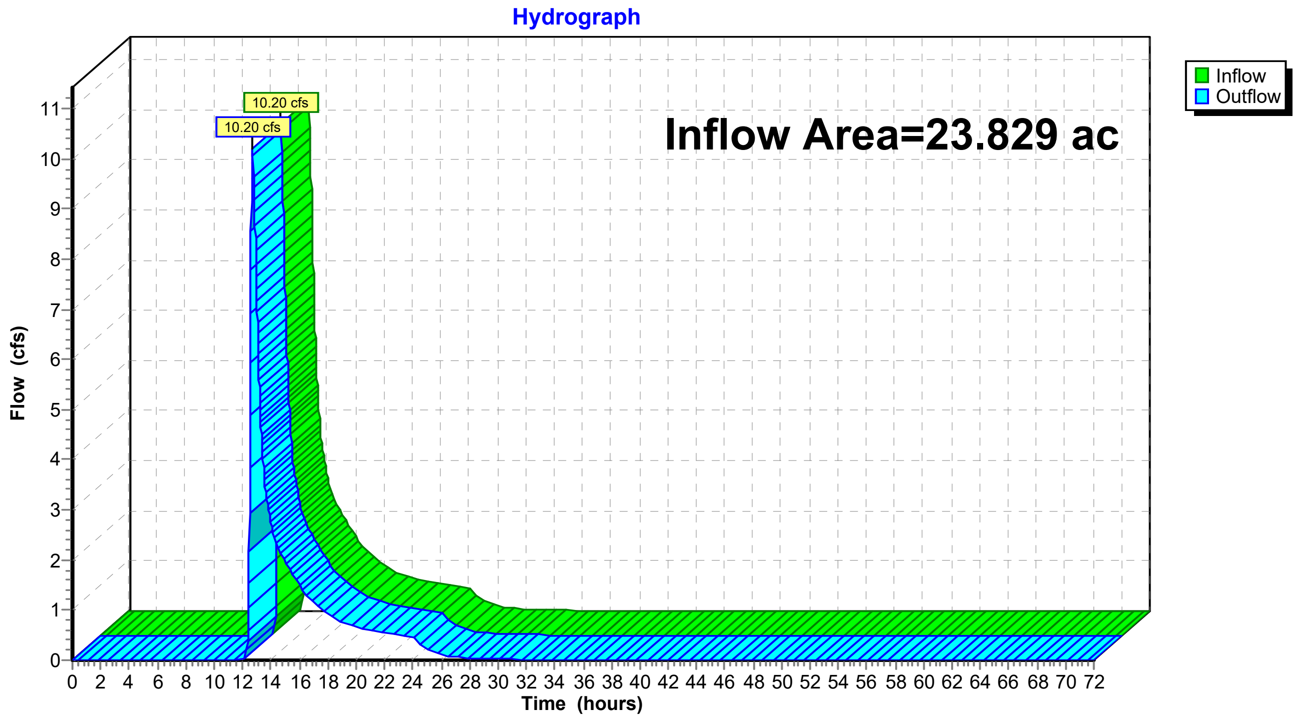


Summary for Reach DP-1: Wetland

Inflow Area = 23.829 ac, 17.47% Impervious, Inflow Depth = 0.82" for 10-yr event
Inflow = 10.20 cfs @ 12.71 hrs, Volume= 1.623 af
Outflow = 10.20 cfs @ 12.71 hrs, Volume= 1.623 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs

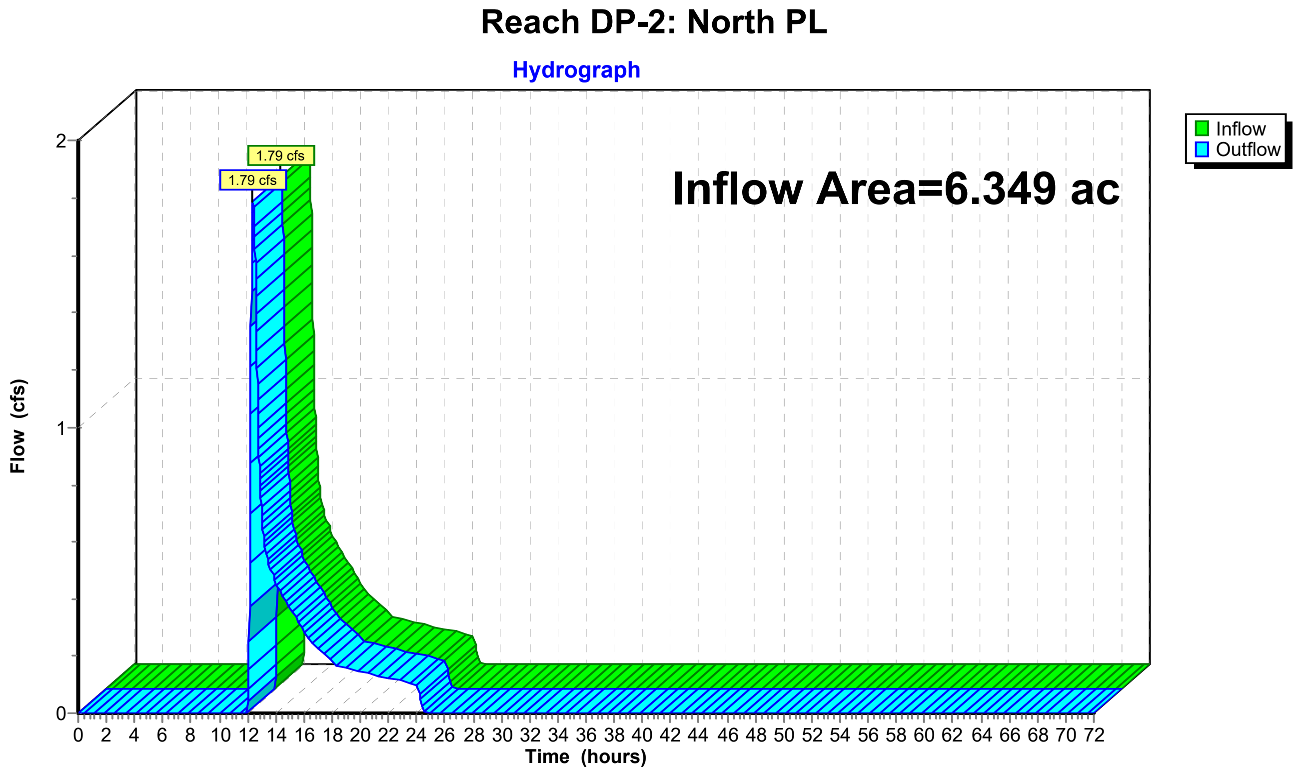
Reach DP-1: Wetland



Summary for Reach DP-2: North PL

Inflow Area =	6.349 ac,	5.99% Impervious, Inflow Depth = 0.57"	for 10-yr event	
Inflow =	1.79 cfs @	12.40 hrs, Volume=	0.304 af	
Outflow =	1.79 cfs @	12.40 hrs, Volume=	0.304 af,	Atten= 0%, Lag= 0.0 min

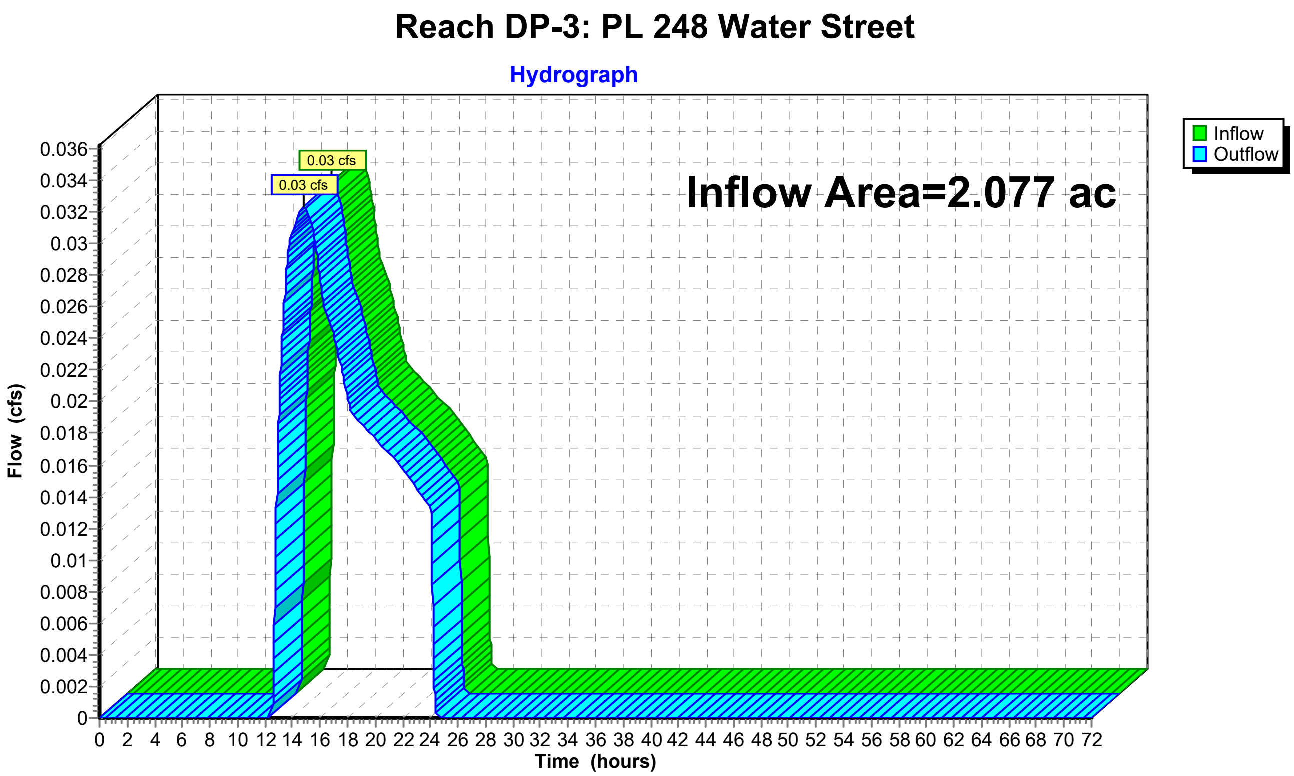
Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs



Summary for Reach DP-3: PL 248 Water Street

Inflow Area =	2.077 ac,	4.01% Impervious,	Inflow Depth = 0.12"	for 10-yr event	
Inflow =	0.03 cfs @	14.82 hrs,	Volume=	0.020 af	
Outflow =	0.03 cfs @	14.82 hrs,	Volume=	0.020 af,	Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs

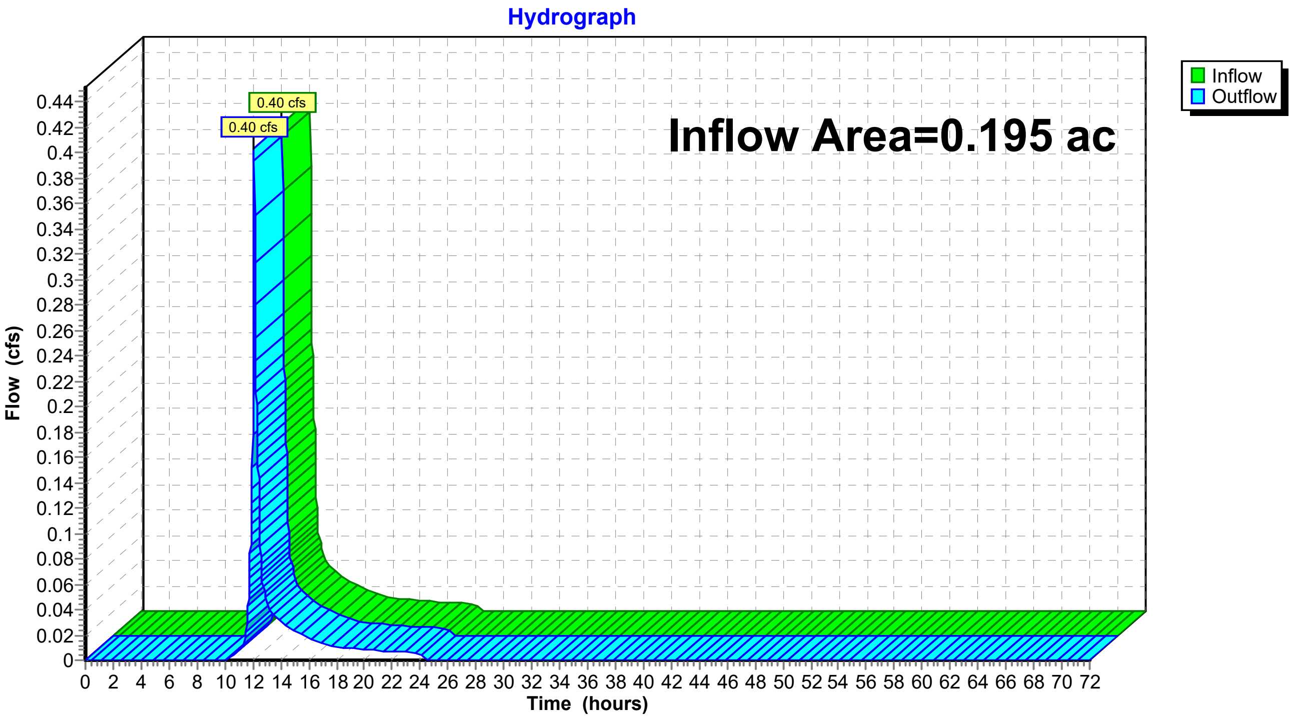


Summary for Reach DP-4: South PL

Inflow Area =	0.195 ac,	0.00% Impervious, Inflow Depth = 1.82"	for 10-yr event	
Inflow =	0.40 cfs @	12.09 hrs, Volume=	0.029 af	
Outflow =	0.40 cfs @	12.09 hrs, Volume=	0.029 af,	Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs

Reach DP-4: South PL



Summary for Pond E-P1: Wetland

Inflow Area = 5.973 ac, 62.63% Impervious, Inflow Depth = 2.63" for 10-yr event
Inflow = 10.20 cfs @ 12.44 hrs, Volume= 1.310 af
Outflow = 10.18 cfs @ 12.46 hrs, Volume= 1.143 af, Atten= 0%, Lag= 0.9 min
Primary = 10.18 cfs @ 12.46 hrs, Volume= 1.143 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 18.06' @ 12.46 hrs Surf.Area= 13,190 sf Storage= 8,052 cf

Plug-Flow detention time= 84.8 min calculated for 1.143 af (87% of inflow)
Center-of-Mass det. time= 26.5 min (874.5 - 848.0)

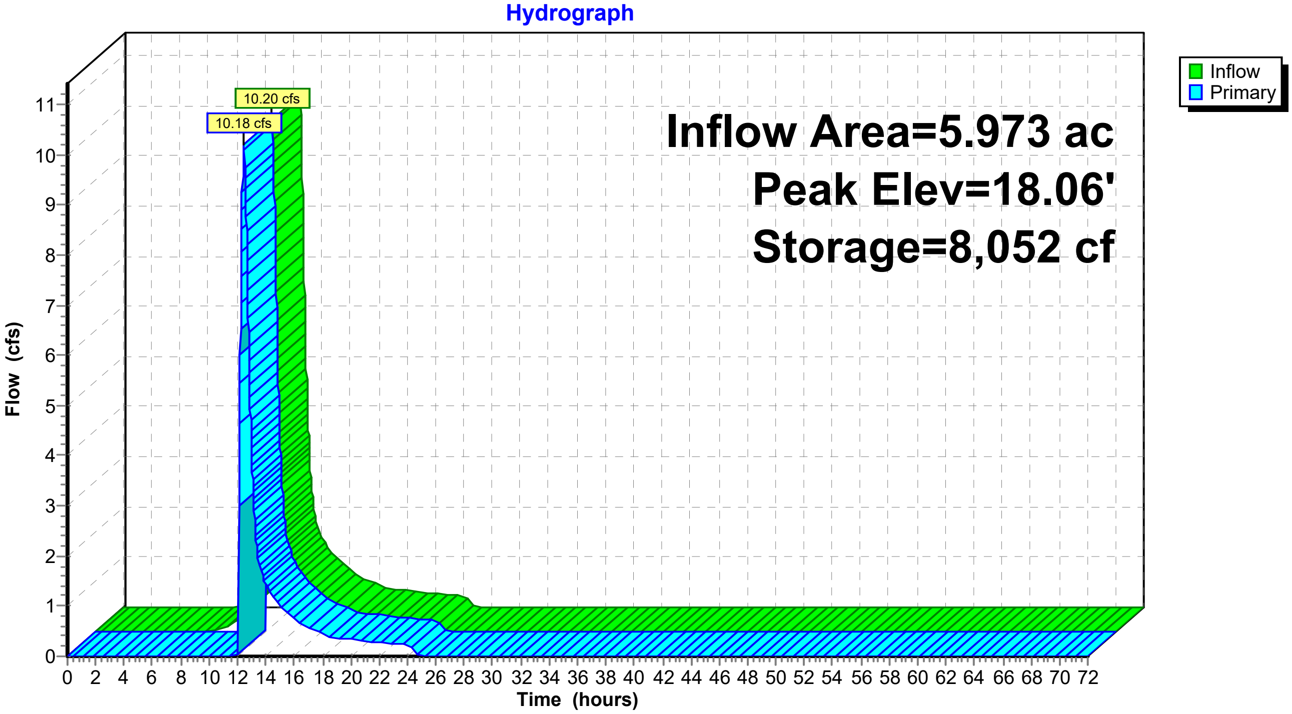
Volume	Invert	Avail.Storage	Storage Description
#1	17.00'	236,253 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
17.00	2,349	0	0
18.00	12,281	7,315	7,315
19.00	27,986	20,134	27,449
20.00	37,607	32,797	60,245
21.00	49,582	43,595	103,840
22.00	66,971	58,277	162,116
23.00	81,302	74,137	236,253

Device	Routing	Invert	Outlet Devices
#1	Primary	18.00'	**Asymmetrical Weir, C= 3.27** Offset (feet) 0.00 10.80 18.43 23.94 57.50 86.92 287.08 357.73 427.57 483.95 528.04 555.94 Elev. (feet) 23.00 22.00 21.00 20.00 19.00 18.00 18.00 19.00 20.00 21.00 22.00 23.00

Primary OutFlow Max=9.21 cfs @ 12.46 hrs HW=18.06' (Free Discharge)
└─**1=Asymmetrical Weir** (Weir Controls 9.21 cfs @ 0.77 fps)

Pond E-P1: Wetland



Summary for Pond E-P2: Wetland

Inflow Area = 11.148 ac, 36.37% Impervious, Inflow Depth = 1.81" for 10-yr event
Inflow = 14.31 cfs @ 12.41 hrs, Volume= 1.685 af
Outflow = 9.66 cfs @ 12.72 hrs, Volume= 1.445 af, Atten= 32%, Lag= 18.2 min
Primary = 9.66 cfs @ 12.72 hrs, Volume= 1.445 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Peak Elev= 13.20' @ 12.72 hrs Surf.Area= 29,550 sf Storage= 20,172 cf

Plug-Flow detention time= 143.4 min calculated for 1.445 af (86% of inflow)
Center-of-Mass det. time= 80.8 min (959.6 - 878.8)

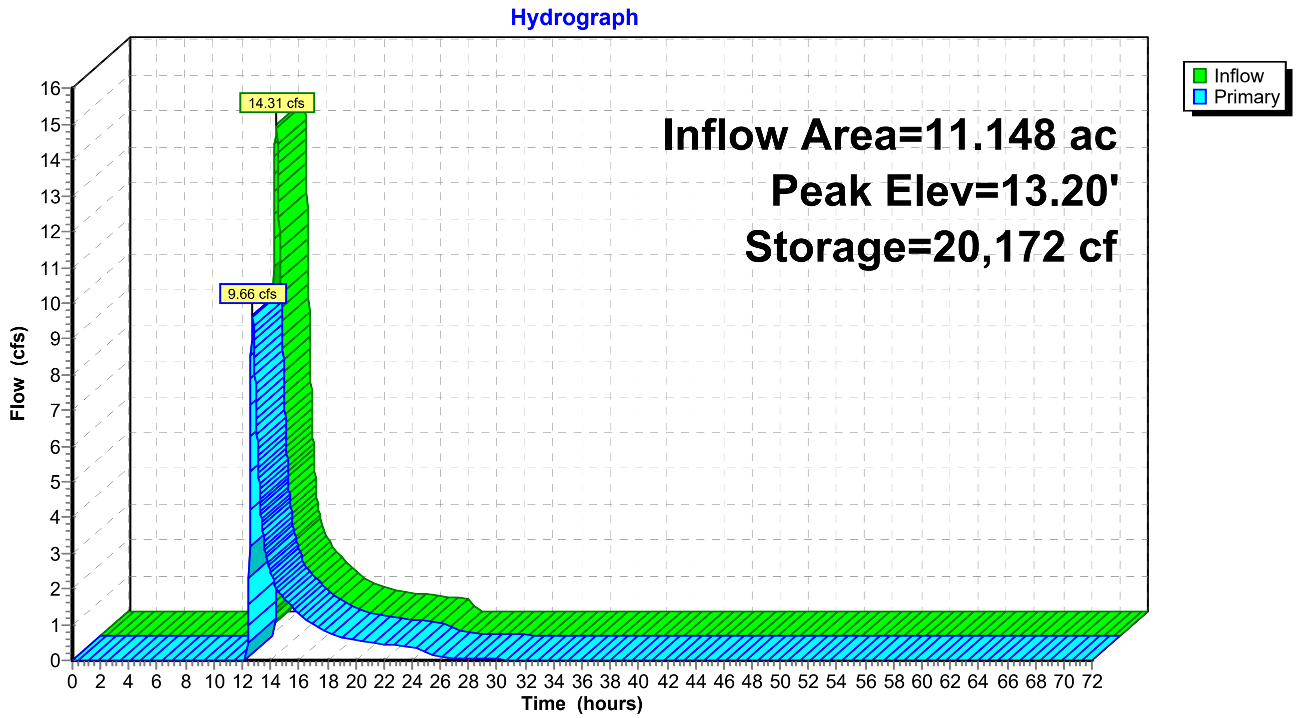
Volume	Invert	Avail.Storage	Storage Description
#1	12.00'	47,617 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
12.00	1,826	0	0
13.00	27,167	14,497	14,497
14.00	39,073	33,120	47,617

Device	Routing	Invert	Outlet Devices
#1	Primary	12.83'	**Asymmetrical Weir, C= 3.27** Offset (feet) 0.00 13.92 43.45 57.57 61.89 74.87 84.88 105.86 131.31 Elev. (feet) 14.00 13.56 13.12 13.03 12.83 13.08 13.85 13.88 14.00

Primary OutFlow Max=9.65 cfs @ 12.72 hrs HW=13.20' (Free Discharge)
└─**1=Asymmetrical Weir** (Weir Controls 9.65 cfs @ 1.02 fps)

Pond E-P2: Wetland



Time span=0.00-72.00 hrs, dt=0.02 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment E1: Property Offsite	Runoff Area=260,170 sf 62.63% Impervious Runoff Depth=3.42" Flow Length=343' Tc=31.4 min CN=80 Runoff=13.24 cfs 1.703 af
Subcatchment E2: E2	Runoff Area=225,440 sf 6.06% Impervious Runoff Depth=1.82" Flow Length=319' Tc=21.2 min CN=62 Runoff=6.85 cfs 0.786 af
Subcatchment E3: SW Property	Runoff Area=256,545 sf 1.84% Impervious Runoff Depth=0.06" Flow Length=683' Tc=13.5 min CN=31 Runoff=0.04 cfs 0.028 af
Subcatchment E4: Central Property	Runoff Area=295,827 sf 0.00% Impervious Runoff Depth=0.59" Flow Length=808' Tc=17.9 min CN=44 Runoff=1.79 cfs 0.335 af
Subcatchment E5: Central Property	Runoff Area=276,580 sf 5.99% Impervious Runoff Depth=0.95" Flow Length=808' Tc=17.9 min CN=50 Runoff=3.68 cfs 0.504 af
Subcatchment E6: SE Property	Runoff Area=90,483 sf 4.01% Impervious Runoff Depth=0.29" Flow Length=290' Tc=13.3 min CN=38 Runoff=0.15 cfs 0.051 af
Subcatchment E7: SE Property	Runoff Area=8,473 sf 0.00% Impervious Runoff Depth=2.49" Tc=6.0 min CN=70 Runoff=0.56 cfs 0.040 af
Reach DP-1: Wetland	Inflow=18.26 cfs 2.444 af Outflow=18.26 cfs 2.444 af
Reach DP-2: North PL	Inflow=3.68 cfs 0.504 af Outflow=3.68 cfs 0.504 af
Reach DP-3: PL 248 Water Street	Inflow=0.15 cfs 0.051 af Outflow=0.15 cfs 0.051 af
Reach DP-4: South PL	Inflow=0.56 cfs 0.040 af Outflow=0.56 cfs 0.040 af
Pond E-P1: Wetland	Peak Elev=18.07' Storage=8,236 cf Inflow=13.24 cfs 1.703 af Outflow=13.22 cfs 1.535 af
Pond E-P2: Wetland	Peak Elev=13.28' Storage=22,622 cf Inflow=19.44 cfs 2.321 af Outflow=16.65 cfs 2.082 af

Total Runoff Area = 32.450 ac Runoff Volume = 3.447 af Average Runoff Depth = 1.27"
85.74% Pervious = 27.824 ac 14.26% Impervious = 4.626 ac

Summary for Subcatchment E1: Property Offsite

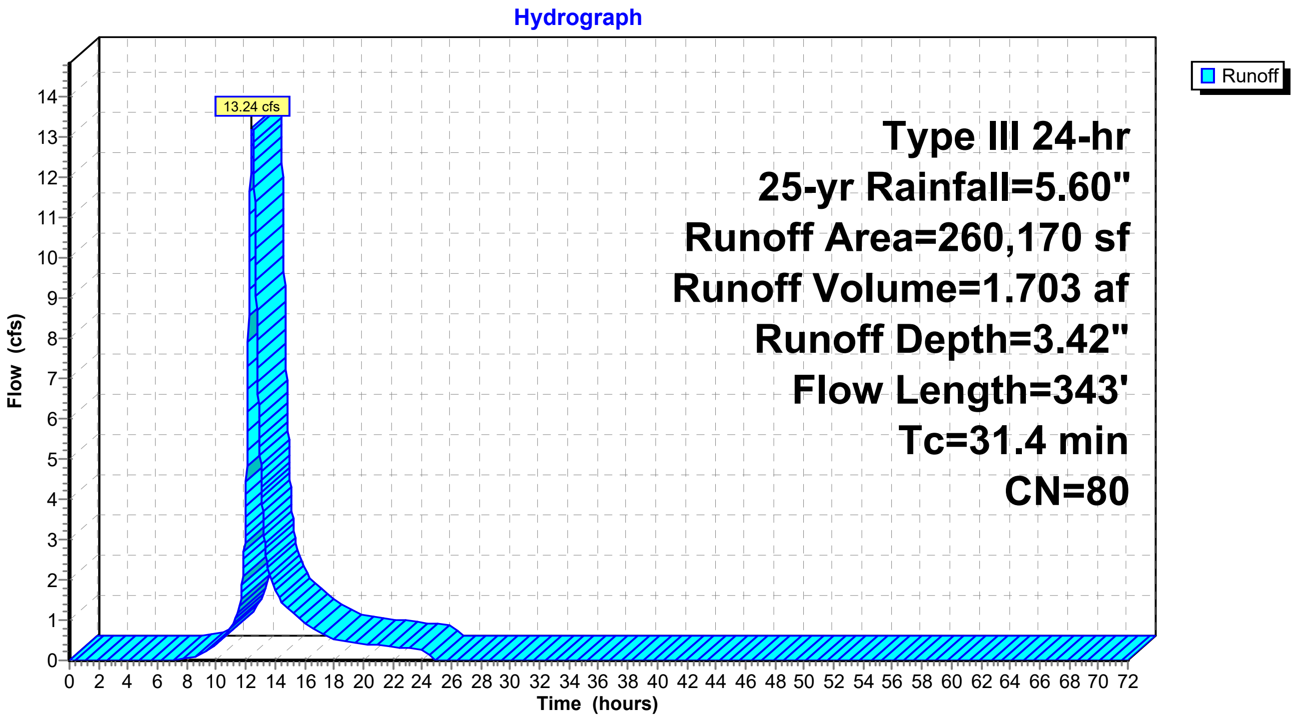
Runoff = 13.24 cfs @ 12.44 hrs, Volume= 1.703 af, Depth= 3.42"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-yr Rainfall=5.60"

	Area (sf)	CN	Description
*	142,754	89	Urban commercial, 85% imp, HSG A (OFFSITE)
*	31,587	30	Woods, Good, HSG A (OFFSITE)
*	48,943	94	Urban commercial, 85% imp, HSG C (OFFSITE)
*	8,690	78	Wetlands/woods, HSG A (OFFSITE)
*	25,996	70	Woods, Good, HSG C (OFFSITE)
*	2,200	78	Wetlands/woods, HSG C (OFFSITE)
	260,170	80	Weighted Average
	97,228		37.37% Pervious Area
	162,942		62.63% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.8	50	0.0040	0.04		**Sheet Flow, Start** Woods: Light underbrush n= 0.400 P2= 3.40"
6.6	126	0.0040	0.32		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
2.0	167	0.0800	1.41		**Shallow Concentrated Flow, C-WETLAND** Woodland Kv= 5.0 fps
31.4	343	Total			

Subcatchment E1: Property Offsite



Summary for Subcatchment E2: E2

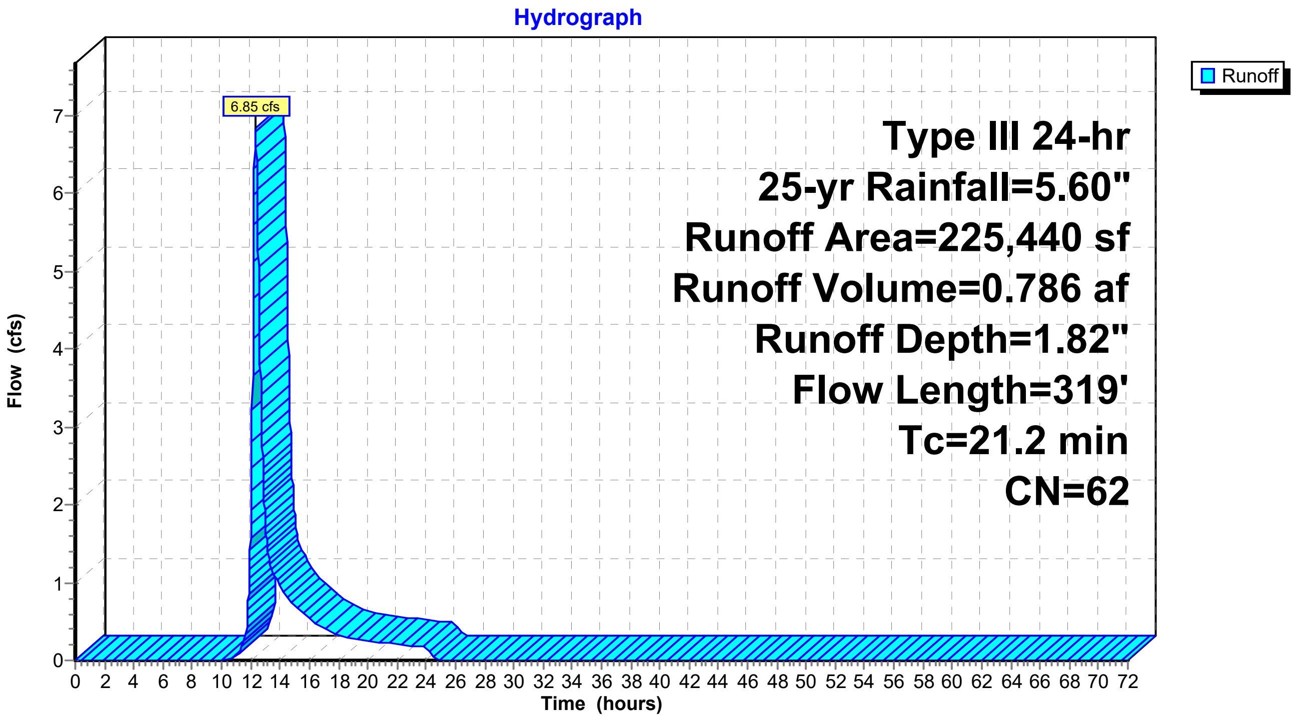
Runoff = 6.85 cfs @ 12.32 hrs, Volume= 0.786 af, Depth= 1.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-yr Rainfall=5.60"

	Area (sf)	CN	Description
*	9,050	98	Paved parking, HSG A (OFFSITE)
*	49,865	30	Woods, Good, HSG A (OFFSITE)
*	20,149	78	Wetlands/woods. HSG A (OFFSITE)
*	4,604	98	Paved parking, HSG C (OFFSITE)
*	4,156	70	Woods, Good, HSG C (OFFSITE)
*	3,605	78	Wetlands/woods, HSG C (OFFSITE)
	83,652	70	Woods, Good, HSG C
*	5,924	78	Wetlands/woods, HSG C
*	28,611	78	Wetlands/woods, HSG A
	15,824	30	Woods, Good, HSG A
	225,440	62	Weighted Average
	211,786		93.94% Pervious Area
	13,654		6.06% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.8	50	0.0100	0.05		**Sheet Flow, START** Woods: Light underbrush n= 0.400 P2= 3.40"
3.2	95	0.0100	0.50		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
2.2	174	0.0710	1.33		**Shallow Concentrated Flow, c-WETLAND** Woodland Kv= 5.0 fps
21.2	319	Total			

Subcatchment E2: E2



Summary for Subcatchment E3: SW Property

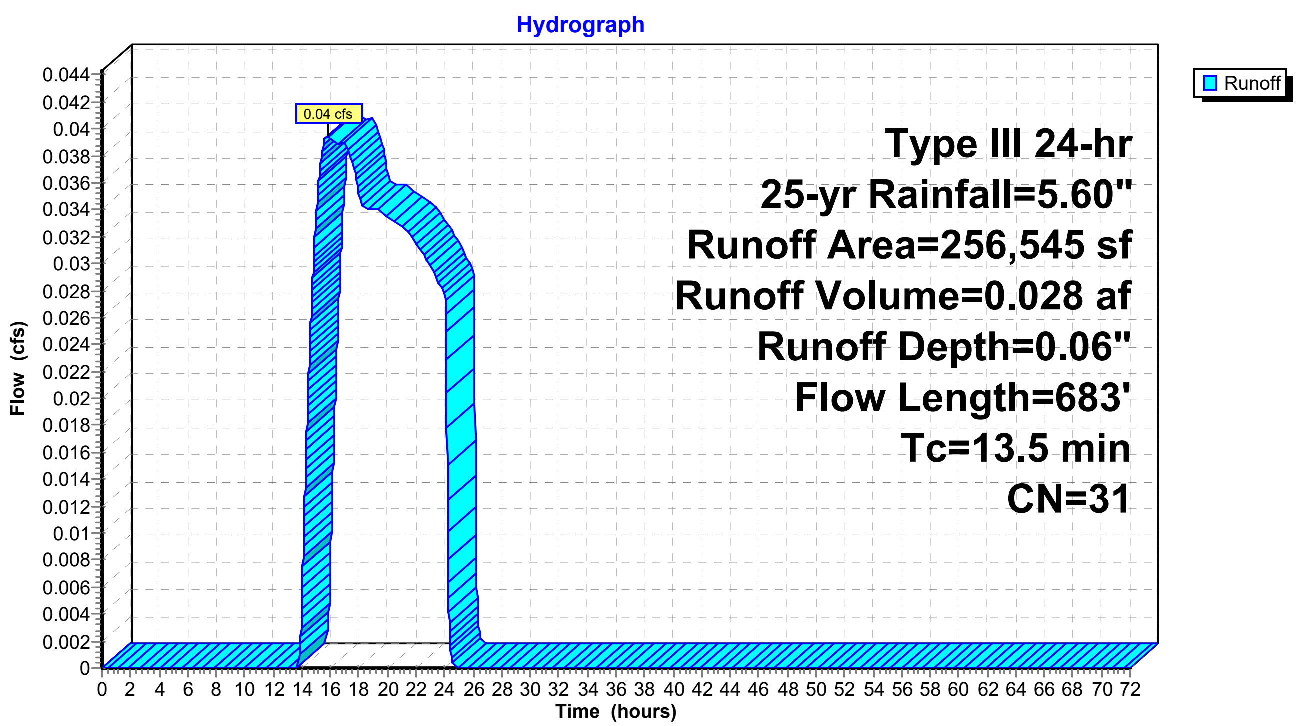
Runoff = 0.04 cfs @ 15.81 hrs, Volume= 0.028 af, Depth= 0.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-yr Rainfall=5.60"

	Area (sf)	CN	Description
	157,110	30	Woods, Good, HSG A
*	94,725	30	Woods, Fair, HSG A (OFFSITE)
*	4,710	98	Impervious, HSG A (OFFSITE)
	256,545	31	Weighted Average
	251,835		98.16% Pervious Area
	4,710		1.84% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.2	50	0.0300	0.08		**Sheet Flow, Start Off Property** Woods: Light underbrush n= 0.400 P2= 3.40"
3.3	633	0.0400	3.22		**Shallow Concentrated Flow, To Wetland** Unpaved Kv= 16.1 fps
13.5	683	Total			

Subcatchment E3: SW Property



Summary for Subcatchment E4: Central Property

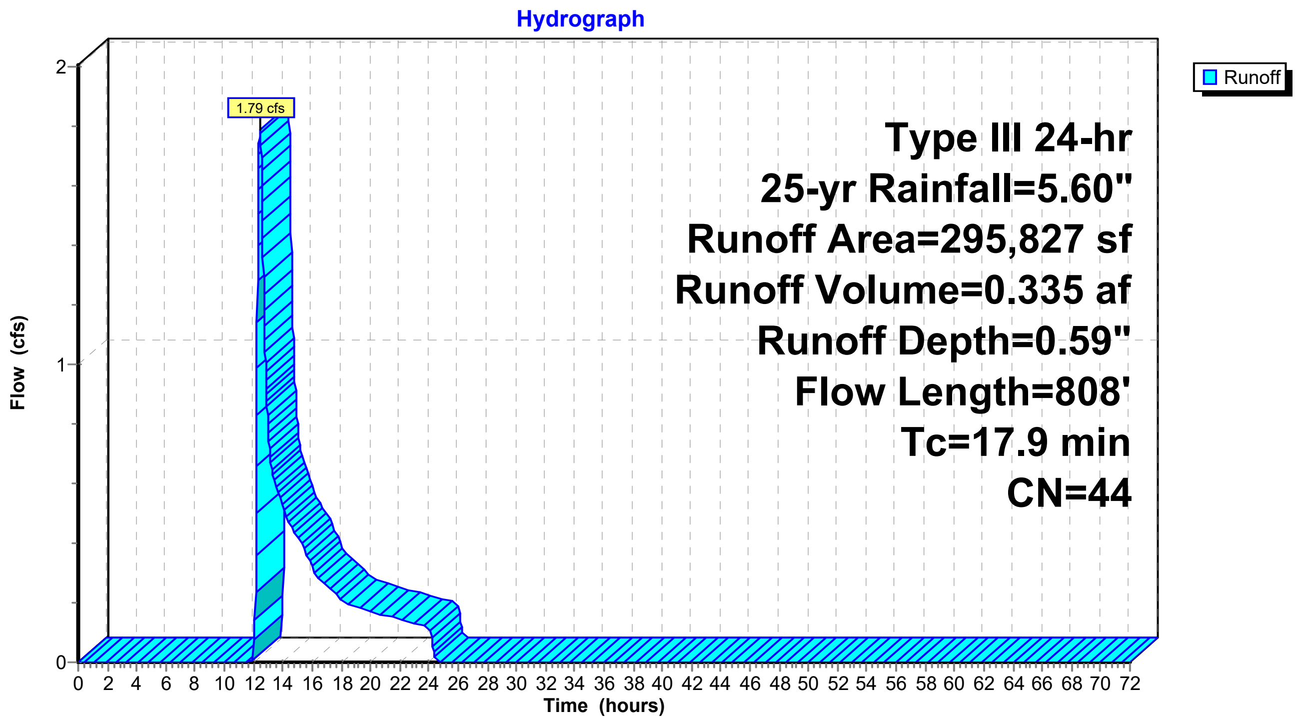
Runoff = 1.79 cfs @ 12.45 hrs, Volume= 0.335 af, Depth= 0.59"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-yr Rainfall=5.60"

Area (sf)	CN	Description
195,082	30	Woods, Good, HSG A
100,745	70	Woods, Good, HSG C
295,827	44	Weighted Average
295,827		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.4	50	0.0150	0.06		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.40"
4.5	758	0.0310	2.83		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
17.9	808	Total			

Subcatchment E4: Central Property



Summary for Subcatchment E5: Central Property

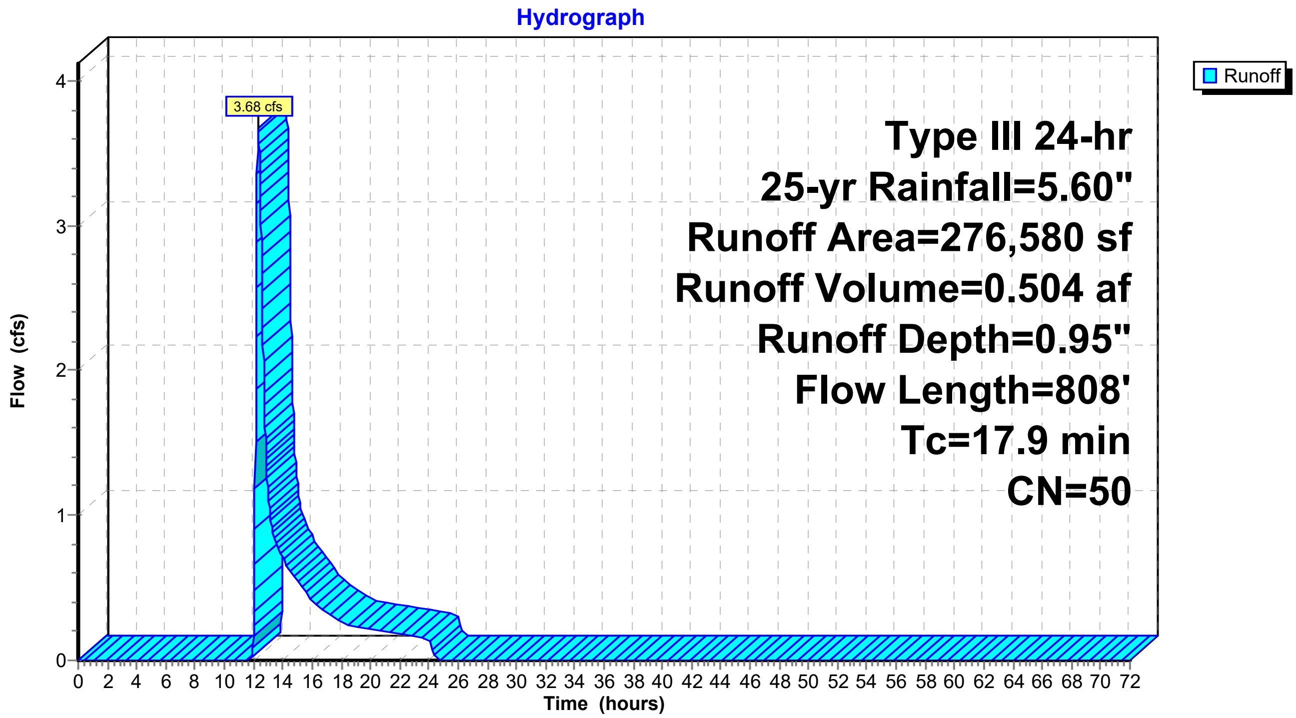
Runoff = 3.68 cfs @ 12.32 hrs, Volume= 0.504 af, Depth= 0.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-yr Rainfall=5.60"

	Area (sf)	CN	Description
*	3,765	98	Pavement, HSG A (OFFSITE)
*	8,121	98	Impervious, HSG A (OFFSITE)
*	17,970	30	Woods, Good, HSG A (OFFSITE)
*	41,632	39	>75% Grass cover, Good, HSG A (OFFSITE)
	69,621	70	Woods, Good, HSG C
	103,483	30	Woods, Good, HSG A
*	2,694	98	Pavement, HSG A
*	1,985	98	Roofs, HSG A
	27,309	74	>75% Grass cover, Good, HSG C
	276,580	50	Weighted Average
	260,015		94.01% Pervious Area
	16,565		5.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.4	50	0.0150	0.06		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.40"
4.5	758	0.0310	2.83		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
17.9	808	Total			

Subcatchment E5: Central Property



Summary for Subcatchment E6: SE Property

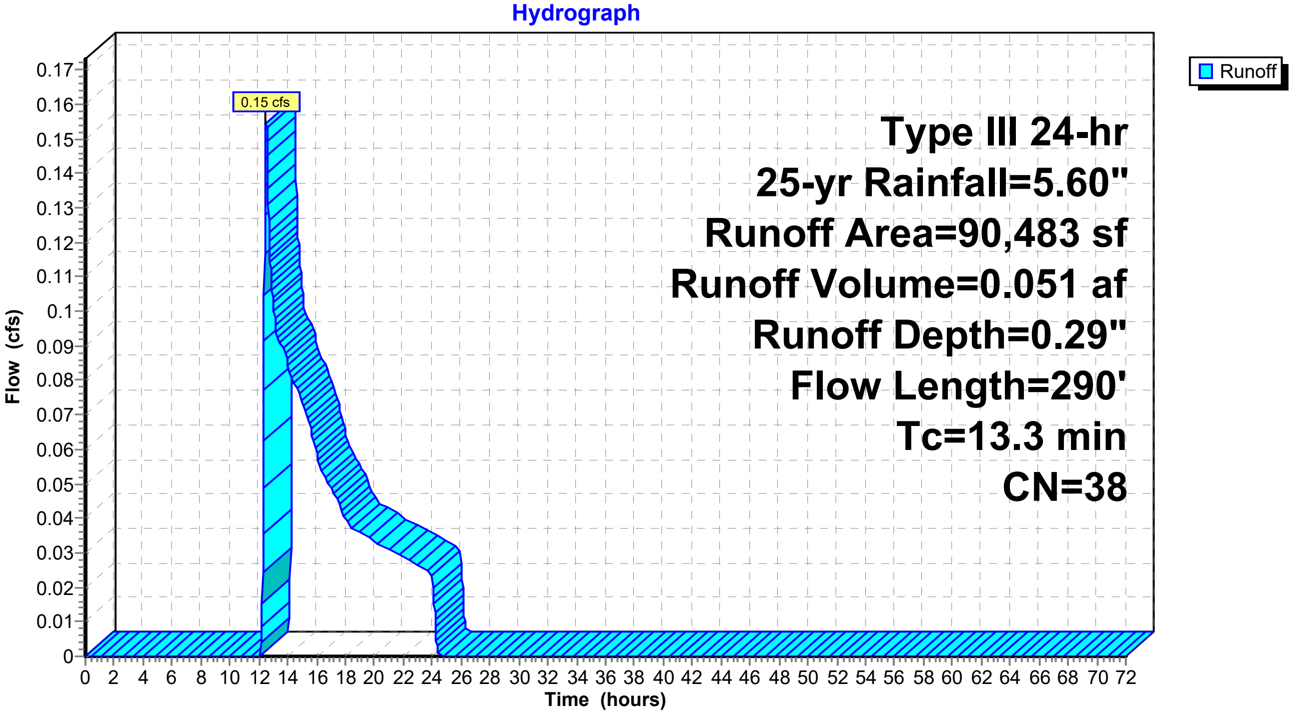
Runoff = 0.15 cfs @ 12.53 hrs, Volume= 0.051 af, Depth= 0.29"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-yr Rainfall=5.60"

	Area (sf)	CN	Description
	39,519	30	Woods, Good, HSG A
	1,209	70	Woods, Good, HSG C
	11,750	49	50-75% Grass cover, Fair, HSG A
	770	98	Paved parking, HSG A
*	15,917	30	Woods, Good, HSG A (OFFSITE)
*	406	70	Woods, Good, HSG C (OFFSITE)
*	18,054	39	>75% Grass cover, Good, HSG A (OFFSITE)
*	2,858	98	Paved parking, HSG A (OFFSITE)
	90,483	38	Weighted Average
	86,855		95.99% Pervious Area
	3,628		4.01% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.5	50	0.0220	0.07		**Sheet Flow, A-B**
					Woods: Light underbrush n= 0.400 P2= 3.40"
1.8	240	0.0200	2.28		**Shallow Concentrated Flow, B-C**
					Unpaved Kv= 16.1 fps
13.3	290	Total			

Subcatchment E6: SE Property



Summary for Subcatchment E7: SE Property

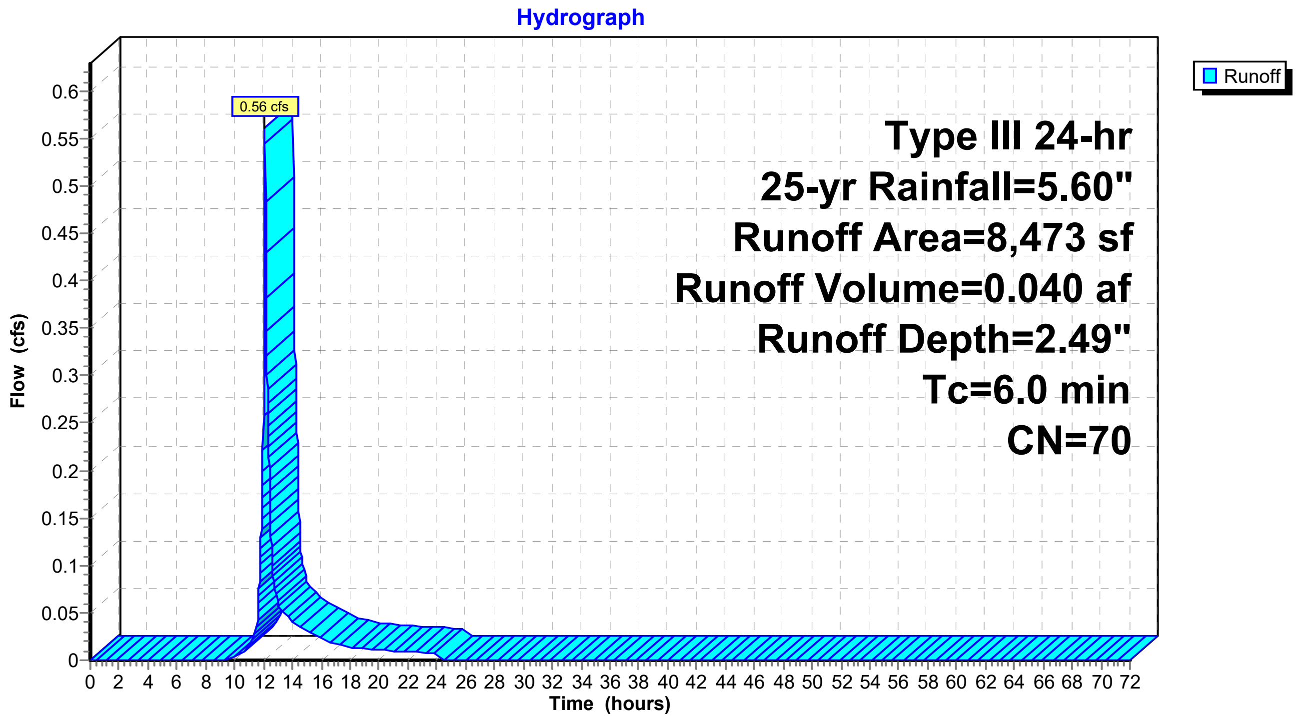
Runoff = 0.56 cfs @ 12.09 hrs, Volume= 0.040 af, Depth= 2.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-yr Rainfall=5.60"

Area (sf)	CN	Description
8,473	70	Woods, Good, HSG C
8,473		100.00% Pervious Area

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

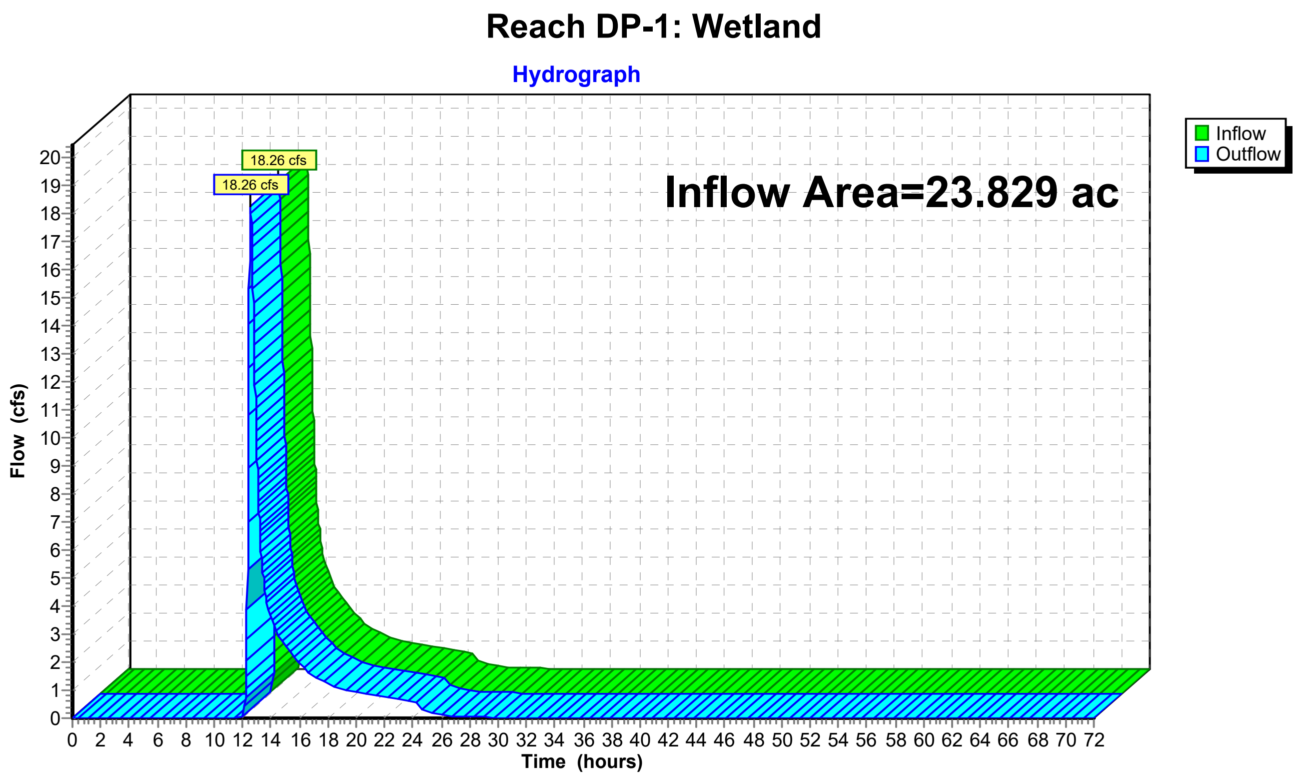
Subcatchment E7: SE Property



Summary for Reach DP-1: Wetland

Inflow Area =	23.829 ac,	17.47% Impervious,	Inflow Depth = 1.23"	for 25-yr event
Inflow =	18.26 cfs @	12.57 hrs, Volume=	2.444 af	
Outflow =	18.26 cfs @	12.57 hrs, Volume=	2.444 af, Atten= 0%, Lag= 0.0 min	

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs

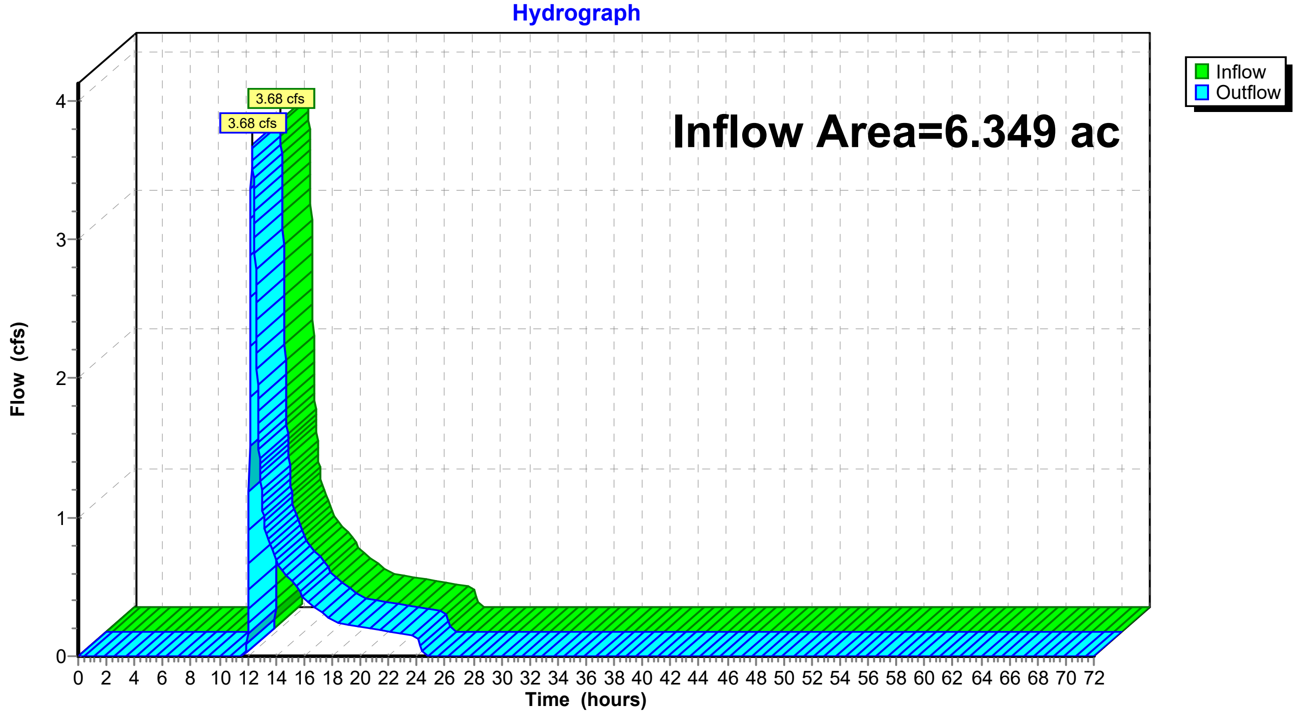


Summary for Reach DP-2: North PL

Inflow Area =	6.349 ac,	5.99% Impervious, Inflow Depth = 0.95"	for 25-yr event	
Inflow =	3.68 cfs @	12.32 hrs, Volume=	0.504 af	
Outflow =	3.68 cfs @	12.32 hrs, Volume=	0.504 af,	Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs

Reach DP-2: North PL

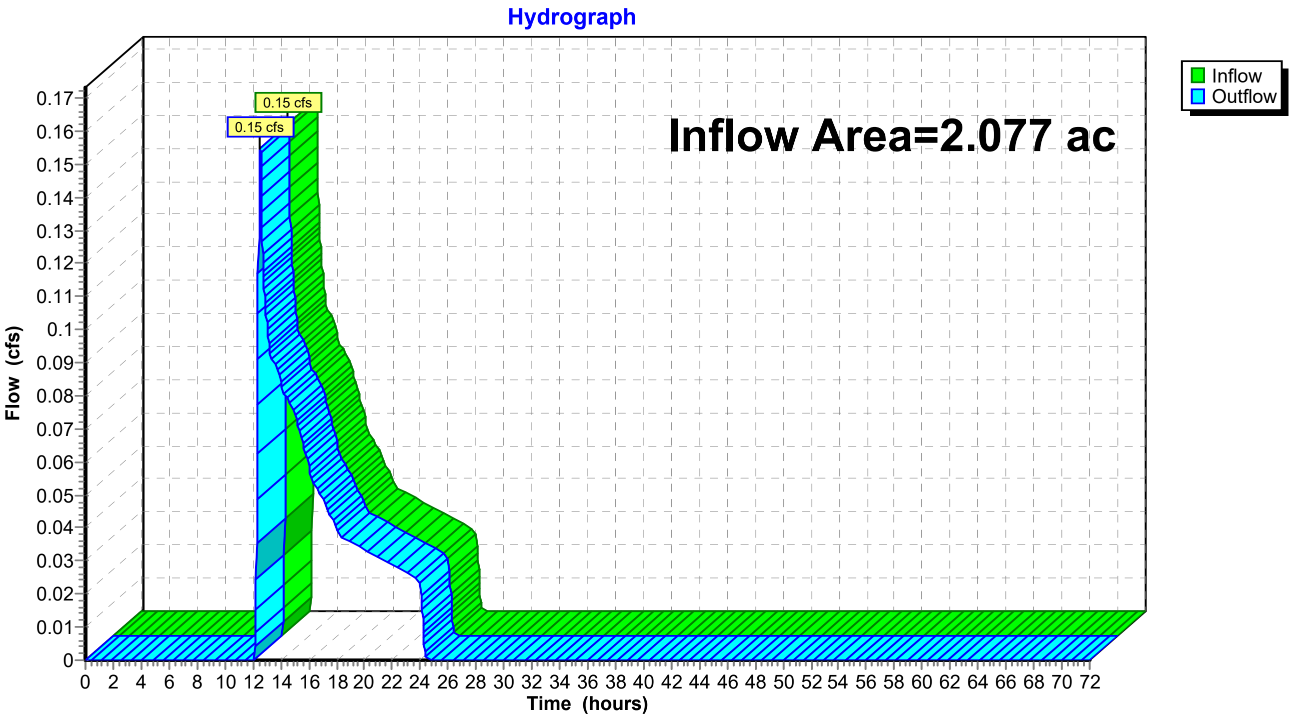


Summary for Reach DP-3: PL 248 Water Street

Inflow Area =	2.077 ac,	4.01% Impervious,	Inflow Depth = 0.29"	for 25-yr event	
Inflow =	0.15 cfs @	12.53 hrs,	Volume=	0.051 af	
Outflow =	0.15 cfs @	12.53 hrs,	Volume=	0.051 af,	Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs

Reach DP-3: PL 248 Water Street

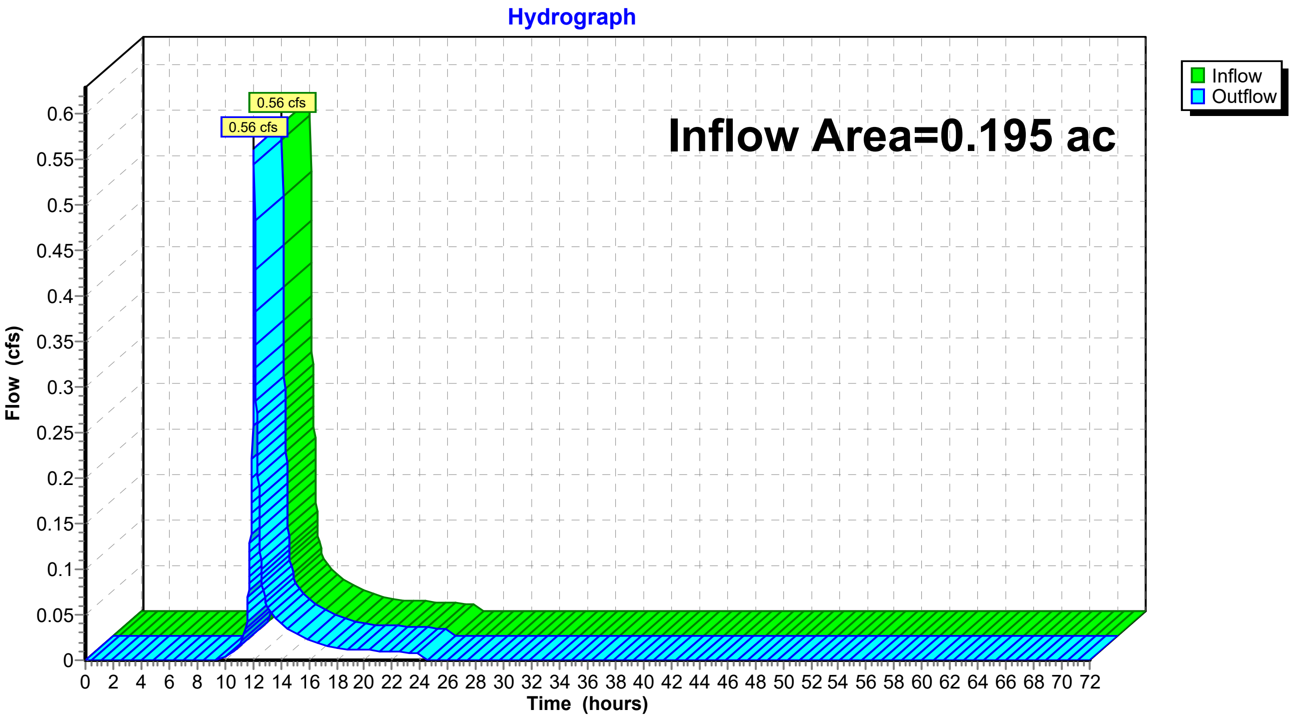


Summary for Reach DP-4: South PL

Inflow Area = 0.195 ac, 0.00% Impervious, Inflow Depth = 2.49" for 25-yr event
Inflow = 0.56 cfs @ 12.09 hrs, Volume= 0.040 af
Outflow = 0.56 cfs @ 12.09 hrs, Volume= 0.040 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs

Reach DP-4: South PL



Summary for Pond E-P1: Wetland

Inflow Area = 5.973 ac, 62.63% Impervious, Inflow Depth = 3.42" for 25-yr event
Inflow = 13.24 cfs @ 12.44 hrs, Volume= 1.703 af
Outflow = 13.22 cfs @ 12.45 hrs, Volume= 1.535 af, Atten= 0%, Lag= 1.0 min
Primary = 13.22 cfs @ 12.45 hrs, Volume= 1.535 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 18.07' @ 12.45 hrs Surf.Area= 13,407 sf Storage= 8,236 cf

Plug-Flow detention time= 71.2 min calculated for 1.535 af (90% of inflow)
Center-of-Mass det. time= 22.8 min (863.4 - 840.5)

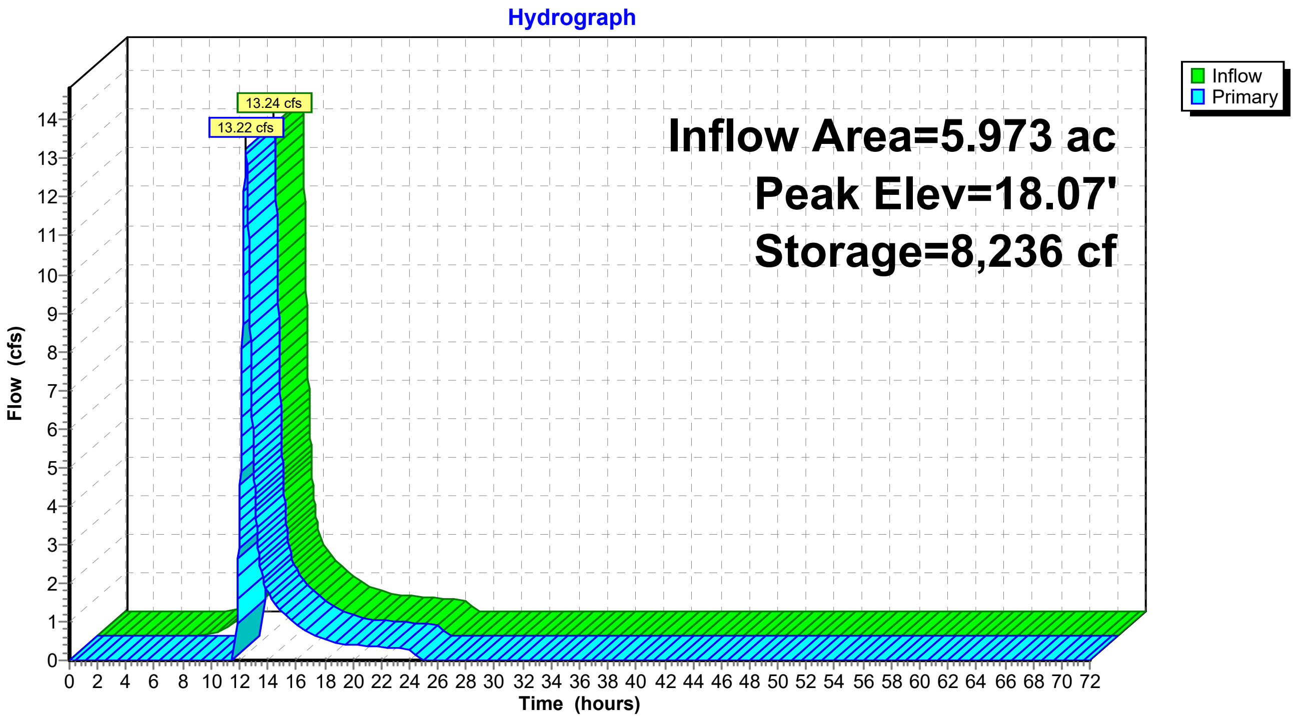
Volume	Invert	Avail.Storage	Storage Description
#1	17.00'	236,253 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
17.00	2,349	0	0
18.00	12,281	7,315	7,315
19.00	27,986	20,134	27,449
20.00	37,607	32,797	60,245
21.00	49,582	43,595	103,840
22.00	66,971	58,277	162,116
23.00	81,302	74,137	236,253

Device	Routing	Invert	Outlet Devices
#1	Primary	18.00'	**Asymmetrical Weir, C= 3.27** Offset (feet) 0.00 10.80 18.43 23.94 57.50 86.92 287.08 357.73 427.57 483.95 528.04 555.94 Elev. (feet) 23.00 22.00 21.00 20.00 19.00 18.00 18.00 19.00 20.00 21.00 22.00 23.00

Primary OutFlow Max=12.74 cfs @ 12.45 hrs HW=18.07' (Free Discharge)
└—**1=Asymmetrical Weir** (Weir Controls 12.74 cfs @ 0.86 fps)

Pond E-P1: Wetland



Summary for Pond E-P2: Wetland

Inflow Area = 11.148 ac, 36.37% Impervious, Inflow Depth = 2.50" for 25-yr event
Inflow = 19.44 cfs @ 12.40 hrs, Volume= 2.321 af
Outflow = 16.65 cfs @ 12.58 hrs, Volume= 2.082 af, Atten= 14%, Lag= 10.9 min
Primary = 16.65 cfs @ 12.58 hrs, Volume= 2.082 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Peak Elev= 13.28' @ 12.58 hrs Surf.Area= 30,521 sf Storage= 22,622 cf

Plug-Flow detention time= 110.5 min calculated for 2.082 af (90% of inflow)
Center-of-Mass det. time= 60.9 min (928.6 - 867.6)

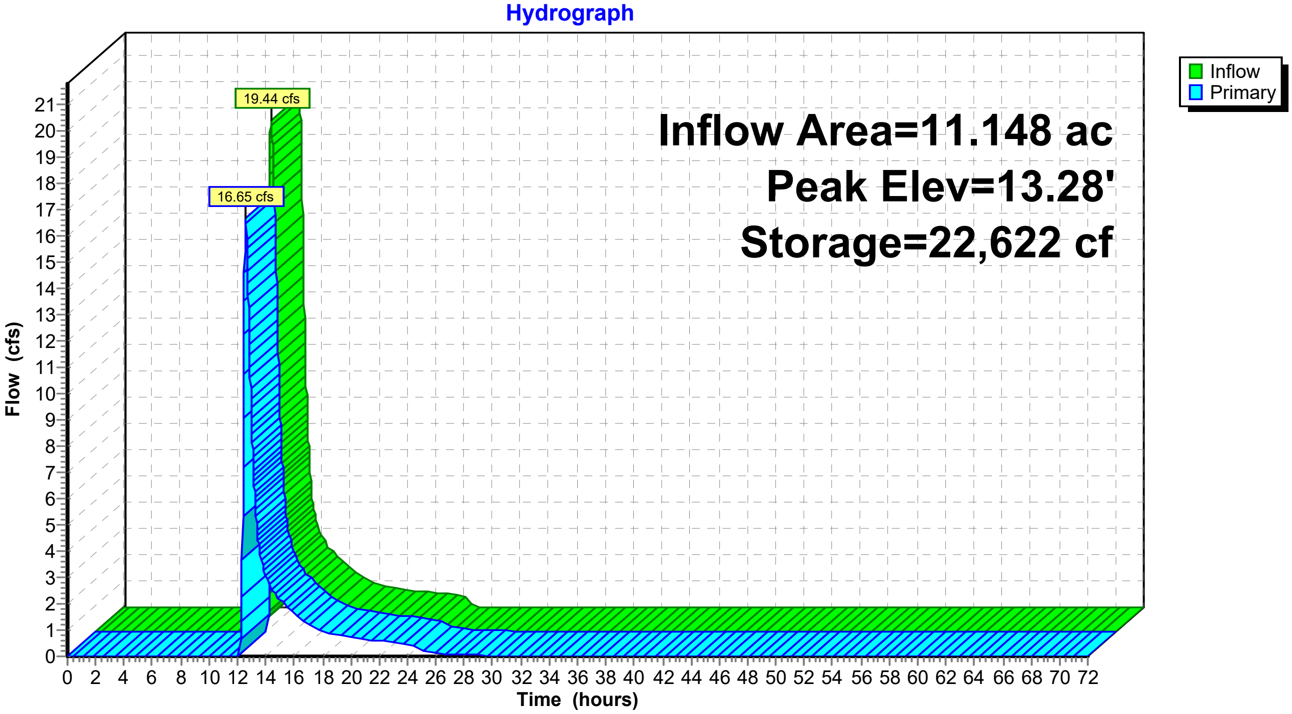
Volume	Invert	Avail.Storage	Storage Description
#1	12.00'	47,617 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
12.00	1,826	0	0
13.00	27,167	14,497	14,497
14.00	39,073	33,120	47,617

Device	Routing	Invert	Outlet Devices
#1	Primary	12.83'	**Asymmetrical Weir, C= 3.27** Offset (feet) 0.00 13.92 43.45 57.57 61.89 74.87 84.88 105.86 131.31 Elev. (feet) 14.00 13.56 13.12 13.03 12.83 13.08 13.85 13.88 14.00

Primary OutFlow Max=16.64 cfs @ 12.58 hrs HW=13.28' (Free Discharge)
└─**1=Asymmetrical Weir** (Weir Controls 16.64 cfs @ 1.22 fps)

Pond E-P2: Wetland



Time span=0.00-72.00 hrs, dt=0.02 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment E1: Property Offsite	Runoff Area=260,170 sf 62.63% Impervious Runoff Depth=4.69" Flow Length=343' Tc=31.4 min CN=80 Runoff=18.06 cfs 2.337 af
Subcatchment E2: E2	Runoff Area=225,440 sf 6.06% Impervious Runoff Depth=2.80" Flow Length=319' Tc=21.2 min CN=62 Runoff=10.90 cfs 1.208 af
Subcatchment E3: SW Property	Runoff Area=256,545 sf 1.84% Impervious Runoff Depth=0.26" Flow Length=683' Tc=13.5 min CN=31 Runoff=0.22 cfs 0.128 af
Subcatchment E4: Central Property	Runoff Area=295,827 sf 0.00% Impervious Runoff Depth=1.15" Flow Length=808' Tc=17.9 min CN=44 Runoff=4.68 cfs 0.654 af
Subcatchment E5: Central Property	Runoff Area=276,580 sf 5.99% Impervious Runoff Depth=1.67" Flow Length=808' Tc=17.9 min CN=50 Runoff=7.53 cfs 0.882 af
Subcatchment E6: SE Property	Runoff Area=90,483 sf 4.01% Impervious Runoff Depth=0.70" Flow Length=290' Tc=13.3 min CN=38 Runoff=0.66 cfs 0.121 af
Subcatchment E7: SE Property	Runoff Area=8,473 sf 0.00% Impervious Runoff Depth=3.62" Tc=6.0 min CN=70 Runoff=0.82 cfs 0.059 af
Reach DP-1: Wetland	Inflow=30.86 cfs 3.919 af Outflow=30.86 cfs 3.919 af
Reach DP-2: North PL	Inflow=7.53 cfs 0.882 af Outflow=7.53 cfs 0.882 af
Reach DP-3: PL 248 Water Street	Inflow=0.66 cfs 0.121 af Outflow=0.66 cfs 0.121 af
Reach DP-4: South PL	Inflow=0.82 cfs 0.059 af Outflow=0.82 cfs 0.059 af
Pond E-P1: Wetland	Peak Elev=18.09' Storage=8,469 cf Inflow=18.06 cfs 2.337 af Outflow=18.05 cfs 2.169 af
Pond E-P2: Wetland	Peak Elev=13.37' Storage=25,364 cf Inflow=27.97 cfs 3.377 af Outflow=26.58 cfs 3.137 af

Total Runoff Area = 32.450 ac Runoff Volume = 5.388 af Average Runoff Depth = 1.99"
85.74% Pervious = 27.824 ac 14.26% Impervious = 4.626 ac

Summary for Subcatchment E1: Property Offsite

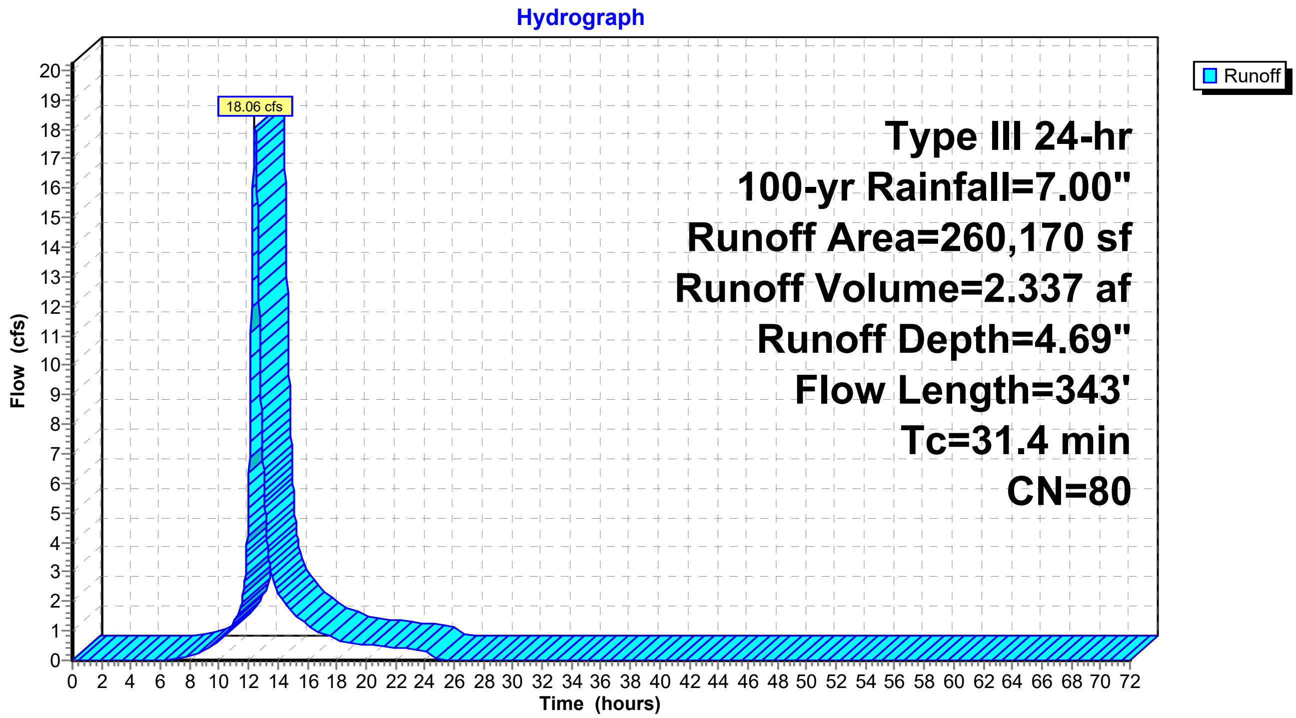
Runoff = 18.06 cfs @ 12.43 hrs, Volume= 2.337 af, Depth= 4.69"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-yr Rainfall=7.00"

