

# DRAINAGE SUMMARY REPORT

FOR  
"HOPE STREET TOWNHOUSES"

LOCATED AT  
91 HOPE STREET  
STAMFORD, CONNECTICUT

PREPARED FOR  
RRIT, LLC

December 12, 2023



A handwritten signature in black ink that reads "Derek Daunais". The signature is written over a horizontal line.

Derek E. Daunais, PE  
CT License No. 22861

20XE DSR 0

**D'ANDREA SURVEYING & ENGINEERING, PC**  
LAND PLANNERS • ENGINEERS • SURVEYORS

**Applicant / Site Information:**

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**Site Information:**

91 Hope Street  
Block 295, Tax Account #002-6785  
Existing Zone: R-7½ Zoning District  
Proposed Zone: RM-1 Zoning District  
Existing Use: Church  
Proposed Use: Residential

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## **Introduction:**

The Applicant for the property located at 91 Hope Street in Stamford, Connecticut, is proposing to construct a 27-Unit residential development along with associated improvements at the already developed site. The purpose of this report is to summarize the proposed stormwater treatment improvements for the site as part of the proposed residential redevelopment. The property is located along the eastern side of Hope Street, just south of the intersection with Howes Avenue. The property is bordered by single-family residential properties to the north and east and a multi-family condominium residential development to the south. The subject property has a total area of 2.331 acres and is currently located in the “R-7½” zoning district. However, part of this application is to change the zone for the property to the “RM-1” zoning district. The property is located outside all Flood Hazard Areas (refer to Exhibit D).

The property currently contains three structures on site. The large structure toward the southern portion of the site was previously used as a church building. There is also an existing dwelling near the northwest corner of the property and a detached garage structure on the site. The proposed redevelopment of the property includes the removal of the existing church building and detached garage structure. The existing dwelling is proposed to remain and to be renovated. The total area of land disturbance for the proposed project will be approximately 2.2 acres or 95% of the property. The remaining 5% of the property, consisting of the northwest corner of the site around the existing dwelling, will remain the same as under existing conditions.

The proposed improvements will include the removal of the two previously mentioned structures and the large bituminous concrete parking lot and driveways, the construction of eight new multi-family residential buildings, the construction of new bituminous concrete driveways and parking lot areas with curbing, retaining walls, sidewalks, the installation of a stormwater collection, retention and conveyance system, the installation of a sanitary sewer system and various underground utilities, and the implementation of a planting plan. There are currently three existing driveway entrances to the site. The proposed improvements will eliminate these existing entrances and construct only one new one that will be used to serve the residential development. Refer to the “Site Plan Review Set”, prepared by D'Andrea Surveying & Engineering, P.C. for a depiction of existing conditions and the proposed site improvements.

The proposed development will increase the total amount of impervious coverage from 39,215 square feet (S.F.) (or 38.6%) to 56,162 S.F. (or 55.3%), which is an increase of approximately 16,947 S.F. or (16.7%), as compared to existing conditions. Therefore, a proposed storm drainage system, including catch basins with deep sumps and traps, a cyclonic hydrodynamic oil/grit removal treatment system, and subsurface retention/infiltration systems, will be installed to provide groundwater recharge, treat Water Quality Flow (WQF), infiltrate a minimum of the Water Quality Volume (WQV), and reduce peak flow discharge rates and runoff volume to off-site areas, as compared to existing conditions. There are currently no stormwater retention or infiltration treatment measures on the site within the areas of proposed development. Drainage patterns and discharge points will be similar as under existing conditions.

The on-site watershed drainage basins for existing and proposed conditions were modeled using HydroCAD 10.0 developed by HydroCAD Software Solutions LLC. The software was used to generate peak stormwater runoff flow rates for the 1-year through 50-year design storm events, using the National Resources Conservation Services (NRCS) method.

**Existing Conditions:**

Currently, the entire property supports three buildings, as previously mentioned. The existing dwelling and detached garage are located in the northwest corner of the site. The church building and its associated large contiguous paved parking lot area are located in the southwest corner and central portion of the site. The perimeter of the eastern portion of the site consists of a narrow swath of woodlands. The remainder of the property consists of well-manicured lawn and landscaping areas. There is a ridge line that runs north to south through the western portion of the site. A small narrow area of land along the western property line slopes downhill toward Hope Street and Howes Avenue. The majority of the site east of the ridgeline gradually slopes downhill toward the east. The large lawn area to east of the existing parking lot contains a shallow low-spot. This shallow low-spot area was incorporated into the existing conditions drainage analysis model as a stormwater ponding area. Stormwater runoff collected in this shallow low-spot area that isn't infiltrated into the ground will overflow toward the east.

Stormwater runoff from the entire site flows to four different Points of Concern (POC). Refer to Exhibit "A" for a depiction of existing conditions stormwater runoff flow patterns and watershed areas. Drainage Area 1 (DA-1) consists of the small area in the southwest corner of the property. The stormwater runoff from DA-1 flows overland toward Hope Street where it then flows south along the Hope Street gutterline until it is collected by an existing street catch basin, and discharged into the City of Stamford storm drainage system heading south, POC-A. Drainage Area 2 (DA-2) consists of the majority of the western portion of the site up to the ridgeline and includes the existing dwelling and two driveway entrances. The stormwater runoff from DA-2 flows overland toward both Hope Street and Howes Avenue where it then flows along the Hope Street and Howe Avenue gutterlines until it is collected by a set of existing street catch basins, and discharged into the City of Stamford storm drainage system heading north, POC-B. Drainage Area 3 (DA-3) consists of the mostly wooded and overgrown northeast portion of the property. The stormwater runoff from DA-3 flows overland toward the northeast corner of the property, POC-C, where it then flows across the adjoining neighbor properties toward Nash Place and is eventually collected by the City's storm drainage system on Howes Avenue. Drainage Area 4B (DA-4B) consists of the large central portion of the property including the church building and the large paved parking lot. The stormwater runoff from DA-4B flows overland toward a shallow low-spot area in the lawn near the eastern portion of the site. Stormwater runoff from this drainage area first ponds within the shallow low-spot area until it eventually overflows toward the eastern property line, POC-D. Drainage Area 4A (DA-4A) consists of the small narrow strip of land between the low-spot ponding area and the eastern property line. Stormwater runoff from DA-4A also flows overland toward the eastern property line, POC-D, where it then flows across the adjoining neighbor properties toward Nash Place and is eventually collected by the City's storm drainage system on Howes Avenue.



### **Proposed Conditions:**

Under proposed conditions, drainage patterns and discharge points will be similar as under existing conditions. However, new storm drainage treatment and retention/infiltration facilities have been proposed to help control and treat stormwater runoff before it is discharged off-site. The proposed drainage analysis includes the division of the property into multiple sub-watershed areas discharging to the same points of concern as under existing conditions. Refer to Exhibit "B" for a depiction of proposed conditions stormwater runoff flow patterns and watershed areas. Refer to Appendix "B" for a summary and comparison of the peak flow rates and volumes discharged from the subject property for both existing and proposed conditions.

Proposed Drainage Area 1 (DA-1) consists of the small area in the southwest corner of the property. The stormwater runoff from DA-1 will flow overland toward Hope Street where it will then flow south along the Hope Street gutterline, in a similar manner as under existing conditions, until it is collected by an existing street catch basin, and discharged into the City of Stamford storm drainage system heading south, POC-A. Drainage Area 2 (DA-2) consists of the narrow western portion of the site and includes the existing dwelling to remain. The stormwater runoff from DA-2 will flow overland toward both Hope Street and Howes Avenue where it will then flow along the Hope Street and Howe Avenue gutterlines, in a similar manner as under existing conditions, until it is collected by a set of existing street catch basins, and discharged into the City of Stamford storm drainage system heading north, POC-B. The proposed development will reduce both the peak flow rate and volume of stormwater runoff to POC-A and POC-B for all computed design storm events, as compared to existing conditions.

Proposed Drainage Areas 3A (DA-3A) and 3B (DA-3B) will discharge stormwater runoff toward the northeast corner of the property, POC-C. DA-3A will consist of the narrow, landscaped portion of the northeast corner of the property. The stormwater runoff from this area will flow overland to POC-C in a similar manner as under existing conditions. DA-3B will consist of proposed dwelling Units 21-26 and their shared driveway area. The stormwater runoff from DA-3B will first be collected by the proposed storm drainage system and then routed into proposed subsurface retention/infiltration system (RS-1). RS-1 has been designed to retain a minimum of the water quality volume from its contributing watershed area plus it contains additional storage volume in order to reduce the overall peak rate of runoff flow toward POC-C, as compared to existing conditions. The overflow from RS-1 will be piped further downstream into a level-spreader prior to being discharged from the site toward POC-C, where it will then flow across the adjoining neighbor properties toward Nash Place and will eventually be collected by the City's storm drainage system on Howes Avenue.

Proposed Drainage Areas 4A (DA-4A) through 4D (DA-4D) will discharge stormwater runoff toward the eastern property line, POC-D. DA-4A will consist of the proposed porous playground area and narrow, landscaped portion of the southeast corner of the property. The stormwater runoff from this area will flow overland toward POC-D in a similar manner as under existing conditions. DA-4B will consist of proposed dwelling Units 1-3 and 10-12, their shared driveway area, and the surface parking lot located to the east of the existing dwelling. The stormwater runoff from DA-4B will be collected by the proposed storm drainage system and then

routed into proposed subsurface retention/infiltration system (RS-2). The overflow from RS-2 will be piped further downstream toward RS-4 prior to being discharged from the site toward POC-D. The stormwater runoff from the surface parking lot in DA-4B will first be collected by a deep sump catch basin and then routed through a hydrodynamic oil/grit separator stormwater treatment system prior to being discharged into RS-2. DA-4C will consist of proposed dwelling Units 13 through 20 and their shared driveway area. The stormwater runoff from DA-4C will be collected by the proposed storm drainage system and then routed into proposed subsurface retention/infiltration system (RS-3). The overflow from RS-3 will be piped further downstream toward RS-4 prior to being discharged from the site toward POC-D. DA-4D will consist of proposed dwelling Units 4 through 9, their shared driveway area, and the small surface parking lot in the southeast portion of the property. The stormwater runoff from DA-4D will be collected by the proposed storm drainage system and then routed into proposed subsurface retention/infiltration system (RS-4). The overflow from RS-4 will be piped further downstream into a level-spreader prior to being discharged from the site toward POC-D, where it will then flow across the adjoining neighbor properties toward Nash Place and will eventually be collected by the City's storm drainage system on Howes Avenue. RS-2, RS-3, and RS-4 have each been designed to retain a minimum of the water quality volume from their respective contributing watershed areas. Plus, they each contain additional storage volume in order to help reduce the overall peak rate of runoff flow and volume toward POC-D, as compared to existing conditions.

All proposed catch basins will be equipped with deep sumps and hooded traps over the outlet pipes, which will be used to pretreat the stormwater runoff prior to discharge downstream.

According to the USDA soil delineation map included in Exhibit "C", the narrow western portion of the property lies within mapped area of Hydraulic Soil Group (HSG)-B soils and the majority of the remaining property lies within a mapped area of HSG-D soils. Refer to Exhibit "C" for the NRCS soil delineation map and hydrologic soil group ratings. Deep test pits have been performed on the site and the results have been included as part of the "Site Plan Review Set". Hydraulic conductivity infiltration tests have also been performed in the areas of the proposed retention/infiltration systems. The performed testing was conducted in accordance with the 2004 Connecticut Stormwater Quality Manual guidelines. The results of the hydraulic conductivity tests are listed in Appendix F. The results of the soil testing verified that there were no restrictive soil layers (ledge, groundwater, or seasonal high-groundwater) within the areas of the proposed retention systems. The soils were dry and consisted mostly of a silty sand material. The infiltration tests determined that the existing soils at the bottom of the proposed retention systems have well-draining infiltration characteristics, better than what is depicted on the USDA soils map. Since there were no restrictive soil layers found, the bottoms of the proposed subsurface retention/infiltration systems have been designed to be set a minimum of 1-foot above the bottoms of the deep test pits.

Refer to Appendix "A" for water quality volume calculations and retention system stage-storage data. The proposed cyclonic hydrodynamic oil/grit removal treatment system will be designed to treat a minimum of the water quality flow rate from its contributing watershed area prior to discharging into its downstream retention system. Refer to Appendix "A" for water quality flow rate calculations.

Conveyance calculations will be performed prior to the issuance of a building permit to verify that all of the major proposed storm drainage pipes are sized to convey the peak flow rate for the minimum of the 25-year design storm event in accordance with the 2004 "Connecticut Stormwater Quality Manual" published by CT DEEP.

Based on the HydroCAD models, the peak rate of stormwater runoff exiting the site will be decreased for all modeled design storm events to all points of concern. Refer to Appendix "B" for a summary and comparison of the peak flow and volume discharge from the subject property for both existing and proposed conditions. In addition to reducing the peak flows, infiltrating the Water Quality Volume from the majority of the development and treating the Water Quality Flow from the larger proposed surface parking lot will help pretreat stormwater runoff from the proposed asphalt driveway and parking lot areas and building roofs prior to discharging downstream.

The proposed development will also reduce stormwater runoff volume to all points of concern for all modeled design storm events, except for the 25 and 50-year design storm events to POC-C. However, this analysis does not incorporate the use of exfiltration from the bottoms of the proposed subsurface retention systems, in accordance with City of Stamford Drainage Manual standards. However, when exfiltration is incorporated into the model, the proposed development results in a decrease in runoff volume for all storm events. Therefore, the design calculations are conservative and actual peak runoff flow rates and volumes discharging from the site under proposed conditions will most likely be less than reported.

During the construction phase of the project, pretreatment of stormwater runoff will be provided by the use of temporary soil and erosion controls as outlined on the "Sedimentation and Erosion Control Plan," prepared by D'Andrea Surveying & Engineering, P.C. This includes the stockpiling of excess materials for control of sediment and periodic on-site inspections to ensure that the development of the site remains "tight" and stable throughout the construction phase.

### **Conclusion**

The proposed improvements will increase the total amount of overall impervious surfaces on the subject property. However, a storm drainage system has been incorporated into the proposed design that will both provide water quality treatment measures and reduce stormwater runoff volumes and peak flow rates, as compared to existing conditions.

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



**Exhibits “A” & “B”**

**Watershed Maps**  
**Existing & Proposed Conditions**

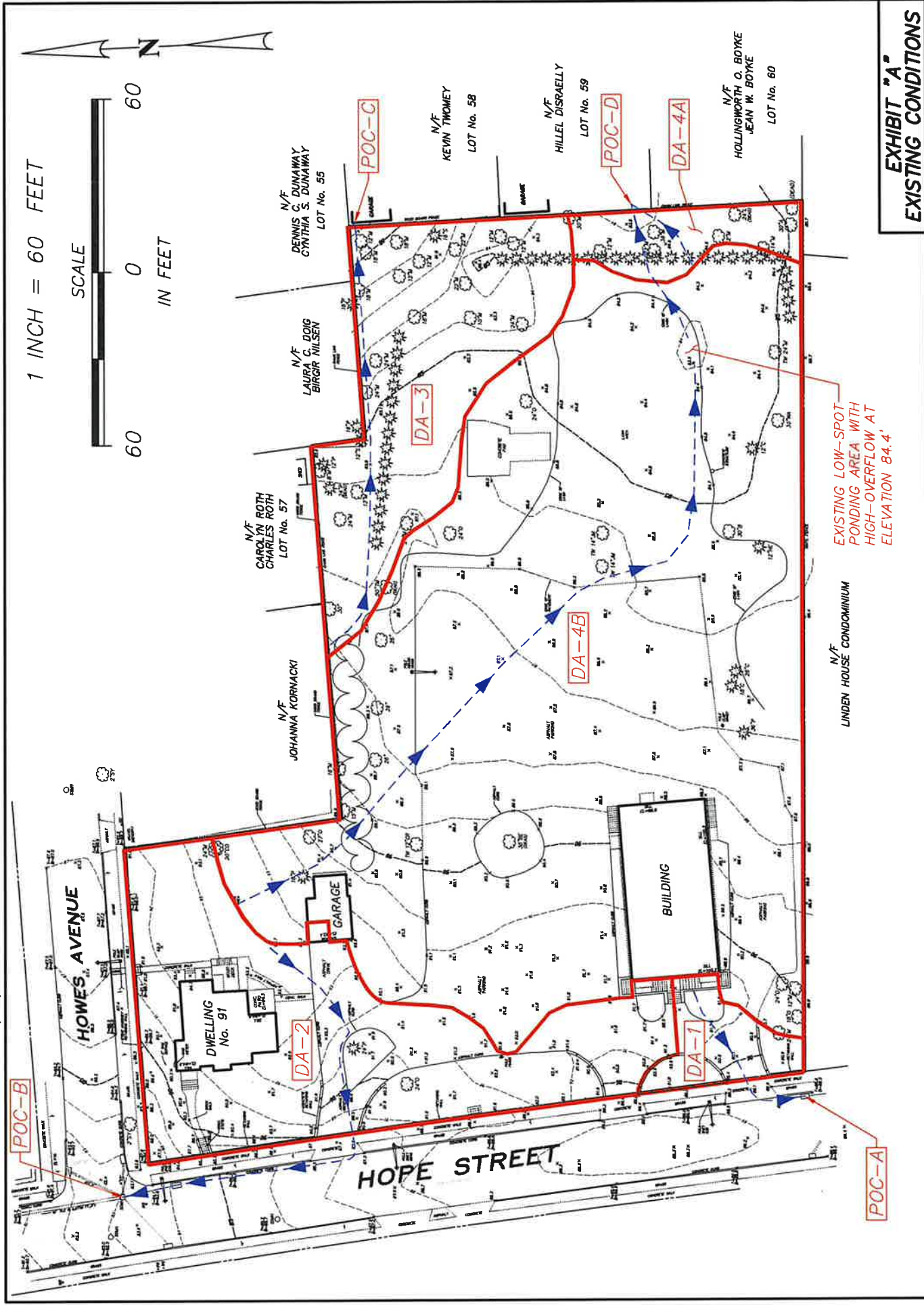


EXHIBIT "A"  
EXISTING CONDITIONS



1 INCH = 60 FEET

SCALE



IN FEET



HOWES AVENUE

HOPE STREET

POC-B

DA-2

DA-4B

DA-1

POC-A

PROPOSED SUBSURFACE RETENTION/INFILTRATION SYSTEM (RS-2)

PROPOSED HYDRODYNAMIC STORMWATER TREATMENT SYSTEM

PROPOSED SUBSURFACE RETENTION/INFILTRATION SYSTEM (RS-3)

PROPOSED SUBSURFACE RETENTION/INFILTRATION SYSTEM (RS-1)

POC-C

PROPOSED LEVEL SPREADER

POC-D

PROPOSED LEVEL SPREADER

PROPOSED SUBSURFACE RETENTION/INFILTRATION SYSTEM (RS-4)

EXISTING DWELLING No. 91 UNIT 27

N/F JOHANNA KORNACKI

N/F CAROLYN ROTH CHARLES ROTH LOT No. 57

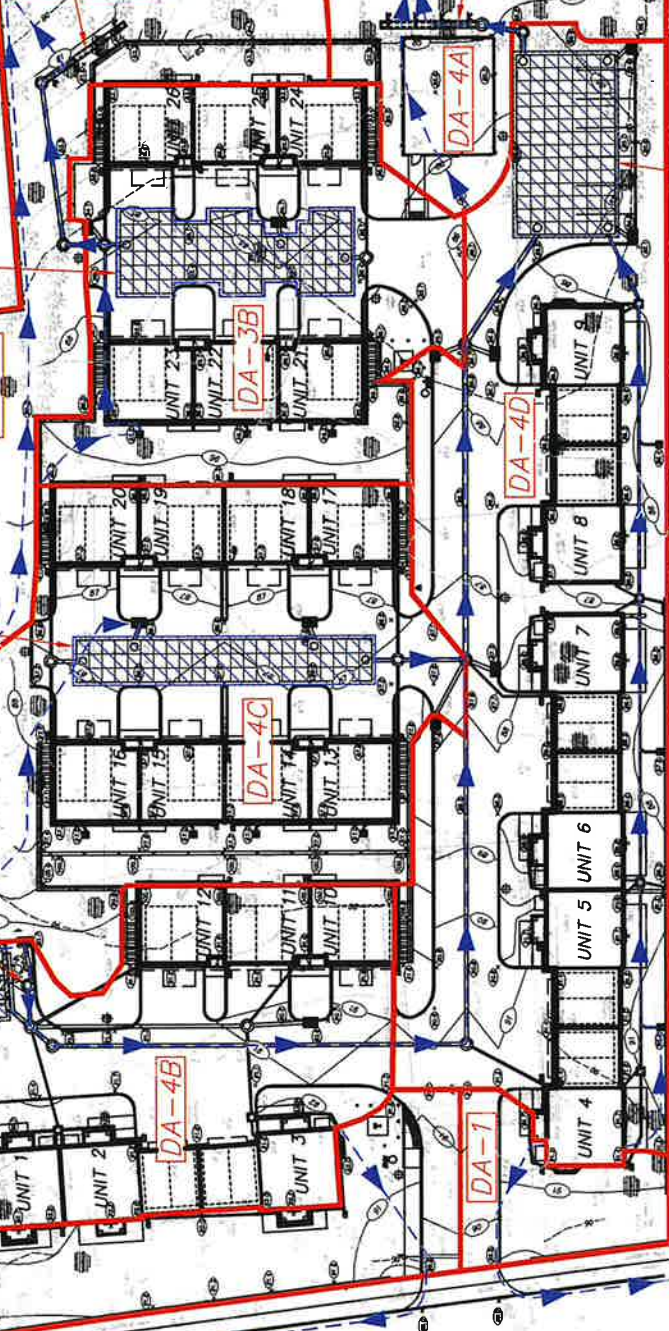
N/F DENNIS C. DUNAWAY CYNTHIA S. DUNAWAY LOT No. 55

N/F LAURA C. DOIG BIRGR NILSEN

N/F KEVIN THOMEY LOT No. 58

N/F HILDEL DISRAELLY LOT No. 59

N/F HOLLINGWORTH O. BOYKE JEAN W. BOYKE LOT No. 60



N/F LINDEN HOUSE CONDOMINIUM

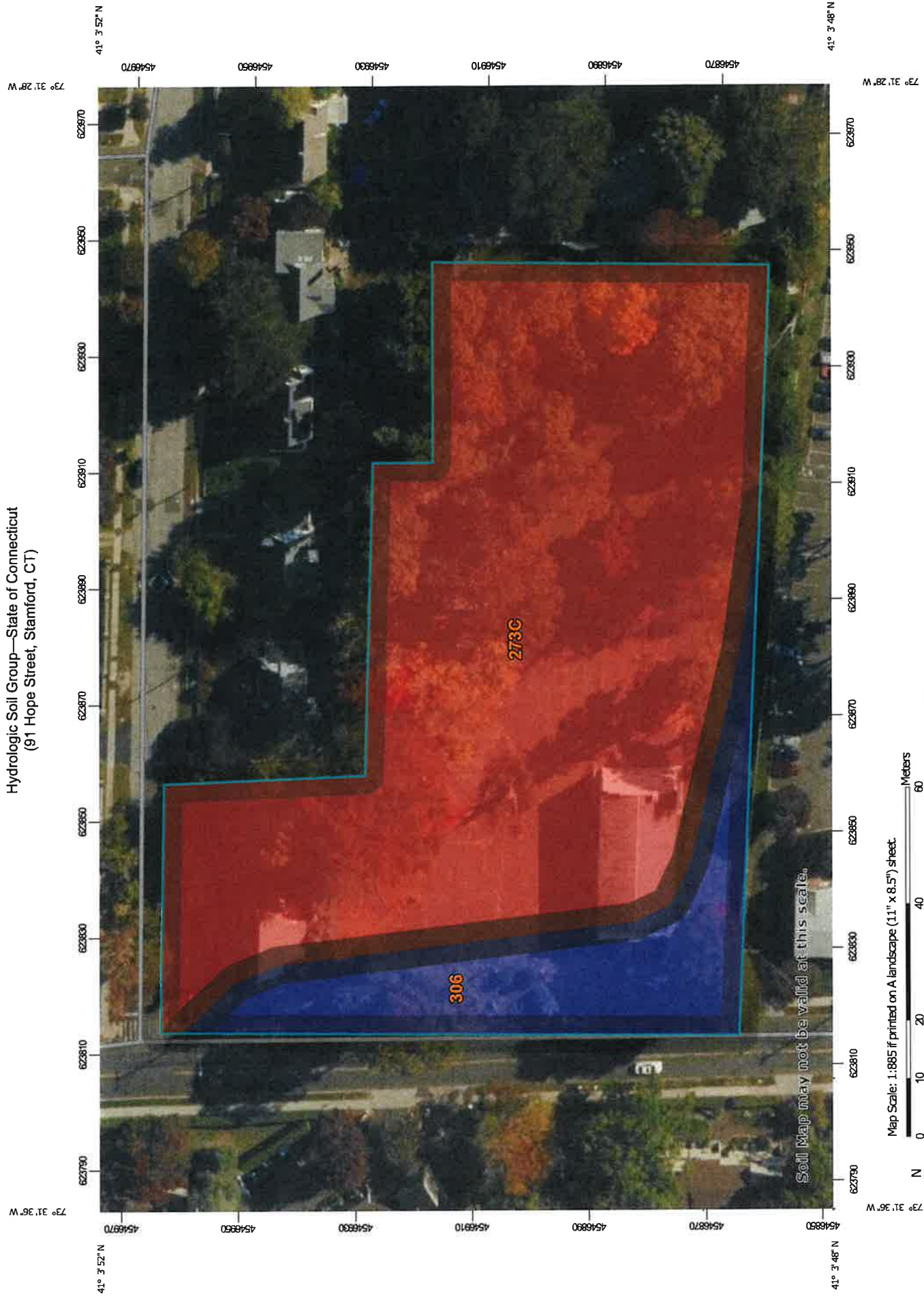
EXHIBIT "B" PROPOSED CONDITIONS

**Exhibit “C”**

**NRCS Soil Map &  
Hydraulic Soil Group Rating**



Hydrologic Soil Group—State of Connecticut  
(91 Hope Street, Stamford, CT)



































Map Scale: 1:885 if printed on A landscape (11" x 8.5") sheet.



