Attachment D

Eversource ESS – Martha's Vineyard Stormwater Management Report

Stormwater Management Report

Eversource Energy
Martha's Vineyard, MA

Submitted to:

Town of Edgartown
75 Main Street
PO Box 5130
Edgartown, MA 02539

Prepared for:

Prepared by:

Eversource Energy
PO Box 5017
Hartford, CT 06102

TRC Engineers, Inc.
650 Suffolk Street
Lowell, MA 01854

August 2018

Prepared by: Paul Baltzersen
Stephen M. Loss, P.E.
Massachusetts P.E. No. 53021

TABLE OF CONTENTS

1.0 INTRODUCTION 1-1
1.1 Scope of Report 1-1
2.0 PROJECT INFORMATION 2-1
2.1 Project Description 2-1
2.2 Soil Types 2-2
2.3 Water Resources 2-3
3.0 STORMWATER MANAGEMENT 3-1
3.1 Protection of Wetlands, No Untreated Discharges 3-1
3.2 Peak Rate Attenuation 3-2
3.3 Stormwater Recharge 3-7
3.4 Water Quality 3-7
3.5 Critical Areas 3-8
3.6 Construction Period Controls 3-8
3.7 Operation and Maintenance Plan 3-8
3.8 Illicit Discharge Statement 3-9
4.0 CONCLUSION 4-9

TABLES:

Table I – List of Preliminary Drawings for the Proposed Energy Storage Facility 2-2
Table II - Table of Soil Characteristics 2-3
Table III-1 – Pre-Development Drainage Areas 3-3
Table III-2 – Precipitation Frequency Estimates (inches) 3-3
Table III-3 – Pre-Development Peak Rates of Runoff (cfs) 3-4
Table III-4 - Pre-Development Peak Runoff Volumes (ac-ft) 3-4
Table III-5 – Post Development Drainage Areas ..... **Error! Bookmark not defined.**
Table III-6 – Post Development Peak Rates of Runoff (cfs) 3-5
Table III-7 - Post Development Peak Runoff Volumes (ac-ft) 3-6
Table III-8 – Pre- and Post-Development Peak Rate Comparisons 3-6
Table III-9 - Pre-and Post-Development Peak Runoff Volume Comparisons 3-6
Table III-10 - Site-Wide Peak Runoff Volume Comparison 3-7

APPENDICES:

Appendix A – Hydrologic Soil Group
Appendix B – Pre-Development Scenario
Appendix C – Pre-Development HydroCAD Report
Appendix D – Post-Development Scenario
Appendix E – Post-Development HydroCAD Report

1.0 INTRODUCTION

1.1 Scope of Report

This Stormwater Management Report was prepared in accordance with the Massachusetts Department of Environmental Protection (MassDEP) Stormwater Management Handbook on behalf of Eversource Energy. The report provides the required stormwater design analysis, which addresses long-term erosion and sediment controls for the proposed Eversource Energy Storage Facility (Facility) to be located at an existing facility at 208 Edgartown Vineyard Haven Road (Site) in Edgartown, Massachusetts on a parcel of land identified by the Town of Edgartown Tax Assessor's office as Lots 2 and 11 on Map 40, currently owned by Commonwealth Electric Company.

2.0 PROJECT INFORMATION

2.1 Project Description

The proposed energy/battery storage facility consists of a new gravel pad and storage building constructed on a portion of a 2.74-acre parcel owned by Commonwealth Electric Company, located in the Town of Oak Bluffs, Duke County, Massachusetts (herein referred to as the 'Site").

The proposed Facility involves improvements including a gravel pad with a total area of approximately 36,000 SF along with the storage facility building, a stormwater detention basin and all other associated underground conduit runs, transformer/HVAC/switchgear equipment pads, and perimeter fencing. Under existing conditions, a large portion of the site is impervious. The proposed improvements will result in 16,885 SF of impervious area generated by the installation of the battery storage facility and concrete equipment pads. A total of approximately 52,600 square feet or 1.21 acres of disturbed area is anticipated, including lay-down and staging areas, and construction activities associated with the project. All work will take place within the proposed property limits.

This Stormwater Report includes the calculations, runoff modeling, and engineering analysis required to evaluate the existing pre-development and post-development conditions associated with the proposed energy storage facility and associated improvements. This Stormwater Report utilizes the most current information available (survey data July 2018).

The project site is located North of the Edgartown Vineyard Haven Rd and Head of the Pond Road Rd intersection in Oak Bluffs, MA. In general, groundcover and existing vegetation are in fair to poor condition. The area surrounding the Site is a mix of commercial and forested landcover. The energy storage facility area will be accessed by the existing driveway from Edgartown Vineyard Haven Road that accesses the Site, therefore it is already constructed to handle large vehicles

The installation of the Facility and impervious surfaces added across the Site will modify the runoff characteristics (curve numbers, times of concentration, and associated peak rates of runoff) during storm events. Impervious surfaces will be created with the installation of the storage facility and associated transformer and inverter pads. Much of the area associated with the construction of the building and pad is currently paved.

The impervious surfaces defined above will be kept to the minimum practical. This design gives preference to proposed drainage infrastructure, low impact development, and maintains existing grade, as much as practical. Upon completion of the facility, the disturbed areas of the Site will be revegetated with an approved seed mixture. The stormwater management design also incorporates temporary and permanent erosion and sediment control measures to prevent off-site

transport of sediment and protect existing wetlands resources throughout construction, restoration, and Facility operation phases. Subsequent stabilization and revegetation activities are anticipated to be implemented throughout the construction process. The following table summarizes the list of preliminary design drawings pertinent to MassDEP and Town of Edgartown requirements.

Table I – List of Preliminary Drawings for the Proposed Energy Storage Facility

Drawing No.	Drawing Title
C-1	Title Page
C-2	Notes & Tables
C-101	Existing Conditions Plan
C-201	Demolition Plan – Phase I
C-202	Demolition Plan – Phase II
C-301	Site Plan – Phase I
C-302	Site Plan – Phase II
C-401	Site Details
C-501	Grading and Stormwater Management Plan – Phase I
C-502	Grading and Stormwater Management Plan – Phase II
C-601	Stormwater Management Details
C-701	Erosion and Sediment Control Plan – Phase I
C-702	Erosion and Sediment Control Plan – Phase II
C-801	Erosion Control Notes and Details

2.2 Soil Types

The Natural Resource Conservation Service (NRCS) Web Soil Survey data identified two principal soil types at the Site. Table II provides a tabular listing of soil types present. A copy of the NRCS Soils Map and other key soil characteristics are included in Appendix A.

Table II – Table of Soil Characteristics:
Duke County, Massachusetts

Map Unit	Soil Name	Slopes	Hydrologic Soils Group
259B	Carver loamy course sand	3-8%	A
288B	Riverhead sandy loam	3-8%	A

The area primarily proposed for development is underlain by formations of loamy sand (HSG A). According to NRCS information, depth to groundwater in areas of this soil type exceeds 80-inches.

2.3 Water Resources

The Energy Storage Facility will be constructed on a portion of the parcel. Elevations within the Site range from approximately 70 to 82 feet above mean sea level. Existing topography at the Site is mostly consistent and generally slopes from northeast to southwest. The entire project site is located within the Lagoon Pond watershed.

3.0 STORMWATER MANAGEMENT

Development will consist of construction of a gravel building pad, a 16,000 square-foot energy storage facility building and a stormwater detention basin. Evaluation and sizing of these Best Management Practices (BMPs) was completed in accordance with the specifications for Structural BMPs as described in the Massachusetts Stormwater Handbook. In accordance with MassDEP requirements, the site development plans for the Site were designed such that the post-development peak flows generated by 2-year, 10-year, 25-year and 100-year return period design storms will be similar to those of the pre-development condition. New impervious surfaces will be limited to the storage facility building, and associated concrete equipment pads. The Site will be stabilized and revegetated following construction activities and temporary erosion controls will be kept in place until the Site is fully stabilized. The project was designed to meet the 8 Standards as described in the Massachusetts Stormwater Handbook Volume Three Chapter One Documenting compliance.

Following construction activities, long-term stormwater and erosion controls will be maintained through an operation and maintenance plan. A preliminary plan is provided in Appendix F.

The following sections address the 10 standards for stormwater design from the MassDEP Stormwater Handbook.

3.1 Protection of Wetlands, No Untreated Discharges

In accordance with Standard 1, stormwater runoff from impervious areas will be treated on-site and will not be directly discharged to adjacent wetlands or natural resource areas. Prior to any earth disturbing activities, perimeter silt fence will be installed around the limits of disturbance. During site preparation and Facility installation activities, sediment will be intercepted by silt fence and/or compost filter sock before reaching the adjacent receptors. New impervious surfaces proposed for this project will consist of the concrete equipment pads and the storage building. Upon completion of construction activities, the disturbed areas of the Site will be revegetated such that runoff will not result in channelized flow from the developed areas, and will not cause erosion in wetlands or waters of the Commonwealth. The retention basin will attenuate stormwater runoff and provide a measure of Total Suspended Solids (TSS) treatment.

No outlets, outfalls or structures discharge runoff from the Site directly to wetlands or resource areas. The supporting calculations, consistent with the requirements of Volume 2, Chapter 3 of the Massachusetts Stormwater Handbook for this stormwater analysis are provided in Section 3.3.

3.2 Peak Rate Attenuation

Peak rate attenuation is to be achieved through the use of proposed stormwater management features. The stormwater runoff model was developed using HydroCAD software, which employs Technical Release No. 20: Computer Program for Project Formulation Hydrology (TR-20) and Technical Release No. 55: Urban Hydrology for Small Watersheds (TR-55) methodology to calculate peak flows. Minimum time of concentration (Tc) is 6 minutes (0.1 hours) per TR-55 manual.

Modeling assumptions, inputs, and outputs for the pre- and post-development routing calculations are provided with Appendix B-E. Site-wide, post-development peak flows decrease slightly due to improvements to ground cover and existing drainage when compared with the pre-development peak flows for the 2-year, 10-year, 25-year, and 100-year, 24-hour storm events.

Stormwater runoff was estimated using HydroCAD Software. This software utilizes the methodology described in TR-20.

Analysis of Pre-Development Stormwater Runoff

This section presents hydrologic data and information to demonstrate that the proposed development and associated new impervious surfaces will not result in increased peak stormwater runoff flows when compared to pre-development conditions for the 2-year, 24-hour, 10-year, 24-hour, 25-year, 24- hour and 100-year, 24-hour rainfall events.

Pre-development runoff rates were determined by separating the Site into four subcatchments. The boundaries of the subcatchments are based on existing topography and drainage patterns, controlling buffers and setbacks. Existing land use for the Site is listed in the table below. The pre-development stormwater management site plan is included in Appendix B.

Precipitation events with a 24-hour duration and a Type III distribution were used in this analysis. Rainfall return frequencies of 2, 10, 25, and 100 years were applied. Storm event precipitation depths are summarized in Table III-2. Rainfall data for the design storms was determined from Intensity Frequency Duration Curves provided by Cornell University's "Extreme Precipitation in New York and New England: An Interactive Web Tool for Extreme Precipitation Analysis."

Table III-2 – Precipitation Frequency Estimates (inches)

Duration	Average Recurrence Interval (years)			
	2 Year	**10 Year**	**25 Year**	**100 Year**
24-Hours	3.31	4.91	6.16	8.67

For each subcatchment, time of concentration (Tc) was determined using the hydraulically longest flow path. The Tc flow paths are identified in the Pre-Development Stormwater Management Plan. In the pre-development model, the maximum sheet flow length used is 50 feet, per MassDEP recommendations. Curve numbers (CNs) were generated for the subcatchments based on hydrologic soil group and land cover type as observed during site visits, site surveys, and available aerial imagery. Peak rates of runoff were evaluated for each subcatchment. HydroCAD output for predevelopment conditions for the 2-year, 10-year, 25-year, and 100-year, 24-hour storm events are included in Appendix C. Pre-development peak runoff rates and volumes are summarized in Table III-3.

Table III-3 – PRE-DEVELOPMENT PEAK RATES OF RUNOFF				
Storm Event	**PR-1 (cfs)**	**PR-2 (cfs)**	**PR-3 (cfs)**	**PR-4 (cfs)**
2-year, 24-hour	0.38	0.28	0.68	0.04
10-year, 24-hour	1.10	0.84	1.20	0.29
25-year, 24-hour	1.76	1.36	1.62	0.58
100-year, 24-hour	3.22	2.53	2.46	1.27

Table III-4 – PRE-DEVELOPMENT PEAK RUNOFF VOLUME				
Storm Event	**PR-1 (ac-ft)**	**PR-2 (ac-ft)**	**PR-3 (ac-ft)**	**PR-4 (ac-ft)**
2-year, 24-hour	0.034	0.026	0.049	0.009
10-year, 24-hour	0.084	0.065	0.088	0.028
25-year, 24-hour	0.130	0.101	0.120	0.048
100-year, 24-hour	0.233	0.184	0.186	0.098

Post-development runoff rates were determined using the same approach. The proposed development and implementation of stormwater BMPs will slightly alter drainage patterns at the Site by reducing slopes to meet racking tolerances and installing the proposed access drive, however, the overall pattern of drainage will remain similar and therefore the site will remain divided in the same 5 subcatchments as analyzed under predevelopment conditions, as shown in Appendix E – Post Development HydroCAD Report.

As in the post-development analysis, the Tc was determined using the hydraulically longest flow path. The Tc flow paths for each subcatchment are identified in the Post-Development HydroCAD Report located in Appendix E. In accordance with recommendations from the MassDEP, a maximum sheet flow length of 50 feet was used in the time of concentration calculations. HydroCAD output for Post-Development conditions for the 2-year, 10-year, 25-year, and 100-year, 24-hour storm events are included in Appendix E and summarized in Table III-5.

Table III-6 – POST-DEVELOPMENT PEAK RATES OF RUNOFF

Storm Event	PR-1 (cfs)	PR-2 (cfs)	PR-3 (cfs)	PR-4 (cfs)
2-year, 24-hour	0.03	0.01	0.67	0.00
10-year, 24-hour	0.60	0.11	1.13	1.58
25-year, 24-hour	1.45	0.31	1.48	1.63
100-year, 24-hour	2.80	0.82	2.19	2.33

Table III-7 – POST-DEVELOPMENT PEAK RUNOFF VOLUME

Storm Event	PR-1 (ac-ft)	PR-2 (ac-ft)	PR-3 (ac-ft)	PR-4 (ac-ft)
2-year, 24-hour	0.013	0.003	0.049	0.000
10-year, 24-hour	0.105	0.015	0.084	0.022
25-year, 24-hour	0.183	0.029	0.112	0.045
100-year, 24-hour	0.335	0.064	0.169	0.098

Table III-6 provides a comparison between pre-development and post-development runoff conditions for each design storm. As shown in Table III-6, projected peak runoff discharge rates remain generally unchanged or slightly reduced under post-development conditions.

Table III-8 - PRE- AND POST PEAK RATE COMPARISON								
Storm Event	**DP-1**		**DP-2**		**DP-3**		**DP-4**	
	PRE	**POST**	**PRE**	**POST**	**PRE**	**POST**	**PRE**	**POST**
2-year, 24-hour	0.38	0.03	0.28	0.01	0.68	0.67	0.04	0.00
10-year, 24-hour	1.10	0.60	0.84	0.11	1.20	1.13	0.29	1.58
25-year, 24-hour	1.76	1.45	1.36	0.31	1.62	1.48	0.58	1.63
100-year, 24-hour	3.22	2.80	2.53	0.82	2.46	2.19	1.27	2.33

Table III-9 - PRE- AND POST PEAK VOLUME COMPARISON								
Storm Event	**DP-1**		**DP-2**		**DP-3**		**DP-4**	
	PRE	**POST**	**PRE**	**POST**	**PRE**	**POST**	**PRE**	**POST**
2-year, 24-hour	0.034	0.013	0.026	0.003	0.049	0.049	0.009	0.000
10-year, 24-hour	0.084	0.105	0.065	0.015	0.088	0.084	0.028	0.022
25-year, 24-hour	0.130	0.183	0.101	0.029	0.120	0.112	0.048	0.045
100-year, 24-hour	0.233	0.335	0.184	0.064	0.186	0.169	0.098	0.098

Construction of the energy storage building and facility will result in localized watershed areas to be modified resulting in slight increases and decreases in peak volume for a particular design point. Overall the volume of runoff will remain consistent or slightly decrease. A summation of site-wide runoff volume is presented in Table III-10 below.

Table III-10 – SITE-WIDE PRE- AND POST DEVELOPMENT PEAK VOLUME COMPARISON (AC-FT)		
Storm Event	**SITE-WIDE**	
	PRE	**POST**
2-year, 24-hour	0.118	0.065
10-year, 24-hour	0.265	0.226
25-year, 24-hour	0.399	0.369
100-year, 24-hour	0.701	0.666

3.3 Stormwater Recharge

Stormwater recharge will be attained for the Site via the proposed retention/infiltration basin. The Massachusetts Stormwater Manual states that the amount of recharge required for a site is based on the total amount of impervious area and a coefficient of recharge that is presented in Volume 1 Chapter 1 page 6. The entire site consists Hydrologic Soil Group "A" soils. Therefore, from the Manual, the volume to recharge times the Total Impervious Area is 0.60 inches. The total impervious area for the site is 18,616 sf.

Calculating the volume to recharge for the Site is then:

Volume to recharge = [(0.60")/12]*18,616 sf = 931 cf.

The infiltration basin was designed to retain over 2000 cf of stormwater below the outlet pipe and therefore exceeds the requirements for recharge.

3.4 Water Quality

The Massachusetts Stormwater Manual states that the required water quality volume equals 1.0 inch of runoff times the total impervious area of the post-development project site for a discharge. The total impervious area for the site is 18,616 sf.

Calculating the required water quality volume for the Site is then:

WQv = [(1.0")/12]*18,616sf = 1,551 cf.

The infiltration basin has been designed to retain over 2000 cf of stormwater below the outlet pipe and therefore exceeds the requirements for water quality volume. The assumed rate of infiltration for the basin was based on the Massachusetts Stormwater Manual guidelines as presented in Table 2.3.3. 1982 Rawls Rates. The National Resources Conservation Service (NRCS) soil survey classifies soils at the site as Hydrologic soil group A consisting of "loamy coarse sand and sandy loam". A conservative value of 0.52 Inches/Hour was used in the HydroCAD model.

Additional water quality features include an infiltration trench that runs along the Northwest edge of the gravel pad and a gravel diaphragm along the Southwestern edge of the pad. These features will capture and treat runoff from the proposed equipment pads to be installed west of the building. The gravel diaphragm is sloped to drain into the infiltration basin and will act as pre-treatment for stormwater flows.

Total Suspended Solids (TSS)

As indicated in the stormwater calculations provided in Attachment E, BMPs have been sized to adequately capture and manage runoff at the Site, and therefore, with proper maintenance will effectively remove 80% of the average annual TSS load.

3.5 Critical Areas

The proposed stormwater BMPs will generally maintain the existing flow conditions at the Site and serve to treat stormwater discharges from new impervious areas associated with developing the property. Higher potential pollutant loads are not likely to occur as a result of the proposed Battery Storage Facility construction. The appropriate set-backs from any wetlands and other resource areas have been incorporated into the design drawings.

3.6 Construction Period Controls

A plan will be developed by the contractor in coordination with TRC to identify potential construction-related impacts, including erosion, sedimentation, and other pollutant sources during construction and land disturbance activities. Land disturbance and construction activities will be implemented in a manner that limits off-site TSS transport through the installation of silt fencing and other necessary erosion control measures down-gradient of the limit of disturbance. The Plan will also include a schedule for sequencing construction and stormwater management activities that minimize land disturbance and expedite restoration activities. The construction sequence will begin with the installation of compost filter sock, the construction entrance and any additional erosion and sediment BMPs. Once all temporary BMPs are in place, access road improvements will commence followed by the installation of chain link fencing and the Facility. A temporary stabilized construction entrance will be installed at the Site entrance. Disturbed areas will be stabilized with straw mulch and seeded. After final stabilization has been achieved, temporary erosion and sediment control BMPs will be removed.

3.7 Operation and Maintenance Plan

The stormwater management system BMPs will be maintained by Eversource, the energy storage facility owner. Preliminary Long-Term Operations and Maintenance Plan and Operation and Maintenance Plans can be found in Appendix F. These will be finalized prior to operations.

3.8 Illicit Discharge Statement

The proposed stormwater management system will generally maintain the existing on-site flow conditions generated during a 100-year, 24-hour design storm. The Site will be surrounded by fencing and access to the Site will be further limited by locked gates to limit the probability of illicit discharges to the Site stormwater BMPs. Stormwater operation and maintenance will be performed according to the Operation and Maintenance Plan and the implementation measures for all specified pollution prevention measures.

4.0 CONCLUSION

The Battery Storage Facility installation will disturb approximately 1.21 acres and will incorporate non-structural stormwater BMPs manage surface water runoff from the Site. The proposed development will result in no net change to the stormwater flow from the Site due to the designed infiltration/retention basin. The design of the proposed BMPs and global improvements to existing vegetation based on site restoration practices, peak runoff from the Site will be generally unchanged under post-development conditions. The proposed installation of the Facility is not anticipated to adversely affect the Site or adjacent properties and will maintain water quality as required by the Town of Edgartown, and MassDEP. It is TRC's professional opinion that the proposed improvements to the Site have been designed in accordance with these requirements and can be constructed without causing or contributing to the pollution of surface waters and groundwater in the project area.

APPENDIX A

HYDROLOGIC SOIL GROUP

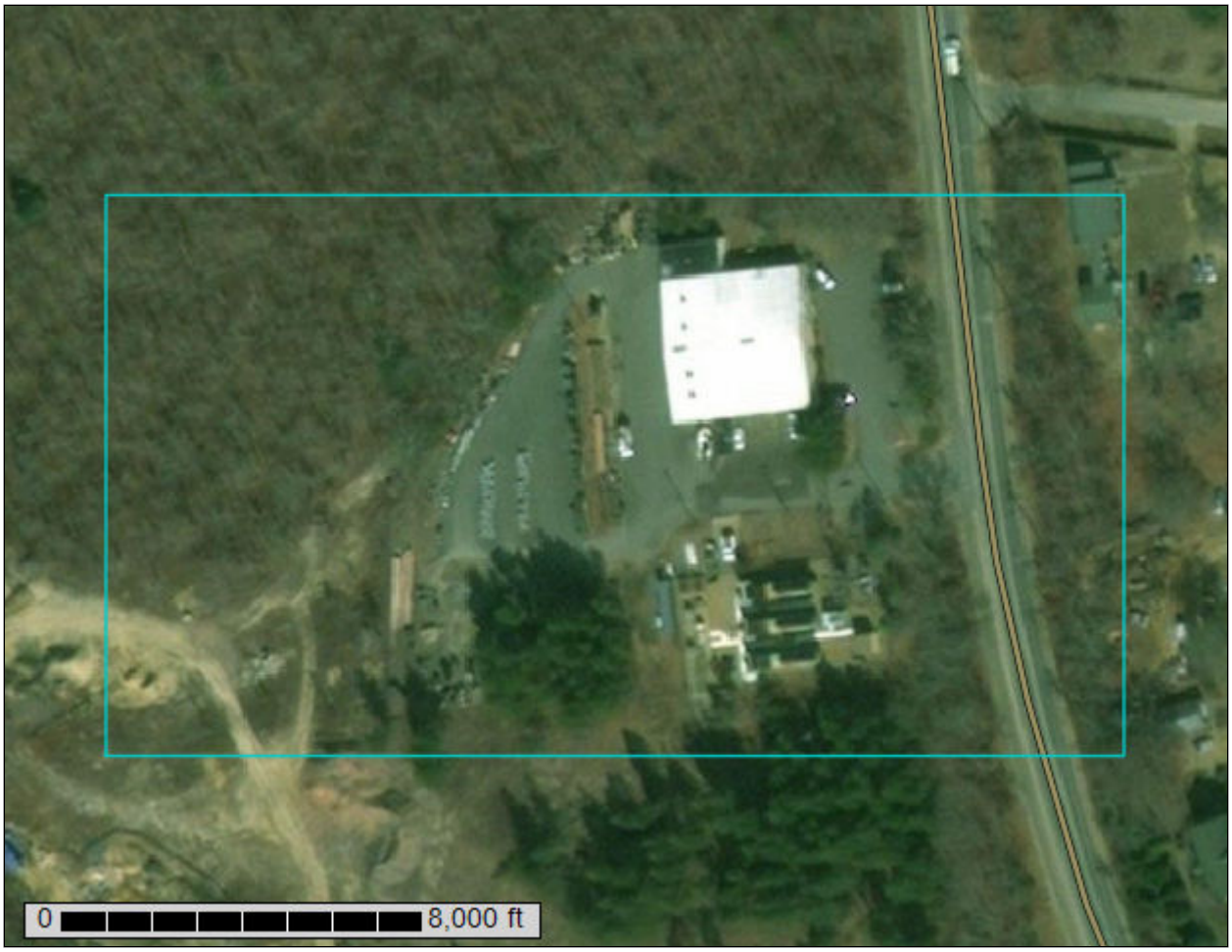
United States Department of Agriculture

NRCS

Natural Resources Conservation Service

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

Custom Soil Resource Report for Dukes County, Massachusetts



July 23, 2018

Preface

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

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

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

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

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

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

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

Preface..... 2
How Soil Surveys Are Made..... 5
Soil Map..... 8
Soil Map..... 9
Legend..... 10
Map Unit Legend..... 11
Map Unit Descriptions..... 11
Dukes County, Massachusetts..... 13
259B—Carver loamy coarse sand, 3 to 8 percent slopes..... 13
288B—Riverhead sandy loam, 3 to 8 percent slopes..... 14
References..... 16

How Soil Surveys Are Made

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

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

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

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

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

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

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

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

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

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

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

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

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

Custom Soil Resource Report
Soil Map

Map Scale: 1:1,210 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 15 30 60 90

Feet: 0 50 100 200 300

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 19N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

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

Special Point Features

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

Water Features

- Streams and Canals

Transportation

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

Background

- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Dukes County, Massachusetts
Survey Area Data: Version 14, Jan 25, 2018

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

Date(s) aerial images were photographed: Dec 31, 2009—Jun 7, 2016

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
259B	Carver loamy coarse sand, 3 to 8 percent slopes	3.9	60.1%
288B	Riverhead sandy loam, 3 to 8 percent slopes	2.6	39.9%
Totals for Area of Interest		**6.6**	**100.0%**

Map Unit Descriptions

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

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

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

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

onsite investigation is needed to define and locate the soils and miscellaneous areas.

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

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

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

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

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

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

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Dukes County, Massachusetts

259B—Carver loamy coarse sand, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 98wp
Mean annual precipitation: 41 to 48 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 175 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Carver and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Carver

Setting

Landform: Outwash plains
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Rise
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loose sandy glaciofluvial deposits

Typical profile

H1 - 0 to 4 inches: loamy coarse sand
H2 - 4 to 30 inches: loamy coarse sand
H3 - 30 to 60 inches: coarse sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Very high (20.00 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Eastchop

Percent of map unit: 10 percent
Hydric soil rating: No

Riverhead
Percent of map unit: 5 percent
Hydric soil rating: No

Haven
Percent of map unit: 3 percent
Hydric soil rating: No

Klej
Percent of map unit: 2 percent
Hydric soil rating: No

288B—Riverhead sandy loam, 3 to 8 percent slopes

Map Unit Setting
National map unit symbol: 98y2
Mean annual precipitation: 41 to 48 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 175 to 240 days
Farmland classification: All areas are prime farmland

Map Unit Composition
Riverhead and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Riverhead

Setting
Landform: Outwash plains
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Riser
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Friable coarse-loamy eolian deposits over loose sandy and gravelly glaciofluvial deposits

Typical profile
H1 - 0 to 4 inches: sandy loam
H2 - 4 to 16 inches: sandy loam
H3 - 16 to 24 inches: loamy sand
H4 - 24 to 60 inches: stratified sand and gravel

Properties and qualities
Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches

Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2s
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Carver

Percent of map unit: 5 percent
Hydric soil rating: No

Haven

Percent of map unit: 5 percent
Hydric soil rating: No

Klej

Percent of map unit: 5 percent
Hydric soil rating: No

Tisbury

Percent of map unit: 5 percent
Hydric soil rating: No

References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

National Research Council. 1995. Wetlands: Characteristics and boundaries.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577

Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580

Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374

United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084

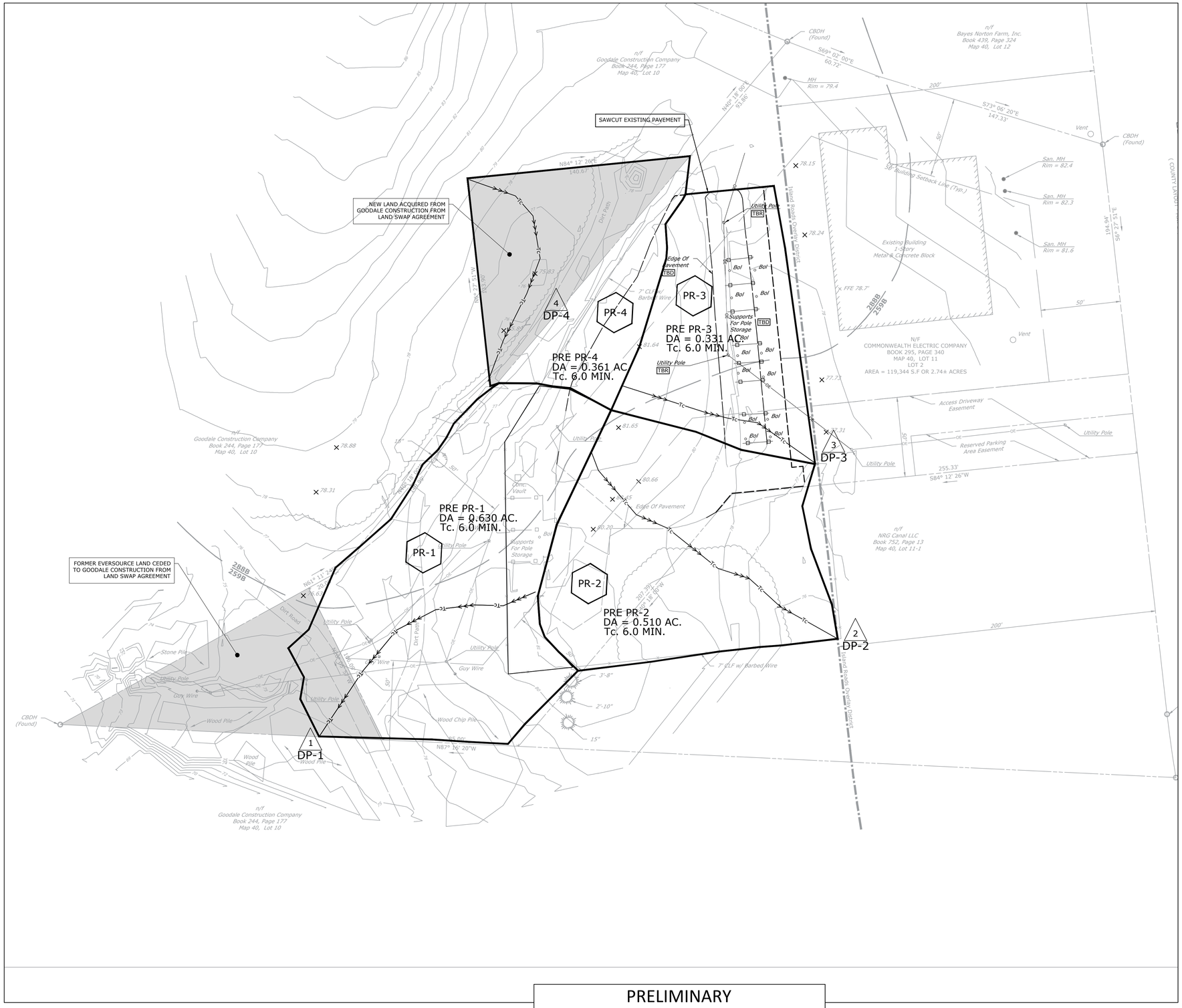
United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf

APPENDIX B

PRE-DEVELOPMENT SCENARIO



DRAINAGE AREA BOUNDARY

Tc — TIME OF CONCENTRATION TRAVEL PATH

1 — DRAINAGE AREA POINT OF INTEREST

ALL SITE SOILS ARE HYDROLOGIC SOIL GROUP "A"

SOILS INFORMATION

259B	Carver loamy course sand, 3 TO 8 PERCENT SLOPES [HYDROLOGIC GROUP A]
288B	Riverhead sandy loam, 3 TO 8 PERCENT SLOPES [HYDROLOGIC GROUP A]

LEGEND

EXISTING FEATURES

- EDGE OF PAVED BITUMINOUS SURFACE
- EDGE OF GRAVEL OR CRUSHED STONE SURFACE
- PROPERTY BOUNDARY LINE
- IRON PIN OR PIPE
- ADJOINING PROPERTY BOUNDARY LINE
- EASEMENT LINE
- LEGAL RIGHT OF WAY LINE
- MINIMUM BUILDING SETBACK LINE
- ZONING DISTRICT BOUNDARY LINE
- 420 — INDEX CONTOUR LINE
- 421 — INTERMEDIATE CONTOUR LINE
- × 500.00 — SPOT ELEVATION
- BENCHMARK LABEL
- BUILDING
- CONCRETE SURFACE
- OE — OVERHEAD ELECTRIC LINES
- MANHOLE
- UTILITY POLE
- Bol — BOLLARD
- TREELINE
- BOREHOLE
- FENCE
- SOIL TYPE BOUNDARY LINE

NO.	REVISION	DATE
C	ISSUED FOR PERMIT	2018.11.16
B	ISSUED FOR TOWN COMMENT	2018.11.08
A	ISSUED FOR OWNER COMMENT	2018.08.13

Property Owner:
Eversource Energy
247 Station Drive
Westwood, MA 02090
https://www.eversource.com/

TRC Engineers, Inc.
650 Suffolk Street
Lowell, MA 01854
Tel: 978-970-5600
www.trcsolutions.com

© TRC Engineers, Inc.

Applicant:

MARTHA'S VINEYARD ENERGY STORAGE PROJECT
208 Edgartown Vineyard Haven Road
Oak Bluffs, MA 02557

DRAWING TITLE:
PRE-DEVELOPMENT MAP PHASE II

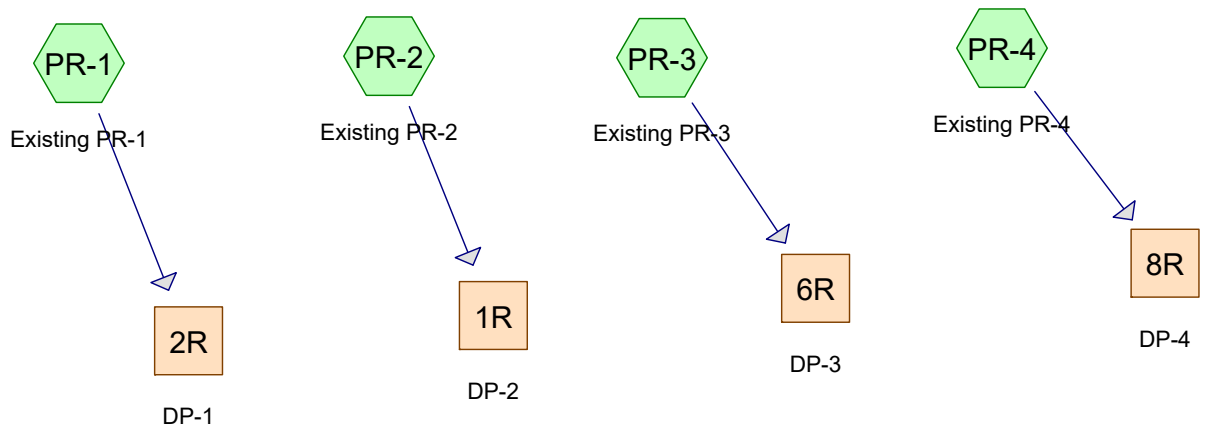
SCALE:	1" = 30'
DATE:	10/12/2018
DRAWN BY:	ROE
CHECKED BY:	CAW
PROJECT:	292138.MV02.0000
DRAWING NO.:	DA-1

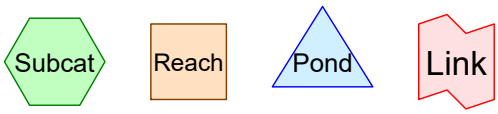
GRAPHIC SCALE
30 15 0 30
SCALE IN FEET
1" = 30'

PRELIMINARY
ISSUED FOR PERMIT
NOT FOR CONSTRUCTION

APPENDIX C

PRE-DEVELOPMENT HYDROCAD REPORT





Routing Diagram for Marthas Vineyard Stormwater - Phase II - Existing Only
Prepared by TRC, Printed 11/30/2018
HydroCAD® 10.00-19 s/n 01402 © 2016 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.264	48	Brush, HSG A (PR-4)
0.627	48	Brush, Poor, HSG A (PR-1, PR-2, PR-3)
0.059	72	Dirt roads, HSG A (PR-1)
0.075	77	Fallow, bare soil, HSG A (PR-1)
0.566	98	Paved parking, HSG A (PR-1, PR-2, PR-3)
0.097	98	Unconnected pavement, HSG A (PR-4)
0.144	43	Woods/grass comb., Fair, HSG A (PR-2)
1.832	**68**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
1.832	HSG A	PR-1, PR-2, PR-3, PR-4
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.000	Other	
1.832		**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
0.264	0.000	0.000	0.000	0.000	0.264	Brush	PR-4
0.627	0.000	0.000	0.000	0.000	0.627	Brush, Poor	PR-1, PR-2, PR-3
0.059	0.000	0.000	0.000	0.000	0.059	Dirt roads	PR-1
0.075	0.000	0.000	0.000	0.000	0.075	Fallow, bare soil	PR-1
0.566	0.000	0.000	0.000	0.000	0.566	Paved parking	PR-1, PR-2, PR-3
0.097	0.000	0.000	0.000	0.000	0.097	Unconnected pavement	PR-4
0.144	0.000	0.000	0.000	0.000	0.144	Woods/grass comb., Fair	PR-2
1.832	**0.000**	**0.000**	**0.000**	**0.000**	**1.832**	**TOTAL AREA**	

Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points
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 PR-1: Existing PR-1 Runoff Area=0.630 ac 22.86% Impervious Runoff Depth=0.65"
Flow Length=314' Tc=6.0 min CN=65 Runoff=0.38 cfs 0.034 af

Subcatchment PR-2: Existing PR-2 Runoff Area=0.510 ac 35.69% Impervious Runoff Depth=0.61"
Flow Length=217' Tc=6.0 min CN=64 Runoff=0.28 cfs 0.026 af

Subcatchment PR-3: Existing PR-3 Runoff Area=0.331 ac 72.51% Impervious Runoff Depth=1.77"
Tc=6.0 min CN=84 Runoff=0.68 cfs 0.049 af

Subcatchment PR-4: Existing PR-4 Runoff Area=15,719 sf 26.84% Impervious Runoff Depth=0.28"
Flow Length=140' Tc=7.2 min UI Adjusted CN=55 Runoff=0.04 cfs 0.009 af

Reach 1R: DP-2 Inflow=0.28 cfs 0.026 af
Outflow=0.28 cfs 0.026 af

Reach 2R: DP-1 Inflow=0.38 cfs 0.034 af
Outflow=0.38 cfs 0.034 af

Reach 6R: DP-3 Inflow=0.68 cfs 0.049 af
Outflow=0.68 cfs 0.049 af

Reach 8R: DP-4 Inflow=0.04 cfs 0.009 af
Outflow=0.04 cfs 0.009 af

Total Runoff Area = 1.832 ac Runoff Volume = 0.118 af Average Runoff Depth = 0.77"
63.82% Pervious = 1.169 ac 36.18% Impervious = 0.663 ac

Summary for Subcatchment PR-1: Existing PR-1

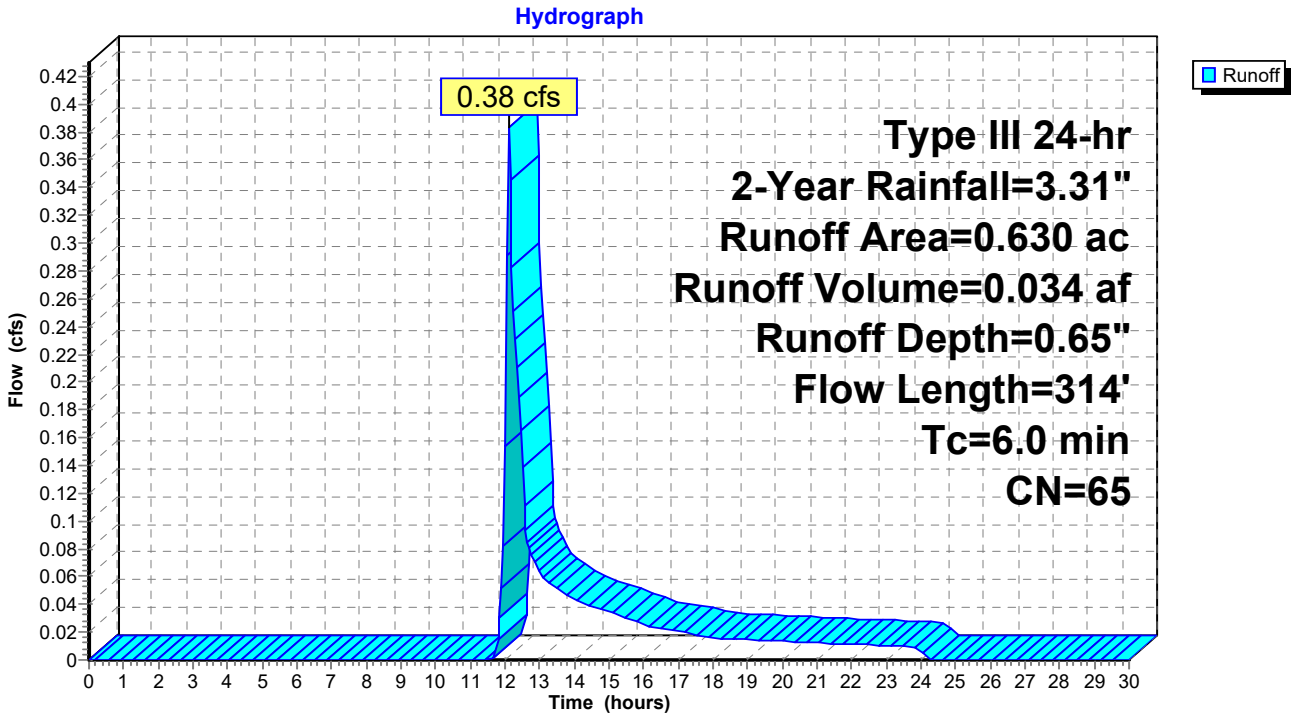
Runoff = 0.38 cfs @ 12.11 hrs, Volume= 0.034 af, Depth= 0.65"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.31"

Area (ac)	CN	Description
0.059	72	Dirt roads, HSG A
0.352	48	Brush, Poor, HSG A
0.075	77	Fallow, bare soil, HSG A
0.144	98	Paved parking, HSG A
0.630	65	Weighted Average
0.486		77.14% Pervious Area
0.144		22.86% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.2	50	0.0226	0.38		**Sheet Flow,** Fallow n= 0.050 P2= 3.31"
2.0	264	0.0189	2.21		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
4.2	314	Total, Increased to minimum Tc = 6.0 min			

Subcatchment PR-1: Existing PR-1



Summary for Subcatchment PR-2: Existing PR-2

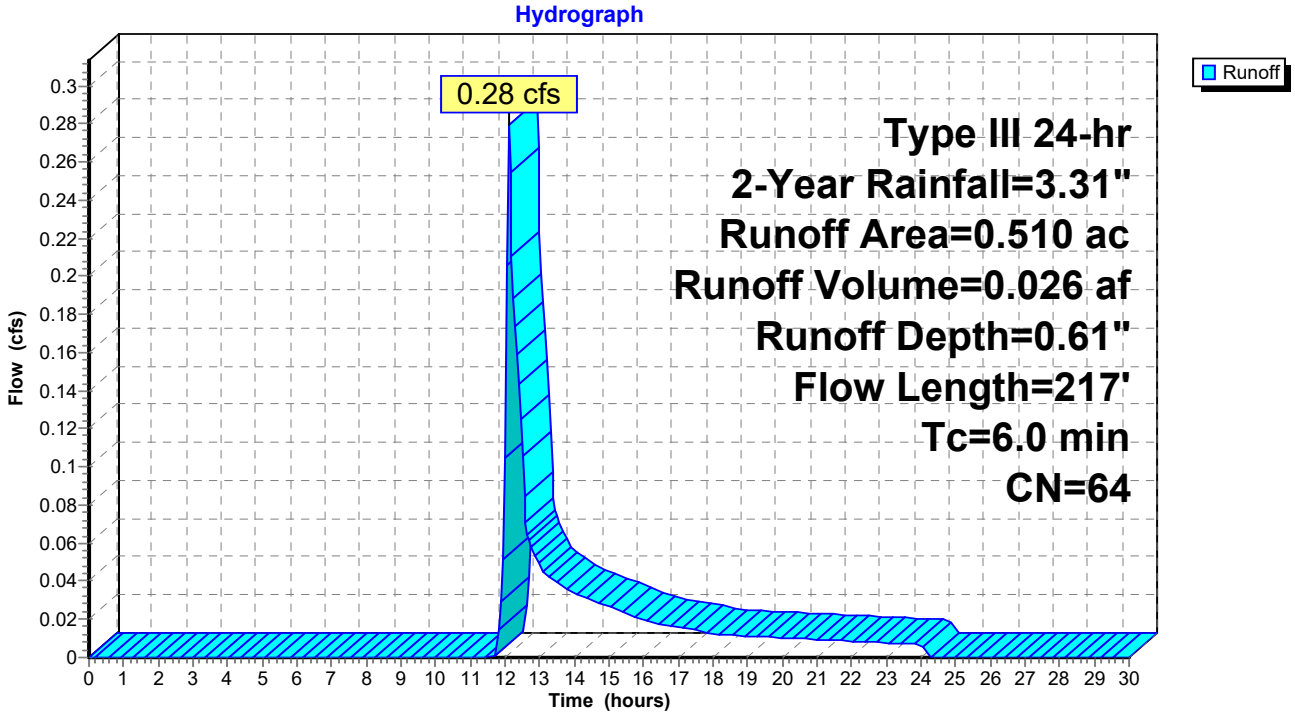
Runoff = 0.28 cfs @ 12.11 hrs, Volume= 0.026 af, Depth= 0.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.31"

Area (ac)	CN	Description
0.144	43	Woods/grass comb., Fair, HSG A
0.182	98	Paved parking, HSG A
0.184	48	Brush, Poor, HSG A
0.510	64	Weighted Average
0.328		64.31% Pervious Area
0.182		35.69% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	50	0.0240	1.31		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.31"
0.2	27	0.0230	2.44		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.3	75	0.0350	0.94		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.4	65	0.0280	2.69		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
2.5	217	Total, Increased to minimum Tc = 6.0 min			

Subcatchment PR-2: Existing PR-2



Summary for Subcatchment PR-3: Existing PR-3

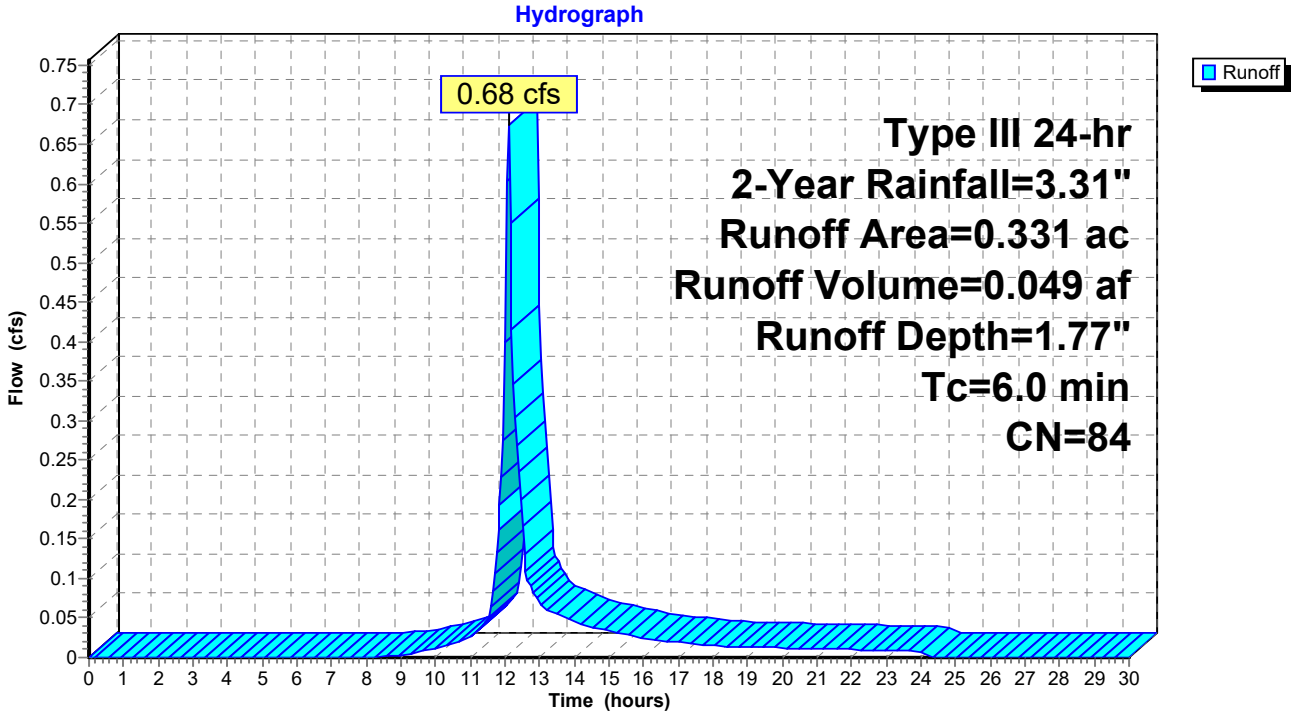
Runoff = 0.68 cfs @ 12.09 hrs, Volume= 0.049 af, Depth= 1.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.31"

