#260-22

STORMWATER REPORT

Elderly Housing with Services

Crafts Street & Court Street
Newton, MA

PREPARED FOR

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APRIL 4, 2022

Table of Contents

List of Tables

Stormwater Report Narrative

On behalf of co-petitioners SRG HoldCo. Investments, LLC and Crafts Development LLC (the Proponents), VHB is pleased to submit the following report and supporting documentation for the proposed stormwater management system design of the Crafts Street Elderly Housing with Services Project, located at Crafts and Court Street in Newton, MA

This Stormwater Report has been prepared to demonstrate compliance with the Massachusetts Stormwater Management Standards in accordance with the Massachusetts Wetlands Protection Act Regulations (310 CMR 10.00) and Water Quality Certification Regulations (314 CMR 9.00). This report also demonstrates compliance with the City of Newton's Requirements for On-Site Drainage (Stormwater Management) 2018, and the Environmental Protection Agency (EPA) Municipal Separate Storm Sewer System (MS4) Permit Requirements.

Project Description

The Proponents are proposing to construct a 7-story, 224,000 GSF Elderly Housing with Services facility that includes 209 dwelling units for independent living (IL), assisted living (AL) and memory care (MC), associated first-floor amenities and a below-grade parking garage at Crafts Street and Court Street (the Project). Site features include a vehicular entrance from Crafts Street with pick-up/drop-off area at the IL and AL wing entrances, access to the below-grade parking garage, and seven (7) at-grade parallel parking spaces; a second curb cut on Crafts Street at the north end of the site for loading access; a perimeter limited and emergency vehicle access road from Court Street to the loading area; and associated pedestrian courtyards, sidewalks, landscaping features, and utility services.

Site Description

The Project Site is a 2.7-acre proposed development parcel comprised of seven (7) existing lots (the Site) located at Crafts Street and Court Street in Newton, Massachusetts (see Figure 1, Site Locus Map). The Site lies within the surface watershed of the Charles River and is bounded to the north by commercial properties on Crafts Street and Maguire Court, to the east by Crafts Street, to the south by Marty's Fine Wines and Wholefoods, and to the west by residential properties on Court Street.

There are no Wetland Resource Areas on or adjacent to the site, nor is the Project located within a 100-year floodplain.

Soils Information

According to the Natural Resources Conservation Service (NRCS), surface soils on the Site include Merrimac-Urban land complex and urban fill. On-site natural soils are classified as Hydrologic Soil Groups (HSG) A. Based on the soil evaluation included in Appendix C, the Site is considered to be within an area of rapid infiltration (soils with a saturated hydraulic conductivity greater than 2.4 inches per hour).

A preliminary geotechnical due diligence evaluation, included in Appendix C, was performed by Sanborn Head & Associates, Inc. in October of 2016. Based on the soil classifications, a Hydrologic Soil Group (HSG) A rating and Rawl's infiltration rate of 8.27 in/hr was recommended to be used for the hydrologic analysis.

Groundwater depths in the vicinity of the site ranged from approximately 11 and 15 feet below the ground surface (El. 24 to 26.5 feet), and an estimated seasonal high groundwater table (ESHGWT) of elevation 28.0 has been recommended for preliminary design purposes, pending additional on-site verification.

It is understood per the City of Newton Requirements, that an on-site soil evaluation in accordance with Title V shall be performed within 25-ft of proposed infiltration structures, which shall be pursued to verify the design assumptions noted herein. Should the additional investigations indicate soil conditions that differ from the states design assumptions, the proposed BMPs will be revised accordingly.

Existing Drainage Conditions

Under existing conditions, the site is predominantly broken pavement and densely-packed gravel surface which exhibit surface characteristics of impervious coverage, with two (2) commercial buildings and a paved surface parking lot at Crafts Street, and two (2) and two (2) residential lots at the southwest corner. Figure 2 illustrates the existing drainage patterns on the Site. Currently, the Site is divided into drainage areas as stormwater runoff flows to two (2) Design Points (DP), which are summarized in Table 1 below.

Table 1 Existing Conditions Hydrologic Data

Drainage Area	Discharge Location	Design Point	Area (Acres)	Curve Number	Time of Concentration (min)
1 – Site	Court Street	1	0.2	76	5.0
2 – Site	Crafts Street	2	2.5	79	5.0
3 - Site	Court Street	2	0.3	94	5.0

Proposed Drainage Conditions

Figure 3 illustrates the proposed "post-construction" drainage conditions for the project. As shown, the Site will be divided into nine (9) drainage areas that discharge treated stormwater to the three (3) existing Design Points. Existing grading and drainage patterns will be maintained to the maximum extent practicable to meet or reduce discharges at the analyzed design points. Table 2 below provides a summary of the proposed conditions hydrologic data:

Table 2 Proposed Conditions Hydrologic Data

Drainage Area	Discharge Location	Design Point	Area (Acres)	Curve Number	Time of Concentration (min)
10 – Site	Court Street	1	0.3	73	5.0
11 – Site	Court Street	1	0.2	56	5.0
20 – Site	Crafts Street	2	0.5	69	5.0
21 – Building	Crafts Street	2	0.4	98	5.0
22 – Site	Crafts Street	2	0.3	79	5.0
23 – Site	Crafts Street	2	0.2	73	5.0
24 – Site	Crafts Street	2	0.6	82	5.0
25 – Building	Crafts Street	2	0.4	98	5.0
26 – Building	Crafts Street	2	0.2	98	5.0

The site design integrates a comprehensive stormwater management system that has been developed in accordance with the Massachusetts Stormwater Handbook.

Environmentally Sensitive and Low Impact Development (LID) Techniques

Low Impact Development (LID) techniques and stormwater Best Management Practices (BMPs) implemented into the site design include an increase in landscape open space of approximately 0.8-acres, disconnected impervious areas, and minimized disturbance to existing trees and vegetation. In general, stormwater from the proposed impervious surfaces on site is directed to landscape areas and site drives into the closed drainage systems with proprietary water quality treatment devices for pretreatment, and then to subsurface infiltration systems for water quality, recharge, and peak rate and runoff volume attenuation. As the design is refined, the Project will look to incorporate additional LID techniques including surface rain gardens/bioretention basins to provide additional water quality treatment from surface runoff. The design included herein has been prepared to meet the requirements regardless.

Figure 1 Site Locus Map

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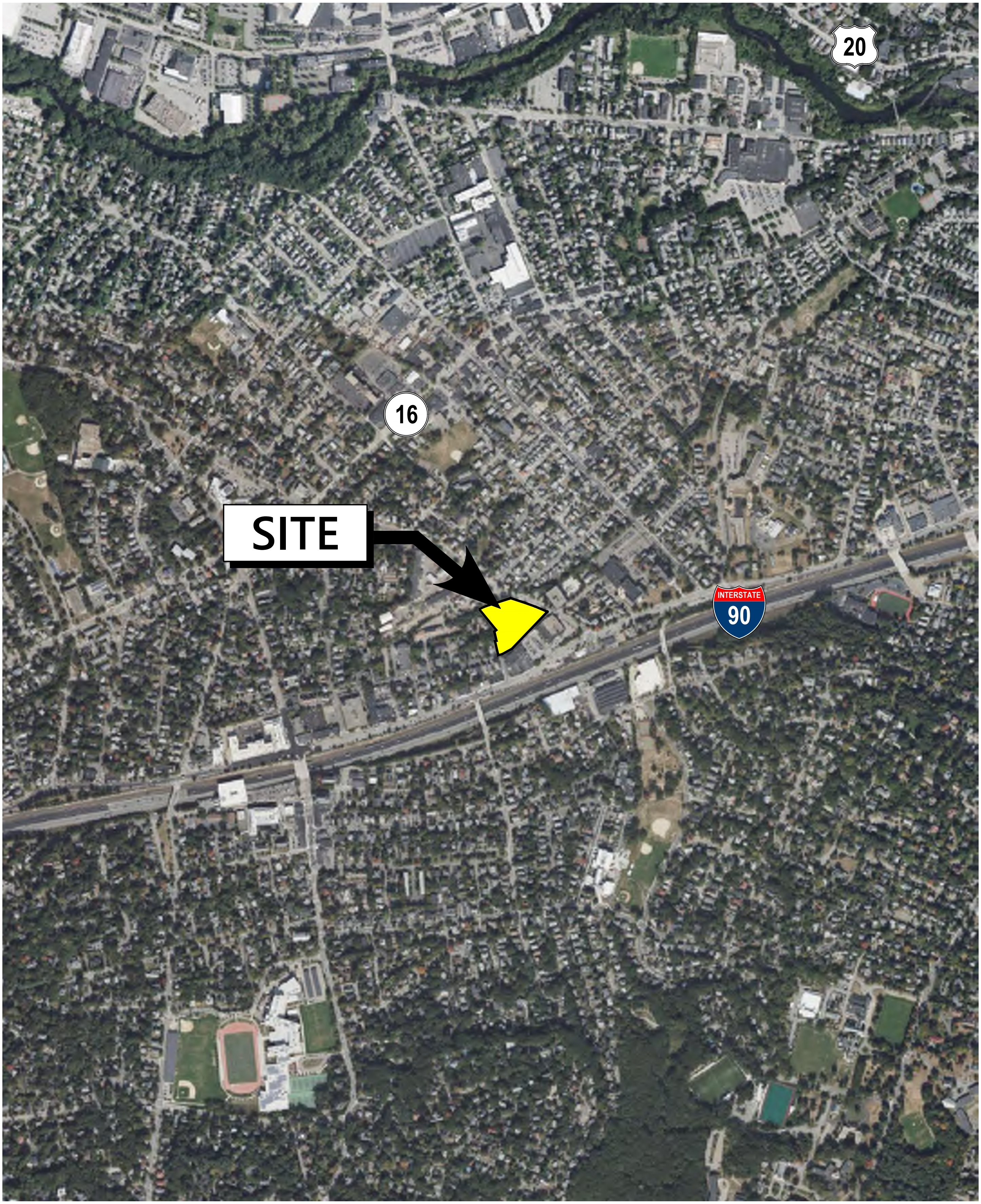

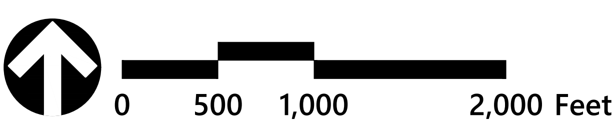

Site Locus Map
Elderly Housing with Services
Crafts Street & Court Street
Newton, MA

Figure 1

04/04/2022

Figure 2 Existing Drainage Conditions

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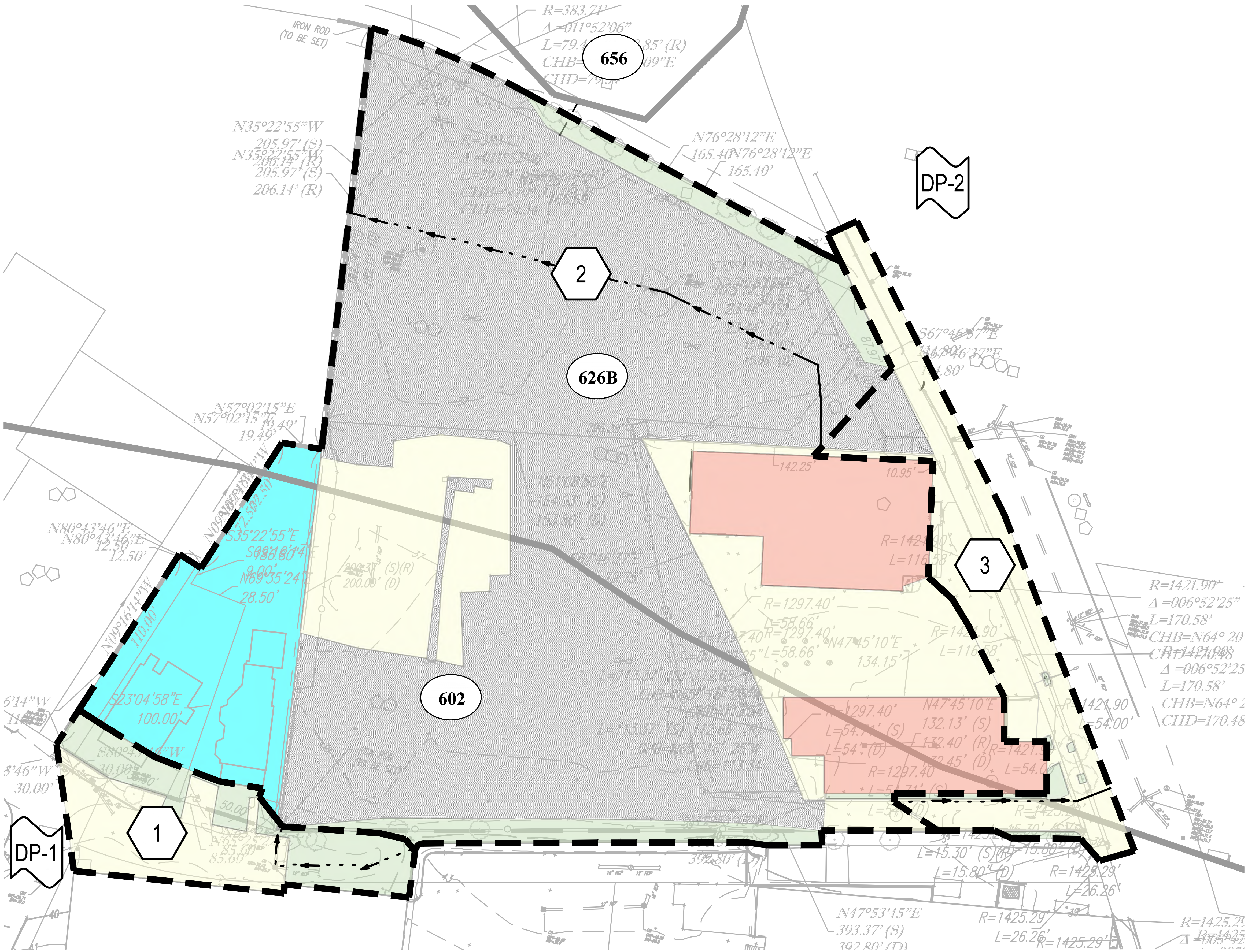

Legend

SYMBOLS

- DESIGN POINT
- DRAINAGE AREA DESIGNATION
- POND

LINETYPES

- DRAINAGE AREA BOUNDARY
- TIME OF CONCENTRATION FLOW LINE
- SOIL TYPE BOUNDARY

SCS SOIL CLASSIFICATIONS

- 656 UDORTHENTS-URBAN LAND COMPLEX
- 626B MERRIMAC-URBAN LAND COMPLEX, 0 TO 8 PERCENT SLOPES, HSG A
- 602 URBAN LAND

IMPERVIOUS AREAS

- BUILDING
- IMPERVIOUS
- GRASS
- GRAVEL
- MIXED LOTS

0 25 50 100Feet

Existing Drainage Conditions
Elderly Housing with Services
Crafts Street & Court Street
Newton, MA

Figure 2

03/31/2022

Figure 3 Proposed Drainage Conditions

Legend

SYMBOLS

- DESIGN POINT
- DRAINAGE AREA DESIGNATION
- POND

LINETYPES

- DRAINAGE AREA BOUNDARY
- TIME OF CONCENTRATION FLOW LINE
- SOIL TYPE BOUNDARY

SCS SOIL CLASSIFICATIONS

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- 602 — URBAN LAND

IMPERVIOUS AREAS

- BUILDING
- IMPERVIOUS
- PERVIOUS

0 25 50 100Feet

vhb

Proposed Drainage Conditions
Elderly Housing with Services
Crafts Street & Court Street
Newton, MA

Figure 3

03/31/2022

Regulatory Compliance

Massachusetts Department of Environmental Protection (DEP) – Stormwater Management Standards

Per the EPA MS4 Permit, stormwater management systems design shall be consistent with, or more stringent than, the requirements of the 2008 Massachusetts Stormwater Handbook. As demonstrated below, the proposed Project fully complies with the DEP Stormwater Management Standards.

Standard 1: No New Untreated Discharges or Erosion to Wetlands

The Project has been designed to comply with Standard 1.

The Best Management Practices (BMPs) included in the proposed stormwater management system have been designed in accordance with the Massachusetts Stormwater Handbook. Supporting information and computations demonstrating that no new untreated discharges will result from the Project are presented through compliance with Standards 4 through 6.

All proposed Project stormwater outlets and conveyances have been designed to not cause erosion or scour to wetlands or receiving waters/systems.

The proposed closed drainage system will be designed for the 25-year storm event. Drainage pipes will be sized using Manning's Equation for full-flow capacity and the Rational Method. Additionally, the performance of the system was analyzed using StormCAD, a HEC-22 based program.

The Project also includes relocation of an existing 36" municipal storm culvert in order to accommodate the proposed structure. The relocation will replace the existing culvert with a new 36" reinforced concrete pipe, and reduce the length between the upstream and downstream connection points from approximately 250 LF to 200 LF, resulting in no reduction in slope and capacity of the drain.

Upon further development of the design, computations and supporting information for the sizing and selection of materials used to protect from scour and erosion will be included in Appendix A.

Standard 2: Peak Rate Attenuation

The Project has been designed to comply with Standard 2.

The rainfall-runoff response of the Site under existing and proposed conditions was evaluated for storm events with recurrence intervals of 2, 10, and 25-years. Rainfall volumes used for this analysis were based on the Natural Resources Conservation Service (NRCS) Type III, 24-hour storm and NOAA Atlas 14 precipitation depths for the site: 3.25, 5.13 and 6.30 inches, respectively. In addition, the conditions were evaluated for the 24-hour, 100-year design storm event with a rainfall volume 8.78 inches per the City of Newton Requirements for On-Site Drainage (Stormwater Management) 2018. Runoff coefficients for the pre- and post-development conditions, as previously shown in Tables 1 and 2 respectively, were determined using NRCS Technical Release 55 (TR-55) methodology as provided in HydroCAD. Drainage areas used in the analyses were described in previous sections and shown on Figures 2 and 3. The HydroCAD model is based on the NRCS Technical Release 20 (TR-20) Model for Project Formulation Hydrology.

The results of the analysis, as summarized in Table 3 and 4 below, indicate that there is no increase in peak discharge rates or runoff volume between the existing and proposed conditions.

Computations and supporting information regarding the hydrologic modeling are included in Appendix B.

Table 3 Peak Discharge Rates (cfs)

Design Point	2-year	10-year	25-year	100-year
Design Point 1: Court Street				
Existing	0.3	0.6	0.8	1.3
Proposed	0.0	0.2	0.3	1.2
Design Point 2: Crafts Street				
Existing	4.8	9.9	13.3	20.4
Proposed	0.5	4.2	8.4	18.2

Table 4 Stormwater Volume Analysis (acre-ft)

Design Point	2-year	10-year	25-year	100-year
Design Point 1: Court Street				
Existing	0.02	0.04	0.06	0.09
Proposed	0.00	0.01	0.02	0.07
Design Point 2: Crafts Street				
Existing	0.35	0.71	0.95	1.48
Proposed	0.04	0.17	0.29	0.59

Standard 3: Stormwater Recharge

The Project has been designed to comply with Standard 3.

In accordance with the Stormwater Handbook, the Required Recharge Volume for the Project is 4,733 cubic feet.

Recharge of stormwater has been provided through the use of subsurface infiltration systems, which have been sized using the Static method. Each infiltration BMP has been designed to drain completely within 72 hours. Table 5 below provides a summary of the proposed infiltration BMPs utilized for the Project.

Table 5 Summary of Recharge Calculations

Infiltration BMP	Provided Recharge Volume (cubic feet)
Subsurface Infiltration System "A"	1,163
Subsurface Infiltration System "B"	3,779
Subsurface Infiltration System "C"	2,326
Total Provided Recharge	**7,268**
Total Required Recharge	**4,733**

Soil evaluation (including preliminary Geotechnical Report), computations, and supporting information are included in Appendix C.

Standard 4: Water Quality

The Project has been designed to comply with Standard 4.

The proposed stormwater management system implements a treatment train of BMPs that has been designed to treat the one-inch Water Quality Volume, and provide a minimum of 80% TSS removal of stormwater runoff from all proposed impervious surfaces, as well as 44% pretreatment from non-roof impervious areas prior to infiltration BMPs.

Additionally, per the EPA MS4 Permit and the Charles River Lower Watershed Total Maximum Daily Load (TMDL), the Project has been designed to provide 65% Total Phosphorous (TP) removal.

Computations and supporting information, including the Long-Term Pollution Prevention Plan (i.e. Operation and Maintenance Manual), are included in Appendix D.

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

The Project is not considered a LUHPPL. Notwithstanding, the system has been designed with suitable BMPs sized to treat the 1-inch Water Quality Volume and provide the pretreatment requirement of 44% TSS removal prior to infiltration.

Standard 6: Critical Areas

The Project will not discharge stormwater near or to a critical area. Similarly with Standard 5, the system has been designed with suitable BMPs sized to treat the 1-inch Water Quality Volume and provide the pretreatment requirement of 44% TSS removal prior to infiltration.