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



## MAP LEGEND

<b>Area of Interest (AOI)</b>	 C
 Area of Interest (AOI)	 C/D
<b>Soils</b>	 D
<b>Soil Rating Polygons</b>	 Not rated or not available
 A	<b>Water Features</b>
 A/D	 Streams and Canals
 B	<b>Transportation</b>
 B/D	 Rails
 C	 Interstate Highways
 C/D	 US Routes
 D	 Major Roads
 Not rated or not available	 Local Roads
<b>Soil Rating Lines</b>	<b>Background</b>
 A	 Aerial Photography
 A/D	
 B	
 B/D	
 C	
 C/D	
 D	
 Not rated or not available	
<b>Soil Rating Points</b>	
 A	
 A/D	
 B	
 B/D	

## 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 22, Sep 12, 2022

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

Date(s) aerial images were photographed: Oct 21, 2022—Oct 27, 2022

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
273C	Urban land-Charlton-Chatfield complex, rocky, 3 to 15 percent slopes	D	2.0	81.9%
306	Udorthents-Urban land complex	B	0.4	18.1%
<b>Totals for Area of Interest</b>			<b>2.5</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*

**Exhibit “D”**

**FIRM Map**



# National Flood Hazard Layer FIRMette



73°31'52"W 41°43'43"N



73°31'15"W 41°43'36"N

## Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

**SPECIAL FLOOD HAZARD AREAS**

- Without Base Flood Elevation (BFE)  
*Zone A, V, X59*
- With BFE or Depth *Zone AE, AO, AH, VE, AP*
- Regulatory Floodway

**OTHER AREAS OF FLOOD HAZARD**

- 0.2% Annual Chance Flood Hazard, Area of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee, See Notes, *Zone X*
- Area with Flood Risk due to Levee *Zone D*

**OTHER AREAS**

- Area of Minimal Flood Hazard *Zone X*
- Effective LOMRS
- Area of Undetermined Flood Hazard *Zone*

**GENERAL STRUCTURES**

- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

**OTHER FEATURES**

- Cross Sections with 1% Annual Chance Water Surface Elevation
- Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

**MAP PANELS**

- Digital Data Available
- No Digital Data Available
- Unmapped

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards.

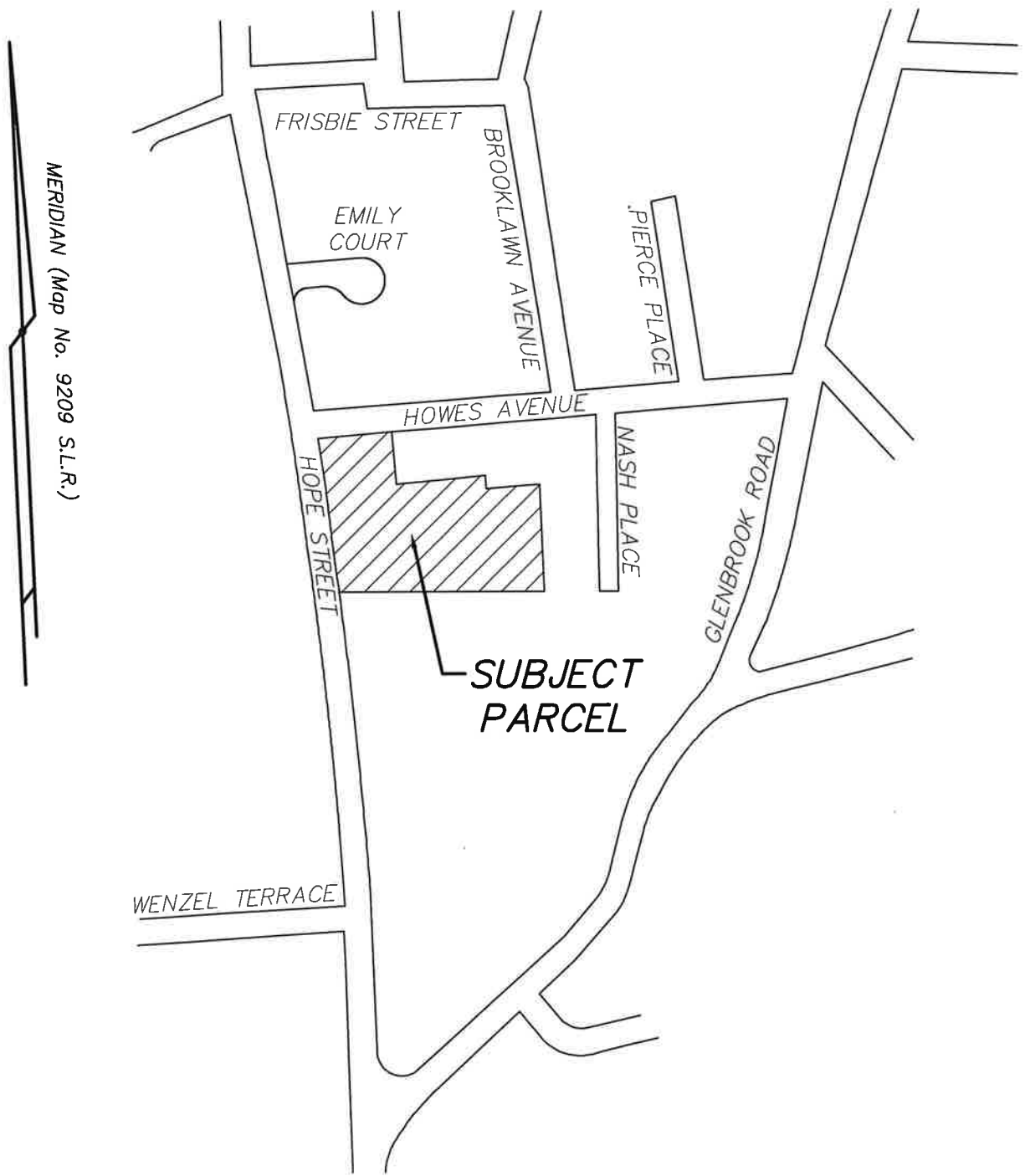
The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on **9/21/2023 at 3:57 PM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.



**Exhibit “E”**

**Site Vicinity Map**



MERIDIAN (Map No. 9209 S.L.R.)

LOCATION MAP - 1"=800'±

**Exhibit “F”**

**USGS Topographic Quad Map**





91 HOPE STREET

Glenbrook

STAMFORD

45 49000m N.

45 48000m N.

45 47000m N.

45 46000m N.

45 45000m N.

45 49000m N.

45 48000m N.

45 47000m N.

45 46000m N.

45 45000m N.

622000m E.

623000m E.

624000m E.

625000m E.

WGS84 Zone 18T 626000m E.





**Exhibit “G”**

**Rainfall Depths and Intensity**





**POINT PRECIPITATION FREQUENCY ESTIMATES**

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

NOAA, National Weather Service, Silver Spring, Maryland

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

**PF tabular**

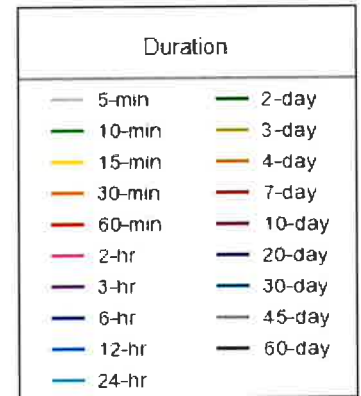
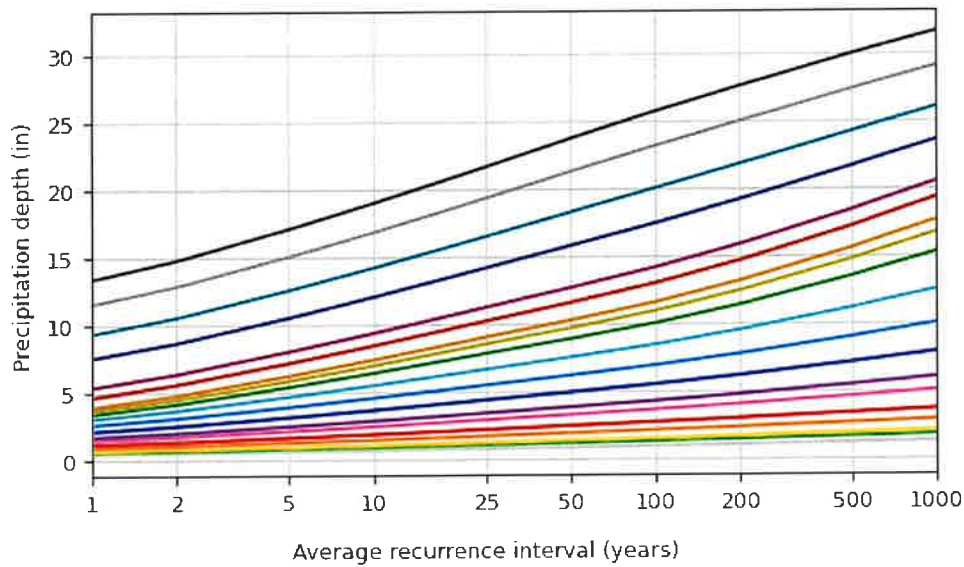
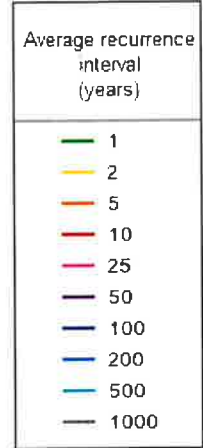
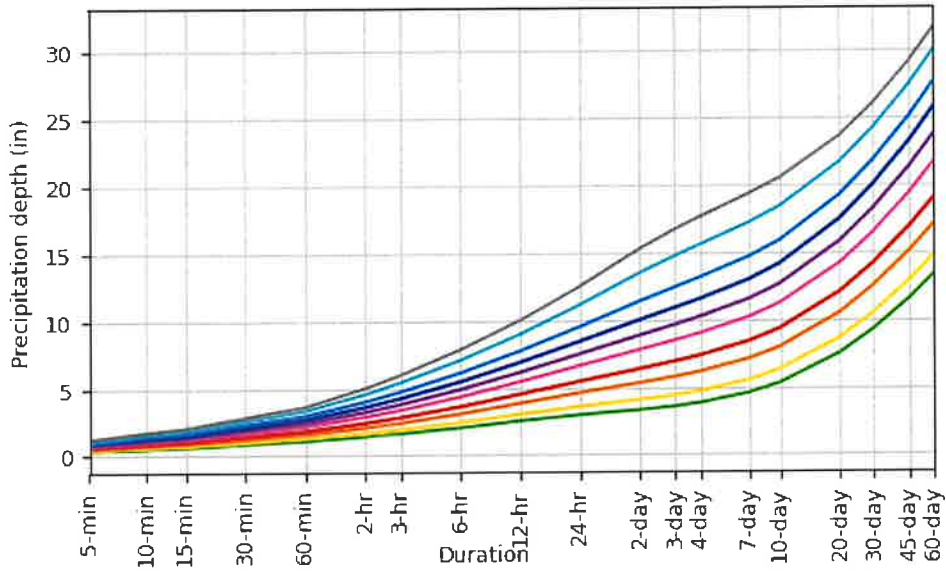
<b>PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)<sup>1</sup></b>										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.365 (0.282-0.464)	0.425 (0.328-0.540)	0.523 (0.402-0.666)	0.604 (0.462-0.774)	0.716 (0.531-0.949)	0.801 (0.583-1.08)	0.888 (0.626-1.23)	0.983 (0.662-1.40)	1.12 (0.722-1.63)	1.22 (0.773-1.82)
10-min	0.517 (0.400-0.657)	0.602 (0.465-0.765)	0.741 (0.570-0.944)	0.856 (0.655-1.10)	1.01 (0.752-1.34)	1.13 (0.824-1.53)	1.26 (0.887-1.75)	1.39 (0.936-1.98)	1.58 (1.02-2.31)	1.73 (1.10-2.58)
15-min	0.609 (0.471-0.773)	0.708 (0.547-0.900)	0.871 (0.671-1.11)	1.01 (0.771-1.29)	1.19 (0.885-1.58)	1.33 (0.970-1.80)	1.48 (1.04-2.06)	1.64 (1.10-2.33)	1.86 (1.20-2.72)	2.04 (1.29-3.04)
30-min	0.851 (0.658-1.08)	0.992 (0.766-1.26)	1.22 (0.941-1.56)	1.41 (1.08-1.81)	1.67 (1.24-2.22)	1.87 (1.36-2.52)	2.08 (1.46-2.88)	2.30 (1.54-3.26)	2.59 (1.68-3.80)	2.83 (1.79-4.22)
60-min	1.09 (0.846-1.39)	1.28 (0.984-1.62)	1.57 (1.21-2.00)	1.82 (1.39-2.33)	2.16 (1.60-2.85)	2.41 (1.75-3.25)	2.68 (1.88-3.71)	2.95 (1.99-4.20)	3.33 (2.16-4.87)	3.62 (2.29-5.40)
2-hr	1.41 (1.10-1.78)	1.66 (1.29-2.10)	2.07 (1.60-2.62)	2.41 (1.86-3.07)	2.88 (2.15-3.80)	3.24 (2.36-4.34)	3.60 (2.56-4.98)	4.00 (2.70-5.66)	4.56 (2.97-6.64)	5.01 (3.18-7.42)
3-hr	1.63 (1.27-2.04)	1.93 (1.50-2.42)	2.42 (1.88-3.05)	2.82 (2.18-3.58)	3.38 (2.53-4.44)	3.80 (2.79-5.09)	4.24 (3.02-5.85)	4.73 (3.20-6.65)	5.42 (3.53-7.86)	5.98 (3.80-8.82)
6-hr	2.05 (1.61-2.56)	2.44 (1.92-3.05)	3.08 (2.42-3.87)	3.62 (2.82-4.55)	4.35 (3.28-5.69)	4.90 (3.62-6.52)	5.48 (3.93-7.54)	6.13 (4.16-8.57)	7.08 (4.62-10.2)	7.85 (5.01-11.5)
12-hr	2.54 (2.01-3.14)	3.03 (2.40-3.77)	3.85 (3.03-4.79)	4.52 (3.54-5.66)	5.45 (4.14-7.09)	6.15 (4.57-8.14)	6.88 (4.97-9.43)	7.73 (5.27-10.7)	8.96 (5.88-12.8)	9.99 (6.39-14.5)
24-hr	2.97 (2.37-3.66)	3.60 (2.86-4.44)	4.61 (3.66-5.71)	5.46 (4.30-6.78)	6.62 (5.06-8.57)	7.49 (5.60-9.88)	8.41 (6.12-11.5)	9.50 (6.50-13.1)	11.1 (7.31-15.8)	12.5 (8.01-18.1)
2-day	3.32 (2.66-4.06)	4.08 (3.27-5.00)	5.33 (4.26-6.55)	6.37 (5.06-7.86)	7.80 (6.00-10.0)	8.86 (6.68-11.6)	10.0 (7.34-13.6)	11.4 (7.81-15.6)	13.5 (8.88-19.0)	15.3 (9.83-21.9)
3-day	3.58 (2.89-4.37)	4.42 (3.56-5.40)	5.79 (4.64-7.09)	6.93 (5.52-8.52)	8.49 (6.56-10.9)	9.65 (7.30-12.6)	10.9 (8.04-14.8)	12.4 (8.55-17.0)	14.7 (9.74-20.7)	16.7 (10.8-23.9)
4-day	3.84 (3.10-4.67)	4.72 (3.81-5.74)	6.16 (4.96-7.52)	7.36 (5.88-9.03)	9.01 (6.98-11.5)	10.2 (7.76-13.4)	11.6 (8.53-15.7)	13.2 (9.06-17.9)	15.6 (10.3-21.9)	17.6 (11.4-25.2)
7-day	4.58 (3.72-5.54)	5.54 (4.49-6.70)	7.11 (5.75-8.63)	8.41 (6.76-10.3)	10.2 (7.93-13.0)	11.5 (8.78-14.9)	13.0 (9.58-17.4)	14.7 (10.1-19.9)	17.2 (11.4-24.0)	19.3 (12.5-27.4)
10-day	5.30 (4.32-6.39)	6.32 (5.14-7.62)	7.97 (6.46-9.64)	9.34 (7.53-11.4)	11.2 (8.74-14.2)	12.6 (9.63-16.3)	14.1 (10.4-18.8)	15.9 (11.0-21.4)	18.4 (12.2-25.6)	20.5 (13.3-29.0)
20-day	7.48 (6.14-8.95)	8.62 (7.07-10.3)	10.5 (8.56-12.6)	12.0 (9.76-14.5)	14.1 (11.1-17.7)	15.8 (12.0-20.0)	17.4 (12.8-22.8)	19.2 (13.4-25.7)	21.7 (14.5-29.9)	23.6 (15.3-33.1)
30-day	9.28 (7.65-11.1)	10.5 (8.65-12.5)	12.5 (10.3-15.0)	14.2 (11.6-17.1)	16.5 (12.9-20.4)	18.3 (13.9-23.0)	20.0 (14.7-25.9)	21.8 (15.3-29.1)	24.2 (16.2-33.3)	26.0 (17.0-36.4)
45-day	11.5 (9.51-13.6)	12.8 (10.6-15.2)	15.0 (12.4-17.9)	16.8 (13.8-20.1)	19.3 (15.2-23.8)	21.3 (16.3-26.6)	23.2 (17.0-29.7)	25.0 (17.6-33.2)	27.4 (18.4-37.4)	29.1 (19.0-40.5)
60-day	13.3 (11.1-15.8)	14.8 (12.2-17.5)	17.1 (14.1-20.3)	19.0 (15.6-22.7)	21.6 (17.1-26.6)	23.7 (18.2-29.5)	25.7 (18.9-32.8)	27.6 (19.5-36.5)	30.0 (20.2-40.8)	31.7 (20.7-44.0)

<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**

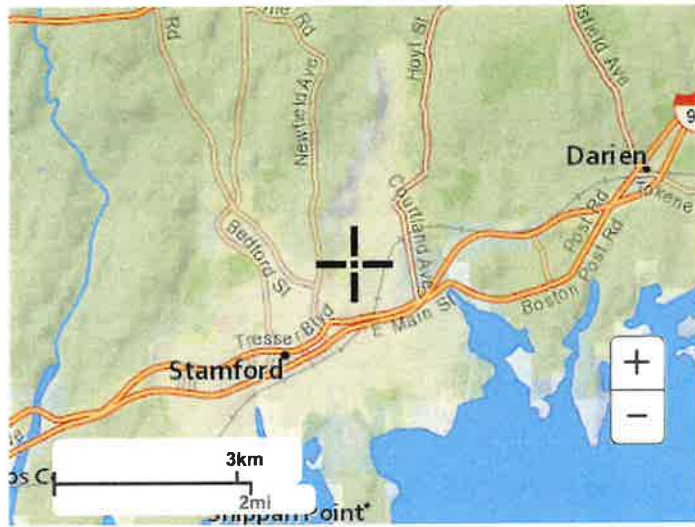
PDS-based depth-duration-frequency (DDF) curves  
 Latitude: 41.0638°, Longitude: -73.5260°



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**Maps & aerials**

**Small scale terrain**



Large scale terrain



Large scale map



Large scale aerial





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1325 East West Highway  
Silver Spring, MD 20910  
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**Appendix “A”**  
**Stormwater Calculations**

## Water Quality Volume (WQV) Calculations

Name: RRIT, LLC  
 Address: 91 Hope Street, Stamford, Connecticut  
 Project: "Hope Street Townhouses"

$$WQV = \left( \frac{1 \text{ in}}{12 \frac{\text{in}}{\text{ft}}} \right) RA$$

Where,

R= Volumetric Runoff Coefficient = 0.05+0.009I

I= Percent Impervious Coverage

A= Watershed Area (sf)

Drainage Area	Total Area (sf)	Impervious Coverage		R (Runoff Coefficient)	WQV (cf)
		Area (sf)	% Coverage		
Pr. Area #1	2,450	721	29.4	0.3146	64.2
Pr. Area #2	12,455	3,095	24.8	0.2732	283.6
Pr. Area #3A	8,002	72	0.1	0.0509	33.9
Pr. Area #3B	13,527	9,308	68.8	0.6692	754.4
Pr. Area #4A	4,525	54	1.2	0.0608	22.9
Pr. Area #4B	17,591	13,961	79.4	0.7646	1,120.8
Pr. Area #4C	18,286	11,383	62.2	0.6098	929.2
Pr. Area #4D	24,703	17,568	71.1	0.6899	1,420.2

Pr. Area #3B: The WQV for this drainage area will be collected and infiltrated by Retention System #1. The storage volume of Retention System #1 below the 12" high-overflow outlet orifice will be approximately 4,884 cf. Refer to attached Stage-Area Storage Table for RS-1.

Pr. Area #4B: The WQV for this drainage area will first be pretreated by hydrodynamic Stormwater Treatment System #1 and then it will be collected and infiltrated by Retention System #2. The storage

volume of Retention System #2 below the 12" high-overflow outlet orifice will be approximately 3,764 cf. Refer to attached Stage-Area Storage Table for RS-2.

Pr. Area #4C: The WQV for this drainage area will be collected and infiltrated by Retention System #3. The storage volume of Retention System #3 below the 12" high-overflow outlet orifice will be approximately 3,852 cf. Refer to attached Stage-Area Storage Table for RS-3.

Pr. Area #4D: The WQV for this drainage area will be collected and infiltrated by Retention System #4. The storage volume of Retention System #4 below the 15" high-overflow outlet orifice will be approximately 5,267 cf. Refer to attached Stage-Area Storage Table for RS-4.