Area (ac)	CN	Description
0.240	98	Paved parking, HSG A
0.091	48	Brush, Poor, HSG A
0.331	84	Weighted Average
0.091		27.49% Pervious Area
0.240		72.51% Impervious Area

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

Subcatchment PR-3: Existing PR-3



Summary for Subcatchment PR-4: Existing PR-4

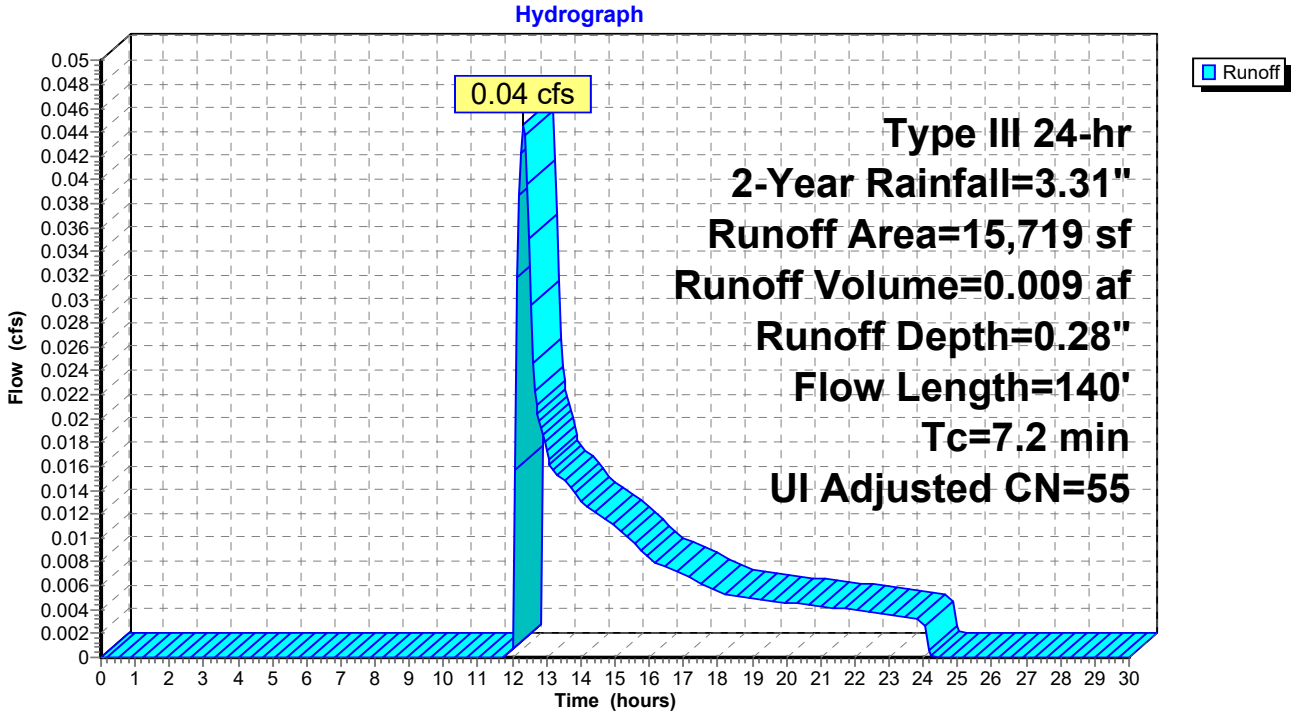
Runoff = 0.04 cfs @ 12.33 hrs, Volume= 0.009 af, Depth= 0.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.31"

	Area (sf)	CN	Adj	Description
*	11,500	48		Brush, HSG A
	4,219	98		Unconnected pavement, HSG A
	15,719	61	55	Weighted Average, UI Adjusted
	11,500			73.16% Pervious Area
	4,219			26.84% Impervious Area
	4,219			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.5	100	0.0400	0.26		**Sheet Flow, SF** Range n= 0.130 P2= 3.31"
0.7	40	0.0200	0.99		**Shallow Concentrated Flow, S** Short Grass Pasture Kv= 7.0 fps
7.2	140	Total			

Subcatchment PR-4: Existing PR-4

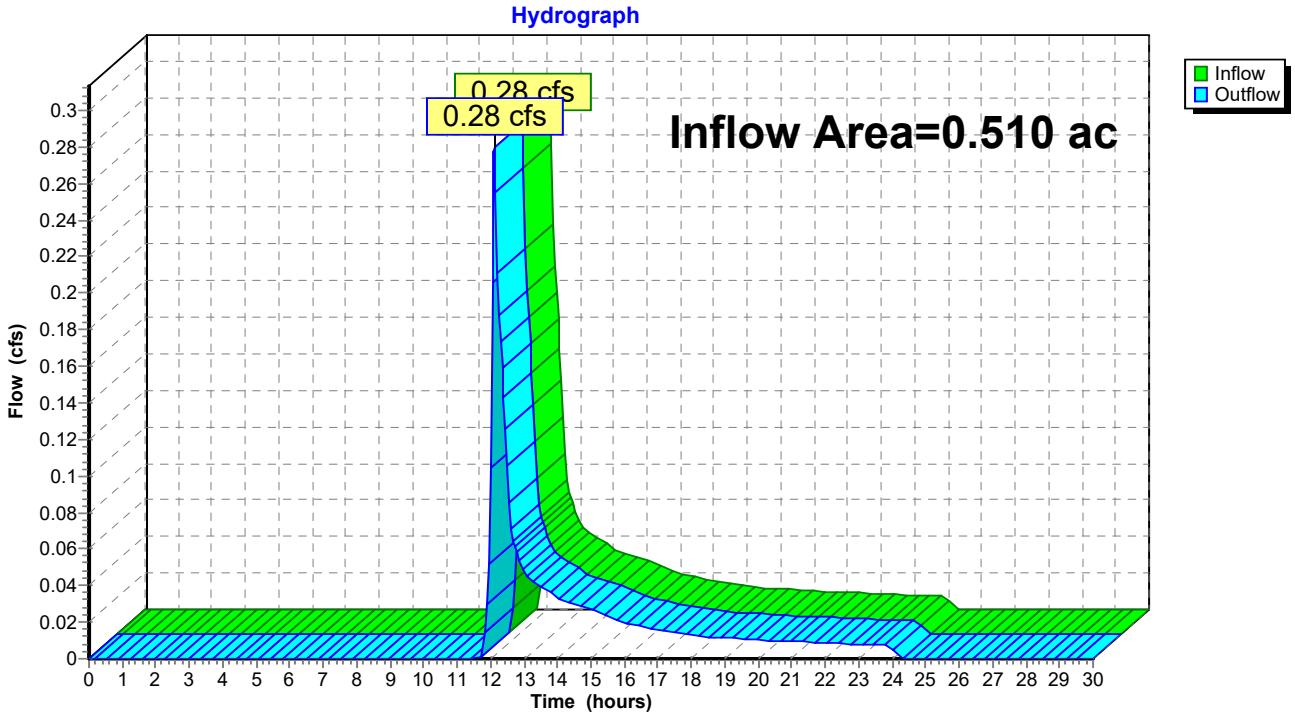


Summary for Reach 1R: DP-2

Inflow Area = 0.510 ac, 35.69% Impervious, Inflow Depth = 0.61" for 2-Year event
Inflow = 0.28 cfs @ 12.11 hrs, Volume= 0.026 af
Outflow = 0.28 cfs @ 12.11 hrs, Volume= 0.026 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Reach 1R: DP-2

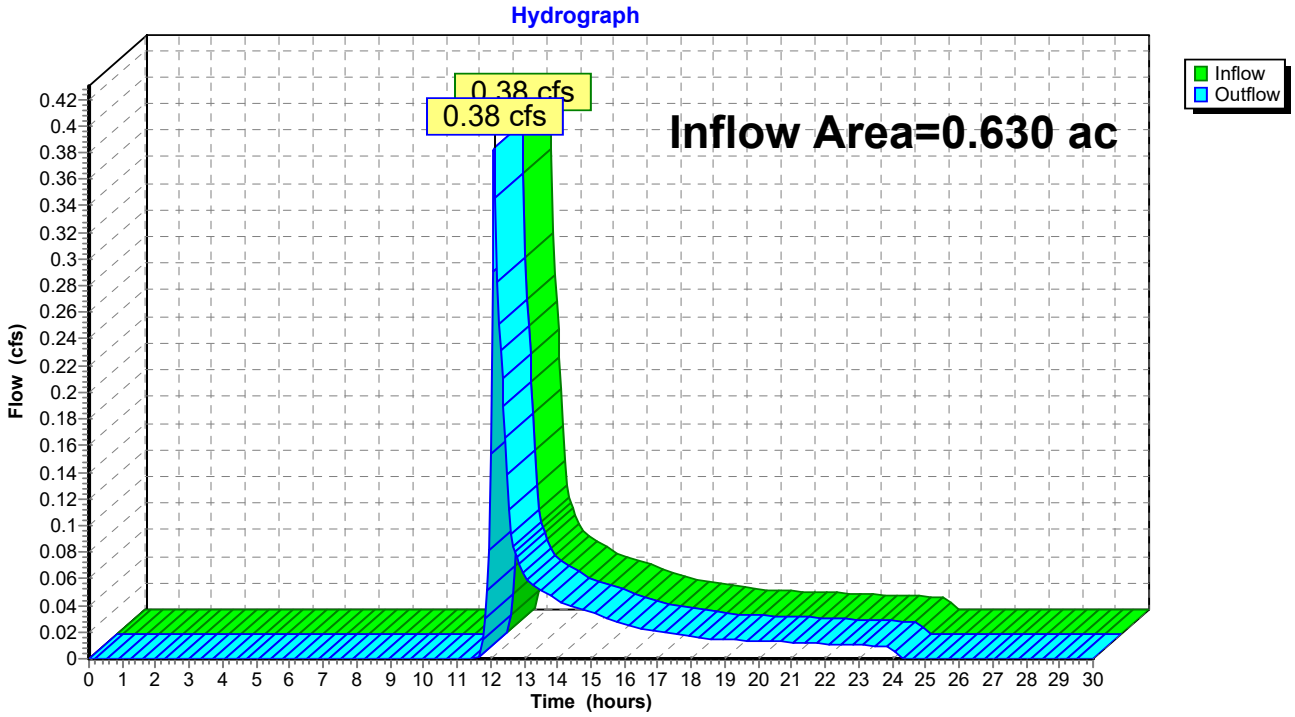


Summary for Reach 2R: DP-1

Inflow Area = 0.630 ac, 22.86% Impervious, Inflow Depth = 0.65" for 2-Year event
Inflow = 0.38 cfs @ 12.11 hrs, Volume= 0.034 af
Outflow = 0.38 cfs @ 12.11 hrs, Volume= 0.034 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Reach 2R: DP-1

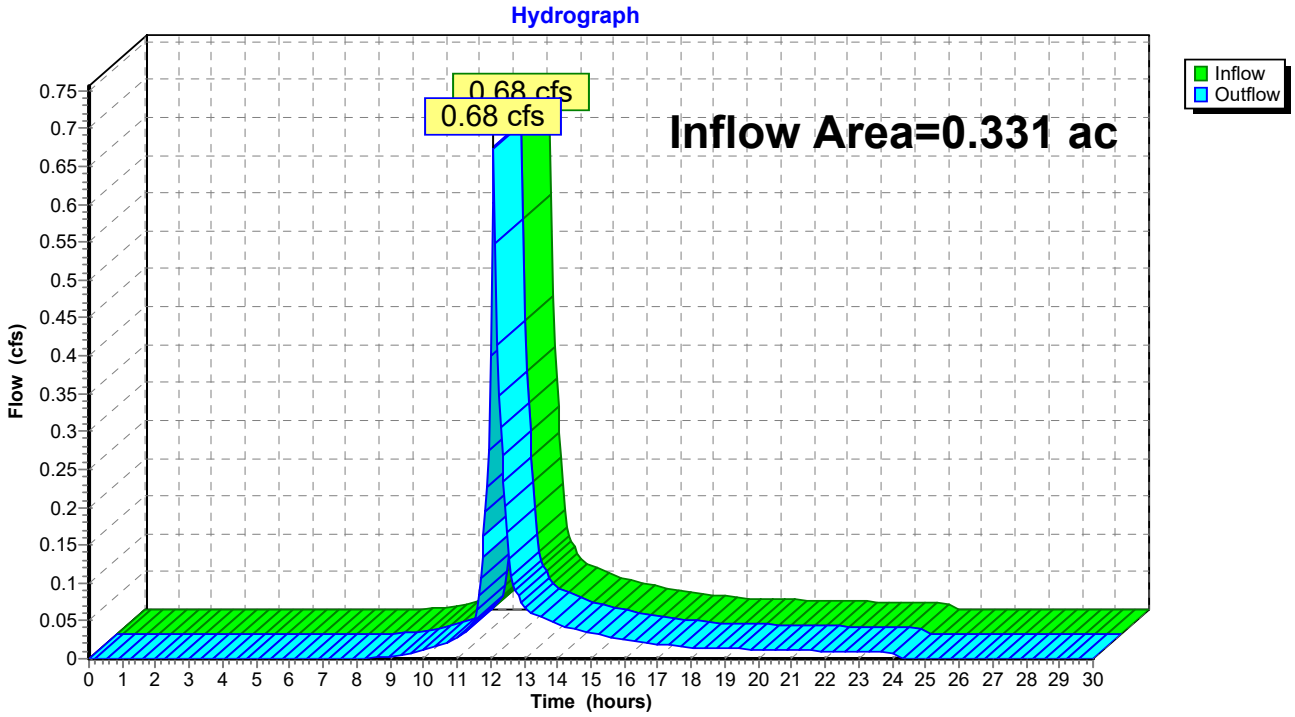


Summary for Reach 6R: DP-3

Inflow Area = 0.331 ac, 72.51% Impervious, Inflow Depth = 1.77" for 2-Year event
Inflow = 0.68 cfs @ 12.09 hrs, Volume= 0.049 af
Outflow = 0.68 cfs @ 12.09 hrs, Volume= 0.049 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Reach 6R: DP-3

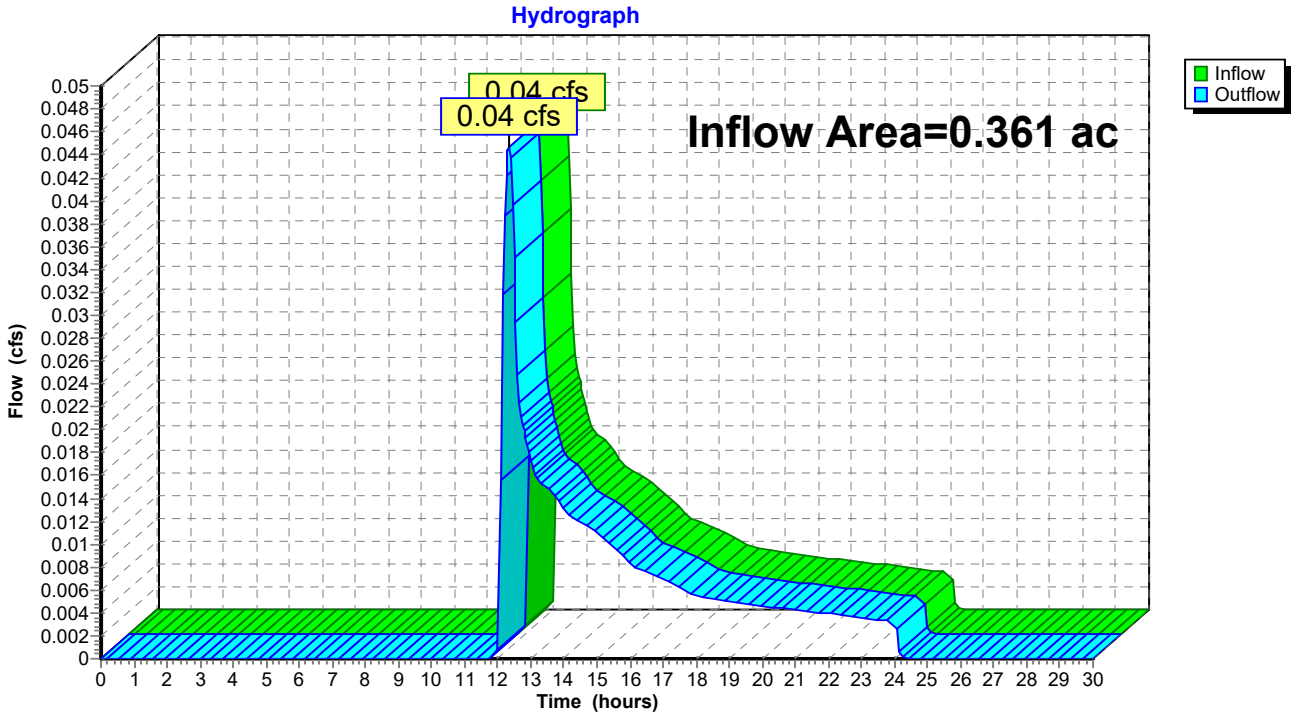


Summary for Reach 8R: DP-4

Inflow Area = 0.361 ac, 26.84% Impervious, Inflow Depth = 0.28" for 2-Year event
Inflow = 0.04 cfs @ 12.33 hrs, Volume= 0.009 af
Outflow = 0.04 cfs @ 12.33 hrs, Volume= 0.009 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Reach 8R: DP-4



Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points
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 PR-1: Existing PR-1 Runoff Area=0.630 ac 22.86% Impervious Runoff Depth=1.59"
Flow Length=314' Tc=6.0 min CN=65 Runoff=1.10 cfs 0.084 af

Subcatchment PR-2: Existing PR-2 Runoff Area=0.510 ac 35.69% Impervious Runoff Depth=1.52"
Flow Length=217' Tc=6.0 min CN=64 Runoff=0.84 cfs 0.065 af

Subcatchment PR-3: Existing PR-3 Runoff Area=0.331 ac 72.51% Impervious Runoff Depth=3.19"
Tc=6.0 min CN=84 Runoff=1.20 cfs 0.088 af

Subcatchment PR-4: Existing PR-4 Runoff Area=15,719 sf 26.84% Impervious Runoff Depth=0.94"
Flow Length=140' Tc=7.2 min UI Adjusted CN=55 Runoff=0.29 cfs 0.028 af

Reach 1R: DP-2 Inflow=0.84 cfs 0.065 af
Outflow=0.84 cfs 0.065 af

Reach 2R: DP-1 Inflow=1.10 cfs 0.084 af
Outflow=1.10 cfs 0.084 af

Reach 6R: DP-3 Inflow=1.20 cfs 0.088 af
Outflow=1.20 cfs 0.088 af

Reach 8R: DP-4 Inflow=0.29 cfs 0.028 af
Outflow=0.29 cfs 0.028 af

Total Runoff Area = 1.832 ac Runoff Volume = 0.264 af Average Runoff Depth = 1.73"
63.82% Pervious = 1.169 ac 36.18% Impervious = 0.663 ac

Summary for Subcatchment PR-1: Existing PR-1

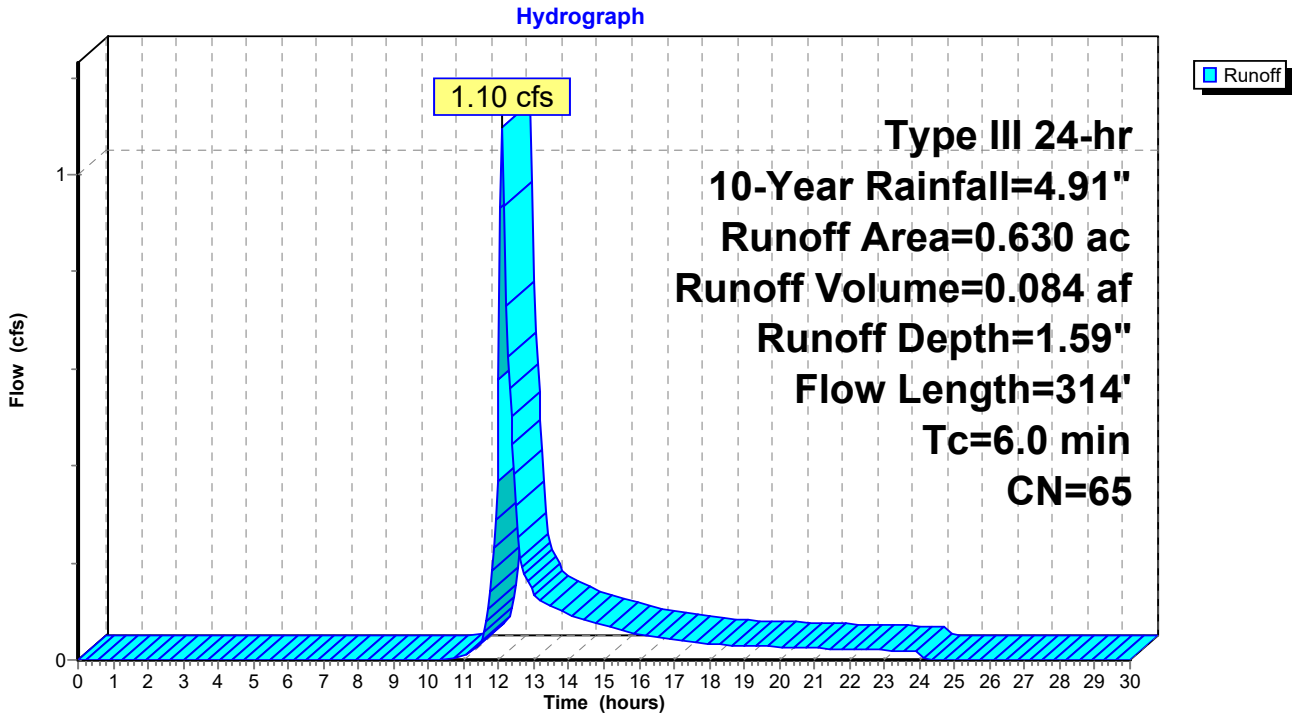
Runoff = 1.10 cfs @ 12.10 hrs, Volume= 0.084 af, Depth= 1.59"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.91"

Area (ac)	CN	Description
0.059	72	Dirt roads, HSG A
0.352	48	Brush, Poor, HSG A
0.075	77	Fallow, bare soil, HSG A
0.144	98	Paved parking, HSG A
0.630	65	Weighted Average
0.486		77.14% Pervious Area
0.144		22.86% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.2	50	0.0226	0.38		**Sheet Flow,** Fallow n= 0.050 P2= 3.31"
2.0	264	0.0189	2.21		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
4.2	314	Total, Increased to minimum Tc = 6.0 min			

Subcatchment PR-1: Existing PR-1



Summary for Subcatchment PR-2: Existing PR-2

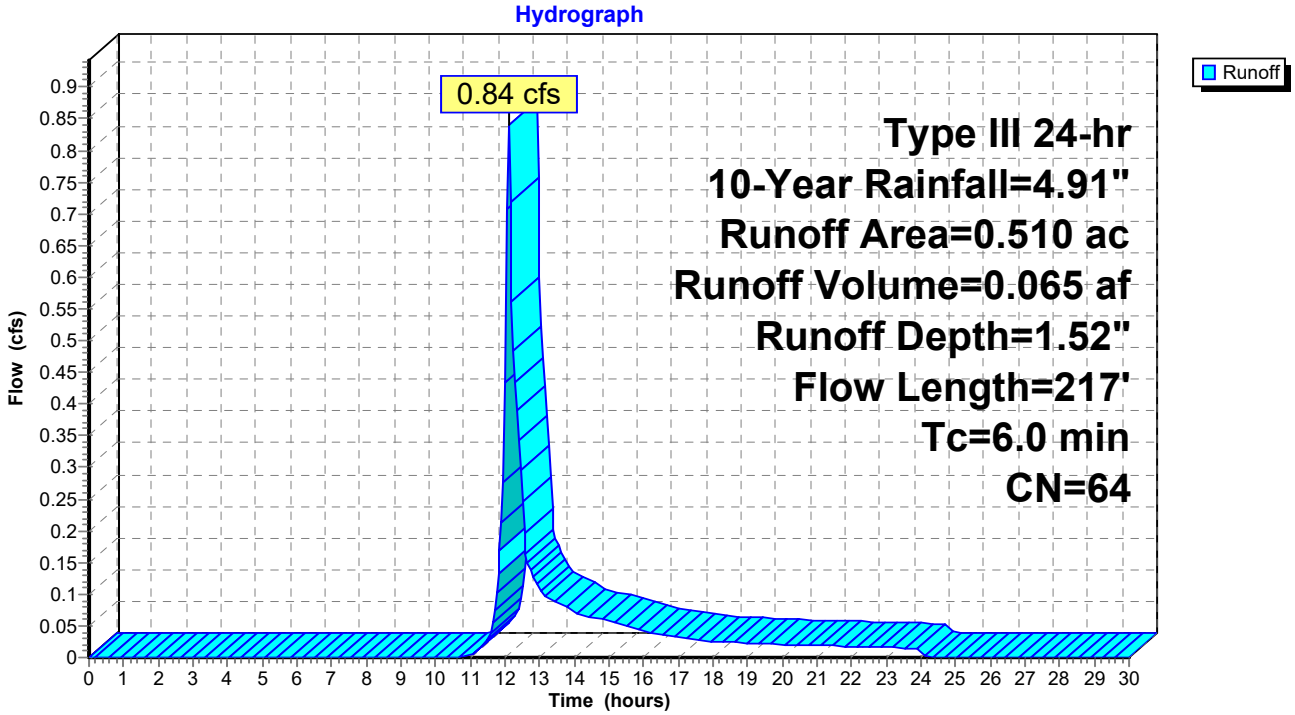
Runoff = 0.84 cfs @ 12.10 hrs, Volume= 0.065 af, Depth= 1.52"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.91"

Area (ac)	CN	Description
0.144	43	Woods/grass comb., Fair, HSG A
0.182	98	Paved parking, HSG A
0.184	48	Brush, Poor, HSG A
0.510	64	Weighted Average
0.328		64.31% Pervious Area
0.182		35.69% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	50	0.0240	1.31		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.31"
0.2	27	0.0230	2.44		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.3	75	0.0350	0.94		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.4	65	0.0280	2.69		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
2.5	217	Total, Increased to minimum Tc = 6.0 min			

Subcatchment PR-2: Existing PR-2



Summary for Subcatchment PR-3: Existing PR-3

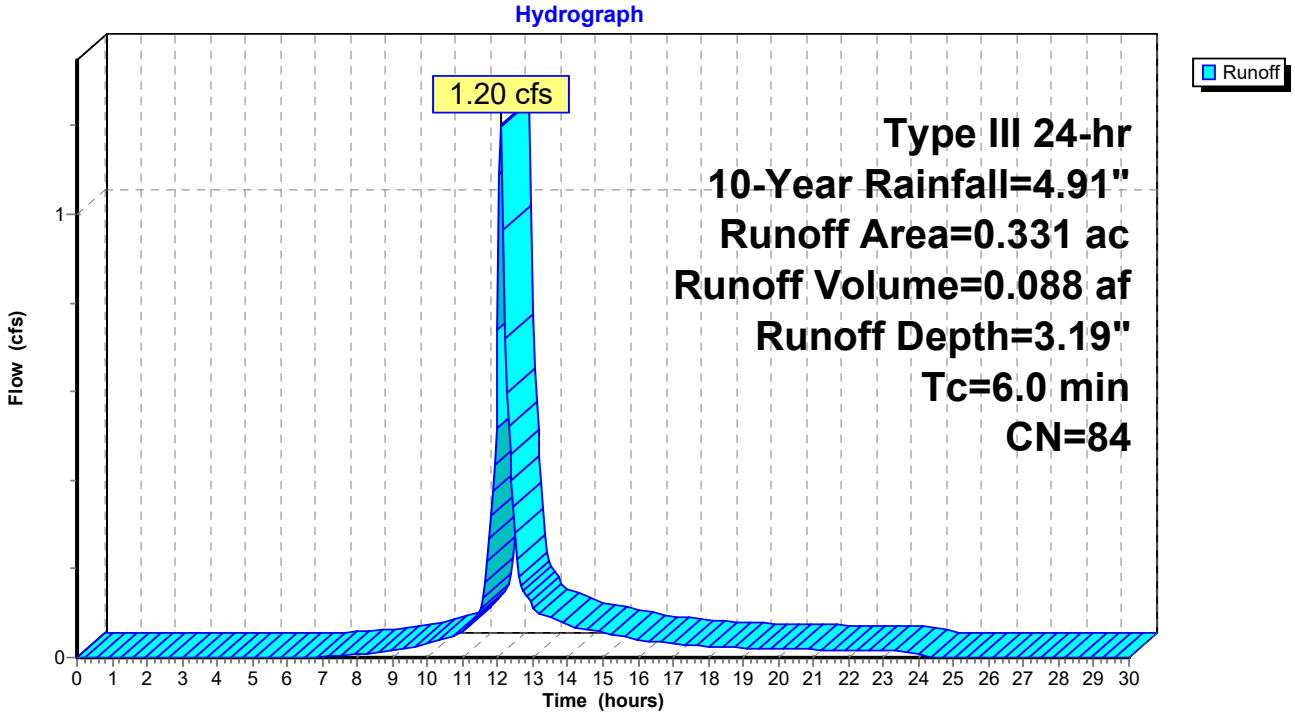
Runoff = 1.20 cfs @ 12.09 hrs, Volume= 0.088 af, Depth= 3.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.91"

Area (ac)	CN	Description
0.240	98	Paved parking, HSG A
0.091	48	Brush, Poor, HSG A
0.331	84	Weighted Average
0.091		27.49% Pervious Area
0.240		72.51% Impervious Area

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

Subcatchment PR-3: Existing PR-3



Summary for Subcatchment PR-4: Existing PR-4

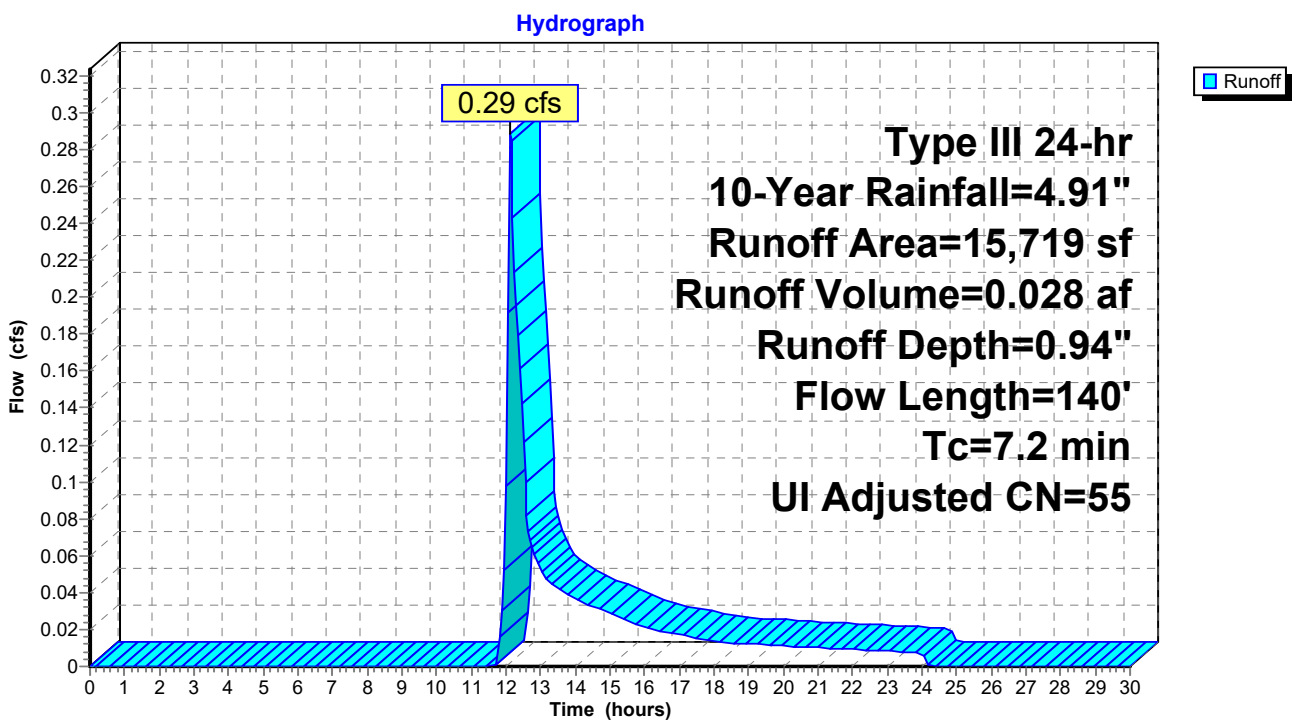
Runoff = 0.29 cfs @ 12.13 hrs, Volume= 0.028 af, Depth= 0.94"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.91"

	Area (sf)	CN	Adj	Description
*	11,500	48		Brush, HSG A
	4,219	98		Unconnected pavement, HSG A
	15,719	61	55	Weighted Average, UI Adjusted
	11,500			73.16% Pervious Area
	4,219			26.84% Impervious Area
	4,219			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.5	100	0.0400	0.26		**Sheet Flow, SF** Range n= 0.130 P2= 3.31"
0.7	40	0.0200	0.99		**Shallow Concentrated Flow, S** Short Grass Pasture Kv= 7.0 fps
7.2	140	Total			

Subcatchment PR-4: Existing PR-4

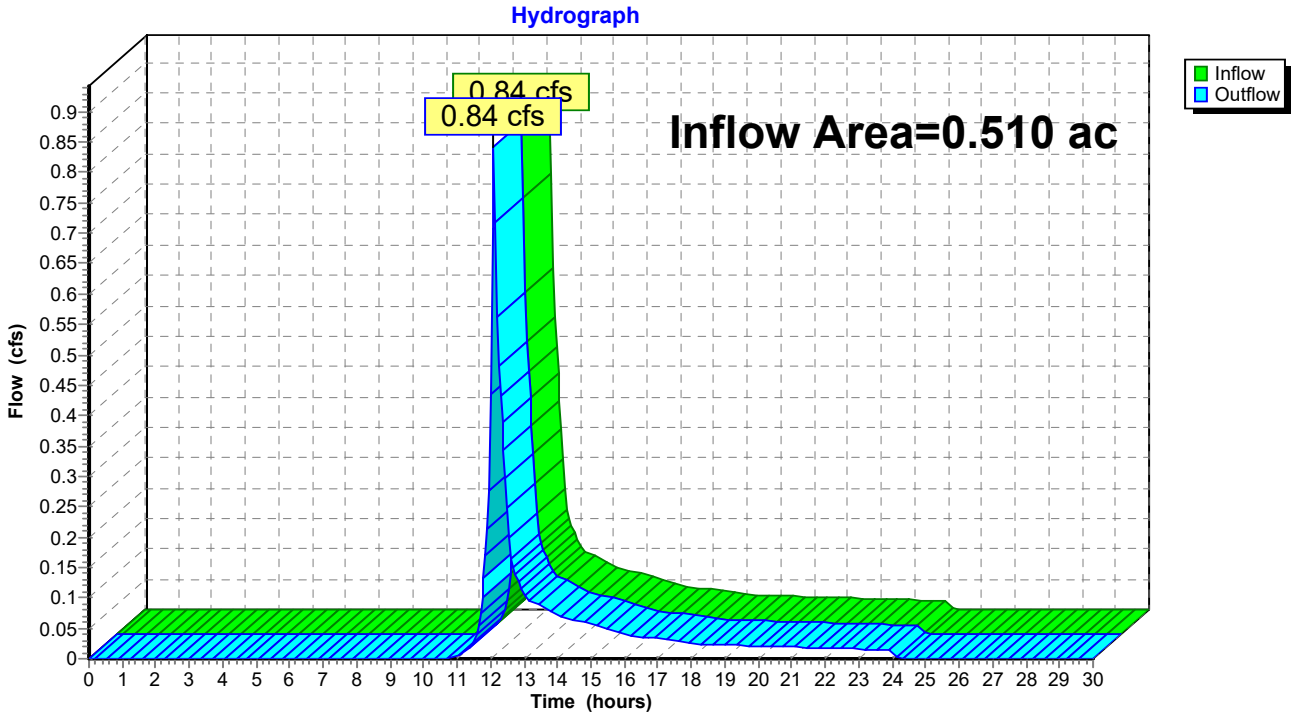


Summary for Reach 1R: DP-2

Inflow Area = 0.510 ac, 35.69% Impervious, Inflow Depth = 1.52" for 10-Year event
Inflow = 0.84 cfs @ 12.10 hrs, Volume= 0.065 af
Outflow = 0.84 cfs @ 12.10 hrs, Volume= 0.065 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Reach 1R: DP-2

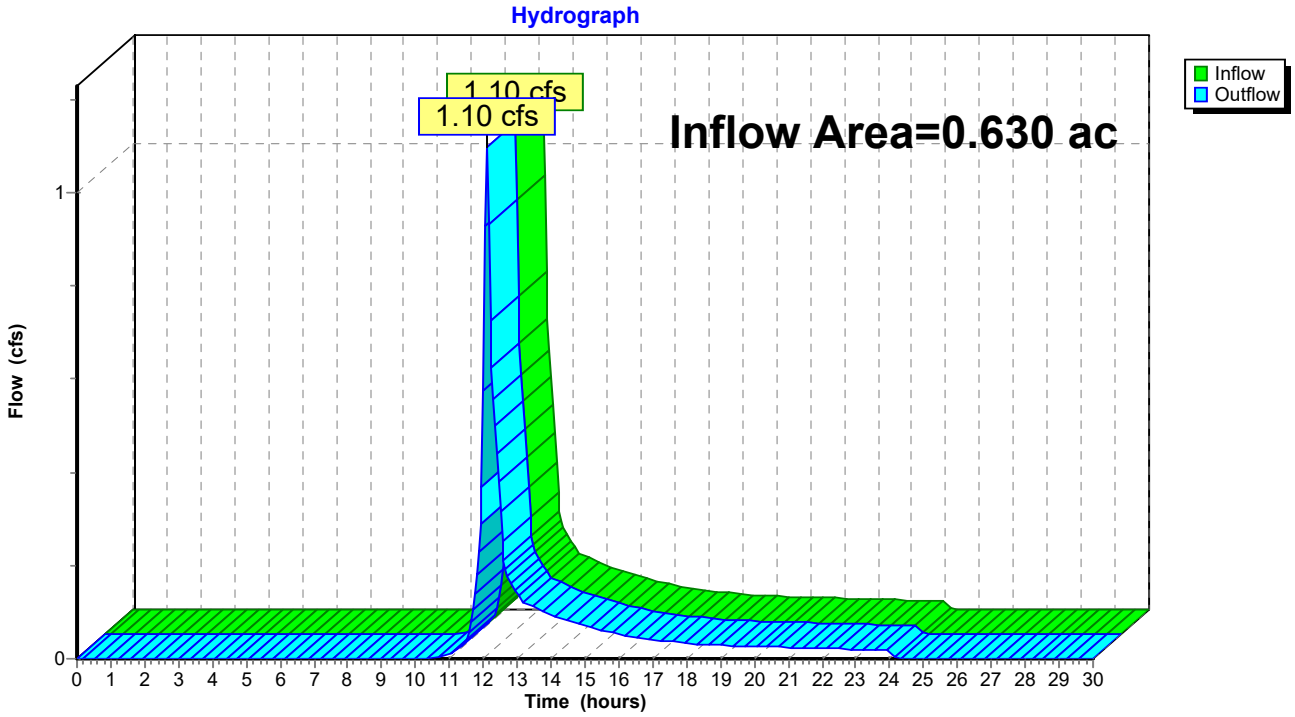


Summary for Reach 2R: DP-1

Inflow Area = 0.630 ac, 22.86% Impervious, Inflow Depth = 1.59" for 10-Year event
Inflow = 1.10 cfs @ 12.10 hrs, Volume= 0.084 af
Outflow = 1.10 cfs @ 12.10 hrs, Volume= 0.084 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Reach 2R: DP-1

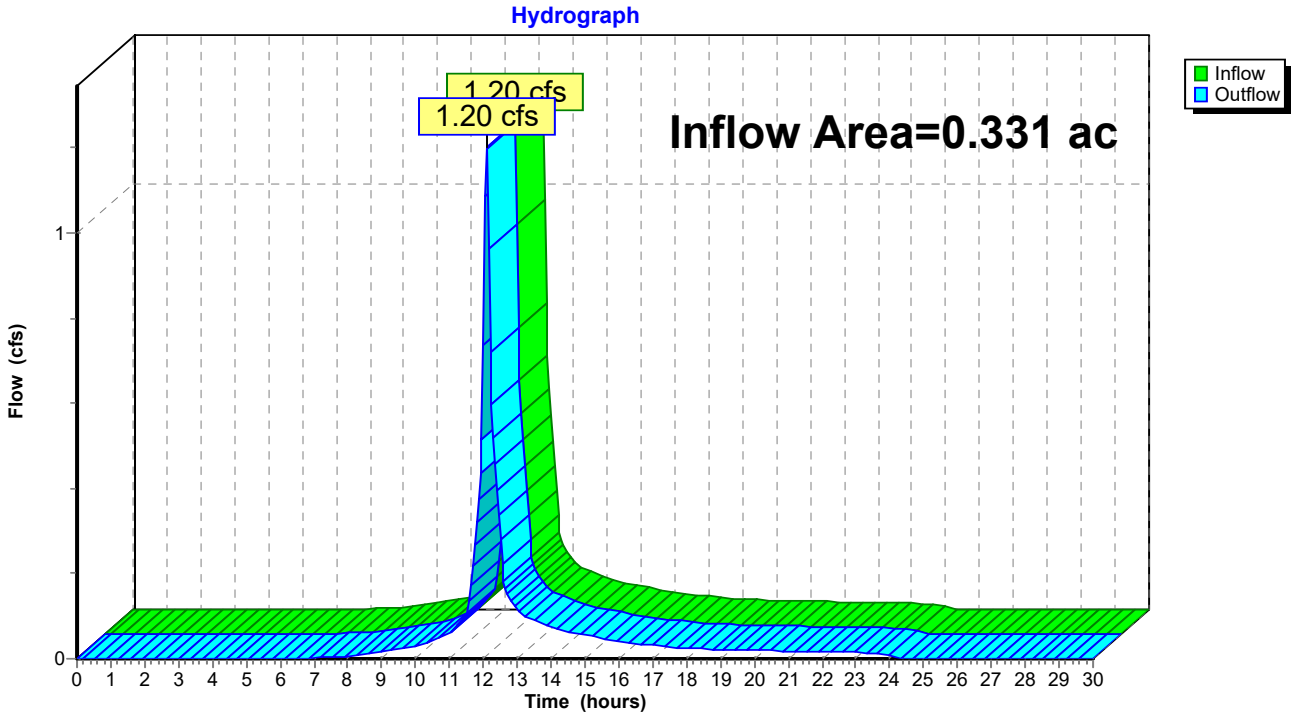


Summary for Reach 6R: DP-3

Inflow Area = 0.331 ac, 72.51% Impervious, Inflow Depth = 3.19" for 10-Year event
Inflow = 1.20 cfs @ 12.09 hrs, Volume= 0.088 af
Outflow = 1.20 cfs @ 12.09 hrs, Volume= 0.088 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Reach 6R: DP-3

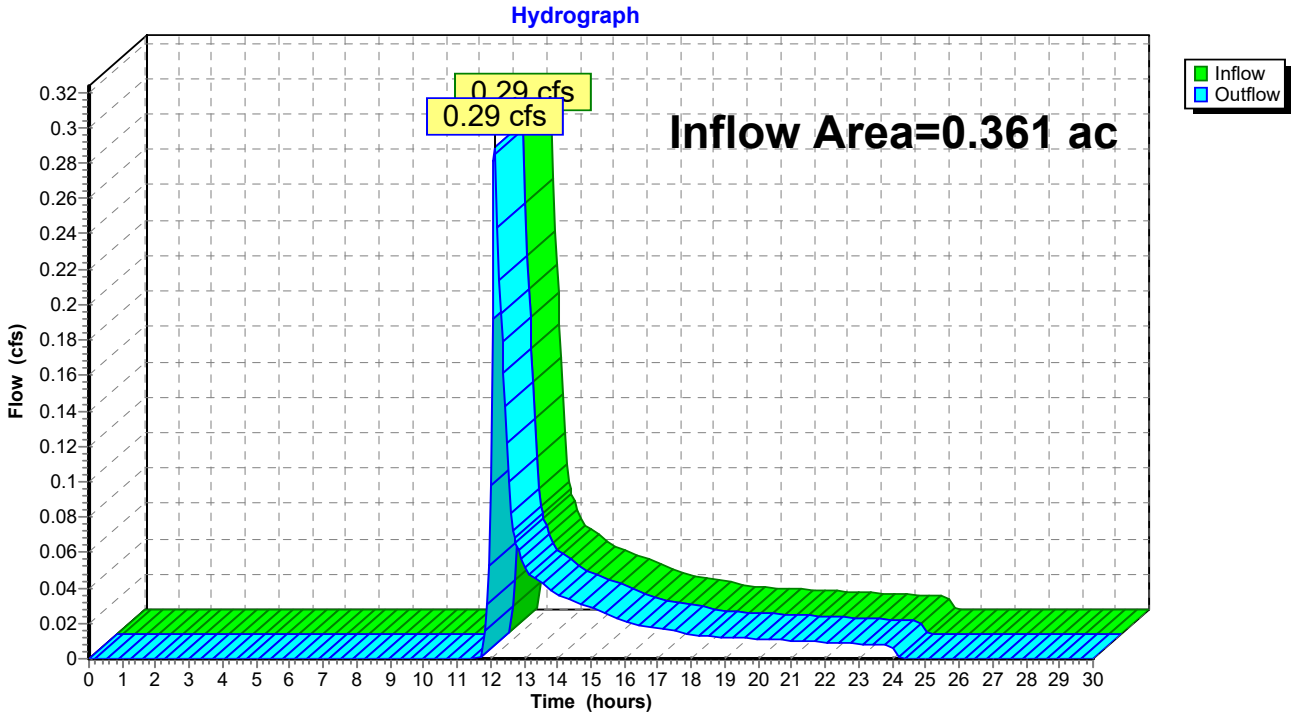


Summary for Reach 8R: DP-4

Inflow Area = 0.361 ac, 26.84% Impervious, Inflow Depth = 0.94" for 10-Year event
Inflow = 0.29 cfs @ 12.13 hrs, Volume= 0.028 af
Outflow = 0.29 cfs @ 12.13 hrs, Volume= 0.028 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Reach 8R: DP-4



Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points
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 PR-1: Existing PR-1 Runoff Area=0.630 ac 22.86% Impervious Runoff Depth=2.47"
Flow Length=314' Tc=6.0 min CN=65 Runoff=1.76 cfs 0.130 af

Subcatchment PR-2: Existing PR-2 Runoff Area=0.510 ac 35.69% Impervious Runoff Depth=2.38"
Flow Length=217' Tc=6.0 min CN=64 Runoff=1.36 cfs 0.101 af

Subcatchment PR-3: Existing PR-3 Runoff Area=0.331 ac 72.51% Impervious Runoff Depth=4.35"
Tc=6.0 min CN=84 Runoff=1.62 cfs 0.120 af

Subcatchment PR-4: Existing PR-4 Runoff Area=15,719 sf 26.84% Impervious Runoff Depth=1.61"
Flow Length=140' Tc=7.2 min UI Adjusted CN=55 Runoff=0.58 cfs 0.048 af

Reach 1R: DP-2 Inflow=1.36 cfs 0.101 af
Outflow=1.36 cfs 0.101 af

Reach 2R: DP-1 Inflow=1.76 cfs 0.130 af
Outflow=1.76 cfs 0.130 af

Reach 6R: DP-3 Inflow=1.62 cfs 0.120 af
Outflow=1.62 cfs 0.120 af

Reach 8R: DP-4 Inflow=0.58 cfs 0.048 af
Outflow=0.58 cfs 0.048 af

Total Runoff Area = 1.832 ac Runoff Volume = 0.399 af Average Runoff Depth = 2.61"
63.82% Pervious = 1.169 ac 36.18% Impervious = 0.663 ac

Summary for Subcatchment PR-1: Existing PR-1

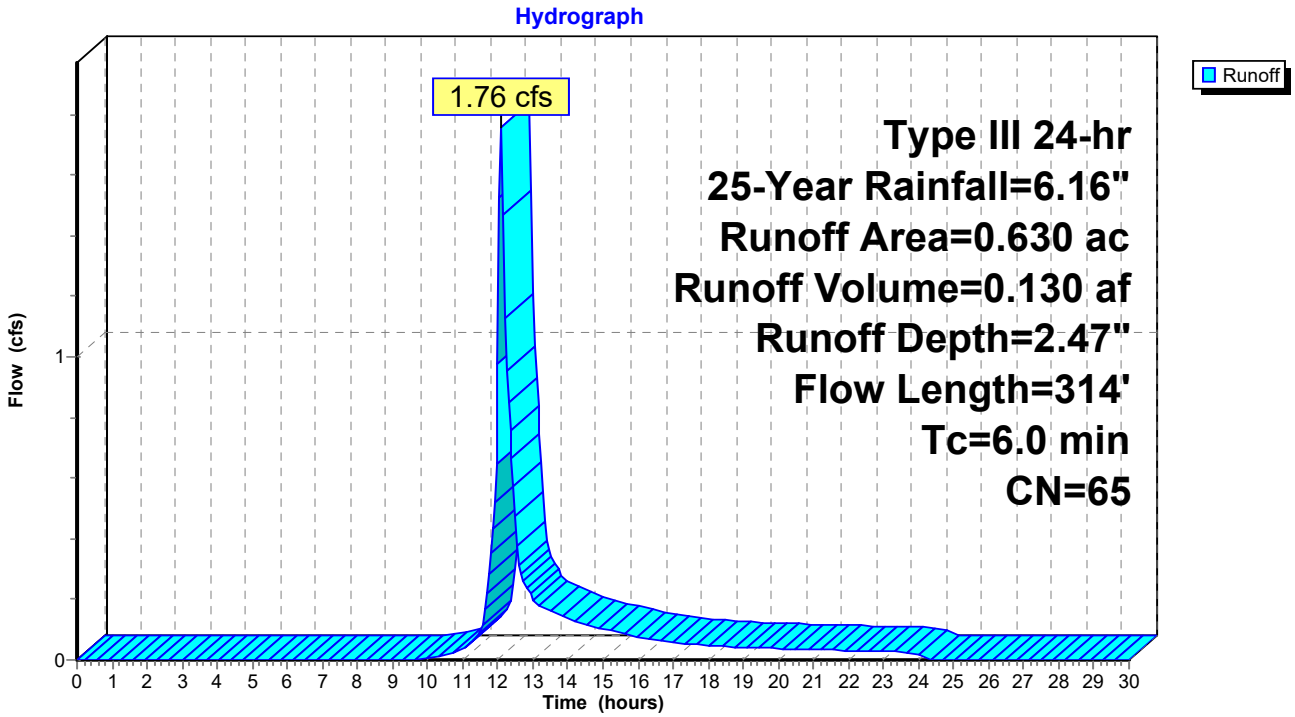
Runoff = 1.76 cfs @ 12.10 hrs, Volume= 0.130 af, Depth= 2.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.16"

