

# Stormwater Management Report

Prepared for:

## Proposed Industrial Redevelopment

419 & 650 West Avenue  
Stamford, Connecticut



September 3, 2021

LANDTECH



Civil Engineering · Site Planning  
Environmental Science & Engineering  
Structural Engineering · Land Surveying  
Permit Coordination & Management  
Construction Management & Financing

## Executive Summary:

### Existing Site Description:

Currently, the site is developed with three industrial/warehouse/office buildings, stormwater collection and conveyance facilities, utility infrastructure, access drives, surface parking areas, and loading areas. The site currently contains 5.3± acres of impervious coverage, or approximately 34% of the total site.

From a stormwater perspective, runoff is currently collected and conveyed by a network of roof drains, catch basins, underground piping, and manholes, and discharged directly to upland areas that are upgradient of the existing wetland areas on the site. There are currently no stormwater detention/retention measures to control the rate of runoff. With the exception of catch basin sumps, there are no stormwater quality elements present to improve the quality of the runoff.

Runoff is collected and conveyed by two primary stormwater system. System #1 consists of a series of inlets, catch basins, manholes, and piping that accepts runoff from developed off-site properties to the north, as well as portions of paved areas along the eastern side of the site. This system discharges towards an existing wetland corridor to the south. System #2 collects and conveys runoff from the remainder of the developed areas of the site through a network of roof drains, catch basins, underground piping, manholes, and discharged to a precast concrete plunge pool on the western side of the developed area of the site, where the runoff then travels westerly to an existing on-site wetland corridor.

### Proposed Site Conditions:

The proposed redevelopment of the subject site consists of the demolition of the larger office building located in the northeastern sector of the property and replacing the existing building with a 66K± square foot industrial building. There will also be revisions to the existing access drives, parking, and on-site utilities to accommodate the construction of the new building. The proposal will result in an increase in total impervious coverage of approximately 0.6 acres, which will raise the total impervious coverage on the site to 38%. Important to note is that while total impervious coverage is increased, the areas of surface coverage (parking, loading, access drives, and sidewalks) is increased by only 0.035 acres (1524 S.F.)

As to stormwater, existing drainage patterns will be maintained. The area of the site contributing to System #1 will be reduced and the corresponding peak flow rates will likewise be reduced. System #2 will be enhanced with the inclusion of a subsurface detention system to maintain current peak flows. We have proposed enhancing the quality of the stormwater runoff at System #1 by utilizing an off-line hydrodynamic stormwater quality chamber. Stormwater quality at the discharge of System #2 will be enhanced by infiltrating the first inch of runoff from the areas of surface coverage that are collected by the system.

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## Introduction:

LandTech has been retained by West Avenue Industrial, LLC to provide site design and permitting assistance for property they own, located at 419 & 650 West Avenue in Stamford Connecticut. The project consists of the redevelopment of an existing industrial/office site. Currently the site is developed with three buildings, two of which are to remain. The third building, located in the eastern portion of the site, is to be removed and replaced with a larger industrial/warehouse building. There will be modifications to the existing access drives, parking, and any utilities affected by the proposed redevelopment.

The subject site is comprised of 15.6± acres total. Of the total site area, approximately 8.4± acres (54% of the total site), located along the western side of the property, is reserved as a conservation easement. The site generally slopes from east to west and there is a wetland corridor to the west and south of the developed area of the site. The site currently contains 5.3± acres of impervious coverage, or approximately 34% of the total site

The proposed redevelopment will result in an increase in total impervious coverage of approximately 0.6 acres, which will raise the total impervious coverage on the site to 38%. Important to note is that while total impervious coverage is increased, the areas of surface coverage (parking, loading, access drives, and sidewalks) are increased by only 0.035 acres (1524 S.F.) This is especially important considering that the majority of pollutants are produced by runoff from impervious areas associated with vehicular usage.

## General Methodology:

The rainwater runoff from the site was analyzed using the HydroCAD® computer software which utilizes NRCS TR-55/TR-20 methodology. Surface Area, Type of Ground Cover, Slopes, Soil Characteristics, and Rainfall Distribution are all inputs into the calculation. Surface areas were determined by digitizing within the AutoCAD files. Soil types were determined using the NRCS Web-based soil mapping service. Other calculations were performed using generally accepted engineering formulae as applicable.

Rainfall depths were taken from the NOAA Atlas 14, volume 10, custom printed for the project site. This information is provided in Appendix B. We have provided computations for the 1-Year, 2-Year, 5-Year, 10-Year, 25-Year, and 100-Year storm events.

For the purposes of our analysis, no allowance for infiltration into the soils below the underground detention system was considered.

## On-Site Soils:

Soils within the developed portion of the site are predominately Udorthents, Urban Land, or a combination thereof. The undeveloped areas of the site are comprised of Calden and Freetown soils (lower, flatter/wetland areas) and Hollis-Chatfield-Rock Outcrop complex in the upland areas.

The Hydrologic Soil Groups represented are B, D, and B/D. Selected portions of the NRCS Soils Report are provided in Appendix A.

Test Pits observed in the vicinity of the proposed underground detention system indicate the presence of varying depths of fill present. To ensure that draining out of the system occurs, we have proposed over-excavation below the system and backfill with granular material.

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## Site Hydrological Description:

From a hydrological standpoint, the site can be viewed as divided into two overall drainage areas.

Drainage Area 1 includes the eastern portion of the site. Drainage from this area is currently collected by a closed conduit system that runs generally from north to south. This system also accepts stormwater flow from developed off-site properties to the north. Discharge from this system is directed onto an upland area which slopes towards a wetland area to the south.

Drainage Area #2 is located in the western portion of the site. It includes the majority of the developed area of the site as well as the undeveloped areas towards the west. Runoff from the developed areas of the site is collected and conveyed via a network of roof drains, catch basins, underground piping, manholes, and discharged to a precast concrete plunge pool on the western side of the developed area of the site, where the runoff then travels westerly to an existing on-site wetland corridor.

The drainage areas are more completely described as follows:

### Existing Conditions:

**Drainage Area EX-1:** This drainage area consists of 8.12 acres of the site, and includes the eastern portion of the developed area of the site and the southernmost portion of the undeveloped area of the site. The overall watershed is comprised of approximately 30.4% impervious coverage and 69.5% pervious coverage. The pervious areas are largely comprised of wooded areas outside of the developed portion of the site.

**Drainage Area EX-2:** This drainage area consists of 7.4 acres and is located in the western and northern portion of the site. This area is approximately 38% impervious coverage and 62% pervious coverage. Again, the pervious areas within this drainage area are predominately wooded areas located to the west of the developed portion of the site.

### Proposed Conditions:

**Drainage Area PR-1:** This drainage area consists of 7.68 acres of the site, and includes the eastern portion of the developed area of the site and the southernmost portion of the undeveloped area of the site. The overall watershed is comprised of approximately 32.0% impervious coverage and 68.0% pervious coverage. The pervious areas are largely comprised of wooded areas outside of the developed portion of the site.

**Drainage Area PR-2A:** This area consists of the developed portion of the site between the northern two buildings and the property line. It also represents a portion of the site that will be predominately impervious, and is able to be collected and routed to the underground detention system. This area is approximately 0.7 acres in size and is approximately 69% impervious.

**Drainage Area PR-2B:** This area is located to the south of the proposed industrial building and, like area PR-2A above, is routed to the underground detention system. This area is approximately 0.5 acres and is proposed to be approximately 95% impervious.

**Drainage Area PR-2C:** Drainage Area PR-2C is comprised of the areas of pavement on the site that are generally to remain intact as part of the redevelopment as well as the undeveloped portion of the site to the west. These areas will discharge to the concrete box outlet structure in the same way that they currently do. This area is approximately 4.7 acres and is proposed to be approximately 11% impervious. The large areas on pervious coverage are generally comprised of the wooded areas to the west of the developed portions of the site.

**Drainage Area PR-2D:** This drainage area consists of the existing roof areas of the two (existing and proposed) industrial buildings at the northernmost portion of the site. The total area is approximately 2.0 acres and is entirely impervious.

## HydroCAD Results Summary:

The following summary table represents the results of our analysis, as described above.

Storm Event	DA EX1	DA-EX2	Exist. Total	DA-PR1	DA-PR2	Proposed Total	Change (C.F.S.)	Change (%)
1-Year	11.2	3.7	14.9	11.4	6.2	17.6	2.7	18%
2-Year	15.4	5.8	21.2	15.6	7.6	23.2	2.00	9%
5-Year	22.8	9.7	32.5	22.8	10.9	33.7	1.2	4%
10-Year	28.9	13.2	42.1	28.9	14.3	43.2	1.1	3%
25-Year	37.6	18.3	55.9	37.3	18.6	55.9	0.0	0%
100-Year	51.2	26.6	77.8	50.6	26.5	77.1	-0.7	-1%

As shown, runoff rates for the smaller storm events are increased slightly, while the rates for the more severe 25-Year and 100-Year are maintained at current levels or reduced. We are comfortable with the minor increases for the smaller storm events in that the downstream facilities (existing wetland corridor and dam/spillway) will serve to attenuate these minor increases, with such attenuation not accounted for in our model.

## Stormwater Quality:

Under the existing conditions, there are no stormwater facilities on the site, save for the existing catch basin sumps. Given the existing site constraints, we have proposed several water quality treatment measures that will serve to improve the quality of the stormwater discharge over the current conditions.

As previously discussed, we have considered the site area as two distinct drainage areas. Given the various constraints associated with each of these areas, we have approached the subject of stormwater quality differently in each area, as further described below:

**Drainage Area #1:** As previously discussed, runoff from this area is combined with runoff from off-site sources to the north. Based on the current design, the contributing area from the subject site will be reduced by approximately 0.44 acres. For DA#1, we are proposing an off-line hydrodynamic water quality chamber to be installed to treat the stormwater from this area. The proposed chamber will provide sediment removal (target 80% removal rate), oil separation, and trash/floatable sequestration.

**Drainage Area #2:** Our approach to DA#2 is to focus water quality improvements on the areas of surface coverage (drives, walks, parking areas), rather than the building roof areas. Generally, the

below the outlet (dead storage). This equals a runoff depth of 0.81 inches from all of the surface coverage within DA#2 and a runoff depth of 1.24" from the surface coverage areas that we are actually able to collect.

## Conclusions:

The proposed stormwater management system has been designed to maintain existing drainage patterns on the site and to maintain existing rates of flow as close to the existing conditions as possible. In addition, stormwater quality measures have been proposed that will necessarily improve the quality of the stormwater from the site.

**Based on the above information, the proposed improvements are designed in accordance with the City of Stamford Stormwater Drainage Manual and will not adversely impact adjacent or downstream properties or City-owned drainage facilities.**

## **Appendix A**


### **NRCS Soils Information**

# Hydrologic Soil Group—State of Connecticut



## MAP LEGEND

### Area of Interest (AOI)









 Area of Interest (AOI)

### Soils

#### Soil Rating Polygons





 A  
 A/D  
 B  
 B/D  
 C  
 C/D  
 D  
 Not rated or not available

#### Soil Rating Lines


 A  
 A/D  
 B  
 B/D  
 C  
 C/D  
 D  
 Not rated or not available

#### Soil Rating Points






 A  
 A/D  
 B  
 B/D

 C  
 C/D  
 D  
 Not rated or not available


### 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 1:12,000.

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: State of Connecticut  
 Survey Area Data: Version 20, Jun 9, 2020

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

Date(s) aerial images were photographed: Jul 21, 2014—Aug 27, 2014

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.

## Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
18	Catden and Freetown soils, 0 to 2 percent slopes	B/D	6.6	14.2%
75C	Hollis-Chatfield-Rock outcrop complex, 3 to 15 percent slopes	D	1.1	2.3%
306	Udorthents-Urban land complex	B	20.2	43.2%
307	Urban land	D	18.8	40.3%
<b>Totals for Area of Interest</b>			<b>46.8</b>	<b>100.0%</b>

## Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

## Rating Options

*Aggregation Method:* Dominant Condition

*Component Percent Cutoff:* None Specified

*Tie-break Rule:* Higher

## **Appendix B**

### **NOAA Rainfall Data**



**NOAA Atlas 14, Volume 10, Version 3**  
**Location name: Stamford, Connecticut, USA\***  
**Latitude: 41.0386°, Longitude: -73.5606°**  
**Elevation: 34.8 ft\*\***  
 \* source: ESRI Maps  
 \*\* source: USGS



### POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sandra Pavlovic, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Orlan Wilhite

NOAA, National Weather Service, Silver Spring, Maryland

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

### PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches) <sup>1</sup>										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.365 (0.280-0.466)	0.425 (0.326-0.544)	0.524 (0.401-0.673)	0.606 (0.461-0.781)	0.719 (0.531-0.958)	0.805 (0.582-1.09)	0.893 (0.628-1.25)	0.990 (0.664-1.41)	1.13 (0.728-1.64)	1.23 (0.780-1.83)
10-min	0.517 (0.397-0.661)	0.602 (0.462-0.771)	0.742 (0.567-0.952)	0.859 (0.653-1.11)	1.02 (0.752-1.36)	1.14 (0.825-1.54)	1.26 (0.890-1.76)	1.40 (0.940-1.99)	1.59 (1.03-2.33)	1.75 (1.11-2.60)
15-min	0.608 (0.467-0.777)	0.709 (0.543-0.907)	0.874 (0.668-1.12)	1.01 (0.769-1.30)	1.20 (0.884-1.60)	1.34 (0.970-1.82)	1.49 (1.05-2.08)	1.65 (1.11-2.35)	1.88 (1.21-2.74)	2.06 (1.30-3.06)
30-min	0.850 (0.653-1.09)	0.992 (0.761-1.27)	1.22 (0.936-1.57)	1.42 (1.08-1.83)	1.68 (1.24-2.24)	1.88 (1.36-2.55)	2.09 (1.47-2.91)	2.31 (1.55-3.29)	2.62 (1.69-3.82)	2.86 (1.81-4.25)
60-min	1.09 (0.839-1.40)	1.28 (0.978-1.63)	1.58 (1.21-2.02)	1.82 (1.39-2.35)	2.17 (1.60-2.88)	2.43 (1.75-3.28)	2.69 (1.89-3.74)	2.98 (2.00-4.23)	3.36 (2.17-4.91)	3.66 (2.31-5.44)
2-hr	1.42 (1.10-1.80)	1.67 (1.29-2.12)	2.08 (1.60-2.65)	2.41 (1.85-3.09)	2.88 (2.13-3.81)	3.23 (2.35-4.35)	3.60 (2.54-4.98)	3.99 (2.69-5.64)	4.54 (2.95-6.59)	4.97 (3.16-7.35)
3-hr	1.64 (1.27-2.07)	1.93 (1.50-2.45)	2.42 (1.86-3.07)	2.82 (2.16-3.59)	3.37 (2.51-4.45)	3.79 (2.76-5.08)	4.22 (2.99-5.83)	4.69 (3.17-6.61)	5.36 (3.49-7.76)	5.90 (3.75-8.68)
6-hr	2.06 (1.61-2.59)	2.45 (1.91-3.08)	3.08 (2.39-3.89)	3.60 (2.78-4.57)	4.33 (3.24-5.68)	4.87 (3.58-6.51)	5.44 (3.88-7.49)	6.08 (4.12-8.50)	7.00 (4.57-10.1)	7.74 (4.94-11.3)
12-hr	2.53 (1.98-3.16)	3.02 (2.37-3.78)	3.83 (2.99-4.81)	4.50 (3.50-5.67)	5.43 (4.09-7.09)	6.12 (4.52-8.14)	6.85 (4.92-9.40)	7.69 (5.23-10.7)	8.91 (5.83-12.7)	9.92 (6.35-14.4)
24-hr	2.95 (2.33-3.67)	3.57 (2.82-4.44)	4.59 (3.61-5.72)	5.43 (4.24-6.80)	6.59 (5.00-8.57)	7.45 (5.54-9.87)	8.38 (6.07-11.5)	9.46 (6.46-13.1)	11.1 (7.27-15.7)	12.4 (7.98-17.9)
2-day	3.30 (2.62-4.07)	4.06 (3.22-5.01)	5.30 (4.19-6.56)	6.33 (4.97-7.87)	7.74 (5.91-10.0)	8.79 (6.59-11.6)	9.92 (7.25-13.6)	11.3 (7.73-15.5)	13.4 (8.81-18.9)	15.1 (9.75-21.7)
3-day	3.57 (2.85-4.39)	4.40 (3.50-5.41)	5.75 (4.56-7.09)	6.87 (5.42-8.51)	8.42 (6.45-10.9)	9.56 (7.19-12.6)	10.8 (7.92-14.7)	12.3 (8.44-16.8)	14.6 (9.63-20.5)	16.6 (10.7-23.6)
4-day	3.82 (3.06-4.68)	4.69 (3.75-5.76)	6.12 (4.87-7.52)	7.30 (5.78-9.02)	8.93 (6.85-11.5)	10.1 (7.63-13.3)	11.4 (8.40-15.5)	13.0 (8.94-17.7)	15.4 (10.2-21.6)	17.4 (11.3-24.8)
7-day	4.55 (3.66-5.55)	5.50 (4.41-6.71)	7.04 (5.63-8.61)	8.32 (6.62-10.2)	10.1 (7.77-12.9)	11.4 (8.61-14.8)	12.8 (9.41-17.2)	14.5 (9.98-19.6)	17.0 (11.2-23.6)	19.1 (12.3-27.0)
10-day	5.27 (4.25-6.40)	6.26 (5.04-7.61)	7.88 (6.32-9.61)	9.23 (7.36-11.3)	11.1 (8.55-14.1)	12.5 (9.42-16.1)	13.9 (10.2-18.6)	15.6 (10.8-21.1)	18.1 (12.0-25.2)	20.2 (13.1-28.5)
20-day	7.42 (6.02-8.96)	8.54 (6.92-10.3)	10.4 (8.36-12.5)	11.9 (9.52-14.4)	13.9 (10.8-17.5)	15.5 (11.7-19.8)	17.1 (12.5-22.5)	18.9 (13.1-25.3)	21.3 (14.2-29.3)	23.2 (15.1-32.5)
30-day	9.21 (7.50-11.1)	10.4 (8.47-12.5)	12.4 (10.0-14.9)	14.0 (11.3-17.0)	16.2 (12.6-20.3)	18.0 (13.6-22.7)	19.7 (14.4-25.6)	21.5 (15.0-28.6)	23.8 (15.9-32.6)	25.6 (16.7-35.7)
45-day	11.4 (9.33-13.7)	12.7 (10.4-15.2)	14.9 (12.1-17.8)	16.6 (13.4-20.1)	19.1 (14.8-23.6)	21.0 (15.9-26.3)	22.8 (16.7-29.3)	24.6 (17.2-32.7)	26.9 (18.1-36.7)	28.6 (18.7-39.7)
60-day	13.2 (10.9-15.8)	14.6 (12.0-17.5)	16.9 (13.8-20.2)	18.8 (15.2-22.6)	21.4 (16.7-26.4)	23.4 (17.8-29.3)	25.4 (18.5-32.5)	27.2 (19.1-36.0)	29.5 (19.9-40.2)	31.2 (20.4-43.2)

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

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

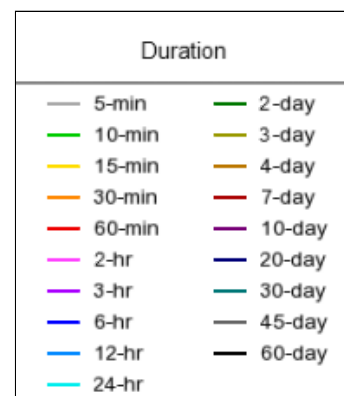
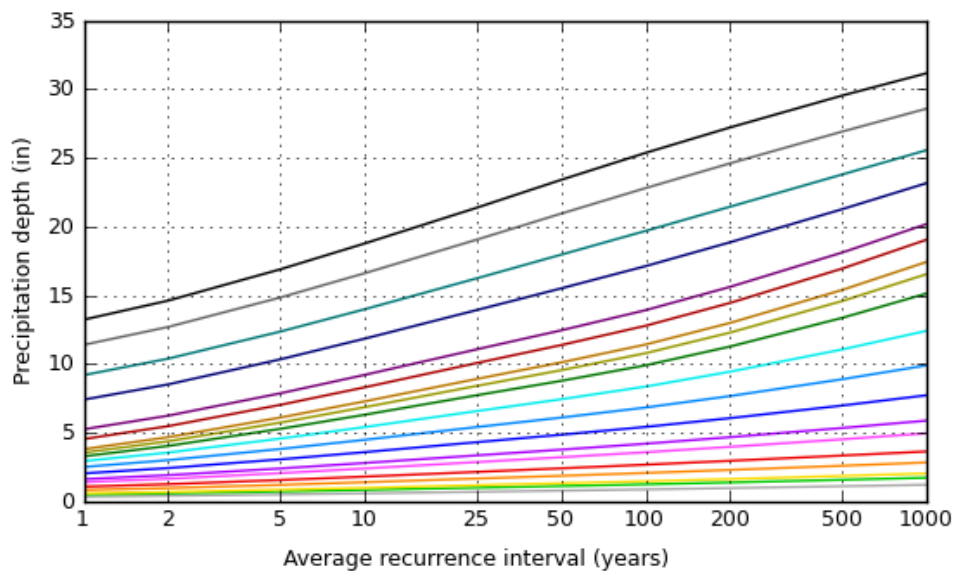
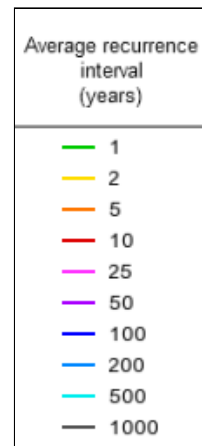
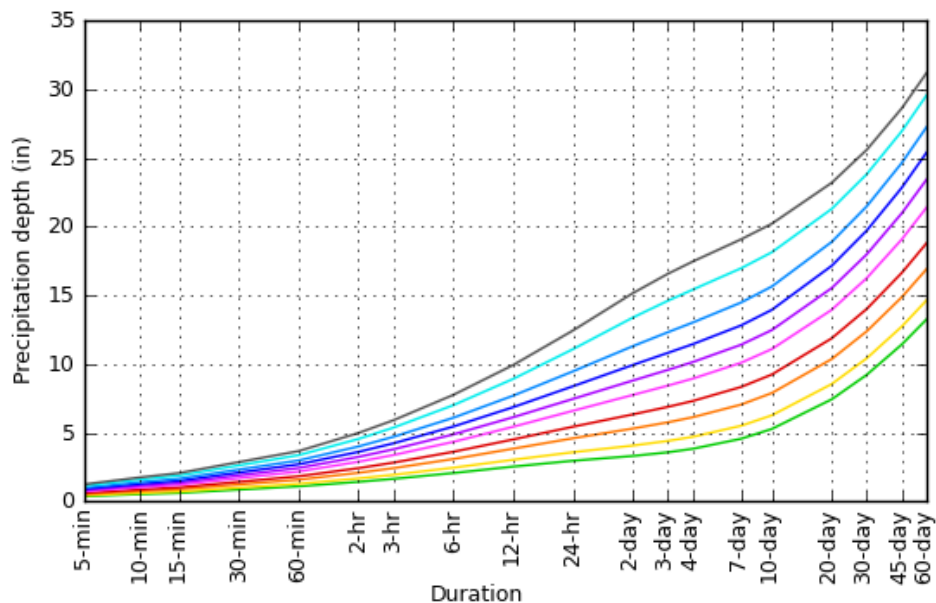
Please refer to NOAA Atlas 14 document for more information.

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### PF graphical

## PDS-based depth-duration-frequency (DDF) curves

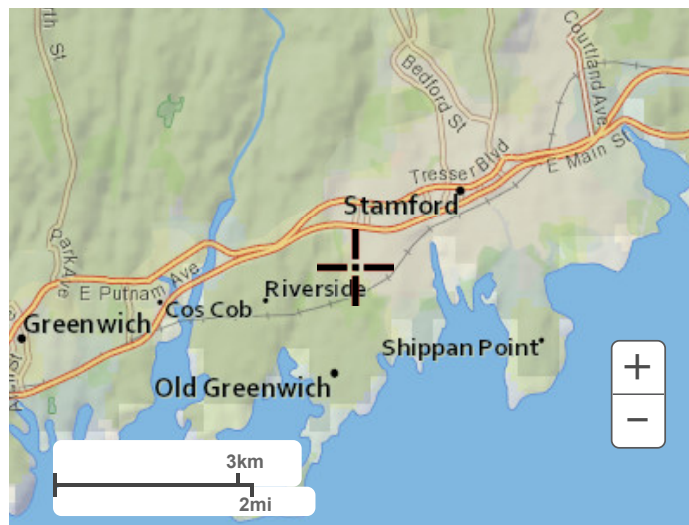
Latitude: 41.0386°, Longitude: -73.5606°



NOAA Atlas 14, Volume 10, Version 3

Created (GMT): Wed Jul 14 21:51:29 2021

[Back to Top](#)**Maps & arials****Small scale terrain**



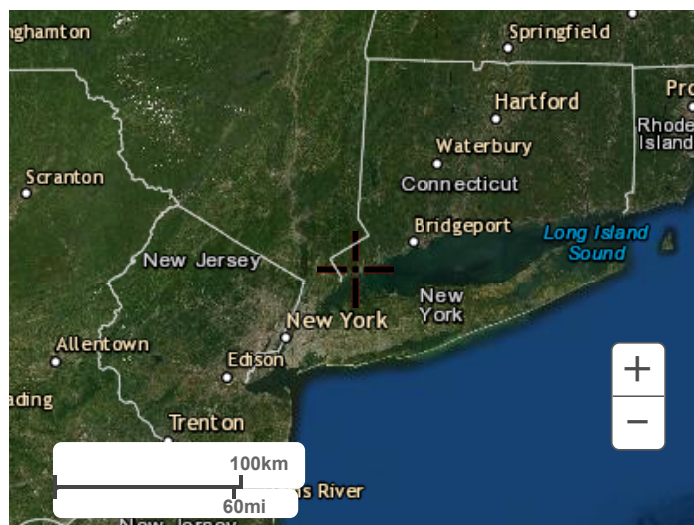
Large scale terrain



Large scale map



Large scale aerial



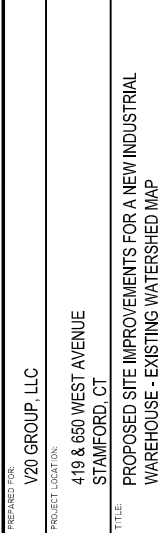
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1325 East West Highway  
Silver Spring, MD 20910  
Questions?: [HDSC.Questions@noaa.gov](mailto:HDSC.Questions@noaa.gov)

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**Appendix C**  
**Watershed Maps**



PROJECT No. 21157	
SCALE 1" = 120'	DATE 7/2/2021
DRAWN BY: SM	CHECKED BY: RP

**EX-WS**

[illegible]

**LANDTECH**

Civil Engineering • Site Planning  
Environmental Science & Engineering  
Construction Management & Planning  
Permit Coordinating & Management

518 Riverside Avenue • Westport, Connecticut 06880 203-454-2110 info@landtechconsult.com

518 Riverside Avenue • Westport, Connecticut 06880 203-454-2110 info@landtechconsult.com

PREPARED FOR:	V20 GROUP, LLC
PROJECT LOCATION:	419 & 650 WEST AVENUE STAMFORD, CT
TITLE:	PROPOSED SITE IMPROVEMENTS FOR A NEW INDUSTRIAL WAREHOUSE - PROPOSED WATERSHED MAP

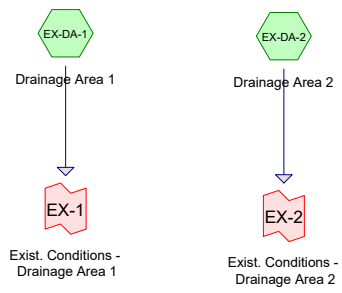
PROJECT No. 21157	
SCALE 1" = 120'	DATE 7/2/2021
DRAWN BY: SM	CHECKED BY: RP

**PR-WS**

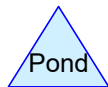
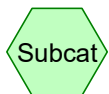
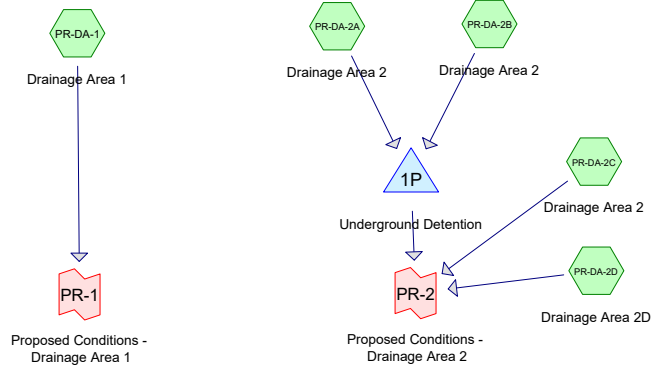
## **Appendix D**

### **HydroCAD® Summary Output**

# Existing Conditions



# Proposed Conditions



Routing Diagram for 419 & 650 West Avenue - Drainage - RP Workspace

Prepared by LandTech Associates, Inc., Printed 9/2/2021  
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## 419 & 650 West Avenue - Drainage - RP Workspace

Prepared by LandTech Associates, Inc.

Printed 9/2/2021

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Page 2

### Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	1yr Storm	Type III 24-hr		Default	24.00	1	2.95	2
2	2yr Storm	Type III 24-hr		Default	24.00	1	3.57	2
3	5yr Storm	Type III 24-hr		Default	24.00	1	4.59	2
4	10yr Storm	Type III 24-hr		Default	24.00	1	5.43	2
5	25yr Storm	Type III 24-hr		Default	24.00	1	6.59	2
6	100yr Storm	Type III 24-hr		Default	24.00	1	8.42	2

### Summary for Subcatchment EX-DA-1: Drainage Area 1

Runoff = 11.15 cfs @ 12.14 hrs, Volume= 39,466 cf, Depth> 1.34"

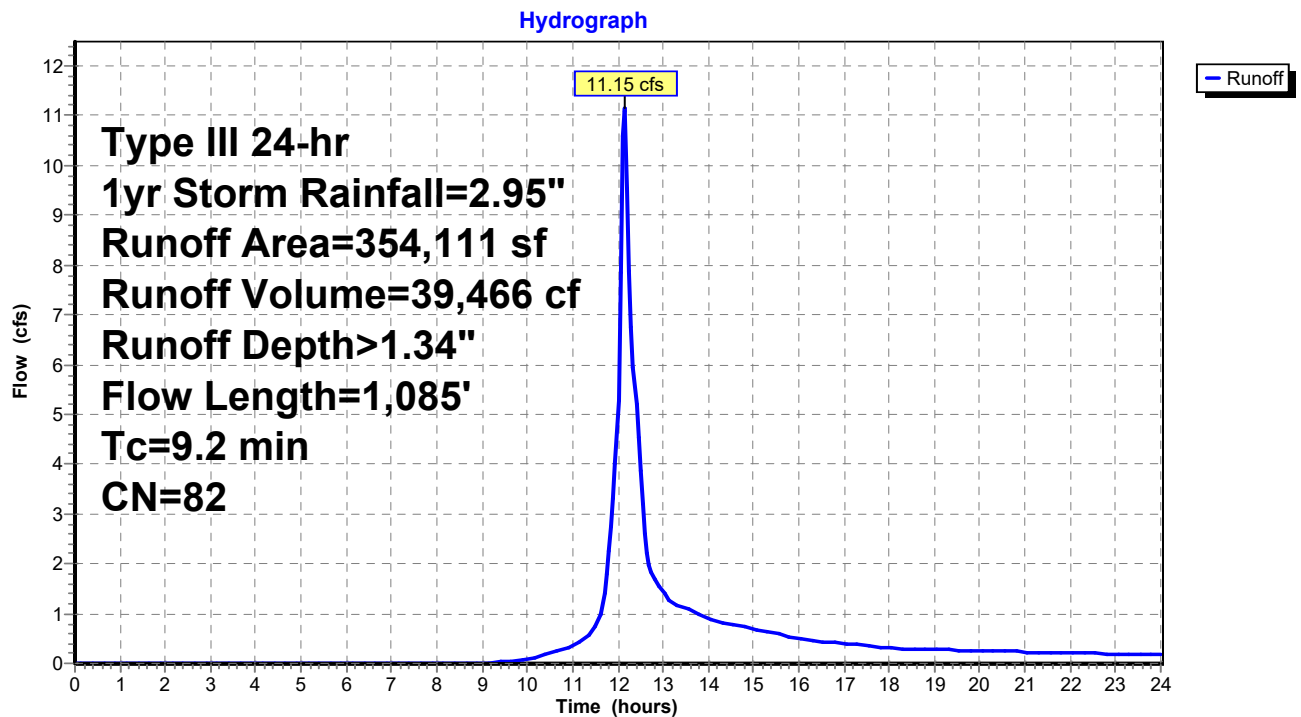
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 1yr Storm Rainfall=2.95"

Area (sf)	CN	Description
* 40,230	98	Existing Building Roof Area
* 64,877	98	Existing Parking/Driveway
* 3,024	98	Existing Walkways
6,845	61	>75% Grass cover, Good, HSG B
39,096	80	>75% Grass cover, Good, HSG D
16,789	55	Woods, Good, HSG B
183,250	77	Woods, Good, HSG D
354,111	82	Weighted Average
245,980		69.46% Pervious Area
108,131		30.54% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.5	70	0.0600	0.18		<b>Sheet Flow,</b> Grass: Dense n= 0.240 P2= 3.63"
0.3	95	0.1100	4.97		<b>Shallow Concentrated Flow,</b> Grassed Waterway Kv= 15.0 fps
0.6	80	0.0250	2.37		<b>Shallow Concentrated Flow,</b> Grassed Waterway Kv= 15.0 fps
1.8	840	0.0120	7.89	24.78	<b>Pipe Channel,</b> 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013
9.2	1,085	Total			

### Subcatchment EX-DA-1: Drainage Area 1



### Summary for Subcatchment EX-DA-2: Drainage Area 2

Runoff = 3.67 cfs @ 12.41 hrs, Volume= 20,757 cf, Depth> 0.77"

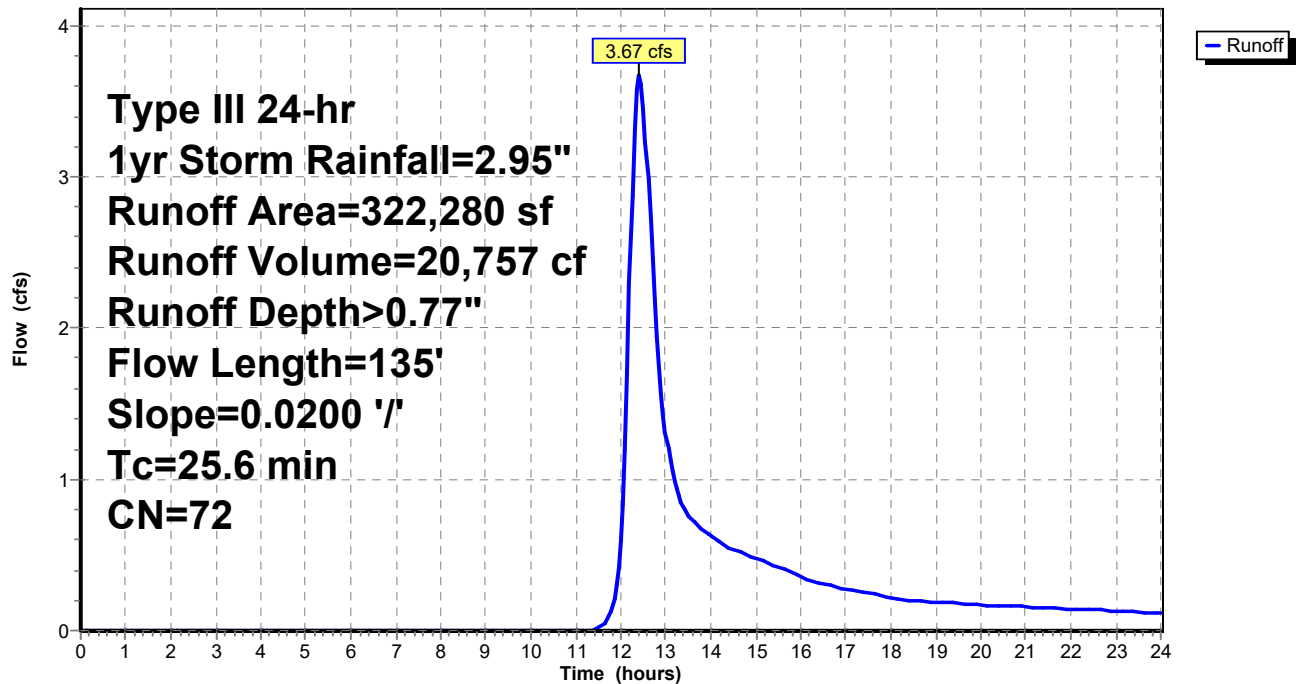
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 1yr Storm Rainfall=2.95"

	Area (sf)	CN	Description
*	62,634	98	Existing Building Roof Area
*	57,463	98	Existing Parking/Driveway
*	1,678	98	Existing Walkways
	33,495	61	>75% Grass cover, Good, HSG B
	918	80	>75% Grass cover, Good, HSG D
	161,382	55	Woods, Good, HSG B
	4,710	77	Woods, Good, HSG D
	322,280	72	Weighted Average
	200,505		62.21% Pervious Area
	121,775		37.79% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.6	135	0.0200	0.09		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.63"

### Subcatchment EX-DA-2: Drainage Area 2

Hydrograph



### Summary for Subcatchment PR-DA-1: Drainage Area 1

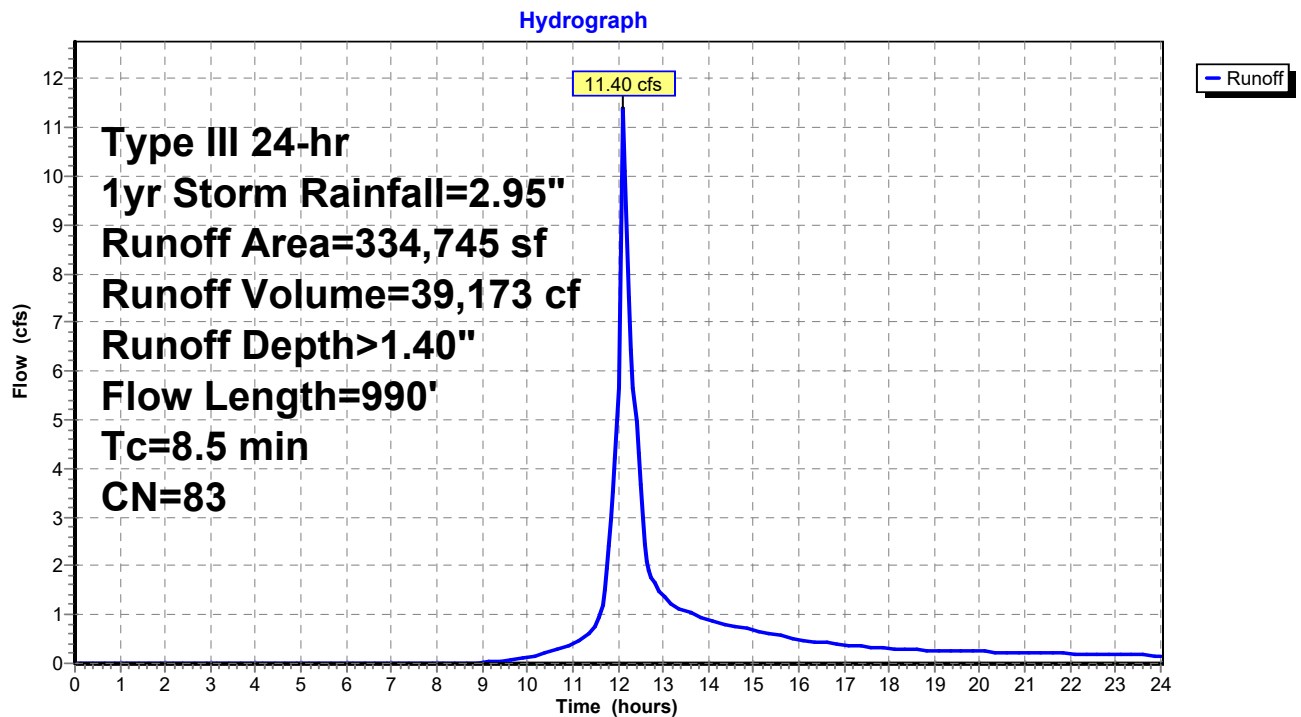
Runoff = 11.40 cfs @ 12.12 hrs, Volume= 39,173 cf, Depth> 1.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 1yr Storm Rainfall=2.95"

	Area (sf)	CN	Description
*	40,230	98	Existing Building Roof Area
*	61,104	98	Proposed Parking/Driveway
*	5,763	98	Proposed Walkways
	878	61	>75% Grass cover, Good, HSG B
	26,731	80	>75% Grass cover, Good, HSG D
	16,789	55	Woods, Good, HSG B
	183,250	77	Woods, Good, HSG D
	334,745	83	Weighted Average
	227,648		68.01% Pervious Area
	107,097		31.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.5	70	0.0600	0.18		<b>Sheet Flow,</b> Grass: Dense n= 0.240 P2= 3.63"
0.2	65	0.1100	4.97		<b>Shallow Concentrated Flow,</b> Grassed Waterway Kv= 15.0 fps
1.8	855	0.0120	7.89	24.78	<b>Pipe Channel,</b> 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013
8.5	990	Total			

**Subcatchment PR-DA-1: Drainage Area 1**



### Summary for Subcatchment PR-DA-2A: Drainage Area 2

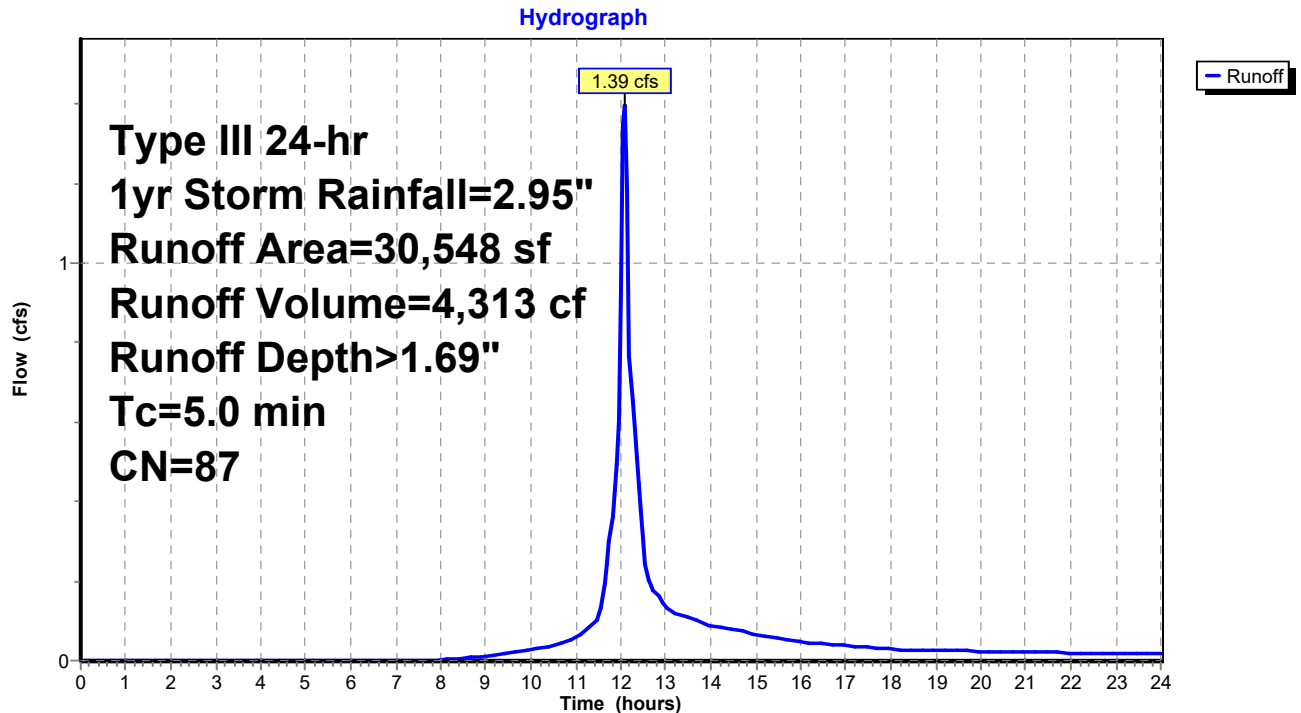
Runoff = 1.39 cfs @ 12.08 hrs, Volume= 4,313 cf, Depth> 1.69"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 1yr Storm Rainfall=2.95"

	Area (sf)	CN	Description
*	20,234	98	Proposed Pavement
*	922	98	Proposed Walkways
	9,313	61	>75% Grass cover, Good, HSG B
	79	80	>75% Grass cover, Good, HSG D
	30,548	87	Weighted Average
	9,392		30.75% Pervious Area
	21,156		69.25% Impervious Area

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

### Subcatchment PR-DA-2A: Drainage Area 2



### Summary for Subcatchment PR-DA-2B: Drainage Area 2

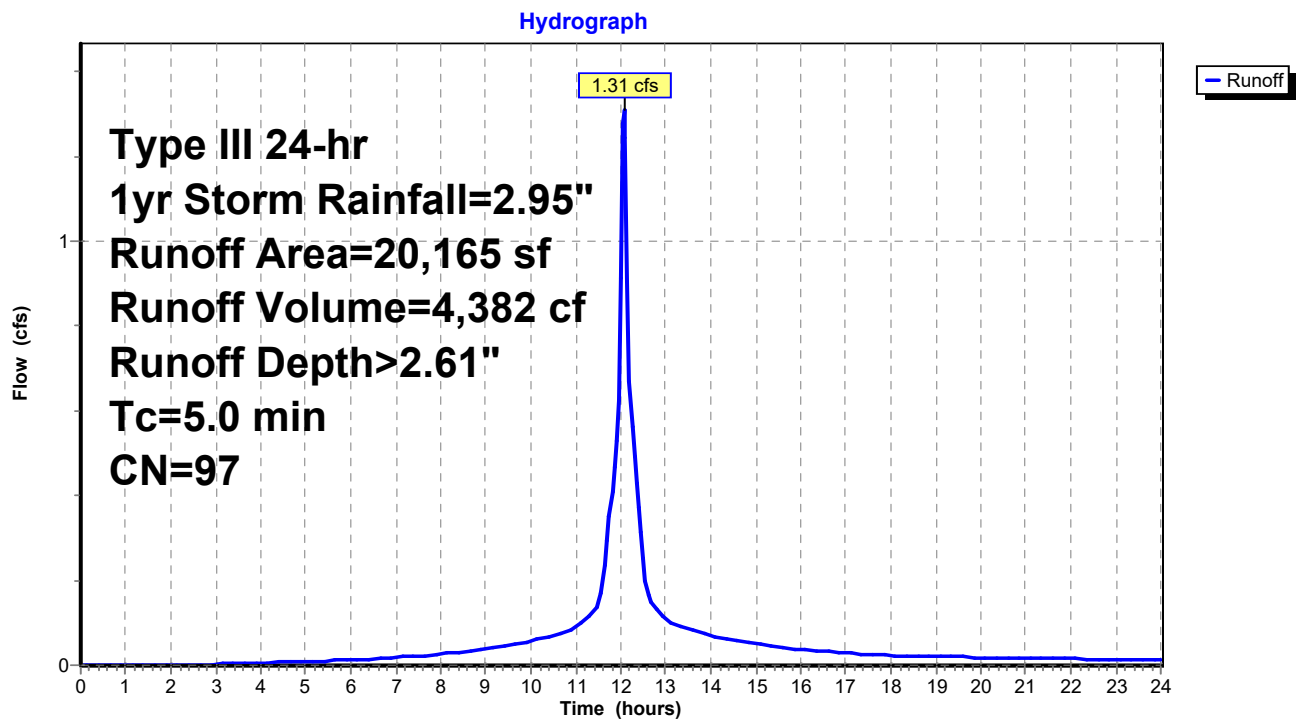
Runoff = 1.31 cfs @ 12.07 hrs, Volume= 4,382 cf, Depth> 2.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 1yr Storm Rainfall=2.95"

	Area (sf)	CN	Description
*	18,184	98	Proposed Pavement
*	866	98	Proposed Walkways
	1,115	80	>75% Grass cover, Good, HSG D
	20,165	97	Weighted Average
	1,115		5.53% Pervious Area
	19,050		94.47% Impervious Area

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

### Subcatchment PR-DA-2B: Drainage Area 2



### Summary for Subcatchment PR-DA-2C: Drainage Area 2

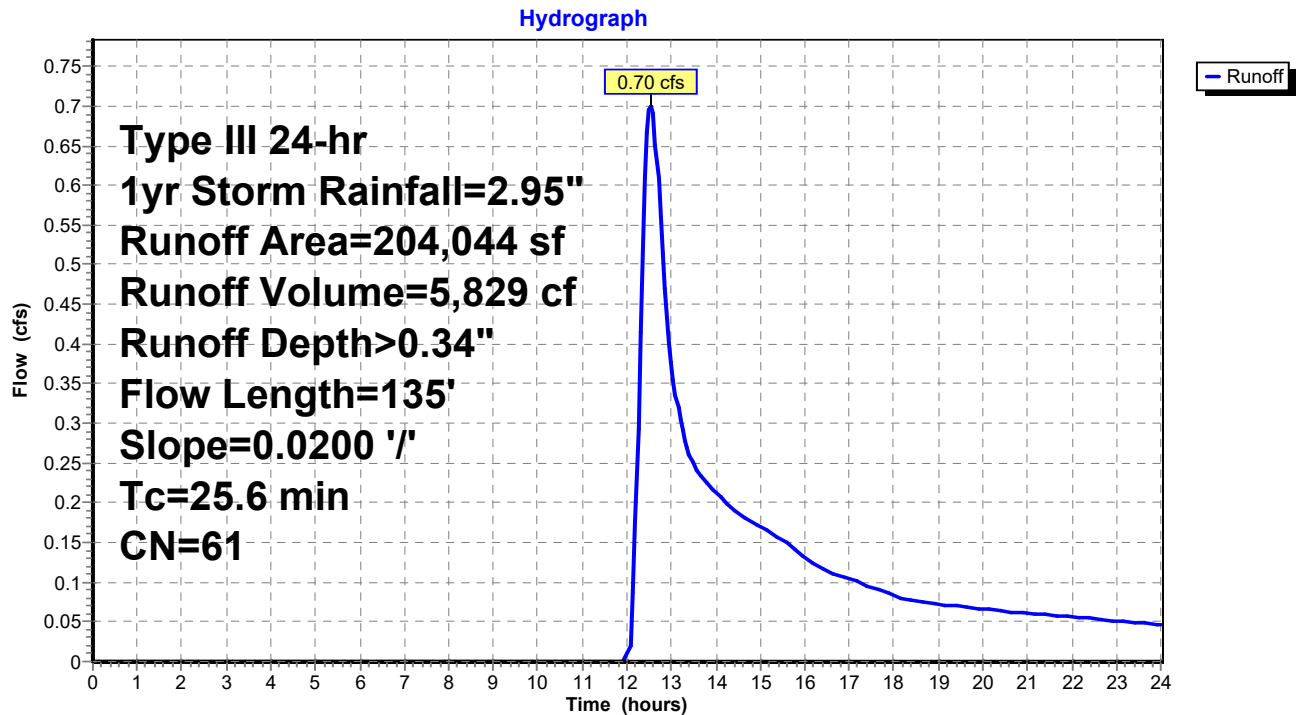
Runoff = 0.70 cfs @ 12.53 hrs, Volume= 5,829 cf, Depth> 0.34"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 1yr Storm Rainfall=2.95"