Stage-Area-Storage for Pond 7P: RS-1

Elevation (feet)	Storage (cubic-feet)	Elevation (feet)	Storage (cubic-feet)
77.90	0	83.10	5,193
78.00	71	83.20	5,210
78.10	142	83.30	5,228
78.20	213	83.40	5,246
78.30	284	83.50	5,264
78.40	355	83.60	5,281
78.50	481	83.70	5,299
78.60	608	83.80	5,317
78.70	737	83.90	5,335
78.80	868	84.00	5,352
78.90	999	84.10	5,370
79.00	1,130	84.20	5,388
79.10	1,261	84.30	5,406
79.20	1,392	84.40	<b>5,423</b>
79.30	1,522		
79.40	1,653		
79.50	1,783		
79.60	1,914		
79.70	2,044		
79.80	2,174		
79.90	2,304		
80.00	2,434		
80.10	2,564		
80.20	2,693		
80.30	2,823		
80.40	2,953		
80.50	3,082		
80.60	3,211		
80.70	3,341		
80.80	3,470		
80.90	3,599		
81.00	3,728		
81.10	3,857		
81.20	3,985		
81.30	4,114		
81.40	4,242		
81.50	4,371		
81.60	4,499		
81.70	4,627		
81.80	4,756		
<del>81.90</del>	<del>4,884</del>		
82.00	4,990		
82.10	5,009		
82.20	5,029		
82.30	5,049		
82.40	5,068		
82.50	5,086		
82.60	5,104		
82.70	5,122		
82.80	5,139		
82.90	5,157		
83.00	5,175		

**F HIGH-OVERFLOW OUTLET**



**Stage-Area-Storage for Pond 6P: RS-2**

Elevation (feet)	Storage (cubic-feet)	Elevation (feet)	Storage (cubic-feet)	Elevation (feet)	Storage (cubic-feet)
84.30	0	86.38	3,042	88.46	4,378
84.34	33	86.42	3,099	88.50	4,386
84.38	66	86.46	3,156	88.54	4,395
84.42	98	86.50	3,211	88.58	4,403
84.46	131	86.54	3,265	88.62	4,411
84.50	164	86.58	3,318	88.66	4,419
84.54	197	86.62	3,370	88.70	4,427
84.58	230	86.66	3,421	88.74	4,436
84.62	263	86.70	3,469	88.78	4,444
84.66	295	86.74	3,516	88.82	4,452
84.70	328	86.78	3,561	88.86	4,460
84.74	361	86.82	3,603	88.90	4,469
84.78	394	86.86	3,642	88.94	4,477
84.82	447	86.90	3,679	88.98	4,485
84.86	519	86.94	3,714	89.02	4,493
84.90	591	86.98	3,748	89.06	4,501
84.94	662	87.02	3,781	89.10	4,510
84.98	733	87.06	3,813	89.14	4,518
85.02	804	87.10	3,846	89.18	4,526
85.06	875	87.14	3,879	89.22	4,534
85.10	945	87.18	3,912	89.26	4,542
85.14	1,016	87.22	3,945	89.30	4,551
85.18	1,086	87.26	3,978	89.34	4,559
85.22	1,156	87.30	4,010	89.38	4,567
85.26	1,226	87.34	4,043	89.42	4,575
85.30	1,296	87.38	4,076	89.46	4,583
85.34	1,365	87.42	4,109	89.50	4,592
85.38	1,434	87.46	4,142	89.54	4,600
85.42	1,503	87.50	4,175	89.58	4,608
85.46	1,571	87.54	4,190	89.62	4,616
85.50	1,639	87.58	4,198	89.66	4,624
85.54	1,707	87.62	4,206	89.70	4,633
85.58	1,775	87.66	4,214	89.74	4,641
85.62	1,842	87.70	4,222	89.78	4,649
85.66	1,908	87.74	4,231	89.82	4,657
85.70	1,975	87.78	4,239	89.86	4,665
85.74	2,041	87.82	4,247	89.90	4,674
85.78	2,107	87.86	4,255	89.94	4,682
85.82	2,173	87.90	4,263	89.98	4,690
85.86	2,238	87.94	4,272		
85.90	2,303	87.98	4,280		
85.94	2,368	88.02	4,288		
85.98	2,433	88.06	4,296		
86.02	2,496	88.10	4,304		
86.06	2,559	88.14	4,313		
86.10	2,622	88.18	4,321		
86.14	2,684	88.22	4,329		
86.18	2,745	88.26	4,337		
86.22	2,806	88.30	4,345		
86.26	2,866	88.34	4,354		
86.30	2,925	88.38	4,362		
86.34	2,984	88.42	4,370		

87.0 3,764



HIGH-OVERFLOW OUTLET

**Stage-Area-Storage for Pond 10P: RS-3**

Elevation (feet)	Storage (cubic-feet)	Elevation (feet)	Storage (cubic-feet)	Elevation (feet)	Storage (cubic-feet)
80.00	0	82.08	1,902	84.16	3,946
80.04	23	82.12	1,943	84.20	3,953
80.08	46	82.16	1,984	84.24	3,960
80.12	69	82.20	2,025	84.28	3,968
80.16	91	82.24	2,066	84.32	3,975
80.20	114	82.28	2,106	84.36	3,982
80.24	137	82.32	2,147	84.40	3,989
80.28	160	82.36	2,188	84.44	3,996
80.32	183	82.40	2,229	84.48	4,003
80.36	206	82.44	2,270	84.52	4,009
80.40	229	82.48	2,310	84.56	4,015
80.44	251	82.52	2,351	84.60	4,021
80.48	274	82.56	2,392	84.64	4,027
80.52	306	82.60	2,433	84.68	4,032
80.56	345	82.64	2,474	84.72	4,038
80.60	385	82.68	2,514	84.76	4,044
80.64	425	82.72	2,555	84.80	4,049
80.68	465	82.76	2,596	84.84	4,055
80.72	505	82.80	2,636	84.88	4,061
80.76	546	82.84	2,677	84.92	4,067
80.80	587	82.88	2,718	84.96	4,072
80.84	628	82.92	2,758	85.00	4,078
80.88	669	82.96	2,799	85.04	4,084
80.92	710	83.00	2,840	85.08	4,089
80.96	752	83.04	2,880	85.12	4,095
81.00	793	83.08	2,921	85.16	4,101
81.04	834	83.12	2,962	85.20	4,107
81.08	875	83.16	3,002	85.24	4,112
81.12	917	83.20	3,043	85.28	4,118
81.16	958	83.24	3,083	85.32	4,124
81.20	999	83.28	3,124	85.36	4,129
81.24	1,040	83.32	3,164	85.40	4,135
81.28	1,081	83.36	3,205	85.44	4,141
81.32	1,123	83.40	3,245	85.48	4,147
81.36	1,164	83.44	3,286	85.52	4,152
81.40	1,205	83.48	3,326	85.56	4,158
81.44	1,246	83.52	3,367	85.60	4,164
81.48	1,287	83.56	3,407	85.64	4,169
81.52	1,328	83.60	3,448	85.68	4,175
81.56	1,369	83.64	3,488	85.72	4,181
81.60	1,410	83.68	3,529	85.76	4,187
81.64	1,451	83.72	3,569	85.80	4,192
81.68	1,492	83.76	3,609	85.84	4,198
81.72	1,533	83.80	3,650	85.88	4,204
81.76	1,574	83.84	3,690	85.92	4,209
81.80	1,615	83.88	3,731	85.96	4,215
81.84	1,656	83.92	3,771	86.00	4,221
81.88	1,697	83.96	3,811		
81.92	1,738	<u>84.00</u>	<u>3,852</u>		
81.96	1,779	84.04	3,892		
82.00	1,820	84.08	3,932		
82.04	1,861	84.12	3,939		

*High-Overflow Outlet*

**Stage-Area-Storage for Pond 11P: RS-4**

Elevation (feet)	Storage (cubic-feet)	Elevation (feet)	Storage (cubic-feet)
77.50	0	82.70	5,690
77.60	76	82.80	5,709
77.70	152	82.90	5,728
77.80	228	83.00	5,747
77.90	304	83.10	5,766
78.00	380	83.20	5,785
78.10	517	83.30	5,805
78.20	653	83.40	5,824
78.30	793	83.50	5,843
78.40	934	83.60	5,862
78.50	1,075	83.70	5,881
78.60	1,217	83.80	5,900
78.70	1,358	83.90	5,919
78.80	1,499	84.00	<b>5,938</b>
78.90	1,640		
79.00	1,781		
79.10	1,922		
79.20	2,062		
79.30	2,203		
79.40	2,343		
79.50	2,484		
79.60	2,624		
79.70	2,764		
79.80	2,904		
79.90	3,044		
80.00	3,184		
80.10	3,323		
80.20	3,463		
80.30	3,602		
80.40	3,742		
80.50	3,881		
80.60	4,020		
80.70	4,159		
80.80	4,298		
80.90	4,437		
81.00	4,575		
81.10	4,714		
81.20	4,853		
81.30	4,991		
81.40	5,129		
<u>81.50</u>	<u>5,267</u>		
81.60	5,401		
81.70	5,440		
81.80	5,479		
81.90	5,518		
82.00	5,557		
82.10	5,576		
82.20	5,595		
82.30	5,614		
82.40	5,633		
82.50	5,652		
82.60	5,671		

← HIGH-OVERFLOW OUTLET

## Infiltration System Drawdown Calculations

Name: RRIT, LLC  
Address: 91 Hope Street, Stamford, Connecticut  
Project: "Hope Street Townhouses"

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### □ Drawdown Calculations

According to the NRCS Web Soil Survey in Exhibit "C", the majority of the site lies within a mapped area of HSG-D soils. The four proposed retention/infiltration systems lie within this mapped HSG-D soil group area. However, hydraulic conductivity tests were performed in the areas of each of the proposed retention/infiltration systems to verify the infiltration rate of the existing soil in that area. Refer to the HCT test results summarized in Appendix "F".

### □ Retention System #1 (RS-1)

$$T_{\text{drawdown}} = (DV) / [(k)(A)(1\text{ft}/12\text{in})]$$

DV	= Design Volume	=	4,884 ft <sup>3</sup>
k	= Infiltration Rate	=	1.3 in/hr (HCT "B" – Appendix "F")
A	= Bottom Area	=	1,776 ft <sup>2</sup>

$$T_{\text{drawdown}} = (4,884 \text{ ft}^3) / [(1.3 \text{ in/hr})(1,776 \text{ ft}^2)(1\text{ft}/12\text{in})] = 25.4 \text{ hrs.}$$

**The proposed Retention System will draw down within 25.4 hours.**

### □ Retention System #2 (RS-2)

$$T_{\text{drawdown}} = (DV) / [(k)(A)(1\text{ft}/12\text{in})]$$

DV	= Design Volume	=	3,764 ft <sup>3</sup>
k	= Infiltration Rate	=	5.8 in/hr (HCT "E" – Appendix "F")
A	= Bottom Area	=	2,051 ft <sup>2</sup>

$$T_{\text{drawdown}} = (3,764 \text{ ft}^3) / [(5.8 \text{ in/hr})(2,051 \text{ ft}^2)(1\text{ft}/12\text{in})] = 3.8 \text{ hrs.}$$

**The proposed Retention System will draw down within 3.8 hours.**

### □ Retention System #3 (RS-3)

$$T_{\text{drawdown}} = (DV) / [(k)(A)(1\text{ft}/12\text{in})]$$

DV	= Design Volume	=	3,852 ft <sup>3</sup>
k	= Infiltration Rate	=	2.9 in/hr (HCT "C" – Appendix "F")
A	= Bottom Area	=	1,428 ft <sup>2</sup>

$$T_{\text{drawdown}} = (3,852 \text{ ft}^3) / [(2.9 \text{ in/hr})(1,428 \text{ ft}^2)(1\text{ft}/12\text{in})] = 11.2 \text{ hrs.}$$

**The proposed Retention System will draw down within 11.2 hours.**



□ **Retention System #4 (RS-4)**

$$T_{\text{drawdown}} = (DV) / [(k)(A)(1\text{ft}/12\text{in})]$$

DV	= Design Volume	=	5,267 ft <sup>3</sup>
k	= Infiltration Rate	=	2.75 in/hr (HCT "A" – Appendix "F")
A	= Bottom Area	=	1,902 ft <sup>2</sup>

$$T_{\text{drawdown}} = (5,267 \text{ ft}^3) / [(2.75 \text{ in/hr})(1,902 \text{ ft}^2)(1\text{ft}/12\text{in})] = 12.1 \text{ hrs.}$$

**The proposed Retention System will draw down within 12.1 hours.**

## Water Quality Volume and Flow Calculations For Proposed Stormwater Treatment System

The following calculations have been performed for Drainage Area 4B to SWTS #1.

• **Calculate the Water Quality Volume (WQV)**

$$WQV = \left( \frac{1 \text{ in}}{12 \frac{\text{in}}{\text{ft}}} \right) RA$$

$$A = \text{Drainage Area 4B} = 17,591 \text{ ft}^2$$

$$A_{\text{impervious}} = 13,961 \text{ ft}^2$$

$$I = \% \text{ Impervious} = \frac{A_{\text{impervious}}}{A} = \frac{13,961 \text{ ft}^2}{17,591 \text{ ft}^2} (100) = 79.4\%$$

$$R = \text{Runoff Coefficient} = 0.05 + 0.009 I = 0.05 + 0.009 (79.4\%) = 0.7646$$

$$WQV = \left( \frac{1 \text{ in}}{12 \frac{\text{in}}{\text{ft}}} \right) (0.7646) (17,591 \text{ ft}^2) = 1,120.8 \text{ ft}^3$$

**Compute the Water Quality Flow Rate (WQF)**

$$WQF = q_u A Q$$

$$Q = \frac{WQV \left( 12 \frac{\text{in}}{\text{ft}} \right)}{A} = \frac{1,120.8 \text{ ft}^3 \left( 12 \frac{\text{in}}{\text{ft}} \right)}{17,591 \text{ ft}^2} = 0.7646 \text{ in}$$

$$P = \text{Design Precipitation} = 1 \text{ inch}$$

$$CN = \frac{1000}{10 + 5(1 \text{ in}) + 10(0.7646 \text{ in}) - 10((0.7646 \text{ in})^2 + 1.25(0.7646 \text{ in})(1 \text{ in}))^{1/2}} = 97.7$$

$$T_c = 0.167 \text{ hr} = 10 \text{ min} \text{ (Minimum value used in calculation)}$$

$$I_a = 0.047 \text{ in} \text{ (extrapolated from Table 4-1 2004 CT Stormwater Quality Manual)}$$

$$\frac{I_a}{P} = 0.047 \rightarrow q_u \approx 650 \frac{\text{csm}}{\text{in}} \text{ (From Exhibit 4-111 2004 CT Stormwater Quality Manual)}$$

$$WQF = q_u A Q = \left( 650 \frac{\text{csm}}{\text{in}} \right) \left( \frac{17,591 \text{ ft}^2}{\left( 5,280 \frac{\text{mi}}{\text{ft}} \right)^2} \right) (0.7646 \text{ in}) = 0.31 \frac{\text{ft}^3}{\text{s}} \quad WQF = 0.31 \frac{\text{ft}^3}{\text{s}}$$

2. Compute the time of concentration ( $t_c$ ) based on the methods described in Chapter 3 of TR-55. A minimum value of 0.167 hours (10 minutes) should be used. For sheet flow, the flow path should not be longer than 300 feet.
3. Using the computed CN,  $t_c$ , and drainage area (A) in acres, compute the peak discharge for the water quality storm (i.e., the water quality flow [WQF]), based on the procedures described in Chapter 4 of TR-55.
  - Read initial abstraction ( $I_a$ ) from Table 4-1 in Chapter 4 of TR-55 (reproduced below); compute  $I_a/P$

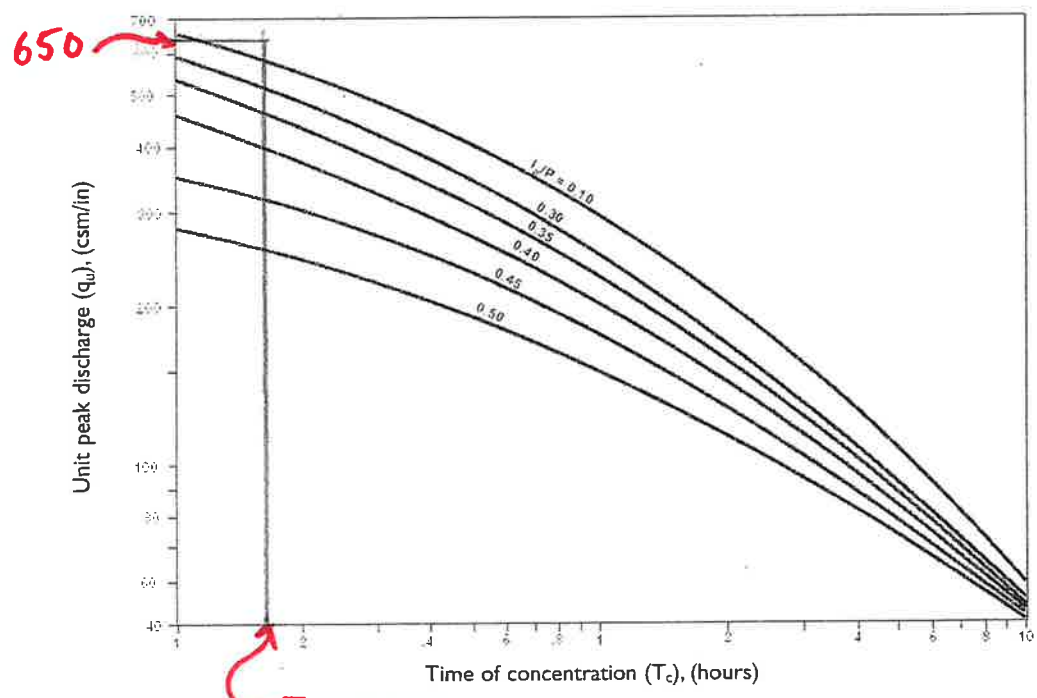
**Table 4-1  $I_a$  values for runoff curve numbers**

Curve number	$I_a$ (in)	Curve number	$I_a$ (in)	Curve number	$I_a$ (in)	Curve number	$I_a$ (in)
40	3.000	55	1.636	70	0.857	85	0.353
41	2.878	56	1.571	71	0.817	86	0.326
42	2.762	57	1.509	72	0.778	87	0.299
43	2.651	58	1.448	73	0.740	88	0.273
44	2.545	59	1.390	74	0.703	89	0.247
45	2.444	60	1.333	75	0.667	90	0.222
46	2.348	61	1.279	76	0.632	91	0.198
47	2.255	62	1.226	77	0.597	92	0.174
48	2.167	63	1.175	78	0.564	93	0.151
49	2.082	64	1.125	79	0.532	94	0.128
50	2.000	65	1.077	80	0.500	95	0.105
51	1.922	66	1.030	81	0.469	96	0.083
52	1.846	67	0.985	82	0.439	97	0.062
53	1.774	68	0.941	83	0.410	98	0.041
54	1.704	69	0.899	84	0.381		

97.7 ..... 0.047

- Read the unit peak discharge ( $q_u$ ) from Exhibit 4-III in Chapter 4 of TR-55 (reproduced below) for appropriate  $t_c$

**Exhibit 4-III Unit peak discharge ( $q_u$ ) for NRCS (SCS) type III rainfall distribution**



$T_c = 0.167 \text{ hrs}$

**Appendix “B”**

**HydroCAD Summary Table  
Existing & Proposed Conditions**



**HydroCAD Summary**  
**"Hope Street Townhouses"**  
**91 Hope Street, Stamford, CT**  
**Project ID: 20XE**

POC	1 Year Storm				2 Year Storm				5 Year Storm				10 Year Storm				25 Year Storm				50 Year Storm			
	q <sub>ex</sub> (ft <sup>3</sup> /s)	q <sub>p</sub> (ft <sup>3</sup> /s)	Δq (ft <sup>3</sup> /s)	%Δq (cf)	q <sub>ex</sub> (ft <sup>3</sup> /s)	q <sub>p</sub> (ft <sup>3</sup> /s)	Δq (ft <sup>3</sup> /s)	%Δq (cf)	q <sub>ex</sub> (ft <sup>3</sup> /s)	q <sub>p</sub> (ft <sup>3</sup> /s)	Δq (ft <sup>3</sup> /s)	%Δq (cf)	q <sub>ex</sub> (ft <sup>3</sup> /s)	q <sub>p</sub> (ft <sup>3</sup> /s)	Δq (ft <sup>3</sup> /s)	%Δq (cf)	q <sub>ex</sub> (ft <sup>3</sup> /s)	q <sub>p</sub> (ft <sup>3</sup> /s)	Δq (ft <sup>3</sup> /s)	%Δq (cf)	q <sub>ex</sub> (ft <sup>3</sup> /s)	q <sub>p</sub> (ft <sup>3</sup> /s)	Δq (ft <sup>3</sup> /s)	%Δq (cf)
A	0.08	0.05	-0.03	-38%	0.11	0.08	-0.03	-27%	0.16	0.13	-0.03	-19%	0.21	0.17	-0.04	-19%	0.27	0.24	-0.03	-11%	0.32	0.29	-0.03	-9%
B	0.66	0.27	-0.39	-59%	0.92	0.42	-0.50	-54%	1.35	0.67	-0.68	-50%	1.72	0.89	-0.83	-48%	2.23	1.21	-1.02	-46%	2.61	1.45	-1.16	-44%
C	0.18	0.16	-0.02	-11%	0.26	0.23	-0.03	-12%	0.40	0.35	-0.05	-13%	0.53	0.46	-0.07	-13%	0.71	0.61	-0.10	-14%	0.85	0.72	-0.13	-15%
D	2.38	0.11	-2.27	-95%	3.18	0.15	-3.03	-95%	4.49	0.41	-4.08	-91%	5.59	2.03	-3.56	-64%	7.12	5.18	-1.94	-27%	8.27	8.21	-0.06	-1%

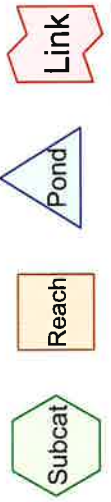
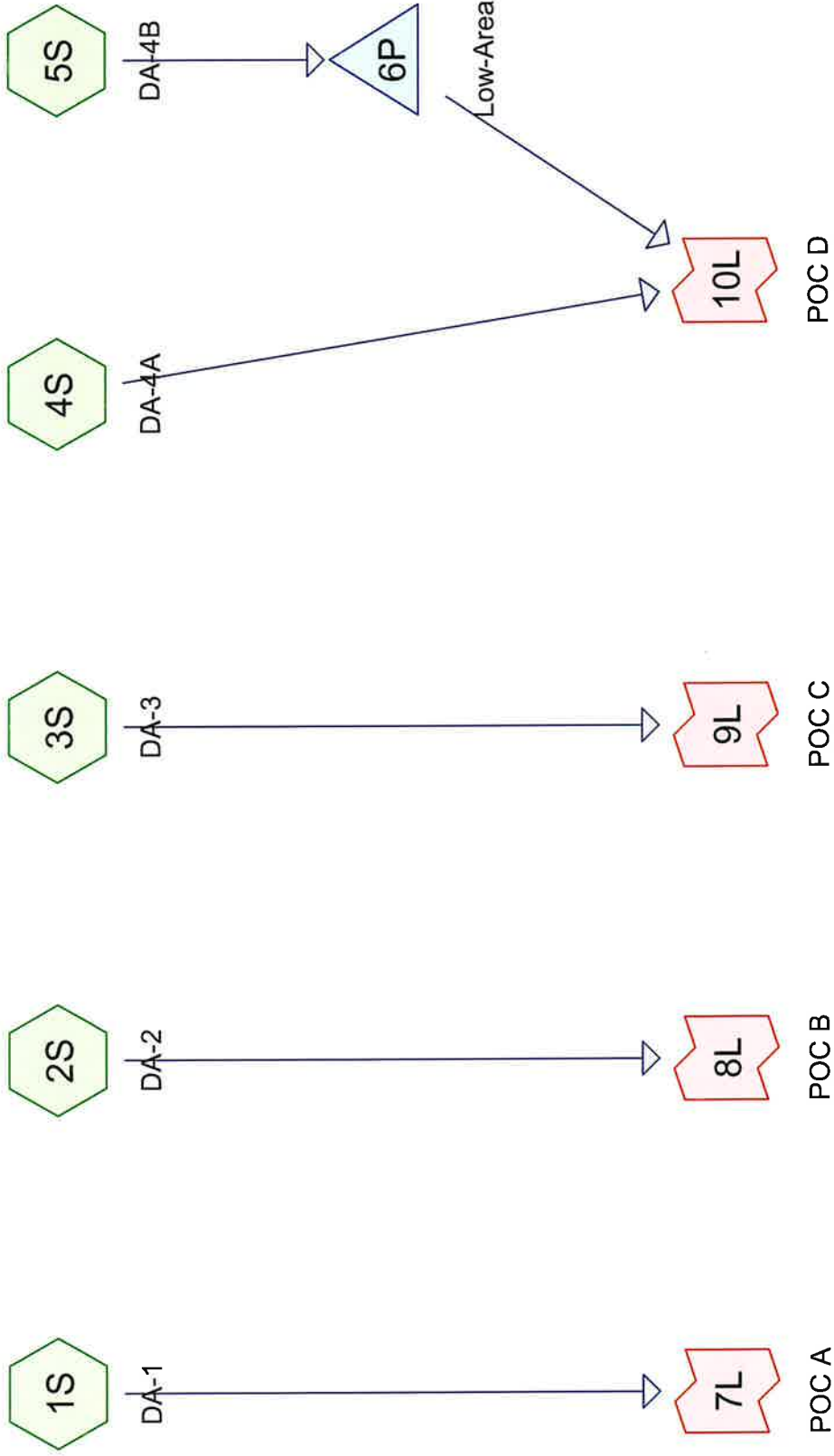
Table 1: Comparison of Existing and Proposed Peak Flow Rates for all Points of Concern.

POC	1 Year Storm				2 Year Storm				5 Year Storm				10 Year Storm				25 Year Storm				50 Year Storm			
	v <sub>ex</sub> (cf)	v <sub>p</sub> (cf)	Δv (cf)	%Δv (cf)	v <sub>ex</sub> (cf)	v <sub>p</sub> (cf)	Δv (cf)	%Δv (cf)	v <sub>ex</sub> (cf)	v <sub>p</sub> (cf)	Δv (cf)	%Δv (cf)	v <sub>ex</sub> (cf)	v <sub>p</sub> (cf)	Δv (cf)	%Δv (cf)	v <sub>ex</sub> (cf)	v <sub>p</sub> (cf)	Δv (cf)	%Δv (cf)	v <sub>ex</sub> (cf)	v <sub>p</sub> (cf)	Δv (cf)	%Δv (cf)
A	233	160	-73	-31%	325	241	-84	-26%	485	386	-99	-20%	625	520	-105	-17%	824	713	-111	-13%	977	865	-112	-11%
B	2,072	943	-1,129	-54%	2,857	1,383	-1,474	-52%	4,192	2,165	-2,027	-48%	5,365	2,874	-2,491	-46%	7,011	3,891	-3,120	-45%	8,269	4,682	-3,587	-43%
C	1,068	774	-294	-28%	1,532	1,091	-441	-29%	2,343	1,639	-704	-30%	3,069	2,330	-739	-24%	4,103	4,298	195	5%	4,902	5,791	889	18%
D	8,755	434	-8,321	-95%	11,893	1,169	-10,724	-90%	17,121	6,369	-10,752	-63%	21,640	10,807	-10,833	-50%	27,914	16,922	-10,992	-39%	32,676	21,536	-11,140	-34%

Table 2: Comparison of Existing and Proposed Runoff Volumes for all Points of Concern.