Area (ac)	CN	Description
0.059	72	Dirt roads, HSG A
0.352	48	Brush, Poor, HSG A
0.075	77	Fallow, bare soil, HSG A
0.144	98	Paved parking, HSG A
0.630	65	Weighted Average
0.486		77.14% Pervious Area
0.144		22.86% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.2	50	0.0226	0.38		**Sheet Flow,** Fallow n= 0.050 P2= 3.31"
2.0	264	0.0189	2.21		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
4.2	314	Total, Increased to minimum Tc = 6.0 min			

Subcatchment PR-1: Existing PR-1



Summary for Subcatchment PR-2: Existing PR-2

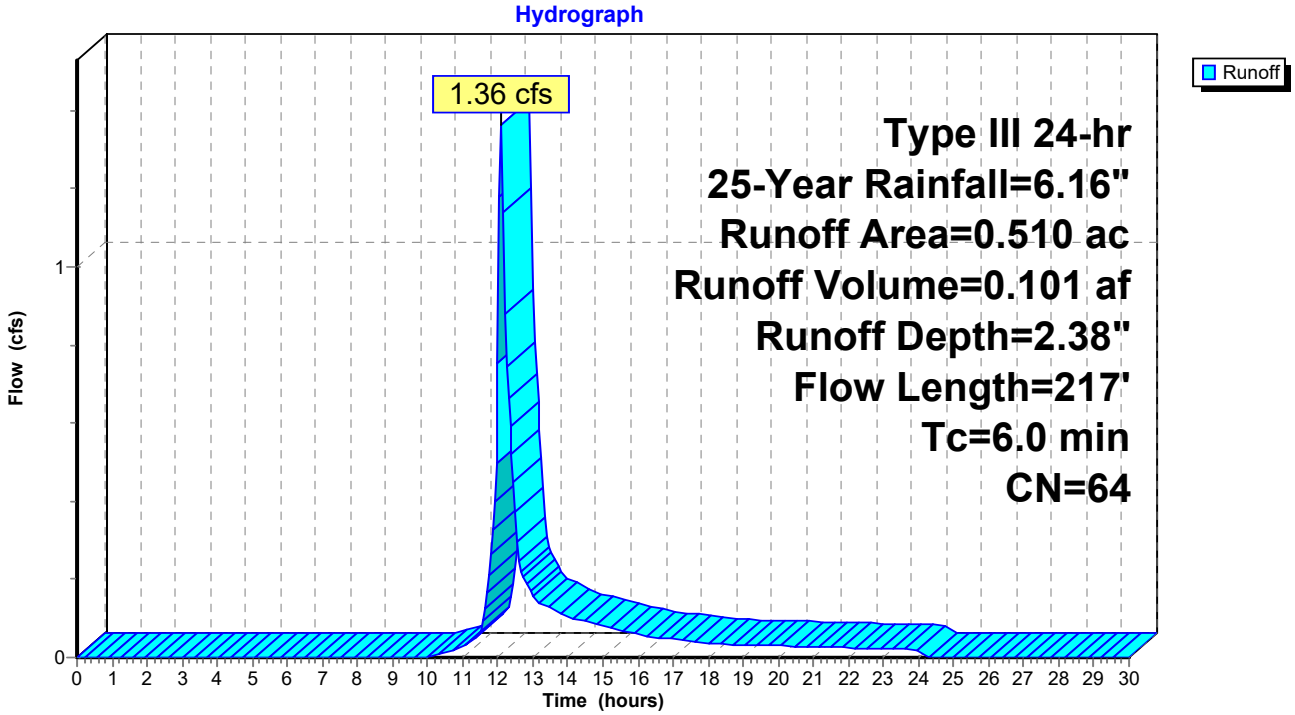
Runoff = 1.36 cfs @ 12.10 hrs, Volume= 0.101 af, Depth= 2.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.16"

Area (ac)	CN	Description
0.144	43	Woods/grass comb., Fair, HSG A
0.182	98	Paved parking, HSG A
0.184	48	Brush, Poor, HSG A
0.510	64	Weighted Average
0.328		64.31% Pervious Area
0.182		35.69% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	50	0.0240	1.31		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.31"
0.2	27	0.0230	2.44		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.3	75	0.0350	0.94		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.4	65	0.0280	2.69		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
2.5	217	Total, Increased to minimum Tc = 6.0 min			

Subcatchment PR-2: Existing PR-2



Summary for Subcatchment PR-3: Existing PR-3

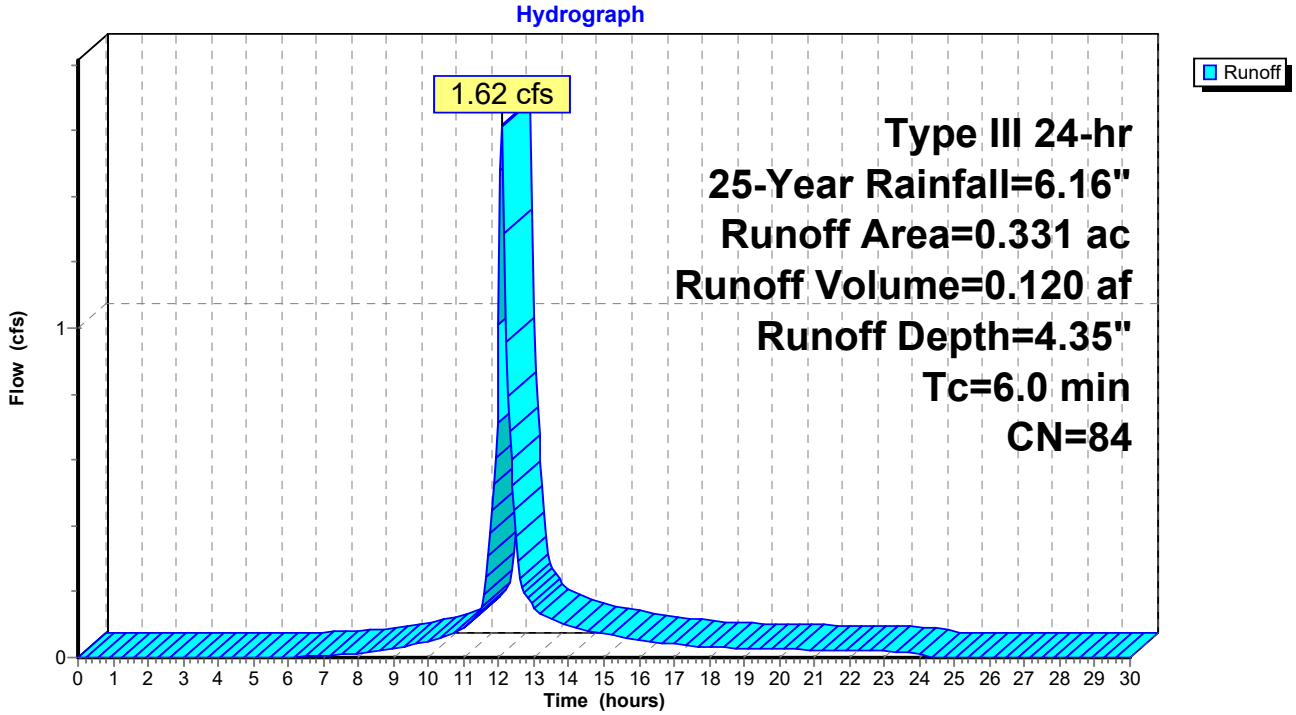
Runoff = 1.62 cfs @ 12.09 hrs, Volume= 0.120 af, Depth= 4.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.16"

Area (ac)	CN	Description
0.240	98	Paved parking, HSG A
0.091	48	Brush, Poor, HSG A
0.331	84	Weighted Average
0.091		27.49% Pervious Area
0.240		72.51% Impervious Area

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

Subcatchment PR-3: Existing PR-3



Summary for Subcatchment PR-4: Existing PR-4

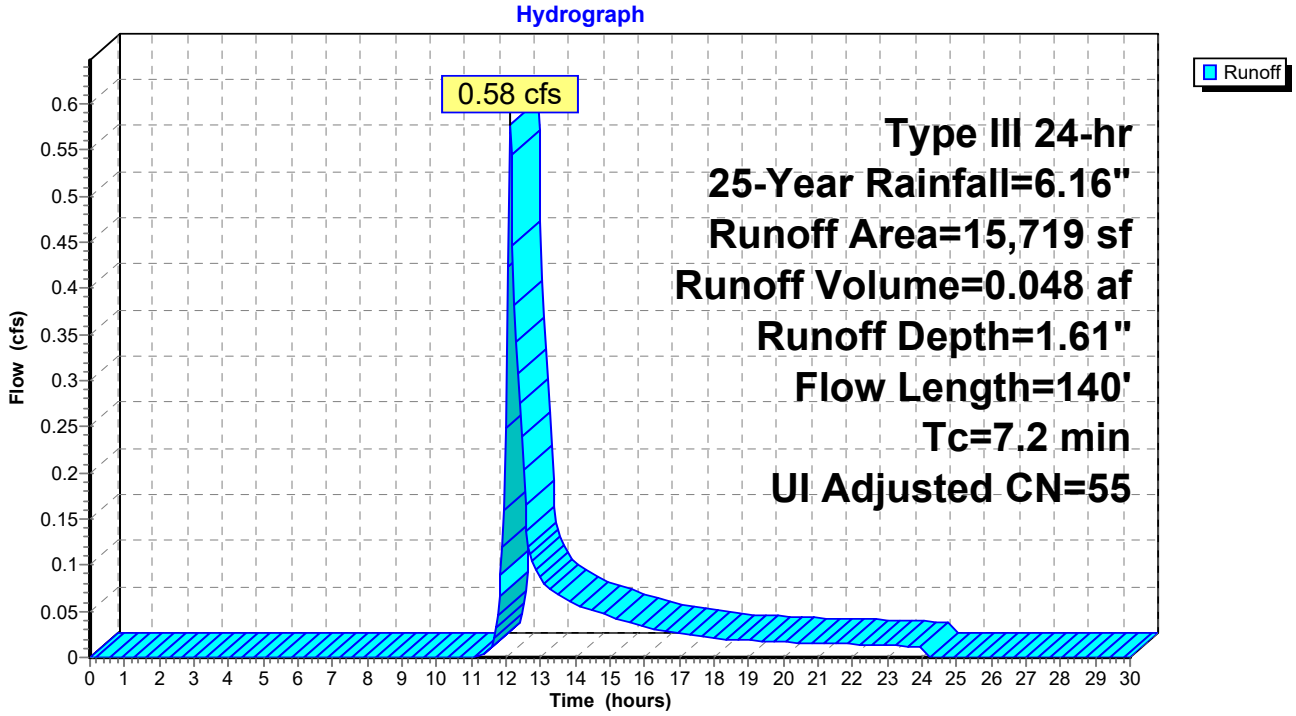
Runoff = 0.58 cfs @ 12.12 hrs, Volume= 0.048 af, Depth= 1.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.16"

	Area (sf)	CN	Adj	Description
*	11,500	48		Brush, HSG A
	4,219	98		Unconnected pavement, HSG A
	15,719	61	55	Weighted Average, UI Adjusted
	11,500			73.16% Pervious Area
	4,219			26.84% Impervious Area
	4,219			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.5	100	0.0400	0.26		**Sheet Flow, SF** Range n= 0.130 P2= 3.31"
0.7	40	0.0200	0.99		**Shallow Concentrated Flow, S** Short Grass Pasture Kv= 7.0 fps
7.2	140	Total			

Subcatchment PR-4: Existing PR-4

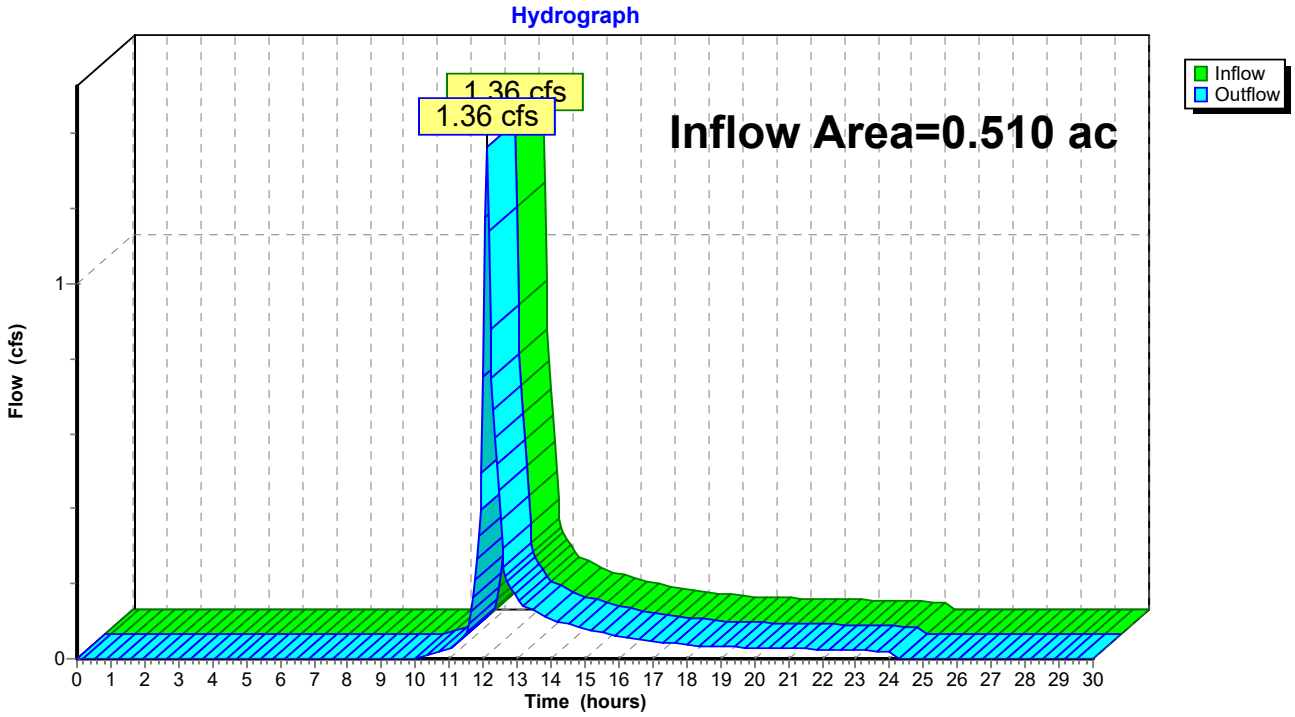


Summary for Reach 1R: DP-2

Inflow Area = 0.510 ac, 35.69% Impervious, Inflow Depth = 2.38" for 25-Year event
Inflow = 1.36 cfs @ 12.10 hrs, Volume= 0.101 af
Outflow = 1.36 cfs @ 12.10 hrs, Volume= 0.101 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Reach 1R: DP-2

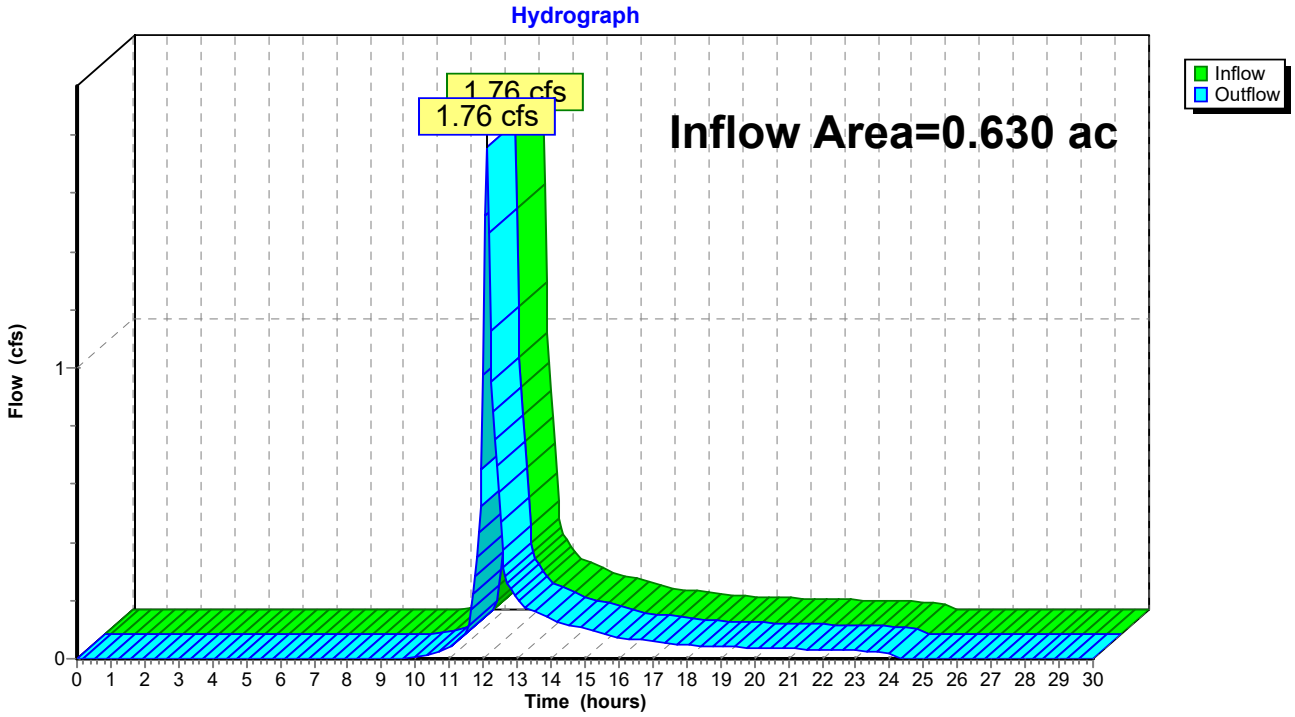


Summary for Reach 2R: DP-1

Inflow Area = 0.630 ac, 22.86% Impervious, Inflow Depth = 2.47" for 25-Year event
Inflow = 1.76 cfs @ 12.10 hrs, Volume= 0.130 af
Outflow = 1.76 cfs @ 12.10 hrs, Volume= 0.130 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Reach 2R: DP-1

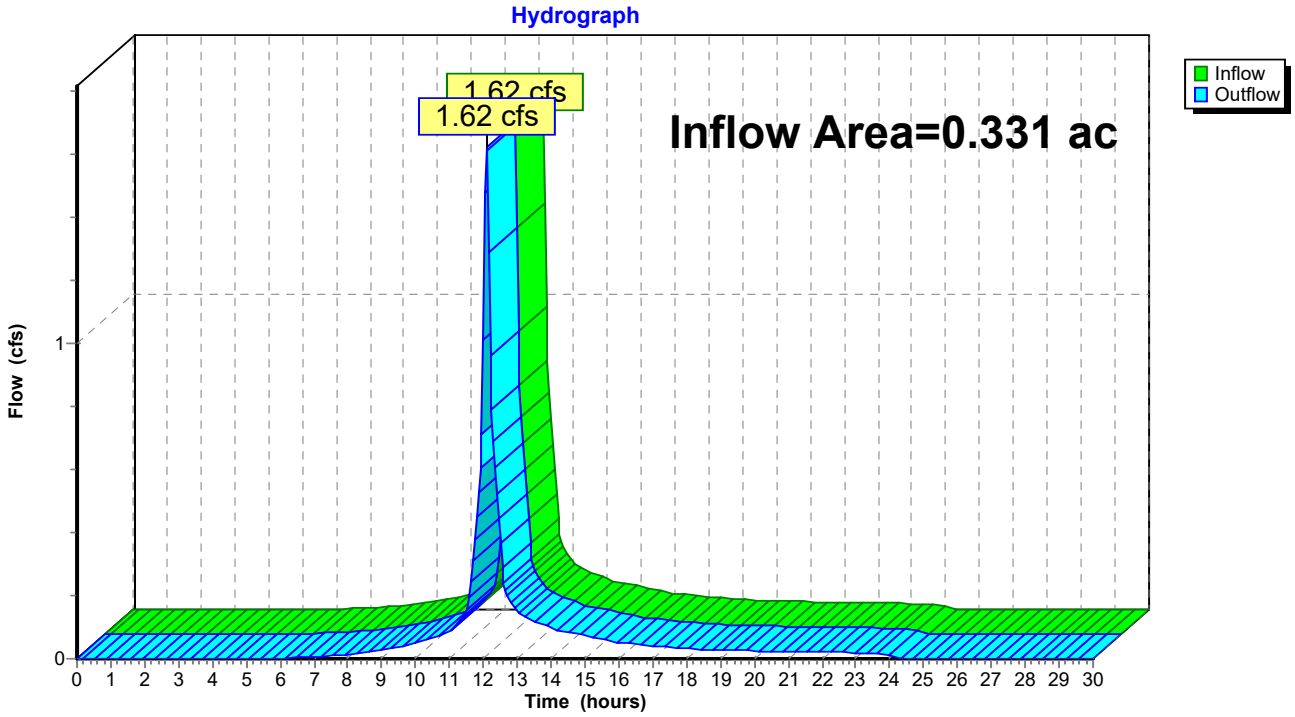


Summary for Reach 6R: DP-3

Inflow Area = 0.331 ac, 72.51% Impervious, Inflow Depth = 4.35" for 25-Year event
Inflow = 1.62 cfs @ 12.09 hrs, Volume= 0.120 af
Outflow = 1.62 cfs @ 12.09 hrs, Volume= 0.120 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Reach 6R: DP-3

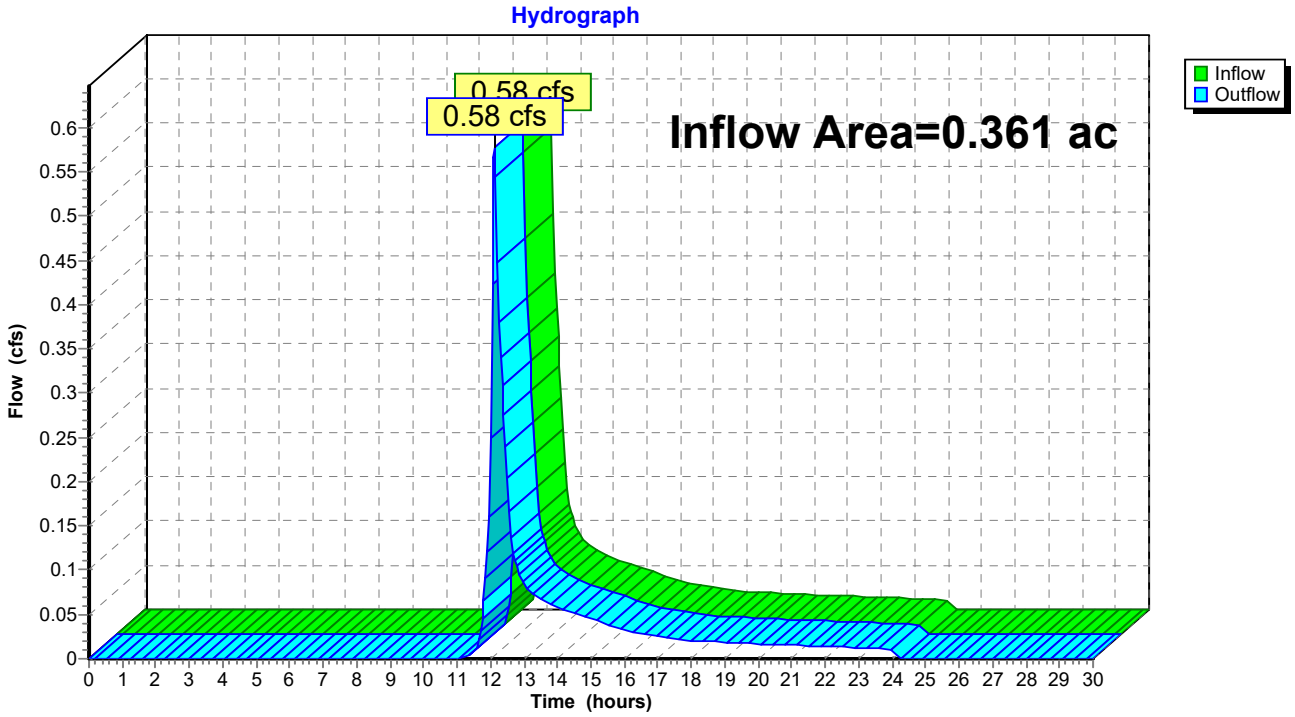


Summary for Reach 8R: DP-4

Inflow Area = 0.361 ac, 26.84% Impervious, Inflow Depth = 1.61" for 25-Year event
Inflow = 0.58 cfs @ 12.12 hrs, Volume= 0.048 af
Outflow = 0.58 cfs @ 12.12 hrs, Volume= 0.048 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Reach 8R: DP-4



Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points
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 PR-1: Existing PR-1 Runoff Area=0.630 ac 22.86% Impervious Runoff Depth=4.44"
Flow Length=314' Tc=6.0 min CN=65 Runoff=3.22 cfs 0.233 af

Subcatchment PR-2: Existing PR-2 Runoff Area=0.510 ac 35.69% Impervious Runoff Depth=4.32"
Flow Length=217' Tc=6.0 min CN=64 Runoff=2.53 cfs 0.184 af

Subcatchment PR-3: Existing PR-3 Runoff Area=0.331 ac 72.51% Impervious Runoff Depth=6.74"
Tc=6.0 min CN=84 Runoff=2.46 cfs 0.186 af

Subcatchment PR-4: Existing PR-4 Runoff Area=15,719 sf 26.84% Impervious Runoff Depth=3.25"
Flow Length=140' Tc=7.2 min UI Adjusted CN=55 Runoff=1.27 cfs 0.098 af

Reach 1R: DP-2 Inflow=2.53 cfs 0.184 af
Outflow=2.53 cfs 0.184 af

Reach 2R: DP-1 Inflow=3.22 cfs 0.233 af
Outflow=3.22 cfs 0.233 af

Reach 6R: DP-3 Inflow=2.46 cfs 0.186 af
Outflow=2.46 cfs 0.186 af

Reach 8R: DP-4 Inflow=1.27 cfs 0.098 af
Outflow=1.27 cfs 0.098 af

Total Runoff Area = 1.832 ac Runoff Volume = 0.701 af Average Runoff Depth = 4.59"
63.82% Pervious = 1.169 ac 36.18% Impervious = 0.663 ac

Summary for Subcatchment PR-1: Existing PR-1

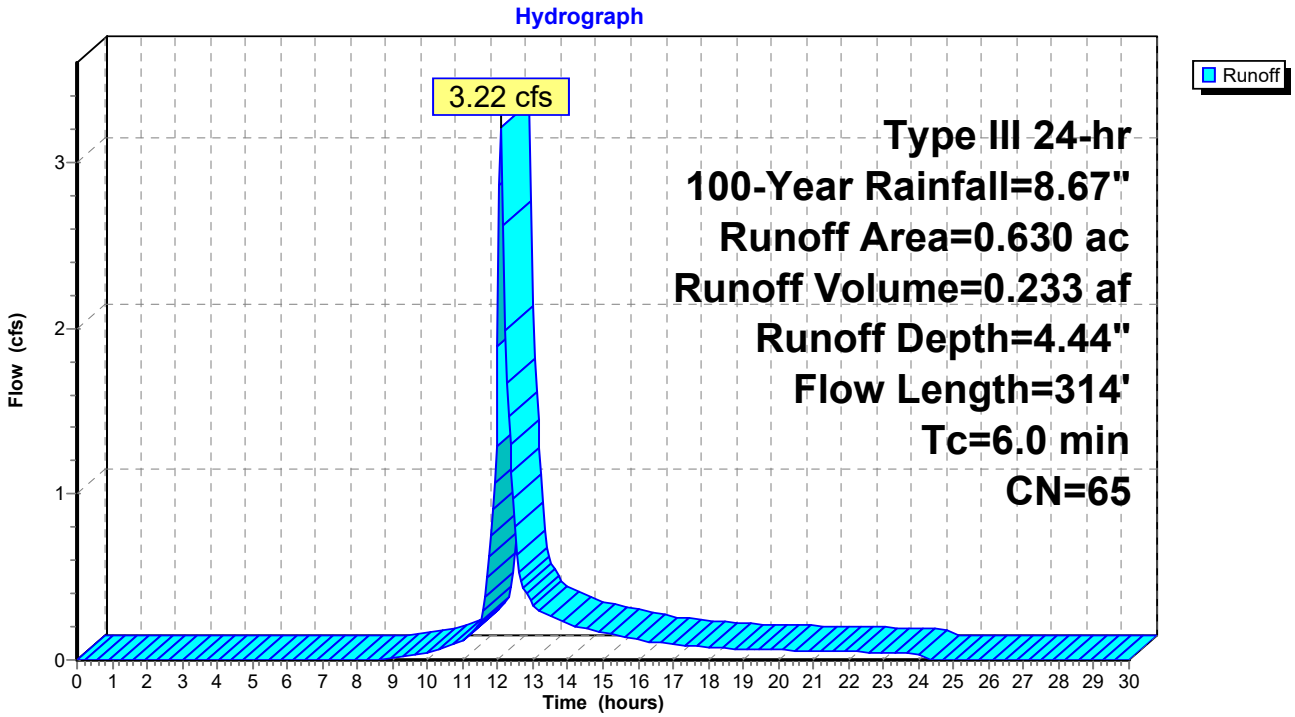
Runoff = 3.22 cfs @ 12.09 hrs, Volume= 0.233 af, Depth= 4.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.67"

Area (ac)	CN	Description
0.059	72	Dirt roads, HSG A
0.352	48	Brush, Poor, HSG A
0.075	77	Fallow, bare soil, HSG A
0.144	98	Paved parking, HSG A
0.630	65	Weighted Average
0.486		77.14% Pervious Area
0.144		22.86% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.2	50	0.0226	0.38		**Sheet Flow,** Fallow n= 0.050 P2= 3.31"
2.0	264	0.0189	2.21		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
4.2	314	Total, Increased to minimum Tc = 6.0 min			

Subcatchment PR-1: Existing PR-1



Summary for Subcatchment PR-2: Existing PR-2

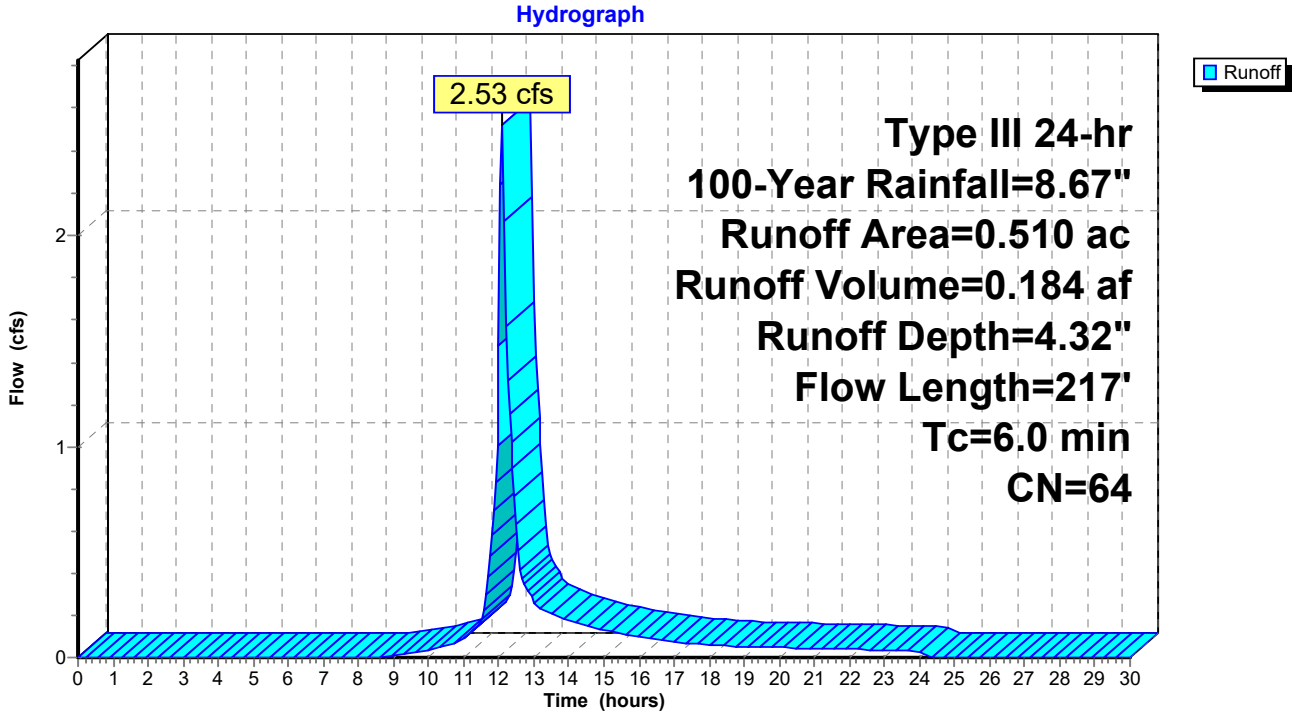
Runoff = 2.53 cfs @ 12.09 hrs, Volume= 0.184 af, Depth= 4.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.67"

Area (ac)	CN	Description
0.144	43	Woods/grass comb., Fair, HSG A
0.182	98	Paved parking, HSG A
0.184	48	Brush, Poor, HSG A
0.510	64	Weighted Average
0.328		64.31% Pervious Area
0.182		35.69% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	50	0.0240	1.31		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.31"
0.2	27	0.0230	2.44		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.3	75	0.0350	0.94		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.4	65	0.0280	2.69		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
2.5	217	Total, Increased to minimum Tc = 6.0 min			

Subcatchment PR-2: Existing PR-2



Summary for Subcatchment PR-3: Existing PR-3

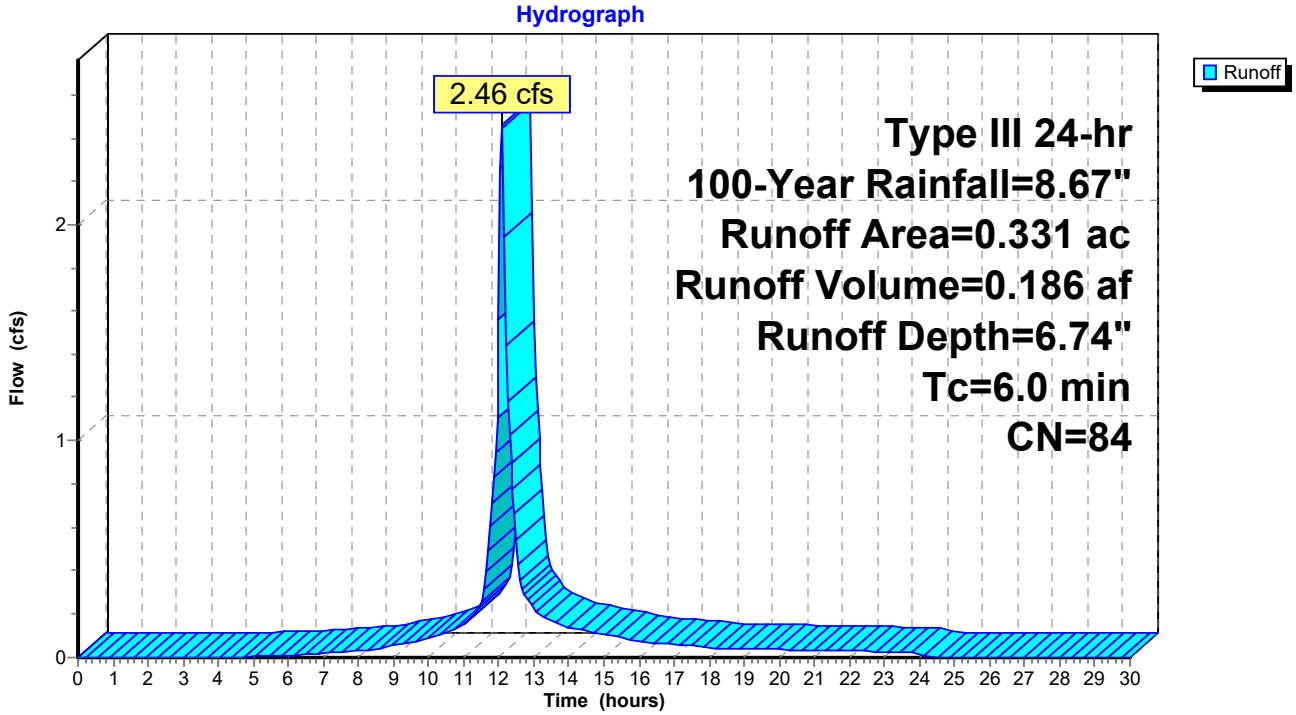
Runoff = 2.46 cfs @ 12.09 hrs, Volume= 0.186 af, Depth= 6.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.67"

Area (ac)	CN	Description
0.240	98	Paved parking, HSG A
0.091	48	Brush, Poor, HSG A
0.331	84	Weighted Average
0.091		27.49% Pervious Area
0.240		72.51% Impervious Area

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

Subcatchment PR-3: Existing PR-3



Summary for Subcatchment PR-4: Existing PR-4

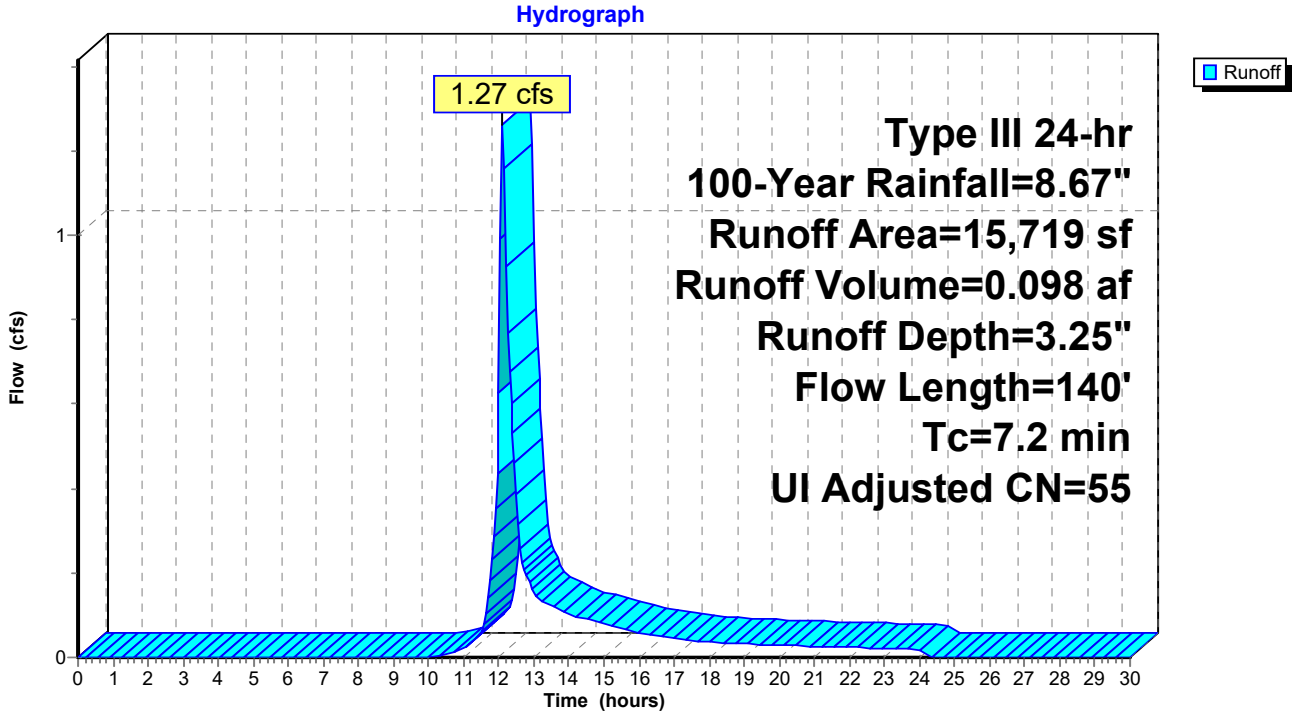
Runoff = 1.27 cfs @ 12.11 hrs, Volume= 0.098 af, Depth= 3.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.67"

	Area (sf)	CN	Adj	Description
*	11,500	48		Brush, HSG A
	4,219	98		Unconnected pavement, HSG A
	15,719	61	55	Weighted Average, UI Adjusted
	11,500			73.16% Pervious Area
	4,219			26.84% Impervious Area
	4,219			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.5	100	0.0400	0.26		**Sheet Flow, SF** Range n= 0.130 P2= 3.31"
0.7	40	0.0200	0.99		**Shallow Concentrated Flow, S** Short Grass Pasture Kv= 7.0 fps
7.2	140	Total			

Subcatchment PR-4: Existing PR-4

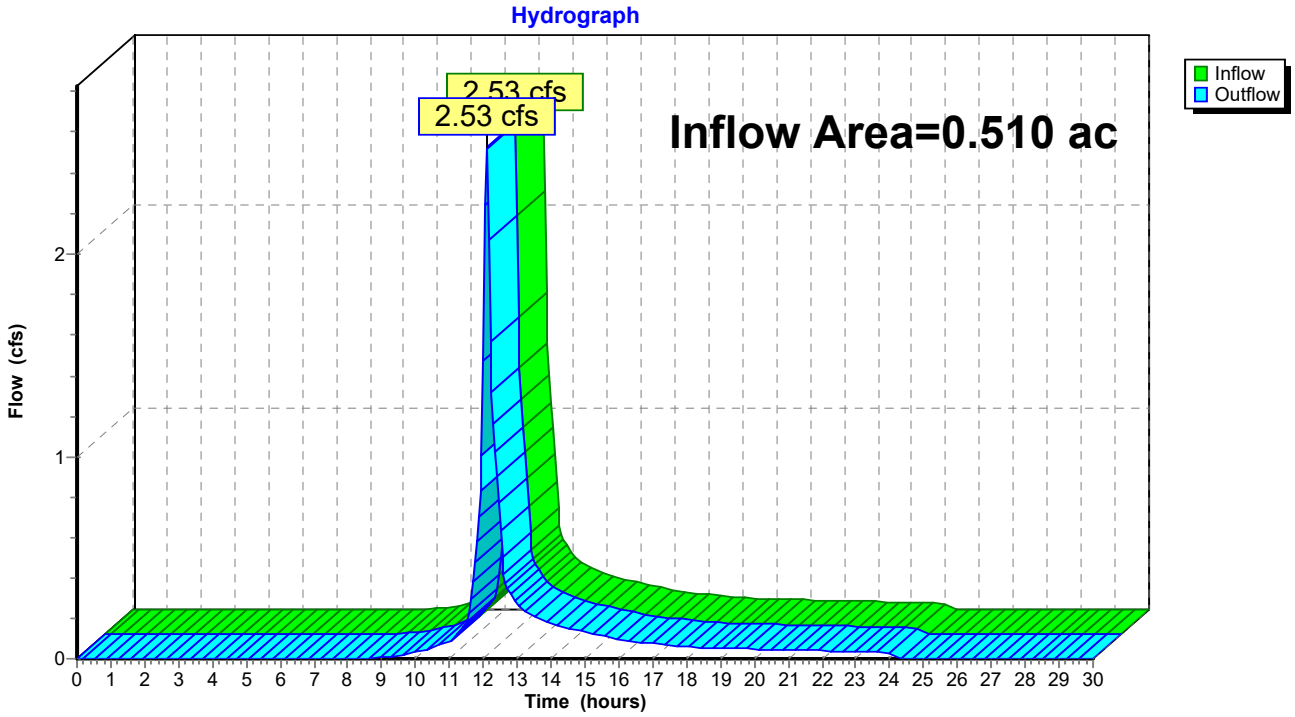


Summary for Reach 1R: DP-2

Inflow Area = 0.510 ac, 35.69% Impervious, Inflow Depth = 4.32" for 100-Year event
Inflow = 2.53 cfs @ 12.09 hrs, Volume= 0.184 af
Outflow = 2.53 cfs @ 12.09 hrs, Volume= 0.184 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Reach 1R: DP-2

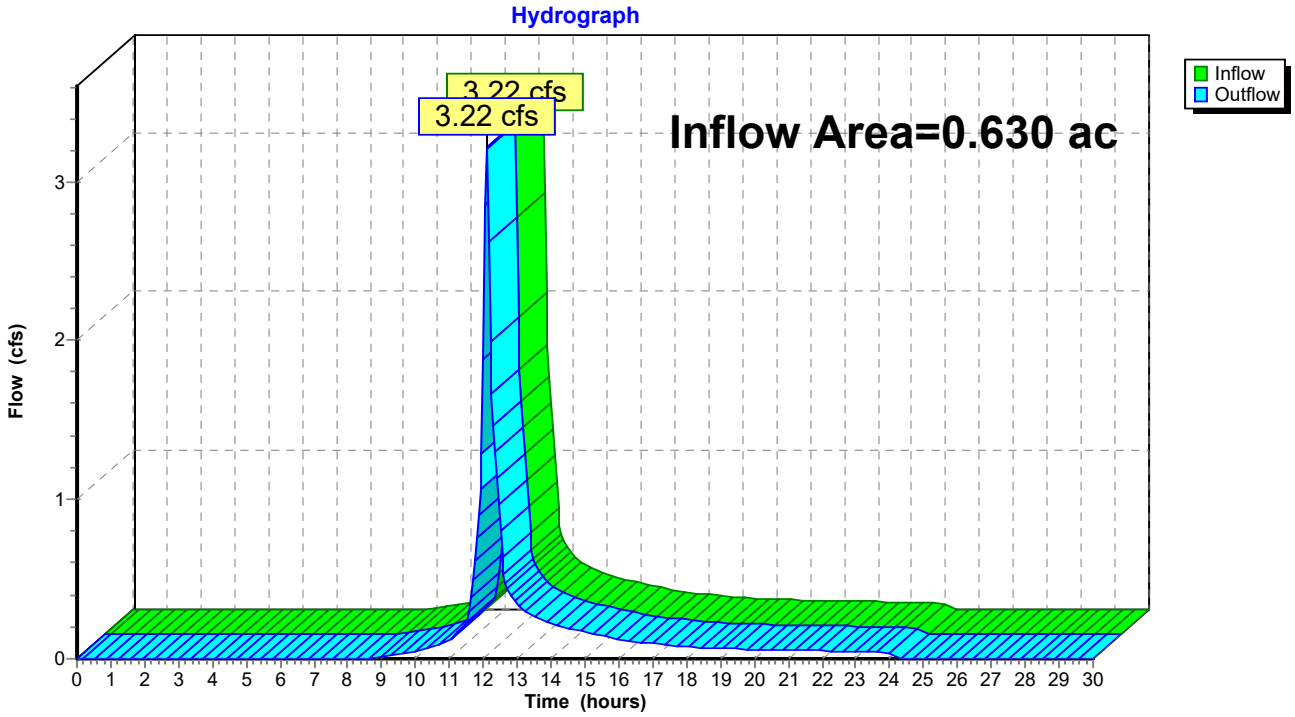


Summary for Reach 2R: DP-1

Inflow Area = 0.630 ac, 22.86% Impervious, Inflow Depth = 4.44" for 100-Year event
Inflow = 3.22 cfs @ 12.09 hrs, Volume= 0.233 af
Outflow = 3.22 cfs @ 12.09 hrs, Volume= 0.233 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Reach 2R: DP-1

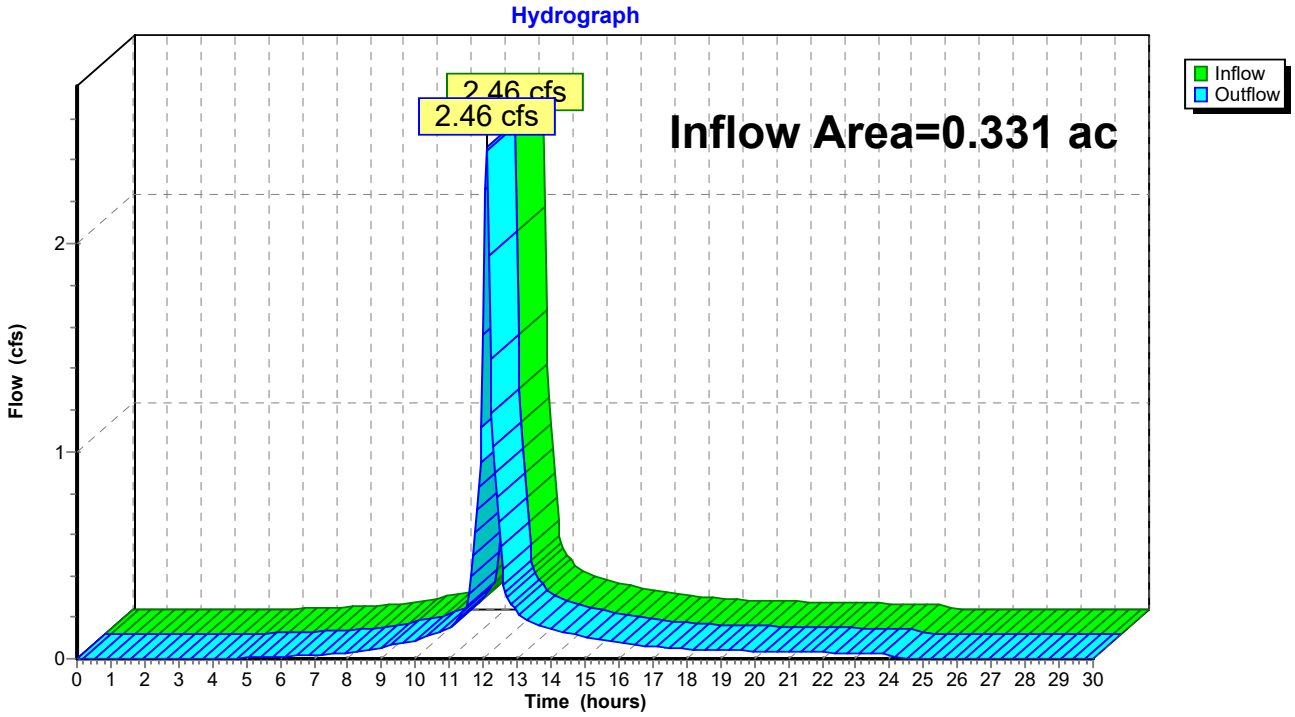


Summary for Reach 6R: DP-3

Inflow Area = 0.331 ac, 72.51% Impervious, Inflow Depth = 6.74" for 100-Year event
Inflow = 2.46 cfs @ 12.09 hrs, Volume= 0.186 af
Outflow = 2.46 cfs @ 12.09 hrs, Volume= 0.186 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Reach 6R: DP-3

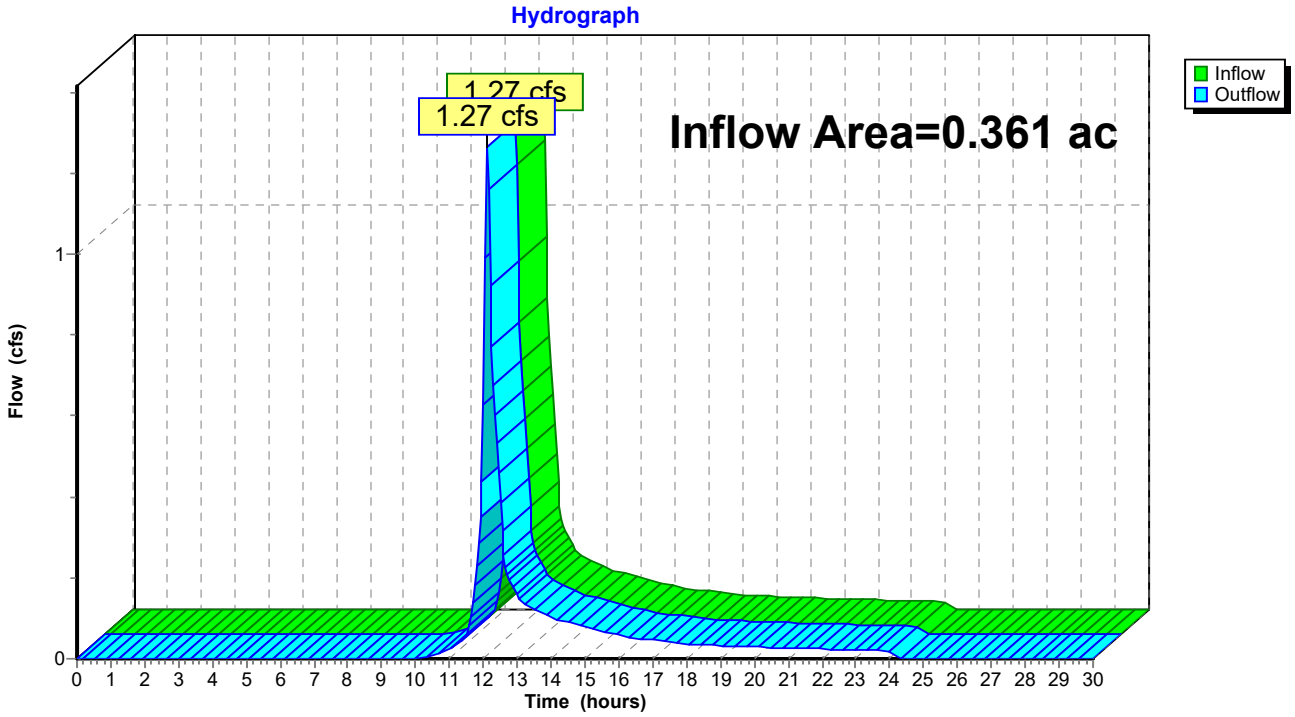


Summary for Reach 8R: DP-4

Inflow Area = 0.361 ac, 26.84% Impervious, Inflow Depth = 3.25" for 100-Year event
Inflow = 1.27 cfs @ 12.11 hrs, Volume= 0.098 af
Outflow = 1.27 cfs @ 12.11 hrs, Volume= 0.098 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Reach 8R: DP-4



APPENDIX D

POST-DEVELOPMENT SCENARIO

DRAINAGE AREA BOUNDARY

TIME OF CONCENTRATION TRAVEL PATH

DRAINAGE AREA POINT OF INTEREST

ALL SITE SOILS ARE HYDROLOGIC SOIL GROUP "A"

SOILS INFORMATION

259B *Carver loamy course sand, 3 TO 8 PERCENT SLOPES [HYDROLOGIC GROUP A]*

288B *Riverhead sandy loam, 3 TO 8 PERCENT SLOPES [HYDROLOGIC GROUP A]*

LEGEND

EXISTING FEATURES

- EDGE OF PAVED BITUMINOUS SURFACE
- EDGE OF GRAVEL OR CRUSHED STONE SURFACE
- PROPERTY BOUNDARY LINE
- IRON PIN OR PIPE
- ADJOINING PROPERTY BOUNDARY LINE
- EASEMENT LINE
- LEGAL RIGHT OF WAY LINE
- MINIMUM BUILDING SETBACK LINE
- ZONING DISTRICT BOUNDARY LINE
- 420 INDEX CONTOUR LINE
- 421 INTERMEDIATE CONTOUR LINE
- × 500.00 SPOT ELEVATION
- BENCHMARK LABEL
- BUILDING
- CONCRETE SURFACE
- OE OVERHEAD ELECTRIC LINES
- MANHOLE
- UTILITY POLE
- BOLLARD
- TREELINE
- BOREHOLE
- FENCE
- SOIL TYPE BOUNDARY LINE

NO.	REVISION	DATE
C	ISSUED FOR PERMIT	2018.11.16
B	ISSUED FOR TOWN COMMENT	2018.11.08
A	ISSUED FOR OWNER COMMENT	2018.08.13

Property Owner:

Eversource Energy
247 Station Drive
Westwood, MA 02090
https://www.eversource.com/

TRC Results you can rely on

TRC Engineers, Inc.
650 Suffolk Street
Lowell, MA 01854
Tel: 978-970-5600
www.trcsolutions.com

© TRC Engineers, Inc.