	Area (sf)	CN	Description
*	21,493	98	Proposed Parking/Driveway
	14,491	61	>75% Grass cover, Good, HSG B
	1,968	80	>75% Grass cover, Good, HSG D
	161,382	55	Woods, Good, HSG B
	4,710	77	Woods, Good, HSG D
	204,044	61	Weighted Average
	182,551		89.47% Pervious Area
	21,493		10.53% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.6	135	0.0200	0.09		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.63"

### Subcatchment PR-DA-2C: Drainage Area 2



### Summary for Subcatchment PR-DA-2D: Drainage Area 2D

Runoff = 6.19 cfs @ 12.03 hrs, Volume= 19,682 cf, Depth> 2.72"

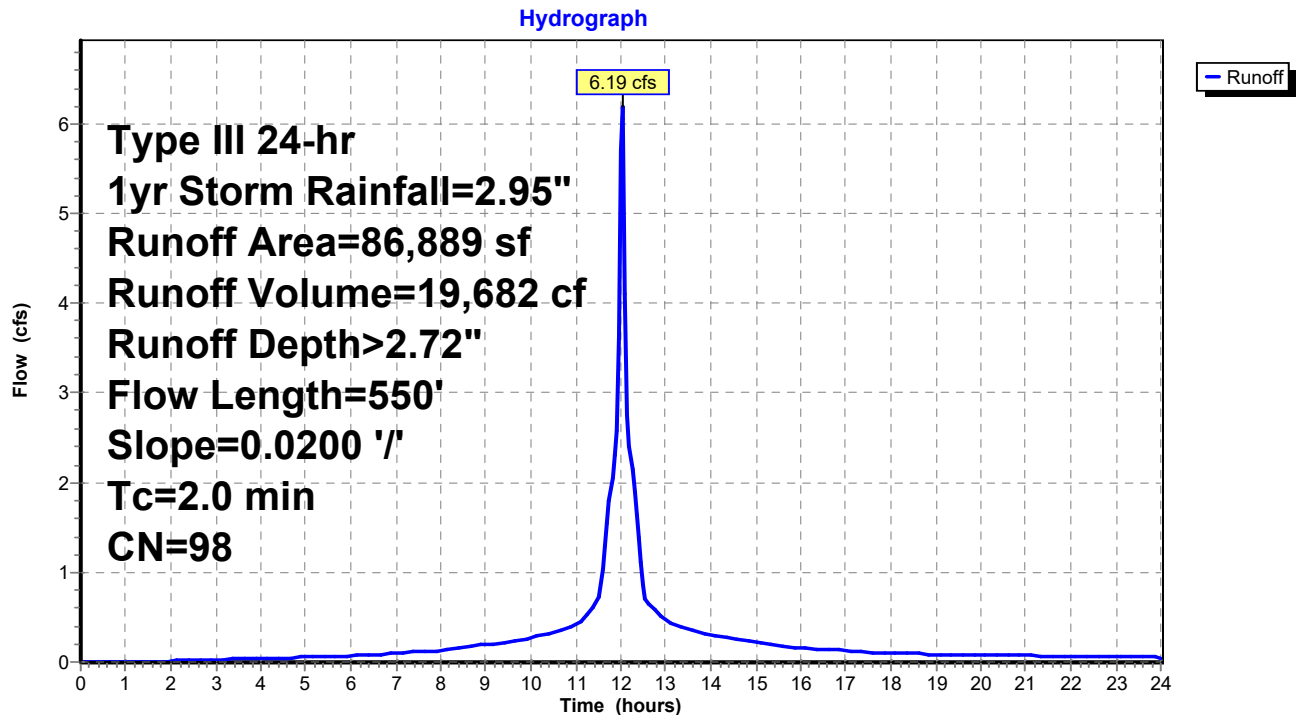
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 1yr Storm Rainfall=2.95"

Area (sf)	CN	Description
86,889	98	Roofs, HSG C
86,889		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.28		<b>Sheet Flow, Roof Flow to Roof Drain</b> Smooth surfaces n= 0.011 P2= 3.63"
1.3	500	0.0200	6.42	5.04	<b>Pipe Channel,</b> 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
2.0	550	Total			

### Subcatchment PR-DA-2D: Drainage Area 2D



### Summary for Pond 1P: Underground Detention

Inflow Area = 50,713 sf, 79.28% Impervious, Inflow Depth > 2.06" for 1yr Storm event  
 Inflow = 2.71 cfs @ 12.07 hrs, Volume= 8,695 cf  
 Outflow = 0.30 cfs @ 12.78 hrs, Volume= 4,141 cf, Atten= 89%, Lag= 42.4 min  
 Primary = 0.30 cfs @ 12.78 hrs, Volume= 4,141 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
 Peak Elev= 19.78' @ 12.78 hrs Surf.Area= 0.094 ac Storage= 0.119 af

Plug-Flow detention time= 278.4 min calculated for 4,132 cf (48% of inflow)  
 Center-of-Mass det. time= 159.7 min ( 953.4 - 793.7 )

Volume	Invert	Avail.Storage	Storage Description
#1A	18.00'	0.078 af	<b>40.17'W x 101.50'L x 3.54'H Field A</b> 0.331 af Overall - 0.136 af Embedded = 0.195 af x 40.0% Voids
#2A	18.50'	0.136 af	<b>Cultec R-330XLHD</b> x 112 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 8 rows
		0.214 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	18.80'	<b>24.0" Round Culvert</b> L= 30.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 18.80' / 18.50' S= 0.0100 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 3.14 sf
#2	Device 1	19.50'	<b>10.5" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#3	Device 1	21.40'	<b>6.0' long Sharp-Crested Rectangular Weir</b> 0 End Contraction(s) 1.0' Crest Height

**Primary OutFlow** Max=0.30 cfs @ 12.78 hrs HW=19.78' TW=0.00' (Dynamic Tailwater)

- 1=Culvert (Passes 0.30 cfs of 4.09 cfs potential flow)
- 2=Orifice/Grate (Orifice Controls 0.30 cfs @ 1.81 fps)
- 3=Sharp-Crested Rectangular Weir( Controls 0.00 cfs)

## Pond 1P: Underground Detention - Chamber Wizard Field A

### Chamber Model = Cultec R-330XLHD (Cultec Recharger® 330XLHD)

Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf

Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap

Row Length Adjustment= +1.50' x 7.45 sf x 8 rows

52.0" Wide + 6.0" Spacing = 58.0" C-C Row Spacing

14 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 99.50' Row Length +12.0" End Stone x 2 =  
101.50' Base Length

8 Rows x 52.0" Wide + 6.0" Spacing x 7 + 12.0" Side Stone x 2 = 40.17' Base Width

6.0" Stone Base + 30.5" Chamber Height + 6.0" Stone Cover = 3.54' Field Height

112 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 8 Rows = 5,931.0 cf Chamber Storage

14,439.1 cf Field - 5,931.0 cf Chambers = 8,508.1 cf Stone x 40.0% Voids = 3,403.2 cf Stone Storage

Chamber Storage + Stone Storage = 9,334.2 cf = 0.214 af

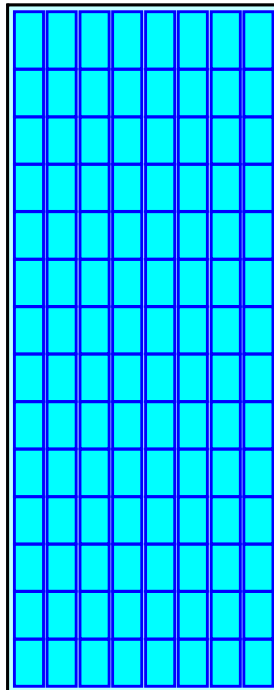
Overall Storage Efficiency = 64.6%

Overall System Size = 101.50' x 40.17' x 3.54'

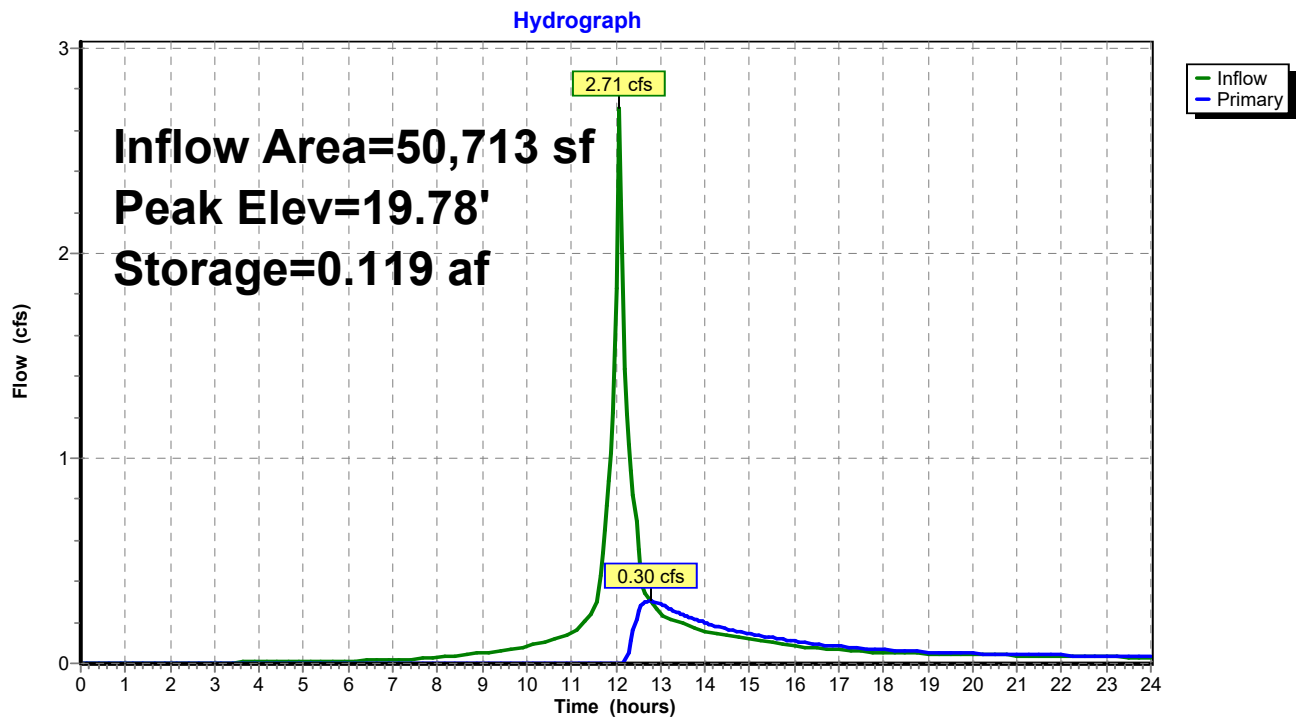
112 Chambers

534.8 cy Field

315.1 cy Stone



### Pond 1P: Underground Detention

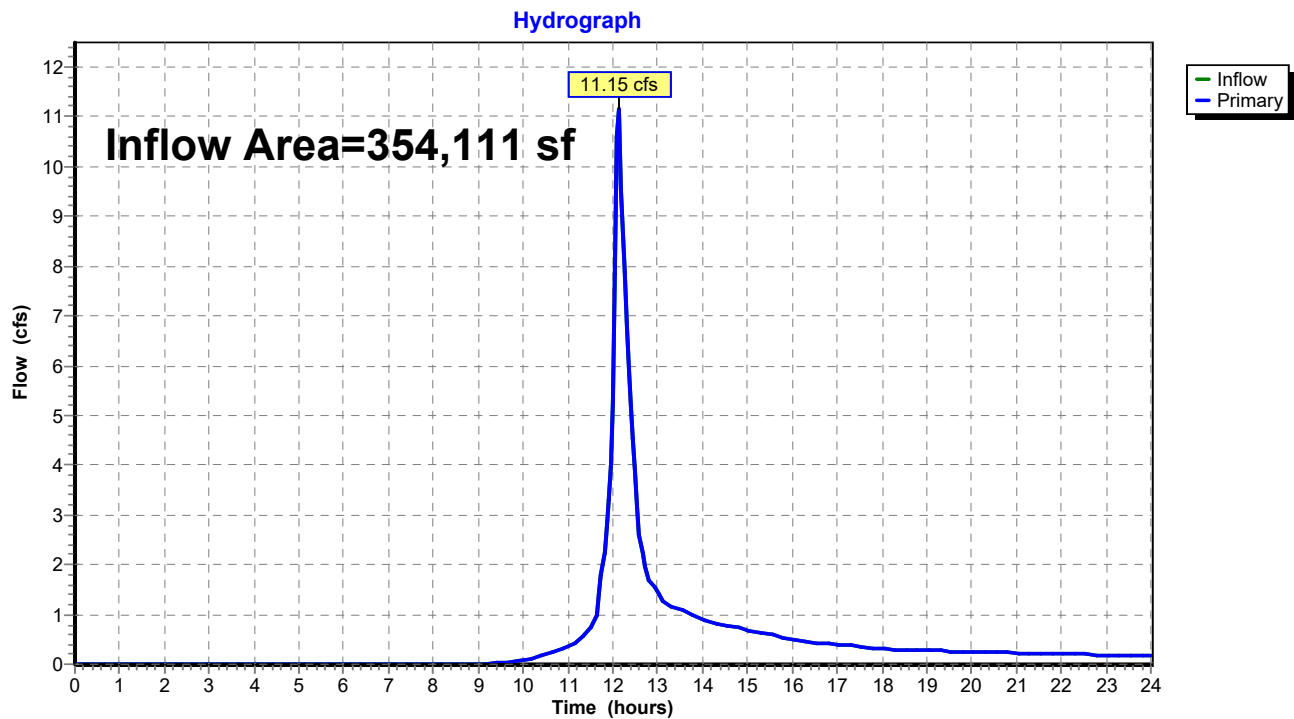


### Summary for Link EX-1: Exist. Conditions - Drainage Area 1

Inflow Area = 354,111 sf, 30.54% Impervious, Inflow Depth > 1.34" for 1yr Storm event  
Inflow = 11.15 cfs @ 12.14 hrs, Volume= 39,466 cf  
Primary = 11.15 cfs @ 12.14 hrs, Volume= 39,466 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

### Link EX-1: Exist. Conditions - Drainage Area 1

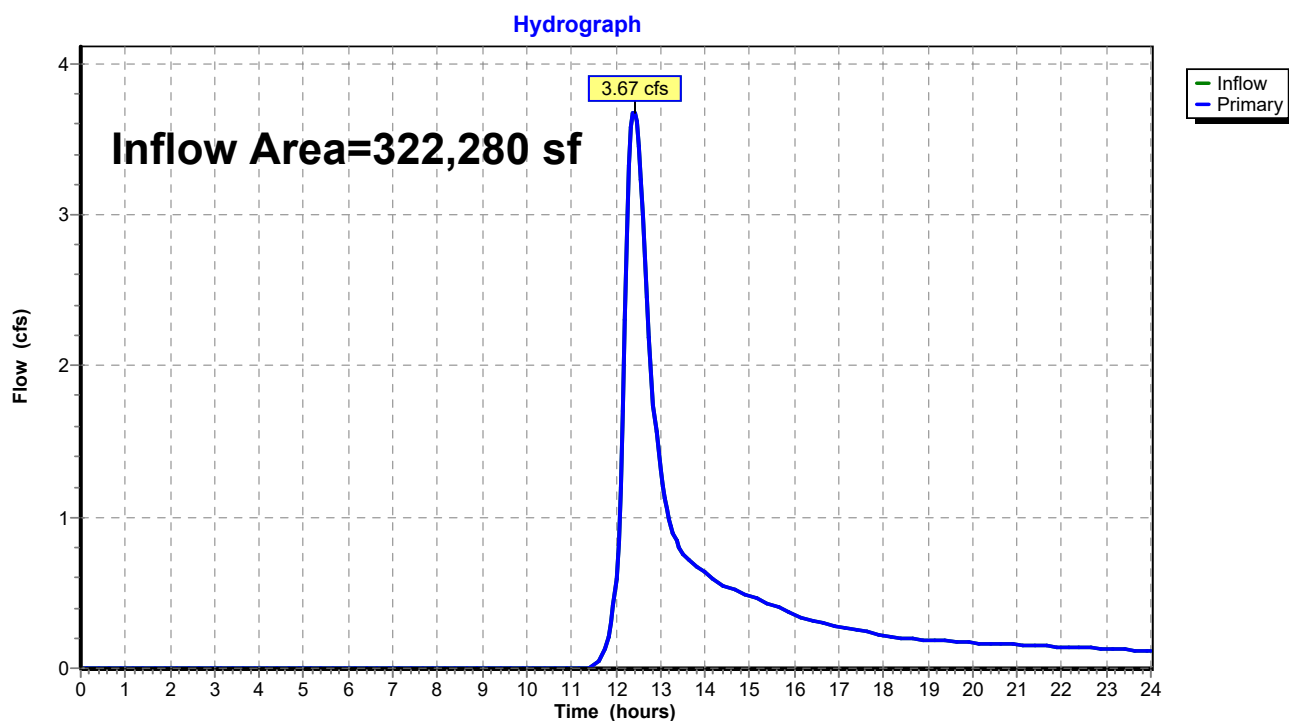


### Summary for Link EX-2: Exist. Conditions - Drainage Area 2

Inflow Area = 322,280 sf, 37.79% Impervious, Inflow Depth > 0.77" for 1yr Storm event  
Inflow = 3.67 cfs @ 12.41 hrs, Volume= 20,757 cf  
Primary = 3.67 cfs @ 12.41 hrs, Volume= 20,757 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

### Link EX-2: Exist. Conditions - Drainage Area 2

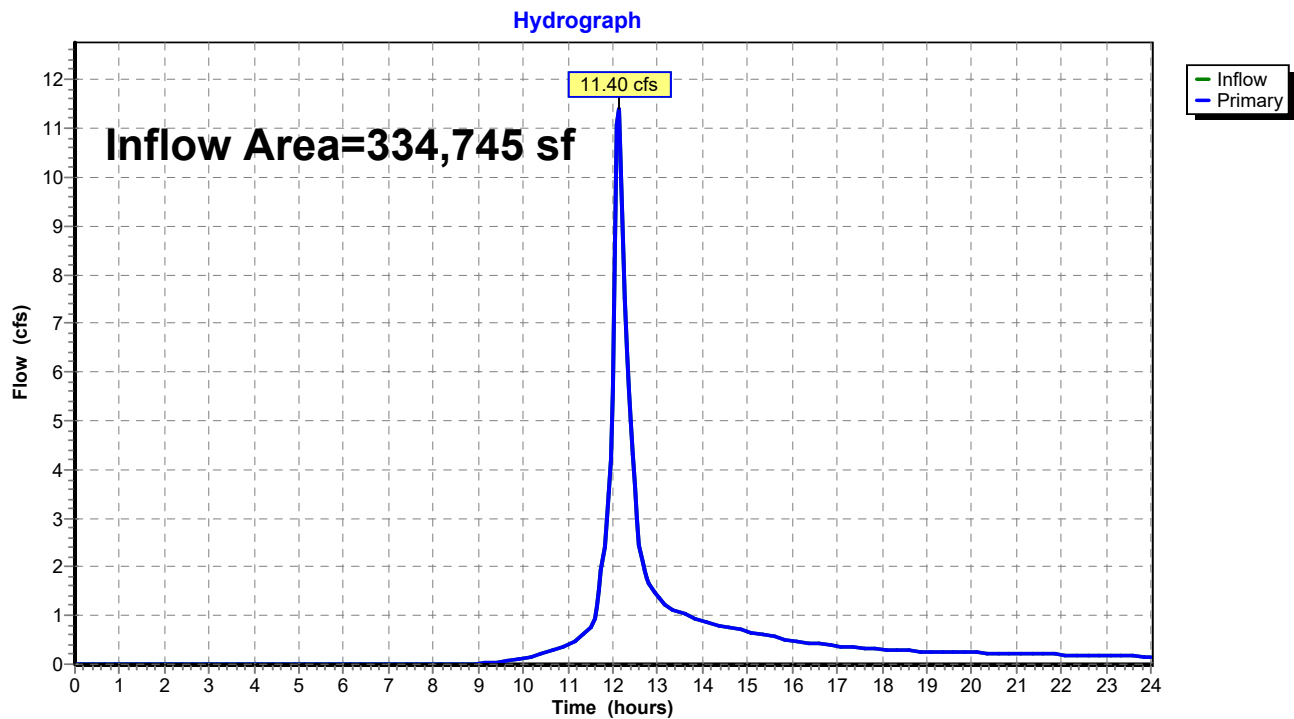


### Summary for Link PR-1: Proposed Conditions - Drainage Area 1

Inflow Area = 334,745 sf, 31.99% Impervious, Inflow Depth > 1.40" for 1yr Storm event  
Inflow = 11.40 cfs @ 12.12 hrs, Volume= 39,173 cf  
Primary = 11.40 cfs @ 12.12 hrs, Volume= 39,173 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

### Link PR-1: Proposed Conditions - Drainage Area 1

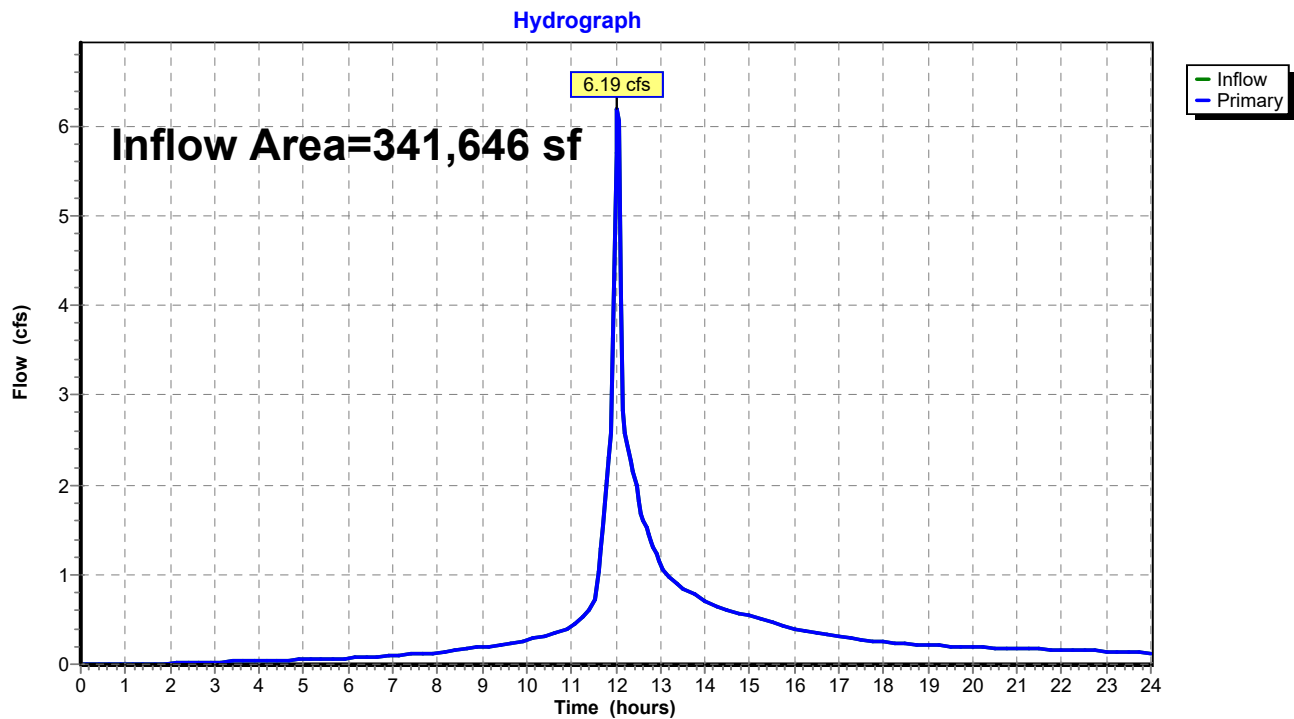


### Summary for Link PR-2: Proposed Conditions - Drainage Area 2

Inflow Area = 341,646 sf, 43.49% Impervious, Inflow Depth > 1.04" for 1yr Storm event  
Inflow = 6.19 cfs @ 12.03 hrs, Volume= 29,652 cf  
Primary = 6.19 cfs @ 12.03 hrs, Volume= 29,652 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

### Link PR-2: Proposed Conditions - Drainage Area 2



### Summary for Subcatchment EX-DA-1: Drainage Area 1

Runoff = 15.43 cfs @ 12.13 hrs, Volume= 54,226 cf, Depth> 1.84"

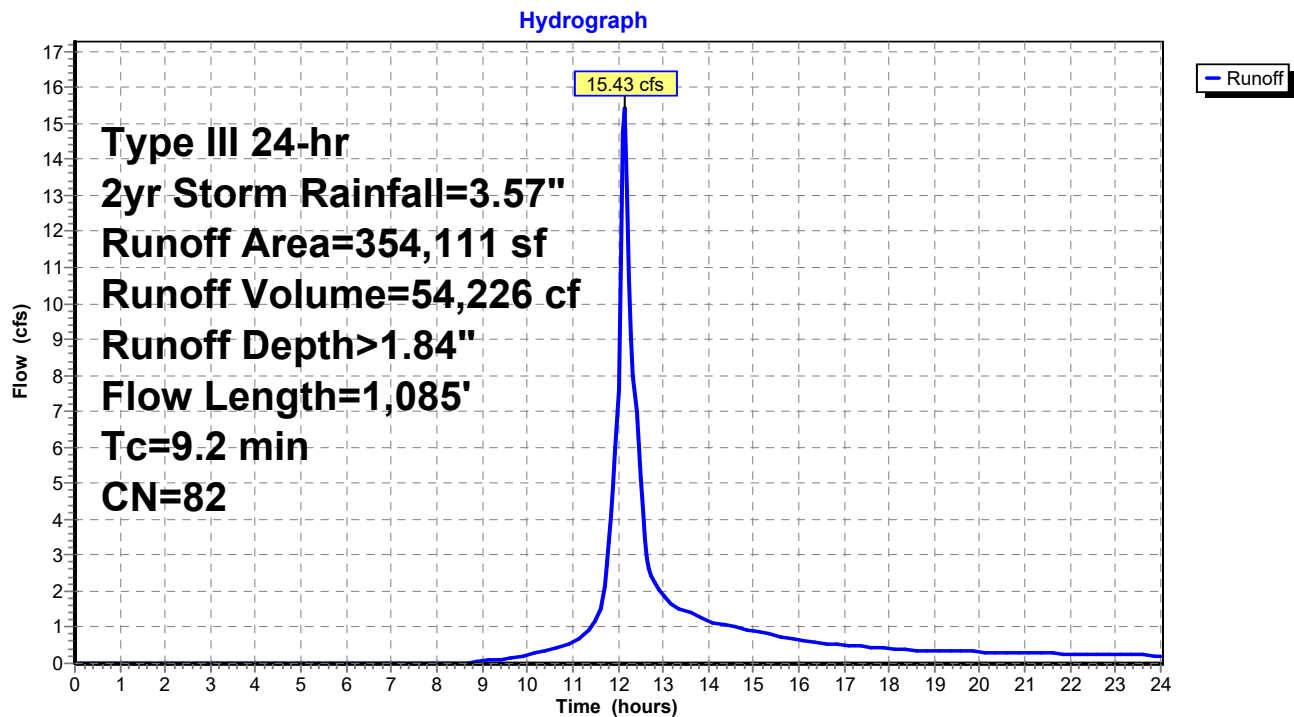
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 2yr Storm Rainfall=3.57"

	Area (sf)	CN	Description
*	40,230	98	Existing Building Roof Area
*	64,877	98	Existing Parking/Driveway
*	3,024	98	Existing Walkways
	6,845	61	>75% Grass cover, Good, HSG B
	39,096	80	>75% Grass cover, Good, HSG D
	16,789	55	Woods, Good, HSG B
	183,250	77	Woods, Good, HSG D
	354,111	82	Weighted Average
	245,980		69.46% Pervious Area
	108,131		30.54% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.5	70	0.0600	0.18		<b>Sheet Flow,</b> Grass: Dense n= 0.240 P2= 3.63"
0.3	95	0.1100	4.97		<b>Shallow Concentrated Flow,</b> Grassed Waterway Kv= 15.0 fps
0.6	80	0.0250	2.37		<b>Shallow Concentrated Flow,</b> Grassed Waterway Kv= 15.0 fps
1.8	840	0.0120	7.89	24.78	<b>Pipe Channel,</b> 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013
9.2	1,085	Total			

### Subcatchment EX-DA-1: Drainage Area 1



### Summary for Subcatchment EX-DA-2: Drainage Area 2

Runoff = 5.79 cfs @ 12.39 hrs, Volume= 31,135 cf, Depth> 1.16"

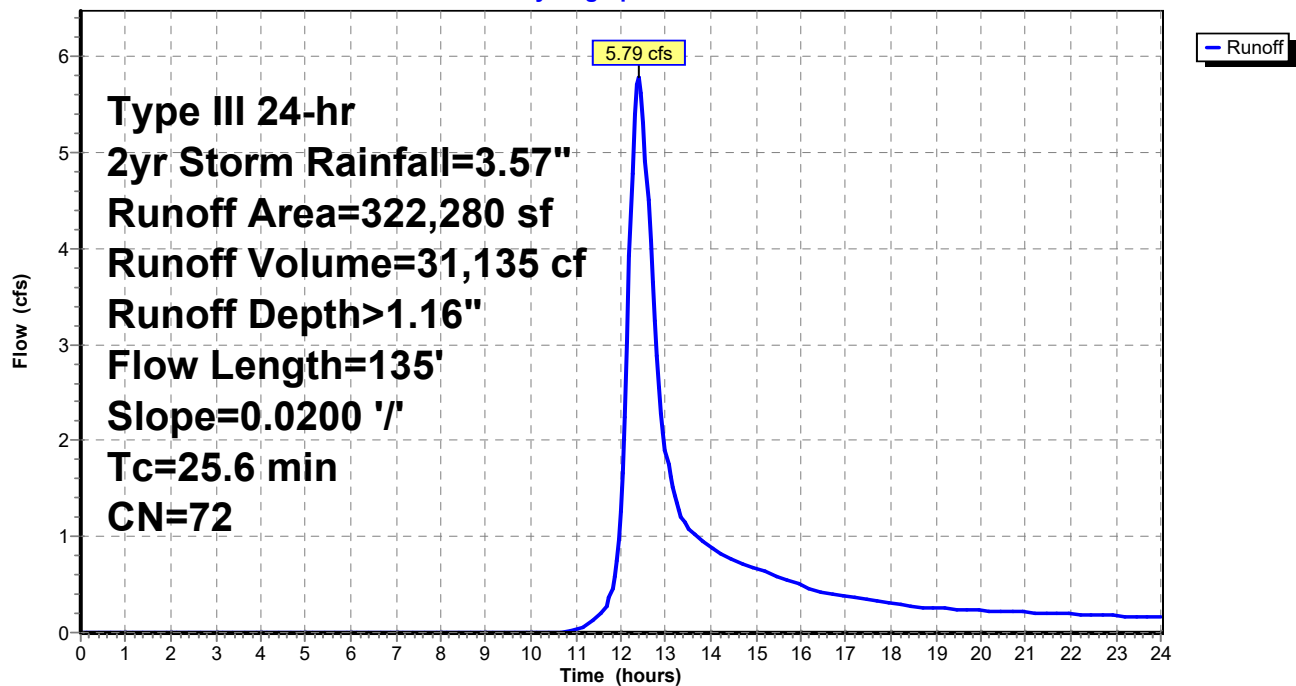
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 2yr Storm Rainfall=3.57"

	Area (sf)	CN	Description
*	62,634	98	Existing Building Roof Area
*	57,463	98	Existing Parking/Driveway
*	1,678	98	Existing Walkways
	33,495	61	>75% Grass cover, Good, HSG B
	918	80	>75% Grass cover, Good, HSG D
	161,382	55	Woods, Good, HSG B
	4,710	77	Woods, Good, HSG D
	322,280	72	Weighted Average
	200,505		62.21% Pervious Area
	121,775		37.79% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.6	135	0.0200	0.09		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.63"

### Subcatchment EX-DA-2: Drainage Area 2

Hydrograph



### Summary for Subcatchment PR-DA-1: Drainage Area 1

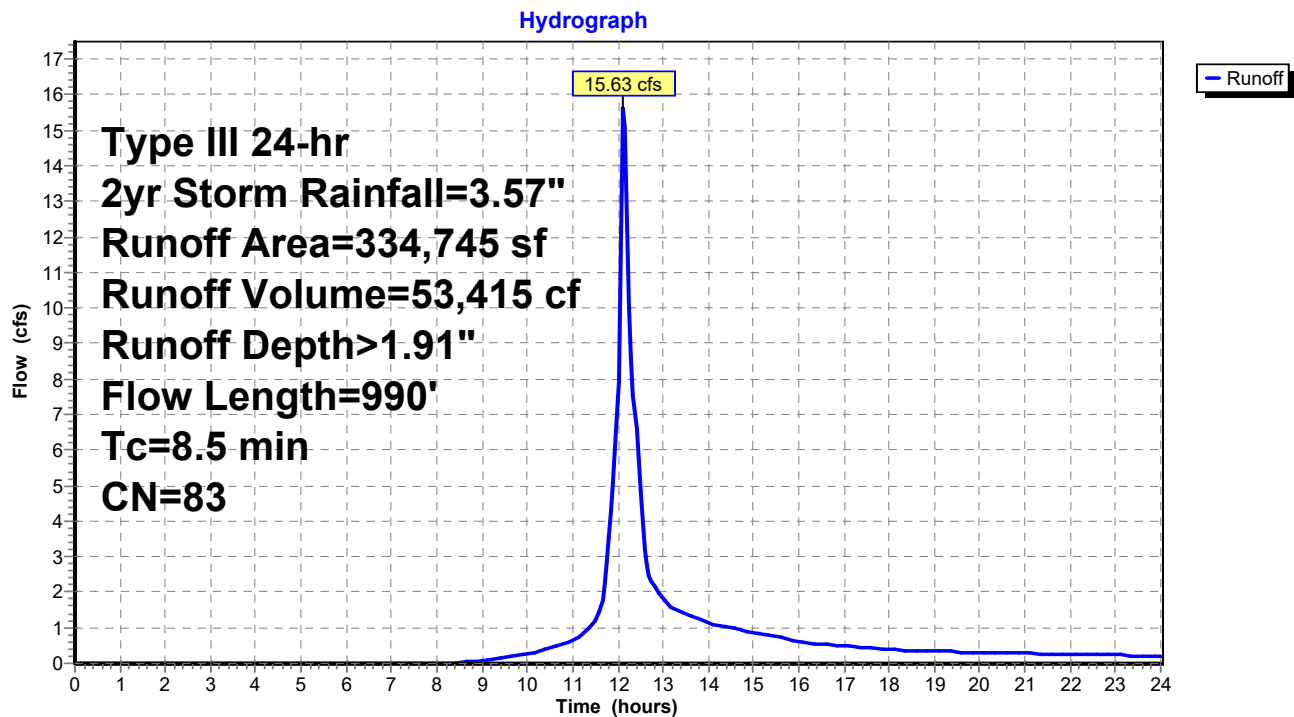
Runoff = 15.63 cfs @ 12.12 hrs, Volume= 53,415 cf, Depth> 1.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2yr Storm Rainfall=3.57"

	Area (sf)	CN	Description
*	40,230	98	Existing Building Roof Area
*	61,104	98	Proposed Parking/Driveway
*	5,763	98	Proposed Walkways
	878	61	>75% Grass cover, Good, HSG B
	26,731	80	>75% Grass cover, Good, HSG D
	16,789	55	Woods, Good, HSG B
	183,250	77	Woods, Good, HSG D
	334,745	83	Weighted Average
	227,648		68.01% Pervious Area
	107,097		31.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.5	70	0.0600	0.18		<b>Sheet Flow,</b> Grass: Dense n= 0.240 P2= 3.63"
0.2	65	0.1100	4.97		<b>Shallow Concentrated Flow,</b> Grassed Waterway Kv= 15.0 fps
1.8	855	0.0120	7.89	24.78	<b>Pipe Channel,</b> 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013
8.5	990	Total			

### Subcatchment PR-DA-1: Drainage Area 1



### Summary for Subcatchment PR-DA-2A: Drainage Area 2

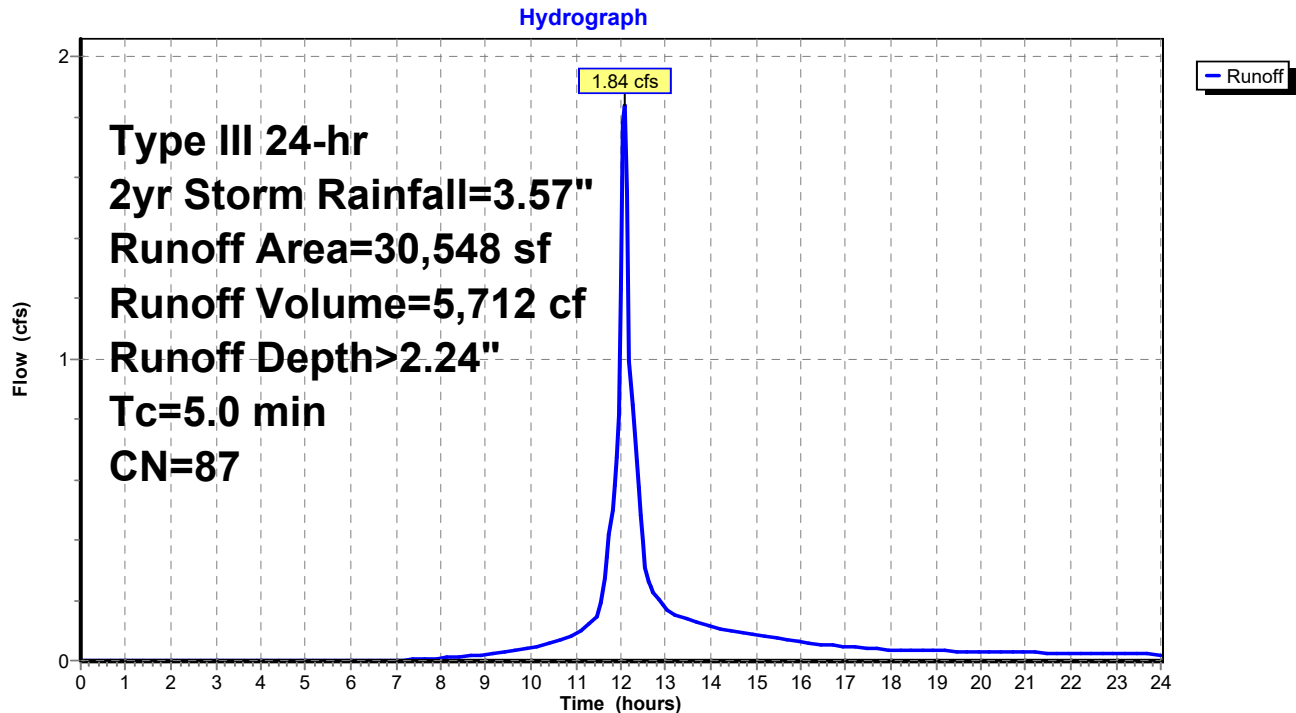
Runoff = 1.84 cfs @ 12.08 hrs, Volume= 5,712 cf, Depth> 2.24"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 2yr Storm Rainfall=3.57"

	Area (sf)	CN	Description
*	20,234	98	Proposed Pavement
*	922	98	Proposed Walkways
	9,313	61	>75% Grass cover, Good, HSG B
	79	80	>75% Grass cover, Good, HSG D
	30,548	87	Weighted Average
	9,392		30.75% Pervious Area
	21,156		69.25% Impervious Area

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

### Subcatchment PR-DA-2A: Drainage Area 2



### Summary for Subcatchment PR-DA-2B: Drainage Area 2

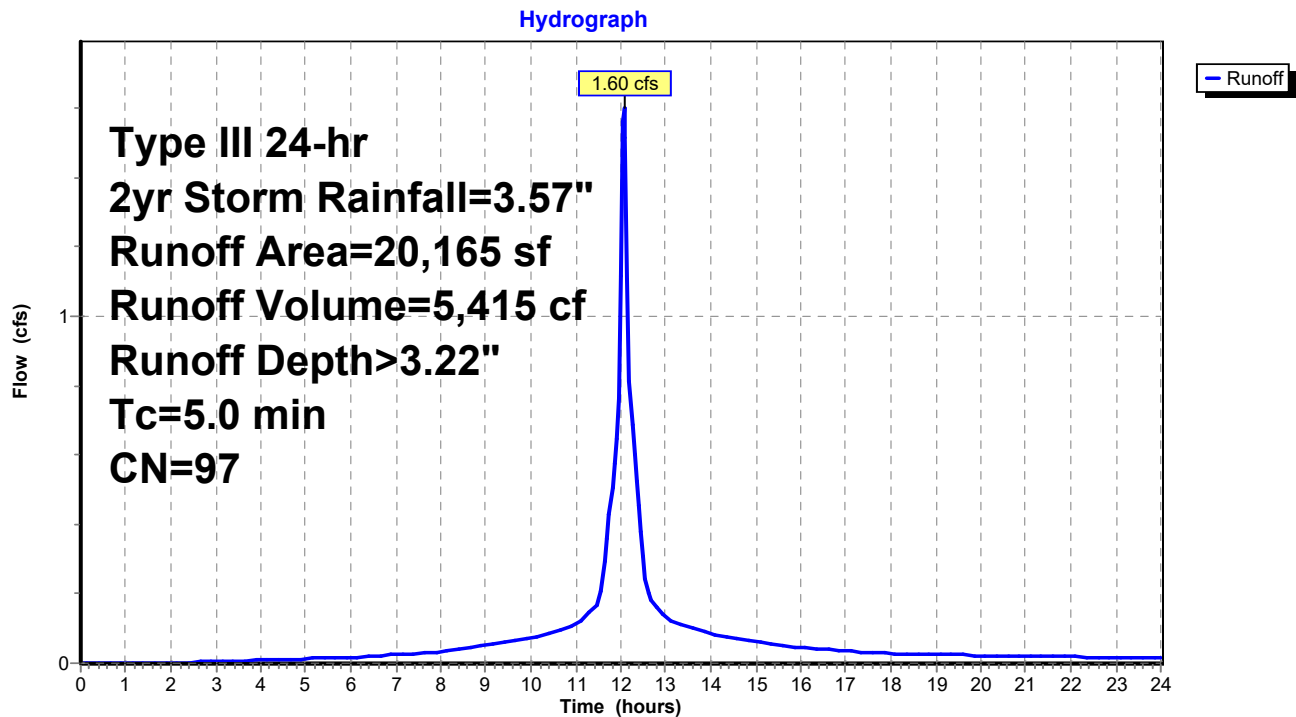
Runoff = 1.60 cfs @ 12.07 hrs, Volume= 5,415 cf, Depth> 3.22"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 2yr Storm Rainfall=3.57"

	Area (sf)	CN	Description
*	18,184	98	Proposed Pavement
*	866	98	Proposed Walkways
	1,115	80	>75% Grass cover, Good, HSG D
	20,165	97	Weighted Average
	1,115		5.53% Pervious Area
	19,050		94.47% Impervious Area

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

### Subcatchment PR-DA-2B: Drainage Area 2



### Summary for Subcatchment PR-DA-2C: Drainage Area 2

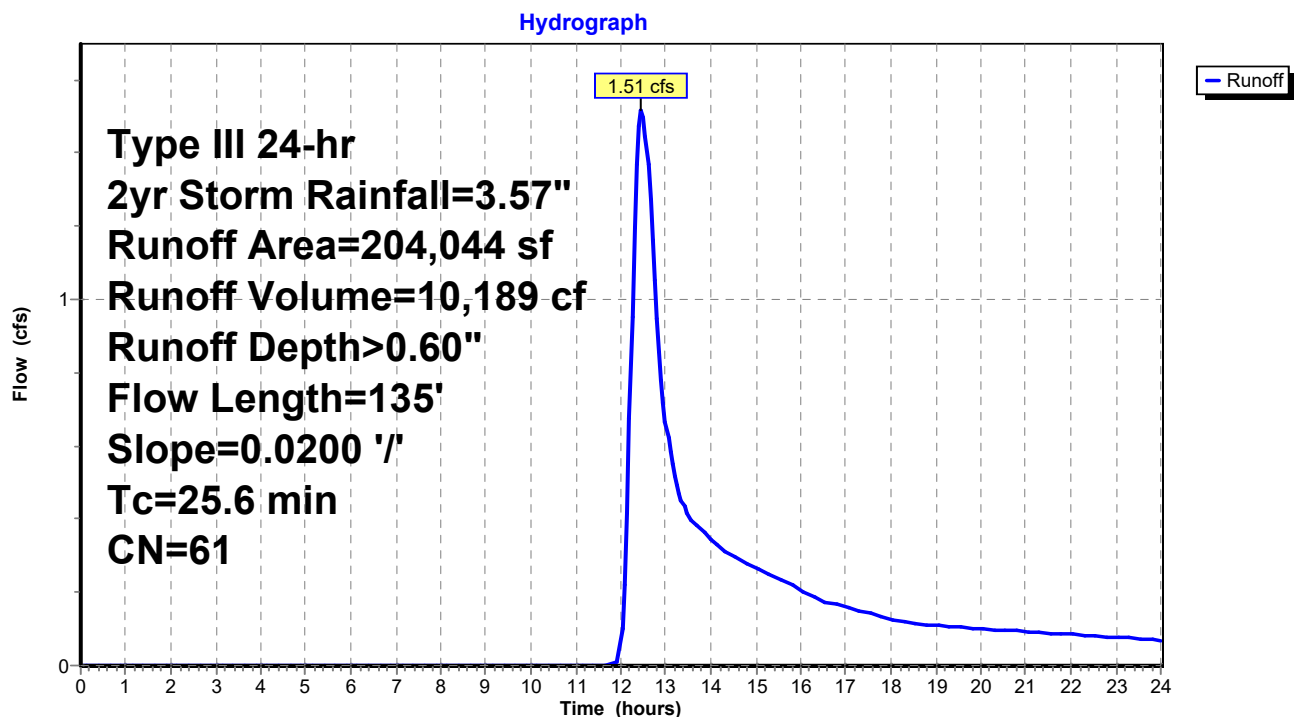
Runoff = 1.51 cfs @ 12.46 hrs, Volume= 10,189 cf, Depth> 0.60"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 2yr Storm Rainfall=3.57"

	Area (sf)	CN	Description
*	21,493	98	Proposed Parking/Driveway
	14,491	61	>75% Grass cover, Good, HSG B
	1,968	80	>75% Grass cover, Good, HSG D
	161,382	55	Woods, Good, HSG B
	4,710	77	Woods, Good, HSG D
	204,044	61	Weighted Average
	182,551		89.47% Pervious Area
	21,493		10.53% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.6	135	0.0200	0.09		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.63"

### Subcatchment PR-DA-2C: Drainage Area 2



### Summary for Subcatchment PR-DA-2D: Drainage Area 2D

Runoff = 7.52 cfs @ 12.03 hrs, Volume= 24,155 cf, Depth> 3.34"

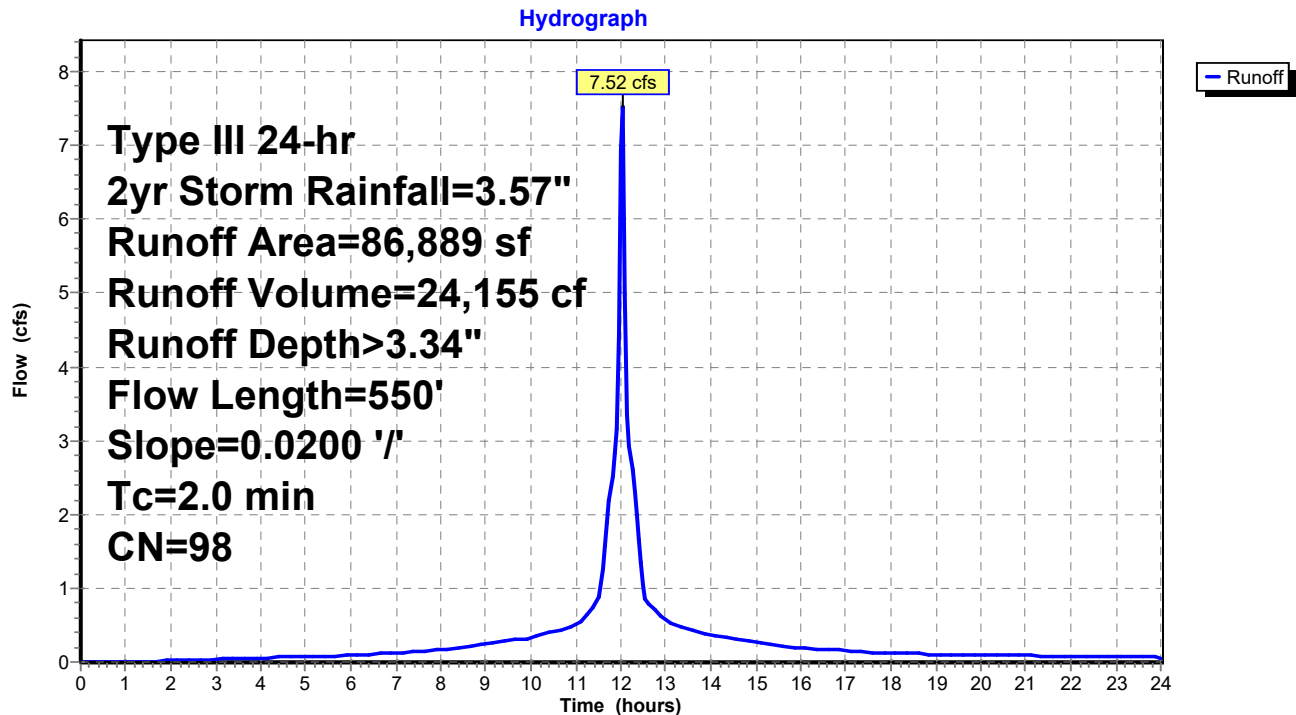
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 2yr Storm Rainfall=3.57"

Area (sf)	CN	Description
86,889	98	Roofs, HSG C
86,889		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.28		<b>Sheet Flow, Roof Flow to Roof Drain</b> Smooth surfaces n= 0.011 P2= 3.63"
1.3	500	0.0200	6.42	5.04	<b>Pipe Channel,</b> 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
2.0	550	Total			

### Subcatchment PR-DA-2D: Drainage Area 2D



### Summary for Pond 1P: Underground Detention

Inflow Area = 50,713 sf, 79.28% Impervious, Inflow Depth > 2.63" for 2yr Storm event  
 Inflow = 3.45 cfs @ 12.07 hrs, Volume= 11,127 cf  
 Outflow = 0.88 cfs @ 12.45 hrs, Volume= 6,542 cf, Atten= 74%, Lag= 22.4 min  
 Primary = 0.88 cfs @ 12.45 hrs, Volume= 6,542 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
 Peak Elev= 20.01' @ 12.45 hrs Surf.Area= 0.094 ac Storage= 0.136 af

Plug-Flow detention time= 226.8 min calculated for 6,542 cf (59% of inflow)  
 Center-of-Mass det. time= 120.0 min ( 908.2 - 788.2 )

Volume	Invert	Avail.Storage	Storage Description
#1A	18.00'	0.078 af	<b>40.17'W x 101.50'L x 3.54'H Field A</b> 0.331 af Overall - 0.136 af Embedded = 0.195 af x 40.0% Voids
#2A	18.50'	0.136 af	<b>Cultec R-330XLHD</b> x 112 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 8 rows
		0.214 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	18.80'	<b>24.0" Round Culvert</b> L= 30.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 18.80' / 18.50' S= 0.0100 ' / Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 3.14 sf
#2	Device 1	19.50'	<b>10.5" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#3	Device 1	21.40'	<b>6.0' long Sharp-Crested Rectangular Weir</b> 0 End Contraction(s) 1.0' Crest Height

**Primary OutFlow** Max=0.88 cfs @ 12.45 hrs HW=20.01' TW=0.00' (Dynamic Tailwater)

- 1=Culvert (Passes 0.88 cfs of 5.86 cfs potential flow)
- 2=Orifice/Grate (Orifice Controls 0.88 cfs @ 2.43 fps)
- 3=Sharp-Crested Rectangular Weir( Controls 0.00 cfs)