**Appendix “C”**

**HydroCAD Analysis -  
Existing Conditions**



**Routing Diagram for 20XE\_Ex-0**  
 Prepared by RVDI, Printed 12/14/2023  
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**Area Listing (all nodes)**

Area (sq-ft)	CN	Description (subcatchment-numbers)
8,109	61.0	>75% Grass cover, Good, HSG B (1S, 2S, 5S)
26,198	80.0	>75% Grass cover, Good, HSG D (2S, 5S)
39,215	98.0	Paved parking, HSG D (1S, 2S, 5S)
1,806	55.0	Woods, Good, HSG B (4S, 5S)
26,211	77.0	Woods, Good, HSG D (3S, 4S, 5S)
<b>101,539</b>	<b>84.2</b>	<b>TOTAL AREA</b>



20XE\_Ex-0

Prepared by RVDI

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Existing Conditions  
Type III 24-hr 1-Year Rainfall=2.97"

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Page 2

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points  
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

<b>Subcatchment 1S: DA-1</b>	Runoff Area=2,278 sf 51.32% Impervious Runoff Depth>1.23" Tc=5.0 min CN=80.0 Runoff=0.08 cfs 233 cf
<b>Subcatchment 2S: DA-2</b>	Runoff Area=18,552 sf 41.33% Impervious Runoff Depth>1.34" Flow Length=226' Tc=6.1 min CN=81.8 Runoff=0.66 cfs 2,072 cf
<b>Subcatchment 3S: DA-3</b>	Runoff Area=12,314 sf 0.00% Impervious Runoff Depth>1.04" Flow Length=203' Tc=34.0 min CN=77.0 Runoff=0.18 cfs 1,068 cf
<b>Subcatchment 4S: DA-4A</b>	Runoff Area=2,647 sf 0.00% Impervious Runoff Depth>0.98" Flow Length=24' Slope=0.0330 '/' Tc=9.2 min CN=75.7 Runoff=0.06 cfs 215 cf
<b>Subcatchment 5S: DA-4B</b>	Runoff Area=65,748 sf 46.21% Impervious Runoff Depth>1.69" Flow Length=337' Tc=11.9 min CN=86.7 Runoff=2.46 cfs 9,237 cf
<b>Pond 6P: Low-Area</b>	Peak Elev=84.50' Storage=1,132 cf Inflow=2.46 cfs 9,237 cf Outflow=2.33 cfs 8,540 cf
<b>Link 7L: POC A</b>	Inflow=0.08 cfs 233 cf Primary=0.08 cfs 233 cf
<b>Link 8L: POC B</b>	Inflow=0.66 cfs 2,072 cf Primary=0.66 cfs 2,072 cf
<b>Link 9L: POC C</b>	Inflow=0.18 cfs 1,068 cf Primary=0.18 cfs 1,068 cf
<b>Link 10L: POC D</b>	Inflow=2.38 cfs 8,755 cf Primary=2.38 cfs 8,755 cf

**Total Runoff Area = 101,539 sf Runoff Volume = 12,825 cf Average Runoff Depth = 1.52"**  
**61.38% Pervious = 62,324 sf 38.62% Impervious = 39,215 sf**

20XE\_Ex-0

Prepared by RVDI

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Existing Conditions  
Type III 24-hr 2-Year Rainfall=3.60"

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Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points  
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

<b>Subcatchment 1S: DA-1</b>	Runoff Area=2,278 sf 51.32% Impervious Runoff Depth>1.71" Tc=5.0 min CN=80.0 Runoff=0.11 cfs 325 cf
<b>Subcatchment 2S: DA-2</b>	Runoff Area=18,552 sf 41.33% Impervious Runoff Depth>1.85" Flow Length=226' Tc=6.1 min CN=81.8 Runoff=0.92 cfs 2,857 cf
<b>Subcatchment 3S: DA-3</b>	Runoff Area=12,314 sf 0.00% Impervious Runoff Depth>1.49" Flow Length=203' Tc=34.0 min CN=77.0 Runoff=0.26 cfs 1,532 cf
<b>Subcatchment 4S: DA-4A</b>	Runoff Area=2,647 sf 0.00% Impervious Runoff Depth>1.42" Flow Length=24' Slope=0.0330 '/' Tc=9.2 min CN=75.7 Runoff=0.09 cfs 312 cf
<b>Subcatchment 5S: DA-4B</b>	Runoff Area=65,748 sf 46.21% Impervious Runoff Depth>2.24" Flow Length=337' Tc=11.9 min CN=86.7 Runoff=3.27 cfs 12,282 cf
<b>Pond 6P: Low-Area</b>	Peak Elev=84.53' Storage=1,249 cf Inflow=3.27 cfs 12,282 cf Outflow=3.11 cfs 11,581 cf
<b>Link 7L: POC A</b>	Inflow=0.11 cfs 325 cf Primary=0.11 cfs 325 cf
<b>Link 8L: POC B</b>	Inflow=0.92 cfs 2,857 cf Primary=0.92 cfs 2,857 cf
<b>Link 9L: POC C</b>	Inflow=0.26 cfs 1,532 cf Primary=0.26 cfs 1,532 cf
<b>Link 10L: POC D</b>	Inflow=3.18 cfs 11,893 cf Primary=3.18 cfs 11,893 cf

**Total Runoff Area = 101,539 sf Runoff Volume = 17,308 cf Average Runoff Depth = 2.05"**  
**61.38% Pervious = 62,324 sf 38.62% Impervious = 39,215 sf**

20XE\_Ex-0

Prepared by RVDI  
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Existing Conditions  
Type III 24-hr 5-Year Rainfall=4.61"

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Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points  
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

<b>Subcatchment 1S: DA-1</b>	Runoff Area=2,278 sf 51.32% Impervious Runoff Depth>2.55" Tc=5.0 min CN=80.0 Runoff=0.16 cfs 485 cf
<b>Subcatchment 2S: DA-2</b>	Runoff Area=18,552 sf 41.33% Impervious Runoff Depth>2.71" Flow Length=226' Tc=6.1 min CN=81.8 Runoff=1.35 cfs 4,192 cf
<b>Subcatchment 3S: DA-3</b>	Runoff Area=12,314 sf 0.00% Impervious Runoff Depth>2.28" Flow Length=203' Tc=34.0 min CN=77.0 Runoff=0.40 cfs 2,343 cf
<b>Subcatchment 4S: DA-4A</b>	Runoff Area=2,647 sf 0.00% Impervious Runoff Depth>2.19" Flow Length=24' Slope=0.0330 '/' Tc=9.2 min CN=75.7 Runoff=0.14 cfs 483 cf
<b>Subcatchment 5S: DA-4B</b>	Runoff Area=65,748 sf 46.21% Impervious Runoff Depth>3.17" Flow Length=337' Tc=11.9 min CN=86.7 Runoff=4.58 cfs 17,345 cf
<b>Pond 6P: Low-Area</b>	Peak Elev=84.56' Storage=1,429 cf Inflow=4.58 cfs 17,345 cf Outflow=4.37 cfs 16,638 cf
<b>Link 7L: POC A</b>	Inflow=0.16 cfs 485 cf Primary=0.16 cfs 485 cf
<b>Link 8L: POC B</b>	Inflow=1.35 cfs 4,192 cf Primary=1.35 cfs 4,192 cf
<b>Link 9L: POC C</b>	Inflow=0.40 cfs 2,343 cf Primary=0.40 cfs 2,343 cf
<b>Link 10L: POC D</b>	Inflow=4.49 cfs 17,121 cf Primary=4.49 cfs 17,121 cf

**Total Runoff Area = 101,539 sf Runoff Volume = 24,847 cf Average Runoff Depth = 2.94"**  
**61.38% Pervious = 62,324 sf 38.62% Impervious = 39,215 sf**

20XE\_Ex-0

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Existing Conditions  
Type III 24-hr 10-Year Rainfall=5.46"

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Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points  
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

<b>Subcatchment 1S: DA-1</b>	Runoff Area=2,278 sf 51.32% Impervious Runoff Depth>3.29" Tc=5.0 min CN=80.0 Runoff=0.21 cfs 625 cf
<b>Subcatchment 2S: DA-2</b>	Runoff Area=18,552 sf 41.33% Impervious Runoff Depth>3.47" Flow Length=226' Tc=6.1 min CN=81.8 Runoff=1.72 cfs 5,365 cf
<b>Subcatchment 3S: DA-3</b>	Runoff Area=12,314 sf 0.00% Impervious Runoff Depth>2.99" Flow Length=203' Tc=34.0 min CN=77.0 Runoff=0.53 cfs 3,069 cf
<b>Subcatchment 4S: DA-4A</b>	Runoff Area=2,647 sf 0.00% Impervious Runoff Depth>2.89" Flow Length=24' Slope=0.0330 '/' Tc=9.2 min CN=75.7 Runoff=0.18 cfs 637 cf
<b>Subcatchment 5S: DA-4B</b>	Runoff Area=65,748 sf 46.21% Impervious Runoff Depth>3.96" Flow Length=337' Tc=11.9 min CN=86.7 Runoff=5.68 cfs 21,714 cf
<b>Pond 6P: Low-Area</b>	Peak Elev=84.58' Storage=1,576 cf Inflow=5.68 cfs 21,714 cf Outflow=5.44 cfs 21,003 cf
<b>Link 7L: POC A</b>	Inflow=0.21 cfs 625 cf Primary=0.21 cfs 625 cf
<b>Link 8L: POC B</b>	Inflow=1.72 cfs 5,365 cf Primary=1.72 cfs 5,365 cf
<b>Link 9L: POC C</b>	Inflow=0.53 cfs 3,069 cf Primary=0.53 cfs 3,069 cf
<b>Link 10L: POC D</b>	Inflow=5.59 cfs 21,640 cf Primary=5.59 cfs 21,640 cf

**Total Runoff Area = 101,539 sf Runoff Volume = 31,410 cf Average Runoff Depth = 3.71"**  
**61.38% Pervious = 62,324 sf 38.62% Impervious = 39,215 sf**

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points  
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
 Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

<b>Subcatchment 1S: DA-1</b>	Runoff Area=2,278 sf 51.32% Impervious Runoff Depth>4.34" Tc=5.0 min CN=80.0 Runoff=0.27 cfs 824 cf
<b>Subcatchment 2S: DA-2</b>	Runoff Area=18,552 sf 41.33% Impervious Runoff Depth>4.53" Flow Length=226' Tc=6.1 min CN=81.8 Runoff=2.23 cfs 7,011 cf
<b>Subcatchment 3S: DA-3</b>	Runoff Area=12,314 sf 0.00% Impervious Runoff Depth>4.00" Flow Length=203' Tc=34.0 min CN=77.0 Runoff=0.71 cfs 4,103 cf
<b>Subcatchment 4S: DA-4A</b>	Runoff Area=2,647 sf 0.00% Impervious Runoff Depth>3.88" Flow Length=24' Slope=0.0330 '/' Tc=9.2 min CN=75.7 Runoff=0.25 cfs 856 cf
<b>Subcatchment 5S: DA-4B</b>	Runoff Area=65,748 sf 46.21% Impervious Runoff Depth>5.07" Flow Length=337' Tc=11.9 min CN=86.7 Runoff=7.19 cfs 27,774 cf
<b>Pond 6P: Low-Area</b>	Peak Elev=84.61' Storage=1,768 cf Inflow=7.19 cfs 27,774 cf Outflow=6.91 cfs 27,058 cf
<b>Link 7L: POC A</b>	Inflow=0.27 cfs 824 cf Primary=0.27 cfs 824 cf
<b>Link 8L: POC B</b>	Inflow=2.23 cfs 7,011 cf Primary=2.23 cfs 7,011 cf
<b>Link 9L: POC C</b>	Inflow=0.71 cfs 4,103 cf Primary=0.71 cfs 4,103 cf
<b>Link 10L: POC D</b>	Inflow=7.12 cfs 27,914 cf Primary=7.12 cfs 27,914 cf

**Total Runoff Area = 101,539 sf Runoff Volume = 40,569 cf Average Runoff Depth = 4.79"**  
**61.38% Pervious = 62,324 sf 38.62% Impervious = 39,215 sf**

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points  
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
 Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

<b>Subcatchment 1S: DA-1</b>	Runoff Area=2,278 sf 51.32% Impervious Runoff Depth>5.14" Tc=5.0 min CN=80.0 Runoff=0.32 cfs 977 cf
<b>Subcatchment 2S: DA-2</b>	Runoff Area=18,552 sf 41.33% Impervious Runoff Depth>5.35" Flow Length=226' Tc=6.1 min CN=81.8 Runoff=2.61 cfs 8,269 cf
<b>Subcatchment 3S: DA-3</b>	Runoff Area=12,314 sf 0.00% Impervious Runoff Depth>4.78" Flow Length=203' Tc=34.0 min CN=77.0 Runoff=0.85 cfs 4,902 cf
<b>Subcatchment 4S: DA-4A</b>	Runoff Area=2,647 sf 0.00% Impervious Runoff Depth>4.65" Flow Length=24' Slope=0.0330 '/' Tc=9.2 min CN=75.7 Runoff=0.30 cfs 1,027 cf
<b>Subcatchment 5S: DA-4B</b>	Runoff Area=65,748 sf 46.21% Impervious Runoff Depth>5.91" Flow Length=337' Tc=11.9 min CN=86.7 Runoff=8.32 cfs 32,370 cf
<b>Pond 6P: Low-Area</b>	Peak Elev=84.63' Storage=1,904 cf Inflow=8.32 cfs 32,370 cf Outflow=8.01 cfs 31,649 cf
<b>Link 7L: POC A</b>	Inflow=0.32 cfs 977 cf Primary=0.32 cfs 977 cf
<b>Link 8L: POC B</b>	Inflow=2.61 cfs 8,269 cf Primary=2.61 cfs 8,269 cf
<b>Link 9L: POC C</b>	Inflow=0.85 cfs 4,902 cf Primary=0.85 cfs 4,902 cf
<b>Link 10L: POC D</b>	Inflow=8.27 cfs 32,676 cf Primary=8.27 cfs 32,676 cf

**Total Runoff Area = 101,539 sf Runoff Volume = 47,544 cf Average Runoff Depth = 5.62"**  
**61.38% Pervious = 62,324 sf 38.62% Impervious = 39,215 sf**

**Summary for Subcatchment 1S: DA-1**

Runoff = 0.27 cfs @ 12.07 hrs, Volume= 824 cf, Depth> 4.34"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Type III 24-hr 25-Year Rainfall=6.62"

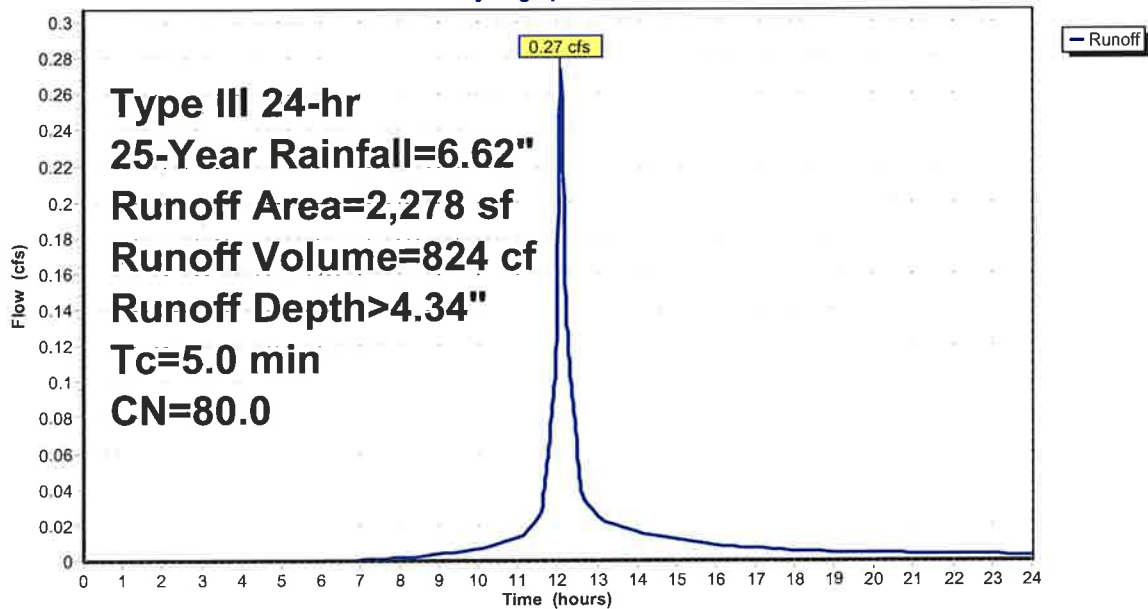
Area (sf)	CN	Description
1,169	98.0	Paved parking, HSG D
1,109	61.0	>75% Grass cover, Good, HSG B
2,278	80.0	Weighted Average
1,109		48.68% Pervious Area
1,169		51.32% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, 1

**Subcatchment 1S: DA-1**

**Hydrograph**





**Summary for Subcatchment 2S: DA-2**

Runoff = 2.23 cfs @ 12.09 hrs, Volume= 7,011 cf, Depth> 4.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Type III 24-hr 25-Year Rainfall=6.62"

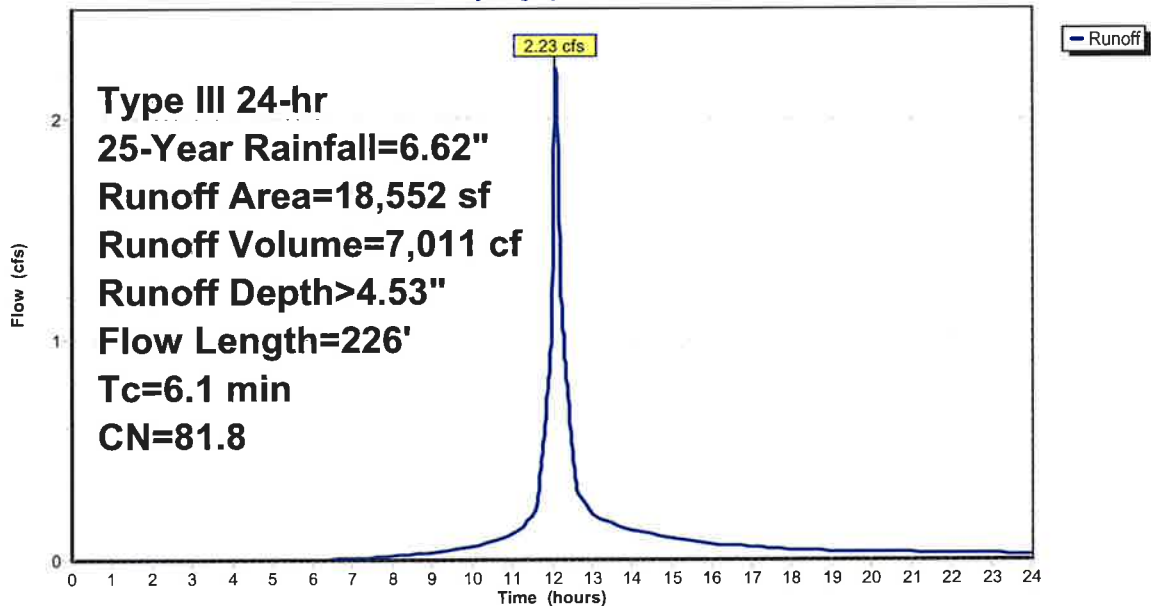
Area (sf)	CN	Description
7,667	98.0	Paved parking, HSG D
5,463	61.0	>75% Grass cover, Good, HSG B
5,422	80.0	>75% Grass cover, Good, HSG D
18,552	81.8	Weighted Average
10,885		58.67% Pervious Area
7,667		41.33% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.2	28	0.0170	0.09		<b>Sheet Flow, 1</b> Grass: Dense n= 0.240 P2= 3.60"
0.3	30	0.0430	1.56		<b>Sheet Flow, 2</b> Smooth surfaces n= 0.011 P2= 3.60"
0.2	60	0.0750	5.56		<b>Shallow Concentrated Flow, 3</b> Paved Kv= 20.3 fps
0.3	83	0.0390	4.01		<b>Shallow Concentrated Flow, 4</b> Paved Kv= 20.3 fps
0.1	25	0.0200	7.58	5.95	<b>Pipe Channel, 5</b> 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean
6.1	226	Total			

**Subcatchment 2S: DA-2**

**Hydrograph**



**Summary for Subcatchment 3S: DA-3**

Runoff = 0.71 cfs @ 12.47 hrs, Volume= 4,103 cf, Depth> 4.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Type III 24-hr 25-Year Rainfall=6.62"

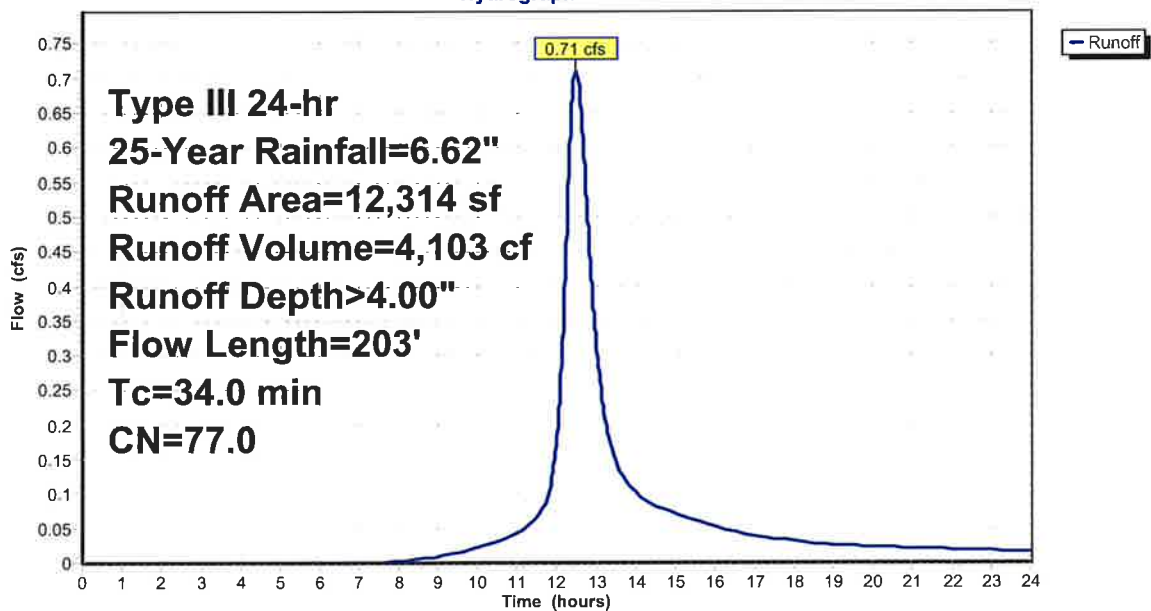
Area (sf)	CN	Description
12,314	77.0	Woods, Good, HSG D
12,314		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
31.3	100	0.0270	0.05		<b>Sheet Flow, 1</b> Woods: Dense underbrush n= 0.800 P2= 3.60"
2.7	103	0.0640	0.63		<b>Shallow Concentrated Flow, 2</b> Forest w/Heavy Litter Kv= 2.5 fps
34.0	203	Total			

**Subcatchment 3S: DA-3**

**Hydrograph**



**Summary for Subcatchment 4S: DA-4A**

Runoff = 0.25 cfs @ 12.13 hrs, Volume= 856 cf, Depth> 3.88"

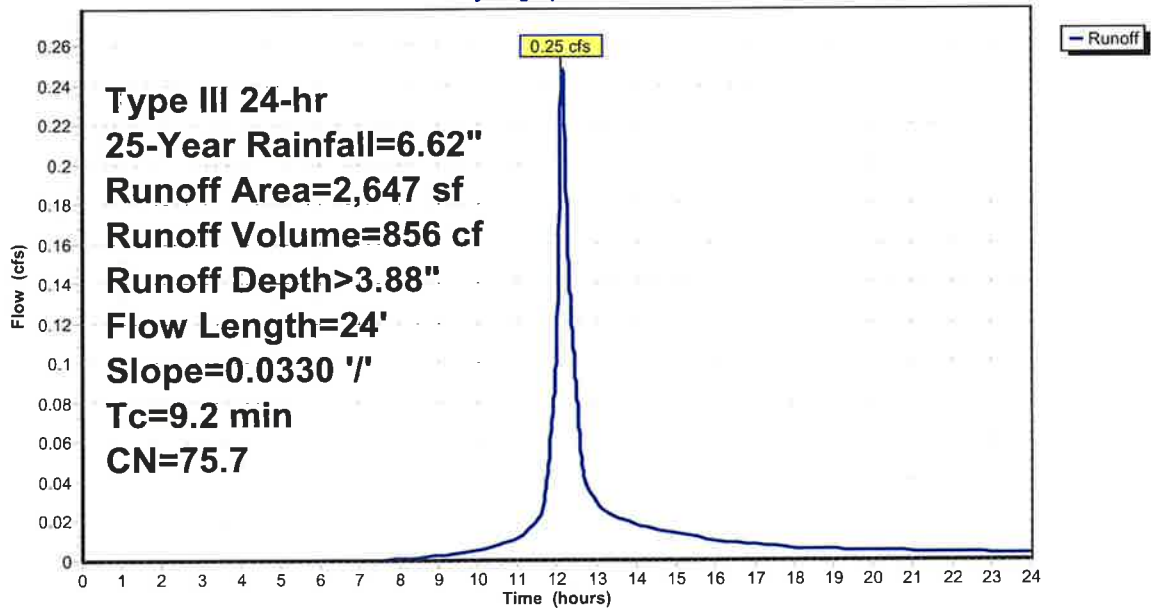
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Type III 24-hr 25-Year Rainfall=6.62"

Area (sf)	CN	Description
154	55.0	Woods, Good, HSG B
2,493	77.0	Woods, Good, HSG D
2,647	75.7	Weighted Average
2,647		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.2	24	0.0330	0.04		<b>Sheet Flow, 1</b> Woods: Dense underbrush n= 0.800 P2= 3.60"

**Subcatchment 4S: DA-4A**

**Hydrograph**



**Summary for Subcatchment 5S: DA-4B**

Runoff = 7.19 cfs @ 12.16 hrs, Volume= 27,774 cf, Depth> 5.07"