Applicant:

MARTHA'S VINEYARD ENERGY STORAGE PROJECT
208 Edgartown Vineyard Haven Road
Oak Bluffs, MA 02557

DRAWING TITLE:

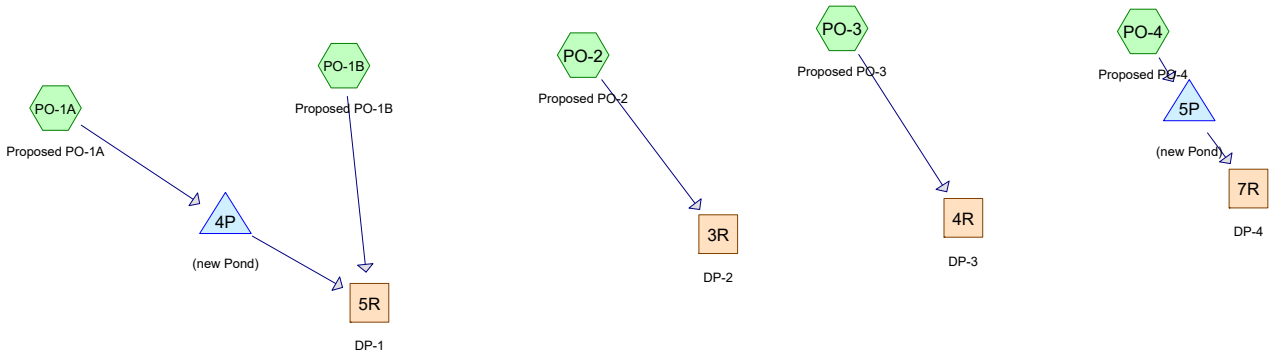
POST-DEVELOPMENT MAP PHASE II

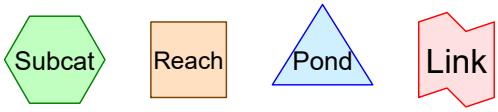
GRAPHIC SCALE
30 15 0 30
SCALE IN FEET
1" = 30'

SCALE:	1" = 30'
DATE:	10/12/2018
DRAWN BY:	ROE
CHECKED BY:	CAW
PROJECT:	292138.MV02.0000
DRAWING NO.:	DA-2

APPENDIX E

POST-DEVELOPMENT HYDROCAD REPORT





Routing Diagram for Marthas Vineyard Stormwater - PHASE II - Proposed Only

Prepared by TRC, Printed 11/30/2018

HydroCAD® 10.00-19 s/n 01402 © 2016 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.152	39	>75% Grass cover, Good, HSG A (PO-1A, PO-1B)
0.159	48	Brush, Poor, HSG A (PO-1B, PO-2)
0.030	72	Dirt roads, HSG A (PO-1B)
0.107	76	Gravel Surface, HSG A (PO-1A)
0.017	76	Gravel roads, HSG A (PO-1B, PO-2)
0.078	76	Infiltration beds, HSG A (PO-4)
0.273	98	Paved parking, HSG A (PO-2, PO-3)
0.055	49	Pole Storage Area (PO-3)
0.392	98	Roofs, HSG A (PO-1A)
0.285	76	Unconnected gravel pavement, HSG A (PO-4)
0.140	98	Unconnected pavement, HSG A (PO-1A)
0.144	32	Woods/grass comb., Good, HSG A (PO-2)
1.832	**76**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
1.776	HSG A	PO-1A, PO-1B, PO-2, PO-3, PO-4
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.055	Other	PO-3
1.832		**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
0.152	0.000	0.000	0.000	0.000	0.152	>75% Grass cover, Good	PO-1A, PO-1B
0.159	0.000	0.000	0.000	0.000	0.159	Brush, Poor	PO-1B, PO-2
0.030	0.000	0.000	0.000	0.000	0.030	Dirt roads	PO-1B
0.107	0.000	0.000	0.000	0.000	0.107	Gravel Surface	PO-1A
0.017	0.000	0.000	0.000	0.000	0.017	Gravel roads	PO-1B, PO-2
0.078	0.000	0.000	0.000	0.000	0.078	Infiltration beds	PO-4
0.273	0.000	0.000	0.000	0.000	0.273	Paved parking	PO-2, PO-3
0.000	0.000	0.000	0.000	0.055	0.055	Pole Storage Area	PO-3
0.392	0.000	0.000	0.000	0.000	0.392	Roofs	PO-1A
0.285	0.000	0.000	0.000	0.000	0.285	Unconnected gravel pavement	PO-4
0.140	0.000	0.000	0.000	0.000	0.140	Unconnected pavement	PO-1A
0.144	0.000	0.000	0.000	0.000	0.144	Woods/grass comb., Good	PO-2
1.776	**0.000**	**0.000**	**0.000**	**0.055**	**1.832**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	4P	76.00	76.00	20.0	0.0000	0.010	12.0	0.0	0.0

Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points
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 PO-1A: Proposed PO-1A Runoff Area=0.751 ac 70.84% Impervious Runoff Depth=1.93"
Tc=6.0 min CN=86 Runoff=1.67 cfs 0.121 af

Subcatchment PO-1B: Proposed PO-1B Runoff Area=0.138 ac 0.00% Impervious Runoff Depth=0.20"
Tc=6.0 min CN=52 Runoff=0.01 cfs 0.002 af

Subcatchment PO-2: Proposed PO-2 Runoff Area=0.299 ac 15.72% Impervious Runoff Depth=0.13"
Tc=6.0 min CN=49 Runoff=0.01 cfs 0.003 af

Subcatchment PO-3: Proposed PO-3 Runoff Area=12,240 sf 80.40% Impervious Runoff Depth=2.10"
Tc=6.0 min CN=88 Runoff=0.67 cfs 0.049 af

Subcatchment PO-4: Proposed PO-4 Runoff Area=15,791 sf 0.00% Impervious Runoff Depth=1.23"
Tc=6.0 min CN=76 Runoff=0.50 cfs 0.037 af

Reach 3R: DP-2 Inflow=0.01 cfs 0.003 af
Outflow=0.01 cfs 0.003 af

Reach 4R: DP-3 Inflow=0.67 cfs 0.049 af
Outflow=0.67 cfs 0.049 af

Reach 5R: DP-1 Inflow=0.03 cfs 0.013 af
Outflow=0.03 cfs 0.013 af

Reach 7R: DP-4 Inflow=0.00 cfs 0.000 af
Outflow=0.00 cfs 0.000 af

Pond 4P: (new Pond) Peak Elev=76.13' Storage=3,783 cf Inflow=1.67 cfs 0.121 af
Discarded=0.03 cfs 0.040 af Primary=0.03 cfs 0.010 af Secondary=0.00 cfs 0.000 af Outflow=0.05 cfs 0.051 af

Pond 5P: (new Pond) Peak Elev=77.73' Storage=546 cf Inflow=0.50 cfs 0.037 af
Discarded=0.06 cfs 0.037 af Primary=0.00 cfs 0.000 af Outflow=0.06 cfs 0.037 af

Total Runoff Area = 1.832 ac Runoff Volume = 0.213 af Average Runoff Depth = 1.39"
56.05% Pervious = 1.027 ac 43.95% Impervious = 0.805 ac

Summary for Subcatchment PO-1A: Proposed PO-1A

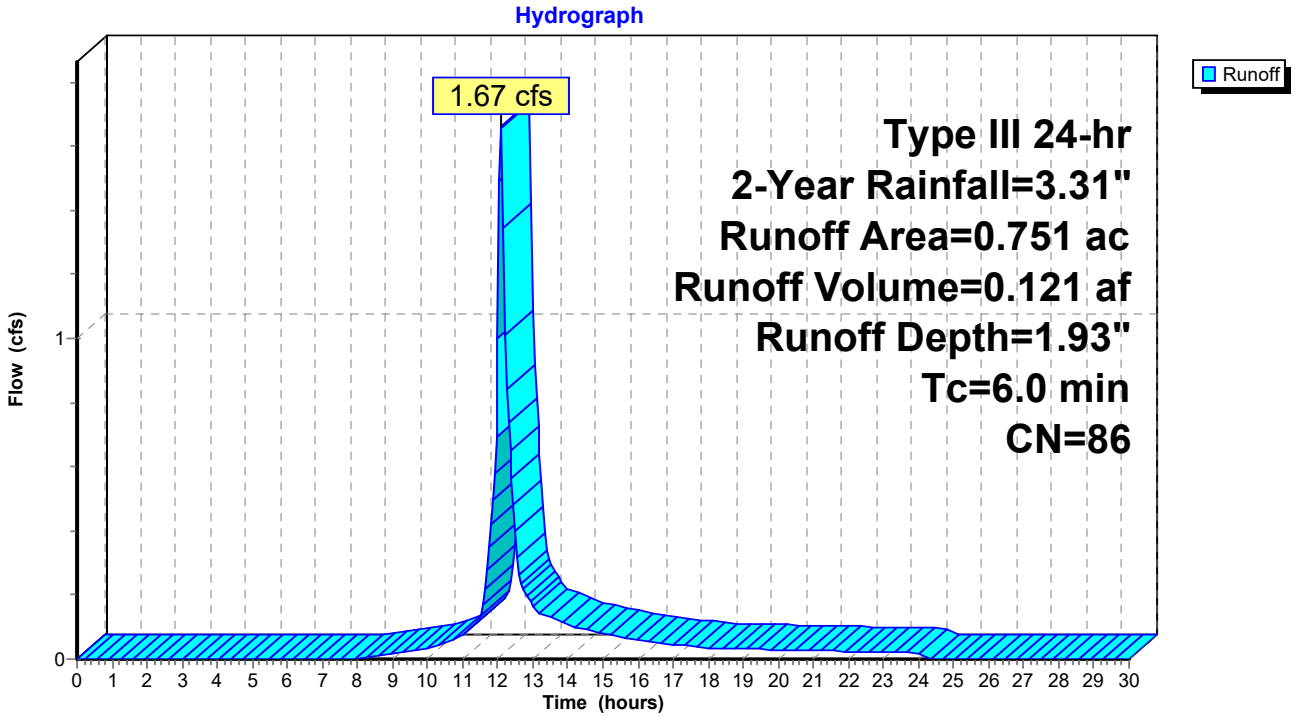
Runoff = 1.67 cfs @ 12.09 hrs, Volume= 0.121 af, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.31"

	Area (ac)	CN	Description
	0.392	98	Roofs, HSG A
	0.140	98	Unconnected pavement, HSG A
	0.112	39	>75% Grass cover, Good, HSG A
*	0.107	76	Gravel Surface, HSG A
	0.751	86	Weighted Average
	0.219		29.16% Pervious Area
	0.532		70.84% Impervious Area
	0.140		26.32% Unconnected

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

Subcatchment PO-1A: Proposed PO-1A



Summary for Subcatchment PO-1B: Proposed PO-1B

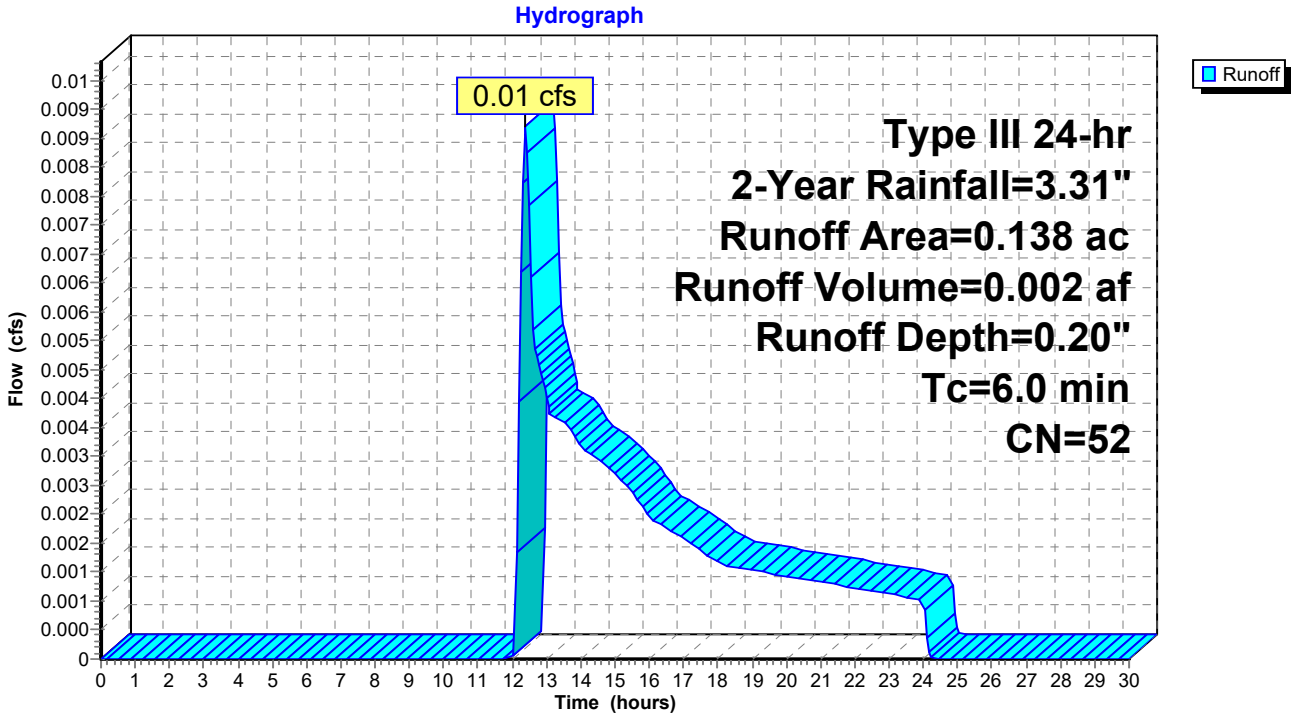
Runoff = 0.01 cfs @ 12.39 hrs, Volume= 0.002 af, Depth= 0.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.31"

Area (ac)	CN	Description
0.030	72	Dirt roads, HSG A
0.060	48	Brush, Poor, HSG A
0.040	39	>75% Grass cover, Good, HSG A
0.008	76	Gravel roads, HSG A
0.138	52	Weighted Average
0.138		100.00% Pervious Area

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

Subcatchment PO-1B: Proposed PO-1B



Summary for Subcatchment PO-2: Proposed PO-2

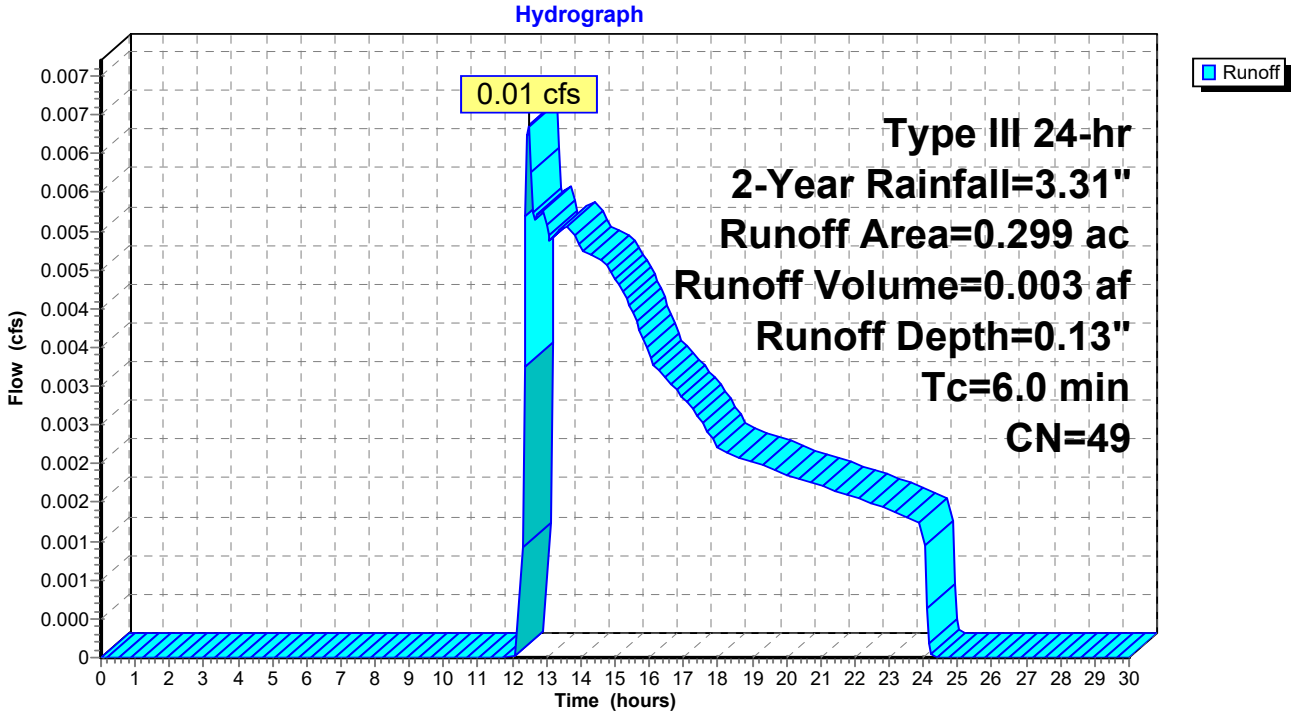
Runoff = 0.01 cfs @ 12.48 hrs, Volume= 0.003 af, Depth= 0.13"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.31"

Area (ac)	CN	Description
0.009	76	Gravel roads, HSG A
0.144	32	Woods/grass comb., Good, HSG A
0.047	98	Paved parking, HSG A
0.099	48	Brush, Poor, HSG A
0.299	49	Weighted Average
0.252		84.28% Pervious Area
0.047		15.72% Impervious Area

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

Subcatchment PO-2: Proposed PO-2



Summary for Subcatchment PO-3: Proposed PO-3

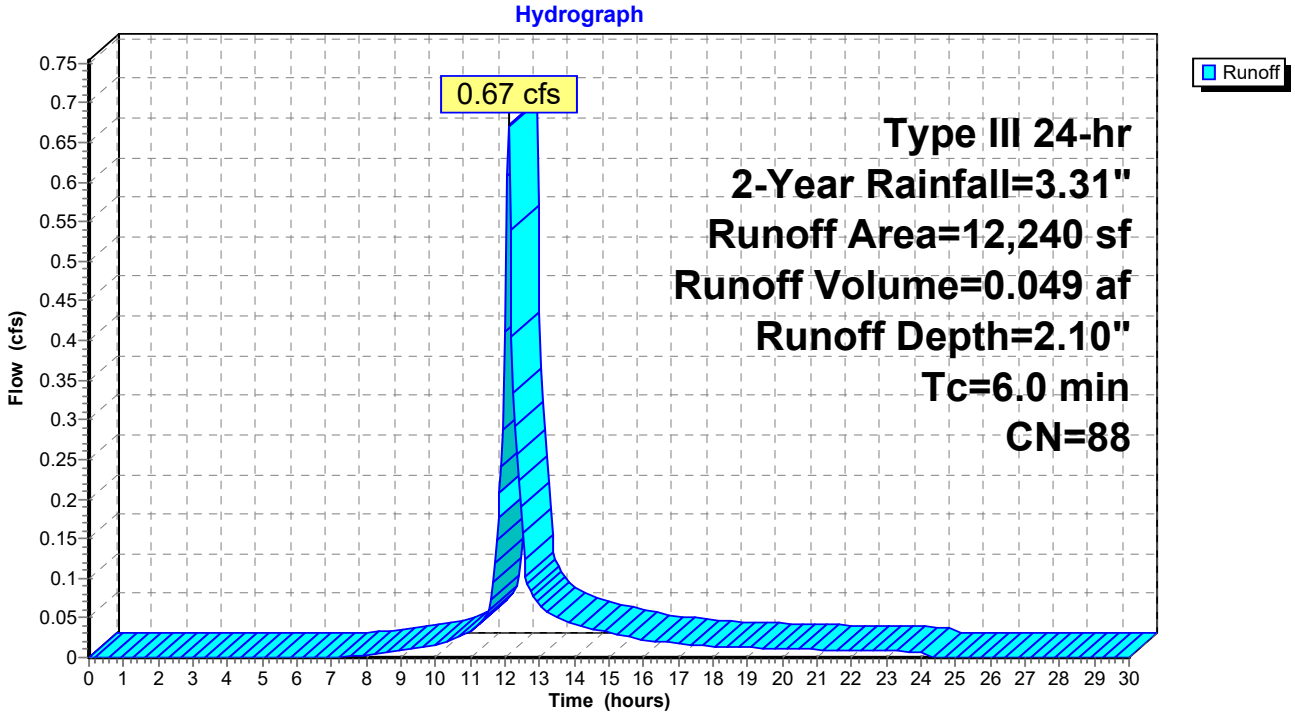
Runoff = 0.67 cfs @ 12.09 hrs, Volume= 0.049 af, Depth= 2.10"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.31"

	Area (sf)	CN	Description
	9,841	98	Paved parking, HSG A
*	2,399	49	Pole Storage Area
	12,240	88	Weighted Average
	2,399		19.60% Pervious Area
	9,841		80.40% Impervious Area

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

Subcatchment PO-3: Proposed PO-3



Summary for Subcatchment PO-4: Proposed PO-4

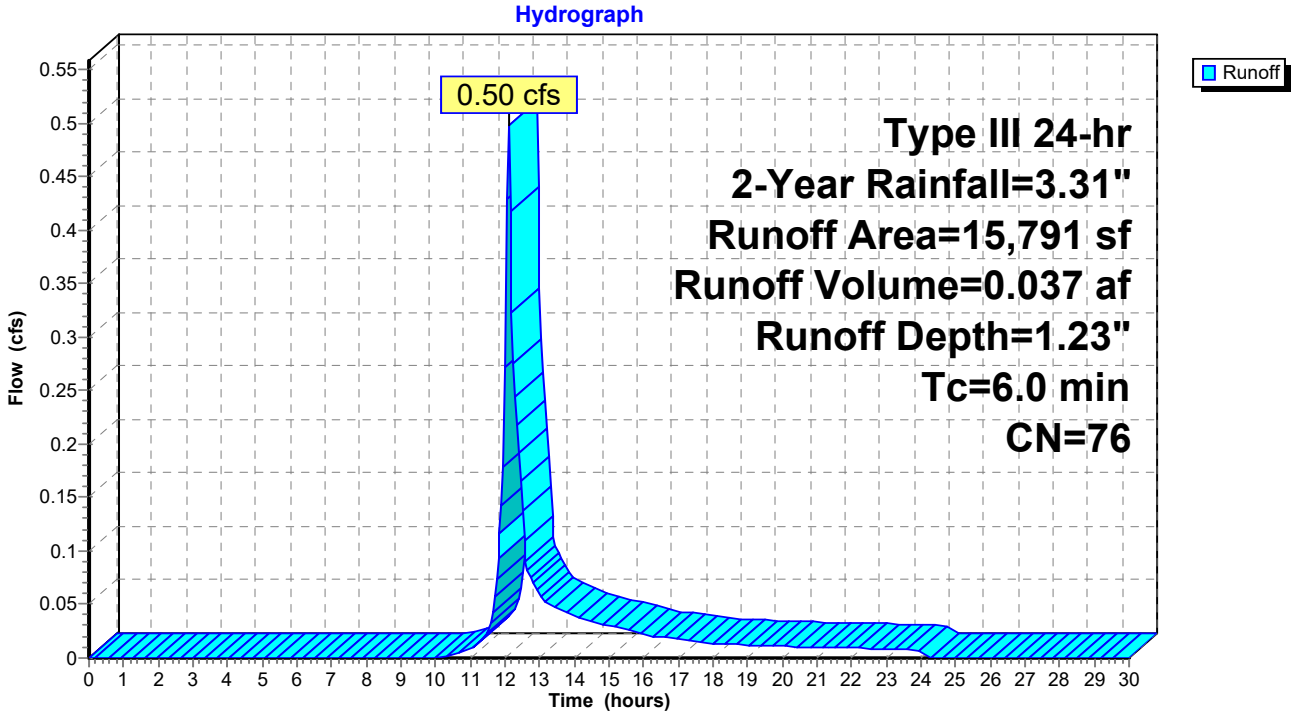
Runoff = 0.50 cfs @ 12.10 hrs, Volume= 0.037 af, Depth= 1.23"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.31"

	Area (sf)	CN	Description
*	12,414	76	Unconnected gravel pavement, HSG A
*	3,377	76	Infiltration beds, HSG A
	15,791	76	Weighted Average
	15,791		100.00% Pervious Area

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

Subcatchment PO-4: Proposed PO-4

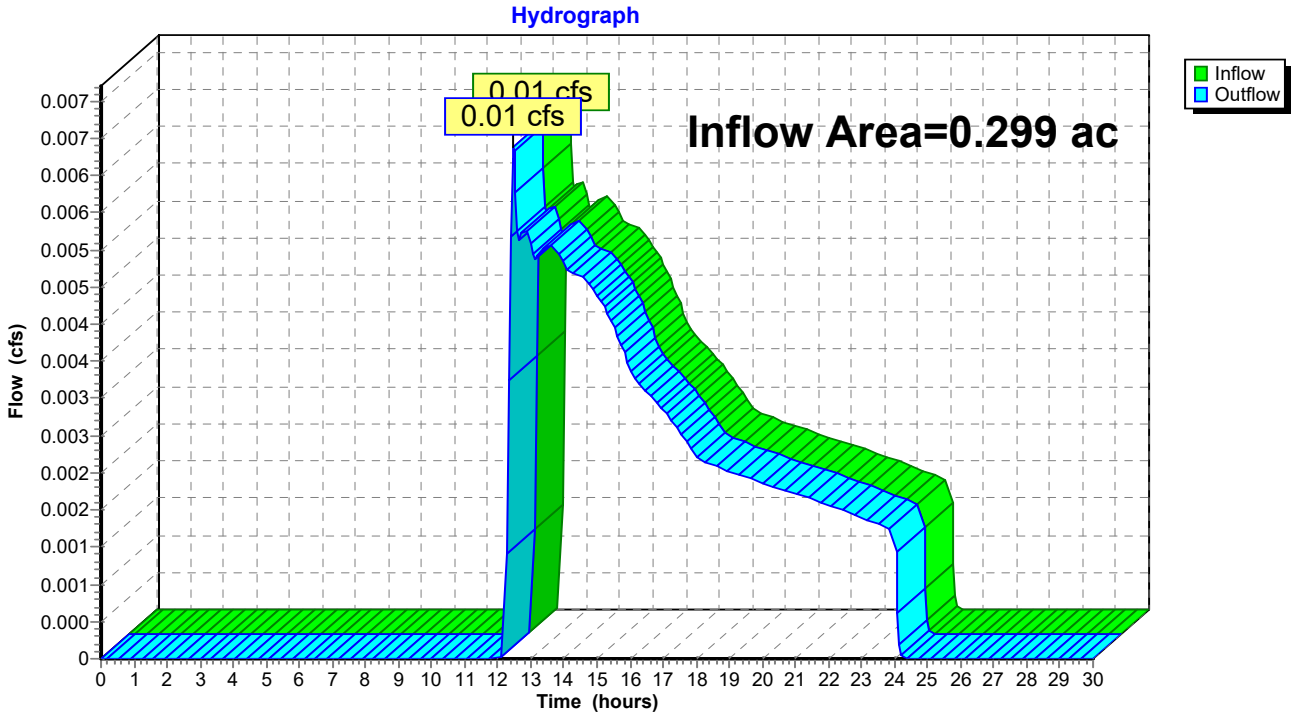


Summary for Reach 3R: DP-2

Inflow Area = 0.299 ac, 15.72% Impervious, Inflow Depth = 0.13" for 2-Year event
Inflow = 0.01 cfs @ 12.48 hrs, Volume= 0.003 af
Outflow = 0.01 cfs @ 12.48 hrs, Volume= 0.003 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Reach 3R: DP-2

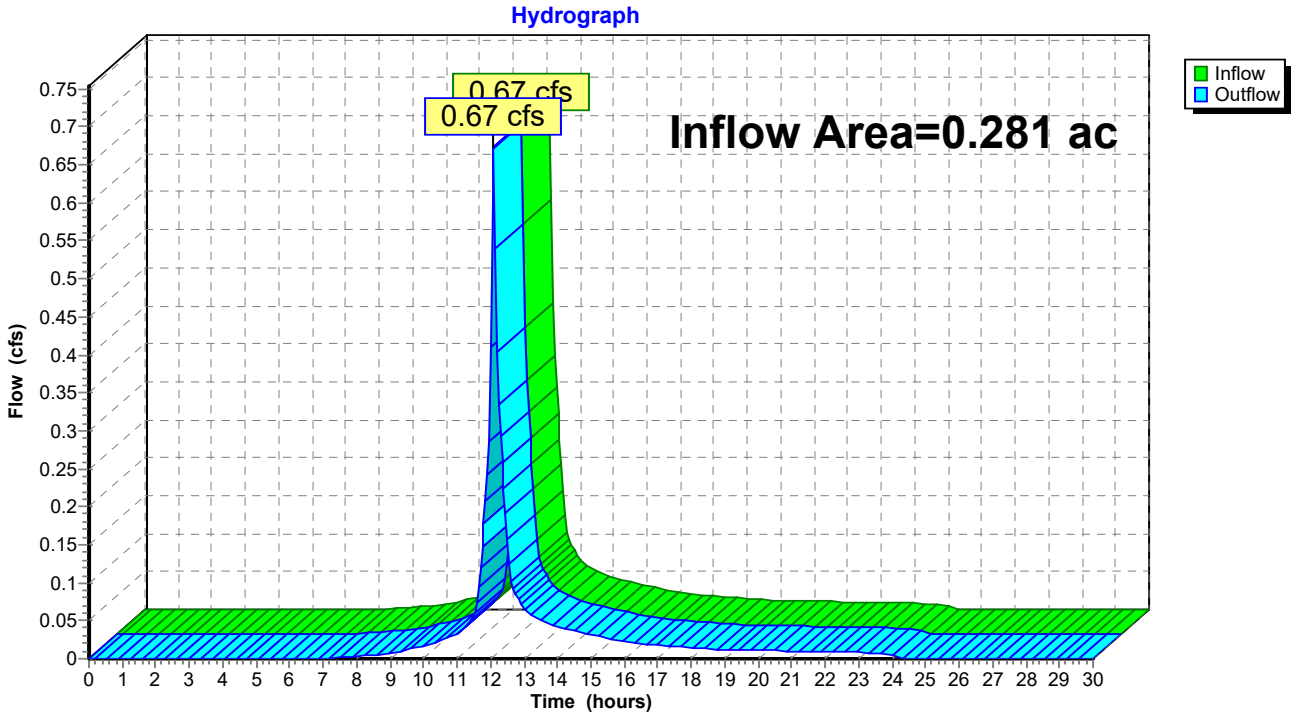


Summary for Reach 4R: DP-3

Inflow Area = 0.281 ac, 80.40% Impervious, Inflow Depth = 2.10" for 2-Year event
Inflow = 0.67 cfs @ 12.09 hrs, Volume= 0.049 af
Outflow = 0.67 cfs @ 12.09 hrs, Volume= 0.049 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Reach 4R: DP-3

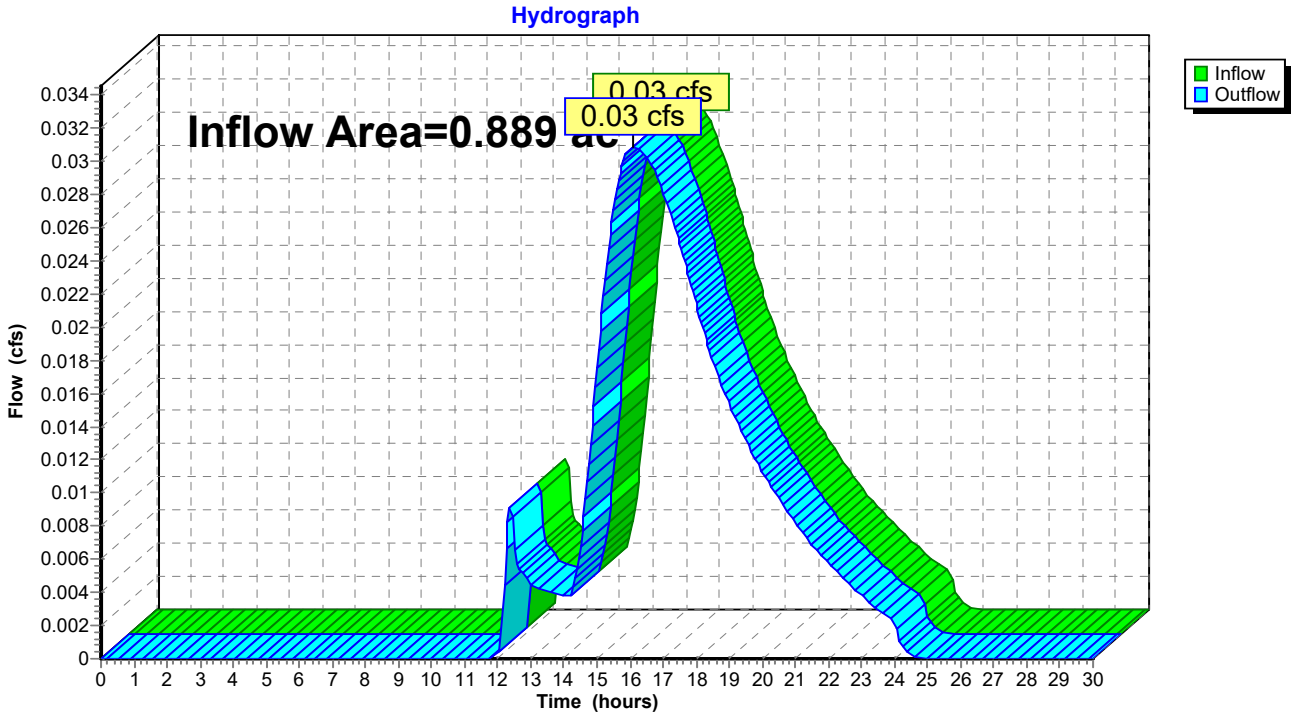


Summary for Reach 5R: DP-1

Inflow Area = 0.889 ac, 59.84% Impervious, Inflow Depth = 0.17" for 2-Year event
Inflow = 0.03 cfs @ 16.11 hrs, Volume= 0.013 af
Outflow = 0.03 cfs @ 16.11 hrs, Volume= 0.013 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Reach 5R: DP-1

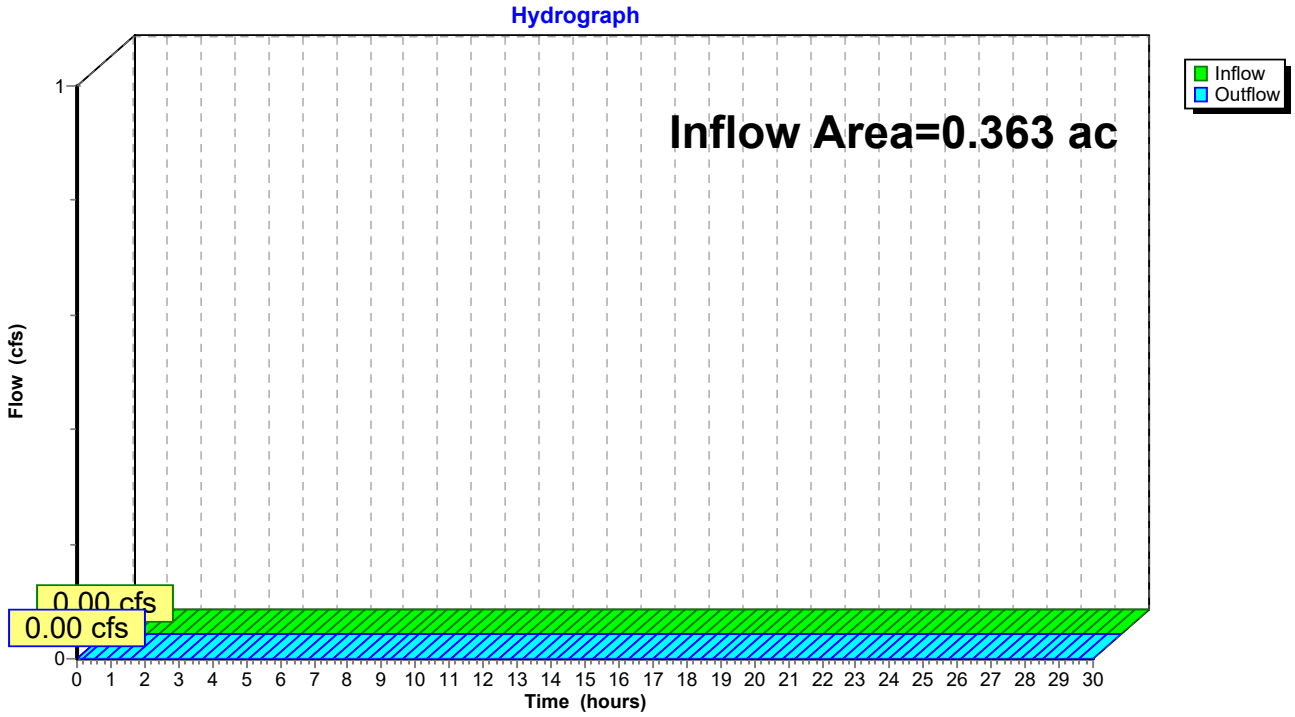


Summary for Reach 7R: DP-4

Inflow Area = 0.363 ac, 0.00% Impervious, Inflow Depth = 0.00" for 2-Year event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Reach 7R: DP-4



Summary for Pond 4P: (new Pond)

Inflow Area = 0.751 ac, 70.84% Impervious, Inflow Depth = 1.93" for 2-Year event
Inflow = 1.67 cfs @ 12.09 hrs, Volume= 0.121 af
Outflow = 0.05 cfs @ 16.16 hrs, Volume= 0.051 af, Atten= 97%, Lag= 243.8 min
Discarded = 0.03 cfs @ 16.16 hrs, Volume= 0.040 af
Primary = 0.03 cfs @ 16.16 hrs, Volume= 0.010 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 76.13' @ 16.16 hrs Surf.Area= 2,200 sf Storage= 3,783 cf

Plug-Flow detention time= 483.1 min calculated for 0.051 af (42% of inflow)
Center-of-Mass det. time= 362.6 min (1,183.7 - 821.1)

Volume	Invert	Avail.Storage	Storage Description
#1	73.20'	9,722 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
73.20	650	0	0
74.00	856	602	602
75.00	1,416	1,136	1,738
76.00	2,106	1,761	3,499
77.00	2,822	2,464	5,963
78.00	4,696	3,759	9,722

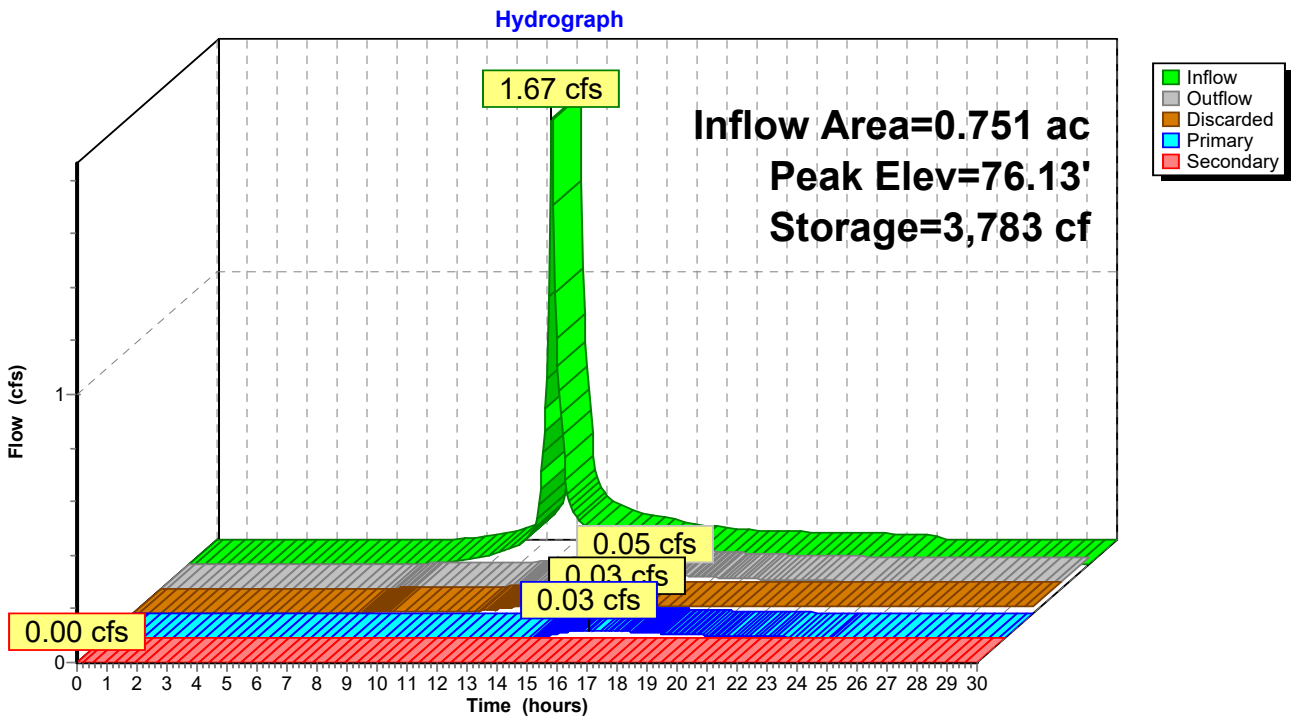
Device	Routing	Invert	Outlet Devices
#1	Primary	76.00'	**12.0" Round Culvert** L= 20.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 76.00' / 76.00' S= 0.0000 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf
#2	Secondary	77.25'	**15.0' long x 6.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.37 2.51 2.70 2.68 2.68 2.67 2.65 2.65 2.65 2.65 2.66 2.66 2.67 2.69 2.72 2.76 2.83
#3	Discarded	73.20'	**0.520 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.03 cfs @ 16.16 hrs HW=76.13' (Free Discharge)
└**3=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=0.03 cfs @ 16.16 hrs HW=76.13' TW=0.00' (Dynamic Tailwater)
└**1=Culvert** (Barrel Controls 0.03 cfs @ 0.71 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=73.20' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 4P: (new Pond)



Summary for Pond 5P: (new Pond)

Inflow Area =	0.363 ac,	0.00% Impervious,	Inflow Depth =	1.23"	for 2-Year event
Inflow =	0.50 cfs @	12.10 hrs,	Volume=	0.037 af	
Outflow =	0.06 cfs @	11.85 hrs,	Volume=	0.037 af,	Atten= 88%, Lag= 0.0 min
Discarded =	0.06 cfs @	11.85 hrs,	Volume=	0.037 af	
Primary =	0.00 cfs @	0.00 hrs,	Volume=	0.000 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 77.73' @ 13.02 hrs Surf.Area= 500 sf Storage= 546 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 80.2 min (933.8 - 853.6)