	Area (sf)	CN	Description
*	142,754	89	Urban commercial, 85% imp, HSG A (OFFSITE)
*	31,587	30	Woods, Good, HSG A (OFFSITE)
*	48,943	94	Urban commercial, 85% imp, HSG C (OFFSITE)
*	8,690	78	Wetlands/woods, HSG A (OFFSITE)
*	25,996	70	Woods, Good, HSG C (OFFSITE)
*	2,200	78	Wetlands/woods, HSG C (OFFSITE)
	260,170	80	Weighted Average
	97,228		37.37% Pervious Area
	162,942		62.63% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.8	50	0.0040	0.04		**Sheet Flow, Start** Woods: Light underbrush n= 0.400 P2= 3.40"
6.6	126	0.0040	0.32		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
2.0	167	0.0800	1.41		**Shallow Concentrated Flow, C-WETLAND** Woodland Kv= 5.0 fps
31.4	343	Total			

Subcatchment E1: Property Offsite



Summary for Subcatchment E2: E2

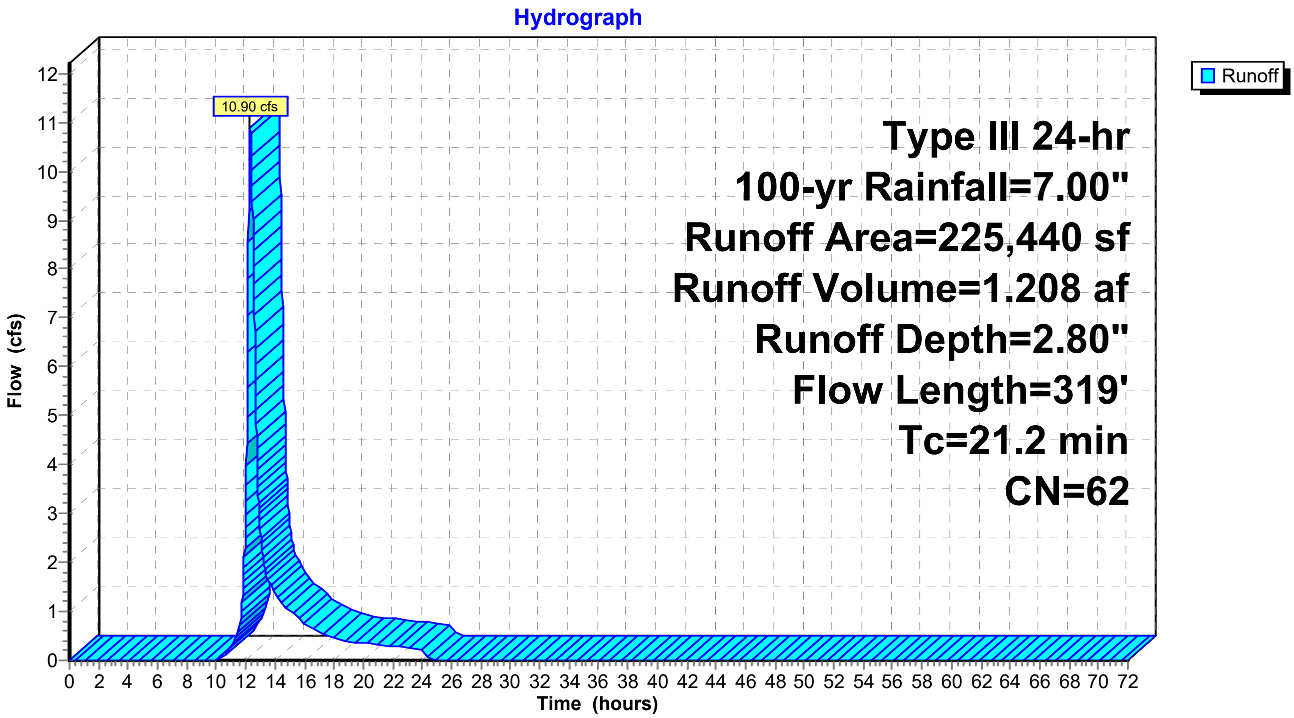
Runoff = 10.90 cfs @ 12.31 hrs, Volume= 1.208 af, Depth= 2.80"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-yr Rainfall=7.00"

	Area (sf)	CN	Description
*	9,050	98	Paved parking, HSG A (OFFSITE)
*	49,865	30	Woods, Good, HSG A (OFFSITE)
*	20,149	78	Wetlands/woods. HSG A (OFFSITE)
*	4,604	98	Paved parking, HSG C (OFFSITE)
*	4,156	70	Woods, Good, HSG C (OFFSITE)
*	3,605	78	Wetlands/woods, HSG C (OFFSITE)
	83,652	70	Woods, Good, HSG C
*	5,924	78	Wetlands/woods, HSG C
*	28,611	78	Wetlands/woods, HSG A
	15,824	30	Woods, Good, HSG A
	225,440	62	Weighted Average
	211,786		93.94% Pervious Area
	13,654		6.06% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.8	50	0.0100	0.05		**Sheet Flow, START** Woods: Light underbrush n= 0.400 P2= 3.40"
3.2	95	0.0100	0.50		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
2.2	174	0.0710	1.33		**Shallow Concentrated Flow, c-WETLAND** Woodland Kv= 5.0 fps
21.2	319	Total			

Subcatchment E2: E2



Summary for Subcatchment E3: SW Property

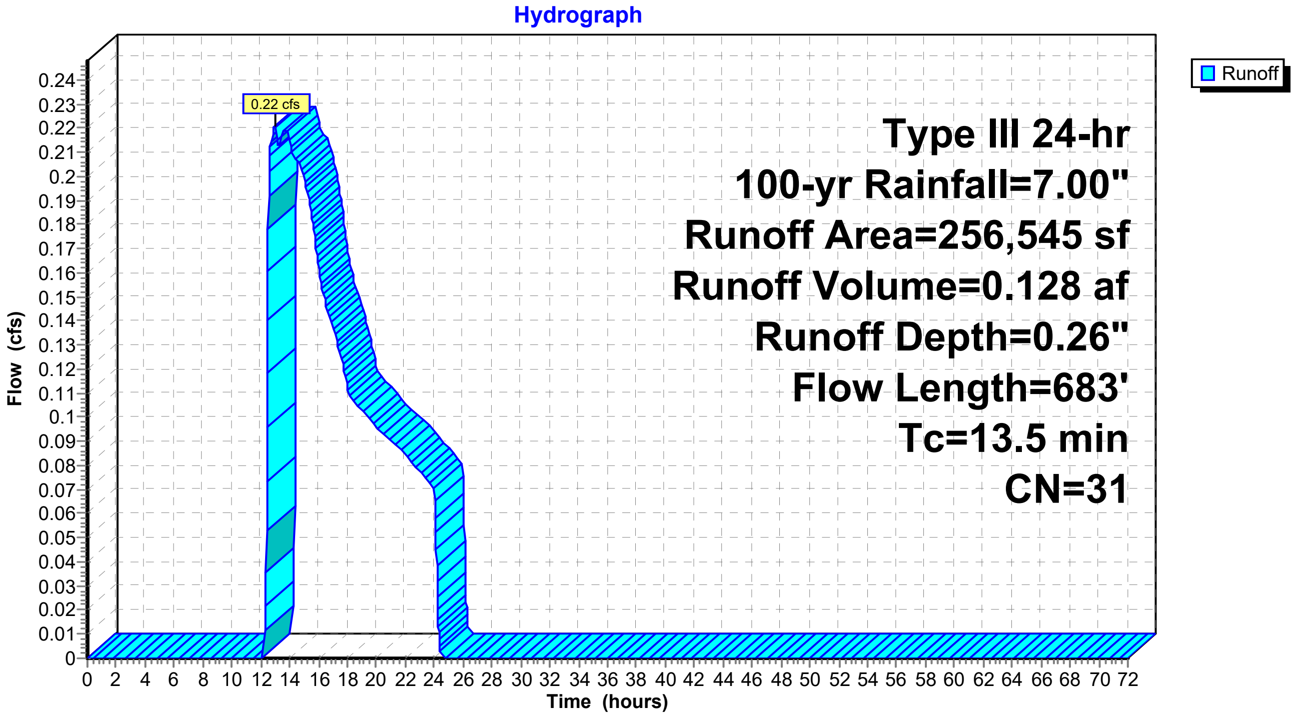
Runoff = 0.22 cfs @ 12.95 hrs, Volume= 0.128 af, Depth= 0.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-yr Rainfall=7.00"

	Area (sf)	CN	Description
	157,110	30	Woods, Good, HSG A
*	94,725	30	Woods, Fair, HSG A (OFFSITE)
*	4,710	98	Impervious, HSG A (OFFSITE)
	256,545	31	Weighted Average
	251,835		98.16% Pervious Area
	4,710		1.84% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.2	50	0.0300	0.08		**Sheet Flow, Start Off Property** Woods: Light underbrush n= 0.400 P2= 3.40"
3.3	633	0.0400	3.22		**Shallow Concentrated Flow, To Wetland** Unpaved Kv= 16.1 fps
13.5	683	Total			

Subcatchment E3: SW Property



Summary for Subcatchment E4: Central Property

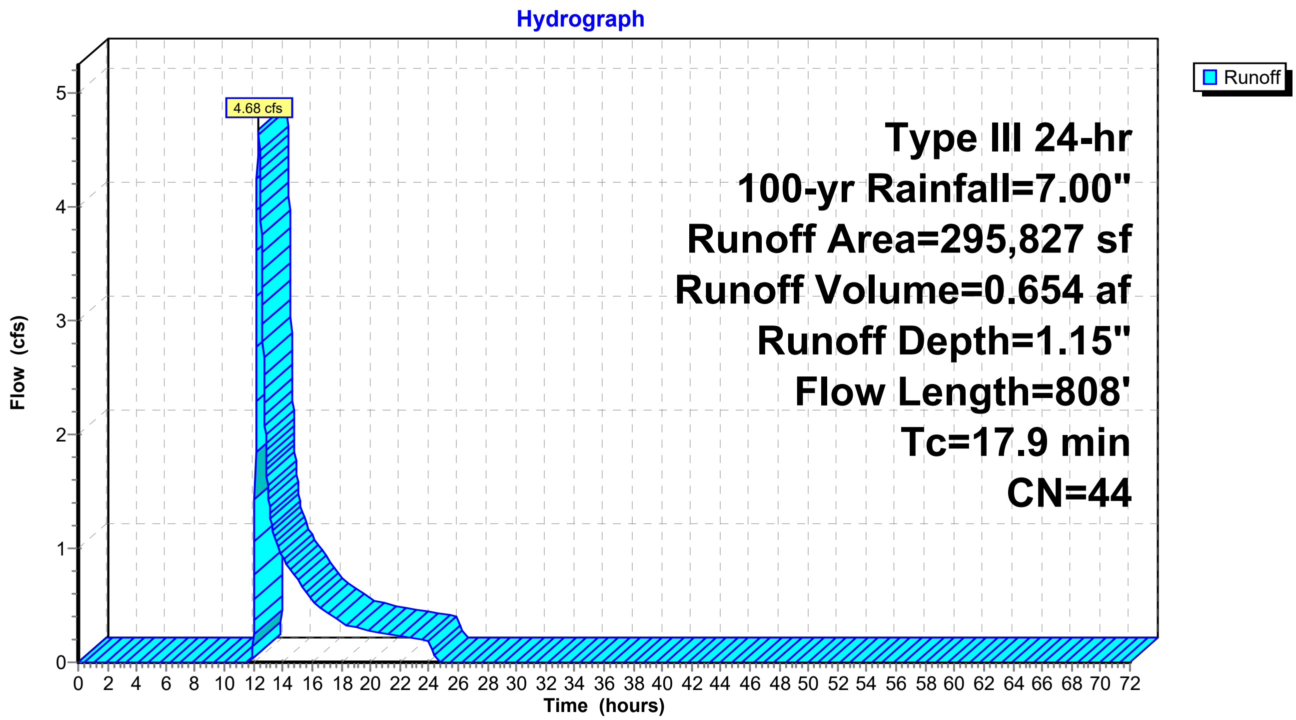
Runoff = 4.68 cfs @ 12.32 hrs, Volume= 0.654 af, Depth= 1.15"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-yr Rainfall=7.00"

Area (sf)	CN	Description
195,082	30	Woods, Good, HSG A
100,745	70	Woods, Good, HSG C
295,827	44	Weighted Average
295,827		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.4	50	0.0150	0.06		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.40"
4.5	758	0.0310	2.83		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
17.9	808	Total			

Subcatchment E4: Central Property



Summary for Subcatchment E5: Central Property

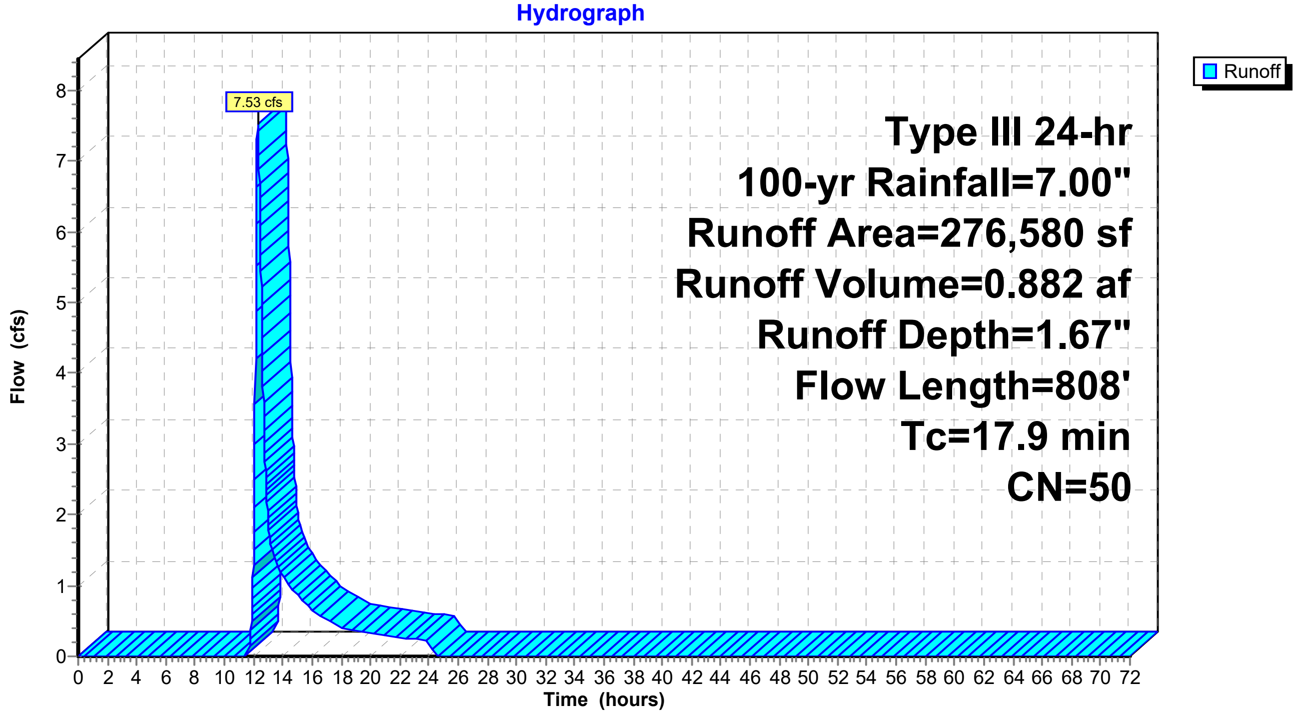
Runoff = 7.53 cfs @ 12.28 hrs, Volume= 0.882 af, Depth= 1.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-yr Rainfall=7.00"

	Area (sf)	CN	Description
*	3,765	98	Pavement, HSG A (OFFSITE)
*	8,121	98	Impervious, HSG A (OFFSITE)
*	17,970	30	Woods, Good, HSG A (OFFSITE)
*	41,632	39	>75% Grass cover, Good, HSG A (OFFSITE)
	69,621	70	Woods, Good, HSG C
	103,483	30	Woods, Good, HSG A
*	2,694	98	Pavement, HSG A
*	1,985	98	Roofs, HSG A
	27,309	74	>75% Grass cover, Good, HSG C
	276,580	50	Weighted Average
	260,015		94.01% Pervious Area
	16,565		5.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.4	50	0.0150	0.06		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.40"
4.5	758	0.0310	2.83		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
17.9	808	Total			

Subcatchment E5: Central Property



Summary for Subcatchment E6: SE Property

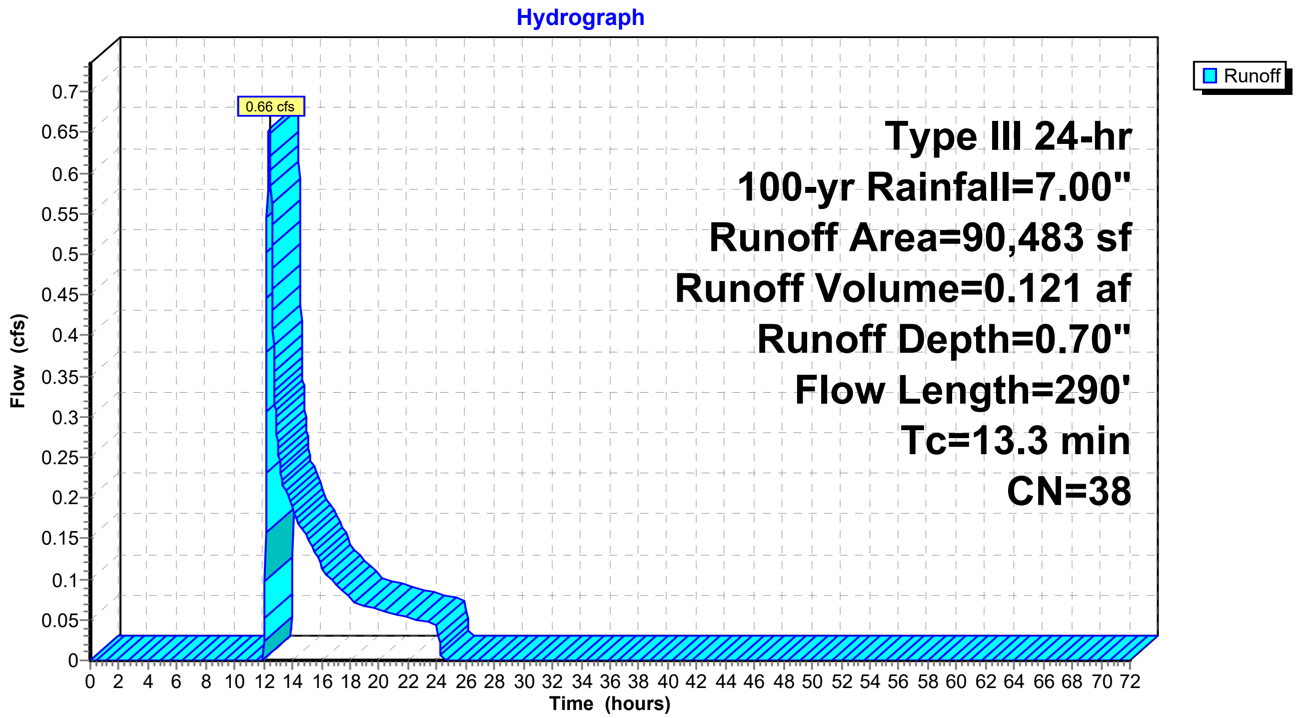
Runoff = 0.66 cfs @ 12.39 hrs, Volume= 0.121 af, Depth= 0.70"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-yr Rainfall=7.00"

	Area (sf)	CN	Description
	39,519	30	Woods, Good, HSG A
	1,209	70	Woods, Good, HSG C
	11,750	49	50-75% Grass cover, Fair, HSG A
	770	98	Paved parking, HSG A
*	15,917	30	Woods, Good, HSG A (OFFSITE)
*	406	70	Woods, Good, HSG C (OFFSITE)
*	18,054	39	>75% Grass cover, Good, HSG A (OFFSITE)
*	2,858	98	Paved parking, HSG A (OFFSITE)
	90,483	38	Weighted Average
	86,855		95.99% Pervious Area
	3,628		4.01% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.5	50	0.0220	0.07		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.40"
1.8	240	0.0200	2.28		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
13.3	290	Total			

Subcatchment E6: SE Property



Summary for Subcatchment E7: SE Property

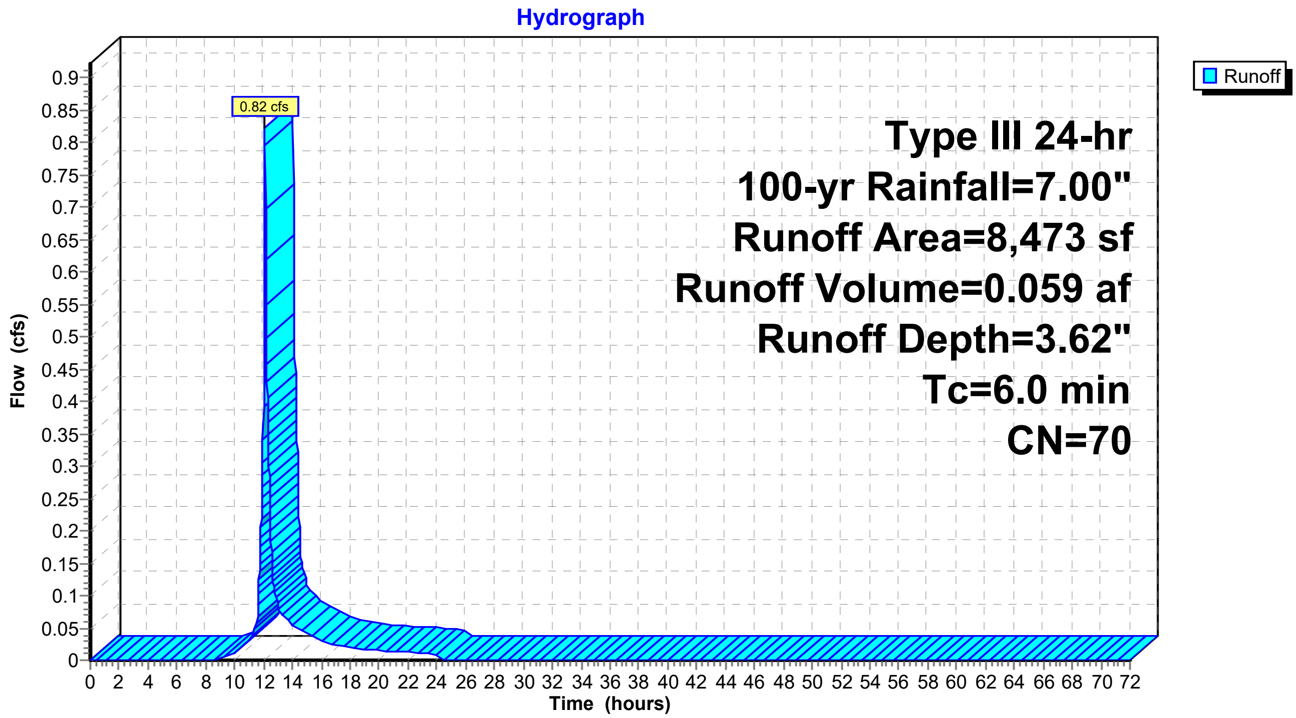
Runoff = 0.82 cfs @ 12.09 hrs, Volume= 0.059 af, Depth= 3.62"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-yr Rainfall=7.00"

Area (sf)	CN	Description
8,473	70	Woods, Good, HSG C
8,473		100.00% Pervious Area

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

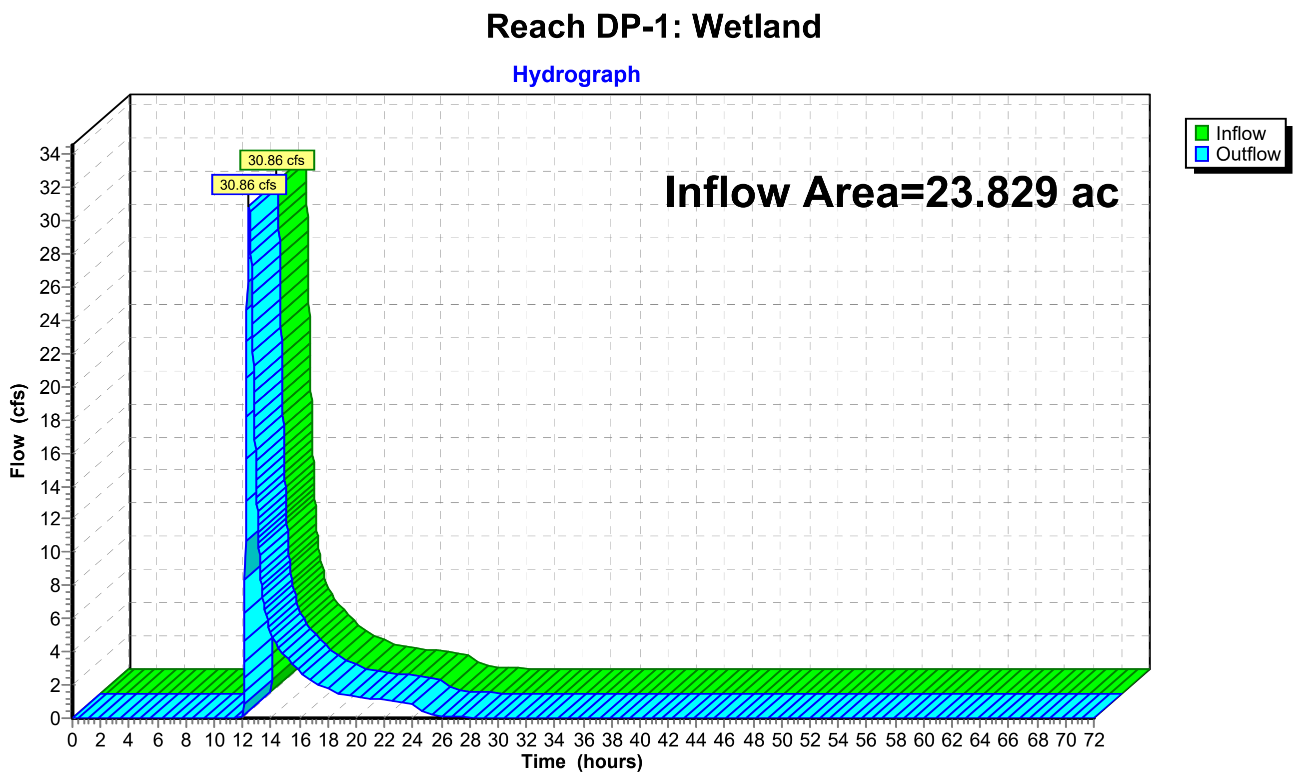
Subcatchment E7: SE Property



Summary for Reach DP-1: Wetland

Inflow Area = 23.829 ac, 17.47% Impervious, Inflow Depth = 1.97" for 100-yr event
Inflow = 30.86 cfs @ 12.47 hrs, Volume= 3.919 af
Outflow = 30.86 cfs @ 12.47 hrs, Volume= 3.919 af, Atten= 0%, Lag= 0.0 min

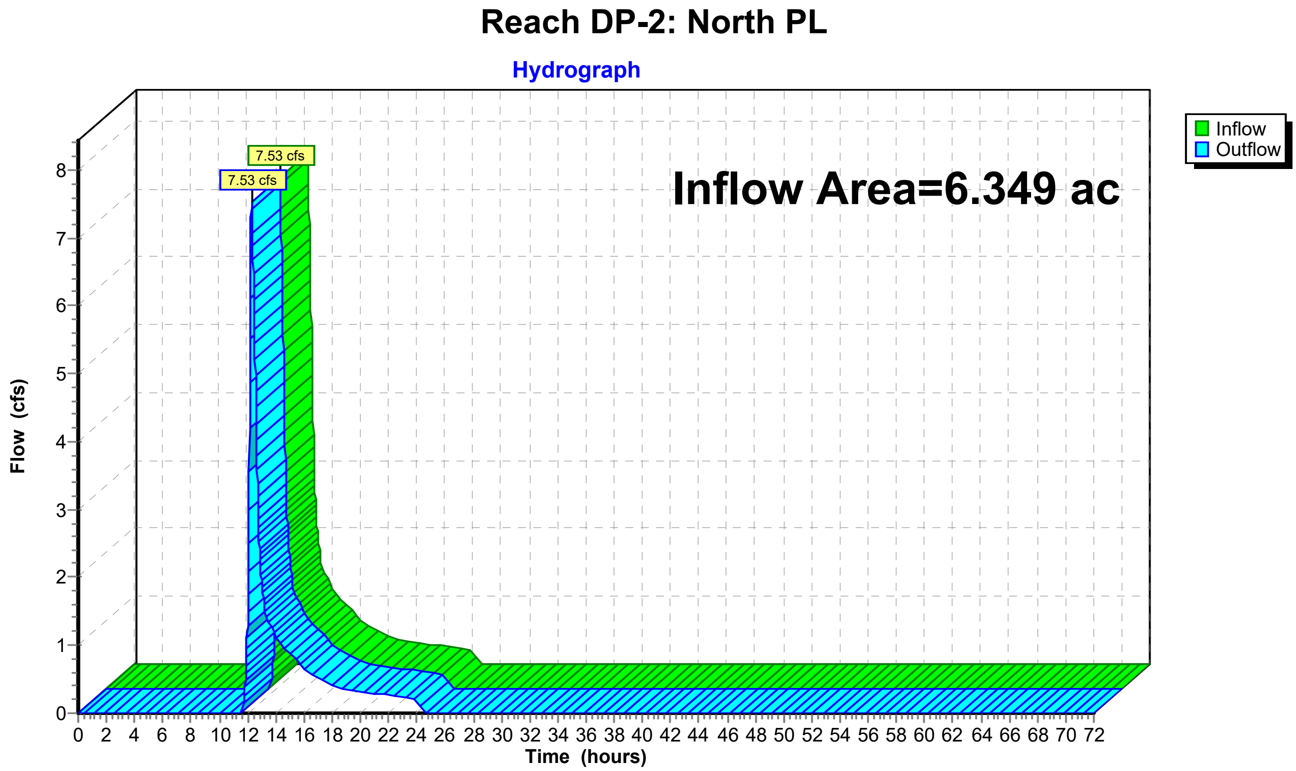
Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs



Summary for Reach DP-2: North PL

Inflow Area = 6.349 ac, 5.99% Impervious, Inflow Depth = 1.67" for 100-yr event
Inflow = 7.53 cfs @ 12.28 hrs, Volume= 0.882 af
Outflow = 7.53 cfs @ 12.28 hrs, Volume= 0.882 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs

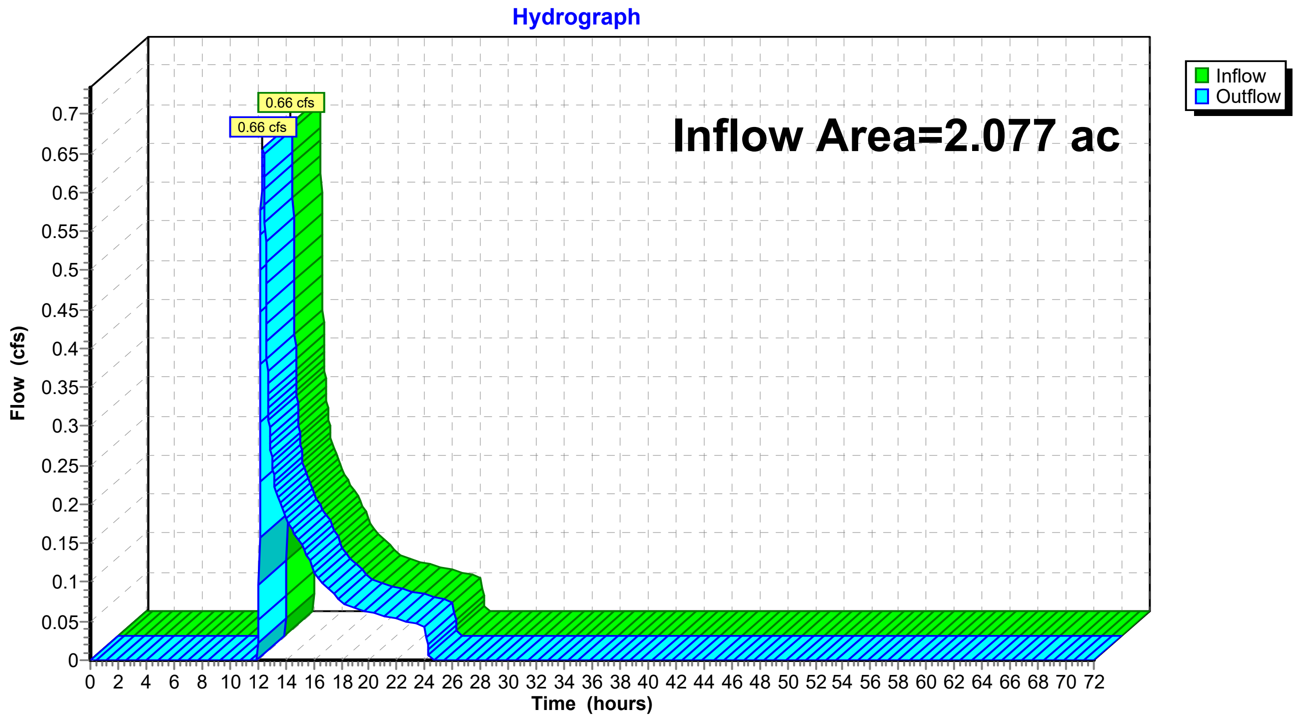


Summary for Reach DP-3: PL 248 Water Street

Inflow Area =	2.077 ac,	4.01% Impervious,	Inflow Depth = 0.70"	for 100-yr event
Inflow =	0.66 cfs @	12.39 hrs,	Volume=	0.121 af
Outflow =	0.66 cfs @	12.39 hrs,	Volume=	0.121 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs

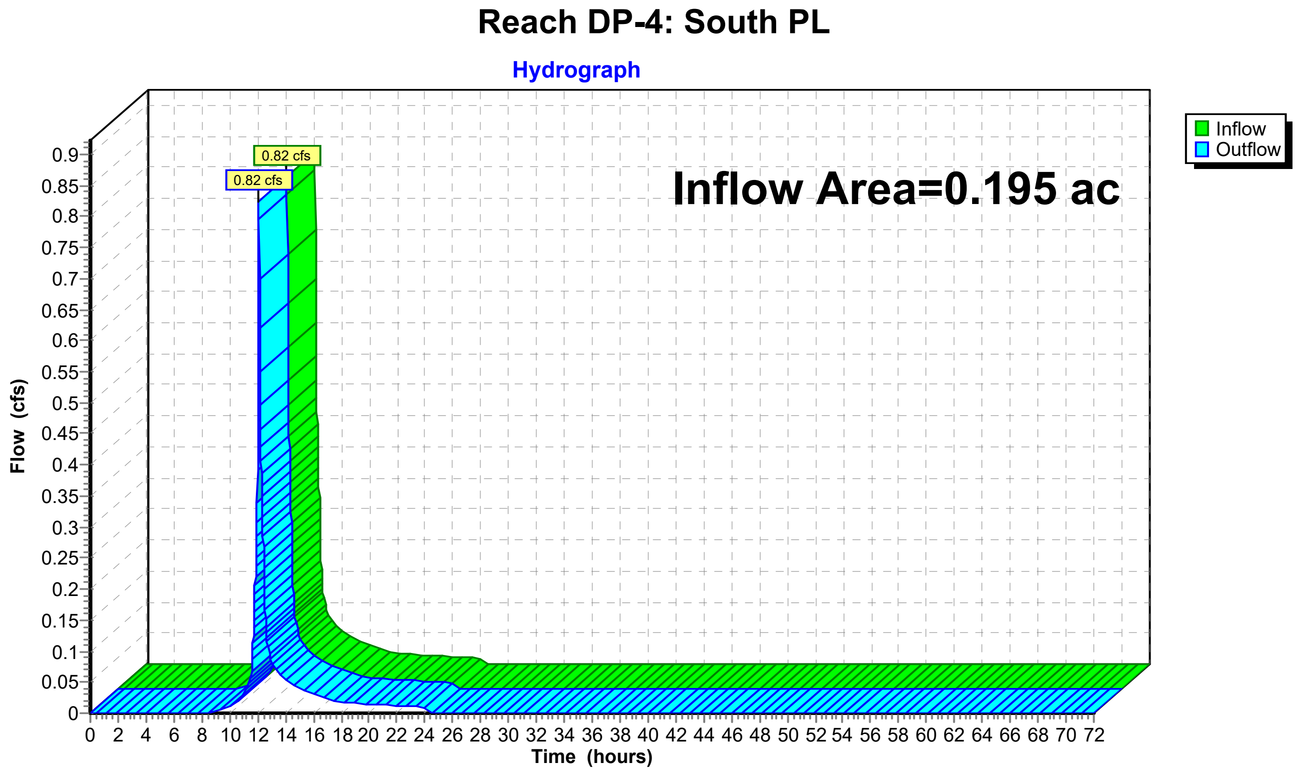
Reach DP-3: PL 248 Water Street



Summary for Reach DP-4: South PL

Inflow Area = 0.195 ac, 0.00% Impervious, Inflow Depth = 3.62" for 100-yr event
Inflow = 0.82 cfs @ 12.09 hrs, Volume= 0.059 af
Outflow = 0.82 cfs @ 12.09 hrs, Volume= 0.059 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs



Summary for Pond E-P1: Wetland

Inflow Area = 5.973 ac, 62.63% Impervious, Inflow Depth = 4.69" for 100-yr event
Inflow = 18.06 cfs @ 12.43 hrs, Volume= 2.337 af
Outflow = 18.05 cfs @ 12.44 hrs, Volume= 2.169 af, Atten= 0%, Lag= 0.7 min
Primary = 18.05 cfs @ 12.44 hrs, Volume= 2.169 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 18.09' @ 12.44 hrs Surf.Area= 13,677 sf Storage= 8,469 cf

Plug-Flow detention time= 57.4 min calculated for 2.169 af (93% of inflow)
Center-of-Mass det. time= 19.7 min (851.2 - 831.5)

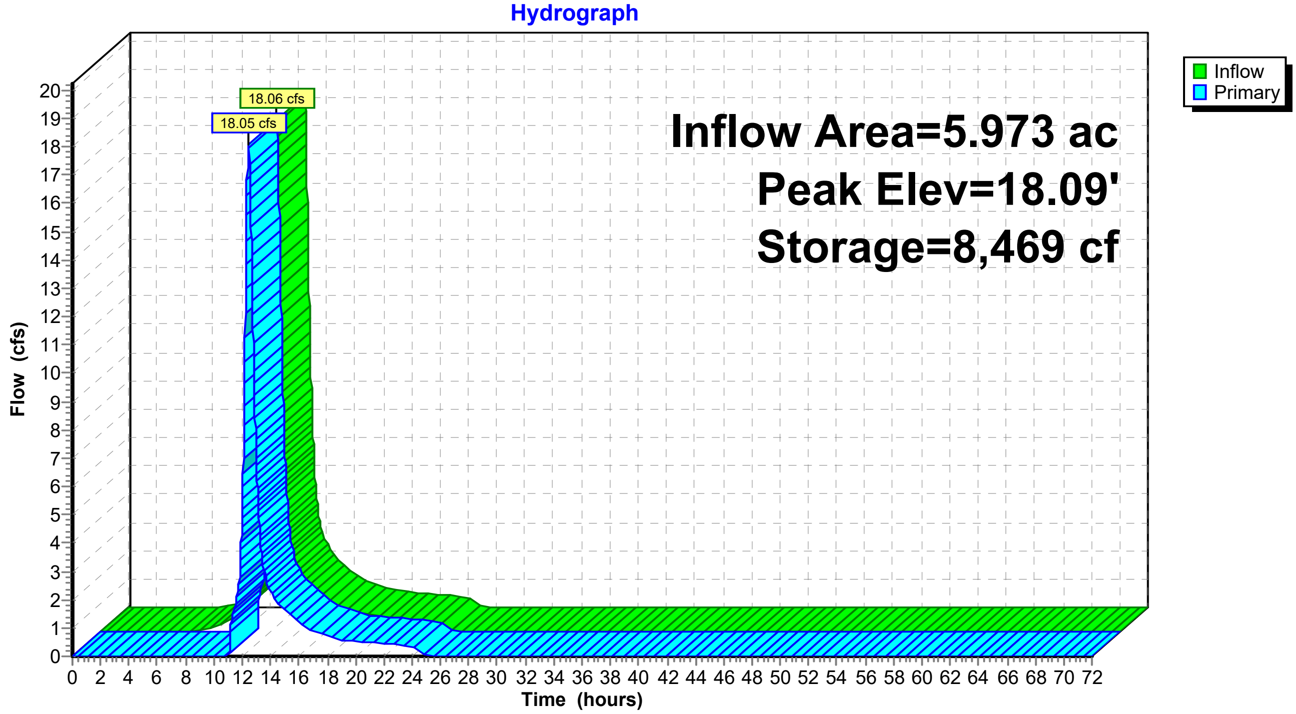
Volume	Invert	Avail.Storage	Storage Description
#1	17.00'	236,253 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
17.00	2,349	0	0
18.00	12,281	7,315	7,315
19.00	27,986	20,134	27,449
20.00	37,607	32,797	60,245
21.00	49,582	43,595	103,840
22.00	66,971	58,277	162,116
23.00	81,302	74,137	236,253

Device	Routing	Invert	Outlet Devices
#1	Primary	18.00'	**Asymmetrical Weir, C= 3.27** Offset (feet) 0.00 10.80 18.43 23.94 57.50 86.92 287.08 357.73 427.57 483.95 528.04 555.94 Elev. (feet) 23.00 22.00 21.00 20.00 19.00 18.00 18.00 19.00 20.00 21.00 22.00 23.00

Primary OutFlow Max=17.66 cfs @ 12.44 hrs HW=18.09' (Free Discharge)
└─**1=Asymmetrical Weir** (Weir Controls 17.66 cfs @ 0.95 fps)

Pond E-P1: Wetland



Summary for Pond E-P2: Wetland

Inflow Area = 11.148 ac, 36.37% Impervious, Inflow Depth = 3.63" for 100-yr event
Inflow = 27.97 cfs @ 12.38 hrs, Volume= 3.377 af
Outflow = 26.58 cfs @ 12.48 hrs, Volume= 3.137 af, Atten= 5%, Lag= 5.9 min
Primary = 26.58 cfs @ 12.48 hrs, Volume= 3.137 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Peak Elev= 13.37' @ 12.48 hrs Surf.Area= 31,572 sf Storage= 25,364 cf

Plug-Flow detention time= 81.8 min calculated for 3.136 af (93% of inflow)
Center-of-Mass det. time= 45.8 min (901.3 - 855.4)

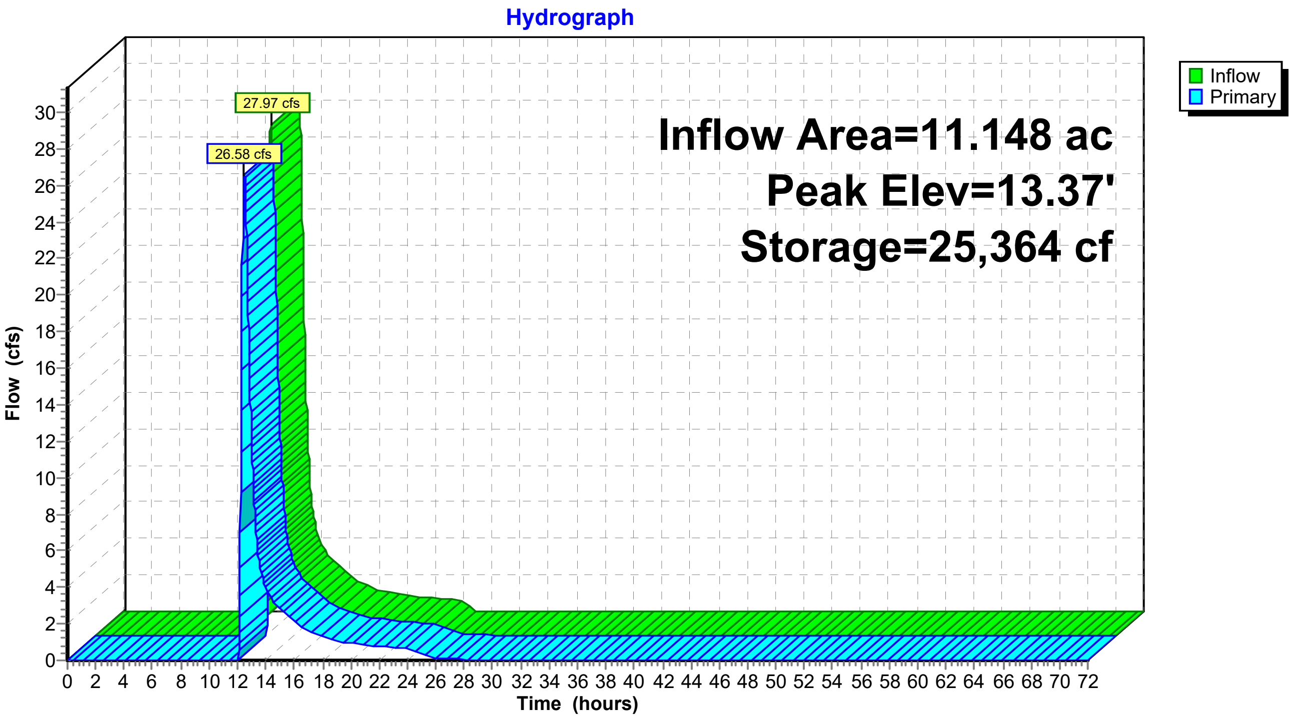
Volume	Invert	Avail.Storage	Storage Description
#1	12.00'	47,617 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
12.00	1,826	0	0
13.00	27,167	14,497	14,497
14.00	39,073	33,120	47,617

Device	Routing	Invert	Outlet Devices
#1	Primary	12.83'	**Asymmetrical Weir, C= 3.27** Offset (feet) 0.00 13.92 43.45 57.57 61.89 74.87 84.88 105.86 131.31 Elev. (feet) 14.00 13.56 13.12 13.03 12.83 13.08 13.85 13.88 14.00

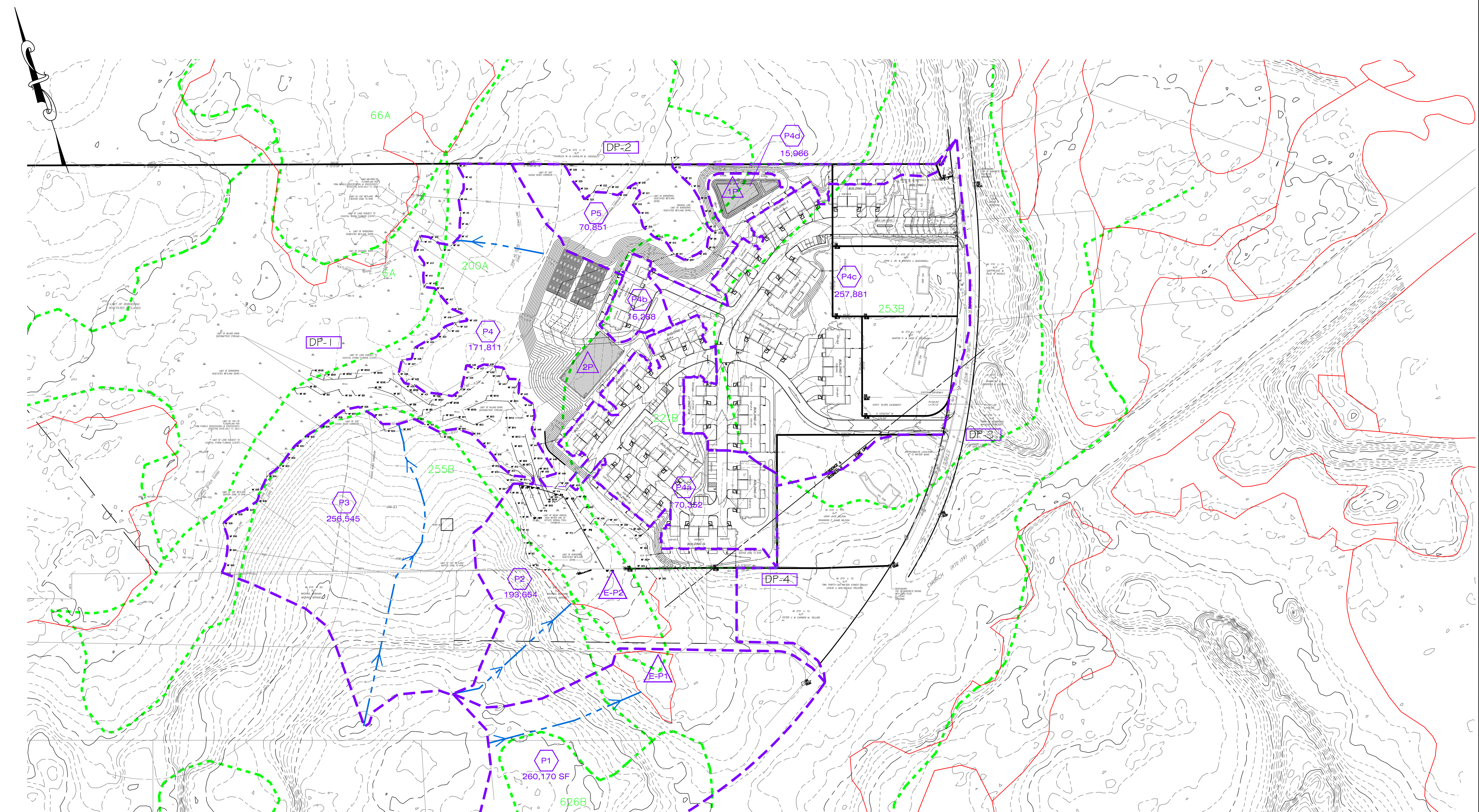
Primary OutFlow Max=26.56 cfs @ 12.48 hrs HW=13.37' (Free Discharge)
└─**1=Asymmetrical Weir** (Weir Controls 26.56 cfs @ 1.37 fps)

Pond E-P2: Wetland



A P P E N D I X B

Post-Development Condition



SOILS LEGEND

6A	SCARBORO MUCK, 0 TO 3 PERCENT SLOPES	HYDROLOGICAL SOIL GROUP: A/D
200A	SQUAMSCOTT FINE SANDY LOAM, 3 TO 8 PERCENT SLOPES	HYDROLOGIC SOIL GROUP: A
221B	ELDRIDGE FINE SANDY LOAM, 3 TO 8 PERCENT SLOPES	HYDROLOGIC SOIL GROUP: C
253B	HINCKLEY LOAMY SAND, 3 TO 8 PERCENT SLOPES	HYDROLOGIC SOIL GROUP: A
255B	WINDSOR LOAMY SAND, 3 TO 8 PERCENT SLOPES	HYDROLOGIC SOIL GROUP: A

LEGEND

- E — SUBCATCHMENT AREA
- P — POND
- SUBCATCHMENT AREA LINE
- DP-X — DISCHARGE POINT
- TIME OF CONCENTRATION FLOW PATH
- LIMIT OF SOIL BOUNDARY
- LIMIT OF WETLAND BOUNDARY (MASSGIS OLIVER)

* OFFSITE CONTOURS DOWNLOADED FROM MASSGIS LIDAR

GRAPHIC SCALE

100 0 50 100 200 400

(IN FEET)
1 inch = 100 ft.

REV	DATE	DESCRIPTION	BY	APP
1	4/5/2021	MERRILL ENGINEERS PEER REVIEW COMMENTS	SBS	BCM
2	6/7/2021	RECONFIGURED WTTP, STORMWATER SYSTEM AND BUILDINGS	SBS	BCM

PREPARED BY:
MCKENZIE ENGINEERING GROUP
Assinippi Office Park
150 Longwater Drive, Suite 101
Norwell, MA 02061
P: 781.792.3900
F: 781.792.0333
www.mckeng.com

RIVER MARSH VILLAGE COMPREHENSIVE PERMIT PLAN

(ASSESSOR'S MAP E-17, LOT 0 AND E-17A, LOT 274)

WATER STREET
PEMBROKE, MASSACHUSETTS

PROFESSIONAL ENGINEER:

OWNER/APPLICANT:
RIVER MARSH, LLC
293R WASHINGTON STREET
NORWELL, MA 02061

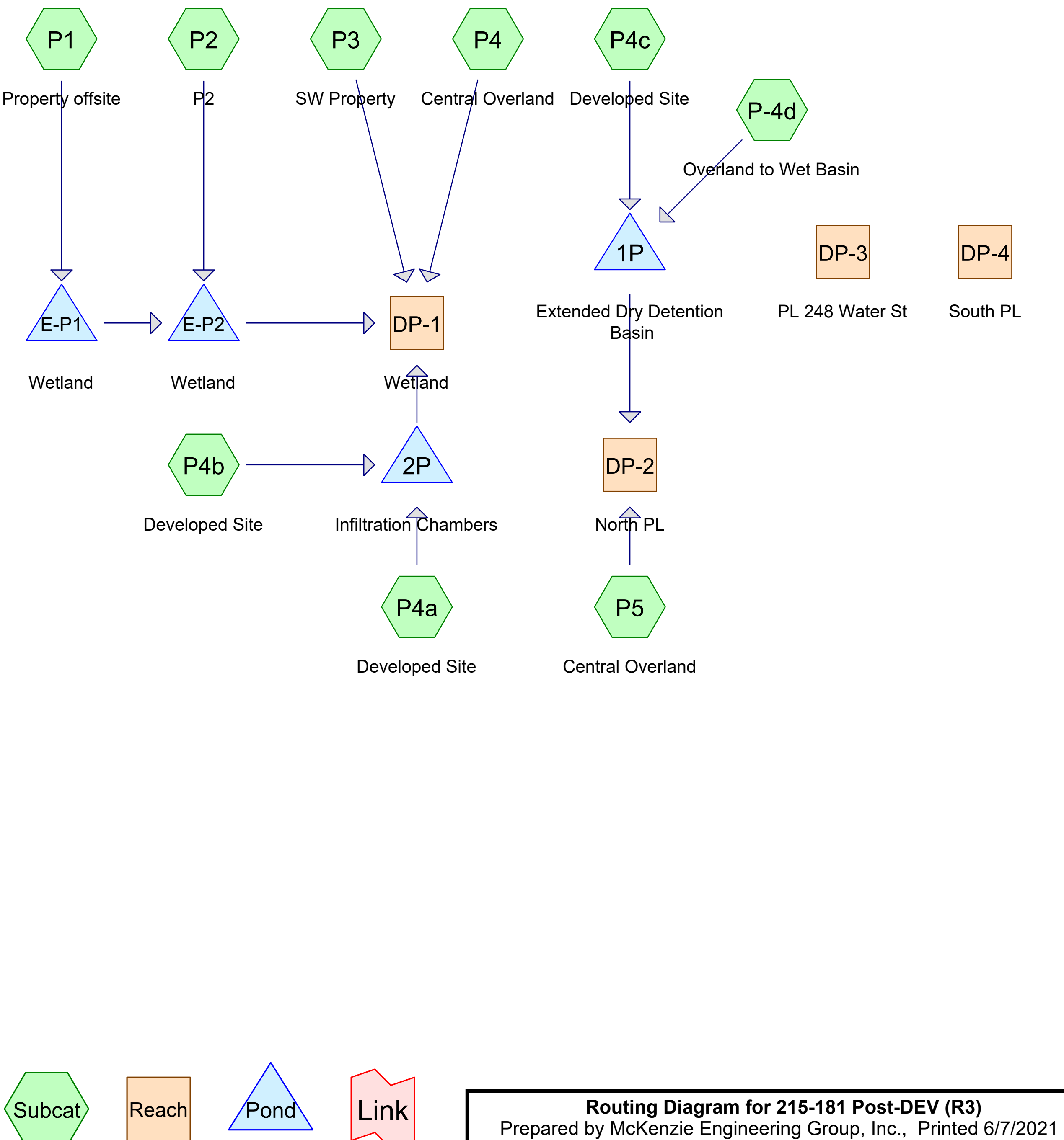
PERMITTING

DRAWN BY:	AJC
DESIGNED BY:	SBS
CHECKED BY:	SBS
APPROVED BY:	BCM
DATE:	AUGUST 1, 2018
SCALE:	1"=100'
PROJECT NO.:	215-181

DWG. TITLE:
POST-DEVELOPMENT WATERSHED PLAN

DWG. NO.:
WS-2

M:\MEG\2015 PROJECTS\215-181\DWGS\CUT SHEETS\ZBA APPLICATION\SUBMISSION (R3)\215-181 WATERSHED (R3).DWG



Routing Diagram for 215-181 Post-DEV (R3)
Prepared by McKenzie Engineering Group, Inc., Printed 6/7/2021
HydroCAD® 10.10-5a s/n 00452 © 2020 HydroCAD Software Solutions LLC

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-yr	Type III 24-hr		Default	24.00	1	3.40	2
2	10-yr	Type III 24-hr		Default	24.00	1	4.70	2
3	25-yr	Type III 24-hr		Default	24.00	1	5.60	2
4	100-yr	Type III 24-hr		Default	24.00	1	7.00	2

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
3.305	39	>75% Grass cover, Good, HSG A (P-4d, P4, P4c, P5)
1.404	39	>75% Grass cover, Good, HSG A (OFFSITE) (P4c, P5)
2.528	74	>75% Grass cover, Good, HSG C (P-4d, P2, P4, P4a, P4b, P4c, P5)
0.086	98	Decks, HSG A (P4, P4c, P5)
0.116	98	Decks, HSG C (P2, P4, P4a, P5)
0.057	76	Gravel roads, HSG A (P4)
0.033	89	Gravel roads, HSG C (P4b)
0.295	98	Impervious, HSG A (OFFSITE) (P3, P4c)
1.116	98	Paved parking, HSG A (P4c)
0.261	98	Paved parking, HSG A (OFFSITE) (P2, P4c)
1.204	98	Paved parking, HSG C (P4a, P4b, P4c)
0.106	98	Paved parking, HSG C (OFFSITE) (P2)
0.086	98	Pavement, HSG A (OFFSITE) (P4c, P5)
0.749	98	Roofs, HSG A (P4a, P4b)
1.660	98	Roofs, HSG C (P4a, P4b)
3.277	89	Urban commercial, 85% imp, HSG A (OFFSITE) (P1)
1.124	94	Urban commercial, 85% imp, HSG C (OFFSITE) (P1)
0.014	98	Walks, HSG A (P4c)
0.011	98	Walks, HSG C (P4c)
0.657	78	Wetlands/woods, HSG A (P2)
0.199	78	Wetlands/woods, HSG A (OFFSITE) (P1)
0.136	78	Wetlands/woods, HSG C (P2)
0.133	78	Wetlands/woods, HSG C (OFFSITE) (P1, P2)
0.463	78	Wetlands/woods. HSG A (OFFSITE) (P2)
2.175	30	Woods, Fair, HSG A (OFFSITE) (P3)
6.778	30	Woods, Good, HSG A (P2, P3, P4, P5)
2.648	30	Woods, Good, HSG A (OFFSITE) (P1, P2, P4c)
0.270	70	Woods, Good, HSG C (P2, P5)
1.560	70	Woods, Good, HSG C (OFFSITE) (P1, P2, P4c)
32.450	**60**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
23.569	HSG A	P-4d, P1, P2, P3, P4, P4a, P4b, P4c, P5
0.000	HSG B	
8.881	HSG C	P-4d, P1, P2, P4, P4a, P4b, P4c, P5
0.000	HSG D	
0.000	Other	
32.450		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
4.708	0.000	2.528	0.000	0.000	7.237	>75% Grass cover, Good	P-4d, P2, P4, P4a, P4b, P4c, P5
0.086	0.000	0.116	0.000	0.000	0.202	Decks	P2, P4, P4a, P4c, P5
0.057	0.000	0.033	0.000	0.000	0.091	Gravel roads	P4, P4b
0.295	0.000	0.000	0.000	0.000	0.295	Impervious	P3, P4c
1.377	0.000	1.310	0.000	0.000	2.687	Paved parking	P2, P4a, P4b, P4c
0.086	0.000	0.000	0.000	0.000	0.086	Pavement	P4c, P5
0.749	0.000	1.660	0.000	0.000	2.409	Roofs	P4a, P4b
3.277	0.000	1.124	0.000	0.000	4.401	Urban commercial, 85% imp	P1
0.014	0.000	0.011	0.000	0.000	0.025	Walks	P4c
0.856	0.000	0.269	0.000	0.000	1.126	Wetlands/woods	P1, P2
0.463	0.000	0.000	0.000	0.000	0.463	Wetlands/woods.	P2
2.175	0.000	0.000	0.000	0.000	2.175	Woods, Fair	P3
9.426	0.000	1.830	0.000	0.000	11.256	Woods, Good	P1, P2, P3, P4, P4c, P5
23.569	**0.000**	**8.881**	**0.000**	**0.000**	**32.450**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)
1	1P	15.50	15.23	27.0	0.0100	0.013	0.0	15.0	0.0
2	2P	16.00	15.74	26.0	0.0100	0.013	0.0	24.0	0.0
3	E-P2	12.83	12.83	18.0	0.0000	0.022	144.0	72.0	0.0

Time span=0.00-144.00 hrs, dt=0.02 hrs, 7201 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

SubcatchmentP-4d: Overland to Wet Basin Runoff Area=15,966 sf 0.00% Impervious Runoff Depth=0.66"
Tc=6.0 min CN=64 Runoff=0.22 cfs 0.020 af

SubcatchmentP1: Property offsite Runoff Area=260,170 sf 62.63% Impervious Runoff Depth=1.56"
Flow Length=343' Tc=31.4 min CN=80 Runoff=5.98 cfs 0.775 af

SubcatchmentP2: P2 Runoff Area=193,654 sf 7.83% Impervious Runoff Depth=0.66"
Flow Length=315' Tc=15.1 min CN=64 Runoff=2.01 cfs 0.243 af

SubcatchmentP3: SW Property Runoff Area=256,545 sf 1.84% Impervious Runoff Depth=0.00"
Flow Length=683' Tc=13.5 min CN=31 Runoff=0.00 cfs 0.000 af

SubcatchmentP4: Central Overland Runoff Area=171,811 sf 0.76% Impervious Runoff Depth=0.00"
Flow Length=190' Tc=17.0 min CN=39 Runoff=0.00 cfs 0.002 af

SubcatchmentP4a: Developed Site Runoff Area=170,352 sf 78.81% Impervious Runoff Depth=2.64"
Tc=6.0 min CN=93 Runoff=11.65 cfs 0.860 af

SubcatchmentP4b: Developed Site Runoff Area=16,288 sf 69.59% Impervious Runoff Depth=2.54"
Tc=6.0 min CN=92 Runoff=1.08 cfs 0.079 af

SubcatchmentP4c: Developed Site Runoff Area=257,881 sf 31.09% Impervious Runoff Depth=0.41"
Tc=6.0 min CN=58 Runoff=1.56 cfs 0.204 af

SubcatchmentP5: Central Overland Runoff Area=70,851 sf 2.13% Impervious Runoff Depth=0.04"
Flow Length=190' Tc=17.0 min CN=43 Runoff=0.01 cfs 0.005 af

Reach DP-1: Wetland Inflow=1.51 cfs 0.782 af
Outflow=1.51 cfs 0.782 af

Reach DP-2: North PL Inflow=0.17 cfs 0.229 af
Outflow=0.17 cfs 0.229 af

Reach DP-3: PL 248 Water St
Outflow=0.00 cfs 0.000 af

Reach DP-4: South PL
Outflow=0.00 cfs 0.000 af

Pond 1P: Extended Dry Detention Basin Peak Elev=16.81' Storage=5,141 cf Inflow=1.78 cfs 0.224 af
Outflow=0.16 cfs 0.224 af

Pond 2P: Infiltration Chambers Peak Elev=20.81' Storage=26,452 cf Inflow=12.73 cfs 0.939 af
Discarded=0.21 cfs 0.772 af Primary=0.28 cfs 0.167 af Outflow=0.49 cfs 0.939 af

Pond E-P1: Wetland Peak Elev=18.04' Storage=7,861 cf Inflow=5.98 cfs 0.775 af
Outflow=5.93 cfs 0.607 af

Pond E-P2: Wetland Peak Elev=13.03' Storage=15,283 cf Inflow=7.41 cfs 0.850 af
144.0" x 72.0" Box Culvert n=0.022 L=18.0' S=0.0000 '/' Outflow=1.43 cfs 0.614 af

Total Runoff Area = 32.450 ac Runoff Volume = 2.188 af Average Runoff Depth = 0.81"
70.90% Pervious = 23.006 ac 29.10% Impervious = 9.444 ac

Summary for Subcatchment P-4d: Overland to Wet Basin

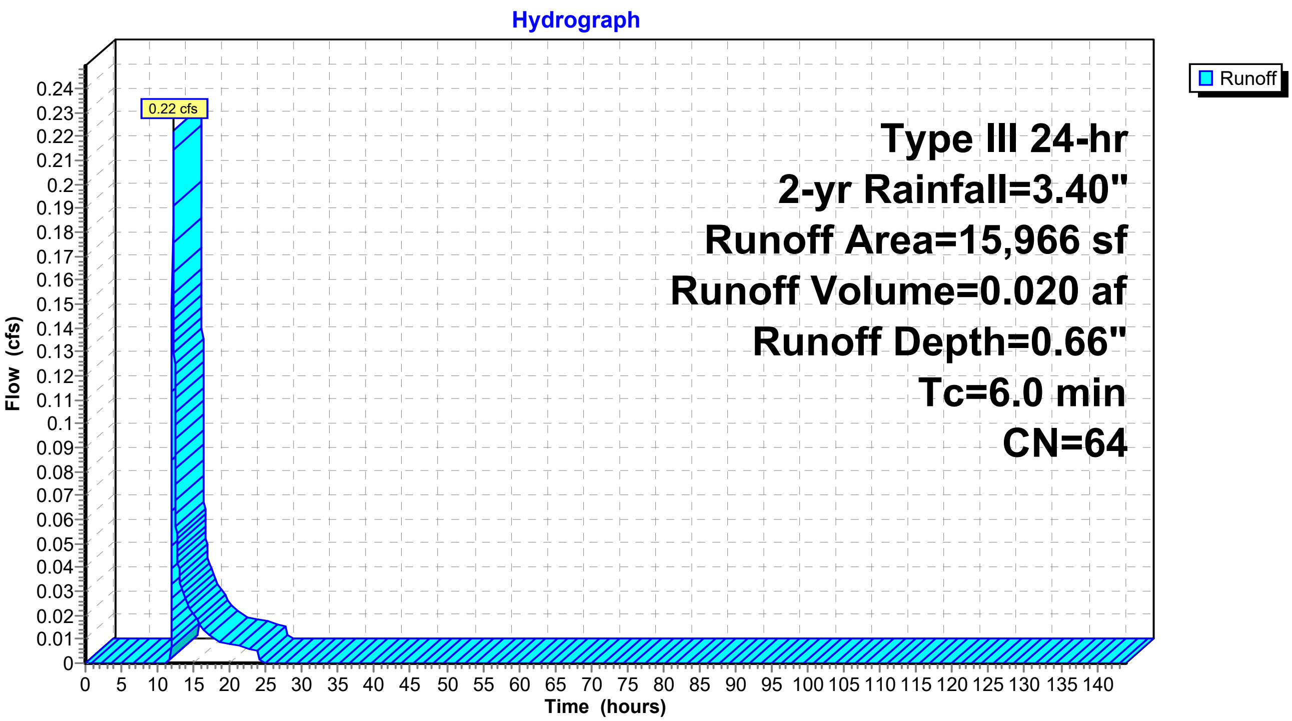
Runoff = 0.22 cfs @ 12.11 hrs, Volume= 0.020 af, Depth= 0.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-yr Rainfall=3.40"

Area (sf)	CN	Description
4,551	39	>75% Grass cover, Good, HSG A
11,415	74	>75% Grass cover, Good, HSG C
15,966	64	Weighted Average
15,966		100.00% Pervious Area

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

Subcatchment P-4d: Overland to Wet Basin



Summary for Subcatchment P1: Property offsite

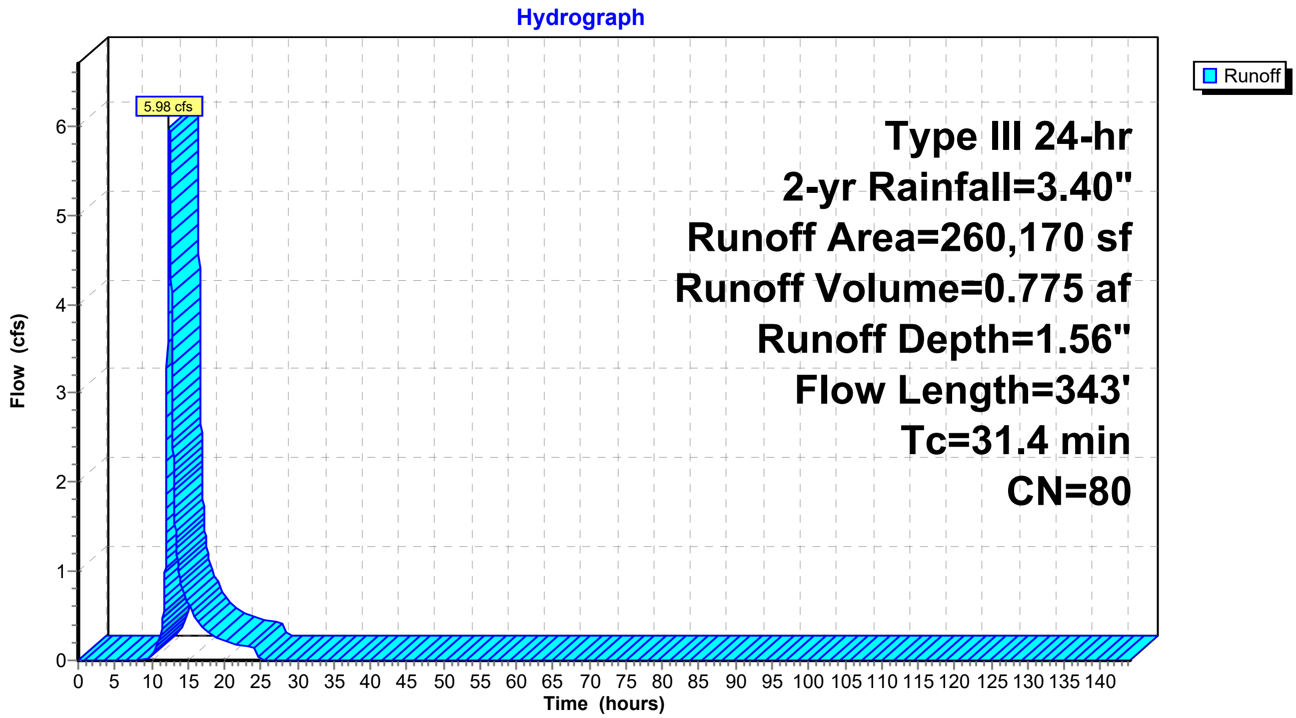
Runoff = 5.98 cfs @ 12.45 hrs, Volume= 0.775 af, Depth= 1.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-yr Rainfall=3.40"

	Area (sf)	CN	Description
*	142,754	89	Urban commercial, 85% imp, HSG A (OFFSITE)
*	31,587	30	Woods, Good, HSG A (OFFSITE)
*	48,943	94	Urban commercial, 85% imp, HSG C (OFFSITE)
*	8,690	78	Wetlands/woods, HSG A (OFFSITE)
*	25,996	70	Woods, Good, HSG C (OFFSITE)
*	2,200	78	Wetlands/woods, HSG C (OFFSITE)
	260,170	80	Weighted Average
	97,228		37.37% Pervious Area
	162,942		62.63% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.8	50	0.0040	0.04		**Sheet Flow, Start** Woods: Light underbrush n= 0.400 P2= 3.40"
6.6	126	0.0040	0.32		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
2.0	167	0.0800	1.41		**Shallow Concentrated Flow, C-WETLAND** Woodland Kv= 5.0 fps
31.4	343	Total			

Subcatchment P1: Property offsite



Summary for Subcatchment P2: P2

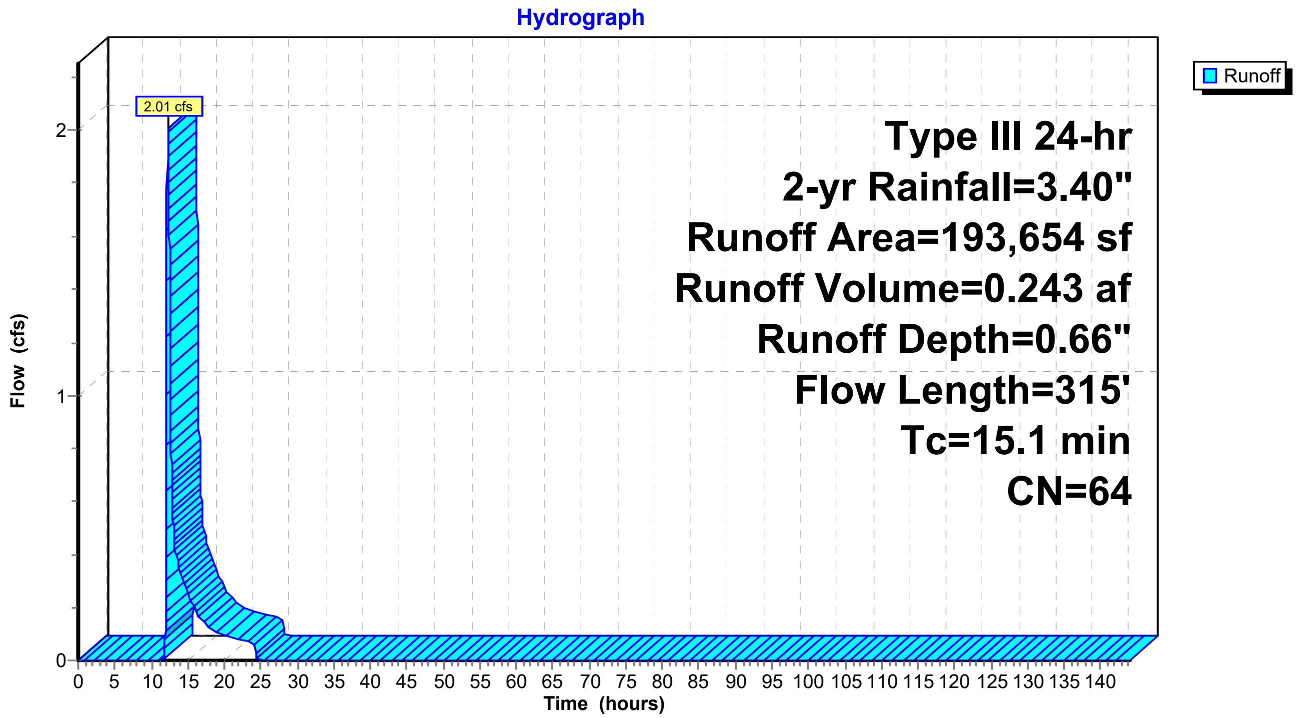
Runoff = 2.01 cfs @ 12.25 hrs, Volume= 0.243 af, Depth= 0.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-yr Rainfall=3.40"

	Area (sf)	CN	Description
*	9,050	98	Paved parking, HSG A (OFFSITE)
*	49,865	30	Woods, Good, HSG A (OFFSITE)
*	20,149	78	Wetlands/woods. HSG A (OFFSITE)
*	4,604	98	Paved parking, HSG C (OFFSITE)
*	41,546	70	Woods, Good, HSG C (OFFSITE)
*	3,605	78	Wetlands/woods, HSG C (OFFSITE)
	11,149	70	Woods, Good, HSG C
*	5,924	78	Wetlands/woods, HSG C
*	28,611	78	Wetlands/woods, HSG A
	3,016	30	Woods, Good, HSG A
*	1,504	98	Decks, HSG C
	14,631	74	>75% Grass cover, Good, HSG C
	193,654	64	Weighted Average
	178,496		92.17% Pervious Area
	15,158		7.83% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.2	50	0.0190	0.07		**Sheet Flow, START** Woods: Light underbrush n= 0.400 P2= 3.40"
1.5	116	0.0690	1.31		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
0.1	20	0.0200	2.87		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
1.3	129	0.1100	1.66		**Shallow Concentrated Flow, D-WETLAND** Woodland Kv= 5.0 fps
15.1	315	Total			

Subcatchment P2: P2



Summary for Subcatchment P3: SW Property

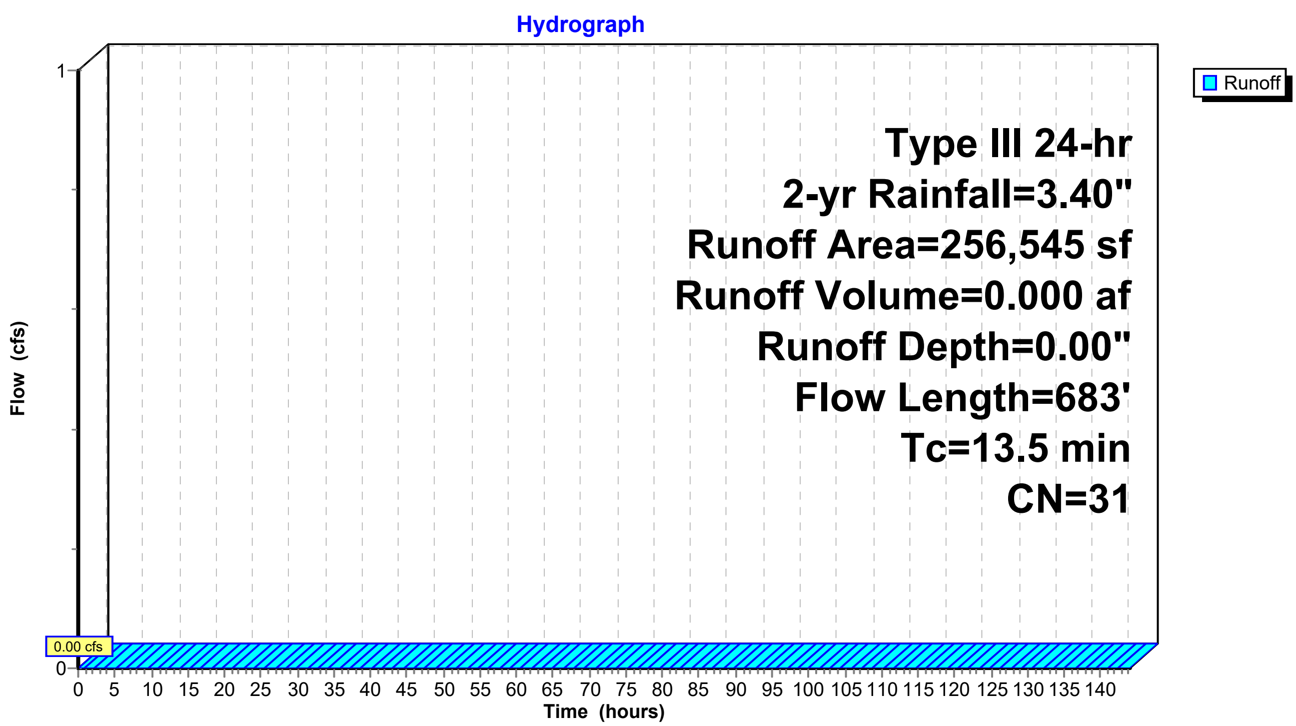
Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-yr Rainfall=3.40"