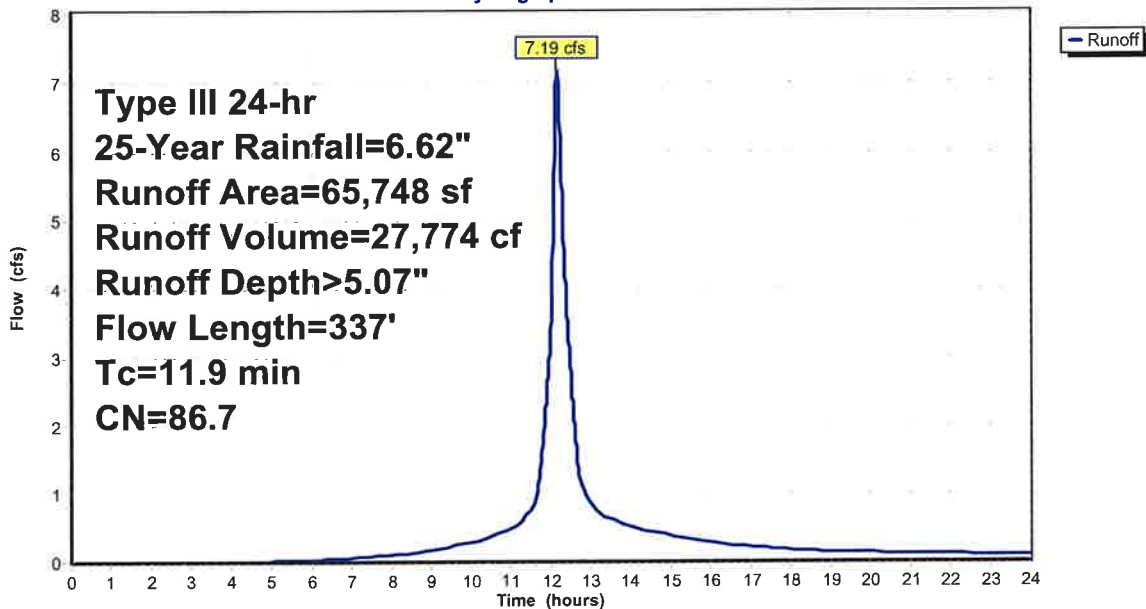
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
Type III 24-hr 25-Year Rainfall=6.62"

Area (sf)	CN	Description
30,379	98.0	Paved parking, HSG D
1,537	61.0	>75% Grass cover, Good, HSG B
20,776	80.0	>75% Grass cover, Good, HSG D
1,652	55.0	Woods, Good, HSG B
11,404	77.0	Woods, Good, HSG D
65,748	86.7	Weighted Average
35,369		53.79% Pervious Area
30,379		46.21% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.5	107	0.0540	0.19		<b>Sheet Flow, 1</b> Grass: Dense n= 0.240 P2= 3.60"
1.4	110	0.0150	1.33		<b>Sheet Flow, 2</b> Smooth surfaces n= 0.011 P2= 3.60"
1.0	120	0.0160	2.04		<b>Shallow Concentrated Flow, 3</b> Unpaved Kv= 16.1 fps
11.9	337	Total			

**Subcatchment 5S: DA-4B**

**Hydrograph**



**Summary for Pond 6P: Low-Area**

Inflow Area = 65,748 sf, 46.21% Impervious, Inflow Depth > 5.07" for 25-Year event  
 Inflow = 7.19 cfs @ 12.16 hrs, Volume= 27,774 cf  
 Outflow = 6.91 cfs @ 12.19 hrs, Volume= 27,058 cf, Atten= 4%, Lag= 2.2 min  
 Primary = 6.91 cfs @ 12.19 hrs, Volume= 27,058 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Peak Elev= 84.61' @ 12.19 hrs Surf.Area= 6,377 sf Storage= 1,768 cf

Plug-Flow detention time= 27.5 min calculated for 27,047 cf (97% of inflow)  
 Center-of-Mass det. time= 12.2 min ( 808.6 - 796.4 )

Volume	Invert	Avail.Storage	Storage Description
#1	83.90'	4,920 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)

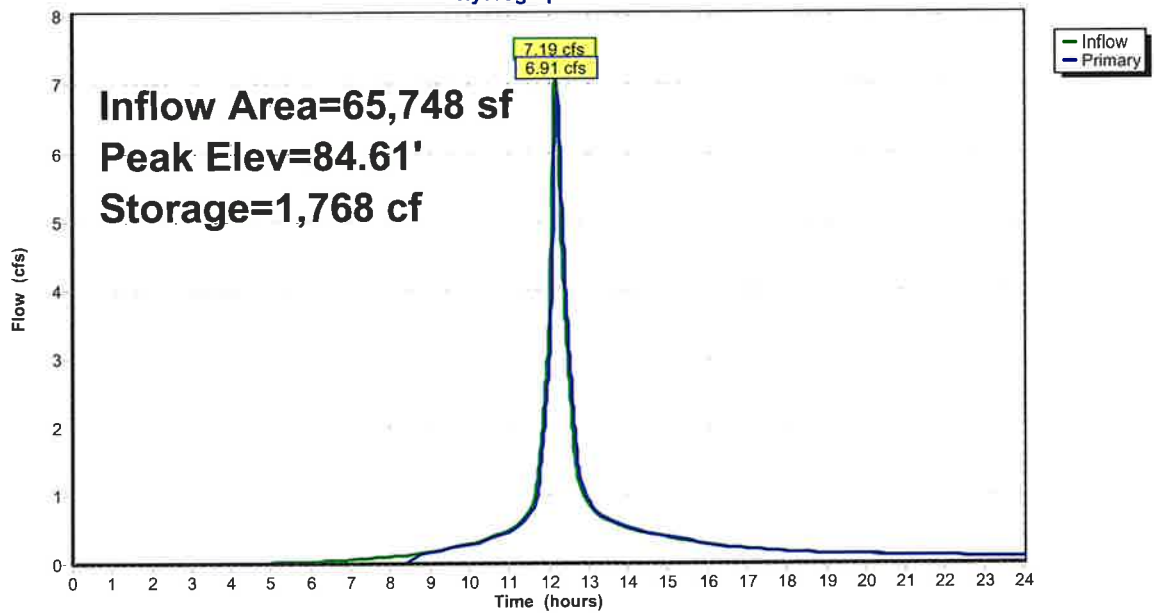
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
83.90	0	0	0
84.00	220	11	11
84.20	1,385	161	172
84.40	3,640	503	674
84.50	5,185	441	1,115
84.60	6,280	573	1,688
84.70	7,050	667	2,355
85.00	10,050	2,565	4,920

Device	Routing	Invert	Outlet Devices
#1	Primary	84.40'	<b>30.0' long x 5.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

**Primary OutFlow** Max=6.90 cfs @ 12.19 hrs HW=84.61' TW=0.00' (Dynamic Tailwater)  
 ↳=Broad-Crested Rectangular Weir (Weir Controls 6.90 cfs @ 1.08 fps)

**Pond 6P: Low-Area**

**Hydrograph**

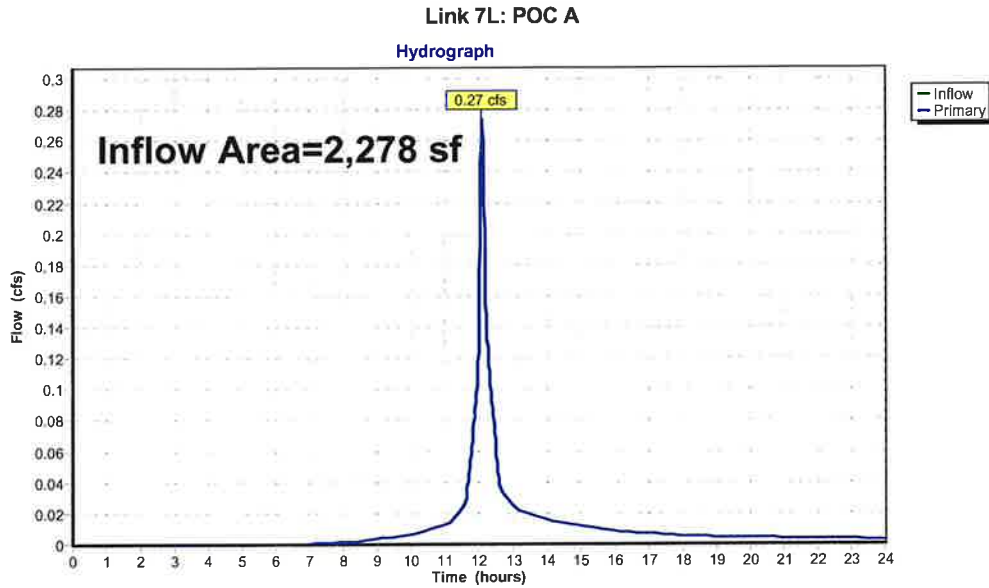




### Summary for Link 7L: POC A

Inflow Area = 2,278 sf, 51.32% Impervious, Inflow Depth > 4.34" for 25-Year event  
Inflow = 0.27 cfs @ 12.07 hrs, Volume= 824 cf  
Primary = 0.27 cfs @ 12.07 hrs, Volume= 824 cf, Atten= 0%, Lag= 0.0 min

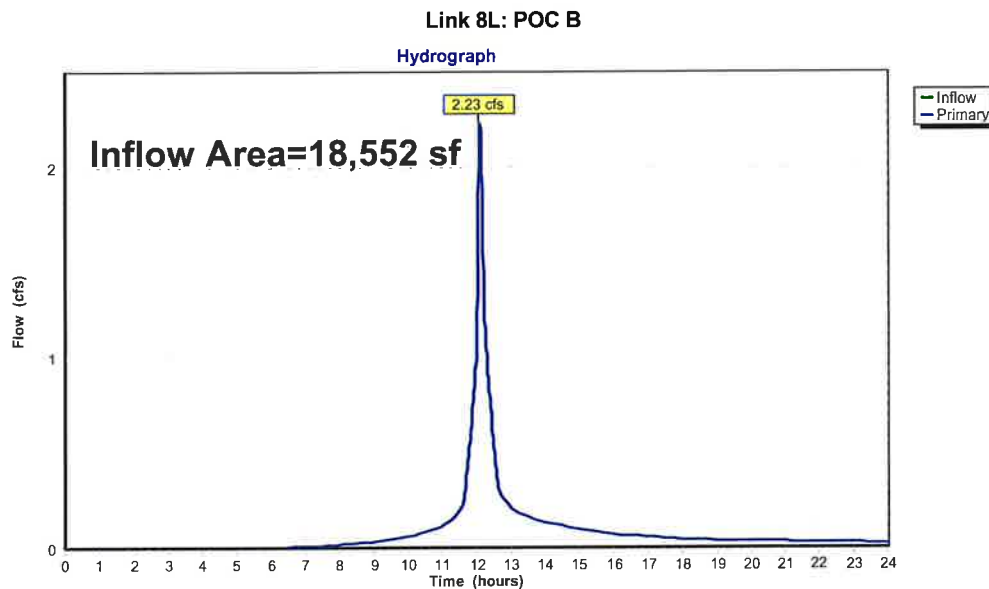
Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs



### Summary for Link 8L: POC B

Inflow Area = 18,552 sf, 41.33% Impervious, Inflow Depth > 4.53" for 25-Year event  
Inflow = 2.23 cfs @ 12.09 hrs, Volume= 7,011 cf  
Primary = 2.23 cfs @ 12.09 hrs, Volume= 7,011 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs



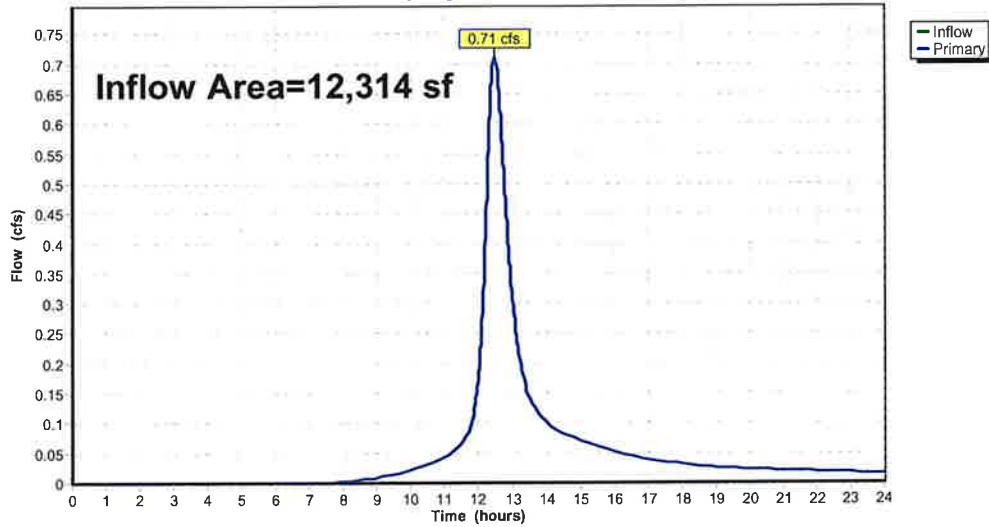
### Summary for Link 9L: POC C

Inflow Area = 12,314 sf, 0.00% Impervious, Inflow Depth > 4.00" for 25-Year event  
Inflow = 0.71 cfs @ 12.47 hrs, Volume= 4,103 cf  
Primary = 0.71 cfs @ 12.47 hrs, Volume= 4,103 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

#### Link 9L: POC C

Hydrograph



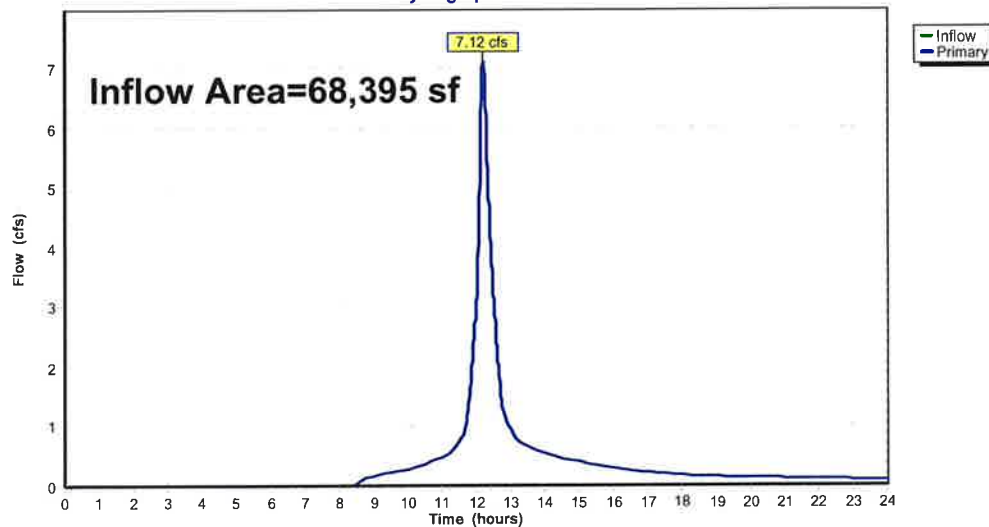
### Summary for Link 10L: POC D

Inflow Area = 68,395 sf, 44.42% Impervious, Inflow Depth > 4.90" for 25-Year event  
Inflow = 7.12 cfs @ 12.19 hrs, Volume= 27,914 cf  
Primary = 7.12 cfs @ 12.19 hrs, Volume= 27,914 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

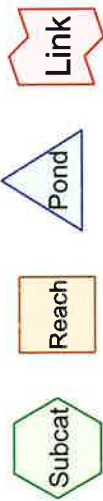
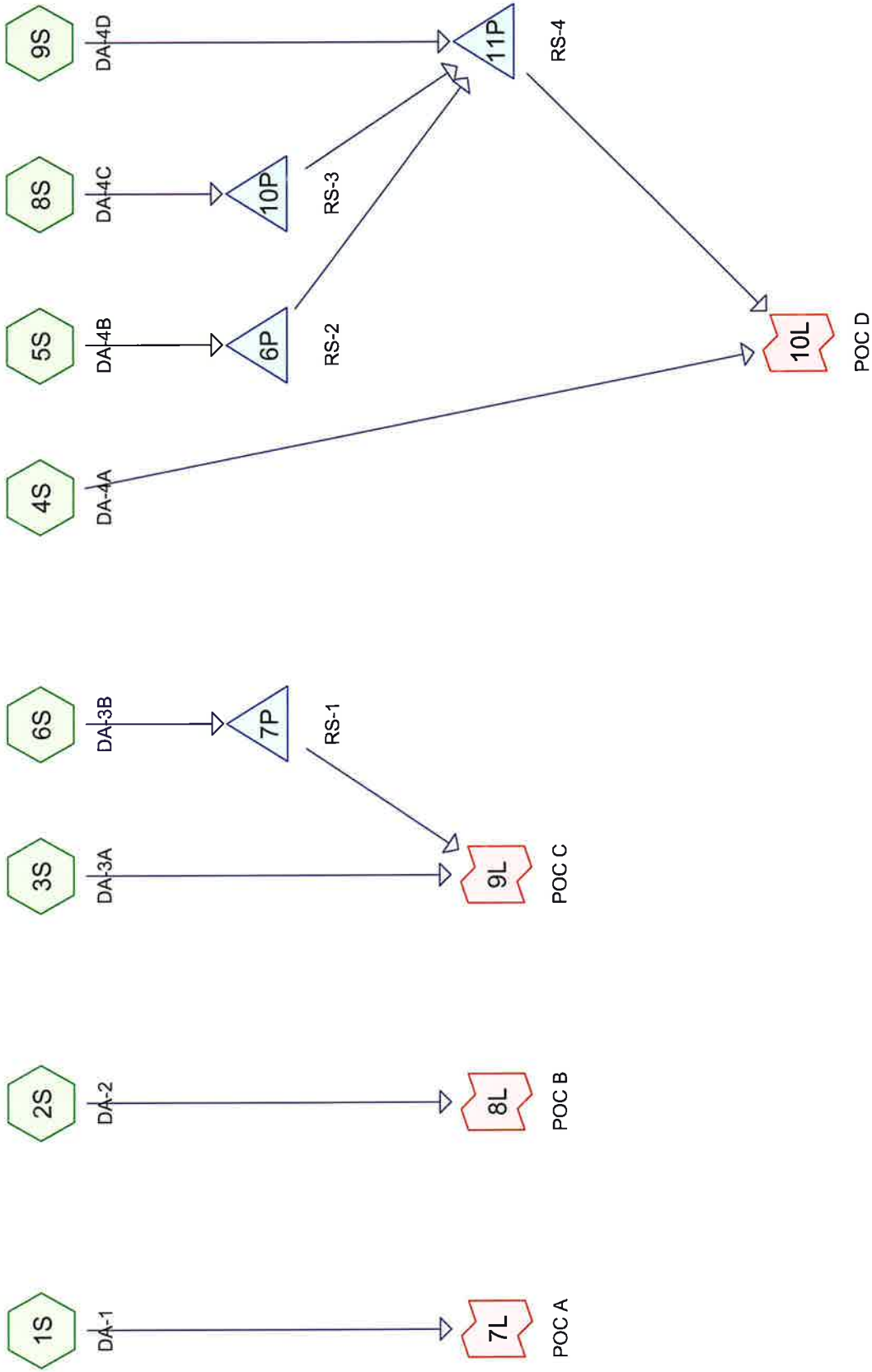
#### Link 10L: POC D

Hydrograph



## **Appendix “D”**

### **HydroCAD Analysis - Proposed Conditions**



**Routing Diagram for 20XE\_Pr-1**  
 Prepared by RVDI, Printed 12/14/2023  
 HydroCAD® 10.00-26 s/n 07356 © 2020 HydroCAD Software Solutions LLC

**Area Listing (all nodes)**

Area (sq-ft)	CN	Description (subcatchment-numbers)
11,572	61.0	>75% Grass cover, Good, HSG B (1S, 2S, 4S, 9S)
28,875	80.0	>75% Grass cover, Good, HSG D (2S, 3S, 4S, 5S, 6S, 8S, 9S)
56,162	98.0	Paved parking, HSG D (1S, 2S, 3S, 4S, 5S, 6S, 8S, 9S)
56	55.0	Woods, Good, HSG B (4S)
4,874	77.0	Woods, Good, HSG D (3S, 4S, 8S)
<b>101,539</b>	<b>87.6</b>	<b>TOTAL AREA</b>



Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points  
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: DA-1	Runoff Area=2,450 sf 29.43% Impervious Runoff Depth>0.78" Tc=5.0 min CN=71.9 Runoff=0.05 cfs 160 cf
Subcatchment 2S: DA-2	Runoff Area=12,455 sf 24.85% Impervious Runoff Depth>0.91" Flow Length=299' Tc=7.1 min CN=74.4 Runoff=0.27 cfs 943 cf
Subcatchment 3S: DA-3A	Runoff Area=8,002 sf 0.90% Impervious Runoff Depth>1.16" Flow Length=213' Tc=20.4 min CN=79.0 Runoff=0.16 cfs 774 cf
Subcatchment 4S: DA-4A	Runoff Area=4,525 sf 1.19% Impervious Runoff Depth>1.15" Flow Length=81' Tc=14.1 min CN=78.8 Runoff=0.11 cfs 434 cf
Subcatchment 5S: DA-4B	Runoff Area=17,591 sf 79.36% Impervious Runoff Depth>2.35" Tc=5.0 min CN=94.3 Runoff=1.11 cfs 3,443 cf
Subcatchment 6S: DA-3B	Runoff Area=13,527 sf 68.81% Impervious Runoff Depth>2.17" Flow Length=104' Tc=5.3 min CN=92.4 Runoff=0.79 cfs 2,443 cf
Subcatchment 8S: DA-4C	Runoff Area=18,286 sf 62.25% Impervious Runoff Depth>2.05" Flow Length=118' Tc=9.5 min CN=91.1 Runoff=0.89 cfs 3,122 cf
Subcatchment 9S: DA-4D	Runoff Area=24,703 sf 71.12% Impervious Runoff Depth>1.99" Flow Length=294' Slope=0.0200 '/' Tc=7.0 min CN=90.4 Runoff=1.27 cfs 4,093 cf
Pond 6P: RS-2	Peak Elev=86.68' Storage=3,443 cf Inflow=1.11 cfs 3,443 cf 12.0" Round Culvert n=0.013 L=5.0' S=0.0200 '/' Outflow=0.00 cfs 0 cf
Pond 7P: RS-1	Peak Elev=80.01' Storage=2,443 cf Inflow=0.79 cfs 2,443 cf 12.0" Round Culvert n=0.013 L=9.0' S=0.0222 '/' Outflow=0.00 cfs 0 cf
Pond 10P: RS-3	Peak Elev=83.28' Storage=3,122 cf Inflow=0.89 cfs 3,122 cf 12.0" Round Culvert n=0.013 L=17.0' S=0.0294 '/' Outflow=0.00 cfs 0 cf

Pond 11P: RS-4	Peak Elev=80.65' Storage=4,093 cf Inflow=1.27 cfs 4,093 cf 15.0" Round Culvert n=0.013 L=13.0' S=0.0308 '/' Outflow=0.00 cfs 0 cf
Link 7L: POC A	Inflow=0.05 cfs 160 cf Primary=0.05 cfs 160 cf
Link 8L: POC B	Inflow=0.27 cfs 943 cf Primary=0.27 cfs 943 cf
Link 9L: POC C	Inflow=0.16 cfs 774 cf Primary=0.16 cfs 774 cf
Link 10L: POC D	Inflow=0.11 cfs 434 cf Primary=0.11 cfs 434 cf

Total Runoff Area = 101,539 sf Runoff Volume = 15,412 cf Average Runoff Depth = 1.82"  
44.69% Pervious = 45,377 sf 55.31% Impervious = 56,162 sf

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points  
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

<b>Subcatchment 1S: DA-1</b>	Runoff Area=2,450 sf 29.43% Impervious Runoff Depth>1.18" Tc=5.0 min CN=71.9 Runoff=0.08 cfs 241 cf
<b>Subcatchment 2S: DA-2</b>	Runoff Area=12,455 sf 24.85% Impervious Runoff Depth>1.33" Flow Length=299' Tc=7.1 min CN=74.4 Runoff=0.42 cfs 1,383 cf
<b>Subcatchment 3S: DA-3A</b>	Runoff Area=8,002 sf 0.90% Impervious Runoff Depth>1.64" Flow Length=213' Tc=20.4 min CN=79.0 Runoff=0.23 cfs 1,091 cf
<b>Subcatchment 4S: DA-4A</b>	Runoff Area=4,525 sf 1.19% Impervious Runoff Depth>1.62" Flow Length=81' Tc=14.1 min CN=78.8 Runoff=0.15 cfs 613 cf
<b>Subcatchment 5S: DA-4B</b>	Runoff Area=17,591 sf 79.36% Impervious Runoff Depth>2.96" Tc=5.0 min CN=94.3 Runoff=1.38 cfs 4,342 cf
<b>Subcatchment 6S: DA-3B</b>	Runoff Area=13,527 sf 68.81% Impervious Runoff Depth>2.77" Flow Length=104' Tc=5.3 min CN=92.4 Runoff=1.00 cfs 3,122 cf
<b>Subcatchment 8S: DA-4C</b>	Runoff Area=18,286 sf 62.25% Impervious Runoff Depth>2.64" Flow Length=118' Tc=9.5 min CN=91.1 Runoff=1.13 cfs 4,025 cf
<b>Subcatchment 9S: DA-4D</b>	Runoff Area=24,703 sf 71.12% Impervious Runoff Depth>2.58" Flow Length=294' Slope=0.0200 '/' Tc=7.0 min CN=90.4 Runoff=1.63 cfs 5,303 cf
<b>Pond 6P: RS-2</b>	Peak Elev=87.08' Storage=3,830 cf Inflow=1.38 cfs 4,342 cf 12.0" Round Culvert n=0.013 L=5.0' S=0.0200 '/' Outflow=0.03 cfs 533 cf
<b>Pond 7P: RS-1</b>	Peak Elev=80.53' Storage=3,122 cf Inflow=1.00 cfs 3,122 cf 12.0" Round Culvert n=0.013 L=9.0' S=0.0222 '/' Outflow=0.00 cfs 0 cf
<b>Pond 10P: RS-3</b>	Peak Elev=84.06' Storage=3,908 cf Inflow=1.13 cfs 4,025 cf 12.0" Round Culvert n=0.013 L=17.0' S=0.0294 '/' Outflow=0.01 cfs 118 cf