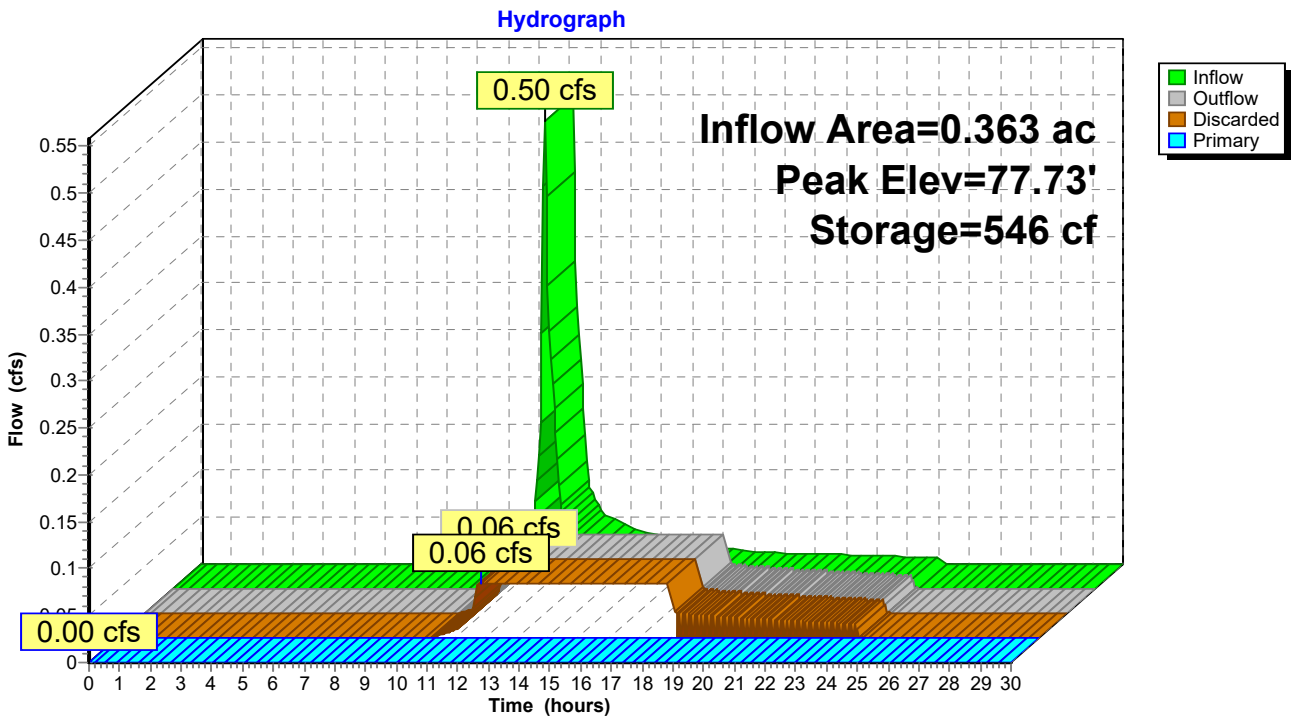
Volume	Invert	Avail.Storage	Storage Description
#1	75.00'	800 cf	**4.00'W x 125.00'L x 4.00'H Prismatoid** 2,000 cf Overall x 40.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Discarded	75.00'	**5.000 in/hr Exfiltration over Surface area**
#2	Primary	78.00'	**125.0' long x 2.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Discarded OutFlow Max=0.06 cfs @ 11.85 hrs HW=75.08' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.06 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=75.00' TW=0.00' (Dynamic Tailwater)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 5P: (new Pond)



Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points
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 PO-1A: Proposed PO-1A Runoff Area=0.751 ac 70.84% Impervious Runoff Depth=3.38"
Tc=6.0 min CN=86 Runoff=2.88 cfs 0.212 af

Subcatchment PO-1B: Proposed PO-1B Runoff Area=0.138 ac 0.00% Impervious Runoff Depth=0.76"
Tc=6.0 min CN=52 Runoff=0.08 cfs 0.009 af

Subcatchment PO-2: Proposed PO-2 Runoff Area=0.299 ac 15.72% Impervious Runoff Depth=0.60"
Tc=6.0 min CN=49 Runoff=0.11 cfs 0.015 af

Subcatchment PO-3: Proposed PO-3 Runoff Area=12,240 sf 80.40% Impervious Runoff Depth=3.58"
Tc=6.0 min CN=88 Runoff=1.13 cfs 0.084 af

Subcatchment PO-4: Proposed PO-4 Runoff Area=15,791 sf 0.00% Impervious Runoff Depth=2.46"
Tc=6.0 min CN=76 Runoff=1.02 cfs 0.074 af

Reach 3R: DP-2 Inflow=0.11 cfs 0.015 af
Outflow=0.11 cfs 0.015 af

Reach 4R: DP-3 Inflow=1.13 cfs 0.084 af
Outflow=1.13 cfs 0.084 af

Reach 5R: DP-1 Inflow=0.60 cfs 0.105 af
Outflow=0.60 cfs 0.105 af

Reach 7R: DP-4 Inflow=1.58 cfs 0.022 af
Outflow=1.58 cfs 0.022 af

Pond 4P: (new Pond) Peak Elev=76.54' Storage=4,733 cf Inflow=2.88 cfs 0.212 af
Discarded=0.03 cfs 0.044 af Primary=0.57 cfs 0.096 af Secondary=0.00 cfs 0.000 af Outflow=0.60 cfs 0.140 af

Pond 5P: (new Pond) Peak Elev=78.03' Storage=606 cf Inflow=1.02 cfs 0.074 af
Discarded=0.06 cfs 0.053 af Primary=1.58 cfs 0.022 af Outflow=1.64 cfs 0.074 af

Total Runoff Area = 1.832 ac Runoff Volume = 0.394 af Average Runoff Depth = 2.58"
56.05% Pervious = 1.027 ac 43.95% Impervious = 0.805 ac

Summary for Subcatchment PO-1A: Proposed PO-1A

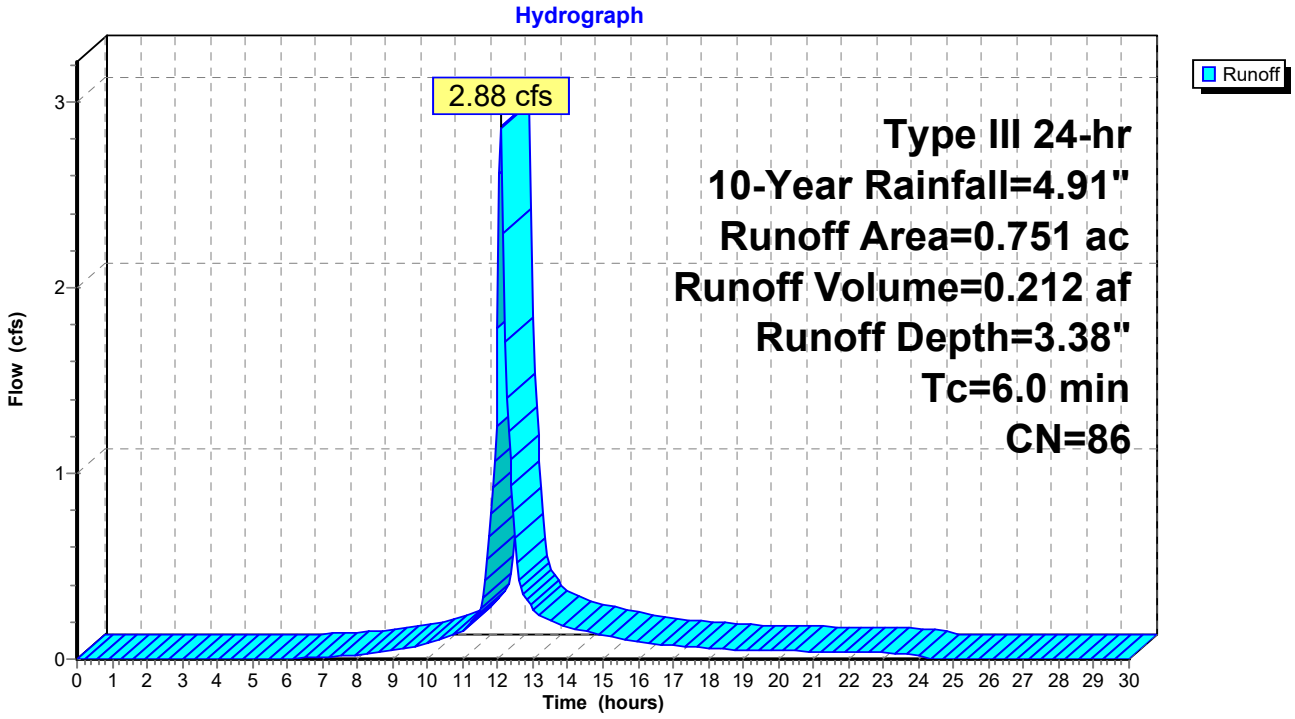
Runoff = 2.88 cfs @ 12.09 hrs, Volume= 0.212 af, Depth= 3.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.91"

	Area (ac)	CN	Description
	0.392	98	Roofs, HSG A
	0.140	98	Unconnected pavement, HSG A
	0.112	39	>75% Grass cover, Good, HSG A
*	0.107	76	Gravel Surface, HSG A
	0.751	86	Weighted Average
	0.219		29.16% Pervious Area
	0.532		70.84% Impervious Area
	0.140		26.32% Unconnected

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

Subcatchment PO-1A: Proposed PO-1A



Summary for Subcatchment PO-1B: Proposed PO-1B

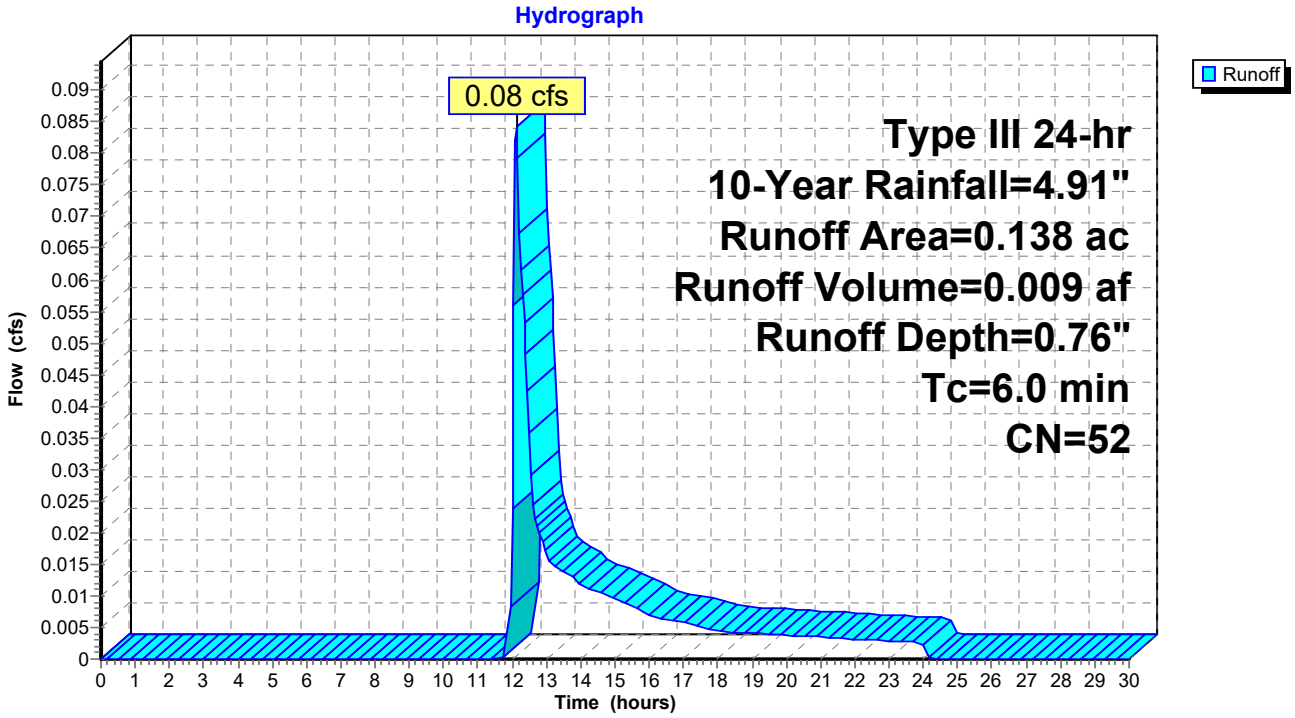
Runoff = 0.08 cfs @ 12.12 hrs, Volume= 0.009 af, Depth= 0.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.91"

Area (ac)	CN	Description
0.030	72	Dirt roads, HSG A
0.060	48	Brush, Poor, HSG A
0.040	39	>75% Grass cover, Good, HSG A
0.008	76	Gravel roads, HSG A
0.138	52	Weighted Average
0.138		100.00% Pervious Area

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

Subcatchment PO-1B: Proposed PO-1B



Summary for Subcatchment PO-2: Proposed PO-2

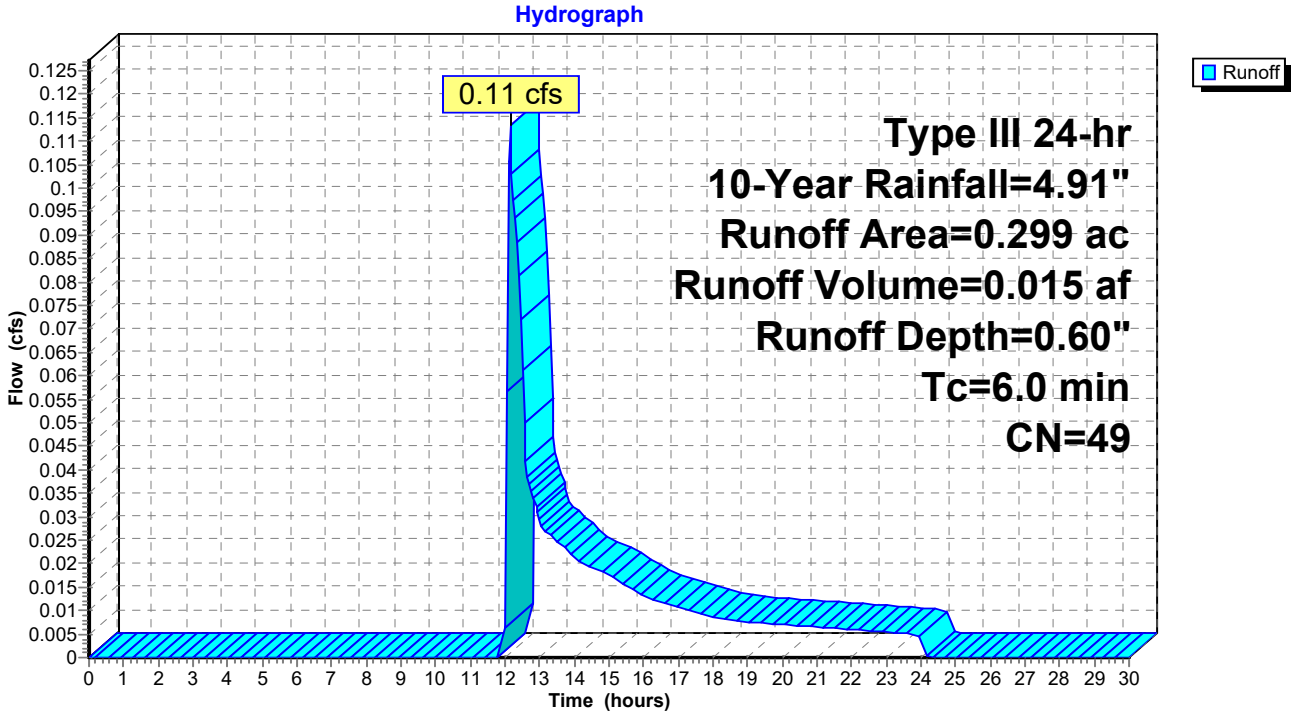
Runoff = 0.11 cfs @ 12.15 hrs, Volume= 0.015 af, Depth= 0.60"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.91"

Area (ac)	CN	Description
0.009	76	Gravel roads, HSG A
0.144	32	Woods/grass comb., Good, HSG A
0.047	98	Paved parking, HSG A
0.099	48	Brush, Poor, HSG A
0.299	49	Weighted Average
0.252		84.28% Pervious Area
0.047		15.72% Impervious Area

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

Subcatchment PO-2: Proposed PO-2



Summary for Subcatchment PO-3: Proposed PO-3

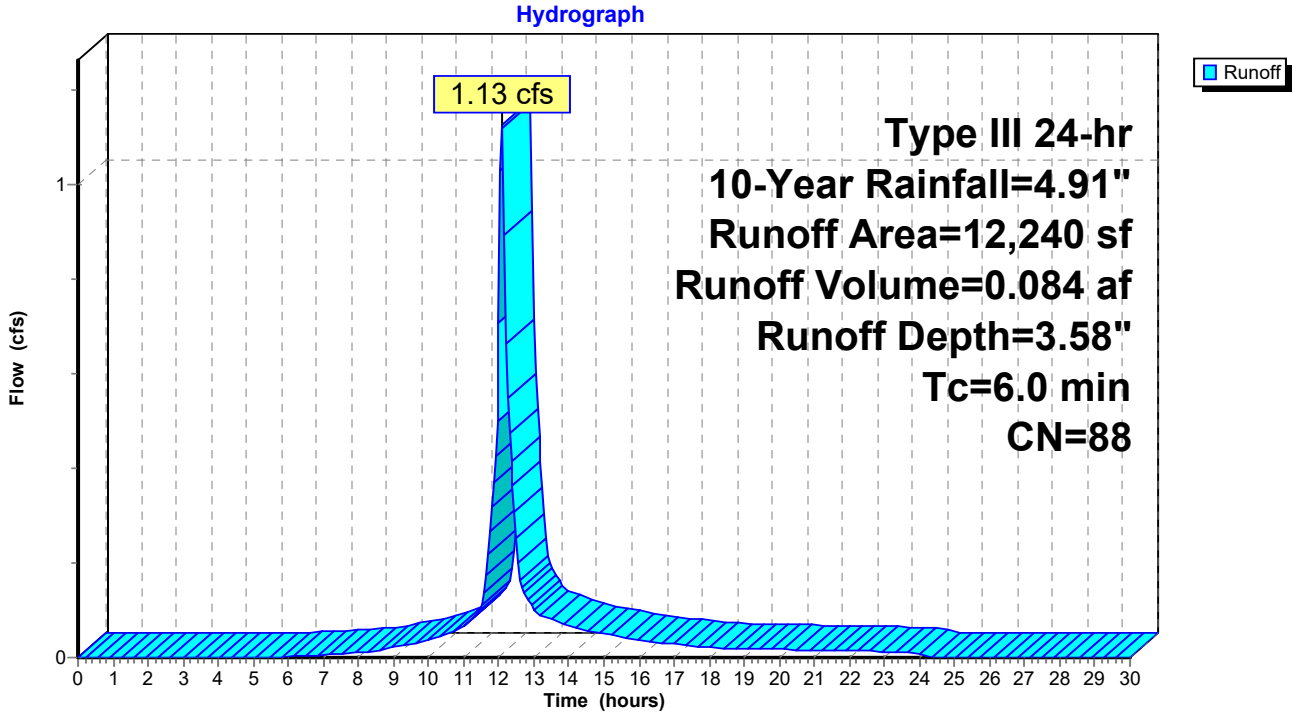
Runoff = 1.13 cfs @ 12.09 hrs, Volume= 0.084 af, Depth= 3.58"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.91"

	Area (sf)	CN	Description
	9,841	98	Paved parking, HSG A
*	2,399	49	Pole Storage Area
	12,240	88	Weighted Average
	2,399		19.60% Pervious Area
	9,841		80.40% Impervious Area

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

Subcatchment PO-3: Proposed PO-3



Summary for Subcatchment PO-4: Proposed PO-4

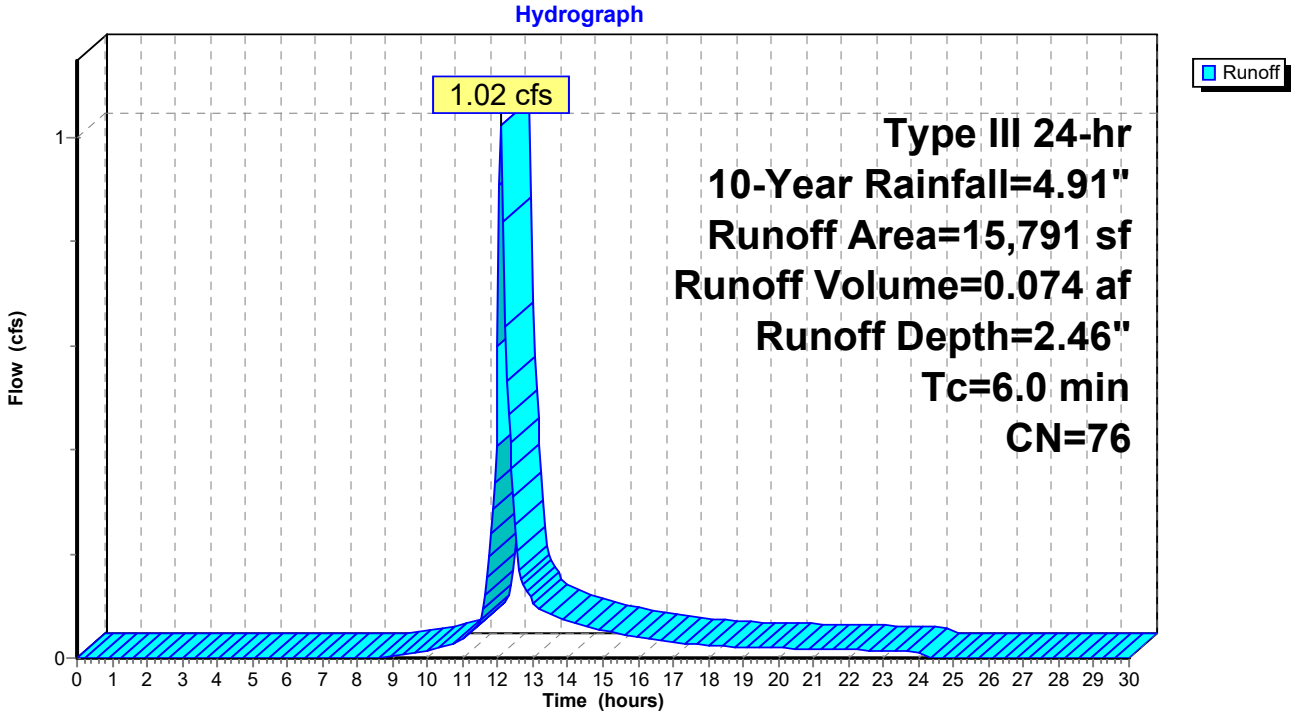
Runoff = 1.02 cfs @ 12.09 hrs, Volume= 0.074 af, Depth= 2.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.91"

	Area (sf)	CN	Description
*	12,414	76	Unconnected gravel pavement, HSG A
*	3,377	76	Infiltration beds, HSG A
	15,791	76	Weighted Average
	15,791		100.00% Pervious Area

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

Subcatchment PO-4: Proposed PO-4

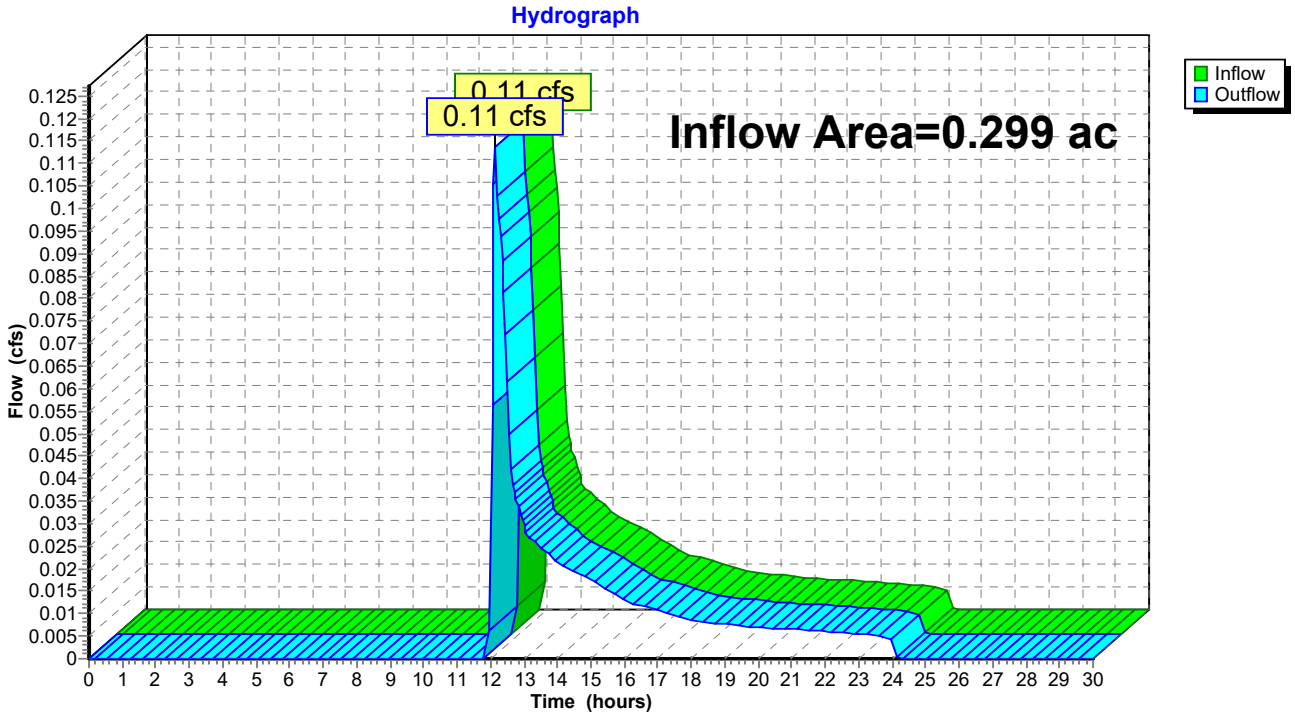


Summary for Reach 3R: DP-2

Inflow Area = 0.299 ac, 15.72% Impervious, Inflow Depth = 0.60" for 10-Year event
Inflow = 0.11 cfs @ 12.15 hrs, Volume= 0.015 af
Outflow = 0.11 cfs @ 12.15 hrs, Volume= 0.015 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Reach 3R: DP-2

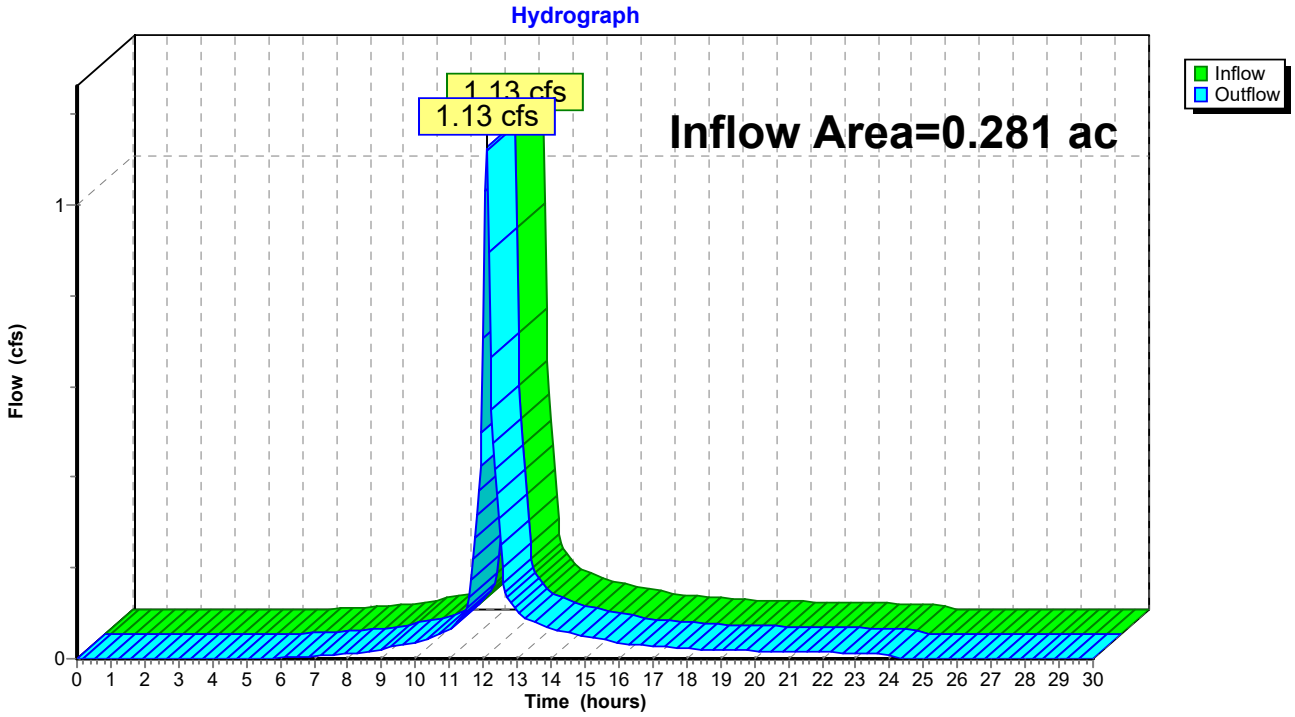


Summary for Reach 4R: DP-3

Inflow Area = 0.281 ac, 80.40% Impervious, Inflow Depth = 3.58" for 10-Year event
Inflow = 1.13 cfs @ 12.09 hrs, Volume= 0.084 af
Outflow = 1.13 cfs @ 12.09 hrs, Volume= 0.084 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Reach 4R: DP-3

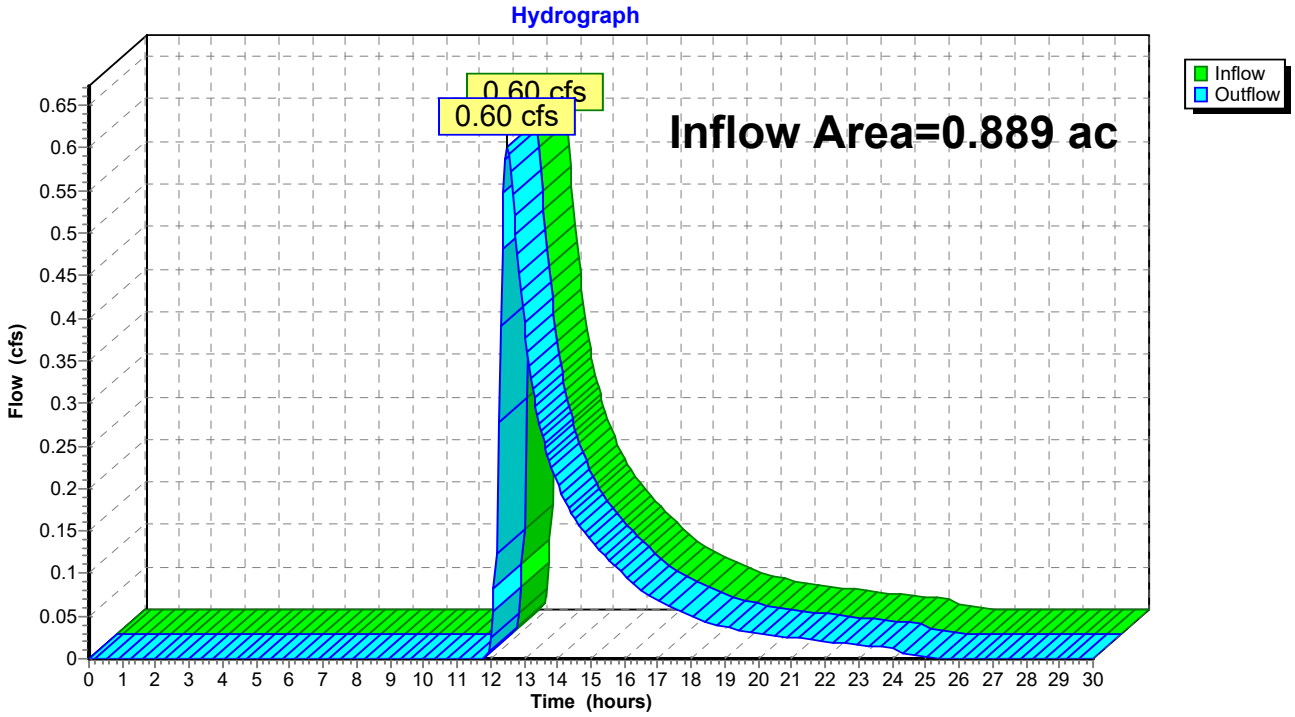


Summary for Reach 5R: DP-1

Inflow Area = 0.889 ac, 59.84% Impervious, Inflow Depth = 1.42" for 10-Year event
Inflow = 0.60 cfs @ 12.51 hrs, Volume= 0.105 af
Outflow = 0.60 cfs @ 12.51 hrs, Volume= 0.105 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Reach 5R: DP-1

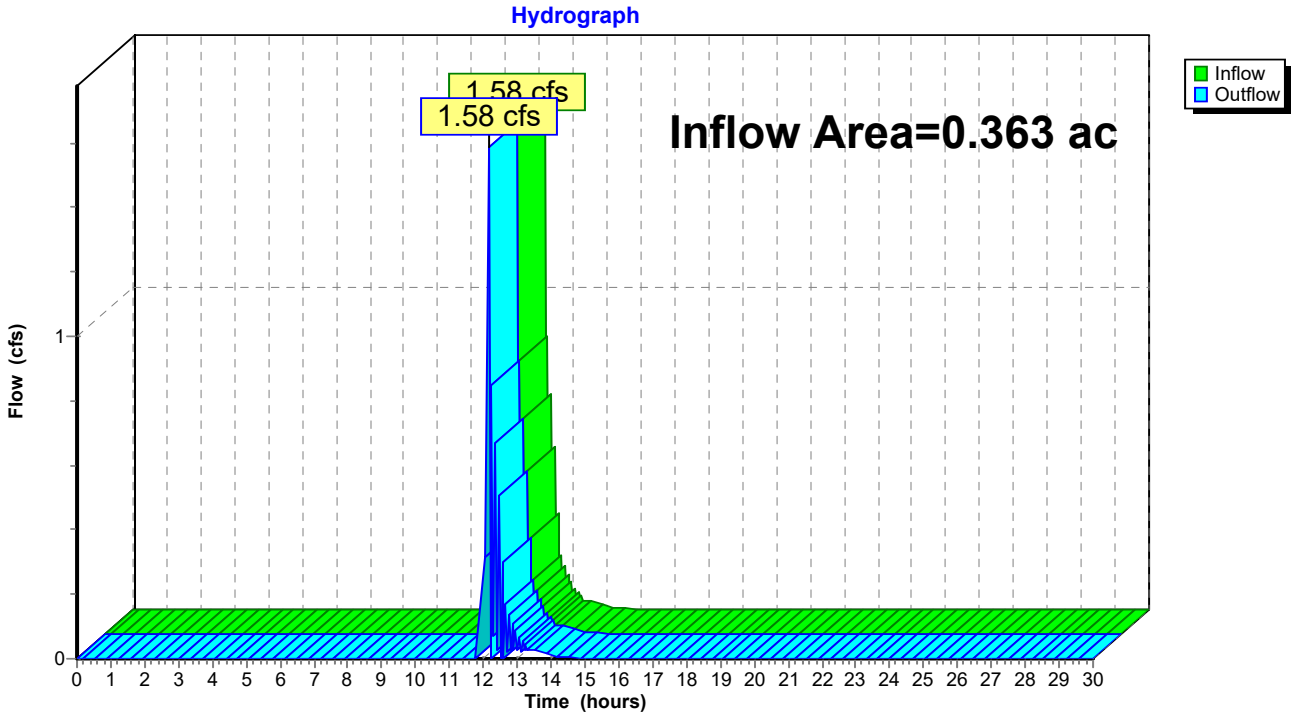


Summary for Reach 7R: DP-4

Inflow Area = 0.363 ac, 0.00% Impervious, Inflow Depth = 0.71" for 10-Year event
Inflow = 1.58 cfs @ 12.15 hrs, Volume= 0.022 af
Outflow = 1.58 cfs @ 12.15 hrs, Volume= 0.022 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Reach 7R: DP-4



Summary for Pond 4P: (new Pond)

Inflow Area =	0.751 ac, 70.84% Impervious, Inflow Depth = 3.38" for 10-Year event				
Inflow =	2.88 cfs @	12.09 hrs,	Volume=	0.212 af	
Outflow =	0.60 cfs @	12.52 hrs,	Volume=	0.140 af,	Atten= 79%, Lag= 26.0 min
Discarded =	0.03 cfs @	12.52 hrs,	Volume=	0.044 af	
Primary =	0.57 cfs @	12.52 hrs,	Volume=	0.096 af	
Secondary =	0.00 cfs @	0.00 hrs,	Volume=	0.000 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 76.54' @ 12.52 hrs Surf.Area= 2,490 sf Storage= 4,733 cf

Plug-Flow detention time= 270.4 min calculated for 0.140 af (66% of inflow)
Center-of-Mass det. time= 172.2 min (977.3 - 805.1)

Volume	Invert	Avail.Storage	Storage Description
#1	73.20'	9,722 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
73.20	650	0	0
74.00	856	602	602
75.00	1,416	1,136	1,738
76.00	2,106	1,761	3,499
77.00	2,822	2,464	5,963
78.00	4,696	3,759	9,722

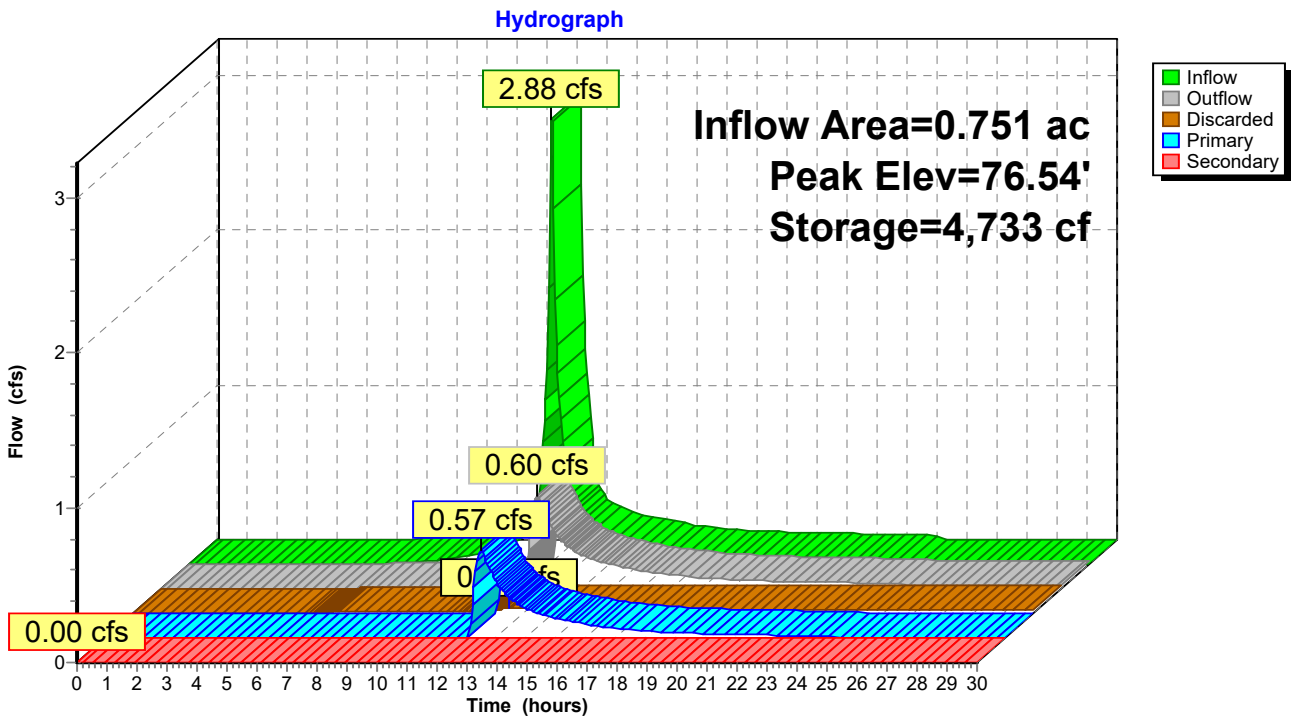
Device	Routing	Invert	Outlet Devices
#1	Primary	76.00'	**12.0" Round Culvert** L= 20.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 76.00' / 76.00' S= 0.0000 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf
#2	Secondary	77.25'	**15.0' long x 6.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.37 2.51 2.70 2.68 2.68 2.67 2.65 2.65 2.65 2.65 2.66 2.66 2.67 2.69 2.72 2.76 2.83
#3	Discarded	73.20'	**0.520 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.03 cfs @ 12.52 hrs HW=76.54' (Free Discharge)
└**3=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=0.56 cfs @ 12.52 hrs HW=76.54' TW=0.00' (Dynamic Tailwater)
└**1=Culvert** (Barrel Controls 0.56 cfs @ 1.91 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=73.20' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 4P: (new Pond)



Summary for Pond 5P: (new Pond)

Inflow Area =	0.363 ac,	0.00% Impervious,	Inflow Depth =	2.46"	for 10-Year event
Inflow =	1.02 cfs @	12.09 hrs,	Volume=	0.074 af	
Outflow =	1.64 cfs @	12.15 hrs,	Volume=	0.074 af,	Atten= 0%, Lag= 3.4 min
Discarded =	0.06 cfs @	11.60 hrs,	Volume=	0.053 af	
Primary =	1.58 cfs @	12.15 hrs,	Volume=	0.022 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 78.03' @ 12.15 hrs Surf.Area= 500 sf Storage= 606 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 71.1 min (904.2 - 833.2)

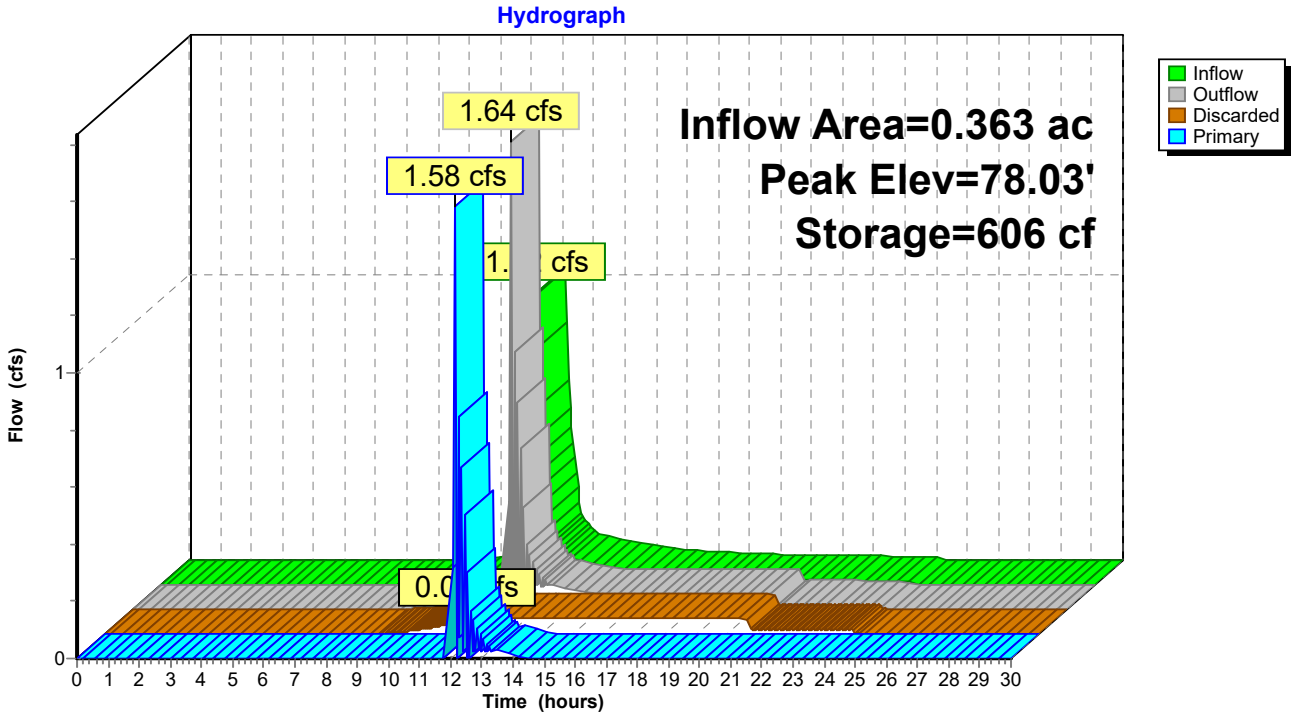
Volume	Invert	Avail.Storage	Storage Description
#1	75.00'	800 cf	**4.00'W x 125.00'L x 4.00'H Prismatoid** 2,000 cf Overall x 40.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Discarded	75.00'	**5.000 in/hr Exfiltration over Surface area**
#2	Primary	78.00'	**125.0' long x 2.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Discarded OutFlow Max=0.06 cfs @ 11.60 hrs HW=75.06' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.06 cfs)

Primary OutFlow Max=1.58 cfs @ 12.15 hrs HW=78.03' TW=0.00' (Dynamic Tailwater)
└**2=Broad-Crested Rectangular Weir** (Weir Controls 1.58 cfs @ 0.43 fps)

Pond 5P: (new Pond)



Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points
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 PO-1A: Proposed PO-1A Runoff Area=0.751 ac 70.84% Impervious Runoff Depth=4.56"
Tc=6.0 min CN=86 Runoff=3.83 cfs 0.285 af

Subcatchment PO-1B: Proposed PO-1B Runoff Area=0.138 ac 0.00% Impervious Runoff Depth=1.37"
Tc=6.0 min CN=52 Runoff=0.19 cfs 0.016 af

Subcatchment PO-2: Proposed PO-2 Runoff Area=0.299 ac 15.72% Impervious Runoff Depth=1.15"
Tc=6.0 min CN=49 Runoff=0.31 cfs 0.029 af

Subcatchment PO-3: Proposed PO-3 Runoff Area=12,240 sf 80.40% Impervious Runoff Depth=4.78"
Tc=6.0 min CN=88 Runoff=1.48 cfs 0.112 af

Subcatchment PO-4: Proposed PO-4 Runoff Area=15,791 sf 0.00% Impervious Runoff Depth=3.52"
Tc=6.0 min CN=76 Runoff=1.47 cfs 0.106 af

Reach 3R: DP-2 Inflow=0.31 cfs 0.029 af
Outflow=0.31 cfs 0.029 af

Reach 4R: DP-3 Inflow=1.48 cfs 0.112 af
Outflow=1.48 cfs 0.112 af

Reach 5R: DP-1 Inflow=1.45 cfs 0.183 af
Outflow=1.45 cfs 0.183 af

Reach 7R: DP-4 Inflow=1.63 cfs 0.045 af
Outflow=1.63 cfs 0.045 af

Pond 4P: (new Pond) Peak Elev=76.86' Storage=5,584 cf Inflow=3.83 cfs 0.285 af
Discarded=0.03 cfs 0.045 af Primary=1.35 cfs 0.167 af Secondary=0.00 cfs 0.000 af Outflow=1.38 cfs 0.213 af

Pond 5P: (new Pond) Peak Elev=78.03' Storage=606 cf Inflow=1.47 cfs 0.106 af
Discarded=0.06 cfs 0.062 af Primary=1.63 cfs 0.045 af Outflow=1.69 cfs 0.106 af

Total Runoff Area = 1.832 ac Runoff Volume = 0.548 af Average Runoff Depth = 3.59"
56.05% Pervious = 1.027 ac 43.95% Impervious = 0.805 ac

Summary for Subcatchment PO-1A: Proposed PO-1A

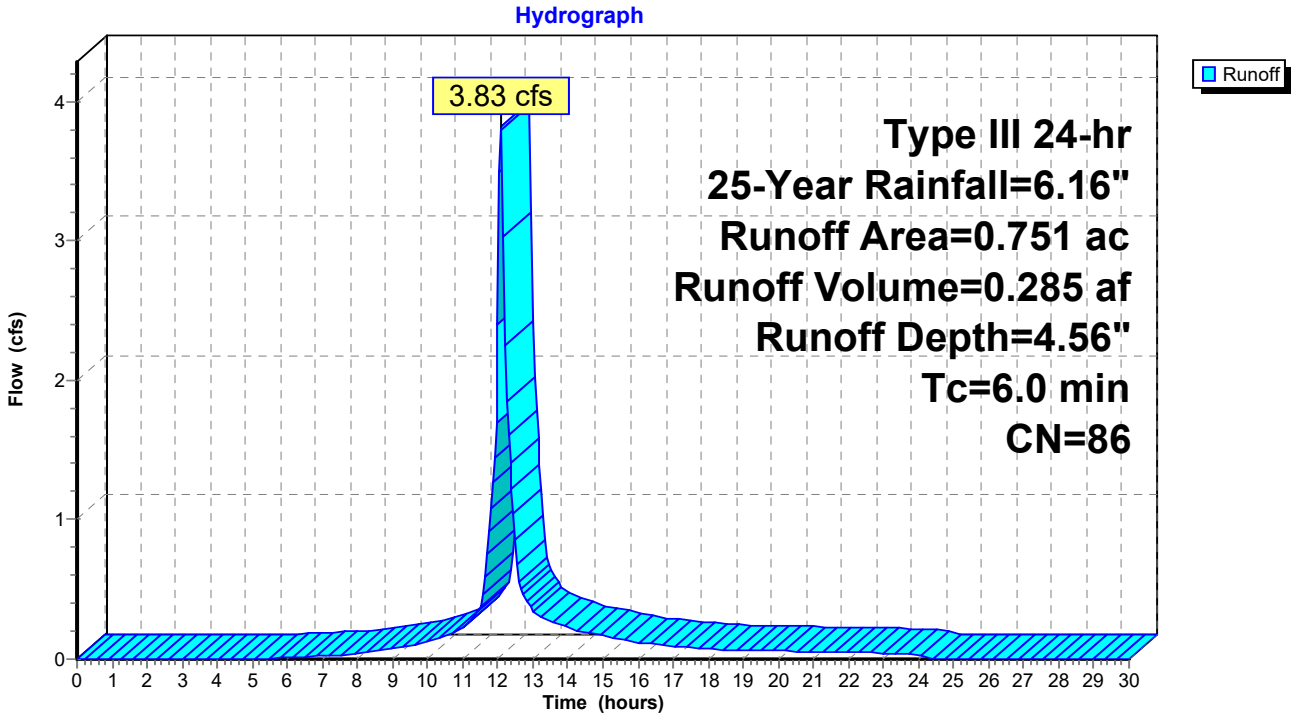
Runoff = 3.83 cfs @ 12.09 hrs, Volume= 0.285 af, Depth= 4.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.16"

	Area (ac)	CN	Description
	0.392	98	Roofs, HSG A
	0.140	98	Unconnected pavement, HSG A
	0.112	39	>75% Grass cover, Good, HSG A
*	0.107	76	Gravel Surface, HSG A
	0.751	86	Weighted Average
	0.219		29.16% Pervious Area
	0.532		70.84% Impervious Area
	0.140		26.32% Unconnected