	Area (sf)	CN	Description
	157,110	30	Woods, Good, HSG A
*	94,725	30	Woods, Fair, HSG A (OFFSITE)
*	4,710	98	Impervious, HSG A (OFFSITE)
	256,545	31	Weighted Average
	251,835		98.16% Pervious Area
	4,710		1.84% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.2	50	0.0300	0.08		**Sheet Flow, Start Off Property** Woods: Light underbrush n= 0.400 P2= 3.40"
3.3	633	0.0400	3.22		**Shallow Concentrated Flow, To Wetland** Unpaved Kv= 16.1 fps
13.5	683	Total			

Subcatchment P3: SW Property



Summary for Subcatchment P4: Central Overland

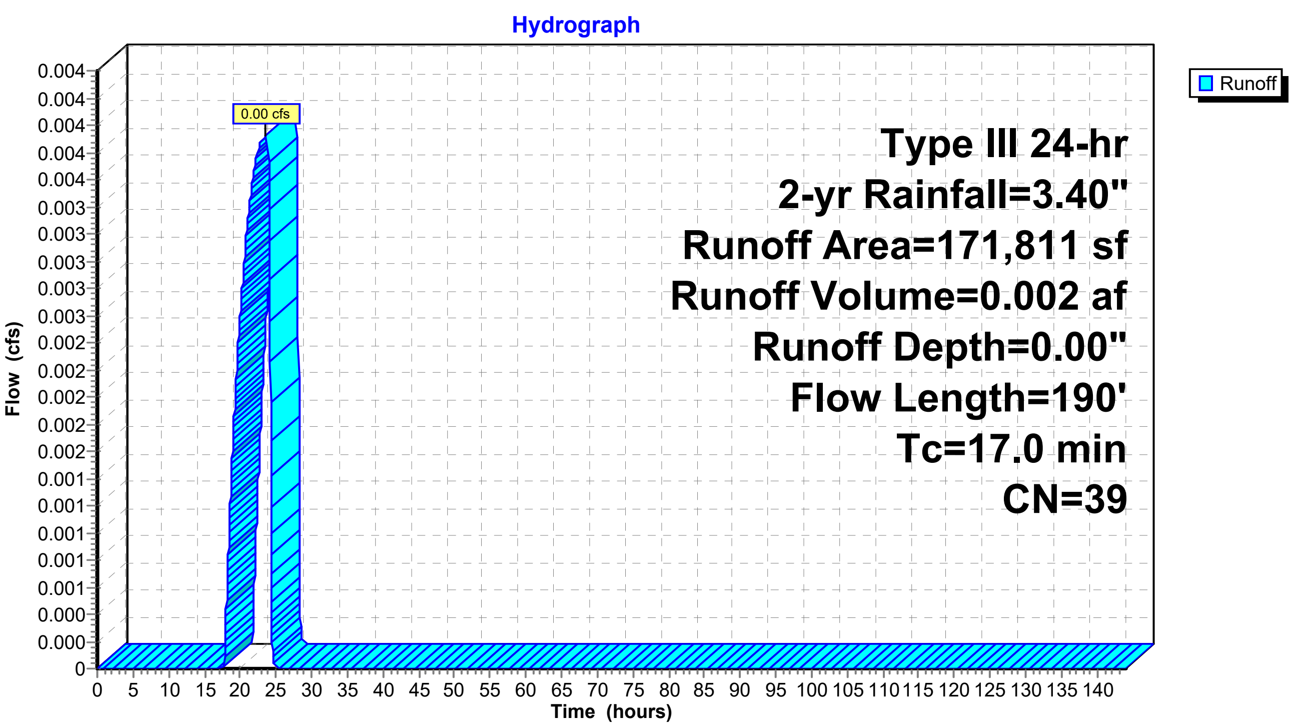
Runoff = 0.00 cfs @ 23.56 hrs, Volume= 0.002 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-yr Rainfall=3.40"

	Area (sf)	CN	Description
	104,548	30	Woods, Good, HSG A
	41,769	39	>75% Grass cover, Good, HSG A
	2,502	76	Gravel roads, HSG A
	21,686	74	>75% Grass cover, Good, HSG C
*	767	98	Decks, HSG C
*	539	98	Decks, HSG A
	171,811	39	Weighted Average
	170,505		99.24% Pervious Area
	1,306		0.76% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.8	50	0.0100	0.05		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.40"
1.2	140	0.0150	1.97		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
17.0	190	Total			

Subcatchment P4: Central Overland



Summary for Subcatchment P4a: Developed Site

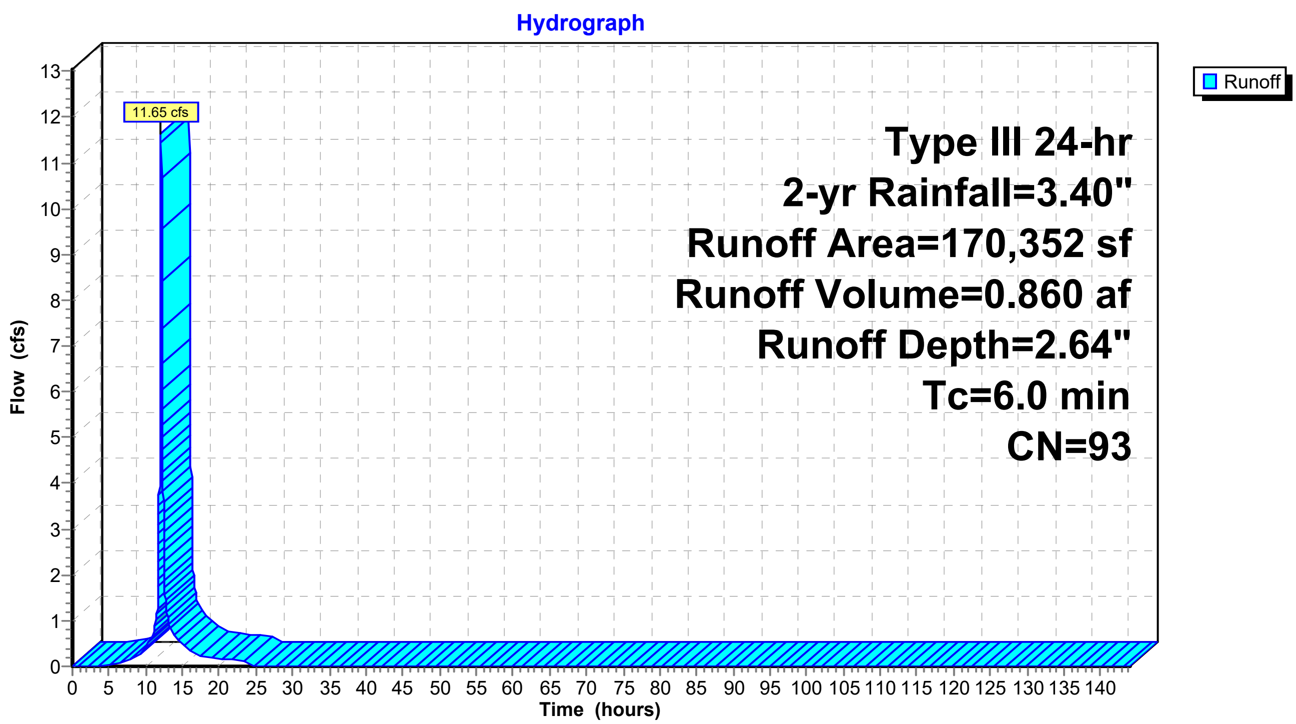
Runoff = 11.65 cfs @ 12.09 hrs, Volume= 0.860 af, Depth= 2.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-yr Rainfall=3.40"

	Area (sf)	CN	Description
	32,445	98	Roofs, HSG A
	36,095	74	>75% Grass cover, Good, HSG C
	64,685	98	Roofs, HSG C
*	35,350	98	Paved parking, HSG C
*	1,777	98	Decks, HSG C
	170,352	93	Weighted Average
	36,095		21.19% Pervious Area
	134,257		78.81% Impervious Area

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

Subcatchment P4a: Developed Site



Summary for Subcatchment P4b: Developed Site

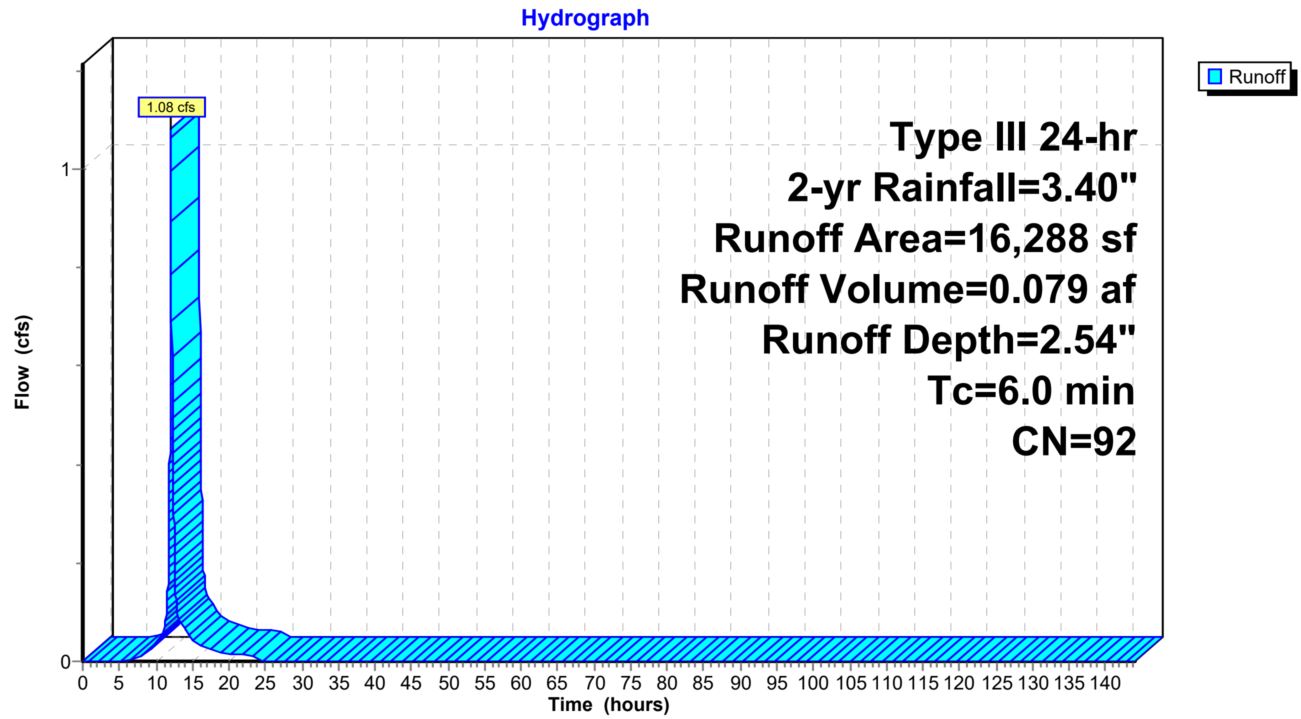
Runoff = 1.08 cfs @ 12.09 hrs, Volume= 0.079 af, Depth= 2.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-yr Rainfall=3.40"

	Area (sf)	CN	Description
	191	98	Roofs, HSG A
	7,608	98	Roofs, HSG C
*	3,536	98	Paved parking, HSG C
	3,501	74	>75% Grass cover, Good, HSG C
	1,452	89	Gravel roads, HSG C
	16,288	92	Weighted Average
	4,953		30.41% Pervious Area
	11,335		69.59% Impervious Area

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

Subcatchment P4b: Developed Site



Summary for Subcatchment P4c: Developed Site

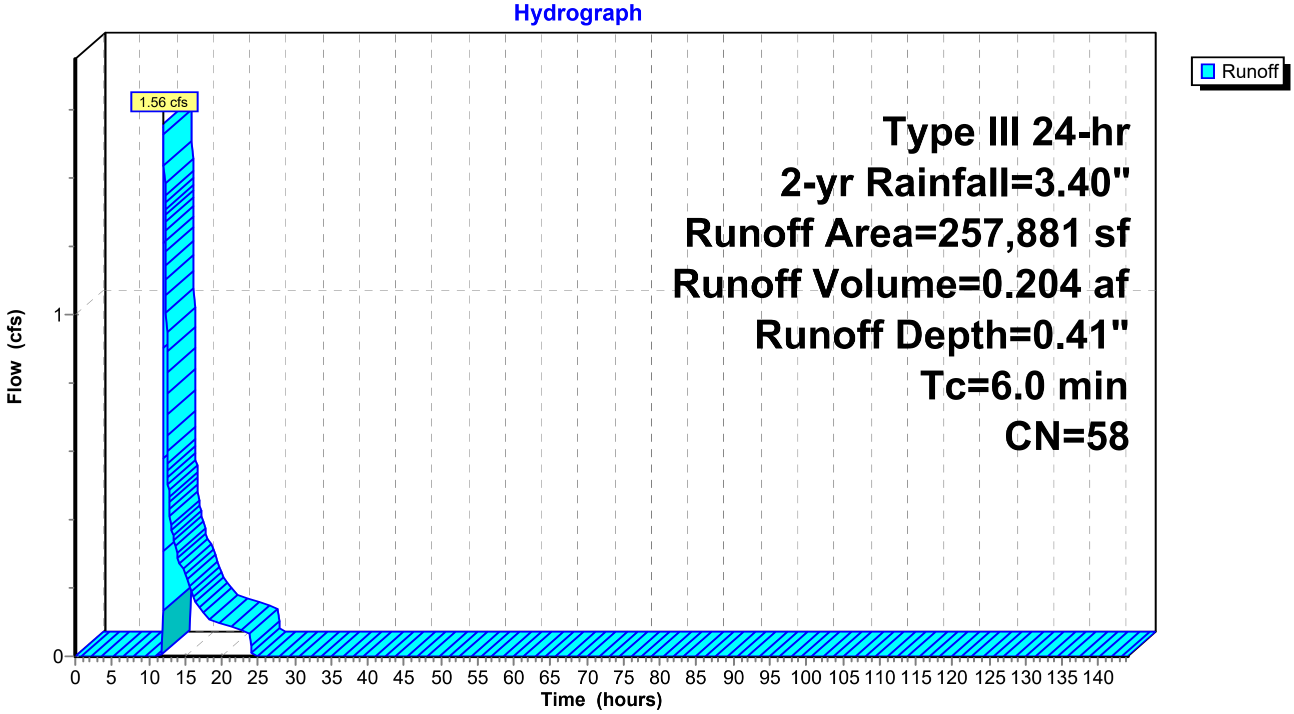
Runoff = 1.56 cfs @ 12.13 hrs, Volume= 0.204 af, Depth= 0.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-yr Rainfall=3.40"

	Area (sf)	CN	Description
	72,562	39	>75% Grass cover, Good, HSG A
	48,621	98	Paved parking, HSG A
*	599	98	Walks, HSG A
*	2,713	98	Decks, HSG A
	10,062	74	>75% Grass cover, Good, HSG C
*	13,564	98	Paved parking, HSG C
*	491	98	Walks, HSG C
*	406	70	Woods, Good, HSG C (OFFSITE)
*	33,887	30	Woods, Good, HSG A (OFFSITE)
*	60,799	39	>75% Grass cover, Good, HSG A (OFFSITE)
*	3,744	98	Pavement, HSG A (OFFSITE)
*	2,312	98	Paved parking, HSG A (OFFSITE)
*	8,121	98	Impervious, HSG A (OFFSITE)
	257,881	58	Weighted Average
	177,716		68.91% Pervious Area
	80,165		31.09% Impervious Area

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

Subcatchment P4c: Developed Site



Summary for Subcatchment P5: Central Overland

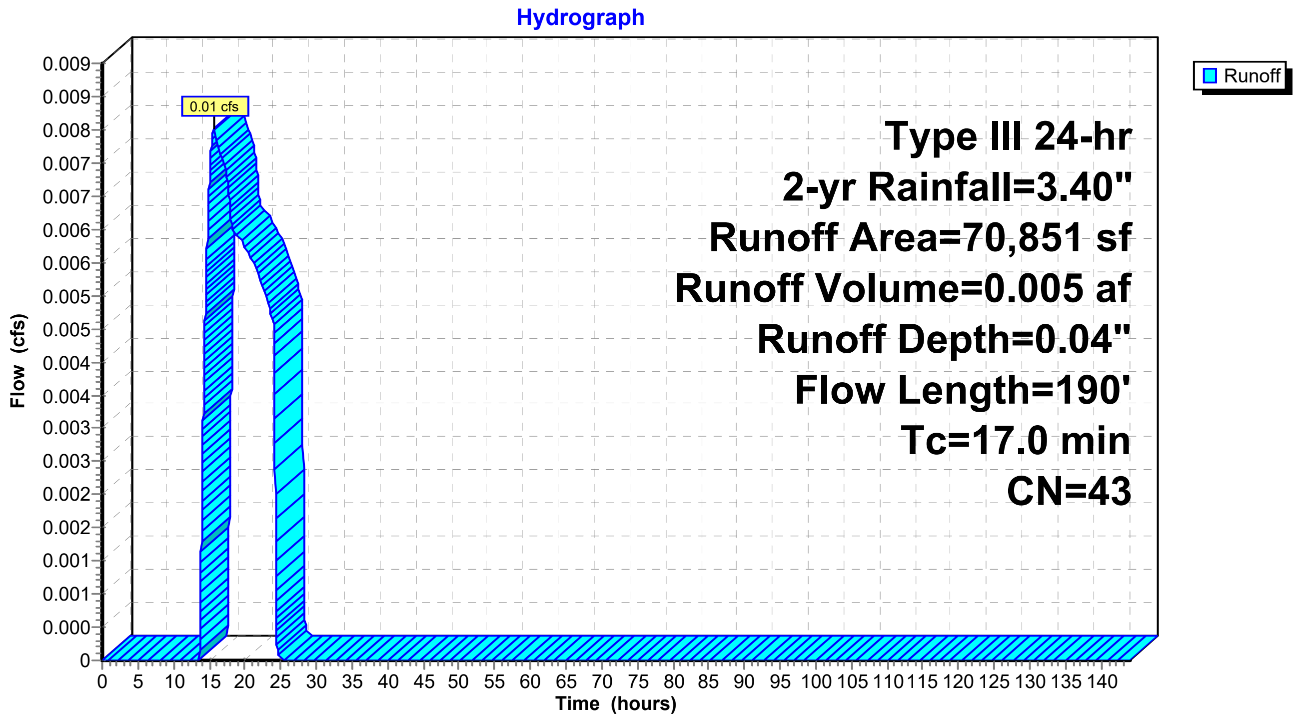
Runoff = 0.01 cfs @ 15.70 hrs, Volume= 0.005 af, Depth= 0.04"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-yr Rainfall=3.40"

	Area (sf)	CN	Description
	30,577	30	Woods, Good, HSG A
	25,063	39	>75% Grass cover, Good, HSG A
	610	70	Woods, Good, HSG C
	12,737	74	>75% Grass cover, Good, HSG C
*	999	98	Decks, HSG C
*	487	98	Decks, HSG A
*	22	98	Pavement, HSG A (OFFSITE)
*	356	39	>75% Grass cover, Good, HSG A (OFFSITE)
	70,851	43	Weighted Average
	69,343		97.87% Pervious Area
	1,508		2.13% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.8	50	0.0100	0.05		**Sheet Flow, A-B**
					Woods: Light underbrush n= 0.400 P2= 3.40"
1.2	140	0.0150	1.97		**Shallow Concentrated Flow, B-C**
					Unpaved Kv= 16.1 fps
17.0	190	Total			

Subcatchment P5: Central Overland

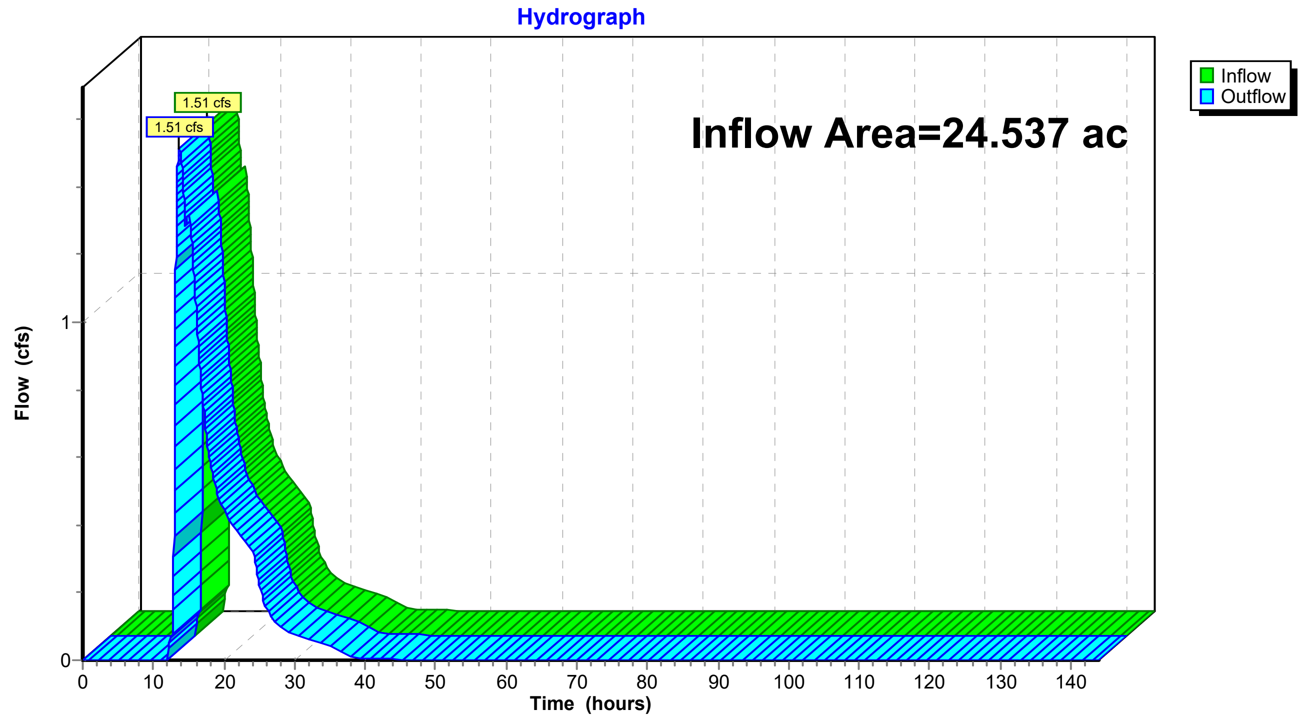


Summary for Reach DP-1: Wetland

Inflow Area = 24.537 ac, 30.85% Impervious, Inflow Depth = 0.38" for 2-yr event
Inflow = 1.51 cfs @ 13.69 hrs, Volume= 0.782 af
Outflow = 1.51 cfs @ 13.69 hrs, Volume= 0.782 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs / 2

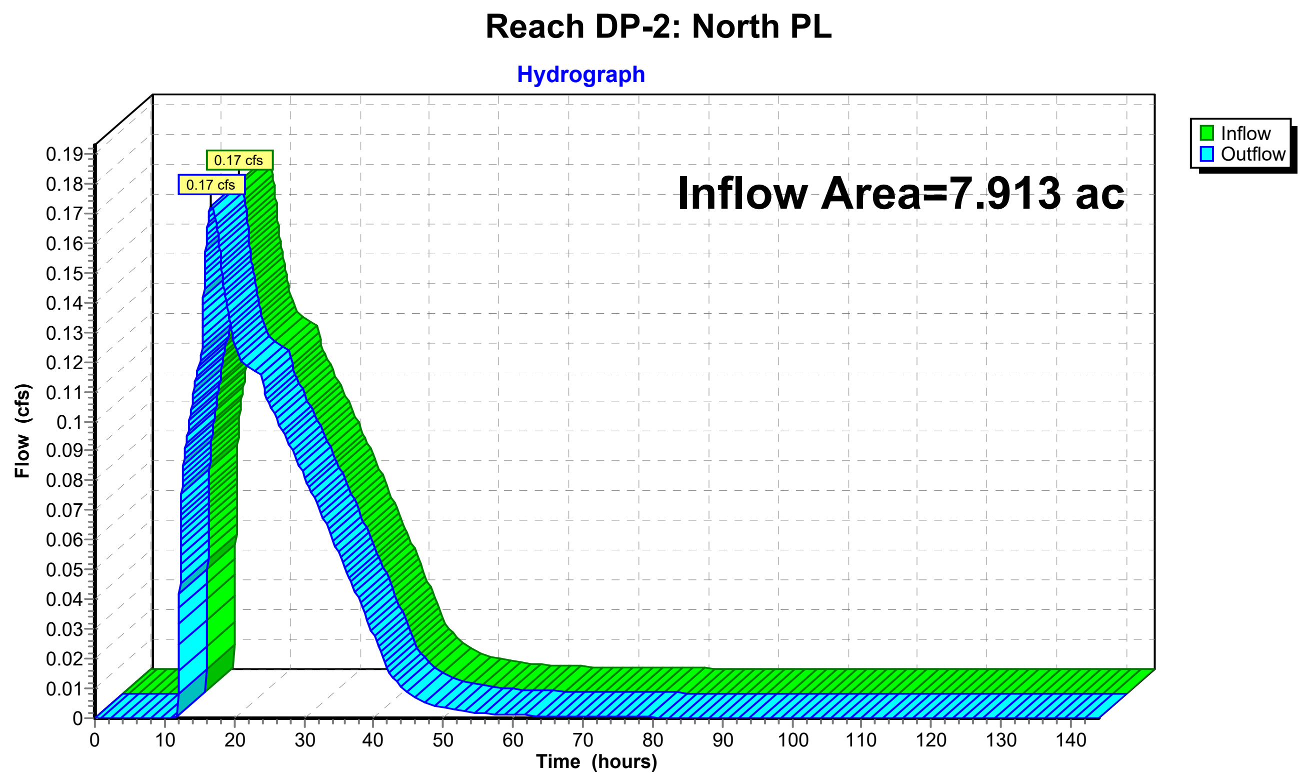
Reach DP-1: Wetland



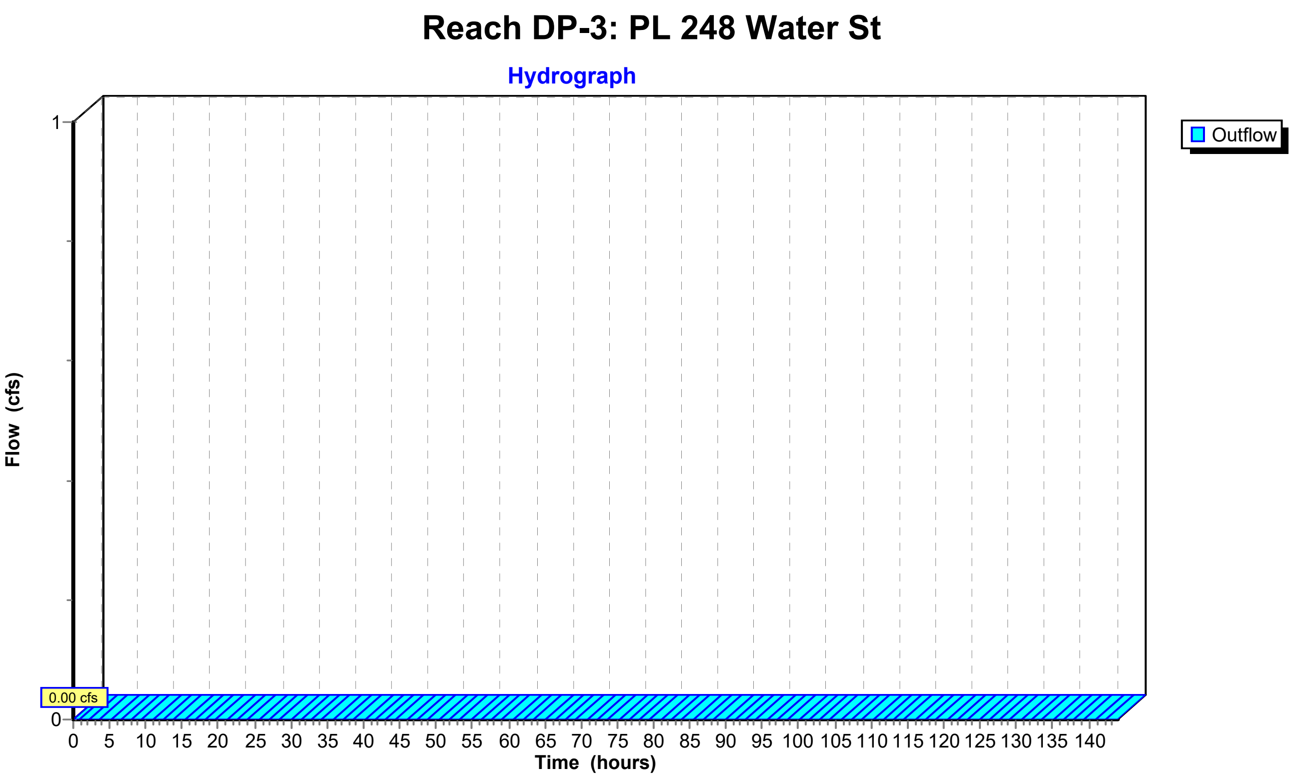
Summary for Reach DP-2: North PL

Inflow Area = 7.913 ac, 23.69% Impervious, Inflow Depth > 0.35" for 2-yr event
Inflow = 0.17 cfs @ 16.78 hrs, Volume= 0.229 af
Outflow = 0.17 cfs @ 16.78 hrs, Volume= 0.229 af, Atten= 0%, Lag= 0.0 min

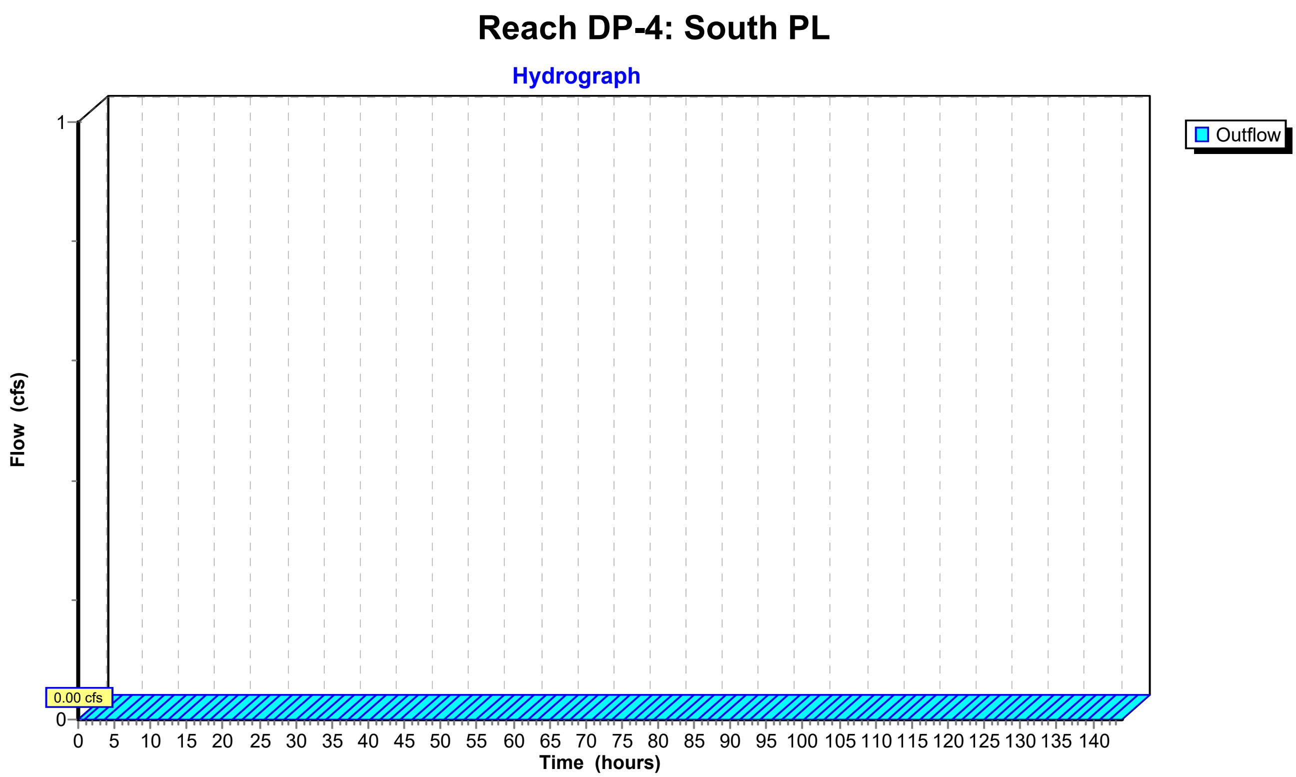
Routing by Dyn-Stor-Ind method, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs / 2



Summary for Reach DP-3: PL 248 Water St



Summary for Reach DP-4: South PL



Summary for Pond 1P: Extended Dry Detention Basin

Inflow Area = 6.287 ac, 29.27% Impervious, Inflow Depth = 0.43" for 2-yr event
Inflow = 1.78 cfs @ 12.13 hrs, Volume= 0.224 af
Outflow = 0.16 cfs @ 16.79 hrs, Volume= 0.224 af, Atten= 91%, Lag= 279.5 min
Primary = 0.16 cfs @ 16.79 hrs, Volume= 0.224 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 16.81' @ 16.79 hrs Surf.Area= 4,444 sf Storage= 5,141 cf

Plug-Flow detention time= 577.0 min calculated for 0.224 af (100% of inflow)
Center-of-Mass det. time= 576.1 min (1,496.9 - 920.8)

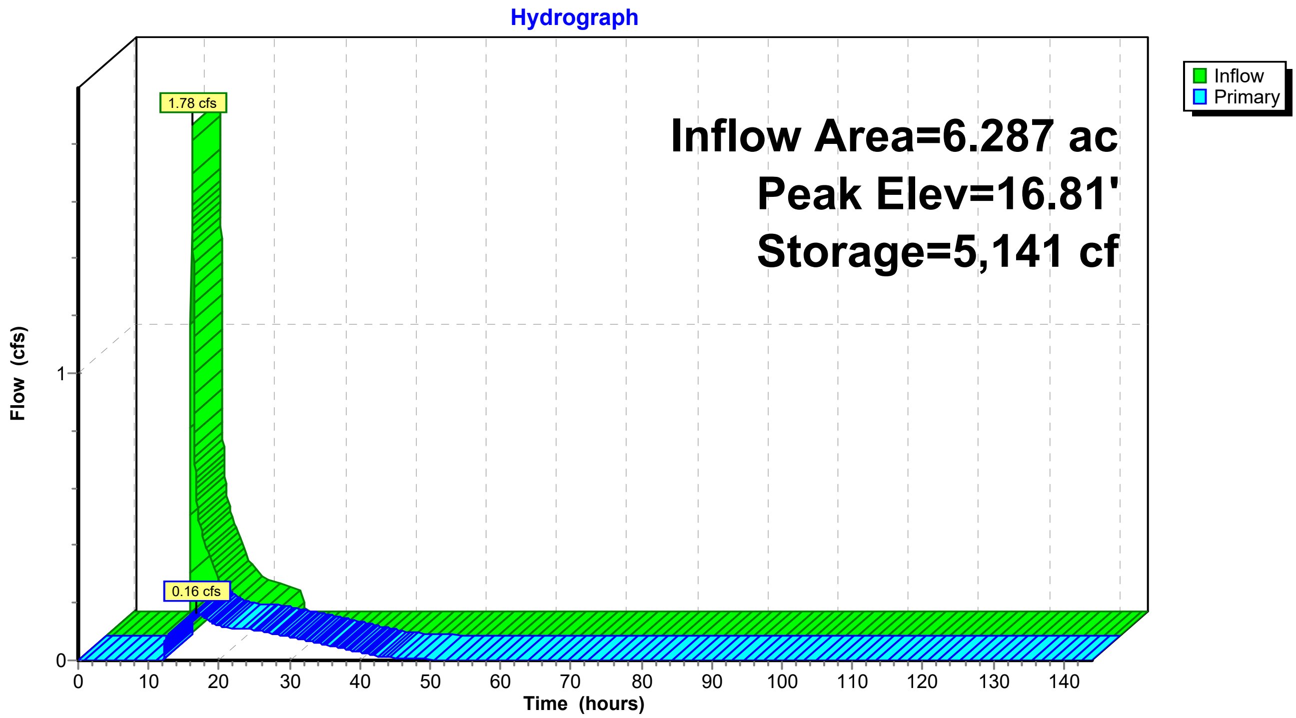
Volume	Invert	Avail.Storage	Storage Description
#1	15.50'	17,959 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
15.50	3,413	0	0
16.00	3,794	1,802	1,802
17.00	4,596	4,195	5,997
18.00	5,456	5,026	11,023
18.10	6,539	600	11,623
19.00	7,541	6,336	17,959

Device	Routing	Invert	Outlet Devices
#1	Primary	15.50'	**15.0" Round Culvert** L= 27.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 15.50' / 15.23' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf
#2	Device 1	15.50'	**2.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	16.75'	**1.0' long x 2.20' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=0.16 cfs @ 16.79 hrs HW=16.81' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 0.16 cfs of 3.86 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.12 cfs @ 5.33 fps)
  └─**3=Sharp-Crested Rectangular Weir** (Weir Controls 0.05 cfs @ 0.81 fps)

Pond 1P: Extended Dry Detention Basin



Summary for Pond 2P: Infiltration Chambers

Inflow Area =	4.285 ac, 78.01% Impervious, Inflow Depth = 2.63" for 2-yr event		
Inflow =	12.73 cfs @ 12.09 hrs,	Volume=	0.939 af
Outflow =	0.49 cfs @ 15.31 hrs,	Volume=	0.939 af, Atten= 96%, Lag= 193.5 min
Discarded =	0.21 cfs @ 9.48 hrs,	Volume=	0.772 af
Primary =	0.28 cfs @ 15.31 hrs,	Volume=	0.167 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 20.81' @ 15.31 hrs Surf.Area= 8,736 sf Storage= 26,452 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 900.9 min (1,691.9 - 791.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	16.60'	11,916 cf	**66.50'W x 131.37'L x 5.75'H Field A** 50,231 cf Overall - 20,441 cf Embedded = 29,790 cf x 40.0% Voids
#2A	17.35'	20,441 cf	**Cultec R-902HD** x 315 Inside #1 Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap 315 Chambers in 9 Rows Cap Storage= +2.8 cf x 2 x 9 rows = 49.7 cf
		32,357 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	16.00'	**24.0" Round Culvert** L= 26.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 16.00' / 15.74' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#2	Device 1	18.40'	**1.5" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	20.75'	**4.0' long x 2.60' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#4	Discarded	16.60'	**1.020 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.21 cfs @ 9.48 hrs HW=16.67' (Free Discharge)
└─**4=Exfiltration** (Exfiltration Controls 0.21 cfs)

Primary OutFlow Max=0.28 cfs @ 15.31 hrs HW=20.81' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 0.28 cfs of 23.31 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.09 cfs @ 7.38 fps)
  └─**3=Sharp-Crested Rectangular Weir** (Weir Controls 0.19 cfs @ 0.80 fps)

Pond 2P: Infiltration Chambers - Chamber Wizard Field A

Chamber Model = Cultec R-902HD (Cultec Recharger®902HD)
Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf
Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap
Cap Storage= +2.8 cf x 2 x 9 rows = 49.7 cf

78.0" Wide + 9.0" Spacing = 87.0" C-C Row Spacing

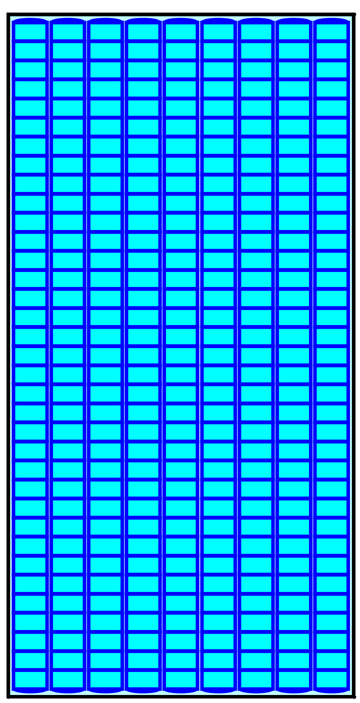
35 Chambers/Row x 3.67' Long +0.52' Cap Length x 2 = 129.37' Row Length +12.0" End Stone x 2 = 131.37' Base Length
9 Rows x 78.0" Wide + 9.0" Spacing x 8 + 12.0" Side Stone x 2 = 66.50' Base Width
9.0" Stone Base + 48.0" Chamber Height + 12.0" Stone Cover = 5.75' Field Height

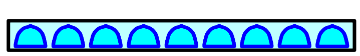
315 Chambers x 64.7 cf + 2.8 cf Cap Volume x 2 x 9 Rows = 20,441.2 cf Chamber Storage

50,231.3 cf Field - 20,441.2 cf Chambers = 29,790.1 cf Stone x 40.0% Voids = 11,916.0 cf Stone Storage

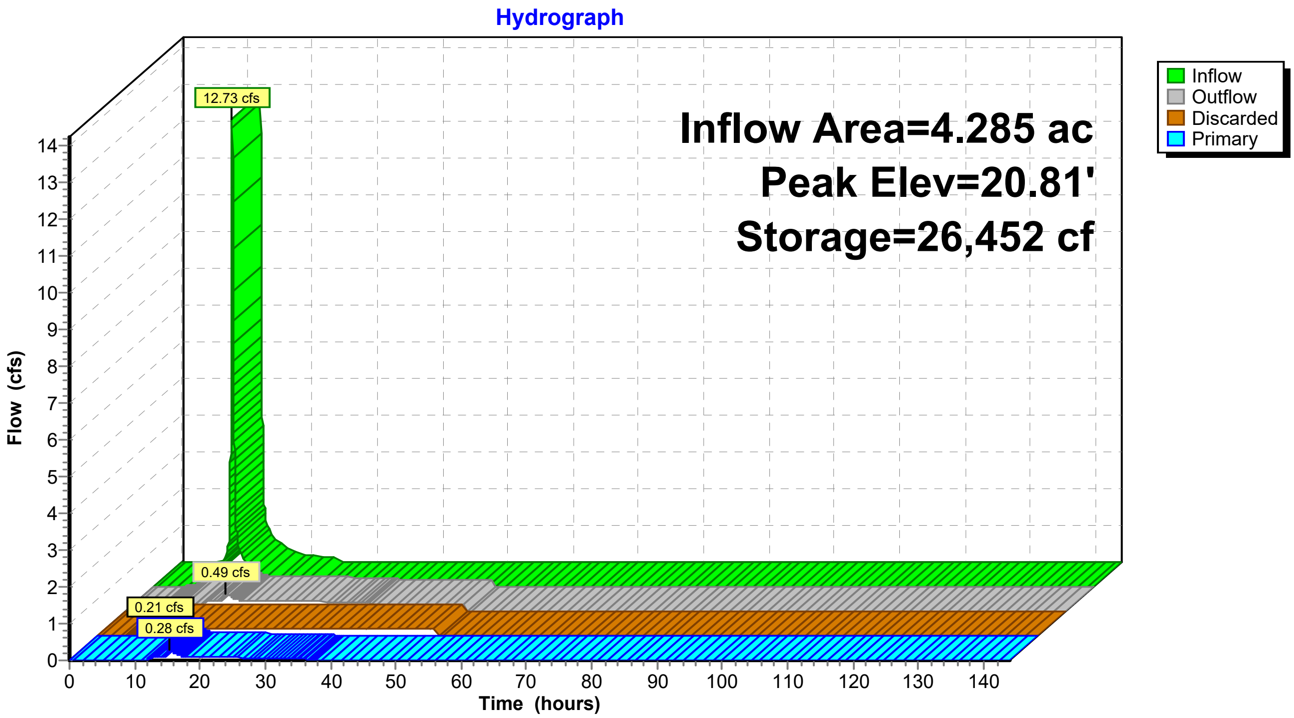
Chamber Storage + Stone Storage = 32,357.3 cf = 0.743 af
Overall Storage Efficiency = 64.4%
Overall System Size = 131.37' x 66.50' x 5.75'

315 Chambers
1,860.4 cy Field
1,103.3 cy Stone





Pond 2P: Infiltration Chambers



Summary for Pond E-P1: Wetland

Inflow Area = 5.973 ac, 62.63% Impervious, Inflow Depth = 1.56" for 2-yr event
Inflow = 5.98 cfs @ 12.45 hrs, Volume= 0.775 af
Outflow = 5.93 cfs @ 12.49 hrs, Volume= 0.607 af, Atten= 1%, Lag= 2.1 min
Primary = 5.93 cfs @ 12.49 hrs, Volume= 0.607 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 18.04' @ 12.49 hrs Surf.Area= 12,960 sf Storage= 7,861 cf

Plug-Flow detention time= 126.0 min calculated for 0.607 af (78% of inflow)
Center-of-Mass det. time= 42.7 min (905.9 - 863.2)

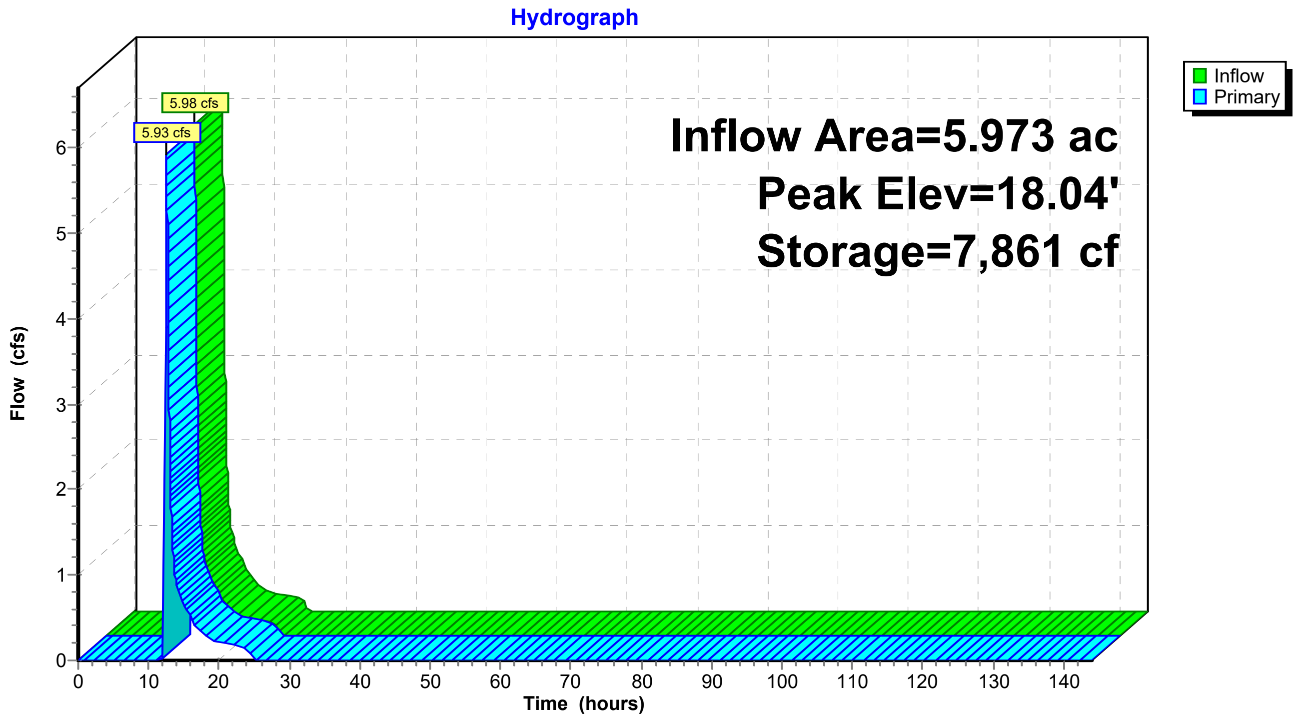
Volume	Invert	Avail.Storage	Storage Description
#1	17.00'	236,253 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
17.00	2,349	0	0
18.00	12,281	7,315	7,315
19.00	27,986	20,134	27,449
20.00	37,607	32,797	60,245
21.00	49,582	43,595	103,840
22.00	66,971	58,277	162,116
23.00	81,302	74,137	236,253

Device	Routing	Invert	Outlet Devices
#1	Primary	18.00'	**Asymmetrical Weir, C= 3.27** Offset (feet) 0.00 10.80 18.43 23.94 57.50 86.92 287.08 357.73 427.57 483.95 528.04 555.94 Elev. (feet) 23.00 22.00 21.00 20.00 19.00 18.00 18.00 19.00 20.00 21.00 22.00 23.00

Primary OutFlow Max=5.92 cfs @ 12.49 hrs HW=18.04' TW=12.51' (Dynamic Tailwater)
└─**1=Asymmetrical Weir** (Weir Controls 5.92 cfs @ 0.67 fps)

Pond E-P1: Wetland



Summary for Pond E-P2: Wetland

Inflow Area = 10.418 ac, 39.24% Impervious, Inflow Depth = 0.98" for 2-yr event
Inflow = 7.41 cfs @ 12.48 hrs, Volume= 0.850 af
Outflow = 1.43 cfs @ 13.68 hrs, Volume= 0.614 af, Atten= 81%, Lag= 72.1 min
Primary = 1.43 cfs @ 13.68 hrs, Volume= 0.614 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 13.03' @ 13.68 hrs Surf.Area= 27,509 sf Storage= 15,283 cf

Plug-Flow detention time= 268.7 min calculated for 0.614 af (72% of inflow)
Center-of-Mass det. time= 167.6 min (1,072.5 - 904.8)

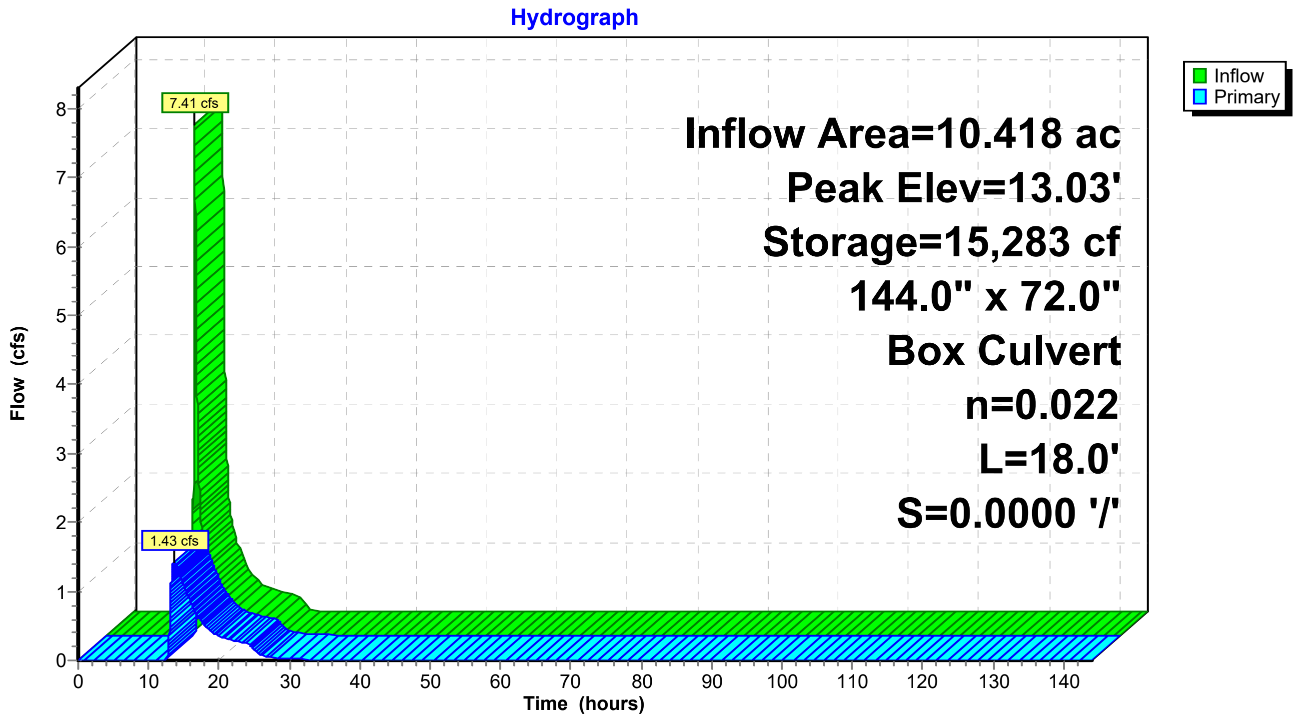
Volume	Invert	Avail.Storage	Storage Description
#1	12.00'	47,617 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
12.00	1,826	0	0
13.00	27,167	14,497	14,497
14.00	39,073	33,120	47,617

Device	Routing	Invert	Outlet Devices
#1	Primary	12.83'	**144.0" W x 72.0" H Box Culvert** L= 18.0' Box, 0° wingwalls, square crown edge, Ke= 0.700 Inlet / Outlet Invert= 12.83' / 12.83' S= 0.0000 '/' Cc= 0.900 n= 0.022 Earth, clean & straight, Flow Area= 72.00 sf

Primary OutFlow Max=1.43 cfs @ 13.68 hrs HW=13.03' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Barrel Controls 1.43 cfs @ 0.80 fps)

Pond E-P2: Wetland



Time span=0.00-144.00 hrs, dt=0.02 hrs, 7201 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

SubcatchmentP-4d: Overland to Wet Basin Runoff Area=15,966 sf 0.00% Impervious Runoff Depth=1.39"
Tc=6.0 min CN=64 Runoff=0.55 cfs 0.042 af

SubcatchmentP1: Property offsite Runoff Area=260,170 sf 62.63% Impervious Runoff Depth=2.63"
Flow Length=343' Tc=31.4 min CN=80 Runoff=10.20 cfs 1.310 af

SubcatchmentP2: P2 Runoff Area=193,654 sf 7.83% Impervious Runoff Depth=1.39"
Flow Length=315' Tc=15.1 min CN=64 Runoff=5.02 cfs 0.515 af

SubcatchmentP3: SW Property Runoff Area=256,545 sf 1.84% Impervious Runoff Depth=0.00"
Flow Length=683' Tc=13.5 min CN=31 Runoff=0.01 cfs 0.001 af

SubcatchmentP4: Central Overland Runoff Area=171,811 sf 0.76% Impervious Runoff Depth=0.14"
Flow Length=190' Tc=17.0 min CN=39 Runoff=0.08 cfs 0.047 af

SubcatchmentP4a: Developed Site Runoff Area=170,352 sf 78.81% Impervious Runoff Depth=3.90"
Tc=6.0 min CN=93 Runoff=16.87 cfs 1.272 af

SubcatchmentP4b: Developed Site Runoff Area=16,288 sf 69.59% Impervious Runoff Depth=3.80"
Tc=6.0 min CN=92 Runoff=1.58 cfs 0.118 af

SubcatchmentP4c: Developed Site Runoff Area=257,881 sf 31.09% Impervious Runoff Depth=1.01"
Tc=6.0 min CN=58 Runoff=5.83 cfs 0.497 af

SubcatchmentP5: Central Overland Runoff Area=70,851 sf 2.13% Impervious Runoff Depth=0.27"
Flow Length=190' Tc=17.0 min CN=43 Runoff=0.12 cfs 0.037 af

Reach DP-1: Wetland Inflow=9.08 cfs 2.039 af
Outflow=9.08 cfs 2.039 af

Reach DP-2: North PL Inflow=1.53 cfs 0.576 af
Outflow=1.53 cfs 0.576 af

Reach DP-3: PL 248 Water St
Outflow=0.00 cfs 0.000 af

Reach DP-4: South PL
Outflow=0.00 cfs 0.000 af

Pond 1P: Extended Dry Detention Basin Peak Elev=17.33' Storage=7,544 cf Inflow=6.38 cfs 0.540 af
Outflow=1.41 cfs 0.539 af

Pond 2P: Infiltration Chambers Peak Elev=21.33' Storage=28,780 cf Inflow=18.45 cfs 1.390 af
Discarded=0.21 cfs 0.821 af Primary=5.67 cfs 0.570 af Outflow=5.87 cfs 1.391 af

Pond E-P1: Wetland Peak Elev=18.06' Storage=8,104 cf Inflow=10.20 cfs 1.310 af
Outflow=10.19 cfs 1.142 af

Pond E-P2: Wetland Peak Elev=13.30' Storage=23,126 cf Inflow=13.79 cfs 1.657 af
144.0" x 72.0" Box Culvert n=0.022 L=18.0' S=0.0000 '/' Outflow=6.90 cfs 1.421 af

Total Runoff Area = 32.450 ac Runoff Volume = 3.841 af Average Runoff Depth = 1.42"
70.90% Pervious = 23.006 ac 29.10% Impervious = 9.444 ac

Summary for Subcatchment P-4d: Overland to Wet Basin

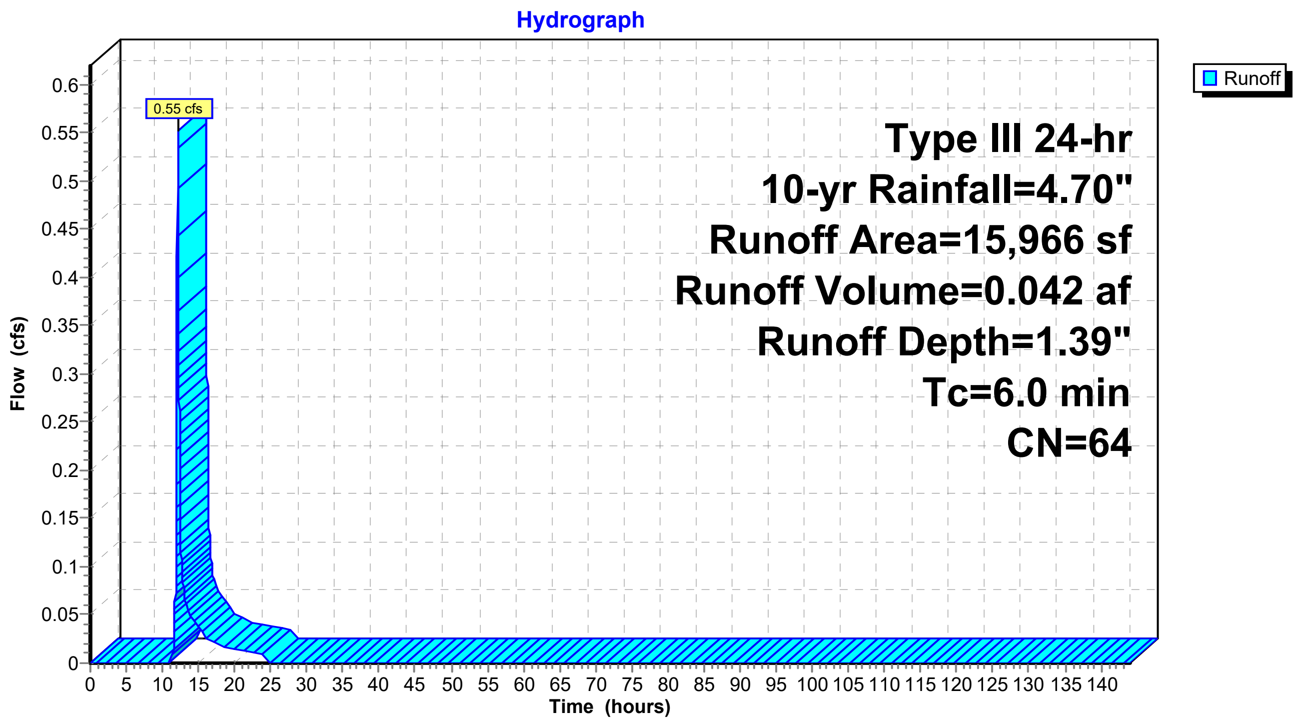
Runoff = 0.55 cfs @ 12.10 hrs, Volume= 0.042 af, Depth= 1.39"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-yr Rainfall=4.70"

Area (sf)	CN	Description
4,551	39	>75% Grass cover, Good, HSG A
11,415	74	>75% Grass cover, Good, HSG C
15,966	64	Weighted Average
15,966		100.00% Pervious Area

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

Subcatchment P-4d: Overland to Wet Basin



Summary for Subcatchment P1: Property offsite

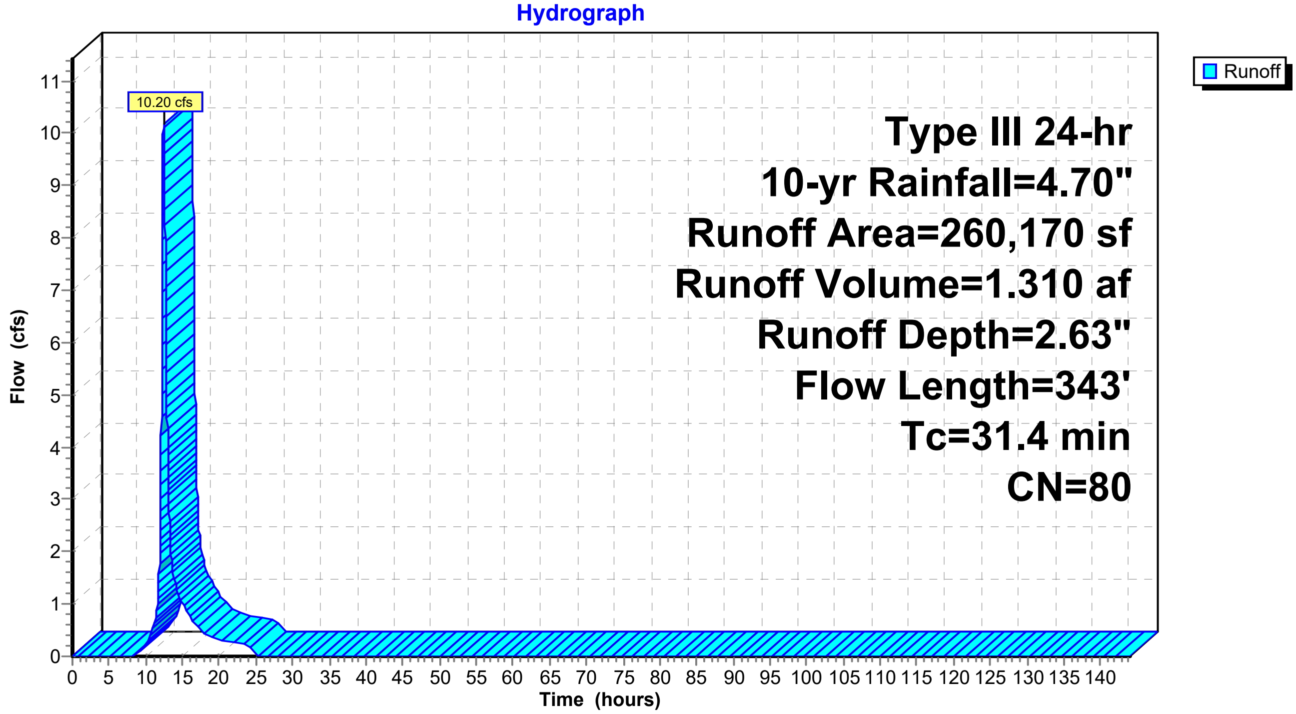
Runoff = 10.20 cfs @ 12.44 hrs, Volume= 1.310 af, Depth= 2.63"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-yr Rainfall=4.70"

	Area (sf)	CN	Description
*	142,754	89	Urban commercial, 85% imp, HSG A (OFFSITE)
*	31,587	30	Woods, Good, HSG A (OFFSITE)
*	48,943	94	Urban commercial, 85% imp, HSG C (OFFSITE)
*	8,690	78	Wetlands/woods, HSG A (OFFSITE)
*	25,996	70	Woods, Good, HSG C (OFFSITE)
*	2,200	78	Wetlands/woods, HSG C (OFFSITE)
	260,170	80	Weighted Average
	97,228		37.37% Pervious Area
	162,942		62.63% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.8	50	0.0040	0.04		**Sheet Flow, Start** Woods: Light underbrush n= 0.400 P2= 3.40"
6.6	126	0.0040	0.32		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
2.0	167	0.0800	1.41		**Shallow Concentrated Flow, C-WETLAND** Woodland Kv= 5.0 fps
31.4	343	Total			

Subcatchment P1: Property offsite



Summary for Subcatchment P2: P2

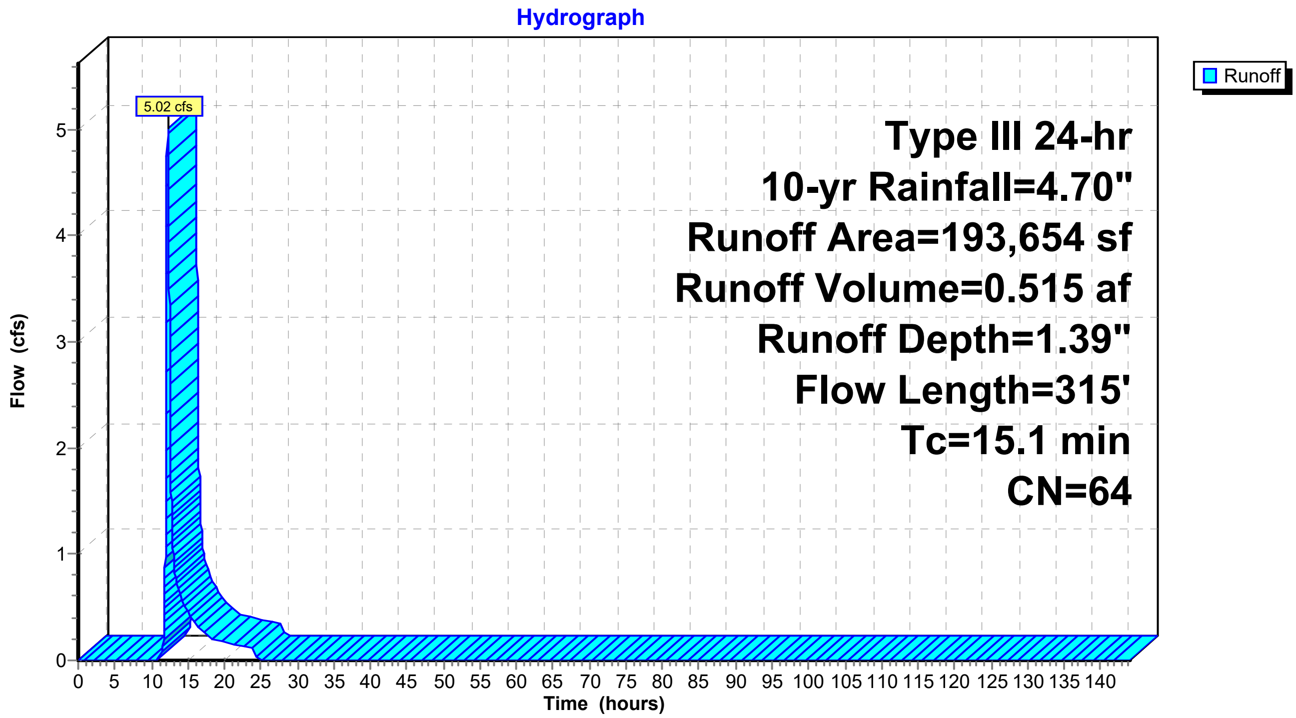
Runoff = 5.02 cfs @ 12.23 hrs, Volume= 0.515 af, Depth= 1.39"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-yr Rainfall=4.70"

	Area (sf)	CN	Description
*	9,050	98	Paved parking, HSG A (OFFSITE)
*	49,865	30	Woods, Good, HSG A (OFFSITE)
*	20,149	78	Wetlands/woods. HSG A (OFFSITE)
*	4,604	98	Paved parking, HSG C (OFFSITE)
*	41,546	70	Woods, Good, HSG C (OFFSITE)
*	3,605	78	Wetlands/woods, HSG C (OFFSITE)
	11,149	70	Woods, Good, HSG C
*	5,924	78	Wetlands/woods, HSG C
*	28,611	78	Wetlands/woods, HSG A
	3,016	30	Woods, Good, HSG A
*	1,504	98	Decks, HSG C
	14,631	74	>75% Grass cover, Good, HSG C
	193,654	64	Weighted Average
	178,496		92.17% Pervious Area
	15,158		7.83% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.2	50	0.0190	0.07		**Sheet Flow, START** Woods: Light underbrush n= 0.400 P2= 3.40"
1.5	116	0.0690	1.31		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
0.1	20	0.0200	2.87		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
1.3	129	0.1100	1.66		**Shallow Concentrated Flow, D-WETLAND** Woodland Kv= 5.0 fps
15.1	315	Total			

Subcatchment P2: P2



Summary for Subcatchment P3: SW Property

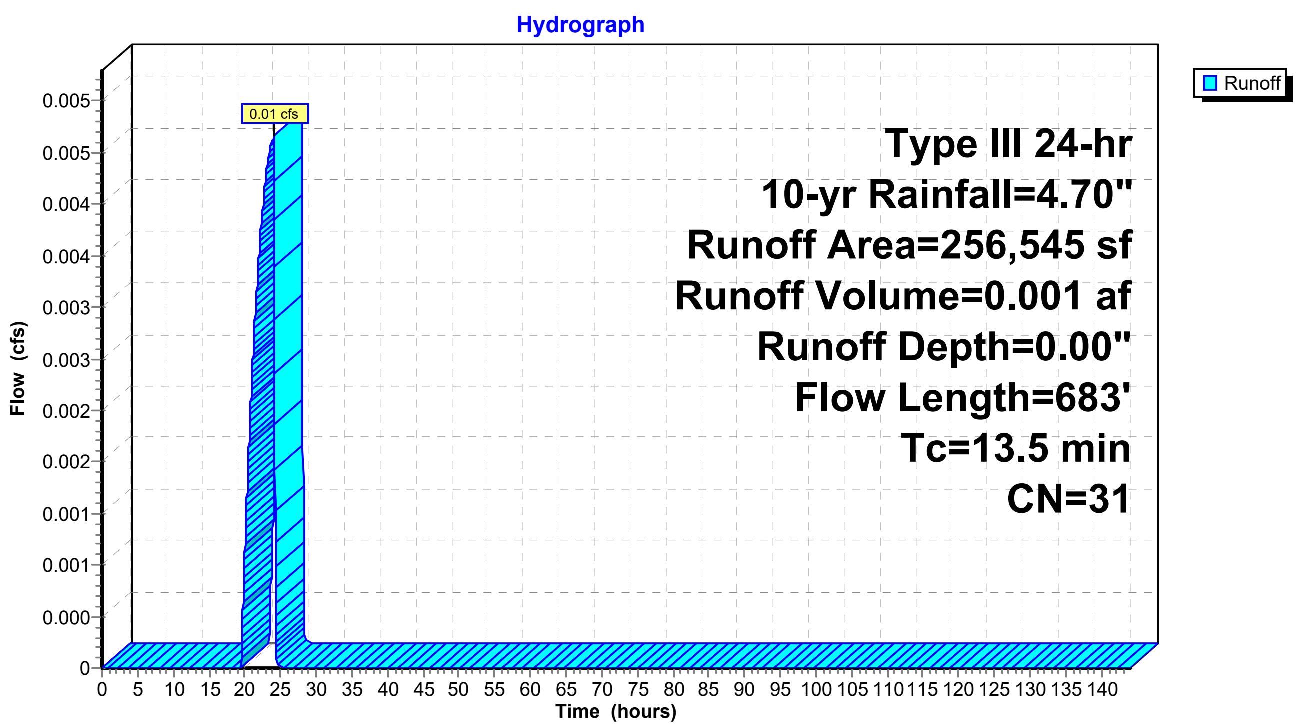
Runoff = 0.01 cfs @ 24.02 hrs, Volume= 0.001 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-yr Rainfall=4.70"

	Area (sf)	CN	Description
	157,110	30	Woods, Good, HSG A
*	94,725	30	Woods, Fair, HSG A (OFFSITE)
*	4,710	98	Impervious, HSG A (OFFSITE)
	256,545	31	Weighted Average
	251,835		98.16% Pervious Area
	4,710		1.84% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.2	50	0.0300	0.08		**Sheet Flow, Start Off Property** Woods: Light underbrush n= 0.400 P2= 3.40"
3.3	633	0.0400	3.22		**Shallow Concentrated Flow, To Wetland** Unpaved Kv= 16.1 fps
13.5	683	Total			

Subcatchment P3: SW Property



Summary for Subcatchment P4: Central Overland

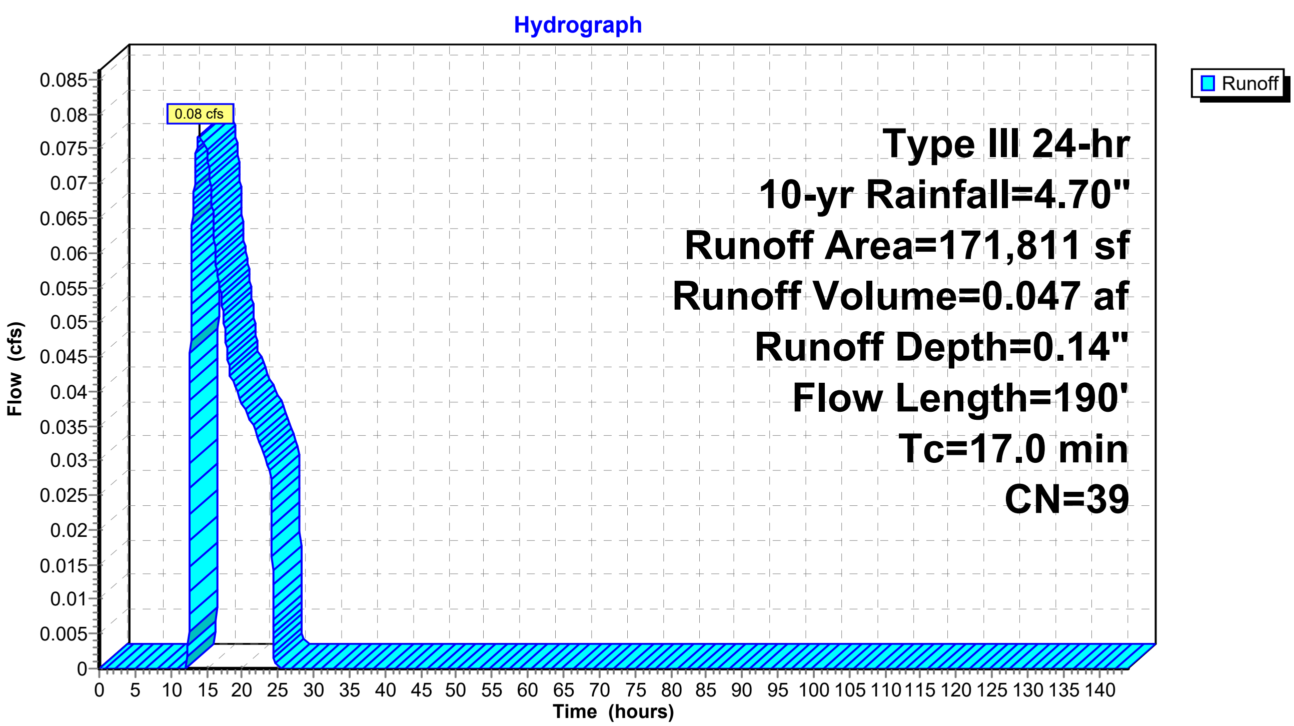
Runoff = 0.08 cfs @ 13.92 hrs, Volume= 0.047 af, Depth= 0.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-yr Rainfall=4.70"

	Area (sf)	CN	Description
	104,548	30	Woods, Good, HSG A
	41,769	39	>75% Grass cover, Good, HSG A
	2,502	76	Gravel roads, HSG A
	21,686	74	>75% Grass cover, Good, HSG C
*	767	98	Decks, HSG C
*	539	98	Decks, HSG A
	171,811	39	Weighted Average
	170,505		99.24% Pervious Area
	1,306		0.76% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.8	50	0.0100	0.05		**Sheet Flow, A-B**
					Woods: Light underbrush n= 0.400 P2= 3.40"
1.2	140	0.0150	1.97		**Shallow Concentrated Flow, B-C**
					Unpaved Kv= 16.1 fps
17.0	190	Total			

Subcatchment P4: Central Overland



Summary for Subcatchment P4a: Developed Site

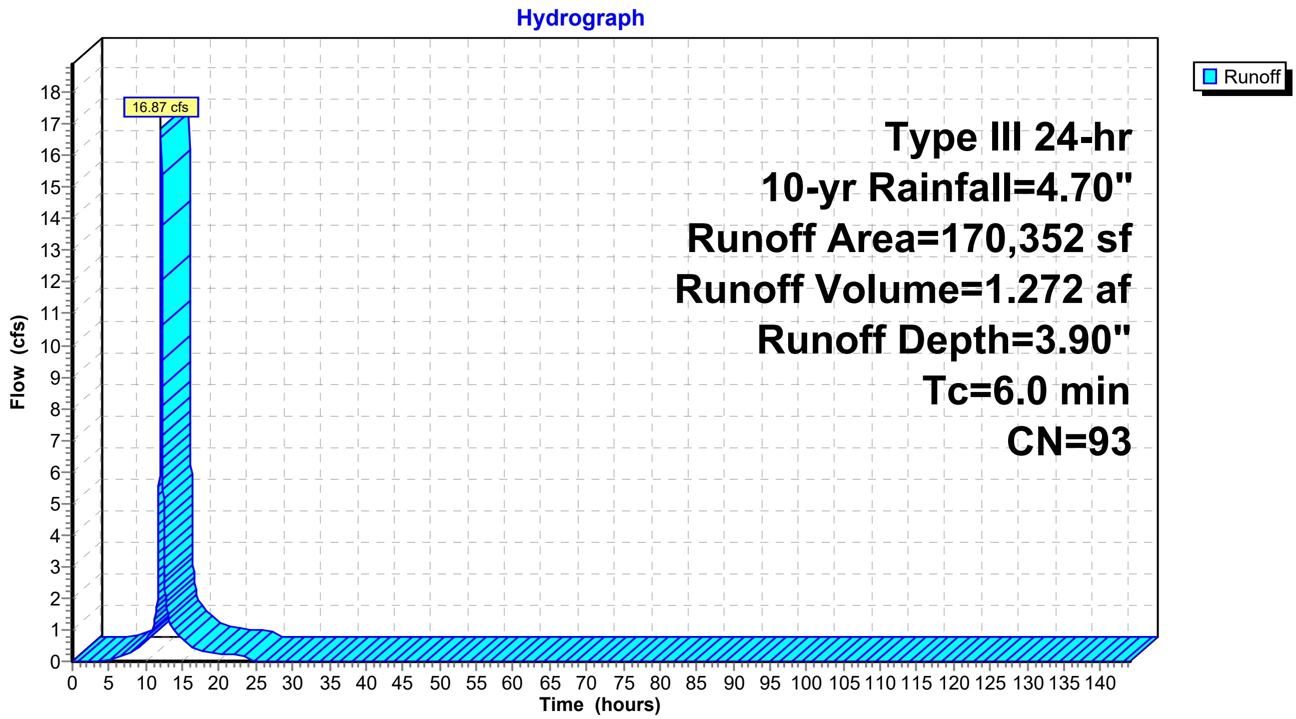
Runoff = 16.87 cfs @ 12.08 hrs, Volume= 1.272 af, Depth= 3.90"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-yr Rainfall=4.70"