## Pond 1P: Underground Detention - Chamber Wizard Field A

### Chamber Model = Cultec R-330XLHD (Cultec Recharger® 330XLHD)

Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf

Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap

Row Length Adjustment= +1.50' x 7.45 sf x 8 rows

52.0" Wide + 6.0" Spacing = 58.0" C-C Row Spacing

14 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 99.50' Row Length +12.0" End Stone x 2 =  
101.50' Base Length

8 Rows x 52.0" Wide + 6.0" Spacing x 7 + 12.0" Side Stone x 2 = 40.17' Base Width

6.0" Stone Base + 30.5" Chamber Height + 6.0" Stone Cover = 3.54' Field Height

112 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 8 Rows = 5,931.0 cf Chamber Storage

14,439.1 cf Field - 5,931.0 cf Chambers = 8,508.1 cf Stone x 40.0% Voids = 3,403.2 cf Stone Storage

Chamber Storage + Stone Storage = 9,334.2 cf = 0.214 af

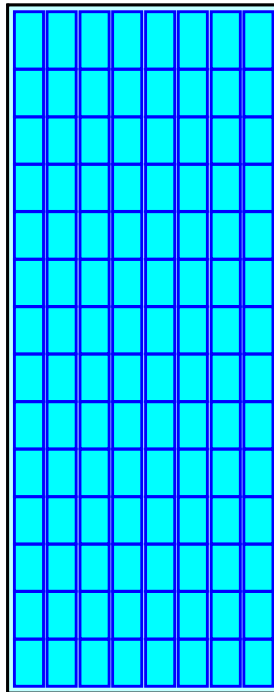
Overall Storage Efficiency = 64.6%

Overall System Size = 101.50' x 40.17' x 3.54'

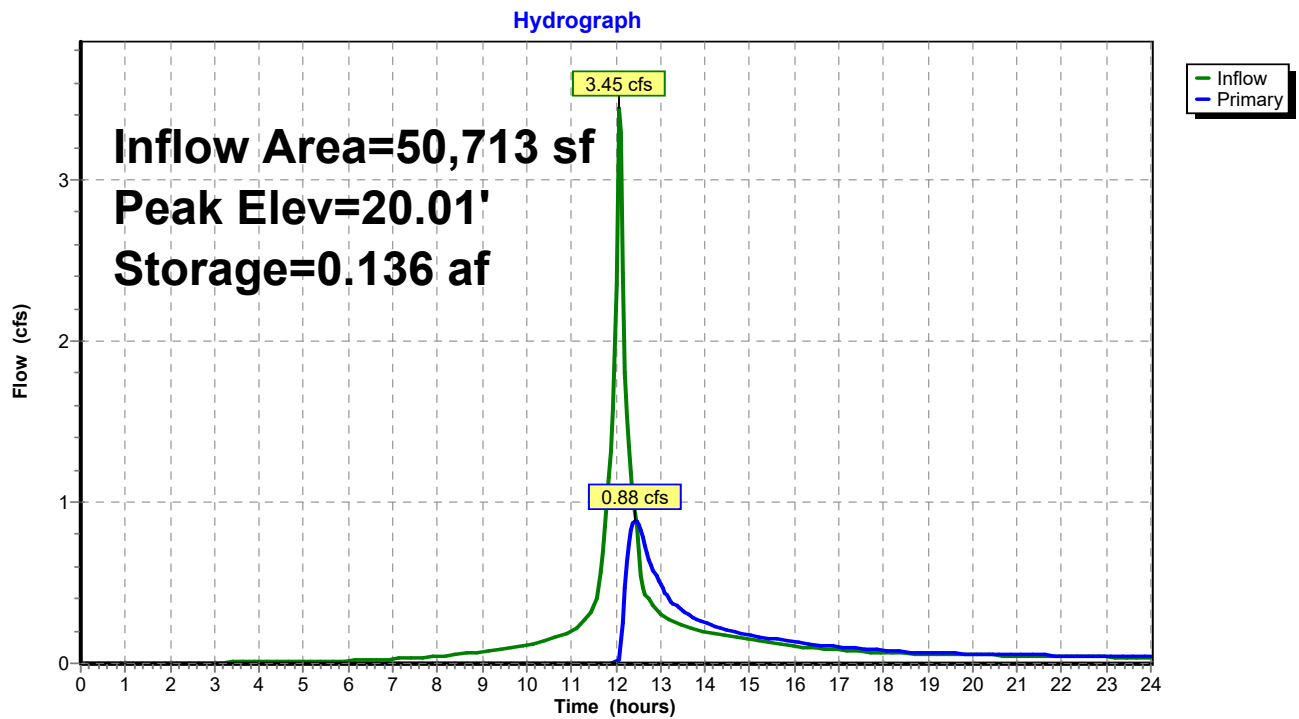
112 Chambers

534.8 cy Field

315.1 cy Stone



### Pond 1P: Underground Detention

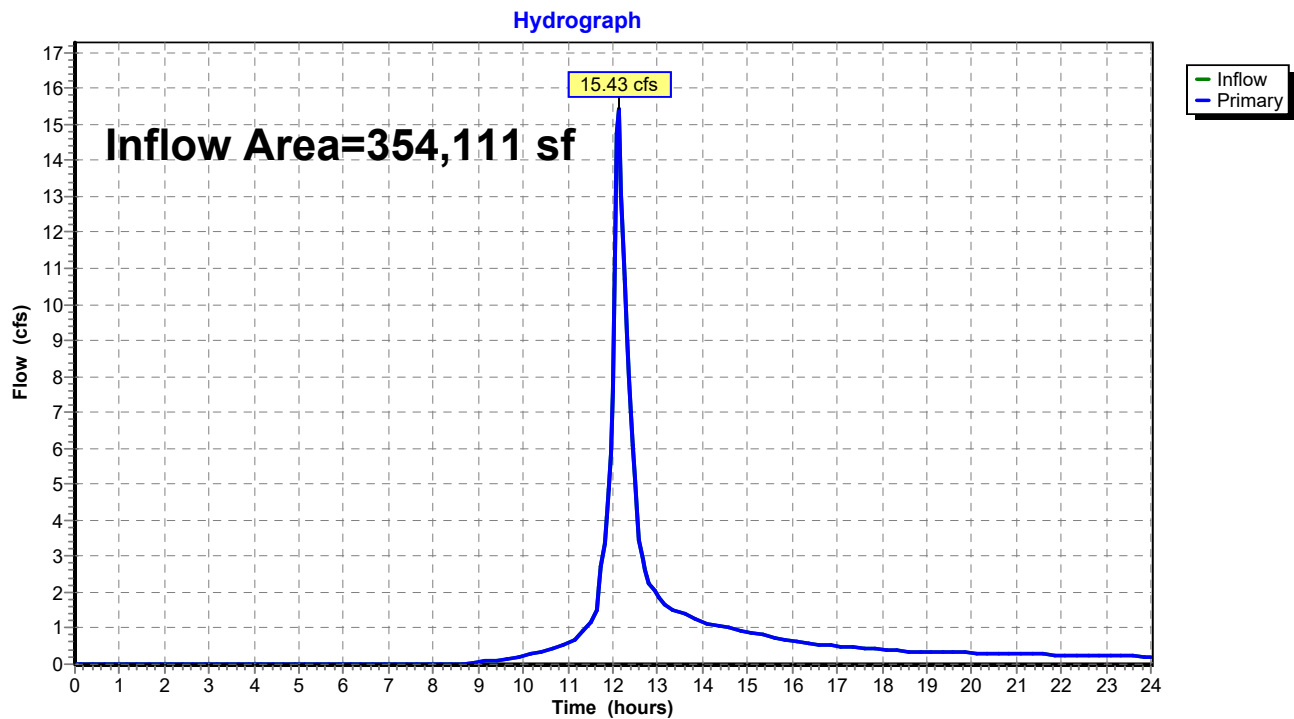


### Summary for Link EX-1: Exist. Conditions - Drainage Area 1

Inflow Area = 354,111 sf, 30.54% Impervious, Inflow Depth > 1.84" for 2yr Storm event  
Inflow = 15.43 cfs @ 12.13 hrs, Volume= 54,226 cf  
Primary = 15.43 cfs @ 12.13 hrs, Volume= 54,226 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

### Link EX-1: Exist. Conditions - Drainage Area 1

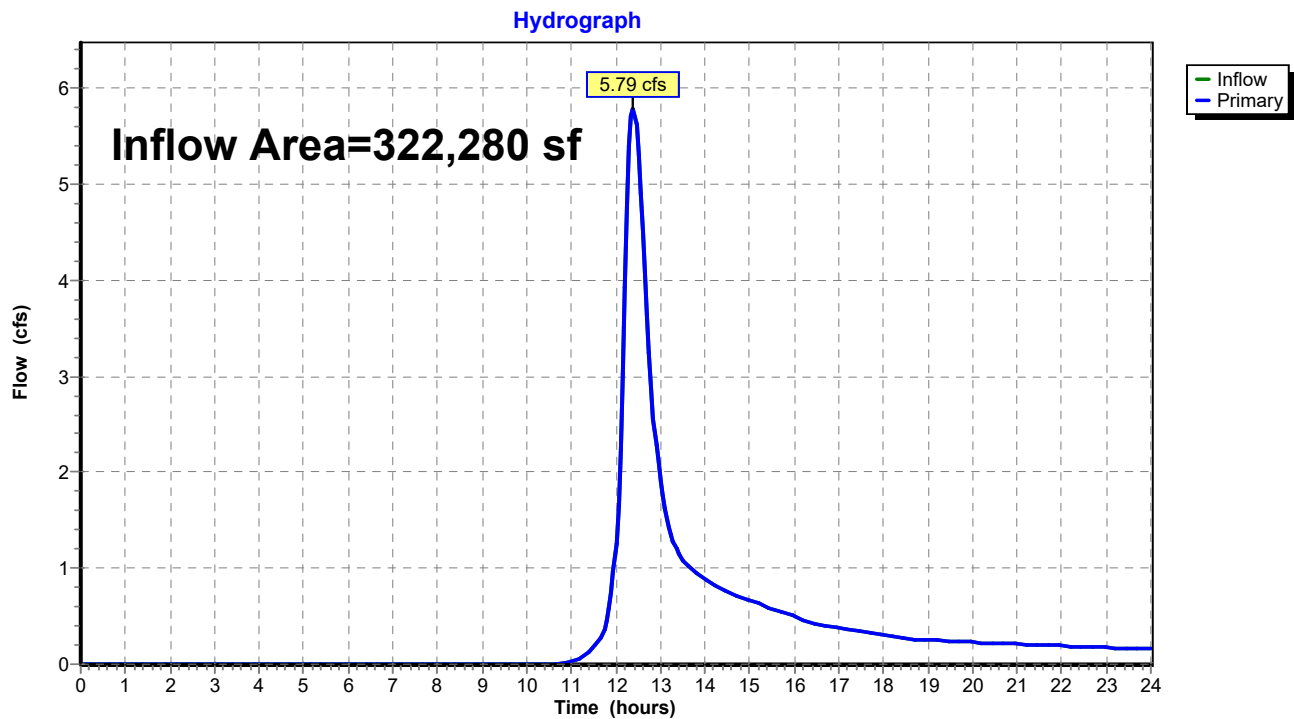


### Summary for Link EX-2: Exist. Conditions - Drainage Area 2

Inflow Area = 322,280 sf, 37.79% Impervious, Inflow Depth > 1.16" for 2yr Storm event  
Inflow = 5.79 cfs @ 12.39 hrs, Volume= 31,135 cf  
Primary = 5.79 cfs @ 12.39 hrs, Volume= 31,135 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

### Link EX-2: Exist. Conditions - Drainage Area 2

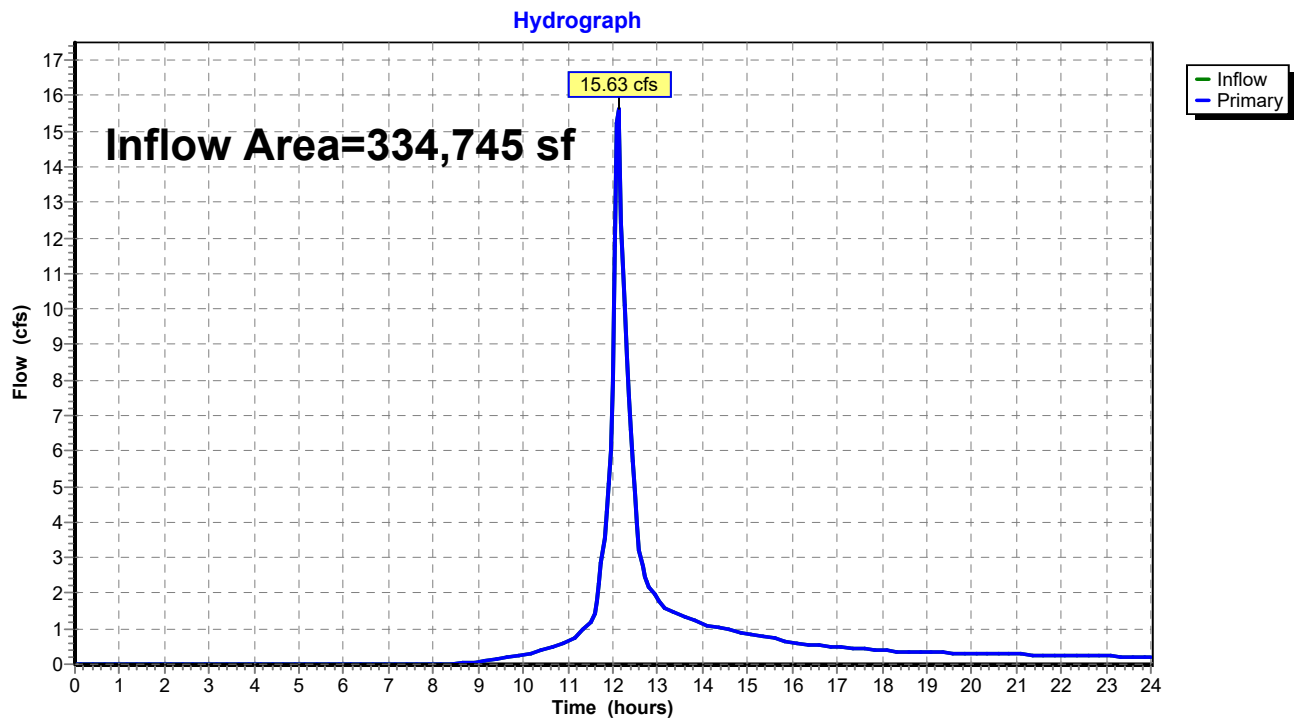


### Summary for Link PR-1: Proposed Conditions - Drainage Area 1

Inflow Area = 334,745 sf, 31.99% Impervious, Inflow Depth > 1.91" for 2yr Storm event  
Inflow = 15.63 cfs @ 12.12 hrs, Volume= 53,415 cf  
Primary = 15.63 cfs @ 12.12 hrs, Volume= 53,415 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

### Link PR-1: Proposed Conditions - Drainage Area 1

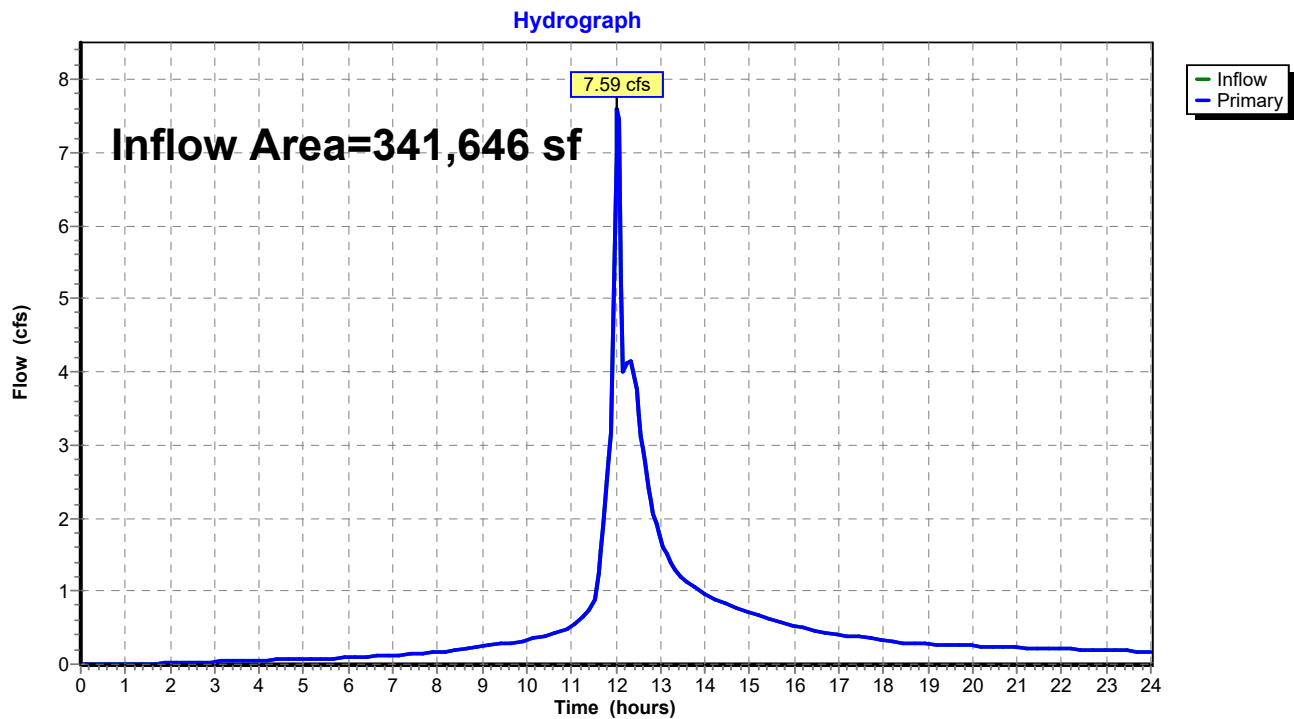


### Summary for Link PR-2: Proposed Conditions - Drainage Area 2

Inflow Area = 341,646 sf, 43.49% Impervious, Inflow Depth > 1.44" for 2yr Storm event  
Inflow = 7.59 cfs @ 12.03 hrs, Volume= 40,886 cf  
Primary = 7.59 cfs @ 12.03 hrs, Volume= 40,886 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

### Link PR-2: Proposed Conditions - Drainage Area 2



### Summary for Subcatchment EX-DA-1: Drainage Area 1

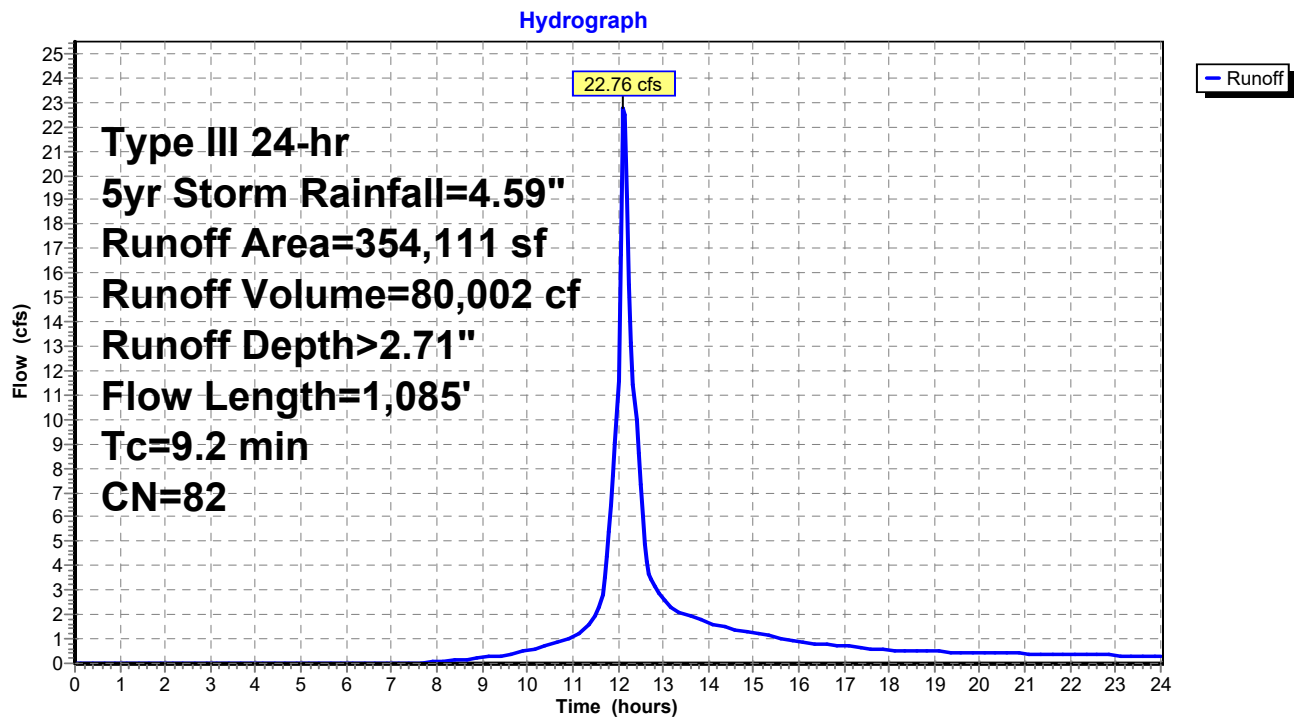
Runoff = 22.76 cfs @ 12.13 hrs, Volume= 80,002 cf, Depth> 2.71"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 5yr Storm Rainfall=4.59"

	Area (sf)	CN	Description
*	40,230	98	Existing Building Roof Area
*	64,877	98	Existing Parking/Driveway
*	3,024	98	Existing Walkways
	6,845	61	>75% Grass cover, Good, HSG B
	39,096	80	>75% Grass cover, Good, HSG D
	16,789	55	Woods, Good, HSG B
	183,250	77	Woods, Good, HSG D
	354,111	82	Weighted Average
	245,980		69.46% Pervious Area
	108,131		30.54% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.5	70	0.0600	0.18		<b>Sheet Flow,</b> Grass: Dense n= 0.240 P2= 3.63"
0.3	95	0.1100	4.97		<b>Shallow Concentrated Flow,</b> Grassed Waterway Kv= 15.0 fps
0.6	80	0.0250	2.37		<b>Shallow Concentrated Flow,</b> Grassed Waterway Kv= 15.0 fps
1.8	840	0.0120	7.89	24.78	<b>Pipe Channel,</b> 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013
9.2	1,085	Total			

### Subcatchment EX-DA-1: Drainage Area 1



### Summary for Subcatchment EX-DA-2: Drainage Area 2

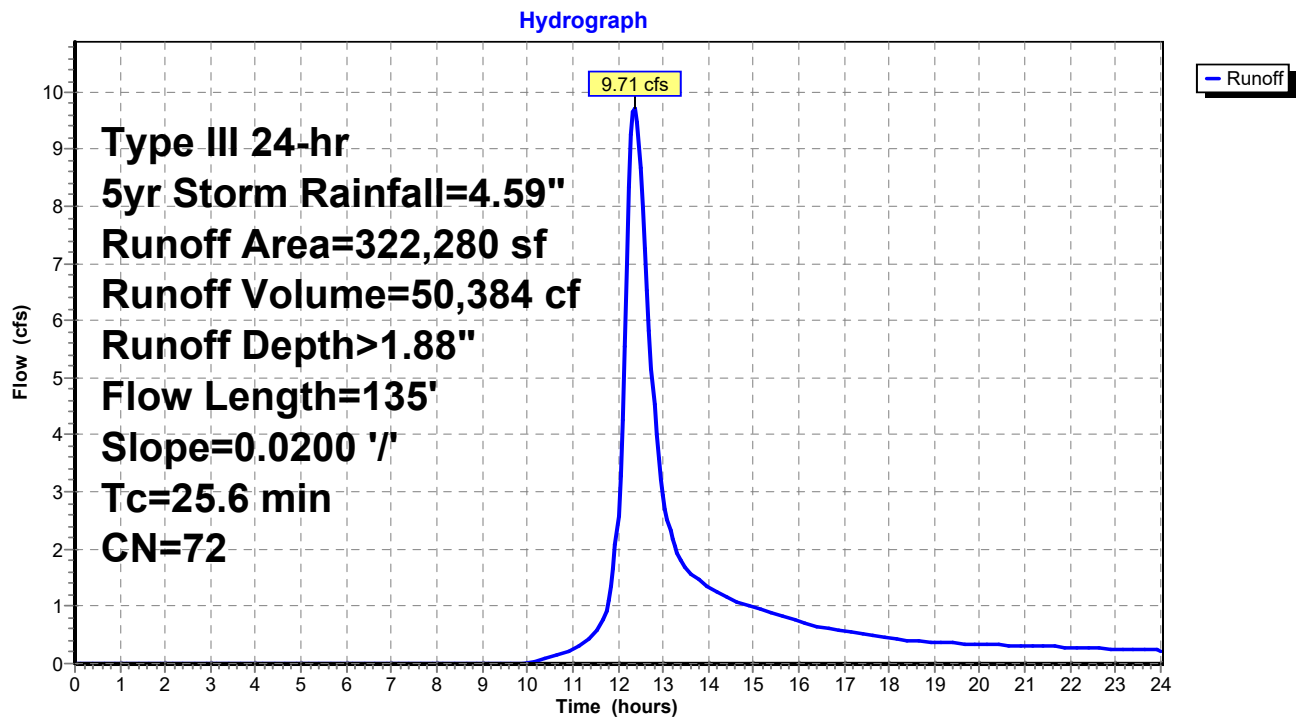
Runoff = 9.71 cfs @ 12.37 hrs, Volume= 50,384 cf, Depth> 1.88"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 5yr Storm Rainfall=4.59"

	Area (sf)	CN	Description
*	62,634	98	Existing Building Roof Area
*	57,463	98	Existing Parking/Driveway
*	1,678	98	Existing Walkways
	33,495	61	>75% Grass cover, Good, HSG B
	918	80	>75% Grass cover, Good, HSG D
	161,382	55	Woods, Good, HSG B
	4,710	77	Woods, Good, HSG D
	322,280	72	Weighted Average
	200,505		62.21% Pervious Area
	121,775		37.79% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.6	135	0.0200	0.09		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.63"

### Subcatchment EX-DA-2: Drainage Area 2



**419 & 650 West Avenue - Drainage - RP Workspace Type III 24-hr 5yr Storm Rainfall=4.59"**

Prepared by LandTech Associates, Inc.

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**Summary for Subcatchment PR-DA-1: Drainage Area 1**

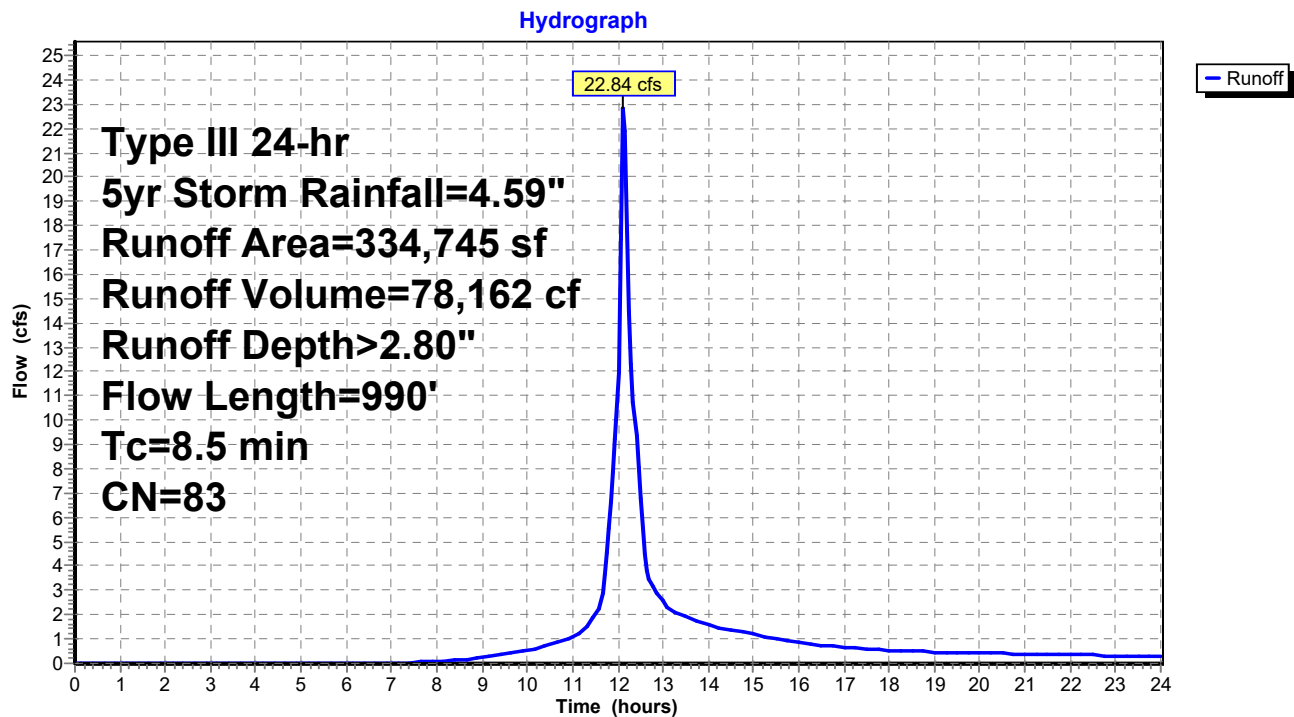
Runoff = 22.84 cfs @ 12.12 hrs, Volume= 78,162 cf, Depth&gt; 2.80"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 5yr Storm Rainfall=4.59"

	Area (sf)	CN	Description
*	40,230	98	Existing Building Roof Area
*	61,104	98	Proposed Parking/Driveway
*	5,763	98	Proposed Walkways
	878	61	>75% Grass cover, Good, HSG B
	26,731	80	>75% Grass cover, Good, HSG D
	16,789	55	Woods, Good, HSG B
	183,250	77	Woods, Good, HSG D
	334,745	83	Weighted Average
	227,648		68.01% Pervious Area
	107,097		31.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.5	70	0.0600	0.18		<b>Sheet Flow,</b> Grass: Dense n= 0.240 P2= 3.63"
0.2	65	0.1100	4.97		<b>Shallow Concentrated Flow,</b> Grassed Waterway Kv= 15.0 fps
1.8	855	0.0120	7.89	24.78	<b>Pipe Channel,</b> 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013
8.5	990	Total			

### Subcatchment PR-DA-1: Drainage Area 1



### Summary for Subcatchment PR-DA-2A: Drainage Area 2

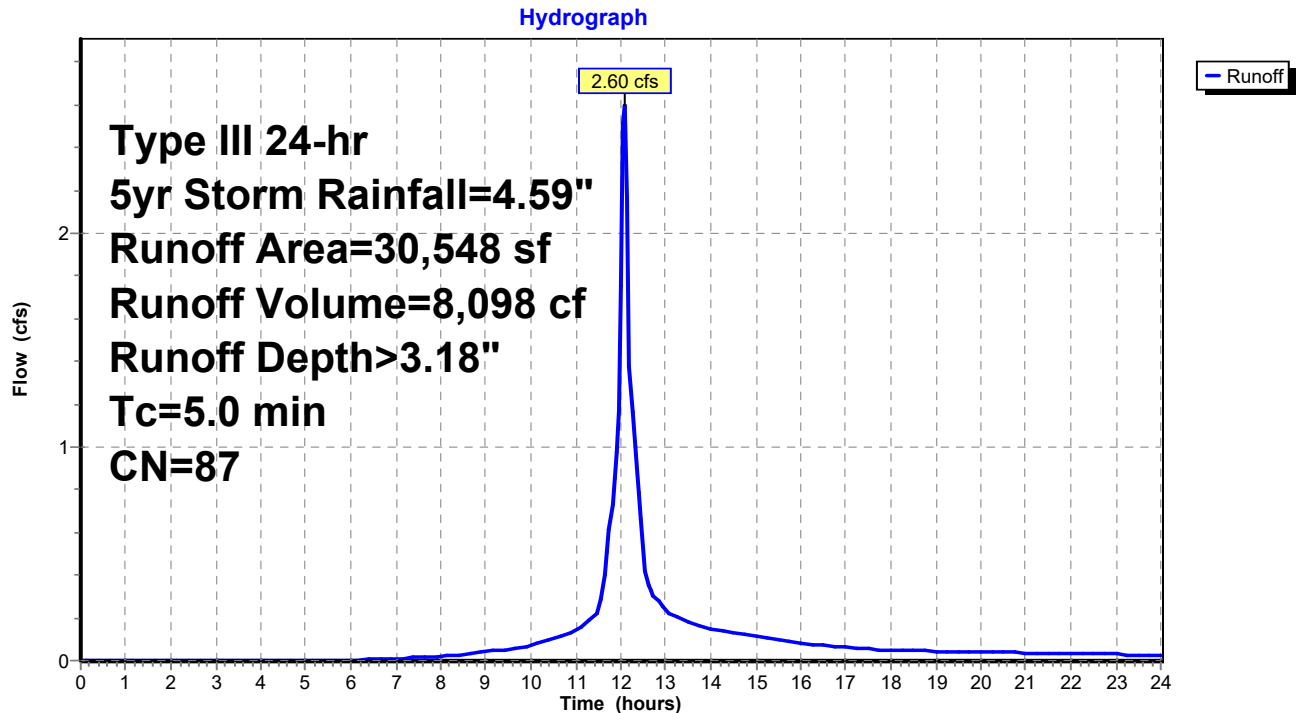
Runoff = 2.60 cfs @ 12.07 hrs, Volume= 8,098 cf, Depth> 3.18"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 5yr Storm Rainfall=4.59"

	Area (sf)	CN	Description
*	20,234	98	Proposed Pavement
*	922	98	Proposed Walkways
	9,313	61	>75% Grass cover, Good, HSG B
	79	80	>75% Grass cover, Good, HSG D
	30,548	87	Weighted Average
	9,392		30.75% Pervious Area
	21,156		69.25% Impervious Area

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

### Subcatchment PR-DA-2A: Drainage Area 2



### Summary for Subcatchment PR-DA-2B: Drainage Area 2

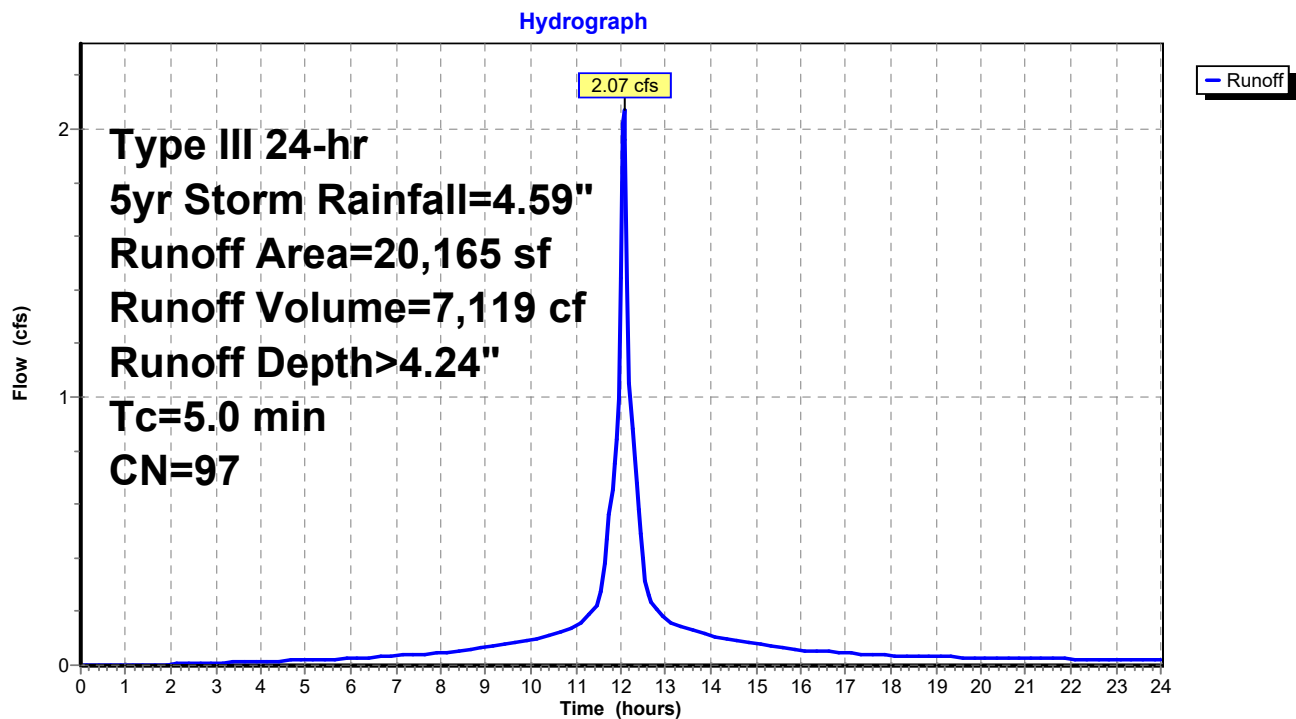
Runoff = 2.07 cfs @ 12.07 hrs, Volume= 7,119 cf, Depth> 4.24"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 5yr Storm Rainfall=4.59"

	Area (sf)	CN	Description
*	18,184	98	Proposed Pavement
*	866	98	Proposed Walkways
	1,115	80	>75% Grass cover, Good, HSG D
	20,165	97	Weighted Average
	1,115		5.53% Pervious Area
	19,050		94.47% Impervious Area

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

### Subcatchment PR-DA-2B: Drainage Area 2



### Summary for Subcatchment PR-DA-2C: Drainage Area 2

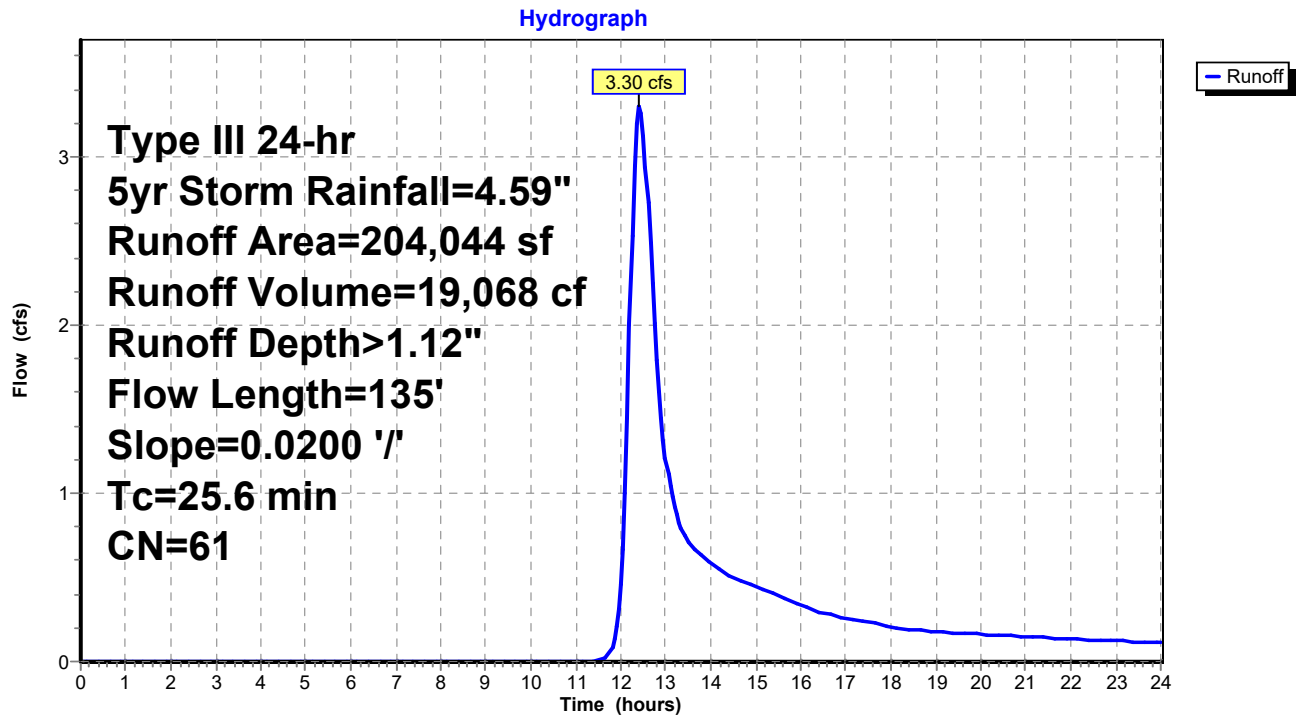
Runoff = 3.30 cfs @ 12.41 hrs, Volume= 19,068 cf, Depth> 1.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 5yr Storm Rainfall=4.59"

	Area (sf)	CN	Description
*	21,493	98	Proposed Parking/Driveway
	14,491	61	>75% Grass cover, Good, HSG B
	1,968	80	>75% Grass cover, Good, HSG D
	161,382	55	Woods, Good, HSG B
	4,710	77	Woods, Good, HSG D
	204,044	61	Weighted Average
	182,551		89.47% Pervious Area
	21,493		10.53% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.6	135	0.0200	0.09		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.63"

### Subcatchment PR-DA-2C: Drainage Area 2



### Summary for Subcatchment PR-DA-2D: Drainage Area 2D

Runoff = 9.71 cfs @ 12.03 hrs, Volume= 31,523 cf, Depth> 4.35"

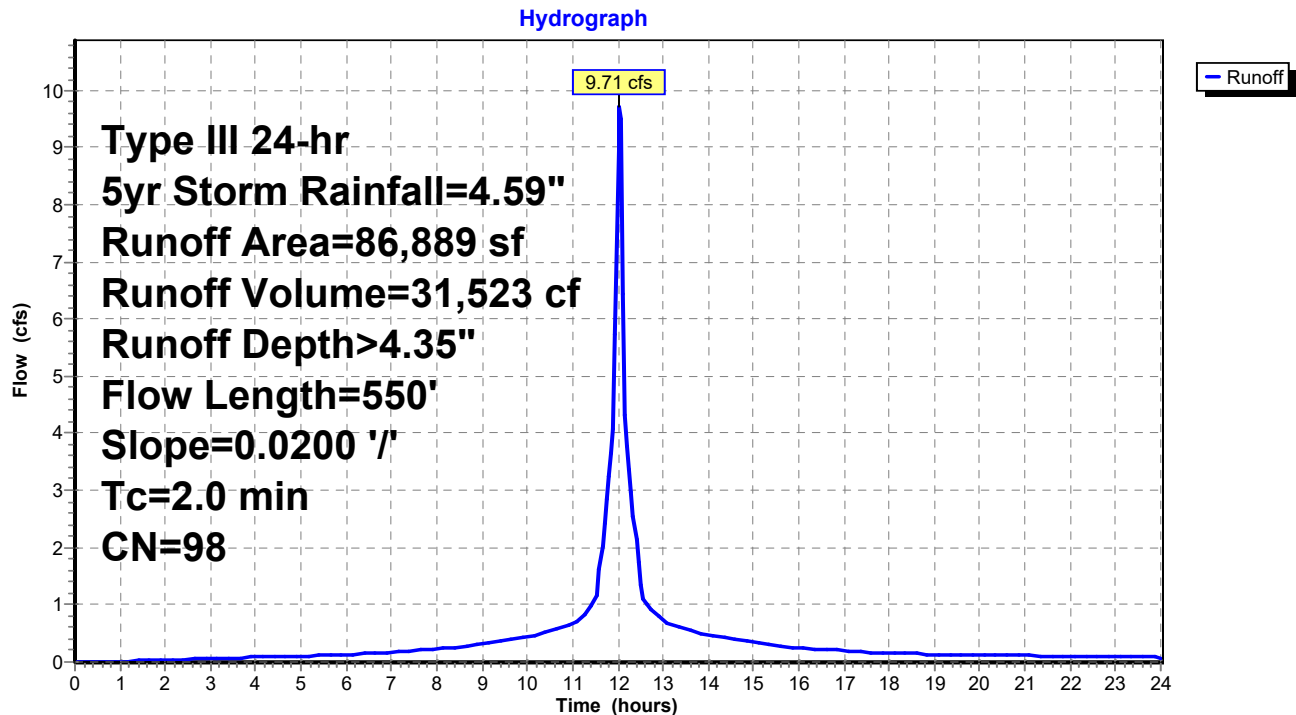
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 5yr Storm Rainfall=4.59"

Area (sf)	CN	Description
86,889	98	Roofs, HSG C
86,889		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.28		<b>Sheet Flow, Roof Flow to Roof Drain</b> Smooth surfaces n= 0.011 P2= 3.63"
1.3	500	0.0200	6.42	5.04	<b>Pipe Channel,</b> 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
2.0	550	Total			

### Subcatchment PR-DA-2D: Drainage Area 2D



### Summary for Pond 1P: Underground Detention

Inflow Area = 50,713 sf, 79.28% Impervious, Inflow Depth > 3.60" for 5yr Storm event  
 Inflow = 4.67 cfs @ 12.07 hrs, Volume= 15,217 cf  
 Outflow = 1.91 cfs @ 12.28 hrs, Volume= 10,586 cf, Atten= 59%, Lag= 12.4 min  
 Primary = 1.91 cfs @ 12.28 hrs, Volume= 10,586 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
 Peak Elev= 20.37' @ 12.28 hrs Surf.Area= 0.094 ac Storage= 0.161 af

Plug-Flow detention time= 186.7 min calculated for 10,586 cf (70% of inflow)  
 Center-of-Mass det. time= 93.1 min ( 874.3 - 781.2 )

Volume	Invert	Avail.Storage	Storage Description
#1A	18.00'	0.078 af	<b>40.17'W x 101.50'L x 3.54'H Field A</b> 0.331 af Overall - 0.136 af Embedded = 0.195 af x 40.0% Voids
#2A	18.50'	0.136 af	<b>Cultec R-330XLHD</b> x 112 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 8 rows
		0.214 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	18.80'	<b>24.0" Round Culvert</b> L= 30.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 18.80' / 18.50' S= 0.0100 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 3.14 sf
#2	Device 1	19.50'	<b>10.5" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#3	Device 1	21.40'	<b>6.0' long Sharp-Crested Rectangular Weir</b> 0 End Contraction(s) 1.0' Crest Height

**Primary OutFlow** Max=1.91 cfs @ 12.28 hrs HW=20.37' TW=0.00' (Dynamic Tailwater)

- ↑ **1=Culvert** (Passes 1.91 cfs of 8.88 cfs potential flow)
- ↑ **2=Orifice/Grate** (Orifice Controls 1.91 cfs @ 3.18 fps)
- ↑ **3=Sharp-Crested Rectangular Weir** ( Controls 0.00 cfs)

## Pond 1P: Underground Detention - Chamber Wizard Field A

### Chamber Model = Cultec R-330XLHD (Cultec Recharger® 330XLHD)

Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf

Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap

Row Length Adjustment= +1.50' x 7.45 sf x 8 rows

52.0" Wide + 6.0" Spacing = 58.0" C-C Row Spacing

14 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 99.50' Row Length +12.0" End Stone x 2 =  
 101.50' Base Length

8 Rows x 52.0" Wide + 6.0" Spacing x 7 + 12.0" Side Stone x 2 = 40.17' Base Width

6.0" Stone Base + 30.5" Chamber Height + 6.0" Stone Cover = 3.54' Field Height

112 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 8 Rows = 5,931.0 cf Chamber Storage

14,439.1 cf Field - 5,931.0 cf Chambers = 8,508.1 cf Stone x 40.0% Voids = 3,403.2 cf Stone Storage

Chamber Storage + Stone Storage = 9,334.2 cf = 0.214 af

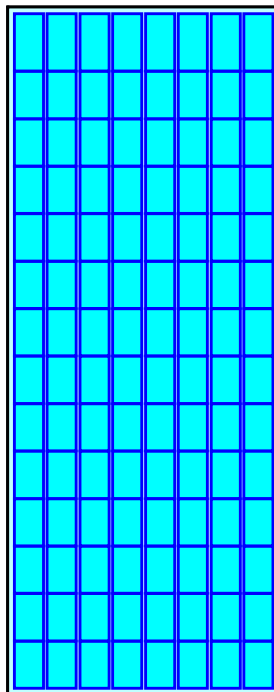
Overall Storage Efficiency = 64.6%

Overall System Size = 101.50' x 40.17' x 3.54'

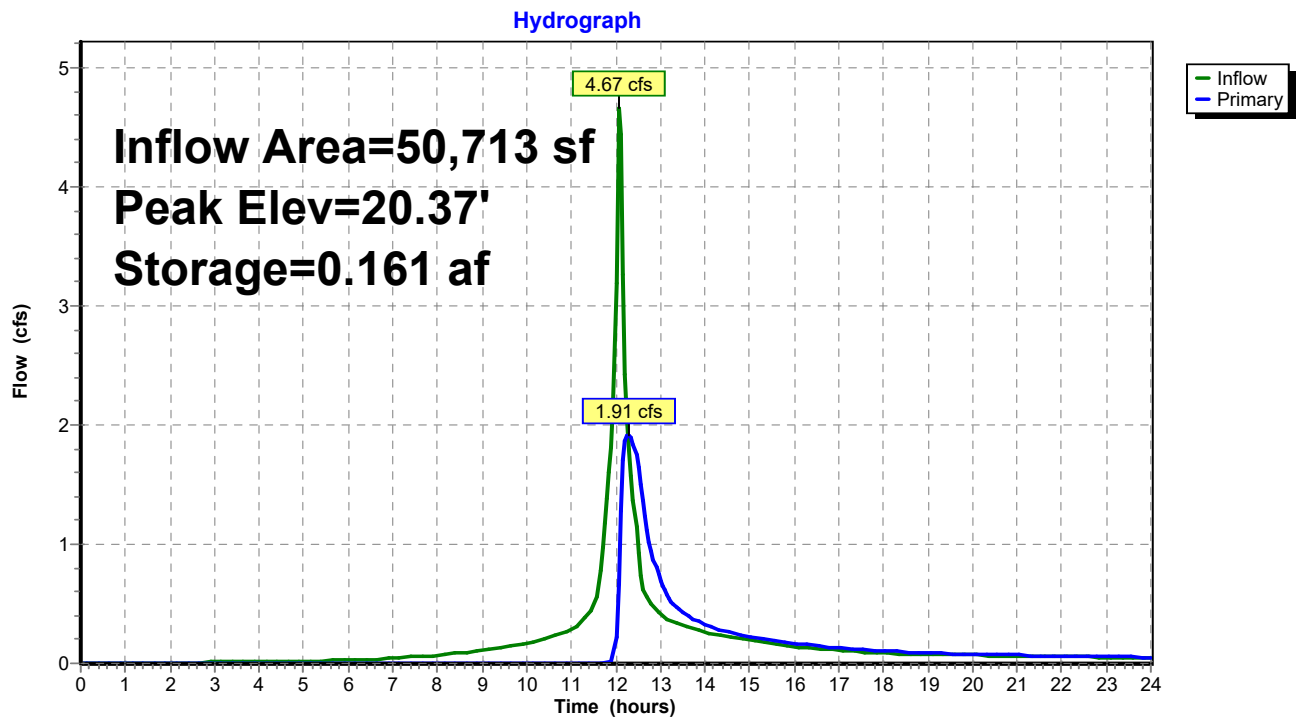
112 Chambers

534.8 cy Field

315.1 cy Stone



### Pond 1P: Underground Detention

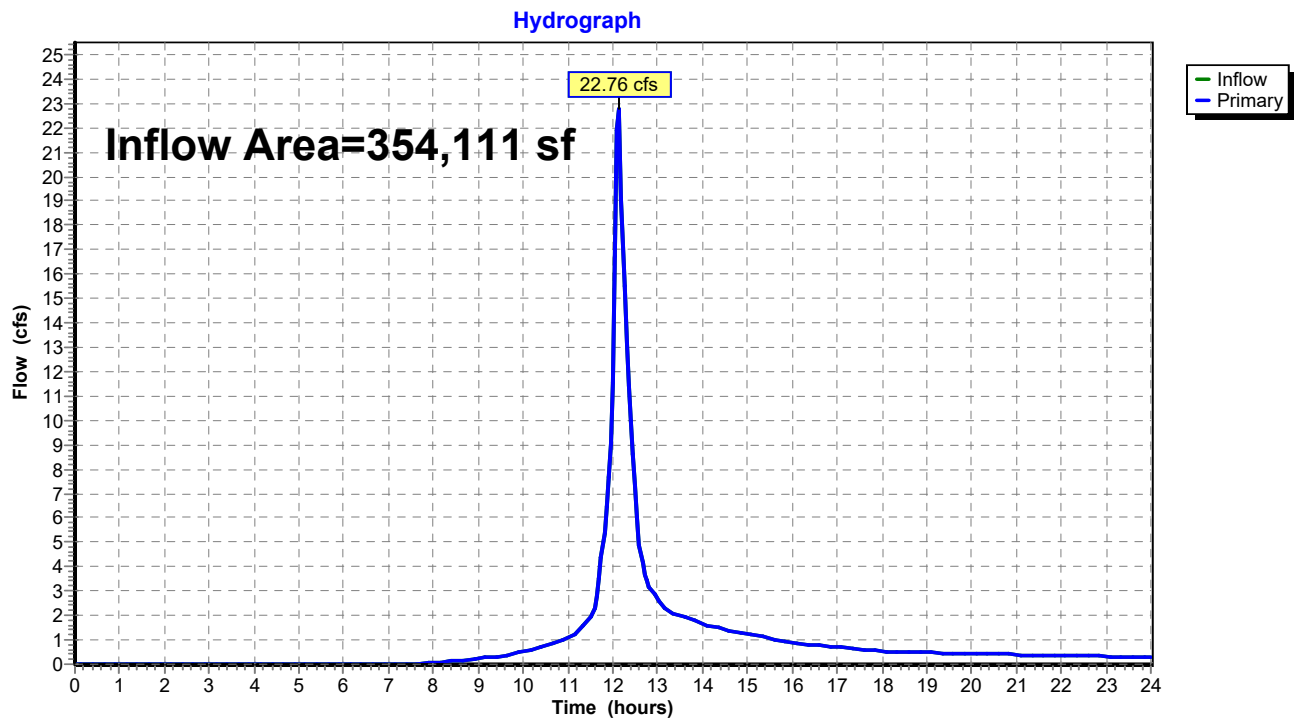


### Summary for Link EX-1: Exist. Conditions - Drainage Area 1

Inflow Area = 354,111 sf, 30.54% Impervious, Inflow Depth > 2.71" for 5yr Storm event  
Inflow = 22.76 cfs @ 12.13 hrs, Volume= 80,002 cf  
Primary = 22.76 cfs @ 12.13 hrs, Volume= 80,002 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