<b>Pond 11P: RS-4</b>	Peak Elev=81.60' Storage=5,401 cf Inflow=1.63 cfs 5,955 cf 15.0" Round Culvert n=0.013 L=13.0' S=0.0308 '/' Outflow=0.05 cfs 557 cf
<b>Link 7L: POC A</b>	Inflow=0.08 cfs 241 cf Primary=0.08 cfs 241 cf
<b>Link 8L: POC B</b>	Inflow=0.42 cfs 1,383 cf Primary=0.42 cfs 1,383 cf
<b>Link 9L: POC C</b>	Inflow=0.23 cfs 1,091 cf Primary=0.23 cfs 1,091 cf
<b>Link 10L: POC D</b>	Inflow=0.15 cfs 1,169 cf Primary=0.15 cfs 1,169 cf

**Total Runoff Area = 101,539 sf Runoff Volume = 20,120 cf Average Runoff Depth = 2.38"**  
**44.69% Pervious = 45,377 sf 55.31% Impervious = 56,162 sf**

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points  
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
 Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

<b>Subcatchment 1S: DA-1</b>	Runoff Area=2,450 sf 29.43% Impervious Runoff Depth>1.89" Tc=5.0 min CN=71.9 Runoff=0.13 cfs 386 cf
<b>Subcatchment 2S: DA-2</b>	Runoff Area=12,455 sf 24.85% Impervious Runoff Depth>2.09" Flow Length=299' Tc=7.1 min CN=74.4 Runoff=0.67 cfs 2,165 cf
<b>Subcatchment 3S: DA-3A</b>	Runoff Area=8,002 sf 0.90% Impervious Runoff Depth>2.46" Flow Length=213' Tc=20.4 min CN=79.0 Runoff=0.35 cfs 1,639 cf
<b>Subcatchment 4S: DA-4A</b>	Runoff Area=4,525 sf 1.19% Impervious Runoff Depth>2.44" Flow Length=81' Tc=14.1 min CN=78.8 Runoff=0.23 cfs 922 cf
<b>Subcatchment 5S: DA-4B</b>	Runoff Area=17,591 sf 79.36% Impervious Runoff Depth>3.95" Tc=5.0 min CN=94.3 Runoff=1.81 cfs 5,796 cf
<b>Subcatchment 6S: DA-3B</b>	Runoff Area=13,527 sf 68.81% Impervious Runoff Depth>3.75" Flow Length=104' Tc=5.3 min CN=92.4 Runoff=1.33 cfs 4,225 cf
<b>Subcatchment 8S: DA-4C</b>	Runoff Area=18,286 sf 62.25% Impervious Runoff Depth>3.61" Flow Length=118' Tc=9.5 min CN=91.1 Runoff=1.52 cfs 5,500 cf
<b>Subcatchment 9S: DA-4D</b>	Runoff Area=24,703 sf 71.12% Impervious Runoff Depth>3.54" Flow Length=294' Slope=0.0200 '/' Tc=7.0 min CN=90.4 Runoff=2.20 cfs 7,284 cf
<b>Pond 6P: RS-2</b>	Peak Elev=87.20' Storage=3,925 cf Inflow=1.81 cfs 5,796 cf 12.0" Round Culvert n=0.013 L=5.0' S=0.0200 '/' Outflow=0.15 cfs 1,981 cf
<b>Pond 7P: RS-1</b>	Peak Elev=81.39' Storage=4,225 cf Inflow=1.33 cfs 4,225 cf 12.0" Round Culvert n=0.013 L=9.0' S=0.0222 '/' Outflow=0.00 cfs 0 cf
<b>Pond 10P: RS-3</b>	Peak Elev=84.16' Storage=3,947 cf Inflow=1.52 cfs 5,500 cf 12.0" Round Culvert n=0.013 L=17.0' S=0.0294 '/' Outflow=0.12 cfs 1,585 cf

<b>Pond 11P: RS-4</b>	Peak Elev=81.79' Storage=5,474 cf Inflow=2.20 cfs 10,850 cf 15.0" Round Culvert n=0.013 L=13.0' S=0.0308 '/' Outflow=0.39 cfs 5,447 cf
<b>Link 7L: POC A</b>	Inflow=0.13 cfs 386 cf Primary=0.13 cfs 386 cf
<b>Link 8L: POC B</b>	Inflow=0.67 cfs 2,165 cf Primary=0.67 cfs 2,165 cf
<b>Link 9L: POC C</b>	Inflow=0.35 cfs 1,639 cf Primary=0.35 cfs 1,639 cf
<b>Link 10L: POC D</b>	Inflow=0.41 cfs 6,369 cf Primary=0.41 cfs 6,369 cf

**Total Runoff Area = 101,539 sf Runoff Volume = 27,917 cf Average Runoff Depth = 3.30"**  
**44.69% Pervious = 45,377 sf 55.31% Impervious = 56,162 sf**

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points  
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
 Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

<b>Subcatchment 1S: DA-1</b>	Runoff Area=2,450 sf 29.43% Impervious Runoff Depth>2.55" Tc=5.0 min CN=71.9 Runoff=0.17 cfs 520 cf
<b>Subcatchment 2S: DA-2</b>	Runoff Area=12,455 sf 24.85% Impervious Runoff Depth>2.77" Flow Length=299' Tc=7.1 min CN=74.4 Runoff=0.89 cfs 2,874 cf
<b>Subcatchment 3S: DA-3A</b>	Runoff Area=8,002 sf 0.90% Impervious Runoff Depth>3.19" Flow Length=213' Tc=20.4 min CN=79.0 Runoff=0.46 cfs 2,126 cf
<b>Subcatchment 4S: DA-4A</b>	Runoff Area=4,525 sf 1.19% Impervious Runoff Depth>3.17" Flow Length=81' Tc=14.1 min CN=78.8 Runoff=0.30 cfs 1,197 cf
<b>Subcatchment 5S: DA-4B</b>	Runoff Area=17,591 sf 79.36% Impervious Runoff Depth>4.79" Tc=5.0 min CN=94.3 Runoff=2.17 cfs 7,026 cf
<b>Subcatchment 6S: DA-3B</b>	Runoff Area=13,527 sf 68.81% Impervious Runoff Depth>4.58" Flow Length=104' Tc=5.3 min CN=92.4 Runoff=1.61 cfs 5,163 cf
<b>Subcatchment 8S: DA-4C</b>	Runoff Area=18,286 sf 62.25% Impervious Runoff Depth>4.43" Flow Length=118' Tc=9.5 min CN=91.1 Runoff=1.85 cfs 6,757 cf
<b>Subcatchment 9S: DA-4D</b>	Runoff Area=24,703 sf 71.12% Impervious Runoff Depth>4.36" Flow Length=294' Slope=0.0200 '/' Tc=7.0 min CN=90.4 Runoff=2.68 cfs 8,975 cf
<b>Pond 6P: RS-2</b>	Peak Elev=87.43' Storage=4,114 cf Inflow=2.17 cfs 7,026 cf 12.0" Round Culvert n=0.013 L=5.0' S=0.0200 '/' Outflow=0.60 cfs 3,207 cf
<b>Pond 7P: RS-1</b>	Peak Elev=81.96' Storage=4,964 cf Inflow=1.61 cfs 5,163 cf 12.0" Round Culvert n=0.013 L=9.0' S=0.0222 '/' Outflow=0.02 cfs 204 cf
<b>Pond 10P: RS-3</b>	Peak Elev=84.39' Storage=3,987 cf Inflow=1.85 cfs 6,757 cf 12.0" Round Culvert n=0.013 L=17.0' S=0.0294 '/' Outflow=0.61 cfs 2,836 cf

<b>Pond 11P: RS-4</b>	Peak Elev=82.17' Storage=5,590 cf Inflow=2.68 cfs 15,018 cf 15.0" Round Culvert n=0.013 L=13.0' S=0.0308 '/' Outflow=1.87 cfs 9,611 cf
<b>Link 7L: POC A</b>	Inflow=0.17 cfs 520 cf Primary=0.17 cfs 520 cf
<b>Link 8L: POC B</b>	Inflow=0.89 cfs 2,874 cf Primary=0.89 cfs 2,874 cf
<b>Link 9L: POC C</b>	Inflow=0.46 cfs 2,330 cf Primary=0.46 cfs 2,330 cf
<b>Link 10L: POC D</b>	Inflow=2.03 cfs 10,807 cf Primary=2.03 cfs 10,807 cf

**Total Runoff Area = 101,539 sf Runoff Volume = 34,637 cf Average Runoff Depth = 4.09"**  
**44.69% Pervious = 45,377 sf 55.31% Impervious = 56,162 sf**

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points  
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

<b>Subcatchment 1S: DA-1</b>	Runoff Area=2,450 sf 29.43% Impervious Runoff Depth>3.49" Tc=5.0 min CN=71.9 Runoff=0.24 cfs 713 cf
<b>Subcatchment 2S: DA-2</b>	Runoff Area=12,455 sf 24.85% Impervious Runoff Depth>3.75" Flow Length=299' Tc=7.1 min CN=74.4 Runoff=1.21 cfs 3,891 cf
<b>Subcatchment 3S: DA-3A</b>	Runoff Area=8,002 sf 0.90% Impervious Runoff Depth>4.22" Flow Length=213' Tc=20.4 min CN=79.0 Runoff=0.61 cfs 2,815 cf
<b>Subcatchment 4S: DA-4A</b>	Runoff Area=4,525 sf 1.19% Impervious Runoff Depth>4.21" Flow Length=81' Tc=14.1 min CN=78.8 Runoff=0.40 cfs 1,586 cf
<b>Subcatchment 5S: DA-4B</b>	Runoff Area=17,591 sf 79.36% Impervious Runoff Depth>5.94" Tc=5.0 min CN=94.3 Runoff=2.66 cfs 8,711 cf
<b>Subcatchment 6S: DA-3B</b>	Runoff Area=13,527 sf 68.81% Impervious Runoff Depth>5.72" Flow Length=104' Tc=5.3 min CN=92.4 Runoff=1.98 cfs 6,450 cf
<b>Subcatchment 8S: DA-4C</b>	Runoff Area=18,286 sf 62.25% Impervious Runoff Depth>5.57" Flow Length=118' Tc=9.5 min CN=91.1 Runoff=2.30 cfs 8,486 cf
<b>Subcatchment 9S: DA-4D</b>	Runoff Area=24,703 sf 71.12% Impervious Runoff Depth>5.49" Flow Length=294' Slope=0.0200 '/' Tc=7.0 min CN=90.4 Runoff=3.33 cfs 11,303 cf
<b>Pond 6P: RS-2</b>	Peak Elev=87.85' Storage=4,252 cf Inflow=2.66 cfs 8,711 cf 12.0" Round Culvert n=0.013 L=5.0' S=0.0200 '/' Outflow=1.84 cfs 4,886 cf
<b>Pond 7P: RS-1</b>	Peak Elev=82.05' Storage=5,000 cf Inflow=1.98 cfs 6,450 cf 12.0" Round Culvert n=0.013 L=9.0' S=0.0222 '/' Outflow=0.10 cfs 1,483 cf
<b>Pond 10P: RS-3</b>	Peak Elev=84.71' Storage=4,036 cf Inflow=2.30 cfs 8,486 cf 12.0" Round Culvert n=0.013 L=17.0' S=0.0294 '/' Outflow=1.70 cfs 4,558 cf

<b>Pond 11P: RS-4</b>	Peak Elev=82.79' Storage=5,707 cf Inflow=4.98 cfs 20,748 cf 15.0" Round Culvert n=0.013 L=13.0' S=0.0308 '/' Outflow=4.80 cfs 15,336 cf
<b>Link 7L: POC A</b>	Inflow=0.24 cfs 713 cf Primary=0.24 cfs 713 cf
<b>Link 8L: POC B</b>	Inflow=1.21 cfs 3,891 cf Primary=1.21 cfs 3,891 cf
<b>Link 9L: POC C</b>	Inflow=0.61 cfs 4,298 cf Primary=0.61 cfs 4,298 cf
<b>Link 10L: POC D</b>	Inflow=5.18 cfs 16,922 cf Primary=5.18 cfs 16,922 cf

**Total Runoff Area = 101,539 sf Runoff Volume = 43,955 cf Average Runoff Depth = 5.19"**  
**44.69% Pervious = 45,377 sf 55.31% Impervious = 56,162 sf**



Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points  
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: DA-1	Runoff Area=2,450 sf 29.43% Impervious Runoff Depth>4.23" Tc=5.0 min CN=71.9 Runoff=0.29 cfs 865 cf
Subcatchment 2S: DA-2	Runoff Area=12,455 sf 24.85% Impervious Runoff Depth>4.51" Flow Length=299' Tc=7.1 min CN=74.4 Runoff=1.45 cfs 4,682 cf
Subcatchment 3S: DA-3A	Runoff Area=8,002 sf 0.90% Impervious Runoff Depth>5.02" Flow Length=213' Tc=20.4 min CN=79.0 Runoff=0.72 cfs 3,345 cf
Subcatchment 4S: DA-4A	Runoff Area=4,525 sf 1.19% Impervious Runoff Depth>5.00" Flow Length=81' Tc=14.1 min CN=78.8 Runoff=0.47 cfs 1,885 cf
Subcatchment 5S: DA-4B	Runoff Area=17,591 sf 79.36% Impervious Runoff Depth>6.81" Tc=5.0 min CN=94.3 Runoff=3.02 cfs 9,977 cf
Subcatchment 6S: DA-3B	Runoff Area=13,527 sf 68.81% Impervious Runoff Depth>6.58" Flow Length=104' Tc=5.3 min CN=92.4 Runoff=2.26 cfs 7,419 cf
Subcatchment 8S: DA-4C	Runoff Area=18,286 sf 62.25% Impervious Runoff Depth>6.42" Flow Length=118' Tc=9.5 min CN=91.1 Runoff=2.63 cfs 9,789 cf
Subcatchment 9S: DA-4D	Runoff Area=24,703 sf 71.12% Impervious Runoff Depth>6.34" Flow Length=294' Slope=0.0200 '/' Tc=7.0 min CN=90.4 Runoff=3.82 cfs 13,060 cf
Pond 6P: RS-2	Peak Elev=88.15' Storage=4,314 cf Inflow=3.02 cfs 9,977 cf 12.0" Round Culvert n=0.013 L=5.0' S=0.0200 '/' Outflow=2.82 cfs 6,148 cf
Pond 7P: RS-1	Peak Elev=82.14' Storage=5,017 cf Inflow=2.26 cfs 7,419 cf 12.0" Round Culvert n=0.013 L=9.0' S=0.0222 '/' Outflow=0.24 cfs 2,446 cf
Pond 10P: RS-3	Peak Elev=84.94' Storage=4,069 cf Inflow=2.63 cfs 9,789 cf 12.0" Round Culvert n=0.013 L=17.0' S=0.0294 '/' Outflow=2.52 cfs 5,858 cf

Pond 11P: RS-4	Peak Elev=83.85' Storage=5,909 cf Inflow=8.27 cfs 25,066 cf 15.0" Round Culvert n=0.013 L=13.0' S=0.0308 '/' Outflow=7.76 cfs 19,651 cf
Link 7L: POC A	Inflow=0.29 cfs 865 cf Primary=0.29 cfs 865 cf
Link 8L: POC B	Inflow=1.45 cfs 4,682 cf Primary=1.45 cfs 4,682 cf
Link 9L: POC C	Inflow=0.72 cfs 5,791 cf Primary=0.72 cfs 5,791 cf
Link 10L: POC D	Inflow=8.21 cfs 21,536 cf Primary=8.21 cfs 21,536 cf

**Total Runoff Area = 101,539 sf Runoff Volume = 51,022 cf Average Runoff Depth = 6.03"**  
**44.69% Pervious = 45,377 sf 55.31% Impervious = 56,162 sf**

**Summary for Subcatchment 1S: DA-1**

Runoff = 0.24 cfs @ 12.08 hrs, Volume= 713 cf, Depth> 3.49"

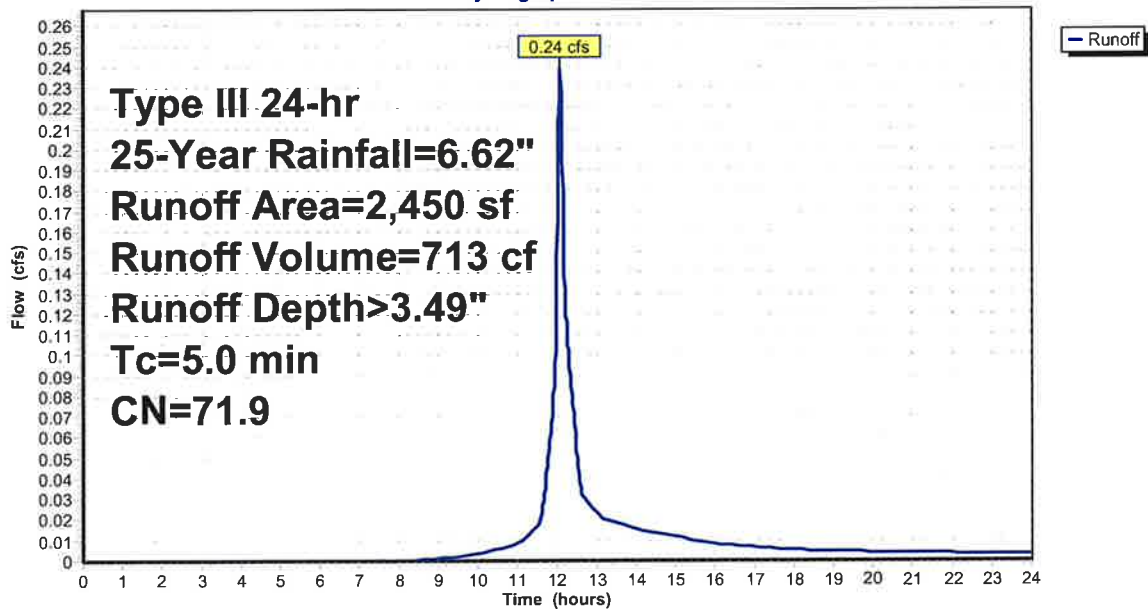
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Type III 24-hr 25-Year Rainfall=6.62"

Area (sf)	CN	Description
721	98.0	Paved parking, HSG D
1,729	61.0	>75% Grass cover, Good, HSG B
2,450	71.9	Weighted Average
1,729		70.57% Pervious Area
721		29.43% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, 1

**Subcatchment 1S: DA-1**

**Hydrograph**



**Summary for Subcatchment 2S: DA-2**

Runoff = 1.21 cfs @ 12.10 hrs, Volume= 3,891 cf, Depth> 3.75"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Type III 24-hr 25-Year Rainfall=6.62"

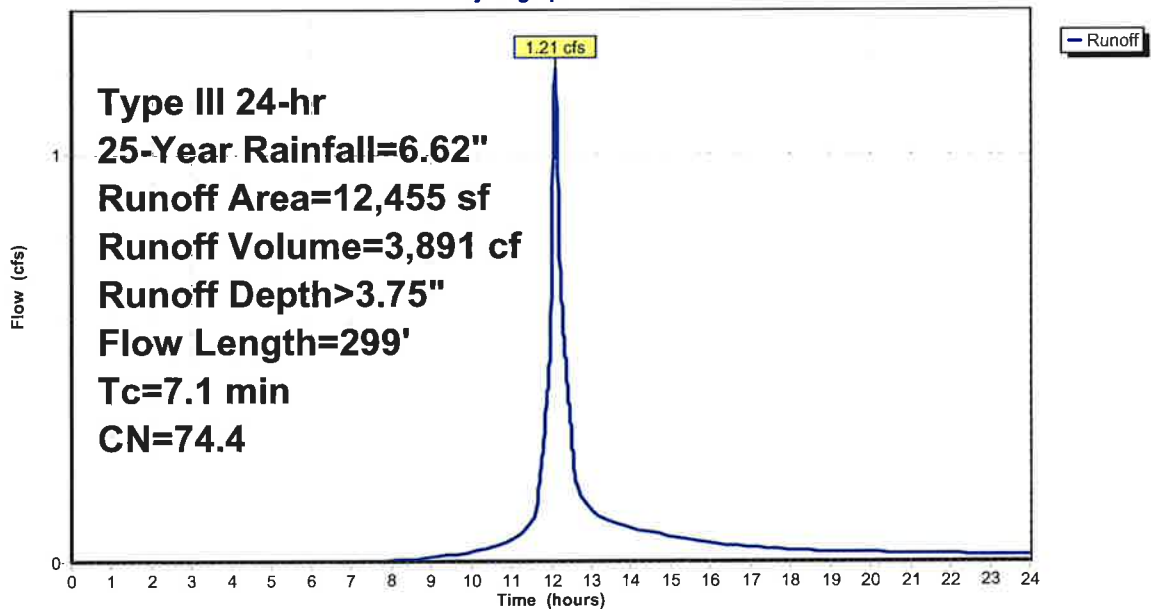
Area (sf)	CN	Description
3,095	98.0	Paved parking, HSG D
6,629	61.0	>75% Grass cover, Good, HSG B
2,731	80.0	>75% Grass cover, Good, HSG D
12,455	74.4	Weighted Average
9,360		75.15% Pervious Area
3,095		24.85% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	46	0.0350	0.13		<b>Sheet Flow, 1</b> Grass: Dense n= 0.240 P2= 3.60"
0.1	20	0.0350	3.80		<b>Shallow Concentrated Flow, 2</b> Paved Kv= 20.3 fps
1.1	208	0.0240	3.14		<b>Shallow Concentrated Flow, 3</b> Paved Kv= 20.3 fps
0.1	25	0.0200	7.58	5.95	<b>Pipe Channel, 4</b> 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean
7.1	299	Total			

**Subcatchment 2S: DA-2**

**Hydrograph**



**Summary for Subcatchment 3S: DA-3A**

Runoff = 0.61 cfs @ 12.27 hrs, Volume= 2,815 cf, Depth> 4.22"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Type III 24-hr 25-Year Rainfall=6.62"

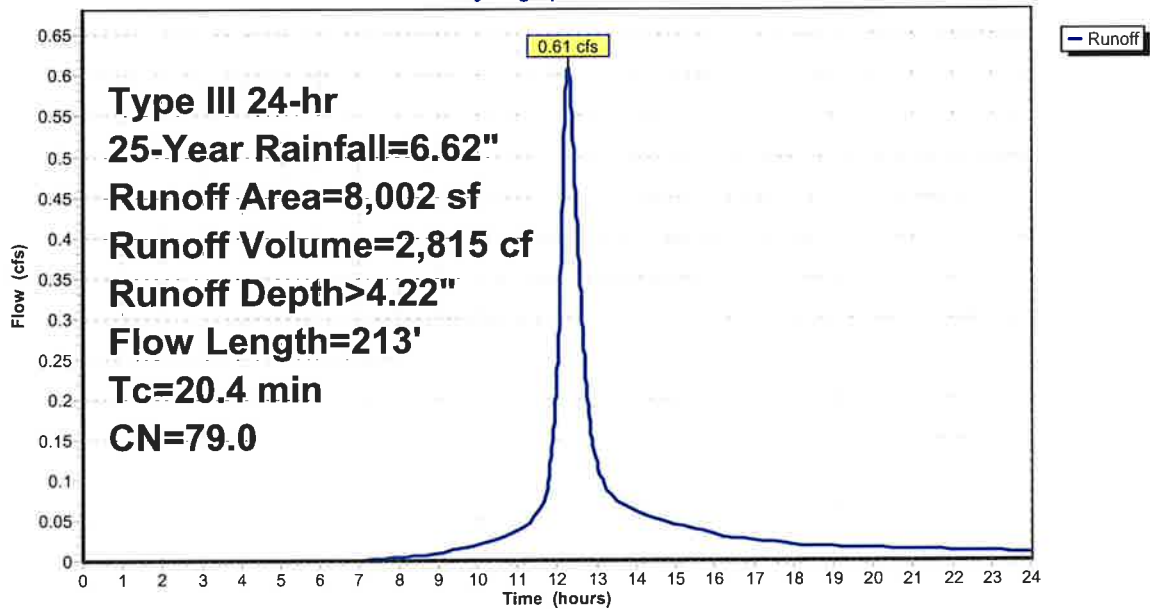
Area (sf)	CN	Description
72	98.0	Paved parking, HSG D
4,723	80.0	>75% Grass cover, Good, HSG D
3,207	77.0	Woods, Good, HSG D
8,002	79.0	Weighted Average
7,930		99.10% Pervious Area
72		0.90% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.9	12	0.0250	0.03		<b>Sheet Flow, 1</b> Woods: Dense underbrush n= 0.800 P2= 3.60"
11.3	88	0.0240	0.13		<b>Sheet Flow, 2</b> Grass: Dense n= 0.240 P2= 3.60"
3.2	113	0.0540	0.58		<b>Shallow Concentrated Flow, 3</b> Forest w/Heavy Litter Kv= 2.5 fps
20.4	213	Total			