	Area (sf)	CN	Description
	32,445	98	Roofs, HSG A
	36,095	74	>75% Grass cover, Good, HSG C
	64,685	98	Roofs, HSG C
*	35,350	98	Paved parking, HSG C
*	1,777	98	Decks, HSG C
	170,352	93	Weighted Average
	36,095		21.19% Pervious Area
	134,257		78.81% Impervious Area

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

Subcatchment P4a: Developed Site



Summary for Subcatchment P4b: Developed Site

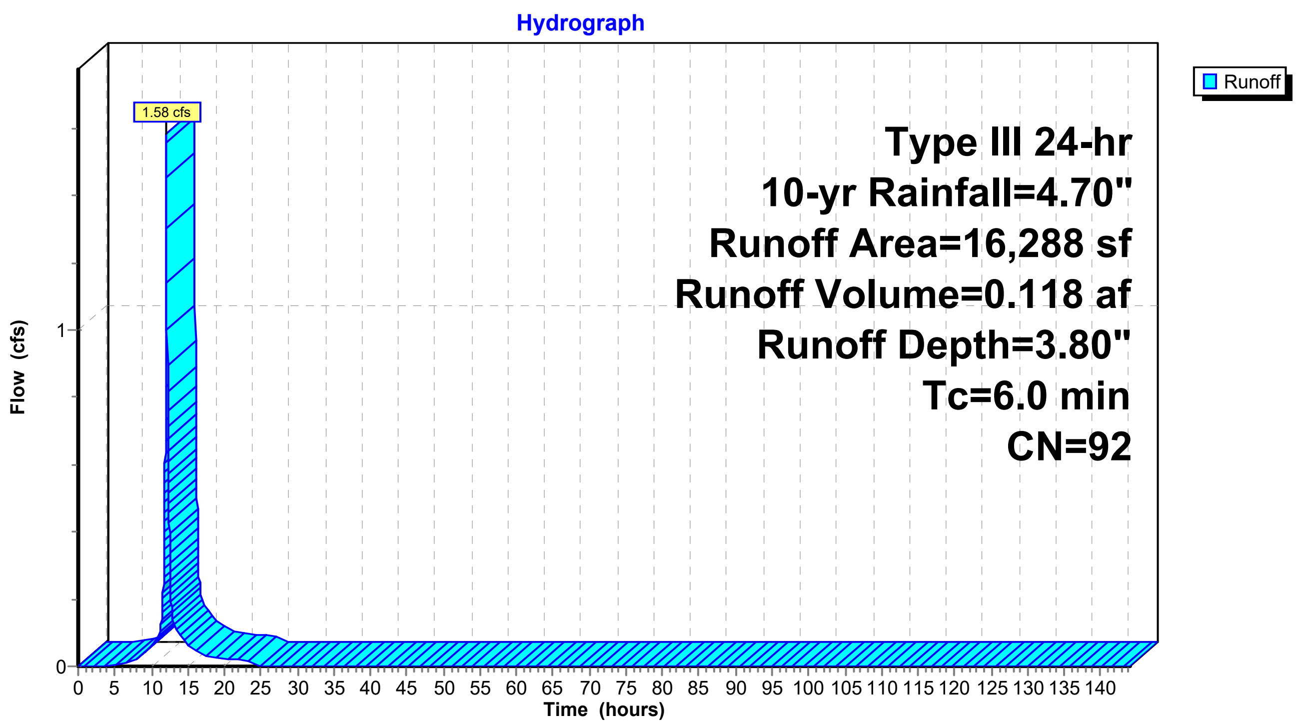
Runoff = 1.58 cfs @ 12.08 hrs, Volume= 0.118 af, Depth= 3.80"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-yr Rainfall=4.70"

	Area (sf)	CN	Description
	191	98	Roofs, HSG A
	7,608	98	Roofs, HSG C
*	3,536	98	Paved parking, HSG C
	3,501	74	>75% Grass cover, Good, HSG C
	1,452	89	Gravel roads, HSG C
	16,288	92	Weighted Average
	4,953		30.41% Pervious Area
	11,335		69.59% Impervious Area

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

Subcatchment P4b: Developed Site



Summary for Subcatchment P4c: Developed Site

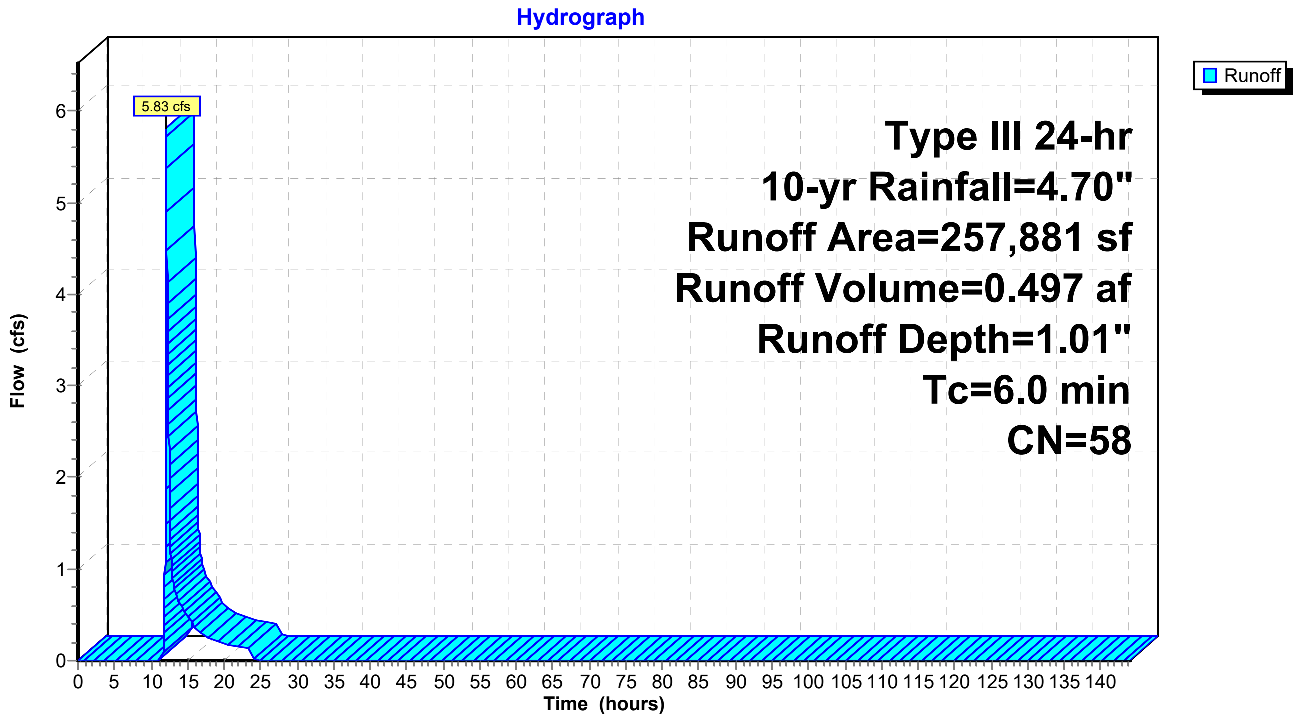
Runoff = 5.83 cfs @ 12.10 hrs, Volume= 0.497 af, Depth= 1.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-yr Rainfall=4.70"

	Area (sf)	CN	Description
	72,562	39	>75% Grass cover, Good, HSG A
	48,621	98	Paved parking, HSG A
*	599	98	Walks, HSG A
*	2,713	98	Decks, HSG A
	10,062	74	>75% Grass cover, Good, HSG C
*	13,564	98	Paved parking, HSG C
*	491	98	Walks, HSG C
*	406	70	Woods, Good, HSG C (OFFSITE)
*	33,887	30	Woods, Good, HSG A (OFFSITE)
*	60,799	39	>75% Grass cover, Good, HSG A (OFFSITE)
*	3,744	98	Pavement, HSG A (OFFSITE)
*	2,312	98	Paved parking, HSG A (OFFSITE)
*	8,121	98	Impervious, HSG A (OFFSITE)
	257,881	58	Weighted Average
	177,716		68.91% Pervious Area
	80,165		31.09% Impervious Area

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

Subcatchment P4c: Developed Site



Summary for Subcatchment P5: Central Overland

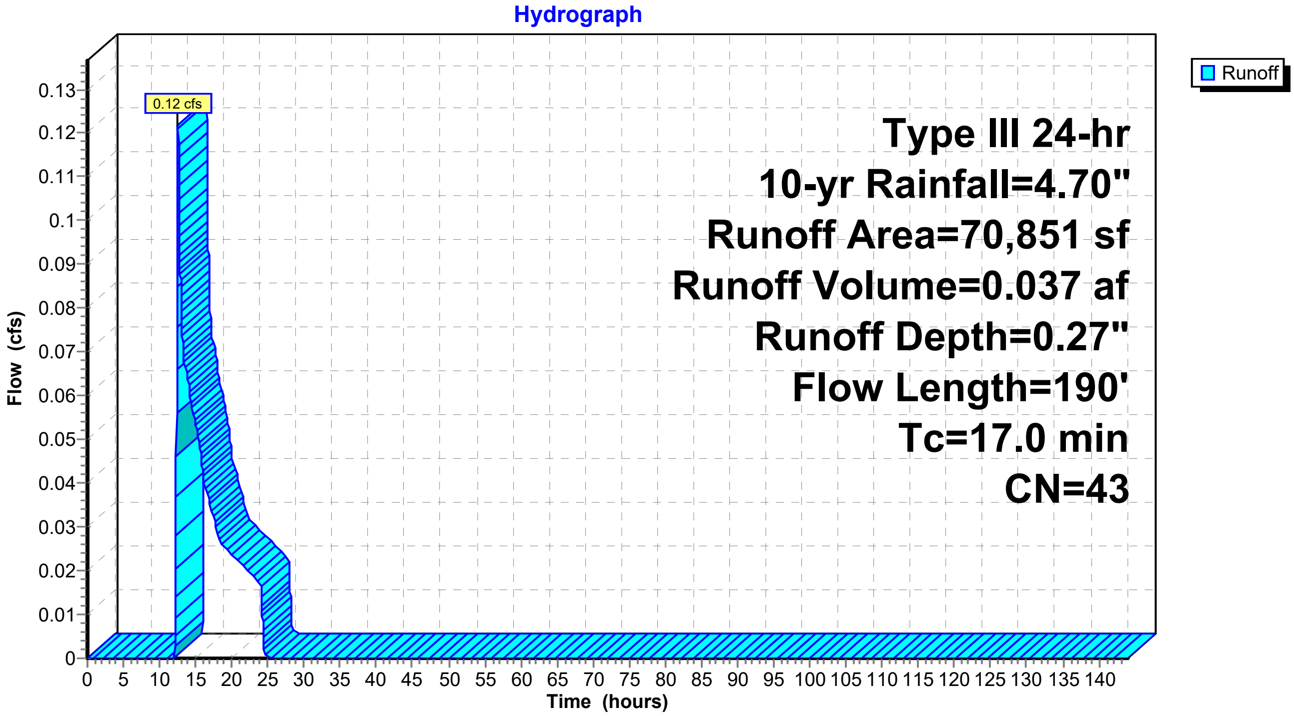
Runoff = 0.12 cfs @ 12.56 hrs, Volume= 0.037 af, Depth= 0.27"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-yr Rainfall=4.70"

	Area (sf)	CN	Description
	30,577	30	Woods, Good, HSG A
	25,063	39	>75% Grass cover, Good, HSG A
	610	70	Woods, Good, HSG C
	12,737	74	>75% Grass cover, Good, HSG C
*	999	98	Decks, HSG C
*	487	98	Decks, HSG A
*	22	98	Pavement, HSG A (OFFSITE)
*	356	39	>75% Grass cover, Good, HSG A (OFFSITE)
	70,851	43	Weighted Average
	69,343		97.87% Pervious Area
	1,508		2.13% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.8	50	0.0100	0.05		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.40"
1.2	140	0.0150	1.97		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
17.0	190	Total			

Subcatchment P5: Central Overland

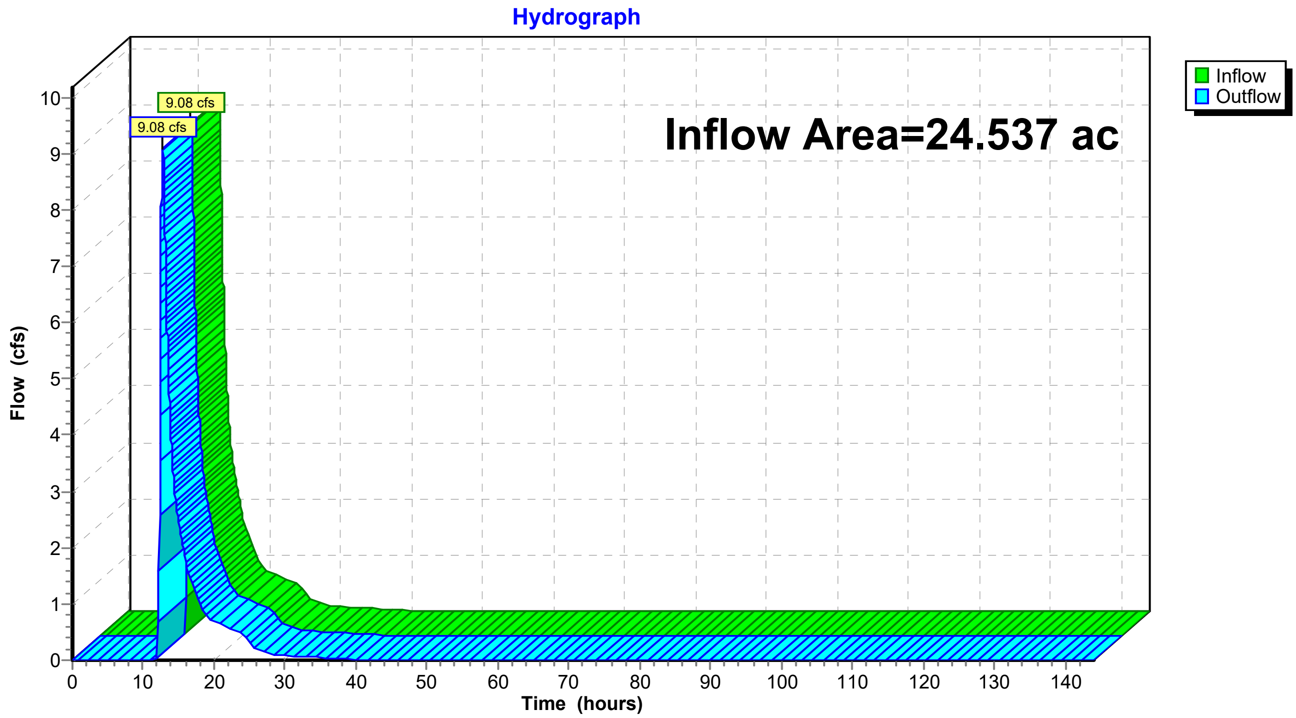


Summary for Reach DP-1: Wetland

Inflow Area = 24.537 ac, 30.85% Impervious, Inflow Depth = 1.00" for 10-yr event
Inflow = 9.08 cfs @ 12.77 hrs, Volume= 2.039 af
Outflow = 9.08 cfs @ 12.77 hrs, Volume= 2.039 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs / 2

Reach DP-1: Wetland

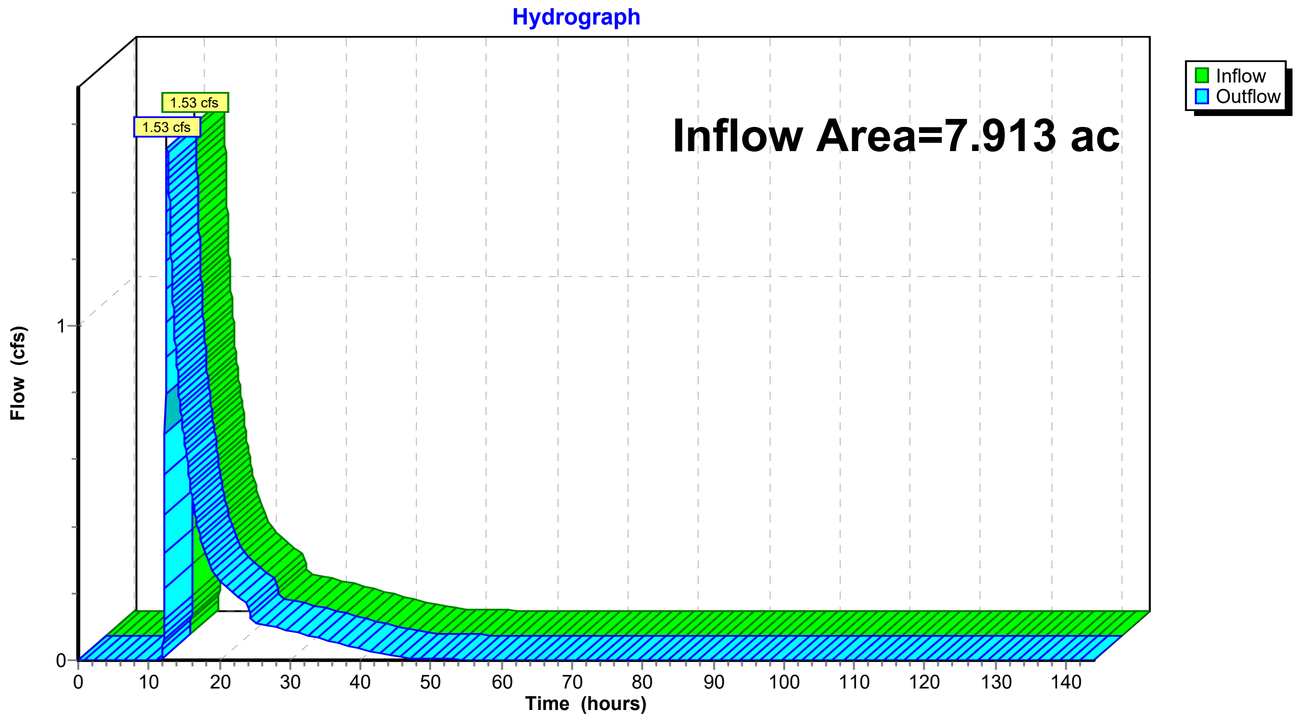


Summary for Reach DP-2: North PL

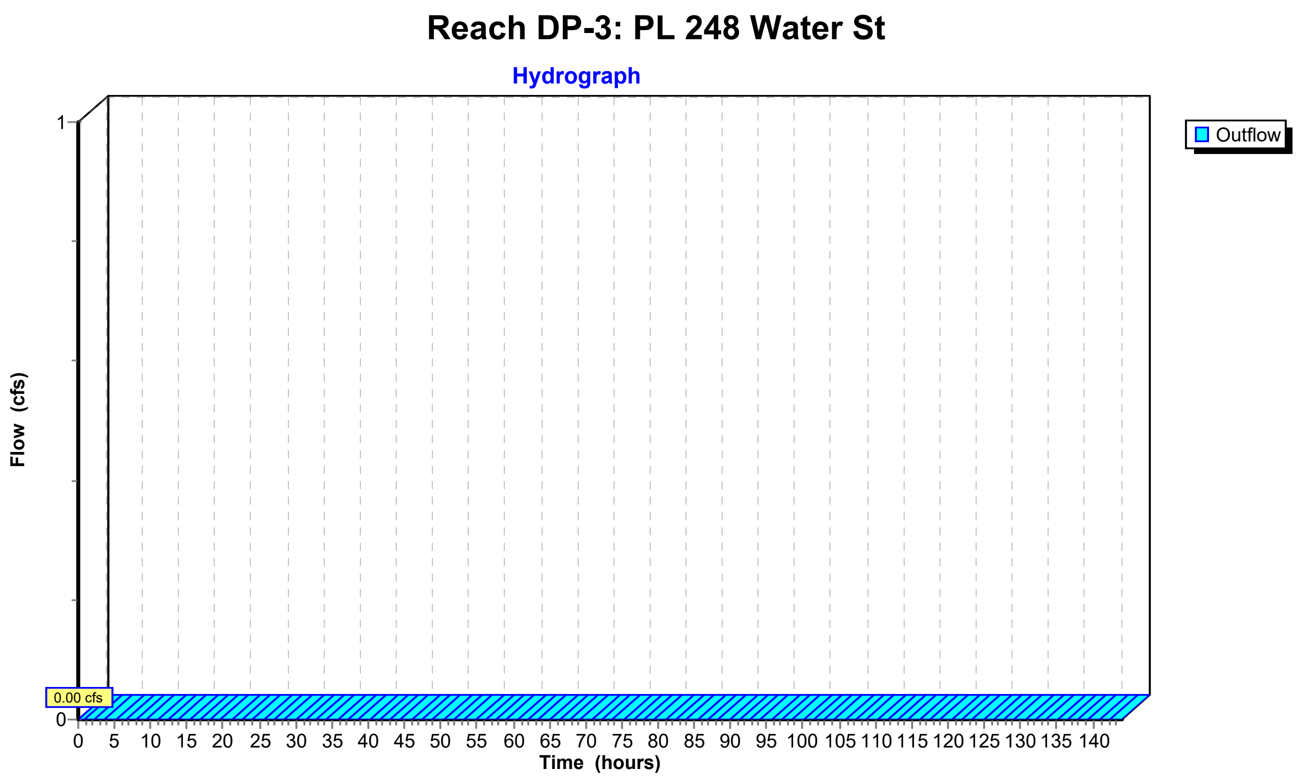
Inflow Area =	7.913 ac,	23.69% Impervious,	Inflow Depth = 0.87"	for 10-yr event	
Inflow =	1.53 cfs @	12.60 hrs,	Volume=	0.576 af	
Outflow =	1.53 cfs @	12.60 hrs,	Volume=	0.576 af,	Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs / 2

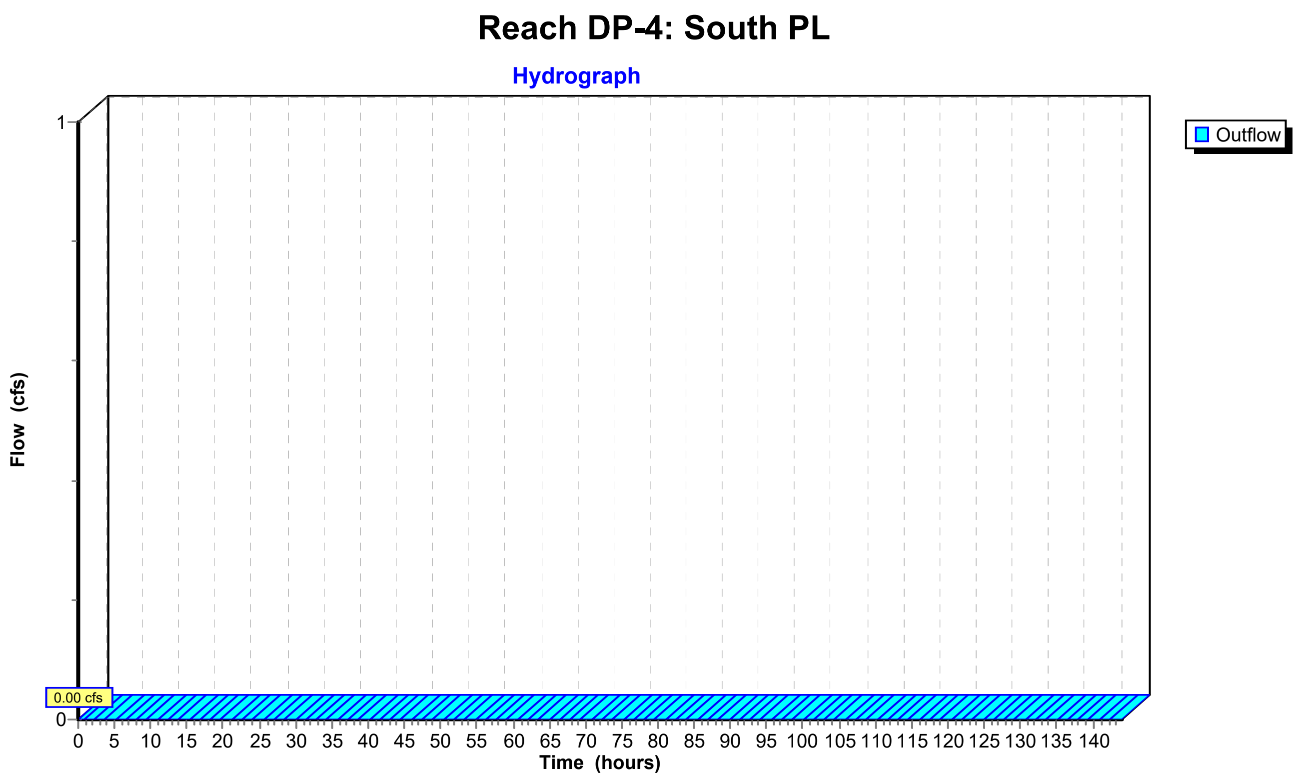
Reach DP-2: North PL



Summary for Reach DP-3: PL 248 Water St



Summary for Reach DP-4: South PL



Summary for Pond 1P: Extended Dry Detention Basin

Inflow Area = 6.287 ac, 29.27% Impervious, Inflow Depth = 1.03" for 10-yr event
Inflow = 6.38 cfs @ 12.10 hrs, Volume= 0.540 af
Outflow = 1.41 cfs @ 12.61 hrs, Volume= 0.539 af, Atten= 78%, Lag= 30.3 min
Primary = 1.41 cfs @ 12.61 hrs, Volume= 0.539 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 17.33' @ 12.61 hrs Surf.Area= 4,877 sf Storage= 7,544 cf

Plug-Flow detention time= 290.1 min calculated for 0.539 af (100% of inflow)
Center-of-Mass det. time= 290.6 min (1,176.2 - 885.6)

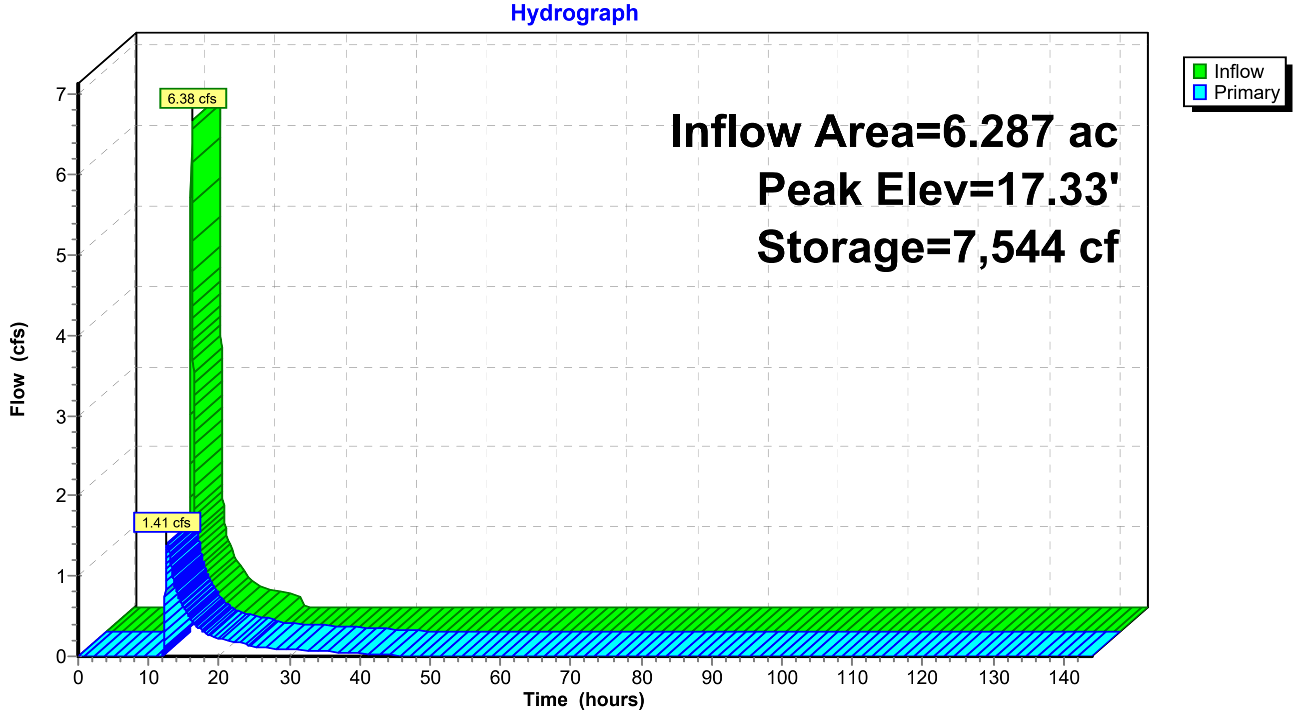
Volume	Invert	Avail.Storage	Storage Description
#1	15.50'	17,959 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
15.50	3,413	0	0
16.00	3,794	1,802	1,802
17.00	4,596	4,195	5,997
18.00	5,456	5,026	11,023
18.10	6,539	600	11,623
19.00	7,541	6,336	17,959

Device	Routing	Invert	Outlet Devices
#1	Primary	15.50'	**15.0" Round Culvert** L= 27.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 15.50' / 15.23' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf
#2	Device 1	15.50'	**2.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	16.75'	**1.0' long x 2.20' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=1.41 cfs @ 12.61 hrs HW=17.33' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 1.41 cfs of 5.11 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.14 cfs @ 6.36 fps)
  └─**3=Sharp-Crested Rectangular Weir** (Weir Controls 1.27 cfs @ 2.48 fps)

Pond 1P: Extended Dry Detention Basin



Summary for Pond 2P: Infiltration Chambers

Inflow Area = 4.285 ac, 78.01% Impervious, Inflow Depth = 3.89" for 10-yr event
Inflow = 18.45 cfs @ 12.08 hrs, Volume= 1.390 af
Outflow = 5.87 cfs @ 12.39 hrs, Volume= 1.391 af, Atten= 68%, Lag= 18.1 min
Discarded = 0.21 cfs @ 8.36 hrs, Volume= 0.821 af
Primary = 5.67 cfs @ 12.39 hrs, Volume= 0.570 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 21.33' @ 12.39 hrs Surf.Area= 8,736 sf Storage= 28,780 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 667.0 min (1,447.6 - 780.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	16.60'	11,916 cf	**66.50'W x 131.37'L x 5.75'H Field A** 50,231 cf Overall - 20,441 cf Embedded = 29,790 cf x 40.0% Voids
#2A	17.35'	20,441 cf	**Cultec R-902HD** x 315 Inside #1 Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap 315 Chambers in 9 Rows Cap Storage= +2.8 cf x 2 x 9 rows = 49.7 cf
		32,357 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	16.00'	**24.0" Round Culvert** L= 26.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 16.00' / 15.74' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#2	Device 1	18.40'	**1.5" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	20.75'	**4.0' long x 2.60' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#4	Discarded	16.60'	**1.020 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.21 cfs @ 8.36 hrs HW=16.67' (Free Discharge)
└—**4=Exfiltration** (Exfiltration Controls 0.21 cfs)

Primary OutFlow Max=5.65 cfs @ 12.39 hrs HW=21.33' TW=0.00' (Dynamic Tailwater)
└—**1=Culvert** (Passes 5.65 cfs of 24.84 cfs potential flow)
  ├—**2=Orifice/Grate** (Orifice Controls 0.10 cfs @ 8.15 fps)
  └—**3=Sharp-Crested Rectangular Weir** (Weir Controls 5.55 cfs @ 2.48 fps)

Pond 2P: Infiltration Chambers - Chamber Wizard Field A

Chamber Model = Cultec R-902HD (Cultec Recharger®902HD)
Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf
Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap
Cap Storage= +2.8 cf x 2 x 9 rows = 49.7 cf

78.0" Wide + 9.0" Spacing = 87.0" C-C Row Spacing

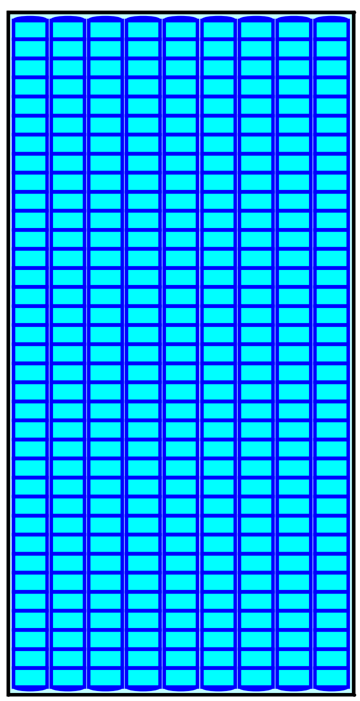
35 Chambers/Row x 3.67' Long +0.52' Cap Length x 2 = 129.37' Row Length +12.0" End Stone x 2 = 131.37' Base Length
9 Rows x 78.0" Wide + 9.0" Spacing x 8 + 12.0" Side Stone x 2 = 66.50' Base Width
9.0" Stone Base + 48.0" Chamber Height + 12.0" Stone Cover = 5.75' Field Height

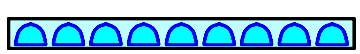
315 Chambers x 64.7 cf + 2.8 cf Cap Volume x 2 x 9 Rows = 20,441.2 cf Chamber Storage

50,231.3 cf Field - 20,441.2 cf Chambers = 29,790.1 cf Stone x 40.0% Voids = 11,916.0 cf Stone Storage

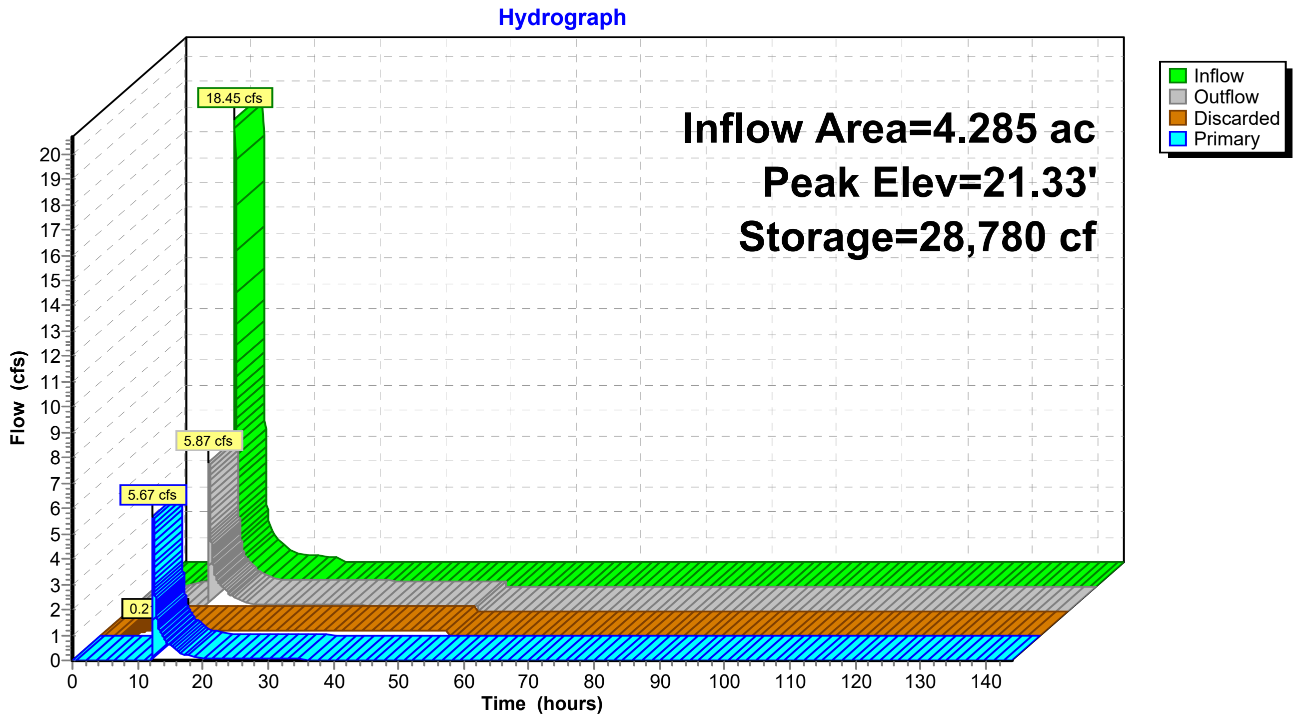
Chamber Storage + Stone Storage = 32,357.3 cf = 0.743 af
Overall Storage Efficiency = 64.4%
Overall System Size = 131.37' x 66.50' x 5.75'

315 Chambers
1,860.4 cy Field
1,103.3 cy Stone





Pond 2P: Infiltration Chambers



Summary for Pond E-P1: Wetland

Inflow Area = 5.973 ac, 62.63% Impervious, Inflow Depth = 2.63" for 10-yr event
Inflow = 10.20 cfs @ 12.44 hrs, Volume= 1.310 af
Outflow = 10.19 cfs @ 12.46 hrs, Volume= 1.142 af, Atten= 0%, Lag= 0.8 min
Primary = 10.19 cfs @ 12.46 hrs, Volume= 1.142 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 18.06' @ 12.46 hrs Surf.Area= 13,252 sf Storage= 8,104 cf

Plug-Flow detention time= 85.3 min calculated for 1.142 af (87% of inflow)
Center-of-Mass det. time= 27.0 min (875.0 - 848.0)

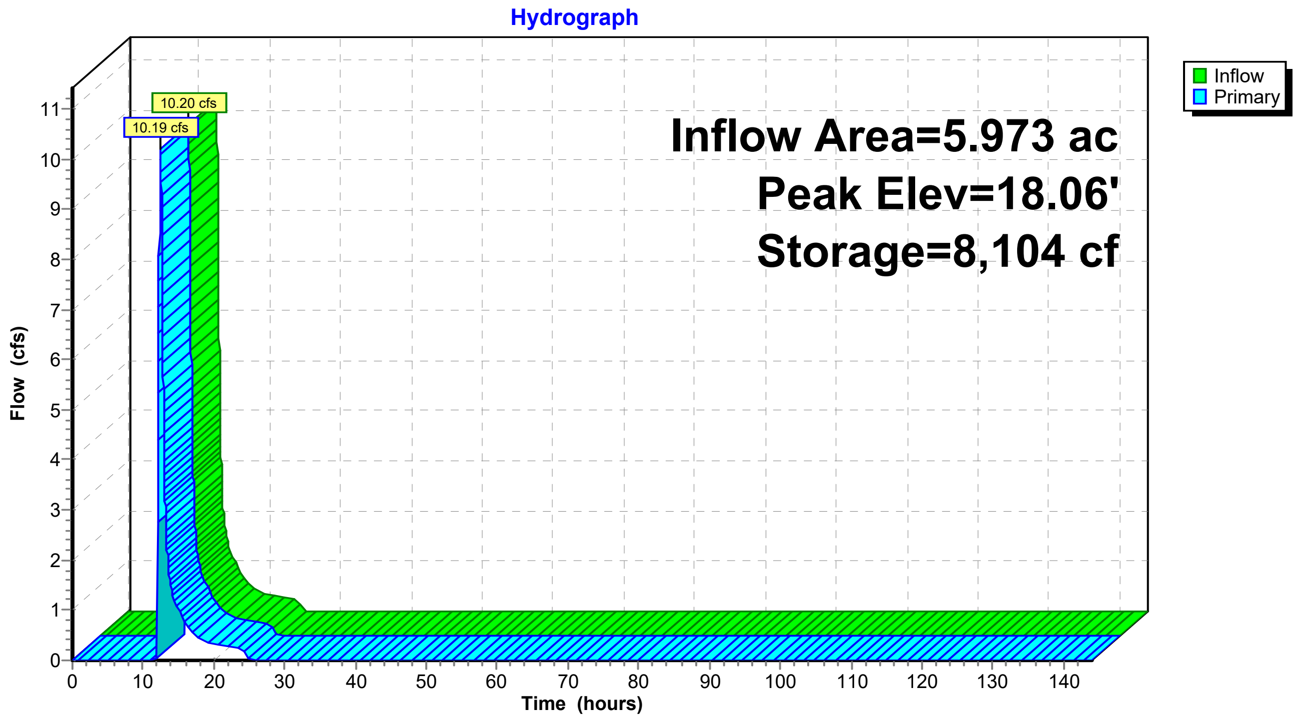
Volume	Invert	Avail.Storage	Storage Description
#1	17.00'	236,253 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
17.00	2,349	0	0
18.00	12,281	7,315	7,315
19.00	27,986	20,134	27,449
20.00	37,607	32,797	60,245
21.00	49,582	43,595	103,840
22.00	66,971	58,277	162,116
23.00	81,302	74,137	236,253

Device	Routing	Invert	Outlet Devices
#1	Primary	18.00'	**Asymmetrical Weir, C= 3.27** Offset (feet) 0.00 10.80 18.43 23.94 57.50 86.92 287.08 357.73 427.57 483.95 528.04 555.94 Elev. (feet) 23.00 22.00 21.00 20.00 19.00 18.00 18.00 19.00 20.00 21.00 22.00 23.00

Primary OutFlow Max=10.18 cfs @ 12.46 hrs HW=18.06' TW=13.06' (Dynamic Tailwater)
└─**1=Asymmetrical Weir** (Weir Controls 10.18 cfs @ 0.80 fps)

Pond E-P1: Wetland



Summary for Pond E-P2: Wetland

Inflow Area = 10.418 ac, 39.24% Impervious, Inflow Depth = 1.91" for 10-yr event
Inflow = 13.79 cfs @ 12.40 hrs, Volume= 1.657 af
Outflow = 6.90 cfs @ 12.84 hrs, Volume= 1.421 af, Atten= 50%, Lag= 26.5 min
Primary = 6.90 cfs @ 12.84 hrs, Volume= 1.421 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 13.30' @ 12.84 hrs Surf.Area= 30,717 sf Storage= 23,126 cf

Plug-Flow detention time= 154.2 min calculated for 1.421 af (86% of inflow)
Center-of-Mass det. time= 90.6 min (965.9 - 875.4)

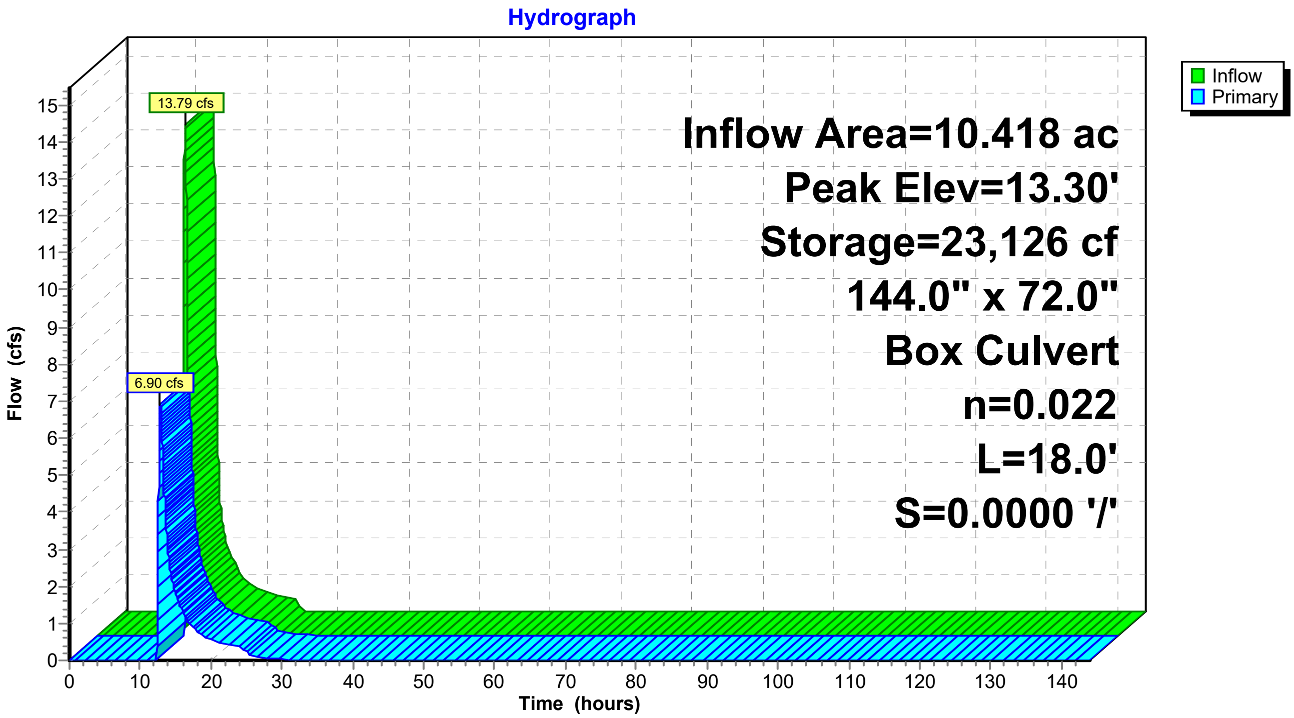
Volume	Invert	Avail.Storage	Storage Description
#1	12.00'	47,617 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
12.00	1,826	0	0
13.00	27,167	14,497	14,497
14.00	39,073	33,120	47,617

Device	Routing	Invert	Outlet Devices
#1	Primary	12.83'	**144.0" W x 72.0" H Box Culvert** L= 18.0' Box, 0° wingwalls, square crown edge, Ke= 0.700 Inlet / Outlet Invert= 12.83' / 12.83' S= 0.0000 '/' Cc= 0.900 n= 0.022 Earth, clean & straight, Flow Area= 72.00 sf

Primary OutFlow Max=6.90 cfs @ 12.84 hrs HW=13.30' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Barrel Controls 6.90 cfs @ 1.64 fps)

Pond E-P2: Wetland



Time span=0.00-144.00 hrs, dt=0.02 hrs, 7201 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

SubcatchmentP-4d: Overland to Wet Basin Runoff Area=15,966 sf 0.00% Impervious Runoff Depth=1.98"
Tc=6.0 min CN=64 Runoff=0.82 cfs 0.061 af

SubcatchmentP1: Property offsite Runoff Area=260,170 sf 62.63% Impervious Runoff Depth=3.42"
Flow Length=343' Tc=31.4 min CN=80 Runoff=13.24 cfs 1.703 af

SubcatchmentP2: P2 Runoff Area=193,654 sf 7.83% Impervious Runoff Depth=1.98"
Flow Length=315' Tc=15.1 min CN=64 Runoff=7.45 cfs 0.735 af

SubcatchmentP3: SW Property Runoff Area=256,545 sf 1.84% Impervious Runoff Depth=0.06"
Flow Length=683' Tc=13.5 min CN=31 Runoff=0.04 cfs 0.028 af

SubcatchmentP4: Central Overland Runoff Area=171,811 sf 0.76% Impervious Runoff Depth=0.34"
Flow Length=190' Tc=17.0 min CN=39 Runoff=0.38 cfs 0.111 af

SubcatchmentP4a: Developed Site Runoff Area=170,352 sf 78.81% Impervious Runoff Depth=4.79"
Tc=6.0 min CN=93 Runoff=20.45 cfs 1.560 af

SubcatchmentP4b: Developed Site Runoff Area=16,288 sf 69.59% Impervious Runoff Depth=4.68"
Tc=6.0 min CN=92 Runoff=1.93 cfs 0.146 af

SubcatchmentP4c: Developed Site Runoff Area=257,881 sf 31.09% Impervious Runoff Depth=1.51"
Tc=6.0 min CN=58 Runoff=9.50 cfs 0.746 af

SubcatchmentP5: Central Overland Runoff Area=70,851 sf 2.13% Impervious Runoff Depth=0.54"
Flow Length=190' Tc=17.0 min CN=43 Runoff=0.37 cfs 0.073 af

Reach DP-1: Wetland Inflow=15.56 cfs 3.034 af
Outflow=15.56 cfs 3.034 af

Reach DP-2: North PL Inflow=3.61 cfs 0.879 af
Outflow=3.61 cfs 0.879 af

Reach DP-3: PL 248 Water St
Outflow=0.00 cfs 0.000 af

Reach DP-4: South PL
Outflow=0.00 cfs 0.000 af

Pond 1P: Extended Dry Detention Basin Peak Elev=17.89' Storage=10,451 cf Inflow=10.32 cfs 0.807 af
Outflow=3.25 cfs 0.807 af

Pond 2P: Infiltration Chambers Peak Elev=21.74' Storage=30,236 cf Inflow=22.38 cfs 1.706 af
Discarded=0.21 cfs 0.844 af Primary=12.41 cfs 0.862 af Outflow=12.61 cfs 1.706 af

Pond E-P1: Wetland Peak Elev=18.07' Storage=8,260 cf Inflow=13.24 cfs 1.703 af
Outflow=13.23 cfs 1.535 af

Pond E-P2: Wetland Peak Elev=13.47' Storage=28,503 cf Inflow=18.49 cfs 2.270 af
144.0" x 72.0" Box Culvert n=0.022 L=18.0' S=0.0000 '/' Outflow=11.74 cfs 2.034 af

Total Runoff Area = 32.450 ac Runoff Volume = 5.162 af Average Runoff Depth = 1.91"
70.90% Pervious = 23.006 ac 29.10% Impervious = 9.444 ac

Summary for Subcatchment P-4d: Overland to Wet Basin

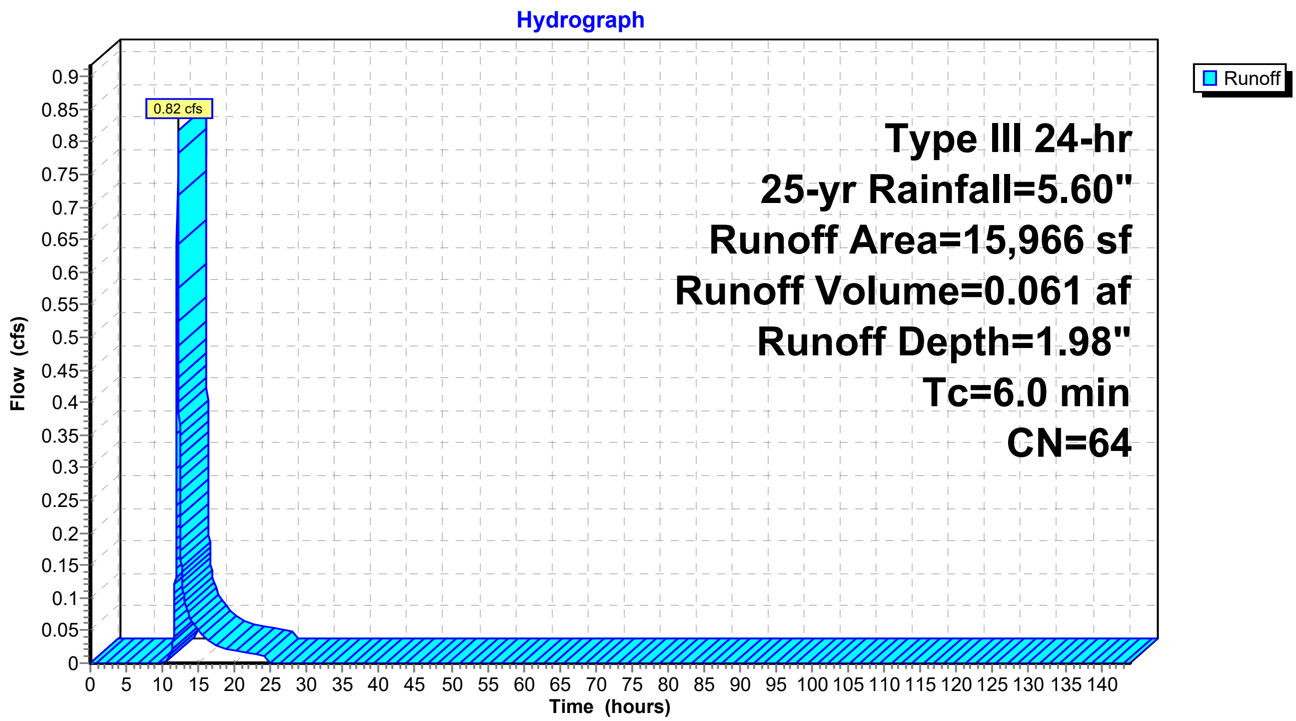
Runoff = 0.82 cfs @ 12.09 hrs, Volume= 0.061 af, Depth= 1.98"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-yr Rainfall=5.60"

Area (sf)	CN	Description
4,551	39	>75% Grass cover, Good, HSG A
11,415	74	>75% Grass cover, Good, HSG C
15,966	64	Weighted Average
15,966		100.00% Pervious Area

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

Subcatchment P-4d: Overland to Wet Basin



Summary for Subcatchment P1: Property offsite

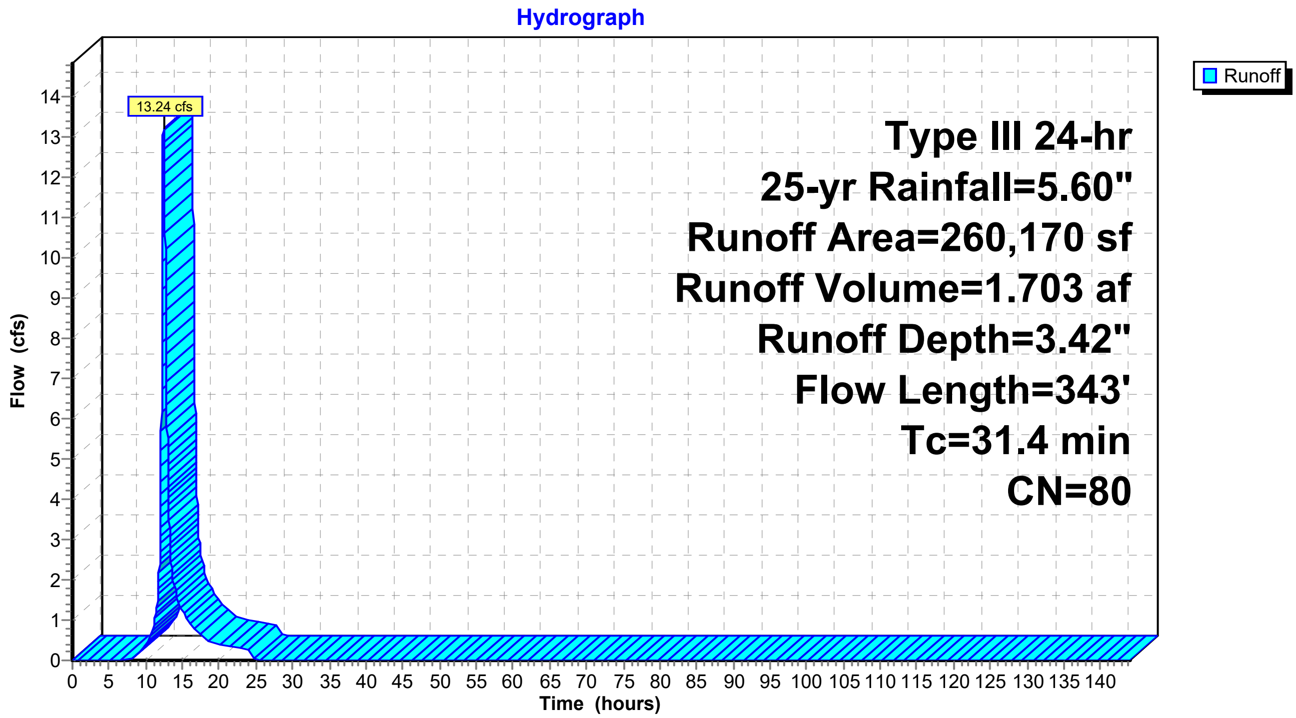
Runoff = 13.24 cfs @ 12.44 hrs, Volume= 1.703 af, Depth= 3.42"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-yr Rainfall=5.60"

	Area (sf)	CN	Description
*	142,754	89	Urban commercial, 85% imp, HSG A (OFFSITE)
*	31,587	30	Woods, Good, HSG A (OFFSITE)
*	48,943	94	Urban commercial, 85% imp, HSG C (OFFSITE)
*	8,690	78	Wetlands/woods, HSG A (OFFSITE)
*	25,996	70	Woods, Good, HSG C (OFFSITE)
*	2,200	78	Wetlands/woods, HSG C (OFFSITE)
	260,170	80	Weighted Average
	97,228		37.37% Pervious Area
	162,942		62.63% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.8	50	0.0040	0.04		**Sheet Flow, Start** Woods: Light underbrush n= 0.400 P2= 3.40"
6.6	126	0.0040	0.32		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
2.0	167	0.0800	1.41		**Shallow Concentrated Flow, C-WETLAND** Woodland Kv= 5.0 fps
31.4	343	Total			

Subcatchment P1: Property offsite



Summary for Subcatchment P2: P2

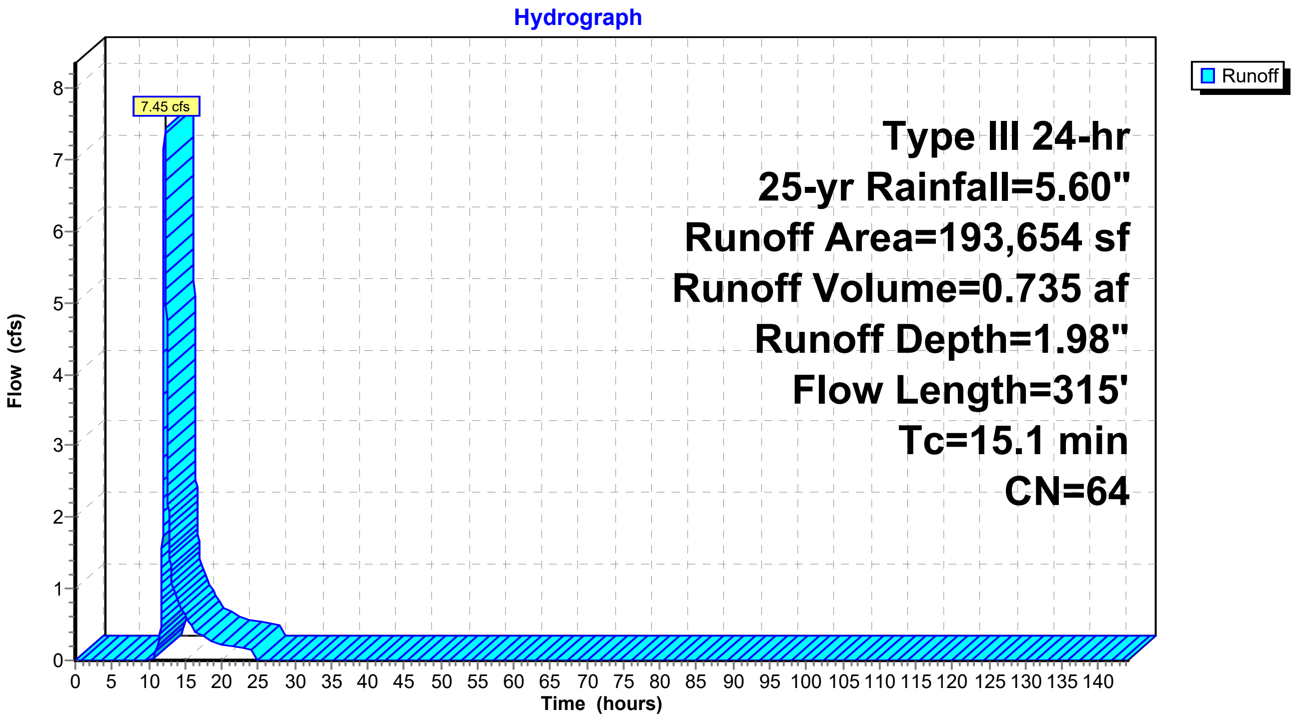
Runoff = 7.45 cfs @ 12.22 hrs, Volume= 0.735 af, Depth= 1.98"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-yr Rainfall=5.60"

	Area (sf)	CN	Description
*	9,050	98	Paved parking, HSG A (OFFSITE)
*	49,865	30	Woods, Good, HSG A (OFFSITE)
*	20,149	78	Wetlands/woods. HSG A (OFFSITE)
*	4,604	98	Paved parking, HSG C (OFFSITE)
*	41,546	70	Woods, Good, HSG C (OFFSITE)
*	3,605	78	Wetlands/woods, HSG C (OFFSITE)
	11,149	70	Woods, Good, HSG C
*	5,924	78	Wetlands/woods, HSG C
*	28,611	78	Wetlands/woods, HSG A
	3,016	30	Woods, Good, HSG A
*	1,504	98	Decks, HSG C
	14,631	74	>75% Grass cover, Good, HSG C
	193,654	64	Weighted Average
	178,496		92.17% Pervious Area
	15,158		7.83% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.2	50	0.0190	0.07		**Sheet Flow, START** Woods: Light underbrush n= 0.400 P2= 3.40"
1.5	116	0.0690	1.31		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
0.1	20	0.0200	2.87		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
1.3	129	0.1100	1.66		**Shallow Concentrated Flow, D-WETLAND** Woodland Kv= 5.0 fps
15.1	315	Total			

Subcatchment P2: P2



Summary for Subcatchment P3: SW Property

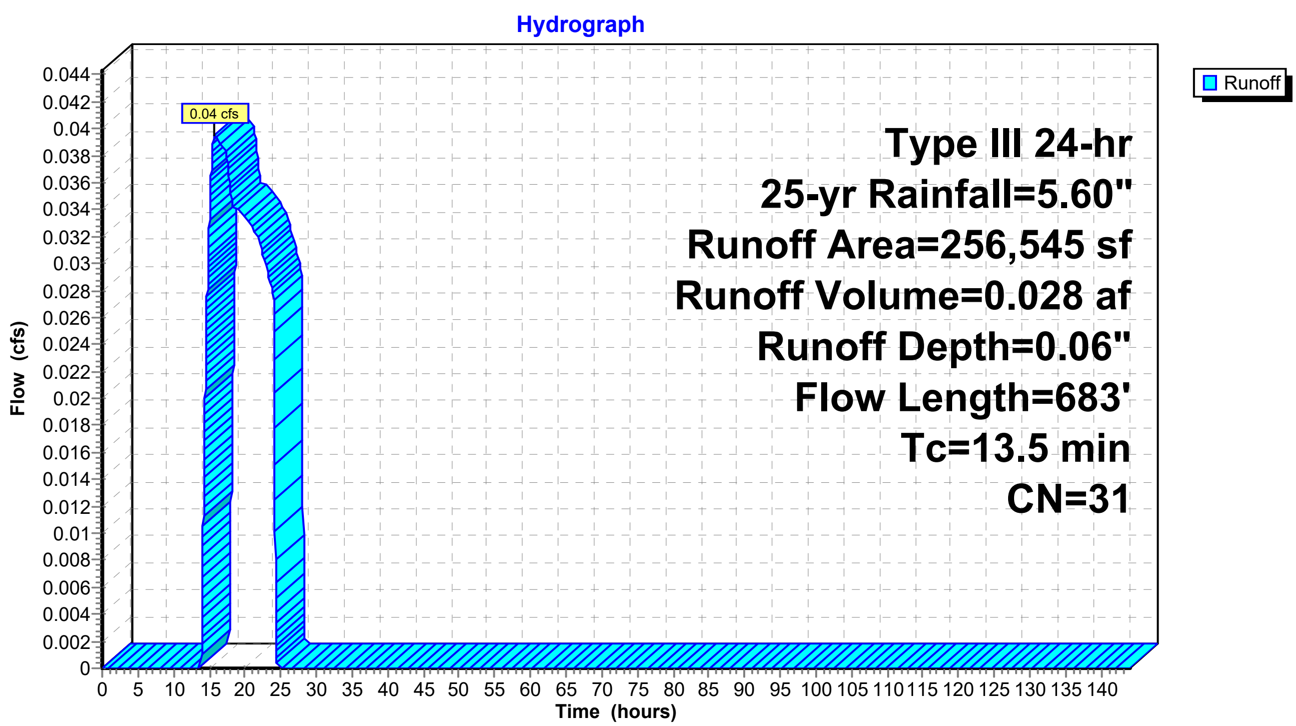
Runoff = 0.04 cfs @ 15.81 hrs, Volume= 0.028 af, Depth= 0.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-yr Rainfall=5.60"

	Area (sf)	CN	Description
	157,110	30	Woods, Good, HSG A
*	94,725	30	Woods, Fair, HSG A (OFFSITE)
*	4,710	98	Impervious, HSG A (OFFSITE)
	256,545	31	Weighted Average
	251,835		98.16% Pervious Area
	4,710		1.84% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.2	50	0.0300	0.08		**Sheet Flow, Start Off Property** Woods: Light underbrush n= 0.400 P2= 3.40"
3.3	633	0.0400	3.22		**Shallow Concentrated Flow, To Wetland** Unpaved Kv= 16.1 fps
13.5	683	Total			

Subcatchment P3: SW Property



Summary for Subcatchment P4: Central Overland

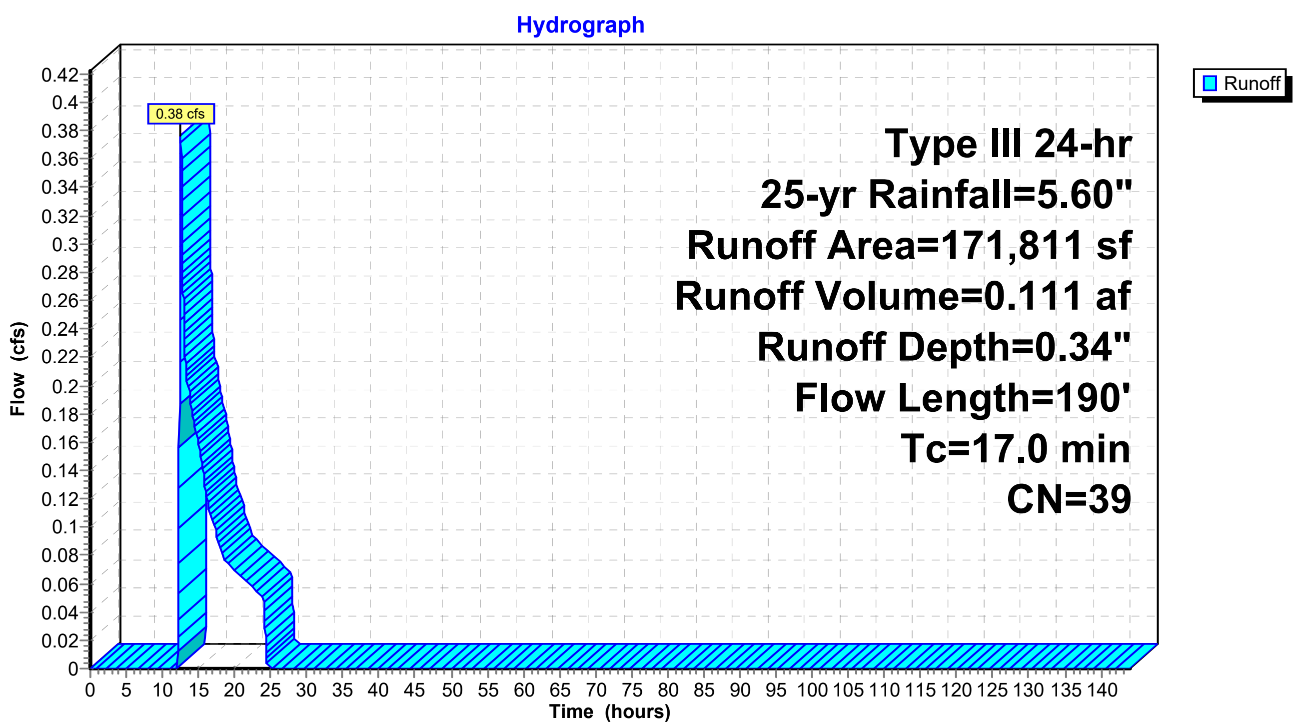
Runoff = 0.38 cfs @ 12.55 hrs, Volume= 0.111 af, Depth= 0.34"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-yr Rainfall=5.60"

	Area (sf)	CN	Description
	104,548	30	Woods, Good, HSG A
	41,769	39	>75% Grass cover, Good, HSG A
	2,502	76	Gravel roads, HSG A
	21,686	74	>75% Grass cover, Good, HSG C
*	767	98	Decks, HSG C
*	539	98	Decks, HSG A
	171,811	39	Weighted Average
	170,505		99.24% Pervious Area
	1,306		0.76% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.8	50	0.0100	0.05		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.40"
1.2	140	0.0150	1.97		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
17.0	190	Total			

Subcatchment P4: Central Overland



Summary for Subcatchment P4a: Developed Site

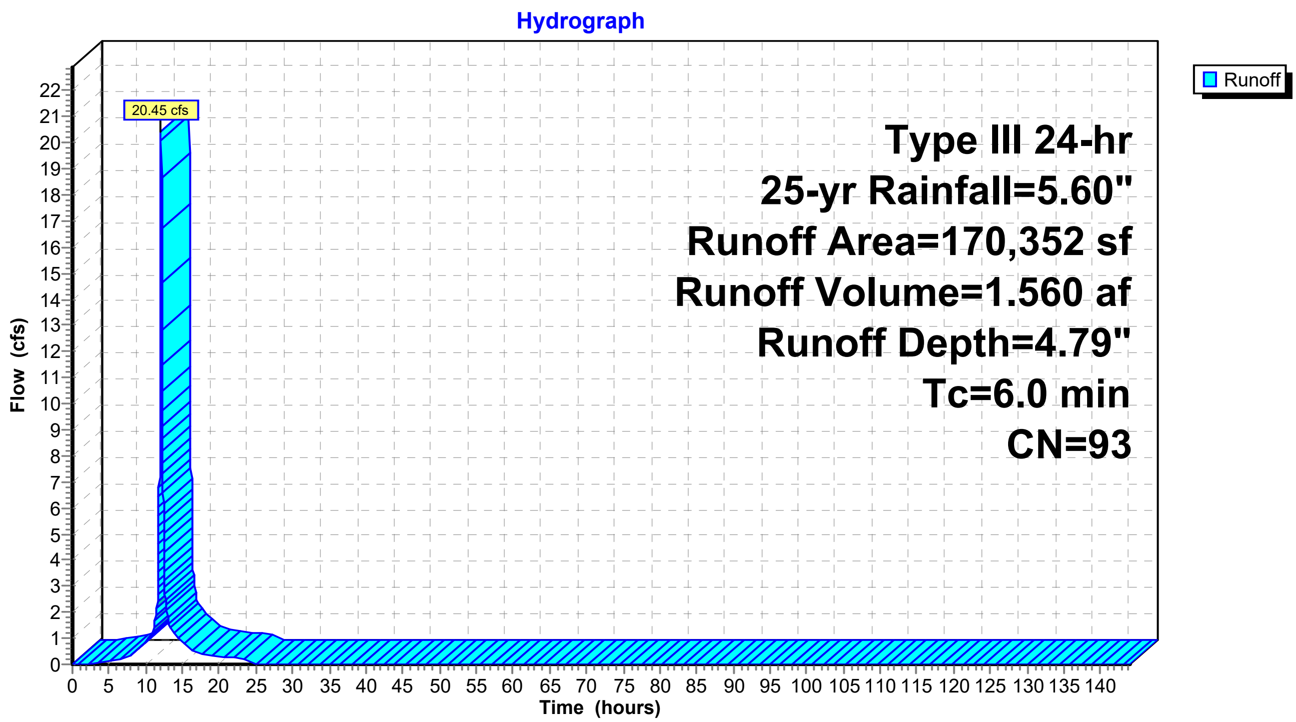
Runoff = 20.45 cfs @ 12.08 hrs, Volume= 1.560 af, Depth= 4.79"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-yr Rainfall=5.60"

	Area (sf)	CN	Description
	32,445	98	Roofs, HSG A
	36,095	74	>75% Grass cover, Good, HSG C
	64,685	98	Roofs, HSG C
*	35,350	98	Paved parking, HSG C
*	1,777	98	Decks, HSG C
	170,352	93	Weighted Average
	36,095		21.19% Pervious Area
	134,257		78.81% Impervious Area

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

Subcatchment P4a: Developed Site



Summary for Subcatchment P4b: Developed Site

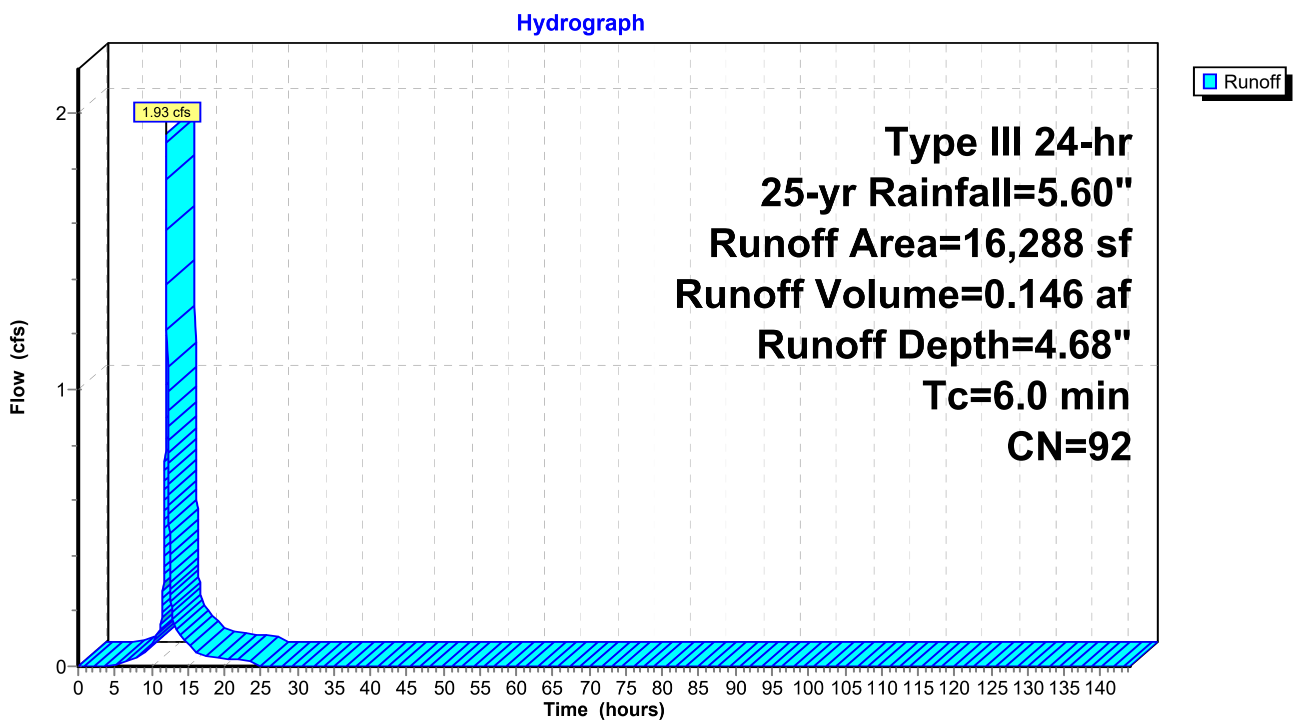
Runoff = 1.93 cfs @ 12.08 hrs, Volume= 0.146 af, Depth= 4.68"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-yr Rainfall=5.60"

	Area (sf)	CN	Description
	191	98	Roofs, HSG A
	7,608	98	Roofs, HSG C
*	3,536	98	Paved parking, HSG C
	3,501	74	>75% Grass cover, Good, HSG C
	1,452	89	Gravel roads, HSG C
	16,288	92	Weighted Average
	4,953		30.41% Pervious Area
	11,335		69.59% Impervious Area

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

Subcatchment P4b: Developed Site



Summary for Subcatchment P4c: Developed Site

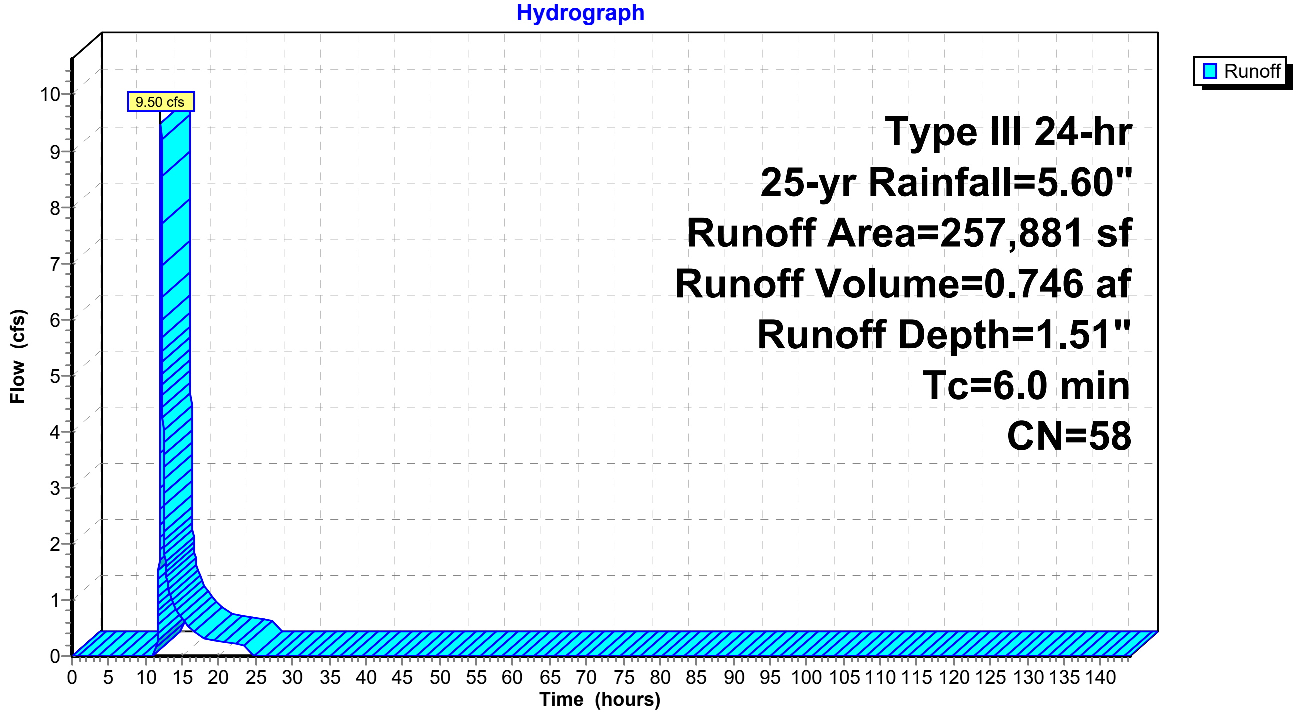
Runoff = 9.50 cfs @ 12.10 hrs, Volume= 0.746 af, Depth= 1.51"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-yr Rainfall=5.60"

	Area (sf)	CN	Description
	72,562	39	>75% Grass cover, Good, HSG A
	48,621	98	Paved parking, HSG A
*	599	98	Walks, HSG A
*	2,713	98	Decks, HSG A
	10,062	74	>75% Grass cover, Good, HSG C
*	13,564	98	Paved parking, HSG C
*	491	98	Walks, HSG C
*	406	70	Woods, Good, HSG C (OFFSITE)
*	33,887	30	Woods, Good, HSG A (OFFSITE)
*	60,799	39	>75% Grass cover, Good, HSG A (OFFSITE)
*	3,744	98	Pavement, HSG A (OFFSITE)
*	2,312	98	Paved parking, HSG A (OFFSITE)
*	8,121	98	Impervious, HSG A (OFFSITE)
	257,881	58	Weighted Average
	177,716		68.91% Pervious Area
	80,165		31.09% Impervious Area