### Link EX-1: Exist. Conditions - Drainage Area 1

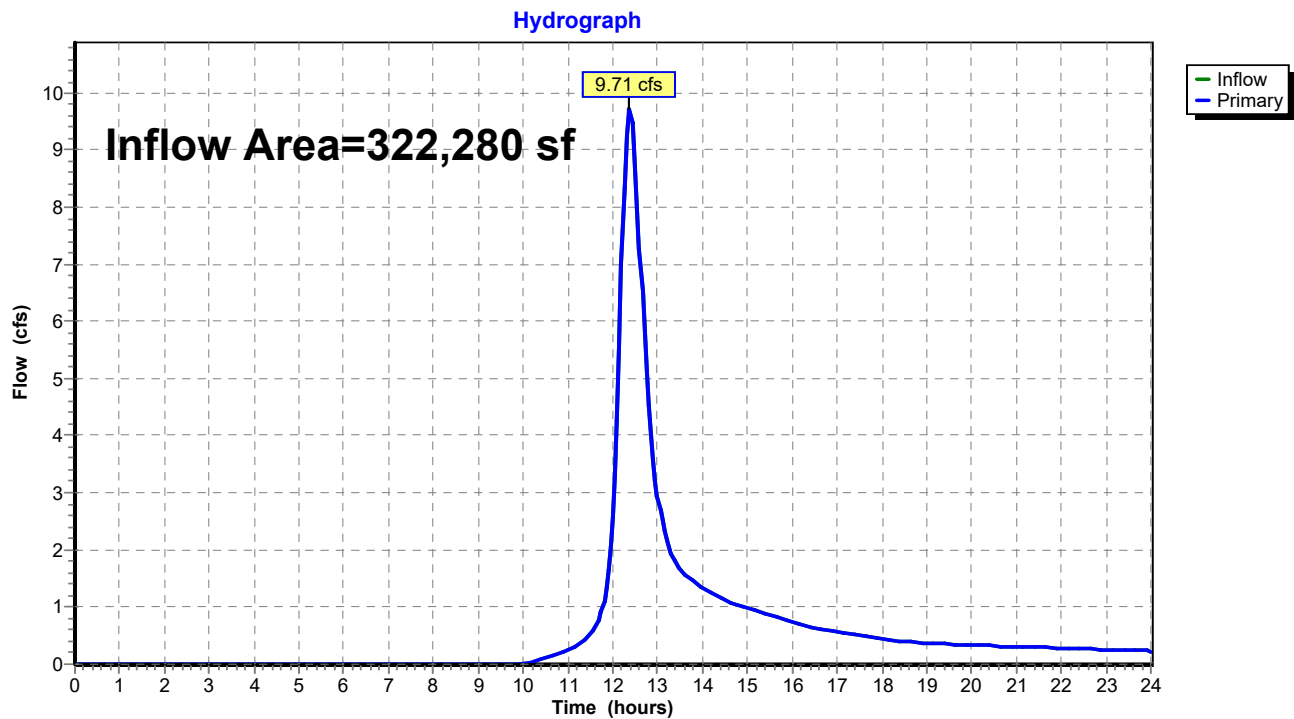


### Summary for Link EX-2: Exist. Conditions - Drainage Area 2

Inflow Area = 322,280 sf, 37.79% Impervious, Inflow Depth > 1.88" for 5yr Storm event  
Inflow = 9.71 cfs @ 12.37 hrs, Volume= 50,384 cf  
Primary = 9.71 cfs @ 12.37 hrs, Volume= 50,384 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

### Link EX-2: Exist. Conditions - Drainage Area 2

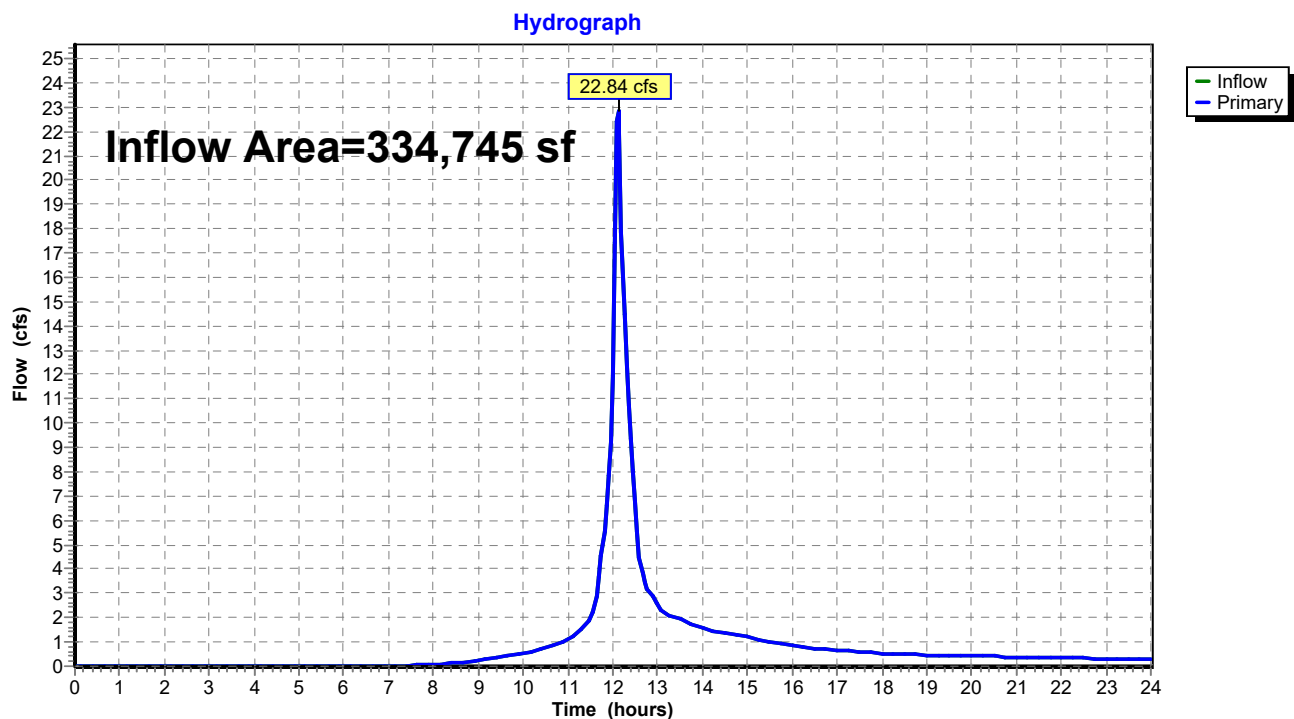


### Summary for Link PR-1: Proposed Conditions - Drainage Area 1

Inflow Area = 334,745 sf, 31.99% Impervious, Inflow Depth > 2.80" for 5yr Storm event  
Inflow = 22.84 cfs @ 12.12 hrs, Volume= 78,162 cf  
Primary = 22.84 cfs @ 12.12 hrs, Volume= 78,162 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

### Link PR-1: Proposed Conditions - Drainage Area 1

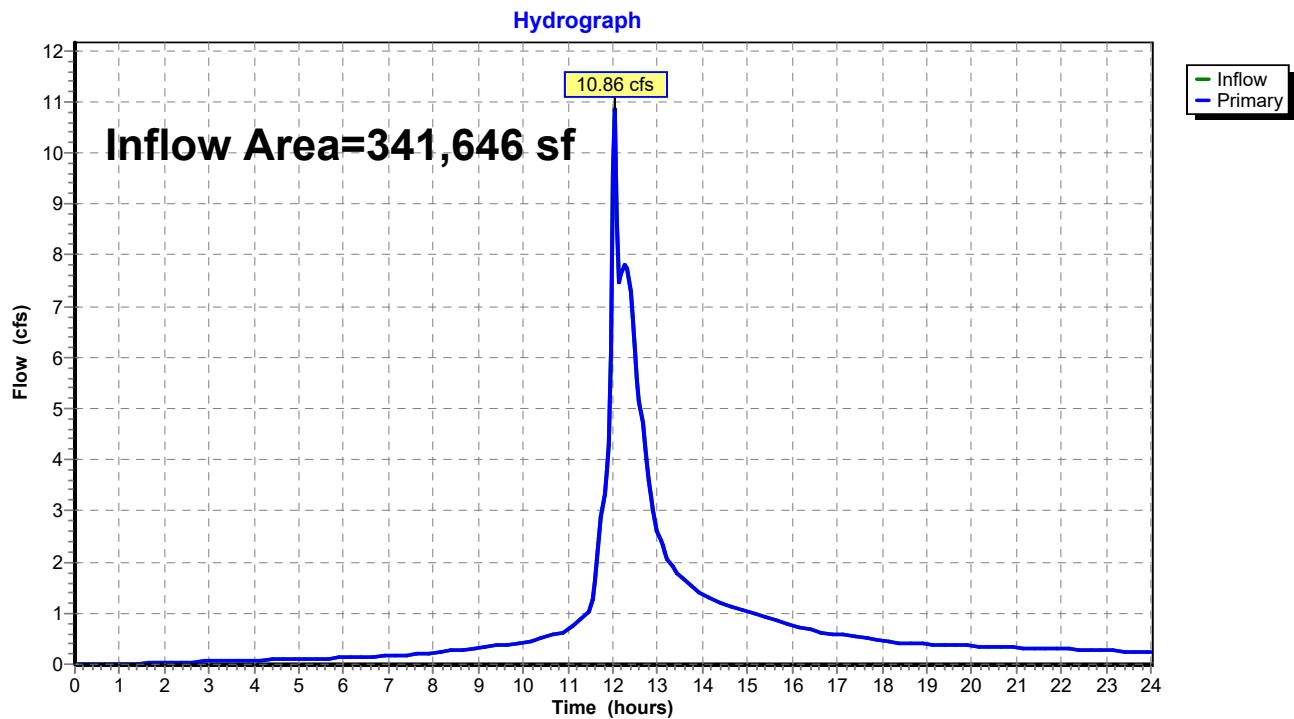


### Summary for Link PR-2: Proposed Conditions - Drainage Area 2

Inflow Area = 341,646 sf, 43.49% Impervious, Inflow Depth > 2.15" for 5yr Storm event  
Inflow = 10.86 cfs @ 12.04 hrs, Volume= 61,177 cf  
Primary = 10.86 cfs @ 12.04 hrs, Volume= 61,177 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

### Link PR-2: Proposed Conditions - Drainage Area 2



### Summary for Subcatchment EX-DA-1: Drainage Area 1

Runoff = 28.94 cfs @ 12.13 hrs, Volume= 102,144 cf, Depth> 3.46"

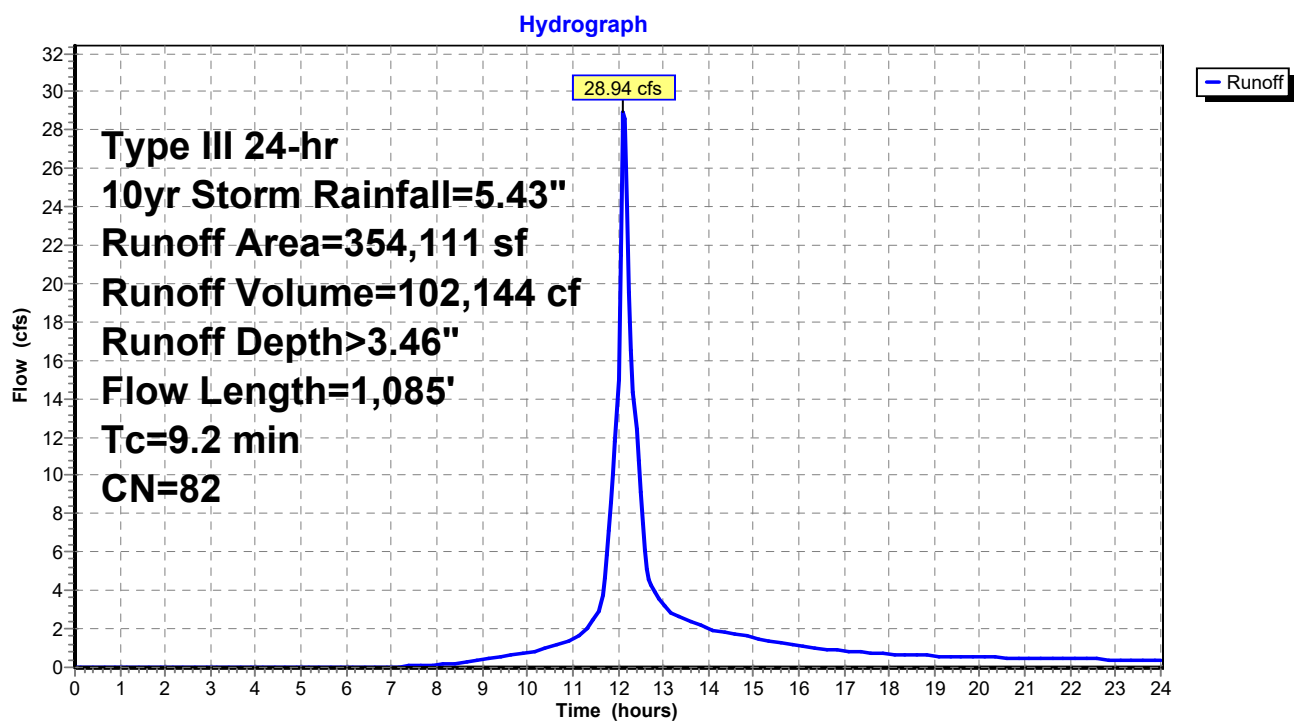
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 10yr Storm Rainfall=5.43"

	Area (sf)	CN	Description
*	40,230	98	Existing Building Roof Area
*	64,877	98	Existing Parking/Driveway
*	3,024	98	Existing Walkways
	6,845	61	>75% Grass cover, Good, HSG B
	39,096	80	>75% Grass cover, Good, HSG D
	16,789	55	Woods, Good, HSG B
	183,250	77	Woods, Good, HSG D
	354,111	82	Weighted Average
	245,980		69.46% Pervious Area
	108,131		30.54% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.5	70	0.0600	0.18		<b>Sheet Flow,</b> Grass: Dense n= 0.240 P2= 3.63"
0.3	95	0.1100	4.97		<b>Shallow Concentrated Flow,</b> Grassed Waterway Kv= 15.0 fps
0.6	80	0.0250	2.37		<b>Shallow Concentrated Flow,</b> Grassed Waterway Kv= 15.0 fps
1.8	840	0.0120	7.89	24.78	<b>Pipe Channel,</b> 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013
9.2	1,085	Total			

### Subcatchment EX-DA-1: Drainage Area 1



### Summary for Subcatchment EX-DA-2: Drainage Area 2

Runoff = 13.20 cfs @ 12.37 hrs, Volume= 67,680 cf, Depth> 2.52"

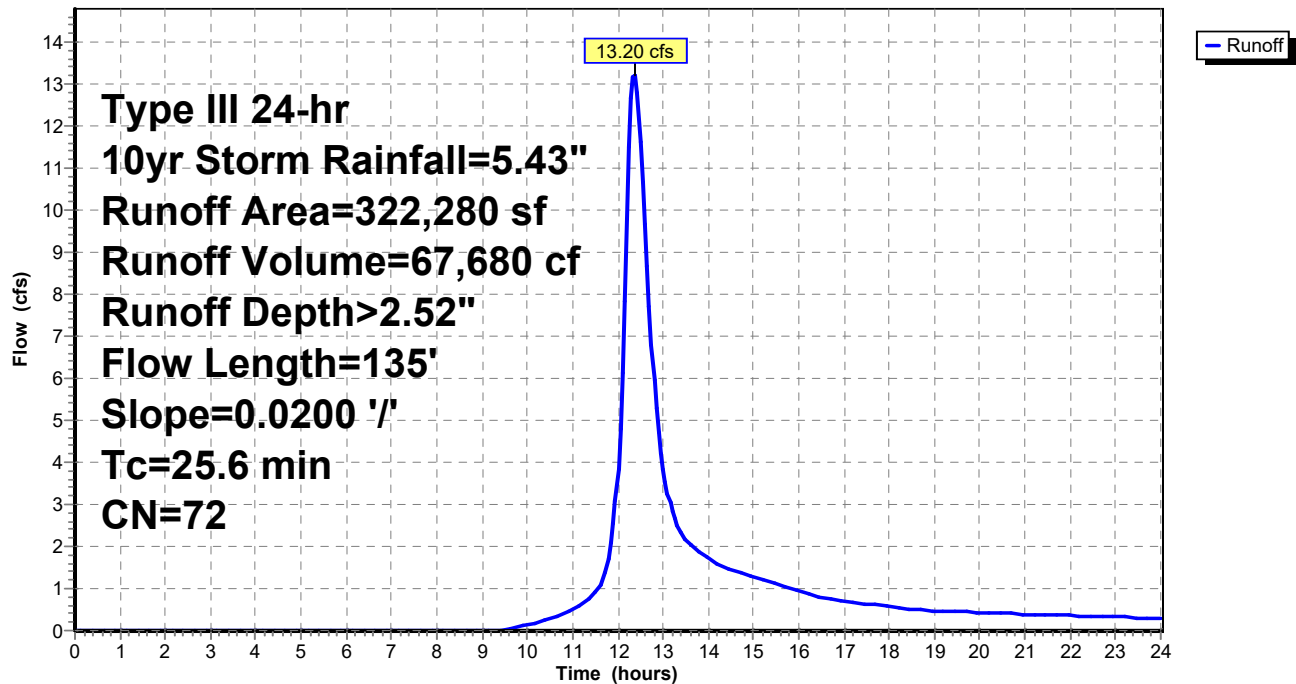
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 10yr Storm Rainfall=5.43"

	Area (sf)	CN	Description
*	62,634	98	Existing Building Roof Area
*	57,463	98	Existing Parking/Driveway
*	1,678	98	Existing Walkways
	33,495	61	>75% Grass cover, Good, HSG B
	918	80	>75% Grass cover, Good, HSG D
	161,382	55	Woods, Good, HSG B
	4,710	77	Woods, Good, HSG D
	322,280	72	Weighted Average
	200,505		62.21% Pervious Area
	121,775		37.79% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.6	135	0.0200	0.09		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.63"

### Subcatchment EX-DA-2: Drainage Area 2

Hydrograph



### Summary for Subcatchment PR-DA-1: Drainage Area 1

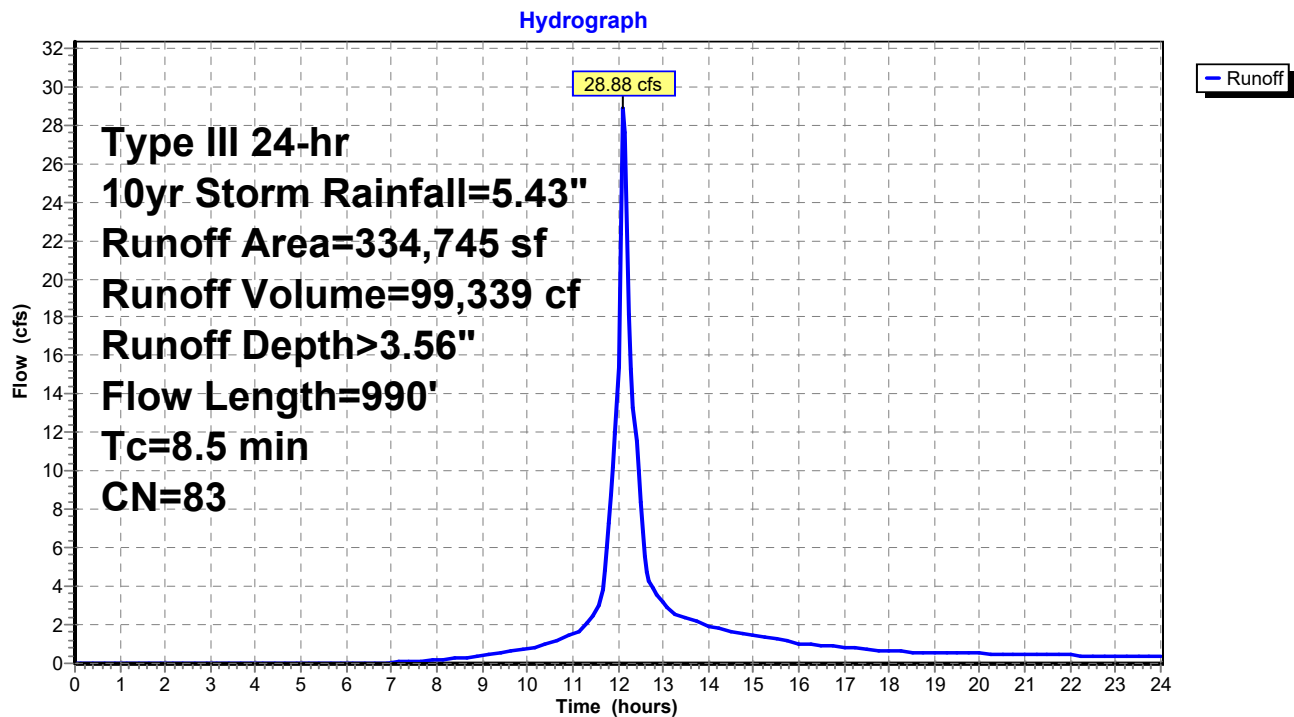
Runoff = 28.88 cfs @ 12.12 hrs, Volume= 99,339 cf, Depth> 3.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10yr Storm Rainfall=5.43"

	Area (sf)	CN	Description
*	40,230	98	Existing Building Roof Area
*	61,104	98	Proposed Parking/Driveway
*	5,763	98	Proposed Walkways
	878	61	>75% Grass cover, Good, HSG B
	26,731	80	>75% Grass cover, Good, HSG D
	16,789	55	Woods, Good, HSG B
	183,250	77	Woods, Good, HSG D
	334,745	83	Weighted Average
	227,648		68.01% Pervious Area
	107,097		31.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.5	70	0.0600	0.18		<b>Sheet Flow,</b> Grass: Dense n= 0.240 P2= 3.63"
0.2	65	0.1100	4.97		<b>Shallow Concentrated Flow,</b> Grassed Waterway Kv= 15.0 fps
1.8	855	0.0120	7.89	24.78	<b>Pipe Channel,</b> 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013
8.5	990	Total			

### Subcatchment PR-DA-1: Drainage Area 1



### Summary for Subcatchment PR-DA-2A: Drainage Area 2

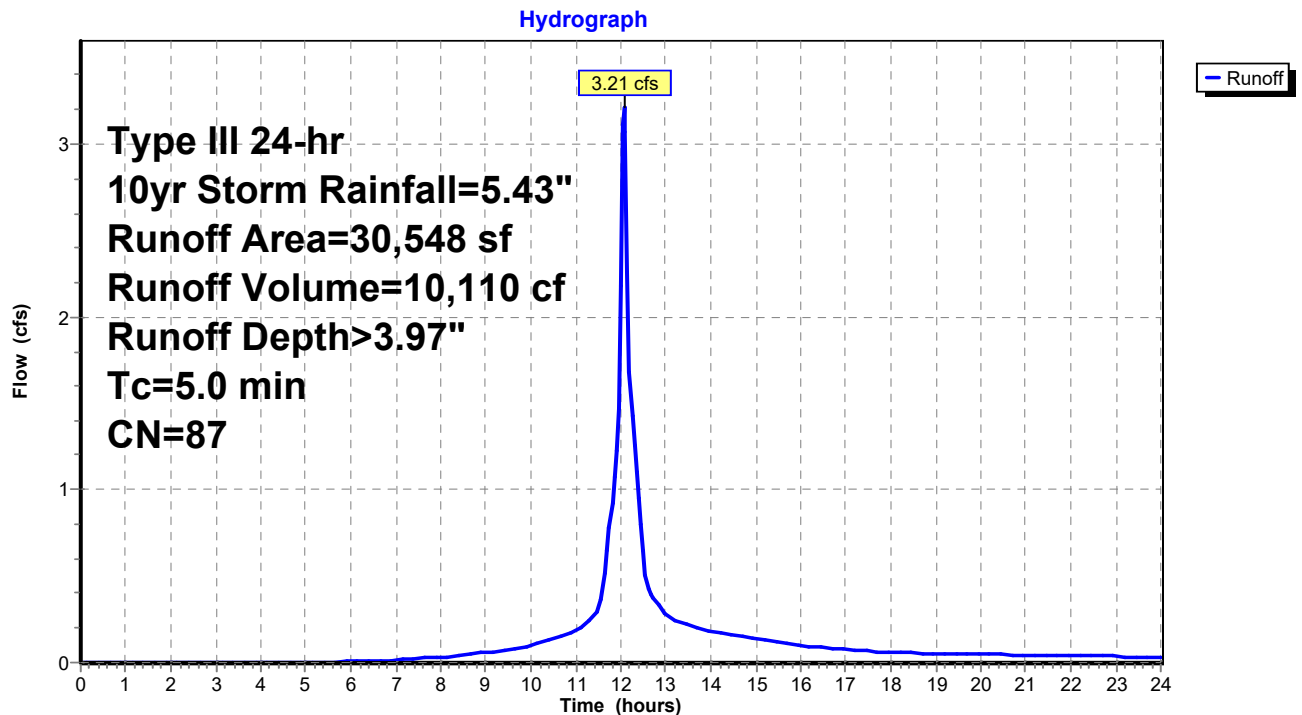
Runoff = 3.21 cfs @ 12.07 hrs, Volume= 10,110 cf, Depth> 3.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 10yr Storm Rainfall=5.43"

	Area (sf)	CN	Description
*	20,234	98	Proposed Pavement
*	922	98	Proposed Walkways
	9,313	61	>75% Grass cover, Good, HSG B
	79	80	>75% Grass cover, Good, HSG D
	30,548	87	Weighted Average
	9,392		30.75% Pervious Area
	21,156		69.25% Impervious Area

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

### Subcatchment PR-DA-2A: Drainage Area 2



### Summary for Subcatchment PR-DA-2B: Drainage Area 2

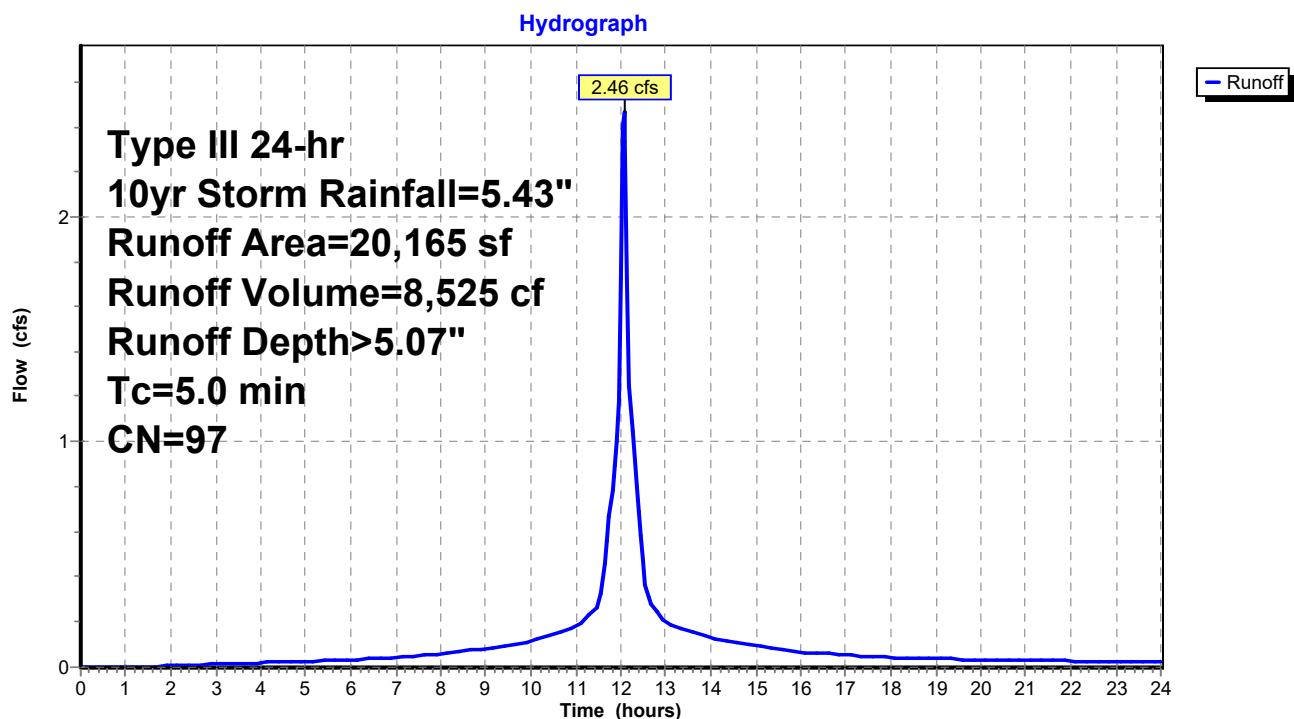
Runoff = 2.46 cfs @ 12.07 hrs, Volume= 8,525 cf, Depth> 5.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 10yr Storm Rainfall=5.43"

	Area (sf)	CN	Description
*	18,184	98	Proposed Pavement
*	866	98	Proposed Walkways
	1,115	80	>75% Grass cover, Good, HSG D
	20,165	97	Weighted Average
	1,115		5.53% Pervious Area
	19,050		94.47% Impervious Area

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

### Subcatchment PR-DA-2B: Drainage Area 2



### Summary for Subcatchment PR-DA-2C: Drainage Area 2

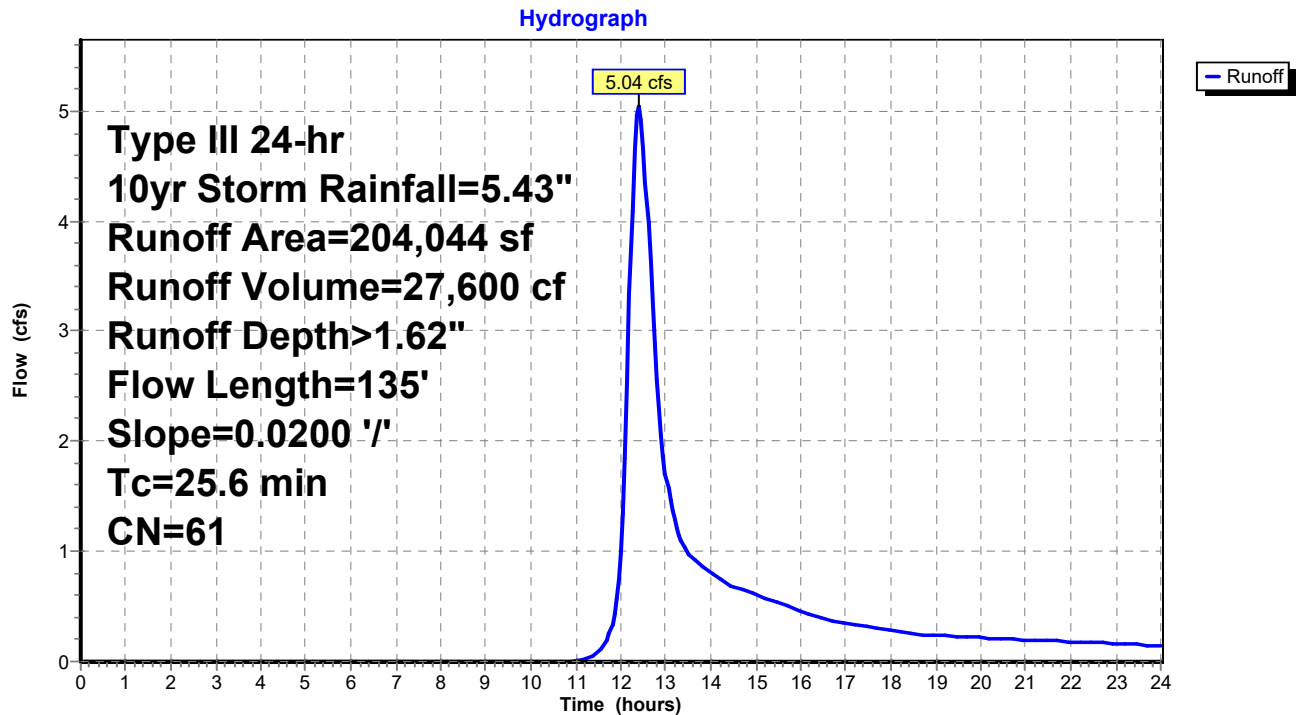
Runoff = 5.04 cfs @ 12.39 hrs, Volume= 27,600 cf, Depth> 1.62"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 10yr Storm Rainfall=5.43"

	Area (sf)	CN	Description
*	21,493	98	Proposed Parking/Driveway
	14,491	61	>75% Grass cover, Good, HSG B
	1,968	80	>75% Grass cover, Good, HSG D
	161,382	55	Woods, Good, HSG B
	4,710	77	Woods, Good, HSG D
	204,044	61	Weighted Average
	182,551		89.47% Pervious Area
	21,493		10.53% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.6	135	0.0200	0.09		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.63"

### Subcatchment PR-DA-2C: Drainage Area 2



### Summary for Subcatchment PR-DA-2D: Drainage Area 2D

Runoff = 11.51 cfs @ 12.03 hrs, Volume= 37,595 cf, Depth> 5.19"

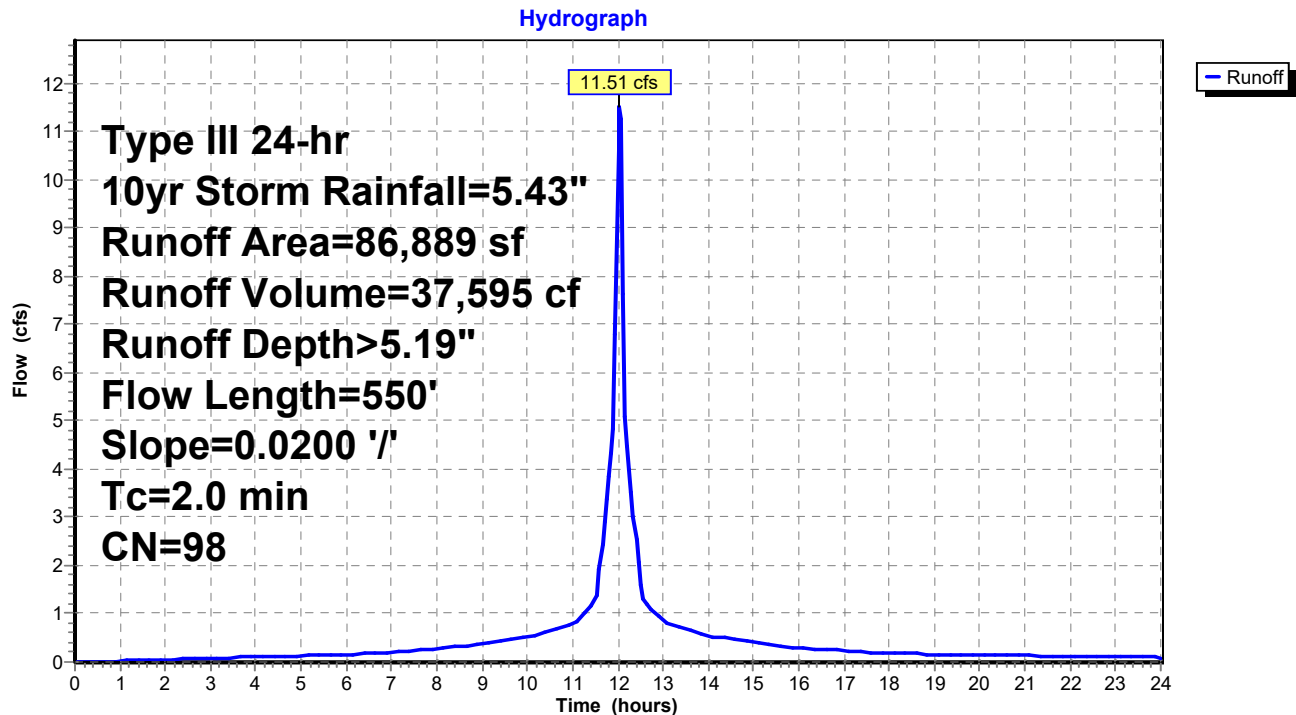
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 10yr Storm Rainfall=5.43"

Area (sf)	CN	Description
86,889	98	Roofs, HSG C
86,889		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.28		<b>Sheet Flow, Roof Flow to Roof Drain</b> Smooth surfaces n= 0.011 P2= 3.63"
1.3	500	0.0200	6.42	5.04	<b>Pipe Channel,</b> 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
2.0	550	Total			

### Subcatchment PR-DA-2D: Drainage Area 2D



### Summary for Pond 1P: Underground Detention

Inflow Area = 50,713 sf, 79.28% Impervious, Inflow Depth > 4.41" for 10yr Storm event  
 Inflow = 5.67 cfs @ 12.07 hrs, Volume= 18,636 cf  
 Outflow = 2.60 cfs @ 12.24 hrs, Volume= 13,971 cf, Atten= 54%, Lag= 10.1 min  
 Primary = 2.60 cfs @ 12.24 hrs, Volume= 13,971 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
 Peak Elev= 20.74' @ 12.24 hrs Surf.Area= 0.094 ac Storage= 0.183 af

Plug-Flow detention time= 167.5 min calculated for 13,942 cf (75% of inflow)  
 Center-of-Mass det. time= 83.3 min ( 860.1 - 776.7 )

Volume	Invert	Avail.Storage	Storage Description
#1A	18.00'	0.078 af	<b>40.17'W x 101.50'L x 3.54'H Field A</b> 0.331 af Overall - 0.136 af Embedded = 0.195 af x 40.0% Voids
#2A	18.50'	0.136 af	<b>Cultec R-330XLHD</b> x 112 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 8 rows
		0.214 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	18.80'	<b>24.0" Round Culvert</b> L= 30.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 18.80' / 18.50' S= 0.0100 ' / Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 3.14 sf
#2	Device 1	19.50'	<b>10.5" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#3	Device 1	21.40'	<b>6.0' long Sharp-Crested Rectangular Weir</b> 0 End Contraction(s) 1.0' Crest Height

**Primary OutFlow** Max=2.60 cfs @ 12.24 hrs HW=20.74' TW=0.00' (Dynamic Tailwater)

- 1=Culvert (Passes 2.60 cfs of 11.67 cfs potential flow)
- 2=Orifice/Grate (Orifice Controls 2.60 cfs @ 4.32 fps)
- 3=Sharp-Crested Rectangular Weir( Controls 0.00 cfs)

## Pond 1P: Underground Detention - Chamber Wizard Field A

### Chamber Model = Cultec R-330XLHD (Cultec Recharger® 330XLHD)

Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf

Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap

Row Length Adjustment= +1.50' x 7.45 sf x 8 rows

52.0" Wide + 6.0" Spacing = 58.0" C-C Row Spacing

14 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 99.50' Row Length +12.0" End Stone x 2 =  
101.50' Base Length

8 Rows x 52.0" Wide + 6.0" Spacing x 7 + 12.0" Side Stone x 2 = 40.17' Base Width

6.0" Stone Base + 30.5" Chamber Height + 6.0" Stone Cover = 3.54' Field Height

112 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 8 Rows = 5,931.0 cf Chamber Storage

14,439.1 cf Field - 5,931.0 cf Chambers = 8,508.1 cf Stone x 40.0% Voids = 3,403.2 cf Stone Storage

Chamber Storage + Stone Storage = 9,334.2 cf = 0.214 af

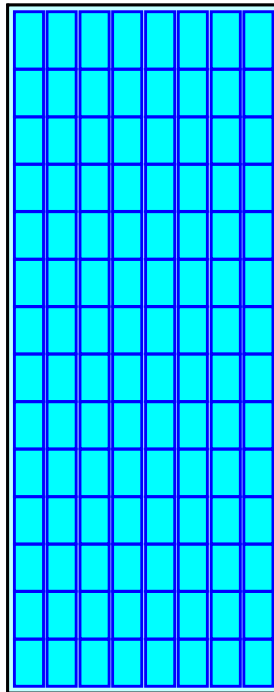
Overall Storage Efficiency = 64.6%

Overall System Size = 101.50' x 40.17' x 3.54'

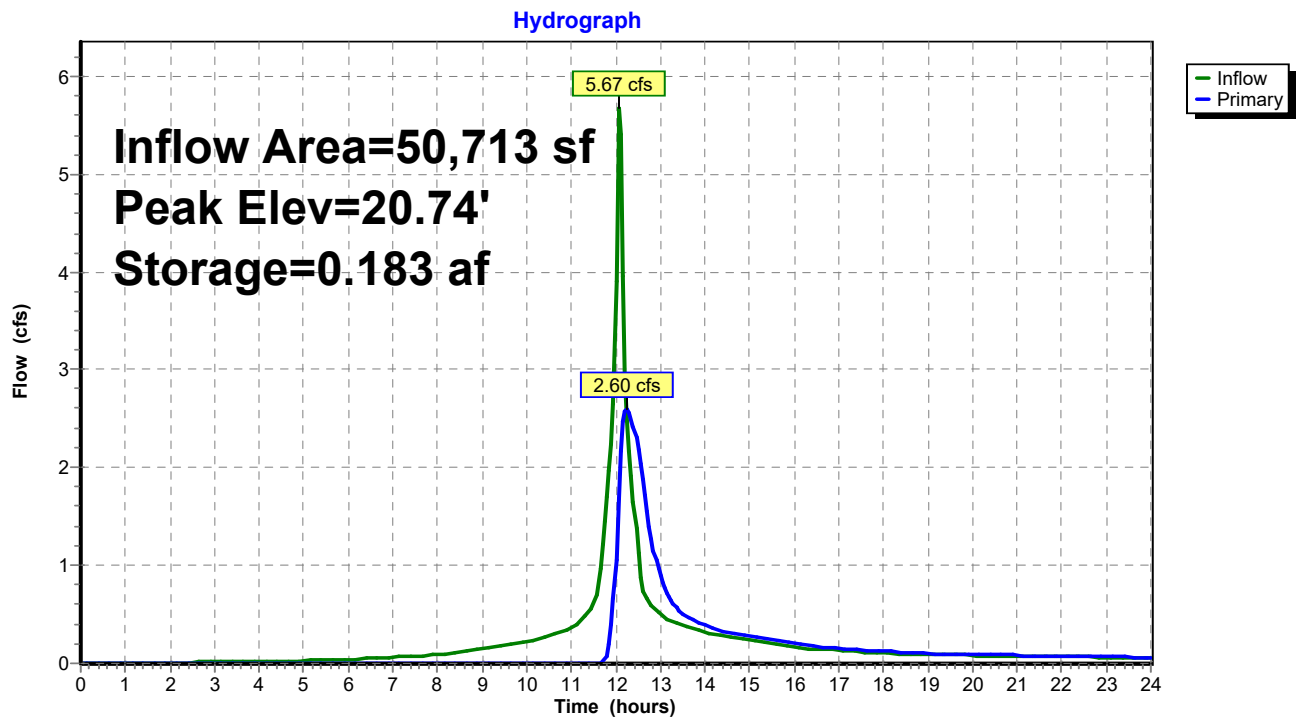
112 Chambers

534.8 cy Field

315.1 cy Stone



### Pond 1P: Underground Detention

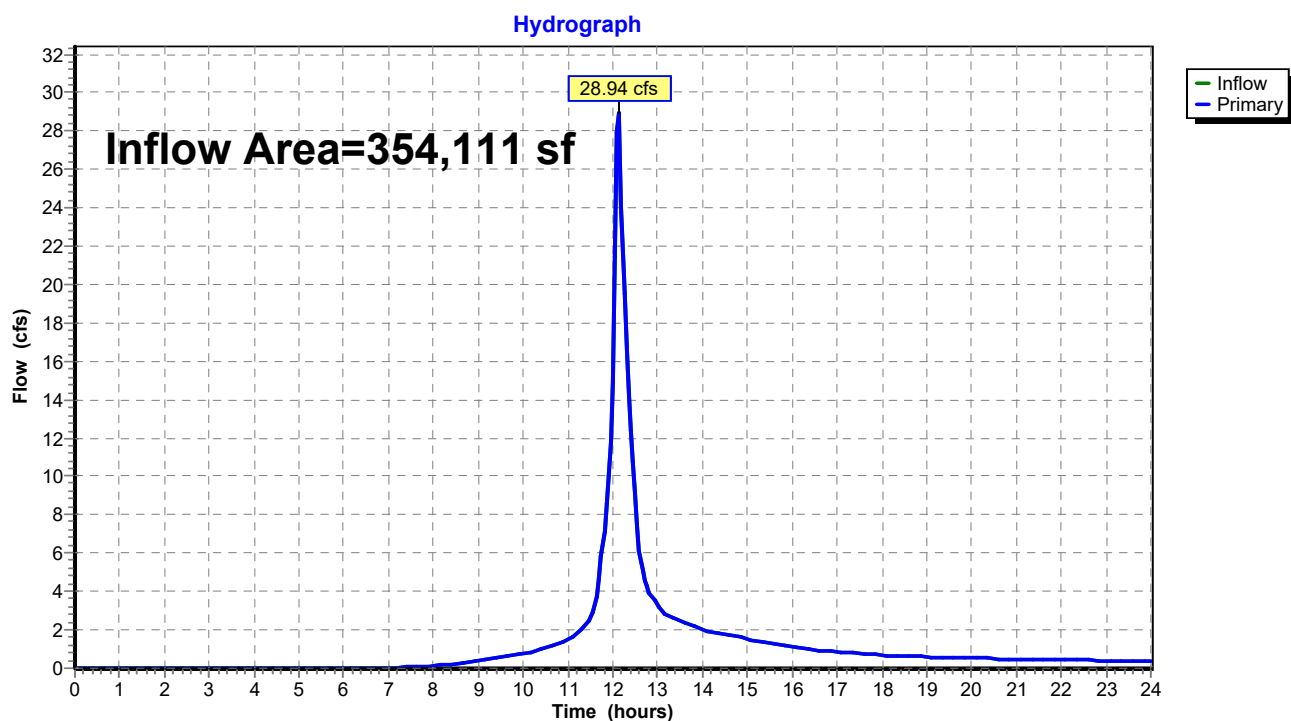


### Summary for Link EX-1: Exist. Conditions - Drainage Area 1

Inflow Area = 354,111 sf, 30.54% Impervious, Inflow Depth > 3.46" for 10yr Storm event  
 Inflow = 28.94 cfs @ 12.13 hrs, Volume= 102,144 cf  
 Primary = 28.94 cfs @ 12.13 hrs, Volume= 102,144 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

### Link EX-1: Exist. Conditions - Drainage Area 1

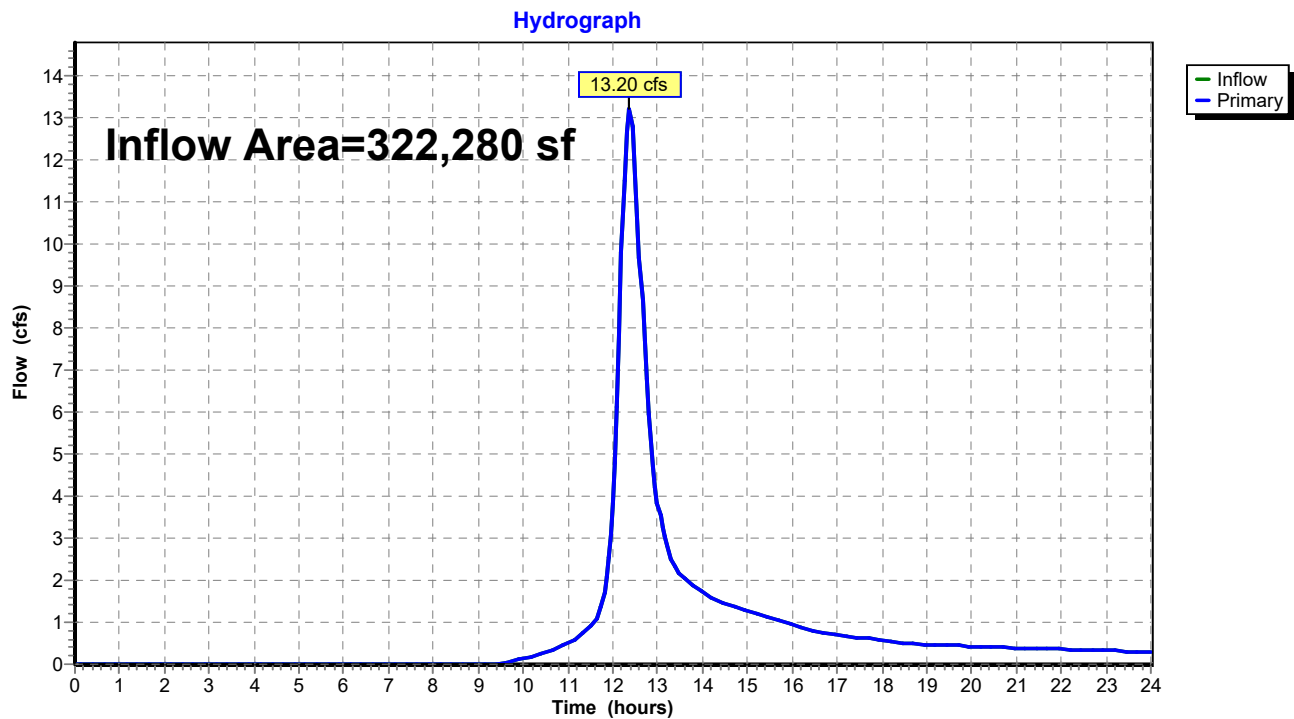


### Summary for Link EX-2: Exist. Conditions - Drainage Area 2

Inflow Area = 322,280 sf, 37.79% Impervious, Inflow Depth > 2.52" for 10yr Storm event  
Inflow = 13.20 cfs @ 12.37 hrs, Volume= 67,680 cf  
Primary = 13.20 cfs @ 12.37 hrs, Volume= 67,680 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