**Subcatchment 3S: DA-3A**

**Hydrograph**



**Summary for Subcatchment 4S: DA-4A**

Runoff = 0.40 cfs @ 12.19 hrs, Volume= 1,586 cf, Depth> 4.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Type III 24-hr 25-Year Rainfall=6.62"

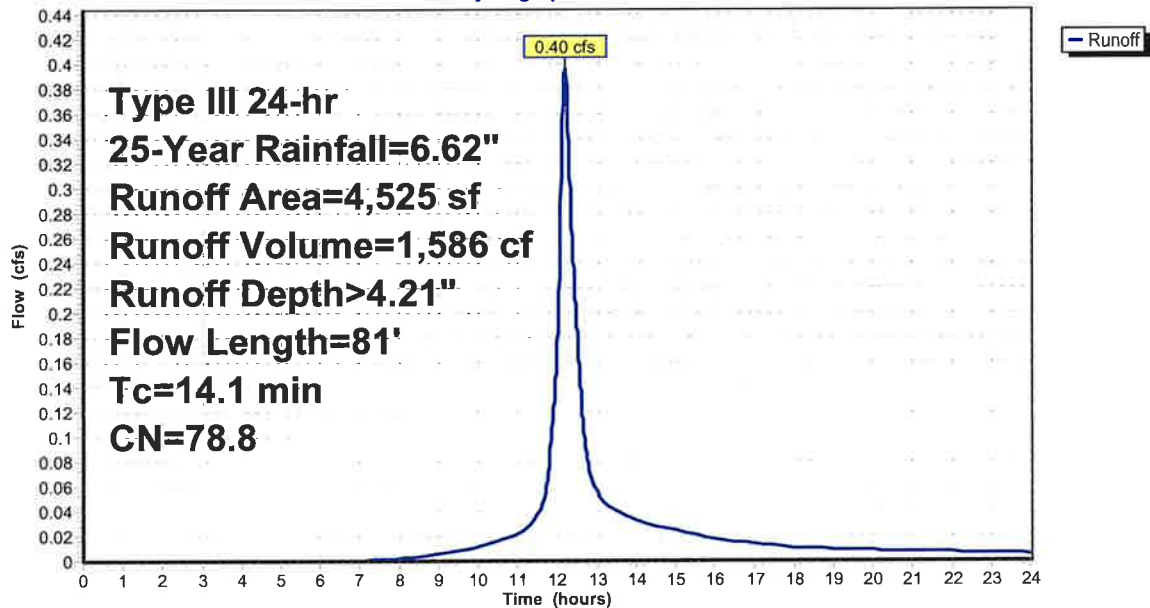
Area (sf)	CN	Description
54	98.0	Paved parking, HSG D
92	61.0	>75% Grass cover, Good, HSG B
3,312	80.0	>75% Grass cover, Good, HSG D
56	55.0	Woods, Good, HSG B
1,011	77.0	Woods, Good, HSG D
4,525	78.8	Weighted Average
4,471		98.81% Pervious Area
54		1.19% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.1	70	0.0350	0.14		<b>Sheet Flow, 1</b> Grass: Dense n= 0.240 P2= 3.60"
6.0	11	0.0200	0.03		<b>Sheet Flow, 2</b> Woods: Dense underbrush n= 0.800 P2= 3.60"
14.1	81	Total			

**Subcatchment 4S: DA-4A**

**Hydrograph**





**Summary for Subcatchment 5S: DA-4B**

Runoff = 2.66 cfs @ 12.07 hrs, Volume= 8,711 cf, Depth> 5.94"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Type III 24-hr 25-Year Rainfall=6.62"

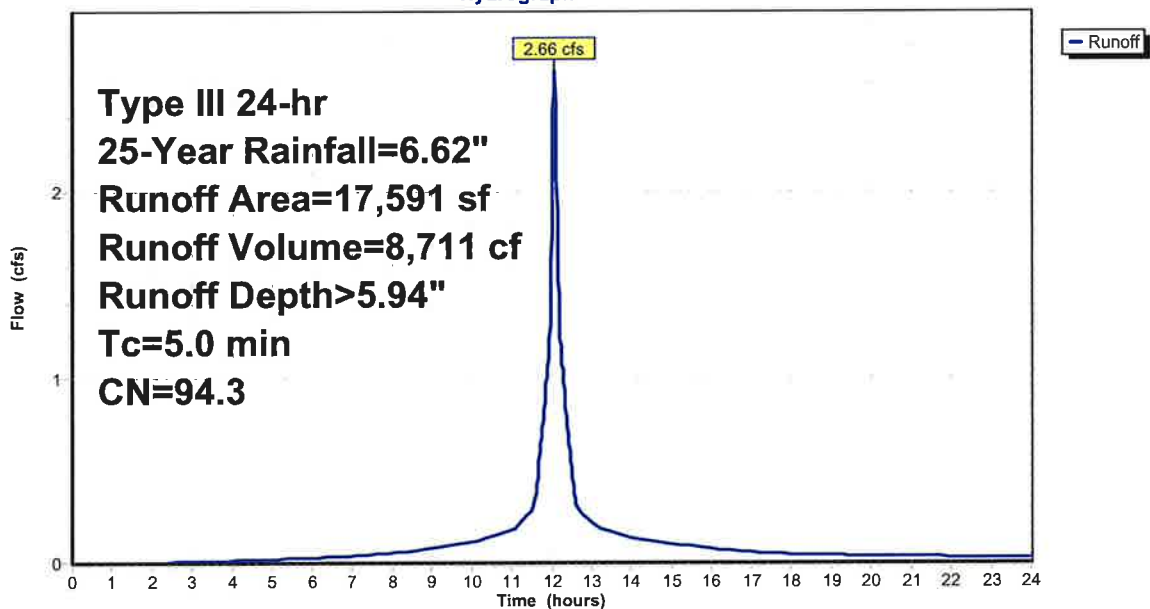
Area (sf)	CN	Description
13,961	98.0	Paved parking, HSG D
3,630	80.0	>75% Grass cover, Good, HSG D
17,591	94.3	Weighted Average
3,630		20.64% Pervious Area
13,961		79.36% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					Direct Entry, 1

**Subcatchment 5S: DA-4B**

**Hydrograph**



**Summary for Subcatchment 6S: DA-3B**

Runoff = 1.98 cfs @ 12.07 hrs, Volume= 6,450 cf, Depth> 5.72"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Type III 24-hr 25-Year Rainfall=6.62"

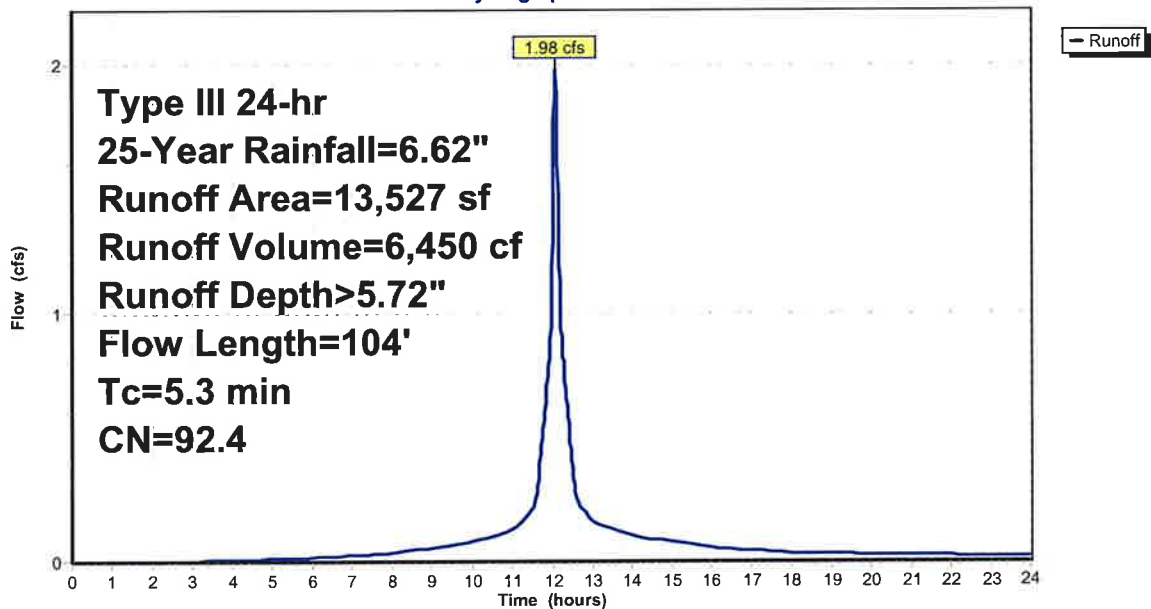
Area (sf)	CN	Description
9,308	98.0	Paved parking, HSG D
4,219	80.0	>75% Grass cover, Good, HSG D
13,527	92.4	Weighted Average
4,219		31.19% Pervious Area
9,308		68.81% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.1	36	0.0300	0.12		<b>Sheet Flow, 1</b> Grass: Dense n= 0.240 P2= 3.60"
0.2	68	0.0200	5.25	1.03	<b>Pipe Channel, 1</b> 6.0" Round Area= 0.2 sf Perim= 1.6' r= 0.13' n= 0.010 PVC, smooth interior
5.3	104	Total			

**Subcatchment 6S: DA-3B**

**Hydrograph**



**Summary for Subcatchment 8S: DA-4C**

Runoff = 2.30 cfs @ 12.13 hrs, Volume= 8,486 cf, Depth> 5.57"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Type III 24-hr 25-Year Rainfall=6.62"

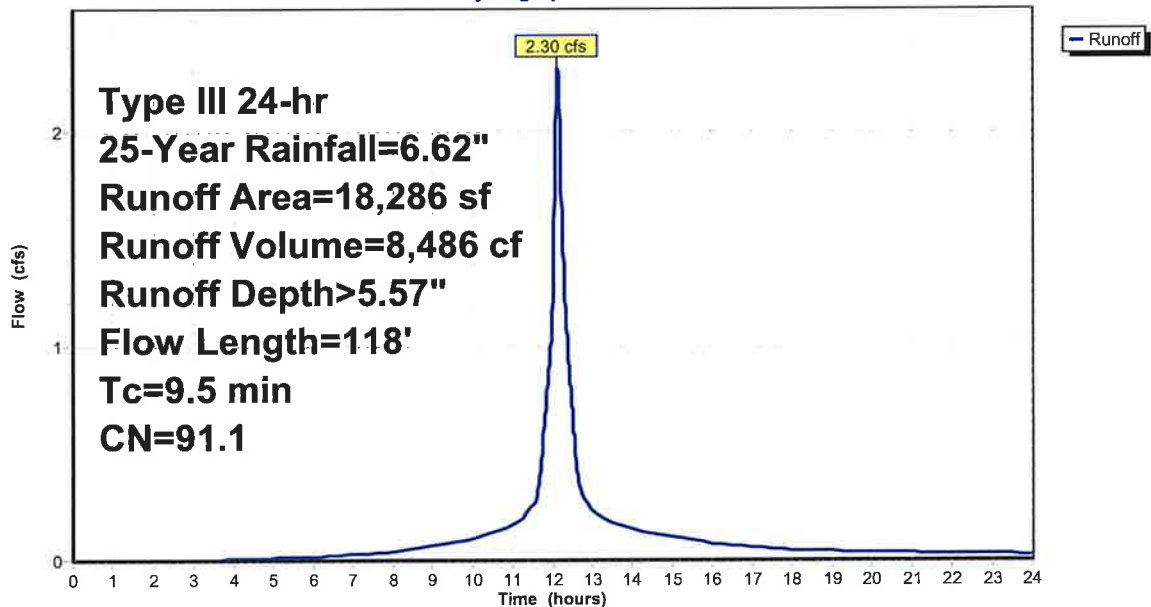
Area (sf)	CN	Description
11,383	98.0	Paved parking, HSG D
6,247	80.0	>75% Grass cover, Good, HSG D
656	77.0	Woods, Good, HSG D
18,286	91.1	Weighted Average
6,903		37.75% Pervious Area
11,383		62.25% impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.1	90	0.0430	0.16		<b>Sheet Flow, 1</b> Grass: Dense n= 0.240 P2= 3.60"
0.4	28	0.0210	1.15		<b>Sheet Flow, 2</b> Smooth surfaces n= 0.011 P2= 3.60"
9.5	118	Total			

**Subcatchment 8S: DA-4C**

**Hydrograph**



**Summary for Subcatchment 9S: DA-4D**

Runoff = 3.33 cfs @ 12.10 hrs, Volume= 11,303 cf, Depth> 5.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Type III 24-hr 25-Year Rainfall=6.62"

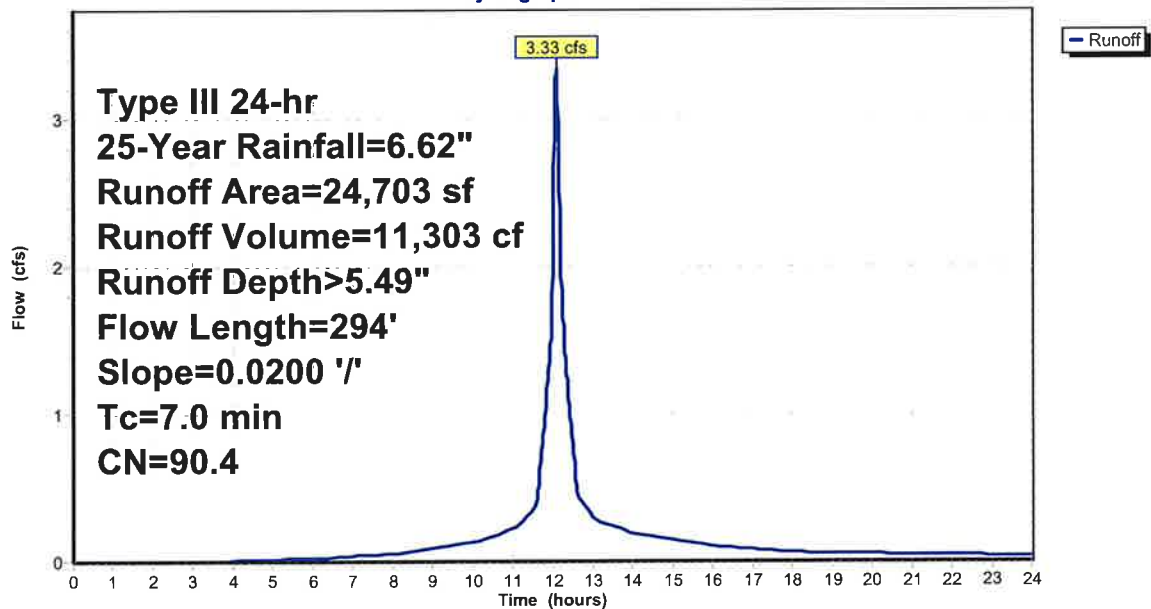
Area (sf)	CN	Description
17,568	98.0	Paved parking, HSG D
3,122	61.0	>75% Grass cover, Good, HSG B
4,013	80.0	>75% Grass cover, Good, HSG D
24,703	90.4	Weighted Average
7,135		28.88% Pervious Area
17,568		71.12% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	39	0.0200	0.10		<b>Sheet Flow, 1</b> Grass: Dense n= 0.240 P2= 3.60"
0.7	255	0.0200	6.36	2.22	<b>Pipe Channel, 2</b> 8.0" Round Area= 0.3 sf Perim= 2.1' r= 0.17' n= 0.010 PVC, smooth interior
7.0	294	Total			

**Subcatchment 9S: DA-4D**

**Hydrograph**



**Summary for Pond 6P: RS-2**

Inflow Area = 17,591 sf, 79.36% Impervious, Inflow Depth > 5.94" for 25-Year event  
 Inflow = 2.66 cfs @ 12.07 hrs, Volume= 8,711 cf  
 Outflow = 1.84 cfs @ 12.15 hrs, Volume= 4,886 cf, Atten= 31%, Lag= 4.5 min  
 Primary = 1.84 cfs @ 12.15 hrs, Volume= 4,886 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Peak Elev= 87.85' @ 12.15 hrs Surf.Area= 4,103 sf Storage= 4,252 cf

Plug-Flow detention time= 222.2 min calculated for 4,884 cf (56% of inflow)  
 Center-of-Mass det. time= 111.5 min ( 874.7 - 763.2 )

Volume	Invert	Avail.Storage	Storage Description
#1A	84.30'	1,601 cf	<b>23.58"W x 87.00'L x 3.21'H Field A</b> 6,583 cf Overall - 2,580 cf Embedded = 4,002 cf x 40.0% Voids
#2A	84.80'	2,580 cf	<b>Cultec R-280HD</b> x 60 Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 5 rows
#3	87.50'	513 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc) 5,128 cf Overall x 10.0% Voids
		4,694 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
87.50	2,051	0	0
90.00	2,051	5,128	5,128

Device	Routing	Invert	Outlet Devices
#1	Primary	87.00'	<b>12.0" Round Culvert</b> L= 5.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 87.00' / 86.90' S= 0.0200 '/ Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

**Primary OutFlow** Max=1.83 cfs @ 12.15 hrs HW=87.84' TW=81.75' (Dynamic Tailwater)  
**1=Culvert** (Barrel Controls 1.83 cfs @ 3.50 fps)

**Pond 6P: RS-2 - Chamber Wizard Field A**

**Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)**

Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf  
 Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap  
 Row Length Adjustment= +1.00' x 6.07 sf x 5 rows

47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

12 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 85.00' Row Length +12.0" End Stone x 2 = 87.00' Base Length  
 5 Rows x 47.0" Wide + 6.0" Spacing x 4 + 12.0" Side Stone x 2 = 23.58' Base Width  
 6.0" Base + 26.5" Chamber Height + 6.0" Cover = 3.21' Field Height

60 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 5 Rows = 2,580.5 cf Chamber Storage

6,582.7 cf Field - 2,580.5 cf Chambers = 4,002.2 cf Stone x 40.0% Voids = 1,600.9 cf Stone Storage

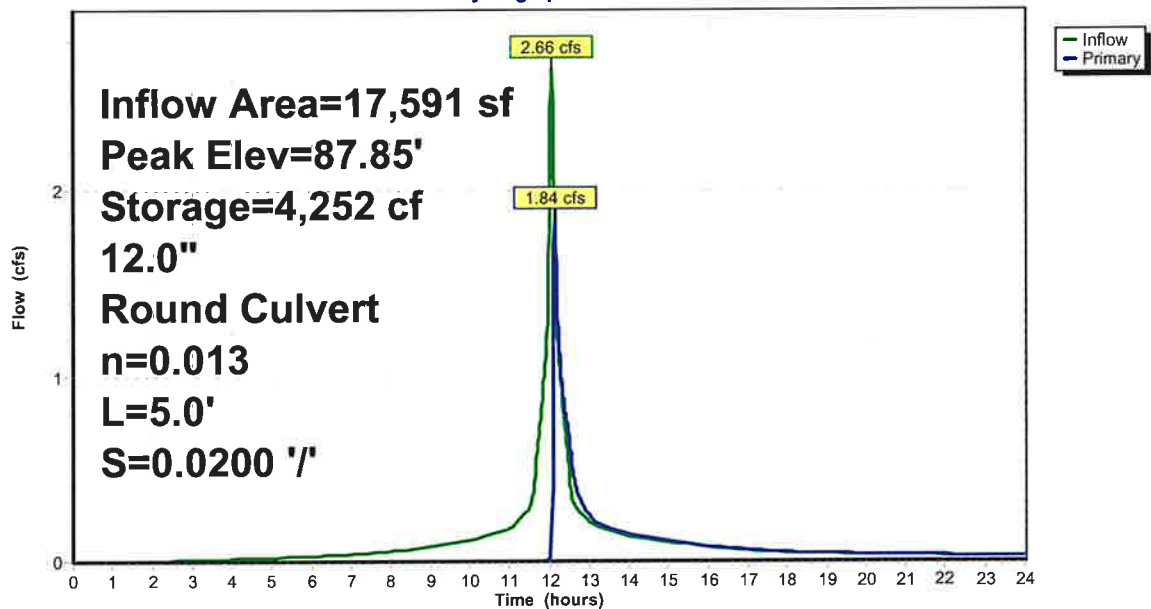
Chamber Storage + Stone Storage = 4,181.4 cf = 0.096 af  
 Overall Storage Efficiency = 63.5%  
 Overall System Size = 87.00' x 23.58' x 3.21'

60 Chambers  
 243.8 cy Field  
 148.2 cy Stone



**Pond 6P: RS-2**

**Hydrograph**





**Summary for Pond 7P: RS-1**

Inflow Area = 13,527 sf, 68.81% Impervious, Inflow Depth > 5.72" for 25-Year event  
 Inflow = 1.98 cfs @ 12.07 hrs, Volume= 6,450 cf  
 Outflow = 0.10 cfs @ 14.07 hrs, Volume= 1,483 cf, Atten= 95%, Lag= 119.9 min  
 Primary = 0.10 cfs @ 14.07 hrs, Volume= 1,483 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Peak Elev= 82.05' @ 14.07 hrs Surf.Area= 1,776 sf Storage= 5,000 cf

Plug-Flow detention time= 470.8 min calculated for 1,482 cf (23% of inflow)  
 Center-of-Mass det. time= 278.4 min ( 1,049.9 - 771.6 )

Volume	Invert	Avail.Storage	Storage Description
#1A	77.90'	1,077 cf	<b>24.00'W x 74.00'L x 4.50'H Field A</b> 7,992 cf Overall - 5,299 cf Embedded = 2,693 cf x 40.0% Voids
#2A	78.40'	3,991 cf	<b>Concrete Galley 4x4x4</b> x 90 Inside #1 Inside= 42.0"W x 43.0"H => 12.67 sf x 3.50'L = 44.3 cf Outside= 52.8"W x 48.0"H => 14.72 sf x 4.00'L = 58.9 cf 90 Chambers in 5 Rows
#3	82.40'	355 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc) 3,552 cf Overall x 10.0% Voids
		5,423 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
82.40	1,776	0	0
84.40	1,776	3,552	3,552

Device	Routing	Invert	Outlet Devices
#1	Primary	81.90'	<b>12.0" Round Culvert</b> L= 9.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 81.90' / 81.70' S= 0.0222 1/1' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

**Primary OutFlow** Max=0.10 cfs @ 14.07 hrs HW=82.05' TW=0.00' (Dynamic Tailwater)  
 1=Culvert (inlet Controls 0.10 cfs @ 1.33 fps)

**Pond 7P: RS-1 - Chamber Wizard Field A**

**Chamber Model = Concrete Galley 4x4x4 (Concrete Galley, UCPI 4x4x4 Galley or equivalent)**  
 Inside= 42.0"W x 43.0"H => 12.67 sf x 3.50'L = 44.3 cf  
 Outside= 52.8"W x 48.0"H => 14.72 sf x 4.00'L = 58.9 cf

18 Chambers/Row x 4.00' Long = 72.00' Row Length +12.0" End Stone x 2 = 74.00' Base Length  
 5 Rows x 52.8" Wide + 12.0" Side Stone x 2 = 24.00' Base Width  
 6.0" Base + 48.0" Chamber Height = 4.50' Field Height

90 Chambers x 44.3 cf = 3,991.0 cf Chamber Storage  
 90 Chambers x 58.9 cf = 5,298.9 cf Displacement

7,992.0 cf Field - 5,298.9 cf Chambers = 2,693.1 cf Stone x 40.0% Voids = 1,077.3 cf Stone Storage

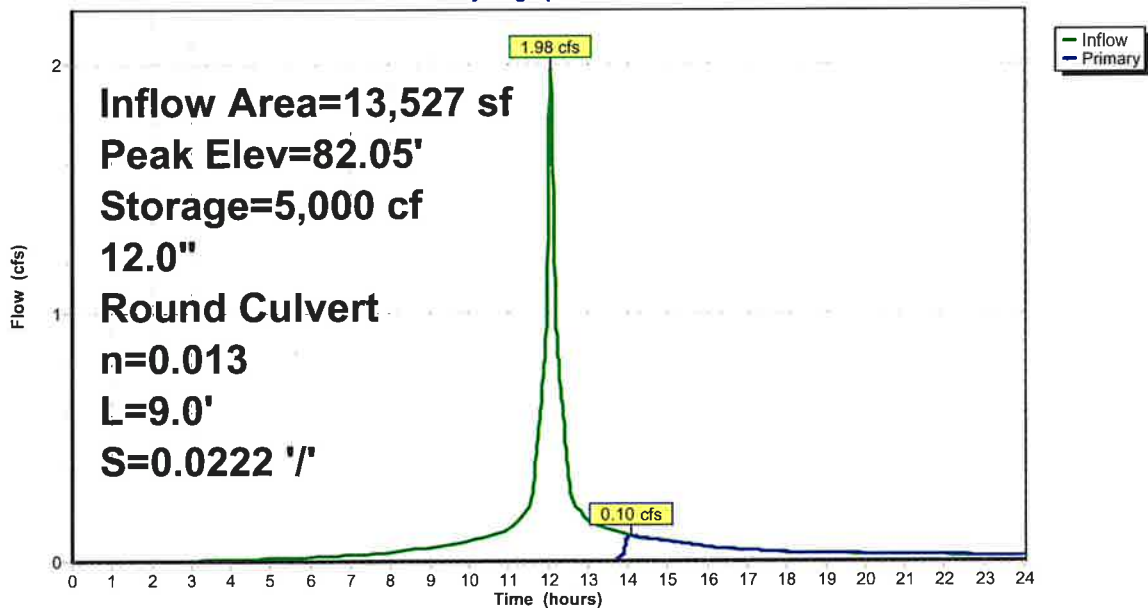
Chamber Storage + Stone Storage = 5,068.3 cf = 0.116 af  
 Overall Storage Efficiency = 63.4%  
 Overall System Size = 74.00' x 24.00' x 4.50'