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

Subcatchment P4c: Developed Site



Summary for Subcatchment P5: Central Overland

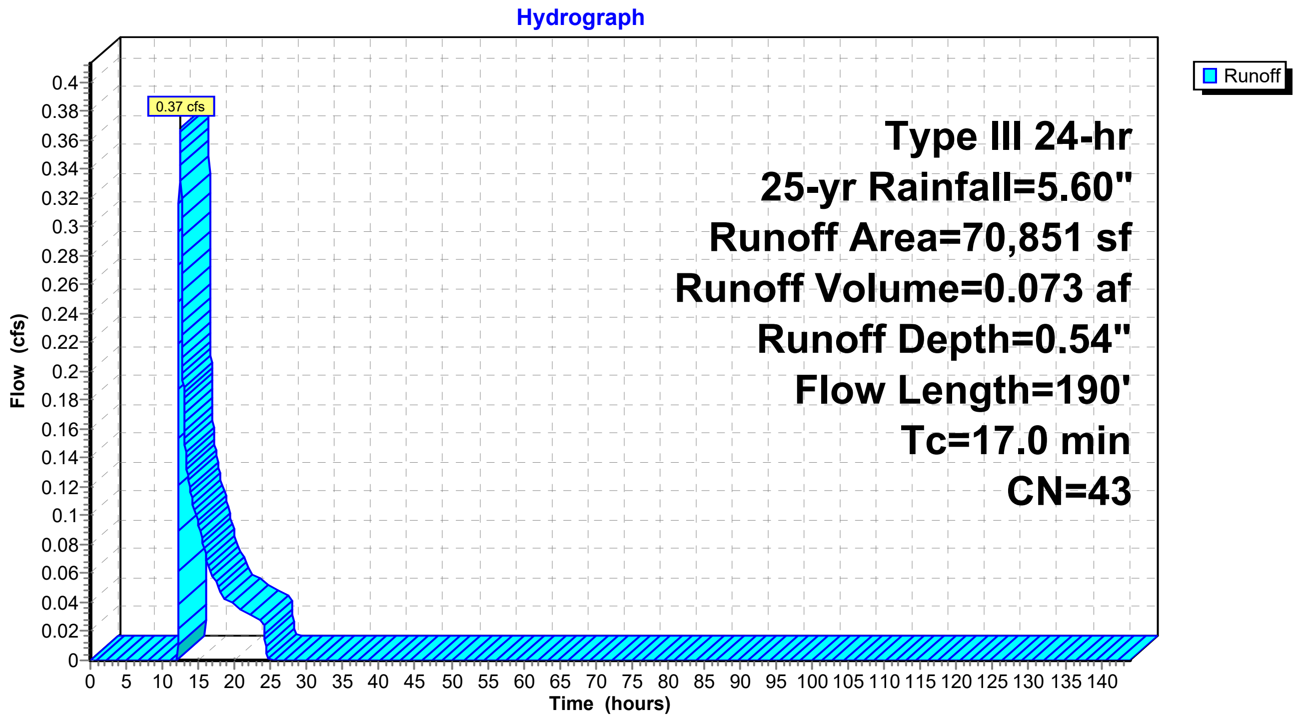
Runoff = 0.37 cfs @ 12.46 hrs, Volume= 0.073 af, Depth= 0.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-yr Rainfall=5.60"

	Area (sf)	CN	Description
	30,577	30	Woods, Good, HSG A
	25,063	39	>75% Grass cover, Good, HSG A
	610	70	Woods, Good, HSG C
	12,737	74	>75% Grass cover, Good, HSG C
*	999	98	Decks, HSG C
*	487	98	Decks, HSG A
*	22	98	Pavement, HSG A (OFFSITE)
*	356	39	>75% Grass cover, Good, HSG A (OFFSITE)
	70,851	43	Weighted Average
	69,343		97.87% Pervious Area
	1,508		2.13% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.8	50	0.0100	0.05		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.40"
1.2	140	0.0150	1.97		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
17.0	190	Total			

Subcatchment P5: Central Overland

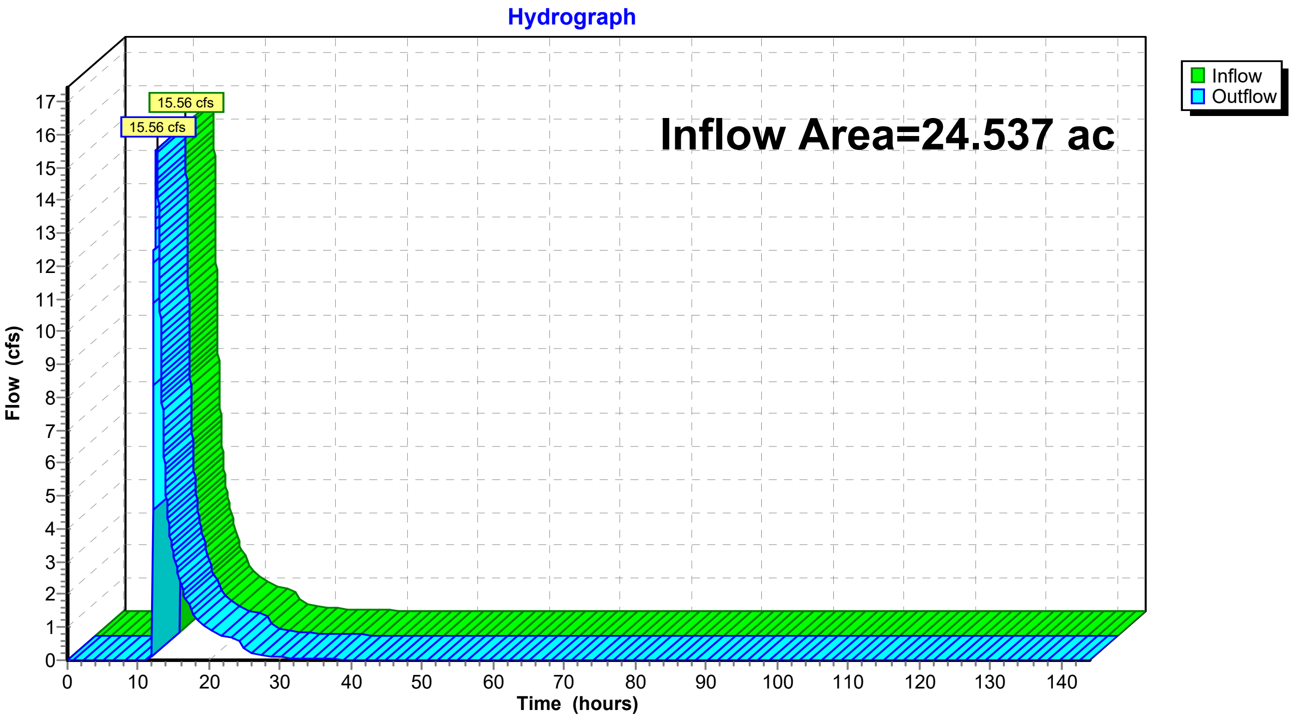


Summary for Reach DP-1: Wetland

Inflow Area = 24.537 ac, 30.85% Impervious, Inflow Depth = 1.48" for 25-yr event
Inflow = 15.56 cfs @ 12.57 hrs, Volume= 3.034 af
Outflow = 15.56 cfs @ 12.57 hrs, Volume= 3.034 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs / 2

Reach DP-1: Wetland

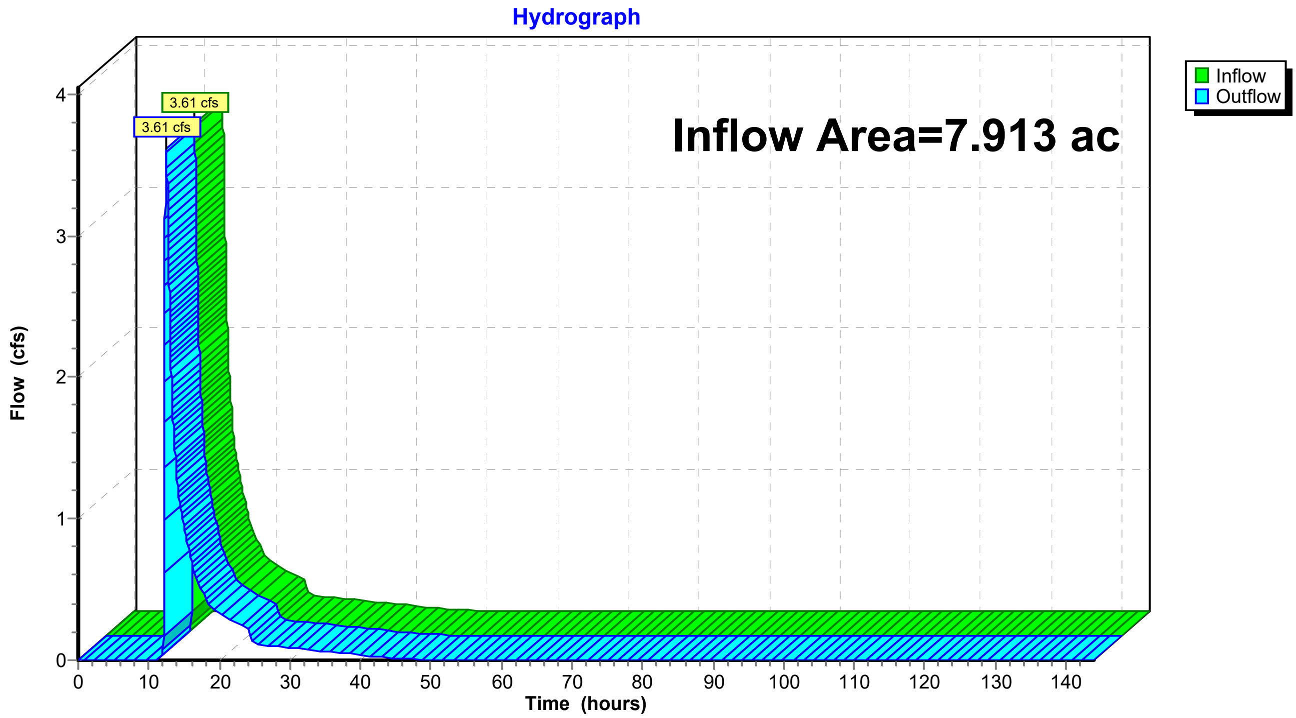


Summary for Reach DP-2: North PL

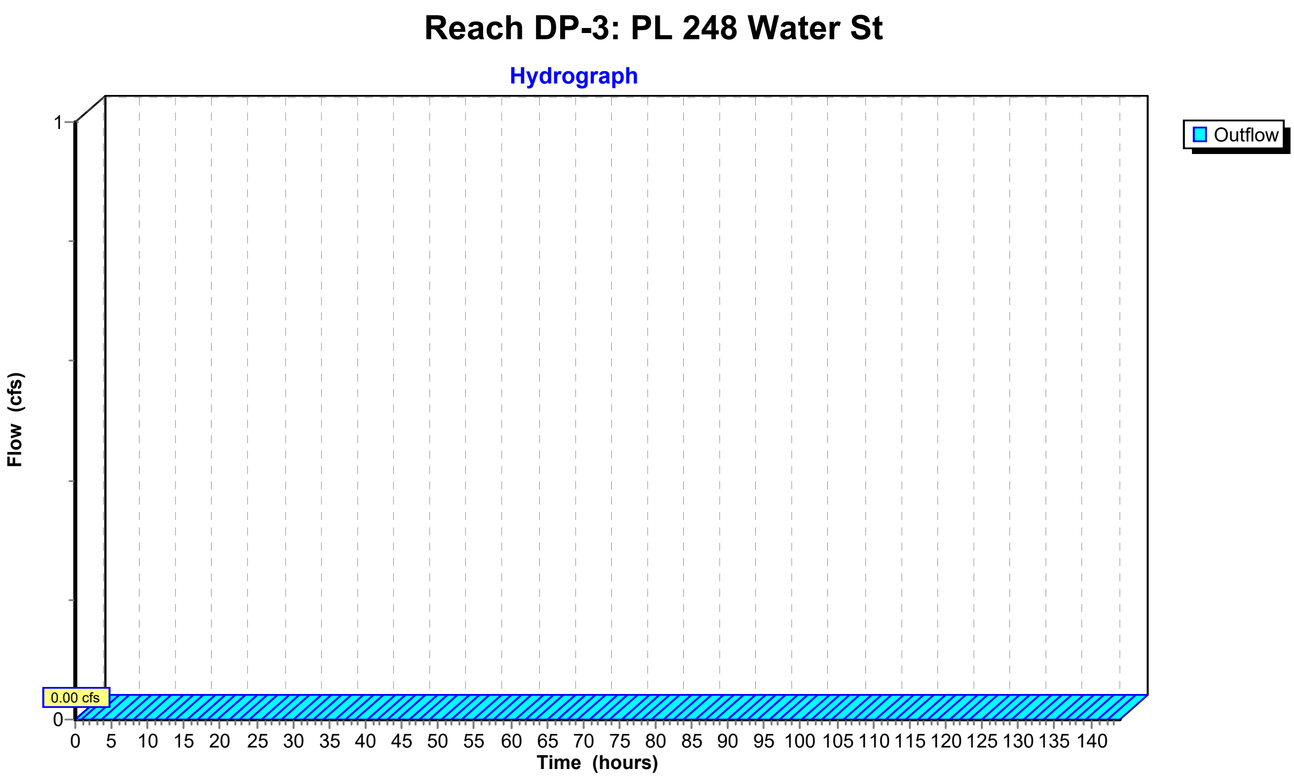
Inflow Area = 7.913 ac, 23.69% Impervious, Inflow Depth = 1.33" for 25-yr event
Inflow = 3.61 cfs @ 12.49 hrs, Volume= 0.879 af
Outflow = 3.61 cfs @ 12.49 hrs, Volume= 0.879 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs / 2

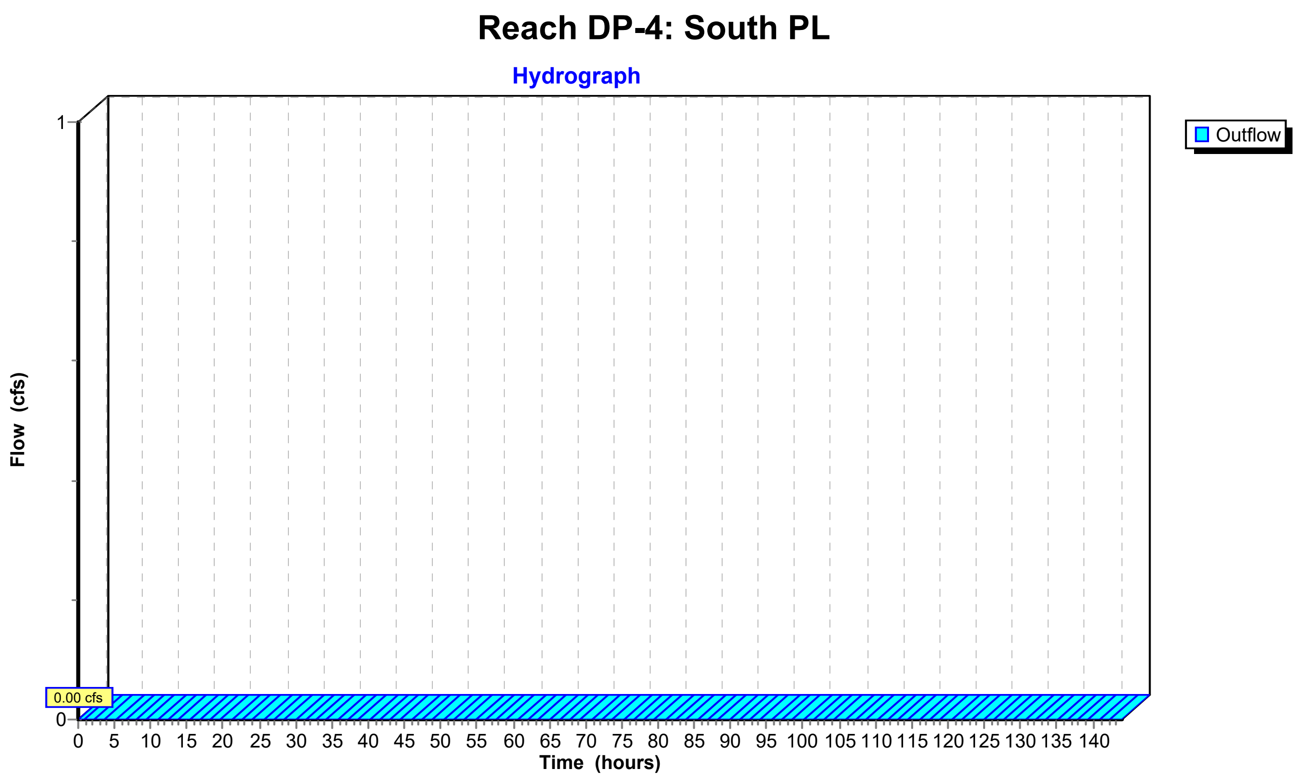
Reach DP-2: North PL



Summary for Reach DP-3: PL 248 Water St



Summary for Reach DP-4: South PL



Summary for Pond 1P: Extended Dry Detention Basin

Inflow Area = 6.287 ac, 29.27% Impervious, Inflow Depth = 1.54" for 25-yr event
Inflow = 10.32 cfs @ 12.10 hrs, Volume= 0.807 af
Outflow = 3.25 cfs @ 12.49 hrs, Volume= 0.807 af, Atten= 69%, Lag= 23.5 min
Primary = 3.25 cfs @ 12.49 hrs, Volume= 0.807 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 17.89' @ 12.49 hrs Surf.Area= 5,365 sf Storage= 10,451 cf

Plug-Flow detention time= 207.2 min calculated for 0.806 af (100% of inflow)
Center-of-Mass det. time= 207.8 min (1,079.7 - 871.9)

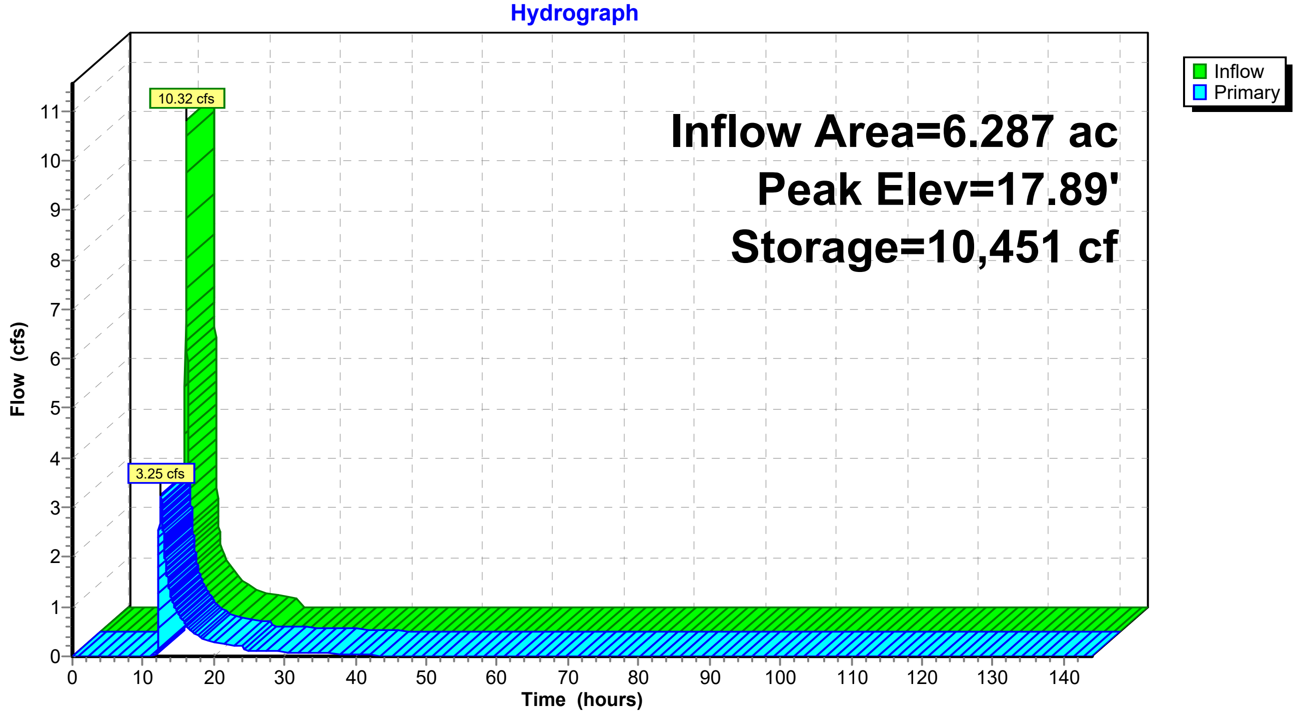
Volume	Invert	Avail.Storage	Storage Description
#1	15.50'	17,959 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
15.50	3,413	0	0
16.00	3,794	1,802	1,802
17.00	4,596	4,195	5,997
18.00	5,456	5,026	11,023
18.10	6,539	600	11,623
19.00	7,541	6,336	17,959

Device	Routing	Invert	Outlet Devices
#1	Primary	15.50'	**15.0" Round Culvert** L= 27.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 15.50' / 15.23' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf
#2	Device 1	15.50'	**2.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	16.75'	**1.0' long x 2.20' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=3.25 cfs @ 12.49 hrs HW=17.89' TW=0.00' (Dynamic Tailwater)
1=Culvert (Passes 3.25 cfs of 6.20 cfs potential flow)
2=Orifice/Grate (Orifice Controls 0.16 cfs @ 7.32 fps)
3=Sharp-Crested Rectangular Weir (Weir Controls 3.09 cfs @ 3.50 fps)

Pond 1P: Extended Dry Detention Basin



Summary for Pond 2P: Infiltration Chambers

Inflow Area = 4.285 ac, 78.01% Impervious, Inflow Depth = 4.78" for 25-yr event
Inflow = 22.38 cfs @ 12.08 hrs, Volume= 1.706 af
Outflow = 12.61 cfs @ 12.20 hrs, Volume= 1.706 af, Atten= 44%, Lag= 7.1 min
Discarded = 0.21 cfs @ 7.60 hrs, Volume= 0.844 af
Primary = 12.41 cfs @ 12.20 hrs, Volume= 0.862 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 21.74' @ 12.20 hrs Surf.Area= 8,736 sf Storage= 30,236 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 565.0 min (1,340.3 - 775.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	16.60'	11,916 cf	**66.50'W x 131.37'L x 5.75'H Field A** 50,231 cf Overall - 20,441 cf Embedded = 29,790 cf x 40.0% Voids
#2A	17.35'	20,441 cf	**Cultec R-902HD** x 315 Inside #1 Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap 315 Chambers in 9 Rows Cap Storage= +2.8 cf x 2 x 9 rows = 49.7 cf
		32,357 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	16.00'	**24.0" Round Culvert** L= 26.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 16.00' / 15.74' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#2	Device 1	18.40'	**1.5" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	20.75'	**4.0' long x 2.60' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#4	Discarded	16.60'	**1.020 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.21 cfs @ 7.60 hrs HW=16.67' (Free Discharge)
└─**4=Exfiltration** (Exfiltration Controls 0.21 cfs)

Primary OutFlow Max=12.38 cfs @ 12.20 hrs HW=21.74' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 12.38 cfs of 26.00 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.11 cfs @ 8.72 fps)
  └─**3=Sharp-Crested Rectangular Weir** (Weir Controls 12.27 cfs @ 3.26 fps)

Pond 2P: Infiltration Chambers - Chamber Wizard Field A

Chamber Model = Cultec R-902HD (Cultec Recharger®902HD)
Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf
Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap
Cap Storage= +2.8 cf x 2 x 9 rows = 49.7 cf

78.0" Wide + 9.0" Spacing = 87.0" C-C Row Spacing

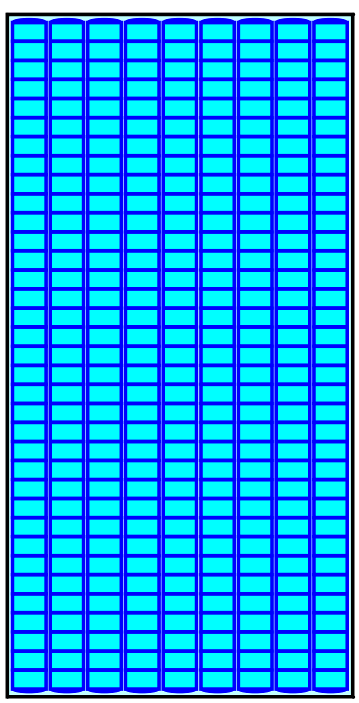
35 Chambers/Row x 3.67' Long +0.52' Cap Length x 2 = 129.37' Row Length +12.0" End Stone x 2 = 131.37' Base Length
9 Rows x 78.0" Wide + 9.0" Spacing x 8 + 12.0" Side Stone x 2 = 66.50' Base Width
9.0" Stone Base + 48.0" Chamber Height + 12.0" Stone Cover = 5.75' Field Height

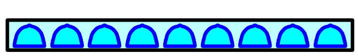
315 Chambers x 64.7 cf + 2.8 cf Cap Volume x 2 x 9 Rows = 20,441.2 cf Chamber Storage

50,231.3 cf Field - 20,441.2 cf Chambers = 29,790.1 cf Stone x 40.0% Voids = 11,916.0 cf Stone Storage

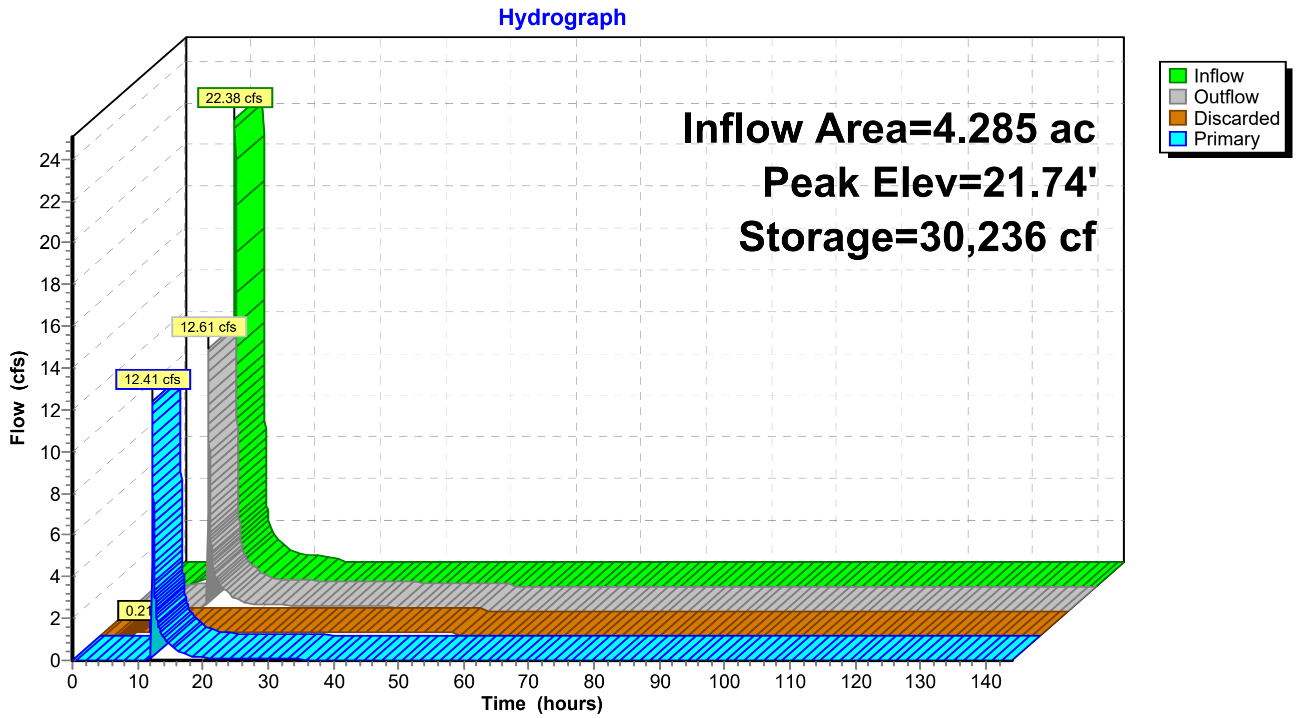
Chamber Storage + Stone Storage = 32,357.3 cf = 0.743 af
Overall Storage Efficiency = 64.4%
Overall System Size = 131.37' x 66.50' x 5.75'

315 Chambers
1,860.4 cy Field
1,103.3 cy Stone





Pond 2P: Infiltration Chambers



Summary for Pond E-P1: Wetland

Inflow Area = 5.973 ac, 62.63% Impervious, Inflow Depth = 3.42" for 25-yr event
Inflow = 13.24 cfs @ 12.44 hrs, Volume= 1.703 af
Outflow = 13.23 cfs @ 12.45 hrs, Volume= 1.535 af, Atten= 0%, Lag= 0.8 min
Primary = 13.23 cfs @ 12.45 hrs, Volume= 1.535 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 18.07' @ 12.45 hrs Surf.Area= 13,435 sf Storage= 8,260 cf

Plug-Flow detention time= 71.3 min calculated for 1.535 af (90% of inflow)
Center-of-Mass det. time= 23.2 min (863.7 - 840.5)

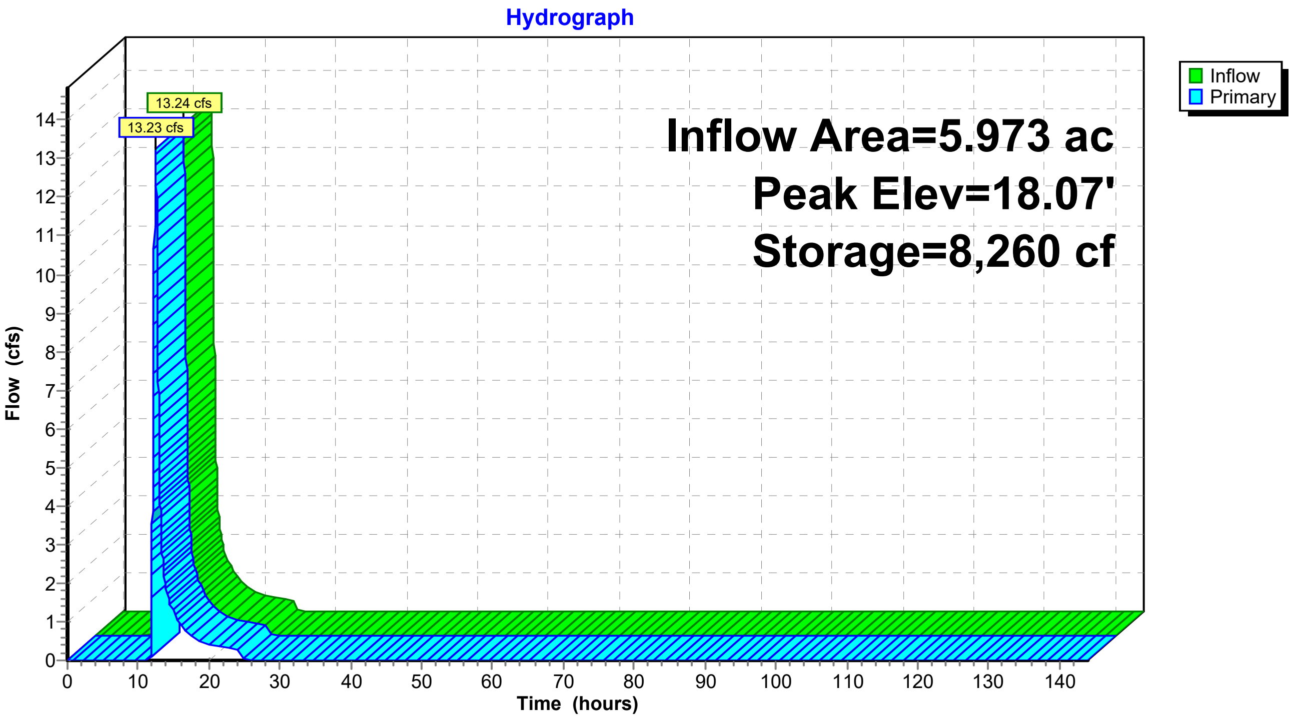
Volume	Invert	Avail.Storage	Storage Description
#1	17.00'	236,253 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
17.00	2,349	0	0
18.00	12,281	7,315	7,315
19.00	27,986	20,134	27,449
20.00	37,607	32,797	60,245
21.00	49,582	43,595	103,840
22.00	66,971	58,277	162,116
23.00	81,302	74,137	236,253

Device	Routing	Invert	Outlet Devices
#1	Primary	18.00'	**Asymmetrical Weir, C= 3.27** Offset (feet) 0.00 10.80 18.43 23.94 57.50 86.92 287.08 357.73 427.57 483.95 528.04 555.94 Elev. (feet) 23.00 22.00 21.00 20.00 19.00 18.00 18.00 19.00 20.00 21.00 22.00 23.00

Primary OutFlow Max=13.22 cfs @ 12.45 hrs HW=18.07' TW=13.33' (Dynamic Tailwater)
└─**1=Asymmetrical Weir** (Weir Controls 13.22 cfs @ 0.87 fps)

Pond E-P1: Wetland



Summary for Pond E-P2: Wetland

Inflow Area = 10.418 ac, 39.24% Impervious, Inflow Depth = 2.61" for 25-yr event
Inflow = 18.49 cfs @ 12.38 hrs, Volume= 2.270 af
Outflow = 11.74 cfs @ 12.71 hrs, Volume= 2.034 af, Atten= 37%, Lag= 19.7 min
Primary = 11.74 cfs @ 12.71 hrs, Volume= 2.034 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 13.47' @ 12.71 hrs Surf.Area= 32,735 sf Storage= 28,503 cf

Plug-Flow detention time= 120.6 min calculated for 2.033 af (90% of inflow)
Center-of-Mass det. time= 71.5 min (935.7 - 864.2)

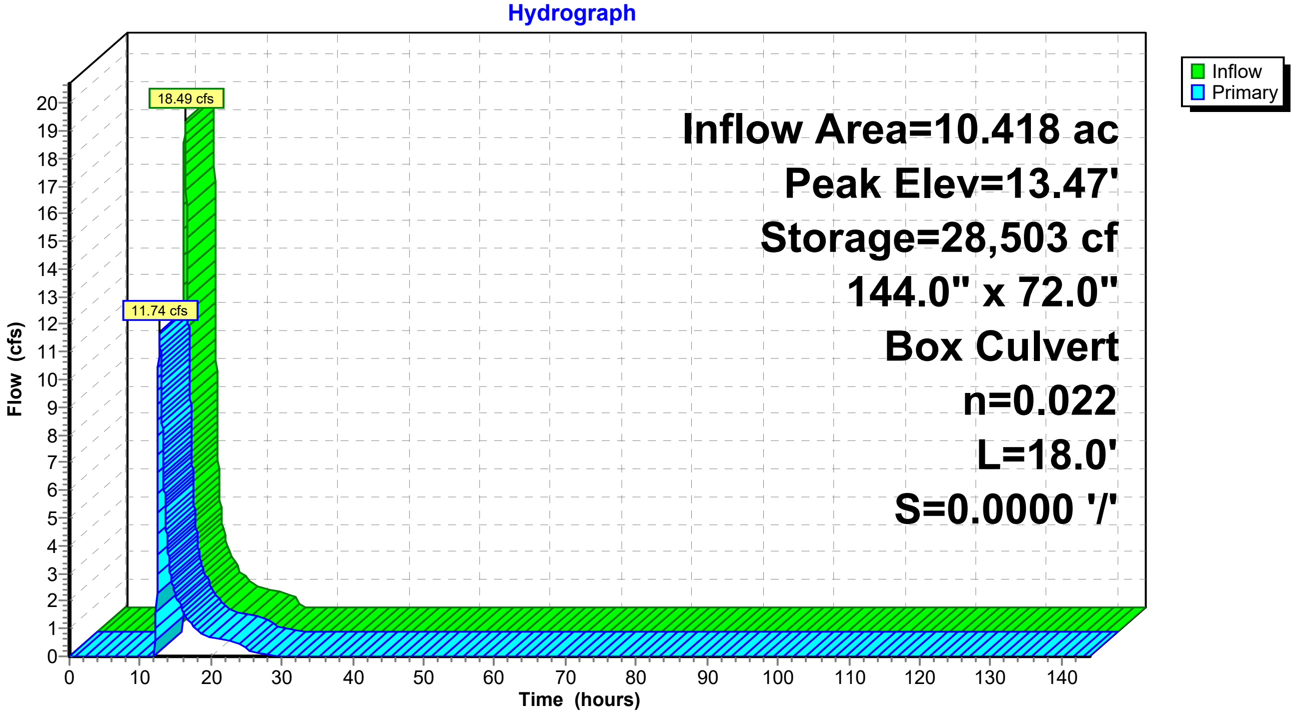
Volume	Invert	Avail.Storage	Storage Description
#1	12.00'	47,617 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
12.00	1,826	0	0
13.00	27,167	14,497	14,497
14.00	39,073	33,120	47,617

Device	Routing	Invert	Outlet Devices
#1	Primary	12.83'	**144.0" W x 72.0" H Box Culvert** L= 18.0' Box, 0° wingwalls, square crown edge, Ke= 0.700 Inlet / Outlet Invert= 12.83' / 12.83' S= 0.0000 '/' Cc= 0.900 n= 0.022 Earth, clean & straight, Flow Area= 72.00 sf

Primary OutFlow Max=11.73 cfs @ 12.71 hrs HW=13.47' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Barrel Controls 11.73 cfs @ 2.04 fps)

Pond E-P2: Wetland



Time span=0.00-144.00 hrs, dt=0.02 hrs, 7201 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment P-4d: Overland to Wet Basin Runoff Area=15,966 sf 0.00% Impervious Runoff Depth=3.00"
Tc=6.0 min CN=64 Runoff=1.27 cfs 0.092 af

Subcatchment P1: Property offsite Runoff Area=260,170 sf 62.63% Impervious Runoff Depth=4.69"
Flow Length=343' Tc=31.4 min CN=80 Runoff=18.06 cfs 2.337 af

Subcatchment P2: P2 Runoff Area=193,654 sf 7.83% Impervious Runoff Depth=3.00"
Flow Length=315' Tc=15.1 min CN=64 Runoff=11.60 cfs 1.112 af

Subcatchment P3: SW Property Runoff Area=256,545 sf 1.84% Impervious Runoff Depth=0.26"
Flow Length=683' Tc=13.5 min CN=31 Runoff=0.22 cfs 0.128 af

Subcatchment P4: Central Overland Runoff Area=171,811 sf 0.76% Impervious Runoff Depth=0.77"
Flow Length=190' Tc=17.0 min CN=39 Runoff=1.40 cfs 0.253 af

Subcatchment P4a: Developed Site Runoff Area=170,352 sf 78.81% Impervious Runoff Depth=6.17"
Tc=6.0 min CN=93 Runoff=25.98 cfs 2.011 af

Subcatchment P4b: Developed Site Runoff Area=16,288 sf 69.59% Impervious Runoff Depth=6.05"
Tc=6.0 min CN=92 Runoff=2.46 cfs 0.189 af

Subcatchment P4c: Developed Site Runoff Area=257,881 sf 31.09% Impervious Runoff Depth=2.41"
Tc=6.0 min CN=58 Runoff=15.99 cfs 1.189 af

Subcatchment P5: Central Overland Runoff Area=70,851 sf 2.13% Impervious Runoff Depth=1.07"
Flow Length=190' Tc=17.0 min CN=43 Runoff=1.01 cfs 0.146 af

Reach DP-1: Wetland Inflow=27.67 cfs 4.757 af
Outflow=27.67 cfs 4.757 af

Reach DP-2: North PL Inflow=6.77 cfs 1.425 af
Outflow=6.77 cfs 1.425 af

Reach DP-3: PL 248 Water St
Outflow=0.00 cfs 0.000 af

Reach DP-4: South PL
Outflow=0.00 cfs 0.000 af

Pond 1P: Extended Dry Detention Basin Peak Elev=18.79' Storage=16,382 cf Inflow=17.26 cfs 1.280 af
Outflow=5.82 cfs 1.280 af

Pond 2P: Infiltration Chambers Peak Elev=22.34' Storage=32,333 cf Inflow=28.44 cfs 2.200 af
Discarded=0.21 cfs 0.869 af Primary=24.32 cfs 1.331 af Outflow=24.53 cfs 2.200 af

Pond E-P1: Wetland Peak Elev=18.09' Storage=8,487 cf Inflow=18.06 cfs 2.337 af
Outflow=18.05 cfs 2.169 af

Pond E-P2: Wetland Peak Elev=13.70' Storage=36,316 cf Inflow=26.16 cfs 3.281 af
144.0" x 72.0" Box Culvert n=0.022 L=18.0' S=0.0000 '/' Outflow=19.56 cfs 3.044 af

Total Runoff Area = 32.450 ac Runoff Volume = 7.455 af Average Runoff Depth = 2.76"
70.90% Pervious = 23.006 ac 29.10% Impervious = 9.444 ac

Summary for Subcatchment P-4d: Overland to Wet Basin

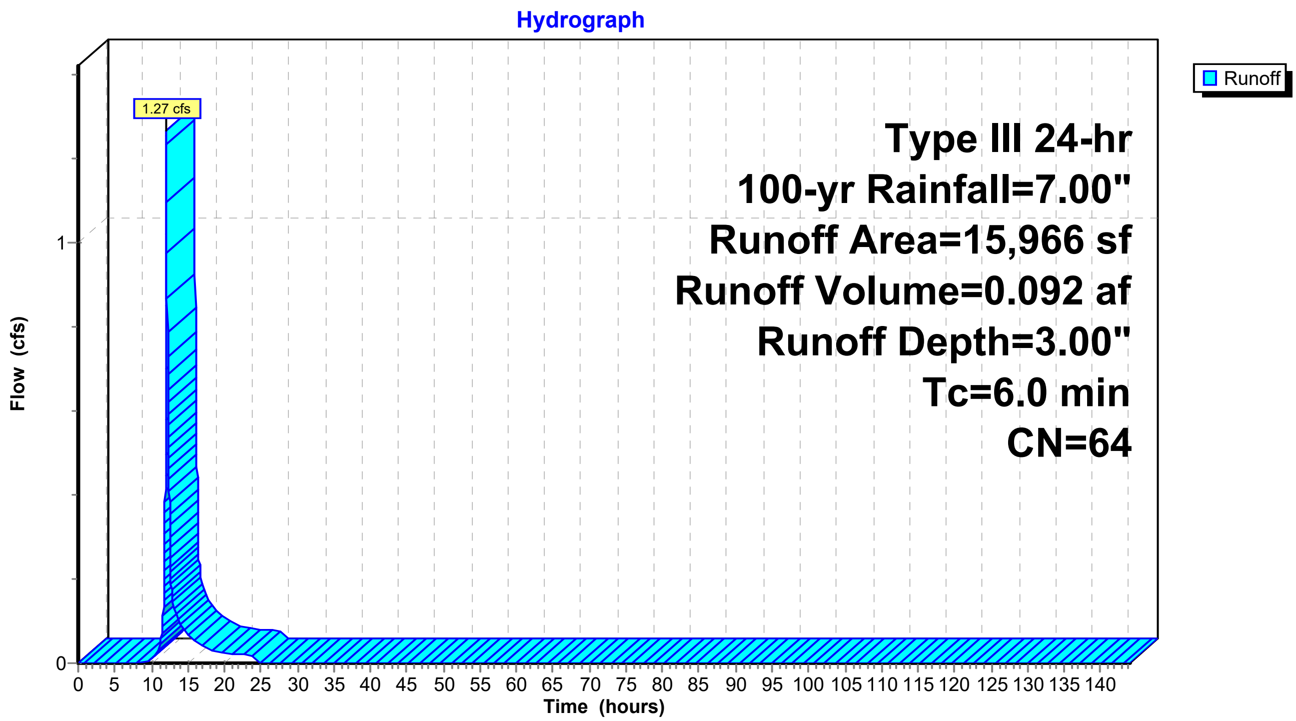
Runoff = 1.27 cfs @ 12.09 hrs, Volume= 0.092 af, Depth= 3.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-yr Rainfall=7.00"

Area (sf)	CN	Description
4,551	39	>75% Grass cover, Good, HSG A
11,415	74	>75% Grass cover, Good, HSG C
15,966	64	Weighted Average
15,966		100.00% Pervious Area

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

Subcatchment P-4d: Overland to Wet Basin



Summary for Subcatchment P1: Property offsite

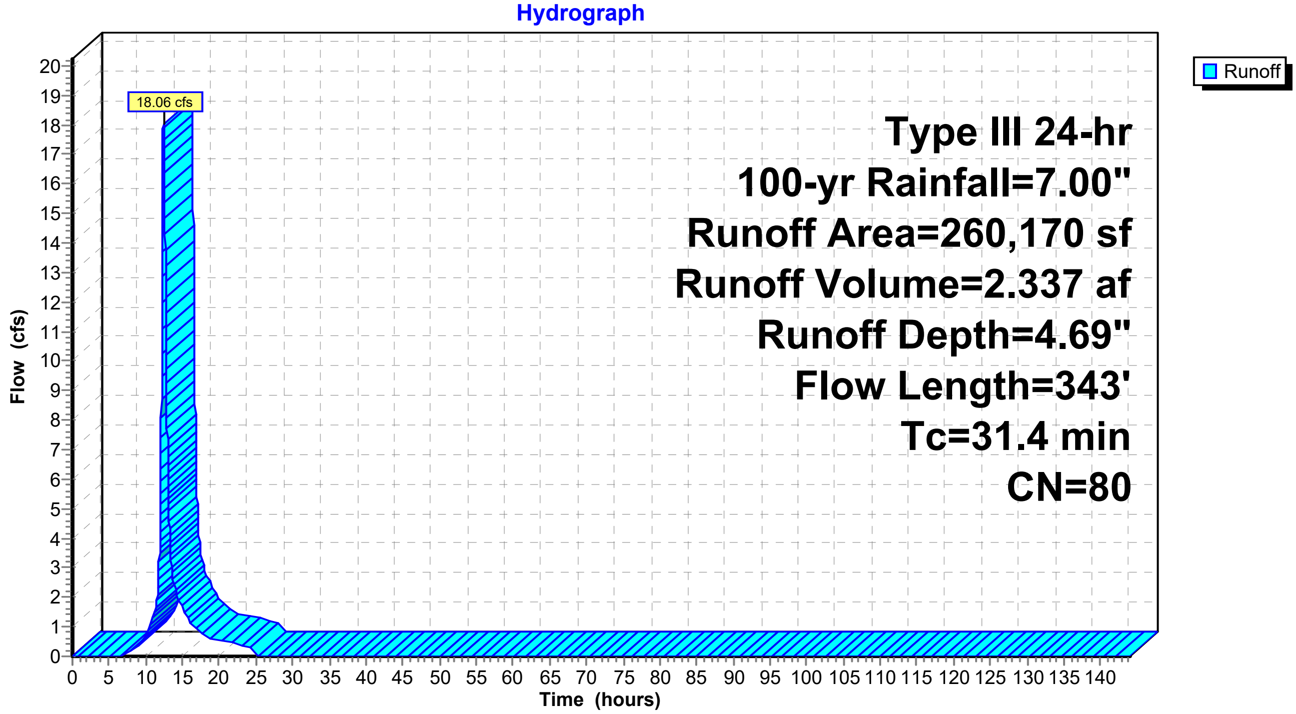
Runoff = 18.06 cfs @ 12.43 hrs, Volume= 2.337 af, Depth= 4.69"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-yr Rainfall=7.00"

	Area (sf)	CN	Description
*	142,754	89	Urban commercial, 85% imp, HSG A (OFFSITE)
*	31,587	30	Woods, Good, HSG A (OFFSITE)
*	48,943	94	Urban commercial, 85% imp, HSG C (OFFSITE)
*	8,690	78	Wetlands/woods, HSG A (OFFSITE)
*	25,996	70	Woods, Good, HSG C (OFFSITE)
*	2,200	78	Wetlands/woods, HSG C (OFFSITE)
	260,170	80	Weighted Average
	97,228		37.37% Pervious Area
	162,942		62.63% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.8	50	0.0040	0.04		**Sheet Flow, Start** Woods: Light underbrush n= 0.400 P2= 3.40"
6.6	126	0.0040	0.32		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
2.0	167	0.0800	1.41		**Shallow Concentrated Flow, C-WETLAND** Woodland Kv= 5.0 fps
31.4	343	Total			

Subcatchment P1: Property offsite



Summary for Subcatchment P2: P2

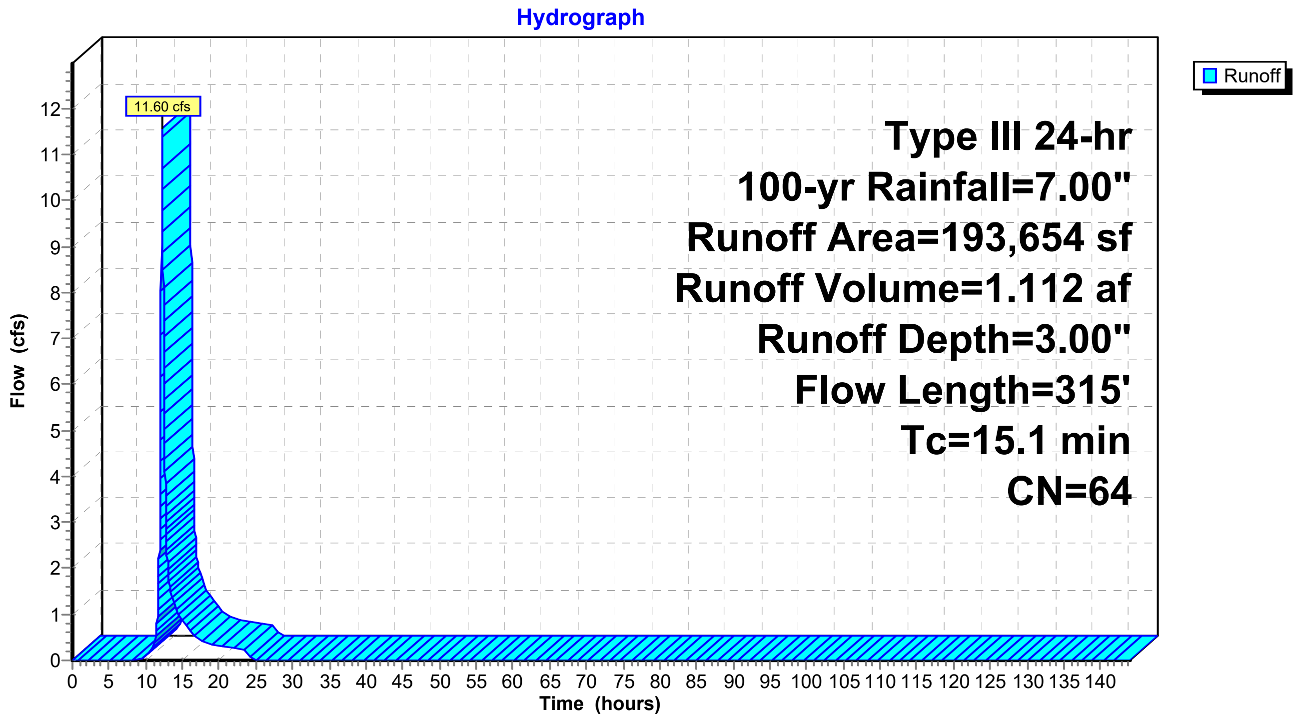
Runoff = 11.60 cfs @ 12.21 hrs, Volume= 1.112 af, Depth= 3.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-yr Rainfall=7.00"

	Area (sf)	CN	Description
*	9,050	98	Paved parking, HSG A (OFFSITE)
*	49,865	30	Woods, Good, HSG A (OFFSITE)
*	20,149	78	Wetlands/woods. HSG A (OFFSITE)
*	4,604	98	Paved parking, HSG C (OFFSITE)
*	41,546	70	Woods, Good, HSG C (OFFSITE)
*	3,605	78	Wetlands/woods, HSG C (OFFSITE)
	11,149	70	Woods, Good, HSG C
*	5,924	78	Wetlands/woods, HSG C
*	28,611	78	Wetlands/woods, HSG A
	3,016	30	Woods, Good, HSG A
*	1,504	98	Decks, HSG C
	14,631	74	>75% Grass cover, Good, HSG C
	193,654	64	Weighted Average
	178,496		92.17% Pervious Area
	15,158		7.83% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.2	50	0.0190	0.07		**Sheet Flow, START** Woods: Light underbrush n= 0.400 P2= 3.40"
1.5	116	0.0690	1.31		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
0.1	20	0.0200	2.87		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
1.3	129	0.1100	1.66		**Shallow Concentrated Flow, D-WETLAND** Woodland Kv= 5.0 fps
15.1	315	Total			

Subcatchment P2: P2



Summary for Subcatchment P3: SW Property

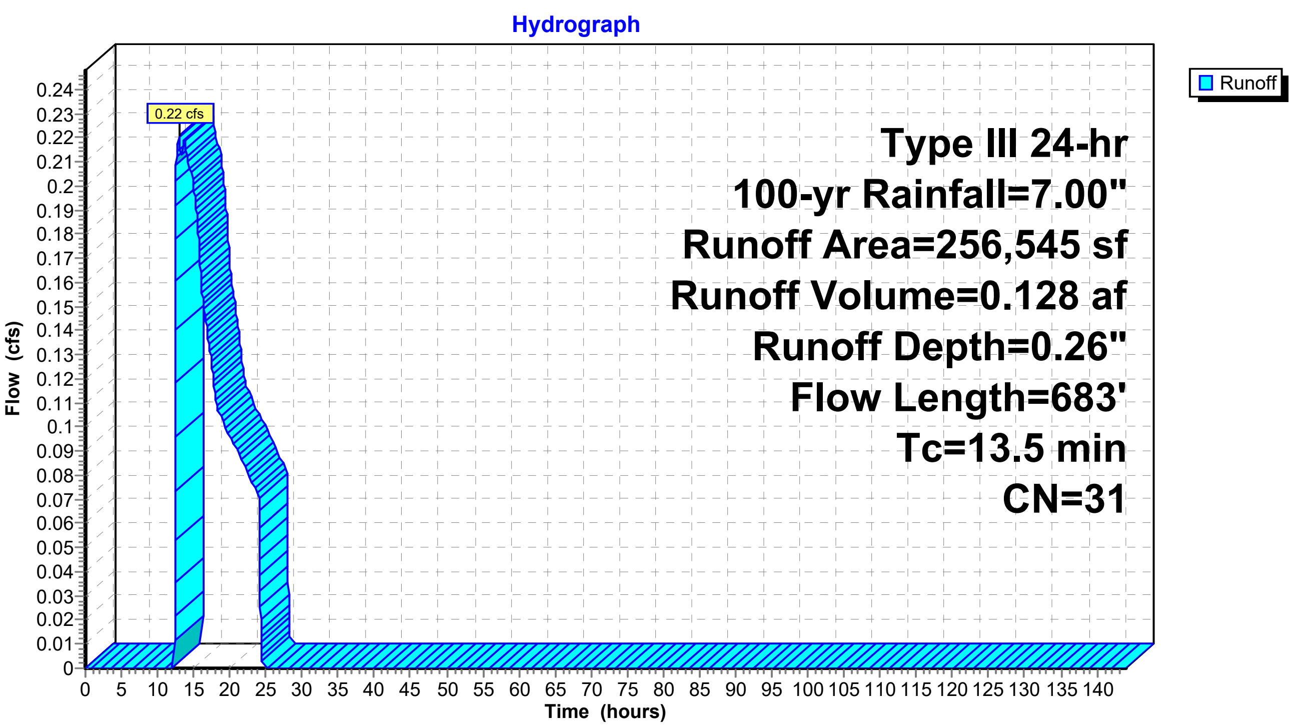
Runoff = 0.22 cfs @ 12.95 hrs, Volume= 0.128 af, Depth= 0.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-yr Rainfall=7.00"

	Area (sf)	CN	Description
	157,110	30	Woods, Good, HSG A
*	94,725	30	Woods, Fair, HSG A (OFFSITE)
*	4,710	98	Impervious, HSG A (OFFSITE)
	256,545	31	Weighted Average
	251,835		98.16% Pervious Area
	4,710		1.84% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.2	50	0.0300	0.08		**Sheet Flow, Start Off Property** Woods: Light underbrush n= 0.400 P2= 3.40"
3.3	633	0.0400	3.22		**Shallow Concentrated Flow, To Wetland** Unpaved Kv= 16.1 fps
13.5	683	Total			

Subcatchment P3: SW Property



Summary for Subcatchment P4: Central Overland

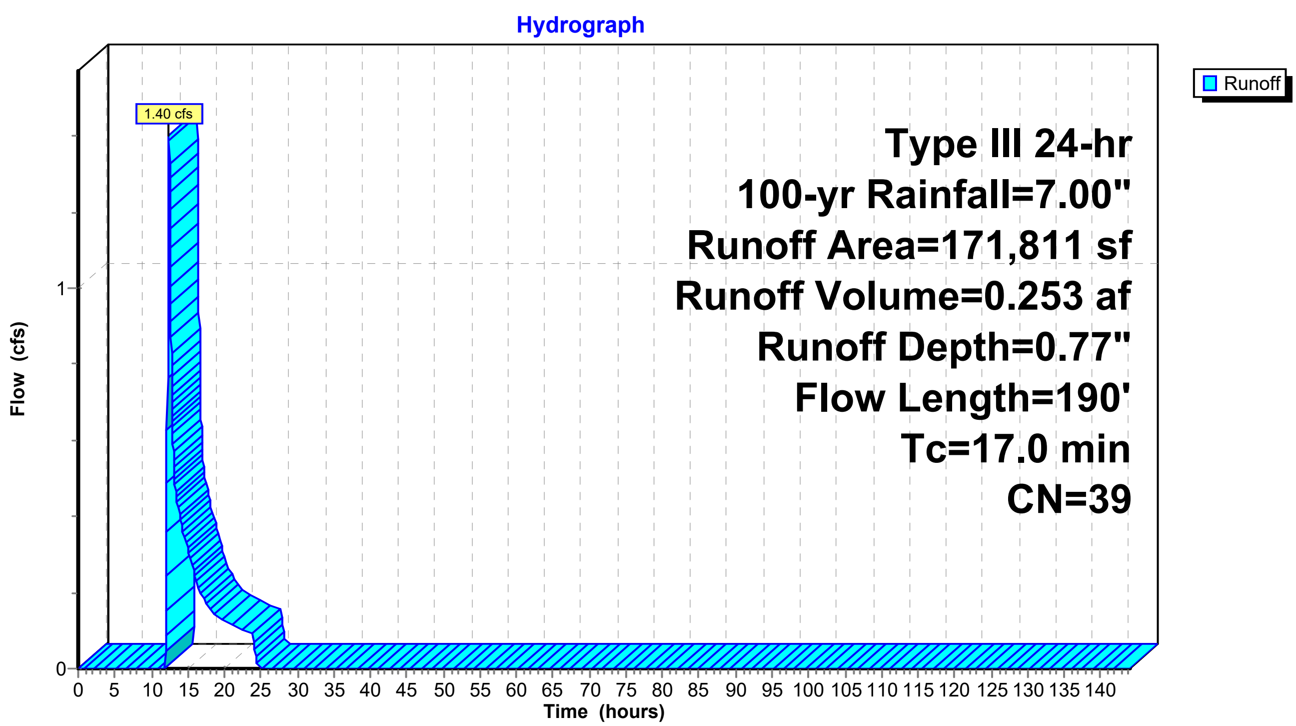
Runoff = 1.40 cfs @ 12.42 hrs, Volume= 0.253 af, Depth= 0.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-yr Rainfall=7.00"

	Area (sf)	CN	Description
	104,548	30	Woods, Good, HSG A
	41,769	39	>75% Grass cover, Good, HSG A
	2,502	76	Gravel roads, HSG A
	21,686	74	>75% Grass cover, Good, HSG C
*	767	98	Decks, HSG C
*	539	98	Decks, HSG A
	171,811	39	Weighted Average
	170,505		99.24% Pervious Area
	1,306		0.76% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.8	50	0.0100	0.05		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.40"
1.2	140	0.0150	1.97		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
17.0	190	Total			

Subcatchment P4: Central Overland



Summary for Subcatchment P4a: Developed Site

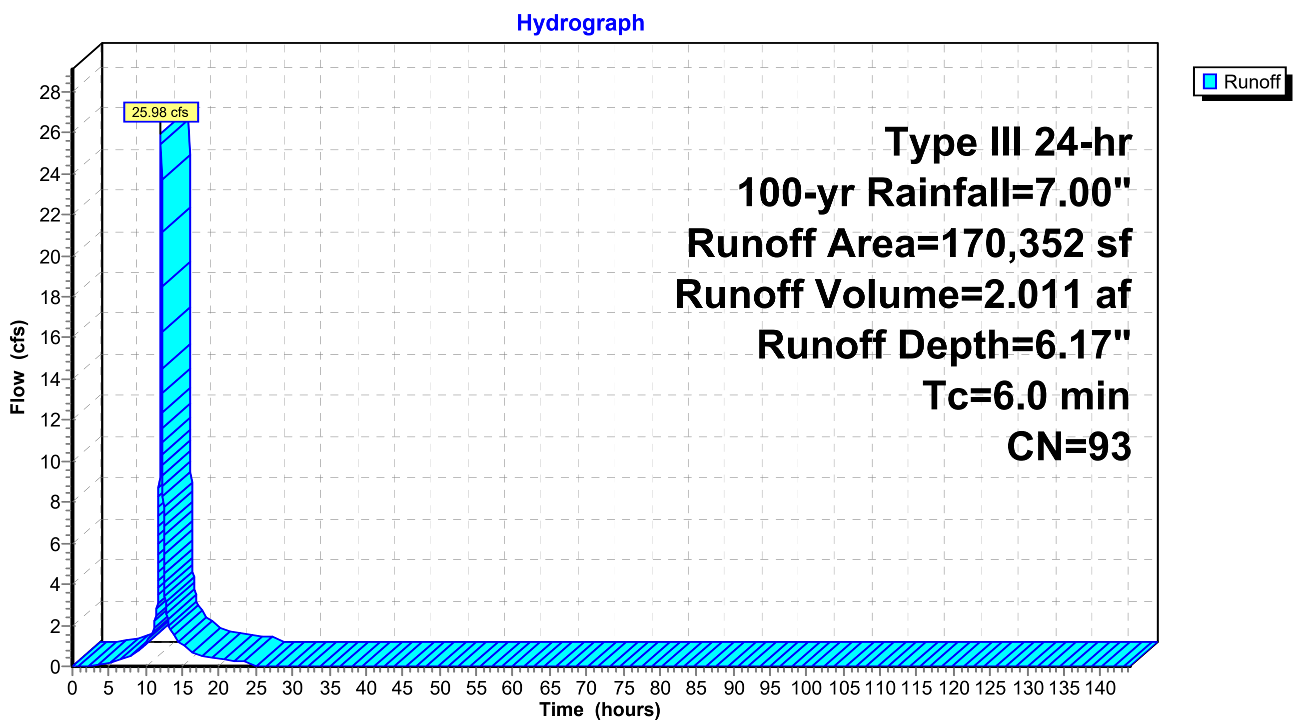
Runoff = 25.98 cfs @ 12.08 hrs, Volume= 2.011 af, Depth= 6.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-yr Rainfall=7.00"

	Area (sf)	CN	Description
	32,445	98	Roofs, HSG A
	36,095	74	>75% Grass cover, Good, HSG C
	64,685	98	Roofs, HSG C
*	35,350	98	Paved parking, HSG C
*	1,777	98	Decks, HSG C
	170,352	93	Weighted Average
	36,095		21.19% Pervious Area
	134,257		78.81% Impervious Area

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

Subcatchment P4a: Developed Site



Summary for Subcatchment P4b: Developed Site

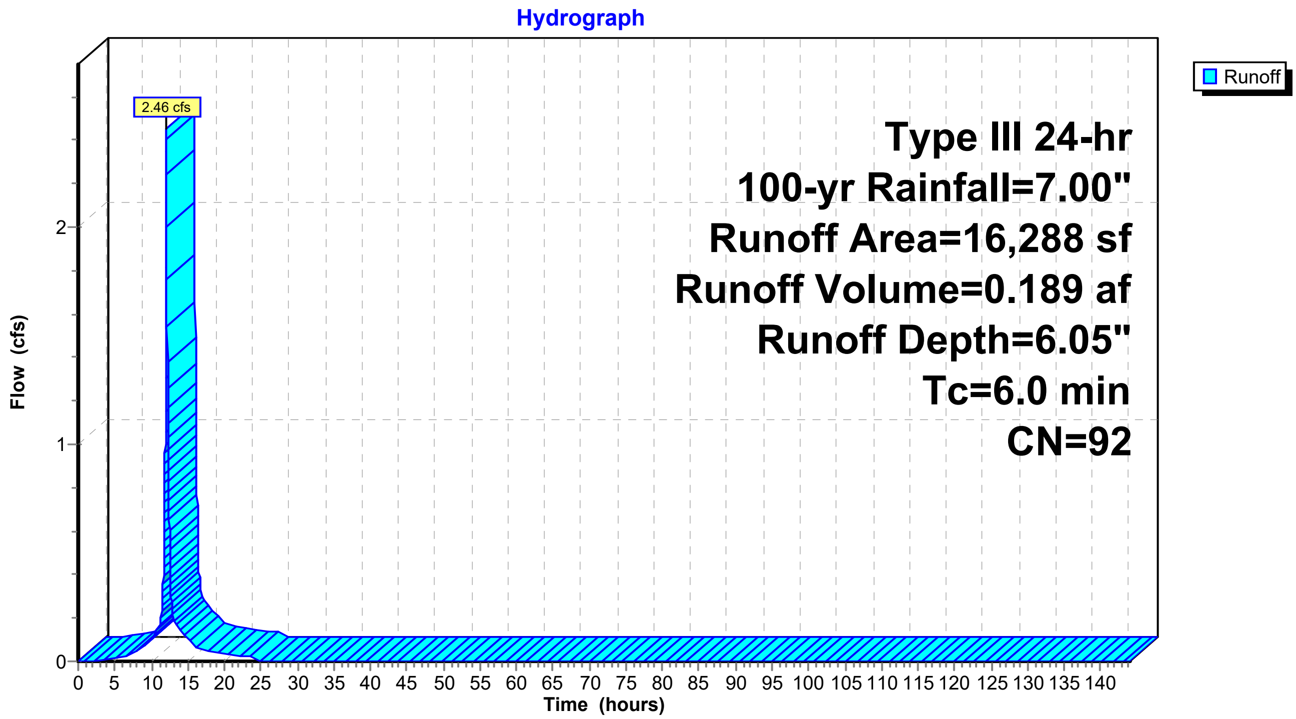
Runoff = 2.46 cfs @ 12.08 hrs, Volume= 0.189 af, Depth= 6.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-yr Rainfall=7.00"

	Area (sf)	CN	Description
	191	98	Roofs, HSG A
	7,608	98	Roofs, HSG C
*	3,536	98	Paved parking, HSG C
	3,501	74	>75% Grass cover, Good, HSG C
	1,452	89	Gravel roads, HSG C
	16,288	92	Weighted Average
	4,953		30.41% Pervious Area
	11,335		69.59% Impervious Area

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

Subcatchment P4b: Developed Site



Summary for Subcatchment P4c: Developed Site

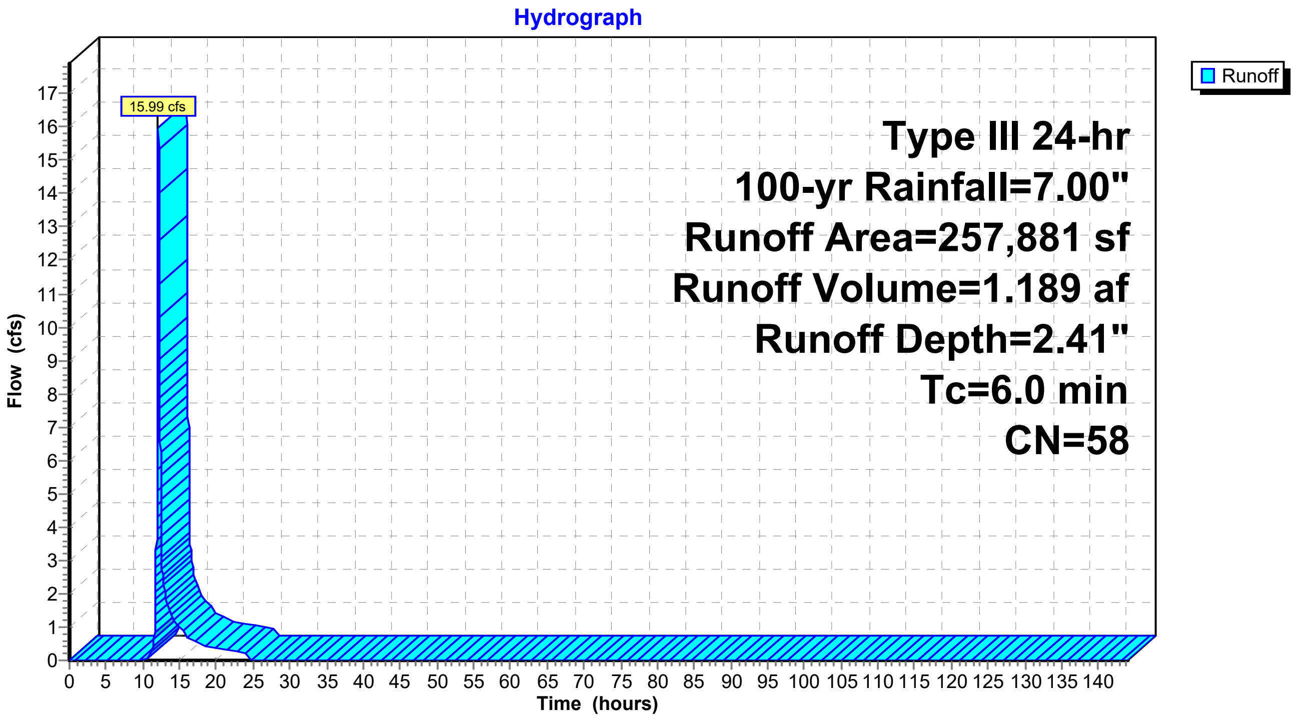
Runoff = 15.99 cfs @ 12.10 hrs, Volume= 1.189 af, Depth= 2.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-yr Rainfall=7.00"

	Area (sf)	CN	Description
	72,562	39	>75% Grass cover, Good, HSG A
	48,621	98	Paved parking, HSG A
*	599	98	Walks, HSG A
*	2,713	98	Decks, HSG A
	10,062	74	>75% Grass cover, Good, HSG C
*	13,564	98	Paved parking, HSG C
*	491	98	Walks, HSG C
*	406	70	Woods, Good, HSG C (OFFSITE)
*	33,887	30	Woods, Good, HSG A (OFFSITE)
*	60,799	39	>75% Grass cover, Good, HSG A (OFFSITE)
*	3,744	98	Pavement, HSG A (OFFSITE)
*	2,312	98	Paved parking, HSG A (OFFSITE)
*	8,121	98	Impervious, HSG A (OFFSITE)
	257,881	58	Weighted Average
	177,716		68.91% Pervious Area
	80,165		31.09% Impervious Area

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

Subcatchment P4c: Developed Site



Summary for Subcatchment P5: Central Overland

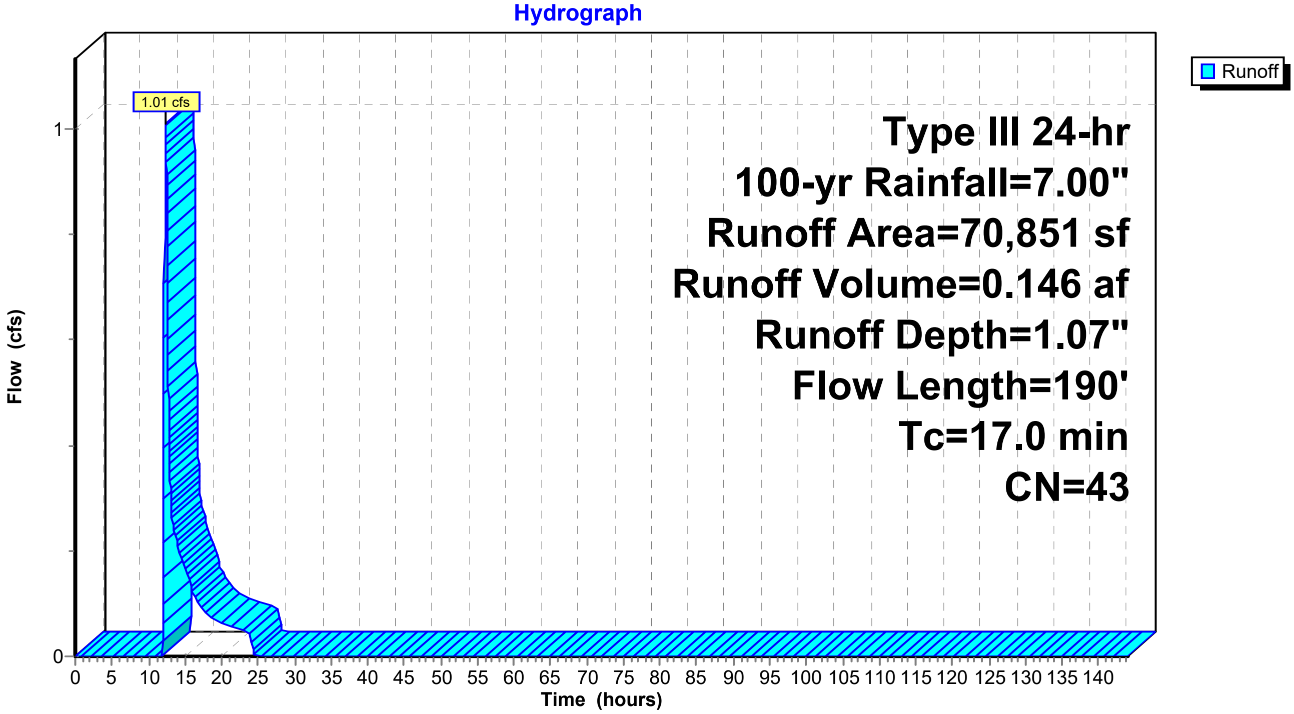
Runoff = 1.01 cfs @ 12.32 hrs, Volume= 0.146 af, Depth= 1.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-yr Rainfall=7.00"

	Area (sf)	CN	Description
	30,577	30	Woods, Good, HSG A
	25,063	39	>75% Grass cover, Good, HSG A
	610	70	Woods, Good, HSG C
	12,737	74	>75% Grass cover, Good, HSG C
*	999	98	Decks, HSG C
*	487	98	Decks, HSG A
*	22	98	Pavement, HSG A (OFFSITE)
*	356	39	>75% Grass cover, Good, HSG A (OFFSITE)
	70,851	43	Weighted Average
	69,343		97.87% Pervious Area
	1,508		2.13% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.8	50	0.0100	0.05		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.40"
1.2	140	0.0150	1.97		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
17.0	190	Total			

Subcatchment P5: Central Overland

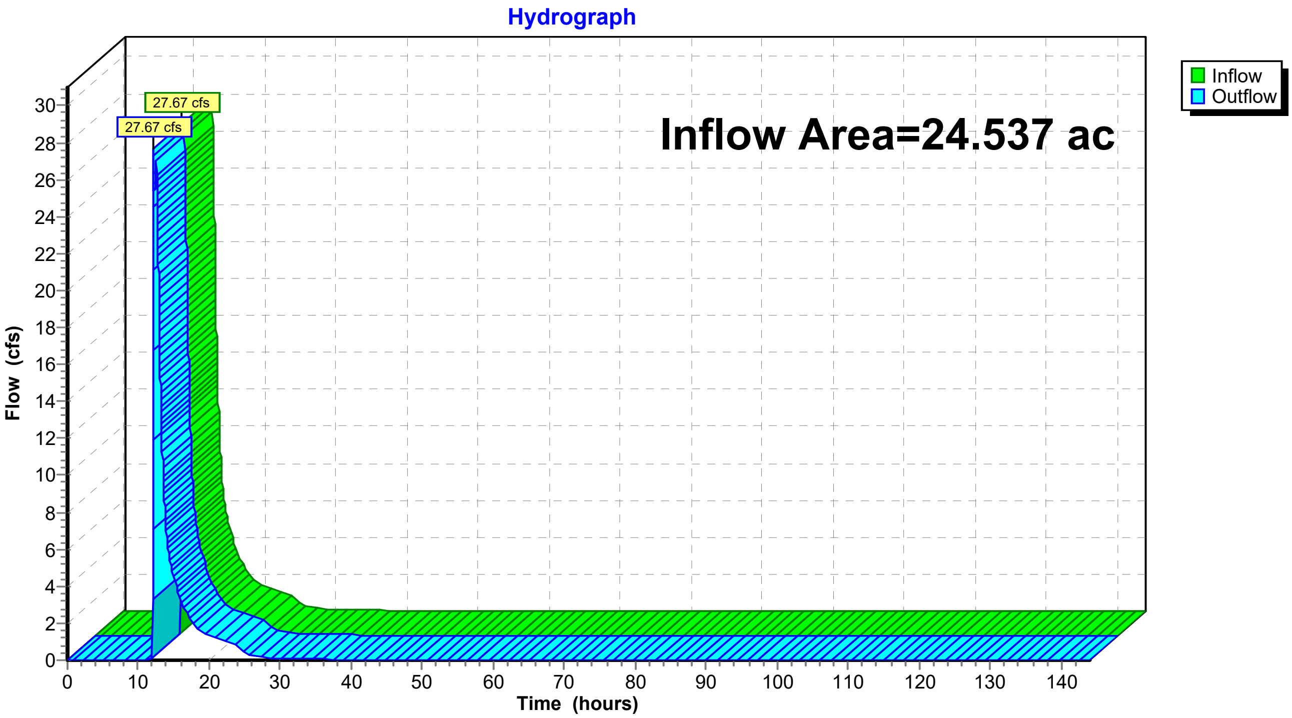


Summary for Reach DP-1: Wetland

Inflow Area = 24.537 ac, 30.85% Impervious, Inflow Depth = 2.33" for 100-yr event
Inflow = 27.67 cfs @ 12.15 hrs, Volume= 4.757 af
Outflow = 27.67 cfs @ 12.15 hrs, Volume= 4.757 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs / 2