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

Subcatchment PO-1A: Proposed PO-1A



Summary for Subcatchment PO-1B: Proposed PO-1B

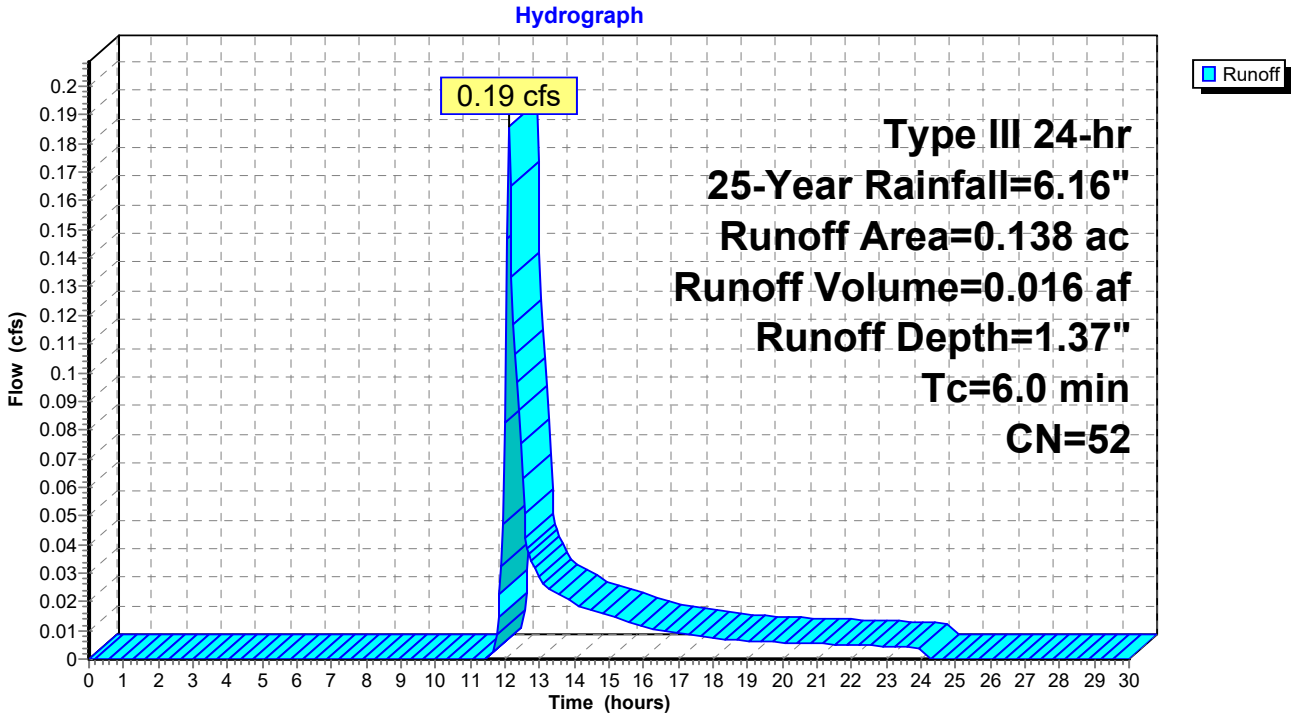
Runoff = 0.19 cfs @ 12.11 hrs, Volume= 0.016 af, Depth= 1.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.16"

Area (ac)	CN	Description
0.030	72	Dirt roads, HSG A
0.060	48	Brush, Poor, HSG A
0.040	39	>75% Grass cover, Good, HSG A
0.008	76	Gravel roads, HSG A
0.138	52	Weighted Average
0.138		100.00% Pervious Area

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

Subcatchment PO-1B: Proposed PO-1B



Summary for Subcatchment PO-2: Proposed PO-2

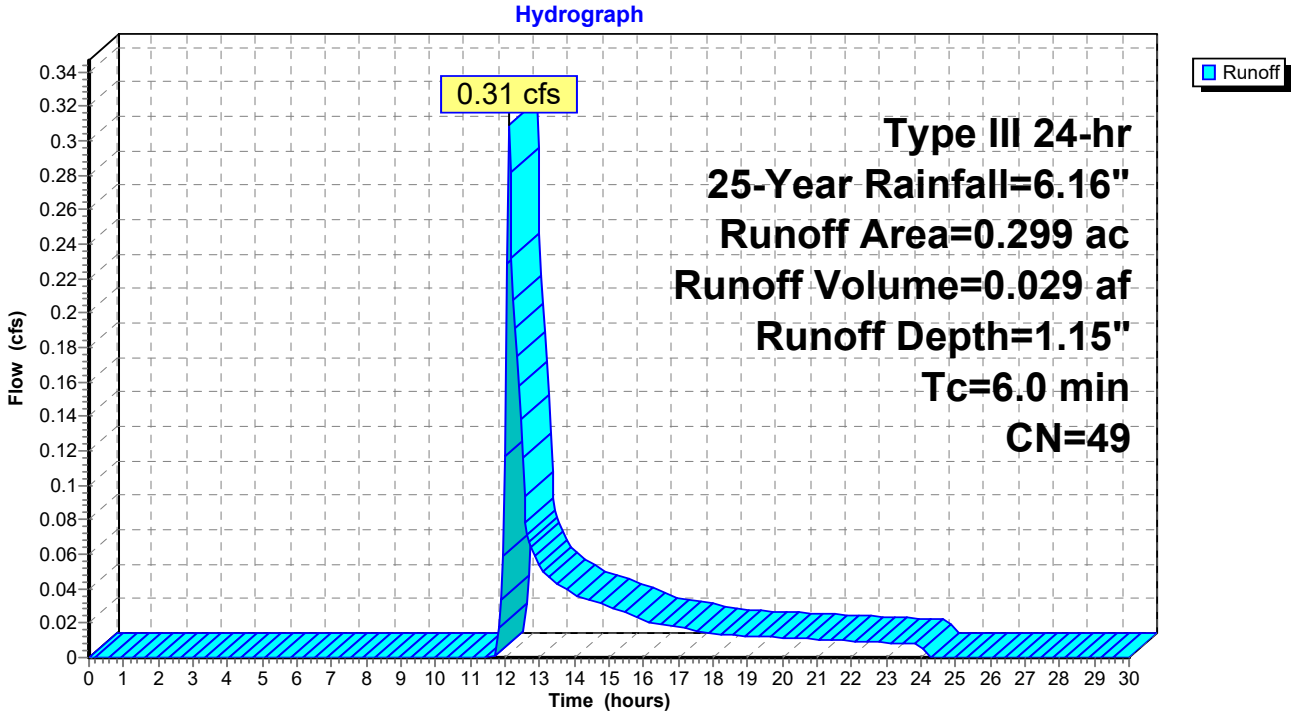
Runoff = 0.31 cfs @ 12.11 hrs, Volume= 0.029 af, Depth= 1.15"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.16"

Area (ac)	CN	Description
0.009	76	Gravel roads, HSG A
0.144	32	Woods/grass comb., Good, HSG A
0.047	98	Paved parking, HSG A
0.099	48	Brush, Poor, HSG A
0.299	49	Weighted Average
0.252		84.28% Pervious Area
0.047		15.72% Impervious Area

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

Subcatchment PO-2: Proposed PO-2



Summary for Subcatchment PO-3: Proposed PO-3

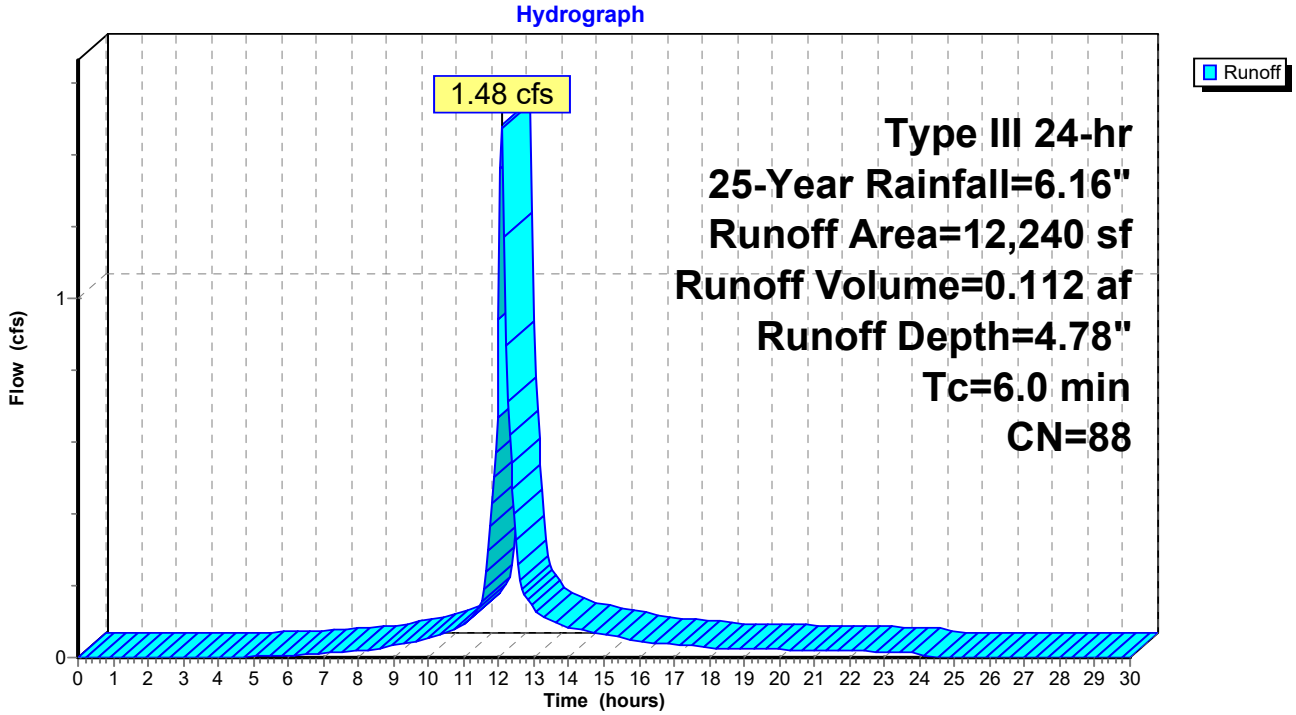
Runoff = 1.48 cfs @ 12.09 hrs, Volume= 0.112 af, Depth= 4.78"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.16"

	Area (sf)	CN	Description
	9,841	98	Paved parking, HSG A
*	2,399	49	Pole Storage Area
	12,240	88	Weighted Average
	2,399		19.60% Pervious Area
	9,841		80.40% Impervious Area

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

Subcatchment PO-3: Proposed PO-3



Summary for Subcatchment PO-4: Proposed PO-4

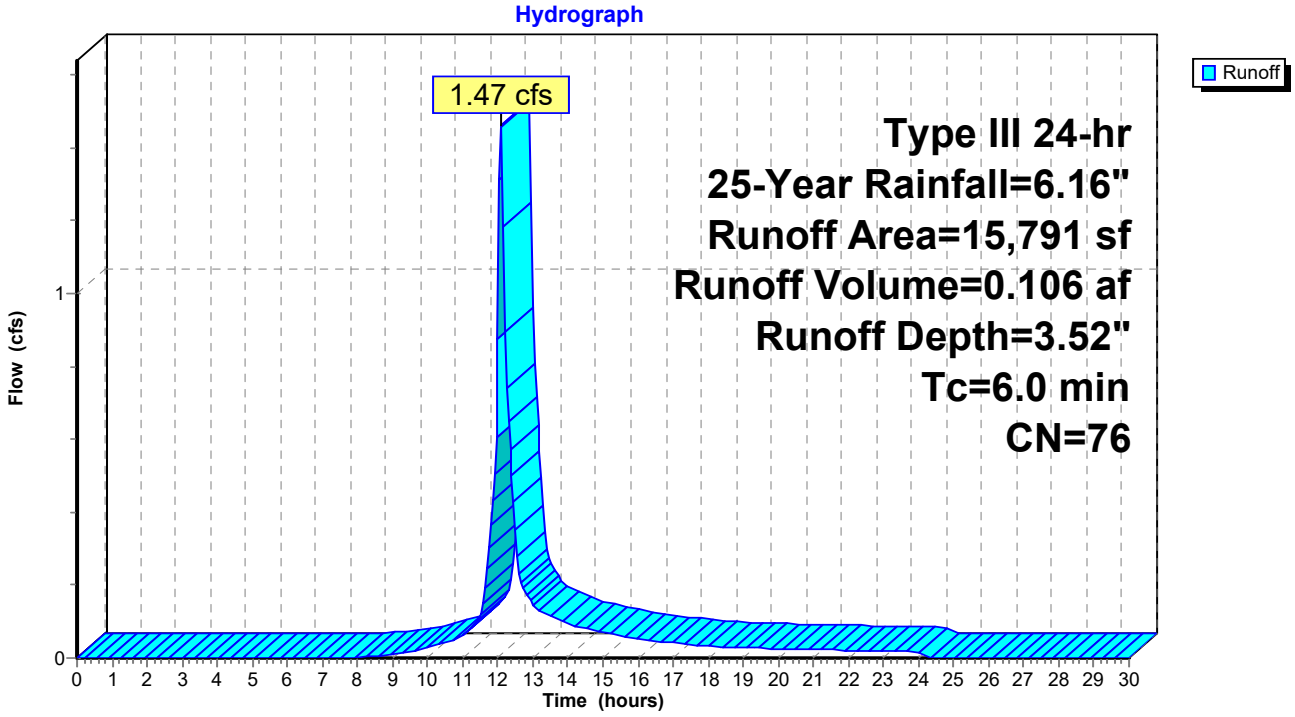
Runoff = 1.47 cfs @ 12.09 hrs, Volume= 0.106 af, Depth= 3.52"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.16"

	Area (sf)	CN	Description
*	12,414	76	Unconnected gravel pavement, HSG A
*	3,377	76	Infiltration beds, HSG A
	15,791	76	Weighted Average
	15,791		100.00% Pervious Area

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

Subcatchment PO-4: Proposed PO-4

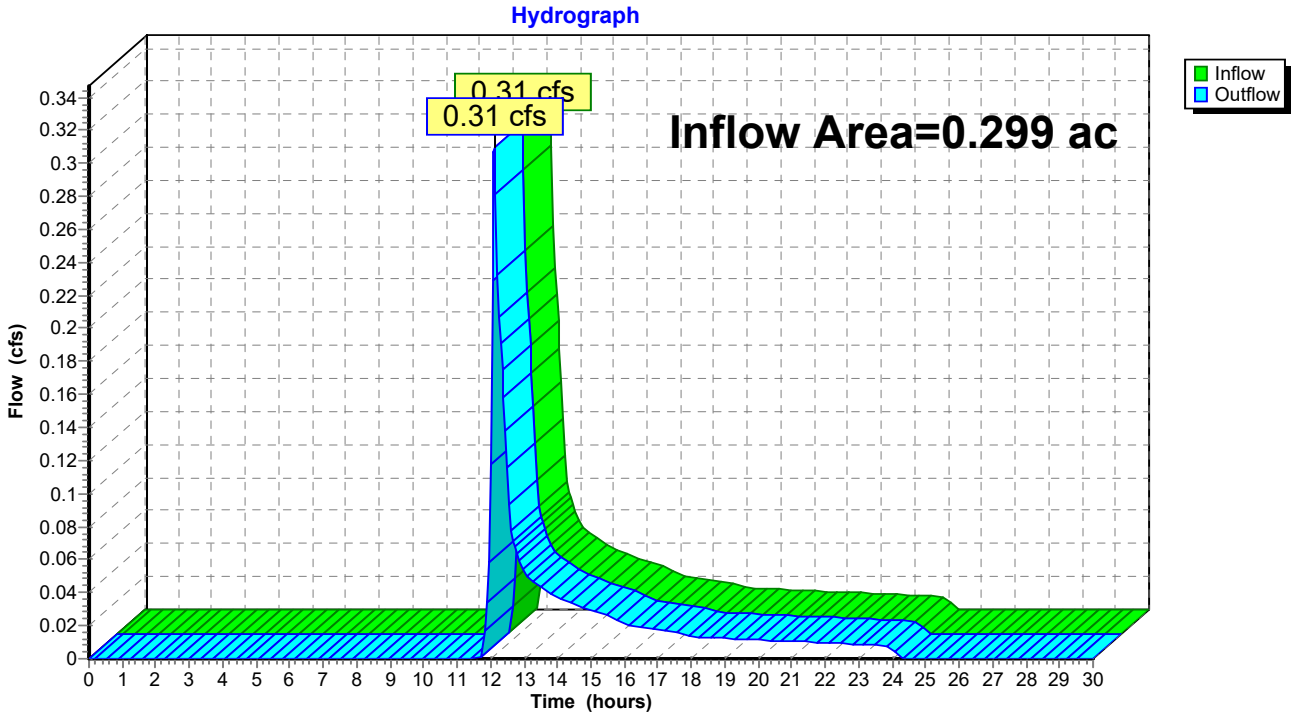


Summary for Reach 3R: DP-2

Inflow Area = 0.299 ac, 15.72% Impervious, Inflow Depth = 1.15" for 25-Year event
Inflow = 0.31 cfs @ 12.11 hrs, Volume= 0.029 af
Outflow = 0.31 cfs @ 12.11 hrs, Volume= 0.029 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Reach 3R: DP-2

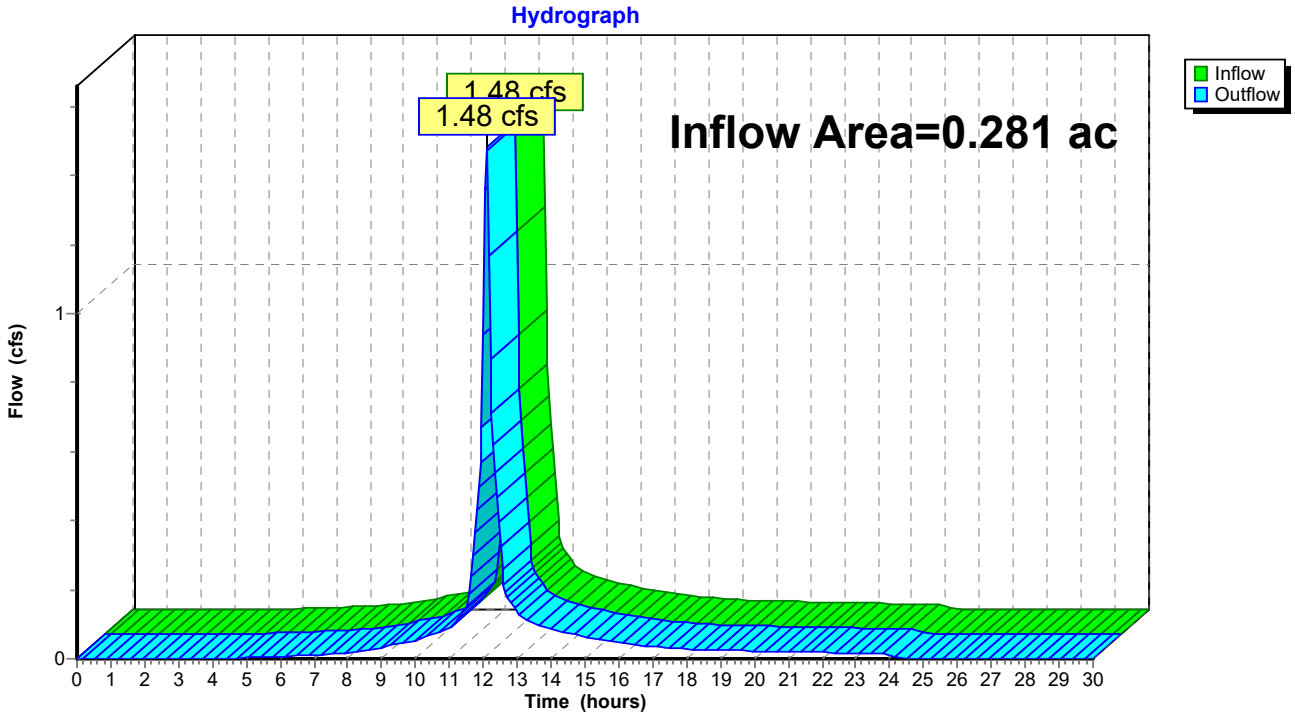


Summary for Reach 4R: DP-3

Inflow Area = 0.281 ac, 80.40% Impervious, Inflow Depth = 4.78" for 25-Year event
Inflow = 1.48 cfs @ 12.09 hrs, Volume= 0.112 af
Outflow = 1.48 cfs @ 12.09 hrs, Volume= 0.112 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Reach 4R: DP-3

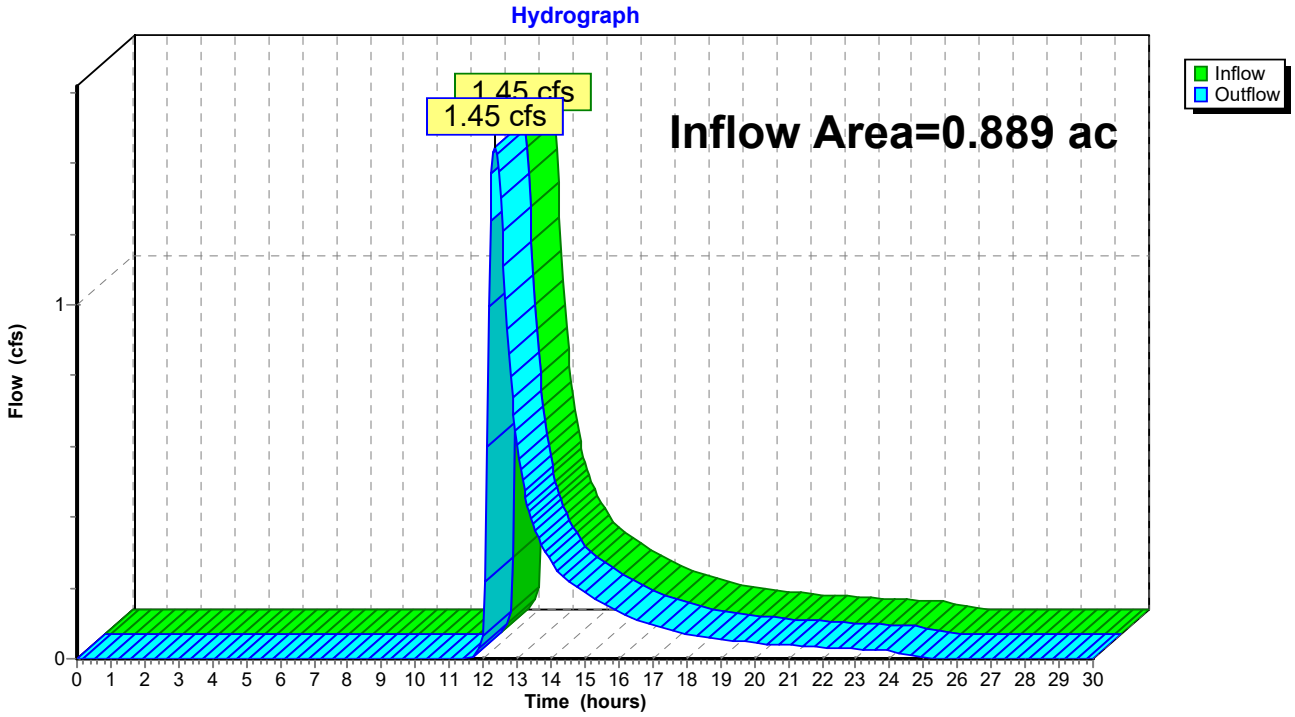


Summary for Reach 5R: DP-1

Inflow Area = 0.889 ac, 59.84% Impervious, Inflow Depth = 2.47" for 25-Year event
Inflow = 1.45 cfs @ 12.35 hrs, Volume= 0.183 af
Outflow = 1.45 cfs @ 12.35 hrs, Volume= 0.183 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Reach 5R: DP-1

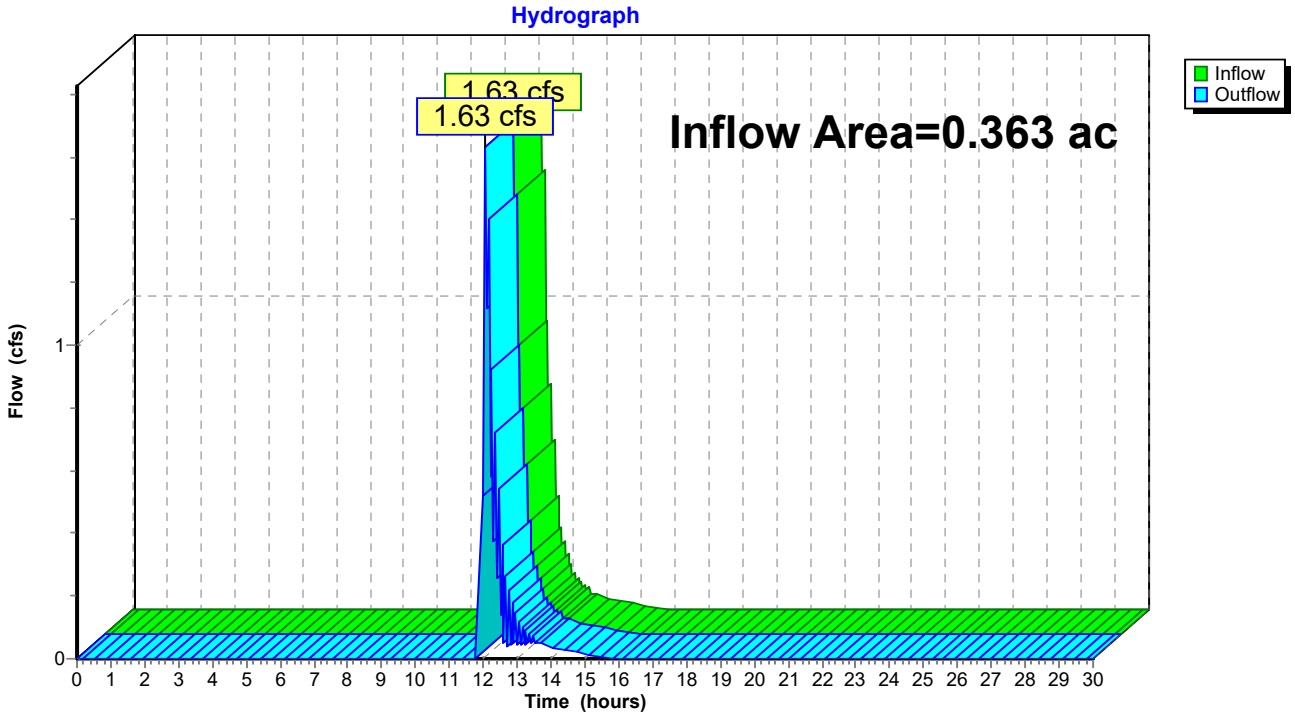


Summary for Reach 7R: DP-4

Inflow Area = 0.363 ac, 0.00% Impervious, Inflow Depth = 1.47" for 25-Year event
Inflow = 1.63 cfs @ 12.06 hrs, Volume= 0.045 af
Outflow = 1.63 cfs @ 12.06 hrs, Volume= 0.045 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Reach 7R: DP-4



Summary for Pond 4P: (new Pond)

Inflow Area =	0.751 ac, 70.84% Impervious, Inflow Depth = 4.56" for 25-Year event				
Inflow =	3.83 cfs @	12.09 hrs,	Volume=	0.285 af	
Outflow =	1.38 cfs @	12.36 hrs,	Volume=	0.213 af,	Atten= 64%, Lag= 16.3 min
Discarded =	0.03 cfs @	12.36 hrs,	Volume=	0.045 af	
Primary =	1.35 cfs @	12.36 hrs,	Volume=	0.167 af	
Secondary =	0.00 cfs @	0.00 hrs,	Volume=	0.000 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 76.86' @ 12.36 hrs Surf.Area= 2,724 sf Storage= 5,584 cf

Plug-Flow detention time= 213.3 min calculated for 0.213 af (75% of inflow)
Center-of-Mass det. time= 127.6 min (924.3 - 796.8)

Volume	Invert	Avail.Storage	Storage Description
#1	73.20'	9,722 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
73.20	650	0	0
74.00	856	602	602
75.00	1,416	1,136	1,738
76.00	2,106	1,761	3,499
77.00	2,822	2,464	5,963
78.00	4,696	3,759	9,722

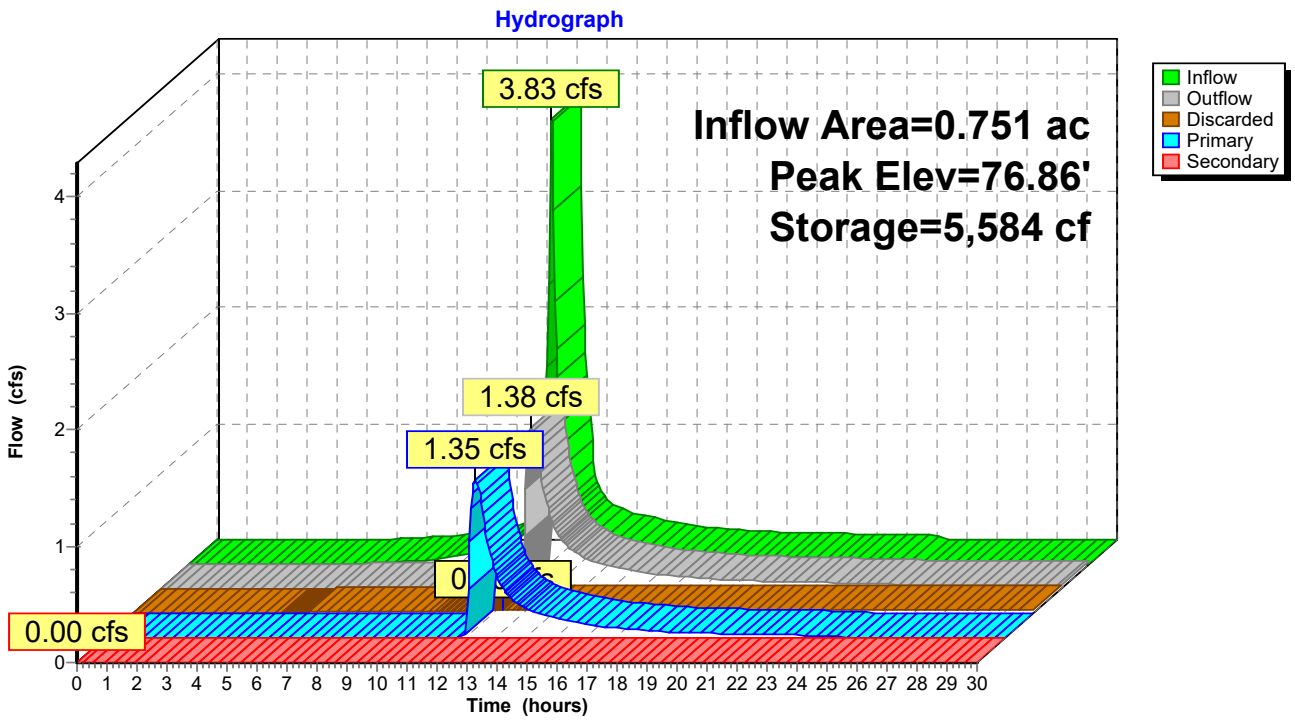
Device	Routing	Invert	Outlet Devices
#1	Primary	76.00'	**12.0" Round Culvert** L= 20.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 76.00' / 76.00' S= 0.0000 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf
#2	Secondary	77.25'	**15.0' long x 6.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.37 2.51 2.70 2.68 2.68 2.67 2.65 2.65 2.65 2.65 2.66 2.66 2.67 2.69 2.72 2.76 2.83
#3	Discarded	73.20'	**0.520 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.03 cfs @ 12.36 hrs HW=76.86' (Free Discharge)
└**3=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=1.35 cfs @ 12.36 hrs HW=76.86' TW=0.00' (Dynamic Tailwater)
└**1=Culvert** (Barrel Controls 1.35 cfs @ 2.51 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=73.20' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 4P: (new Pond)



Summary for Pond 5P: (new Pond)

Inflow Area =	0.363 ac,	0.00% Impervious,	Inflow Depth =	3.52"	for 25-Year event
Inflow =	1.47 cfs @	12.09 hrs,	Volume=	0.106 af	
Outflow =	1.69 cfs @	12.06 hrs,	Volume=	0.106 af,	Atten= 0%, Lag= 0.0 min
Discarded =	0.06 cfs @	11.20 hrs,	Volume=	0.062 af	
Primary =	1.63 cfs @	12.06 hrs,	Volume=	0.045 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 78.03' @ 12.05 hrs Surf.Area= 500 sf Storage= 606 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 60.3 min (883.2 - 822.9)

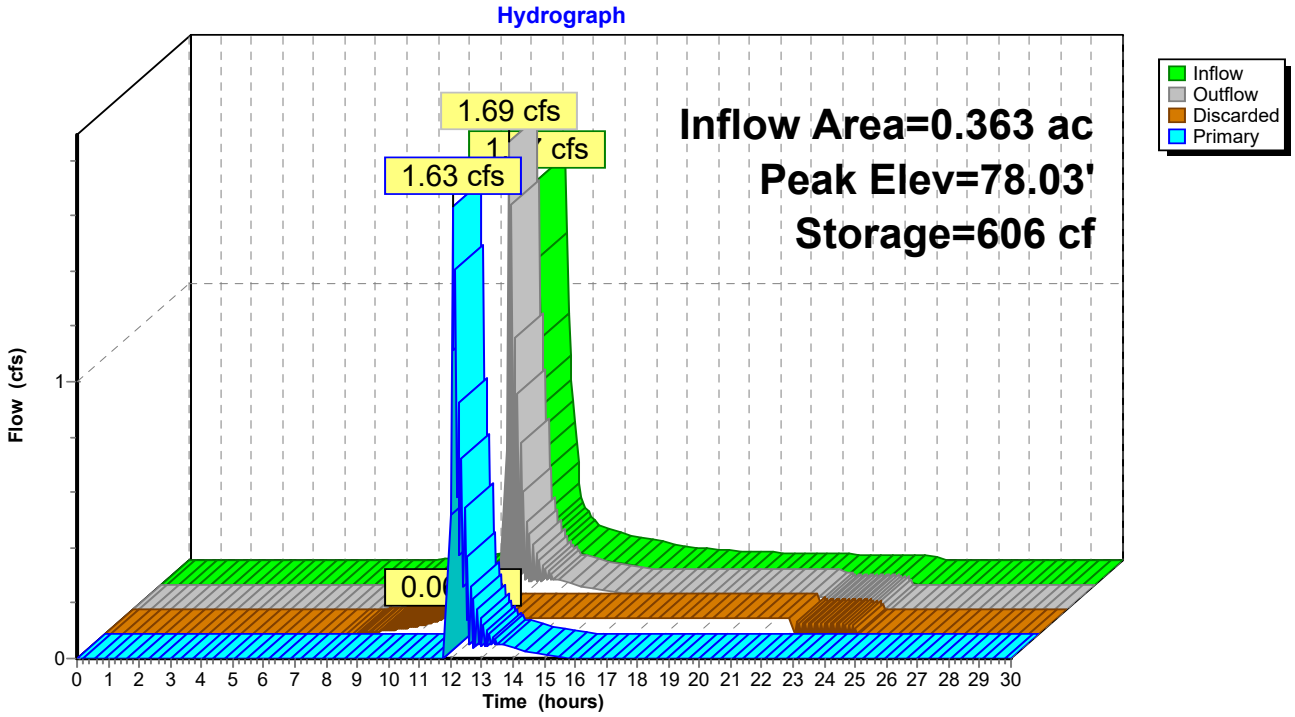
Volume	Invert	Avail.Storage	Storage Description
#1	75.00'	800 cf	**4.00'W x 125.00'L x 4.00'H Prismatoid** 2,000 cf Overall x 40.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Discarded	75.00'	**5.000 in/hr Exfiltration over Surface area**
#2	Primary	78.00'	**125.0' long x 2.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Discarded OutFlow Max=0.06 cfs @ 11.20 hrs HW=75.04' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.06 cfs)

Primary OutFlow Max=1.43 cfs @ 12.06 hrs HW=78.03' TW=0.00' (Dynamic Tailwater)
└**2=Broad-Crested Rectangular Weir** (Weir Controls 1.43 cfs @ 0.42 fps)

Pond 5P: (new Pond)



Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points
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 PO-1A: Proposed PO-1A Runoff Area=0.751 ac 70.84% Impervious Runoff Depth=6.98"
Tc=6.0 min CN=86 Runoff=5.73 cfs 0.437 af

Subcatchment PO-1B: Proposed PO-1B Runoff Area=0.138 ac 0.00% Impervious Runoff Depth=2.90"
Tc=6.0 min CN=52 Runoff=0.44 cfs 0.033 af

Subcatchment PO-2: Proposed PO-2 Runoff Area=0.299 ac 15.72% Impervious Runoff Depth=2.55"
Tc=6.0 min CN=49 Runoff=0.82 cfs 0.064 af

Subcatchment PO-3: Proposed PO-3 Runoff Area=12,240 sf 80.40% Impervious Runoff Depth=7.22"
Tc=6.0 min CN=88 Runoff=2.19 cfs 0.169 af

Subcatchment PO-4: Proposed PO-4 Runoff Area=15,791 sf 0.00% Impervious Runoff Depth=5.77"
Tc=6.0 min CN=76 Runoff=2.38 cfs 0.174 af

Reach 3R: DP-2 Inflow=0.82 cfs 0.064 af
Outflow=0.82 cfs 0.064 af

Reach 4R: DP-3 Inflow=2.19 cfs 0.169 af
Outflow=2.19 cfs 0.169 af

Reach 5R: DP-1 Inflow=2.80 cfs 0.335 af
Outflow=2.80 cfs 0.335 af

Reach 7R: DP-4 Inflow=2.33 cfs 0.098 af
Outflow=2.33 cfs 0.098 af

Pond 4P: (new Pond) Peak Elev=77.35' Storage=7,071 cf Inflow=5.73 cfs 0.437 af
Discarded=0.04 cfs 0.049 af Primary=2.48 cfs 0.301 af Secondary=1.15 cfs 0.014 af Outflow=3.67 cfs 0.364 af

Pond 5P: (new Pond) Peak Elev=78.04' Storage=608 cf Inflow=2.38 cfs 0.174 af
Discarded=0.06 cfs 0.076 af Primary=2.33 cfs 0.098 af Outflow=2.38 cfs 0.174 af

Total Runoff Area = 1.832 ac Runoff Volume = 0.877 af Average Runoff Depth = 5.75"
56.05% Pervious = 1.027 ac 43.95% Impervious = 0.805 ac

Summary for Subcatchment PO-1A: Proposed PO-1A

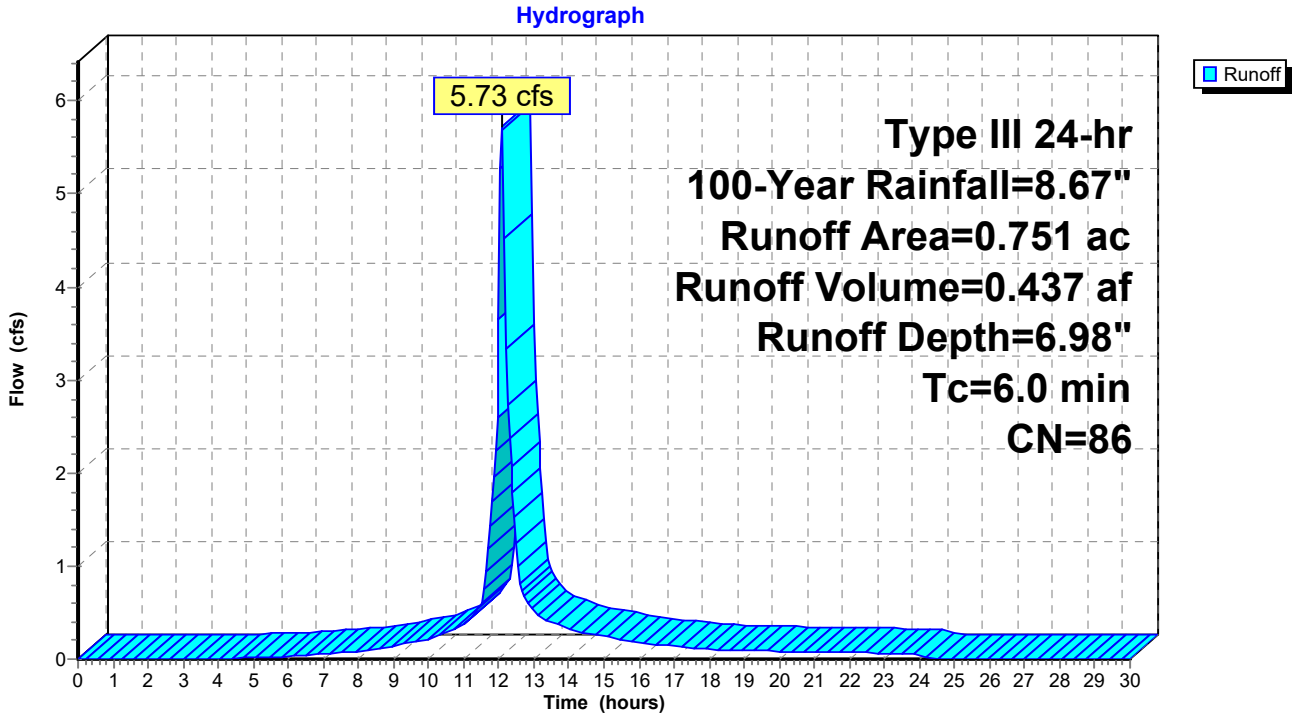
Runoff = 5.73 cfs @ 12.09 hrs, Volume= 0.437 af, Depth= 6.98"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.67"

	Area (ac)	CN	Description
	0.392	98	Roofs, HSG A
	0.140	98	Unconnected pavement, HSG A
	0.112	39	>75% Grass cover, Good, HSG A
*	0.107	76	Gravel Surface, HSG A
	0.751	86	Weighted Average
	0.219		29.16% Pervious Area
	0.532		70.84% Impervious Area
	0.140		26.32% Unconnected

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

Subcatchment PO-1A: Proposed PO-1A



Summary for Subcatchment PO-1B: Proposed PO-1B

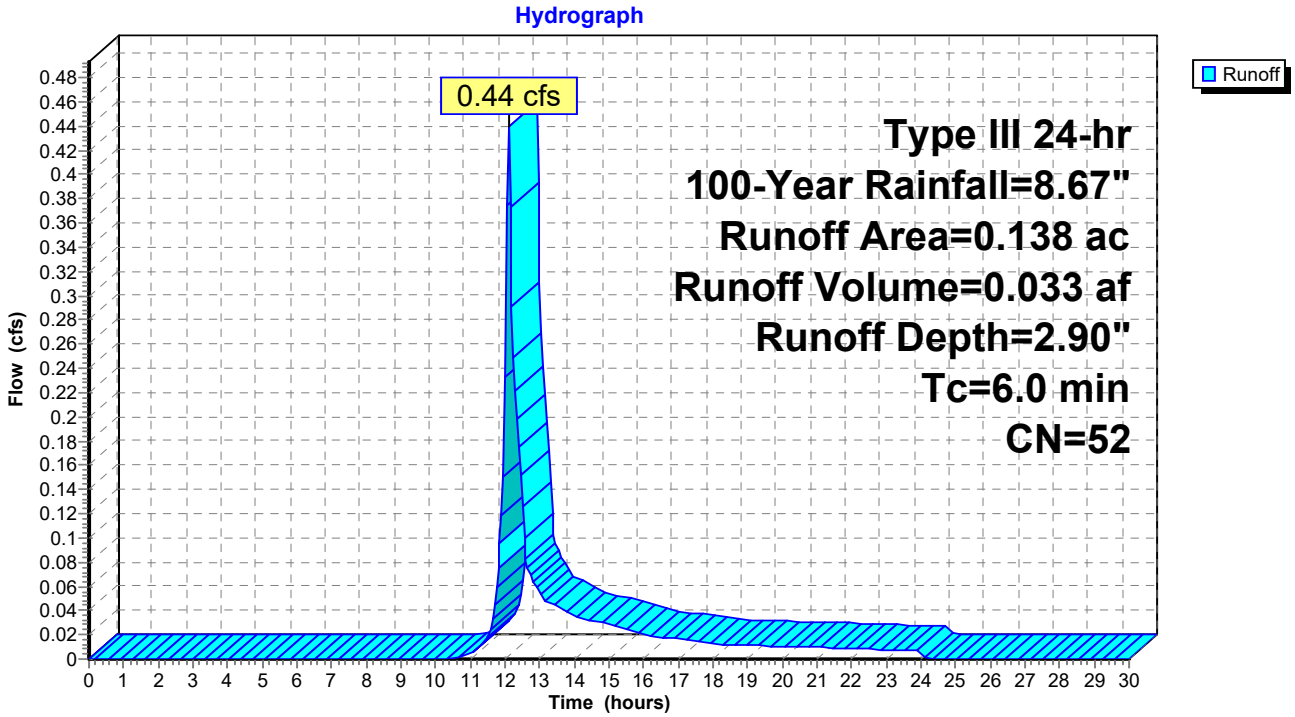
Runoff = 0.44 cfs @ 12.10 hrs, Volume= 0.033 af, Depth= 2.90"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.67"

Area (ac)	CN	Description
0.030	72	Dirt roads, HSG A
0.060	48	Brush, Poor, HSG A
0.040	39	>75% Grass cover, Good, HSG A
0.008	76	Gravel roads, HSG A
0.138	52	Weighted Average
0.138		100.00% Pervious Area

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

Subcatchment PO-1B: Proposed PO-1B



Summary for Subcatchment PO-2: Proposed PO-2

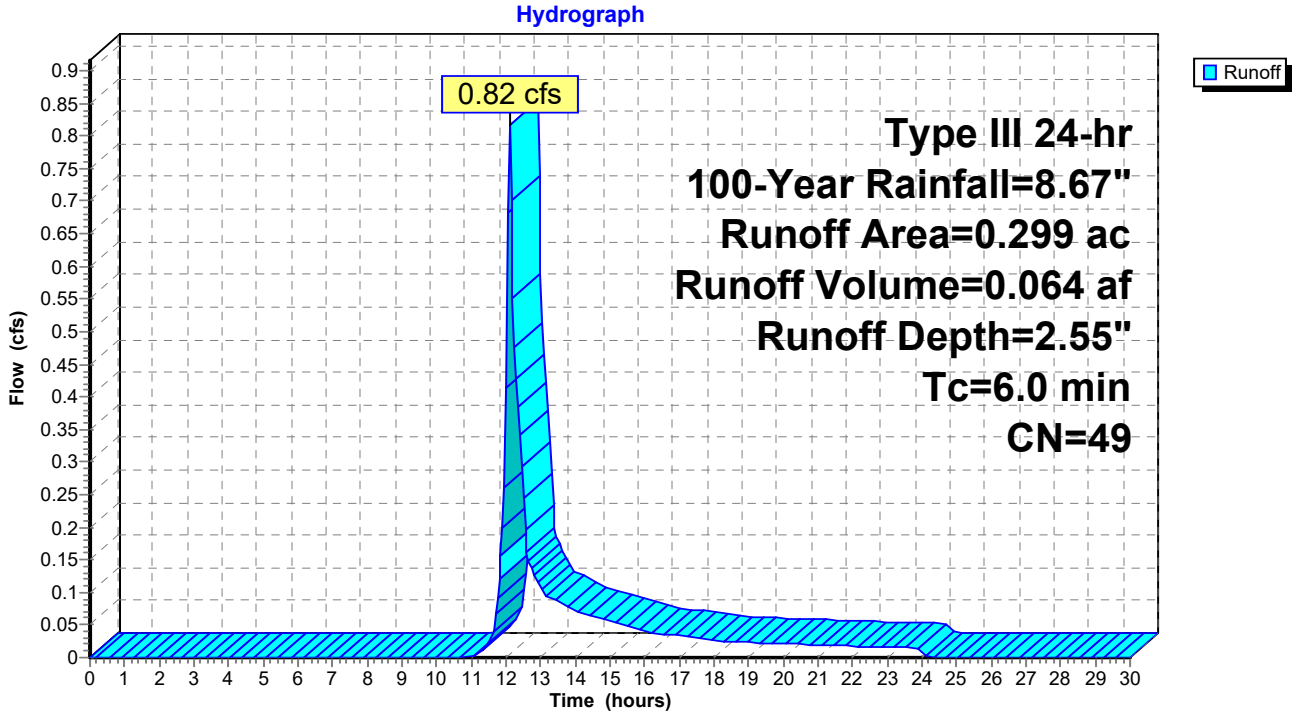
Runoff = 0.82 cfs @ 12.10 hrs, Volume= 0.064 af, Depth= 2.55"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.67"

Area (ac)	CN	Description
0.009	76	Gravel roads, HSG A
0.144	32	Woods/grass comb., Good, HSG A
0.047	98	Paved parking, HSG A
0.099	48	Brush, Poor, HSG A
0.299	49	Weighted Average
0.252		84.28% Pervious Area
0.047		15.72% Impervious Area

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

Subcatchment PO-2: Proposed PO-2



Summary for Subcatchment PO-3: Proposed PO-3

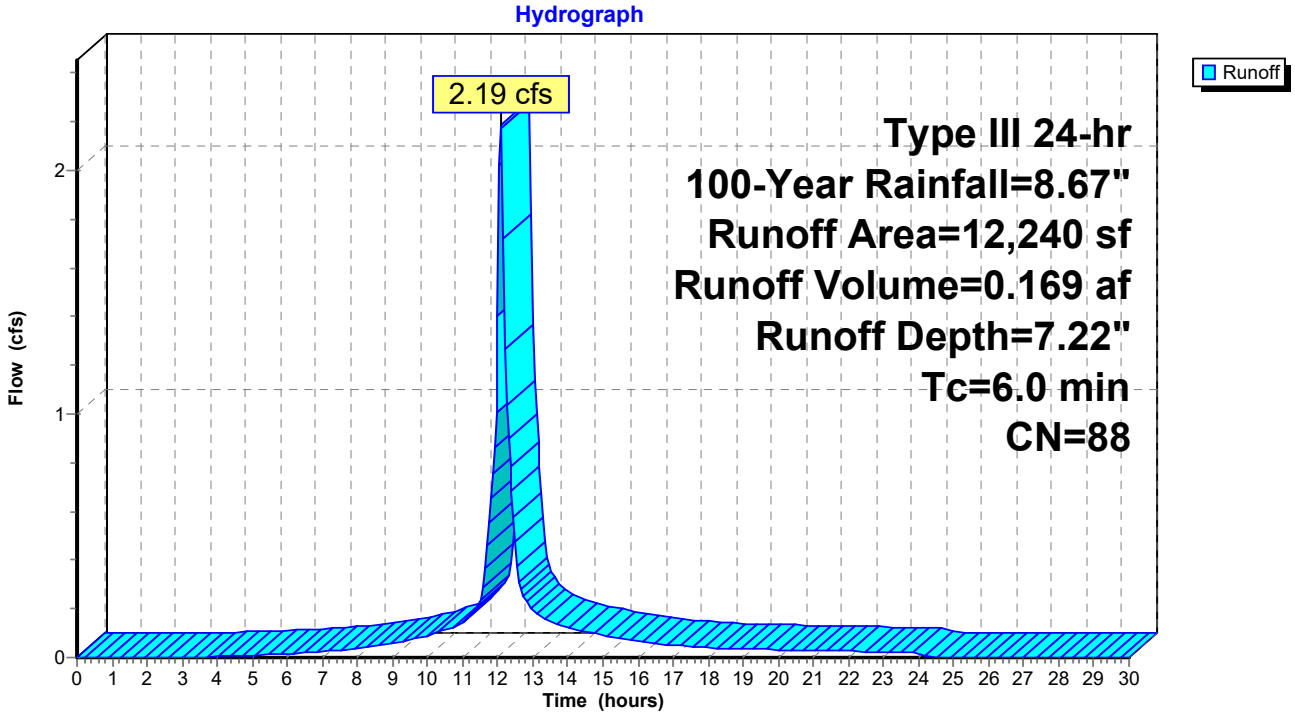
Runoff = 2.19 cfs @ 12.09 hrs, Volume= 0.169 af, Depth= 7.22"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.67"