90 Chambers  
 296.0 cy Field  
 99.7 cy Stone



**Pond 7P: RS-1**

**Hydrograph**



**Summary for Pond 10P: RS-3**

Inflow Area = 18,286 sf, 62.25% Impervious, Inflow Depth > 5.57" for 25-Year event  
 Inflow = 2.30 cfs @ 12.13 hrs, Volume= 8,486 cf  
 Outflow = 1.70 cfs @ 12.22 hrs, Volume= 4,558 cf, Atten= 26%, Lag= 5.7 min  
 Primary = 1.70 cfs @ 12.22 hrs, Volume= 4,558 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Peak Elev= 84.71' @ 12.22 hrs Surf.Area= 2,857 sf Storage= 4,036 cf

Plug-Flow detention time= 217.0 min calculated for 4,558 cf (54% of inflow)  
 Center-of-Mass det. time= 106.5 min ( 886.5 - 780.0 )

Volume	Invert	Avail.Storage	Storage Description
#1A	80.00'	947 cf	<b>15.20"W x 94.00'L x 4.50'H Field A</b> 6,430 cf Overall - 4,062 cf Embedded = 2,367 cf x 40.0% Voids
#2A	80.50'	3,060 cf	<b>Concrete Galley 4x4x4</b> x 69 Inside #1 Inside= 42.0"W x 43.0"H => 12.67 sf x 3.50'L = 44.3 cf Outside= 52.8"W x 48.0"H => 14.72 sf x 4.00'L = 58.9 cf 69 Chambers in 3 Rows
#3	84.50'	214 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc) 2,142 cf Overall x 10.0% Voids
		4,221 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
84.50	1,428	0	0
86.00	1,428	2,142	2,142

Device	Routing	Invert	Outlet Devices
#1	Primary	84.00'	<b>12.0" Round Culvert</b> L= 17.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 84.00' / 83.50' S= 0.0294 ' S= 0.0294 ' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

**Primary OutFlow** Max=1.69 cfs @ 12.22 hrs HW=84.70' TW=82.78' (Dynamic Tailwater)  
 1=Culvert (Inlet Controls 1.69 cfs @ 2.86 fps)

**Pond 10P: RS-3 - Chamber Wizard Field A**

**Chamber Model = Concrete Galley 4x4x4 (Concrete Galley, UCPI 4x4x4 Galley or equivalent)**  
 Inside= 42.0"W x 43.0"H => 12.67 sf x 3.50'L = 44.3 cf  
 Outside= 52.8"W x 48.0"H => 14.72 sf x 4.00'L = 58.9 cf

23 Chambers/Row x 4.00' Long = 92.00' Row Length + 12.0" End Stone x 2 = 94.00' Base Length  
 3 Rows x 52.8" Wide + 12.0" Side Stone x 2 = 15.20' Base Width  
 6.0" Base + 48.0" Chamber Height = 4.50' Field Height

69 Chambers x 44.3 cf = 3,059.8 cf Chamber Storage  
 69 Chambers x 58.9 cf = 4,062.5 cf Displacement

6,429.6 cf Field - 4,062.5 cf Chambers = 2,367.1 cf Stone x 40.0% Voids = 946.9 cf Stone Storage

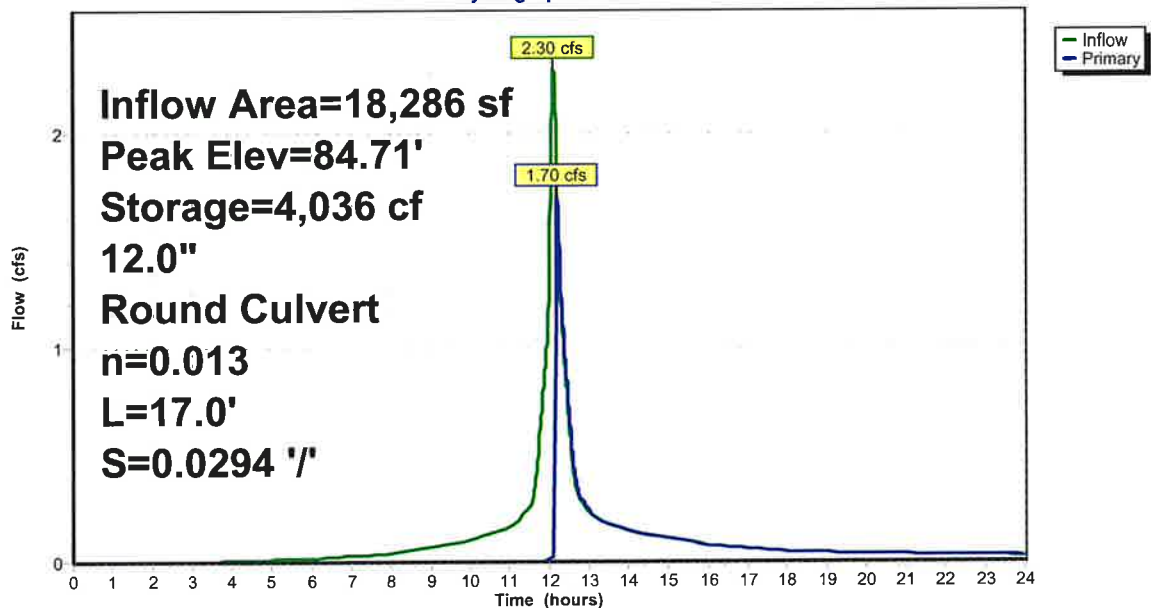
Chamber Storage + Stone Storage = 4,006.6 cf = 0.092 af  
 Overall Storage Efficiency = 62.3%  
 Overall System Size = 94.00' x 15.20' x 4.50'

69 Chambers  
 238.1 cy Field  
 87.7 cy Stone



**Pond 10P: RS-3**

**Hydrograph**



**Summary for Pond 11P: RS-4**

Inflow Area = 60,580 sf, 70.84% Impervious, Inflow Depth > 4.11" for 25-Year event  
 Inflow = 4.98 cfs @ 12.21 hrs, Volume= 20,748 cf  
 Outflow = 4.80 cfs @ 12.23 hrs, Volume= 15,336 cf, Atten= 4%, Lag= 1.0 min  
 Primary = 4.80 cfs @ 12.23 hrs, Volume= 15,336 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs  
 Peak Elev= 82.79' @ 12.23 hrs Surf.Area= 3,804 sf Storage= 5,707 cf

Plug-Flow detention time= 152.2 min calculated for 15,329 cf (74% of inflow)  
 Center-of-Mass det. time= 59.5 min ( 885.5 - 825.9 )

Volume	Invert	Avail.Storage	Storage Description
#1A	77.50'	1,116 cf	<b>32.80"W x 58.00"L x 4.50'H Field A</b> 8,561 cf Overall - 5,770 cf Embedded = 2,791 cf x 40.0% Voids
#2A	78.00'	4,346 cf	<b>Concrete Galley 4x4x4</b> x 98 Inside #1 Inside= 42.0"W x 43.0"H => 12.67 sf x 3.50'L = 44.3 cf Outside= 52.8"W x 48.0"H => 14.72 sf x 4.00'L = 58.9 cf 98 Chambers in 7 Rows
#3	81.50'	476 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc) 4,755 cf Overall x 10.0% Voids
		5,938 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
81.50	1,902	0	0
84.00	1,902	4,755	4,755

Device	Routing	Invert	Outlet Devices
#1	Primary	81.50'	<b>15.0" Round Culvert</b> L= 13.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 81.50' / 81.10' S= 0.0308 ' S Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf

**Primary OutFlow** Max=4.80 cfs @ 12.23 hrs HW=82.79' TW=0.00' (Dynamic Tailwater)  
 1=Culvert (Inlet Controls 4.80 cfs @ 3.91 fps)

**Pond 11P: RS-4 - Chamber Wizard Field A**

**Chamber Model = Concrete Galley 4x4x4 (Concrete Galley, UCPI 4x4x4 Galley or equivalent)**

Inside= 42.0"W x 43.0"H => 12.67 sf x 3.50'L = 44.3 cf  
 Outside= 52.8"W x 48.0"H => 14.72 sf x 4.00'L = 58.9 cf

14 Chambers/Row x 4.00' Long = 56.00' Row Length +12.0" End Stone x 2 = 58.00' Base Length  
 7 Rows x 52.8" Wide + 12.0" Side Stone x 2 = 32.80' Base Width  
 6.0" Base + 48.0" Chamber Height = 4.50' Field Height

98 Chambers x 44.3 cf = 4,345.8 cf Chamber Storage  
 98 Chambers x 58.9 cf = 5,769.9 cf Displacement

8,560.8 cf Field - 5,769.9 cf Chambers = 2,790.9 cf Stone x 40.0% Voids = 1,116.4 cf Stone Storage

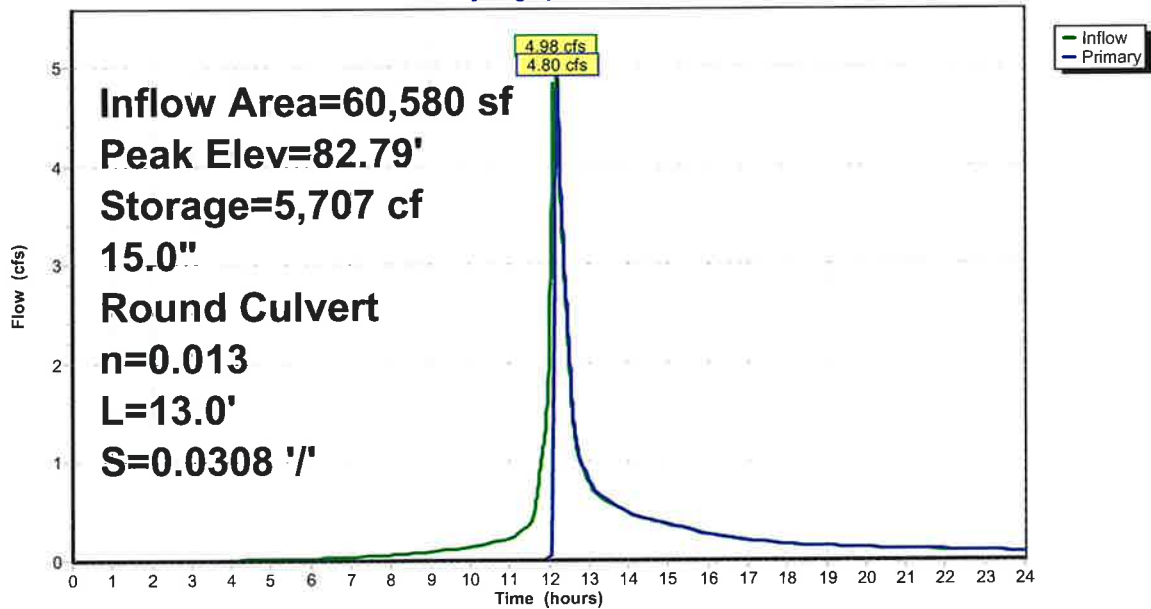
Chamber Storage + Stone Storage = 5,462.1 cf = 0.125 af  
 Overall Storage Efficiency = 63.8%  
 Overall System Size = 58.00' x 32.80' x 4.50'

98 Chambers  
 317.1 cy Field  
 103.4 cy Stone



**Pond 11P: RS-4**

**Hydrograph**





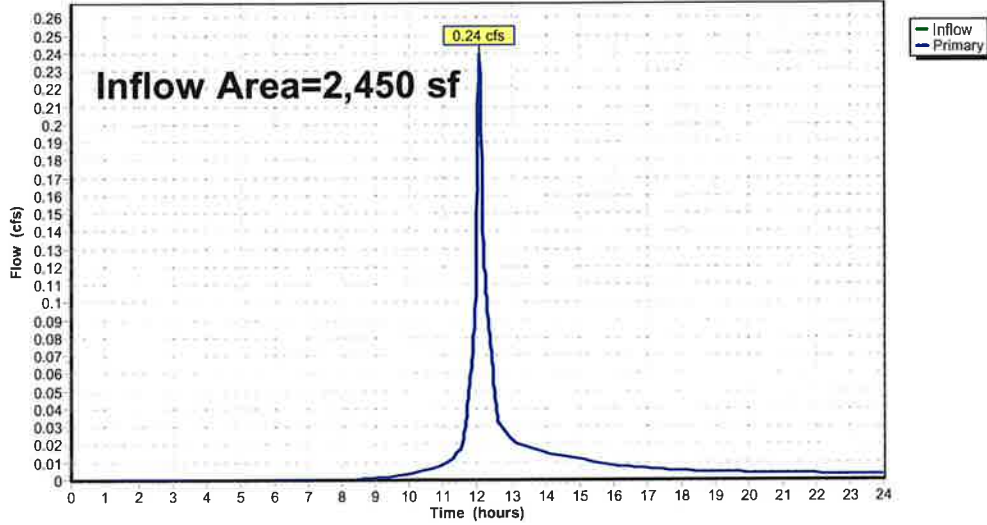
### Summary for Link 7L: POC A

Inflow Area = 2,450 sf, 29.43% Impervious, Inflow Depth > 3.49" for 25-Year event  
Inflow = 0.24 cfs @ 12.08 hrs, Volume= 713 cf  
Primary = 0.24 cfs @ 12.08 hrs, Volume= 713 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

### Link 7L: POC A

Hydrograph



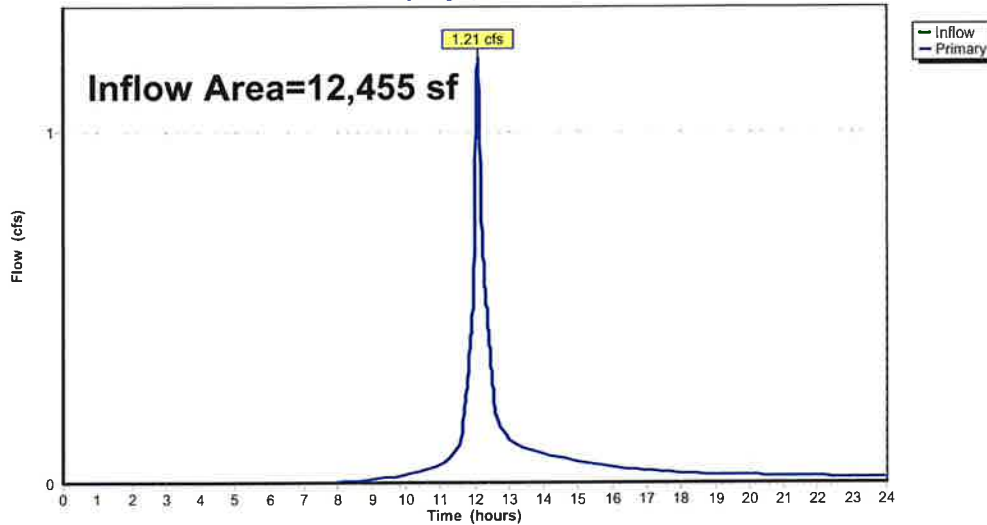
### Summary for Link 8L: POC B

Inflow Area = 12,455 sf, 24.85% Impervious, Inflow Depth > 3.75" for 25-Year event  
Inflow = 1.21 cfs @ 12.10 hrs, Volume= 3,891 cf  
Primary = 1.21 cfs @ 12.10 hrs, Volume= 3,891 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

### Link 8L: POC B

Hydrograph



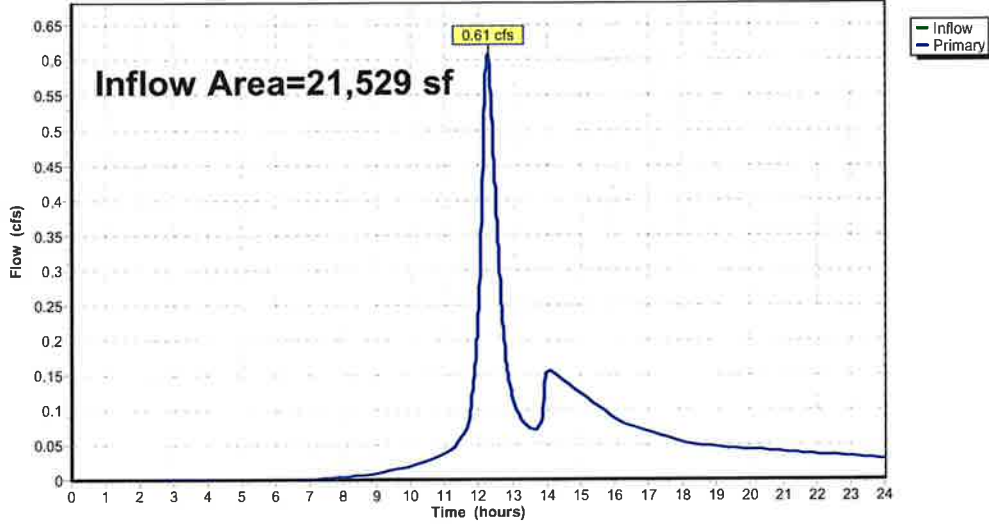
Summary for Link 9L: POC C

Inflow Area = 21,529 sf, 43.57% Impervious, Inflow Depth > 2.40" for 25-Year event  
Inflow = 0.61 cfs @ 12.27 hrs, Volume= 4,298 cf  
Primary = 0.61 cfs @ 12.27 hrs, Volume= 4,298 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Link 9L: POC C

Hydrograph



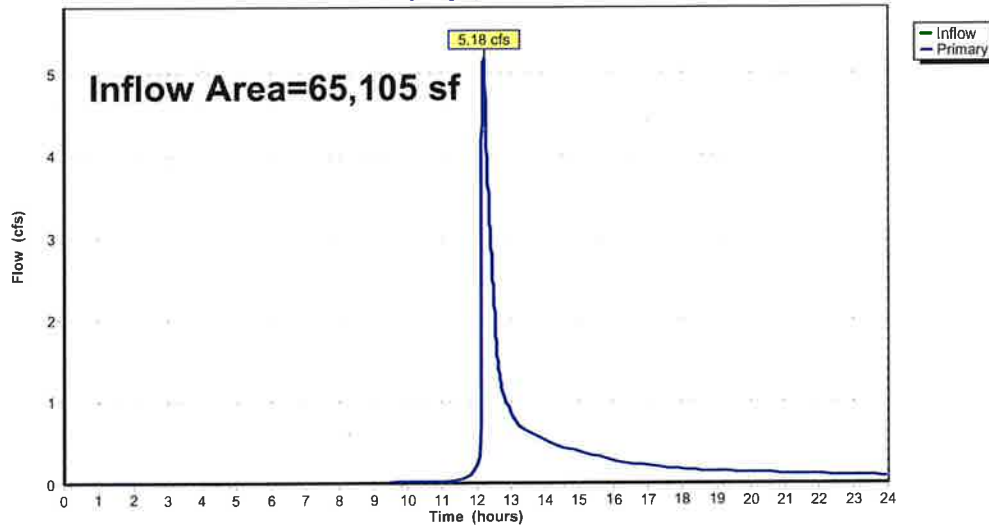
Summary for Link 10L: POC D

Inflow Area = 65,105 sf, 65.99% Impervious, Inflow Depth > 3.12" for 25-Year event  
Inflow = 5.18 cfs @ 12.23 hrs, Volume= 16,922 cf  
Primary = 5.18 cfs @ 12.23 hrs, Volume= 16,922 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Link 10L: POC D

Hydrograph



**Appendix “E”**

**DCIA 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**

<b>Part 1: General Information (All Projects)</b>	
Project Name	"Hope Street Townhouses"
Project Address	91 Hope Street
Project Applicant	RRIT, LLC
Title of Plan	Site Plan Review Set
Revision Date of Plan	12-Dec-23
Tax Account Number	002-6785

<b>Part 2: Project Details (All Projects)</b>	
1. What type of development is this? (choose from dropdown)	Redevelopment
2. What is the total area of the project site?	101,539 ft <sup>2</sup>
3. What is the total area of land disturbance for this project?	97,000 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
Does Standard 1 apply based on information above?	Yes

<b>Part 3: Water Quality Target Total (Only for Standard 1 Projects)</b>	
5. What is the <u>current (pre-development) DCIA</u> for the site?	39,215 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 total impervious area</u> for the site?	56,162 ft <sup>2</sup>
Water Quality Volume (WQV)	4446.2 ft <sup>3</sup>
Standard 1 requirement	Retain WQV on-site
Required retention volume	4446.2 ft <sup>3</sup>
Provided retention volume for proposed development	17,767.0 ft <sup>3</sup>

<b>Part 4: Proposed DCIA Tracking (Only for Standard 1 Projects)</b>	
<u>Pre-development total impervious area</u>	39,215 ft <sup>2</sup>
<u>Current DCIA</u>	39,215 ft <sup>2</sup>
<u>Proposed-development total impervious area</u>	56,162 ft <sup>2</sup>
<u>Proposed-development DCIA</u> (after stormwater management)	3,942 ft <sup>2</sup>
Net change in <b>DCIA</b> from <u>current</u> to <u>proposed-development</u>	-35,273 ft <sup>2</sup>

<b>Part 5: Post-Development (As-Built Certified) DCIA Tracking (Only for Standard 1 Projects)</b>	
<u>Post-development (per as-built) total impervious area</u>	ft <sup>2</sup>
<u>Post-development (per as-built) DCIA</u> (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 Deush Dawn Date 12/12/23 Engineer's Seal

## **Appendix “F”**

### **Soils Infiltration Field Testing Results**

Project: "Hope Street Townhouses"  
 Address: 91 Hope Street, Stamford, CT

Notes: Depths are in inches, measures taken from top of pipe.

**Test for Retention System #1 (RS-1)**

**Saturated Hydraulic Conductivity Test "B"** Depth = 90 inches (Bottom Elevation = 77.2'±)  
 Test Performed on (10/27/2023)

Test	Start	Finish	Delta
Hour 1	17.50	21.00	3.5
Hour 2	21.00	22.75	1.75
Hour 3	22.75	24.50	1.75
Hour 4	17.75	21.25	3.5
Average Per Hour	---	---	2.62 in/hr
			Field Infiltration Rate= 2.6 in/hr
Divide by 2 (Factor of Safety)			<b>Design Infiltration Rate= 1.3 in/hr</b>

**Test for Retention System #3 (RS-3)**

**Saturated Hydraulic Conductivity Test "C"** Depth = 92 inches (Bottom Elevation = 79.6'±)  
 Test Performed on (10/27/2023)

Test	Start	Finish	Delta
Hour 1	17.75	25.25	7.5
Hour 2	18.50	24.25	5.75
Hour 3	16.25	21.75	5.50
Hour 4	21.75	26.25	4.5
Average Per Hour	---	---	5.81 in/hr
			Field Infiltration Rate= 5.8 in/hr
Divide by 2 (Factor of Safety)			<b>Design Infiltration Rate= 2.9 in/hr</b>

**Test for Retention System #4 (RS-4)**

**Saturated Hydraulic Conductivity Test "A"** Depth = 92 inches (Bottom Elevation = 76.7'±)  
 Test Performed on (10/27/2023)

Test	Start	Finish	Delta
Hour 1	21.00	27.00	6.0
Hour 2	18.75	24.75	6.0
Hour 3	18.25	24.25	6.0
Hour 4	20.25	24.50	4.25
Average Per Hour	---	---	5.56 in/hr
			Field Infiltration Rate= 5.5 in/hr
Divide by 2 (Factor of Safety)			<b>Design Infiltration Rate= 2.75 in/hr</b>

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**Test for Retention System #2 (RS-2)**

**Saturated Hydraulic Conductivity Test "D"** Depth = 90 inches (Bottom Elevation = 83.8'±)

*Test Performed on (10/27/2023)*

<b>Test</b>	<b>Start</b>	<b>Finish</b>	<b>Delta</b>
Hour 1/2	19.50	24.25	4.75
Hour 1	21.50	29.75	8.25
Hour 1-1/2	19.00	27.00	8.00
Hour 2	24.50	30.25	5.75
Hour 2-1/2	19.75	28.50	8.75
Hour 3	22.00	28.00	6.00
Hour 3-1/2	21.25	28.75	7.50
Hour 4	20.50	26.25	5.75
Average Per Hour	---	---	13.68 in/hr
			Field Infiltration Rate= 13.6 in/hr
Divide by 2 (Factor of Safety)			<b>Design Infiltration Rate= 6.8 in/hr</b>

**Test for Retention System #2 (RS-2)**

**Saturated Hydraulic Conductivity Test "E"** Depth = 115 inches (Bottom Elevation = 83.5'±)

*Test Performed on (10/27/2023)*

<b>Test</b>	<b>Start</b>	<b>Finish</b>	<b>Delta</b>
Hour 1/2	19.00	26.50	7.50
Hour 1	20.00	26.75	6.75
Hour 1-1/2	19.00	25.25	6.25
Hour 2	25.25	29.25	4.00
Hour 2-1/2	19.25	26.00	6.75
Hour 3	19.75	25.75	6.00
Hour 3-1/2	25.75	30.00	4.25
Hour 4	19.25	24.25	5.00
Average Per Hour	---	---	13.62 in/hr
			Field Infiltration Rate= 11.6 in/hr
Divide by 2 (Factor of Safety)			<b>Design Infiltration Rate= 5.8 in/hr</b>