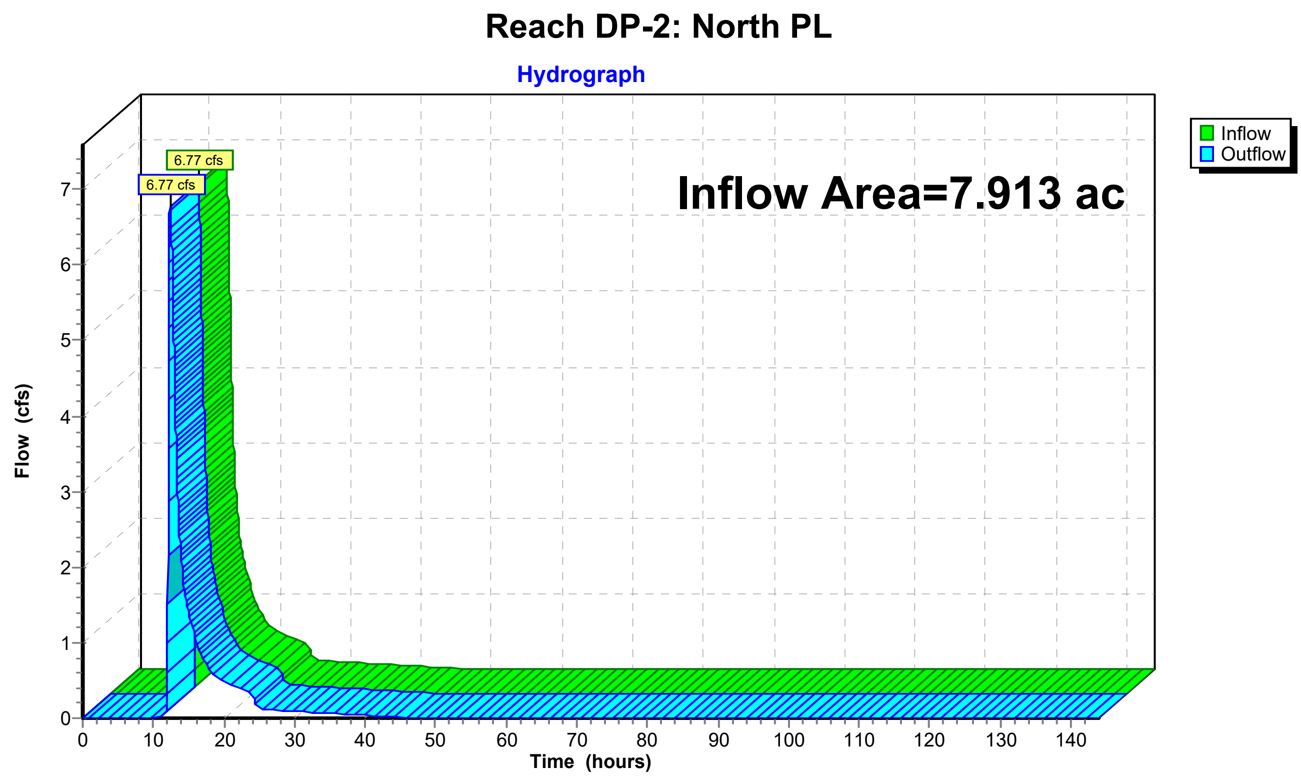
Reach DP-1: Wetland



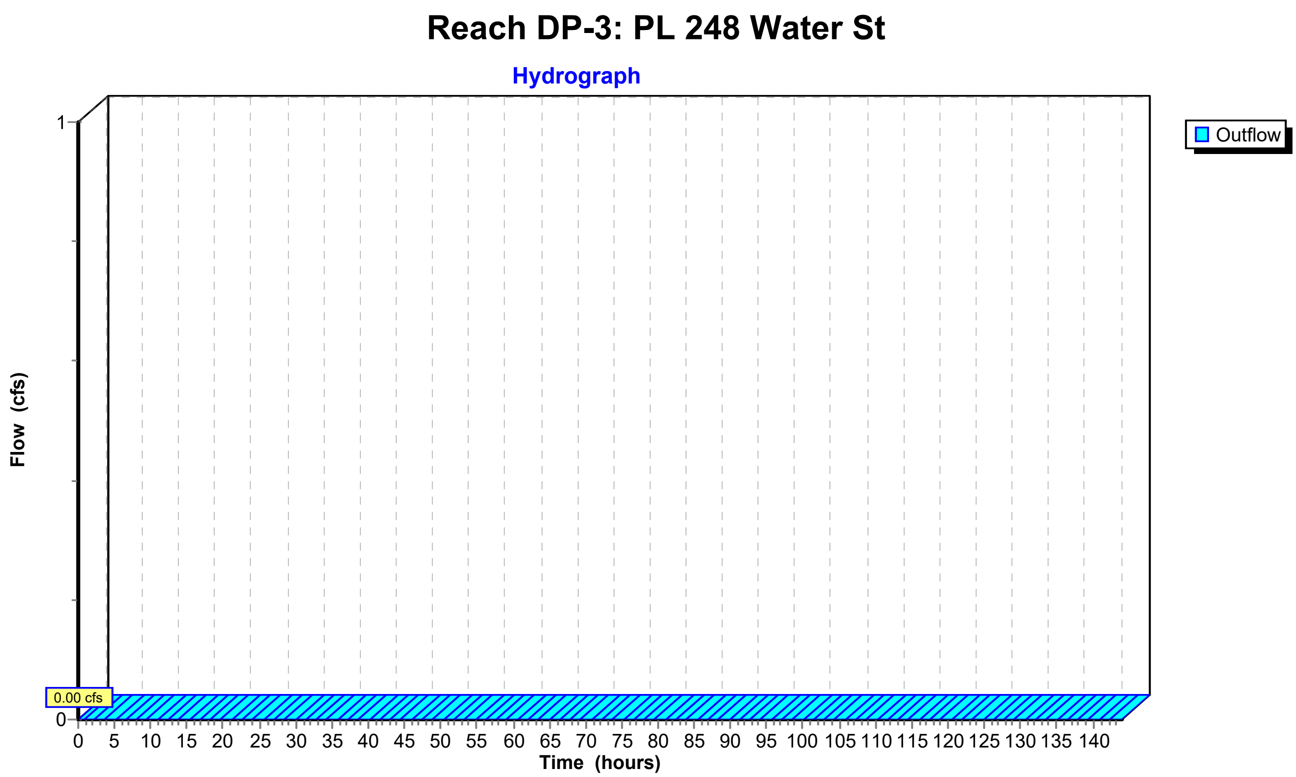
Summary for Reach DP-2: North PL

Inflow Area = 7.913 ac, 23.69% Impervious, Inflow Depth = 2.16" for 100-yr event
Inflow = 6.77 cfs @ 12.41 hrs, Volume= 1.425 af
Outflow = 6.77 cfs @ 12.41 hrs, Volume= 1.425 af, Atten= 0%, Lag= 0.0 min

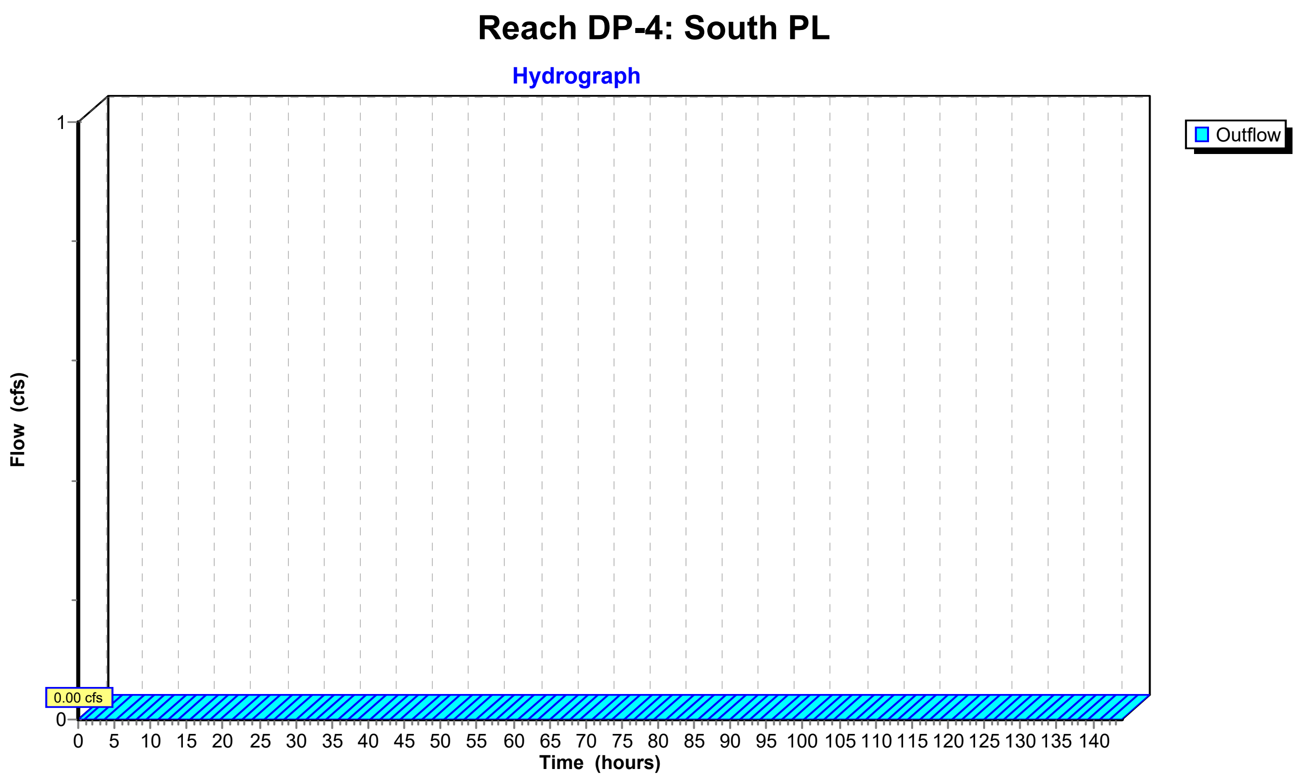
Routing by Dyn-Stor-Ind method, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs / 2



Summary for Reach DP-3: PL 248 Water St



Summary for Reach DP-4: South PL



Summary for Pond 1P: Extended Dry Detention Basin

Inflow Area = 6.287 ac, 29.27% Impervious, Inflow Depth = 2.44" for 100-yr event
Inflow = 17.26 cfs @ 12.10 hrs, Volume= 1.280 af
Outflow = 5.82 cfs @ 12.45 hrs, Volume= 1.280 af, Atten= 66%, Lag= 21.1 min
Primary = 5.82 cfs @ 12.45 hrs, Volume= 1.280 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 18.79' @ 12.45 hrs Surf.Area= 7,305 sf Storage= 16,382 cf

Plug-Flow detention time= 144.8 min calculated for 1.280 af (100% of inflow)
Center-of-Mass det. time= 145.4 min (1,002.8 - 857.4)

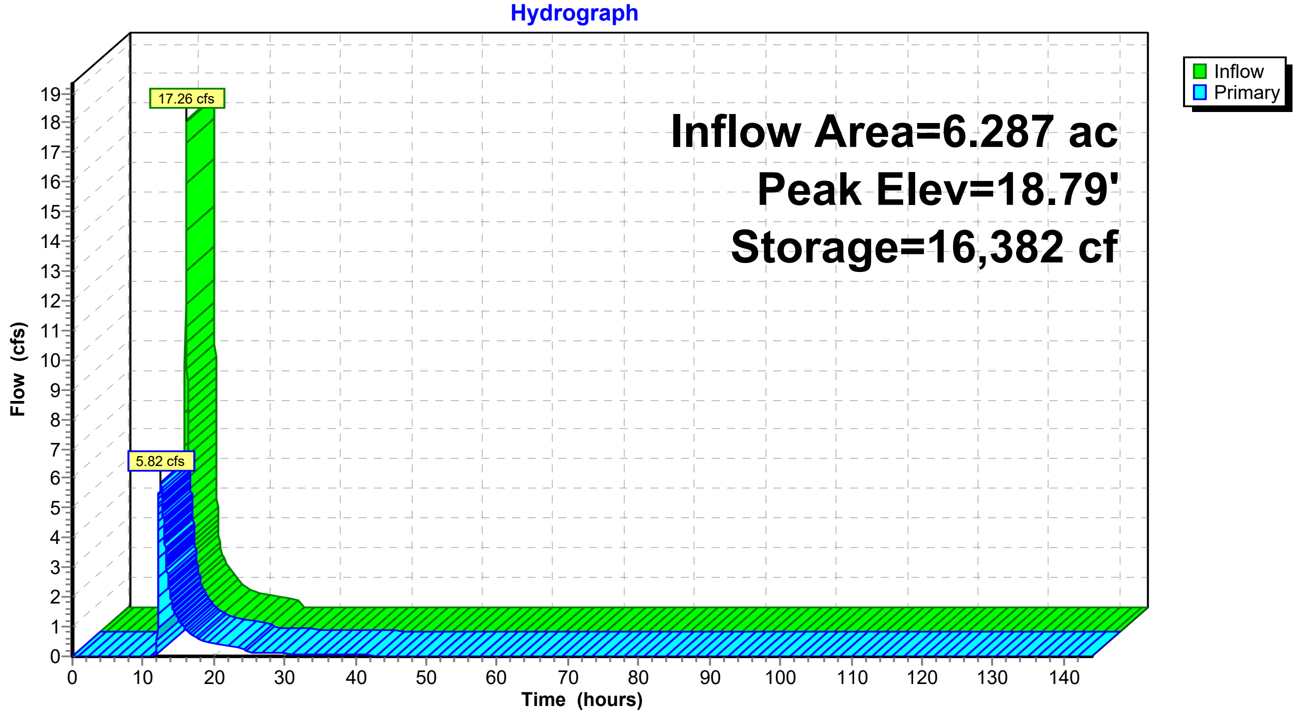
Volume	Invert	Avail.Storage	Storage Description
#1	15.50'	17,959 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
15.50	3,413	0	0
16.00	3,794	1,802	1,802
17.00	4,596	4,195	5,997
18.00	5,456	5,026	11,023
18.10	6,539	600	11,623
19.00	7,541	6,336	17,959

Device	Routing	Invert	Outlet Devices
#1	Primary	15.50'	**15.0" Round Culvert** L= 27.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 15.50' / 15.23' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf
#2	Device 1	15.50'	**2.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	16.75'	**1.0' long x 2.20' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=5.82 cfs @ 12.45 hrs HW=18.79' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 5.82 cfs of 7.61 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.19 cfs @ 8.62 fps)
  └─**3=Sharp-Crested Rectangular Weir** (Weir Controls 5.63 cfs @ 4.67 fps)

Pond 1P: Extended Dry Detention Basin



Summary for Pond 2P: Infiltration Chambers

Inflow Area = 4.285 ac, 78.01% Impervious, Inflow Depth = 6.16" for 100-yr event
Inflow = 28.44 cfs @ 12.08 hrs, Volume= 2.200 af
Outflow = 24.53 cfs @ 12.13 hrs, Volume= 2.200 af, Atten= 14%, Lag= 2.9 min
Discarded = 0.21 cfs @ 6.64 hrs, Volume= 0.869 af
Primary = 24.32 cfs @ 12.13 hrs, Volume= 1.331 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 22.34' @ 12.13 hrs Surf.Area= 8,736 sf Storage= 32,333 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 455.5 min (1,224.6 - 769.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	16.60'	11,916 cf	**66.50'W x 131.37'L x 5.75'H Field A**
			50,231 cf Overall - 20,441 cf Embedded = 29,790 cf x 40.0% Voids
#2A	17.35'	20,441 cf	**Cultec R-902HD** x 315 Inside #1
			Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf
			Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap
			315 Chambers in 9 Rows
			Cap Storage= +2.8 cf x 2 x 9 rows = 49.7 cf
		32,357 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	16.00'	**24.0" Round Culvert**
			L= 26.0' CPP, projecting, no headwall, Ke= 0.900
			Inlet / Outlet Invert= 16.00' / 15.74' S= 0.0100 '/' Cc= 0.900
			n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#2	Device 1	18.40'	**1.5" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	20.75'	**4.0' long x 2.60' rise Sharp-Crested Rectangular Weir**
			2 End Contraction(s)
#4	Discarded	16.60'	**1.020 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.21 cfs @ 6.64 hrs HW=16.67' (Free Discharge)
└─**4=Exfiltration** (Exfiltration Controls 0.21 cfs)

Primary OutFlow Max=24.19 cfs @ 12.13 hrs HW=22.34' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 24.19 cfs of 27.59 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.12 cfs @ 9.48 fps)
  └─**3=Sharp-Crested Rectangular Weir** (Weir Controls 24.08 cfs @ 4.12 fps)

Pond 2P: Infiltration Chambers - Chamber Wizard Field A

Chamber Model = Cultec R-902HD (Cultec Recharger®902HD)
Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf
Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap
Cap Storage= +2.8 cf x 2 x 9 rows = 49.7 cf

78.0" Wide + 9.0" Spacing = 87.0" C-C Row Spacing

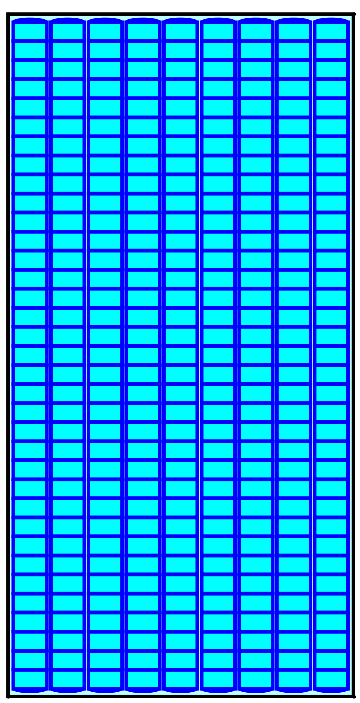
35 Chambers/Row x 3.67' Long +0.52' Cap Length x 2 = 129.37' Row Length +12.0" End Stone x 2 = 131.37' Base Length
9 Rows x 78.0" Wide + 9.0" Spacing x 8 + 12.0" Side Stone x 2 = 66.50' Base Width
9.0" Stone Base + 48.0" Chamber Height + 12.0" Stone Cover = 5.75' Field Height

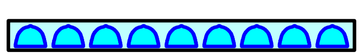
315 Chambers x 64.7 cf + 2.8 cf Cap Volume x 2 x 9 Rows = 20,441.2 cf Chamber Storage

50,231.3 cf Field - 20,441.2 cf Chambers = 29,790.1 cf Stone x 40.0% Voids = 11,916.0 cf Stone Storage

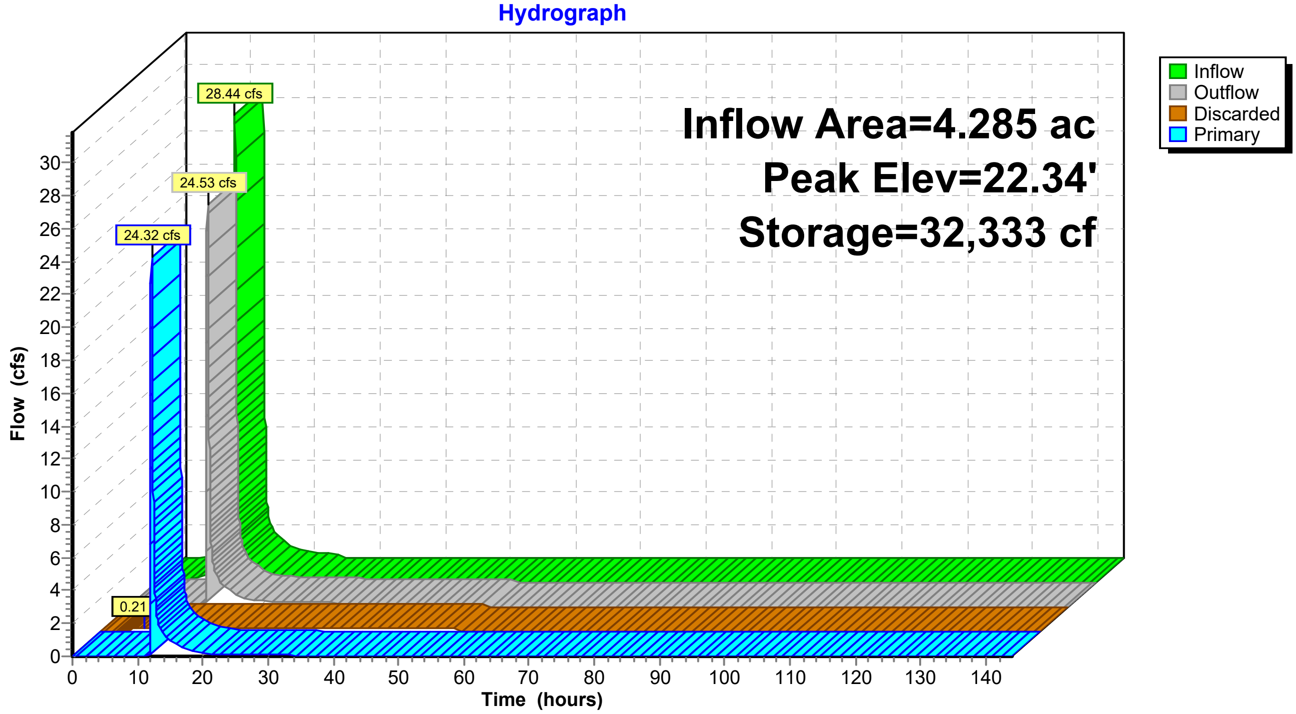
Chamber Storage + Stone Storage = 32,357.3 cf = 0.743 af
Overall Storage Efficiency = 64.4%
Overall System Size = 131.37' x 66.50' x 5.75'

315 Chambers
1,860.4 cy Field
1,103.3 cy Stone





Pond 2P: Infiltration Chambers



Summary for Pond E-P1: Wetland

Inflow Area = 5.973 ac, 62.63% Impervious, Inflow Depth = 4.69" for 100-yr event
Inflow = 18.06 cfs @ 12.43 hrs, Volume= 2.337 af
Outflow = 18.05 cfs @ 12.44 hrs, Volume= 2.169 af, Atten= 0%, Lag= 0.8 min
Primary = 18.05 cfs @ 12.44 hrs, Volume= 2.169 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 18.09' @ 12.44 hrs Surf.Area= 13,697 sf Storage= 8,487 cf

Plug-Flow detention time= 57.5 min calculated for 2.168 af (93% of inflow)
Center-of-Mass det. time= 19.9 min (851.5 - 831.5)

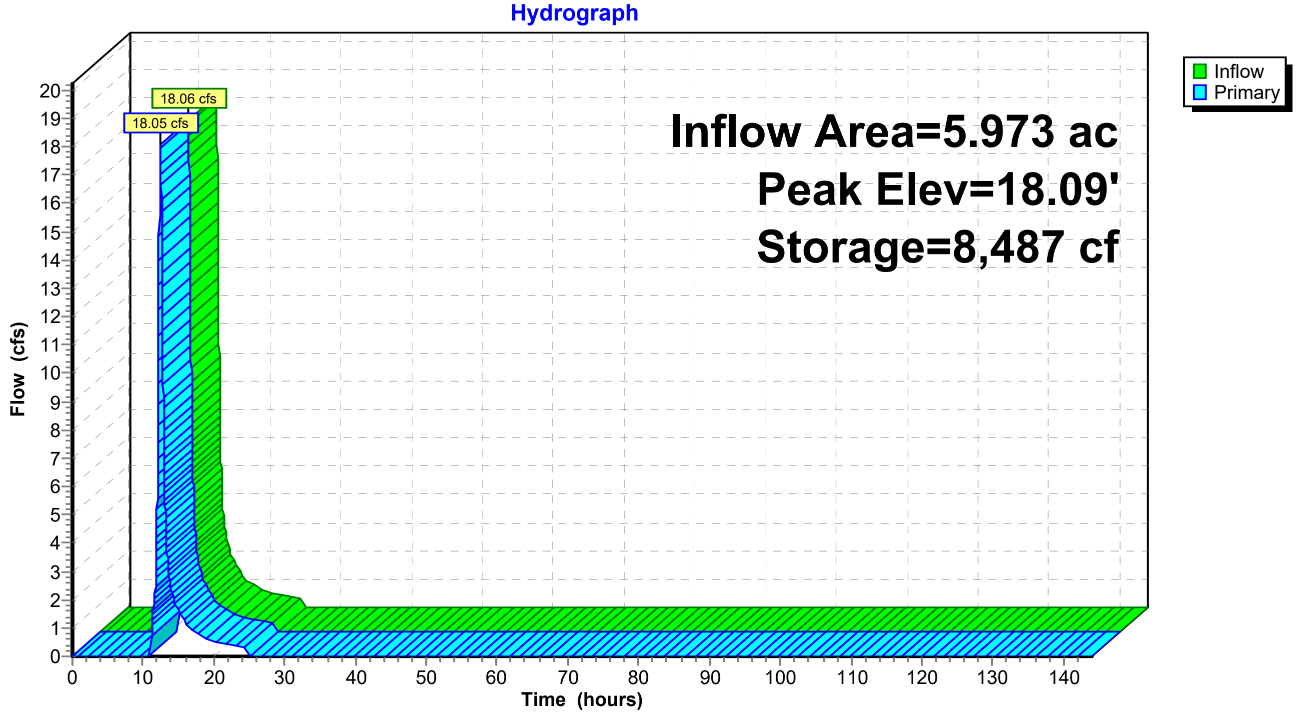
Volume	Invert	Avail.Storage	Storage Description
#1	17.00'	236,253 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
17.00	2,349	0	0
18.00	12,281	7,315	7,315
19.00	27,986	20,134	27,449
20.00	37,607	32,797	60,245
21.00	49,582	43,595	103,840
22.00	66,971	58,277	162,116
23.00	81,302	74,137	236,253

Device	Routing	Invert	Outlet Devices
#1	Primary	18.00'	**Asymmetrical Weir, C= 3.27** Offset (feet) 0.00 10.80 18.43 23.94 57.50 86.92 287.08 357.73 427.57 483.95 528.04 555.94 Elev. (feet) 23.00 22.00 21.00 20.00 19.00 18.00 18.00 19.00 20.00 21.00 22.00 23.00

Primary OutFlow Max=18.05 cfs @ 12.44 hrs HW=18.09' TW=13.62' (Dynamic Tailwater)
└─**1=Asymmetrical Weir** (Weir Controls 18.05 cfs @ 0.96 fps)

Pond E-P1: Wetland



Summary for Pond E-P2: Wetland

Inflow Area = 10.418 ac, 39.24% Impervious, Inflow Depth = 3.78" for 100-yr event
Inflow = 26.16 cfs @ 12.36 hrs, Volume= 3.281 af
Outflow = 19.56 cfs @ 12.62 hrs, Volume= 3.044 af, Atten= 25%, Lag= 15.8 min
Primary = 19.56 cfs @ 12.62 hrs, Volume= 3.044 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 13.70' @ 12.62 hrs Surf.Area= 35,463 sf Storage= 36,316 cf

Plug-Flow detention time= 93.3 min calculated for 3.044 af (93% of inflow)
Center-of-Mass det. time= 57.0 min (908.8 - 851.9)

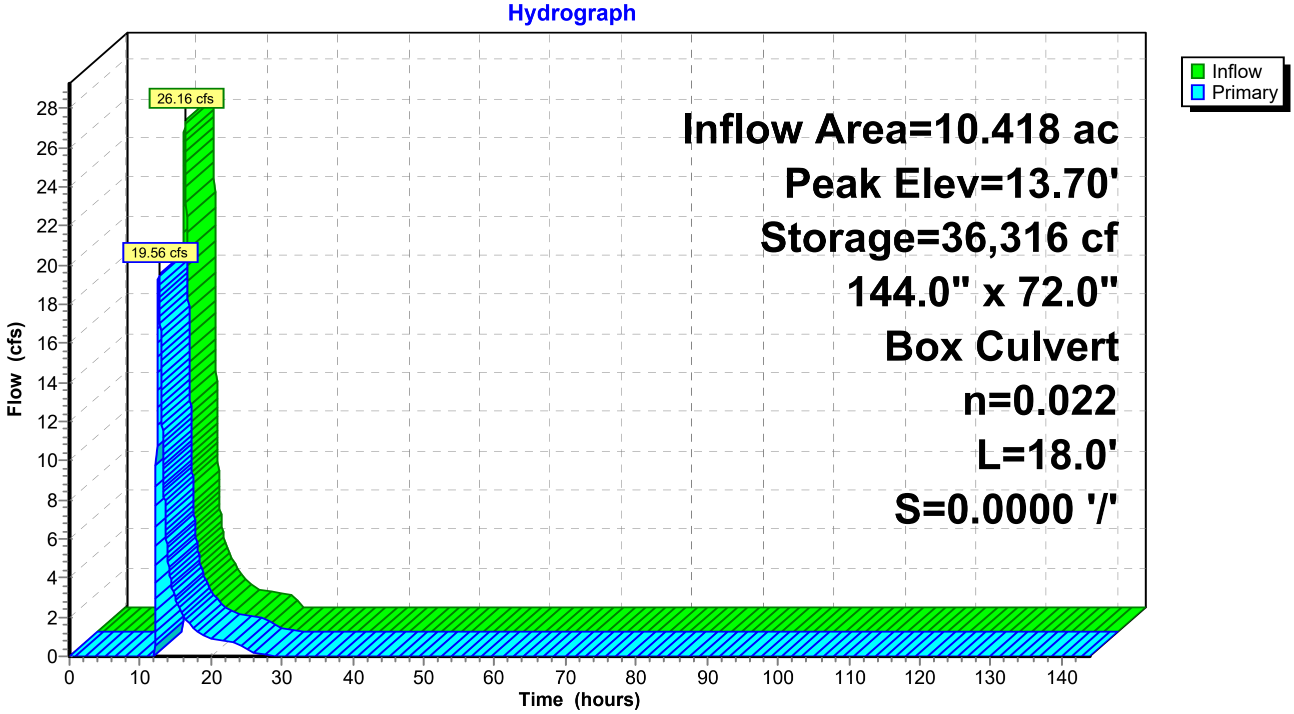
Volume	Invert	Avail.Storage	Storage Description
#1	12.00'	47,617 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
12.00	1,826	0	0
13.00	27,167	14,497	14,497
14.00	39,073	33,120	47,617

Device	Routing	Invert	Outlet Devices
#1	Primary	12.83'	**144.0" W x 72.0" H Box Culvert** L= 18.0' Box, 0° wingwalls, square crown edge, Ke= 0.700 Inlet / Outlet Invert= 12.83' / 12.83' S= 0.0000 '/' Cc= 0.900 n= 0.022 Earth, clean & straight, Flow Area= 72.00 sf

Primary OutFlow Max=19.56 cfs @ 12.62 hrs HW=13.70' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Barrel Controls 19.56 cfs @ 2.51 fps)

Pond E-P2: Wetland



A P P E N D I X C

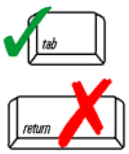
Checklist for Stormwater Report

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands Program

Checklist for Stormwater Report

A. Introduction

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.



A Stormwater Report must be submitted with the Notice of Intent permit application to document compliance with the Stormwater Management Standards. The following checklist is NOT a substitute for the Stormwater Report (which should provide more substantive and detailed information) but is offered here as a tool to help the applicant organize their Stormwater Management documentation for their Report and for the reviewer to assess this information in a consistent format. As noted in the Checklist, the Stormwater Report must contain the engineering computations and supporting information set forth in Volume 3 of the Massachusetts Stormwater Handbook. The Stormwater Report must be prepared and certified by a Registered Professional Engineer (RPE) licensed in the Commonwealth.

The Stormwater Report must include:

- The Stormwater Checklist completed and stamped by a Registered Professional Engineer (see page 2) that certifies that the Stormwater Report contains all required submittals.[1] This Checklist is to be used as the cover for the completed Stormwater Report.
- Applicant/Project Name
- Project Address
- Name of Firm and Registered Professional Engineer that prepared the Report
- Long-Term Pollution Prevention Plan required by Standards 4-6
- Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan required by Standard 8[2]
- Operation and Maintenance Plan required by Standard 9

In addition to all plans and supporting information, the Stormwater Report must include a brief narrative describing stormwater management practices, including environmentally sensitive site design and LID techniques, along with a diagram depicting runoff through the proposed BMP treatment train. Plans are required to show existing and proposed conditions, identify all wetland resource areas, NRCS soil types, critical areas, Land Uses with Higher Potential Pollutant Loads (LUHPPL), and any areas on the site where infiltration rate is greater than 2.4 inches per hour. The Plans shall identify the drainage areas for both existing and proposed conditions at a scale that enables verification of supporting calculations.

As noted in the Checklist, the Stormwater Management Report shall document compliance with each of the Stormwater Management Standards as provided in the Massachusetts Stormwater Handbook. The soils evaluation and calculations shall be done using the methodologies set forth in Volume 3 of the Massachusetts Stormwater Handbook.

To ensure that the Stormwater Report is complete, applicants are required to fill in the Stormwater Report Checklist by checking the box to indicate that the specified information has been included in the Stormwater Report. If any of the information specified in the checklist has not been submitted, the applicant must provide an explanation. The completed Stormwater Report Checklist and Certification must be submitted with the Stormwater Report.

---

[1] The Stormwater Report may also include the Illicit Discharge Compliance Statement required by Standard 10. If not included in the Stormwater Report, the Illicit Discharge Compliance Statement must be submitted prior to the discharge of stormwater runoff to the post-construction best management practices.

[2] For some complex projects, it may not be possible to include the Construction Period Erosion and Sedimentation Control Plan in the Stormwater Report. In that event, the issuing authority has the discretion to issue an Order of Conditions that approves the project and includes a condition requiring the proponent to submit the Construction Period Erosion and Sedimentation Control Plan before commencing any land disturbance activity on the site.

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

The following checklist is intended to serve as a guide for applicants as to the elements that ordinarily need to be addressed in a complete Stormwater Report. The checklist is also intended to provide conservation commissions and other reviewing authorities with a summary of the components necessary for a comprehensive Stormwater Report that addresses the ten Stormwater Standards.

Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the item is not applicable (N.A.) and provide the reasons for that determination.

A complete checklist must include the Certification set forth below signed by the Registered Professional Engineer who prepared the Stormwater Report.

Registered Professional Engineer's Certification

I have reviewed the Stormwater Report, including the soil evaluation, computations, Long-term Pollution Prevention Plan, the Construction Period Erosion and Sedimentation Control Plan (if included), the Long-term Post-Construction Operation and Maintenance Plan, the Illicit Discharge Compliance Statement (if included) and the plans showing the stormwater management system, and have determined that they have been prepared in accordance with the requirements of the Stormwater Management Standards as further elaborated by the Massachusetts Stormwater Handbook. I have also determined that the information presented in the Stormwater Checklist is accurate and that the information presented in the Stormwater Report accurately reflects conditions at the site as of the date of this permit application.

Registered Professional Engineer Block and Signature

COMMONWEALTH OF MASSACHUSETTS
BRADLEY C
McKENZIE
CIVIL
No. 36917
REGISTERED
PROFESSIONAL ENGINEER

6-7-2021

Signature and Date

Checklist

Project Type: Is the application for new development, redevelopment, or a mix of new and redevelopment?

☒ New development

☐ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

LID Measures: Stormwater Standards require LID measures to be considered. Document what environmentally sensitive design and LID Techniques were considered during the planning and design of the project:

☐ No disturbance to any Wetland Resource Areas

☐ Site Design Practices (e.g. clustered development, reduced frontage setbacks)

☐ Reduced Impervious Area (Redevelopment Only)

☐ Minimizing disturbance to existing trees and shrubs

☐ LID Site Design Credit Requested:

- ☐ Credit 1
- ☐ Credit 2
- ☐ Credit 3

☐ Use of "country drainage" versus curb and gutter conveyance and pipe

☐ Bioretention Cells (includes Rain Gardens)

☐ Constructed Stormwater Wetlands (includes Gravel Wetlands designs)

☐ Treebox Filter

☐ Water Quality Swale

☐ Grass Channel

☐ Green Roof

☐ Other (describe): ______________________

Standard 1: No New Untreated Discharges

☒ No new untreated discharges

☒ Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth

☒ Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.

Checklist (continued)

Standard 2: Peak Rate Attenuation

☐ Standard 2 waiver requested because the project is located in land subject to coastal storm flowage and stormwater discharge is to a wetland subject to coastal flooding.

☐ Evaluation provided to determine whether off-site flooding increases during the 100-year 24-hour storm.

☒ Calculations provided to show that post-development peak discharge rates do not exceed pre-development rates for the 2-year and 10-year 24-hour storms. If evaluation shows that off-site flooding increases during the 100-year 24-hour storm, calculations are also provided to show that post-development peak discharge rates do not exceed pre-development rates for the 100-year 24-hour storm.

Standard 3: Recharge

☒ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

☐ Required Recharge volume reduced through use of the LID site Design Credits.

☒ Sizing the infiltration, BMPs is based on the following method: Check the method used.

☒ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

☒ Runoff from all impervious areas at the site discharging to the infiltration BMP.

☐ Runoff from all impervious areas at the site is *not* discharging to the infiltration BMP and calculations are provided showing that the drainage area contributing runoff to the infiltration BMPs is sufficient to generate the required recharge volume.

☒ Recharge BMPs have been sized to infiltrate the Required Recharge Volume.

☐ Recharge BMPs have been sized to infiltrate the Required Recharge Volume *only* to the maximum extent practicable for the following reason:

- ☐ Site is comprised solely of C and D soils and/or bedrock at the land surface
- ☐ M.G.L. c. 21E sites pursuant to 310 CMR 40.0000
- ☐ Solid Waste Landfill pursuant to 310 CMR 19.000
- ☐ Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.

☒ Calculations showing that the infiltration BMPs will drain in 72 hours are provided.

☐ Property includes a M.G.L. c. 21E site or a solid waste landfill and a mounding analysis is included.

[1] 80% TSS removal is required prior to discharge to infiltration BMP if Dynamic Field method is used.

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

☐ The infiltration BMP is used to attenuate peak flows during storms greater than or equal to the 10-year 24-hour storm and separation to seasonal high groundwater is less than 4 feet and a mounding analysis is provided.

☐ Documentation is provided showing that infiltration BMPs do not adversely impact nearby wetland resource areas.

Standard 4: Water Quality

The Long-Term Pollution Prevention Plan typically includes the following:
- Good housekeeping practices;
- Provisions for storing materials and waste products inside or under cover;
- Vehicle washing controls;
- Requirements for routine inspections and maintenance of stormwater BMPs;
- Spill prevention and response plans;
- Provisions for maintenance of lawns, gardens, and other landscaped areas;
- Requirements for storage and use of fertilizers, herbicides, and pesticides;
- Pet waste management provisions;
- Provisions for operation and management of septic systems;
- Provisions for solid waste management;
- Snow disposal and plowing plans relative to Wetland Resource Areas;
- Winter Road Salt and/or Sand Use and Storage restrictions;
- Street sweeping schedules;
- Provisions for prevention of illicit discharges to the stormwater management system;
- Documentation that Stormwater BMPs are designed to provide for shutdown and containment in the event of a spill or discharges to or near critical areas or from LUHPPL;
- Training for staff or personnel involved with implementing Long-Term Pollution Prevention Plan;
- List of Emergency contacts for implementing Long-Term Pollution Prevention Plan.

☒ A Long-Term Pollution Prevention Plan is attached to Stormwater Report and is included as an attachment to the Wetlands Notice of Intent.

☐ Treatment BMPs subject to the 44% TSS removal pretreatment requirement and the one inch rule for calculating the water quality volume are included, and discharge:

- ☐ is within the Zone II or Interim Wellhead Protection Area
- ☐ is near or to other critical areas
- ☒ is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)
- ☐ involves runoff from land uses with higher potential pollutant loads.

☐ The Required Water Quality Volume is reduced through use of the LID site Design Credits.

☒ Calculations documenting that the treatment train meets the 80% TSS removal requirement and, if applicable, the 44% TSS removal pretreatment requirement, are provided.

Checklist (continued)

Standard 4: Water Quality (continued)

☒ The BMP is sized (and calculations provided) based on:

- ☒ The ½" or 1" Water Quality Volume or
- ☐ The equivalent flow rate associated with the Water Quality Volume and documentation is provided showing that the BMP treats the required water quality volume.

☐ The applicant proposes to use proprietary BMPs, and documentation supporting use of proprietary BMP and proposed TSS removal rate is provided. This documentation may be in the form of the propriety BMP checklist found in Volume 2, Chapter 4 of the Massachusetts Stormwater Handbook and submitting copies of the TARP Report, STEP Report, and/or other third party studies verifying performance of the proprietary BMPs.

☐ A TMDL exists that indicates a need to reduce pollutants other than TSS and documentation showing that the BMPs selected are consistent with the TMDL is provided.

Standard 5: Land Uses With Higher Potential Pollutant Loads (LUHPPLs)

☐ The NPDES Multi-Sector General Permit covers the land use and the Stormwater Pollution Prevention Plan (SWPPP) has been included with the Stormwater Report.

☐ The NPDES Multi-Sector General Permit covers the land use and the SWPPP will be submitted ***prior to*** the discharge of stormwater to the post-construction stormwater BMPs.

☐ The NPDES Multi-Sector General Permit does ***not*** cover the land use.

☐ LUHPPLs are located at the site and industry specific source control and pollution prevention measures have been proposed to reduce or eliminate the exposure of LUHPPLs to rain, snow, snow melt and runoff, and been included in the long term Pollution Prevention Plan.

☐ All exposure has been eliminated.

☐ All exposure has ***not*** been eliminated and all BMPs selected are on MassDEP LUHPPL list.

☐ The LUHPPL has the potential to generate runoff with moderate to higher concentrations of oil and grease (e.g. all parking lots with >1000 vehicle trips per day) and the treatment train includes an oil grit separator, a filtering bioretention area, a sand filter or equivalent.

Standard 6: Critical Areas

☐ The discharge is near or to a critical area and the treatment train includes only BMPs that MassDEP has approved for stormwater discharges to or near that particular class of critical area.

☐ Critical areas and BMPs are identified in the Stormwater Report.

Checklist (continued)

Standard 7: Redevelopments and Other Projects Subject to the Standards only to the maximum extent practicable

☐ The project is subject to the Stormwater Management Standards only to the maximum Extent Practicable as a:

- ☐ Limited Project
- ☐ Small Residential Projects: 5-9 single family houses or 5-9 units in a multi-family development provided there is no discharge that may potentially affect a critical area.
- ☐ Small Residential Projects: 2-4 single family houses or 2-4 units in a multi-family development with a discharge to a critical area
- ☐ Marina and/or boatyard provided the hull painting, service and maintenance areas are protected from exposure to rain, snow, snow melt and runoff
- ☐ Bike Path and/or Foot Path
- ☐ Redevelopment Project
- ☐ Redevelopment portion of mix of new and redevelopment.

☐ Certain standards are not fully met (Standard No. 1, 8, 9, and 10 must always be fully met) and an explanation of why these standards are not met is contained in the Stormwater Report.

☐ The project involves redevelopment and a description of all measures that have been taken to improve existing conditions is provided in the Stormwater Report. The redevelopment checklist found in Volume 2 Chapter 3 of the Massachusetts Stormwater Handbook may be used to document that the proposed stormwater management system (a) complies with Standards 2, 3 and the pretreatment and structural BMP requirements of Standards 4-6 to the maximum extent practicable and (b) improves existing conditions.

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control

A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan must include the following information:

- Narrative;
- Construction Period Operation and Maintenance Plan;
- Names of Persons or Entity Responsible for Plan Compliance;
- Construction Period Pollution Prevention Measures;
- Erosion and Sedimentation Control Plan Drawings;
- Detail drawings and specifications for erosion control BMPs, including sizing calculations;
- Vegetation Planning;
- Site Development Plan;
- Construction Sequencing Plan;
- Sequencing of Erosion and Sedimentation Controls;
- Operation and Maintenance of Erosion and Sedimentation Controls;
- Inspection Schedule;
- Maintenance Schedule;
- Inspection and Maintenance Log Form.

☒ A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan containing the information set forth above has been included in the Stormwater Report.

Checklist (continued)

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control (continued)

☐ The project is highly complex and information is included in the Stormwater Report that explains why it is not possible to submit the Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan with the application. A Construction Period Pollution Prevention and Erosion and Sedimentation Control has ***not*** been included in the Stormwater Report but will be submitted ***before*** land disturbance begins.

☐ The project is ***not*** covered by a NPDES Construction General Permit.

☐ The project is covered by a NPDES Construction General Permit and a copy of the SWPPP is in the Stormwater Report.

☒ The project is covered by a NPDES Construction General Permit but no SWPPP been submitted. The SWPPP will be submitted BEFORE land disturbance begins.

Standard 9: Operation and Maintenance Plan

☒ The Post Construction Operation and Maintenance Plan is included in the Stormwater Report and includes the following information:

- ☒ Name of the stormwater management system owners;
- ☒ Party responsible for operation and maintenance;
- ☒ Schedule for implementation of routine and non-routine maintenance tasks;
- ☐ Plan showing the location of all stormwater BMPs maintenance access areas;
- ☐ Description and delineation of public safety features;
- ☐ Estimated operation and maintenance budget; and
- ☒ Operation and Maintenance Log Form.

☐ The responsible party is ***not*** the owner of the parcel where the BMP is located and the Stormwater Report includes the following submissions:

- ☐ A copy of the legal instrument (deed, homeowner's association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of the project site stormwater BMPs;
- ☐ A plan and easement deed that allows site access for the legal entity to operate and maintain BMP functions.

Standard 10: Prohibition of Illicit Discharges

☒ The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;

☒ An Illicit Discharge Compliance Statement is attached;

☐ NO Illicit Discharge Compliance Statement is attached but will be submitted ***prior to*** the discharge of any stormwater to post-construction BMPs.

A P P E N D I X D

Illicit Discharge Compliance Statement
Supplemental BMP Calculations

Illicit Discharge Compliance Statement

I, Bradley C. Mckenzie, P.E., hereby notify the Pembroke Conservation Commission that I have not witnessed, nor am aware of any existing illicit discharges at the site known as Assessor's Map E-17, Lot 0 & E-17A, Lot 274 Water Street in Pembroke, Massachusetts. I also hereby certify that the development of said property as illustrated on the final plans entitled "River Marsh Village Comprehensive Permit Plan (Assessor's Map E-17, Lot 0 & E-17A, Lot 274) Water Street, Pembroke, Mass," prepared by McKenzie Engineering Group. Inc. dated September 22, 2016 and as revised and approved by the Pembroke Conservation Commission and maintenance thereof in accordance with the "Construction Phase Operations and Maintenance Plan" and "Long-Term Operations and Maintenance Plan" prepared by McKenzie Engineering Group, Inc. dated April 5, 2021 and as revised and approved by the Pembroke Conservation Commission will not create any new illicit discharges. There is no warranty implied regarding future illicit discharges that may occur as a result of improper construction or maintenance of the stormwater management system or unforeseen accidents.

Name: Bradley Mckenzie, P.E.

Company: McKenzie Engineering Group, Inc.

Title: President

Signature:

Date: 6-7-2021

MCKENZIE ENGINEERING GROUP

Assinippi Office Park
150 Longwater Drive, Suite 101
Norwell, MA 02061

RIVER MARSH VILLAGE
PEMBROKE, MA

4/5/2021
REVISED 6/7/21

STANDARD 1 - OUTLET PTOTECTION

Outlet From P-1 TO DP-2

Outlet Pipe (inches) = 12
Q50 (cfs) = 4.42

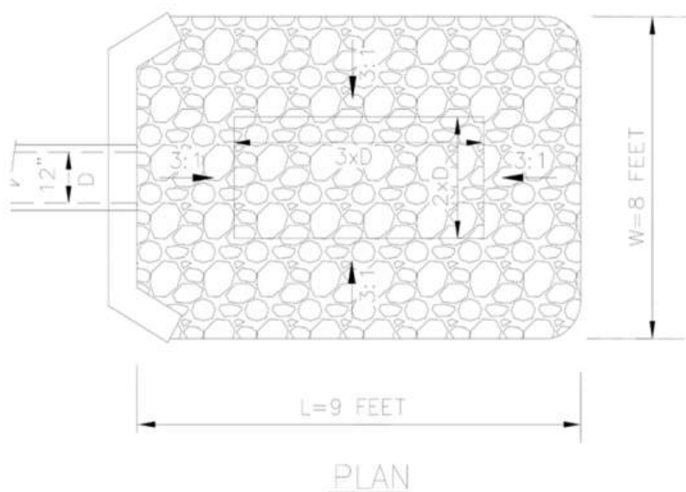
TW = 0 (Assume 0.2') 0.2

Y = Depth of Trap = 1/2 Pipe Size (Min.) = 6" - use 12" (1')

d50 = 0.0125 (Q)^4/3 / TW * Do

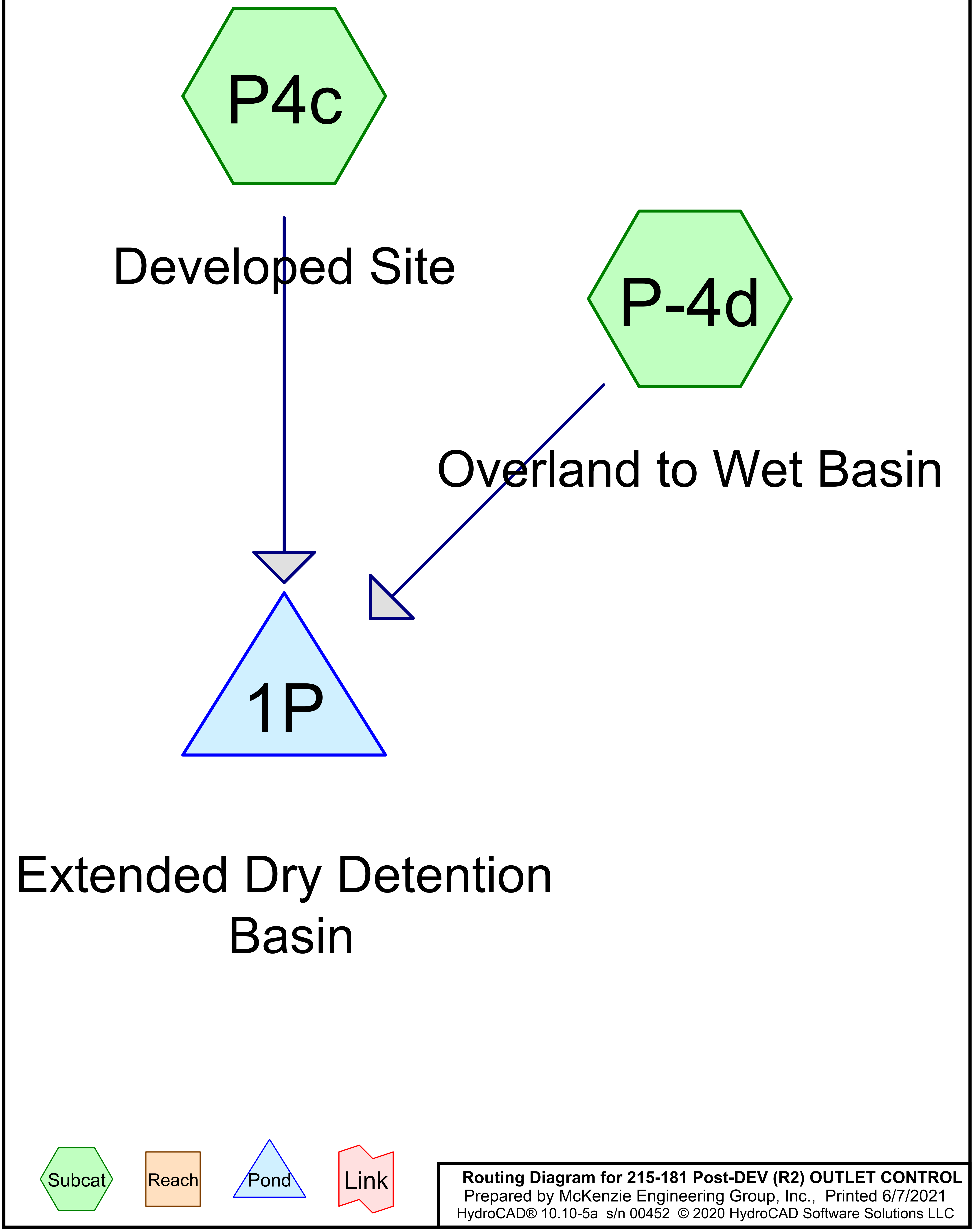
d50 (feet)= 0.453359837 Use Minimum 8" diamater stone

Trap Size



W= 3+2+3 = 8 Feet

L=3+3+3 = 9 Feet



Routing Diagram for 215-181 Post-DEV (R2) OUTLET CONTROL
Prepared by McKenzie Engineering Group, Inc., Printed 6/7/2021

Project Notes

Rainfall events imported from "TP-40-Rain.txt" for 447 MA Plymouth

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
1.770	39	>75% Grass cover, Good, HSG A (P-4d, P4c)
1.396	39	>75% Grass cover, Good, HSG A (OFFSITE) (P4c)
0.493	74	>75% Grass cover, Good, HSG C (P-4d, P4c)
0.062	98	Decks, HSG A (P4c)
0.186	98	Impervious, HSG A (OFFSITE) (P4c)
1.116	98	Paved parking, HSG A (P4c)
0.053	98	Paved parking, HSG A (OFFSITE) (P4c)
0.311	98	Paved parking, HSG C (P4c)
0.086	98	Pavement, HSG A (OFFSITE) (P4c)
0.014	98	Walks, HSG A (P4c)
0.011	98	Walks, HSG C (P4c)
0.778	30	Woods, Good, HSG A (OFFSITE) (P4c)
0.009	70	Woods, Good, HSG C (OFFSITE) (P4c)
6.287	**58**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
5.462	HSG A	P-4d, P4c
0.000	HSG B	
0.825	HSG C	P-4d, P4c
0.000	HSG D	
0.000	Other	
6.287		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
3.166	0.000	0.493	0.000	0.000	3.659	>75% Grass cover, Good	P-4d, P4c
0.062	0.000	0.000	0.000	0.000	0.062	Decks	P4c
0.186	0.000	0.000	0.000	0.000	0.186	Impervious	P4c
1.169	0.000	0.311	0.000	0.000	1.481	Paved parking	P4c
0.086	0.000	0.000	0.000	0.000	0.086	Pavement	P4c
0.014	0.000	0.011	0.000	0.000	0.025	Walks	P4c
0.778	0.000	0.009	0.000	0.000	0.787	Woods, Good	P4c
5.462	**0.000**	**0.825**	**0.000**	**0.000**	**6.287**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)
1	1P	15.50	15.23	27.0	0.0100	0.013	0.0	15.0	0.0

Time span=0.00-144.00 hrs, dt=0.02 hrs, 7201 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

SubcatchmentP-4d: Overland to Wet Basin Runoff Area=15,966 sf 0.00% Impervious Runoff Depth=2.41"
Tc=6.0 min CN=64 Runoff=1.01 cfs 0.074 af

SubcatchmentP4c: Developed Site Runoff Area=257,881 sf 31.09% Impervious Runoff Depth=1.88"
Tc=6.0 min CN=58 Runoff=12.18 cfs 0.929 af

Pond 1P: Extended Dry Detention Basin Peak Elev=18.27' Storage=12,721 cf Inflow=13.19 cfs 1.002 af
Outflow=4.42 cfs 1.002 af

Total Runoff Area = 6.287 ac Runoff Volume = 1.002 af Average Runoff Depth = 1.91"
70.73% Pervious = 4.446 ac 29.27% Impervious = 1.840 ac

Summary for Subcatchment P-4d: Overland to Wet Basin

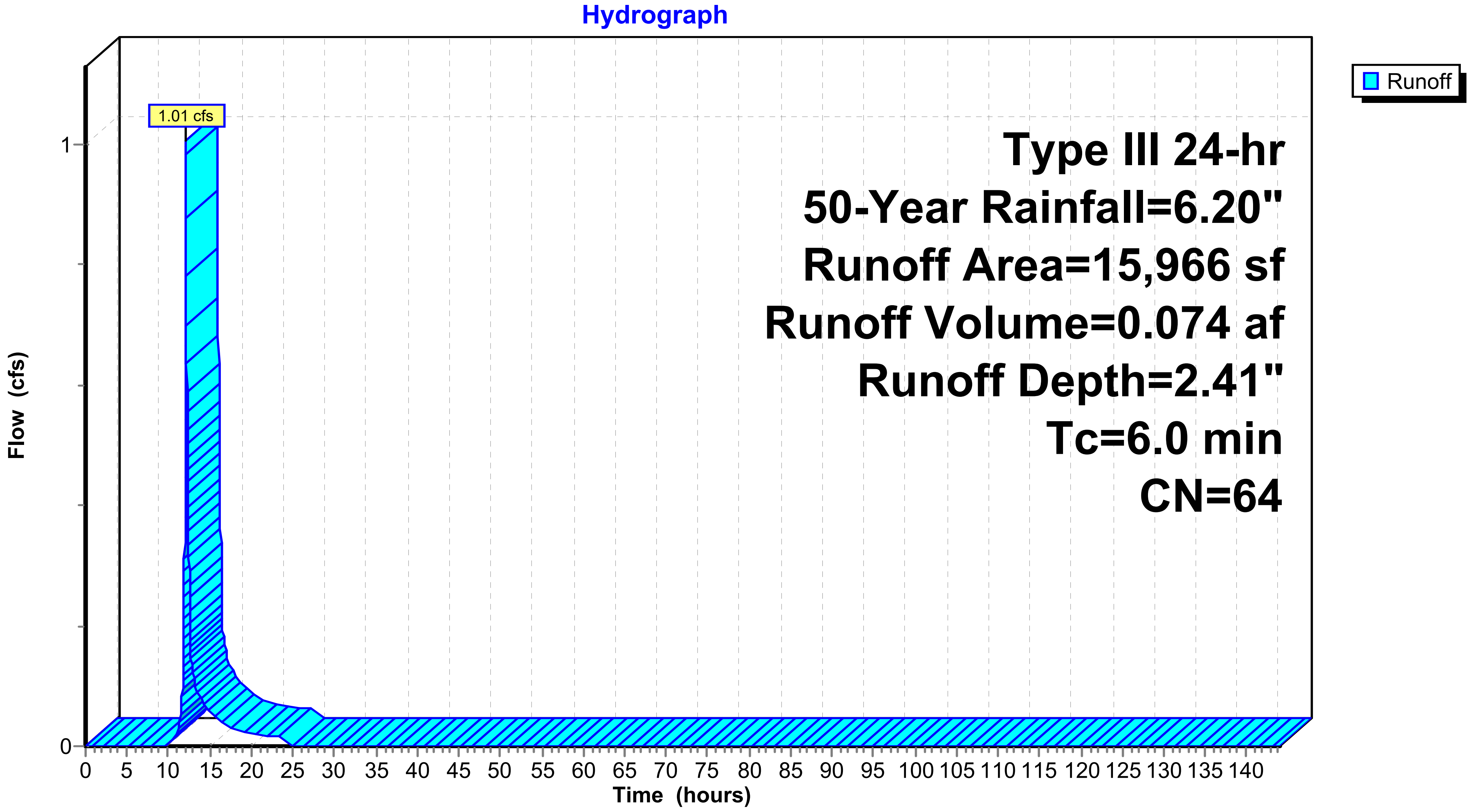
Runoff = 1.01 cfs @ 12.09 hrs, Volume= 0.074 af, Depth= 2.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs
Type III 24-hr 50-Year Rainfall=6.20"

Area (sf)	CN	Description
4,551	39	>75% Grass cover, Good, HSG A
11,415	74	>75% Grass cover, Good, HSG C
15,966	64	Weighted Average
15,966		100.00% Pervious Area

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

Subcatchment P-4d: Overland to Wet Basin



Summary for Subcatchment P4c: Developed Site

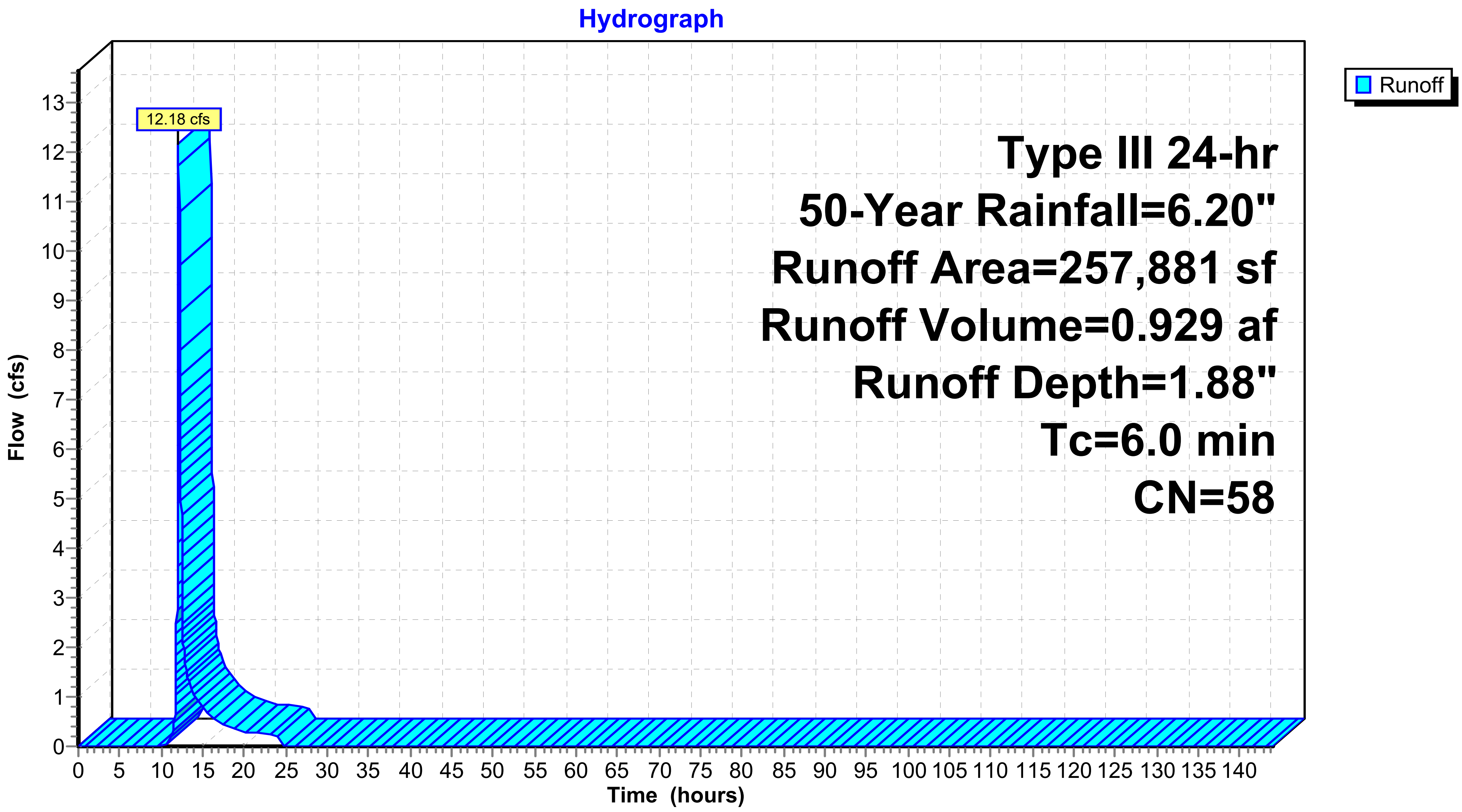
Runoff = 12.18 cfs @ 12.10 hrs, Volume= 0.929 af, Depth= 1.88"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs
Type III 24-hr 50-Year Rainfall=6.20"

	Area (sf)	CN	Description
	72,562	39	>75% Grass cover, Good, HSG A
	48,621	98	Paved parking, HSG A
*	599	98	Walks, HSG A
*	2,713	98	Decks, HSG A
	10,062	74	>75% Grass cover, Good, HSG C
*	13,564	98	Paved parking, HSG C
*	491	98	Walks, HSG C
*	406	70	Woods, Good, HSG C (OFFSITE)
*	33,887	30	Woods, Good, HSG A (OFFSITE)
*	60,799	39	>75% Grass cover, Good, HSG A (OFFSITE)
*	3,744	98	Pavement, HSG A (OFFSITE)
*	2,312	98	Paved parking, HSG A (OFFSITE)
*	8,121	98	Impervious, HSG A (OFFSITE)
	257,881	58	Weighted Average
	177,716		68.91% Pervious Area
	80,165		31.09% Impervious Area

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

Subcatchment P4c: Developed Site



Summary for Pond 1P: Extended Dry Detention Basin

Inflow Area = 6.287 ac, 29.27% Impervious, Inflow Depth = 1.91" for 50-Year event
Inflow = 13.19 cfs @ 12.10 hrs, Volume= 1.002 af
Outflow = 4.42 cfs @ 12.46 hrs, Volume= 1.002 af, Atten= 66%, Lag= 21.9 min
Primary = 4.42 cfs @ 12.46 hrs, Volume= 1.002 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 18.27' @ 12.46 hrs Surf.Area= 6,723 sf Storage= 12,721 cf

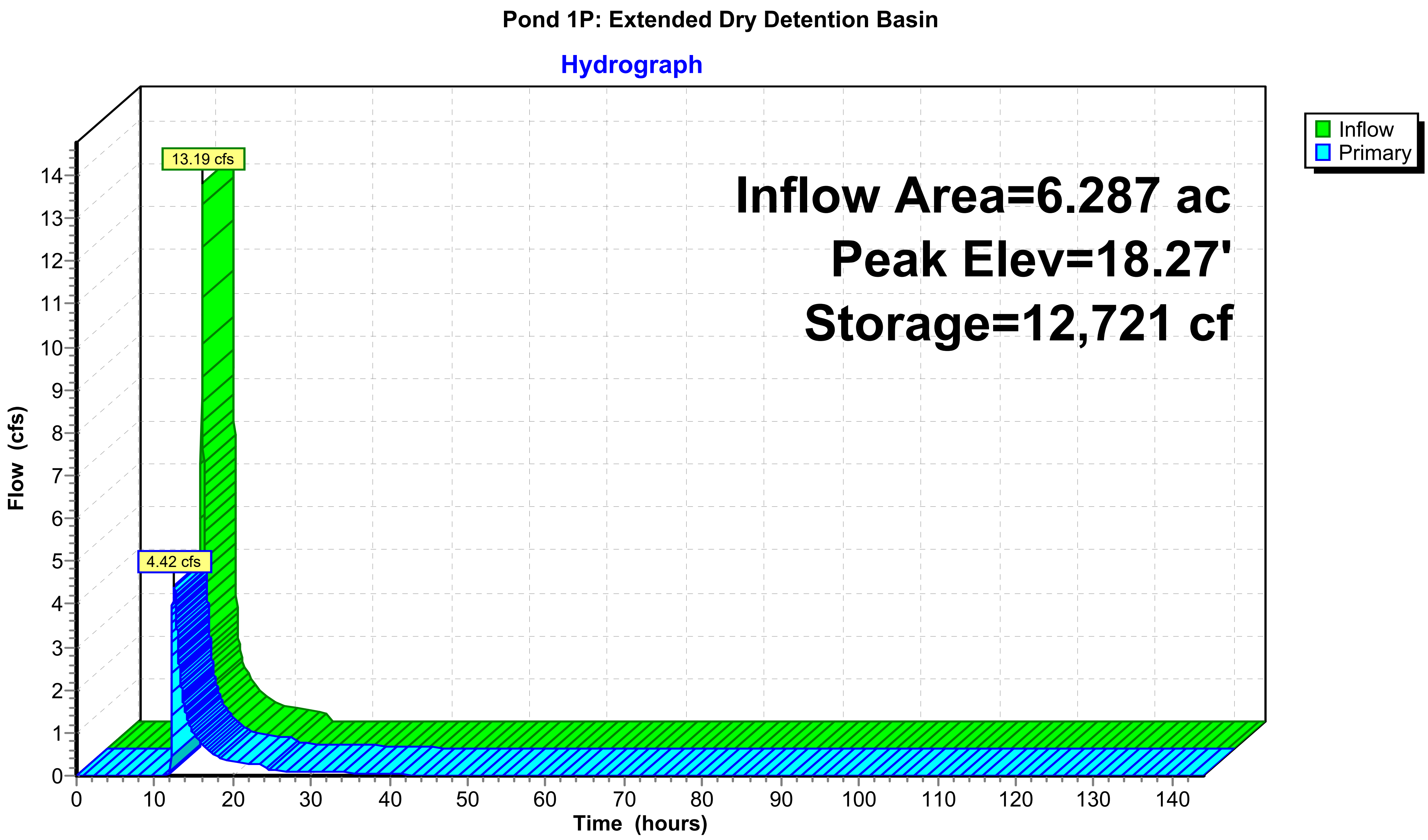
Plug-Flow detention time= 174.9 min calculated for 1.002 af (100% of inflow)
Center-of-Mass det. time= 174.6 min (1,039.6 - 865.0)

Volume	Invert	Avail.Storage	Storage Description
#1	15.50'	17,959 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
15.50	3,413	0	0
16.00	3,794	1,802	1,802
17.00	4,596	4,195	5,997
18.00	5,456	5,026	11,023
18.10	6,539	600	11,623
19.00	7,541	6,336	17,959

Device	Routing	Invert	Outlet Devices
#1	Primary	15.50'	**15.0" Round Culvert** L= 27.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 15.50' / 15.23' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf
#2	Device 1	15.50'	**2.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	16.75'	**1.0' long x 2.20' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=4.42 cfs @ 12.46 hrs HW=18.27' (Free Discharge)
└─**1=Culvert** (Passes 4.42 cfs of 6.82 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.17 cfs @ 7.89 fps)
  └─**3=Sharp-Crested Rectangular Weir** (Weir Controls 4.25 cfs @ 4.03 fps)



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RIVER MARSH VILLAGE
PEMBROKE, MA

4/5/2021
REVISED 6/7/21

REQUIRED RECHARGE VOLUME (CF) *"STATIC METHOD"*

WATERSHED #	IMPERVIOUS AREA (SF)	TARGET DEPTH FACTOR (F) A SOIL	IMPERVIOUS AREA (SF)	TARGET DEPTH FACTOR (F) B SOIL	IMPERVIOUS AREA (SF)	TARGET DEPTH FACTOR (F) C SOIL	IMPERVIOUS AREA (SF)	TARGET DEPTH FACTOR (F) D SOIL		REQUIRED RECHARGE VOLUME (CF)
P2	0	0.60		0.35	1,504	0.25		0.10		31
P4	539	0.60		0.35	767	0.25		0.10		43
P4a	32,445	0.60		0.35	101,812	0.25		0.10		3,743
P4b	191	0.60		0.35	11,144	0.25		0.10		242
P4c	51,933	0.60		0.35	14,055	0.25		0.10		2,889
P5	487	0.60		0.35	999	0.25		0.10		45
	85,595				130,281		**TOTAL**			**6,994**

CAPTURE ADJUSTMENT

WATERSHED #	TOTAL IMPERVIOUS AREA (SF)	TOTAL IMPERVIOUS COLLECTED	% DIRECTED TOWARDS INFILTRATION SYSTEM	STANDARD NO. 3 > 65% CAPTURED	CAPTURE ADJUSTMENT	ADJUSTED REQUIRED RECHARGE VOLUME (CF)
TOTAL SITE	215,876	150,991	69.94%	**CAPTURE ADJUSTMENT REQUIRED**	1.43	9,999

PROVIDED RECHARGE VOLUME (CF)
UP TO ORIFICE INVERT ELEV. 18.40

	REQUIRED RECHARGE VOLUME (CF)	POND	STORAGE VOLUME PROVIDED (CF)	NET STORAGE VOLUME PROVIDED (CF)
	9,999	2P	10,406	407
TOTAL	**9,999**		**10,406**	**407**

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RIVER MARSH VILLAGE **4/5/2021**
PEMBROKE, MA **REVISED 6/7/21**

WATER QUALITY VOLUME ANALYSIS

CATCHMENT AREA	IMPERVIOUS AREA (SF) CN=98	PRECIPITATION (IN)	WATER QUALITY VOLUME REQUIRED (CF)	VOLUME TREATED SUBSURFACE CHAMBERS BELOW ORIFICE INVERT	SEE BELOW FOR WATER QUALITY TREATED BY FIRST DEFENSE UNITS
P4a	37,127	1.00	3,094		
P4b	3,536	1.00	295		
P4c	65,988	1.00	5,499		
P4d	0				
Roofs Only	104,929	1.00	8,744		
P2	1,504	1.00	125		
P4	1,306	1.00	109		
P5	1,486	1.00	124		
2P				10,406	
TOTAL	**215,876**		**17,990**		

SEDIMENT FOREBAY SIZING (0.1-INCH / IMPERVIOUS ACRE)

	WATERSHED	IMPERVIOUS AREA (SF) CN=98	0.1 INCH / IMPERVIOUS ACRE	WATER QUALITY VOLUME REQUIRED (CF)
	P4c	65,988	0.10	550
TOTAL		**65,988**		**550**

SEDIMENT FOREBAY VOLUME PROVIDED

FOREBAY	ELEVATION	AREA (SF)	CUMULATIVE VOLUME (CF)	TREATMENT VOLUME PROVIDED (CF) ELEVATIONS 17 TO 18	NET TREATMENT VOLUME PROVIDED (CF)
BASIN 1P	17.00	484.00	0	636	86
	18	788.00	636		
TOTAL			**636**		**86**

WATER QUALITY VOLUME ANALYSIS - PROPRIETARY STORMWATER TREATMENT UNITS (FIRST DEFENSE UNITS) TO TREAT REQUIRED WATER QUALITY VOLUME

	IMPERVIOUS AREA (SF) CN=98	PRECIPITATION (IN)	qu (Fig 4) Tc 6 min. (CSM/IN)	AREA (SM)	WATER QUALITY REQUIRED (CFS)
FD-1	65,988	1.00	774	2.367E-03	1.832
FD-2	3,536	1.00	774	1.268E-04	0.098
FD-3	37,127	1.00	774	1.332E-03	1.031
	106,651				

*Use 6' Diameter High Capacity First Defense Unit FOR FD-1
*Use 4' Diameter High Capacity First Defense Units For FD-1 AND FD-2

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RIVER MARSH VILLAGE **4/5/2021**
PEMBROKE, MA **REVISED 6/7/21**

DRAWDOWN WITHIN 72 HOURS ANALYSIS
`

POND	RAWLS RATE (IN/HR)	STORAGE VOLUME PROVIDED (CF)	BOTTOM AREA (FT2)	DRAWDOWN (HR)
2P	1.02	10,406	8,736	14

MCKENZIE ENGINEERING GROUP
150 Longwater Dr., Suite 101
Norwell, MA 02061
Office: 781.792.3900
Fax: 781.792.0333
www.mckeng.com

PROFESSIONAL CIVIL ENGINEERING | LAND PLANNING | LAND SURVEYING

JOB: RIVERMARSH
SHEET NO. 1 OF 1
CALCULATED BY: SBS DATE: 6/7/21
CHECKED BY: DATE:
SCALE:

EXTENDED DRY BASIN FOR WQ VOLUME = 24 HRS

$WQV = \frac{1''}{12} \times 65988 = 5,499\ CF$

RAINFALL DRAWN DOWN (24 HRS)

$Q_{AVG} = 5499\ CF / 24 = \frac{229.125}{3600} = .0636\ CFS$

$Q_{MAX} = 2(Q_{AVG}) = 0.127\ CFS$

AREA OF ORIFICE OPENING:

$Q_{MAX} = CA\sqrt{2gh}$

$Q_{MAX} = .127$
$C_{ORIFICE} = 0.6$
$g = 32.2\ ft/sec$
$H = 1.4$ 15.50-16.90
Volume =

$.127 = .6A\sqrt{2(32.2)(1.4)}$

$A = .022$

$A = \pi R^2 \quad R = \sqrt{A/\pi} = .022/\pi = .084'$

$A = 1.0''$ (RADIUS) USE 2" dia ORIFICE

Stage-Area-Storage for Pond 1P: Extended Dry Detention Basin

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
15.50	3,413	0
15.52	3,428	68
15.54	3,443	137
15.56	3,459	206
15.58	3,474	275
15.60	3,489	345
15.62	3,504	415
15.64	3,520	485
15.66	3,535	556
15.68	3,550	627
15.70	3,565	698
15.72	3,581	769
15.74	3,596	841
15.76	3,611	913
15.78	3,626	986
15.80	3,642	1,058
15.82	3,657	1,131
15.84	3,672	1,204
15.86	3,687	1,278
15.88	3,703	1,352
15.90	3,718	1,426
15.92	3,733	1,501
15.94	3,748	1,575
15.96	3,764	1,651
15.98	3,779	1,726
16.00	3,794	1,802
16.02	3,810	1,878
16.04	3,826	1,954
16.06	3,842	2,031
16.08	3,858	2,108
16.10	3,874	2,185
16.12	3,890	2,263
16.14	3,906	2,341
16.16	3,922	2,419
16.18	3,938	2,498
16.20	3,954	2,577
16.22	3,970	2,656
16.24	3,986	2,735
16.26	4,003	2,815
16.28	4,019	2,896
16.30	4,035	2,976
16.32	4,051	3,057
16.34	4,067	3,138
16.36	4,083	3,220
16.38	4,099	3,301
16.40	4,115	3,384
16.42	4,131	3,466
16.44	4,147	3,549
16.46	4,163	3,632
16.48	4,179	3,715
16.50	4,195	3,799
16.52	4,211	3,883
16.54	4,227	3,967
16.56	4,243	4,052
16.58	4,259	4,137
16.60	4,275	4,223
16.62	4,291	4,308
16.64	4,307	4,394
16.66	4,323	4,480
16.68	4,339	4,567
16.70	4,355	4,654
16.72	4,371	4,741
16.74	4,387	4,829
16.76	4,404	4,917
16.78	4,420	5,005
16.80	4,436	5,094
16.82	4,452	5,182
16.84	4,468	5,272
16.86	4,484	5,361
16.88	4,500	5,451
16.90	4,516	5,541
16.92	4,532	5,632
16.94	4,548	5,722
16.96	4,564	5,814
16.98	4,580	5,905
17.00	4,596	5,997
17.02	4,613	6,089
17.04	4,630	6,181
17.06	4,648	6,274
17.08	4,665	6,367
17.10	4,682	6,461
17.12	4,699	6,554
17.14	4,716	6,649
17.16	4,734	6,743
17.18	4,751	6,838
17.20	4,768	6,933
17.22	4,785	7,029
17.24	4,802	7,125
17.26	4,820	7,221
17.28	4,837	7,317
17.30	4,854	7,414
17.32	4,871	7,512
17.34	4,888	7,609
17.36	4,906	7,707
17.38	4,923	7,805
17.40	4,940	7,904
17.42	4,957	8,003
17.44	4,974	8,102
17.46	4,992	8,202
17.48	5,009	8,302
17.50	5,026	8,402
17.52	5,043	8,503
17.54	5,060	8,604
17.56	5,078	8,705
17.58	5,095	8,807
17.60	5,112	8,909
17.62	5,129	9,012
17.64	5,146	9,114
17.66	5,164	9,217
17.68	5,181	9,321
17.70	5,198	9,425
17.72	5,215	9,529
17.74	5,232	9,633
17.76	5,250	9,738
17.78	5,267	9,843
17.80	5,284	9,949
17.82	5,301	10,055
17.84	5,318	10,161
17.86	5,336	10,267
17.88	5,353	10,374
17.90	5,370	10,481
17.92	5,387	10,589
17.94	5,404	10,697
17.96	5,422	10,805
17.98	5,439	10,914
18.00	5,456	11,023
18.02	5,673	11,134
18.04	5,889	11,250
18.06	6,106	11,370
18.08	6,322	11,494
18.10	6,539	11,623
18.12	6,561	11,754
18.14	6,584	11,885
18.16	6,606	12,017
18.18	6,628	12,149
18.20	6,650	12,282
18.22	6,673	12,415
18.24	6,695	12,549
18.26	6,717	12,683
18.28	6,739	12,818
18.30	6,762	12,953
18.32	6,784	13,088
18.34	6,806	13,224
18.36	6,828	13,360
18.38	6,851	13,497
18.40	6,873	13,634
18.42	6,895	13,772
18.44	6,918	13,910
18.46	6,940	14,049
18.48	6,962	14,188
18.50	6,984	14,327
18.52	7,007	14,467
18.54	7,029	14,607
18.56	7,051	14,748
18.58	7,073	14,889
18.60	7,096	15,031
18.62	7,118	15,173
18.64	7,140	15,316
18.66	7,162	15,459
18.68	7,185	15,602
18.70	7,207	15,746
18.72	7,229	15,891
18.74	7,252	16,035
18.76	7,274	16,181
18.78	7,296	16,326
18.80	7,318	16,473
18.82	7,341	16,619
18.84	7,363	16,766
18.86	7,385	16,914
18.88	7,407	17,062
18.90	7,430	17,210
18.92	7,452	17,359
18.94	7,474	17,508
18.96	7,496	17,658
18.98	7,519	17,808
19.00	**7,541**	**17,959**

Stage-Area-Storage for Pond 2P: Infiltration Chambers

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
16.60	**8,736**	0	21.50	8,736	29,387
16.65	8,736	175	21.55	8,736	29,562
16.70	8,736	349	21.60	8,736	29,736
16.75	8,736	524	21.65	8,736	29,911
16.80	8,736	699	21.70	8,736	30,086
16.85	8,736	874	21.75	8,736	30,261
16.90	8,736	1,048	21.80	8,736	30,435
16.95	8,736	1,223	21.85	8,736	30,610
17.00	8,736	1,398	21.90	8,736	30,785
17.05	8,736	1,572	21.95	8,736	30,960
17.10	8,736	1,747	22.00	8,736	31,134
17.15	8,736	1,922	22.05	8,736	31,309
17.20	8,736	2,097	22.10	8,736	31,484
17.25	8,736	2,271	22.15	8,736	31,658
17.30	8,736	2,446	22.20	8,736	31,833
17.35	8,736	2,621	22.25	8,736	32,008
17.40	8,736	2,996	22.30	8,736	32,183
17.45	8,736	3,370	22.35	8,736	**32,357**
17.50	8,736	3,746	22.40	8,736	32,357
17.55	8,736	4,123	22.45	8,736	32,357
17.60	8,736	4,498	22.50	8,736	32,357
17.65	8,736	4,872	22.55	8,736	32,357
17.70	8,736	5,245	22.60	8,736	32,357
17.75	8,736	5,618	22.65	8,736	32,357
17.80	8,736	5,990	22.70	8,736	32,357
17.85	8,736	6,362	22.75	8,736	32,357
17.90	8,736	6,732	22.80	8,736	32,357
17.95	8,736	7,103	22.85	8,736	32,357
18.00	8,736	7,474	22.90	8,736	32,357
18.05	8,736	7,844	22.95	8,736	32,357
18.10	8,736	8,213	23.00	8,736	32,357
18.15	8,736	8,581	23.05	8,736	32,357
18.20	8,736	8,948	23.10	8,736	32,357
18.25	8,736	9,313	23.15	8,736	32,357
18.30	8,736	9,677	23.20	8,736	32,357
18.35	8,736	10,042	23.25	8,736	32,357
18.40	8,736	10,406	23.30	8,736	32,357
18.45	8,736	10,771	23.35	8,736	32,357
18.50	8,736	11,134			
18.55	8,736	11,496			
18.60	8,736	11,857			
18.65	8,736	12,216			
18.70	8,736	12,575			
18.75	8,736	12,933			
18.80	8,736	13,291			
18.85	8,736	13,647			
18.90	8,736	14,003			
18.95	8,736	14,357			
19.00	8,736	14,711			
19.05	8,736	15,065			
19.10	8,736	15,417			
19.15	8,736	15,768			
19.20	8,736	16,118			
19.25	8,736	16,468			
19.30	8,736	16,818			
19.35	8,736	17,166			
19.40	8,736	17,512			
19.45	8,736	17,856			
19.50	8,736	18,200			
19.55	8,736	18,543			
19.60	8,736	18,885			
19.65	8,736	19,226			
19.70	8,736	19,563			
19.75	8,736	19,900			
19.80	8,736	20,234			
19.85	8,736	20,568			
19.90	8,736	20,900			
19.95	8,736	21,229			
20.00	8,736	21,556			
20.05	8,736	21,881			
20.10	8,736	22,204			
20.15	8,736	22,525			
20.20	8,736	22,842			
20.25	8,736	23,157			
20.30	8,736	23,468			
20.35	8,736	23,778			
20.40	8,736	24,084			
20.45	8,736	24,386			
20.50	8,736	24,685			
20.55	8,736	24,980			
20.60	8,736	25,271			
20.65	8,736	25,559			
20.70	8,736	25,842			
20.75	8,736	26,121			
20.80	8,736	26,395			
20.85	8,736	26,664			
20.90	8,736	26,927			
20.95	8,736	27,182			
21.00	8,736	27,427			
21.05	8,736	27,663			
21.10	8,736	27,887			
21.15	8,736	28,100			
21.20	8,736	28,302			
21.25	8,736	28,495			
21.30	8,736	28,682			
21.35	8,736	28,863			
21.40	8,736	29,038			
21.45	8,736	29,212			

UNIVERSITY OF MASSACHUSETTS
AT AMHERST
Water Resources Research Center
Blaisdell House, UMass
310 Hicks Way
Amherst, MA 01003

Massachusetts Stormwater Evaluation Project

(413) 545-5532
(413) 545-2304 FAX
www.mastep.net

MASTEP Technology Review

Technology Name: Hydro International First Defense

Studies Reviewed: Hydro International First Defense Testing Using Maine DEP Protocol Utilizing OK-110 Feed Sand. November 2004, testing conducted October 2004.