	Area (sf)	CN	Description
	9,841	98	Paved parking, HSG A
*	2,399	49	Pole Storage Area
	12,240	88	Weighted Average
	2,399		19.60% Pervious Area
	9,841		80.40% Impervious Area

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

Subcatchment PO-3: Proposed PO-3



Summary for Subcatchment PO-4: Proposed PO-4

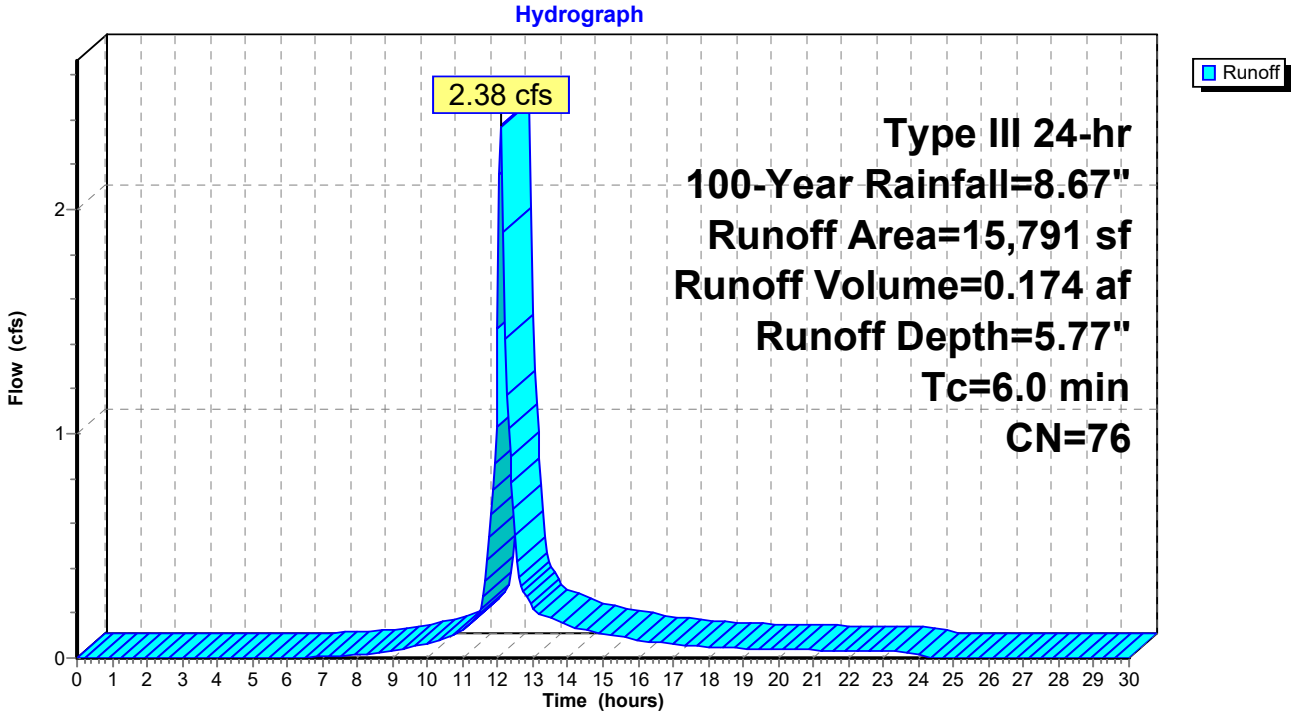
Runoff = 2.38 cfs @ 12.09 hrs, Volume= 0.174 af, Depth= 5.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.67"

	Area (sf)	CN	Description
*	12,414	76	Unconnected gravel pavement, HSG A
*	3,377	76	Infiltration beds, HSG A
	15,791	76	Weighted Average
	15,791		100.00% Pervious Area

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

Subcatchment PO-4: Proposed PO-4

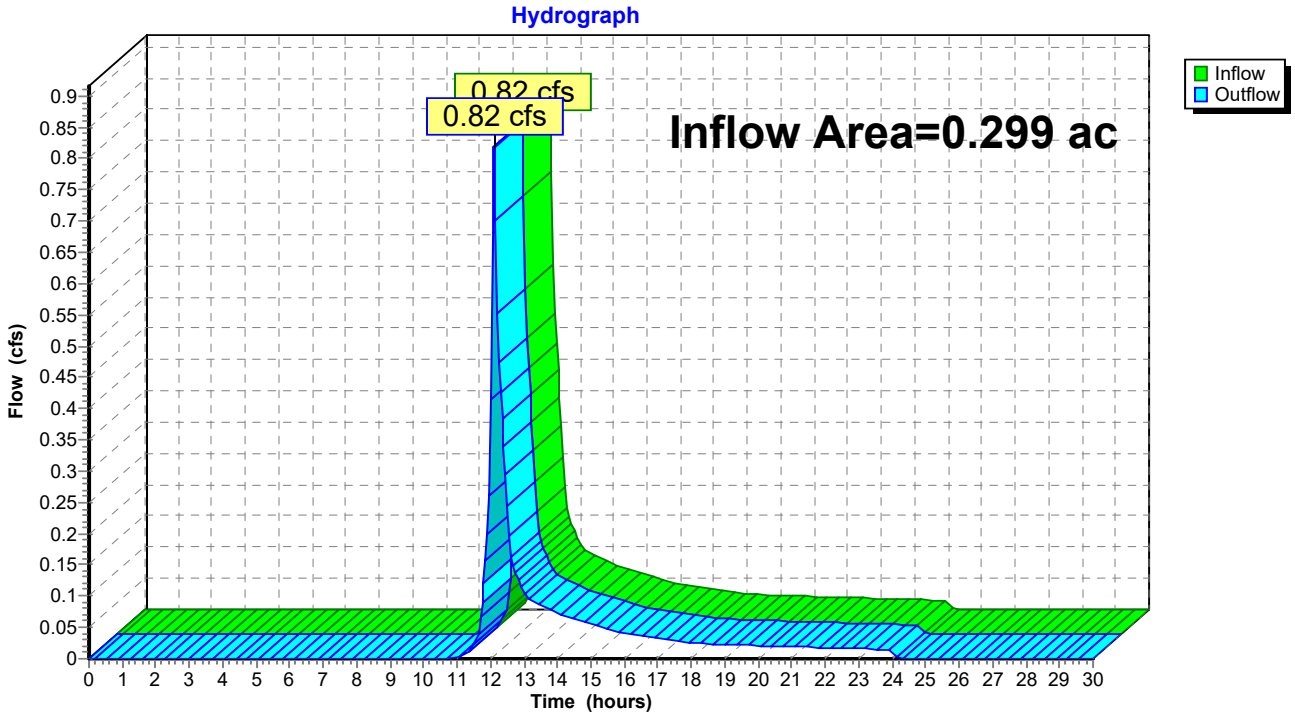


Summary for Reach 3R: DP-2

Inflow Area = 0.299 ac, 15.72% Impervious, Inflow Depth = 2.55" for 100-Year event
Inflow = 0.82 cfs @ 12.10 hrs, Volume= 0.064 af
Outflow = 0.82 cfs @ 12.10 hrs, Volume= 0.064 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Reach 3R: DP-2

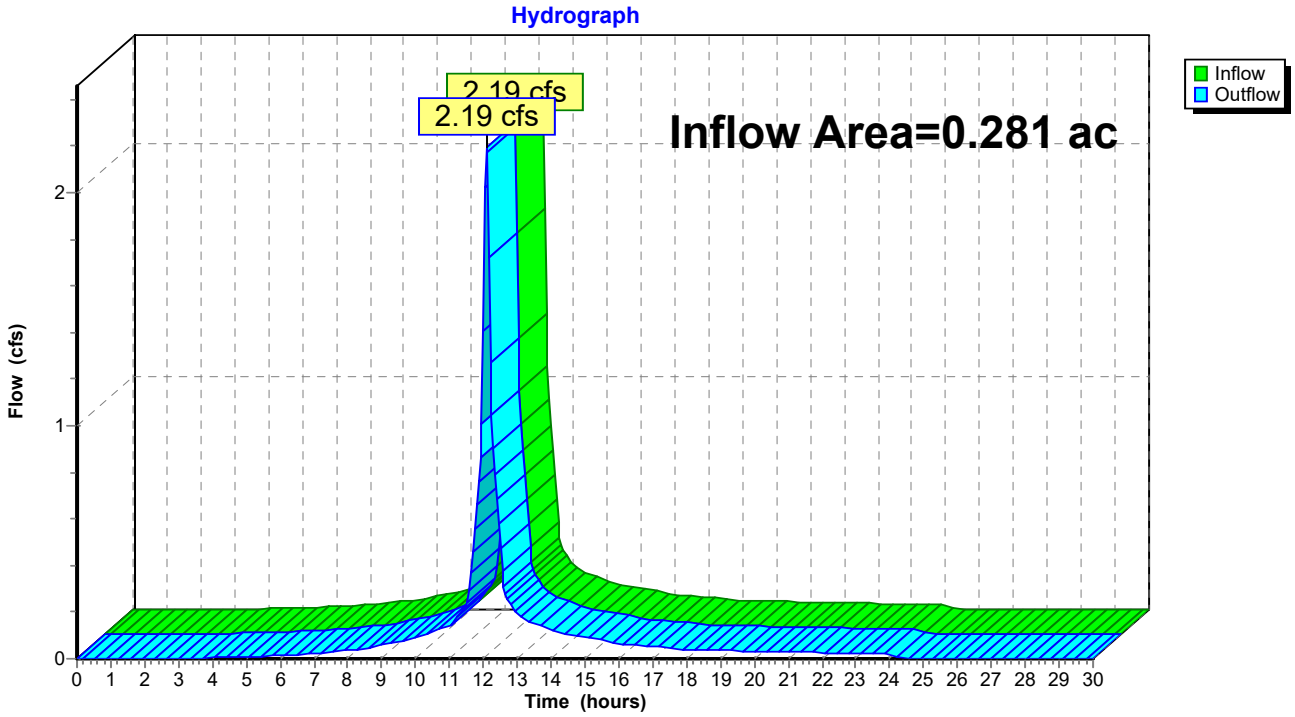


Summary for Reach 4R: DP-3

Inflow Area = 0.281 ac, 80.40% Impervious, Inflow Depth = 7.22" for 100-Year event
Inflow = 2.19 cfs @ 12.09 hrs, Volume= 0.169 af
Outflow = 2.19 cfs @ 12.09 hrs, Volume= 0.169 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Reach 4R: DP-3

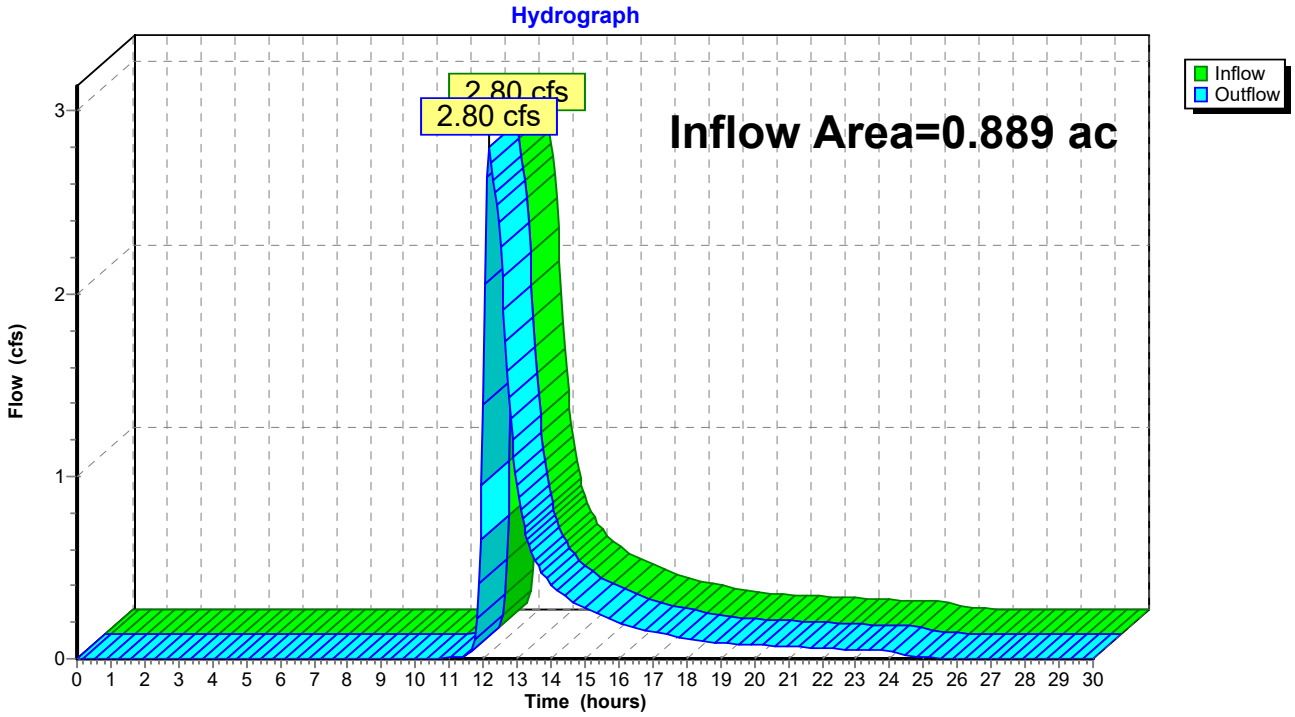


Summary for Reach 5R: DP-1

Inflow Area = 0.889 ac, 59.84% Impervious, Inflow Depth = 4.52" for 100-Year event
Inflow = 2.80 cfs @ 12.17 hrs, Volume= 0.335 af
Outflow = 2.80 cfs @ 12.17 hrs, Volume= 0.335 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Reach 5R: DP-1

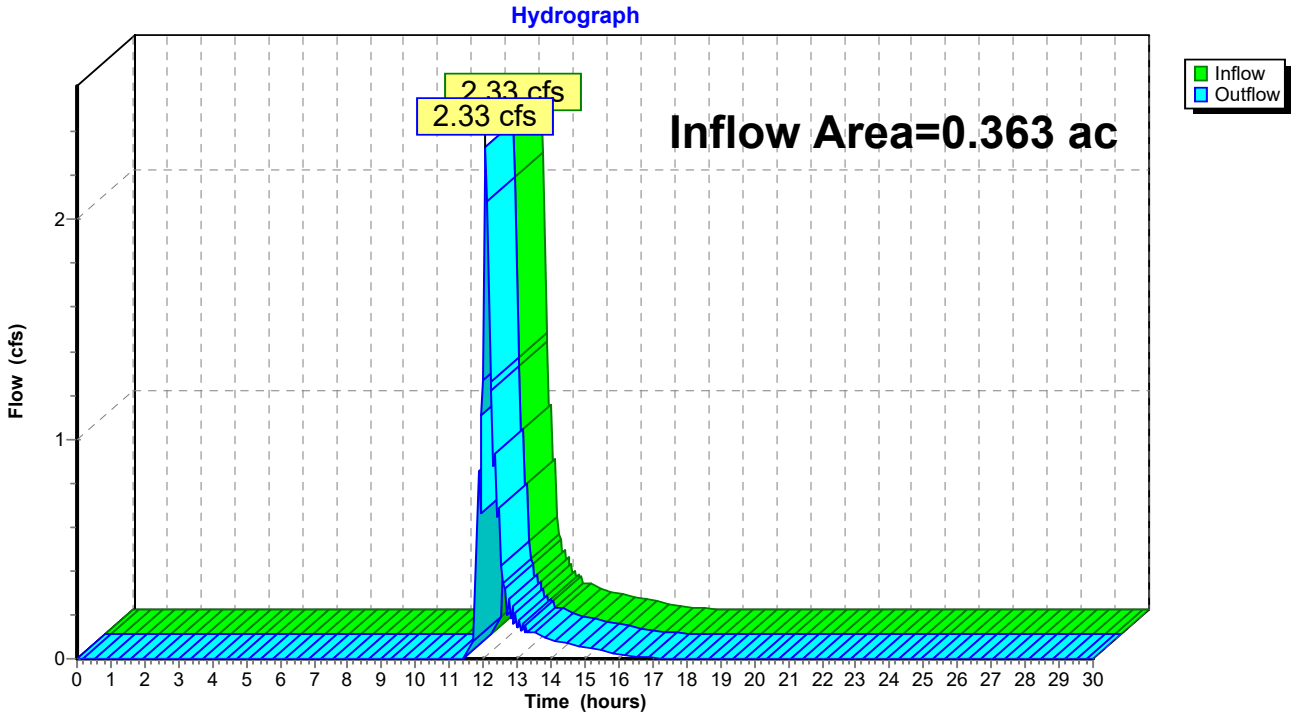


Summary for Reach 7R: DP-4

Inflow Area = 0.363 ac, 0.00% Impervious, Inflow Depth = 3.25" for 100-Year event
Inflow = 2.33 cfs @ 12.07 hrs, Volume= 0.098 af
Outflow = 2.33 cfs @ 12.07 hrs, Volume= 0.098 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Reach 7R: DP-4



Summary for Pond 4P: (new Pond)

Inflow Area = 0.751 ac, 70.84% Impervious, Inflow Depth = 6.98" for 100-Year event
Inflow = 5.73 cfs @ 12.09 hrs, Volume= 0.437 af
Outflow = 3.67 cfs @ 12.20 hrs, Volume= 0.364 af, Atten= 36%, Lag= 6.8 min
Discarded = 0.04 cfs @ 12.20 hrs, Volume= 0.049 af
Primary = 2.48 cfs @ 12.20 hrs, Volume= 0.301 af
Secondary = 1.15 cfs @ 12.20 hrs, Volume= 0.014 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 77.35' @ 12.20 hrs Surf.Area= 3,481 sf Storage= 7,071 cf

Plug-Flow detention time= 162.0 min calculated for 0.364 af (83% of inflow)
Center-of-Mass det. time= 93.7 min (878.9 - 785.1)

Volume	Invert	Avail.Storage	Storage Description
#1	73.20'	9,722 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
73.20	650	0	0
74.00	856	602	602
75.00	1,416	1,136	1,738
76.00	2,106	1,761	3,499
77.00	2,822	2,464	5,963
78.00	4,696	3,759	9,722

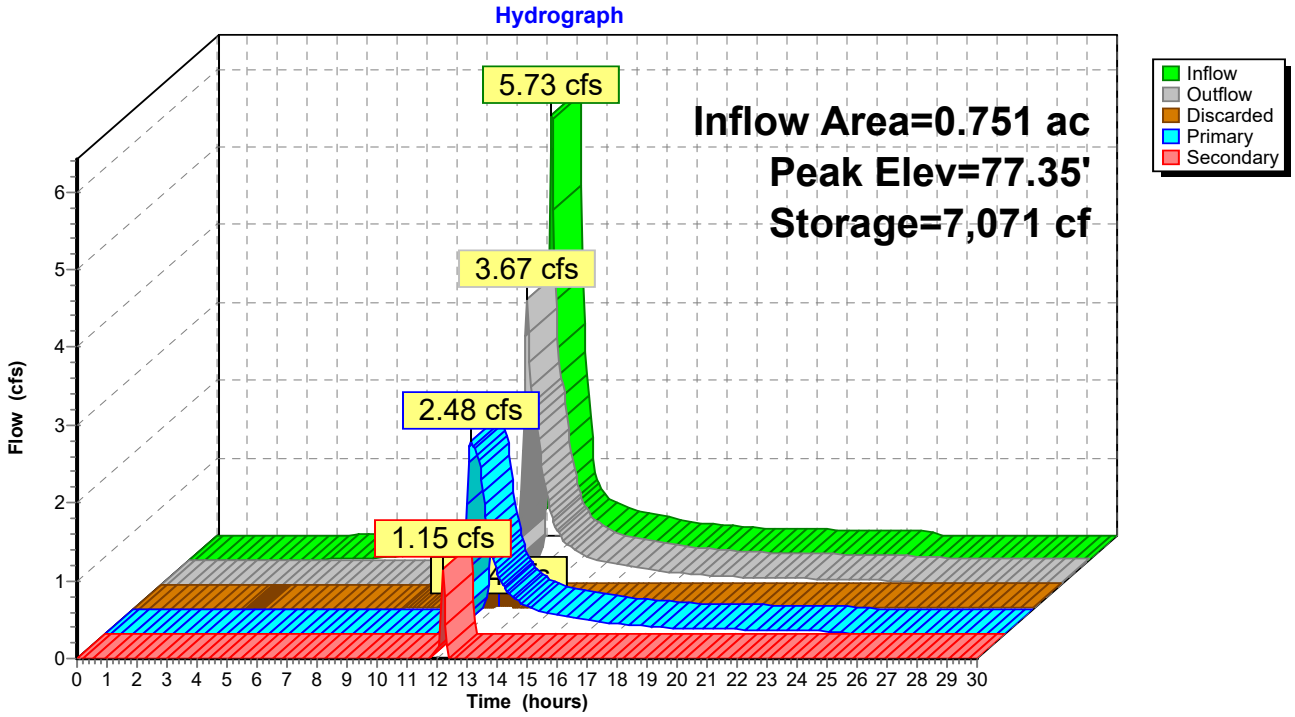
Device	Routing	Invert	Outlet Devices
#1	Primary	76.00'	**12.0" Round Culvert** L= 20.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 76.00' / 76.00' S= 0.0000 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf
#2	Secondary	77.25'	**15.0' long x 6.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.37 2.51 2.70 2.68 2.68 2.67 2.65 2.65 2.65 2.65 2.66 2.66 2.67 2.69 2.72 2.76 2.83
#3	Discarded	73.20'	**0.520 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.04 cfs @ 12.20 hrs HW=77.35' (Free Discharge)
└**3=Exfiltration** (Exfiltration Controls 0.04 cfs)

Primary OutFlow Max=2.48 cfs @ 12.20 hrs HW=77.35' TW=0.00' (Dynamic Tailwater)
└**1=Culvert** (Barrel Controls 2.48 cfs @ 3.16 fps)

Secondary OutFlow Max=1.14 cfs @ 12.20 hrs HW=77.35' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Weir Controls 1.14 cfs @ 0.75 fps)

Pond 4P: (new Pond)



Summary for Pond 5P: (new Pond)

Inflow Area =	0.363 ac,	0.00% Impervious,	Inflow Depth =	5.77"	for 100-Year event
Inflow =	2.38 cfs @	12.09 hrs,	Volume=	0.174 af	
Outflow =	2.38 cfs @	12.07 hrs,	Volume=	0.174 af,	Atten= 0%, Lag= 0.0 min
Discarded =	0.06 cfs @	10.20 hrs,	Volume=	0.076 af	
Primary =	2.33 cfs @	12.07 hrs,	Volume=	0.098 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 78.04' @ 12.07 hrs Surf.Area= 500 sf Storage= 608 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 50.1 min (858.8 - 808.8)

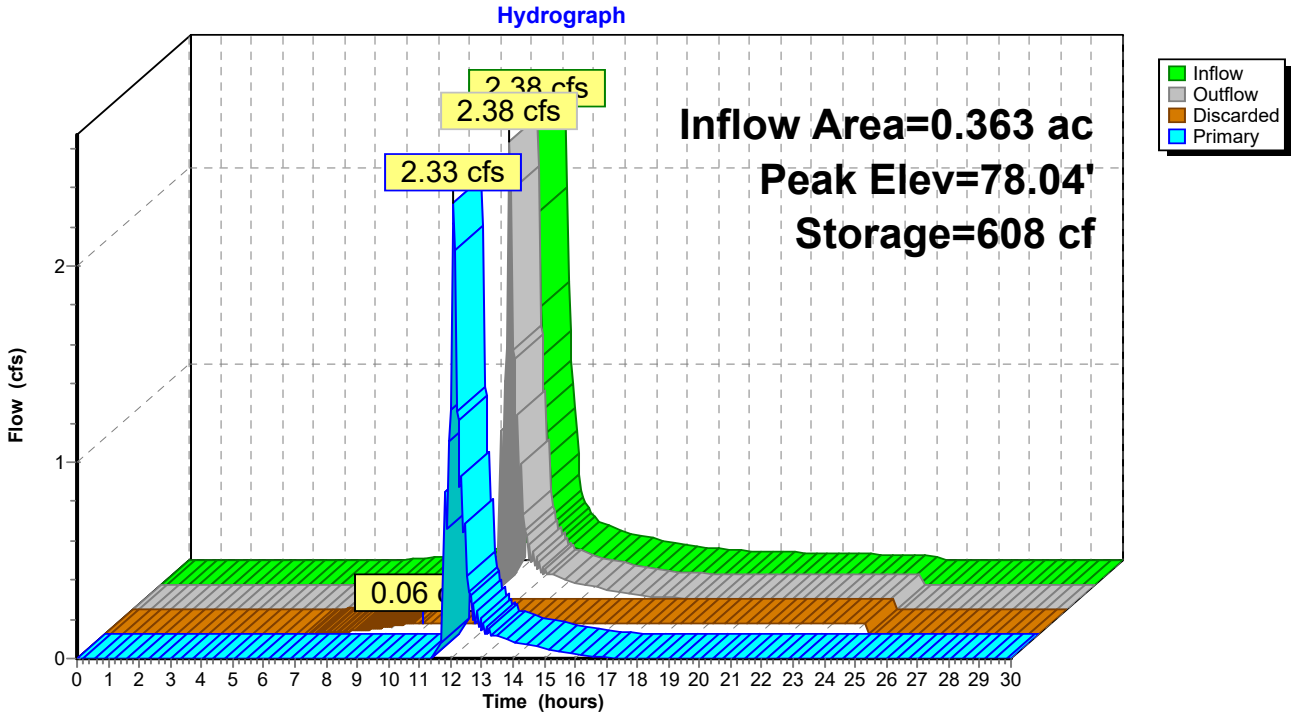
Volume	Invert	Avail.Storage	Storage Description
#1	75.00'	800 cf	**4.00'W x 125.00'L x 4.00'H Prismatoid** 2,000 cf Overall x 40.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Discarded	75.00'	**5.000 in/hr Exfiltration over Surface area**
#2	Primary	78.00'	**125.0' long x 2.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Discarded OutFlow Max=0.06 cfs @ 10.20 hrs HW=75.04' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.06 cfs)

Primary OutFlow Max=2.21 cfs @ 12.07 hrs HW=78.04' TW=0.00' (Dynamic Tailwater)
└─**2=Broad-Crested Rectangular Weir** (Weir Controls 2.21 cfs @ 0.48 fps)

Pond 5P: (new Pond)



APPENDIX F

PRELIMINARY
OPERATION AND MAINTENANCE PLANS

TO BE FINALIZED PRIOR TO OPERATION

Attachment E

Sound Study

Lewis S. Goodfriend & Associates
CONSULTING ENGINEERS IN ACOUSTICS
415 Route 24, 2nd Floor
Chester, NJ 07930
908-955-7763 (O)
908-923-8446 (F)
www.lsga.com

20 November 2018

Mr. Alexander Tang
Project Manager
TRC Environmental Corporation
2 Liberty Square, 6th Floor
Boston, Massachusetts 02109
atang@trcsolutions.com

Re: Updated Summary of Potential Noise Mitigation Measures
Proposed Martha's Vineyard Battery Project
Oak Bluffs, Massachusetts
LSG&A File 2018065

Dear Mr. Tang:

As requested, Lewis S. Goodfriend & Associates (LSG&A) has conducted additional acoustical modeling analyses of the proposed Martha's Vineyard Battery Project (Project), located in Oak Bluffs, Massachusetts. The analyses were conducted for Phases I and II of the Project to determine additional noise mitigation options that would allow for the Project to achieve, or come close to achieving, the acoustic design goals. This letter report updates our report to you dated 25 September 2018.

As discussed in our previous letter, the ambient sound measurement program revealed that minimum ambient L_{90} sound levels are in the range of 29 dB(A) to 31 dB(A). The Massachusetts Department of Public Utilities (Massachusetts DPU) generally requires that the allowable increase above the existing minimum ambient sound level for residential structures be limited to 3 dB(A). As such, Project generated sound levels will need to be maintained at the same level as ambient conditions (30 dB(A) design goal) at any residential structures.

The MassDEP noise regulation (310 C.M.R. 7.10), which is part of the Commonwealth's air pollution control regulation, limits a source of sound to a 10 dB(A) increase above the existing ambient sound level. The criteria are measured both at the property line, and at the nearest inhabited residences.

1.0 ACOUSTICAL EVALUATION

The proposed sound generating sources that were included in the latest acoustical evaluation are summarized in Table 1 below.

Table 1 – Summary of the Proposed Mechanical Equipment Included in the Acoustical Evaluation, Martha's Vineyard Battery Project, Oak Bluffs, Massachusetts.

Equipment	Make / Model	# of Units	Location
Phase I			
Transformers	N/A	5	Northwest Side of Battery Building
Chillers	Carrier AquaSnap 30RBM Model 260	5	Southeast Side of Battery Building
Inverters	ABB PVS980	3	Energy Equipment Room Inside Battery Building
Phase II			
Transformers	N/A	7	Northwest Side of Battery Building
Chillers	Carrier AquaSnap 30RBM Model 400	8	Southeast and Northeast Sides of Battery Building
Inverters	ABB PVS980	8	Energy Equipment Room Inside Battery Building

The source and derivation of the sound emissions data for each of the above pieces of equipment are provided in Table 2.

Table 2 – Sound Emissions Derivation for the Proposed Mechanical Equipment Included in the Acoustical Evaluation, Martha's Vineyard Battery Project, Oak Bluffs, Massachusetts.

Equipment	Sound Emission Derivation
Phase I	
Low Noise Transformers	Low noise units, 6 dB(A) below standard NEMA ratings for 2 MVA transformers. Typical transformer spectrum assumed for octave band data.
Very Low Noise Chillers	Carrier AquaSnap cut sheets for "very low noise" units. 3 dB tolerance added as per cut sheet. Octave band data per vendor cut sheet.
Inverters	ABB vendor cut sheet. Per discussions with TRC, each chiller will be specified to be no greater than 75 dB(A) at one meter. Octave band data based on typical transformer.
Phase II	
Low Noise Transformers	Low noise units, 6 dB(A) below standard NEMA ratings for 2 MVA transformers. Typical transformer spectrum assumed for octave band data.
Very Low Noise Chillers	Carrier AquaSnap cut sheets for "very low noise" units. 3 dB tolerance added as per cut sheet. Octave band data per vendor cut sheet.
Inverters	ABB vendor cut sheet. Per discussions with TRC, each chiller will be specified to be no greater than 75 dB(A) at one meter. Octave band data based on typical transformer.

LSG&A conducted the acoustical evaluation utilizing TRC Environmental's site plan drawing C-302, dated 13 August 2018. The modeling analyses were conducted utilizing SoundPLAN acoustical modeling software. The acoustical model considered the propagation of sound over distance, the reflection and shielding effect of existing and proposed buildings, and the effects of topography and air absorption. A partially acoustically absorptive ground cover was also included. Model receptors were placed at the location of nearby residential structures. These receptor locations are depicted in Figure 1, at the end of this letter.

Multiple iterations of modeling were conducted in order to determine the noise control measures that would be required in order to achieve, or come close to achieving, compliance with the 30 dB(A) design goal at any existing residential structure.

The acoustical analysis revealed that, in addition to utilizing low noise sources as described above, the following noise mitigation measures would be required in order to achieve the design goal:

- Enclosing the very low noise chillers within acoustical enclosures that include air inlet and discharge silencers.
- A 3-sided, 10 foot tall, acoustically absorptive sound barrier wall that shields the "very low noise" chillers. The barrier would be connected to the battery building walls. The sound barrier configuration, along with the location of sound generating sources, is depicted in Figure 2, at the end of this letter.
- A 3-sided, 10 foot tall, acoustically absorptive sound barrier wall that shields the low noise transformers. The barrier would be connected to the battery building walls. This sound barrier configuration is also depicted in Figure 2, at the end of this letter.
- The energy equipment rooms housing the inverters would require high performance acoustical walls and a ceiling that are also acoustically absorptive, and provide the transmission loss values as provided in Table 3.

Table 3 – Energy Equipment Room Wall and Ceiling Minimum Transmission Loss, Martha's Vineyard Battery Storage, Oak Bluffs, Massachusetts.

	Octave Band Center Frequency, Hz								
	31.5	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**
Minimum Transmission Loss (dB)	6	19	29	30	33	33	38	30	30

Table 4 provides a summary of the acoustical evaluation, including the Project design goals, the expected Project generated sound levels for the combined Phases I and II incorporating the above noise control measures, and the expected increases over ambient conditions. A sound contour map depicting the expected Project generated sound levels is provided as Figure 3, at the end of this letter.

Table 4 – Acoustical Evaluation Summary (dB(A)), Martha's Vineyard Battery Project, Oak Bluffs, Massachusetts.

Receptor	Minimum Ambient	Expected Project Generated Sound Level	Combined Future Sound Level	Expected Increase Over Minimum Ambient
Deep Bottom Road East	30	22	31	1
Deep Bottom Road West	30	20	30	0
Wind Farm Circle North	30	26	31	1
Wind Farm Circle South	30	25	31	1
Northwest Residence	30	17	30	0
Project Property Line	30	40	40	10

As provided in Table 4, the Project design goal of a 3 dB(A) increase over existing minimum ambient conditions would be expected to be achieved at all residential structures. The above sound control measures would also be expected to achieve compliance with the 10 dB(A) increase criterion at the Project property line.

Please note that all recommendations included in this report are acoustical in nature and should be reviewed by the appropriate design professionals. I trust that this information is sufficient for your present needs. Please call me if you have questions.

Very truly yours,
LEWIS S. GOODFRIEND & ASSOCIATES

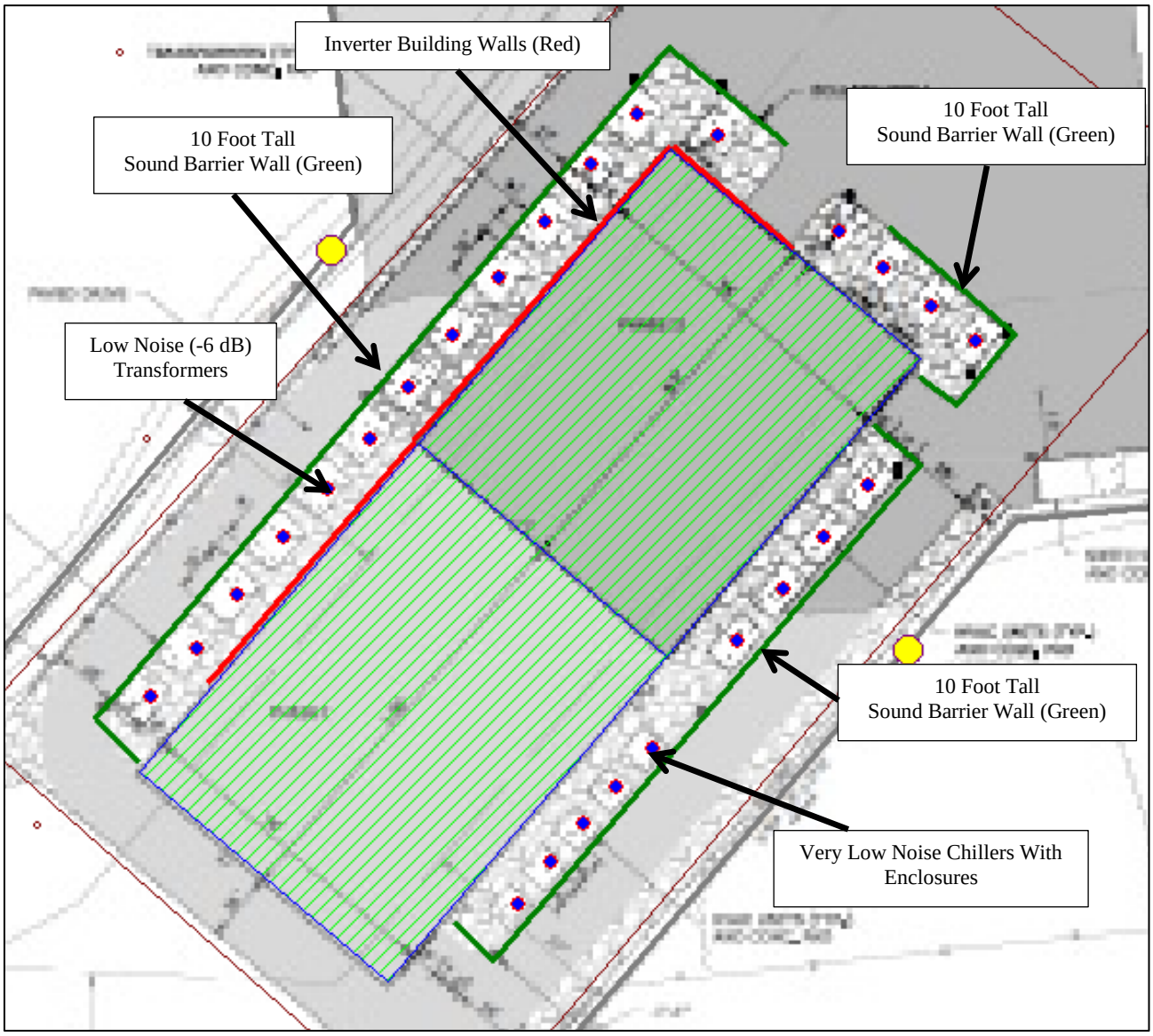
Anthony Agresti, INCE
Project Manager

ACA:aca
Enclosures

Figure 1 – Acoustical Evaluation Receptor Locations, Martha's Vineyard Battery Project, Oaks Bluff, Massachusetts.

Locations Approximate
Not to Scale
Not for Construction

Figure 2 – Equipment Locations and Sound Barrier Wall Configuration, Martha's Vineyard Battery Project, Oaks Bluff, Massachusetts.



Locations Approximate
Not to Scale
Not for Construction

Attachment F

Electric and Magnetic Field Report

Electrical Engineering and Computer Science Practice

Eversource Energy Storage System on Martha's Vineyard

Magnetic Field Modeling

Eversource Energy Storage System on Martha's Vineyard

Magnetic Field Modeling

Prepared for

Eversource Energy
247 Station Drive
Westwood, MA 02090

Prepared by

Exponent, Inc.
17000 Science Drive
Suite 200
Bowie, MD 20715

October 29, 2018

© Exponent, Inc.

1808130.000 - 2577

Introduction

The distribution system on Martha's Vineyard is primarily served via four submarine distribution cables. In the event of an N-1 contingency on the largest cable (#75 circuit), peak load cannot be served by the remaining three submarine cables alone and so load demand is met by operating up to five, 2.5-megawatt (MW) diesel generators. These generators are the primary resource to ensure an adequate and reliable supply of electricity on the island in the case of a submarine cable.

To address the reliability of service on Martha's Vineyard and reduce air emissions, Eversource has proposed an Energy Storage System (ESS) project on Martha's Vineyard as part of their Grid Modernization proposal to reduce the need to operate the diesel generators. The ESS Project is proposed to be constructed on land owned by Eversource at its Oak Bluffs Service Center (Service Center) on the west side of Edgartown-Vineyard Haven Road (shown in Figure 1). The project is divided into two phases. Phase 1 consists of an ESS sized to supply 4.9- MW for up to four hours, or 20-megawatt-hour (MWh). Phase 2 of the project will be located adjacent to the Phase 1 deployment and will consist of adding an incremental 9.8-MW/64-MWh that will result in a total Martha's Vineyard ESS rating of 14.7MW and 84MWh.

The ESS Project is proposed to connect to three existing 23-kilovolt (kV) distribution lines (#75, #97, and #99-Circuits). Lines #75 and #97 currently pass by the Service Center on the east side of Edgartown-Vineyard Haven Road (cyan and brown lines in Figure 1) and are supported on double-circuit wood pole structures. Line #99 is located approximately 0.5 miles south of the Service Center at an open-tie switch (disconnect) between the #97 and #99 Circuits. In Phase 1, the ESS will connect to the #75 line. In Phase 2, the existing open-tie switch (disconnect) between the 97 and 99 Circuits will be moved directly in front of the Service Center. The portion of the 97 Circuit going south from the Service Center opposite the open-tie switch will be renamed as an extension to the 99 Circuit. The portion going north from the open-tie switch will remain the 97 Circuit. In Phase 2, therefore, the ESS is proposed to additionally connect to the #97 Circuit (going north) and the #99 Circuit (going south).

Exponent has calculated the magnetic-field levels from the existing distribution infrastructure in the vicinity of the proposed ESS as well as from the proposed Phase 1 and Phase 2 interconnections of the ESS to the distribution electrical grid.[1] An aerial view of the proposed ESS site is shown in Figure 1 and indicates the approximate location of the ESS and the routes of existing and proposed distribution infrastructure at the site.

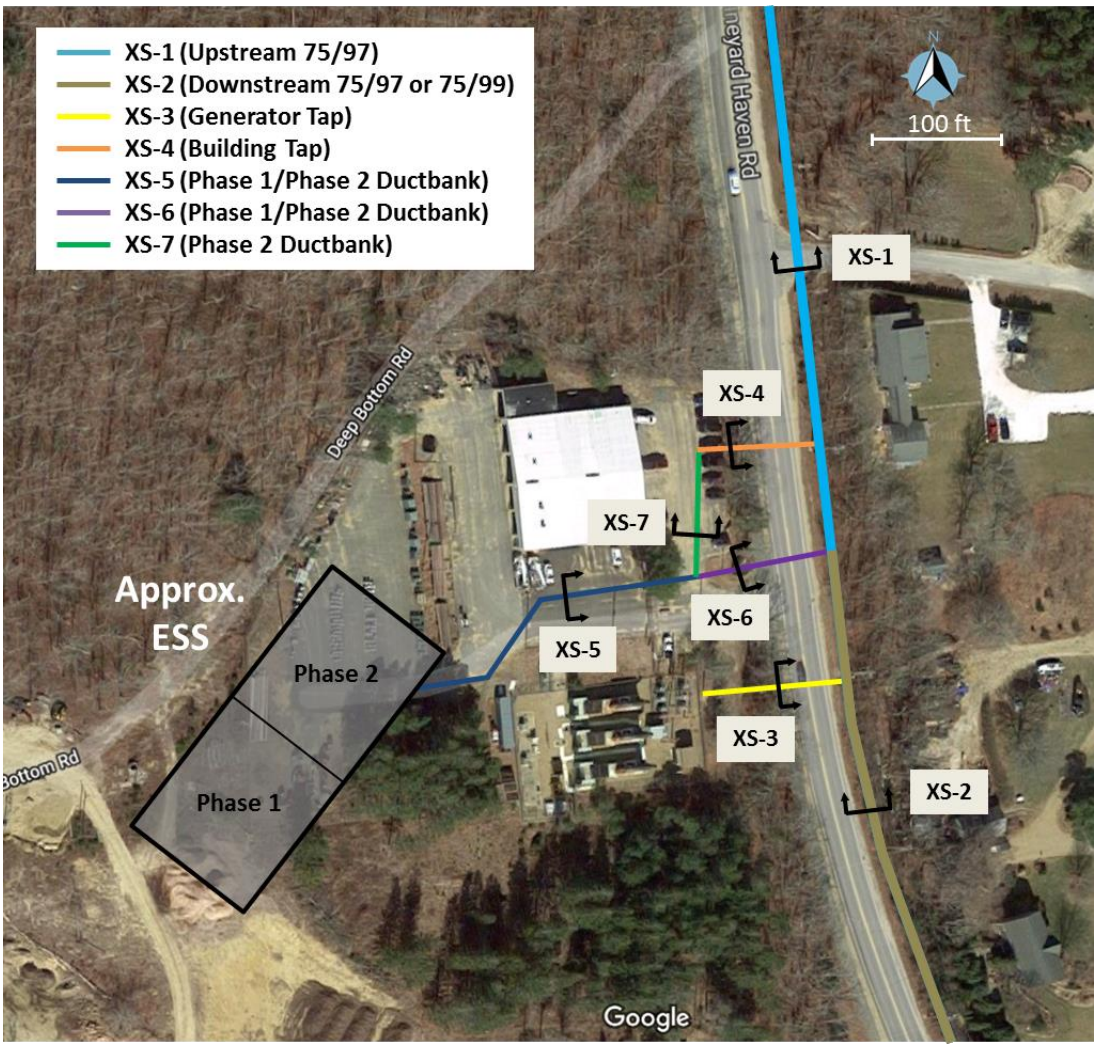


Figure 1. ESS site and distribution interconnections to the 23-kilovolt (kV) #75 and #97 (#99 in phase 2) distribution lines along Edgartown-Vineyard Haven Road. The approximate locations of the 7 modeling cross sections also are shown.

[1] Electric field levels above ground from overhead lines are calculated to be 0.1 kilovolt per meter or less and do not change as a result of this project. No electric field is produced above ground from underground lines. Electric field levels therefore are not presented in this report.

Modeling

Configurations

Seven separate models of the existing and proposed distribution infrastructure at the site were modeled to calculate the magnetic field levels at each location for the existing, Phase 1 and Phase 2 scenarios. The location of each modeling cross section is shown in Figure 1.

- XS-1 includes the two existing distribution Lines (#75 and #97) on the east side of Edgartown-Vineyard Haven Road (cyan line in Figure 1) and represents the upstream (northern) portion of the route.
- XS-2 includes two 23-kV distribution lines on the east side of Edgartown-Vineyard Haven Road (brown line in Figure 1) and represents the downstream (southern) portion of the route. The two existing distribution lines modeled in the Existing and Phase 1 configurations are Lines #75 and #97. In Phase 2 the portion of the #97 line south of the Service Center will be renamed to be the #99 Line.
- XS-3 represents the existing 23-kV generator tap (yellow line in Figure 1),
- XS-4 represents the existing 23-kV service to the Oak Bluffs Service Center as well as the Phase 2 interconnection of the ESS to the #97 Line (orange line in Figure 1)
- XS-5 represents the Phase 1/Phase 2 duct bank from the ESS (blue line in Figure 1)
- XS-6 represents the Phase 1 duct bank connecting to the #75 Line as well as the Phase 2 duct bank connecting to the #99 Line (purple line in Figure 1)
- XS-7 represents the Phase 2 duct bank to riser pole, connecting to the #97 Line (green line in Figure 1).

Details of the physical configuration of the Lines on segments of the distribution route are included in Appendix A. Figure A-1 shows the double-circuit structure used for modeling XS-1 and XS-2. Figure A-2 shows the overhead distribution structure used for modeling XS-3 and XS-4 and Figure A-3 shows the duct banks used for modeling XS-5, XS-6 and XS-7.

Loading

As described above, the ESS is expected to reduce the need to operate diesel generators during peak loading. All loading levels modeled herein are therefore representative of peak loading. In the existing configuration, the #75 Line supplies load primarily downstream (south) of the proposed ESS and so carries substantially more power (approximately 19.8 MW) at the location of the ESS than the #97 Line (~0.27 MW) which supplies load primarily upstream (north) of the proposed ESS. Each of the seven modeling cross sections is evaluated for three separate loading scenarios: Existing, Phase 1 and Phase 2. A graphical summary of the loading scenarios is shown in Figure 2.

- Existing: The Generator Tap is assumed to carry 7.5 MW of power to the #75 Line to downstream (southerly) loads.
- Phase 1: The ESS will supply 4.9 MW and the Generator Tap will supply 2.5 MW of power, both to the #75 Line for downstream (southerly) loads.
- Phase 2: In addition to the 4.9 MW supplied to the #75 Line from Phase 1, the ESS also will supply 4.9 MW of power to the #99 Line for downstream (southerly) loads as well as 4.9 MW of power to the #97 Line for upstream (northerly) loads.

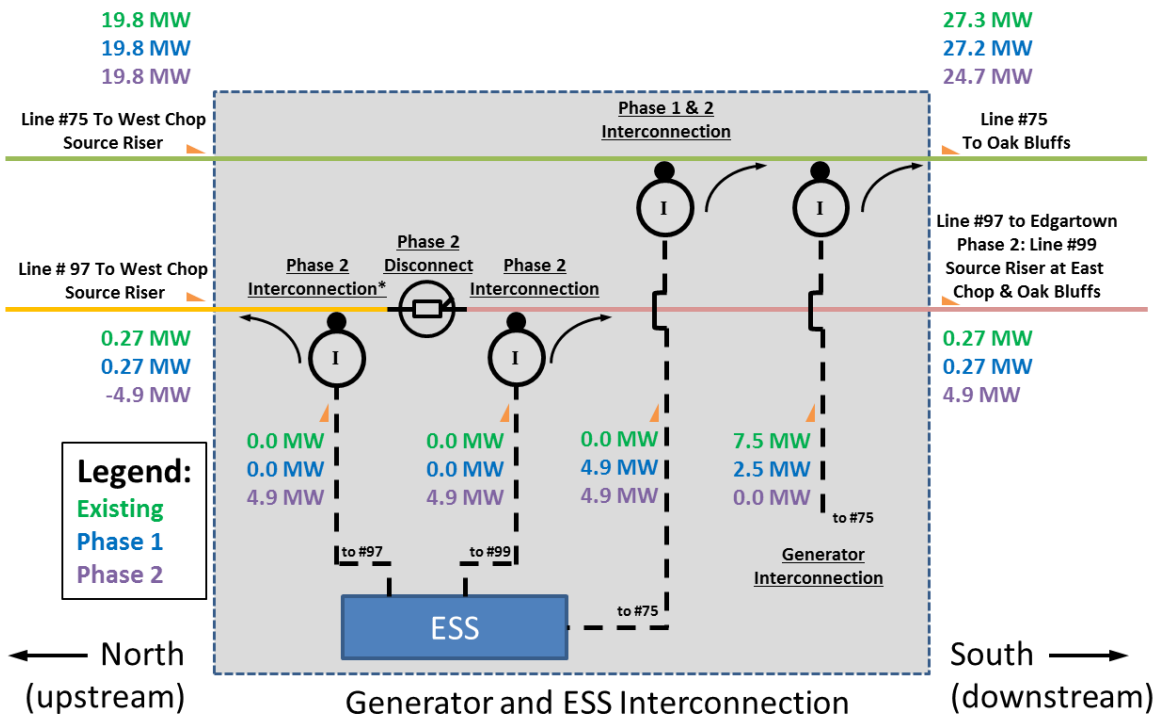


Figure 2. Summary of Existing (green), Phase 1 (blue) and Phase 2 (purple) loading scenarios considered.