### Link EX-2: Exist. Conditions - Drainage Area 2

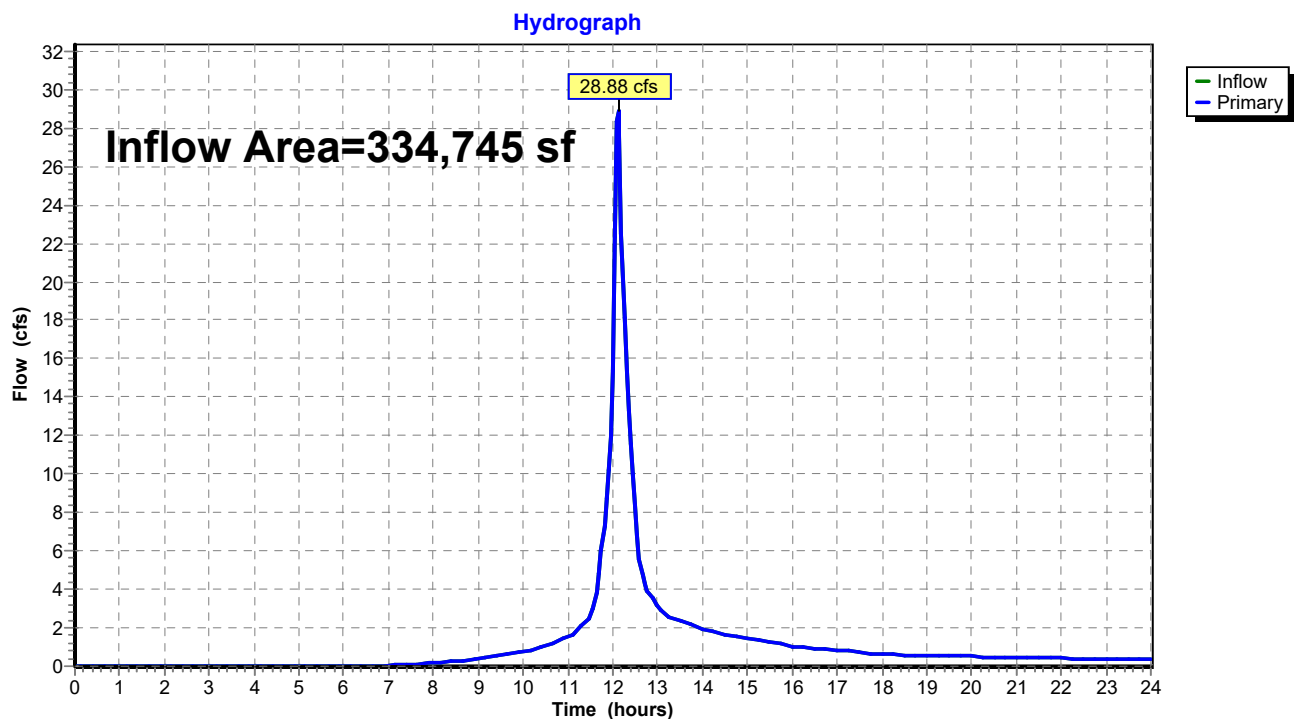


### Summary for Link PR-1: Proposed Conditions - Drainage Area 1

Inflow Area = 334,745 sf, 31.99% Impervious, Inflow Depth > 3.56" for 10yr Storm event  
Inflow = 28.88 cfs @ 12.12 hrs, Volume= 99,339 cf  
Primary = 28.88 cfs @ 12.12 hrs, Volume= 99,339 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

### Link PR-1: Proposed Conditions - Drainage Area 1

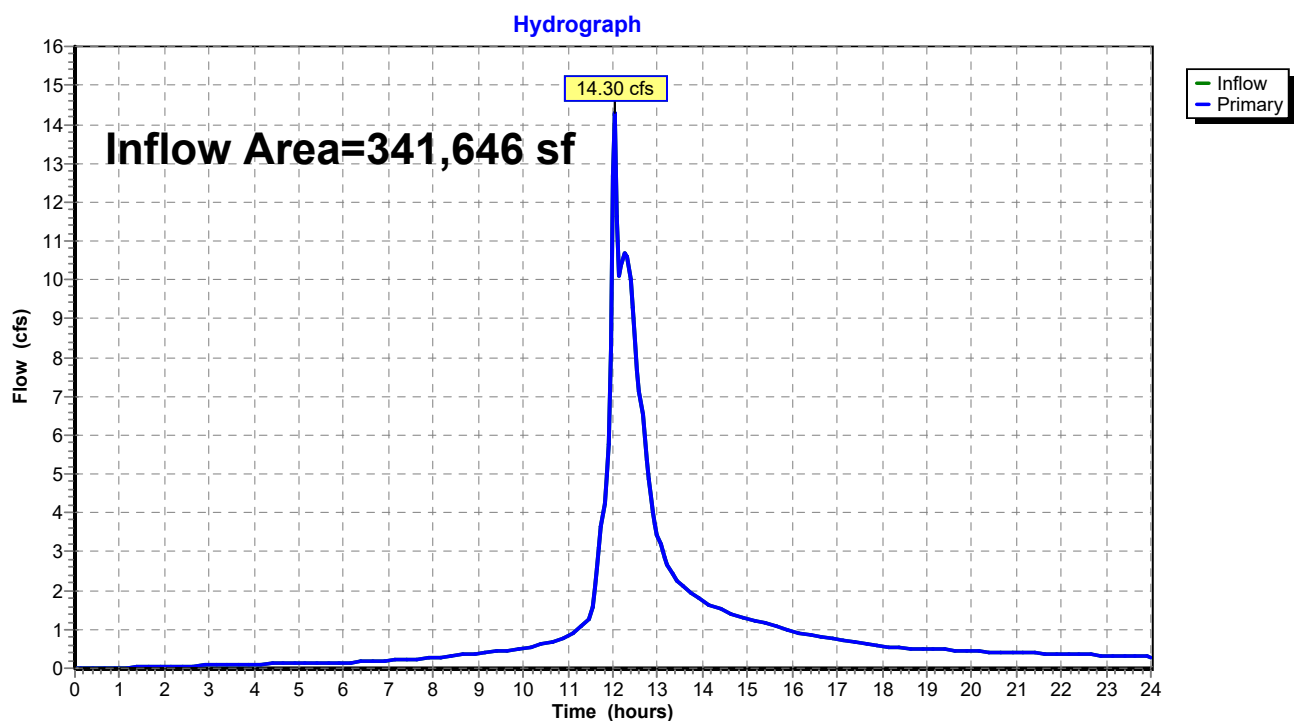


### Summary for Link PR-2: Proposed Conditions - Drainage Area 2

Inflow Area = 341,646 sf, 43.49% Impervious, Inflow Depth > 2.78" for 10yr Storm event  
Inflow = 14.30 cfs @ 12.04 hrs, Volume= 79,166 cf  
Primary = 14.30 cfs @ 12.04 hrs, Volume= 79,166 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

### Link PR-2: Proposed Conditions - Drainage Area 2



### Summary for Subcatchment EX-DA-1: Drainage Area 1

Runoff = 37.57 cfs @ 12.13 hrs, Volume= 133,589 cf, Depth> 4.53"

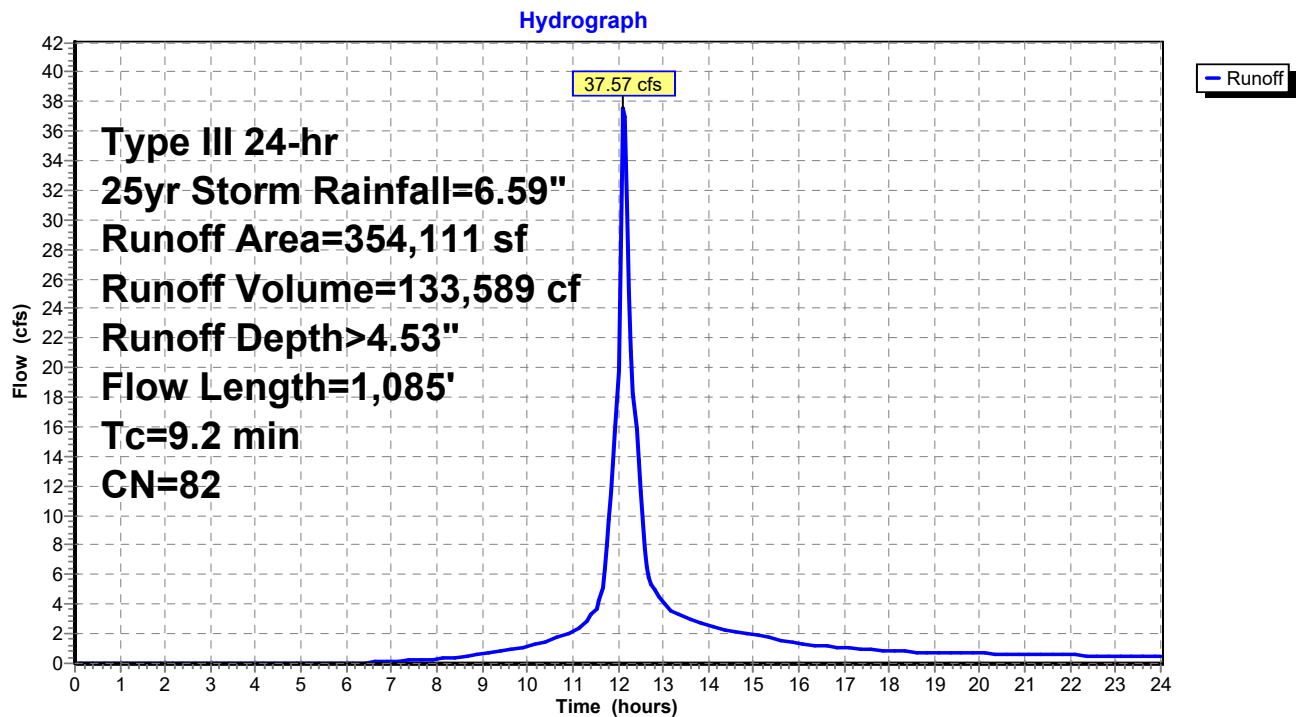
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 25yr Storm Rainfall=6.59"

	Area (sf)	CN	Description
*	40,230	98	Existing Building Roof Area
*	64,877	98	Existing Parking/Driveway
*	3,024	98	Existing Walkways
	6,845	61	>75% Grass cover, Good, HSG B
	39,096	80	>75% Grass cover, Good, HSG D
	16,789	55	Woods, Good, HSG B
	183,250	77	Woods, Good, HSG D
	354,111	82	Weighted Average
	245,980		69.46% Pervious Area
	108,131		30.54% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.5	70	0.0600	0.18		<b>Sheet Flow,</b> Grass: Dense n= 0.240 P2= 3.63"
0.3	95	0.1100	4.97		<b>Shallow Concentrated Flow,</b> Grassed Waterway Kv= 15.0 fps
0.6	80	0.0250	2.37		<b>Shallow Concentrated Flow,</b> Grassed Waterway Kv= 15.0 fps
1.8	840	0.0120	7.89	24.78	<b>Pipe Channel,</b> 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013
9.2	1,085	Total			

**Subcatchment EX-DA-1: Drainage Area 1**



### Summary for Subcatchment EX-DA-2: Drainage Area 2

Runoff = 18.27 cfs @ 12.36 hrs, Volume= 93,040 cf, Depth> 3.46"

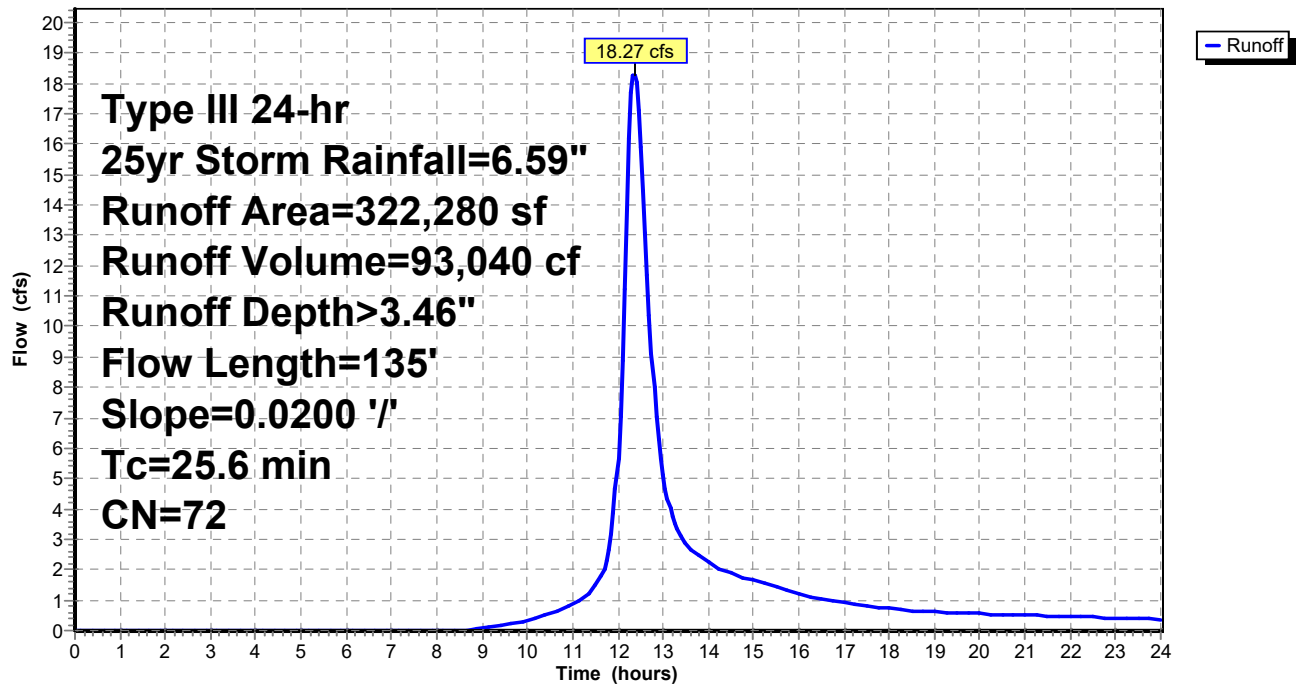
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 25yr Storm Rainfall=6.59"

	Area (sf)	CN	Description
*	62,634	98	Existing Building Roof Area
*	57,463	98	Existing Parking/Driveway
*	1,678	98	Existing Walkways
	33,495	61	>75% Grass cover, Good, HSG B
	918	80	>75% Grass cover, Good, HSG D
	161,382	55	Woods, Good, HSG B
	4,710	77	Woods, Good, HSG D
	322,280	72	Weighted Average
	200,505		62.21% Pervious Area
	121,775		37.79% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.6	135	0.0200	0.09		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.63"

### Subcatchment EX-DA-2: Drainage Area 2

Hydrograph



### Summary for Subcatchment PR-DA-1: Drainage Area 1

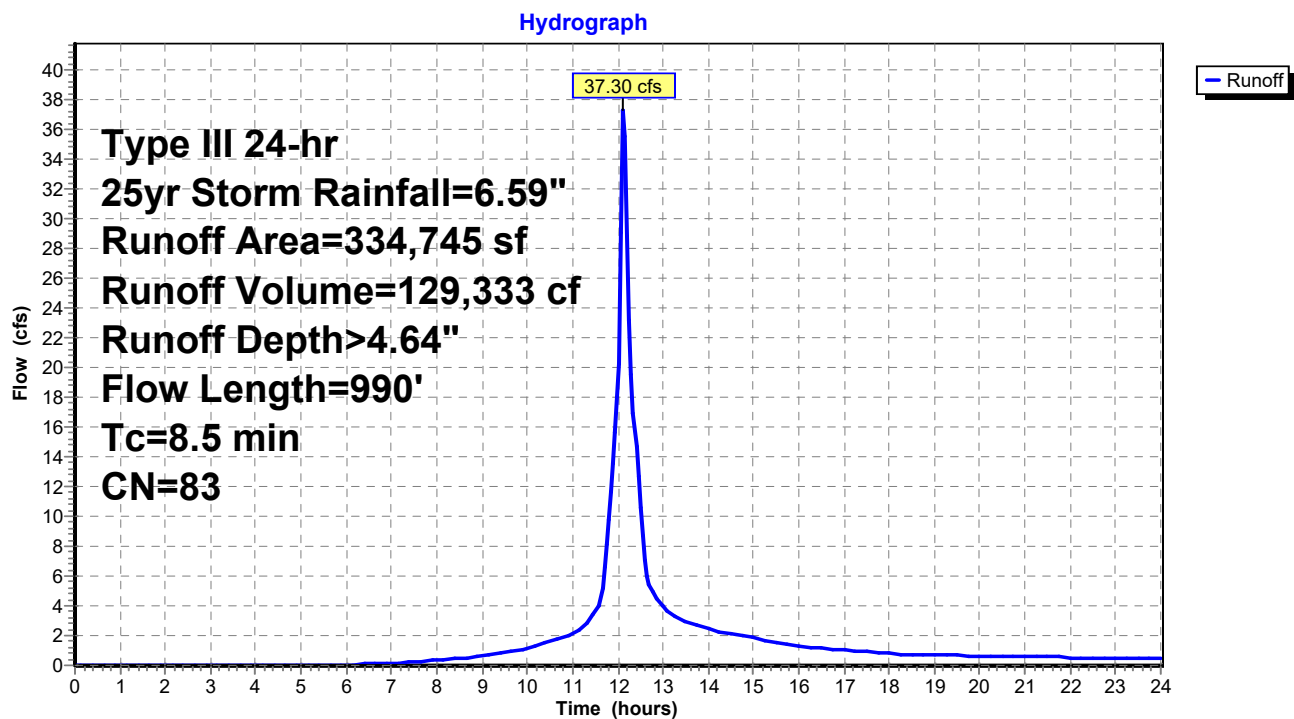
Runoff = 37.30 cfs @ 12.12 hrs, Volume= 129,333 cf, Depth> 4.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 25yr Storm Rainfall=6.59"

	Area (sf)	CN	Description
*	40,230	98	Existing Building Roof Area
*	61,104	98	Proposed Parking/Driveway
*	5,763	98	Proposed Walkways
	878	61	>75% Grass cover, Good, HSG B
	26,731	80	>75% Grass cover, Good, HSG D
	16,789	55	Woods, Good, HSG B
	183,250	77	Woods, Good, HSG D
	334,745	83	Weighted Average
	227,648		68.01% Pervious Area
	107,097		31.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.5	70	0.0600	0.18		<b>Sheet Flow,</b> Grass: Dense n= 0.240 P2= 3.63"
0.2	65	0.1100	4.97		<b>Shallow Concentrated Flow,</b> Grassed Waterway Kv= 15.0 fps
1.8	855	0.0120	7.89	24.78	<b>Pipe Channel,</b> 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013
8.5	990	Total			

### Subcatchment PR-DA-1: Drainage Area 1



### Summary for Subcatchment PR-DA-2A: Drainage Area 2

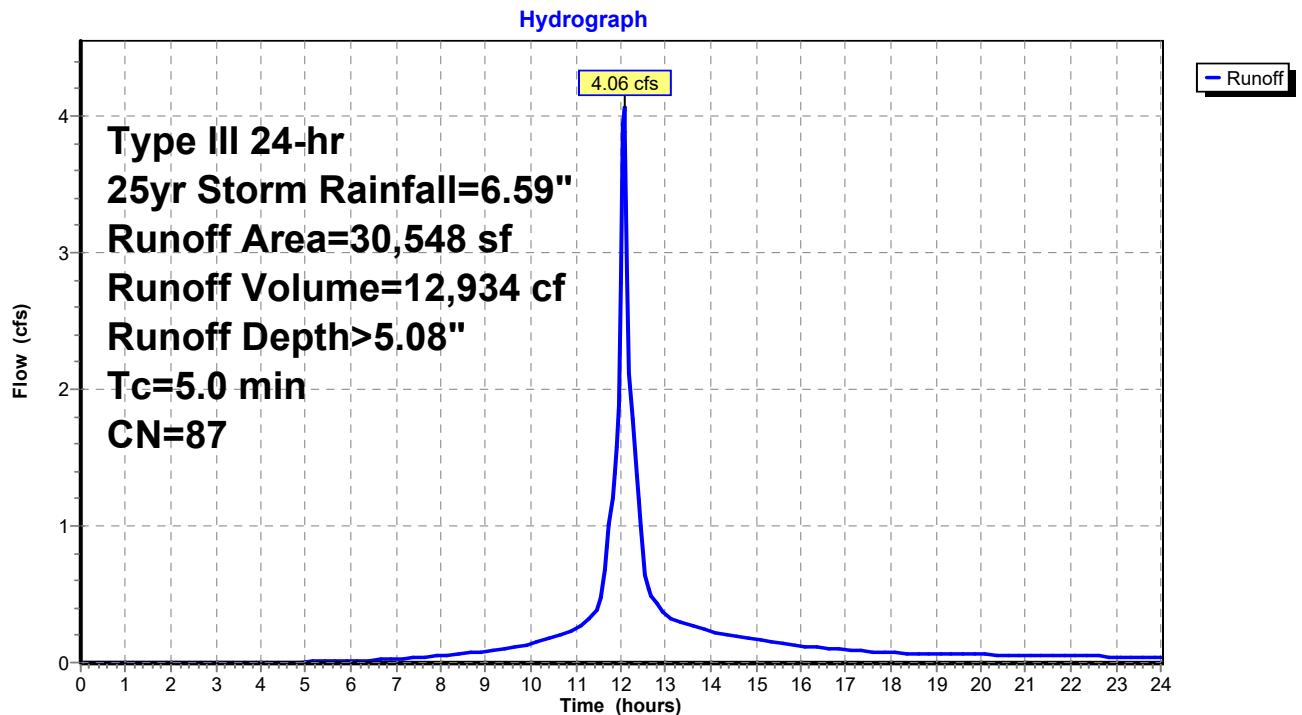
Runoff = 4.06 cfs @ 12.07 hrs, Volume= 12,934 cf, Depth> 5.08"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 25yr Storm Rainfall=6.59"

	Area (sf)	CN	Description
*	20,234	98	Proposed Pavement
*	922	98	Proposed Walkways
	9,313	61	>75% Grass cover, Good, HSG B
	79	80	>75% Grass cover, Good, HSG D
	30,548	87	Weighted Average
	9,392		30.75% Pervious Area
	21,156		69.25% Impervious Area

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

### Subcatchment PR-DA-2A: Drainage Area 2



### Summary for Subcatchment PR-DA-2B: Drainage Area 2

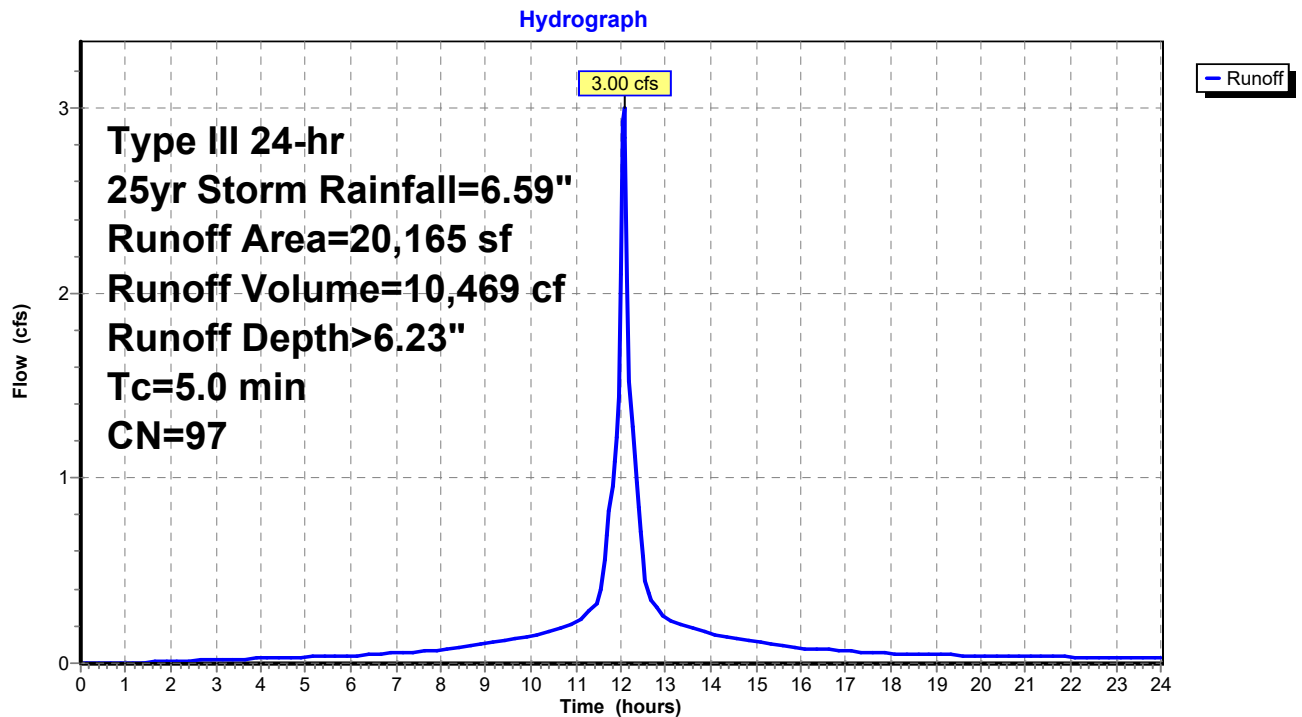
Runoff = 3.00 cfs @ 12.07 hrs, Volume= 10,469 cf, Depth> 6.23"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 25yr Storm Rainfall=6.59"

	Area (sf)	CN	Description
*	18,184	98	Proposed Pavement
*	866	98	Proposed Walkways
	1,115	80	>75% Grass cover, Good, HSG D
	20,165	97	Weighted Average
	1,115		5.53% Pervious Area
	19,050		94.47% Impervious Area

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

### Subcatchment PR-DA-2B: Drainage Area 2



### Summary for Subcatchment PR-DA-2C: Drainage Area 2

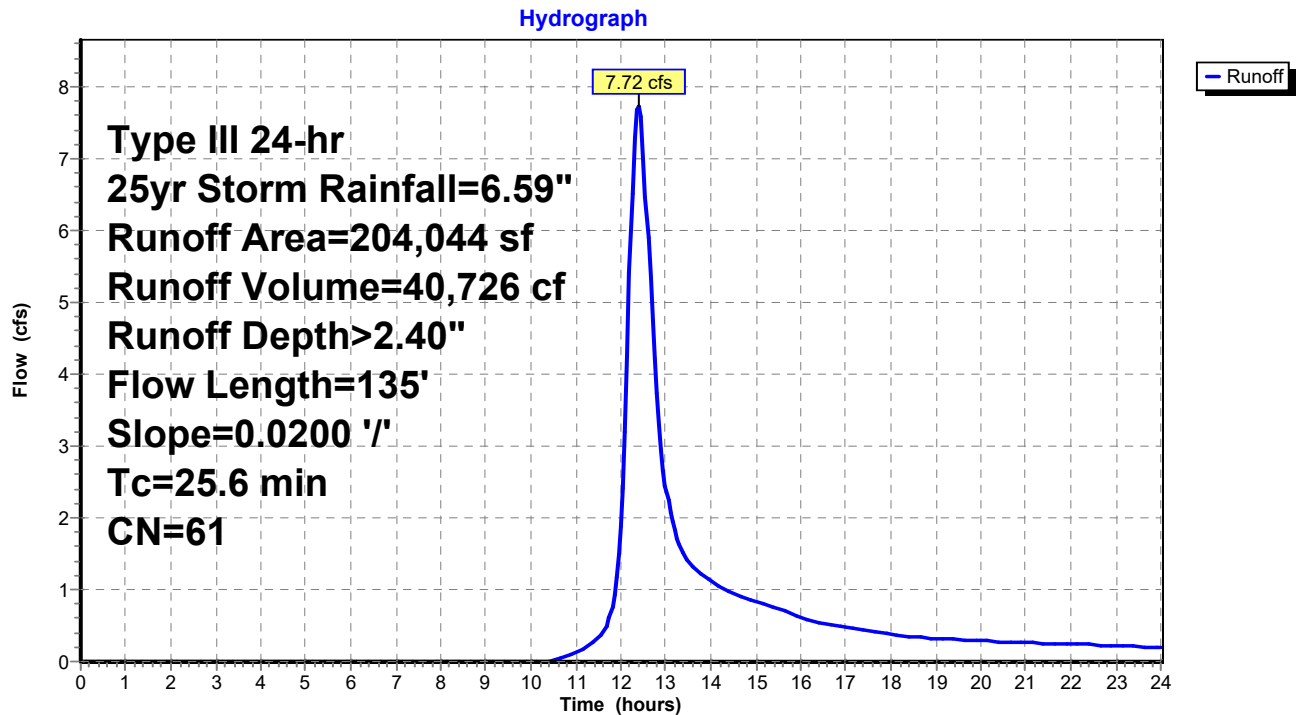
Runoff = 7.72 cfs @ 12.38 hrs, Volume= 40,726 cf, Depth> 2.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 25yr Storm Rainfall=6.59"

	Area (sf)	CN	Description
*	21,493	98	Proposed Parking/Driveway
	14,491	61	>75% Grass cover, Good, HSG B
	1,968	80	>75% Grass cover, Good, HSG D
	161,382	55	Woods, Good, HSG B
	4,710	77	Woods, Good, HSG D
	204,044	61	Weighted Average
	182,551		89.47% Pervious Area
	21,493		10.53% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.6	135	0.0200	0.09		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.63"

### Subcatchment PR-DA-2C: Drainage Area 2



### Summary for Subcatchment PR-DA-2D: Drainage Area 2D

Runoff = 13.99 cfs @ 12.03 hrs, Volume= 45,984 cf, Depth> 6.35"

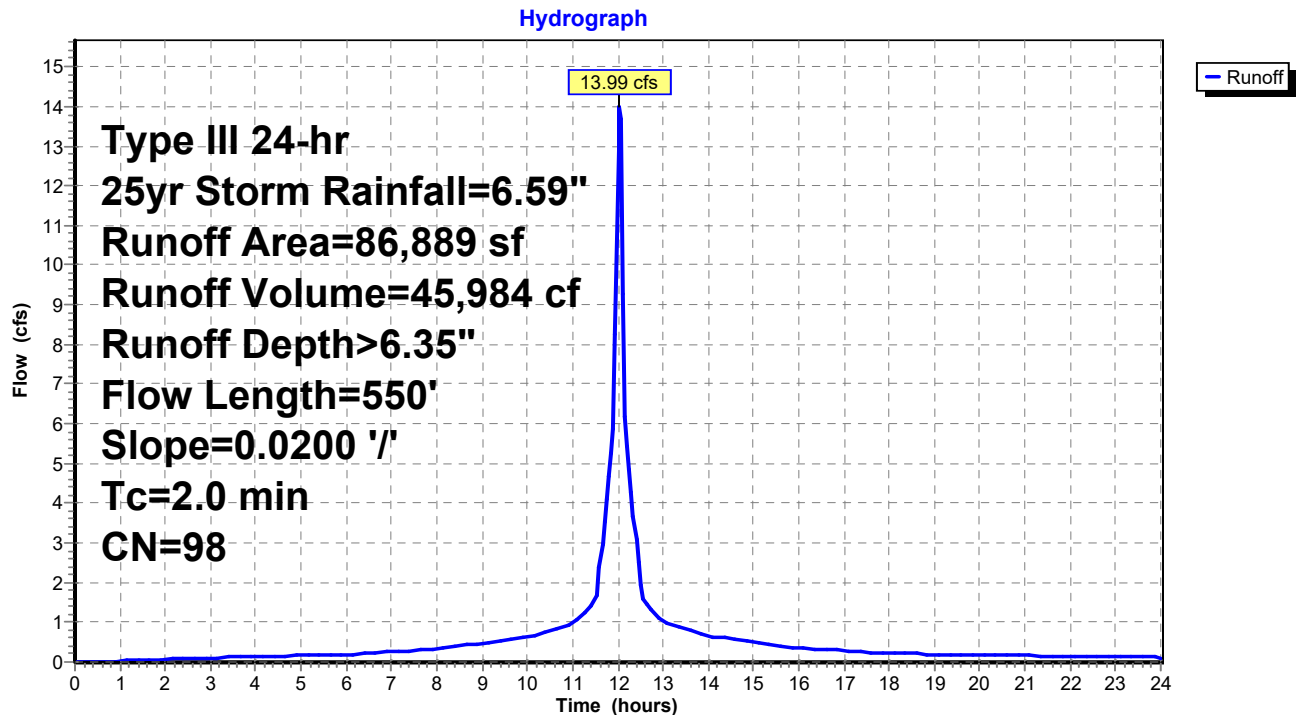
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 25yr Storm Rainfall=6.59"

Area (sf)	CN	Description
86,889	98	Roofs, HSG C
86,889		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.28		<b>Sheet Flow, Roof Flow to Roof Drain</b> Smooth surfaces n= 0.011 P2= 3.63"
1.3	500	0.0200	6.42	5.04	<b>Pipe Channel,</b> 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
2.0	550	Total			

### Subcatchment PR-DA-2D: Drainage Area 2D



### Summary for Pond 1P: Underground Detention

Inflow Area = 50,713 sf, 79.28% Impervious, Inflow Depth > 5.54" for 25yr Storm event  
 Inflow = 7.06 cfs @ 12.07 hrs, Volume= 23,403 cf  
 Outflow = 3.48 cfs @ 12.22 hrs, Volume= 18,697 cf, Atten= 51%, Lag= 8.8 min  
 Primary = 3.48 cfs @ 12.22 hrs, Volume= 18,697 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
 Peak Elev= 21.38' @ 12.22 hrs Surf.Area= 0.094 ac Storage= 0.208 af

Plug-Flow detention time= 150.5 min calculated for 18,658 cf (80% of inflow)  
 Center-of-Mass det. time= 75.7 min ( 847.5 - 771.8 )

Volume	Invert	Avail.Storage	Storage Description
#1A	18.00'	0.078 af	<b>40.17'W x 101.50'L x 3.54'H Field A</b> 0.331 af Overall - 0.136 af Embedded = 0.195 af x 40.0% Voids
#2A	18.50'	0.136 af	<b>Cultec R-330XLHD</b> x 112 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 8 rows
		0.214 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	18.80'	<b>24.0" Round Culvert</b> L= 30.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 18.80' / 18.50' S= 0.0100 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 3.14 sf
#2	Device 1	19.50'	<b>10.5" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#3	Device 1	21.40'	<b>6.0' long Sharp-Crested Rectangular Weir</b> 0 End Contraction(s) 1.0' Crest Height

**Primary OutFlow** Max=3.47 cfs @ 12.22 hrs HW=21.37' TW=0.00' (Dynamic Tailwater)

- 1=Culvert (Passes 3.47 cfs of 14.97 cfs potential flow)
- 2=Orifice/Grate (Orifice Controls 3.47 cfs @ 5.77 fps)
- 3=Sharp-Crested Rectangular Weir( Controls 0.00 cfs)

### Pond 1P: Underground Detention - Chamber Wizard Field A

**Chamber Model = Cultec R-330XLHD (Cultec Recharger® 330XLHD)**

Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf

Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap

Row Length Adjustment= +1.50' x 7.45 sf x 8 rows

52.0" Wide + 6.0" Spacing = 58.0" C-C Row Spacing

14 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 99.50' Row Length +12.0" End Stone x 2 =  
101.50' Base Length

8 Rows x 52.0" Wide + 6.0" Spacing x 7 + 12.0" Side Stone x 2 = 40.17' Base Width

6.0" Stone Base + 30.5" Chamber Height + 6.0" Stone Cover = 3.54' Field Height

112 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 8 Rows = 5,931.0 cf Chamber Storage

14,439.1 cf Field - 5,931.0 cf Chambers = 8,508.1 cf Stone x 40.0% Voids = 3,403.2 cf Stone Storage

Chamber Storage + Stone Storage = 9,334.2 cf = 0.214 af

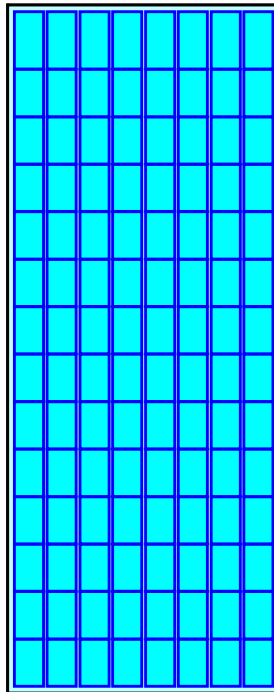
Overall Storage Efficiency = 64.6%

Overall System Size = 101.50' x 40.17' x 3.54'

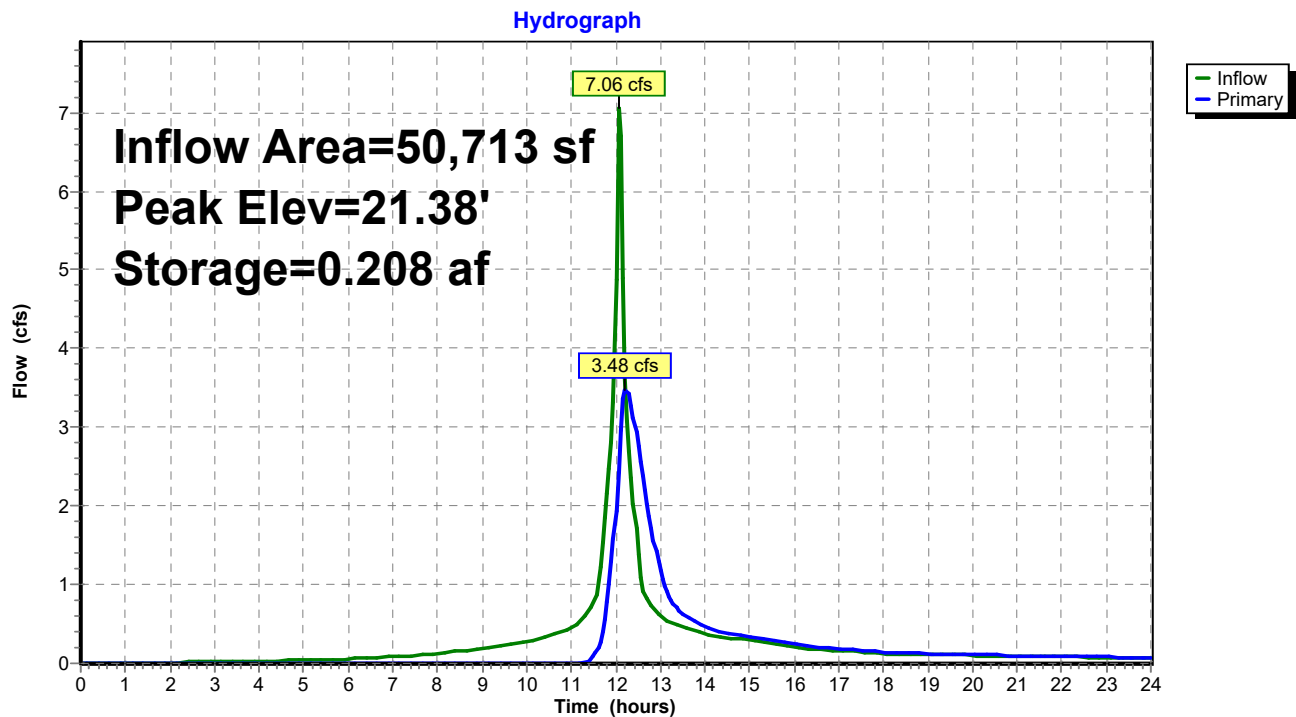
112 Chambers

534.8 cy Field

315.1 cy Stone



### Pond 1P: Underground Detention

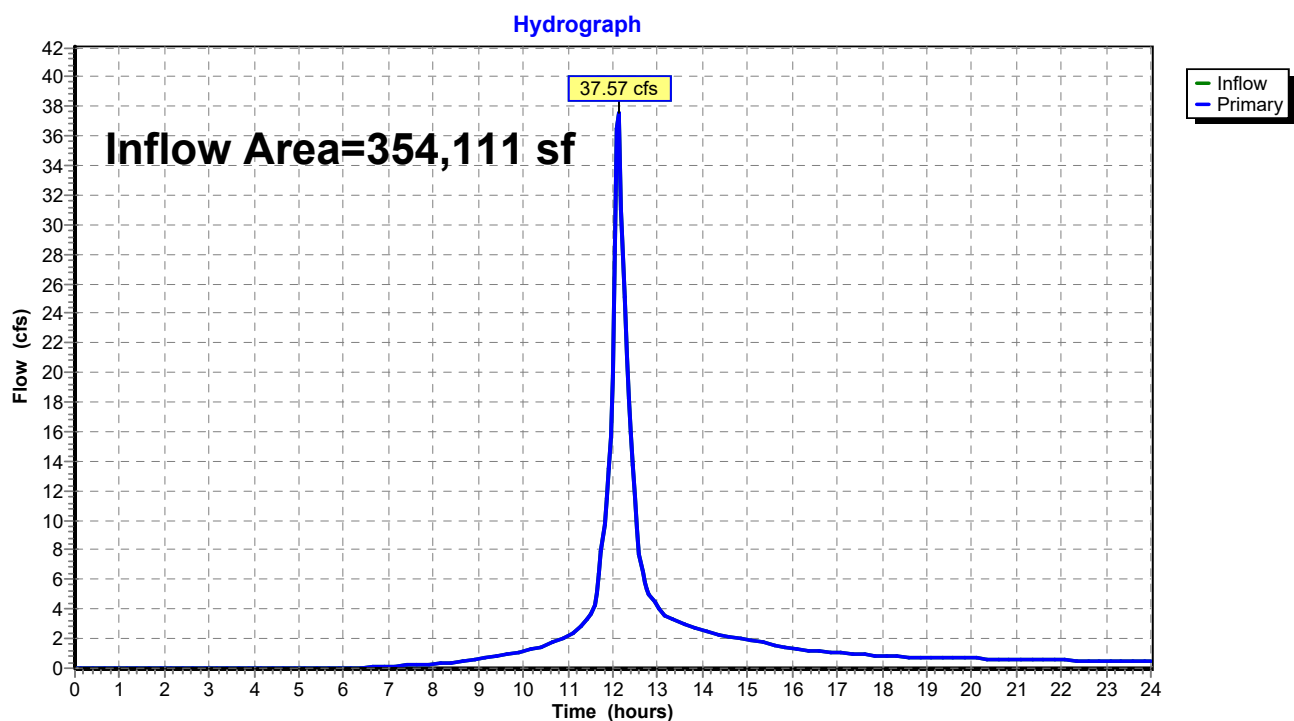


### Summary for Link EX-1: Exist. Conditions - Drainage Area 1

Inflow Area = 354,111 sf, 30.54% Impervious, Inflow Depth > 4.53" for 25yr Storm event  
Inflow = 37.57 cfs @ 12.13 hrs, Volume= 133,589 cf  
Primary = 37.57 cfs @ 12.13 hrs, Volume= 133,589 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

### Link EX-1: Exist. Conditions - Drainage Area 1

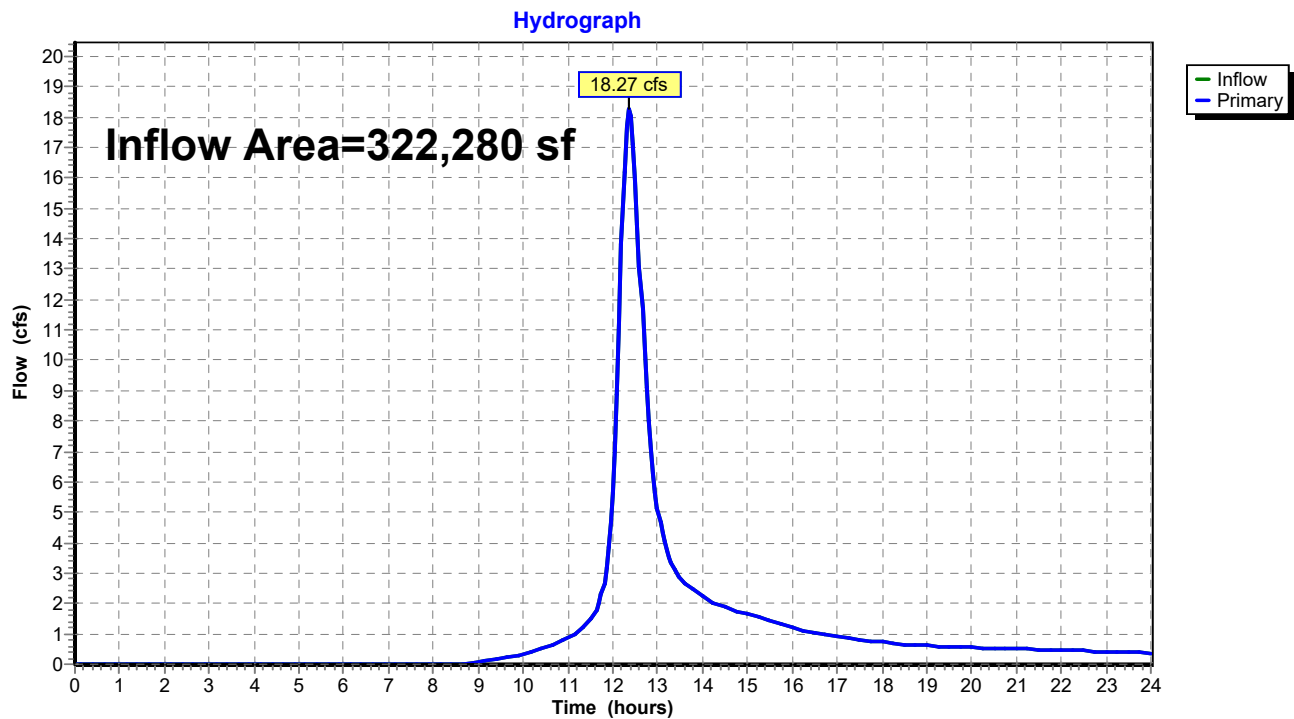


### Summary for Link EX-2: Exist. Conditions - Drainage Area 2

Inflow Area = 322,280 sf, 37.79% Impervious, Inflow Depth > 3.46" for 25yr Storm event  
Inflow = 18.27 cfs @ 12.36 hrs, Volume= 93,040 cf  
Primary = 18.27 cfs @ 12.36 hrs, Volume= 93,040 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

### Link EX-2: Exist. Conditions - Drainage Area 2

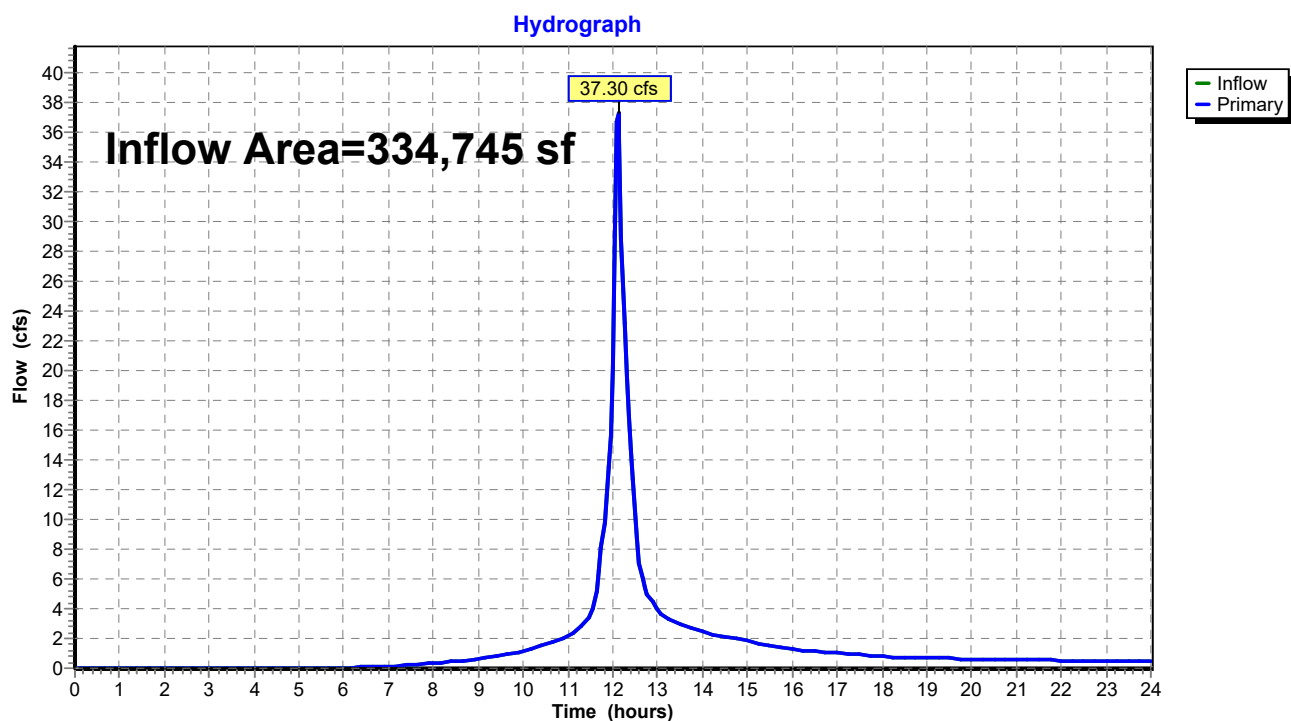


### Summary for Link PR-1: Proposed Conditions - Drainage Area 1

Inflow Area = 334,745 sf, 31.99% Impervious, Inflow Depth > 4.64" for 25yr Storm event  
 Inflow = 37.30 cfs @ 12.12 hrs, Volume= 129,333 cf  
 Primary = 37.30 cfs @ 12.12 hrs, Volume= 129,333 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