Hydro International First Defense Ok-110 Sand TSS (SSC) Removal Confirmation Test. Jeff Dennis, Maine DEP.

First Defense Performance Evaluation –Hydro International February 2011

Date: March 15, 2011

Reviewer: Sarah Titus, Updated by Jerry Schoen

Rating: 2

Brief rationale for rating: This rating is primarily based on the 2011 study report by Hydro International. This study was conducted by the manufacturer on a full scale 4' diameter model using a laboratory testing protocol that closely followed NJ DEP recommended protocol, which protocol is considered by MASTEP as the laboratory analog to TARP Tier II field protocol. The study was well run. 5 runs were conducted at flow rates ranging from 25% - 125% of the design treatment flow rate using OK-110 Silica sand.

TARP Requirements Not Met*:
- OK-110 contains particle size distribution slightly larger than is recommended.
- Although witnessed by a 3rd party, this test was conducted by the manufacturer.
- Influent sediment concentration ranges from approximately 40 to approximately 200 mg/l. This is lower than required, but in one respect produces a more demanding test than the recommended 100-300 range, as lower concentrations are generally harder to treat effectively.

Other notes:
- A Quality Assurance Project Plan was prepared and appears to have been followed during the test.
- Scour tests were conducted according to recommended protocol. No scour was detected.
- Samples were analyzed for both SSC and TSS; removal rates were 71% and 70% respectively/

* Criteria also based on NJDEP laboratory testing guidelines.

Figure 4: for First 1-inch Runoff, Table of qu values for Ia/P Curve = 0.034, listed by tc, for Type III Storm Distribution

Tc (Hours)	qu (csm/in)
0.01	835
0.03	835
0.05	831
0.067	814
0.083	795
0.1	774
0.116	755
0.133	736
0.15	717
0.167	700
0.183	685
0.2	669
0.217	654
0.233	641
0.25	628
0.3	593
0.333	572
0.35	563
0.4	536
0.416	528
0.5	491
0.583	460
0.6	454
0.667	433
0.7	424
0.8	398
0.9	376
1	356
1.1	339
1.2	323
1.3	309
1.4	296
1.5	285
1.6	274
1.7	264
1.8	255
1.9	247
2	239
2.1	232
2.2	225
2.3	219
2.4	213
2.5	207
2.6	202
2.7	197
2.8	192
2.9	187
3	183
3.1	179
3.2	175
3.3	171
3.4	168
3.5	164
3.6	161
3.7	158
3.8	155
3.9	152
4	149
4.1	146
4.2	144
4.3	141
4.4	139
4.5	137
4.6	134
4.7	132
4.8	130
4.9	128
5	126
5.1	124
5.2	122
5.3	120
5.4	119
5.5	117
5.6	115
5.7	114
5.8	112
5.9	111
6	109
6.1	108
6.2	106
6.3	105
6.4	104
6.5	102
6.6	101
6.7	100
6.8	99
6.9	98
7	96
7.1	95
7.2	94
7.3	93
7.4	92
7.5	91
7.6	90
7.7	89
7.8	88
7.9	87
8	86
8.1	85
8.2	84
8.3	84
8.4	83
8.5	82
8.6	81
8.7	80
8.8	79
8.9	79
9	78
9.1	77
9.2	76
9.3	76
9.4	75
9.5	74
9.6	74
9.7	73
9.8	72
9.9	72
10	71

First Defense®

A Simple Solution for your Trickiest Sites

Product Profile

The First Defense® is an enhanced vortex separator that combines an effective stormwater treatment chamber with an integral peak flow bypass. It efficiently removes sediment total suspended solids (TSS), trash and hydrocarbons from stormwater runoff without washing out previously captured pollutants. The First Defense® is available in several model configurations to accommodate a wide range of pipe sizes, peak flows and depth constraints (**Table 1**, next page).

Components

1. Inlet Grate (optional)
2. Inlet Chute
3. Inlet Pipe (optional)
4. Floatables Draw Off Slot (not pictured)
5. Precast Vortex Chamber
6. Internal Bypass
7. Outlet Chute
8. Outlet Pipe
9. Oil and Floatables Storage
10. Sediment Storage Sump

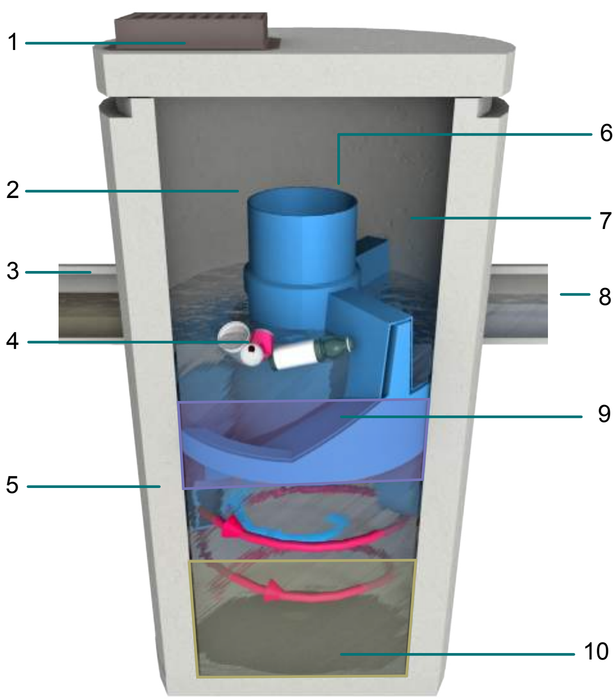

Fig.1 The First Defense® has internal components designed to efficiently capture pollutants and prevent washout at peak flows.

Applications

- Stormwater treatment at the point of entry into the drainage line
- Sites constrained by space, topography or drainage profiles with limited slope and depth of cover
- Retrofit installations where stormwater treatment is placed on or tied into an existing storm drain line
- Pretreatment for filters, infiltration and storage

Advantages

- Inlet options include surface grate or multiple inlet pipes
- Integral high capacity bypass conveys large peak flows without the need for "offline" arrangements using separate junction manholes
- Proven to prevent pollutant washout at up to 500% of its treatment flow
- Long flow path through the device ensures a long residence time within the treatment chamber, enhancing pollutant settling
- Delivered to site pre-assembled and ready for installation

How it Works

The First Defense® has internal components designed to remove and retain gross debris, total suspended solids (TSS) and hydrocarbons (**Fig.1**).

Contaminated stormwater runoff enters the inlet chute from a surface grate and/or inlet pipe. The inlet chute introduces flow into the chamber tangentially to create a low energy vortex flow regime (magenta arrow) that directs sediment into the sump while oils, floating trash and debris rise to the surface.

Treated stormwater exits through a submerged outlet chute located opposite to the direction of the rotating flow (blue arrow). Enhanced vortex separation is provided by forcing the rotating flow within the vessel to follow the longest path possible rather than directly from inlet to outlet.

Higher flows bypass the treatment chamber to prevent turbulence and washout of captured pollutants. An integral bypass conveys infrequent peak flows directly to the outlet chute, eliminating the need for, and expense of, external bypass control structures. A floatables draw off slot functions to convey floatables into the treatment chamber prior to bypass.

Hydro International, 94 Hutchins Drive, Portland, ME 04102
Tel: (207) 756-6200 Fax: (207) 756-6212
Email: stormwaterinquiry@hydro-int.com Web: www.hydro-int.com

First Defense®

Maintenance

The First Defense® needs minimal maintenance, but like all structural best management practices maintenance is necessary for the long-term protection of the environment.

Sediments captured by the First Defense® are stored in the sump; floatable trash and hydrocarbons are stored on the surface of the standing water. A commercially or municipally owned sump-vac is used to remove captured sediment and floatables (**Fig.2**).

More information can be found in the First Defense® Operation and Maintenance Manual, available at hydro-int.com/firstdefense.

Fig.2 Maintenance is performed with a vactor truck.

First Defense® Sizing & Design

Design Options for Inlet and Internal Bypass Arrangements

For maximum flexibility the First Defense® inlet and internal bypass arrangements are available in two configurations (**Fig.3a & 3b**). Model parameters and design criteria are shown in **Table 1**.

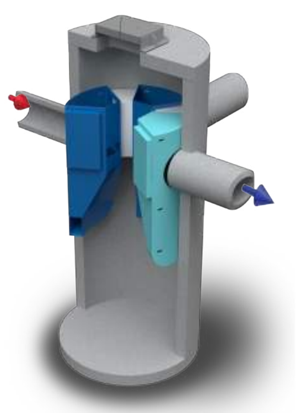

Fig.3a Inlet configurations for all models include options for inlet grates and multiple inlet pipes.

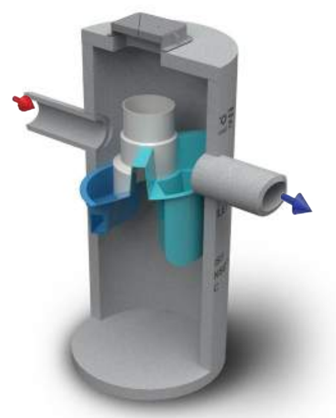

Fig.3b First Defense®-*HC* with higher capacity internal bypass and larger maximum pipe diameter.

Free *Stormwater Separator Sizing Calculator* for Engineers

This simple online tool will recommend the best separatror, model size and online/offline arrangement based on site-specific data entered by the user.

Go to hydro-int.com/sizing to access the tool.

Table 1. First Defense® Models and Design Criteria.

First Defense® Model Number	Diameter	Typical Flow Rates for TSS Treatment		Peak Online Flow Rate	Maximum Pipe Diameter[1]	Oil Storage Capacity	Typical Sediment Storage Capacity[2]	Minimum Distance from Outlet Invert to Top of Rim[3]	Standard Distance from Outlet Invert to Sump Floor
		106µm	230µm						
	(ft / m)	(cfs / L/s)	(cfs / L/s)	(cfs / L/s)	(in / mm)	(gal / L)	(yd^3 / m^3)	(ft / m)	(ft / m)
FD-4	4 / 1.2	0.7 / 20	1.2 / 34	6 / 170	18 / 450	180 / 681	0.7 / 0.5	3.1 / 1.1	4.97 / 1.5
FD-4HC				18 / 510	24 / 600	191 / 723		2.3 - 3.9 / 0.7 - 1.2	
FD-6	6 / 1.8	2.2 / 63	3.8 / 108	18 / 510	24 / 600	420 / 1,590	1.6 / 1.2	4.0 / 1.2	5.97 / 1.8
FD-6HC				32 / 906	30 / 750	496 / 1,878		3.0 - 5.1 / 0.9 - 1.6	

[1]Contact Hydro International when larger pipe sizes are required.

[2]Contact Hydro International when custom sediment storage capacity is required.

[3]The minimum distance for the 4HC and 6HC models depends on pipe diameter.

Standard 4: Pretreatment Calculation:
Extended Dry Detention Basin 1P

MCKENZIE ENGINEERING GROUP
Assinippi Office Park
150 Longwater Drive, Suite 10
Norwell, MA 02061

NAME: River Marsh Village
Pembroke, MA
CLIENT: River Marsh, LLC
COUNTY: Plymouth

Proj. No.: 215-181
Date: 4/5/2021, Revised 6/7/21
Revised:
Computed by: SBS
Checked by: BCM

TSS Removal Calculation

B BMP	C TSS Removal Rate	D Starting TSS Load (*F)	E Amount Removed (C*D)	F Remaining Load (D-E)
Deep Sump and Hooded Catch Basin	0.25	1.00	0.25	0.75
First Defense Unit	0.70	0.75	0.53	0.23
	0.00	0.23	0.00	0.23
	0.00	0.23	0.00	0.23
	0.00	0.23	0.00	0.23

Total TSS Removal = 78%

*Equals remaining load from previous BMP (E)
which enters the BMP

Non-automated TSS Calculation Sheet
must be used if Proprietary BMP Proposed
1. From MassDEP Stormwater Handbook Vol. 1

Mass. Dept. of Environmental Protection

Standard 4: Total Suspended Solids Calculation:
Extended Dry Detention Basin 1P

MCKENZIE ENGINEERING GROUP

Assinippi Office Park
150 Longwater Drive, Suite 10
Norwell, MA 02061

NAME: River Marsh Village
Pembroke, MA
CLIENT: River Marsh, LLC
COUNTY: Plymouth

Proj. No.: 215-181
Date: 4/5/2021, Revised 6/7/21
Revised:
Computed by: SBS
Checked by: BCM

TSS Removal Calculation

B BMP	C TSS Removal Rate	D Starting TSS Load (*F)	E Amount Removed (C*D)	F Remaining Load (D-E)
Deep Sump Hooded Catch Basin	0.25	1.00	0.25	0.75
First Defense Unit	0.70	0.75	0.53	0.23
Extended Dry Detention Basin w/Sediment Forebay	0.50	0.23	0.11	0.11
	0.00	0.11	0.00	0.11
	0.00	0.11	0.00	0.11

Total TSS Removal = 89%

*Equals remaining load from previous BMP (E)
which enters the BMP

Non-automated TSS Calculation Sheet
must be used if Proprietary BMP Proposed
1. From MassDEP Stormwater Handbook Vol. 1

MCKENZIE ENGINEERING GROUP

Standard 4: Pretreatment Calculation: Infiltration Chambers 2P

NAME:	River Marsh Village Pembroke, MA	**Proj. No.:**	215-181
		Date:	4/5/2021, Revised 6/7/21
CLIENT:	River Marsh, LLC	**Revised:**	
COUNTY:	Plymouth	**Computed by:**	SBS
		Checked by:	BCM

Assinippi Office Park
150 Longwater Drive, Suite 10
Norwell, MA 02061

TSS Removal Calculation

B BMP	C TSS Removal Rate	D Starting TSS Load (*F)	E Amount Removed (C*D)	F Remaining Load (D-E)
Deep Sump and Hooded Catch Basin	0.25	1.00	0.25	0.75
First Defense Unit	0.70	0.75	0.53	0.23
	0.00	0.23	0.00	0.23
	0.00	0.23	0.00	0.23
	0.00	0.23	0.00	0.23

Total TSS Removal = 78%

*Equals remaining load from previous BMP (E) which enters the BMP

Non-automated TSS Calculation Sheet
must be used if Proprietary BMP Proposed
1. From MassDEP Stormwater Handbook Vol. 1

Mass. Dept. of Environmental Protection

Standard 4: Total Suspended Solids Calculation:
Infiltration Chambers 2P

MCKENZIE ENGINEERING GROUP

Assinippi Office Park
150 Longwater Drive, Suite 10
Norwell, MA 02061

NAME:	River Marsh Village Pembroke, MA	**Proj. No.:**	215-181
		Date:	4/5/2021, Revised 6/7/21
CLIENT:	River Marsh, LLC	**Revised:**	
COUNTY:	Plymouth	**Computed by:**	SBS
		Checked by:	BCM

TSS Removal Calculation

B BMP	C TSS Removal Rate	D Starting TSS Load (*F)	E Amount Removed (C*D)	F Remaining Load (D-E)
Deep Sump Hooded Catch Basin	0.25	1.00	0.25	0.75
First Defense Unit	0.70	0.75	0.53	0.23
Extended Dry Detention Basin w/Sediment Forebay	0.50	0.23	0.11	0.11
Subsurface Chambers	0.80	0.11	0.09	0.02
	0.00	0.02	0.00	0.02

Total TSS Removal = **98%**

*Equals remaining load from previous BMP (E)
which enters the BMP

Non-automated TSS Calculation Sheet
must be used if Proprietary BMP Proposed
1. From MassDEP Stormwater Handbook Vol. 1

A P P E N D I X E

Soil Testing Data

Commonwealth of Massachusetts
City/Town of Pembroke

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

A. Facility Information

River Marsh, LLC
Owner Name

293R Washington Street
Street Address

Map E-17, Lot 0 & Map E-17A, Lot 274
Map/Lot #

Norwell
City

MA
State

02061
Zip Code

B. Site Information

1. (Check one) ☒ New Construction ☐ Upgrade ☐ Repair

2. Soil Survey Available? ☒ Yes ☐ No If yes: Web Soil Survey (Source) 200A & 221B (Soil Map Unit)

   Squamscott fine sand loam & Eldridge fine s.l.
   Soil Name

   Seasonal high watertables / slow permeability
   Soil Limitations

   Sandy eolian deposits/sandy glaciofluvial deposits

   Lake terraces, Lake Plains
   Landform

3. Surficial Geological Report Available? ☒ Yes ☐ No If yes: 2018 (Year Published/Source) Thin till (Map Unit)

   Till deposits less than 10 - 15 ft. thick
   Description of Geologic Map Unit:

4. Flood Rate Insurance Map Within a regulatory floodway? ☐ Yes ☒ No

5. Within a velocity zone? ☐ Yes ☒ No

6. Within a Mapped Wetland Area? ☐ Yes ☒ No If yes, MassGIS Wetland Data Layer: ______ Wetland Type

7. Current Water Resource Conditions (USGS): March 16, 2021 (Month/Day/ Year) Range: ☐ Above Normal ☒ Normal ☐ Below Normal

8. Other references reviewed:

Commonwealth of Massachusetts
City/Town of Pembroke

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review *(minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: SW-1 (Hole #) | 3/16/21 (Date) | 12:55 PM (Time) | Sunny 34 degrees (Weather) | 42 6' 29.2" (Latitude) | 70 46' 57.3" (Longitude:)

1. Land Use: Woodland (e.g., woodland, agricultural field, vacant lot, etc.) | Pine, oak, maple (Vegetation) | Common, some large boulder (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 1-3% (Slope (%))

   Description of Location: ______

2. Soil Parent Material: Eolian deposits/glaciofluvial deposits | Lake terraces/plains (Landform) | ______ Position on Landscape (SU, SH, BS, FS, TS)

3. Distances from: Open Water Body >100 feet | Drainage Way >100 feet | Wetlands >100 feet
   Property Line 145+/- feet | Drinking Water Well >100 feet | Other ______ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: 82" Depth Weeping from Pit ______ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0"-11"	Ap	Sandy loam	10YR2/2				5%	5-10%	Massive	Friable	
11"-27"	Bw	Loamy sand	10YR4/6				5%	5-10%	Granular	Friable	
27"-46"	C1	Loamy sand	10YR5/6	36"	2.5Y6/3 10YR4/6	25%	5%	5-10%	Granular	Very friable	Medium
46"-126"	C2	Sandy loam	2.5Y5/4			50%	30-40%	30-40%	Massive	Friable to firm	Very stony/ angular coarse particles

Additional Notes:

Commonwealth of Massachusetts
City/Town of Pembroke

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review *(minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: SW-2 (Hole #) 3/16/21 (Date) 12:00 PM (Time) Sunny 34 degrees (Weather) 42 6' 29.2" (Latitude) 70 46' 58.1" (Longitude:)

1. Land Use: Woodland (e.g., woodland, agricultural field, vacant lot, etc.) Pine, oak, maple (Vegetation) Common, some large boulder (Surface Stones (e.g., cobbles, stones, boulders, etc.)) 1-3% (Slope (%))

   Description of Location: ______

2. Soil Parent Material: Eolian deposits/glaciofluvial deposits; Lake terraces/plains (Landform); ______ (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body >100 feet; Drainage Way >100 feet; Wetlands >100 feet; Property Line 180+/- feet; Drinking Water Well >100 feet; Other ____ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No. If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No. If yes: 72" Depth Weeping from Pit; ____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0"-12"	Ap	Sandy loam	7.5YR3/3				<5%	<5%	Massive	Friable	
12"-25"	Bw	Loamy sand	10YR4/6				<5%	<5%	Granular	Friable	
25"-52"	C1	Sand	10YR4/4	30"	2.5Y6/3 10YR4/6	15%	<5%	<5%	Single grain	Very friable	Medium
52"-72"	C2	Sandy loam	2.5Y4/4	52"		40%	<5%	<5%	Blocky	Moderately firm	
72"-126"	C3	Sand/loamy sand	10YR4/4				<5%	<5%	Single grain	Very friable	

Additional Notes:

Commonwealth of Massachusetts
City/Town of Pembroke

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

D. Determination of High Groundwater Elevation

1. Method Used:

	Obs. Hole # SW-1	Obs. Hole # SW-2
☐ Depth observed standing water in observation hole	_____ inches	_____ inches
☐ Depth weeping from side of observation hole	_____ inches	_____ inches
☒ Depth to soil redoximorphic features (mottles)	36 inches	30 inches
☐ Depth to adjusted seasonal high groundwater (S_h) (USGS methodology)	_____ inches	_____ inches

Index Well Number _____ Reading Date _____

$S_h = S_c - [S_r \times (OW_c - OW_{max})/OW_r]$

Obs. Hole/Well# _____ S_c _____ S_r _____ OW_c _____ OW_{max} _____ OW_r _____ S_h _____

2. Estimated Depth to High Groundwater: _____ inches

E. Depth of Pervious Material

1. Depth of Naturally Occurring Pervious Material

a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

☒ Yes ☐ No

b. If yes, at what depth was it observed (exclude A and O Horizons)? Upper boundary: 12 inches Lower boundary: 126 inches

c. If no, at what depth was impervious material observed? Upper boundary: _____ inches Lower boundary: _____ inches

Commonwealth of Massachusetts
City/Town of Pembroke

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

F. Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct soil evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.100 through 15.107.

Alan W. Loomis

Signature of Soil Evaluator

March 16, 2021

Date

Alan W. Loomis, Soil Evaluator #1405

Typed or Printed Name of Soil Evaluator / License #

June 30, 2022

Expiration Date of License

Name of Approving Authority Witness

Approving Authority

Note: In accordance with 310 CMR 15.018(2) this form must be submitted to the approving authority within 60 days of the date of field testing, and to the designer and the property owner with Percolation Test Form 12.

Field Diagrams: Use this area for field diagrams:

Commonwealth of Massachusetts
City/Town of Pembroke

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

A. Facility Information

River Marsh, LLC
Owner Name

293R Washington Street
Street Address

Map E-17, Lot 0 & Map E-17A, Lot 274
Map/Lot #

Norwell
City

MA
State

02061
Zip Code

B. Site Information

1. (Check one) ☒ New Construction ☐ Upgrade ☐ Repair

2. Soil Survey Available? ☒ Yes ☐ No If yes: Web Soil Survey (Source) 200A & 221B (Soil Map Unit)

   Squamscott fine sand loam & Eldridge fine s.l.
   Soil Name

   Seasonal high watertables / slow permeability
   Soil Limitations

   Sandy eolian deposits/sandy glaciofluvial deposits

   Lake terraces, Lake Plains
   Landform

3. Surficial Geological Report Available? ☒ Yes ☐ No If yes: 2018 (Year Published/Source) Thin till (Map Unit)

   Till deposits less than 10 - 15 ft. thick
   Description of Geologic Map Unit:

4. Flood Rate Insurance Map Within a regulatory floodway? ☐ Yes ☒ No

5. Within a velocity zone? ☐ Yes ☒ No

6. Within a Mapped Wetland Area? ☐ Yes ☒ No If yes, MassGIS Wetland Data Layer: ______ Wetland Type

7. Current Water Resource Conditions (USGS): March 16, 2021 (Month/Day/ Year) Range: ☐ Above Normal ☒ Normal ☐ Below Normal

8. Other references reviewed:

Commonwealth of Massachusetts
City/Town of Pembroke

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review *(minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: SW-3 (Hole #) | 3/16/21 (Date) | 12:25 PM (Time) | Sunny 34 degrees (Weather) | 42 6' 28.7" (Latitude) | 70 46' 58.6" (Longitude:)

1. Land Use: Woodland (e.g., woodland, agricultural field, vacant lot, etc.) | Pine, oak, maple (Vegetation) | Common, some large boulder (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 1-3% (Slope (%))

   Description of Location: ______

2. Soil Parent Material: Eolian deposits/glaciofluvial deposits | Lake terraces/plains (Landform) | ______ (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body >100 feet | Drainage Way >100 feet | Wetlands >100 feet
   Property Line 225+/- feet | Drinking Water Well >100 feet | Other ____ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: 55" Depth Weeping from Pit ____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0"-9"	Ap	Sandy loam	10YR3/3				<5%	<5%	Massive	Friable	
9"-27"	Bw	Loamy sand	10YR4/6				<5%	<5%	Granular	Friable	
27"-51"	C1	Loamy sand	10YR4/3	32"	2.5Y6/3 10YR4/6	15%	<5%	<5%	Single grain	Very friable	Medium
51"-71"	C2	Sandy loam	2.5Y4/4	51"		40%	<5%	<5%	Blocky	Moderately firm	
71"-104"	C3	Sand/loamy sand	10YR4/4				<5%	<5%	Single grain	Very friable	

Additional Notes:

Commonwealth of Massachusetts
City/Town of Pembroke

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review *(minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: ______ Hole # ______ Date ______ Time ______ Weather ______ Latitude ______ Longitude:

1. Land Use: ______ (e.g., woodland, agricultural field, vacant lot, etc.) ______ Vegetation ______ Surface Stones (e.g., cobbles, stones, boulders, etc.) ______ Slope (%)

   Description of Location: ______

2. Soil Parent Material: ______ ______ Landform ______ Position on Landscape (SU, SH, BS, FS, TS)

3. Distances from: Open Water Body ______ feet Drainage Way ______ feet Wetlands ______ feet

   Property Line ______ feet Drinking Water Well ______ feet Other ______ feet

4. Unsuitable Materials Present: ☐ Yes ☐ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☐ No If yes: ______ Depth Weeping from Pit ______ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			

Additional Notes: ______

Commonwealth of Massachusetts
City/Town of Pembroke

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

D. Determination of High Groundwater Elevation

1. Method Used: | Obs. Hole # SW-3 | Obs. Hole # _____

- ☐ Depth observed standing water in observation hole | _____ inches | _____ inches
- ☐ Depth weeping from side of observation hole | _____ inches | _____ inches
- ☐ Depth to soil redoximorphic features (mottles) | 32 inches | _____ inches
- ☐ Depth to adjusted seasonal high groundwater (S_h) (USGS methodology) | _____ inches | _____ inches

_____________________ Index Well Number   _____________________ Reading Date

$S_h = S_c - [S_r \times (OW_c - OW_{max})/OW_r]$

Obs. Hole/Well# _____ S_c _____ S_r _____ OW_c _____ OW_{max} _____ OW_r _____ S_h _____

2. Estimated Depth to High Groundwater: _____ inches

E. Depth of Pervious Material

1. Depth of Naturally Occurring Pervious Material

a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

☐ Yes ☐ No

b. If yes, at what depth was it observed (exclude A and O Horizons)? Upper boundary: _____ inches Lower boundary: _____ inches

c. If no, at what depth was impervious material observed? Upper boundary: _____ inches Lower boundary: _____ inches

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

F. Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct soil evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.100 through 15.107.

Alan W. Loomis

Signature of Soil Evaluator

March 16, 2021

Date

Alan W. Loomis, Soil Evaluator #1405

Typed or Printed Name of Soil Evaluator / License #

June 30, 2022

Expiration Date of License

Name of Approving Authority Witness

Approving Authority

Note: In accordance with 310 CMR 15.018(2) this form must be submitted to the approving authority within 60 days of the date of field testing, and to the designer and the property owner with Percolation Test Form 12.

Field Diagrams: Use this area for field diagrams:

Commonwealth of Massachusetts
City/Town of Pembroke

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

A. Facility Information

River Marsh, LLC
Owner Name

293R Washington Street
Street Address

Map E-17, Lot 0 & Map E-17A, Lot 274
Map/Lot #

Norwell
City

MA
State

02061
Zip Code

B. Site Information

1. (Check one) ☒ New Construction ☐ Upgrade ☐ Repair

2. Soil Survey Available? ☒ Yes ☐ No If yes: Web Soil Survey (Source) 200A & 221B (Soil Map Unit)

   Squamscott fine sand loam & Eldridge fine s.l.
   Soil Name

   Seasonal high watertables / slow permeability
   Soil Limitations

   Sandy eolian deposits/sandy glaciofluvial deposits

   Lake terraces, Lake Plains
   Landform

3. Surficial Geological Report Available? ☒ Yes ☐ No If yes: 2018 (Year Published/Source) Thin till (Map Unit)

   Till deposits less than 10 - 15 ft. thick
   Description of Geologic Map Unit:

4. Flood Rate Insurance Map Within a regulatory floodway? ☐ Yes ☒ No

5. Within a velocity zone? ☐ Yes ☒ No

6. Within a Mapped Wetland Area? ☐ Yes ☒ No If yes, MassGIS Wetland Data Layer: ______ Wetland Type

7. Current Water Resource Conditions (USGS): May 17, 2021 (Month/Day/ Year) Range: ☐ Above Normal ☒ Normal ☐ Below Normal

8. Other references reviewed:

Commonwealth of Massachusetts
City/Town of Pembroke

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review *(minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP-A (Hole #) 5/17/21 (Date) 10:40 AM (Time) Sunny 70 degrees (Weather) 42 6' 28.6" (Latitude) 70 46' 58.6" (Longitude:)

1. Land Use: Woodland (e.g., woodland, agricultural field, vacant lot, etc.) Pine, oak, maple (Vegetation) Common, some large boulder (Surface Stones (e.g., cobbles, stones, boulders, etc.)) 1-3% (Slope (%))

   Description of Location: ______

2. Soil Parent Material: Eolian deposits/glaciofluvial deposits Lake terraces/plains (Landform) ______ (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body >100 feet Drainage Way >100 feet Wetlands >100 feet
   Property Line 270+/- feet Drinking Water Well >100 feet Other ______ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: 58" Depth Weeping from Pit ______ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0"-9"	Ap	Sandy loam	10YR3/3				5%	<5%	Massive	Friable	
9"-18"	Bw	Sandy loam	10YR4/6				<5%	<5%	Massive	Friable	
18"-84"	C1	Sand	2.5Y5/4	48"	2.5Y6/3 10YR4/6	25%	<5%	<5%	Single grain	Loose	Medium, lenses of sandy loam
84"-120"	C2	Sand	2.5Y5/4				<5%	<5%	Single grain	Loose	

Additional Notes:

Commonwealth of Massachusetts
City/Town of Pembroke

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review *(minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP-B (Hole #) 5/17/21 (Date) 11:20 AM (Time) Sunny 72 degrees (Weather) 42 6' 29.2" (Latitude) 70 46' 58.1" (Longitude:)

1. Land Use: Woodland (e.g., woodland, agricultural field, vacant lot, etc.) Pine, oak, maple (Vegetation) Common, some large boulder (Surface Stones (e.g., cobbles, stones, boulders, etc.)) 1-3% (Slope (%))

   Description of Location: ______

2. Soil Parent Material: Eolian deposits/glaciofluvial deposits Lake terraces/plains (Landform) ______ (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body >100 feet Drainage Way >100 feet Wetlands >100 feet
   Property Line 225+/- feet Drinking Water Well >100 feet Other ______ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: 60" Depth Weeping from Pit ______ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0"-6"	Ap	Sandy loam	7.5YR3/3				5%	<5%	Massive	Friable	
6"-20"	Bw	Sandy loam	10YR4/6				<5%	<5%	Granular	Friable	
20"-70"	C1	Sand	10YR4/4	32"	2.5Y6/3 10YR4/6	40%	<5%	<5%	Single grain	Loose	Fine-medium
70"-104"	C2	Sandy loam	2.5Y4/4				<5%	<5%	Blocky	Firm	
104"-108"	C3	Sand	10YR4/4				<5%	<5%	Single grain	Loose	Medium

Additional Notes:

Commonwealth of Massachusetts
City/Town of Pembroke

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

D. Determination of High Groundwater Elevation

1. Method Used:

	Obs. Hole #TP-A	Obs. Hole #TP-B
☐ Depth observed standing water in observation hole	_____ inches	_____ inches
☐ Depth weeping from side of observation hole	_____ inches	_____ inches
☒ Depth to soil redoximorphic features (mottles)	48 inches	32 inches
☐ Depth to adjusted seasonal high groundwater (S_h) (USGS methodology)	_____ inches	_____ inches

_____________ Index Well Number   _____________ Reading Date

$S_h = S_c - [S_r \times (OW_c - OW_{max})/OW_r]$

Obs. Hole/Well# _____ S_c _____ S_r _____ OW_c _____ OW_{max} _____ OW_r _____ S_h _____

2. Estimated Depth to High Groundwater: _____ inches

E. Depth of Pervious Material

1. Depth of Naturally Occurring Pervious Material

a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

☒ Yes ☐ No

b. If yes, at what depth was it observed (exclude A and O Horizons)? Upper boundary: 18 inches Lower boundary: 84 inches

c. If no, at what depth was impervious material observed? Upper boundary: _____ inches Lower boundary: _____ inches

Commonwealth of Massachusetts
City/Town of Pembroke

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

F. Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct soil evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.100 through 15.107.

Alan W. Loomis
Signature of Soil Evaluator

May 17, 2021
Date

Alan W. Loomis, Soil Evaluator #1405
Typed or Printed Name of Soil Evaluator / License #

June 30, 2022
Expiration Date of License

Name of Approving Authority Witness

Approving Authority

Note: In accordance with 310 CMR 15.018(2) this form must be submitted to the approving authority within 60 days of the date of field testing, and to the designer and the property owner with Percolation Test Form 12.

Field Diagrams: Use this area for field diagrams:

Commonwealth of Massachusetts
City/Town of Pembroke

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

A. Facility Information

River Marsh, LLC
Owner Name

293R Washington Street
Street Address

Map E-17, Lot 0 & Map E-17A, Lot 274
Map/Lot #

Norwell
City

MA
State

02061
Zip Code

B. Site Information

1. (Check one) ☒ New Construction ☐ Upgrade ☐ Repair

2. Soil Survey Available? ☒ Yes ☐ No If yes: Web Soil Survey (Source) 200A & 221B (Soil Map Unit)

   Squamscott fine sand loam & Eldridge fine s.l.
   Soil Name

   Seasonal high watertables / slow permeability
   Soil Limitations

   Sandy eolian deposits/sandy glaciofluvial deposits

   Lake terraces, Lake Plains
   Landform

3. Surficial Geological Report Available? ☒ Yes ☐ No If yes: 2018 (Year Published/Source) Thin till (Map Unit)

   Till deposits less than 10 - 15 ft. thick
   Description of Geologic Map Unit:

4. Flood Rate Insurance Map Within a regulatory floodway? ☐ Yes ☒ No

5. Within a velocity zone? ☐ Yes ☒ No

6. Within a Mapped Wetland Area? ☐ Yes ☒ No If yes, MassGIS Wetland Data Layer: ____________
   Wetland Type

7. Current Water Resource Conditions (USGS): May 17, 2021 (Month/Day/ Year) Range: ☐ Above Normal ☒ Normal ☐ Below Normal

8. Other references reviewed:

Commonwealth of Massachusetts
City/Town of Pembroke

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review *(minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP-C (Hole #) 5/17/21 (Date) 12:40 PM (Time) Sunny 72 degrees (Weather) 42 6' 29.2" (Latitude) 70 46' 57.3" (Longitude:)

1. Land Use Woodland (e.g., woodland, agricultural field, vacant lot, etc.) Pine, oak, maple (Vegetation) Common, some large boulder (Surface Stones (e.g., cobbles, stones, boulders, etc.)) 3-5% (Slope (%))

   Description of Location: ______

2. Soil Parent Material: Eolian deposits/glaciofluvial deposits Lake terraces/plains (Landform) ______ Position on Landscape (SU, SH, BS, FS, TS)

3. Distances from: Open Water Body >100 feet Drainage Way >100 feet Wetlands >100 feet

   Property Line 250+/- feet Drinking Water Well >100 feet Other ______ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: 66" Depth Weeping from Pit ______ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0"-8"	Ap	Sandy loam	10YR3/3				5-10%	10%	Massive	Friable	
8"-24"	Bw	Sandy loam	10YR4/4	26"	2.5Y6/3 10YR4/6	35%	5-10%	10%	Massive	Friable	
24"-108"	C1	Sandy loam	2.5Y4/4				25%	20%	Massive	Firm	Many cobbles, stones, some boulder

Additional Notes:
Boulder refusal @ 108"

Commonwealth of Massachusetts
City/Town of Pembroke

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review *(minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP-D (Hole #) 5/17/21 (Date) 1:20 AM (Time) Sunny 72 degrees (Weather) 42 6' 28.1" (Latitude) 70 46' 57.9" (Longitude:)

1. Land Use: Woodland (e.g., woodland, agricultural field, vacant lot, etc.) Pine, oak, maple (Vegetation) Common, some large boulder (Surface Stones (e.g., cobbles, stones, boulders, etc.)) 3-5% (Slope (%))

Description of Location: ______

2. Soil Parent Material: Eolian deposits/glaciofluvial deposits Lake terraces/plains (Landform) ______ (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body >100 feet Drainage Way >100 feet Wetlands >100 feet
Property Line 360+/- feet Drinking Water Well >100 feet Other ____ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: 78" Depth Weeping from Pit ____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0"-8"	Ap	Sandy loam	7.5YR3/3				5%	5%	Massive	Friable	
8"-21"	Bw	Sandy loam	10YR4/4				5-10%	5%	Massive	Friable	
21"-54"	C1	Loamy sand	2.5Y4/4	29"	2.5Y6/3 10YR4/6	30%	5-10%	5%	Granular	Friable	Fine-medium
54"-112"	C2	Sandy loam	2.5Y4/4				15-20%	20%	Massive	Firm	

Additional Notes: ______

Commonwealth of Massachusetts
City/Town of Pembroke

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

D. Determination of High Groundwater Elevation

1. Method Used:

	Obs. Hole #TP-C	Obs. Hole #TP-D
☐ Depth observed standing water in observation hole	_____ inches	_____ inches
☐ Depth weeping from side of observation hole	_____ inches	_____ inches
☒ Depth to soil redoximorphic features (mottles)	26 inches	29 inches
☐ Depth to adjusted seasonal high groundwater (S_h) (USGS methodology)	_____ inches	_____ inches

_____________________ Index Well Number _____________________ Reading Date

$S_h = S_c - [S_r \times (OW_c - OW_{max})/OW_r]$

Obs. Hole/Well# _____ S_c _____ S_r _____ OW_c _____ OW_{max} _____ OW_r _____ S_h _____

2. Estimated Depth to High Groundwater: _____ inches

E. Depth of Pervious Material

1. Depth of Naturally Occurring Pervious Material

a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

☐ Yes ☐ No

b. If yes, at what depth was it observed (exclude A and O Horizons)? Upper boundary: _____ inches Lower boundary: _____ inches

c. If no, at what depth was impervious material observed? Upper boundary: _____ inches Lower boundary: _____ inches

Commonwealth of Massachusetts
City/Town of Pembroke

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

F. Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct soil evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.100 through 15.107.

Alan W. Loomis

Signature of Soil Evaluator

May 17, 2021
Date

Alan W. Loomis, Soil Evaluator #1405
Typed or Printed Name of Soil Evaluator / License #

June 30, 2022
Expiration Date of License

Name of Approving Authority Witness

Approving Authority

Note: In accordance with 310 CMR 15.018(2) this form must be submitted to the approving authority within 60 days of the date of field testing, and to the designer and the property owner with Percolation Test Form 12.

Field Diagrams: Use this area for field diagrams:

Commonwealth of Massachusetts
City/Town of Pembroke

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

A. Facility Information

River Marsh, LLC
Owner Name

293R Washington Street
Street Address

Map E-17, Lot 0 & Map E-17A, Lot 274
Map/Lot #

Norwell
City

MA
State

02061
Zip Code

B. Site Information

1. (Check one) ☒ New Construction ☐ Upgrade ☐ Repair

2. Soil Survey Available? ☒ Yes ☐ No If yes: Web Soil Survey (Source) 200A & 221B (Soil Map Unit)

   Squamscott fine sand loam & Eldridge fine s.l.
   Soil Name

   Seasonal high watertables / slow permeability
   Soil Limitations

   Sandy eolian deposits/sandy glaciofluvial deposits

   Lake terraces, Lake Plains
   Landform

3. Surficial Geological Report Available? ☒ Yes ☐ No If yes: 2018 (Year Published/Source) Thin till (Map Unit)

   Till deposits less than 10 - 15 ft. thick
   Description of Geologic Map Unit:

4. Flood Rate Insurance Map Within a regulatory floodway? ☐ Yes ☒ No

5. Within a velocity zone? ☐ Yes ☒ No

6. Within a Mapped Wetland Area? ☐ Yes ☒ No If yes, MassGIS Wetland Data Layer: ______ Wetland Type

7. Current Water Resource Conditions (USGS): May 18, 2021 (Month/Day/ Year) Range: ☐ Above Normal ☒ Normal ☐ Below Normal

8. Other references reviewed:

Commonwealth of Massachusetts
City/Town of Pembroke

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review *(minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP-E (Hole #) 5/18/21 (Date) 10:30 AM (Time) Cloudy 55 degrees (Weather) 42 6' 29.5" (Latitude) 70 46' 59.0" (Longitude:)

1. Land Use Woodland (e.g., woodland, agricultural field, vacant lot, etc.) Pine, oak, maple (Vegetation) Common, some large boulder (Surface Stones (e.g., cobbles, stones, boulders, etc.)) 1-3% (Slope (%))

   Description of Location: ______

2. Soil Parent Material: Eolian deposits/glaciofluvial deposits Lake terraces/plains (Landform) ______ Position on Landscape (SU, SH, BS, FS, TS)

3. Distances from: Open Water Body >100 feet Drainage Way >100 feet Wetlands >100 feet

   Property Line 200+/- feet Drinking Water Well >100 feet Other ______ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: 60" Depth Weeping from Pit ______ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0"-9"	Ap	Sandy loam	10YR3/3				5%	<5%	Massive	Friable	
9"-18"	Bw	Sandy loam	10YR4/4				<5%	5%	Massive	Friable	
18"-54"	C1	Loamy sand	2.5Y4/4	36"	2.5Y6/3 10YR4/6	30%	<5%	5%	Granular	Friable	Very fine to fine
54"-112"	C2	Sand	2.5Y5/4				<5%	<5%	Single grain	Loose	Medium
112"-116"	C3	Sandy loam	2.5Y5/4				15%	20%	Massove	Firm	

Additional Notes:

Commonwealth of Massachusetts
City/Town of Pembroke

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review *(minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP-F (Hole #) 5/18/21 (Date) 11:20 AM (Time) Sunny 60 degrees (Weather) 42 6' 28.5" (Latitude) 70 46' 59.8" (Longitude:)

1. Land Use: Woodland (e.g., woodland, agricultural field, vacant lot, etc.) Pine, oak, maple (Vegetation) Common, some large boulder (Surface Stones (e.g., cobbles, stones, boulders, etc.)) 1-3% (Slope (%))

   Description of Location: ______

2. Soil Parent Material: Eolian deposits/glaciofluvial deposits Lake terraces/plains (Landform) ______ (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body >100 feet Drainage Way >100 feet Wetlands >100 feet
   Property Line 285+/- feet Drinking Water Well >100 feet Other ______ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: 60" Depth Weeping from Pit ______ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0"-9"	Ap	Sandy loam	7.5YR3/3				<5%	<5%	Massive	Friable	
9"-26"	Bw	Sandy loam	10YR4/4				<5%	<5%	Massive	Friable	
26"-96"	C1	Sand	2.5Y5/4	38"	2.5Y6/3 10YR4/6	30%	5-10%	5%	Single grain	Loose	Medium
96"-102"	C2	Sand	2.5Y4/4				20-25%	20%	Single grain	Loose	Medium - coarse Bog iron at bottom of exc.

Additional Notes: ______

Commonwealth of Massachusetts
City/Town of Pembroke

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

D. Determination of High Groundwater Elevation

1. Method Used: Obs. Hole # TP-E Obs. Hole # TP-F

	Obs. Hole # TP-E	Obs. Hole # TP-F
☐ Depth observed standing water in observation hole	_____ inches	_____ inches
☐ Depth weeping from side of observation hole	_____ inches	_____ inches
☒ Depth to soil redoximorphic features (mottles)	36 inches	38 inches
☐ Depth to adjusted seasonal high groundwater (S_h) (USGS methodology)	_____ inches	_____ inches

_______________ Index Well Number _______________ Reading Date

$S_h = S_c - [S_r \times (OW_c - OW_{max})/OW_r]$

Obs. Hole/Well# _____ S_c _____ S_r _____ OW_c _____ OW_{max} _____ OW_r _____ S_h _____

2. Estimated Depth to High Groundwater: _____ inches

E. Depth of Pervious Material

1. Depth of Naturally Occurring Pervious Material

a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

☒ Yes ☐ No

b. If yes, at what depth was it observed (exclude A and O Horizons)? Upper boundary: 26 inches Lower boundary: 102 inches

c. If no, at what depth was impervious material observed? Upper boundary: _____ inches Lower boundary: _____ inches

Commonwealth of Massachusetts
City/Town of Pembroke

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

F. Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct soil evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.100 through 15.107.

Alan W. Loomis

Signature of Soil Evaluator

May 18, 2021

Date

Alan W. Loomis, Soil Evaluator #1405

Typed or Printed Name of Soil Evaluator / License #

June 30, 2022

Expiration Date of License

Name of Approving Authority Witness

Approving Authority

Note: In accordance with 310 CMR 15.018(2) this form must be submitted to the approving authority within 60 days of the date of field testing, and to the designer and the property owner with Percolation Test Form 12.

Field Diagrams: Use this area for field diagrams:

Commonwealth of Massachusetts
City/Town of Pembroke

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

A. Facility Information

River Marsh, LLC
Owner Name

293R Washington Street
Street Address

Map E-17, Lot 0 & Map E-17A, Lot 274
Map/Lot #

Norwell
City

MA
State

02061
Zip Code

B. Site Information

1. (Check one) ☒ New Construction ☐ Upgrade ☐ Repair

2. Soil Survey Available? ☒ Yes ☐ No If yes: Web Soil Survey (Source) 200A & 221B (Soil Map Unit)

   Squamscott fine sand loam & Eldridge fine s.l. (Soil Name)

   Seasonal high watertables / slow permeability (Soil Limitations)

   Sandy eolian deposits/sandy glaciofluvial deposits

   Lake terraces, Lake Plains (Landform)

3. Surficial Geological Report Available? ☒ Yes ☐ No If yes: 2018 (Year Published/Source) Thin till (Map Unit)

   Till deposits less than 10 - 15 ft. thick
   Description of Geologic Map Unit:

4. Flood Rate Insurance Map Within a regulatory floodway? ☐ Yes ☒ No

5. Within a velocity zone? ☐ Yes ☒ No

6. Within a Mapped Wetland Area? ☐ Yes ☒ No If yes, MassGIS Wetland Data Layer: ______ Wetland Type

7. Current Water Resource Conditions (USGS): May 17, 2021 (Month/Day/ Year) Range: ☐ Above Normal ☒ Normal ☐ Below Normal

8. Other references reviewed:

Commonwealth of Massachusetts
City/Town of Pembroke

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review *(minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP-B-1-1 (Hole #) | 5/17/21 (Date) | 1:40 PM (Time) | Sunny 72 degrees (Weather) | 42 6' 27.8" (Latitude) | 70 46' 58.4" (Longitude:)

1. Land Use: Woodland (e.g., woodland, agricultural field, vacant lot, etc.) | Pine, oak, maple (Vegetation) | Common, some large boulder (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 3-5% (Slope (%))

   Description of Location: ______

2. Soil Parent Material: Eolian deposits/glaciofluvial deposits | Lake terraces/plains (Landform) | ______ (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body >100 feet | Drainage Way >100 feet | Wetlands >100 feet
   Property Line 410+/- feet | Drinking Water Well >100 feet | Other ______ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: 50" Depth Weeping from Pit ______ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0"-16"	Ap	Sandy loam	10YR3/3				5%	<5%	Massive	Friable	
16"-30"	Bw	Sandy loam	10YR4/6				5%	5%	Massive	Friable	
30"-54"	C1	Loamy sand	2.5Y5/4	38"	2.5Y6/3 10YR4/6	35%	5%	5%	Granular	Very friable	
54"-108"	C2	Sandy loam	2.5Y5/4				15%	20%	Granular	Firm	

Additional Notes:

Commonwealth of Massachusetts
City/Town of Pembroke

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review *(minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP-B-1-2 (Hole #) 5/17/21 (Date) 2:05 AM (Time) Sunny 72 degrees (Weather) 42 6' 27.5" (Latitude) 70 46' 58.3" (Longitude:)

1. Land Use: Woodland (e.g., woodland, agricultural field, vacant lot, etc.) Pine, oak, maple (Vegetation) Common, some large boulder (Surface Stones (e.g., cobbles, stones, boulders, etc.)) 3-5% (Slope (%))

   Description of Location: ______

2. Soil Parent Material: Eolian deposits/glaciofluvial deposits Lake terraces/plains (Landform) ______ (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body >100 feet Drainage Way >100 feet Wetlands >100 feet
   Property Line 225+/- feet Drinking Water Well >100 feet Other ____ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: 40" Depth Weeping from Pit ____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0"-16"	Ap	Sandy loam	7.5YR3/3				5%	5%	Massive	Friable	
16"-29"	Bw	Sandy loam	10YR4/4				5%	5%	Massive	Friable	
29"-41"	C1	Loamy sand	2.5Y4/4	37"	2.5Y6/3 10YR4/6	40%	10%	10%	Granular	Very friable	Fine-medium
41"-126"	C2	Sandy loam	2.5Y4/4				15%	20%	Blocky	Firm	

Additional Notes:

Commonwealth of Massachusetts
City/Town of Pembroke

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

D. Determination of High Groundwater Elevation

1. Method Used: Obs. Hole #TP-B-1-1 Obs. Hole #TP-B-1-2

	Obs. Hole #TP-B-1-1	Obs. Hole #TP-B-1-2
☐ Depth observed standing water in observation hole	_____ inches	_____ inches
☐ Depth weeping from side of observation hole	_____ inches	_____ inches
☒ Depth to soil redoximorphic features (mottles)	38 inches	37 inches
☐ Depth to adjusted seasonal high groundwater (S_h) (USGS methodology)	_____ inches	_____ inches

_____________________ Index Well Number   _____________________ Reading Date

$S_h = S_c - [S_r \times (OW_c - OW_{max})/OW_r]$

Obs. Hole/Well# _____ S_c _____ S_r _____ OW_c _____ OW_{max} _____ OW_r _____ S_h _____

2. Estimated Depth to High Groundwater: _____ inches

E. Depth of Pervious Material

1. Depth of Naturally Occurring Pervious Material

a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

☐ Yes ☐ No

b. If yes, at what depth was it observed (exclude A and O Horizons)? Upper boundary: _____ inches Lower boundary: _____ inches

c. If no, at what depth was impervious material observed? Upper boundary: _____ inches Lower boundary: _____ inches

Commonwealth of Massachusetts
City/Town of Pembroke

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

F. Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct soil evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.100 through 15.107.

Alan W. Loomis
Signature of Soil Evaluator

May 17, 2021
Date

Alan W. Loomis, Soil Evaluator #1405
Typed or Printed Name of Soil Evaluator / License #

June 30, 2022
Expiration Date of License

Name of Approving Authority Witness

Approving Authority

Note: In accordance with 310 CMR 15.018(2) this form must be submitted to the approving authority within 60 days of the date of field testing, and to the designer and the property owner with Percolation Test Form 12.

Field Diagrams: Use this area for field diagrams:

Commonwealth of Massachusetts
City/Town of 10%

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

A. Facility Information

River Marsh, LLC
Owner Name

293R Washington Street
Street Address

Map E-17, Lot 0 & Map E-17A, Lot 274
Map/Lot #

Norwell
City

MA
State

02061
Zip Code

B. Site Information

1. (Check one) ☒ New Construction ☐ Upgrade ☐ Repair

2. Soil Survey Available? ☒ Yes ☐ No If yes: Web Soil Survey (Source) 200A & 221B (Soil Map Unit)

   Squamscott fine sand loam & Eldridge fine s.l.
   Soil Name

   Seasonal high watertables / slow permeability
   Soil Limitations

   Sandy eolian deposits/sandy glaciofluvial deposits

   Lake terraces, Lake Plains
   Landform

3. Surficial Geological Report Available? ☒ Yes ☐ No If yes: 2018 (Year Published/Source) Thin till (Map Unit)

   Till deposits less than 10 - 15 ft. thick
   Description of Geologic Map Unit:

4. Flood Rate Insurance Map Within a regulatory floodway? ☐ Yes ☒ No

5. Within a velocity zone? ☐ Yes ☒ No

6. Within a Mapped Wetland Area? ☐ Yes ☒ No If yes, MassGIS Wetland Data Layer: ______ Wetland Type

7. Current Water Resource Conditions (USGS): May 17, 2021 (Month/Day/ Year) Range: ☐ Above Normal ☒ Normal ☐ Below Normal

8. Other references reviewed:

Commonwealth of Massachusetts
City/Town of 10%

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review *(minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP-B-1-3 (Hole #) 5/17/21 (Date) 2:30 PM (Time) Sunny 72 degrees (Weather) 42 6' 28.0" (Latitude) 70 46' 57.9" (Longitude:)

1. Land Use Woodland (e.g., woodland, agricultural field, vacant lot, etc.) Pine, oak, maple (Vegetation) Common, some large boulder (Surface Stones (e.g., cobbles, stones, boulders, etc.)) 3-5% (Slope (%))

   Description of Location: ______

2. Soil Parent Material: Eolian deposits/glaciofluvial deposits Lake terraces/plains (Landform) ______ (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body >100 feet Drainage Way >100 feet Wetlands >100 feet
   Property Line 425+/- feet Drinking Water Well >100 feet Other ______ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: 34" Depth Weeping from Pit ______ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0"-9"	Ap	Sandy loam	10YR3/3				5%	5%	Massive	Friable	
9"-21"	Bw	Sandy loam	10YR4/4				5%	5%	Massive	Friable	
21"-64"	C1	Loamy sand	2.5Y6/2	22"	2.5Y6/3 10YR4/6	30%	5%	5%	Blocky	Firm	
64"-90"	C2	Sandy loam	2.5Y4/4				20%	25%	Granular	Firm	Many stones & boulders

Additional Notes:

Commonwealth of Massachusetts
City/Town of 10%

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review *(minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: ______ Hole # ______ Date ______ Time ______ Weather ______ Latitude ______ Longitude:

1. Land Use: ______ (e.g., woodland, agricultural field, vacant lot, etc.) ______ Vegetation ______ Surface Stones (e.g., cobbles, stones, boulders, etc.) ______ Slope (%)

   Description of Location: ______

2. Soil Parent Material: ______ ______ Landform ______ Position on Landscape (SU, SH, BS, FS, TS)

3. Distances from: Open Water Body ______ feet Drainage Way ______ feet Wetlands ______ feet
   Property Line ______ feet Drinking Water Well ______ feet Other ______ feet

4. Unsuitable Materials Present: ☐ Yes ☐ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☐ No If yes: ______ Depth Weeping from Pit ______ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			

Additional Notes:

______

Commonwealth of Massachusetts
City/Town of 10%

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

D. Determination of High Groundwater Elevation

1. Method Used: Obs. Hole #TP-B-1-3 Obs. Hole #_____

	Obs. Hole #TP-B-1-3	Obs. Hole #_____
☐ Depth observed standing water in observation hole	_____ inches	_____ inches
☐ Depth weeping from side of observation hole	_____ inches	_____ inches
☒ Depth to soil redoximorphic features (mottles)	22 inches	_____
☐ Depth to adjusted seasonal high groundwater (S_h) (USGS methodology)	_____ inches	_____ inches

________________________ ________________________
Index Well Number Reading Date

$S_h = S_c - [S_r \times (OW_c - OW_{max})/OW_r]$

Obs. Hole/Well# _____ S_c _____ S_r _____ OW_c _____ OW_{max} _____ OW_r _____ S_h _____

2. Estimated Depth to High Groundwater: _____ inches

E. Depth of Pervious Material

1. Depth of Naturally Occurring Pervious Material

a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

☐ Yes ☐ No

b. If yes, at what depth was it observed (exclude A and O Horizons)? Upper boundary: _____ inches Lower boundary: _____ inches

c. If no, at what depth was impervious material observed? Upper boundary: _____ inches Lower boundary: _____ inches

Commonwealth of Massachusetts
City/Town of 10%

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

F. Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct soil evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.100 through 15.107.

Alan W. Loomis

Signature of Soil Evaluator

May 17, 2021
Date

Alan W. Loomis, Soil Evaluator #1405
Typed or Printed Name of Soil Evaluator / License #

June 30, 2022
Expiration Date of License

Name of Approving Authority Witness

Approving Authority

Note: In accordance with 310 CMR 15.018(2) this form must be submitted to the approving authority within 60 days of the date of field testing, and to the designer and the property owner with Percolation Test Form 12.

Field Diagrams: Use this area for field diagrams:

Commonwealth of Massachusetts
City/Town of Pembroke

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

A. Facility Information

River Marsh, LLC
Owner Name

293R Washington Street
Street Address

Map E-17, Lot 0 & Map E-17A, Lot 274
Map/Lot #

Norwell
City

MA
State

02061
Zip Code

B. Site Information

1. (Check one) ☒ New Construction ☐ Upgrade ☐ Repair

2. Soil Survey Available? ☒ Yes ☐ No If yes: Web Soil Survey (Source) 200A & 221B (Soil Map Unit)

   Squamscott fine sand loam & Eldridge fine s.l.
   Soil Name

   Seasonal high watertables / slow permeability
   Soil Limitations

   Sandy eolian deposits/sandy glaciofluvial deposits

   Lake terraces, Lake Plains
   Landform

3. Surficial Geological Report Available? ☒ Yes ☐ No If yes: 2018 (Year Published/Source) Thin till (Map Unit)

   Till deposits less than 10 - 15 ft. thick
   Description of Geologic Map Unit:

4. Flood Rate Insurance Map Within a regulatory floodway? ☐ Yes ☒ No

5. Within a velocity zone? ☐ Yes ☒ No

6. Within a Mapped Wetland Area? ☐ Yes ☒ No If yes, MassGIS Wetland Data Layer: ______ Wetland Type

7. Current Water Resource Conditions (USGS): May 18, 2021 (Month/Day/ Year) Range: ☐ Above Normal ☒ Normal ☐ Below Normal

8. Other references reviewed:

Commonwealth of Massachusetts
City/Town of Pembroke

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review *(minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP-B-2-1 (Hole #) | 5/18/21 (Date) | 2:10 PM (Time) | Sunny 80 degrees (Weather) | 42 6' 29.1" (Latitude) | 70 46' 52.1" (Longitude:)

1. Land Use: Woodland (e.g., woodland, agricultural field, vacant lot, etc.) | Pine, oak, maple (Vegetation) | Common, some large boulder (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 3-5% (Slope (%))

   Description of Location: ________

2. Soil Parent Material: Eolian deposits/glaciofluvial deposits | Lake terraces/plains (Landform) | ______ Position on Landscape (SU, SH, BS, FS, TS)

3. Distances from: Open Water Body >100 feet | Drainage Way >100 feet | Wetlands >100 feet
   Property Line 30+/- feet | Drinking Water Well >100 feet | Other _____ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: 26" Depth Weeping from Pit _____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0"-13"	Ap	Sandy loam	10YR2/2				5%	10%	Massive	Friable	
13"-23"	Bw	Sandy loam	10YR4/4				5%	10%	Massive	Friable	
23"-38"	C1	Loamy sand	2.5Y6/3	26"	2.5Y6/3 10YR4/6	40%	5%	5%	Granular	Friable	
38"-82"	C2	Dense sandy loam	2.5Y5/4				15%	20%	Blocky	Firm	

Additional Notes:
Boulder refusal at 82"

Commonwealth of Massachusetts
City/Town of Pembroke

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review *(minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP-B-2-2 (Hole #) 5/18/21 (Date) 2:30 PM (Time) Sunny 72 degrees (Weather) 42 6' 29.0" (Latitude) 70 46' 52.5" (Longitude:)

1. Land Use: Woodland (e.g., woodland, agricultural field, vacant lot, etc.) Pine, oak, maple (Vegetation) Common, some large boulder (Surface Stones (e.g., cobbles, stones, boulders, etc.)) 3-5% (Slope (%))

Description of Location: ______

2. Soil Parent Material: Eolian deposits/glaciofluvial deposits Lake terraces/plains (Landform) ______ (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body >100 feet Drainage Way >100 feet Wetlands >100 feet
Property Line 35+/- feet Drinking Water Well >100 feet Other ______ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: 24" Depth Weeping from Pit ______ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0"-11"	Ap	Sandy loam	10YR2/2				5%	5%	Massive	Friable	
11"-22"	Bw	Sandy loam	10YR7/1				5%	5%	Massive	Friable	
22"-35"	C1	Loamy sand/sand	2.5Y6/2	22"	2.5Y6/3 10YR4/6	40%	10%	10%	Granular	Very friable	Medium
35"-88"	C2	Dense sandy loam	2.5Y5/4				15%	20%	Blocky	Firm	Very silty

Additional Notes:
Boulder refusal at bottom

Commonwealth of Massachusetts
City/Town of Pembroke

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

D. Determination of High Groundwater Elevation

1. Method Used: Obs. Hole # TP-B-2-1 Obs. Hole # TP-B-2-2

	Obs. Hole # TP-B-2-1	Obs. Hole # TP-B-2-2
☐ Depth observed standing water in observation hole	_____ inches	_____ inches
☐ Depth weeping from side of observation hole	_____ inches	_____ inches
☒ Depth to soil redoximorphic features (mottles)	26 inches	22 inches
☐ Depth to adjusted seasonal high groundwater (S_h) (USGS methodology)	_____ inches	_____ inches

_____ Index Well Number _____ Reading Date

$S_h = S_c - [S_r \times (OW_c - OW_{max})/OW_r]$

Obs. Hole/Well# _____ S_c _____ S_r _____ OW_c _____ OW_{max} _____ OW_r _____ S_h _____

2. Estimated Depth to High Groundwater: _____ inches

E. Depth of Pervious Material

1. Depth of Naturally Occurring Pervious Material

a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

☐ Yes ☐ No

b. If yes, at what depth was it observed (exclude A and O Horizons)? Upper boundary: _____ inches Lower boundary: _____ inches

c. If no, at what depth was impervious material observed? Upper boundary: _____ inches Lower boundary: _____ inches

Commonwealth of Massachusetts
City/Town of Pembroke

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

F. Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct soil evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.100 through 15.107.

Alan W. Loomis	May 18, 2021
Signature of Soil Evaluator	Date
Alan W. Loomis, Soil Evaluator #1405	June 30, 2022
Typed or Printed Name of Soil Evaluator / License #	Expiration Date of License
Name of Approving Authority Witness	Approving Authority

Note: In accordance with 310 CMR 15.018(2) this form must be submitted to the approving authority within 60 days of the date of field testing, and to the designer and the property owner with Percolation Test Form 12.

Field Diagrams: Use this area for field diagrams:

Commonwealth of Massachusetts
City/Town of 10%

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

A. Facility Information

River Marsh, LLC
Owner Name

293R Washington Street
Street Address

Map E-17, Lot 0 & Map E-17A, Lot 274
Map/Lot #

Norwell
City

MA
State

02061
Zip Code

B. Site Information

1. (Check one) ☒ New Construction ☐ Upgrade ☐ Repair

2. Soil Survey Available? ☒ Yes ☐ No If yes: Web Soil Survey (Source) 200A & 221B (Soil Map Unit)

   Squamscott fine sand loam & Eldridge fine s.l. (Soil Name)
   Seasonal high watertables / slow permeability (Soil Limitations)
   Sandy eolian deposits/sandy glaciofluvial deposits
   Lake terraces, Lake Plains (Landform)

3. Surficial Geological Report Available? ☒ Yes ☐ No If yes: 2018 (Year Published/Source) Thin till (Map Unit)

   Till deposits less than 10 - 15 ft. thick
   Description of Geologic Map Unit:

4. Flood Rate Insurance Map Within a regulatory floodway? ☐ Yes ☒ No

5. Within a velocity zone? ☐ Yes ☒ No

6. Within a Mapped Wetland Area? ☐ Yes ☒ No If yes, MassGIS Wetland Data Layer: ______ Wetland Type

7. Current Water Resource Conditions (USGS): May 18, 2021 (Month/Day/ Year) Range: ☐ Above Normal ☒ Normal ☐ Below Normal

8. Other references reviewed:

Commonwealth of Massachusetts
City/Town of 10%

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review *(minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP-B-2-3 (Hole #) | 5/18/21 (Date) | 1:45 PM (Time) | Sunny 80 degrees (Weather) | 42 6' 28.9" (Latitude) | 70 46' 51.7" (Longitude:)

1. Land Use: Woodland (e.g., woodland, agricultural field, vacant lot, etc.) | Pine, oak, maple (Vegetation) | Common, some large boulder (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 3-5% (Slope (%))

   Description of Location: ______

2. Soil Parent Material: Eolian deposits/glaciofluvial deposits | Lake terraces/plains (Landform) | ______ (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body >100 feet | Drainage Way >100 feet | Wetlands >100 feet
   Property Line 35+/- feet | Drinking Water Well >100 feet | Other ______ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: 36" Depth Weeping from Pit ______ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0"-11"	Ap	Sandy loam	10YR3/2				10%	10%	Massive	Friable	
11"-26"	Bw	Sandy loam	10YR4/4				10%	10%	Massive	Friable	
26"-38"	C1	Loamy sand	2.5Y4/4	36"	2.5Y6/3 10YR4/6	40%	10%	10%	Granular	Firm	Medium - coarse
38"-72"	C2	Dense Sandy loam	2.5Y4/4				10%	20%	Blocky	Firm	Very silty

Additional Notes:
Boulder or ledge refusal at 72"

Commonwealth of Massachusetts
City/Town of 10%

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review *(minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: ______ Hole # ______ Date ______ Time ______ Weather ______ Latitude ______ Longitude:

1. Land Use: ______ (e.g., woodland, agricultural field, vacant lot, etc.) ______ Vegetation ______ Surface Stones (e.g., cobbles, stones, boulders, etc.) ______ Slope (%)

   Description of Location: ______

2. Soil Parent Material: ______ ______ Landform ______ Position on Landscape (SU, SH, BS, FS, TS)

3. Distances from: Open Water Body ______ feet Drainage Way ______ feet Wetlands ______ feet
   Property Line ______ feet Drinking Water Well ______ feet Other ______ feet

4. Unsuitable Materials Present: ☐ Yes ☐ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☐ No If yes: ______ Depth Weeping from Pit ______ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			

Additional Notes:

Commonwealth of Massachusetts
City/Town of 10%

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

D. Determination of High Groundwater Elevation

1. Method Used:	Obs. Hole # TP-B-2-3	Obs. Hole # _____
☐ Depth observed standing water in observation hole	_____ inches	_____ inches
☐ Depth weeping from side of observation hole	_____ inches	_____ inches
☒ Depth to soil redoximorphic features (mottles)	36 inches	_____
☐ Depth to adjusted seasonal high groundwater (S_h) (USGS methodology)	_____ inches	_____ inches

_____________________ Index Well Number   _____________________ Reading Date

$S_h = S_c - [S_r \times (OW_c - OW_{max})/OW_r]$

Obs. Hole/Well# _____ S_c _____ S_r _____ OW_c _____ OW_{max} _____ OW_r _____ S_h _____

2. Estimated Depth to High Groundwater: _____ inches

E. Depth of Pervious Material

1. Depth of Naturally Occurring Pervious Material

a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

☐ Yes ☐ No

b. If yes, at what depth was it observed (exclude A and O Horizons)? Upper boundary: _____ inches Lower boundary: _____ inches

c. If no, at what depth was impervious material observed? Upper boundary: _____ inches Lower boundary: _____ inches

Commonwealth of Massachusetts
City/Town of 10%

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

F. Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct soil evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.100 through 15.107.

Alan W. Loomis

Signature of Soil Evaluator	May 18, 2021 Date
Alan W. Loomis, Soil Evaluator #1405 Typed or Printed Name of Soil Evaluator / License #	June 30, 2022 Expiration Date of License
Name of Approving Authority Witness	Approving Authority

Note: In accordance with 310 CMR 15.018(2) this form must be submitted to the approving authority within 60 days of the date of field testing, and to the designer and the property owner with Percolation Test Form 12.

Field Diagrams: Use this area for field diagrams:

A P P E N D I X F

Best Management Practices Operation and Maintenance Plans

CONSTRUCTION PHASE POLLUTION PREVENTION AND EROSION AND SEDIMENTATION CONTROL PLAN (BEST MANAGEMENT PRACTICES OPERATION AND MAINTENANCE PLAN)

for

River Marsh Village

In

Pembroke, Massachusetts
(Assessor's Map E-17, Lot 0 & E-17A, Lot 274)

Submitted to:

TOWN OF PEMBROKE

Prepared for:

River Marsh, LLC
239R Washington Street
Norwell, Massachusetts 02061

Prepared by:

MCKENZIE
ENGINEERING GROUP

Professional Civil Engineering • Project Management • Land Planning
150 Longwater Drive, Suite 101, Norwell, Massachusetts 02061
Tel.: (781) 792-3900 Facsimile: (781) 792-0333
www.mckeng.com

April 5, 2021
Revised June 7, 2021

TABLE OF CONTENTS

Construction Phase Pollution Prevention &
Erosion and Sedimentation Control Plan

Erosion and Sedimentation will be controlled at the site by utilizing Structural Practices, Stabilization Practices, and Dust Control. These practices correspond with plans entitled "River Marsh Village Comprehensive Permit Plan, Assessor's Map E-17, Lot 0 & E-17A, Lot 274) Water Street, Pembroke, MA dated September 22, 2016 as revised and approved, prepared by McKenzie Engineering Group, Inc., hereinafter referred to as the Site Plans.

Property Owner:

River Marsh, LLC
293R Washington Street
Norwell, MA 02061

Developer Contact Information:

River marsh, LLC
293R Washington Street
Norwell, MA 02061

Town of Pembroke Contact Information:

Pembroke Department of Public Works
Eugene Fulmine, Jr., Director
100 Center Street
Pembroke, MA 02359
Phone: 781-293-5620
Fax: 781-293-2964

Pembroke Conservation Commission
Robert Clarke, Agent
100 Center Street
Pembroke, MA 02359
Phone: 781-293-4674

Pembroke Building Department
George Verry, Inspector of Buildings & Zoning Officer
100 Center Street
Pembroke, MA 02359
Phone: 781-293-3864
Fax: 781-293-9250

Pembroke Zoning Board of Appeals
Matthew Heins, Administrative Assistant
100 Center Street
Pembroke, MA 02359
Phone: 781-294-4425
Fax: 781-709-1453

Erosion and Sedimentation Control Practices:

Structural Practices:

1) **Compost Filter Tube Sock Barrier Controls** – A compost filter tube barrier will be constructed along downward slopes at the limit of work in locations shown on the plans. This control will be installed prior to major soil disturbance on the site. The sediment silt sock should be installed as shown on the Erosion Control Detail Plan.

   Compost Filter Tube Design/Installation Requirements

   a) Locate the compost filter tube identified on the plans.
   b) The compost filter tube line should be nearly level through most of its length to impound a broad, temporary pool. The last 10 to 20 feet at each end of the silt sock should be swung slightly uphill (approximately 0.5 feet in elevation) to provide storage capacity.
   c) The compost filter tube shall be staked every 8 linear feet with 1-inch by 1-inch stakes.
   d) Compost filter tubes should be removed when they have served their useful purpose, but not before the upslope area has been permanently stabilized through one growing season. Retained sediment must be removed and properly disposed of or mulched and seeded.

   Compost Filter Tube Inspection/Maintenance

   a) Compost filter tubes should be inspected immediately after each rainfall event of 1-inch or greater, and at least daily during prolonged rainfall. Inspect the depth of sediment, fabric tears, and to see that the stakes are firmly in the ground. Repair or replace as necessary.
   b) Remove sediment deposits promptly after storm events to provide adequate storage volume for the next rain and to reduce pressure on the sock. Sediment will be removed from behind the silt sock when it becomes about ½ foot deep at the silt sock. Take care to avoid undermining the sock during cleanout.
   c) If the fabric tears, decomposes, or in any way becomes ineffective, replace it immediately.
   d) Remove all compost filter tube materials only after the contributing drainage areas have been properly stabilized. Sediment deposits and silt sock materials remaining after stakes have been removed should be graded to conform to the existing topography and vegetated.

2) **Stabilized Construction Entrance** – A stabilized construction entrances will be placed at the proposed entrances on Water Street. The stabilized construction entrances will be installed immediately after the clearing and grubbing of the site entrance and associated roadway cut/fill to maintain access to the site are completed. The stormwater runoff from the entrance will be diverted to temporary sedimentation basins alongside the proposed driveway. The construction entrance will keep mud and sediment from being tracked off the construction site onto Water Street by vehicles leaving the site. The stabilized construction entrances shall be constructed as shown on the Erosion Control Detail Plan.

Construction Entrance Design/Construction Requirements *

a) Grade foundation for positive drainage towards the temporary sedimentation basin along the side of the roadway.

b) Stone for a stabilized construction entrance shall consist of 1 to 3-inch stone placed on a stable foundation.

c) Pad dimensions: The minimum length of the gravel pad should be 50 feet. The pad should extend the full width of the proposed roadway, or wide enough so that the largest construction vehicle will fit in the entrance with room to spare; whichever is greater. If a large amount of traffic is expected at the entrance, then the stabilized construction entrance should be wide enough to fit two vehicles across with room to spare.

d) A geotextile filter fabric shall be placed between the stone fill and the earth surface below the pad to reduce the migration of soil particles from the underlying soil into the stone and vice versa. The filter fabric should be Amoco woven polypropylene 1198 or equivalent.

e) Washing: If the site conditions are such that the majority of mud is not removed from the vehicle tires by the gravel pad, then the tires should be washed before the vehicle enters the street. The wash area should be a level area with 3-inch washed stone minimum, or a commercial rack.

f) Water employed in the washing process shall be directed to a sediment trap or approved sediment-trapping device prior to discharge to a temporary sedimentation basin along side the site entrance drives. Sediment should be prevented from entering any watercourses.

Construction Entrance Inspection/Maintenance *

a) The entrance should be maintained in a condition that will prevent tracking or flowing of sediment onto Water Street. This may require periodic topdressing with additional stone.

b) The construction entrance and sediment disposal area shall be inspected weekly and after heavy rains or heavy use.

c) Mud and sediment tracked or washed onto public road shall be immediately removed by sweeping.

d) Once mud and soil particles clog the voids in the gravel and the effectiveness of the gravel pad is no longer satisfactory, the pad must be topdressed with new stone. Replacement of the entire pad may be necessary when the pad becomes completely clogged.

e) If washing facilities are used, the sediment traps should be cleaned out as often as necessary to assure that adequate trapping efficiency and storage volume is available.

f) The pad shall be reshaped as needed for drainage and runoff control.

g) Broken road pavement on Water Street shall be repaired immediately.

h) All temporary erosion and sediment control measures shall be removed within 30 days after final site stabilization is achieved or after the temporary practices are no longer needed. Trapped sediment shall be removed or stabilized on site. Disturbed soil areas resulting from removal shall be permanently stabilized.