Standard 7: Redevelopments and Other Projects Subject to the Standards only to the Maximum Extent Practicable

The Project has been designed to comply with all ten of the Stormwater Management Standards.

Refer directly to each Standard for applicable computations and supporting information demonstrating compliance with each.

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

The Project will disturb approximately 2.7 acres of land and is therefore required to obtain coverage under the Environmental Protection Agency (EPA) National Pollutant Discharge Elimination System (NPDES) Construction General Permit. As required under this permit, a Stormwater Pollution Prevention Plan (SWPPP) will be developed and submitted before land disturbance begins. Recommended construction period pollution prevention and erosion and sedimentation controls to be finalized in the SWPPP are included in the Operations and Maintenance Manual included in Appendix D.

Standard 9: Operation and Maintenance Plan

In compliance with Standard 9, a Post Construction Stormwater Operation and Maintenance (O&M) Plan has been developed for the Project. The O&M Plan is included in Appendix D as part of the Long Term Pollution Prevention Plan.

Standard 10: Prohibition of Illicit Discharges

Sanitary sewer and storm drainage structures which were part of the previous development on this site are to be completely removed during the site redevelopment. The design plans submitted with this report have been designed in full compliance with current standards. The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges.

The Project will also undergo an Inflow and Infiltration (I&I) mitigation process with the City of Newton relative to the net estimated sewer generation associated with the proposed facility.

Appendix A: Standard 1 Computations and Supporting Information

- Pipe Sizing Calculations

Pipe Sizing Calculations

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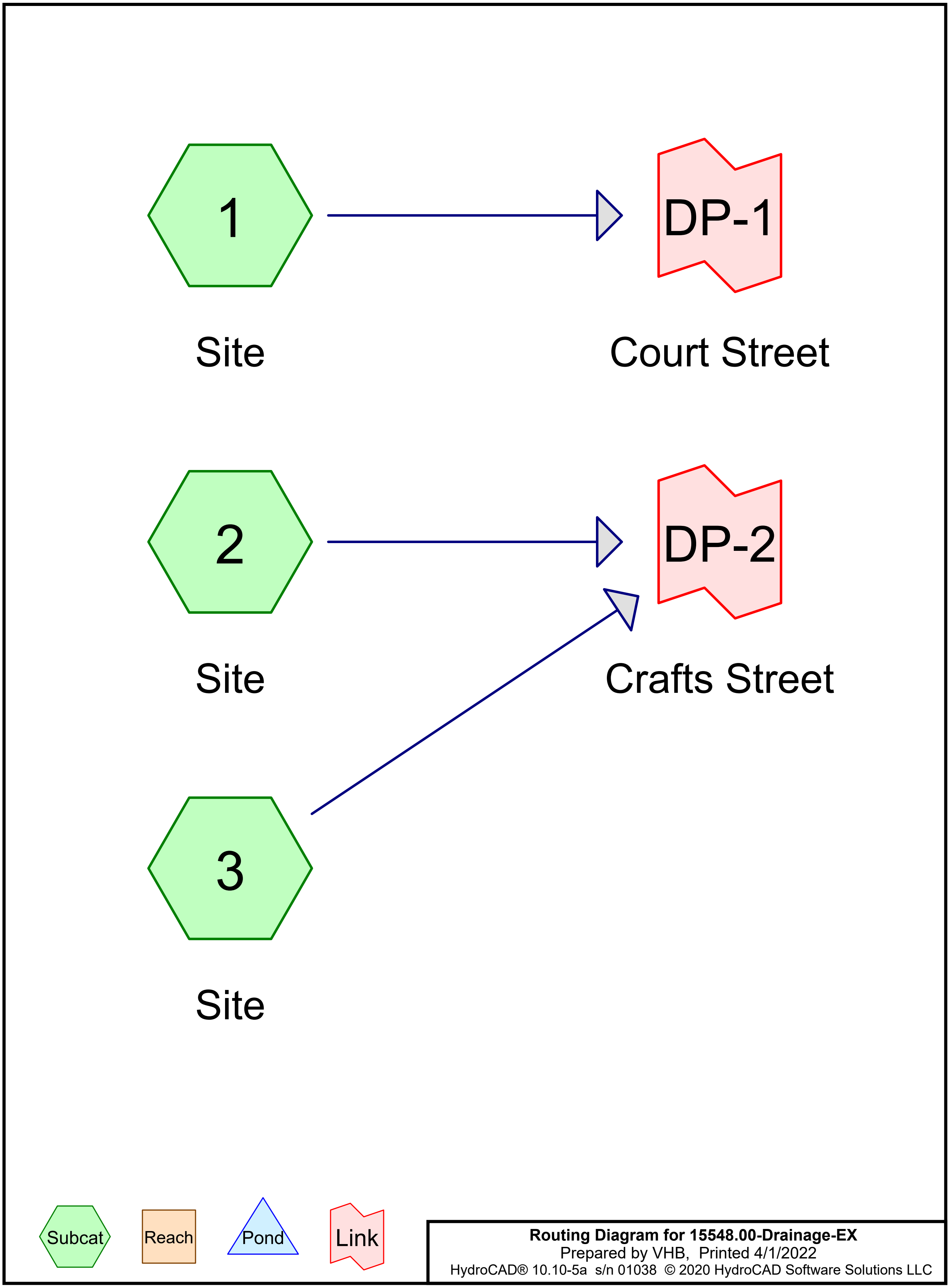
Appendix B: Standard 2 Computations and Supporting Information

› Hydrocad Analysis: Existing Conditions
- 2-Year Storm Event
- 10-Year Storm Event
- 25-Year Storm Event
- 100-Year Storm Event

› Hydrocad Analysis: Proposed Conditions
- 2-Year Storm Event
- 10-Year Storm Event
- 25-Year Storm Event
- 100-Year Storm Event

HydroCAD Analysis: Existing Conditions



Routing Diagram for 15548.00-Drainage-EX
Prepared by VHB, Printed 4/1/2022
HydroCAD® 10.10-5a s/n 01038 © 2020 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.245	61	1/4 acre lots, 38% imp, HSG A (2)
0.206	49	50-75% Grass cover, Fair, HSG A (1, 2, 3)
1.516	76	Gravel roads, HSG A (2, 3)
0.726	98	Paved parking, HSG A (1, 2, 3)
0.268	98	Roofs, HSG A (2)
2.962	**80**	**TOTAL AREA**

2-Year Storm Event – Existing

Time span=0.00-25.00 hrs, dt=0.05 hrs, 501 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1: Site Runoff Area=8,000 sf 55.00% Impervious Runoff Depth=1.19"
Flow Length=90' Tc=5.0 min CN=76 Runoff=0.25 cfs 0.018 af

Subcatchment2: Site Runoff Area=109,550 sf 30.24% Impervious Runoff Depth=1.37"
Flow Length=280' Tc=5.0 min CN=79 Runoff=4.01 cfs 0.288 af

Subcatchment3: Site Runoff Area=11,465 sf 85.74% Impervious Runoff Depth=2.59"
Flow Length=125' Tc=5.0 min CN=94 Runoff=0.77 cfs 0.057 af

Link DP-1: Court Street Inflow=0.25 cfs 0.018 af
Primary=0.25 cfs 0.018 af

Link DP-2: Crafts Street Inflow=4.77 cfs 0.345 af
Primary=4.77 cfs 0.345 af

Total Runoff Area = 2.962 ac Runoff Volume = 0.363 af Average Runoff Depth = 1.47"
63.29% Pervious = 1.875 ac 36.71% Impervious = 1.087 ac

Summary for Subcatchment 1: Site

[49] Hint: Tc<2dt may require smaller dt

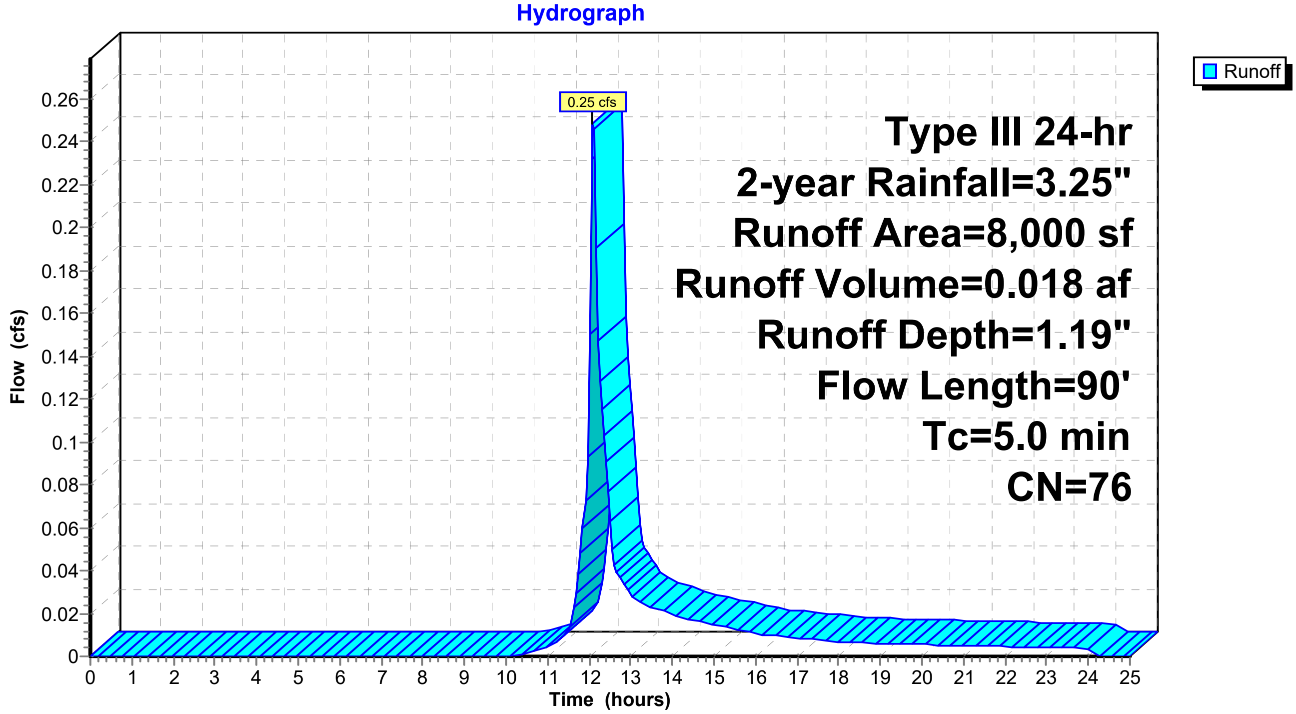
Runoff = 0.25 cfs @ 12.08 hrs, Volume= 0.018 af, Depth= 1.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-year Rainfall=3.25"

Area (sf)	CN	Description
4,400	98	Paved parking, HSG A
0	98	Roofs, HSG A
0	61	1/4 acre lots, 38% imp, HSG A
0	76	Gravel roads, HSG A
3,600	49	50-75% Grass cover, Fair, HSG A
8,000	76	Weighted Average
3,600		45.00% Pervious Area
4,400		55.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.2	50	0.0400	0.20		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 3.25"
0.3	20	0.0050	1.14		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.1	20	0.0050	3.21	2.52	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Concrete pipe, bends & connections
4.6	90	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 1: Site



Summary for Subcatchment 2: Site

[49] Hint: Tc<2dt may require smaller dt
[47] Hint: Peak is 777% of capacity of segment #3

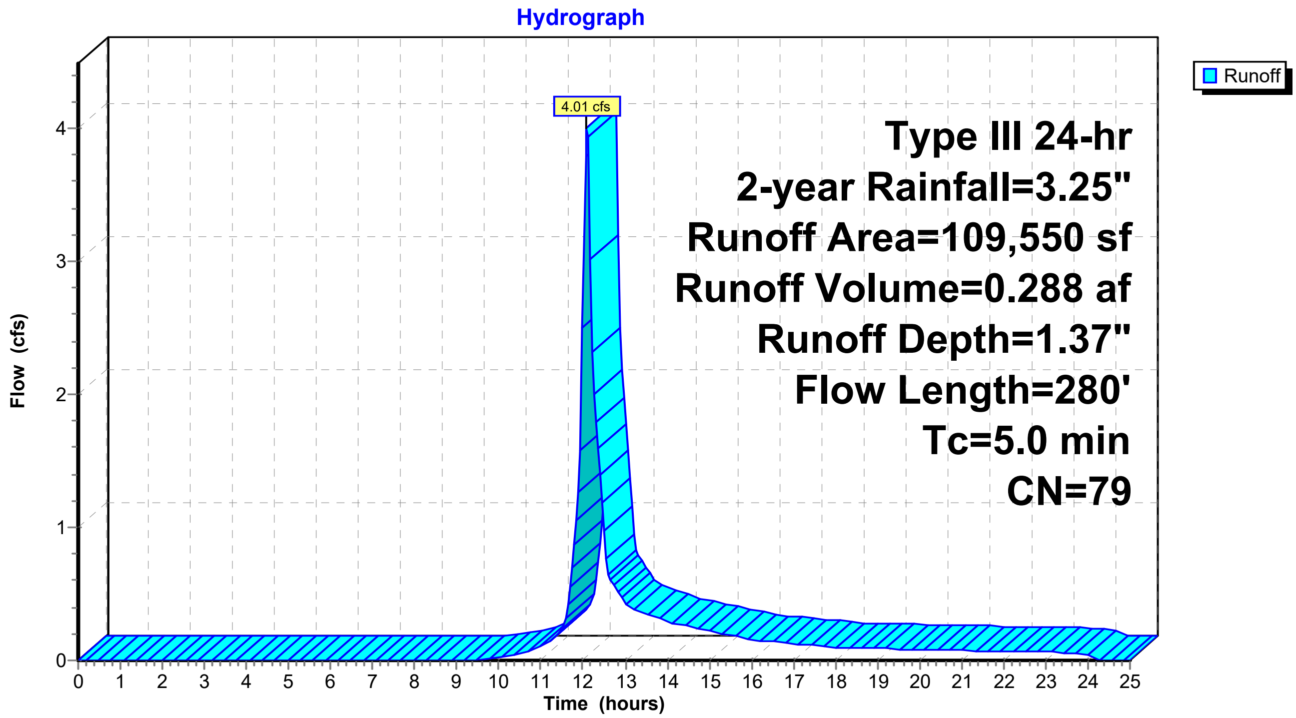
Runoff = 4.01 cfs @ 12.08 hrs, Volume= 0.288 af, Depth= 1.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-year Rainfall=3.25"

Area (sf)	CN	Description
17,405	98	Paved parking, HSG A
11,670	98	Roofs, HSG A
10,675	61	1/4 acre lots, 38% imp, HSG A
64,935	76	Gravel roads, HSG A
4,865	49	50-75% Grass cover, Fair, HSG A
109,550	79	Weighted Average
76,419		69.76% Pervious Area
33,132		30.24% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	50	0.0100	0.91		**Sheet Flow, Sheet Flow** Smooth surfaces n= 0.011 P2= 3.25"
0.6	70	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.0	160	0.0050	2.63	0.52	**Pipe Channel,** 6.0" Round Area= 0.2 sf Perim= 1.6' r= 0.13' n= 0.010 PVC, smooth interior
2.5	280	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 2: Site



Summary for Subcatchment 3: Site

[49] Hint: Tc<2dt may require smaller dt

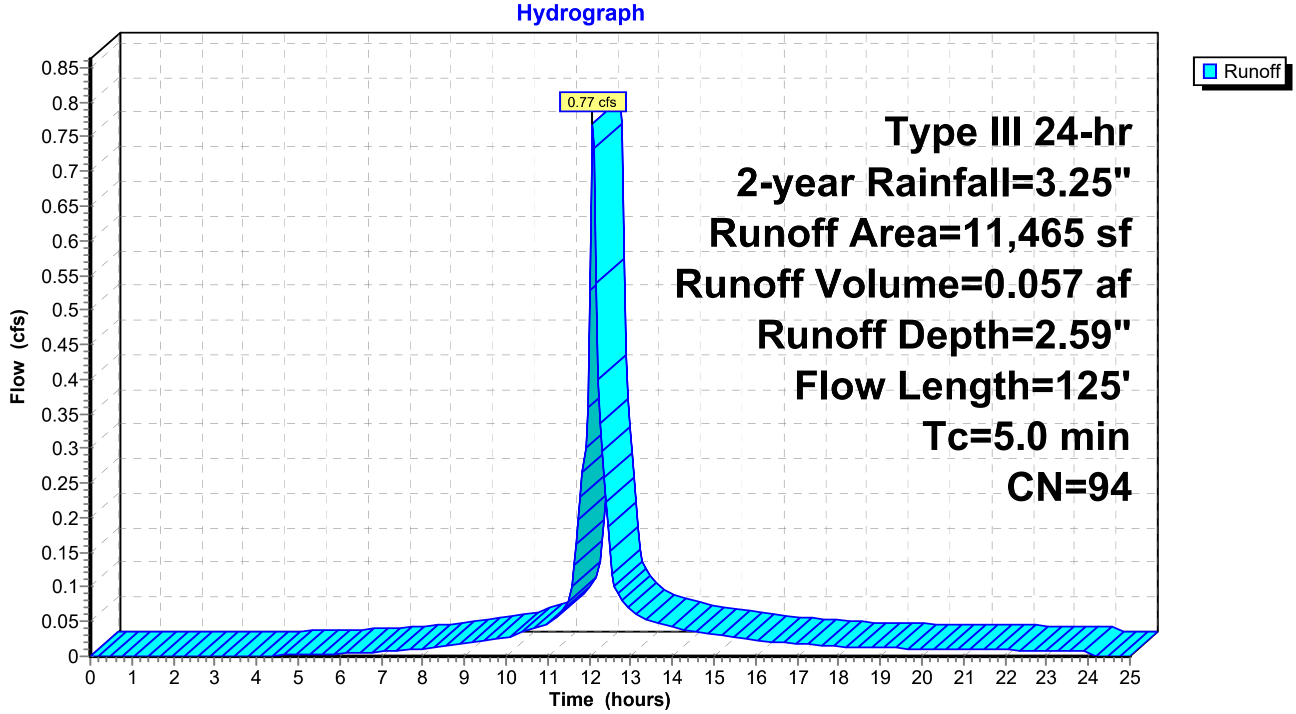
Runoff = 0.77 cfs @ 12.07 hrs, Volume= 0.057 af, Depth= 2.59"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-year Rainfall=3.25"

Area (sf)	CN	Description
9,830	98	Paved parking, HSG A
0	98	Roofs, HSG A
0	61	1/4 acre lots, 38% imp, HSG A
1,115	76	Gravel roads, HSG A
520	49	50-75% Grass cover, Fair, HSG A
11,465	94	Weighted Average
1,635		14.26% Pervious Area
9,830		85.74% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.21		**Sheet Flow, Sheet Flow** Smooth surfaces n= 0.011 P2= 3.25"
0.6	55	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.1	20	0.0050	3.21	2.52	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Concrete pipe, bends & connections
1.4	125	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 3: Site

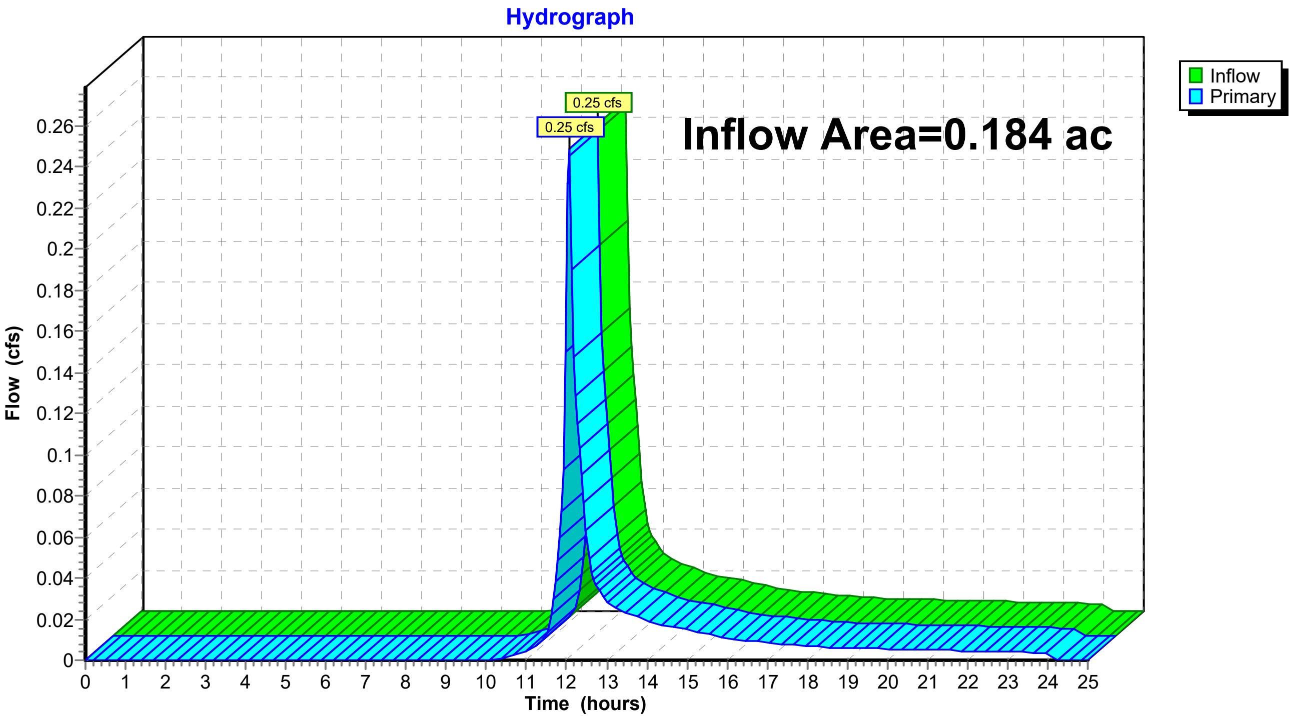


Summary for Link DP-1: Court Street

Inflow Area =	0.184 ac, 55.00% Impervious, Inflow Depth = 1.19" for 2-year event		
Inflow =	0.25 cfs @ 12.08 hrs, Volume=	0.018 af	
Primary =	0.25 cfs @ 12.08 hrs, Volume=	0.018 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs

Link DP-1: Court Street

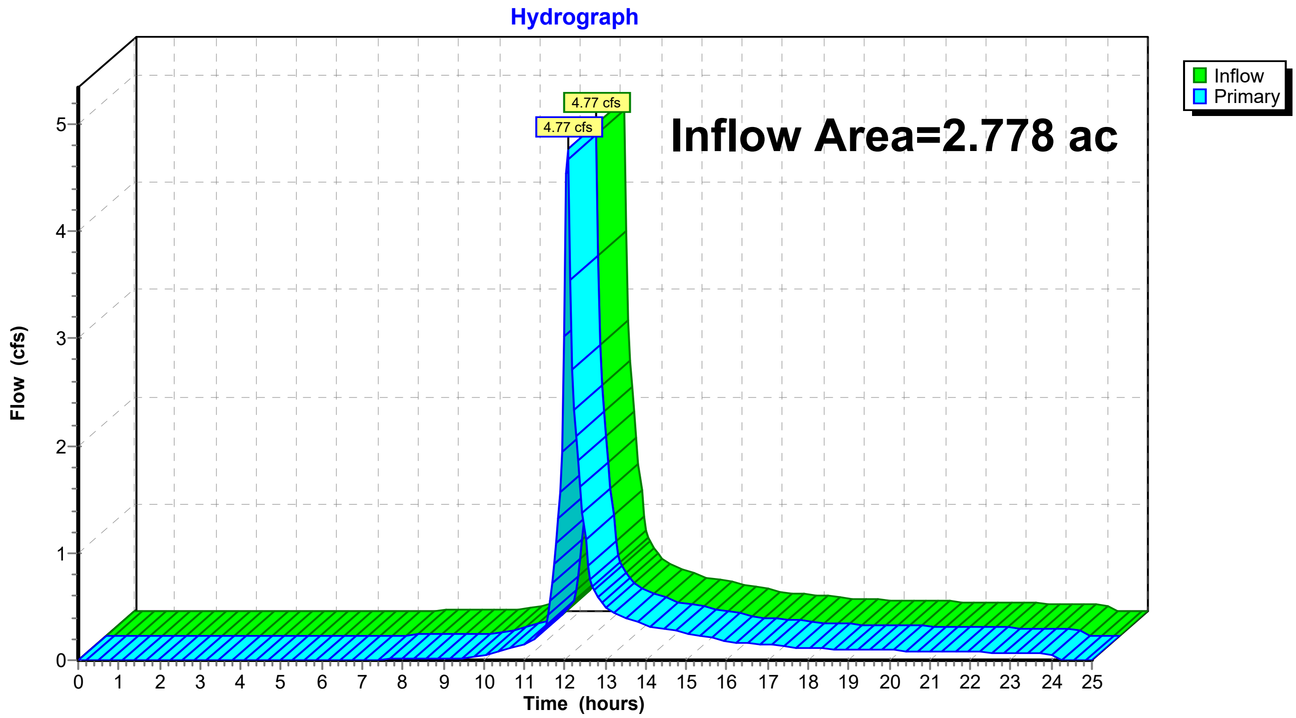


Summary for Link DP-2: Crafts Street

Inflow Area = 2.778 ac, 35.50% Impervious, Inflow Depth = 1.49" for 2-year event
Inflow = 4.77 cfs @ 12.08 hrs, Volume= 0.345 af
Primary = 4.77 cfs @ 12.08 hrs, Volume= 0.345 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs

Link DP-2: Crafts Street



10-Year Storm Event – Existing

Time span=0.00-25.00 hrs, dt=0.05 hrs, 501 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1: Site Runoff Area=8,000 sf 55.00% Impervious Runoff Depth=2.64"
Flow Length=90' Tc=5.0 min CN=76 Runoff=0.57 cfs 0.040 af

Subcatchment2: Site Runoff Area=109,550 sf 30.24% Impervious Runoff Depth=2.91"
Flow Length=280' Tc=5.0 min CN=79 Runoff=8.60 cfs 0.611 af

Subcatchment3: Site Runoff Area=11,465 sf 85.74% Impervious Runoff Depth=4.44"
Flow Length=125' Tc=5.0 min CN=94 Runoff=1.28 cfs 0.097 af

Link DP-1: Court Street Inflow=0.57 cfs 0.040 af
Primary=0.57 cfs 0.040 af

Link DP-2: Crafts Street Inflow=9.86 cfs 0.708 af
Primary=9.86 cfs 0.708 af

Total Runoff Area = 2.962 ac Runoff Volume = 0.748 af Average Runoff Depth = 3.03"
63.29% Pervious = 1.875 ac 36.71% Impervious = 1.087 ac

Summary for Subcatchment 1: Site

[49] Hint: Tc<2dt may require smaller dt

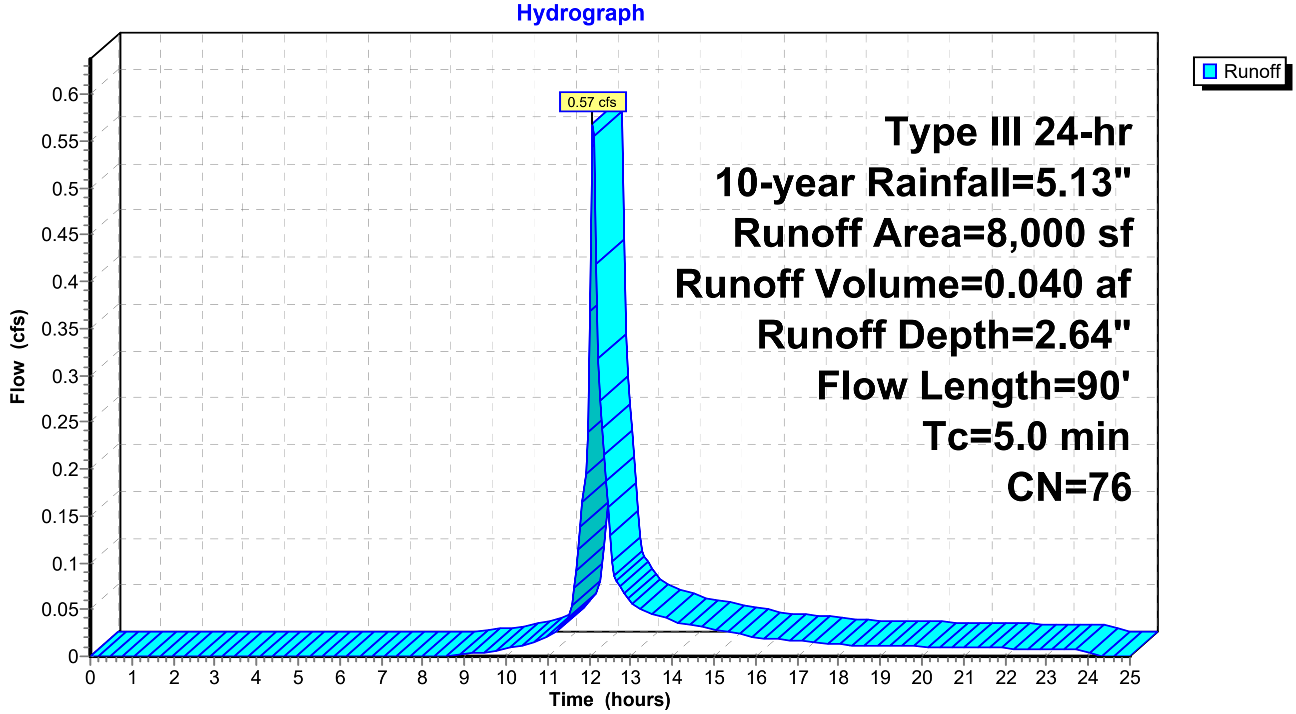
Runoff = 0.57 cfs @ 12.08 hrs, Volume= 0.040 af, Depth= 2.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-year Rainfall=5.13"

Area (sf)	CN	Description
4,400	98	Paved parking, HSG A
0	98	Roofs, HSG A
0	61	1/4 acre lots, 38% imp, HSG A
0	76	Gravel roads, HSG A
3,600	49	50-75% Grass cover, Fair, HSG A
8,000	76	Weighted Average
3,600		45.00% Pervious Area
4,400		55.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.2	50	0.0400	0.20		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 3.25"
0.3	20	0.0050	1.14		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.1	20	0.0050	3.21	2.52	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Concrete pipe, bends & connections
4.6	90	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 1: Site



Summary for Subcatchment 2: Site

[49] Hint: Tc<2dt may require smaller dt
[47] Hint: Peak is 1666% of capacity of segment #3

Runoff = 8.60 cfs @ 12.08 hrs, Volume= 0.611 af, Depth= 2.91"

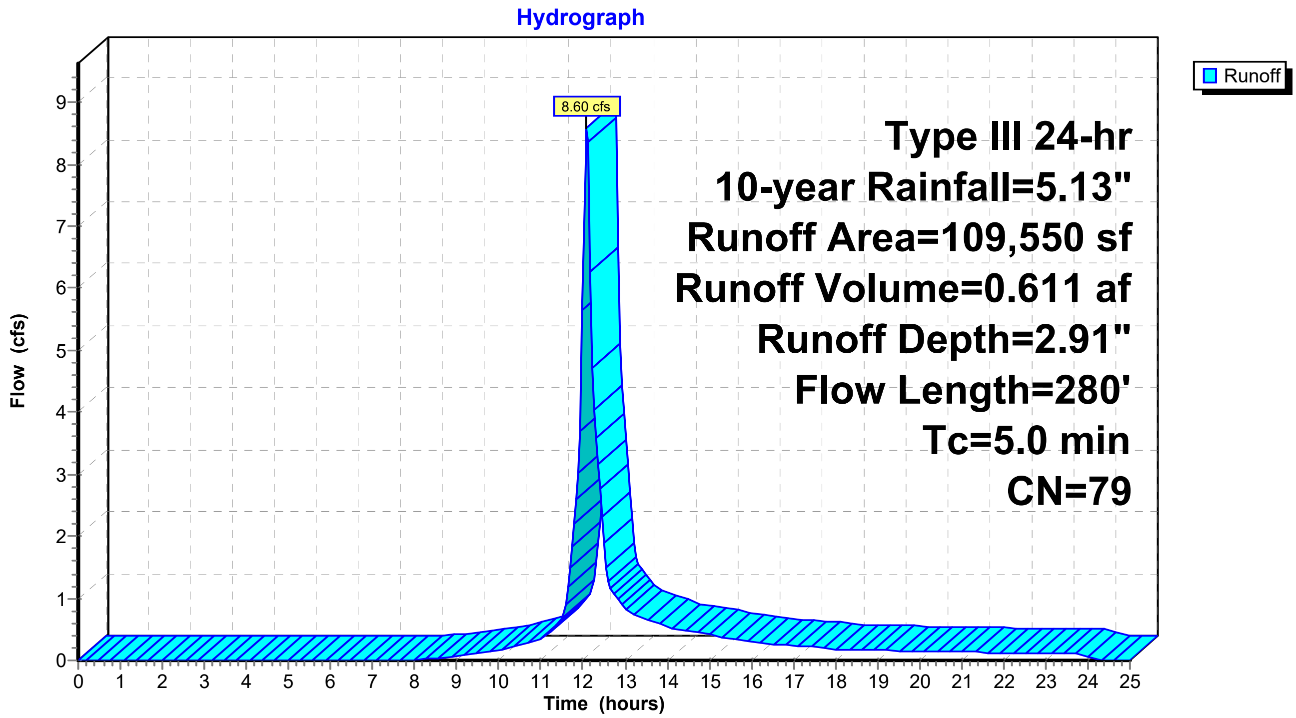
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-year Rainfall=5.13"

Area (sf)	CN	Description
17,405	98	Paved parking, HSG A
11,670	98	Roofs, HSG A
10,675	61	1/4 acre lots, 38% imp, HSG A
64,935	76	Gravel roads, HSG A
4,865	49	50-75% Grass cover, Fair, HSG A
109,550	79	Weighted Average
76,419		69.76% Pervious Area
33,132		30.24% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	50	0.0100	0.91		**Sheet Flow, Sheet Flow** Smooth surfaces n= 0.011 P2= 3.25"
0.6	70	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.0	160	0.0050	2.63	0.52	**Pipe Channel,** 6.0" Round Area= 0.2 sf Perim= 1.6' r= 0.13' n= 0.010 PVC, smooth interior
2.5	280	Total, Increased to minimum Tc = 5.0 min			

#260-22

Subcatchment 2: Site



Summary for Subcatchment 3: Site

[49] Hint: Tc<2dt may require smaller dt

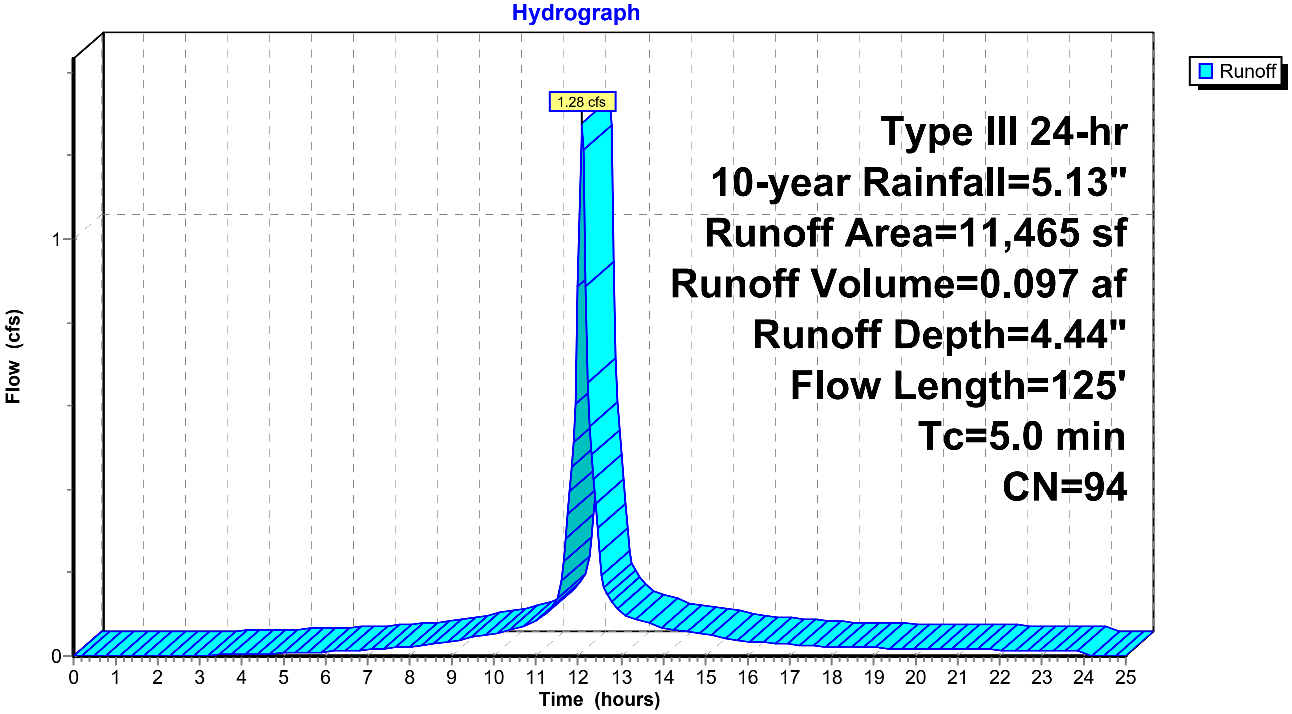
Runoff = 1.28 cfs @ 12.07 hrs, Volume= 0.097 af, Depth= 4.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-year Rainfall=5.13"

Area (sf)	CN	Description
9,830	98	Paved parking, HSG A
0	98	Roofs, HSG A
0	61	1/4 acre lots, 38% imp, HSG A
1,115	76	Gravel roads, HSG A
520	49	50-75% Grass cover, Fair, HSG A
11,465	94	Weighted Average
1,635		14.26% Pervious Area
9,830		85.74% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.21		**Sheet Flow, Sheet Flow** Smooth surfaces n= 0.011 P2= 3.25"
0.6	55	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.1	20	0.0050	3.21	2.52	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Concrete pipe, bends & connections
1.4	125	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 3: Site

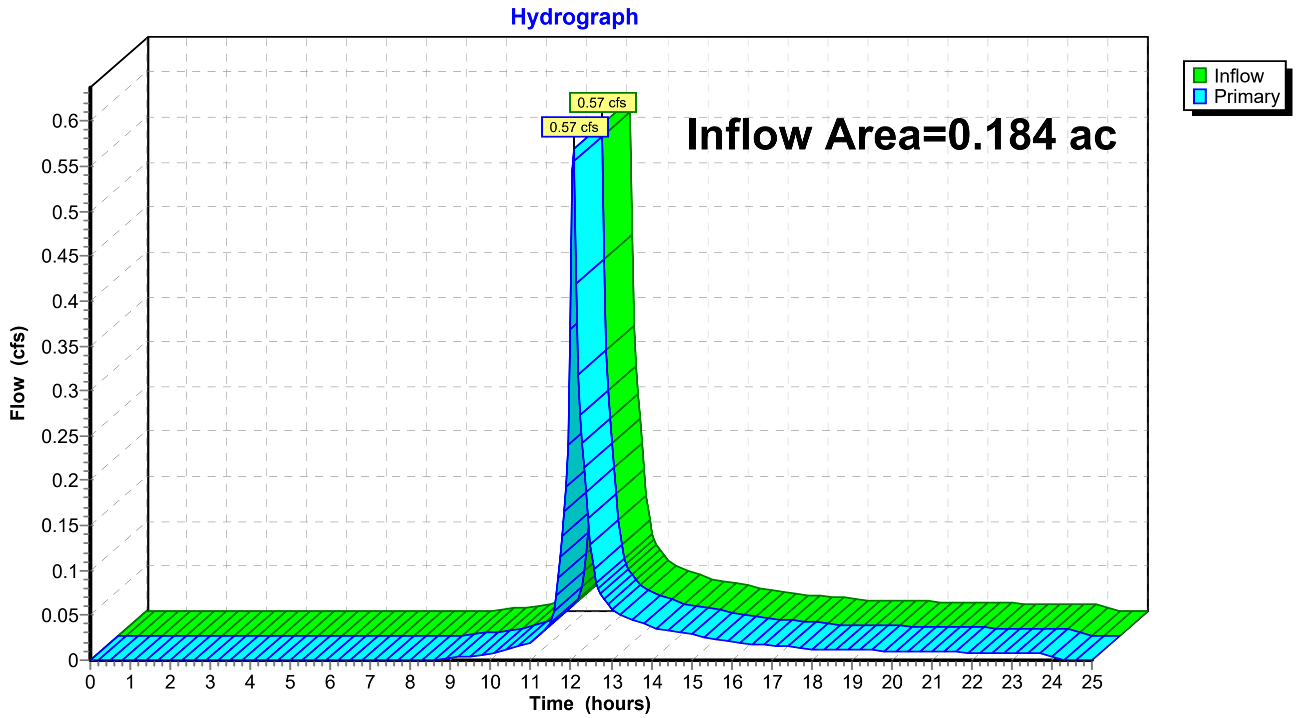


Summary for Link DP-1: Court Street

Inflow Area = 0.184 ac, 55.00% Impervious, Inflow Depth = 2.64" for 10-year event
Inflow = 0.57 cfs @ 12.08 hrs, Volume= 0.040 af
Primary = 0.57 cfs @ 12.08 hrs, Volume= 0.040 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs

Link DP-1: Court Street

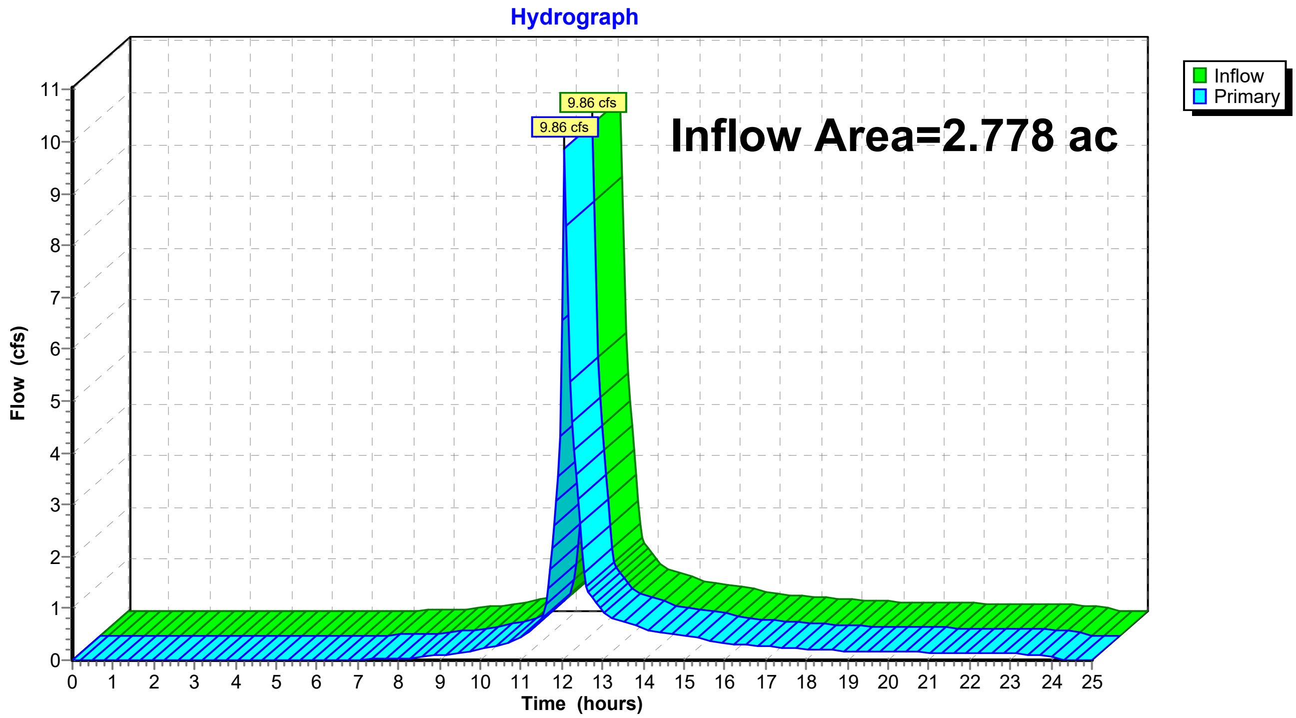


Summary for Link DP-2: Crafts Street

Inflow Area =	2.778 ac,	35.50% Impervious,	Inflow Depth = 3.06"	for 10-year event	
Inflow =	9.86 cfs @	12.08 hrs,	Volume=	0.708 af	
Primary =	9.86 cfs @	12.08 hrs,	Volume=	0.708 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs

Link DP-2: Crafts Street



25-Year Storm Event – Existing

Time span=0.00-25.00 hrs, dt=0.05 hrs, 501 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1: Site Runoff Area=8,000 sf 55.00% Impervious Runoff Depth=3.64"
Flow Length=90' Tc=5.0 min CN=76 Runoff=0.78 cfs 0.056 af

Subcatchment2: Site Runoff Area=109,550 sf 30.24% Impervious Runoff Depth=3.95"
Flow Length=280' Tc=5.0 min CN=79 Runoff=11.59 cfs 0.828 af

Subcatchment3: Site Runoff Area=11,465 sf 85.74% Impervious Runoff Depth=5.59"
Flow Length=125' Tc=5.0 min CN=94 Runoff=1.59 cfs 0.123 af

Link DP-1: Court Street Inflow=0.78 cfs 0.056 af
Primary=0.78 cfs 0.056 af

Link DP-2: Crafts Street Inflow=13.25 cfs 0.950 af
Primary=13.25 cfs 0.950 af

Total Runoff Area = 2.962 ac Runoff Volume = 1.006 af Average Runoff Depth = 4.08"
63.29% Pervious = 1.875 ac 36.71% Impervious = 1.087 ac

Summary for Subcatchment 1: Site

[49] Hint: Tc<2dt may require smaller dt

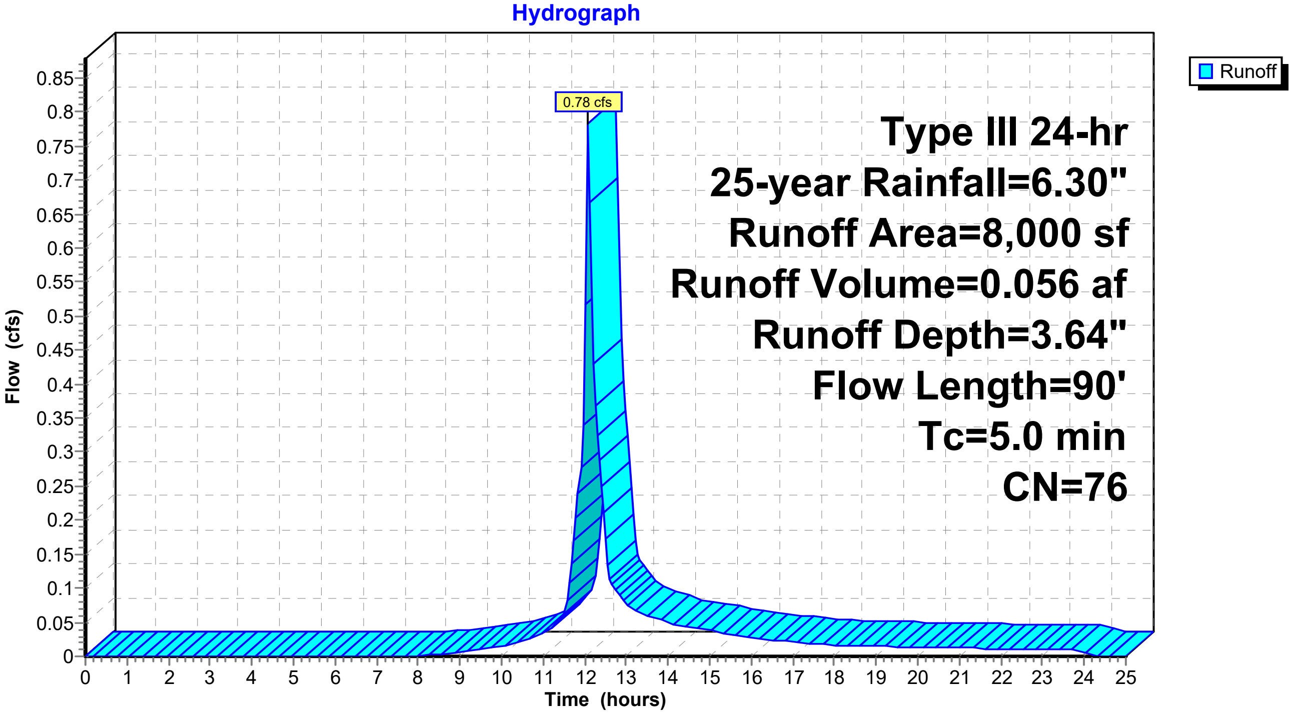
Runoff = 0.78 cfs @ 12.08 hrs, Volume= 0.056 af, Depth= 3.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-year Rainfall=6.30"

Area (sf)	CN	Description
4,400	98	Paved parking, HSG A
0	98	Roofs, HSG A
0	61	1/4 acre lots, 38% imp, HSG A
0	76	Gravel roads, HSG A
3,600	49	50-75% Grass cover, Fair, HSG A
8,000	76	Weighted Average
3,600		45.00% Pervious Area
4,400		55.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.2	50	0.0400	0.20		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 3.25"
0.3	20	0.0050	1.14		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.1	20	0.0050	3.21	2.52	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Concrete pipe, bends & connections
4.6	90	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 1: Site



Summary for Subcatchment 2: Site

[49] Hint: Tc<2dt may require smaller dt
[47] Hint: Peak is 2248% of capacity of segment #3

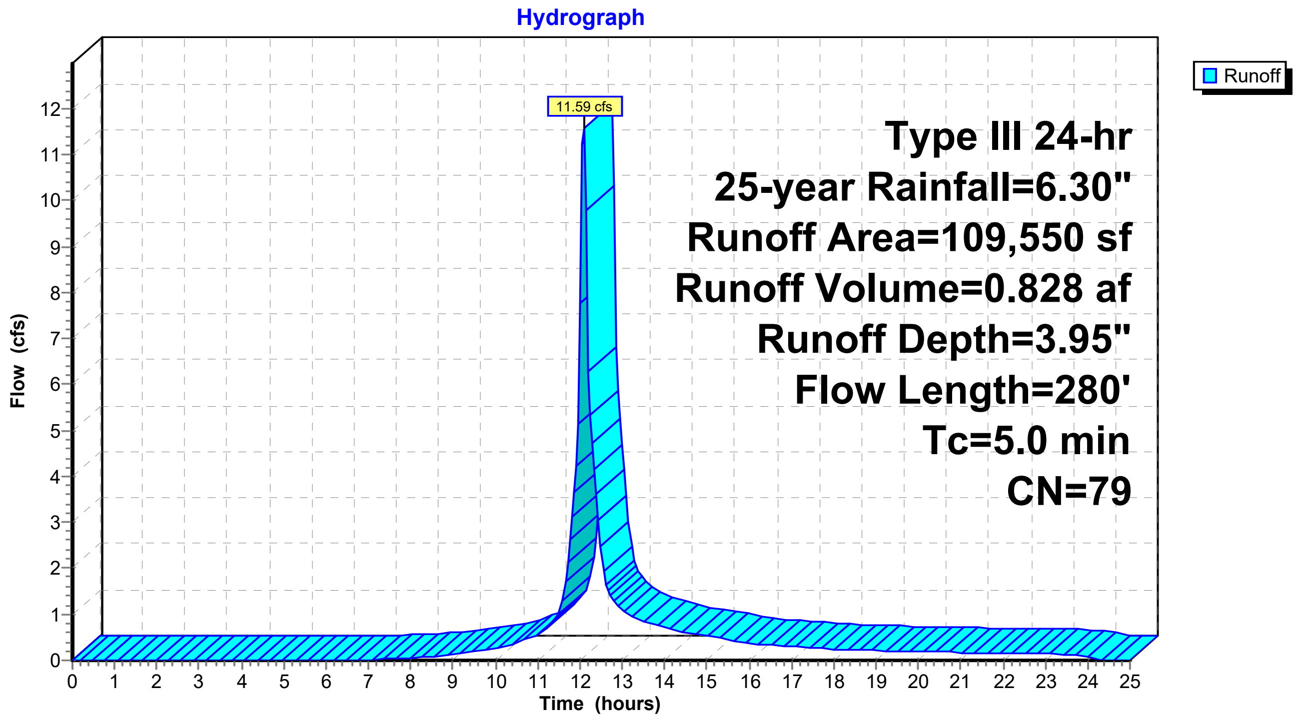
Runoff = 11.59 cfs @ 12.08 hrs, Volume= 0.828 af, Depth= 3.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-year Rainfall=6.30"

Area (sf)	CN	Description
17,405	98	Paved parking, HSG A
11,670	98	Roofs, HSG A
10,675	61	1/4 acre lots, 38% imp, HSG A
64,935	76	Gravel roads, HSG A
4,865	49	50-75% Grass cover, Fair, HSG A
109,550	79	Weighted Average
76,419		69.76% Pervious Area
33,132		30.24% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	50	0.0100	0.91		**Sheet Flow, Sheet Flow** Smooth surfaces n= 0.011 P2= 3.25"
0.6	70	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.0	160	0.0050	2.63	0.52	**Pipe Channel,** 6.0" Round Area= 0.2 sf Perim= 1.6' r= 0.13' n= 0.010 PVC, smooth interior
2.5	280	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 2: Site



Summary for Subcatchment 3: Site

[49] Hint: Tc<2dt may require smaller dt

Runoff = 1.59 cfs @ 12.07 hrs, Volume= 0.123 af, Depth= 5.59"

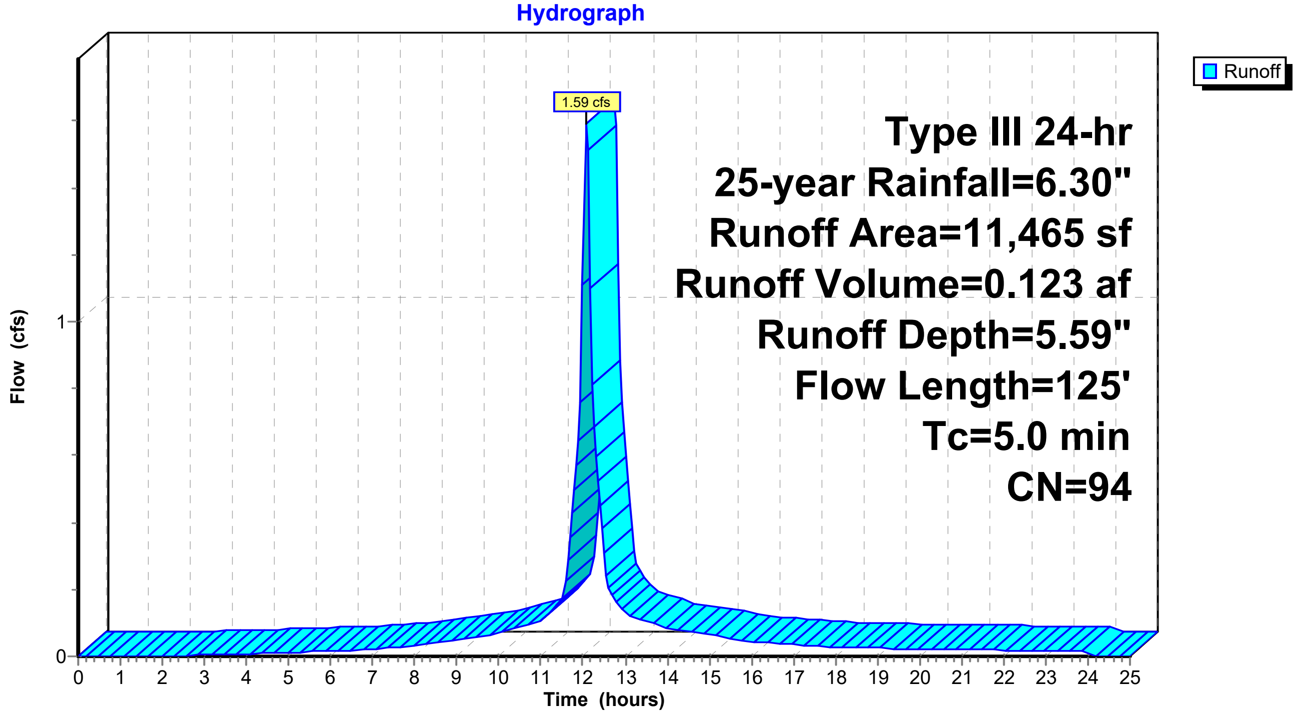
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-year Rainfall=6.30"

Area (sf)	CN	Description
9,830	98	Paved parking, HSG A
0	98	Roofs, HSG A
0	61	1/4 acre lots, 38% imp, HSG A
1,115	76	Gravel roads, HSG A
520	49	50-75% Grass cover, Fair, HSG A
11,465	94	Weighted Average
1,635		14.26% Pervious Area
9,830		85.74% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.21		**Sheet Flow, Sheet Flow** Smooth surfaces n= 0.011 P2= 3.25"
0.6	55	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.1	20	0.0050	3.21	2.52	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Concrete pipe, bends & connections
1.4	125	Total, Increased to minimum Tc = 5.0 min			

#260-22

Subcatchment 3: Site

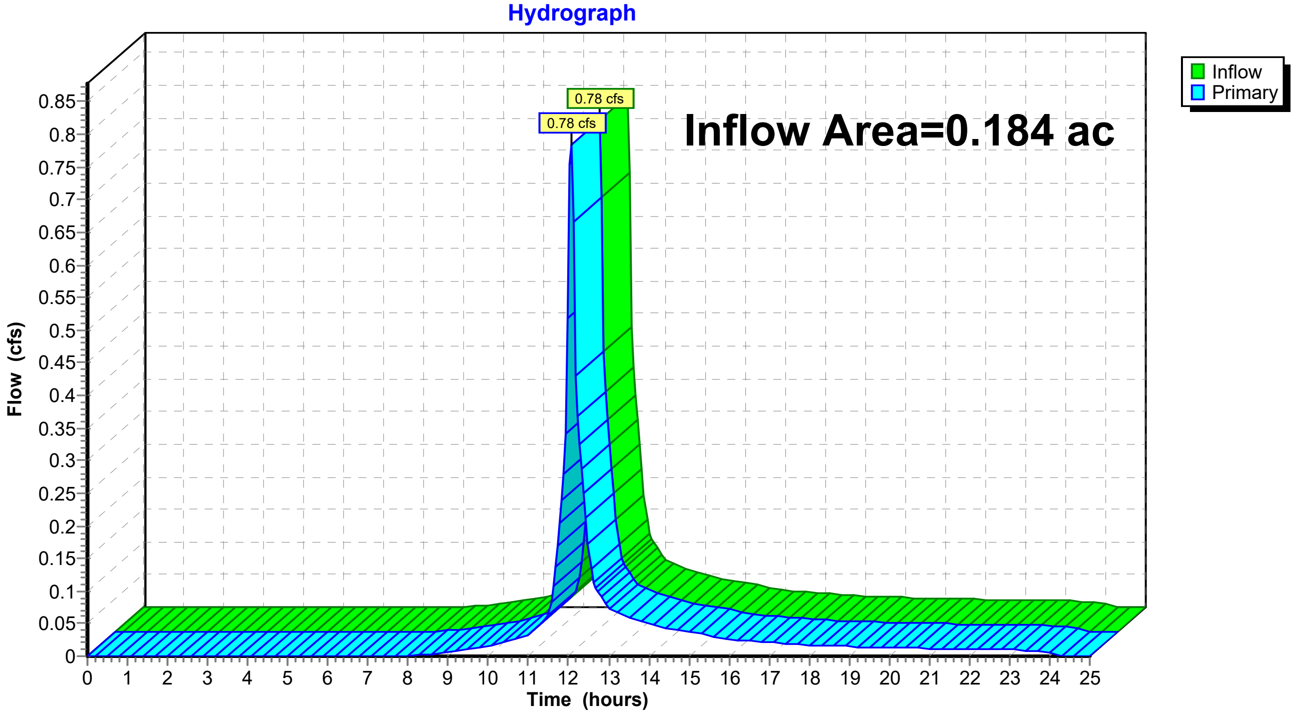


Summary for Link DP-1: Court Street

Inflow Area = 0.184 ac, 55.00% Impervious, Inflow Depth = 3.64" for 25-year event
Inflow = 0.78 cfs @ 12.08 hrs, Volume= 0.056 af
Primary = 0.78 cfs @ 12.08 hrs, Volume= 0.056 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs

Link DP-1: Court Street

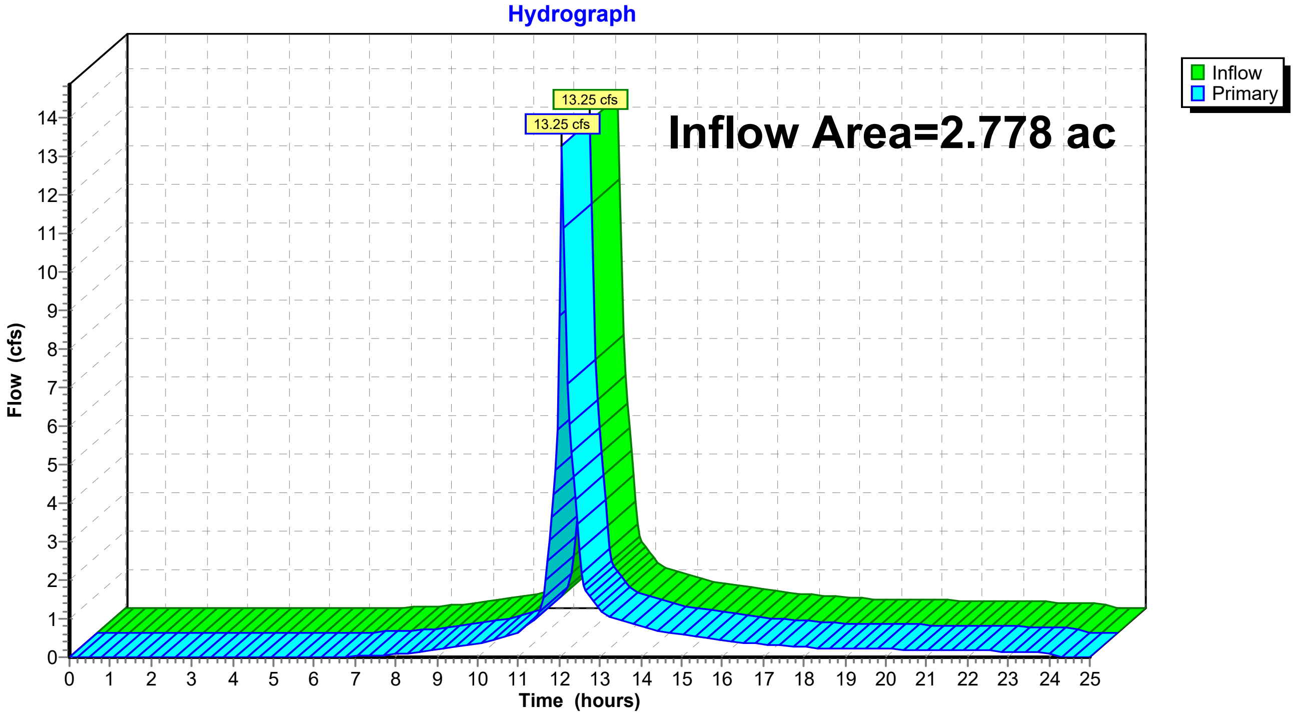


Summary for Link DP-2: Crafts Street

Inflow Area = 2.778 ac, 35.50% Impervious, Inflow Depth = 4.10" for 25-year event
Inflow = 13.25 cfs @ 12.07 hrs, Volume= 0.950 af
Primary = 13.25 cfs @ 12.07 hrs, Volume= 0.950 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs

Link DP-2: Crafts Street



100-Year Storm Event – Existing

Time span=0.00-25.00 hrs, dt=0.05 hrs, 501 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1: Site Runoff Area=8,000 sf 55.00% Impervious Runoff Depth=5.87"
Flow Length=90' Tc=5.0 min CN=76 Runoff=1.26 cfs 0.090 af

Subcatchment2: Site Runoff Area=109,550 sf 30.24% Impervious Runoff Depth=6.24"
Flow Length=280' Tc=5.0 min CN=79 Runoff=18.17 cfs 1.307 af

Subcatchment3: Site Runoff Area=11,465 sf 85.74% Impervious Runoff Depth=8.06"
Flow Length=125' Tc=5.0 min CN=94 Runoff=2.25 cfs 0.177 af

Link DP-1: Court Street Inflow=1.26 cfs 0.090 af
Primary=1.26 cfs 0.090 af

Link DP-2: Crafts Street Inflow=20.42 cfs 1.484 af
Primary=20.42 cfs 1.484 af

Total Runoff Area = 2.962 ac Runoff Volume = 1.574 af Average Runoff Depth = 6.38"
63.29% Pervious = 1.875 ac 36.71% Impervious = 1.087 ac

Summary for Subcatchment 1: Site

[49] Hint: Tc<2dt may require smaller dt

Runoff = 1.26 cfs @ 12.07 hrs, Volume= 0.090 af, Depth= 5.87"

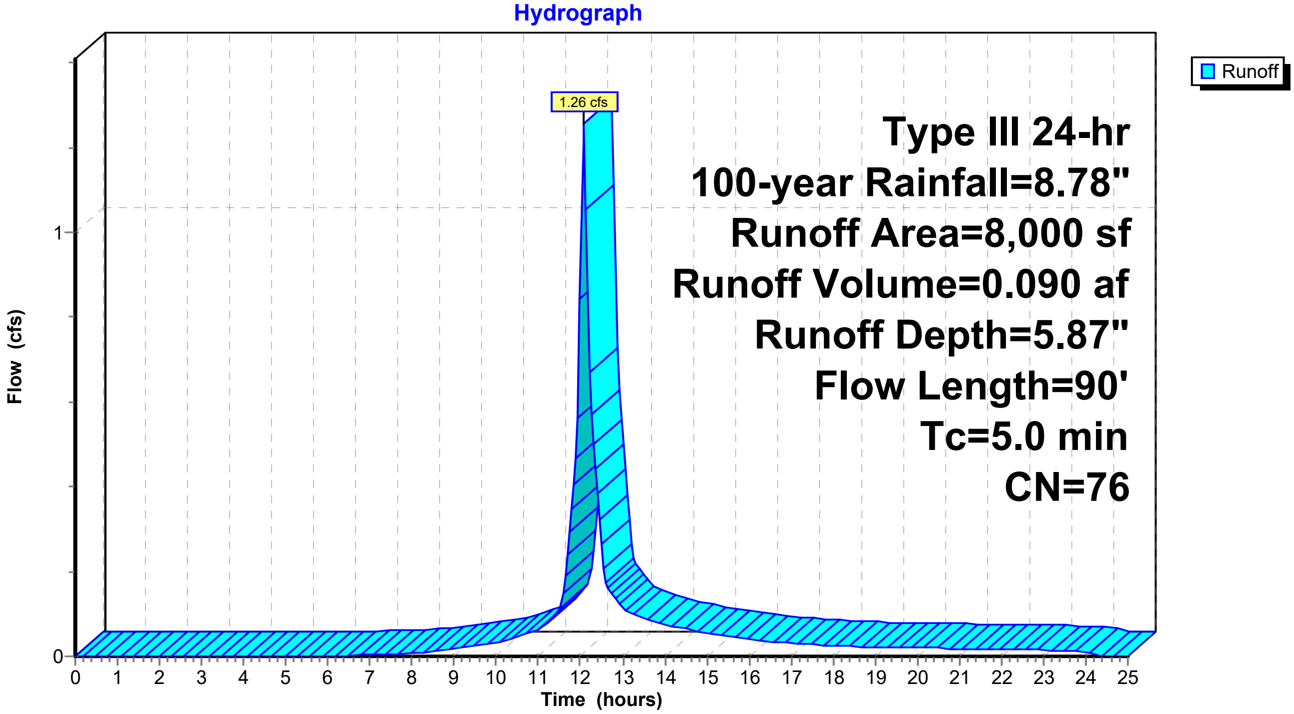
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=8.78"

Area (sf)	CN	Description
4,400	98	Paved parking, HSG A
0	98	Roofs, HSG A
0	61	1/4 acre lots, 38% imp, HSG A
0	76	Gravel roads, HSG A
3,600	49	50-75% Grass cover, Fair, HSG A
8,000	76	Weighted Average
3,600		45.00% Pervious Area
4,400		55.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.2	50	0.0400	0.20		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 3.25"
0.3	20	0.0050	1.14		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.1	20	0.0050	3.21	2.52	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Concrete pipe, bends & connections
4.6	90	Total, Increased to minimum Tc = 5.0 min			

#260-22

Subcatchment 1: Site



Summary for Subcatchment 2: Site

[49] Hint: Tc<2dt may require smaller dt
[47] Hint: Peak is 3523% of capacity of segment #3

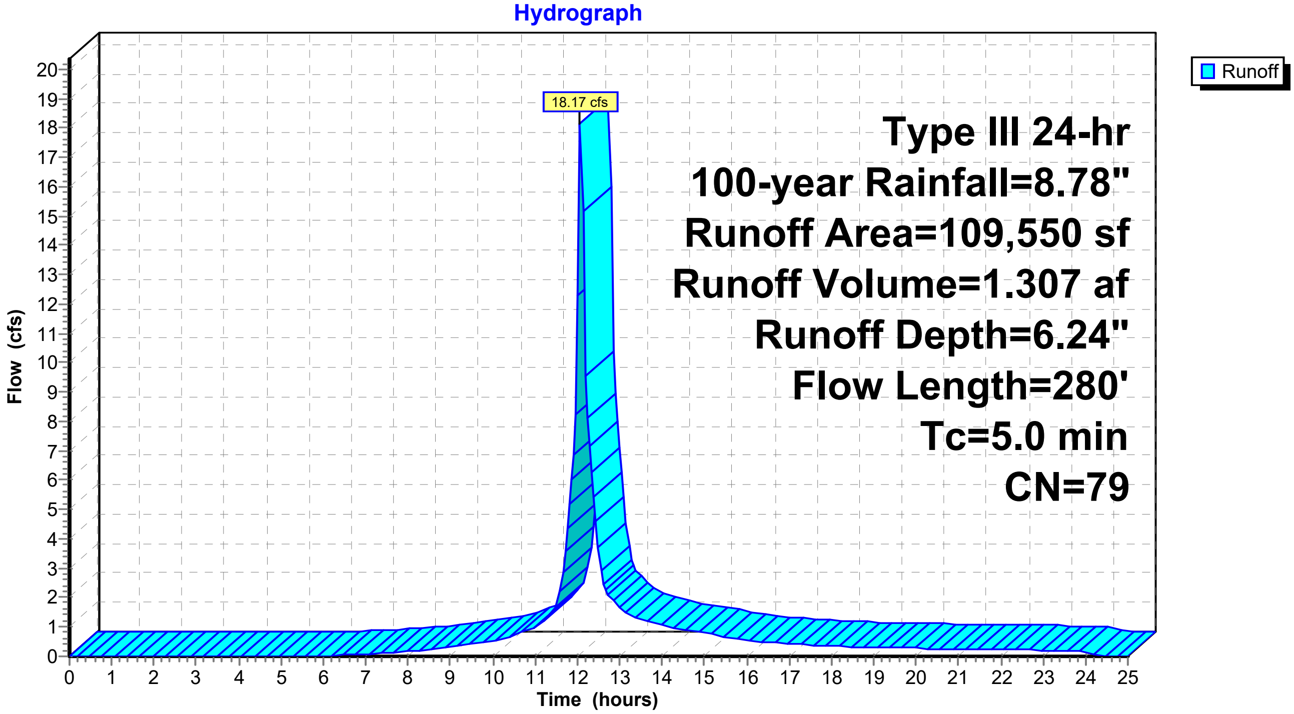
Runoff = 18.17 cfs @ 12.07 hrs, Volume= 1.307 af, Depth= 6.24"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=8.78"

Area (sf)	CN	Description
17,405	98	Paved parking, HSG A
11,670	98	Roofs, HSG A
10,675	61	1/4 acre lots, 38% imp, HSG A
64,935	76	Gravel roads, HSG A
4,865	49	50-75% Grass cover, Fair, HSG A
109,550	79	Weighted Average
76,419		69.76% Pervious Area
33,132		30.24% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	50	0.0100	0.91		**Sheet Flow, Sheet Flow** Smooth surfaces n= 0.011 P2= 3.25"
0.6	70	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.0	160	0.0050	2.63	0.52	**Pipe Channel,** 6.0" Round Area= 0.2 sf Perim= 1.6' r= 0.13' n= 0.010 PVC, smooth interior
2.5	280	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 2: Site



Summary for Subcatchment 3: Site

[49] Hint: Tc<2dt may require smaller dt

Runoff = 2.25 cfs @ 12.07 hrs, Volume= 0.177 af, Depth= 8.06"

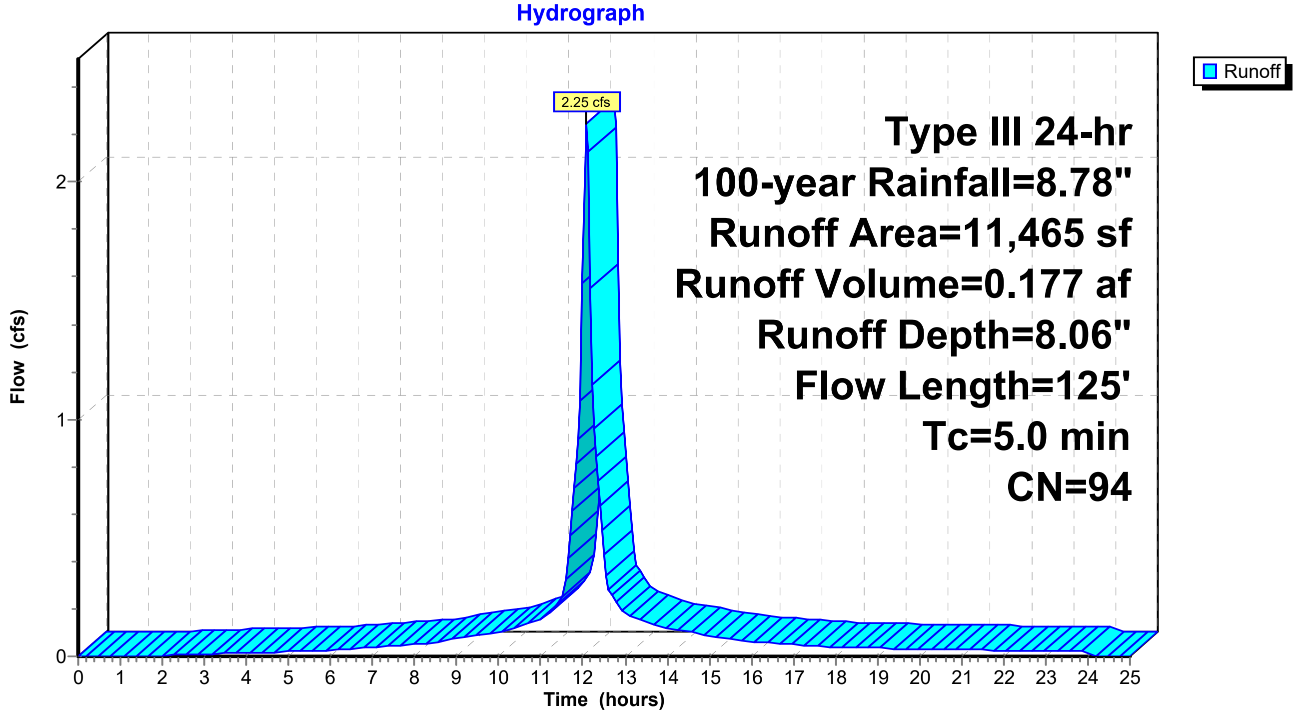
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=8.78"

Area (sf)	CN	Description
9,830	98	Paved parking, HSG A
0	98	Roofs, HSG A
0	61	1/4 acre lots, 38% imp, HSG A
1,115	76	Gravel roads, HSG A
520	49	50-75% Grass cover, Fair, HSG A
11,465	94	Weighted Average
1,635		14.26% Pervious Area
9,830		85.74% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.21		**Sheet Flow, Sheet Flow** Smooth surfaces n= 0.011 P2= 3.25"
0.6	55	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.1	20	0.0050	3.21	2.52	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Concrete pipe, bends & connections
1.4	125	Total, Increased to minimum Tc = 5.0 min			

#260-22

Subcatchment 3: Site

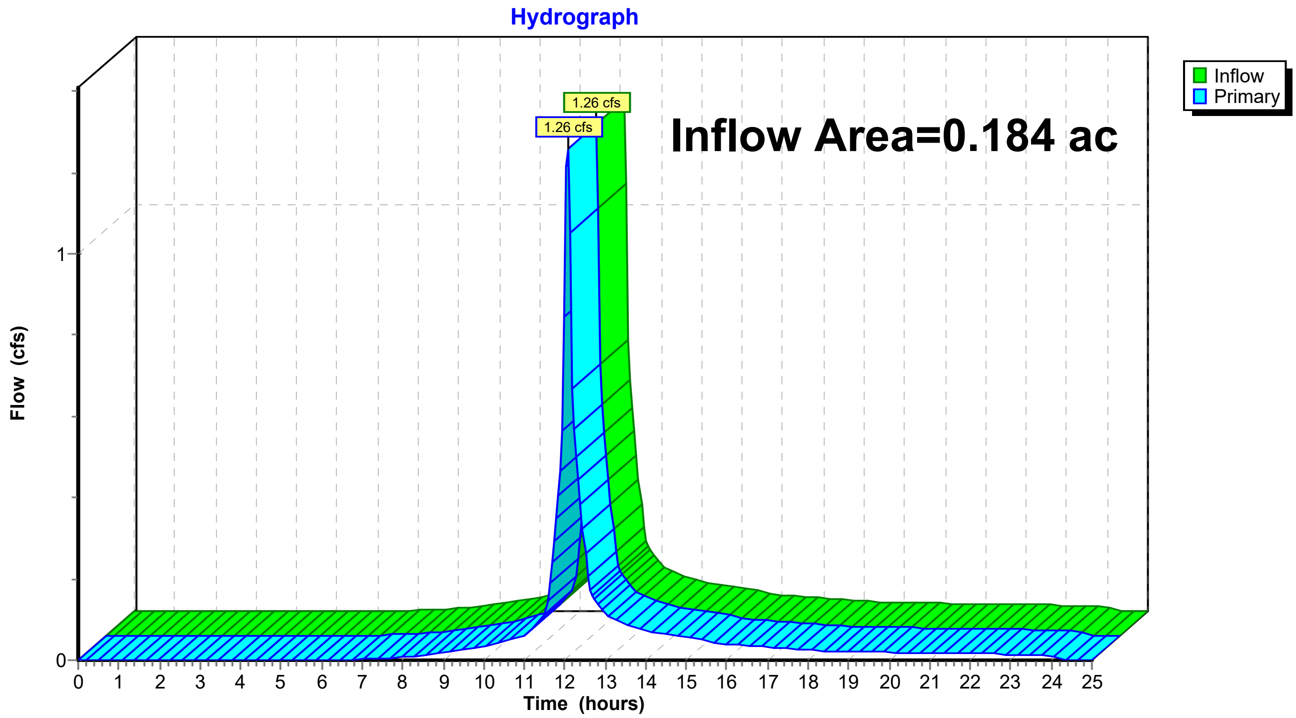


Summary for Link DP-1: Court Street

Inflow Area = 0.184 ac, 55.00% Impervious, Inflow Depth = 5.87" for 100-year event
Inflow = 1.26 cfs @ 12.07 hrs, Volume= 0.090 af
Primary = 1.26 cfs @ 12.07 hrs, Volume= 0.090 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs

Link DP-1: Court Street

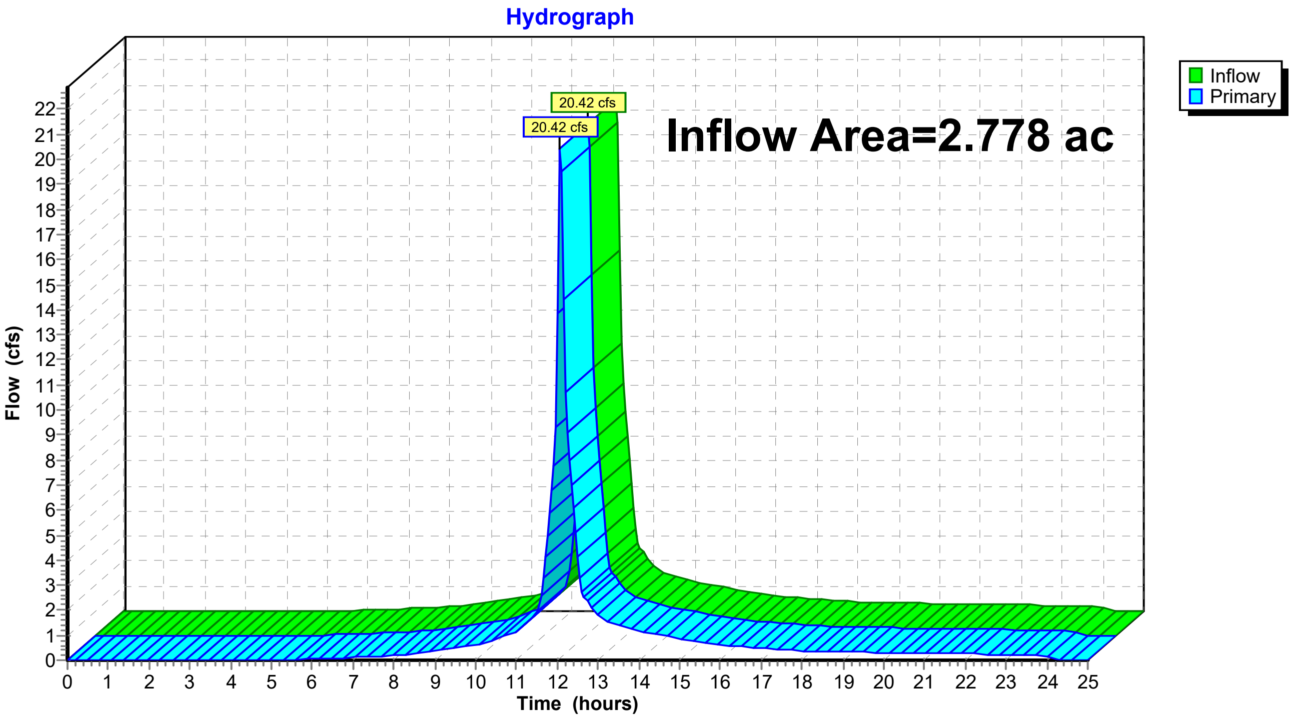


Summary for Link DP-2: Crafts Street

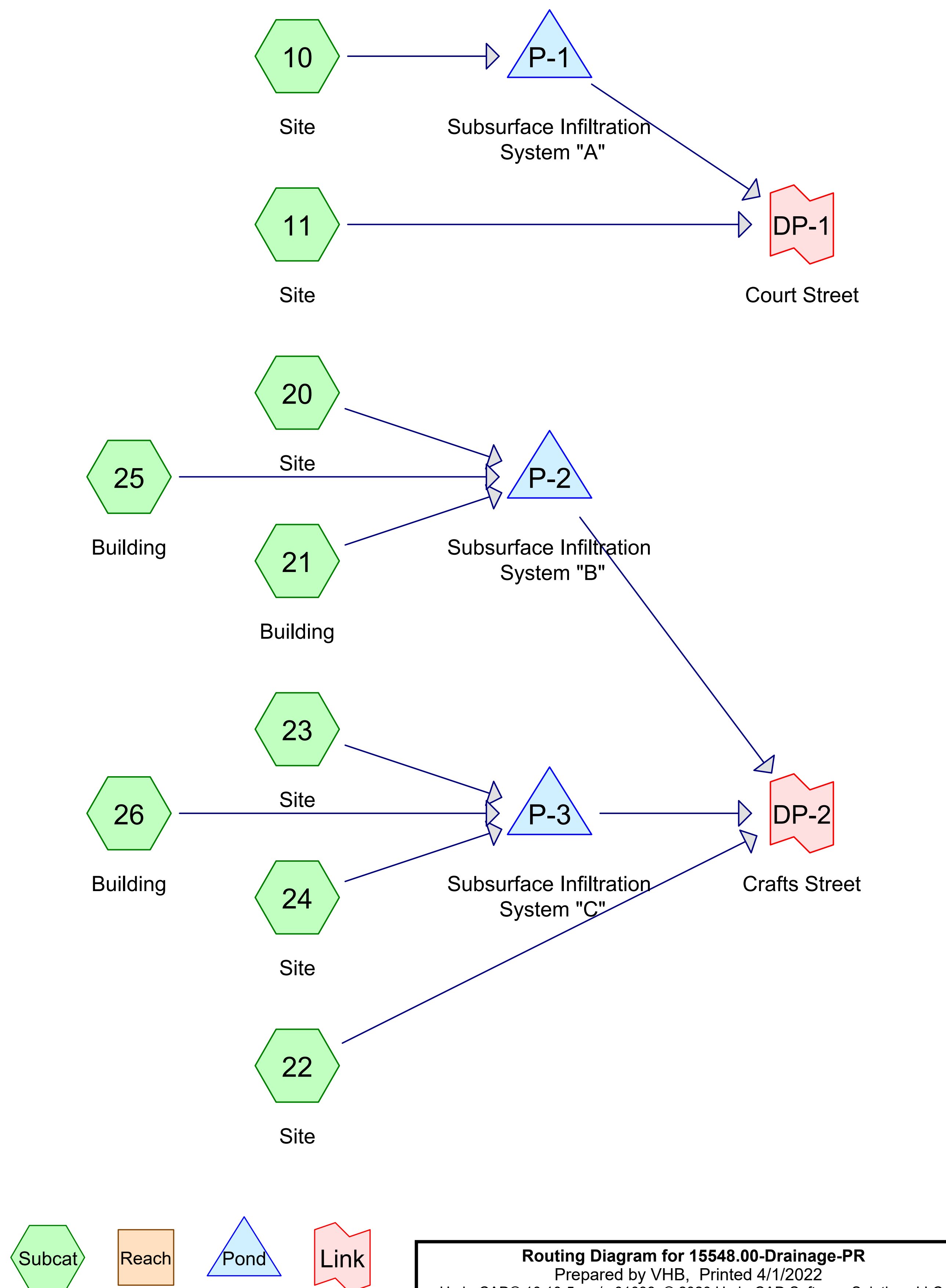
Inflow Area = 2.778 ac, 35.50% Impervious, Inflow Depth = 6.41" for 100-year event
Inflow = 20.42 cfs @ 12.07 hrs, Volume= 1.484 af
Primary = 20.42 cfs @ 12.07 hrs, Volume= 1.484 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs

Link DP-2: Crafts Street



HydroCAD Analysis: Proposed Conditions



Routing Diagram for 15548.00-Drainage-PR
Prepared by VHB, Printed 4/1/2022
HydroCAD® 10.10-5a s/n 01038 © 2020 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
1.010	49	50-75% Grass cover, Fair, HSG A (10, 11, 20, 22, 23, 24)
0.945	98	Paved parking, HSG A (10, 11, 20, 22, 23, 24)
1.007	98	Roofs, HSG A (21, 25, 26)
2.962	**81**	**TOTAL AREA**

2-Year Storm Event – Proposed

Time span=0.00-25.00 hrs, dt=0.05 hrs, 501 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment10: Site Runoff Area=10,950 sf 48.49% Impervious Runoff Depth=1.01"
Tc=5.0 min CN=73 Runoff=0.28 cfs 0.021 af

Subcatchment11: Site Runoff Area=6,635 sf 13.34% Impervious Runoff Depth=0.30"
Tc=5.0 min CN=56 Runoff=0.02 cfs 0.004 af

Subcatchment20: Site Runoff Area=20,460 sf 41.79% Impervious Runoff Depth=0.81"
Tc=5.0 min CN=69 Runoff=0.40 cfs 0.032 af

Subcatchment21: Building Runoff Area=18,390 sf 100.00% Impervious Runoff Depth=3.02"
Tc=5.0 min CN=98 Runoff=1.34 cfs 0.106 af

Subcatchment22: Site Runoff Area=11,540 sf 67.33% Impervious Runoff Depth=1.58"
Tc=5.0 min CN=82 Runoff=0.49 cfs 0.035 af

Subcatchment23: Site Runoff Area=9,590 sf 61.26% Impervious Runoff Depth=1.37"
Tc=5.0 min CN=79 Runoff=0.35 cfs 0.025 af

Subcatchment24: Site Runoff Area=25,970 sf 49.17% Impervious Runoff Depth=1.01"
Tc=5.0 min CN=73 Runoff=0.67 cfs 0.050 af

Subcatchment25: Building Runoff Area=17,390 sf 100.00% Impervious Runoff Depth=3.02"
Tc=5.0 min CN=98 Runoff=1.27 cfs 0.100 af

Subcatchment26: Building Runoff Area=8,090 sf 100.00% Impervious Runoff Depth=3.02"
Tc=5.0 min CN=98 Runoff=0.59 cfs 0.047 af

Pond P-1: Subsurface Infiltration System "A" Peak Elev=31.42' Storage=0.005 af Inflow=0.28 cfs 0.021 af
Discarded=0.07 cfs 0.021 af Primary=0.00 cfs 0.000 af Outflow=0.07 cfs 0.021 af

Pond P-2: Subsurface Infiltration System "B" Peak Elev=32.80' Storage=0.067 af Inflow=2.99 cfs 0.238 af
Discarded=0.59 cfs 0.238 af Primary=0.00 cfs 0.000 af Outflow=0.59 cfs 0.238 af

Pond P-3: Subsurface Infiltration System "C" Peak Elev=31.44' Storage=0.031 af Inflow=1.60 cfs 0.122 af
Discarded=0.37 cfs 0.122 af Primary=0.00 cfs 0.000 af Outflow=0.37 cfs 0.122 af

Link DP-1: Court Street Inflow=0.02 cfs 0.004 af
Primary=0.02 cfs 0.004 af

Link DP-2: Crafts Street Inflow=0.49 cfs 0.035 af
Primary=0.49 cfs 0.035 af

Total Runoff Area = 2.962 ac Runoff Volume = 0.420 af Average Runoff Depth = 1.70"
34.09% Pervious = 1.010 ac 65.91% Impervious = 1.952 ac

Summary for Subcatchment 10: Site

[49] Hint: Tc<2dt may require smaller dt

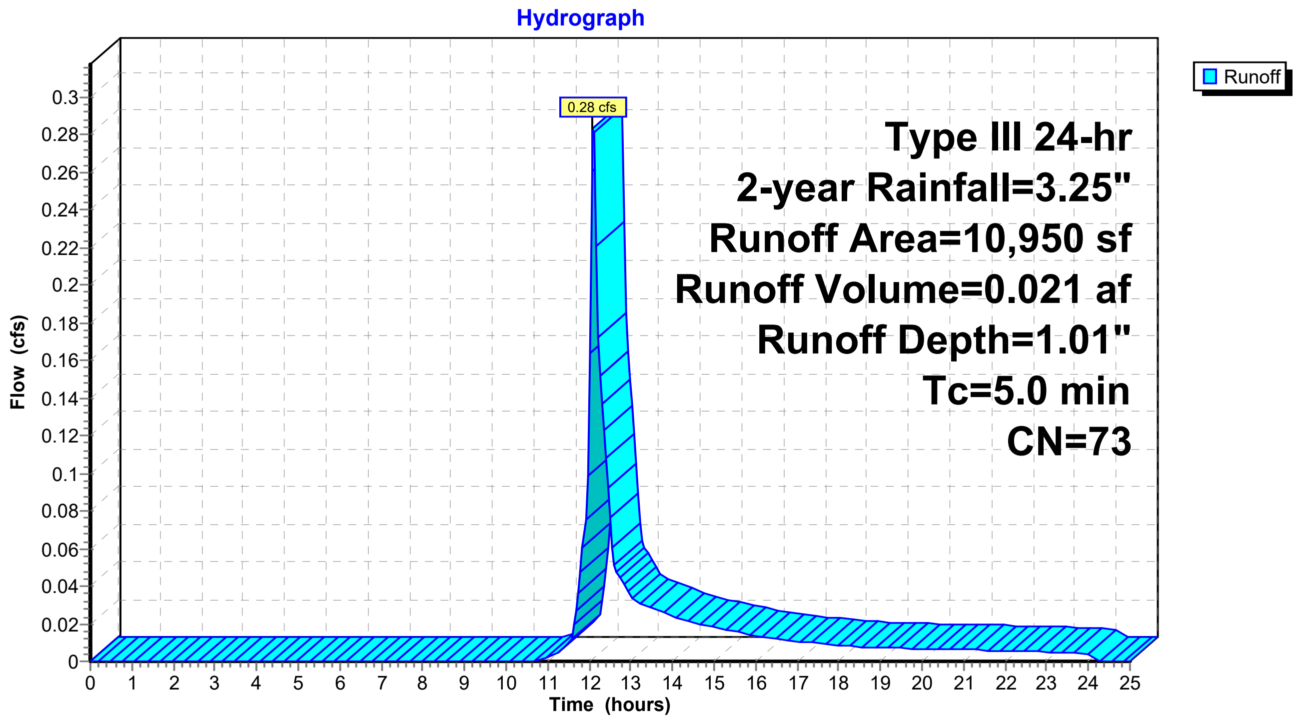
Runoff = 0.28 cfs @ 12.09 hrs, Volume= 0.021 af, Depth= 1.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-year Rainfall=3.25"

Area (sf)	CN	Description
5,310	98	Paved parking, HSG A
0	98	Roofs, HSG A
5,640	49	50-75% Grass cover, Fair, HSG A
10,950	73	Weighted Average
5,640		51.51% Pervious Area
5,310		48.49% Impervious Area

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

Subcatchment 10: Site



Summary for Subcatchment 11: Site

[49] Hint: Tc<2dt may require smaller dt

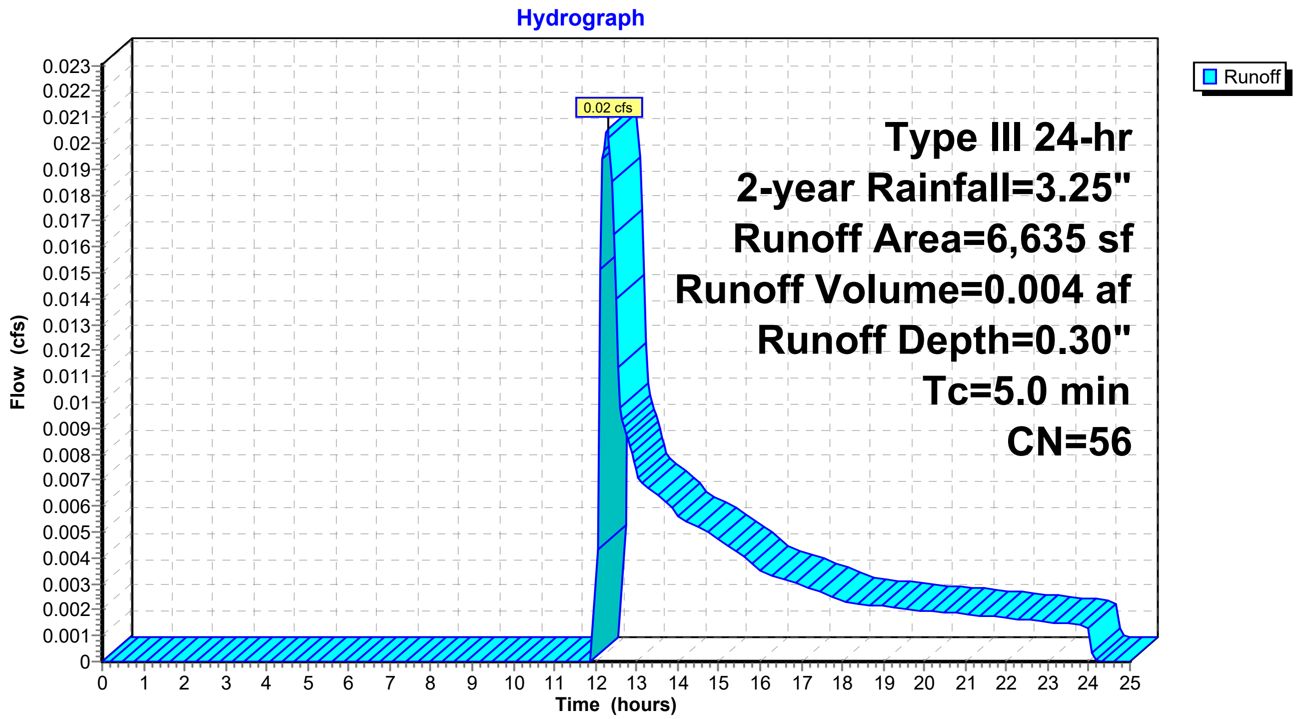
Runoff = 0.02 cfs @ 12.28 hrs, Volume= 0.004 af, Depth= 0.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-year Rainfall=3.25"

Area (sf)	CN	Description
885	98	Paved parking, HSG A
5,750	49	50-75% Grass cover, Fair, HSG A
6,635	56	Weighted Average
5,750		86.66% Pervious Area
885		13.34% Impervious Area

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

Subcatchment 11: Site



Summary for Subcatchment 20: Site

[49] Hint: Tc<2dt may require smaller dt

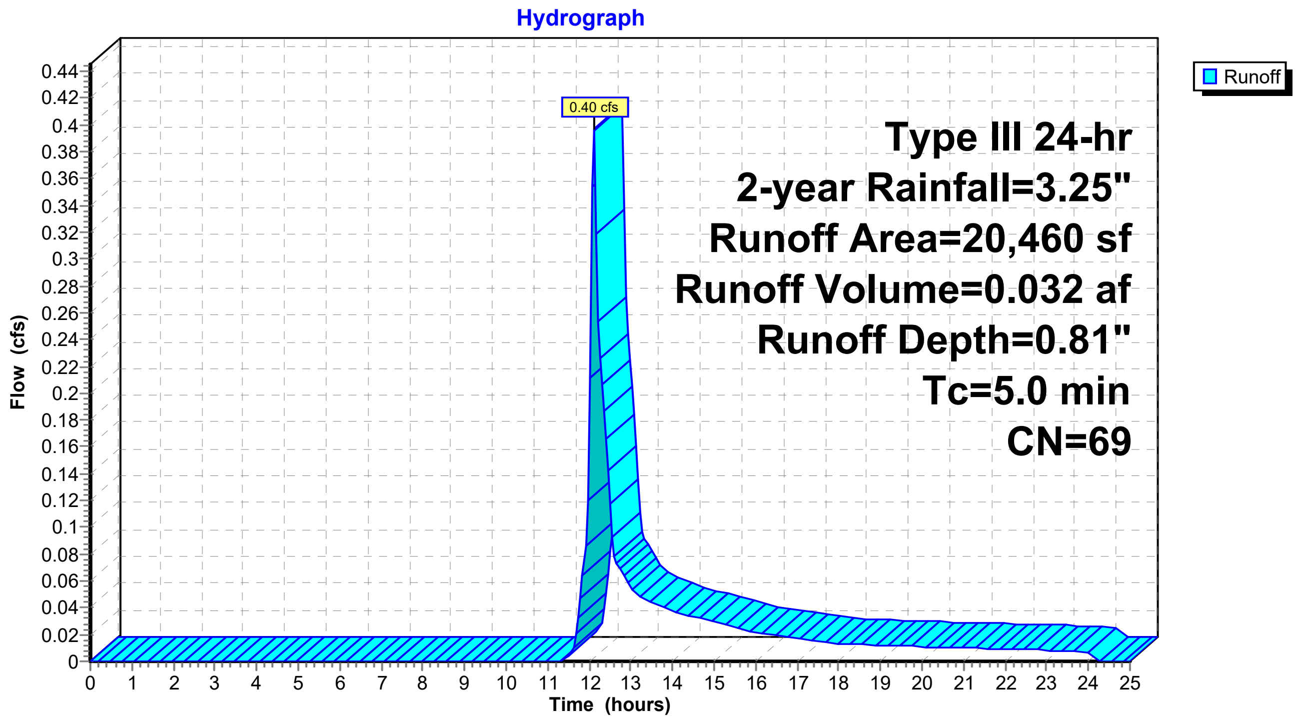
Runoff = 0.40 cfs @ 12.09 hrs, Volume= 0.032 af, Depth= 0.81"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-year Rainfall=3.25"

Area (sf)	CN	Description
8,550	98	Paved parking, HSG A
0	98	Roofs, HSG A
11,910	49	50-75% Grass cover, Fair, HSG A
20,460	69	Weighted Average
11,910		58.21% Pervious Area
8,550		41.79% Impervious Area

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

Subcatchment 20: Site



Summary for Subcatchment 21: Building

[49] Hint: Tc<2dt may require smaller dt

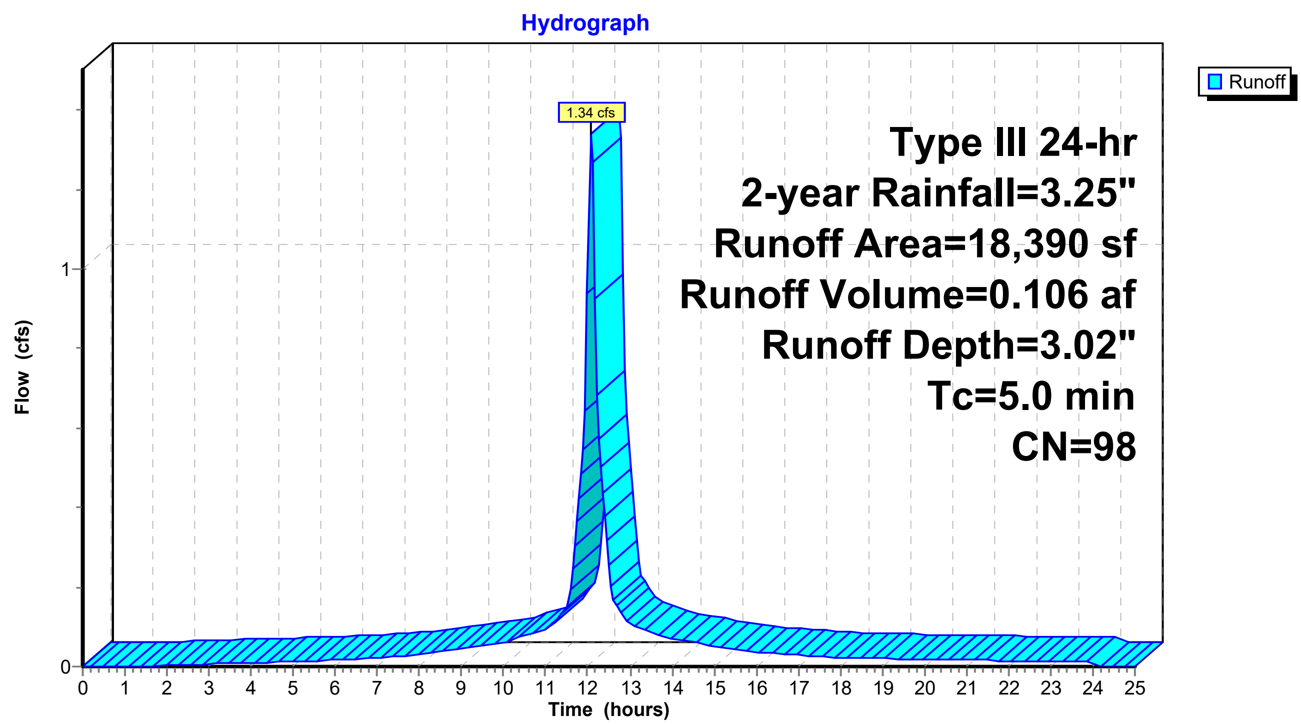
Runoff = 1.34 cfs @ 12.07 hrs, Volume= 0.106 af, Depth= 3.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-year Rainfall=3.25"

Area (sf)	CN	Description
0	98	Paved parking, HSG A
18,390	98	Roofs, HSG A
0	49	50-75% Grass cover, Fair, HSG A
18,390	98	Weighted Average
18,390		100.00% Impervious Area