### Link PR-1: Proposed Conditions - Drainage Area 1

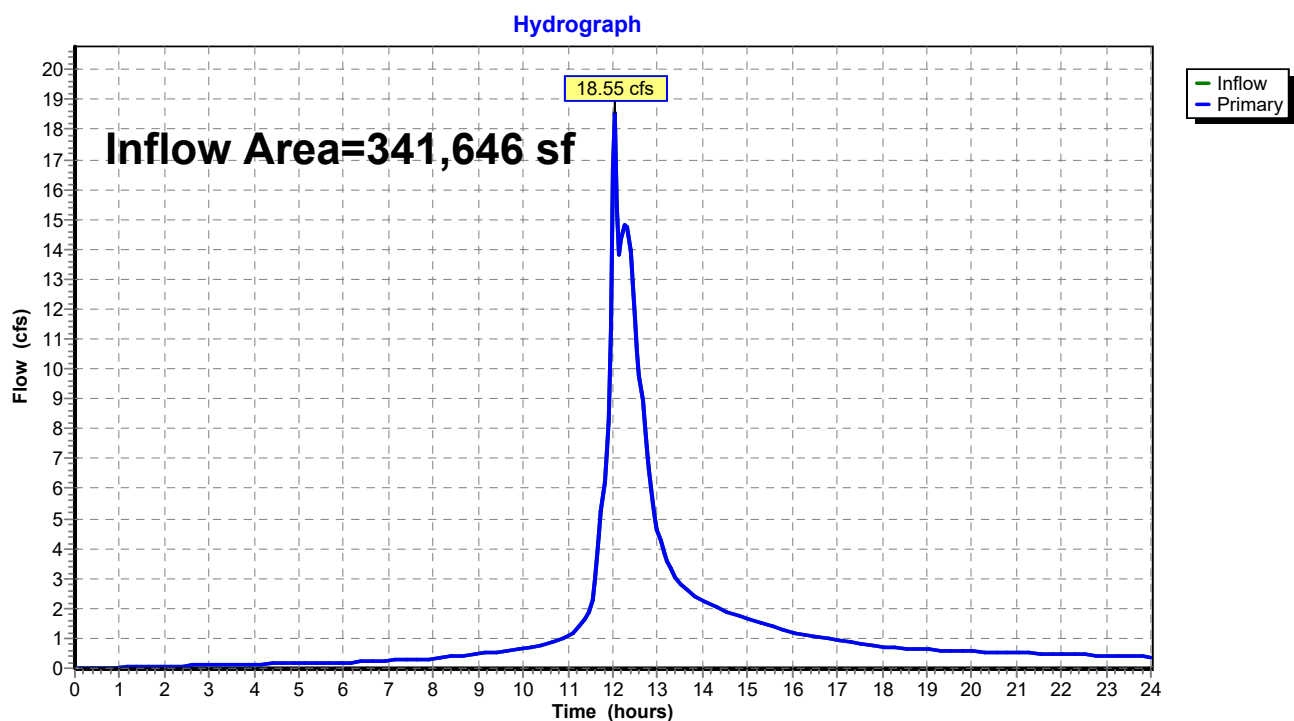


### Summary for Link PR-2: Proposed Conditions - Drainage Area 2

Inflow Area = 341,646 sf, 43.49% Impervious, Inflow Depth > 3.70" for 25yr Storm event  
Inflow = 18.55 cfs @ 12.04 hrs, Volume= 105,407 cf  
Primary = 18.55 cfs @ 12.04 hrs, Volume= 105,407 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

### Link PR-2: Proposed Conditions - Drainage Area 2



### Summary for Subcatchment EX-DA-1: Drainage Area 1

Runoff = 51.20 cfs @ 12.13 hrs, Volume= 184,471 cf, Depth> 6.25"

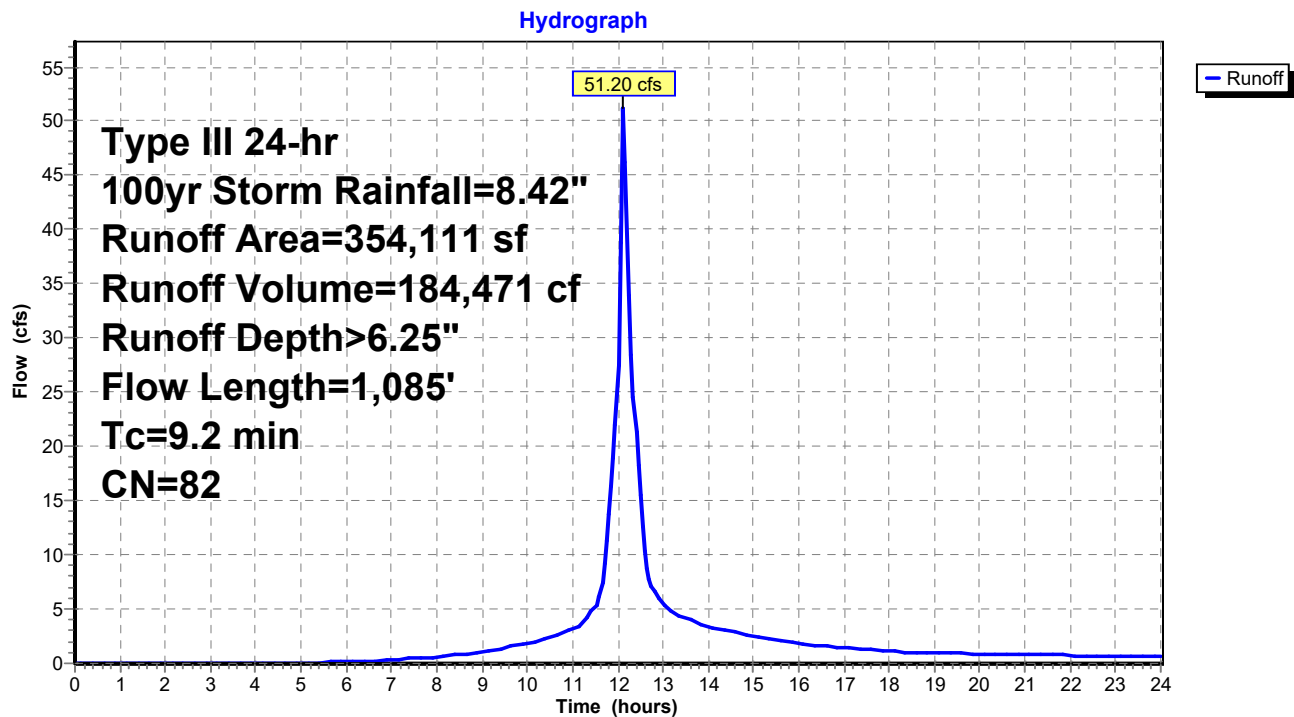
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 100yr Storm Rainfall=8.42"

	Area (sf)	CN	Description
*	40,230	98	Existing Building Roof Area
*	64,877	98	Existing Parking/Driveway
*	3,024	98	Existing Walkways
	6,845	61	>75% Grass cover, Good, HSG B
	39,096	80	>75% Grass cover, Good, HSG D
	16,789	55	Woods, Good, HSG B
	183,250	77	Woods, Good, HSG D
	354,111	82	Weighted Average
	245,980		69.46% Pervious Area
	108,131		30.54% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.5	70	0.0600	0.18		<b>Sheet Flow,</b> Grass: Dense n= 0.240 P2= 3.63"
0.3	95	0.1100	4.97		<b>Shallow Concentrated Flow,</b> Grassed Waterway Kv= 15.0 fps
0.6	80	0.0250	2.37		<b>Shallow Concentrated Flow,</b> Grassed Waterway Kv= 15.0 fps
1.8	840	0.0120	7.89	24.78	<b>Pipe Channel,</b> 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013
9.2	1,085	Total			

### Subcatchment EX-DA-1: Drainage Area 1



### Summary for Subcatchment EX-DA-2: Drainage Area 2

Runoff = 26.59 cfs @ 12.35 hrs, Volume= 135,375 cf, Depth> 5.04"

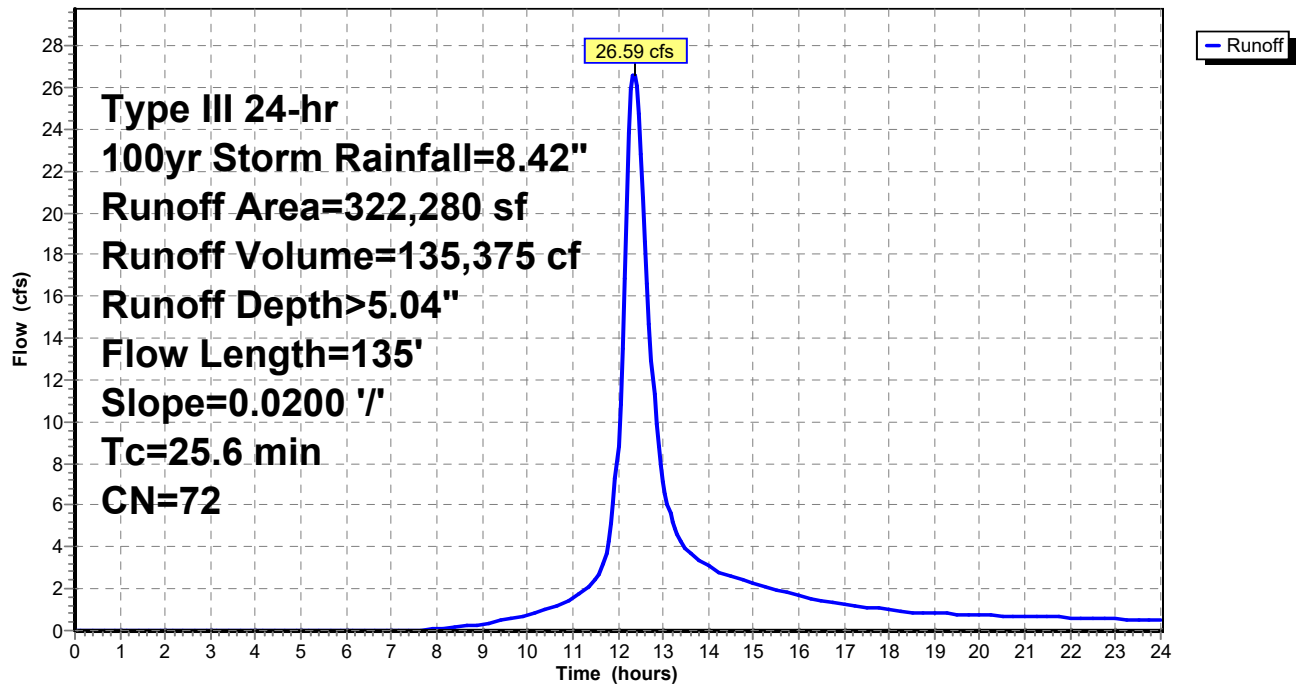
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 100yr Storm Rainfall=8.42"

	Area (sf)	CN	Description
*	62,634	98	Existing Building Roof Area
*	57,463	98	Existing Parking/Driveway
*	1,678	98	Existing Walkways
	33,495	61	>75% Grass cover, Good, HSG B
	918	80	>75% Grass cover, Good, HSG D
	161,382	55	Woods, Good, HSG B
	4,710	77	Woods, Good, HSG D
	322,280	72	Weighted Average
	200,505		62.21% Pervious Area
	121,775		37.79% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.6	135	0.0200	0.09		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.63"

### Subcatchment EX-DA-2: Drainage Area 2

Hydrograph



### Summary for Subcatchment PR-DA-1: Drainage Area 1

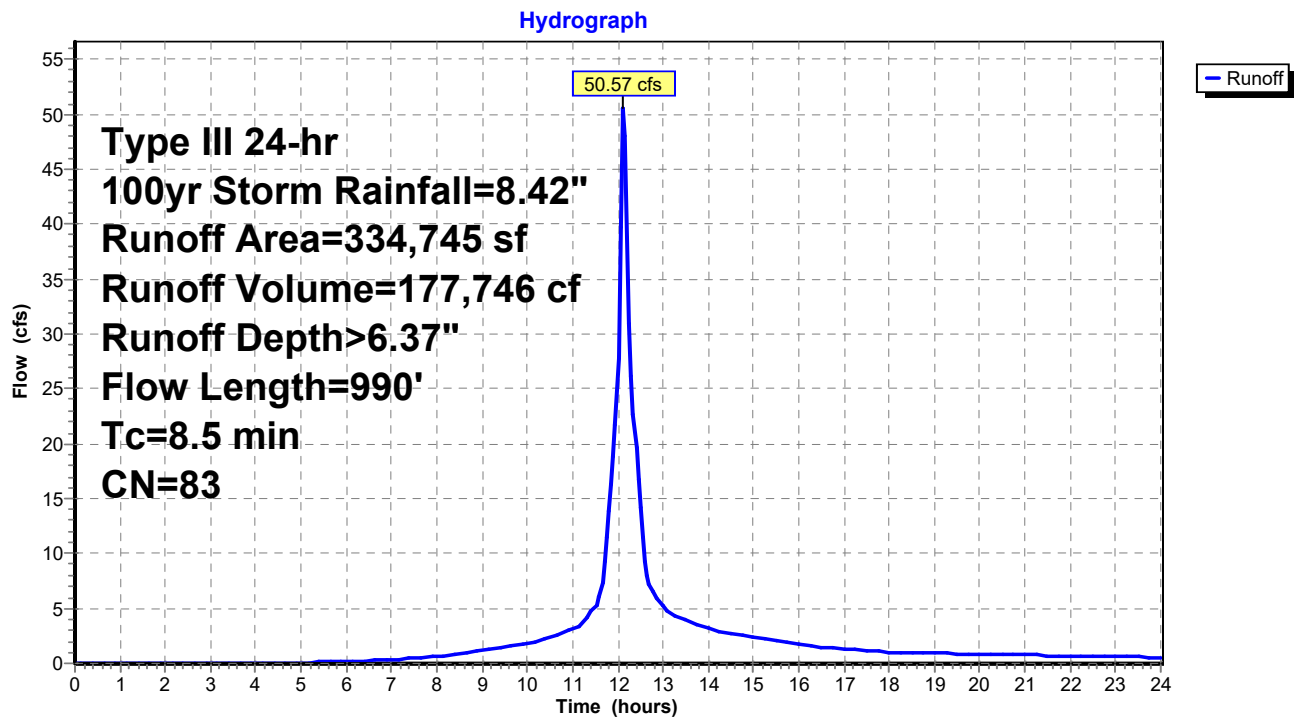
Runoff = 50.57 cfs @ 12.12 hrs, Volume= 177,746 cf, Depth> 6.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 100yr Storm Rainfall=8.42"

	Area (sf)	CN	Description
*	40,230	98	Existing Building Roof Area
*	61,104	98	Proposed Parking/Driveway
*	5,763	98	Proposed Walkways
	878	61	>75% Grass cover, Good, HSG B
	26,731	80	>75% Grass cover, Good, HSG D
	16,789	55	Woods, Good, HSG B
	183,250	77	Woods, Good, HSG D
	334,745	83	Weighted Average
	227,648		68.01% Pervious Area
	107,097		31.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.5	70	0.0600	0.18		<b>Sheet Flow,</b> Grass: Dense n= 0.240 P2= 3.63"
0.2	65	0.1100	4.97		<b>Shallow Concentrated Flow,</b> Grassed Waterway Kv= 15.0 fps
1.8	855	0.0120	7.89	24.78	<b>Pipe Channel,</b> 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013
8.5	990	Total			

### Subcatchment PR-DA-1: Drainage Area 1



### Summary for Subcatchment PR-DA-2A: Drainage Area 2

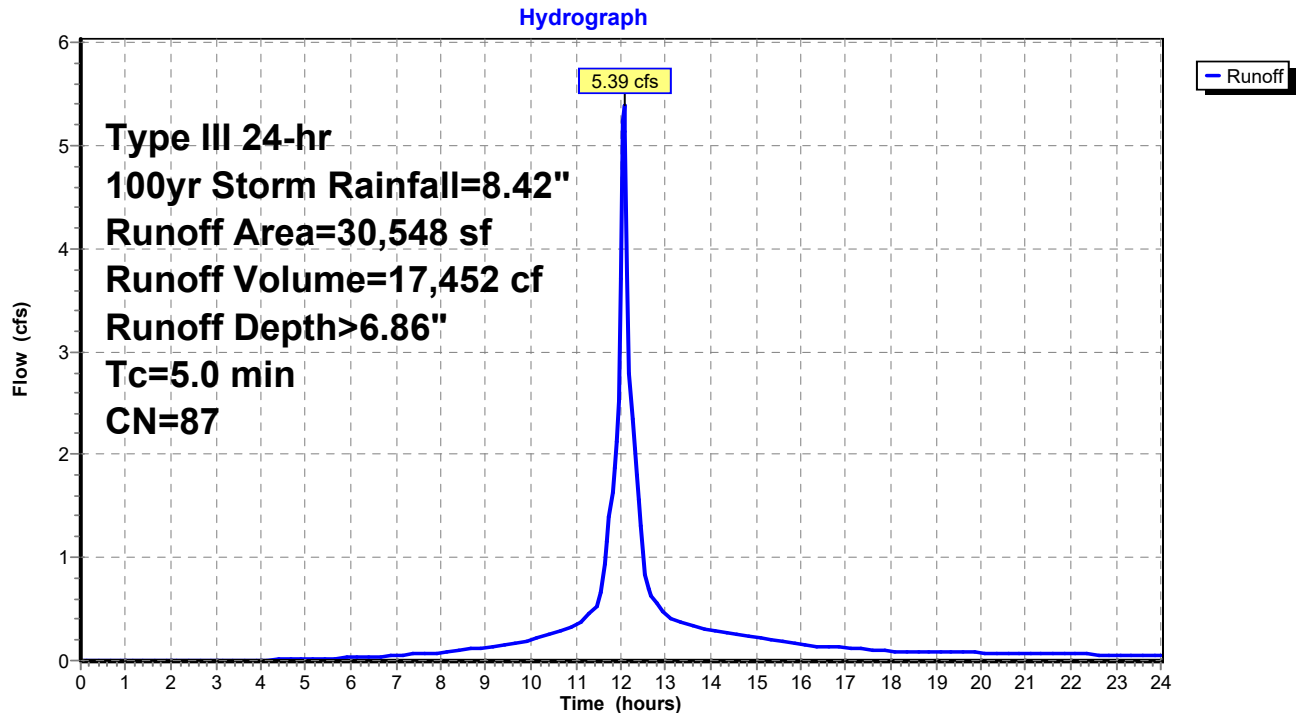
Runoff = 5.39 cfs @ 12.07 hrs, Volume= 17,452 cf, Depth> 6.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 100yr Storm Rainfall=8.42"

	Area (sf)	CN	Description
*	20,234	98	Proposed Pavement
*	922	98	Proposed Walkways
	9,313	61	>75% Grass cover, Good, HSG B
	79	80	>75% Grass cover, Good, HSG D
	30,548	87	Weighted Average
	9,392		30.75% Pervious Area
	21,156		69.25% Impervious Area

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

### Subcatchment PR-DA-2A: Drainage Area 2



### Summary for Subcatchment PR-DA-2B: Drainage Area 2

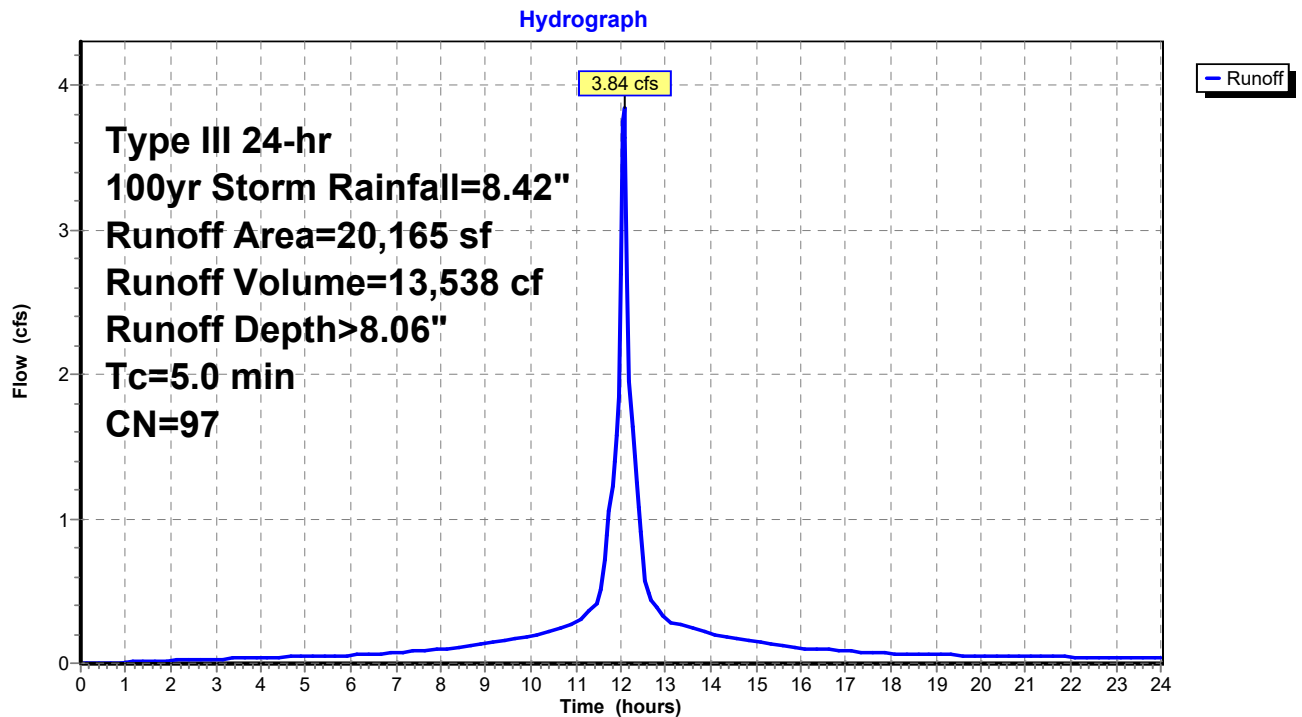
Runoff = 3.84 cfs @ 12.07 hrs, Volume= 13,538 cf, Depth> 8.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 100yr Storm Rainfall=8.42"

	Area (sf)	CN	Description
*	18,184	98	Proposed Pavement
*	866	98	Proposed Walkways
	1,115	80	>75% Grass cover, Good, HSG D
	20,165	97	Weighted Average
	1,115		5.53% Pervious Area
	19,050		94.47% Impervious Area

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

### Subcatchment PR-DA-2B: Drainage Area 2



### Summary for Subcatchment PR-DA-2C: Drainage Area 2

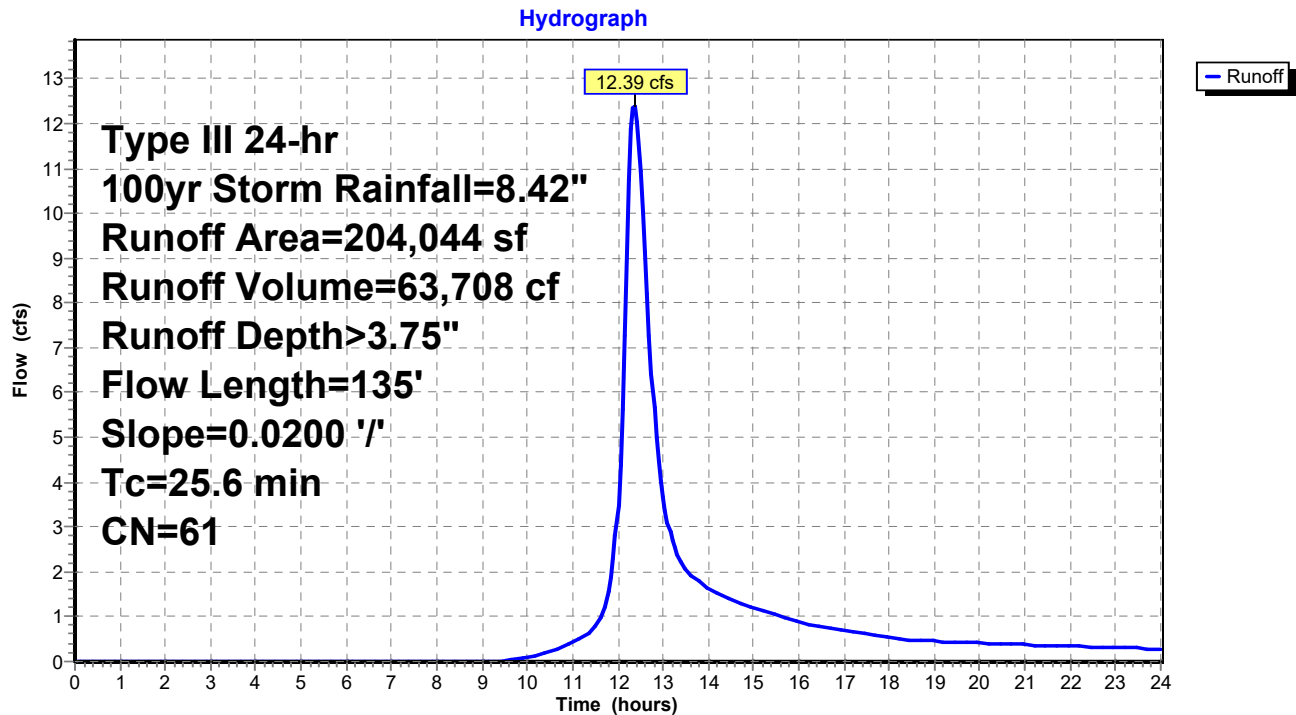
Runoff = 12.39 cfs @ 12.37 hrs, Volume= 63,708 cf, Depth> 3.75"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 100yr Storm Rainfall=8.42"

	Area (sf)	CN	Description
*	21,493	98	Proposed Parking/Driveway
	14,491	61	>75% Grass cover, Good, HSG B
	1,968	80	>75% Grass cover, Good, HSG D
	161,382	55	Woods, Good, HSG B
	4,710	77	Woods, Good, HSG D
	204,044	61	Weighted Average
	182,551		89.47% Pervious Area
	21,493		10.53% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.6	135	0.0200	0.09		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.63"

### Subcatchment PR-DA-2C: Drainage Area 2



### Summary for Subcatchment PR-DA-2D: Drainage Area 2D

Runoff = 17.90 cfs @ 12.03 hrs, Volume= 59,225 cf, Depth> 8.18"

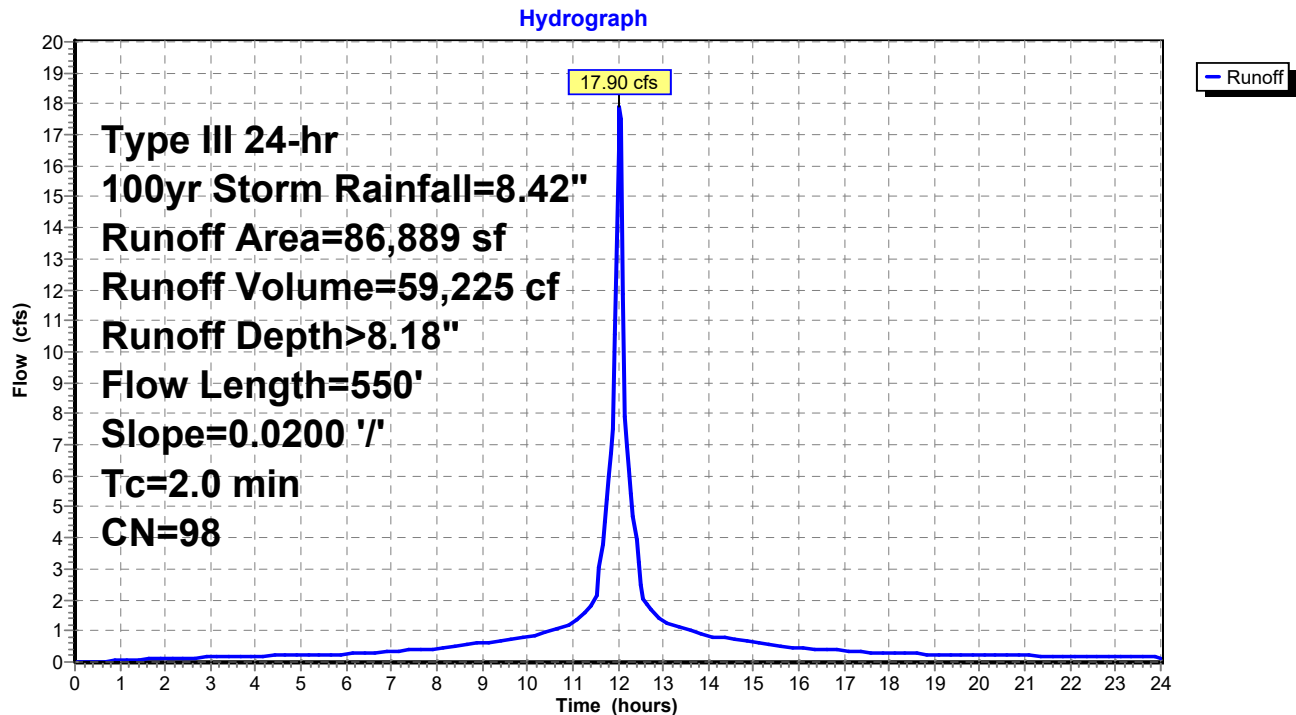
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 100yr Storm Rainfall=8.42"

Area (sf)	CN	Description
86,889	98	Roofs, HSG C
86,889		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.28		<b>Sheet Flow, Roof Flow to Roof Drain</b> Smooth surfaces n= 0.011 P2= 3.63"
1.3	500	0.0200	6.42	5.04	<b>Pipe Channel,</b> 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
2.0	550	Total			

### Subcatchment PR-DA-2D: Drainage Area 2D



### Summary for Pond 1P: Underground Detention

Inflow Area = 50,713 sf, 79.28% Impervious, Inflow Depth > 7.33" for 100yr Storm event  
 Inflow = 9.23 cfs @ 12.07 hrs, Volume= 30,989 cf  
 Outflow = 8.87 cfs @ 12.11 hrs, Volume= 26,224 cf, Atten= 4%, Lag= 2.4 min  
 Primary = 8.87 cfs @ 12.11 hrs, Volume= 26,224 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
 Peak Elev= 21.81' @ 12.12 hrs Surf.Area= 0.094 ac Storage= 0.214 af

Plug-Flow detention time= 130.7 min calculated for 26,170 cf (84% of inflow)  
 Center-of-Mass det. time= 66.8 min ( 832.7 - 765.9 )

Volume	Invert	Avail.Storage	Storage Description
#1A	18.00'	0.078 af	<b>40.17'W x 101.50'L x 3.54'H Field A</b> 0.331 af Overall - 0.136 af Embedded = 0.195 af x 40.0% Voids
#2A	18.50'	0.136 af	<b>Cultec R-330XLHD</b> x 112 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 8 rows
		0.214 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	18.80'	<b>24.0" Round Culvert</b> L= 30.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 18.80' / 18.50' S= 0.0100 ' / Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 3.14 sf
#2	Device 1	19.50'	<b>10.5" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#3	Device 1	21.40'	<b>6.0' long Sharp-Crested Rectangular Weir</b> 0 End Contraction(s) 1.0' Crest Height

**Primary OutFlow** Max=8.21 cfs @ 12.11 hrs HW=21.75' TW=0.00' (Dynamic Tailwater)

- 1=Culvert (Passes 8.21 cfs of 16.69 cfs potential flow)
- 2=Orifice/Grate (Orifice Controls 3.90 cfs @ 6.49 fps)
- 3=Sharp-Crested Rectangular Weir (Weir Controls 4.30 cfs @ 2.03 fps)

## Pond 1P: Underground Detention - Chamber Wizard Field A

### Chamber Model = Cultec R-330XLHD (Cultec Recharger® 330XLHD)

Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf

Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap

Row Length Adjustment= +1.50' x 7.45 sf x 8 rows

52.0" Wide + 6.0" Spacing = 58.0" C-C Row Spacing

14 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 99.50' Row Length +12.0" End Stone x 2 =  
 101.50' Base Length

8 Rows x 52.0" Wide + 6.0" Spacing x 7 + 12.0" Side Stone x 2 = 40.17' Base Width

6.0" Stone Base + 30.5" Chamber Height + 6.0" Stone Cover = 3.54' Field Height

112 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 8 Rows = 5,931.0 cf Chamber Storage

14,439.1 cf Field - 5,931.0 cf Chambers = 8,508.1 cf Stone x 40.0% Voids = 3,403.2 cf Stone Storage

Chamber Storage + Stone Storage = 9,334.2 cf = 0.214 af

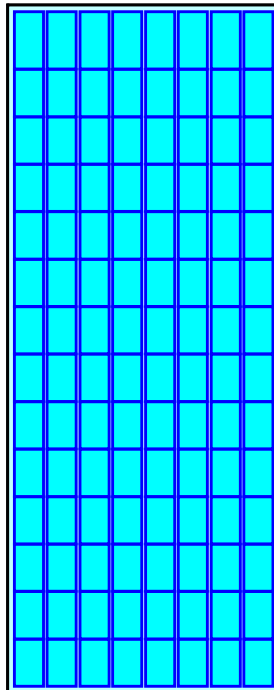
Overall Storage Efficiency = 64.6%

Overall System Size = 101.50' x 40.17' x 3.54'

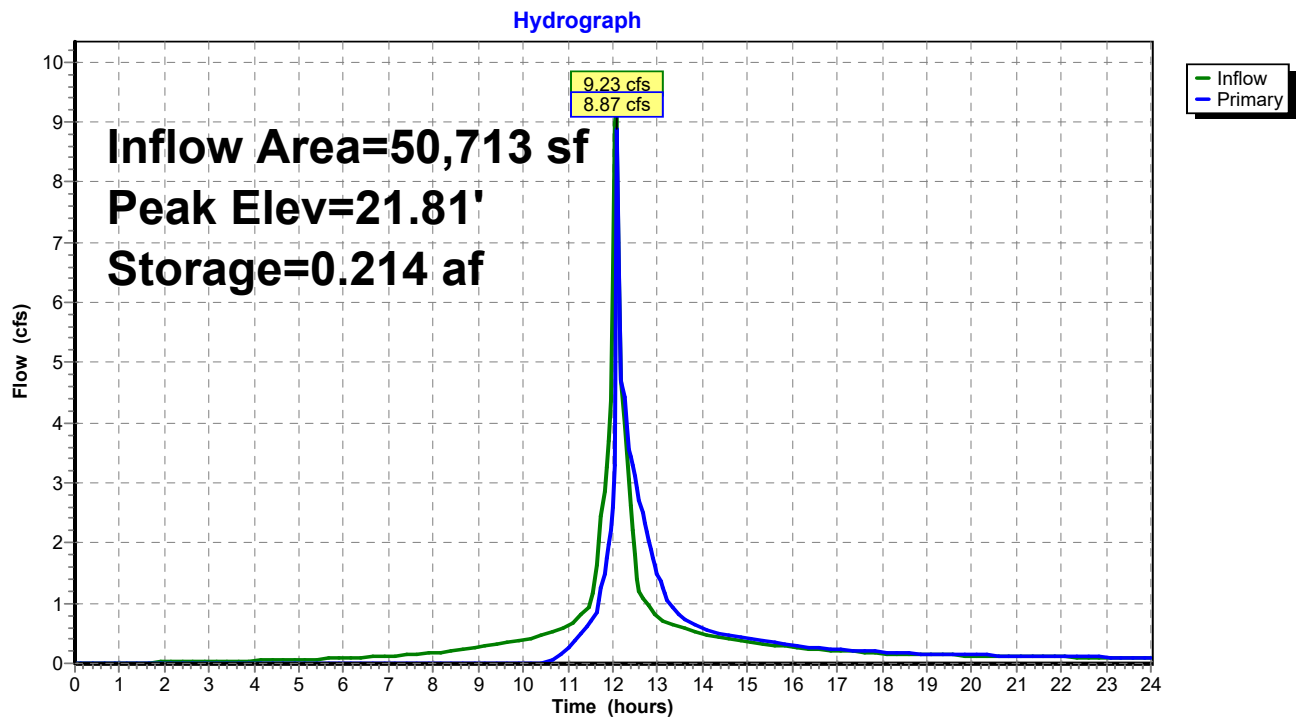
112 Chambers

534.8 cy Field

315.1 cy Stone



### Pond 1P: Underground Detention

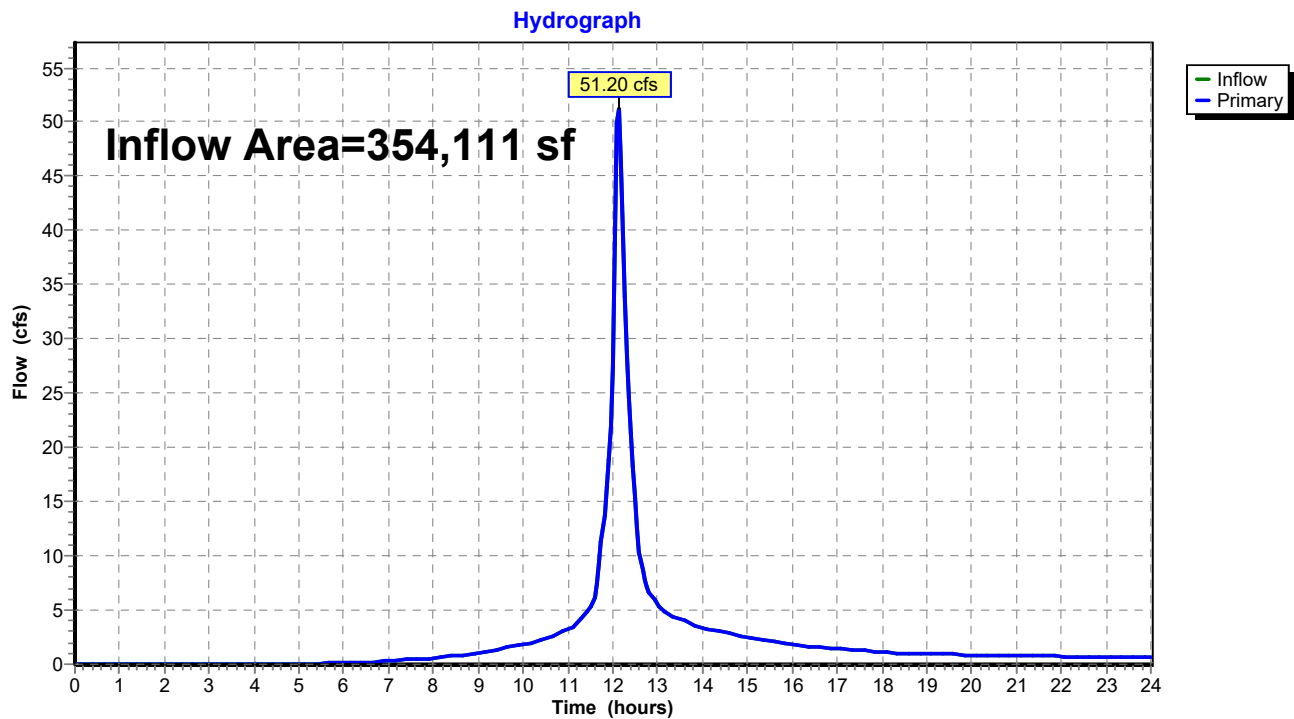


### Summary for Link EX-1: Exist. Conditions - Drainage Area 1

Inflow Area = 354,111 sf, 30.54% Impervious, Inflow Depth > 6.25" for 100yr Storm event  
Inflow = 51.20 cfs @ 12.13 hrs, Volume= 184,471 cf  
Primary = 51.20 cfs @ 12.13 hrs, Volume= 184,471 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

### Link EX-1: Exist. Conditions - Drainage Area 1

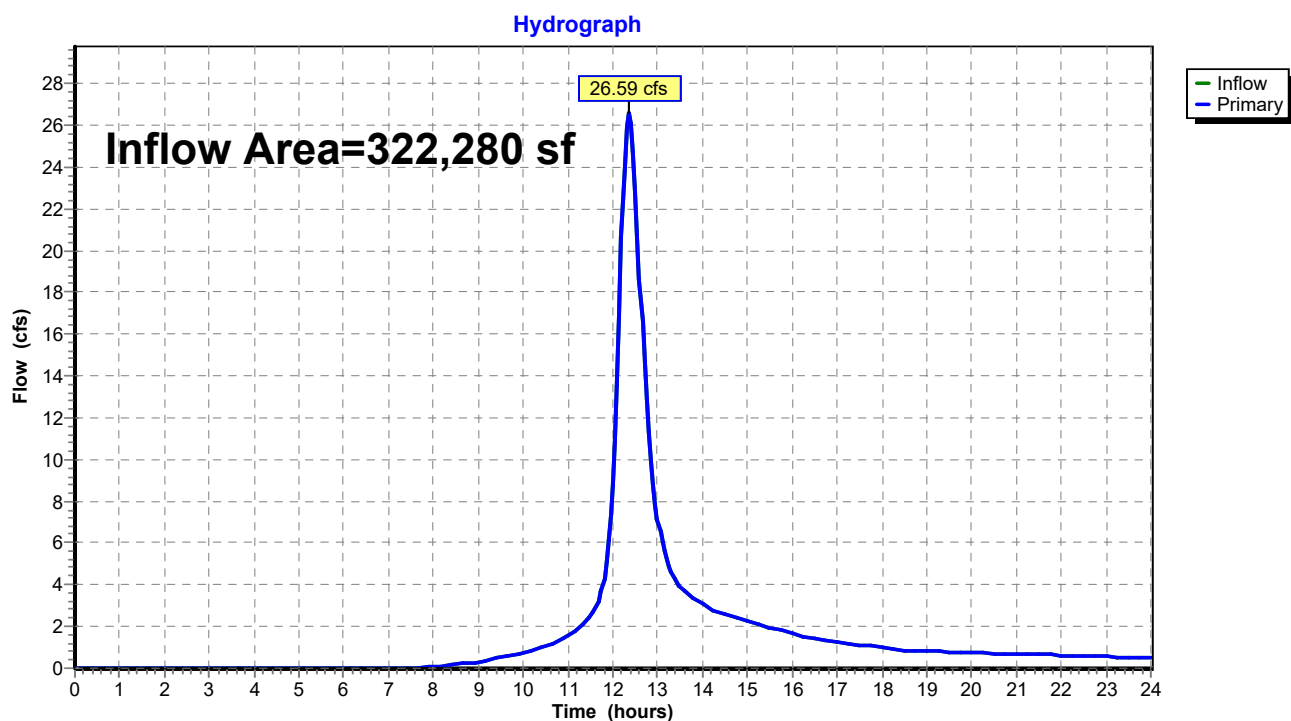


### Summary for Link EX-2: Exist. Conditions - Drainage Area 2

Inflow Area = 322,280 sf, 37.79% Impervious, Inflow Depth > 5.04" for 100yr Storm event  
Inflow = 26.59 cfs @ 12.35 hrs, Volume= 135,375 cf  
Primary = 26.59 cfs @ 12.35 hrs, Volume= 135,375 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

### Link EX-2: Exist. Conditions - Drainage Area 2

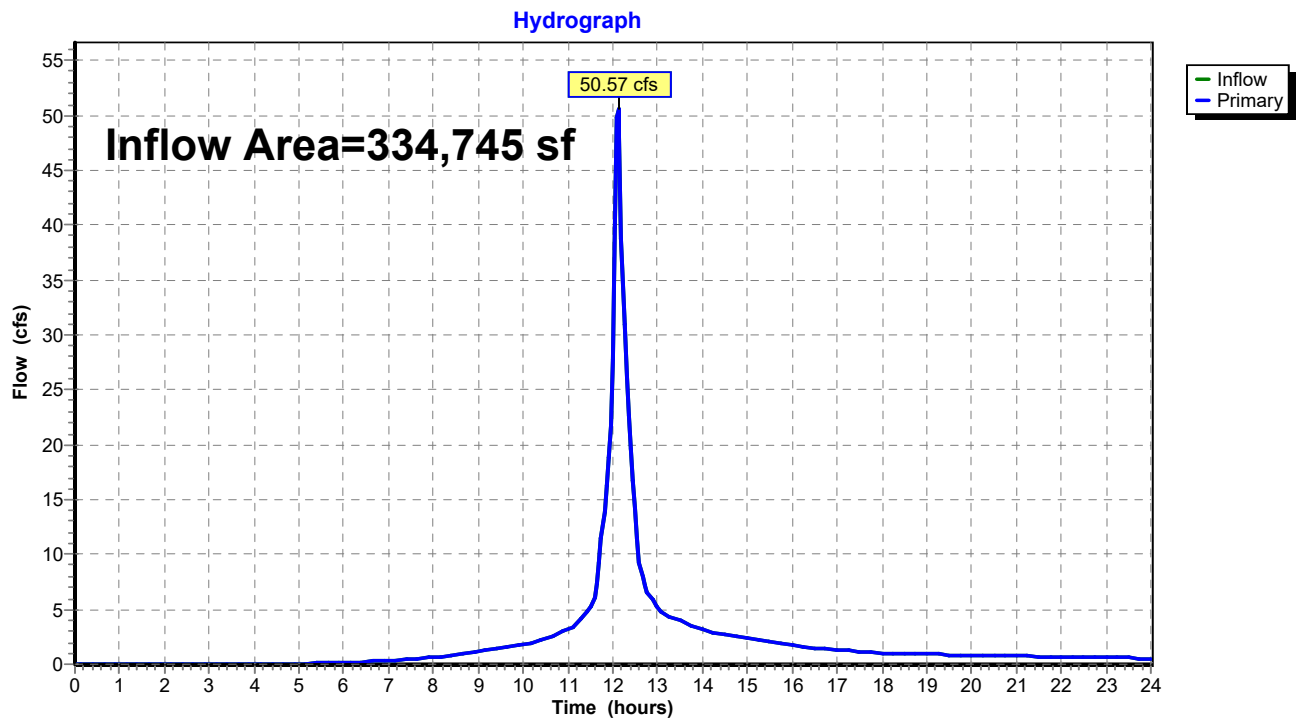


### Summary for Link PR-1: Proposed Conditions - Drainage Area 1

Inflow Area = 334,745 sf, 31.99% Impervious, Inflow Depth > 6.37" for 100yr Storm event  
Inflow = 50.57 cfs @ 12.12 hrs, Volume= 177,746 cf  
Primary = 50.57 cfs @ 12.12 hrs, Volume= 177,746 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

### Link PR-1: Proposed Conditions - Drainage Area 1

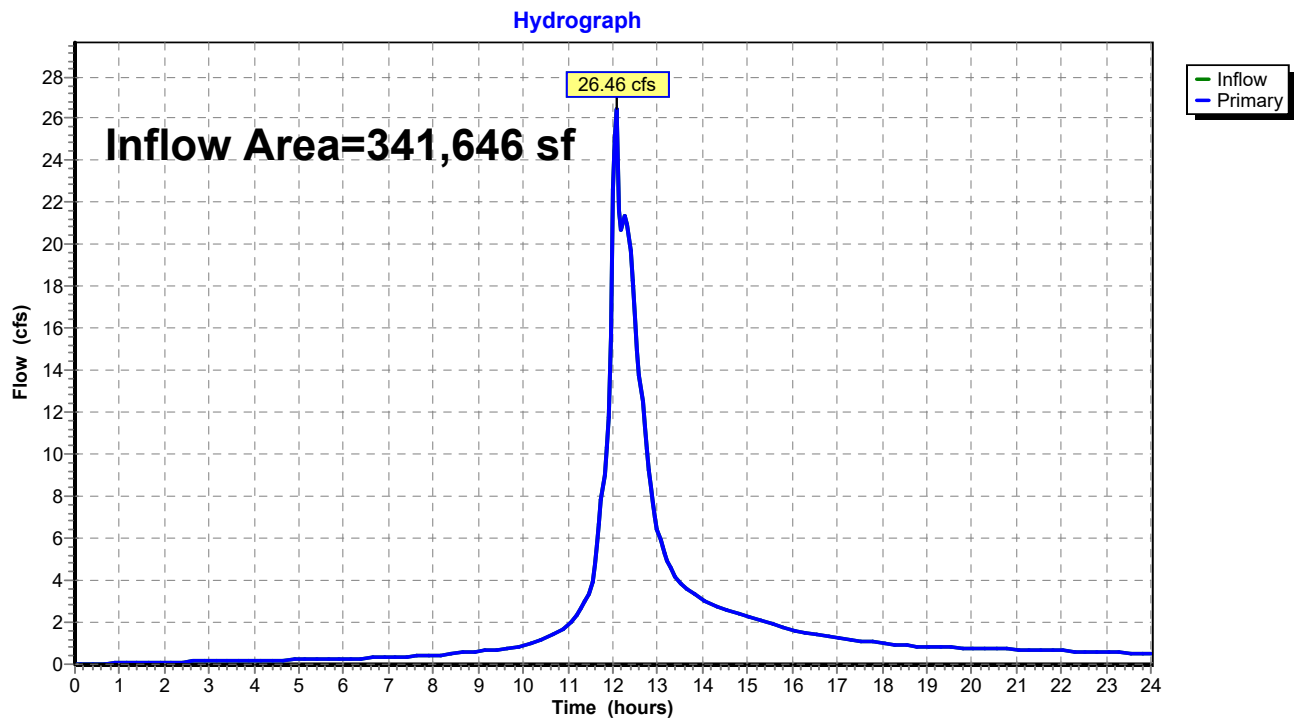


### Summary for Link PR-2: Proposed Conditions - Drainage Area 2

Inflow Area = 341,646 sf, 43.49% Impervious, Inflow Depth > 5.24" for 100yr Storm event  
Inflow = 26.46 cfs @ 12.08 hrs, Volume= 149,157 cf  
Primary = 26.46 cfs @ 12.08 hrs, Volume= 149,157 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

### Link PR-2: Proposed Conditions - Drainage Area 2



## **Appendix E**

### **Water Quality Summary Calculations**

Project: 419 & 650 West Avenue  
Stamford, CT

By: SM  
Checked: RP

Date: 7/14/2021  
Revised:

**1. Water Quality Volume - Total Site less Conservation Easement**

**a. Compute volumetric runoff coefficient, R**

$$R = 0.05 + 0.009(I)$$

**Proposed**

Total Drainage Area, $A$	7.200	acres
Total Impervious Area	5.870	acres
Percentage of Impervious Area, $I$	81.5%	
Runoff Coefficient, $R$	0.784	

**b. Compute water quality volume, WQV**

$$WQV = [(1")(R)(A)]/12$$

Total Project Area, $A$	7.200	acres	
Runoff Coefficient, $R$	0.784		
Water Quality Volume, $WQV$	0.470	acre-foot	
<b>100 % Water Quality Volume, <math>WQV</math></b>	<b>20,484.09</b>	<b>cf</b>	
<b>50% Water Quality Volume, 1/2 WQV</b>	<b>10,242.05</b>	<b>cf</b>	<b><i>Required</i></b>
<b>WQV in Cultec 330XL HD</b>	<b>4,171.00</b>	<b>cf</b>	<b><i>Provided</i></b>

***Water Quality Volume provided > required***

Project: 419 & 650 West Avenue  
Stamford, CT

By: SM  
Checked: RP

Date: 7/14/2021  
Revised:

**1. Water Quality Volume - New Impervious Coverage Only**

**a. Compute volumetric runoff coefficient, R**

$$R = 0.05 + 0.009(I)$$

**Proposed**

Total Drainage Area, $A$	0.590	acres
Total Impervious Area	0.590	acres
Percentage of Impervious Area, $I$	100.0%	
Runoff Coefficient, $R$	0.950	

**b. Compute water quality volume, WQV**

$$WQV = [(1")(R)(A)]/12$$

Total Project Area, $A$	0.590	acres	
Runoff Coefficient, $R$	0.950		
Water Quality Volume, $WQV$	0.047	acre-foot	
<b>100 % Water Quality Volume, <math>WQV</math></b>	<b>2,034.62</b>	<b>cf</b>	<b><i>Required</i></b>

<b>WQV in Cultec 330XL HD</b>	<b>4,171.00</b>	<b>cf</b>	<b><i>Provided</i></b>
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***Water Quality Volume provided > required***

**419 & 650 West Avenue - Drainage - RP Workspace Type III 24-hr 5yr Storm Rainfall=4.59"**

Prepared by Robert P. Pryor, P.E., L.S.