3) **<u>Inlet Protection</u>** – Inlet Protection will be utilized around the catch basin grates. The inlet protection will allow the storm drain inlets to be used before final stabilization. This structural practice will allow early use of the drainage system if the detention basin is already stabilized. Siltsack or equivalent will be utilized for the inlet protection. Siltsack is manufactured by ACF Environmental. The telephone number is 1-800-437-6746. Regular flow siltsack will be utilized, and if it does not allow enough storm water flow, hi-flow siltsack will be utilized.

<u>Silt Sack (or equivalent) Inlet Protection Inspection/Maintenance Requirements *</u>

a) All trapping devices and the structures they protect should be inspected after every rainstorm and repairs made as necessary.

b) Sediment should be removed from the trapping devices after the sediment has reached a maximum depth of one-half the depth of the trap.

c) Sediment should be disposed of in a suitable area and protected from erosion by either structural or vegetative means. Sediment removed shall be disposed of in accordance with all applicable local, state, and federal regulations.

d) The silt sack must be replaced if it is ripped or torn in any way.

e) Temporary traps should be removed and the area repaired as soon as the contributing drainage area to the inlet has been completely stabilized.

<u>Stabilization Practices</u>:

Stabilization measures shall be implemented as soon as practicable in portions of the site where construction activities have temporarily or permanently ceased, but in no case more than 14 days after the construction activity in that portion of the site has temporarily or permanently ceased, with the following exceptions.

- Where the initiation of stabilization measures by the 14th day after construction activity temporary or permanently cease is precluded by snow cover, stabilization measures shall be initiated as soon as practicable.

- Where construction activity will resume on a portion of the site within 21 days from when activities ceased, (e.g. the total time period that construction activity is temporarily ceased is less than 21 days) then stabilization measures do not have to be initiated on that portion of the site by the 14th day after construction activity temporarily ceased.

- The contractor shall provide erosion control measures around all soil stockpiles.

1) **Temporary Seeding** – Temporary seeding will allow a short-term vegetative cover on disturbed site areas that may be in danger of erosion. Temporary seeding will be done at stock piles and disturbed portions of the site where construction activity will temporarily cease for at least 21 days. The temporary seedings will stabilize cleared and unvegetated areas that will not be brought into final grade for several weeks or months.

Temporary Seeding Planting Procedures *

a) Planting should preferably be done between April 1st and June 30th, and September 1st through September 31st. If planting is done in the months of July and August, irrigation may be required. If planting is done between October 1st and March 31st, mulching should be applied immediately after planting. If seeding is done during the summer months, irrigation of some sort will probably be necessary.

b) Before seeding, install structural practice controls. Utilize Amoco supergro or equivalent.

c) The seedbed should be firm with a fairly fine surface. Perform all cultural operations across or at right angles to the slope. A minimum of 2 to 4-inches of tilled topsoil is required. The topsoil must have a sandy loam to silt loam texture with 15% to 20% organic content.

d) Apply uniformly 2 tons of ground limestone per acre (100 lbs. Per 1,000 sq.ft.) or according to soil test. Apply uniformly 10-10-10 analysis fertilizer at the rate of 400 lbs. per acre (14 lbs. per 1,000 sq.ft.) or as indicated by soil test. Forty percent of the nitrogen should be in organic form. Work in lime and fertilizer to a depth of 4-inches using any suitable equipment.

e) Select the appropriate seed species for temporary cover from the following table.

Species	Seeding Rate (lbs/1,000 sq.ft.)	Seeding Rate (lbs/acre)	Recommended Seeding Dates	Seed Cover required
Annual Ryegrass	1	40	April 1st to June 1st August 15th to Sept. 15th	¼ inch
Foxtail Millet	0.7	30	May 1st to June 30th	½ to ¾ inch
Oats	2	80	April 1st to July 1st August 15th to Sept. 15th	1 to 1-½ inch
Winter Rye	3	120	August 15th to Oct. 15th	1 to 1-½ inch

Apply the seed uniformly by hydroseeding, broadcasting, or by hand.

f) Use an effective mulch, such as clean grain straw; tacked and/or tied with netting to protect seedbed and encourage plant growth.

Temporary Seeding Inspection/Maintenance *

a) Inspect within 6 weeks of planting to see if stands are adequate. Check for damage within 24 hours of the end to a heavy rainfall, defined as a 2-year storm event (i.e., 3.2 inches of rainfall within a twenty-four hour period). Stands should be uniform and dense. Fertilize, reseed, and mulch damaged and sparse areas immediately. Tack or tie down mulch as necessary.

b) Seeds should be supplied with adequate moisture. Furnish water as needed, especially in abnormally hot or dry weather. Water application rates should be controlled to prevent runoff.

2) **Geotextiles** - Geotextiles such as jute netting will be used in combination with other practices such as mulching to stabilize slopes. The following geotextile materials or equivalent are to be utilized for structural and nonstructural controls as shown in the following table.

Practice	**Manufacturer**	**Product**	**Remarks**
Sediment Fence	Amoco	Woven polypropylene 1198 or equivalent	0.425 mm opening
Construction Entrance	Amoco	Woven polypropylene 2002 or equivalent	0.300 mm opening
Outlet Protection	Amoco	Nonwoven polypropylene 4551 or equivalent	0.150 mm opening

Amoco may be reached at (800) 445-7732

Geotextile Installation

a) Netting and matting require firm, continuous contact between the materials and the soil. If there is no contact, the material will not hold the soil and erosion will occur underneath the material.

Geotextile Inspection/Maintenance *

a) In the field, regular inspections should be made to check for cracks, tears, or breaches in the fabric. The appropriate repairs should be made.

3) **Mulching and Netting** – Mulching will provide immediate protection to exposed soils during the period of short construction delays, or over winter months through the application of plant residues, or other suitable materials, to exposed soil areas. In areas, which have been seeded either for temporary or permanent cover, mulching should immediately follow seeding. On steep slopes, mulch must be supplemented with netting. The preferred mulching material is straw.

Mulch Maintenance *

a) Inspect after rainstorms to check for movement of mulch or erosion. If washout, breakage, or erosion occurs, repair surface, reseed, remulch, and install new netting.

b) Grass mulches that blow or wash away should be repaired promptly.

c) If plastic netting is used to anchor mulch, care should be taken during initial mowing's to keep the mower height high. Otherwise, the netting can wrap up on the mower blade shafts. After a period of time, the netting degrades and becomes less of a problem.

d) Continue inspections until vegetation is well established.

4) **Land Grading** – Grading on fill slopes, cut slopes, and stockpile areas will be done with full siltation controls in place.

Land Grading Design/Installation Requirements

a) Areas to be graded should be cleared and grubbed of all timber, logs, brush, rubbish, and vegetated matter that will interfere with the grading operation. All brush, tree limbs, tree trunk and stump disposal shall take place off site and within 30 days of cutting. All disposal shall be in accordance with federal, state and local regulations. Any temporary stockpiling of brush, tree limbs, tree trunks or stumps shall be surrounded with an erosion control barrier. Topsoil should be stripped and stockpiled for use on critical disturbed areas for establishment of vegetation. Cut slopes to be topsoiled should be thoroughly scarified to a minimum depth of 3-inches prior to placement of topsoil.

b) Fill materials should be generally free of brush, rubbish, rocks, and stumps. Frozen materials or soft and easily compressible materials should not be used in fills intended to support buildings, parking lots, roads, conduits, or other structures.

c) Earth fill intended to support structural measures should be compacted to a minimum of 90 percent of Standard Proctor Test density with proper moisture control, or as otherwise specified by the engineer responsible for the design. Compaction of other fills should be to the density required to control sloughing, erosion or excessive moisture content. Maximum thickness of fill layers prior to compaction should not exceed 9 inches.

d) The uppermost one foot of fill slopes should be compacted to at least 85 percent of the maximum unit weight (based on the modified AASHTO compaction test). This is usually accomplished by running heavy equipment over the fill.

e) Fill should consist of material from borrow areas and excess cut will be stockpiled in areas shown on the Site Plans. All disturbed areas should be free draining, left with a neat and finished appearance, and should be protected from erosion.

Land Grading Stabilization Inspection/Maintenance *

a) All slopes should be checked periodically to see that vegetation is in good condition. Any rills or damage from erosion and animal burrowing should be repaired immediately to avoid further damage.

b) If seeps develop on the slopes, the area should be evaluated to determine if the seep will cause an unstable condition. Subsurface drains or a gravel mulch may be required to solve seep problems. However, no seeps are anticipated.

c) Areas requiring revegetation should be repaired immediately. Slopes should be limed and fertilized as necessary to keep vegetation healthy. Control undesirable vegetation such as weeds and woody growth to avoid bank stability problems in the future.

5) **Topsoiling *** – Topsoiling will help establish vegetation on all disturbed areas throughout the site during the seeding process. The soil texture of the topsoil to be used will be a sandy loam to a silt loam texture with 15% to 20% organic content.

Topsoiling Placement

a) Topsoil should not be placed while in a frozen or muddy condition, when the subgrade is excessively wet, or when conditions exist that may otherwise be detrimental to proper grading or proposed seeding.

b) Do not place topsoil on slopes steeper than 2.5:1, as it will tend to erode.

c) If topsoil and subsoil are not properly bonded, water will not infiltrate the soil profile evenly and it will be difficult to establish vegetation. The best method is to actually work the topsoil into the layer below for a depth of at least 6 inches.

6) **Permanent Seeding** – Permanent Seeding should be done immediately after the final design grades are achieved. Native species of plants should be used to establish perennial vegetative cover on disturbed areas. The revegetation should be done early enough in the fall so that a good cover is established before cold weather comes and growth stops until the spring. A good cover is defined as vegetation covering 75 percent or more of the ground surface.

Permanent Seeding Seedbed Preparation

a) In infertile or coarse-textured subsoil, it is best to stockpile topsoil and respread it over the finished slope at a minimum 2 to 6-inch depth and roll it to provide a
b) firm seedbed. The topsoil must have a sandy loam to silt loam texture with 15% to 20% organic content. If construction fill operations have left soil exposed with a loose, rough, or irregular surface, smooth with blade and roll.

c) Loosen the soil to a depth of 3-5 inches with suitable agricultural or construction equipment.

d) Areas not to receive topsoil shall be treated to firm the seedbed after incorporation of the lime and fertilizer so that it is depressed no more than ½ - 1 inch when stepped on with a shoe. Areas to receive topsoil shall not be firmed until after topsoiling and lime and fertilizer is applied and incorporated, at which time it shall be treated to firm the seedbed as described above.

Permanent Seeding Grass Selection/Application

a) Select an appropriate cool or warm season grass based on site conditions and seeding date. Apply the seed uniformly by hydroseeding, broadcasting, or by hand. Uniform seed distribution is essential. On steep slopes, hydroseeding may be the most effective seeding method. Surface roughening is particularly important when preparing slopes for hydroseeding.

b) Lime and fertilize. Organic fertilizer shall be utilized in areas within the 100 foot buffer zone to a wetland resource area.

c) Mulch the seedings with straw applied at the rate of ½ tons per acre. Anchor the mulch with erosion control netting or fabric on sloping areas. Amoco supergro or equivalent should be utilized.

Permanent Seeding Inspection/Maintenance *

a) Frequently inspect seeded areas for failure and make necessary repairs and reseed immediately. Conduct or follow-up survey after one year and replace failed plants where necessary.

b) If vegetative cover is inadequate to prevent rill erosion, overseed and fertilize in accordance with soil test results.

c) If a stand has less than 40% cover, reevaluate choice of plant materials and quantities of lime and fertilizer. Re-establish the stand following seedbed preparation and seeding recommendations, omitting lime and fertilizer in the absence of soil test results. If the season prevents resowing, mulch or jute netting is an effective temporary cover.

d) Seeded areas should be fertilized during the second growing season. Lime and fertilize thereafter at periodic intervals, as needed. Organic fertilizer shall be utilized in areas within the 100-foot buffer zone to a wetland resource area.

Dust Control *:

Dust control will be utilized throughout the entire construction process of the site. For example, keeping disturbed surfaces moist during windy periods will be an effective control measure, especially for construction haul roads. The use of dust control will prevent the movement of soil to offsite areas. However, care must be taken to not create runoff from excessive use of water to control dust. The following are methods of Dust Control that may be used on-site:

- Vegetative Cover – The most practical method for disturbed areas not subject to traffic.
- Calcium Chloride – Calcium chloride may be applied by mechanical spreader as loose, dry granules or flakes at a rate that keeps the surface moist but not so high as to cause water pollution or plant damage.
- Sprinkling – The site may be sprinkled until the surface is wet. Sprinkling will be effective for dust control on haul roads and other traffic routes.
- Stone – Stone will be used to stabilize construction roads; will also be effective for dust control.

Non-Stormwater Discharges:

During construction activities at the site, some water from the site will be suitable for discharge to the detention areas and/or temporary sediment basin areas. Non-stormwater discharges will be directed to recharge groundwater and to replenish wetland resource areas.

The construction de-watering and all non-stormwater discharges will be directed into a sediment dirt bag (or equivalent inlet protection) or a sediment basin. Sediment material removed shall be disposed of in accordance with all applicable local, state, and federal regulations.

The developer and site general contractor will comply with the E.P.A.'s Final General Permit for Construction De-watering Discharges.

Soil Stockpiling *:

Topsoil and subsoil from the driveway and parking area grading will be stockpiled in locations shown on the plans.

Stockpile Material Construction Procedure

1) Topsoil and subsoil that are stripped will be stockpiled for later distribution on disturbed areas.

2) The stockpiles will be located as shown on the plans. These locations will allow them to not interfere with work on the site.

3) Seed the stockpiles with a temporary erosion control mix if the stockpile is to remain undisturbed for more than 30 days. The stockpiles must be stable and the side slopes should not exceed 2:1.

4) Sediment silt sock or hay bale barrier erosion control measure should be placed surrounding each stockpile.

5) As needed, the stockpiled topsoil and subsoil are redistributed throughout the site.

Pollution Prevention:

Fueling and Maintenance of Equipment or Vehicles

Refueling/maintenance Rules – The site supervisor shall produce a written document received by all subcontractors and employees that delineates their responsibilities on site. This document shall include language that shall permit the maintenance of vehicles only in designated locations on the job site. In the event of mechanical failure of a vehicle, the vehicle shall be moved to the designated maintenance area on the site to perform maintenance. The site supervisor shall document receipt of these instructions by obtaining the signatures of subcontractors and individuals that may enter the site and the date in which they were notified of their responsibilities. Refueling for vehicles or equipment shall occur either within the designated washout area or shall utilize temporary drip protection measures at the location of fueling. The site supervisor or their representative shall be present at the time of any fueling procedure. The site supervisor shall have a fuel spill plan and measures on site to initiate containment and clean-up in the event a fuel spill occurs.

1. Fueling operations shall take place in designated area(s) as shown on site maps. Provide temporary drip protection during fueling operations which take place outside of designated area(s). Materials necessary to address a spill shall be made readily available in a location known to the site supervisor or his/her designee.
2. Fueling operation procedures shall be in effect throughout the project duration.

Maintenance Requirements

1. All emergency response equipment listed in the Emergency Response Equipment Inventory shall be made readily available and kept in a designated

location known to the site supervisor or his/her designee. All such materials shall be replenished as necessary to the listed amounts.

Washing of Equipment and Vehicles

Vehicle Washing Rules - The site supervisor shall produce a written document received by all subcontractors and employees that delineates their responsibilities on site. The site supervisor shall document receipt of these instructions by obtaining the signatures of subcontractors and individuals that may enter the site and the date in which they were notified of their responsibilities. This document shall include language that shall not permit vehicle washing on the job site. Concrete trucks shall be exempt from this rule. Concrete truck cleaning shall be confined within the work area and conducted in a manner to prevent water drainage beyond the specified area of work.
Concrete truck washout shall be conducted in designated areas and shall not be discharged in areas which would allow wash water to leave the site or enter protected areas.

Maintenance Requirements

1. The site supervisor shall maintain a log of individuals receiving these instructions.

Storage, Handling, and Disposal of Construction Products, Materials, and Wastes

Building Products - Building products are not anticipated during this phase of construction.

Pesticides, Herbicides, Insecticides, Fertilizers, and Landscape Materials

The use of pesticides and herbicides is not currently anticipated for this site. Fertilizers and landscape materials will be used to stabilize slopes and other disturbed areas.

1. Store all fertilizers and landscape materials in designated locations. Store all weather sensitive materials in closed containers in accordance with manufacturer's recommendations.

Maintenance Requirements

1. The site supervisor shall regularly inspect the designated storage areas as well as any portions of the site under construction to ensure that all materials are properly stored. The site supervisor shall immediately address any issues and instruct personnel to secure and properly store all materials.

Diesel Fuel, Oil, Hydraulic Fluids, Other Petroleum Products, and Other Chemicals

Refueling and maintenance for vehicles or equipment shall occur either within the designated washout area or shall utilize temporary drip protection measures at the location of fueling. The site supervisor or their representative shall be present at the time of any fueling procedure. The site supervisor shall have a fuel spill plan and measures on site to initiate containment and clean-up in the event a fuel spill occurs.

Refueling and maintenance of equipment shall take place in designated areas whenever possible. Refueling or maintenance of equipment in locations other than those designated for such activity shall be performed under the supervision of the site supervisor or his/her designee and shall employ drip pans or other suitable means of preventing fuel, hydraulic fluid, etc. from spilling or being otherwise carried offsite or into protected areas.

Maintenance Requirements

1. All emergency response equipment listed in the Emergency Response Equipment Inventory shall be made readily available and kept in a designated location known to the site supervisor or his/her designee. All such materials shall be replenished as necessary to the listed amounts.

Hazardous or Toxic Waste

(Note: Examples include paints, solvents, petroleum-based products, wood preservatives, additives, curing compounds, acids.)

Hazardous or toxic waste associated with paints, solvents, petroleum-based products, wood preservatives, additives, curing compounds, acids shall be collected in approved containers and disposed of in accordance with municipal, state and federal regulations.

Hazardous or toxic waste shall be collected in approved containers and disposed of in accordance with municipal, state and federal regulations. Hazardous and toxic waste shall not be disposed of in solid waste containers intended for non-hazardous construction debris.

Maintenance Requirements

1. The site supervisor shall regularly inspect all portions of the project under construction and ensure that all hazardous or toxic materials are disposed of in accordance with the practices detailed above and shall immediately correct any improper disposal practices.

Construction and Domestic Waste

(Note: Examples include packaging materials, scrap construction materials, masonry products, timber, pipe and electrical cuttings, plastics, styrofoam, concrete, and other trash or building materials.)

Construction and domestic waste shall be disposed of in a trash receptacle (dumpster) which shall be removed and disposed of at an approved land fill.

Recyclable waste material shall be stored in an appropriate container or in a designated location on site until it can be removed.

1. Trash receptacles (dumpsters) and recyclable waste material containers shall be located as needed throughout the site.

Maintenance Requirements

1. The site supervisor shall inspect all trash receptacles and containers to confirm that construction and domestic waste is properly contained, and shall also ascertain that waste is being picked up in a timely manner to ensure that no receptacles are overflowing. Pick-up schedules shall be modified or the number of receptacles shall be increased as needed.

Sanitary Waste

During the construction process, portable toilets will be provided in an appropriate location during the construction process.

Maintenance Requirements

1. The site supervisor shall execute a contract with a vendor to supply and maintain portable toilets throughout the site for the project duration. The site supervisor shall determine if a sufficient number of toilets are present to meet staffing levels and shall ensure that the toilets are regularly and properly maintained.

Washing of Applicators and Containers used for Paint, Concrete or Other Materials

Concrete washout shall be restricted to designated areas. Paints, form release oils, curing compounds, etc. shall be recycled and/or disposed of utilizing appropriate containers in accordance with manufacturer's recommendations and EPA guidelines.

1. Install straw bale and plastic liner washout pit at the designated location on site. Concrete trucks shall wash out only at washout pit or other similar acceptable facility such as a portable roll-off washout pit.
2. Provide suitable containers for recycling or disposal for cleanup of paints, form release oils, curing compounds, etc.

Maintenance Requirements

1. The site supervisor shall inspect concrete washout pits (or other acceptable facility) to ensure that they are properly maintained. If necessary, wash water in a concrete washout pit shall be vacuumed off and the hardened concrete broken up and recycled. Wash water and broken up concrete shall be properly disposed of at a suitable facility. If necessary the wash out pit shall be repaired and relined with plastic prior to continued use.
2. Containers for waste paint, form release oil, curing compounds, etc. shall be sealed and removed from the site and properly disposed of at a suitable facility. Empty containers shall replace those being removed for disposal.

Fertilizers

Fertilizers shall be used only as necessary to establish vegetative stabilized slopes and disturbed areas. Apply at recommended rates. Use only slow release fertilizers to minimize discharge of nitrogen or phosphorous.

1. Store all fertilizers in designated locations. Store all weather sensitive materials in closed containers in accordance with manufacturer's recommendations.
2. To prevent accidental release of fertilizers, the site supervisor shall attempt to coordinate delivery of fertilizers to coincide with application and reduce the need to warehouse large quantities on-site.

Maintenance Requirements

1. Site supervisor shall make regular inspections to ensure that fertilizer is being applied at proper rates and that all perimeter controls are in place and properly maintained to control runoff which may contain fertilizer. Stored fertilizer shall be properly covered or enclosed in a designated location to prevent introduction into stormwater runoff.

Spill Prevention and Response

The site supervisor or their representative shall be present on the job site at all times during the course of work and shall be present during the delivery, removal of any liquid/chemical materials to or from the job site. They will also be present during any refueling practices. All subcontractors will be notified of their responsibilities in writing. In the event a spill occurs, the site supervisor shall be notified immediately.
The site supervisor shall have in place a spill prevention plan and resources to contain and clean up any potential spills in a timely manner. Refer to the following Spill Containment & Management Plan, including Spill Report, Emergency Response Equipment Inventory, and Emergency Notification and phone numbers.

Inspection/Maintenance:

Operator personnel must inspect the construction site at least once every 14 calendar days and within 24 hours of a storm event of ½-inch or greater. The applicant shall be responsible to secure the services of a licensed engineer or similar professional (inspector) on an on-going basis throughout all phases of the project. Refer to the Inspection/Maintenance Requirements presented earlier in the "Structural and Stabilization Practices." The inspector should review the erosion and sediment controls with respect to the following:

- Whether or not the measure was installed/performed correctly.
- Whether or not there has been damage to the measure since it was installed or performed.
- What should be done to correct any problems with the measure.

The inspector should complete the Stormwater Management Construction Phase BMP Inspection Schedule and Evaluation Checklist, as attached, for documenting the findings and should request the required maintenance or repair for the pollution prevention measures when the inspector finds that it is necessary for the measure to be effective. The inspector should notify the appropriate person to make the changes and submit copies of the form to the Pembroke Conservation Commission upon request.

It is essential that the inspector document the inspection of the pollution prevention measures. These records will be used to request maintenance and repair and to prove that the inspection and maintenance were performed. The forms list each of the measures to be inspected on the site, the inspector's name, the date of the inspection, the condition of the measure/area inspected, maintenance or repair performed and any changes which should be made to the Pollution Prevention & Erosion and Sedimentation Control Plan to control or eliminate unforeseen pollution of storm water.

Project Location: River Marsh Village 0 Water Street, Pembroke, MA **Date:**

Stormwater Management – Construction Phase
Best Management Practices – Inspection Schedule and Evaluation Checklist

Construction Practices

Best Management Practice	Inspection Frequency	Date Inspected	Inspector	Minimum Maintenance and Key Items to Check	Cleaning/Repair Needed: (List Items)	Date of Cleaning/ Repair	Performed by
Siltsock Erosion Control Barrier	After heavy rainfall events (minimum weekly)			1. Sediment level 2. Material tears or repairs	☐yes ☐no		
Stabilized Construction Entrance	After heavy rainfall events (minimum weekly)			1. Sediment build-up or clogging	☐yes ☐no		
Inlet Protection	After heavy rainfall events (minimum weekly)			1. Sediment level 2. Sack tears or damage	☐yes ☐no		
Temporary Seeding	After heavy rainfall events (minimum weekly)				☐yes ☐no		
Geotextiles	After heavy rainfall events (minimum weekly)				☐yes ☐no		
Mulching & Netting	After heavy rainfall events (minimum weekly)				☐yes ☐no		
Land Grading	After heavy rainfall events (minimum weekly)				☐yes ☐no		

Topsoiling	After heavy rainfall events (minimum weekly)				☐yes ☐no		
Permanent Seeding	After heavy rainfall events (minimum weekly)				☐yes ☐no		
Dust Control	After heavy rainfall events (minimum weekly)				☐yes ☐no		

(1) Refer to the Massachusetts Stormwater Handbook issued January 2, 2008.

Notes (Include deviations from : Site Plan Approval or Order of Conditions, Construction Sequence and Approved Plan):

Stormwater Control Manager ________________________________

Spill Containment and Management Plan

Initial Notification

In the event of a spill, the facility manager will be notified immediately.

Facility Managers (name) ______________________________
____
Facility Manager (phone) ______________________________

Assessment - Initial Containment

The supervisor will assess the incident and initiate containment control measures with the appropriate spill containment equipment included in the spill kit kept on-site. The supervisor will first contact the Fire Department and then notify the Police Department, Department of Public Works, Board of Health and Conservation Commission. The fire department is ultimately responsible for matters of public health and safety and should be notified immediately.

Contact:	Phone Number:
Fire Department:	911
Police Department:	911
Department of Public Works:	(781) 293 5620
Board of Health Phone:	(781) 293 2718
Conservation Commission Phone:	(781) 293 4674

Further Notification

Based on the assessment from the Fire Chief, additional notification to a cleanup contractor may be made. The Massachusetts Department of Environmental Protection (DEP) and the EPA may be notified depending upon the nature and severity of the spill. The Fire Chief will be responsible for determining the level of cleanup and notification required. The attached list of emergency phone numbers shall be posted in the facility office and readily accessible to all employees.

HAZARDOUS WASTE / OIL SPILL REPORT

Date____/_____/______ Time_____________ AM / PM

Exact location (Transformer #)____

Type of equipment_____________________________Make______________Size_______________

S / N____________________________________Weather Conditions__________________________

On or near water ☐ Yes If yes, name of body of water______________________

☐ No

Type of chemical / oil spilled____________________________

Amount of chemical / oil spilled__________________________

Cause of spill____

____

____

Measures taken to contain or clean up spill____

____

____

Amount of chemical / oil recovered_________________Method______________________________

Material collected as a result of clean up

______________drums containing____

______________drums containing____

______________drums containing____

Location and method of debris disposal____

____

Name and address of any person, firm, or corporation suffering damages_____________________

____

Procedures, method, and precautions instituted to prevent a similar occurrence from recurring____

____

Spill reported to General Office by____________________________Time______________AM / PM

Spill reported to DEP / National Response Center by______________________________________

DEP Date____/_____/______ Time__________ AM / PM Inspector________________

NRC Date____/_____/______ Time__________ AM / PM Inspector________________

Additional comments____

____

____

EMERGENCY RESPONSE EQUIPMENT
INVENTORY

The following equipment and materials shall be maintained at all times and stored in a secure area for long-term emergency response need.

--	SORBENT PADS	1 BALE
--	SAND BAGS (empty)	5
--	SPEEDI-DRI ABSORBENT	1 – 40LB BAGS
--	SQUARE END SHOVELS	1
--	PRY BAR	1

EMERGENCY NOTIFICATION PHONE NUMBERS

1. FACILITY MANAGER

   NAME: ____________________ BEEPER: ____________________

   PHONE: ____________________ CELL PHONE: ____________________

   ALTERNATE:

   NAME: ____________________ BEEPER: N/A ____________________

   PHONE: ____________________ CEL PHONE: ____________________

2. FIRE DEPARTMENT

   EMERGENCY: 911

   BUSINESS: (781) 293 2300

   POLICE DEPARTMENT

   EMERGENCY: 911

   BUSINESS: (781) 293 6363

   DEPARTMENT OF PUBLIC WORKS

   BUSINESS: (781) 293 5620

3. MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

   EMERGENCY: (617) 556-1133

   SOUTHEAST REGION - LAKEVILLE OFFICE: (508) 946-2700

4. NATIONAL RESPONSE CENTER

   PHONE: (800) 424-8802

   ALTERNATE: U.S. ENVIRONMENTAL PROTECTION AGENCY

   EMERGENCY: (617) 223-7265

   BUSINESS: (617) 860-4300

5. DEPARTMENT OF PUBLIC WORKS

   CONTACT: Director of Public Works, Eugene Fulmine, Jr.

   PHONE: (781) 293 5620

   CONSERVATION COMMISSION

   CONTACT: Conservation Agent, Robert Clarke

   PHONE: (781) 293 4674

   BOARD OF HEALTH

   CONTACT: Health Agent, Lisa Cullity

   PHONE: (781) 293 2718

POST-DEVELOPMENT BEST MANAGEMENT PRACTICE
OPERATION AND MAINTENANCE PLAN & LONG-TERM POLLUTION PREVENTION PLAN

for

River Marsh Village

In

Pembroke, Massachusetts
(Assessor's Map E-17, Lot 0 & E-17A, Lot 274)

Submitted to:

TOWN OF PEMBROKE

Prepared for:

River Marsh, LLC
239R Washington Street
Norwell, Massachusetts 02061

Prepared by:

MCKENZIE ENGINEERING GROUP

Professional Civil Engineering • Project Management • Land Planning
150 Longwater Drive, Suite 101, Norwell, Massachusetts 02061
Tel.: (781) 792-3900 Facsimile: (781) 792-0333
www.mckeng.com

April 5, 2021
Revised June 7, 2021

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Post-Development Best Management Practice
Operation and Maintenance Plan &
Long-Term Pollution Prevention Plan

Post-Development Best Management Practices (BMPs) Operation and Maintenance Plan

Responsible Party/Property Owner/Developer contact information:
Property Owner:

River March, LLC
293R Washington Street
Norwell, MA 02061

Developer Contact Information:

River Marsh, LLC
293R Washington Street
Norwell, MA 02061

Town of Pembroke Contact Information:

Pembroke Department of Public Works
Eugene Fulmine, Jr., Director
100 Center Street
Pembroke, MA 02359
Phone: 781-293-5620
Fax: 781-293-2964

Pembroke Conservation Commission
Robert Clarke, Agent
100 Center Street
Pembroke, MA 02359
Phone: 781-293-4674

Pembroke Building Department
George Verry, Inspector of Buildings & Zoning Officer
100 Center Street
Pembroke, MA 02359
Phone: 781-293-3864
Fax: 781-293-9250

Long-Term Operations and Maintenance General Conditions

1. The property owner shall be responsible for scheduling regular inspections and maintenance of the stormwater BMP's as illustrated on the design plans and detailed in the following long-term operations and maintenance plan.
2. All Stormwater BMP's shall be operated and maintained in accordance with the design plans and the following Long-Term Operations and Maintenance Plan.
3. The owner shall:

a. Maintain an Operation and Maintenance Log (see Attachment A) for the last three years. The Log shall include all BMP inspections, repairs, replacement activities and disposal activities (disposal material and disposal location shall be included in the Log);

b. Make the log available to the Pembroke Department of Public Works and Planning Board upon request;

c. Allow members and agents of the Pembroke Department of Public Works to enter the premises and ensure that the Owner has complied with the Operation and Maintenance Plan requirements for each BMP.

4. A recommended inspection and maintenance schedule is outlined below based on statewide averages. This inspection and maintenance schedule should be adhered to at a minimum for the first year of service of all BMP's referenced in this document. At the commencement of the first year of service, a more accurate inspection/maintenance schedule should be determined based on the level of service for this site.

Best Management Practices Operations and Maintenance

1. **Paved Areas** –Sweepers shall sweep paved areas periodically during dry weather to remove excess sediments and to reduce the amount of sediments that the drainage system shall have to remove from the runoff. The sweeping shall be conducted primarily between March 15th and November 15th. Special attention should be made to sweeping paved surfaces in March and April before spring rains wash residual sand into the drainage system.

The frequency of sweeping shall average:

- Monthly if by a high-efficiency vacuum sweeper
- Bi-weekly if by a regenerative air sweeper
- Weekly if by a mechanical sweeper

Salt used for de-icing on the parking lot during winter months shall be limited as much as possible as this will reduce the need for removal and treatment. Sand containing the minimum amount of calcium chloride (or approved equivalent) needed for handling may be applied as part of the routine winter maintenance activities.

Cost: The property owner should consult local sweeping contractors for detailed cost estimates.

2. **Catch Basins -** Catch basin grates shall be checked quarterly and following heavy rainfalls to verify that the inlet openings are not clogged by debris. Debris shall be removed from the grates and disposed of properly. Deep sump catch basins shall be inspected and cleaned bi-annually of all accumulated sediments. Catch basins with hoods shall be inspected annually to check oil build-up and outlet obstructions. Material shall be removed from catch basins and disposed of in accordance with all applicable regulations.

Cost: Estimated $50 - $100 per cleaning as needed. The property owner should consult local vacuum cleaning contractors for detailed cost estimates.

3. **Sediment Forebay Areas –** The sediment forebay areas shall be checked for sediment and debris accumulation on a monthly basis and cleaned quarterly. Additional inspections should be scheduled during the first few months to make sure that the vegetation becomes adequately established. Trash, leaves, branches, etc. shall be removed from facility. Silt, sand and sediment, if significant accumulation occurs, shall be removed by hand annually. Material removed from the areas shall be disposed of in accordance with all applicable local, state, and federal regulations. Where applicable by design, mow grassed areas 2 to 12 times per year as necessary. Any slope erosion within the facilities shall be stabilized and repaired as soon as practical.

   Do not store snow in the sediment forebay areas. Care must be taken during plowing operations to prevent snow from being plowed into the sediment forebay area.

   Cost*:* Estimated $100 - $200 per cleaning as needed. The Owner should consult local landscape contractors for a detailed cost estimate.

4. **Extended Dry Detention Basin -** The extended dry detention basin, inlet and vehicular access shall be checked for debris accumulation on a quarterly basis. Additional inspections should be scheduled during the first few months to make sure that the vegetation becomes adequately established in the infiltration basin and that the facility is functioning as intended. Trash, leaves, branches, etc. shall be removed from facility. Silt, sand and sediment, if significant accumulation occurs, shall be removed by rubber-tired excavator annually. Material removed from the basin shall be disposed of in accordance with all applicable local, state, and federal regulations. The detention basin and vehicular access shall be kept free of woody vegetation by mowing at least twice per year. Reseeding, weed control, and invasive species removal may need to be performed periodically to maintain healthy vegetation and maintain the pollutant removal efficiency of the facilities. In the case that water remains for greater than 24 hours after a storm event, an inspection is warranted and necessary maintenance or repairs to the outlet control structure or bottom of the basin may be necessary. Any slope erosion within the facility shall be stabilized and repaired as soon as practical.

   Cost: $500-$1000 per cleaning if excavator is necessary to remove sediment. The Owner should consult local landscape contractors for a detailed cost estimate.

5. **Proprietary Pretreatment Units –** The proprietary pretreatment units shall be inspected and maintained from the surface, without entry into the unit a minimum of annually and following heavy rain events. Perform maintenance once the stored volume reaches 15% of the unit capacity, or immediately in the event of a spill. Perform Maintenance at quarterly intervals during the first year of installation, so an accurate maintenance schedule can be established. Sediment and debris should be removed through the 24-inch diameter outlet riser pipe. Alternatively, oil and floatables should be removed through the 18-inch oil inspection port. The requirements for the disposal from the units should be in compliance with all local, state and federal regulations. Consult the Medfield Board of Health for transfer station locations prior to disposing the separator contents. Please refer to the Manufacturer's Manual for additional detail on proper inspection and maintenance of the First Defense units.

Cost: Cleaning should be included along with the routine maintenance of the catch basins. The property owner should consult local vacuum cleaning contractors for detailed cost estimates.

6. **Subsurface Infiltration Chamber System** –Proper maintenance of the subsurface infiltration system is essential to the long-term effectiveness of the infiltration function. The subsurface infiltration system shall have inspection ports and additional inspections should be scheduled during the first few months to ensure proper stabilization and function. Thereafter, they shall be checked semiannually and following heavy rainfalls, defined as a 1-year storm event exceeding 2.5 inches of rainfall within a twenty-four-hour period. Water levels in the chambers shall be checked to verify proper drainage. Ponding water in a chamber indicates failure from the bottom. If water remains within the chambers after 72-hours following a storm event, steps to restore the infiltration function shall be taken, as directed by a qualified stormwater management professional. In order to rectify the problem, accumulated sediment must be removed from the bottom of the chamber. The stone aggregate and filter fabric must be removed and replaced, and the underlying soil layer must be scarified to encourage proper infiltration. Material removed from the system shall be disposed of in accordance with all applicable local, state, and federal regulations. Please refer to the Manufacturer's Manual for additional detail on proper inspection and maintenance of the Cultec chambers.

   Cost: The property owner should consult local landscape contractors for a detailed cost estimate.

7. **Pesticides, Herbicides, and Fertilizers -** Pesticides and herbicides shall be used sparingly. Fertilizers should be restricted to the use of organic fertilizers only.

   All structural BMP's as identified on the site plans will be owned and maintained by the homeowner's association of the development and shall run with the title of the property.

   Cost: Included in the routine landscaping maintenance schedule. The Owner should consult local landscaping contractors for details.

8. **Snow Removal -** Snow accumulations removed from driveway and parking areas should be placed in upland areas only, where sand and other debris will remain after snowmelt for later removal. Excess snow should be removed from the site and properly disposed of in an approved snow disposal facility. Care must be exercised not to deposit snow in the following areas: in the rain gardens, bioswales, and where sand and debris can get into the watercourse.

   Cost: The owner should consult local snow removal contractors for a detailed cost estimate.

<u>Maintenance Responsibilities</u>

All post construction maintenance activities should be documented and kept on file and made available to the Pembroke DPW, in addition to the Planning Board upon request.
To develop and implement an operation and maintenance program with the goal of preventing or reducing pollutant runoff by keeping potential pollutants from coming into contact with stormwater or being transported off site without treatment, the following efforts will be made:

- Property Management awareness and training on how to incorporate pollution prevention techniques into maintenance operations.
- Follow appropriate best management practices (BMPs) by proper maintenance and inspection procedures.

Long-Term Pollution Prevention Plan
Good Housekeeping:

Storage and Disposal of Waste and Toxics:

Failure to properly store hazardous materials dramatically increases the probability that they will end up in local waterways. Practices such as covering hazardous materials or even storing them properly, can have dramatic impacts.

The exterior storage of hazardous materials on site shall be prohibited.

The following is a list of management considerations for hazardous materials as outlined by the EPA:

- Ensuring sufficient aisle space to provide access for inspections and to improve the ease of material transport;
- Storing materials well away from high-traffic areas to reduce the likelihood of accidents that might cause spills or damage to drums, bags, or containers.
- Stacking containers in accordance with the manufacturers' directions to avoid damaging the container or the product itself;
- Storing containers on pallets or equivalent structures. This facilitates inspection for leaks and prevents the containers from coming into contact with wet floors, which can cause corrosion. This consideration also reduces the incidence of damage by pests.

Landscape Maintenance:

Using proper landscaping techniques can effectively increase the value of a property while benefiting the environment. These practices can benefit the environment by reducing water use; decreasing energy use (because less water pumping and treatment is required); minimizing runoff of storm and irrigation water that transports soils, fertilizers, and pesticides; and creating additional habitat for plants and wildlife. The following lawn and landscaping management practices will be encouraged:

- Mow lawn areas at the highest recommended height.
- Minimize lawn size and maintain existing native vegetation.
- Abide by water restrictions and other conservation measures implemented by the Town of Pembroke.
- Water only when necessary.
- Use automatic irrigation systems to reduce water use.

Integrated Pest Management (IPM):

This management measure seeks to limit the adverse impacts of insecticides and herbicides by providing information on alternative pest control techniques other than chemicals or explaining how to determine the correct dosages needed to manage pests.

The presence of pesticides in stormwater runoff has a direct impact on the health of aquatic organisms and can present a threat to humans through contamination of drinking water supplies. The pesticides of greatest concern are insecticides, such as diazinon and chloropyrifos, which even at very low levels can be harmful to aquatic life.

The following IPM practices will be encouraged:

- Pesticides and herbicides shall be used sparingly. Fertilizers should be restricted to the use of organic fertilizers only.
- Lawn care and landscaping management programs including appropriate pesticide use management as part of program.

Illicit Discharges:

Illicit discharges are non-stormwater discharges to the storm drain system which typically contain bacteria and other pollutants. All illicit discharges are prohibited. Any illicit discharges should be reported to MassDOT and/or the DPW as applicable to be addressed in accordance with their respective policies.

The following is a list of EPA allowed non-stormwater discharges. If the non-stormwater discharge is not listed, it is prohibited.

1. Water line flushing,
2. Landscape irrigation,
3. Diverted stream flows,
4. Rising ground waters,
5. Uncontaminated ground water infiltration (as defined at 40 CFR 35.2005(20)),
6. Uncontaminated pumped ground water,
7. Discharge from potable water sources,
8. Foundation drains,
9. Air conditioning condensation,
10. Irrigation water, springs,
11. Water from crawl space pumps,
12. Footing drains,
13. Lawn watering,
14. Flows from riparian habitats and wetlands,
15. Street wash water,
16. Discharges or flows from fire fighting activities occur during emergency conditions.

Spill Containment and Management Plan

Initial Notification

In the event of a spill, the facility manager will be notified immediately.

Facility Managers (name) ______________________________________

____

Facility Manager (phone) ______________________________________

Assessment - Initial Containment

The supervisor will assess the incident and initiate containment control measures with the appropriate spill containment equipment included in the spill kit kept on-site. The supervisor will first contact the Fire Department and then notify the Police Department, Department of Public Works, Board of Health and Conservation Commission. The fire department is ultimately responsible for matters of public health and safety and should be notified immediately.

Contact:	Phone Number:
Fire Department:	911
Police Department:	911
Department of Public Works:	(781) 293 5620
Board of Health Phone:	(781) 293 2718
Conservation Commission Phone:	(781) 293 4674

Further Notification

Based on the assessment from the Fire Chief, additional notification to a cleanup contractor may be made. The Massachusetts Department of Environmental Protection (DEP) and the EPA may be notified depending upon the nature and severity of the spill. The Fire Chief will be responsible for determining the level of cleanup and notification required. The attached list of emergency phone numbers shall be posted in the facility office and readily accessible to all employees.

HAZARDOUS WASTE / OIL SPILL REPORT

Date____/_____/______ Time_____________ AM / PM

Exact location (Transformer #)____

Type of equipment_____________________________Make______________Size________________

S / N____________________________________Weather Conditions__________________________

On or near water ☐ Yes If yes, name of body of water______________________

☐ No

Type of chemical / oil spilled____________________________

Amount of chemical / oil spilled__________________________

Cause of spill____

____

____

Measures taken to contain or clean up spill____

____

____

Amount of chemical / oil recovered_________________Method______________________________

Material collected as a result of clean up

______________drums containing____

______________drums containing____

______________drums containing____

Location and method of debris disposal____

____

Name and address of any person, firm, or corporation suffering damages_____________________

____

Procedures, method, and precautions instituted to prevent a similar occurrence from recurring____

____

Spill reported to General Office by____________________________Time______________AM / PM

Spill reported to DEP / National Response Center by______________________________________

DEP Date____/_____/______ Time__________ AM / PM Inspector________________

NRC Date____/_____/______ Time__________ AM / PM Inspector________________

Additional comments____

____

____

EMERGENCY RESPONSE EQUIPMENT
INVENTORY

The following equipment and materials shall be maintained at all times and stored in a secure area for long-term emergency response need.

--	SORBENT PADS	1 BALE
--	SAND BAGS (empty)	5
--	SPEEDI-DRI ABSORBENT	1 – 40LB BAGS
--	SQUARE END SHOVELS	1
--	PRY BAR	1

EMERGENCY NOTIFICATION PHONE NUMBERS

1. FACILITY MANAGER

    NAME: ________________ BEEPER: ______________________

    PHONE: ________________ CELL PHONE: ________________

    ALTERNATE:

    NAME: ________________ BEEPER: N/A ___________________

    PHONE: ________________ CEL PHONE: ___________________

2. FIRE DEPARTMENT

    EMERGENCY: 911

    BUSINESS: (781) 293 2300

    POLICE DEPARTMENT

    EMERGENCY: 911

    BUSINESS: (781) 293 6363

    DEPARTMENT OF PUBLIC WORKS

    BUSINESS: (781) 293 5620

3. MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

    EMERGENCY: (617) 556-1133

    SOUTHEAST REGION - LAKEVILLE OFFICE: (508) 946-2700

4. NATIONAL RESPONSE CENTER

    PHONE: (800) 424-8802

    ALTERNATE: U.S. ENVIRONMENTAL PROTECTION AGENCY

    EMERGENCY: (617) 223-7265

    BUSINESS: (617) 860-4300

5. DEPARTMENT OF PUBLIC WORKS

    CONTACT: Director of Public Works, Eugene Fulmine, Jr.

    PHONE: (781) 293 5620

    CONSERVATION COMMISSION

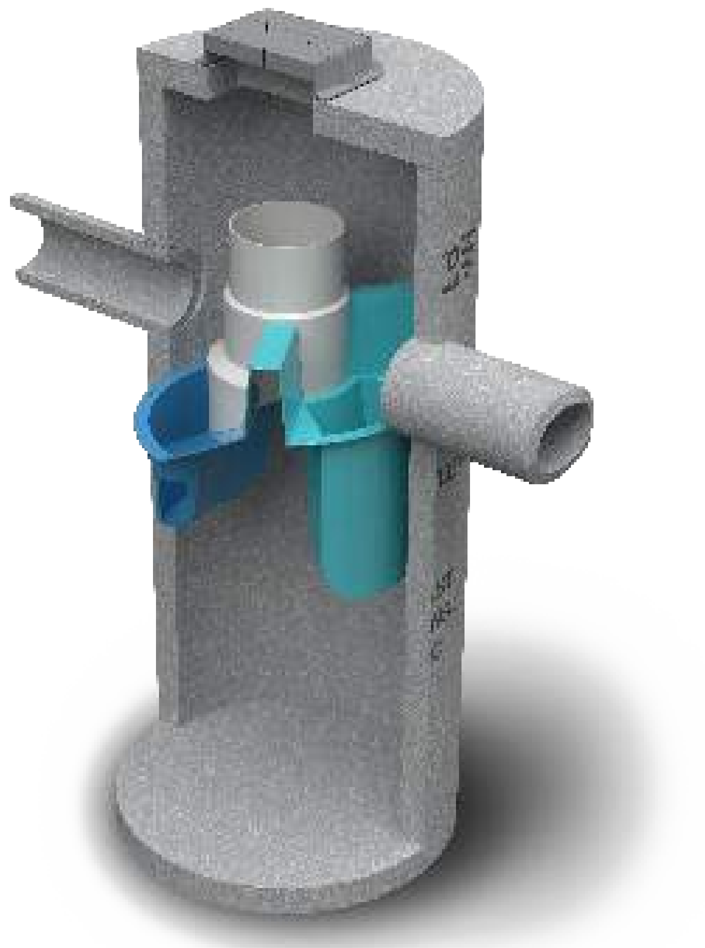
    CONTACT: Conservation Agent, Robert Clarke

    PHONE: (781) 293 4674

    BOARD OF HEALTH

    CONTACT: Health Agent, Lisa Cullity

    PHONE: (781) 293 2718



Operation and Maintenance Manual

First Defense® High Capacity and First Defense® Optimum

Vortex Separator for Stormwater Treatment

Table of Contents

Hydro International (Stormwater), 94 Hutchins Drive, Portland ME 04102
Tel: (207) 756-6200 Fax: (207) 756-6212 Web: www.hydro-int.com

I. First Defense® by Hydro International

Introduction

The First Defense® is an enhanced vortex separator that combines an effective and economical stormwater treatment chamber with an integral peak flow bypass. It efficiently removes total suspended solids (TSS), trash and hydrocarbons from stormwater runoff without washing out previously captured pollutants. The First Defense® is available in several model configurations to accommodate a wide range of pipe sizes, peak flows and depth constraints.

The two product models described in this guide are the First Defense® High Capacity and the First Defense® Optimum; they are inspected and maintained identically.

Operation

The First Defense® operates on simple fluid hydraulics. It is self-activating, has no moving parts, no external power requirement and is fabricated with durable non-corrosive components. No manual procedures are required to operate the unit and maintenance is limited to monitoring accumulations of stored pollutants and periodic clean-outs. The First Defense® has been designed to allow for easy and safe access for inspection, monitoring and clean-out procedures. Neither entry into the unit nor removal of the internal components is necessary for maintenance, thus safety concerns related to confined-space-entry are avoided.

Pollutant Capture and Retention

The internal components of the First Defense® have been designed to optimize pollutant capture. Sediment is captured and retained in the base of the unit, while oil and floatables are stored on the water surface in the inner volume (Fig.1).

The pollutant storage volumes are isolated from the built-in bypass chamber to prevent washout during high-flow storm events. The sump of the First Defense® retains a standing water level between storm events. This ensures a quiescent flow regime at the onset of a storm, preventing resuspension and washout of pollutants captured during previous events.

Accessories such as oil absorbent pads are available for enhanced oil removal and storage. Due to the separation of the oil and floatable storage volume from the outlet, the potential for washout of stored pollutants between clean-outs is minimized.

Applications

- Stormwater treatment at the point of entry into the drainage line
- Sites constrained by space, topography or drainage profiles with limited slope and depth of cover
- Retrofit installations where stormwater treatment is placed on or tied into an existing storm drain line
- Pretreatment for filters, infiltration and storage

Advantages

- Inlet options include surface grate or multiple inlet pipes
- Integral high capacity bypass conveys large peak flows without the need for “offline” arrangements using separate junction manholes
- Long flow path through the device ensures a long residence time within the treatment chamber, enhancing pollutant settling
- Delivered to site pre-assembled and ready for installation

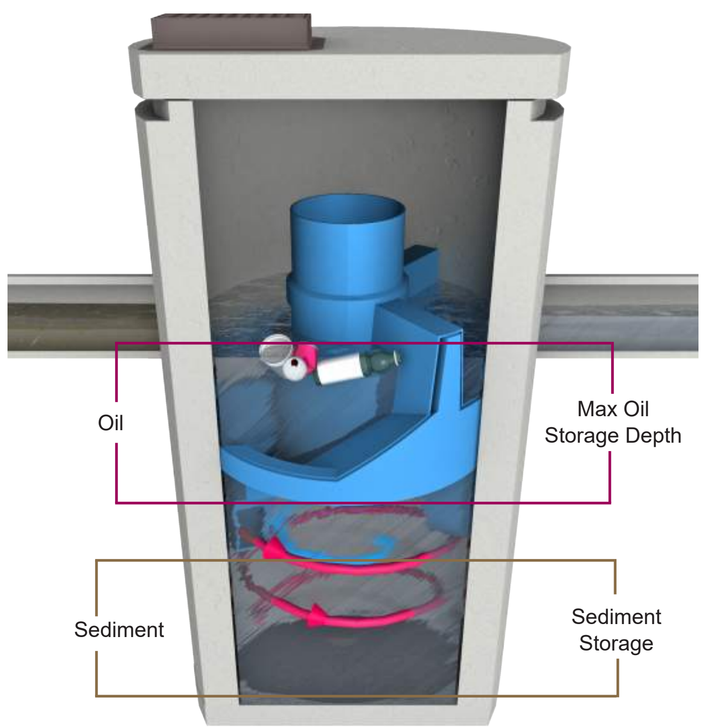


Fig.1 Pollutant storage volumes in the First Defense®.

II. Model Sizes & Configurations

The First Defense® inlet and internal bypass arrangements are available in several model sizes and configurations. The components have modified geometries allowing greater design flexibility to accommodate various site constraints.

All First Defense® models include the internal components that are designed to remove and retain total suspended solids (TSS), gross solids, floatable trash and hydrocarbons (Fig.2). First Defense® model sizes (diameter) are shown in Table 1.

III. Maintenance

First Defense® Components

1. **Built-In Bypass**
2. **Inlet Pipe**
3. **Inlet Chute**
4. **Floatables Draw-off Port**
5. **Outlet Pipe**
6. **Floatables Storage**
7. **Sediment Storage**
8. **Inlet Grate or Cover**

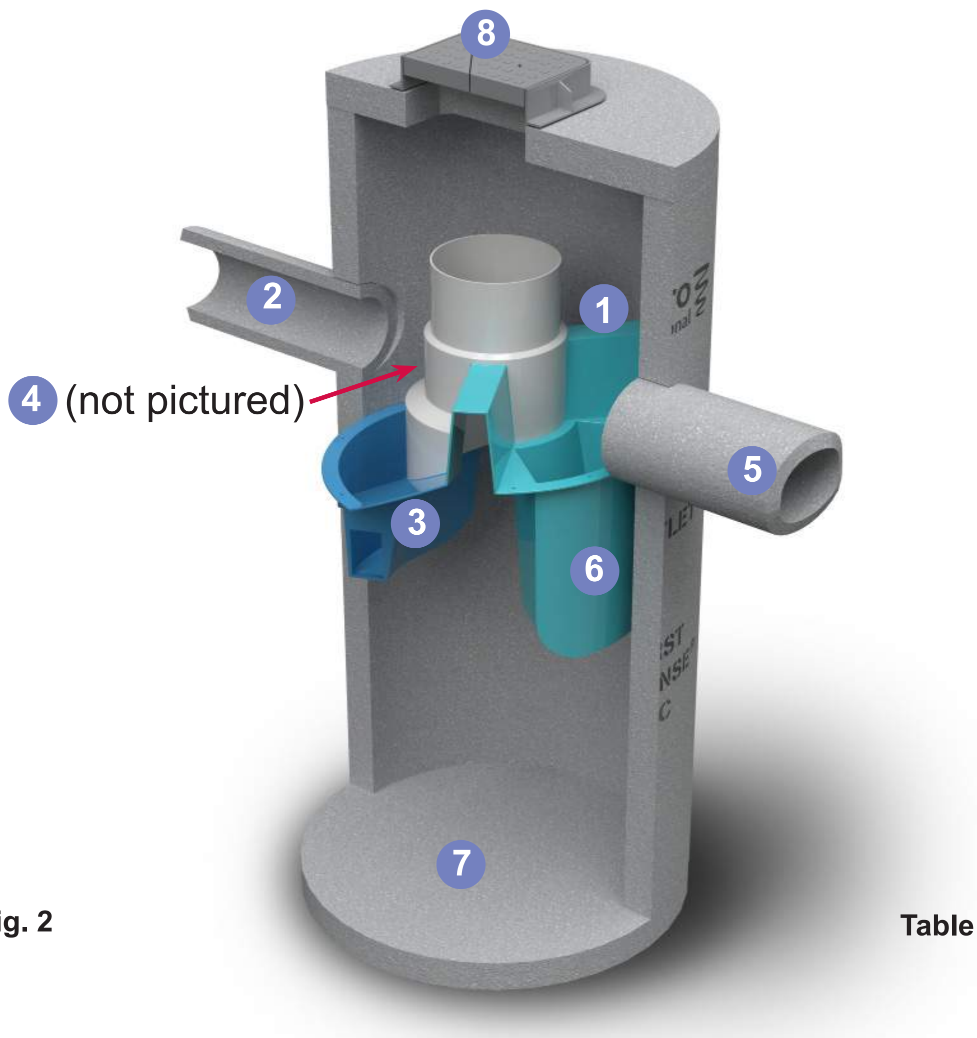


Fig. 2

Table 1

First Defense® Model Sizes
(ft / m) diameter
3 / 0.9
4 / 1.2
5 / 1.5
6 / 1.8
8 / 2.4
10 / 3.0

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Tel: (207) 756-6200 Fax: (207) 756-6212 Web: www.hydro-int.com

Overview

The First Defense® protects the environment by removing a wide range of pollutants from stormwater runoff. Periodic removal of these captured pollutants is essential to the continuous, long-term functioning of the First Defense®. The First Defense® will capture and retain sediment and oil until the sediment and oil storage volumes are full to capacity. When sediment and oil storage capacities are reached, the First Defense® will no longer be able to store removed sediment and oil.

The First Defense® allows for easy and safe inspection, monitoring and clean-out procedures. A commercially or municipally owned sump-vac is used to remove captured sediment and floatables. Access ports are located in the top of the manhole.

Maintenance events may include Inspection, Oil & Floatables Removal, and Sediment Removal. Maintenance events do not require entry into the First Defense®, nor do they require the internal components of the First Defense® to be removed. In the case of inspection and floatables removal, a vactor truck is not required. However, a vactor truck is required if the maintenance event is to include oil removal and/or sediment removal.

Maintenance Equipment Considerations

The internal components of the First Defense® have a centrally located circular shaft through which the sediment storage sump can be accessed with a sump vac hose. The open diameter of this access shaft is 15 inches in diameter (Fig.3). Therefore, the nozzle fitting of any vactor hose used for maintenance should be less than 15 inches in diameter.

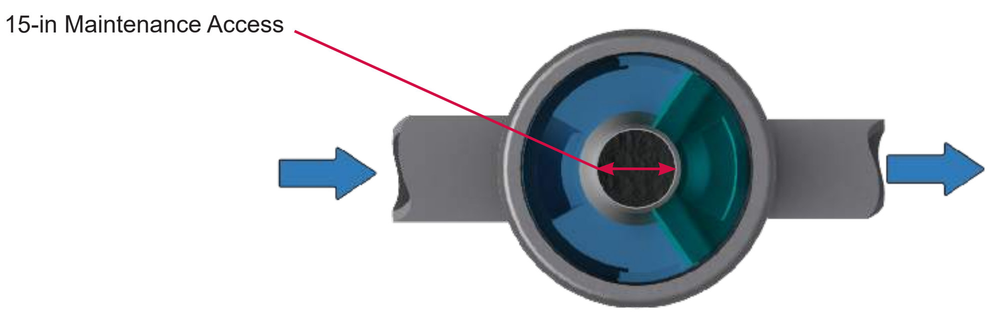

Fig.3 The central opening to the sump of the First Defense®is 15 inches in diameter.

Determining Your Maintenance Schedule

The frequency of clean out is determined in the field after installation. During the first year of operation, the unit should be inspected every six months to determine the rate of sediment and floatables accumulation. A simple probe such as a Sludge-Judge® can be used to determine the level of accumulated solids stored in the sump. This information can be recorded in the maintenance log (see page 9) to establish a routine maintenance schedule.

The vactor procedure, including both sediment and oil / flotables removal, for First Defense® typically takes less than 30 minutes and removes a combined water/oil volume of about 765 gallons.

Inspection Procedures

1. Set up any necessary safety equipment around the access port or grate of the First Defense® as stipulated by local ordinances. Safety equipment should notify passing pedestrian and road traffic that work is being done.

2. Remove the grate or lid to the manhole.

3. Without entering the vessel, look down into the chamber to inspect the inside. Make note of any irregularities. Fig.4 shows the standing water level that should be observed.

4. Without entering the vessel, use the pole with the skimmer net to remove floatables and loose debris from the components and water surface.

5. Using a sediment probe such as a Sludge Judge®, measure the depth of sediment that has collected in the sump of the vessel.

6. On the Maintenance Log (see page 9), record the date, unit location, estimated volume of floatables and gross debris removed, and the depth of sediment measured. Also note any apparent irregularities such as damaged components or blockages.

7. Securely replace the grate or lid.

8. Take down safety equipment.

9. Notify Hydro International of any irregularities noted during inspection.

Fig.4 Floatables are removed with a vactor hose

Floatables and Sediment Clean Out

Floatables clean out is typically done in conjunction with sediment removal. A commercially or municipally owned sump-vac is used to remove captured sediment and floatables (Fig.4).

Floatables and loose debris can also be netted with a skimmer and pole. The access port located at the top of the manhole provides unobstructed access for a vactor hose to be lowered to the base of the sump.

Scheduling

- Floatables and sump clean out are typically conducted once a year during any season.

- Floatables and sump clean out should occur as soon as possible following a spill in the contributing drainage area.

Recommended Equipment

- Safety Equipment (traffic cones, etc)

- Crow bar or other tool to remove grate or lid

- Pole with skimmer or net (if only floatables are being removed)

- Sediment probe (such as a Sludge Judge®)

- Vactor truck (flexible hose recommended)

- First Defense® Maintenance Log

Floatables and Sediment Clean Out Procedures

1. Set up any necessary safety equipment around the access port or grate of the First Defense® as stipulated by local ordinances. Safety equipment should notify passing pedestrian and road traffic that work is being done.

2. Remove the grate or lid to the manhole.

3. Without entering the vessel, look down into the chamber to inspect the inside. Make note of any irregularities.

4. Remove oil and floatables stored on the surface of the water with the vactor hose or with the skimmer or net

5. Using a sediment probe such as a Sludge Judge®, measure the depth of sediment that has collected in the sump of the vessel and record it in the Maintenance Log (page 9).

6. Once all floatables have been removed, drop the vactor hose to the base of the sump. Vactor out the sediment and gross debris off the sump floor

7. Retract the vactor hose from the vessel.

8. On the Maintenance Log provided by Hydro International, record the date, unit location, estimated volume of floatables and gross debris removed, and the depth of sediment measured. Also note any apparent irregularities such as damaged components, blockages, or irregularly high or low water levels.

9. Securely replace the grate or lid.

Maintenance at a Glance

Inspection	- Regularly during first year of installation - Every 6 months after the first year of installation
Oil and Floatables Removal	- Once per year, with sediment removal - Following a spill in the drainage area
Sediment Removal	- Once per year or as needed - Following a spill in the drainage area
NOTE: For most clean outs the entire volume of liquid does not need to be removed from the manhole. Only remove the first few inches of oils and floatables from the water surface to reduce the total volume of liquid removed during a clean out.	

First Defense® Installation Log

HYDRO INTERNATIONAL REFERENCE NUMBER:	
SITE NAME:	
SITE LOCATION:	
OWNER:	CONTRACTOR:
CONTACT NAME:	CONTACT NAME:
COMPANY NAME:	COMPANY NAME:
ADDRESS:	ADDRESS:
TELEPHONE:	TELEPHONE:
FAX:	FAX:

INSTALLATION DATE: / /

MODEL SIZE (CIRCLE ONE): [3-FT] [4-FT] [5-FT] [6-FT] [8-FT] [10-FT]

INLET (CIRCLE ALL THAT APPLY): GRATED INLET (CATCH BASIN) INLET PIPE (FLOW THROUGH)

Hydro International (Stormwater), 94 Hutchins Drive, Portland ME 04102
Tel: (207) 756-6200 Fax: (207) 756-6212 Web: www.hydro-int.com

First Defense® Inspection and Maintenance Log

Date	Initials	Depth of Floatables and Oils	Sediment Depth Measured	Volume of Sediment Removed	Site Activity and Comments

Hydro International (Stormwater), 94 Hutchins Drive, Portland ME 04102
Tel: (207) 756-6200 Fax: (207) 756-6212 Web: www.hydro-int.com

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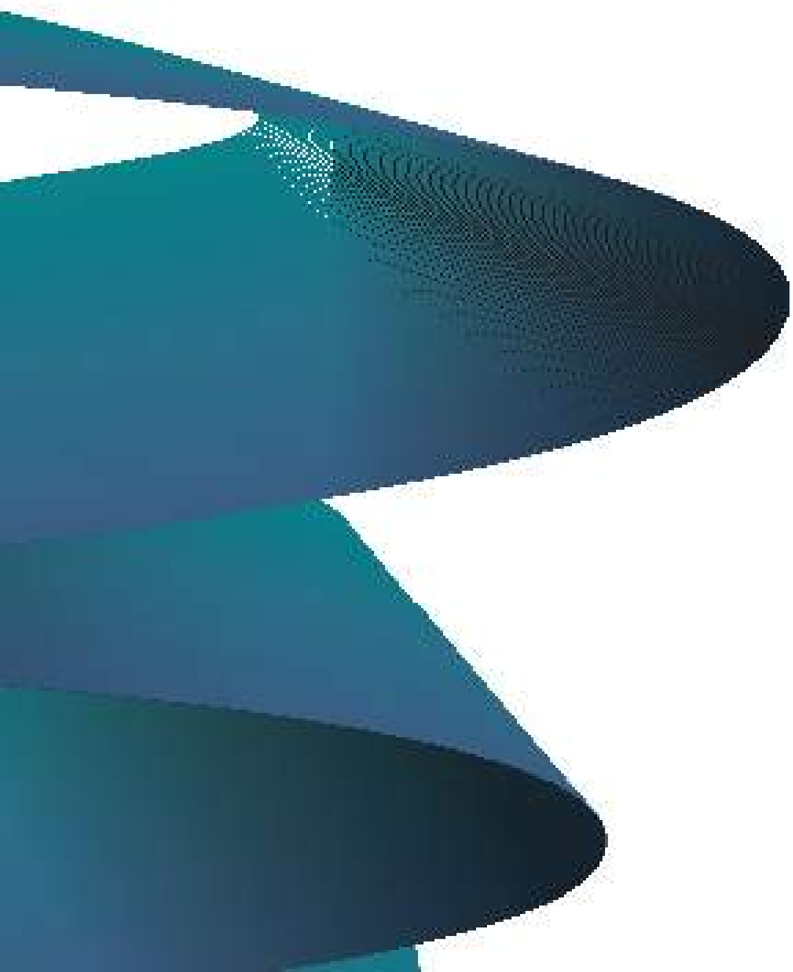

Stormwater Solutions

94 Hutchins Drive
Portland, ME 04102

Tel: (207) 756-6200
Fax: (207) 756-6212
stormwaterinquiry@hydro-int.com

www.hydro-int.com

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P.O. Box 280
878 Federal Road
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www.cultec.com

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May 2017

These instructions are for single-layer traffic applications only. For multi-layer applications, contact CULTEC.
All illustrations and photos shown herein are examples of typical situations. Be sure to follow the engineer's drawings.
Actual designs may vary.

This manual contains guidelines recommended by CULTEC, Inc. and may be used in conjunction with, but not to supersede, local regulations or regulatory authorities. OSHA Guidelines must be followed when inspecting or cleaning any structure.

Introduction

The CULTEC Subsurface Stormwater Management System is a high-density polyethylene (HDPE) chamber system arranged in parallel rows surrounded by washed stone. The CULTEC chambers create arch-shaped voids within the washed stone to provide stormwater detention, retention, infiltration, and reclamation. Filter fabric is placed between the native soil and stone interface to prevent the intrusion of fines into the system. In order to minimize the amount of sediment which may enter the CULTEC system, a sediment collection device (stormwater pretreatment device) is recommended upstream from the CULTEC chamber system. Examples of pretreatment devices include, but are not limited to, an appropriately sized catch basin with sump, pretreatment catchment device, oil grit separator, or baffled distribution box. Manufactured pretreatment devices may also be used in accordance with CULTEC chambers. Installation, operation, and maintenance of these devices shall be in accordance with manufacturer's recommendations. Almost all of the sediment entering the stormwater management system will be collected within the pretreatment device.

Best Management Practices allow for the maintenance of the preliminary collection systems prior to feeding the CULTEC chambers. The pretreatment structures shall be inspected for any debris that will restrict inlet flow rates. Outfall structures, if any, such as outlet control must also be inspected for any obstructions that would restrict outlet flow rates. OSHA Guidelines must be followed when inspecting or cleaning any structure.

Operation and Maintenance Requirements

I. Operation

CULTEC stormwater management systems shall be operated to receive only stormwater run-off in accordance with applicable local regulations. CULTEC subsurface stormwater management chambers operate at peak performance when installed in series with pretreatment. Pretreatment of suspended solids is superior to treatment of solids once they have been introduced into the system. The use of pretreatment is adequate as long as the structure is maintained and the site remains stable with finished impervious surfaces such as parking lots, walkways, and pervious areas are properly maintained. If there is to be an unstable condition, such as improvements to buildings or parking areas, all proper silt control measures shall be implemented according to local regulations.

II. Inspection and Maintenance Options

A. The CULTEC system may be equipped with an inspection port located on the inlet row.
The inspection port is a circular cast box placed in a rectangular concrete collar. When the lid is removed, a 6-inch (150 mm) pipe with a screw-in plug will be exposed. Remove the plug. This will provide access to the CULTEC Chamber row below. From the surface, through this access, the sediment may be measured at this location. A stadia rod may be used to measure the depth of sediment if any in this row. If the depth of sediment is in excess of 3 inches (76 mm), then this row should be cleaned with high pressure water through a culvert cleaning nozzle. This would be carried out through an upstream manhole or through the CULTEC StormFilter Unit (or other pre-treatment device). CCTV inspection of this row can be deployed through this access port to deter mine if any sediment has accumulated in the inlet row.

B. If the CULTEC bed is not equipped with an inspection port, then access to the inlet row will be through an upstream manhole or the CULTEC StormFilter.

1. Manhole Access
This inspection should only be carried out by persons trained in confined space entry and sewer inspection services. After the manhole cover has been removed a gas detector must be lowered into the manhole to ensure that there are not high concentrations of toxic gases present. The inspector should be lowered into the manhole with the proper safety equipment as per OSHA requirements. The inspector may be able to observe sediment from this location. If this is not possible, the inspector will need to deploy a CCTV robot to permit viewing of the sediment.

2. **StormFilter Access**
Remove the manhole cover to allow access to the unit. Typically a 30-inch (750 mm) pipe is used as a riser from the StormFilter to the surface. As in the case with manhole access, this access point requires a technician trained in confined space entry with proper gas detection equipment. This individual must be equipped with the proper safety equipment for entry into the StormFilter. The technician will be lowered onto the StormFilter unit. The hatch on the unit must be removed. Inside the unit are two filters which may be removed according to StormFilter maintenance guidelines. Once these filters are removed the inspector can enter the StormFilter unit to launch the CCTV camera robot.

C. The inlet row of the CULTEC system is placed on a polyethylene liner to prevent scouring of the washed stone beneath this row. This also facilitates the flushing of this row with high pressure water through a culvert cleaning nozzle. The nozzle is deployed through a manhole or the StormFilter and extended to the end of the row. The water is turned on and the inlet row is back-flushed into the manhole or StormFilter. This water is to be removed from the manhole or StormFilter using a vacuum truck.

III. Maintenance Guidelines

The following guidelines shall be adhered to for the operation and maintenance of the CULTEC stormwater management system:

A. The owner shall keep a maintenance log which shall include details of any events which would have an effect on the system's operational capacity.

B. The operation and maintenance procedure shall be reviewed periodically and changed to meet site conditions.

C. Maintenance of the stormwater management system shall be performed by qualified workers and shall follow applicable occupational health and safety requirements.

D. Debris removed from the stormwater management system shall be disposed of in accordance with applicable laws and regulations.

IV. Suggested Maintenance Schedules

A. **Minor Maintenance**
The following suggested schedule shall be followed for routine maintenance during the regular operation of the stormwater system:

Frequency	Action
Monthly in first year	Check inlets and outlets for clogging and remove any debris, as required.
Spring and Fall	Check inlets and outlets for clogging and remove any debris, as required.
One year after commissioning and every third year following	Check inlets and outlets for clogging and remove any debris, as required.

B. **Major Maintenance**
The following suggested maintenance schedule shall be followed to maintain the performance of the CULTEC stormwater management chambers. Additional work may be necessary due to insufficient performance and other issues that might be found during the inspection of the stormwater management chambers. (See table on next page)

For more information, contact CULTEC at (203) 775-4416 or visit www.cultec.com.

	Frequency	Action
Inlets and Outlets	Every 3 years	• Obtain documentation that the inlets, outlets and vents have been cleaned and will function as intended.
	Spring and Fall	• Check inlet and outlets for clogging and remove any debris as required.
CULTEC Stormwater Chambers	2 years after commissioning	• Inspect the interior of the stormwater management chambers through inspection port for deficiencies using CCTV or comparable technique. • Obtain documentation that the stormwater management chambers and feed connectors will function as anticipated.
	9 years after commissioning every 9 years following	• Clean stormwater management chambers and feed connectors of any debris. • Inspect the interior of the stormwater management structures for deficiencies using CCTV or comparable technique. • Obtain documentation that the stormwater management chambers and feed connectors have been cleaned and will function as intended.
	45 years after commissioning	• Clean stormwater management chambers and feed connectors of any debris. • Determine the remaining life expectancy of the stormwater management chambers and recommended schedule and actions to rehabilitate the stormwater management chambers as required. • Inspect the interior of the stormwater management chambers for deficiencies using CCTV or comparable technique. • Replace or restore the stormwater management chambers in accordance with the schedule determined at the 45-year inspection. • Attain the appropriate approvals as required. • Establish a new operation and maintenance schedule.
Surrounding Site	Monthly in 1st year	• Check for depressions in areas over and surrounding the stormwater management system.
	Spring and Fall	• Check for depressions in areas over and surrounding the stormwater management system.
	Yearly	• Confirm that no unauthorized modifications have been performed to the site.

For additional information concerning the maintenance of CULTEC Subsurface Stormwater Management Chambers, please contact CULTEC, Inc. at 1-800-428-5832.

WQMP
Operation & Maintenance (O&M) Plan

Project Name:____

Prepared for:

Project Name: ____

Address:____

City, State Zip:____

Prepared on:

Date:____

This O&M Plan describes the designated responsible party for implementation of this WQMP, including: operation and maintenance of all the structural BMP(s), conducting the training/educational program and duties, and any other necessary activities. The O&M Plan includes detailed inspection and maintenance requirements for all structural BMPs, including copies of any maintenance contract agreements, manufacturer's maintenance requirements, permits, etc.

8.1.1 Project Information

Project name	
Address	
City, State Zip	
Site size	
List of structural BMPs, number of each	
Other notes	

8.1.2 Responsible Party

The responsible party for implementation of this WQMP is:

Name of Person or HOA Property Manager	
Address	
City, State Zip	
Phone number	
24-Hour Emergency Contact number	
Email	

8.1.3 Record Keeping

Parties responsible for the O&M plan shall retain records for at least 5 years.

All training and educational activities and BMP operation and maintenance shall be documented to verify compliance with this O&M Plan. A sample Training Log and Inspection and Maintenance Log are included in this document.

8.1.4 Electronic Data Submittal

This document along with the Site Plan and Attachments shall be provided in PDF format. AutoCAD files and/or GIS coordinates of BMPs shall also be submitted to the City.

Appendix ___

BMP SITE PLAN

Site plan is preferred on minimum 11” by 17” colored sheets, as long as legible.

BMP OPERATION & MAINTENANCE LOG

Project Name: ______________________________

Today's Date: ______________________________

Name of Person Performing Activity (Printed): ______________________________

Signature: ______________________________

BMP Name (As Shown in O&M Plan)	Brief Description of Implementation, Maintenance, and Inspection Activity Performed

Minor Maintenance

Frequency		Action
Monthly in first year		Check inlets and outlets for clogging and remove any debris, as required.
		Notes
□ Month 1	Date:	
□ Month 2	Date:	
□ Month 3	Date:	
□ Month 4	Date	
□ Month 5	Date:	
□ Month 6	Date:	
□ Month 7	Date:	
□ Month 8	Date:	
□ Month 9	Date:	
□ Month 10	Date:	
□ Month 11	Date:	
□ Month 12	Date:	
Spring and Fall		Check inlets and outlets for clogging and remove any debris, as required.
		Notes
□ Spring	Date:	
□ Fall	Date:	
□ Spring	Date:	
□ Fall	Date:	
□ Spring	Date:	
□ Fall	Date:	
□ Spring	Date:	
□ Fall	Date:	
□ Spring	Date:	
□ Fall	Date:	
□ Spring	Date:	
□ Fall	Date:	
One year after commissioning and every third year following		Check inlets and outlets for clogging and remove any debris, as required.
		Notes
□ Year 1	Date:	
□ Year 4	Date:	
□ Year 7	Date:	
□ Year 10	Date:	
□ Year 13	Date:	
□ Year 16	Date:	
□ Year 19	Date:	
□ Year 22	Date:	

Major Maintenance

	Frequency		Action
Inlets and Outlets	**Every 3 years**		Obtain documentation that the inlets, outlets and vents have been cleaned and will function as intended.
			Notes
	□ Year 1	Date:	
	□ Year 4	Date:	
	□ Year 7	Date:	
	□ Year 10	Date:	
	□ Year 13	Date:	
	□ Year 16	Date:	
	□ Year 19	Date:	
	□ Year 22	Date:	
	Spring and Fall		Check inlet and outlets for clogging and remove any debris, as required.
			Notes
	□ Spring	Date:	
	□ Fall	Date:	
	□ Spring	Date:	
	□ Fall	Date:	
	□ Spring	Date:	
	□ Fall	Date:	
	□ Spring	Date:	
	□ Fall	Date:	
	□ Spring	Date:	
	□ Fall	Date:	
	□ Spring	Date:	
	□ Fall	Date:	
CULTEC Stormwater Chambers	**2 years after commissioning**		□ Inspect the interior of the stormwater management chambers through inspection port for deficiencies using CCTV or comparable technique. □ Obtain documentation that the stormwater management chambers and feed connectors will function as anticipated.
			Notes
	□ Year 2	Date:	

Major Maintenance

	Frequency		Action
CULTEC Stormwater Chambers	**9 years after commissioning every 9 years following**		□ Clean stormwater management chambers and feed connectors of any debris. □ Inspect the interior of the stormwater management structures for deficiencies using CCTV or comparable technique. □ Obtain documentation that the stormwater management chambers and feed connectors have been cleaned and will function as intended.
			Notes
	□ Year 9	Date:	
	□ Year 18	Date:	
	□ Year 27	Date:	
	□ Year 36	Date:	
	45 years after commissioning		□ Clean stormwater management chambers and feed connectors of any debris. □ Determine the remaining life expectancy of the stormwater management chambers and recommended schedule and actions to rehabilitate the stormwater management chambers as required. □ Inspect the interior of the stormwater management chambers for deficiencies using CCTV or comparable technique. □ Replace or restore the stormwater management chambers in accordance with the schedule determined at the 45-year inspection. □ Attain the appropriate approvals as required. □ Establish a new operation and maintenance schedule.
			Notes
	□ Year 45	Date:	

Major Maintenance

	Frequency		Action
Surrounding Site	**Monthly in 1st year**		☐ Check for depressions in areas over and surrounding the stormwater management system.
			Notes
	☐ Month 1	Date:	
	☐ Month 2	Date:	
	☐ Month 3	Date:	
	☐ Month 4	Date:	
	☐ Month 5	Date:	
	☐ Month 6	Date:	
	☐ Month 7	Date:	
	☐ Month 8	Date:	
	☐ Month 9	Date:	
	☐ Month 10	Date:	
	☐ Month 11	Date:	
	☐ Month 12	Date:	
	Spring and Fall		☐ Check for depressions in areas over and surrounding the stormwater management system.
			Notes
	☐ Spring	Date:	
	☐ Fall	Date:	
	☐ Spring	Date:	
	☐ Fall	Date:	
	☐ Spring	Date:	
	☐ Fall	Date:	
	☐ Spring	Date:	
	☐ Fall	Date:	
	☐ Spring	Date:	
	☐ Fall	Date:	
	☐ Spring	Date:	
	☐ Fall	Date:	
	Yearly		☐ Confirm that no unauthorized modifications have been performed to the site.
			Notes
	☐ Year 1	Date:	
	☐ Year 2	Date:	
	☐ Year 3	Date:	
	☐ Year 4	Date:	
	☐ Year 5	Date:	
	☐ Year 6	Date:	
	☐ Year 7	Date:	

The Founder of Plastic Chamber Technology

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878 Federal Road | P.O. Box 280 | Brookfield , CT 06804 USA

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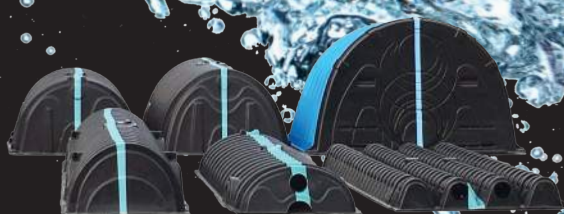

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