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

Subcatchment 21: Building



Summary for Subcatchment 22: Site

[49] Hint: Tc<2dt may require smaller dt

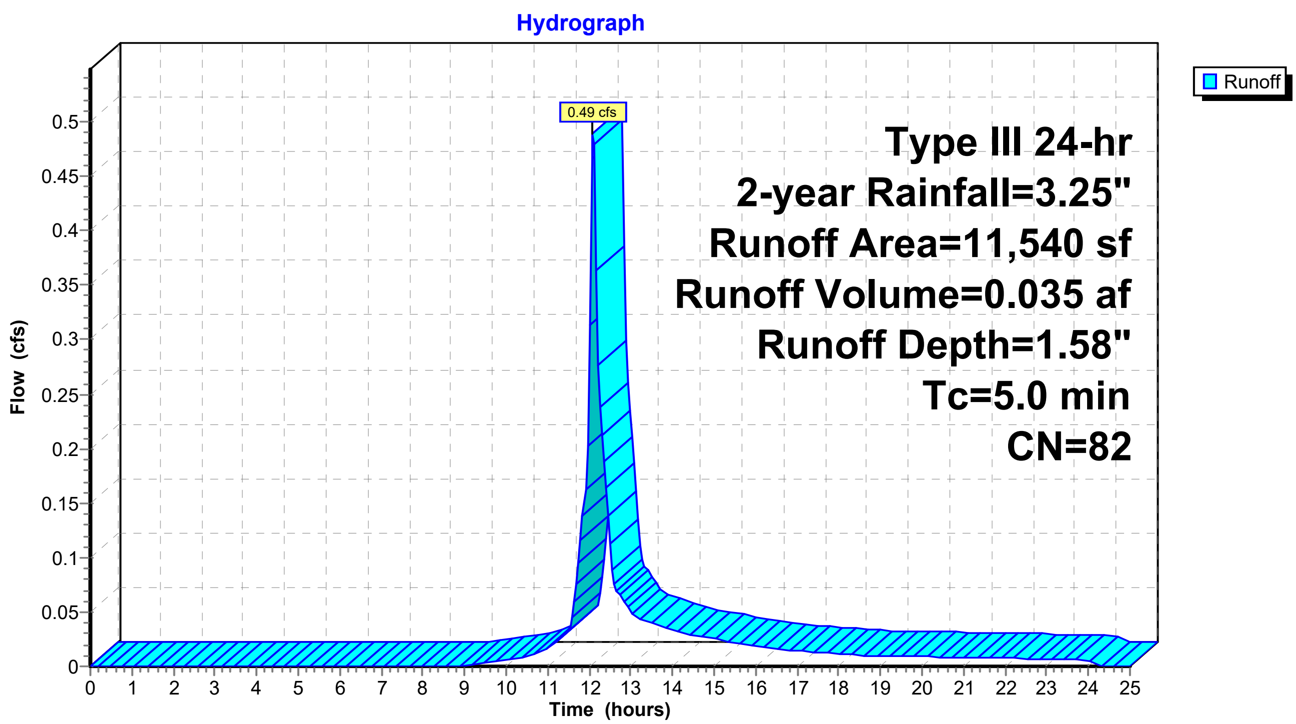
Runoff = 0.49 cfs @ 12.08 hrs, Volume= 0.035 af, Depth= 1.58"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-year Rainfall=3.25"

Area (sf)	CN	Description
7,770	98	Paved parking, HSG A
0	98	Roofs, HSG A
3,770	49	50-75% Grass cover, Fair, HSG A
11,540	82	Weighted Average
3,770		32.67% Pervious Area
7,770		67.33% Impervious Area

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

Subcatchment 22: Site



Summary for Subcatchment 23: Site

[49] Hint: Tc<2dt may require smaller dt

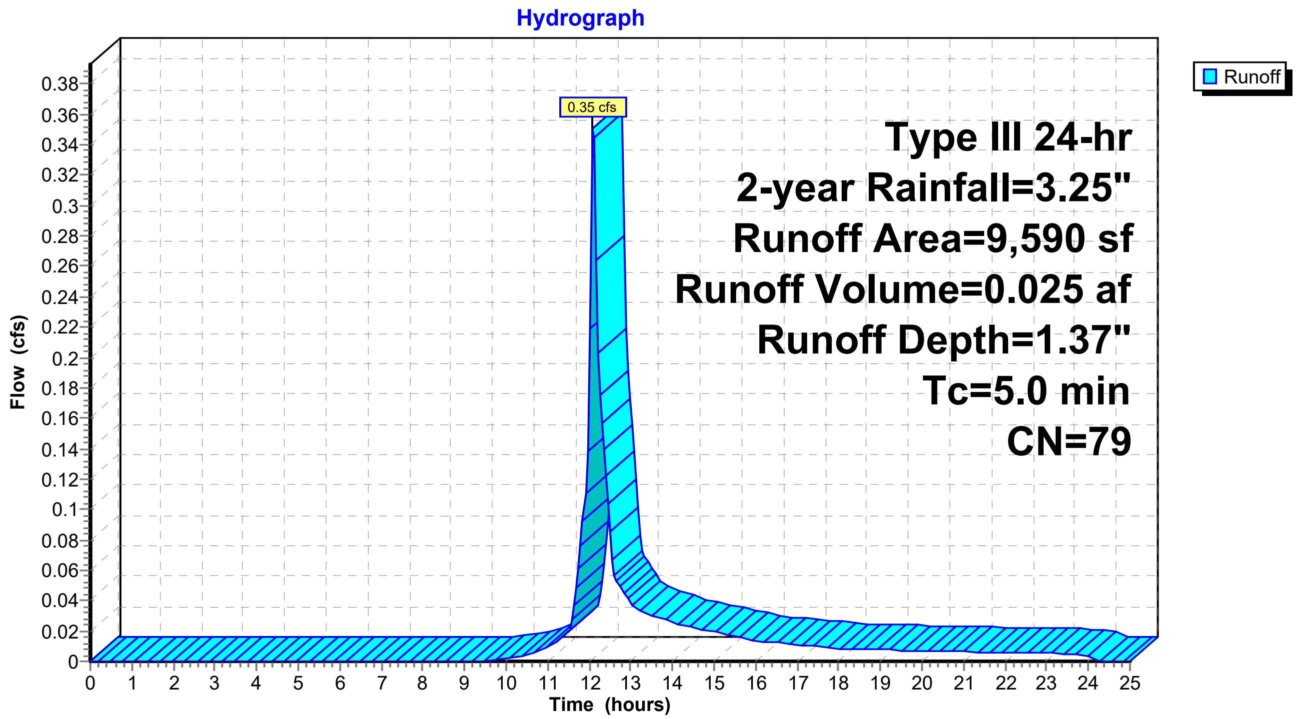
Runoff = 0.35 cfs @ 12.08 hrs, Volume= 0.025 af, Depth= 1.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-year Rainfall=3.25"

Area (sf)	CN	Description
5,875	98	Paved parking, HSG A
0	98	Roofs, HSG A
3,715	49	50-75% Grass cover, Fair, HSG A
9,590	79	Weighted Average
3,715		38.74% Pervious Area
5,875		61.26% Impervious Area

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

Subcatchment 23: Site



Summary for Subcatchment 24: Site

[49] Hint: Tc<2dt may require smaller dt

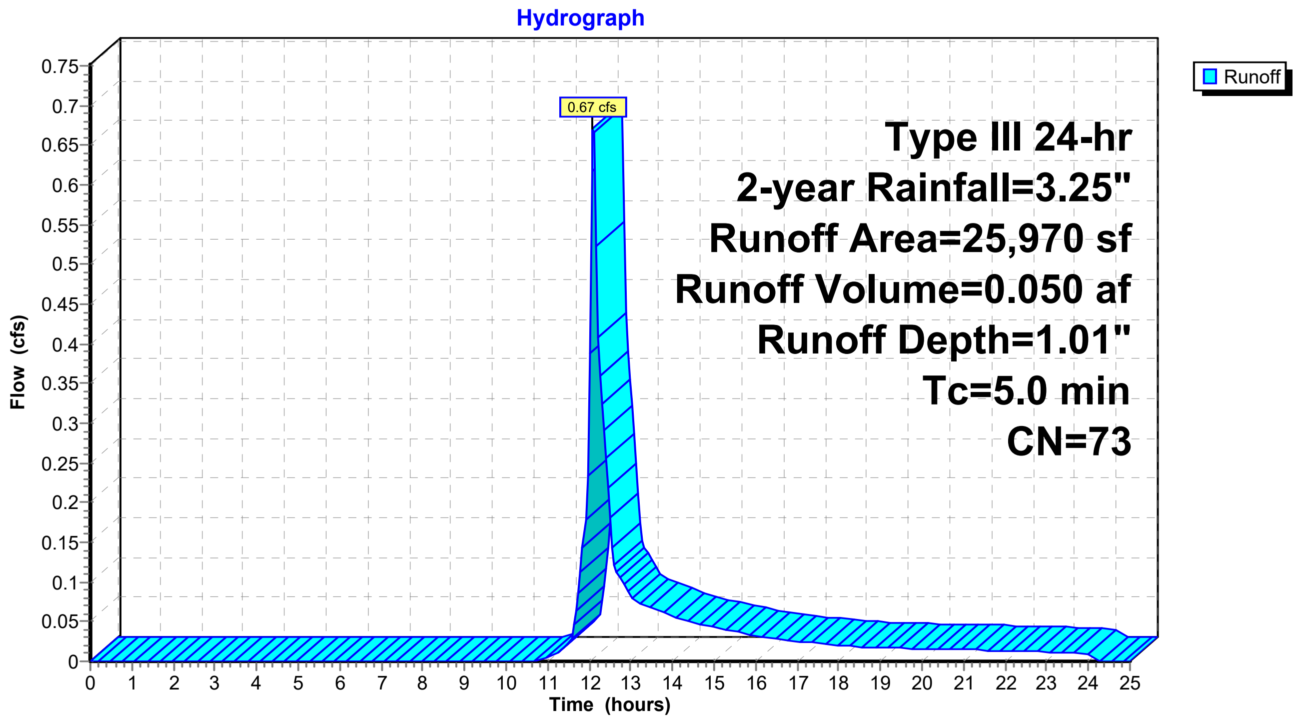
Runoff = 0.67 cfs @ 12.09 hrs, Volume= 0.050 af, Depth= 1.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-year Rainfall=3.25"

Area (sf)	CN	Description
12,770	98	Paved parking, HSG A
0	98	Roofs, HSG A
13,200	49	50-75% Grass cover, Fair, HSG A
25,970	73	Weighted Average
13,200		50.83% Pervious Area
12,770		49.17% Impervious Area

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

Subcatchment 24: Site



Summary for Subcatchment 25: Building

[49] Hint: Tc<2dt may require smaller dt

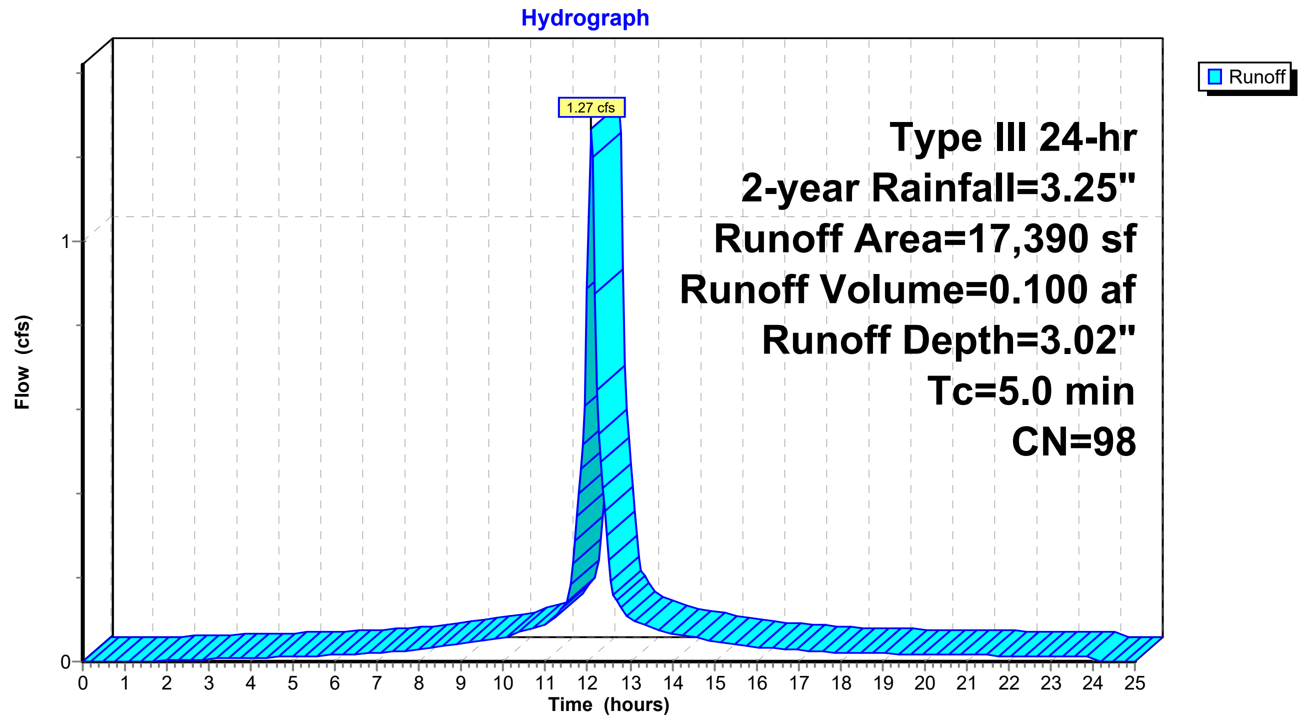
Runoff = 1.27 cfs @ 12.07 hrs, Volume= 0.100 af, Depth= 3.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-year Rainfall=3.25"

Area (sf)	CN	Description
0	98	Paved parking, HSG A
17,390	98	Roofs, HSG A
0	49	50-75% Grass cover, Fair, HSG A
17,390	98	Weighted Average
17,390		100.00% Impervious Area

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

Subcatchment 25: Building



Summary for Subcatchment 26: Building

[49] Hint: Tc<2dt may require smaller dt

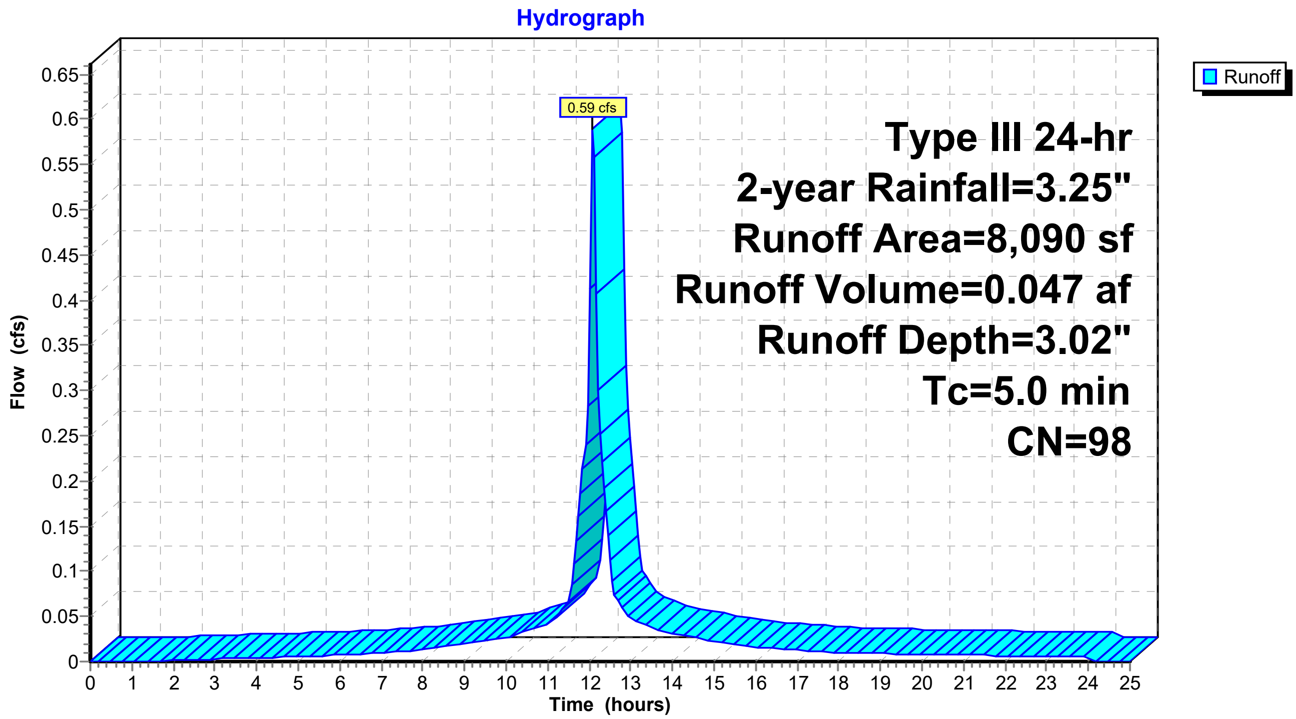
Runoff = 0.59 cfs @ 12.07 hrs, Volume= 0.047 af, Depth= 3.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-year Rainfall=3.25"

Area (sf)	CN	Description
0	98	Paved parking, HSG A
8,090	98	Roofs, HSG A
0	49	50-75% Grass cover, Fair, HSG A
8,090	98	Weighted Average
8,090		100.00% Impervious Area

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

Subcatchment 26: Building



Summary for Pond P-1: Subsurface Infiltration System "A"

Inflow Area = 0.251 ac, 48.49% Impervious, Inflow Depth = 1.01" for 2-year event
Inflow = 0.28 cfs @ 12.09 hrs, Volume= 0.021 af
Outflow = 0.07 cfs @ 12.50 hrs, Volume= 0.021 af, Atten= 74%, Lag= 25.0 min
Discarded = 0.07 cfs @ 12.50 hrs, Volume= 0.021 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs
Peak Elev= 31.42' @ 12.50 hrs Surf.Area= 0.007 ac Storage= 0.005 af

Plug-Flow detention time= 18.7 min calculated for 0.021 af (100% of inflow)
Center-of-Mass det. time= 18.7 min (882.2 - 863.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	30.60'	0.000 af	**6.90'W x 43.19'L x 5.67'H Field A** 0.039 af Overall - 0.039 af Embedded = 0.000 af x 40.0% Voids
#2A	30.60'	0.029 af	**StormTrap ST1 SingleTrap 5-0** x 3 Inside #1 Inside= 82.7"W x 60.0"H => 29.76 sf x 14.06'L = 418.5 cf Outside= 82.7"W x 68.0"H => 39.08 sf x 14.06'L = 549.5 cf 6.90' x 42.19' Core + 0.00' x 0.50' Border = 6.90' x 43.19' System
		0.029 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	34.60'	**12.0" Round Culvert** L= 25.0' RCP, rounded edge headwall, Ke= 0.100 Inlet / Outlet Invert= 34.60' / 34.30' S= 0.0120 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 0.79 sf
#2	Device 1	34.60'	**6.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	35.60'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#4	Discarded	30.60'	**8.270 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 28.00'

Discarded OutFlow Max=0.07 cfs @ 12.50 hrs HW=31.42' (Free Discharge)
└─**4=Exfiltration** (Controls 0.07 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=30.60' (Free Discharge)
└─**1=Culvert** (Controls 0.00 cfs)
  ├─**2=Orifice/Grate** (Controls 0.00 cfs)
  └─**3=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond P-1: Subsurface Infiltration System "A" - Chamber Wizard Field A

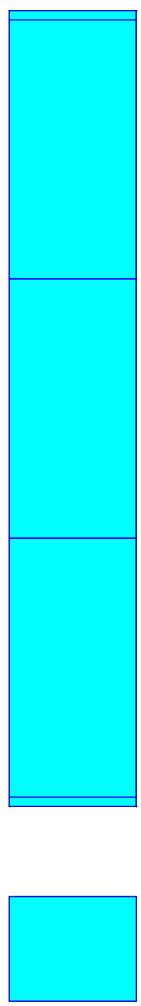
Chamber Model = StormTrap ST1 SingleTrap 5-0 (StormTrap ST1 SingleTrap®Type VI)
Inside= 82.7"W x 60.0"H => 29.76 sf x 14.06'L = 418.5 cf
Outside= 82.7"W x 68.0"H => 39.08 sf x 14.06'L = 549.5 cf

3 Chambers/Row x 14.06' Long = 42.19' Row Length +6.0" Border x 2 = 43.19' Base Length
1 Rows x 82.7" Wide = 6.90' Base Width
68.0" Chamber Height = 5.67' Field Height