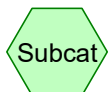
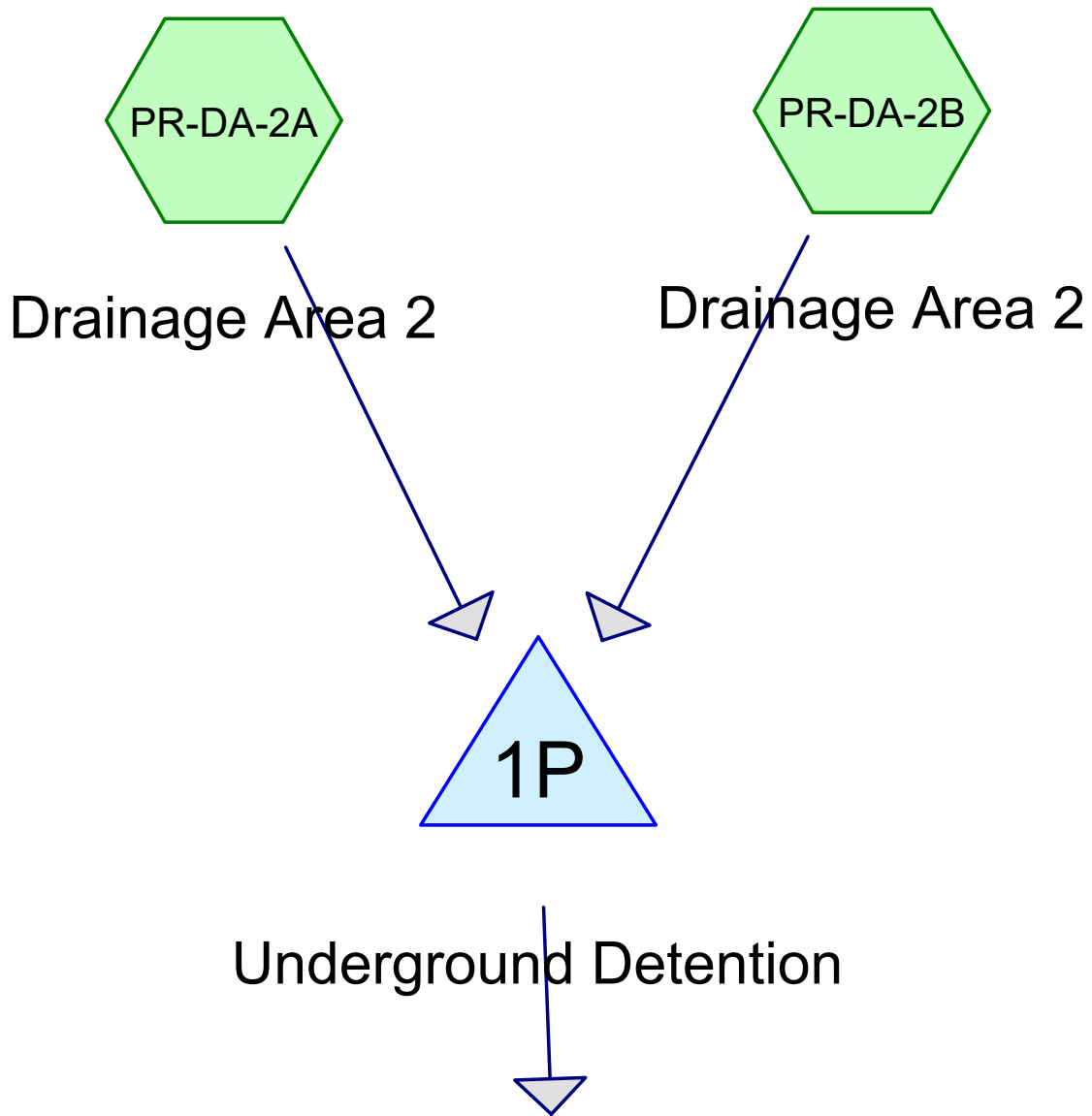
Printed 9/1/2021

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**Stage-Area-Storage for Pond 1P: Underground Detention**

Elevation (feet)	Storage (acre-feet)	Elevation (feet)	Storage (acre-feet)
18.00	0.000	20.60	0.175
18.05	0.002	20.65	0.178
18.10	0.004	20.70	0.180
18.15	0.006	20.75	0.183
18.20	0.007	20.80	0.185
18.25	0.009	20.85	0.188
18.30	0.011	20.90	0.190
18.35	0.013	20.95	0.192
18.40	0.015	21.00	0.194
18.45	0.017	21.05	0.196
18.50	0.019	21.10	0.198
18.55	0.023	21.15	0.200
18.60	0.027	21.20	0.201
18.65	0.031	21.25	0.203
18.70	0.035	21.30	0.205
18.75	0.039	21.35	0.207
18.80	0.043	21.40	0.209
18.85	0.047	21.45	0.211
18.90	0.051	21.50	<b>0.213</b>
18.95	0.055		
19.00	0.059		
19.05	0.063		
19.10	0.067		
19.15	0.071		
19.20	0.075		
19.25	0.079		
19.30	0.082		
19.35	0.086		
19.40	0.090		
19.45	0.094		
19.50	0.098		
19.55	0.102		
19.60	0.105		
19.65	0.109		
19.70	0.113		
19.75	0.117		
19.80	0.121		
19.85	0.124		
19.90	0.128		
19.95	0.132		
20.00	0.135		
20.05	0.139		
20.10	0.142		
20.15	0.146		
20.20	0.149		
20.25	0.153		
20.30	0.156		
20.35	0.159		
20.40	0.162		
20.45	0.166		
20.50	0.169		
20.55	0.172		

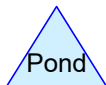
Total Storage Provided Below Outlet:  
0.098 acre-feet = 4171 Cubic Feet



Subcat



Reach



Pond



Link

Routing Diagram for 419 & 650 West Avenue - Drainage - RP Workspace

Prepared by LandTech Associates, Inc., Printed 9/2/2021  
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## 419 & 650 West Avenue - Drainage - RP Workspace

Prepared by LandTech Associates, Inc.

Printed 9/2/2021

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Page 2

### Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	WQS	Type III 6-hr		Default	6.00	1	1.75	2

### Summary for Subcatchment PR-DA-2A: Drainage Area 2

Runoff = 0.82 cfs @ 3.09 hrs, Volume= 1,820 cf, Depth= 0.71"

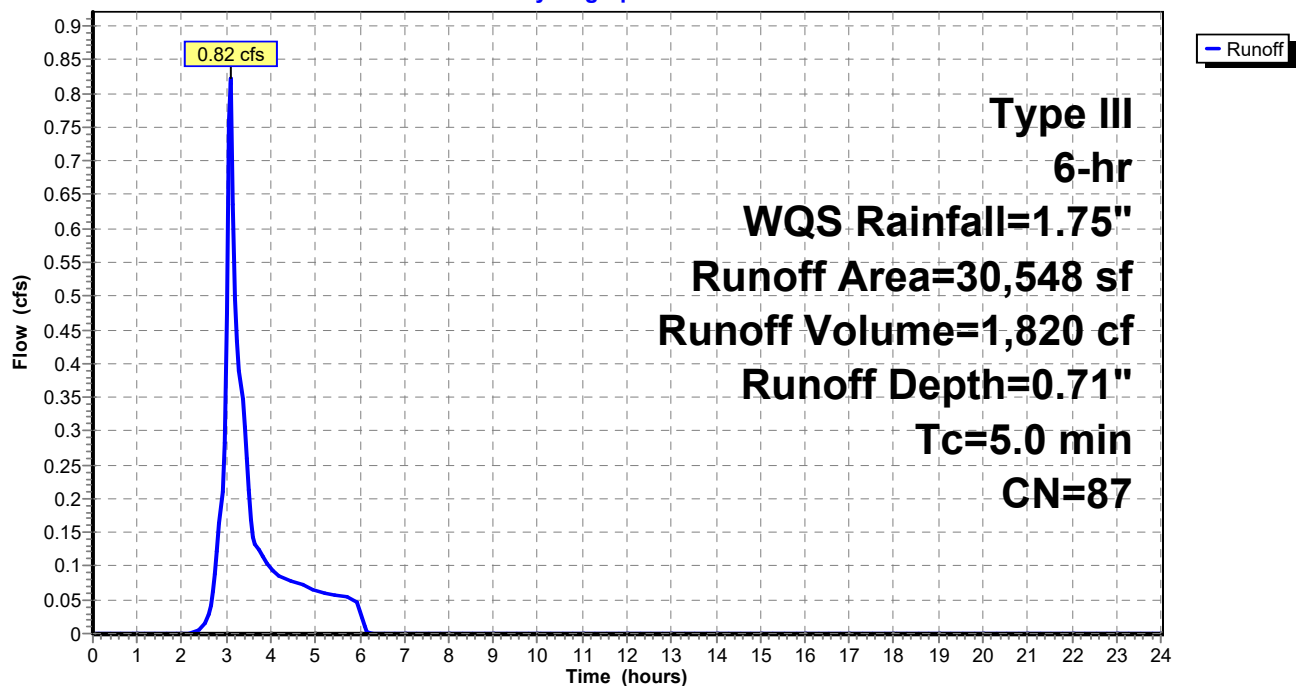
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 6-hr WQS Rainfall=1.75"

	Area (sf)	CN	Description
*	20,234	98	Proposed Pavement
*	922	98	Proposed Walkways
	9,313	61	>75% Grass cover, Good, HSG B
	79	80	>75% Grass cover, Good, HSG D
	30,548	87	Weighted Average
	9,392		30.75% Pervious Area
	21,156		69.25% Impervious Area

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

### Subcatchment PR-DA-2A: Drainage Area 2

Hydrograph



### Summary for Subcatchment PR-DA-2B: Drainage Area 2

Runoff = 1.04 cfs @ 3.07 hrs, Volume= 2,398 cf, Depth= 1.43"

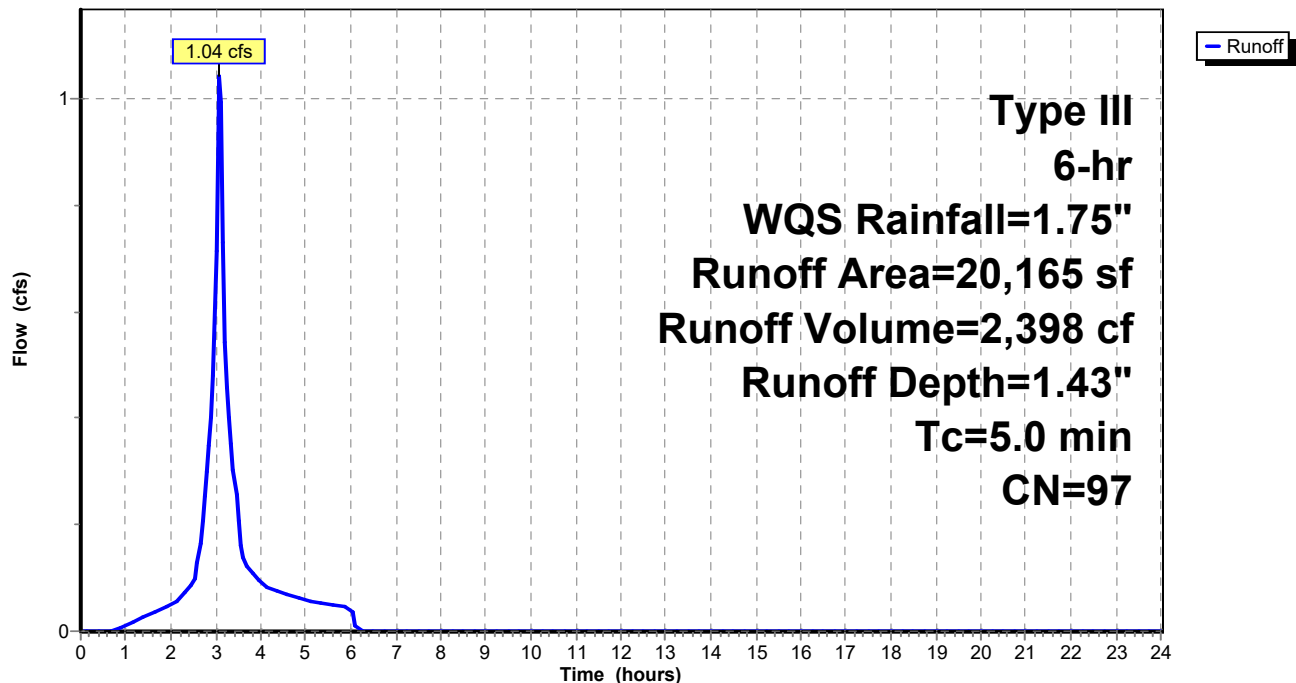
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 6-hr WQS Rainfall=1.75"

	Area (sf)	CN	Description
*	18,184	98	Proposed Pavement
*	866	98	Proposed Walkways
	1,115	80	>75% Grass cover, Good, HSG D
	20,165	97	Weighted Average
	1,115		5.53% Pervious Area
	19,050		94.47% Impervious Area

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

### Subcatchment PR-DA-2B: Drainage Area 2

Hydrograph



### Summary for Pond 1P: Underground Detention

Inflow Area = 50,713 sf, 79.28% Impervious, Inflow Depth = 1.00" for WQS event  
 Inflow = 1.85 cfs @ 3.08 hrs, Volume= 4,218 cf  
 Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 100%, Lag= 0.0 min  
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
 Peak Elev= 19.49' @ 6.35 hrs Surf.Area= 0.094 ac Storage= 0.097 af

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

Volume	Invert	Avail.Storage	Storage Description
#1A	18.00'	0.078 af	<b>40.17'W x 101.50'L x 3.54'H Field A</b> 0.331 af Overall - 0.136 af Embedded = 0.195 af x 40.0% Voids
#2A	18.50'	0.136 af	<b>Cultec R-330XLHD x 112 Inside #1</b> Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 8 rows
		0.214 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	18.80'	<b>24.0" Round Culvert</b> L= 30.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 18.80' / 18.50' S= 0.0100 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 3.14 sf
#2	Device 1	19.50'	<b>10.5" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#3	Device 1	21.40'	<b>6.0' long Sharp-Crested Rectangular Weir</b> 0 End Contraction(s) 1.0' Crest Height

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=18.00' TW=0.00' (Dynamic Tailwater)

1=Culvert ( Controls 0.00 cfs)  
 2=Orifice/Grate ( Controls 0.00 cfs)  
 3=Sharp-Crested Rectangular Weir( Controls 0.00 cfs)

## **Pond 1P: Underground Detention - Chamber Wizard Field A**

### **Chamber Model = Cultec R-330XLHD (Cultec Recharger®330XLHD)**

Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf

Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap

Row Length Adjustment= +1.50' x 7.45 sf x 8 rows

52.0" Wide + 6.0" Spacing = 58.0" C-C Row Spacing

14 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 99.50' Row Length +12.0" End Stone x 2 =  
101.50' Base Length

8 Rows x 52.0" Wide + 6.0" Spacing x 7 + 12.0" Side Stone x 2 = 40.17' Base Width

6.0" Stone Base + 30.5" Chamber Height + 6.0" Stone Cover = 3.54' Field Height

112 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 8 Rows = 5,931.0 cf Chamber Storage

14,439.1 cf Field - 5,931.0 cf Chambers = 8,508.1 cf Stone x 40.0% Voids = 3,403.2 cf Stone Storage

Chamber Storage + Stone Storage = 9,334.2 cf = 0.214 af

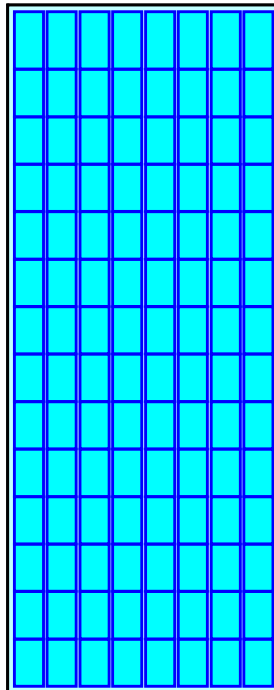
Overall Storage Efficiency = 64.6%

Overall System Size = 101.50' x 40.17' x 3.54'

112 Chambers

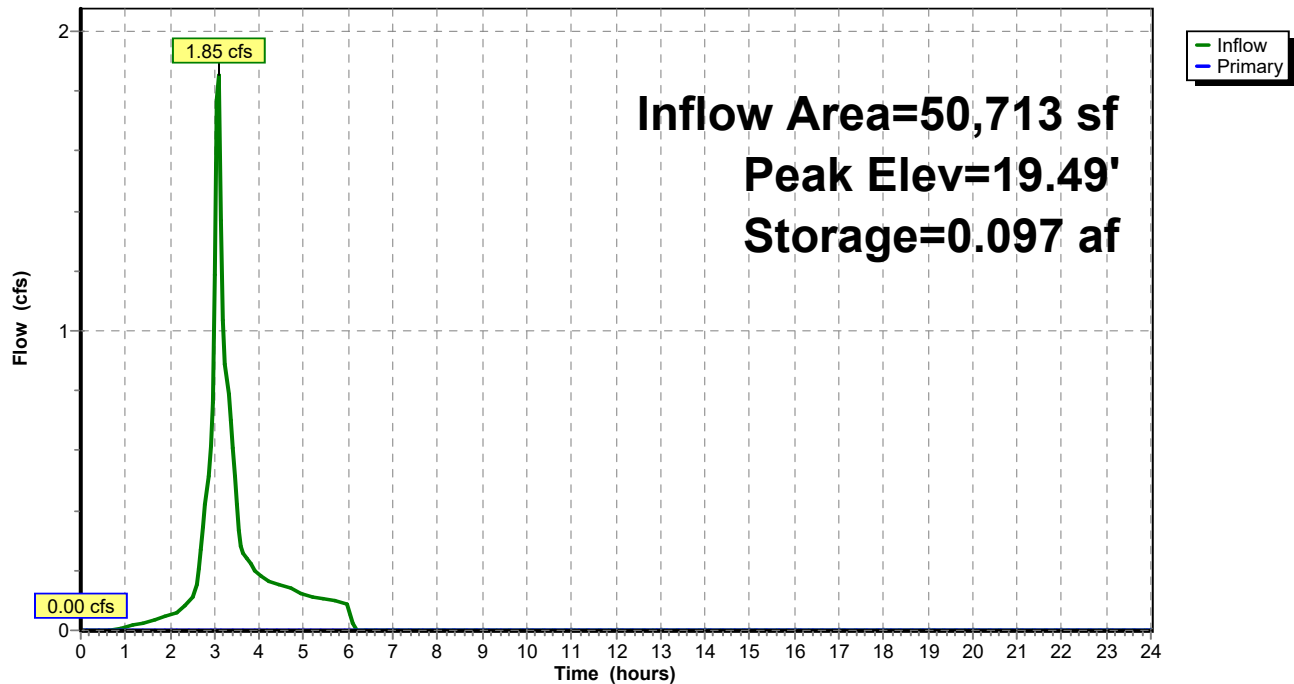
534.8 cy Field

315.1 cy Stone



# Pond 1P: Underground Detention

Hydrograph



## **Appendix F**

### **Operation & Maintenance Plan**

# **Operations and Maintenance Plan**

*419 & 650 West Ave, Stamford, CT*

*September 3, 2021*

## **Scope:**

The purpose of the Operations and Maintenance Plan is to ensure that the existing and proposed stormwater components installed at **419 & 650 West Ave.** are maintained in operational condition throughout the life of the project. The service procedures associated with this plan shall be performed as required by the parties legally responsible for their maintenance.

## **Recommended Frequency of Service:**

As further defined below, all stormwater components should be checked on a periodic basis and kept in full working order. Ultimately, the required frequency of inspection and service will depend on runoff quantities, pollutant loading, and clogging due to debris. At a minimum, we recommend that all stormwater components be inspected and serviced twice per year, once before winter begins and once during spring cleanup.

## **Qualified Inspector:**

The inspections must be completed by an individual experienced in the construction and maintenance of stormwater drainage systems. Once every five years the inspections must be completed by a professional engineer.

## **Service Procedures:**

### **1. Catch Basins & Drainage Inlets:**

- a. Catch basins and drainage inlets shall be completely cleaned of accumulated debris and sediments at the completion of construction.
- b. For the first year, catch basins and drainage inlets shall be inspected on a quarterly basis.
- c. Any accumulated debris within the catch basins/inlets shall be removed and any repairs as required.
- d. From the second year onward, visual inspections shall occur twice per year, once in the spring and once in the fall, after fall cleanup of leaves has occurred.
- e. Accumulated debris within the catch basins/inlets shall be removed and repairs made as required.
- f. Accumulated sediments shall be removed at which time they are within 12 inches of the invert of the outlet pipe.
- g. Any additional maintenance required per the manufacturer's specifications shall also be completed.

### **2. Storm Drainage Piping and Manholes/Junction Boxes:**

- a. All storm drainage piping shall be completely flushed of debris and accumulated sediment at the completion of construction.
- b. Manholes/Junction Boxes shall be inspected and repaired on an annual basis.
- c. Unless system performance indicates degradation of piping, comprehensive video inspection of storm drainage piping shall occur once every ten years.
- d. Any additional maintenance required per the manufacturer's specifications shall also be completed.

3. Stormwater Control Structures:

- a. All control structures (orifice, weir, etc.) shall be completely cleaned of accumulated debris and sediments at the completion of construction. Any repairs shall be performed.
- b. For the first year, control structures (orifice, weir, etc.) shall be inspected on a quarterly basis.
- c. Any accumulated debris shall be removed and any repairs made to the control structures (orifice, weir, etc.) as required.
- d. From the second year onward, visual inspections shall occur twice per year, once in the spring and once in the fall, after fall cleanup of leaves has occurred.
- e. Accumulated debris shall be removed and repairs made as required.
- f. Any additional maintenance required per the manufacturer's specifications shall also be completed.

4. Hydrodynamic Separator:

- a. Hydrodynamic Separator shall be completely cleaned of accumulated debris and sediments at the completion of construction.
- b. For the first year, the hydrodynamic separator shall be inspected on a quarterly basis.
- c. Any accumulated debris within the hydrodynamic separator shall be removed and any repairs made to the unit as required.
- d. From the second year onward, visual inspection shall occur twice per year, once in the spring and once in the fall, after fall cleanup of leaves has occurred.
- e. Accumulated debris within the unit shall be removed and repairs made as required.
- f. Accumulated sediments shall be removed at which time they are within 12 inches of the invert of the outlet pipe.
- g. All inlets, outlets and components of the unit shall be inspected and cleared of debris. Any repairs shall be performed.
- h. Any additional maintenance required per the manufacturer's specifications shall also be completed.

5. Drainage Outfalls/Splash Pads/Scour Holes/Level Spreaders:

- a. All outfalls shall be completely cleaned of accumulated debris and sediments at the completion of construction. Any repairs to outlet protection material (rip rap) shall be performed.
- b. For the first year, outfalls shall be inspected on a quarterly basis.
- c. Any accumulated debris shall be removed and any repairs made to the outfalls as required.
- d. From the second year onward, visual inspections shall occur twice per year, once in the spring and once in the fall, after fall cleanup of leaves has occurred.
- e. Accumulated debris shall be removed and repairs made as required.
- f. Any erosion shall be promptly repaired and the cause of the erosion shall be identified and corrected.
- g. Any additional maintenance required per the manufacturer's specifications shall also be completed.

6. Drywells and Infiltration Systems:

- a. All drywells/infiltrators shall be completely cleaned of accumulated debris and sediments upon the completion of construction.
- b. For the first year, the drywells/infiltrators shall be inspected on a quarterly basis.
- c. Any accumulated debris within the drywells/infiltrators shall be removed and any repairs made to the units as required.
- d. From the second year onward, visual inspection shall occur twice per year, once in the spring and once in the fall, after fall cleanup of leaves has occurred.
- e. Accumulated debris within the units shall be removed and repairs made as required.
- f. Any additional maintenance required per the manufacturer's specifications shall also be completed.

7. Roof Gutters:

- a. Remove accumulated debris and inspect for damage. Any damage should be repaired as required.

8. Groundwater Pump System:

- a. Pump system shall be inspected for proper operation including all connections and force mains.
- b. The backup generator and electrical system must be inspected for proper operation by an electrician.
- c. Sump of the pump chamber shall be cleared of all debris and silt.
- d. The approved pump model is:
- e. The existing pump can only be replaced with a pump matching the specifications of the existing pump listed above. A change to a different pump must be approved by the Engineering Division.
- f. Any additional maintenance required per the manufacturer's specifications shall also be completed.

Disposal of Debris and Sediment:

All debris and sediment removed from the stormwater structures and bioretention/biofiltration basins shall be disposed of legally. There shall be no dumping of silt or debris into or in proximity to any inland or tidal wetlands.

Maintenance Records:

The Owners(s) must maintain all records (logs, invoices, reports, data, etc.) and have them readily available for inspection at all times.

## **Operations and Maintenance Log (Page 1 of 3)**

419 & 650 West Ave, Stamford, CT

September 3, 2021

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Type of Inspection:    ☐ Spring        ☐ Fall        ☐ Other

---

Inspector's Name: \_\_\_\_\_ Date of Inspection: \_\_\_\_\_

Affiliation: \_\_\_\_\_ Phone #: \_\_\_\_\_

---

### **Catch Basins & Drainage Inlets:**

- Has accumulated debris been removed from grates? ☐ Yes    ☐ No    ☐ N/A
- Do any basins require additional repair? (identify below): ☐ Yes    ☐ No    ☐ N/A
- Have sumps been cleaned of sediment? ☐ Yes    ☐ No    ☐ N/A

Notes:

### **Storm Drainage Piping and Manholes/Junction Boxes:**

- Has accumulated debris been removed? ☐ Yes    ☐ No    ☐ N/A
- Do any manholes require additional repair? (identify below): ☐ Yes    ☐ No    ☐ N/A
- Is there any evidence of stormwater piping failure? ☐ Yes    ☐ No    ☐ N/A
- Has a comprehensive video inspection been completed? ☐ Yes    ☐ No    ☐ N/A

Notes:

### **Stormwater Control Structures:**

- Has accumulated debris been removed? ☐ Yes    ☐ No    ☐ N/A
- Are any repairs required? (identify below): ☐ Yes    ☐ No    ☐ N/A
- Have orifices and weirs been cleaned of debris? ☐ Yes    ☐ No    ☐ N/A

Notes:

## **Operations and Maintenance Log (Page 2 of 3)**

419 & 650 West Ave, Stamford, CT

September 3, 2021

### **Hydrodynamic Separators:**

- Has accumulated debris been removed? ☐ Yes ☐ No ☐ N/A
- Does unit require additional repair? (identify below): ☐ Yes ☐ No ☐ N/A
- Has unit been cleaned of sediment? ☐ Yes ☐ No ☐ N/A

Notes:

### **Drainage Outfalls/Splash Pads/Scour Holes/Level Spreaders:**

- Have all drainage outlets been cleared of debris? ☐ Yes ☐ No ☐ N/A
- Have all outlet protections been inspected/repared? ☐ Yes ☐ No ☐ N/A
- Have all erosion issues been repaired? ☐ Yes ☐ No ☐ N/A

Notes:

### **Drywells and Infiltration Systems:**

- Have units been cleared of debris/sediments? ☐ Yes ☐ No ☐ N/A
- Do units require additional repair? (identify below): ☐ Yes ☐ No ☐ N/A
- Has draining times of system been verified? ☐ Yes ☐ No ☐ N/A

Notes:

### **Roof Gutters:**

- Has accumulated debris been removed from gutters? ☐ Yes ☐ No ☐ N/A
- Do any gutters require additional repair? (identify below): ☐ Yes ☐ No ☐ N/A

Notes:

## **Operations and Maintenance Log (Page 3 of 3)**

*419 & 650 West Ave, Stamford, CT*

*September 3, 2021*

### **Groundwater Pump System:**

- |  |                              |                             |                              |
|--|------------------------------|-----------------------------|------------------------------|
| • Has the electrical connections been inspected?                   | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> N/A |
| • Has the electrical connections for the generator been inspected? | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> N/A |
| • Has the generator been exercised?                                | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> N/A |
| • Has the sump been cleaned? (identify below):                     | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> N/A |

Notes:

Please make additional notes/observations and particular concerns below. Also record any additional maintenance that has been performed:

\_\_\_\_\_  
**Signature of Inspector:**

\_\_\_\_\_  
**Date:**

**Appendix G**  
**Geotechnical Report**



GEODesign, Inc.  
984 Southford Rd.  
Middlebury, CT 06762  
(203) 758-8836

June 21, 2021  
File No. 4162-003.00

Joe Vaccaro  
V20 Group, LLC  
403 Nonopoge Rd  
Fairfield, CT 06825

Via email: [joev@v20group.com](mailto:joev@v20group.com)

Re: Geotechnical Report  
New Warehouse – Due Diligence/Preliminary Design Phase  
419 & 650 West Avenue  
Stamford, Connecticut

Dear Joe:

GEODesign, Inc. (GEODesign) [www.geocompanies.com](http://www.geocompanies.com) is providing this geotechnical engineering report for the proposed new warehouse complex at the above referenced site in Stamford, Connecticut (Figure 1 Site Locus – Appendix 1). This proposal is based on the project site plans forwarded via email by you as well as our recent email correspondence, site visit and discussions.

## PROJECT UNDERSTANDING

The site consists of two adjacent properties, 419 and 650 West Avenue, which are both located on the west side of West Avenue in Stamford, Connecticut. 419 West Avenue is the northern property and consists of a warehouse connected to an office building with paved parking areas. 650 West Avenue is the southern property and consists of a warehouse with paved parking areas. We understand that the proposed structure will be a new warehouse to replace the existing office building to be demolished at 419 West Avenue.

The footprint is estimated to be between 60,000 and 70,000 square feet (approximate) and generally will be over the existing footprint plus an expansion into the area of the office building. A parking structure is also under consideration. Our work is in general accordance with our May 13, 2021 proposal for a preliminary geotechnical report for foundations and earthwork for your due diligence/preliminary design phase.

We completed a subsurface exploration program and geotechnical engineering evaluation for the proposed new warehouse. Our services included characterizing the subsurface conditions within the site area as practical at accessible locations around the existing structures, performing geotechnical engineering analyses, and providing geotechnical design and construction recommendations. Our recommendations are based in part on guidance from the 2015 International Building Code (IBC) and the 2018 Connecticut State Building Code.

## **BACKGROUND**

### **Site Description**

The site is occupied by three structures, two warehouses and an office building as shown on the attached Figure 2 (Appendix 1). The office building has a “half-buried” basement level on the east side that daylights on the west side. The south warehouse has a basement and the north warehouse is slab on grade (no basement). A majority of the site outside of the buildings is paved with intervening grassed areas.

Based upon a preliminary survey drawing by William Seymour & Associates of Darien, Connecticut dated June 3, 2021 (not yet signed and finalized) site grades range from about El. 50 feet (1988 NAVD datum) at the northeast corner of the site dropping down to about El. 20 feet on the west side. The site is busy with utilities including numerous easements. South of the south warehouse there is a flood control structure (embankment dam/levee structure).

During the initial site visit, we entered the basement level of the south warehouse to observe existing conditions. The basement appeared dry during the visit.

### **Proposed Construction**

A new warehouse and parking garage are proposed as shown on Figure 2 (Appendix 1).

We assume that the finished floor level of the new structure will roughly match the floor levels of the existing west warehouse building. Based upon the preliminary survey existing basement levels of the west warehouse and the existing office building lower level floor elevation is about El. 29 feet. Some filling may be required in between the existing west warehouse and the office building to meet this grade.

Building foundation and slab loads are not yet available at the time of this report.

### **TEST BORINGS**

Nine test borings designated B-1, B-3, B-4 and B-6 through B-11 were drilled by General Borings Inc. on June 8 and 9, 2021 to explore subsurface conditions. A GEODesign representative observed and logged the test borings. The boring locations are shown on Figure 2 (Appendix 1) and the logs are included in Appendix 2.

We estimated the approximate ground surface elevation at each boring location based on the topographic mapping provided. The locations of the borings and their elevations should be considered approximate.

Hollow-stem-auger drilling methods were used to advance the borings to depths of approximately 7 to 27 feet below current site grades. Most of the borings were terminated in generally medium dense to very dense Gravelly Sand. See details below under the Subsurface Conditions section.

Representative samples were obtained by split barrel sampling procedures in general accordance with ASTM Specification D-1586. The split-barrel sampling procedure utilizes a standard 2-inch O.D. split-barrel sampler that is driven into the bottom of the boring with a 140-pound hammer falling a distance of 30 inches. The number of blows required to advance the sampler the middle 12-inches of a normal 24 inch penetration is recorded as the Standard Penetration Resistance Value (N). The blows (i.e. the "N" values) are indicated on the boring logs at their depth of occurrence and provide an indication of the relative consistency of the material.

Groundwater levels were measured using a weighted tape in the open drill holes or inferred from wet soil samples. Observation wells were installed in B-6 and B-11 to permit a stabilization time after drilling.

## **SUBSURFACE CONDITIONS**

### **Geology**

Published surficial geological data (1:125,000 scale, Surficial Materials Map of Connecticut, Janet Radway Stone, 1992) and published bedrock geological data (1:125,000 scale, Bedrock Geological Map of Connecticut, John Rodgers, 1985) were reviewed.

The surficial materials are mapped on an intersection between Glacial Till, which is described as a poorly sorted nonstratified mixture of rock particles ranging in size from boulders to clay, and Sand and Gravel.

The bedrock is mapped as Harrison Gneiss.

### **General Subsurface Profile**

The generalized subsurface profile, as inferred from the subsurface explorations, consists of Topsoil overlying Fill, overlying Gravelly Sand which is consistent with the published surficial geological mapping.

The following is a more detailed description of the major subsurface materials encountered based on our observations of Borings B-1 through B-4.

### **Topsoil and Fill**

The first few inches at the ground surface consist of topsoil or asphalt pavement, depending on location.

Below the surface a layer of non-engineered Fill, two to twelve feet thick, but typically in the four-to eight-foot-thick range. This stratum generally consisted of loose to very dense, Sand with various proportions of gravel, silt, organic fibers, brick, concrete, wood, metal, glass, plastic and asphalt fragments.

Fill would be expected along the east side of the office building where the basement retaining walls were backfilled.

### **Loose Silty Sand and Loose Sand (Boring B-4)**

A locally loose layer of Silty Sand was found in B-4 below the Fill with an organic odor. Below this layer at this location, Sand continued to a depth of 26.5 feet where a refusal was encountered. The sands may have been artificially disturbed during the drilling process as “running sands” were entering the hollow stem auger. Despite efforts to keep a hydraulic head to counteract this behavior, blow counts at this location may be lower than actual.

### **Gravelly Sand**

A Gravelly Sand was found below the Fill and Silty Sand Layer found in B-4 was generally medium dense to dense in consistency.

### **Bedrock and Drilling Refusals**

Drilling refusals (auger or split spoon sampler) were encountered in the borings at various termination depths as indicated on the logs. Refusal is often indicative of bedrock. No rock cores were taken at refusal depths to confirm bedrock. There is a bedrock surface exposure at the northeast portion of the site.

### **Groundwater**

Groundwater was observed at depths of 9.3 to 14.4 feet below ground surface in the observation wells installed in borings B-6 and B-11, respectively. Water was indicated in other borings as noted on the logs at shallower depths (e.g., 6.5 feet at B-4). Groundwater levels may vary depending on seasonal and other factors.

### **Soils Testing (Sieve Analyses)**

Four soil samples from Fill and natural Gravelly Sand taken in the upper five feet of the soil profile were selected for grain size analyses (sieve testing). Results are attached in Appendix 3. Test results indicate gravelly sand with variable amounts of silt.

## **GEOTECHNICAL CONCLUSIONS AND RECOMMENDATIONS**

### **Foundations and Assumptions**

Subsurface conditions are suitable for normal shallow foundations. We assume that:

- the existing buildings are also supported on normal shallow foundations. This should be confirmed by either obtaining existing foundation plans or digging some test pits to expose foundations of the existing east warehouse
- the existing office building will be demolished
- foundation and slab loading will be provided for final design and preliminary analyses presented in this report will be updated upon receipt of the design information

### **Foundation Type and Bearing Strata**

We recommend supporting the proposed addition on normal shallow spread footings. The footings should bear on undisturbed, natural Gravelly Sand or on Structural Fill (hereinafter specified as Compacted Granular Fill, CGF) over this material.

Existing Fill is not considered a suitable bearing material, and must be excavated from the building areas during site preparation. If CGF is used beneath the footings (e.g., in fill or over-excavated areas), we recommend that it be placed one foot beyond the edge of the footings and at a 1H:1V (horizontal to vertical) slope away and down from the footings.

Based on the proposed first floor level and code specified minimum frost protection depth, the perimeter wall footings are expected to be carried at or near the top of the Gravelly Sand bearing stratum. Some over-excavation and replacement with CGF should be anticipated. Actual bottom of Fill elevations will vary and must be verified during construction excavation.

The extent of the loose Sands and Silt layer found in Boring B-4 should be confirmed with additional borings using casing to minimize “running sand” behavior and disturbed blow counts. This information will be used to determine whether any special treatment is needed in this area (e.g., ground improvement).

### **Footing Levels and Minimum Sizes**

Exterior footings should be constructed at a minimum depth of 42-inches below proposed site grades. Interior footings, in heated areas, should be constructed at a minimum depth of 24-inches below proposed top of basement slab level.

The minimum isolated footing size should be 2.5 feet by 2.5 feet, and the minimum wall footing width should be 1.5 feet.

### **Allowable Bearing Pressure and Estimated Settlement**

We recommend a maximum allowable design bearing pressure of two tons per square foot for footings bearing on the recommended bearing strata.

Based on the recommended bearing pressure and anticipated loads, we anticipate that footings will undergo less than one inch of total settlement and less than a half inch of differential settlement. Settlements will occur as the loads are applied and are expected to be complete at the end of construction.

The foregoing assumes that the loose Sands at location B-4 are improved as needed to support this bearing pressure and control settlement to normal limits. This area must be explored during a final design test boring program.

### **Seismic Design**

We recommend that the project site be considered Site Class “D” (stiff soil) per the 2015 International Building Code (IBC) and ASCE 7-10, Chapter 20. Per Appendix N to the 2018 Connecticut State Building Code,  $S_s$  equals 0.249 and  $S_1$  equals 0.069 for Stamford.

Despite the loose soils found at B-4, in general we do not consider site soils subject to liquefaction. During final design, we will confirm this at the B-4 location with a cased boring with drilling mud to obtain sampler blow counts with a minimum of drilling disturbance.

### **Drainage**

We recommend the use of footing drains to control groundwater.

The footing drains should consist of 4-inch diameter perforated PVC pipe, surrounded by 6-inches of Crushed Stone, wrapped in non-woven filter fabric. Cleanouts should be installed in the direction of flow at the beginning of piping runs and consist of 45 degree elbows (90 degree elbows should not be allowed). The drains should be gravity drained to daylight or to the site drainage system.

### **Slab**

The following recommendations are for slab on grade construction.

### **Subgrade**

We recommend placing the concrete floor slab over a minimum nine inch thick base course layer of crushed stone placed over filter fabric (non woven drainage fabric minimum Mirafi 140 or equivalent). The CGF should be placed on the Glacial Till.

The design subgrade modulus for the recommended subgrade and base course is 200 pounds per cubic inch.

### **Drainage and Damp-Proofing**

Groundwater is estimated to below the proposed top of the slab level. During final design consideration should be given to adding some intermediate slab underdrains (system of 4 inch PVC perforated drain pipe with a sump pump to control water potentially rising up under the slab (or gravity drain downslope). Slab subdrains should be provisionally spaced every 30 feet, notched below the 9 inches of crushed stone with 6 inches of crushed stone all around (with filter fabric between stone and subgrade). Secondly, we recommend that grading be sloped away from the building to a swale and that all roof drain flow be directed away from the building.

Damp-proofing of the slab is recommended in accordance with code requirements. Slab damp-proofing must be installed between the slab and base course, and consist of not less than 6-mil polyethylene with joints lapped at least 6-inches. Other approved methods or materials may be considered.

### **Earth Retaining Structures and Basement Walls**

#### **Backfill and Drainage**

We recommend backfilling site earth retaining structures (e.g. site retaining walls) with compacted Sand and Gravel and installing footing drains. The drains should consist of 4-inch diameter perforated PVC pipe, surrounded by 6-inches of Crushed Stone, wrapped in non-woven filter fabric. Drain inverts shall be set flush with or up to 6-inches above bottom of footing level. The drains shall be gravity drained to daylight or to the site drainage system.

Weep holes may be installed in place of footing drains where they can discharge to non-paved areas (e.g., grassed areas). In paved areas such as sidewalks, weep holes should be avoided to reduce the potential for ice formation in pedestrian access ways. Where weep holes are appropriate, we recommend installing Crushed Stone (minimum diameter of 12 inches), wrapped in non-woven filter fabric at each weep hole location, to prevent movement of wall backfill materials into the weep holes.

#### **Lateral Earth Pressures**

Cantilevered walls that are free to rotate at the top and are not braced shall be designed to resist an equivalent active static horizontal fluid earth pressure equal to 37 pcf (based on  $\phi' = 32^\circ$ ,  $c = 0$ ,

$K_a = 0.31$ , and  $\gamma = 120$  pcf). This assumes no unbalanced hydrostatic pressures, seismic forces, or surcharges from traffic loads. We recommend using a traffic surcharge load of 250 psf.

We do not recommend the reliance on passive earth pressures against the base of walls as there will not be enough wall movement to mobilize these pressures.

### **Coefficient of Friction**

We recommend a maximum coefficient of friction of 0.4 between foundations and the recommending bearing strata.

## **MATERIALS AND COMPACTION REQUIREMENTS**

### **On-Site Materials**

The Topsoil is not considered suitable for reuse except in non-structural and landscape areas, due to its organic content. Existing Fill that does not contain deleterious constituents can be reused as General Site Fill. Some of the existing Fill may be reusable as CGF.

### **Compacted Granular Fill**

CGF should consist of hard, durable sand and gravel; free of ice, clay, shale, roots, sod, rubbish, and other organic matter; graded within the following limits:

Sieve Size	Percent finer by weight
2/3 loose lift thickness*	100%
No. 10	30 – 100
No. 40	10 – 90
No. 200	0 – 12

\*8-inches maximum

Crushed Stone can be used in place of CGF in areas below the water table, or for expediency (as it is much easier to compact than CGF).

### **Sand and Gravel**

Sand and Gravel for use as pavement subbase and retaining wall backfill shall consist of hard, durable sand and gravel; free of ice, clay, shale, roots, sod, rubbish, and other organic matter; graded within the following limits:

Sieve Size	Percent finer by weight
------------	-------------------------

2-inches	100%
1/2-inch	50 – 85
No. 4	40 – 75
No. 40	10 – 35
No. 200	0 – 5

### Crushed Stone

Crushed Stone for use around drains or below foundations and slabs shall consist of sound, tough, durable, rock that is graded within the following:

Sieve Size	Percent finer by weight
5/8-inches	100%
1/2-inch	85 - 100
3/8 inch	15 - 45
No. 4	0 - 15
No. 8	0 - 5

### Processed Aggregate Base

Processed Aggregate Base for use as pavement base shall consist of inorganic soil free of clay, loam, ice and snow, tree stumps, roots, and other organic matter; graded within the following limits:

Sieve Size	Percent finer by weight
2 1/2-inches	100%
2-inch	95 - 100
3/4-inch	50 - 75
1/4-inch	25 - 45
No. 40	5 - 20
No. 100	2 - 12

### Compaction Requirements

We recommend a minimum in-place dry density of 95-percent as per ASTM D1557 for material placed below foundations. We recommend a minimum in-place dry density of 92-percent as per ASTM D1557 for material placed below slabs, paved areas, and as backfill against foundations and retaining walls. Materials should be placed within 2% of their optimum moisture content and compacted in accordance with the following table:

Compaction Method	Maximum Stone Size*	Maximum Loose Lift Thickness		Minimum Number of Passes	
		Below Structures and Pavement	Less Critical Area	Below Structures and Pavement	Less Critical Area
Hand-operated vibratory plate or light roller in confined areas	4"	6"	8"	4	4
Hand-operated vibratory drum rollers weighing at least 1,000# in confined areas	6"	10"	12"	4	4
Light vibratory drum roller minimum dynamic force 3,000#/ft. drum width	8"	12"	18"	4	4
Medium vibratory drum roller minimum dynamic force 5,000#/ft. drum width	8"	18"	24"	6	6

\* And no more than two-thirds (2/3) loose lift thickness.

## CONSTRUCTION CONSIDERATIONS

### Construction Adjacent to Existing Building

Any utilities, and/or remnants of prior construction should be removed in their entirety from the addition area and replaced with CGF below proposed foundation and slab areas. Because the floor level of the addition will match the existing building's slab level, we anticipate that bottom of footing levels will also match, and that support of excavations and underpinning will not be required.

### Footing Preparation

The base of footing excavations should be free of water, ice, and frozen and loose soils prior to placing concrete. We recommend the use of smooth edged excavator buckets to make the final excavation to help protect the subgrade. Concrete should be placed as soon as possible after

excavation so that disturbance of bearing materials does not occur. Should the materials at bearing level become disturbed, the affected materials should be removed prior to placing concrete. A four inch thick layer of crushed stone may be used to protect footing subgrades that are expected to be open for an extended period of time.

### **Temporary Excavations**

The on-site soils are classified as OSHA Class “C” soil and can be cut at a maximum one vertical to one and half horizontal (1V:1.5H) slope for the shallow excavations (less than 10 feet) anticipated for the project. These maximum slope and excavation depth assume no surcharge load (i.e. stockpiles, construction equipment, etc.) at the top of the excavations or seepage (e.g. cuts below the groundwater table).

If excavations cannot be sloped up in accordance with OSHA requirements, a temporary excavation support system will be required. The system should be chosen and installed by the contractor and designed by a Professional Engineer registered in the State of Connecticut.

### **Dewatering**

We expect that temporary storm water control can be accomplished by means of and grading the excavation to low points supplemented as needed by shallow trenches and sumps.

## **FINAL DESIGN DEVELOPMENT**

The foregoing is a preliminary geotechnical report. Additional work is recommended to:

- provide final design information
- explore the loose soil conditions and need for ground improvement in the B-4 condition area
- confirm existing foundations where the proposed and existing buildings will join each other, and
- provide updated settlement estimates and bearing capacity recommendations for foundations when building foundation loads

## **CONSTRUCTION DOCUMENTS AND PLANS**

Project plans should be provided to GEODesign to review for conformance with preliminary geotechnical analyses assumptions and recommendations. If changes are made to the location, slab-on-grade elevation, or type of structure; the recommendations in this report will also need to be updated.

## **CONSTRUCTION OBSERVATION**


We recommend that a GEODesign representative monitor earthwork and foundation and slab preparation during construction to document site conditions and verify compliance with geotechnical specifications. Our site representative can also assist in maximizing reuse of on-site materials which can result in economies.

## LIMITATIONS

This report is subject to the limitations included in Appendix 4. Thank you for the opportunity to be of service. Please feel free to call if you have questions.

Sincerely,

GEODesign, Inc.



Theodore von Rosenvinge, P.E.  
Senior Principal

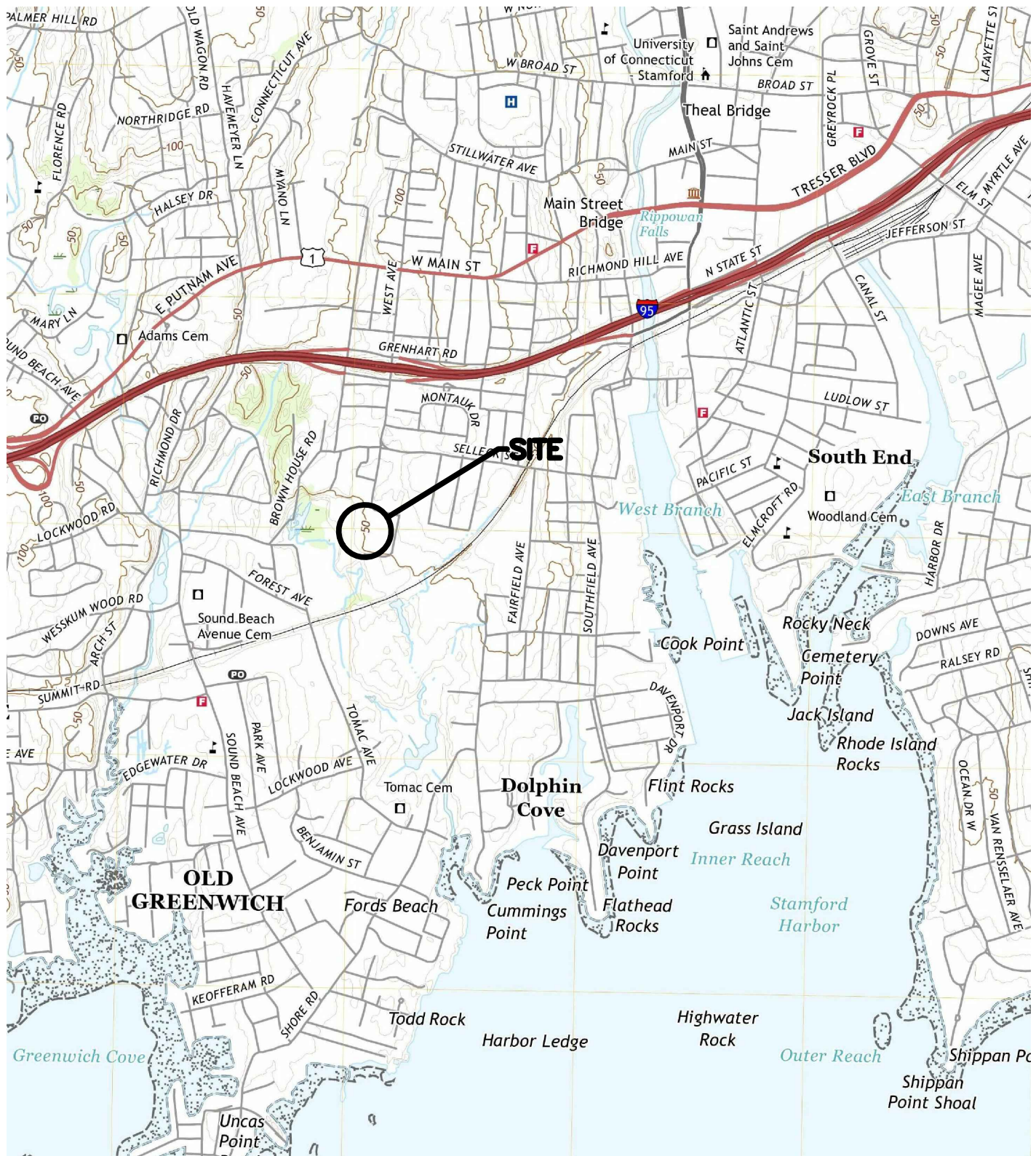


Dylan Carlson, E.I.T.  
Staff Engineer II

Appendices:	Appendix 1	Figures
	Appendix 2	Boring Logs
	Appendix 3	Sieve Test Results
	Appendix 4	Limitations

**APPENDIX 1**  
**FIGURES**

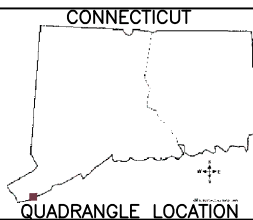
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**GEO DESIGN**

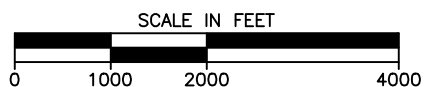
984 SOUTHFORD ROAD  
MIDDLEBURY, CT 06762  
203.758.8836

[geocompanies.com](http://geocompanies.com)



## SITE LOCUS PLAN 419 & 650 WEST AVENUE STAMFORD, CONNECTICUT

REFERENCE:  
U.S.G.S. 7.5 MINUTE QUADRANGLE: STAMFORD, CONNECTICUT.  
FIGURE WAS CREATED USING U.S.G.S. TOPOGRAPHICAL MAP.



PROJECT NO.	4162-003.00
DATE	6/11/2021
FIGURE NO.	1

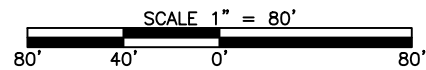
DRAWN BY:	DNC	REVIEWED BY:	TVR
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M:\CL\4162 Vaccaro\003\_419 and 650 West Ave\CAD\BLP.dwg CAD2 6/21/2021 2:48 PM GEO Standard Pen Table.ctb

#### NOTES:

1. BASE MAP DEVELOPED FROM AN ELECTRONIC FILE PROVIDED BY LANGAN ENTITLED "ALTA/NSPS LAND TITLE SURVEY" DATED JANUARY 31, 2019. ORIGINAL SCALE 1"=40'.
2. BORINGS WERE PERFORMED BY GENERAL BORINGS, INC. AND OBSERVED AND LOGGED BY GEODESIGN PERSONNEL.
3. BORINGS B-2, B-5, AND B-12 WERE NOT PERFORMED.
4. TWO INCH I.D. PVC MONITOR WELLS WERE INSTALLED IN BORINGS B-6 AND B-11.
5. THE LOCATIONS OF THE BORINGS WERE DETERMINED BY TAPING AND VISUAL ESTIMATES FROM EXISTING SITE FEATURES. THIS DESIGN SHOULD BE CONSIDERED ACCURATE ONLY TO THE DEGREE IMPLIED BY THE METHOD USED.