Phasing

The analysis of the optimal phasing of the dual-circuit structure supporting the #75 and #97 Lines showed that the maximum magnetic-field level, calculated directly below the centerline, changes by less than 1 milligauss (mG) regardless of the selected phasing. For modeling purposes, the phasing of the #97 Line was conservatively selected to result in the highest magnetic field level for the existing configuration and the same relative phasing was used for Phase 1 and Phase 2 calculations (for both #97 and #99 Lines). In underground sections where more than one line is present (XS-5 and XS-6) the phasing of the lines cannot be controlled because the trefoil bundle will rotate in an uncontrolled way as they are pulled through the individual ducts . Similarly, in XS-3 and XS-6 the phasing does not affect calculated field levels and so no phasing analysis was performed for these sections.

Methods

Eversource provided data to Exponent regarding the configuration and loading of the existing and proposed distribution lines and interconnection taps as described above. In accordance with IEEE Std. C95.3.1-2010 and Std. 0644-1994 (R2008), magnetic field levels were calculated in units of mG as the root-mean-square (RMS) value of the field ellipse along a transect perpendicular to the distribution line at a height of 1 meter (3.28 feet) above ground. Magnetic levels were calculated using computer algorithms developed by the Bonneville Power Administration (BPA), an agency of the U.S. Department of Energy (BPA, 1991). These algorithms have been shown to accurately predict magnetic field levels measured near power lines (Chartier and Dickson, 1990; Perrin et al., 1991). The inputs to the program are data regarding voltage, current flow, phasing, and conductor configurations. The current and voltage of all lines are assumed to be in phase with a unity power factor. The magnetic-field values were calculated along profiles perpendicular to lines at the point of lowest conductor sag (mid-span), i.e., closest to the ground for the entire distance between structures and over flat terrain.[2]

[2] Duct banks were modeled at the Eversource design minimum burial depth of 36-inches to the top of the duct bank. Neutral conductors were not modeled in underground duct banks as their effect on magnetic field levels is expected to be negligible.

Assessment Criteria

While the federal government has no regulations regarding EMF, including levels from transmission or distribution lines, the Massachusetts Energy Facilities Siting Board (EFSB) assesses EMF levels on a case-by-case basis with a focus on practical options to reduce magnetic field levels. This practice is also consistent with the recommendations of the World Health Organization (WHO, 2007).

Consistent with the recommendations of the EFSB and WHO, Eversource is re-using existing infrastructure where possible so that there are fewer new sources of magnetic fields. In addition, the design of new distribution infrastructure uses underground duct banks and bundles the conductors of individual distribution lines together in a single duct to further reduce magnetic-field levels.

Levels of EMF also can be assessed in reference to standards and guidelines developed by scientific and health agencies. Two international agencies that have published limits of exposure to EMF include the International Committee on Electromagnetic Safety (ICES) and the International Commission on Non-Ionizing Radiation Protection (ICNIRP). The assessment levels (reference levels) set by these organizations are summarized in Table 1 below.

Table 1. Reference levels for whole body exposure to 60-Hz fields: general public.

Organization	Magnetic Fields
ICNIRP	2,000 mG
ICES	9,040 mG

Results

The calculated peak magnetic field levels before the construction of the ESS are 17 mG or less. After completion of Phase 1 and Phase 2 of the ESS project the maximum calculated magnetic field level is calculated to decrease to 11 mG and other field levels are calculated to remain generally similar to existing levels. Calculated magnetic-field levels are shown graphically in Appendix B (Figure B-1 through B-7). The figures show the magnetic field levels for Existing, Phase 1 and Phase 2 conditions, calculated out to 100 feet from the center of the respective distribution line or underground duct bank. The calculated magnetic field levels at the centerline of the Line(s) and at ±25, ±50, and ±100-feet from the centerline are presented in Appendix C, Table C-1.

The peak magnetic-field levels below the #75, #97, and in Phase 2, #99 distribution lines north and south of the ESS (XS-1 and XS-2) will not materially change after installation of Phase 1 of the project. Similarly, magnetic-field levels in Phase 2 of the project are calculated to change by 3.7 mG or less. This includes the magnetic field levels south (downstream) of the ESS which are calculated to increase from 3.6 mG to 7.3 mG (an increase of 3.7 mG) directly beneath the lines and increase by 1.3 mG to 2.7 mG or less at 50 feet from the lines. This increase is primarily due to the additional load capacity supplied by the ESS to the #99 Line in Phase 2. North (upstream) of the ESS, the magnetic field levels are calculated to increase by 0.8 mG or less at all distances from the line after the Phase 2 of the project.

Larger variations in magnetic field levels are calculated to occur in the immediate vicinity of the ESS but are limited to the overhead road crossings of the Generator Tap and Building Tap. The magnetic field level from the overhead Generator Tap connecting to the #75 Line (XS-3) is calculated to decrease as a result of the project from an existing maximum level of 17 mG to 5.7 mG in Phase 1 and 0.0 mG in Phase 2. This is because the need for the generators is expected to be supplemented by the ESS. Conversely, the increased load supplied by the ESS to the #97 Line (XS-4) over the overhead Building Tap interconnection in Phase 2 of the project is calculated to increase magnetic field levels directly beneath the line over the Edgartown-Vineyard Haven Road crossing from 0.3 mG to 11 mG in Phase 2.

The highest magnetic-field level from the duct bank connecting the ESS to the #75 and #99 Lines beneath Edgartown-Vineyard Haven Road (XS-6) is 4.2 mG directly above the duct bank, decreasing to 0.3 mG or less at a distance of 25 feet from the duct bank centerline. On Eversource property (XS-5 and XS-7) the maximum Phase 2 magnetic-field level from the underground interconnection duct banks is 6.0 mG and decreases to 0.5 mG or less at a distance of 25 feet from the duct bank centerline.

Summary

This report has summarized calculations of the magnetic-field levels associated with the proposed ESS on Martha's Vineyard. These calculations have been performed using standard methods used by the scientific and engineering community and which have previously been found to match well with field measurements.

The magnetic-field level from the distribution lines extending both north and south of the ESS are calculated not to change during Phase 1 of the project and to change by 3.7 mG or less during Phase 2 of the project. The highest calculated magnetic field levels both before and after the Project are localized to the immediate vicinity of the Oak Bluffs Service Center. The highest existing magnetic field is from the short Generator Tap (17 mG) while after completion of the project the highest magnetic-field level will be less (11 mG) and will be from the short overhead interconnection to the #97 Line. Magnetic field levels above the underground duct banks are calculated to be lower than beneath the overhead distribution lines and will decrease to 0.5 mG or less at distances of 25 feet or more from the duct bank. Electric field levels are calculated to not change as a result of this project. These results indicate that the operation of the ESS system will have a minimal effect on the levels of EMF at the nearest residences.

Notice

At the request of Eversource and TRC, Exponent modeled the levels of electric and magnetic fields associated with the proposed Martha's Vineyard ESS Project. This report summarizes work performed to date and presents the findings resulting from that work. In the analysis, we have relied on geometry, material data, usage conditions, specifications, and various other types of information provided by the client. Eversource has confirmed to Exponent that the summary contained herein of data provided to Exponent is not subject to Critical Energy Infrastructure Information restrictions. We cannot verify the correctness of this input data, and rely on the client for the data's accuracy. Although Exponent has exercised usual and customary care in the conduct of this analysis, the responsibility for the design and operation of the project remains fully with the client.

The findings presented herein are made to a reasonable degree of engineering and scientific certainty. Exponent reserves the right to supplement this report and to expand or modify opinions based on review of additional material as it becomes available, through any additional work, or review of additional work performed by others.

The scope of services performed during this investigation may not adequately address the needs of other users of this report, and any re-use of this report or its findings, conclusions, or recommendations presented herein other than for permitting of the proposed project are at the sole risk of the user. The opinions and comments formulated during this assessment are based on observations and information available at the time of the investigation. No guarantee or warranty as to future life or performance of any reviewed condition is expressed or implied.

Appendix A

Summary of ROW and Conductor Configurations

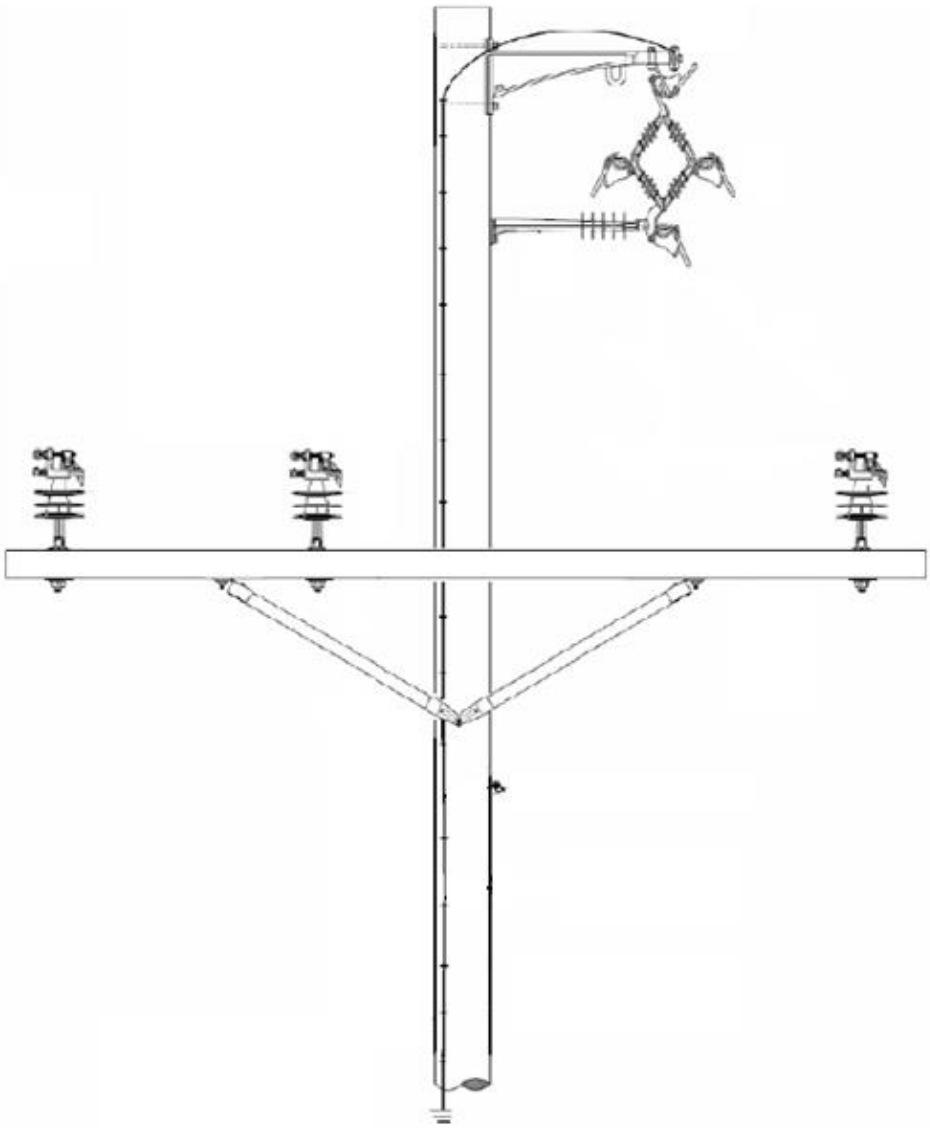


Figure A-1. Double-circuit structure used in XS-1 and XS-2, supporting the #75 Line (top) and #97 Line (bottom) in the Existing and Phase 1 configurations.

In Phase 2, south of the Service Center the same structure is used to support the #75 Line (top) and #99 Line (bottom)

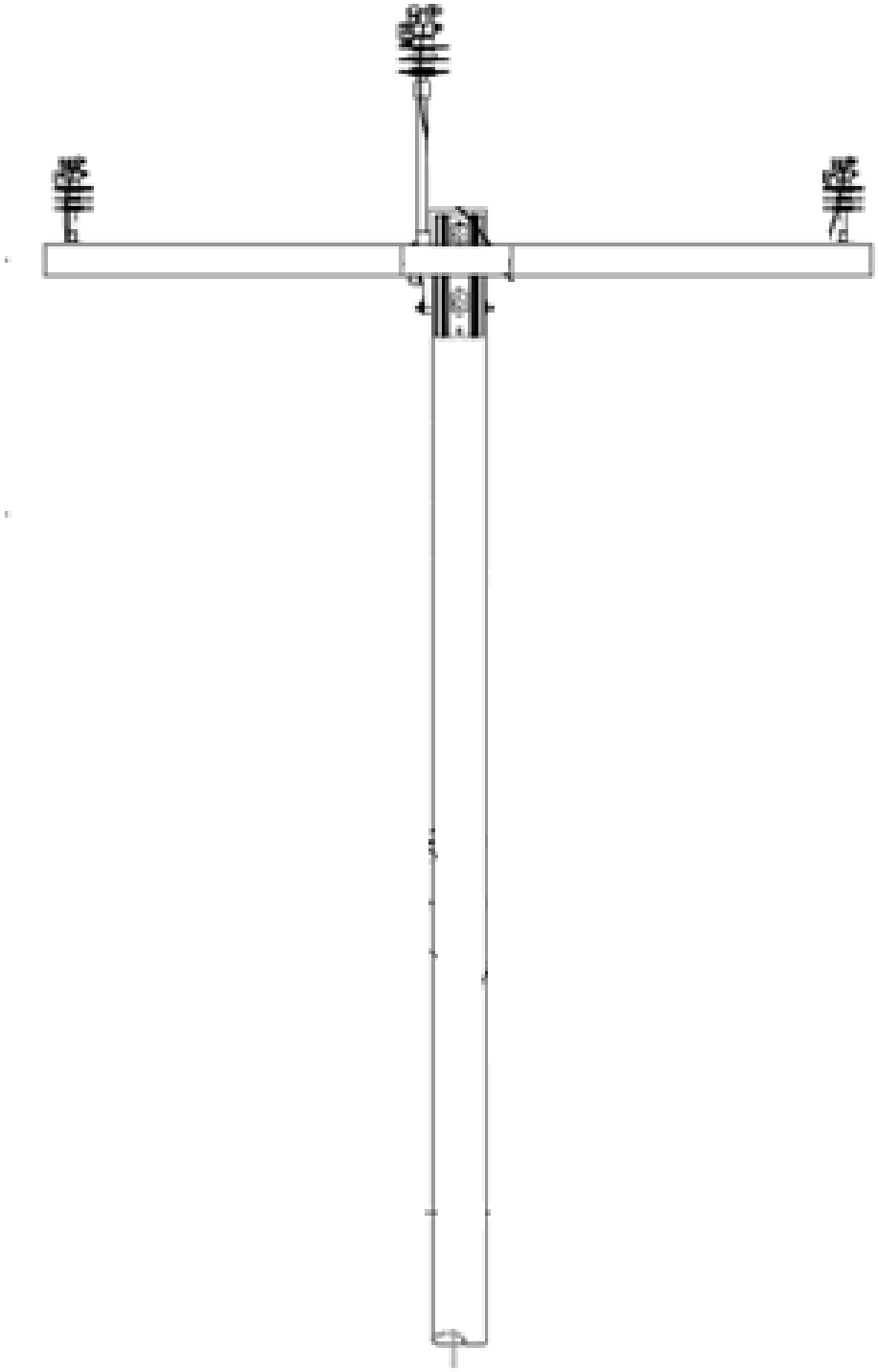


Figure A-2. Structure supporting the Generator Tap (XS-3) and Building Tap (XS-4)

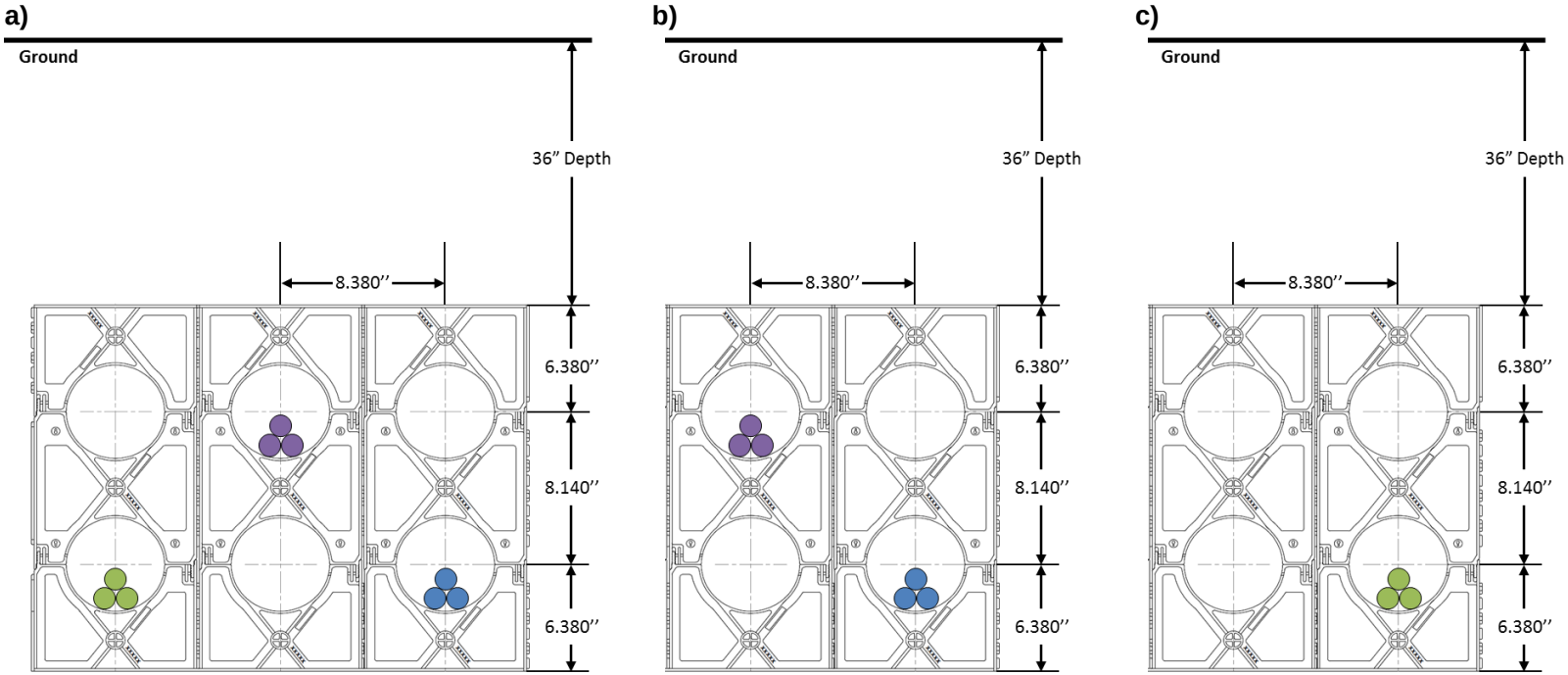


Figure A-3. Underground duct banks used for modeling. a) XS-5, b) XS-6, c) XS-7.

Blue circles represent conductors in Phase 1 & Phase 2 connecting the ESS to the #75 Line. Green circles represent conductors connecting the ESS to the #97 Line in Phase 2. Purple circles represent conductors connecting the ESS to the #99 Line in Phase 2.

Appendix B

Graphical Profiles of Calculated EMF

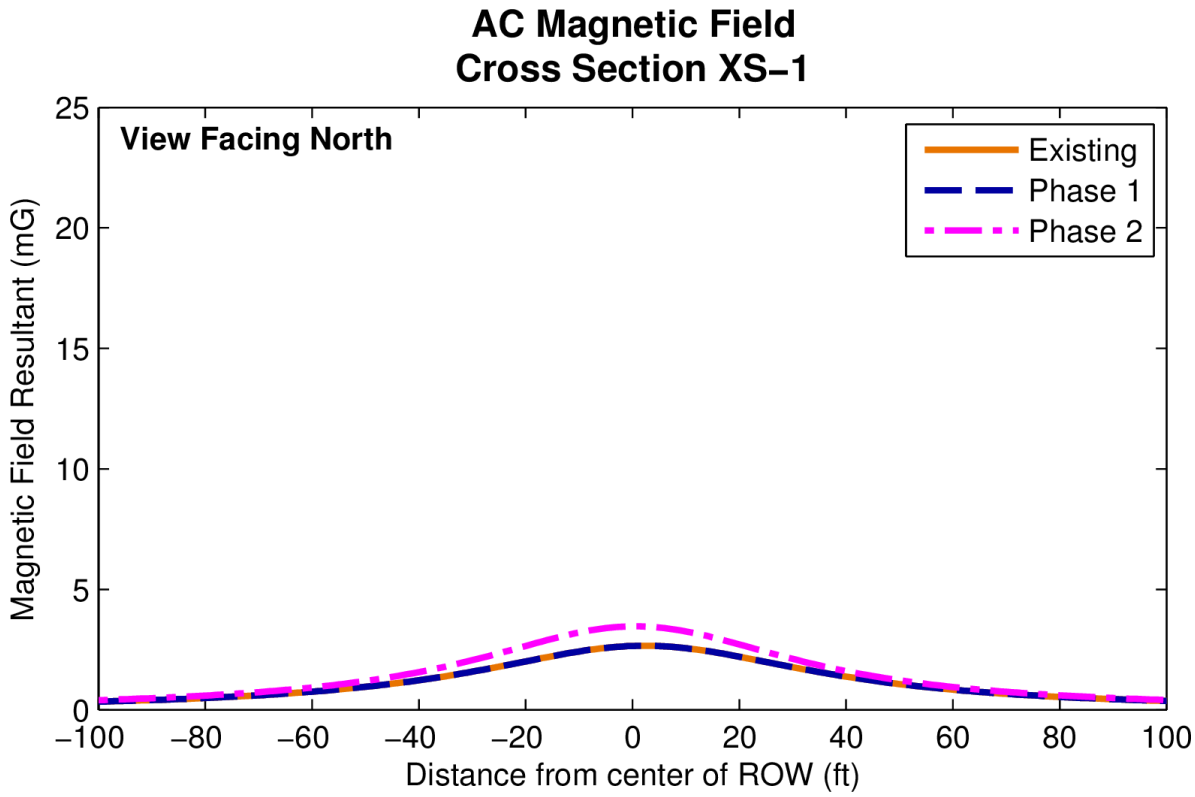


Figure B-1. Magnetic field profile for XS-1 at peak loading.

XS-1 represents the dual-circuit distribution lines (#75 and #97) upstream (north) of the ESS site on the east side of Edgartown-Vineyard Haven Road

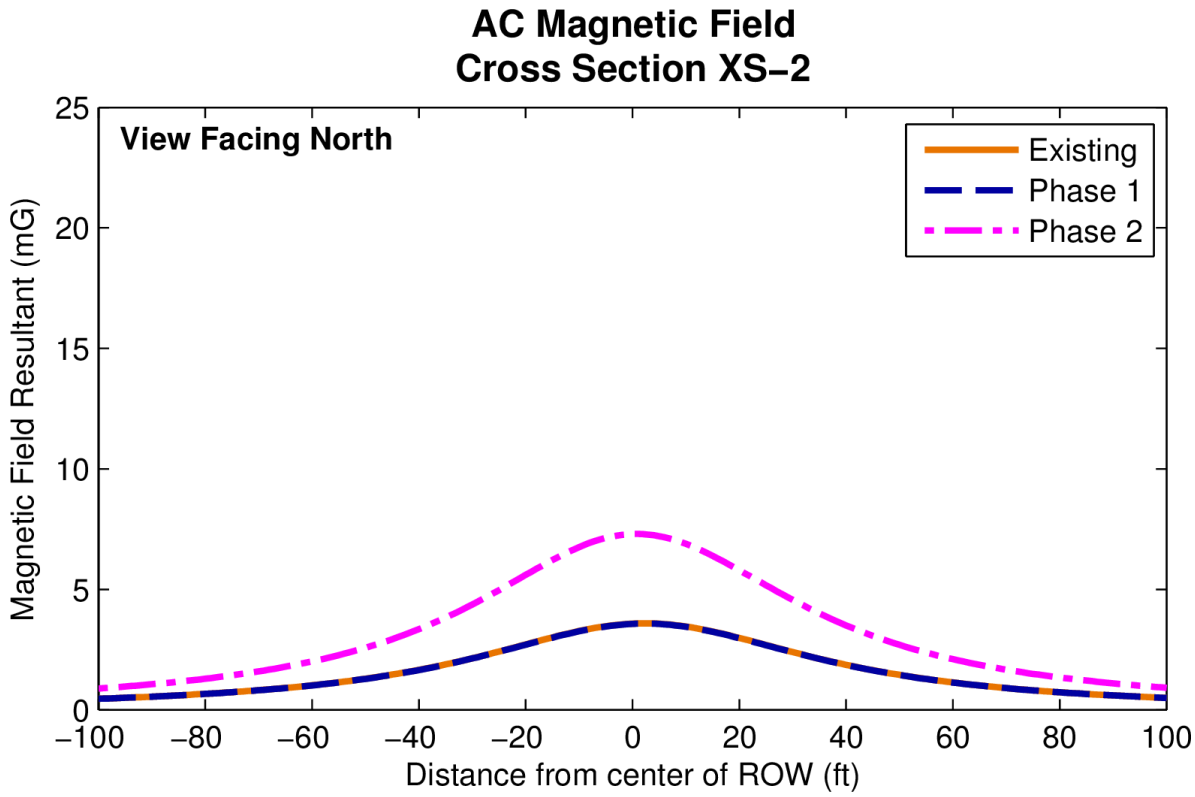


Figure B-2. Magnetic field profile for XS-2 at peak loading.

XS-2 represents the dual-circuit distribution lines (#75 and #97 in Phase 1; #75 and #99 in Phase 2) downstream (south) of the ESS site on the east side of Edgartown-Vineyard Haven Road

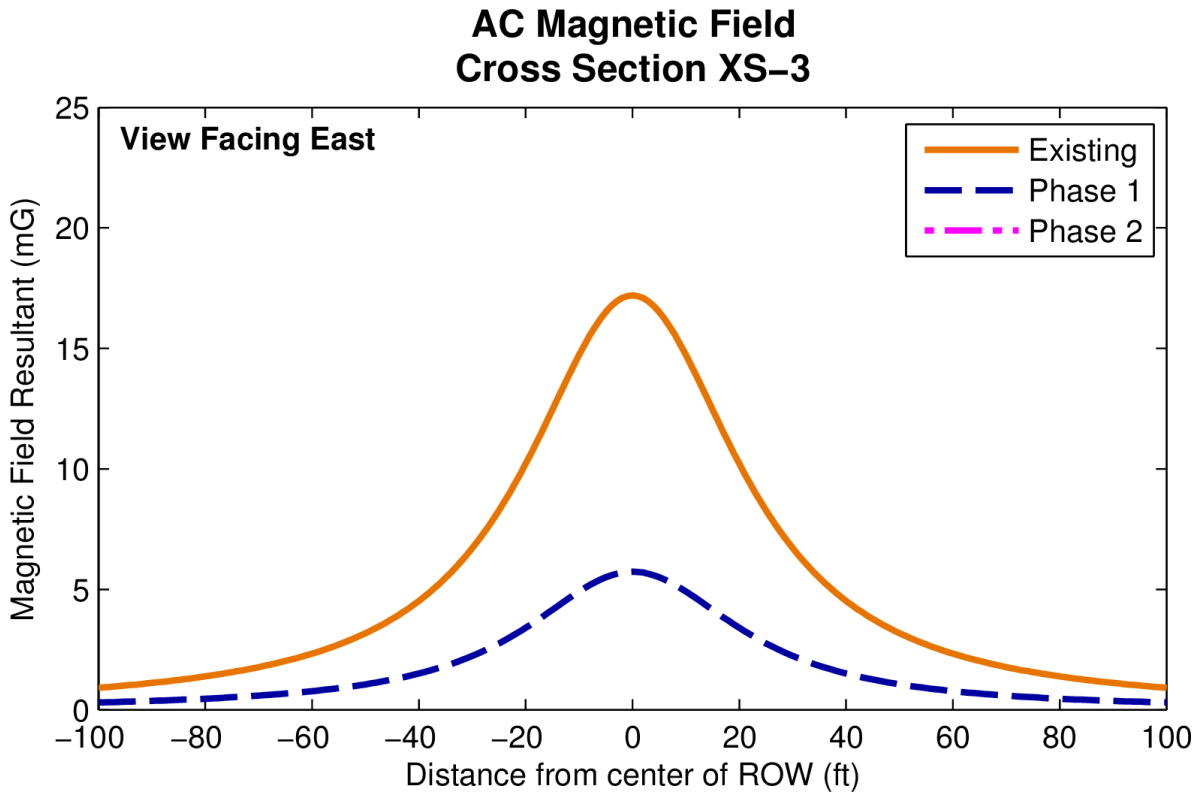


Figure B-3. Magnetic field profile for XS-3 at peak loading.

XS-3 represents the existing Generator Tap to the #75 Line

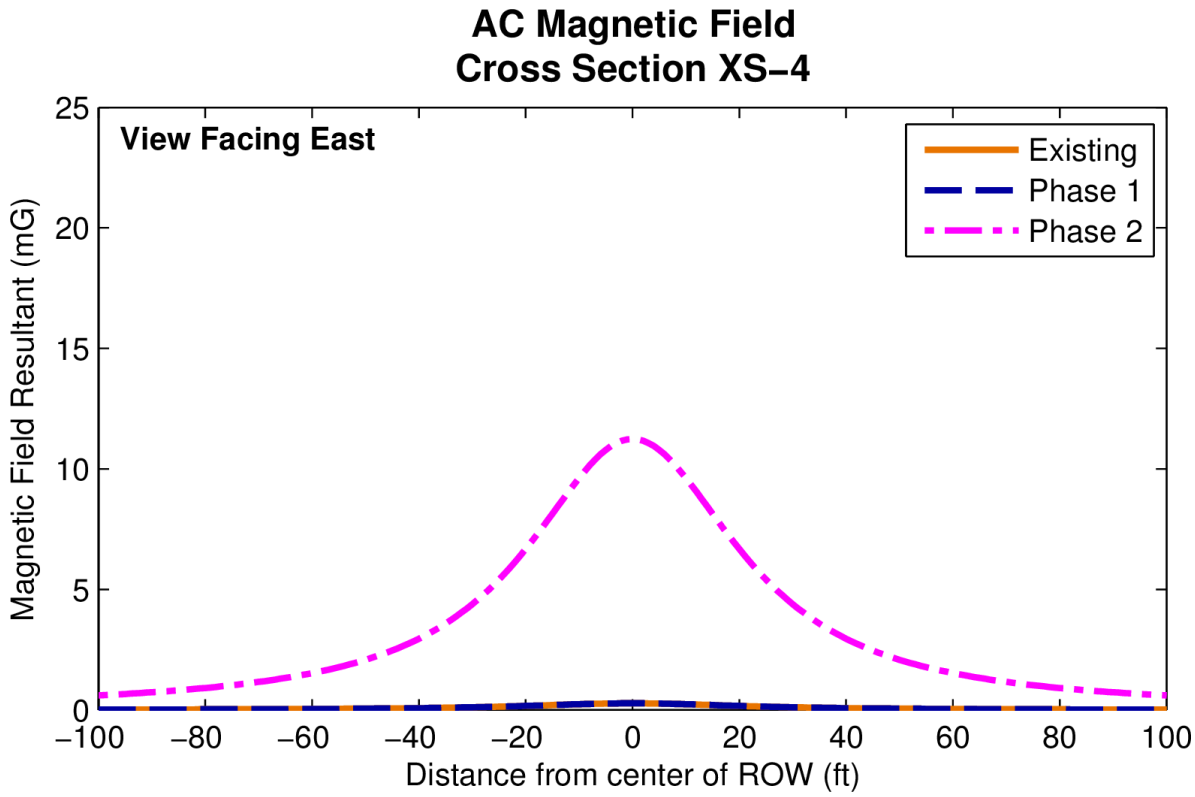


Figure B-4. Magnetic field profile for XS-4 at peak loading.

XS-4 represents the existing Building Tap (and future connection of the Phase 2 ESS) to the #97 Line

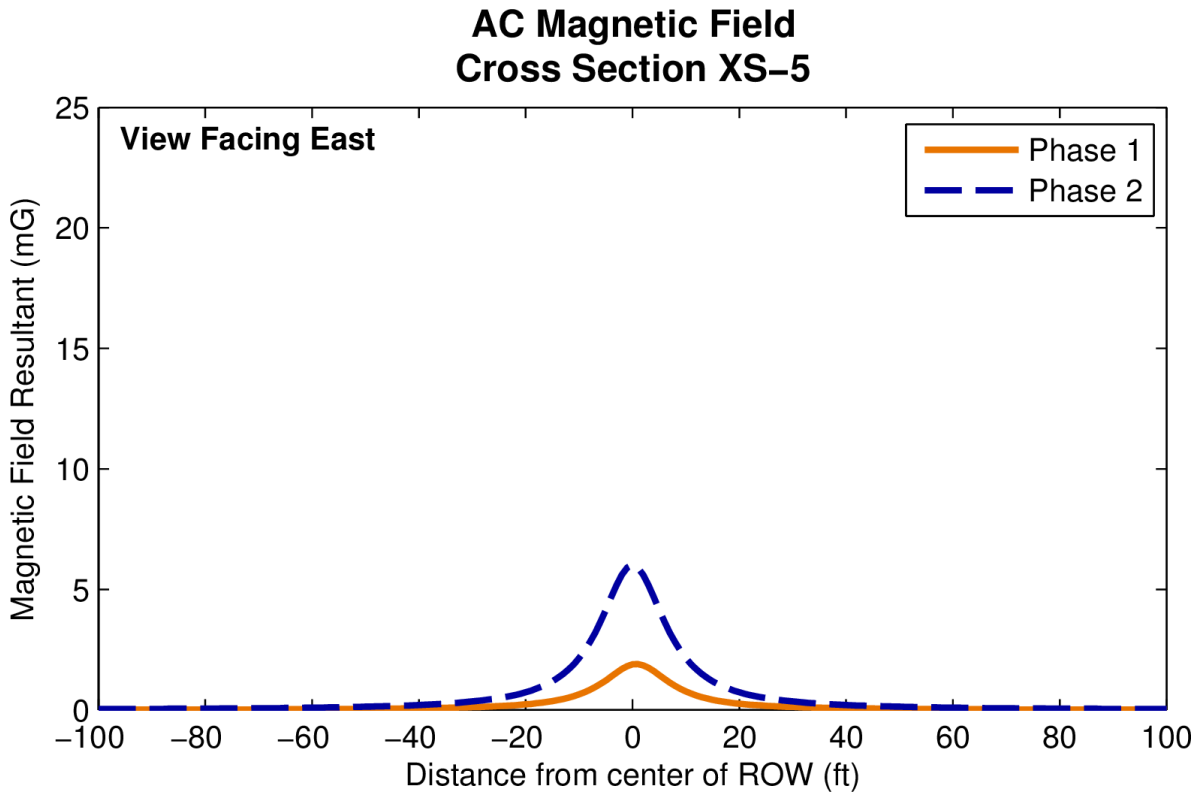


Figure B-5 Magnetic field profile for XS-5 at peak loading.

XS-5 represents the proposed triple-circuit duct bank for connecting the ESS to the #75 Line (Phase 1 and Phase 2) and to the #97 Line and #99 Line (Phase 2)

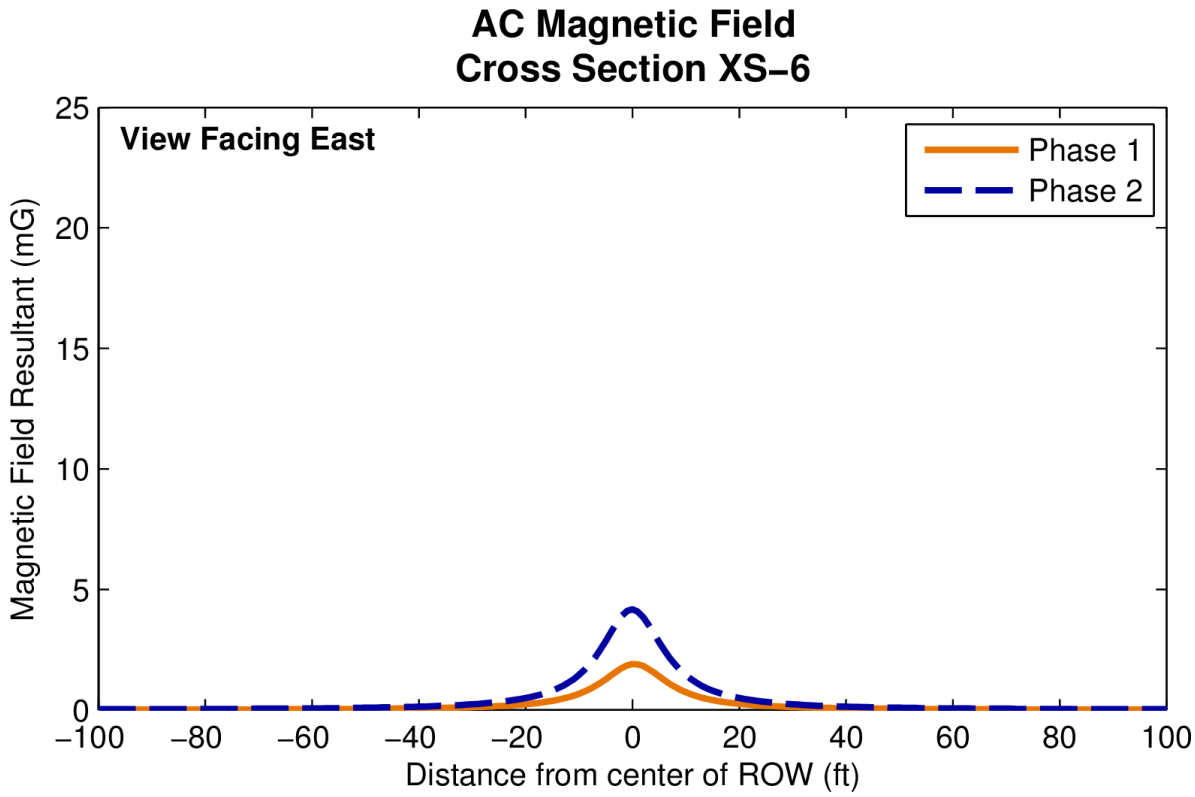


Figure B-6. Magnetic field profile for XS-6 at peak loading.

XS-6 represents the proposed dual-circuit duct bank crossing beneath Edgartown-Vineyard Haven Road for connecting the ESS to the #75 Line (Phase 1 and Phase 2) and to the #99 Line (Phase 2)

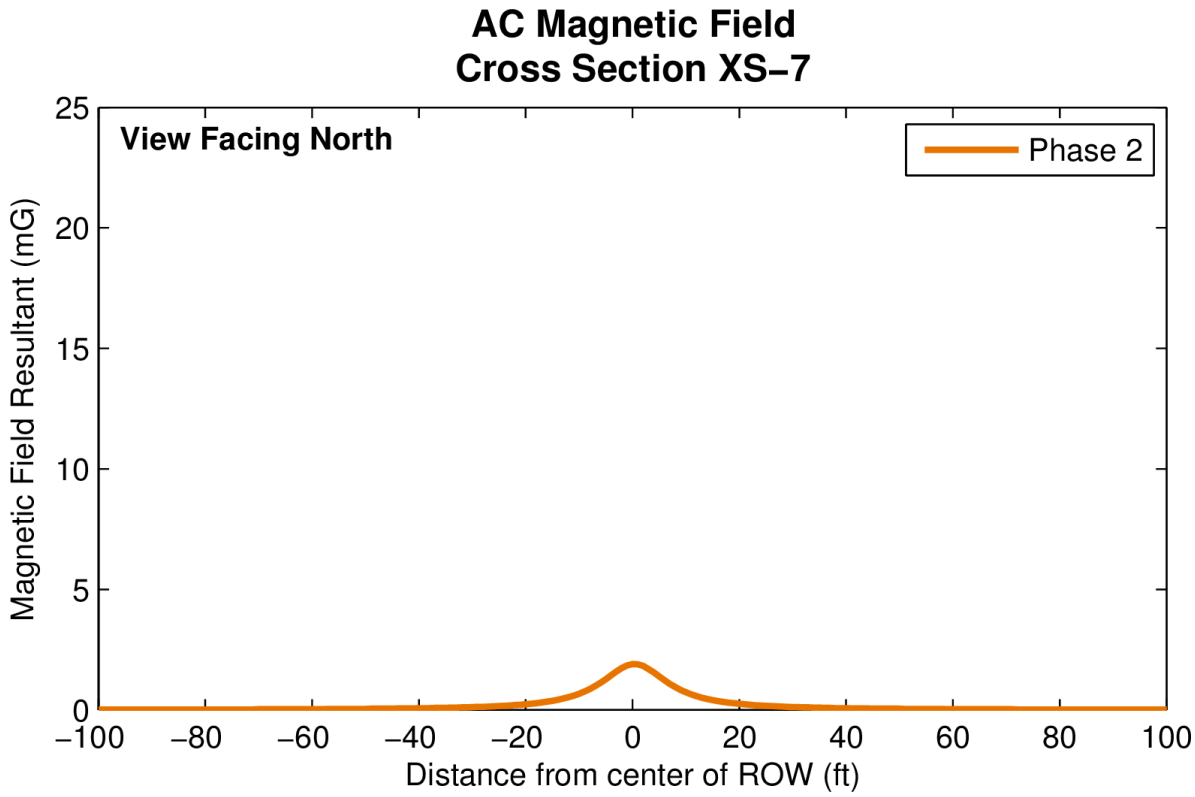


Figure B-7. Magnetic field profile for XS-7 at peak loading.

XS-7 represents the proposed duct bank connecting the ESS to the riser pole adjacent to the Oak Bluffs Service Center for connection to the # 97 Line (Phase 2)

Appendix C

Summary Tables of Calculated EMF

Table C-1. Magnetic-field level (mG) at peak loading.

		Distance from Structure/Duct bank Centerline						
Section	**Configuration**	**–100 ft.**	**–50 ft.**	**–25 ft.**	**Max**	**+25 ft.**	**+50 ft.**	**+100 ft**
XS-1	Existing	0.3	1.0	1.8	2.7	2.0	1.1	0.4
	Phase 1	0.3	1.0	1.8	2.7	2.0	1.1	0.4
	Phase 2	0.4	1.2	2.3	3.5	2.4	1.2	0.4
XS-2	Existing	0.5	1.3	2.4	3.6	2.7	1.5	0.5
	Phase 1	0.5	1.3	2.4	3.6	2.7	1.4	0.5
	Phase 2	0.9	2.6	5.0	7.3	5.2	2.7	0.9
XS-3	Existing	0.9	3.2	8.3	17	8.3	3.2	0.9
	Phase 1	0.3	1.1	2.8	5.7	2.8	1.1	0.3
	Phase 2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
XS-4	Existing	0.0	0.1	0.1	0.3	0.1	0.1	0.0
	Phase 1	0.0	0.1	0.1	0.3	0.1	0.1	0.0
	Phase 2	0.6	2.1	5.4	11	5.4	2.1	0.6
XS-5	Existing	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Phase 1	0.0	0.0	0.2	1.9	0.2	0.0	0.0
	Phase 2	0.0	0.1	0.5	6.0	0.5	0.1	0.0
XS-6	Existing	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Phase 1	0.0	0.0	0.2	1.9	0.2	0.0	0.0
	Phase 2	0.0	0.1	0.3	4.2	0.3	0.1	0.0
XS-7	Existing	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Phase 1	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Phase 2	0.0	0.0	0.2	1.9	0.2	0.0	0.0

Attachment G

Eversource ESS – Martha's Vineyard Visual Simulation of Project

VIEWPOINT LOCATION MAP

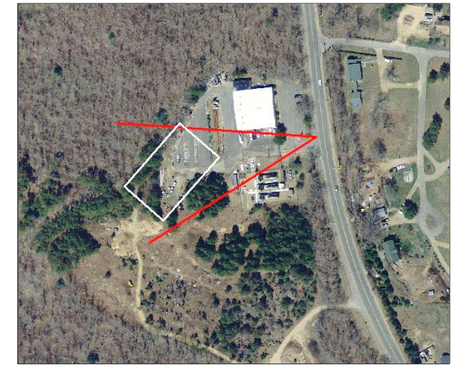
PROPOSED CONDITIONS

TECHNICAL INFORMATION

Viewpoint Coordinates in	1610806.9 E
MA State Plane Isl	155531.6 N
Viewpoint Location	Edgartown-Vineyard Haven Rd
Viewer Elevation (ft msl)	82
Distance to Project	368 ft
Camera Model	Canon EOS Rebel XSi
Lens Setting	50 mm
Date/Time	4.26.2018/1:27 pm

Eversource Energy Storage System
Oak Bluffs, MA
Visual Simulation of Project
November 2018

VIEWPOINT LOCATION MAP



PROPOSED CONDITIONS

TECHNICAL INFORMATION

Viewpoint Coordinates in	1610831.9 E
MA State Plane Isl	155281.2 N
Viewpoint Location	Edgartown-Vineyard Haven Rd
Viewer Elevation (ft msl)	80
Distance to Project	252 ft
Camera Model	Canon EOS Rebel XSi
Lens Setting	50 mm
Date/Time	4.26.2018/1:09 pm

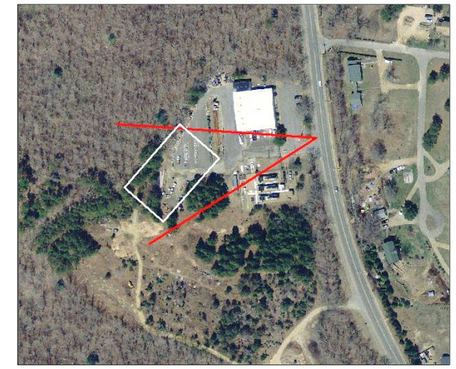
Eversource Energy Storage System
Oak Bluffs, MA
Visual Simulation of Project
November 2018

VP2a EDGARTOWN-VINEYARD HAVEN ROAD

EXISTING CONDITIONS

TRC

VIEWPOINT LOCATION MAP



EXISTING CONDITIONS

TECHNICAL INFORMATION

Viewpoint Coordinates in	1610831.9 E
MA State Plane Isl	155281.2 N
Viewpoint Location	Edgartown-Vineyard Haven Rd
Viewer Elevation (ft msl)	80
Distance to Project	252 ft
Camera Model	Canon EOS Rebel XSi
Lens Setting	50 mm
Date/Time	4.26.2018/1:09 pm

Eversource Energy Storage System
Oak Bluffs, MA
Visual Simulation of Project
November 2018

VP2b EDGARTOWN-VINEYARD HAVEN ROAD

PROPOSED CONDITIONS

TRC

VIEWPOINT LOCATION MAP

PROPOSED CONDITIONS

TECHNICAL INFORMATION

Viewpoint Coordinates in	1610868.4 E
MA State Plane Isl	155118.9 N
Viewpoint Location	Edgartown-Vineyard Haven Rd
Viewer Elevation (ft msl)	79
Distance to Project	302 ft
Camera Model	Canon EOS Rebel XSi
Lens Setting	50 mm
Date/Time	4.26.2018/9:50 am

Eversource Energy Storage System
Oak Bluffs, MA
Visual Simulation of Project
November 2018

VP3a EDGARTOWN-VINEYARD HAVEN ROAD

EXISTING CONDITIONS

TRC

VIEWPOINT LOCATION MAP

EXISTING CONDITIONS

TECHNICAL INFORMATION

Viewpoint Coordinates in	1610868.4 E
MA State Plane Isl	155118.9 N
Viewpoint Location	Edgartown-Vineyard Haven Rd
Viewer Elevation (ft msl)	79
Distance to Project	302 ft
Camera Model	Canon EOS Rebel XSi
Lens Setting	50 mm
Date/Time	4.26.2018/9:50 am

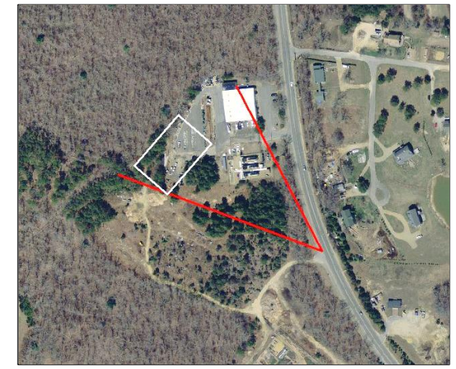
Eversource Energy Storage System
Oak Bluffs, MA
Visual Simulation of Project
November 2018

VP3b EDGARTOWN-VINEYARD HAVEN ROAD

PROPOSED CONDITIONS

TRC

VIEWPOINT LOCATION MAP



PROPOSED CONDITIONS

TECHNICAL INFORMATION

Viewpoint Coordinates in	1610940.2 E
MA State Plane Isl	154888.8 N
Viewpoint Location	Edgartown-Vineyard Haven Rd
Viewer Elevation (ft msl)	76
Distance to Project	484 ft
Camera Model	Canon EOS Rebel XSi
Lens Setting	50 mm
Date/Time	4.26.2018/1:20 pm

Eversource Energy Storage System
Oak Bluffs, MA
Visual Simulation of Project
November 2018