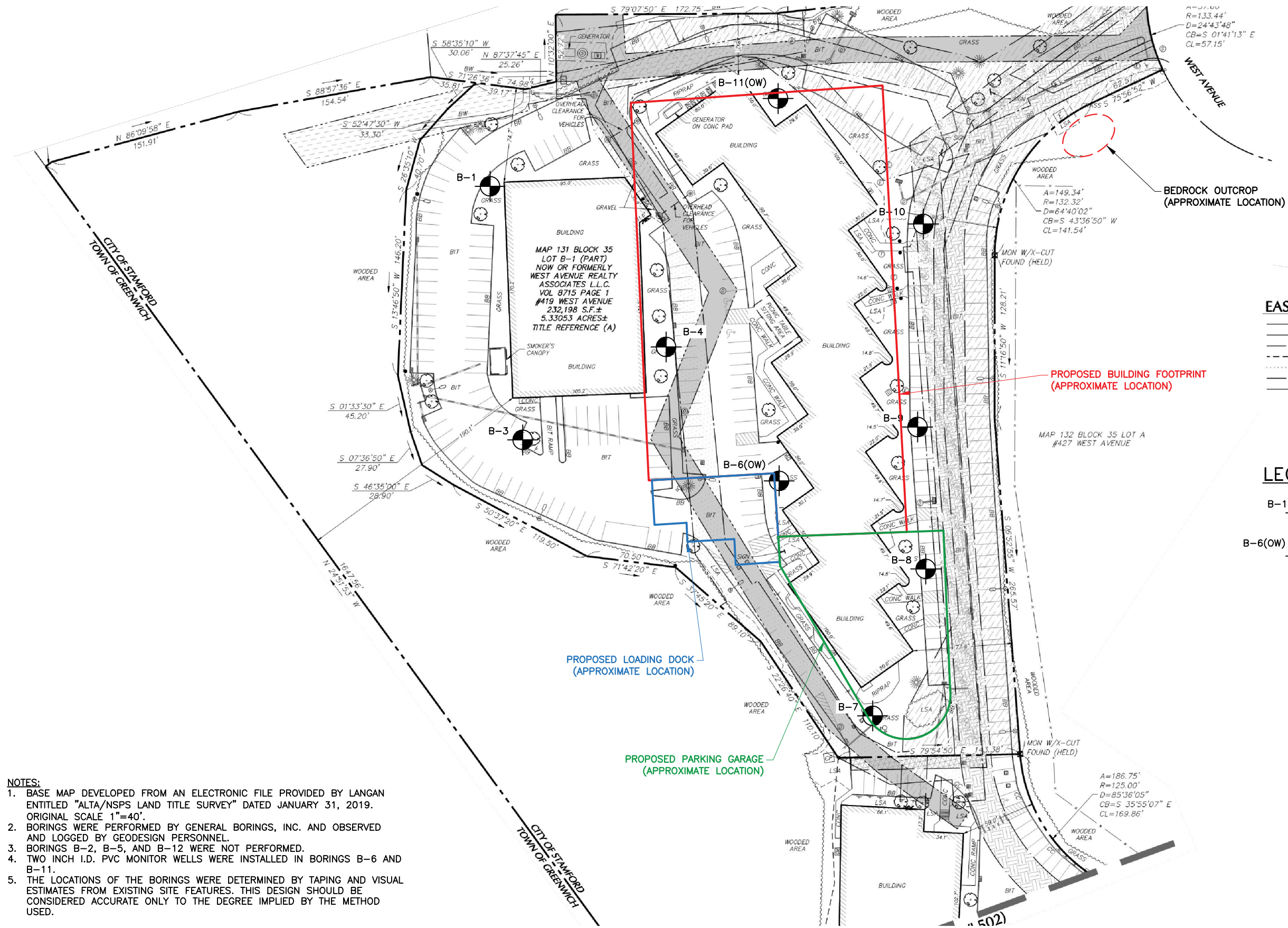
DESIGNED BY	TVR						
DRAWN BY	DNC						
CHECKED BY	TVR						
APPROVED BY	TVR						
	NO.	DATE		DRWN	CHKD	APPVD	
	REVISIONS						



**GEO DESIGN**  
984 SOUTHFORD ROAD  
MIDDLEBURY, CT 06762  
203.758.8836  
geocompanies.com

PROJECT  
**419 & 650 WEST AVENUE  
STAMFORD, CONNECTICUT**  
DWG. TITLE  
**BORING LOCATION PLAN**

PROJECT NO.  
4162-003.00  
SCALE DATE  
AS NOTED 6/15/2021  
FIGURE NO.  
2



#### EASEMENT LINETYPES

---	ACCESS/RIGHT OF WAY EASEMENT
---	ELECTRIC/TELEPHONE EASEMENT
---	GAS EASEMENT
---	CONSERVATION EASEMENT
---	PARKING EASEMENT
---	STORM/SEWER EASEMENT
---	WATER EASEMENT

#### LEGEND

B-1	TEST BORING NO. AND LOCATION BY GEODESIGN, INC.
B-6(OW)	TEST BORING AND GROUNDWATER OBSERVATION WELL NO. AND LOCATION BY GEODESIGN, INC.

**APPENDIX 2**  
**BORING LOGS**

# GEO DESIGN

Geotechnical | Construction | Environmental  
Engineers and Scientists  
984 Southford Road - Middlebury, CT 06762  
Telephone: 203-758-8836 Fax:

## BORING LOG

Project Name

New Warehouse  
419 & 650 West Avenue  
Stamford, CT

Boring No.: **B-1**  
Page No.: 1 of 1  
File No.: 4162-003  
Checked By: RJM

Boring Company: General Borings Inc.  
Foreman: John Wyant  
GeoDesign Rep.: Robert Marshall  
Date Started: June 9, 2021 Date Finished: June 9, 2021  
N. Coordinate: E. Coordinate:  
Ground Surface Elevation (feet): 26  
Station: Offset: ft

Casing:	Sampler:	Groundwater Observations			
Type:	H.S.A.	SS	Date	Depth (ft)	Elev. (ft)
I.D.:	3.25 in.	1.38 in.			
Hammer Wt.:	N/A	140 lbs	6/9/21	8.9	17.1
Hammer Fall:	N/A	30 in.	6/9/21	8.2	17.8
Rig Type:	Diedrich D50-Truck				
Hammer Type:	Automatic - Hydraulic				

Depth (ft)	Sample Information										Strata Description	Symbol	Sample Description	
	Casing Blows/ft	Number	Type	Penetration (inches)	Recovery (inches)	Depth (ft)	Blows / 6 inch Interval				Coring Time (min./ft)	Moisture Content (%)	Classification System: Modified Burmister	
							0 - 6	6 - 12	12 - 18	18 - 24				
		1	SS	24	6	0.0	3	4	7	7			TOPSOIL	Medium dense Brown, Top 3" TOPSOIL
		2	SS	24	1	2.0	5	3	1	5			GRAVELLY SAND	Bottom 3" fine to medium SAND, little Silt, little fine Gravel, damp
														Loose, one piece coarse GRAVEL jammed in tip of spoon
5		3	SS	24	8	5.0	8	9	7	5				Medium dense, Brown fine to coarse SAND, some fine to coarse Gravel, trace Silt, damp
		4	SS	24	10	7.0	8	12	11	9				Medium dense, Brown fine to coarse SAND, little fine to coarse Gravel, trace Silt, wet spoon tip
10		5	SS	5	5	10.0	50/5"							Very Dense, Brown fine to coarse SAND, some fine to coarse Gravel, trace Silt, wet
15														
20														
25														
30														

- Remarks
- 1) Cobbles and/ or Boulders between 3' and 5'
  - 2) Cobbles and/ or Boulders between 9.2' and 10'
  - 3) Spoon refusal at 10.4'

Notes: 1) Stratification lines represent approximate boundary between material types, transitions may be gradual.  
2) Water level readings have been made at times and under conditions stated, fluctuations of groundwater may occur due to other factors than those present at the time measurements were made. AC = After coring; NR = Not Recorded.  
3) Abbreviations: A = Auger; C = Core; MC=Macrocore; D = Driven; G = Grab; PS = Piston Sampler; SS = Split Spoon; SSL = 3.5 Inch ID Split Spoon; ST = Shelby Tube  
V = Vane; WOR/H = Weight of Rod/Hammer  
4) Proportions Used: Trace = 1-10%; Little = 10-20%; Some = 20-35%; And = 35-50%

Boring No.: **B-1**

# GEO DESIGN

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## BORING LOG

Project Name

New Warehouse  
419 & 650 West Avenue  
Stamford, CT

Boring No.: **B-3**

Page No.: 1 of 1

File No.: 4162-003

Checked By: RJM

Boring Company: General Borings Inc.  
Foreman: John Wyant  
GeoDesign Rep.: Robert Marshall  
Date Started: June 9, 2021 Date Finished: June 9, 2021  
N. Coordinator: E. Coordinator:  
Ground Surface Elevation (feet): 24  
Station: Offset: ft

Casing:	Sampler:	Groundwater Observations			
Type:	H.S.A.	SS	Date	Depth (ft)	Elev. (ft)
I.D.:	3.25 in.	1.38 in.			
Hammer Wt.:	N/A	140 lbs	6/9/21		None encountered
Hammer Fall:	N/A	30 in.			
Rig Type:	Diedrich D50-Truck				
Hammer Type:	Automatic - Hydraulic				

Depth (ft)	Casing Blows/ft	Sample Information										Strata Description	Symbol	Sample Description			
		Number	Type	Penetration (inches)	Recovery (inches)	Depth (ft)	Blows / 6 inch Interval				Coring Time (min./ft)				Moisture Content (%)		
							0 - 6	6 - 12	12 - 18	18 - 24							
		1	SS	24	10	0.0	2	3	4	7			Depth & Elevation(feet)	Classification System: Modified Burmister	<div>Loose Brown, top 5" TOPSOIL bottom 5" fine to coarse SAND, some fine to coarse Gravel, little Silt, trace Asphalt fragments</div> <div>Dense, Greyish Brown fine to coarse SAND, some fine to coarse Gravel, trace Silt, trace Organic, slightly organic odor</div>		
		2	SS	24	4	2.0	13	17	24	10						23.6	TOPSOIL FILL
																2.0	GRAVELY SAND
5													4.5	19.5	Bottom of Exploration at 4.5 ft		
10																	
15																	
20																	
25																	
30																	

Remarks: 1) one inch black HDPE tubing in side wall at 1" deep dripping water into completed boring  
2) Auger advanced into inferred rock at 4' to 4.5' refusal

Notes: 1) Stratification lines represent approximate boundary between material types, transitions may be gradual.  
2) Water level readings have been made at times and under conditions stated, fluctuations of groundwater may occur due to other factors than those present at the time measurements were made. AC = After coring; NR = Not Recorded.  
3) Abbreviations: A = Auger; C = Core; MC=Macrocore; D = Driven; G = Grab; PS = Piston Sampler; SS = Split Spoon; SSL = 3.5 Inch ID Split Spoon; ST = Shelby Tube  
V = Vane; WOR/H = Weight of Rod/Hammer  
4) Proportions Used: Trace = 1-10%; Little = 10-20%; Some = 20-35%; And = 35-50%

Boring No.: **B-3**

# GEO DESIGN

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Telephone: 203-758-8836 Fax:

## BORING LOG

Project Name

New Warehouse  
419 & 650 West Avenue  
Stamford, CT

Boring No.: **B-4**  
Page No.: 1 of 1  
File No.: 4162-003  
Checked By: RJM

Boring Company: General Borings Inc.  
Foreman: John Wyant  
GeoDesign Rep.: Robert Marshall  
Date Started: June 9, 2021 Date Finished: June 9, 2021  
N. Coordinate: E. Coordinate:  
Ground Surface Elevation (feet): 27  
Station: Offset: ft

Type:	Casing:	Sampler:	Groundwater Observations			
			Date	Depth (ft)	Elev. (ft)	Notes
I.D.:	3.25 in.	1.38 in.				
Hammer Wt.:	N/A	140 lbs	6/9/21	6.5	20.5	Wet sample
Hammer Fall:	N/A	30 in.				
Rig Type:	Diedrich D50-Truck					
Hammer Type:	Automatic - Hydraulic					

Depth (ft)	Sample Information										Strata Description	Symbol	Sample Description	
	Casing Blows/ft	Number	Type	Penetration (inches)	Recovery (inches)	Depth (ft)	Blows / 6 inch Interval				Coring Time (min./ft)	Moisture Content (%)		Classification System: Modified Burmister
							0 - 6	6 - 12	12 - 18	18 - 24				
		1	SS	24	12	0.0	1	3	5	12			TOPSOIL FILL	Loose, Brown, top 6": TOPSOIL Bottom 6": fine to coarse SAND, little Silt, little fine to coarse Gravel, trace Asphalt fragments
		2	SS	17	12	2.0	18	15	50/5					Very Dense, Grey to Black fine to coarse GRAVEL, some fine to coarse Sand, little Silt, damp
5														
		3	SS	24	24	5.0	5	4	5	6				Loose Black fine SAND and SILT, trace Organic fibers
		4	SS	24	24	7.0	6	3	4	3				Loose Black SILT and fine SAND, trace Organic fibers, wet
10														
		5	SS	24	0	10.0	3	5	33	27				Dense, No recovery
15														
		6	SS	24	16	15.0	WRH	3	6	8				Loose Grey, Black fine to coarse SAND, little fine Gravel, little Silt, wet
20														
		7	SS	24	12	20.0	3	4	5	14				Loose fine to medium SAND, trace Silt, wet
25														
		8	SS	22	18	25.0	4	4	6	30/4"				Medium Dense Grey, top 18": fine to coarse SAND, trace Silt Bottom 6": fine SAND, trace Silt
30														

- Remarks
- 1) Auger advanced into inferred rock from 3.4' to refusal at 3.5': boring relocated 6' North, augered through inferred boulder from 1' to 2'
  - 2) Hydraulic head added prior to plug extraction below 20' in effort to minimize potential for blowing sands

Notes:

- 1) Stratification lines represent approximate boundary between material types, transitions may be gradual.
- 2) Water level readings have been made at times and under conditions stated, fluctuations of groundwater may occur due to other factors than those present at the time measurements were made. AC = After coring; NR = Not Recorded.
- 3) Abbreviations: A = Auger; C = Core; MC=Macrocore; D = Driven; G = Grab; PS = Piston Sampler; SS = Split Spoon; SSL = 3.5 Inch ID Split Spoon; ST = Shelby Tube; V = Vane; WOR/H = Weight of Rod/Hammer
- 4) Proportions Used: Trace = 1-10%; Little = 10-20%; Some = 20-35%; And = 35-50%

Boring No.: **B-4**

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## BORING LOG

Project Name

New Warehouse  
419 & 650 West Avenue  
Stamford, CT

Boring No.: **B-6(OW)**

Page No.: 1 of 1

File No.: 4162-003

Checked By: RJM

Boring Company: General Borings Inc.

Foreman: John Wyant





GeoDesign Rep.: Robert Marshall

Date Started: June 9, 2021 Date Finished: June 9, 2021

N. Coordinate: \_\_\_\_\_ E. Coordinate: \_\_\_\_\_

Ground Surface Elevation (feet): 27.5

Station: \_\_\_\_\_ Offset: \_\_\_\_\_ ft

Casing:		Sampler:	Groundwater Observations				
Type:	H.S.A.	SS	Date	Depth (ft)	Elev. (ft)	Notes	
I.D.:	3.25 in.	1.38 in.					
Hammer Wt.:	N/A	140 lbs	 6/9/21	9.0	18.5	Wet sample	
Hammer Fall:	N/A	30 in.	 6/9/21	9.3	18.2	5 min HSA @10'	
Rig Type:	Diedrich D50-Truck		 6/9/21	9.3	18.2	After 5 hours	
Hammer Type:	Automatic - Hydraulic						

[illegible]

1) 2" ID PVC groundwater monitor well installed upon completion of boring with tip of 9' slotted screen set at 15' depth, with filter sand to 5', bentonite chips to 4'. auger cuttings to surface with protective road box and concrete collar installed

## Notes

- 1) Stratification lines represent approximate boundary between material types, transitions may be gradual.  
 2) Water level readings have been made at times and under conditions stated, fluctuations of groundwater may occur due to other factors than those present at the time measurements were made. AC = After coring; NR = Not Recorded.  
 3) Abbreviations: A = Auger; C = Core; MC = Macrocore; D = Driven; G = Grab; PS = Piston Sample; SS = Split Spoon; SSL = 3.5 Inch ID Split Spoon; ST = Shelby Tube; V = Vane; WOR/H = Weight of Rod/Hammer  
 4) Proportions Used: Trace = 1-10%; Little = 10-20%; Some = 20-35%; And = 35-50%
- Boring No.: **B-6(OW)**

Boring No.: B-6(OW)

# GEO DESIGN

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## BORING LOG

Project Name

New Warehouse  
419 & 650 West Avenue  
Stamford, CT

Boring No.: **B-7**  
Page No.: 1 of 1  
File No.: 4162-003  
Checked By: RJM

Boring Company: General Borings Inc.  
Foreman: John Wyant  
GeoDesign Rep.: Robert Marshall  
Date Started: June 9, 2021 Date Finished: June 9, 2021  
N. Coordinate: E. Coordinate:  
Ground Surface Elevation (feet): 33  
Station: Offset: ft

Casing: Sampler:		Groundwater Observations			
Type:	H.S.A. SS	Date	Depth (ft)	Elev. (ft)	Notes
I.D.:	3.25 in. 1.38 in.				
Hammer Wt.:	N/A 140 lbs	6/9/21			None encountered
Hammer Fall:	N/A 30 in.				
Rig Type:	Diedrich D50-Truck				
Hammer Type:	Automatic - Hydraulic				

Depth (ft)	Sample Information										Strata Description	Symbol	Sample Description	
	Casing Blows/ft	Number	Type	Penetration (inches)	Recovery (inches)	Depth (ft)	Blows/ 6 inch Interval				Coring Time (min./ft)	Moisture Content (%)	Depth & Elevation (feet)	Classification System: Modified Burmister
							0 - 6	6 - 12	12 - 18	18 - 24				
		1	SS	24	22	0.0	1	2	4	8			0.7 TOPSOIL	Loose Brown, top 9" TOPSOIL
													GRAVELLY SAND 32.3	Bottom 13" fine to medium SAND, some (-) Silt, little fine Gravel, damp
		2	SS	24	10	2.0	6	14	19	14				Dense Brown fine to coarse GRAVEL and fine to coarse SAND, little Silt, damp
5														
		3	SS	24	10	5.0	22	35	14	19			7.0	Dense Grey Brown fine to medium SAND and fine to coarse GRAVEL, little Silt, damp and wet
													8.0 BOULDER AND/OR COBBLES 26.0	
													25.0 GRAVELLY SAND	
10														
		4	SS	6	6	10.0	50						10.5	Very Dense Grey Brown fine to medium SAND, some fine to coarse Gravel, little Silt
													Bottom of Exploration at 10.5 ft 22.5	
15														
20														
25														
30														

1) Auger advanced into inferred rock from approximately 7' to 8' with sample spoon refusal at 10.5'

Notes: 1) Stratification lines represent approximate boundary between material types, transitions may be gradual.  
2) Water level readings have been made at times and under conditions stated, fluctuations of groundwater may occur due to other factors than those present at the time measurements were made. AC = After coring; NR = Not Recorded.  
3) Abbreviations: A = Auger; C = Core; MC=Macrocore; D = Driven; G = Grab; PS = Piston Sampler; SS = Split Spoon; SSL = 3.5 Inch ID Split Spoon; ST = Shelby Tube  
V = Vane; WOR/H = Weight of Rod/Hammer  
4) Proportions Used: Trace = 1-10%; Little = 10-20%; Some = 20-35%; And = 35-50%

Boring No.: **B-7**

# GEO DESIGN

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## BORING LOG

Project Name

New Warehouse  
419 & 650 West Avenue  
Stamford, CT

Boring No.: **B-8**


Page No.: 1 of 1

File No.: 4162-003

Checked By: RJM

Boring Company: General Borings Inc.  
Foreman: John Wyant  
GeoDesign Rep.: Robert Marshall  
Date Started: June 8, 2021 Date Finished: June 8, 2021  
N. Coordinate: E. Coordinate:  
Ground Surface Elevation (feet): 41  
Station: Offset: ft

Casing:	Sampler:	Groundwater Observations			
Type:	H.S.A.	SS	Date	Depth (ft)	Elev. (ft)
I.D.:	3.25 in.	1.38 in.			
Hammer Wt.:	N/A	140 lbs	6/8/21		None encountered
Hammer Fall:	N/A	30 in.			
Rig Type:	Diedrich D50-Truck				
Hammer Type:	Automatic - Hydraulic				

Sample Information													Strata Description	Symbol	Sample Description		
Depth (ft)	Casing Blows/ft	Number	Type	Penetration (inches)	Recovery (inches)	Depth (ft)	Blows/ 6 inch Interval				Coring Time (min./ft)	Moisture Content (%)	Depth & Elevation(feet)		Classification System: Modified Burmister		
							0 - 6	6 - 12	12 - 18	18 - 24							
													ASPHALT FILL	40.8		2: Asphalt Pavement 6" Base Course Medium Dense Grey fine to medium SAND, little Silt, little fine Gravel, damp	
		1	SS	24	14	1.0	6	8	10	10							
		2	SS	24	16	3.0	8	7	4	47							
5																	
		3	SS	24	15	5.0	8	7	5	3							
		4	SS	24	18	7.0	4	5	11	12							
10																	
		5	SS	24	20	10.0	10	13	23	15							
15																	
		6	SS	24	22	15.0	6	18	11	9							
20																	
		7	SS	24	20	20.0	7	18	20	15							

Remarks

Notes:

- 1) Stratification lines represent approximate boundary between material types, transitions may be gradual.
- 2) Water level readings have been made at times and under conditions stated, fluctuations of groundwater may occur due to other factors than those present at the time measurements were made. AC = After coring; NR = Not Recorded.
- 3) Abbreviations: A = Auger; C = Core; MC=Macrocore; D = Driven; G = Grab; PS = Piston Sampler; SS = Split Spoon; SSL = 3.5 Inch ID Split Spoon; ST = Shelby Tube; V = Vane; WOR/H = Weight of Rod/Hammer
- 4) Proportions Used: Trace = 1-10%; Little = 10-20%; Some = 20-35%; And = 35-50%

Boring No.: **B-8**

# GEO DESIGN

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## BORING LOG





Project Name

New Warehouse  
419 & 650 West Avenue  
Stamford, CT

Boring No.: **B-9**  
Page No.: 1 of 1  
File No.: 4162-003  
Checked By: RJM

Boring Company: General Borings Inc.  
Foreman: John Wyant  
GeoDesign Rep.: Robert Marshall  
Date Started: June 8, 2021 Date Finished: June 8, 2021  
N. Coordinate: E. Coordinate:  
Ground Surface Elevation (feet): 42  
Station: Offset: ft

Casing:		Sampler:		Groundwater Observations			
Type:	H.S.A.	SS		Date	Depth (ft)	Elev. (ft)	Notes
I.D.:	3.25 in.	1.38 in.					
Hammer Wt.:	N/A	140 lbs	▼	6/8/21			None encountered
Hammer Fall:	N/A	30 in.	▼				
Rig Type:	Diedrich D50-Truck		▼				
Hammer Type:	Automatic - Hydraulic		▼				

Sample Information											Strata Description		Sample Description		
Depth (ft)	Casing Blows/ft	Number	Type	Penetration (inches)	Recovery (inches)	Depth (ft)	Blows / 6 inch Interval				Coring Time (min.ft)	Moisture Content (%)	Depth & Elevation(feet)	Symbol	Classification System: Modified Burmister
							0 - 6	6 - 12	12 - 18	18 - 24					
												ASPHALT FILL	41.8		2" Asphalt Pavement 6" Base Course Medium Dense Gray Brown fine to medium SAND, some (-) fine to coarse Gravel, little Silt, damp
		1	SS	24	16	1.0	12	14	15	13					
		2	SS	24	13	3.0	9	10	11	12					
5		3	SS	24	1	5.0	7	5	6	6					
		4	SS	10	8	7.0	14	54/4"			7.5	BOULDERS AND/OR COBBLES	34.5		Medium Dense Brown fine to medium SAND, little coarse Gravel, trace Silt, dry
10											9.5	SILTY GRAVELLY SAND	32.5		Very Dense Gray Black fine to medium SAND, some Silt, trace fine to coarse Gravel, trace Organics, damp
		5	SS	24	15	10.0	15	19	17	22					
15															
		6	SS	21	3	15.0	14	21	12	50/3"					
											16.8	Bottom of Exploration at 16.8 ft	25.2		Dense, Brown, fine to medium SAND, some fine to coarse fractured Gravel, trace Silt
20															
25															
30															

- Remarks
- 1) Metal debris in auger cuttings from approximate 7' depth
  - 2) Augered through obstruction (inferred boulder) from 7.5' to 9.5' with spoon refusal at 16.8'

Notes:

- 1) Stratification lines represent approximate boundary between material types, transitions may be gradual.
- 2) Water level readings have been made at times and under conditions stated, fluctuations of groundwater may occur due to other factors than those present at the time measurements were made. AC = After coring; NR = Not Recorded.
- 3) Abbreviations: A = Auger; C = Core; MC=Macrocore; D = Driven; G = Grab; PS = Piston Sampler; SS = Split Spoon; SSL = 3.5 Inch ID Split Spoon; ST = Shelby Tube; V = Vane; WOR/H = Weight of Rod/Hammer
- 4) Proportions Used: Trace = 1-10%; Little = 10-20%; Some = 20-35%; And = 35-50%

Boring No.: **B-9**

# GEO DESIGN

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## BORING LOG

Project Name

New Warehouse  
419 & 650 West Avenue  
Stamford, CT

Boring No.: **B-10**

Page No.: 1 of 1

File No.: 4162-003

Checked By: RJM

Boring Company: General Borings Inc.  
Foreman: John Wyant  
GeoDesign Rep.: Robert Marshall  
Date Started: June 8, 2021 Date Finished: June 8, 2021  
N. Coordinate: E. Coordinate:  
Ground Surface Elevation (feet): 43  
Station: Offset: ft

Casing:	Sampler:	Groundwater Observations			
Type:	H.S.A.	SS	Date	Depth (ft)	Elev. (ft)
I.D.:	3.25 in.	1.38 in.			
Hammer Wt.:	N/A	140 lbs	6/8/21		None encountered
Hammer Fall:	N/A	30 in.			
Rig Type:	Diedrich D50-Truck				
Hammer Type:	Automatic - Hydraulic				

Depth (ft)	Sample Information										Strata Description	Symbol	Sample Description	
	Casing Blows/ft	Number	Type	Penetration (inches)	Recovery (inches)	Depth (ft)	Blows/ 6 inch Interval				Coring Time (min./ft)	Moisture Content (%)		Classification System: Modified Burmister
							0 - 6	6 - 12	12 - 18	18 - 24				
		1	SS	24	24	1.0	9	8	6	6			4" Asphalt Pavement	
		2	SS	24	18	3.0	10	13	9	5			6" Base Course	
5													Medium Dense Gray fine to medium SAND, some Silt, little fine to coarse Gravel, damp	
		3	SS	24	15	5.0	1	2	6	19			Medium Dense Gray fine to coarse SAND, some fine to coarse Gravel, some Silt, damp	
		4	SS	3	3	7.0	50/3*						Loose Black fine to coarse SAND, some Silt, little fine to coarse Gravel, trace Brick fragments, trace Organics, wet	
10													Very Dense Black fine to medium SAND, some Silt, some fine to coarse Gravel, trace Brick fragments	
15														
20														
25														
30														

- 1) Solid auger refusal at 7.3' depth  
2) Exposed bedrock outcrop observed 130' Northeast of boring

Notes: 1) Stratification lines represent approximate boundary between material types, transitions may be gradual.  
2) Water level readings have been made at times and under conditions stated, fluctuations of groundwater may occur due to other factors than those present at the time measurements were made. AC = After coring; NR = Not Recorded.  
3) Abbreviations: A = Auger; C = Core; MC=Macrocore; D = Driven; G = Grab; PS = Piston Sampler; SS = Split Spoon; SSL = 3.5 Inch ID Split Spoon; ST = Shelby Tube  
V = Vane; WOR/H = Weight of Rod/Hammer  
4) Proportions Used: Trace = 1-10%; Little = 10-20%; Some = 20-35%; And = 35-50%

Boring No.: **B-10**

# GEO DESIGN

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## BORING LOG

Project Name

New Warehouse  
419 & 650 West Avenue  
Stamford, CT

Boring No.: **B11(OW)**

Page No.: 1 of 1

File No.: 4162-003

Checked By: RJM

Boring Company: General Borings Inc.  
Foreman: John Wyant  
GeoDesign Rep.: Robert Marshall  
Date Started: June 8, 2021 Date Finished: June 8, 2021  
N. Coordinate: E. Coordinate:  
Ground Surface Elevation (feet): 42  
Station: Offset: ft

Casing:	Sampler:	Groundwater Observations			
Type: H.S.A.	SS	Date	Depth (ft)	Elev. (ft)	Notes
I.D.: 3.25 in.	1.38 in.				
Hammer Wt.: N/A	140 lbs	6/8/21	14.5	27.5	Wet rods
Hammer Fall: N/A	30 in.	6/9/21	14.5	27.5	Well after 15 hrs
Rig Type: Diedrich D50-Truck		6/9/21	14.4	27.6	Well after 24 hrs
Hammer Type: Automatic - Hydraulic					

Depth (ft)	Casing Blows/ft	Sample Information										Strata Description	Symbol	Sample Description		
		Number	Type	Penetration (inches)	Recovery (inches)	Depth (ft)	Blows/ 6 inch Interval				Coring Time (min./ft)				Moisture Content (%)	
							0 - 6	6 - 12	12 - 18	18 - 24						
		1	SS	24	12	0.0	3	3	7	9			<div>41.5</div> <div>TOPSOIL FILL</div> <div>47.5</div>	Classification System: Modified Burmister	Medium Dense top 6" Dark Brown Topsoil Bottom 6" Brown fine to medium SAND, little fine to coarse Gravel, little Silt, dry	
		2	SS	24	12	2.0	8	9	12	25				Medium Dense Brown fine to coarse SAND, little fine to coarse Gravel, little Silt, damp		
5																
		3	SS	24	1	5.0	6	3	4	4					Loose Brown fine to coarse SAND, little Silt, trace fine Gravel, damp	
		4	SS	24	8	7.0	4	6	6	6					Medium Dense Gray Black fine to medium SAND, some Silt, little coarse Gravel, damp	
10																
		5	SS	24	10	10.0	3	2	3	3					Loose Black Brown fine to coarse SAND and SILT, little fine Gravel, trace Wood fragments	
15																
		6	SS	24	9	15.0	10	8	5	13						
20																
		7	SS	24	7	20.0	4	3	5	10						
25																
		8	SS	24	10	25.0	8	11	14	14						
30																

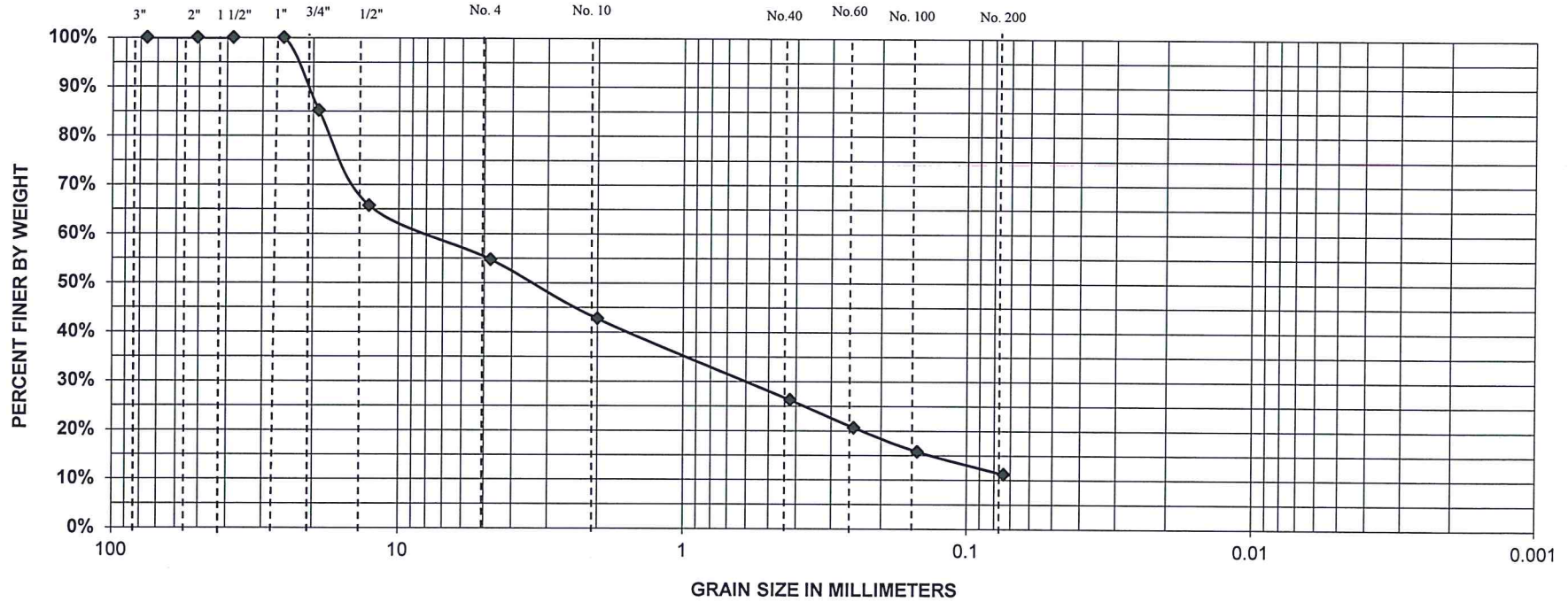
1) Boulder 4' to 4.8'  
2) Augered through inferred cobbles/boulders from 5' to auger refusal at 9.5' depth. Boring relocated 6' southwest then augered to 10' for sample S-5, then augered through inferred boulders below 12' to 14.8'  
3) 2" ID PVC groundwater monitor well installed upon completion of boring with tip of 15' screen set at 25', filter sand to 8', bentonite chips to 7', auger cuttings to surface and roadbox with concrete collar installed.

Notes: 1) Stratification lines represent approximate boundary between material types, transitions may be gradual.  
2) Water level readings have been made at times and under conditions stated, fluctuations of groundwater may occur due to other factors than those present at the time measurements were made. AC = After coring; NR = Not Recorded.  
3) Abbreviations: A = Auger; C = Core; MC=Macrocore; D = Driven; G = Grab; PS = Piston Sampler; SS = Split Spoon; SSL = 3.5 Inch ID Split Spoon; ST = Shelby Tube  
V = Vane; WOR/H = Weight of Rod/Hammer  
4) Proportions Used: Trace = 1-10%; Little = 10-20%; Some = 20-35%; And = 35-50%

Boring No.: **B11(OW)**

**APPENDIX 3**  
**SIEVE TEST RESULTS**

# U.S. STANDARD SIEVE SIZE



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

## GRADATION TEST

419 & 650 West Ave Stamford

BORING NO. B-4  
SAMPLE NO. S-2  
DEPTH 2-3.4'  
TECH. RJM  
REVIEWER TvR  
DATE 06/10/21  
FILE NO. 4162-003

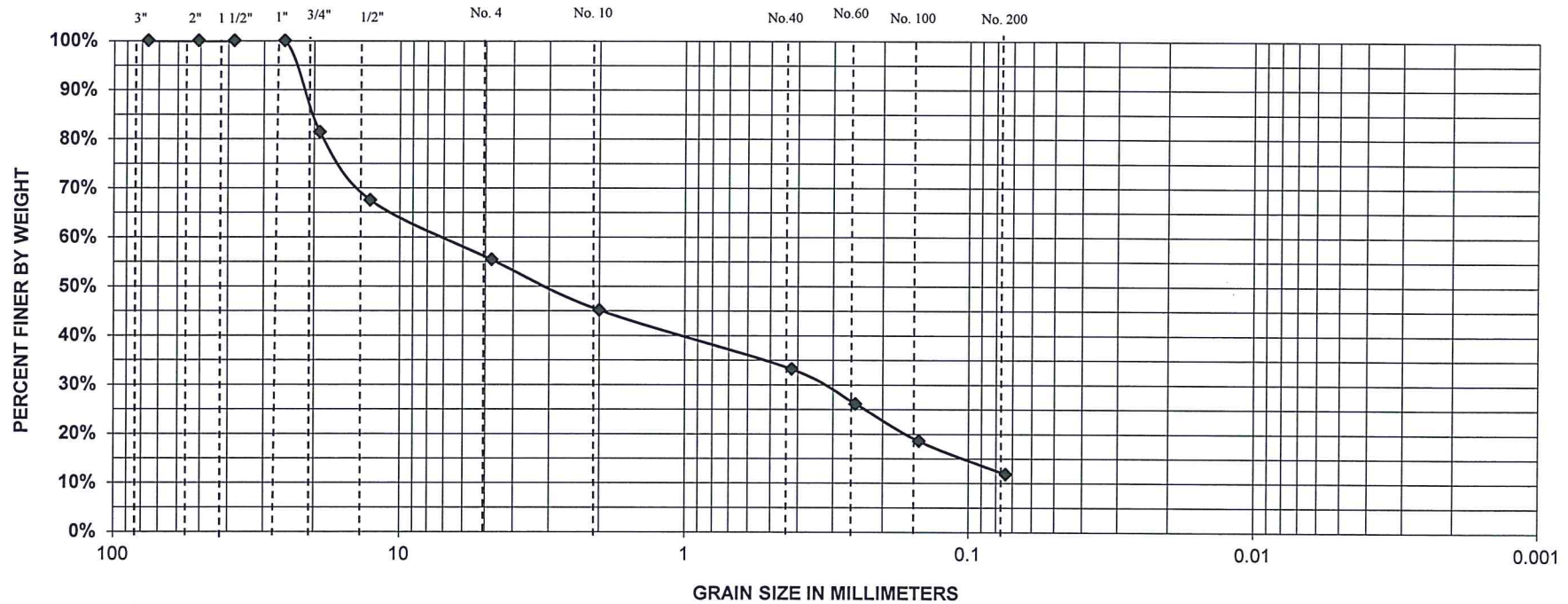
## BURMISTER SOIL CLASSIFICATION SYSTEM

TEST NO.	MATERIAL SOURCE	DESCRIPTION
1 of 4	Test boring jar sample	Fine to coarse GRAVEL, some fine to coarse Sand, little (11%) Silt

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Telephone: 203-758-8836 Fax:

# U.S. STANDARD SIEVE SIZE



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

## GRADATION TEST

419 & 650 West Ave Stamford

BORING NO. B-7  
SAMPLE NO. S-2  
DEPTH 2-4'  
TECH. RJM  
REVIEWER TvR  
DATE 06/10/21  
FILE NO. 4162-003

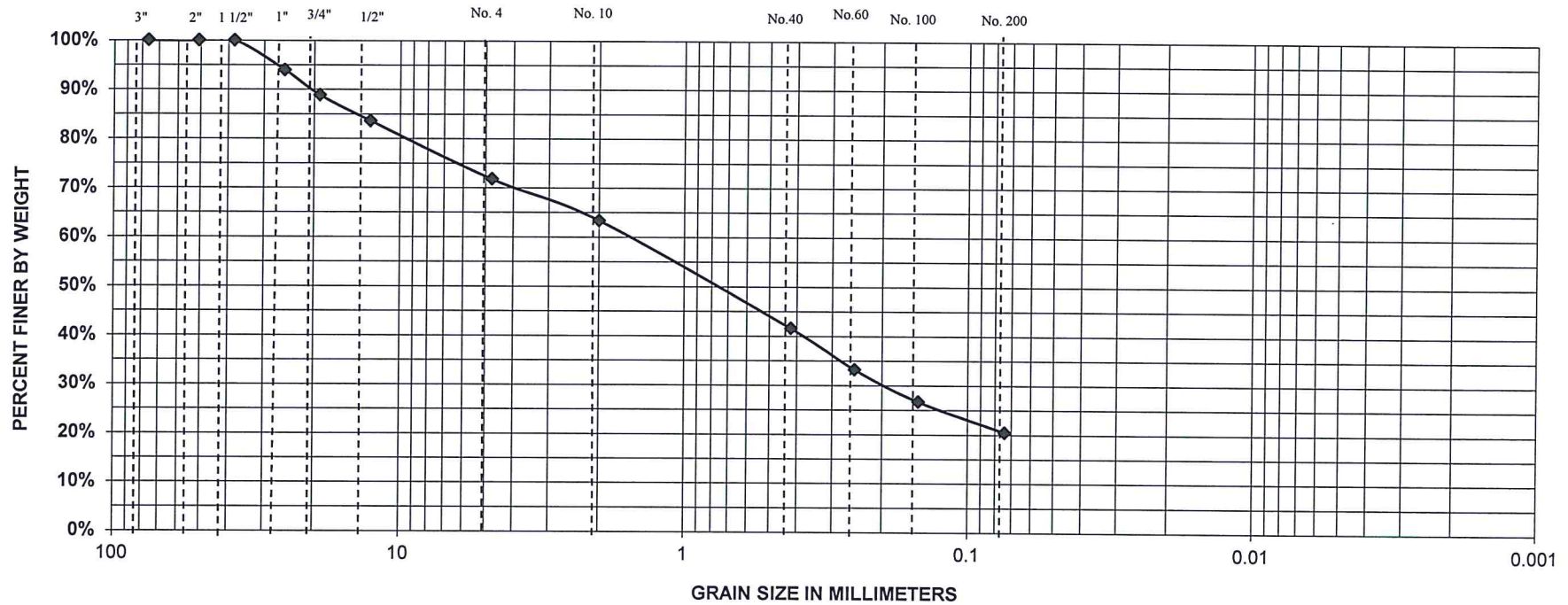
## BURMISTER SOIL CLASSIFICATION SYSTEM

TEST NO.	MATERIAL SOURCE	DESCRIPTION
2 of 4	Test boring jar sample	Fine to coarse GRAVEL and fine to coarse SAND, little (12%) Silt

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Telephone: 203-758-8836 Fax:

# U.S. STANDARD SIEVE SIZE



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

## GRADATION TEST

419 & 650 West Ave Stamford

BORING NO. B-9  
SAMPLE NO. S-2  
DEPTH 3-5'  
TECH. RJM  
REVIEWER TvR  
DATE 06/10/21  
FILE NO. 4162-003

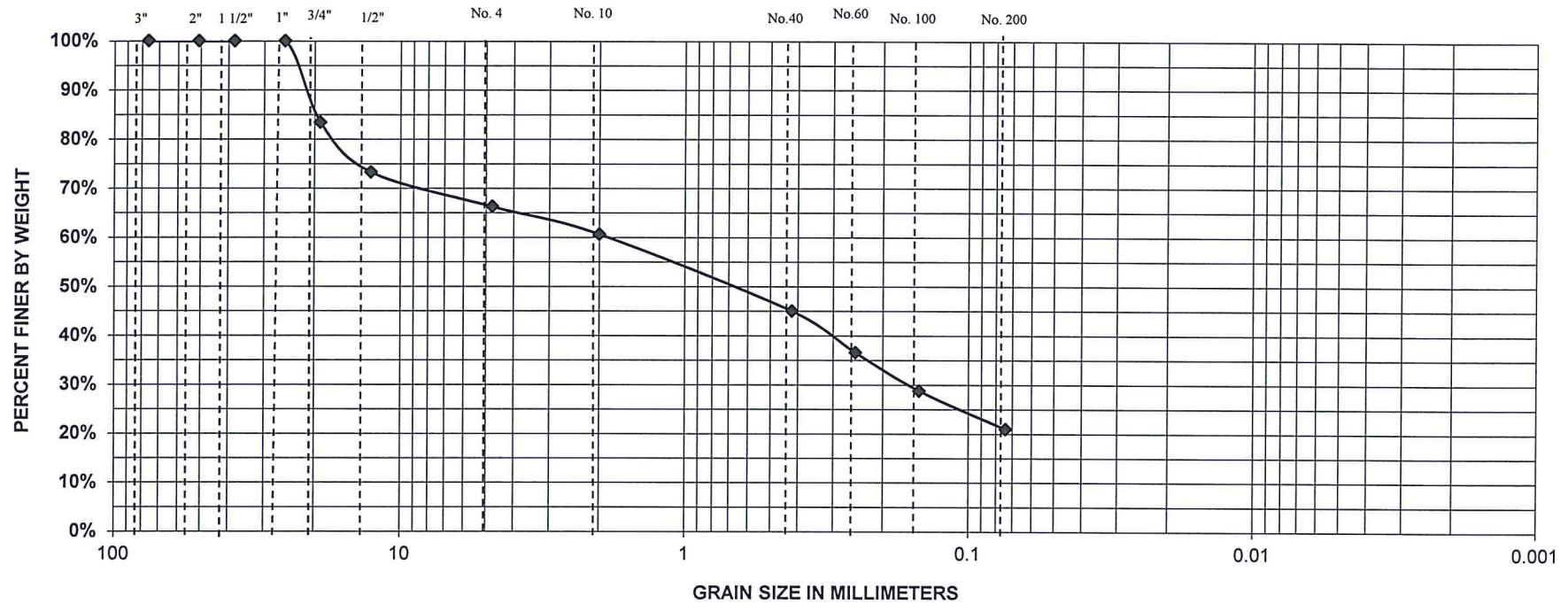
## BURMISTER SOIL CLASSIFICATION SYSTEM

TEST NO.	MATERIAL SOURCE	DESCRIPTION
3 of 4	Test boring jar sample	Black Fine to coarse SAND, some fine to coarse Gravel, some (20.4%) Silt, trace (-) organics

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# U.S. STANDARD SIEVE SIZE



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

## GRADATION TEST

419 & 650 West Ave Stamford

BORING NO. B-11 (OW)  
 SAMPLE NO. S-2  
 DEPTH 2-4'  
 TECH. RJM  
 REVIEWER TvR  
 DATE 06/10/21  
 FILE NO. 4162-003

## BURMISTER SOIL CLASSIFICATION SYSTEM

TEST NO.	MATERIAL SOURCE	DESCRIPTION
4 of 4	Test boring jar sample	Fine to coarse SAND, some (+) fine to coarse Gravel, some (21%) Silt

**GEO DESIGN**

Geotechnical | Construction | Environmental  
 Engineers and Scientists  
 984 Southford Road - Middlebury, CT 06762  
 Telephone: 203-758-8836 Fax:

**APPENDIX 4**  
**LIMITATIONS**



GEODesign, Inc.  
984 Southford Rd.  
Middlebury, CT 06762  
(203) 758-8836

## **Geotechnical Limitations**

### Explorations

1. The analyses and recommendations submitted in this report are based in part upon the data obtained from widely spaced subsurface explorations. The nature and extent of variations between these explorations may not become evident until construction. If variations then appear evident, it will be necessary to reevaluate the recommendations of this report.
2. The generalized soil profile described in the text is intended to convey trends in subsurface conditions. The boundaries between strata are approximate and idealized and have been developed by interpretations of widely spaced explorations and samples; actual soil transitions are probably more erratic. For specific information, refer to the boring logs.
3. Water level readings and moisture conditions have been made in the explorations, and from the samples at times and under conditions stated on the logs. These data have been reviewed and interpretations have been made in the text of this report. However, it must be noted that fluctuations in the level of the groundwater and moisture condition may occur due to variations in rainfall, temperature, and other factors occurring since the time measurements were made.

### Review

4. In the event that any changes in the nature, design or location of the proposed structures is planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and conclusions of this report modified or verified in writing by GEODesign, Inc. We recommend that we be provided the opportunity to review and comment on the finalized project design and relevant construction specifications in order that earthwork and foundation recommendations may be properly interpreted and implemented in the design and specifications.

### Use of Report

5. This report has been prepared for the exclusive use of Client, for specific application to the project, as described in GEODesign's scope of services/ contract and related documents, in accordance with generally accepted soil and foundation engineering practices. No other warranty, express or implied, is made.
6. This report has been prepared for this specific project by GEODesign, Inc. This report is for design purposes only and is not sufficient to prepare an accurate bid. Contractors wishing a copy of the report may secure it with the understanding that its scope is limited to design considerations only, unless otherwise specified in the report.
7. Unless otherwise noted, the scope of our services did not include environmental assessment or investigation for the presence of hazardous or toxic materials in the soil, surface water, groundwater or air, on, below, or around this site.

## **Appendix H**

### **DCIA Tracking Worksheet**

**Directly Connected Impervious Area Tracking Worksheet**  
**City of Stamford Drainage Manual**



**Note to user: complete all cells of this color only, as indicated by section headings**

**Part 1: General Information (All Projects)**

<b>Project Name</b>	West Avenue Industrial Redevelopment
<b>Project Address</b>	419 & 650 West Avenue
<b>Project Applicant</b>	West Avenue Industrial Redevelopment
<b>Title of Plan</b>	West Avenue Industrial Redevelopment
<b>Revision Date of Plan</b>	9/3/2021
<b>Tax Account Number</b>	West Avenue Industrial Redevelopment

**Part 2: Project Details (All Projects)**

1. What type of development is this? (choose from dropdown)	Redevelopment - Industrial	
2. What is the total area of the project site?	678,434 S.F. ( 15.57 Ac.)	ft <sup>2</sup>
3. What is the total area of land disturbance for this project?	190,000 S.F. (4.36 Ac.)	ft <sup>2</sup>
4. Does project site drain to High Quality Waters, a Direct Waterfront, or within 500 ft. of Tidal Wetlands? (Yes/No)	NO	
	YES	
Does Standard 1 apply based on information above?		

**Part 3: Water Quality Target Total (Only for Standard 1 Projects)**

5. What is the <u>current</u> (pre-development) <b>DCIA</b> for the site?	229,906 S.F. (5.28 Ac.)	ft <sup>2</sup>
6. Will the proposed development increase <b>DCIA</b> (without consideration of proposed stormwater management)? (Yes/No)	YES	
7. What is the <u>proposed-development</u> <b>total impervious area</b> for the site?	255,685 S.F. (5.87 Ac.)	ft <sup>2</sup>
Water Quality Volume (WQV)	20,484.1 C.F.	ft <sup>3</sup>
Standard 1 requirement	50%	
Required treatment/retention volume	10,242.0 C.F.	ft <sup>3</sup>
Provided treatment/retention volume for proposed development	4,171.0 C.F.	ft <sup>3</sup>

**Part 4: Proposed DCIA Tracking (Only for Standard 1 Projects)**

<u>Pre-development</u> <b>total impervious area</b>	229,906 S.F. (5.28 Ac.)	ft <sup>2</sup>
<u>Current</u> <b>DCIA</b>	229,906 S.F. (5.28 Ac.)	ft <sup>2</sup>
<u>Proposed-development</u> <b>total impervious area</b>	255,685 S.F. (5.87 Ac.)	ft <sup>2</sup>
<u>Proposed-development</u> <b>DCIA</b> (after stormwater management)	255,685 S.F. (5.87 Ac.)	ft <sup>2</sup>
Net change in <b>DCIA</b> from <u>current</u> to <u>proposed-development</u>	25,779 S.F. (0.59 Ac.)	ft <sup>2</sup>

**Part 5: Post-Development (As-Built Certified) DCIA Tracking (Only for Standard 1 Projects)**

<u>Post-development</u> (per as-built) <b>total impervious area</b>		ft <sup>2</sup>
<u>Post-development</u> (per as-built) <b>DCIA</b> (after stormwater management)		ft <sup>2</sup>
Net change in <b>DCIA</b> from <u>current</u> to <u>post-development</u>		ft <sup>2</sup>

**Certification Statement**

I hereby certify that the information contained in this worksheet is true and correct.

Engineer's Signature \_\_\_\_\_ Date \_\_\_\_\_ Engineer's Seal \_\_\_\_\_