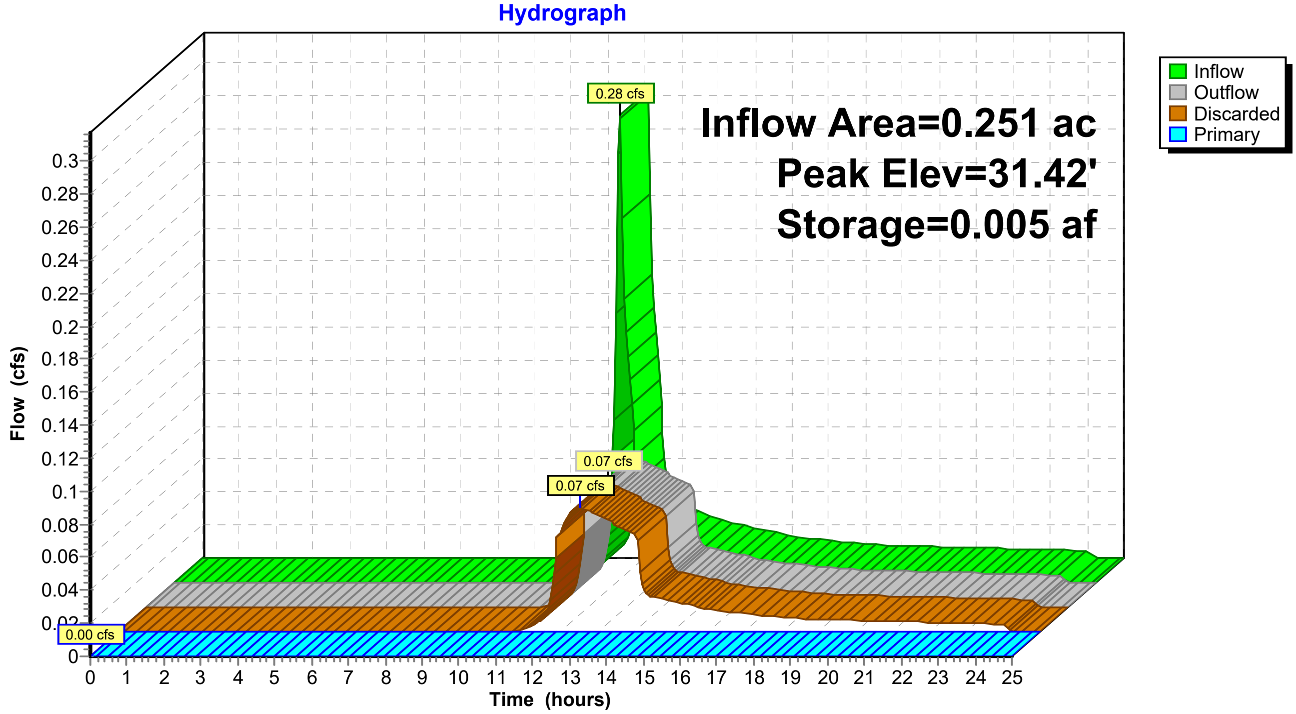
3 Chambers x 418.5 cf = 1,255.5 cf Chamber Storage
3 Chambers x 549.5 cf + 39.1 cf Border = 1,687.6 cf Displacement

Chamber Storage = 1,255.5 cf = 0.029 af
Overall Storage Efficiency = 74.4%
Overall System Size = 43.19' x 6.90' x 5.67'

3 Chambers (plus border)
62.5 cy Field



Pond P-1: Subsurface Infiltration System "A"



Summary for Pond P-2: Subsurface Infiltration System "B"

Inflow Area = 1.291 ac, 78.82% Impervious, Inflow Depth = 2.21" for 2-year event
Inflow = 2.99 cfs @ 12.07 hrs, Volume= 0.238 af
Outflow = 0.59 cfs @ 12.51 hrs, Volume= 0.238 af, Atten= 80%, Lag= 26.2 min
Discarded = 0.59 cfs @ 12.51 hrs, Volume= 0.238 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs
Peak Elev= 32.80' @ 12.51 hrs Surf.Area= 0.031 ac Storage= 0.067 af

Plug-Flow detention time= 37.9 min calculated for 0.238 af (100% of inflow)
Center-of-Mass det. time= 37.8 min (809.2 - 771.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	30.10'	0.000 af	**89.65'W x 15.06'L x 4.67'H Field A** 0.145 af Overall - 0.145 af Embedded = 0.000 af x 40.0% Voids
#2A	30.10'	0.100 af	**StormTrap ST1 SingleTrap 4-0** x 13 Inside #1 Inside= 82.7"W x 48.0"H => 23.79 sf x 14.06'L = 334.5 cf Outside= 82.7"W x 56.0"H => 32.18 sf x 14.06'L = 452.5 cf 13 Chambers in 13 Rows 89.65' x 14.06' Core + 0.00' x 0.50' Border = 89.65' x 15.06' System
#3	33.30'	0.001 af	**4.00'D x 3.10'H Vertical Cone/Cylinder**-Impervious
		0.101 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	33.10'	**12.0" Round Culvert X 2.00** L= 5.0' RCP, rounded edge headwall, Ke= 0.100 Inlet / Outlet Invert= 33.10' / 33.00' S= 0.0200 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 0.79 sf
#2	Discarded	30.10'	**8.270 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 28.00'

Discarded OutFlow Max=0.59 cfs @ 12.51 hrs HW=32.80' (Free Discharge)
└—**2=Exfiltration** (Controls 0.59 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=30.10' (Free Discharge)
└—**1=Culvert** (Controls 0.00 cfs)

Pond P-2: Subsurface Infiltration System "B" - Chamber Wizard Field A

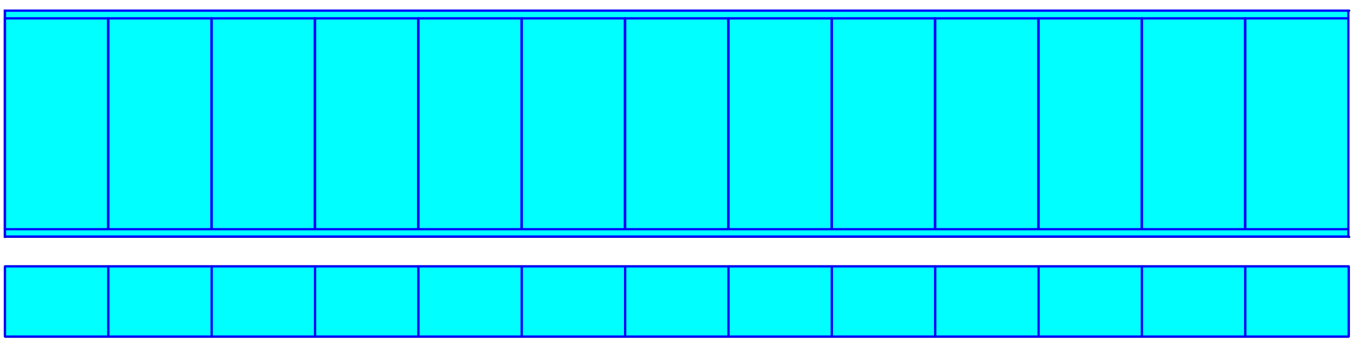
Chamber Model = StormTrap ST1 SingleTrap 4-0 (StormTrap ST1 SingleTrap®Type VI)
Inside= 82.7"W x 48.0"H => 23.79 sf x 14.06'L = 334.5 cf
Outside= 82.7"W x 56.0"H => 32.18 sf x 14.06'L = 452.5 cf

1 Chambers/Row x 14.06' Long = 14.06' Row Length +6.0" Border x 2 = 15.06' Base Length
13 Rows x 82.7" Wide = 89.65' Base Width
56.0" Chamber Height = 4.67' Field Height

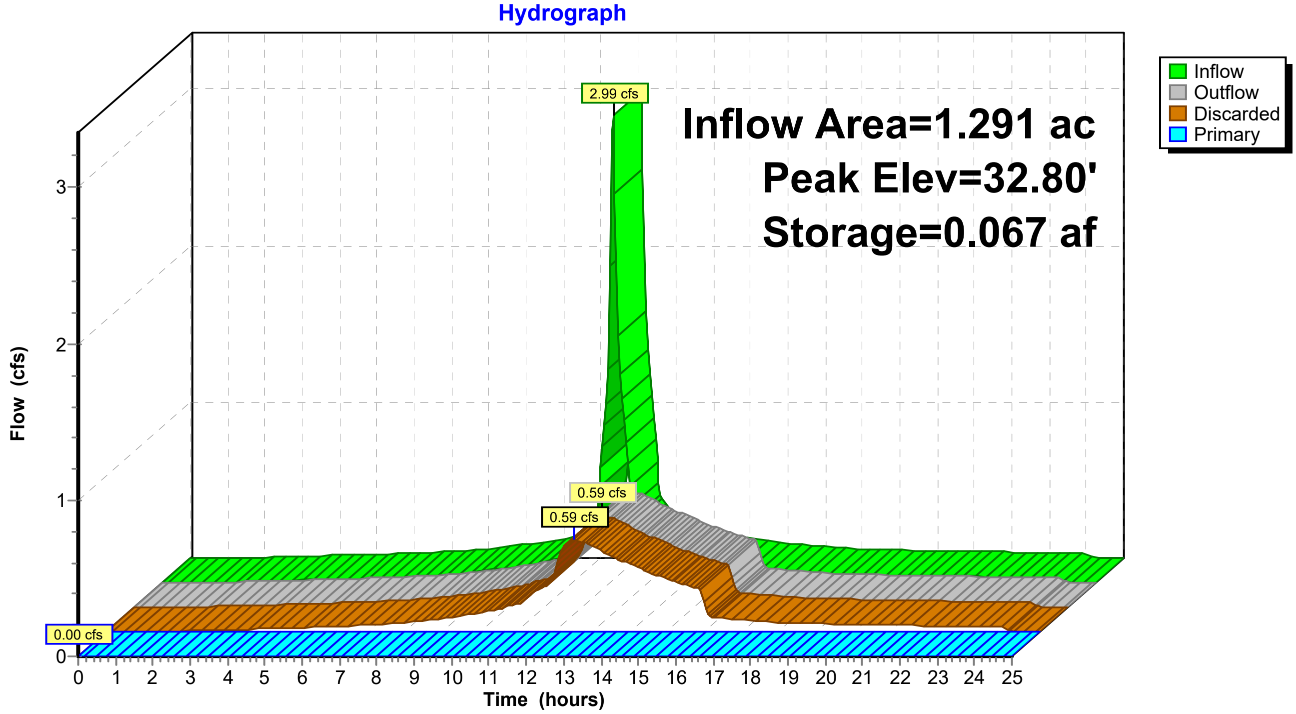
13 Chambers x 334.5 cf = 4,348.5 cf Chamber Storage
13 Chambers x 452.5 cf + 418.3 cf Border = 6,301.4 cf Displacement

Chamber Storage = 4,348.5 cf = 0.100 af
Overall Storage Efficiency = 69.0%
Overall System Size = 15.06' x 89.65' x 4.67'

13 Chambers (plus border)
233.4 cy Field



Pond P-2: Subsurface Infiltration System "B"



Summary for Pond P-3: Subsurface Infiltration System "C"

Inflow Area = 1.002 ac, 61.25% Impervious, Inflow Depth = 1.47" for 2-year event
Inflow = 1.60 cfs @ 12.08 hrs, Volume= 0.122 af
Outflow = 0.37 cfs @ 12.50 hrs, Volume= 0.122 af, Atten= 77%, Lag= 25.5 min
Discarded = 0.37 cfs @ 12.50 hrs, Volume= 0.122 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs
Peak Elev= 31.44' @ 12.50 hrs Surf.Area= 0.027 ac Storage= 0.031 af

Plug-Flow detention time= 26.3 min calculated for 0.122 af (100% of inflow)
Center-of-Mass det. time= 26.3 min (844.4 - 818.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	30.10'	0.000 af	**20.69'W x 57.25'L x 3.67'H Field A** 0.100 af Overall - 0.100 af Embedded = 0.000 af x 40.0% Voids
#2A	30.10'	0.069 af	**StormTrap ST1 SingleTrap 3-0** x 12 Inside #1 Inside= 82.7"W x 36.0"H => 17.81 sf x 14.06'L = 250.5 cf Outside= 82.7"W x 44.0"H => 25.28 sf x 14.06'L = 355.6 cf 12 Chambers in 3 Rows 20.69' x 56.25' Core + 0.00' x 0.50' Border = 20.69' x 57.25' System
#3	32.30'	0.001 af	**4.00'D x 5.10'H Vertical Cone/Cylinder**-Impervious
		0.070 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	32.10'	**12.0" Round Culvert** L= 5.0' RCP, rounded edge headwall, Ke= 0.100 Inlet / Outlet Invert= 32.10' / 32.00' S= 0.0200 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 0.79 sf
#2	Discarded	30.10'	**8.270 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 28.00'

Discarded OutFlow Max=0.37 cfs @ 12.50 hrs HW=31.44' (Free Discharge)
└─**2=Exfiltration** (Controls 0.37 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=30.10' (Free Discharge)
└─**1=Culvert** (Controls 0.00 cfs)

Pond P-3: Subsurface Infiltration System "C" - Chamber Wizard Field A

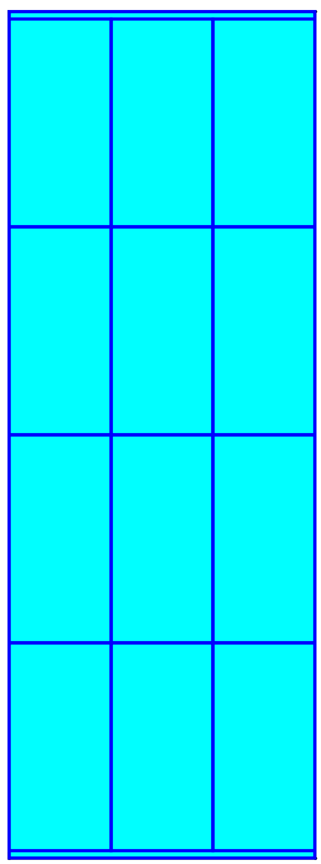
Chamber Model = StormTrap ST1 SingleTrap 3-0 (StormTrap ST1 SingleTrap®Type VI)
Inside= 82.7"W x 36.0"H => 17.81 sf x 14.06'L = 250.5 cf
Outside= 82.7"W x 44.0"H => 25.28 sf x 14.06'L = 355.6 cf

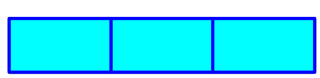
4 Chambers/Row x 14.06' Long = 56.25' Row Length +6.0" Border x 2 = 57.25' Base Length
3 Rows x 82.7" Wide = 20.69' Base Width
44.0" Chamber Height = 3.67' Field Height

12 Chambers x 250.5 cf = 3,006.0 cf Chamber Storage
12 Chambers x 355.6 cf + 75.9 cf Border = 4,342.7 cf Displacement

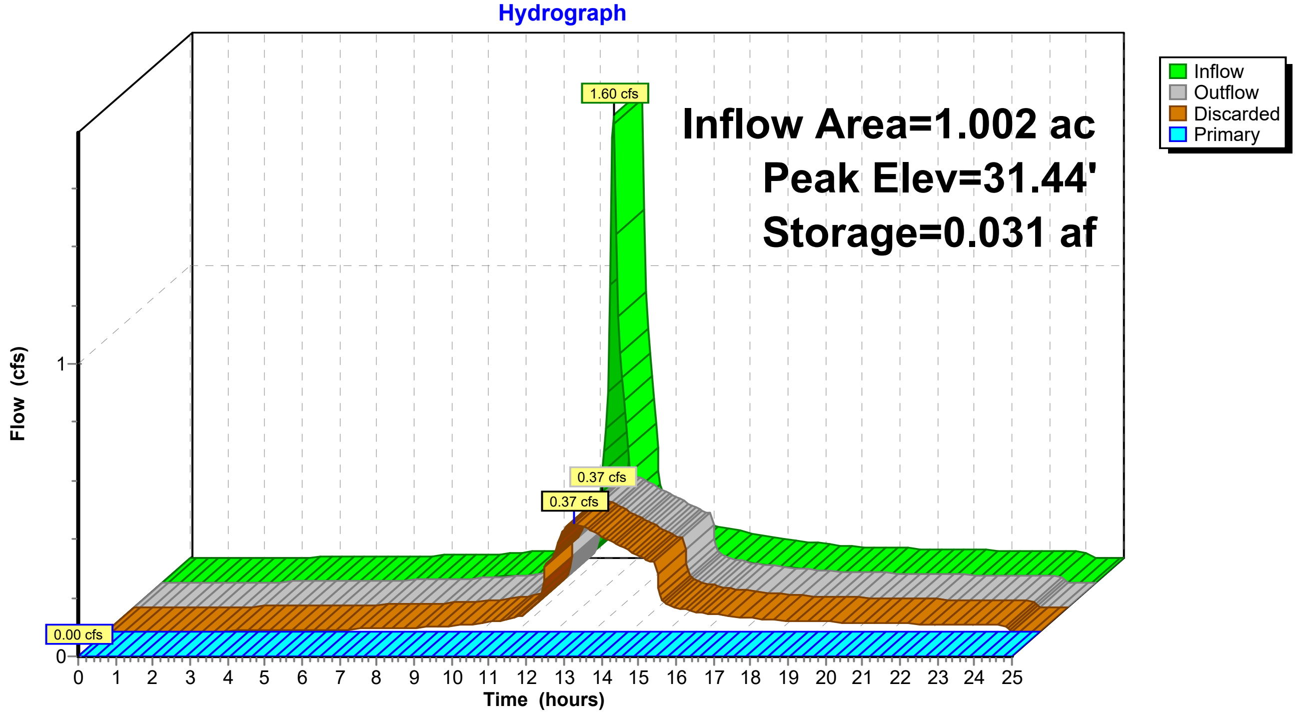
Chamber Storage = 3,006.0 cf = 0.069 af
Overall Storage Efficiency = 69.2%
Overall System Size = 57.25' x 20.69' x 3.67'

12 Chambers (plus border)
160.8 cy Field





Pond P-3: Subsurface Infiltration System "C"

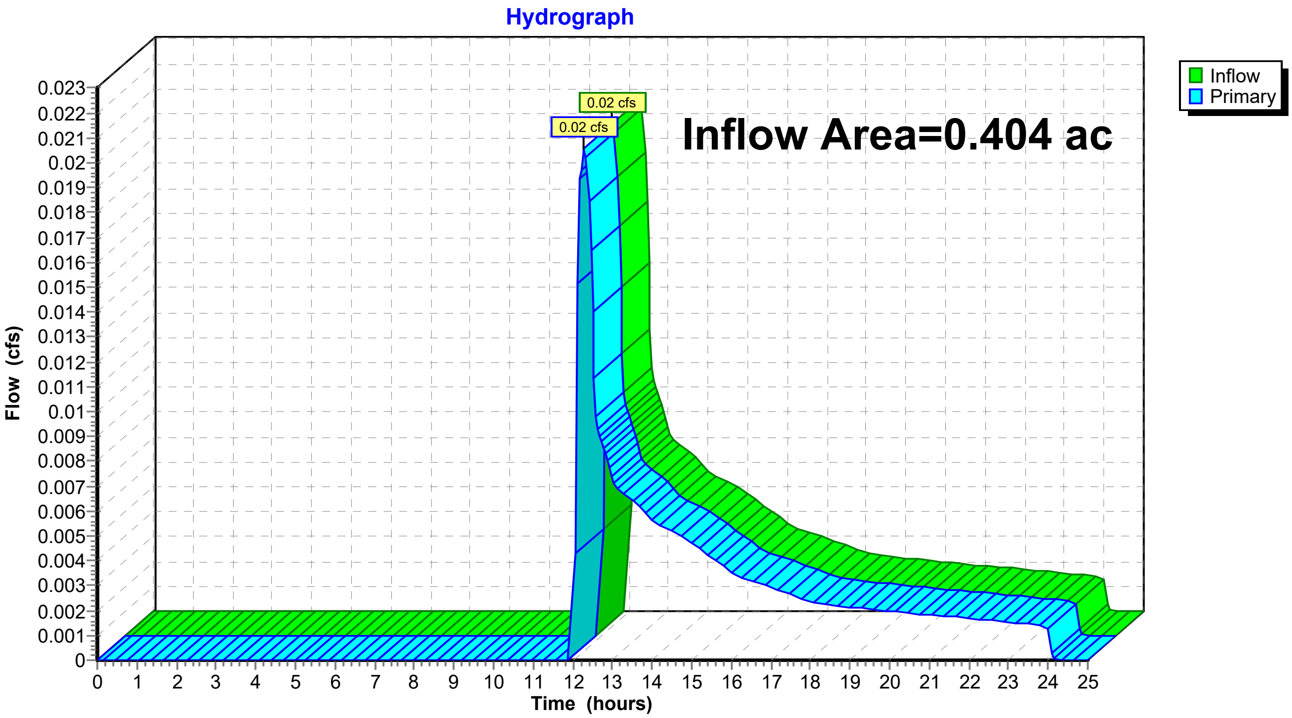


Summary for Link DP-1: Court Street

Inflow Area = 0.404 ac, 35.23% Impervious, Inflow Depth = 0.11" for 2-year event
Inflow = 0.02 cfs @ 12.28 hrs, Volume= 0.004 af
Primary = 0.02 cfs @ 12.28 hrs, Volume= 0.004 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs

Link DP-1: Court Street

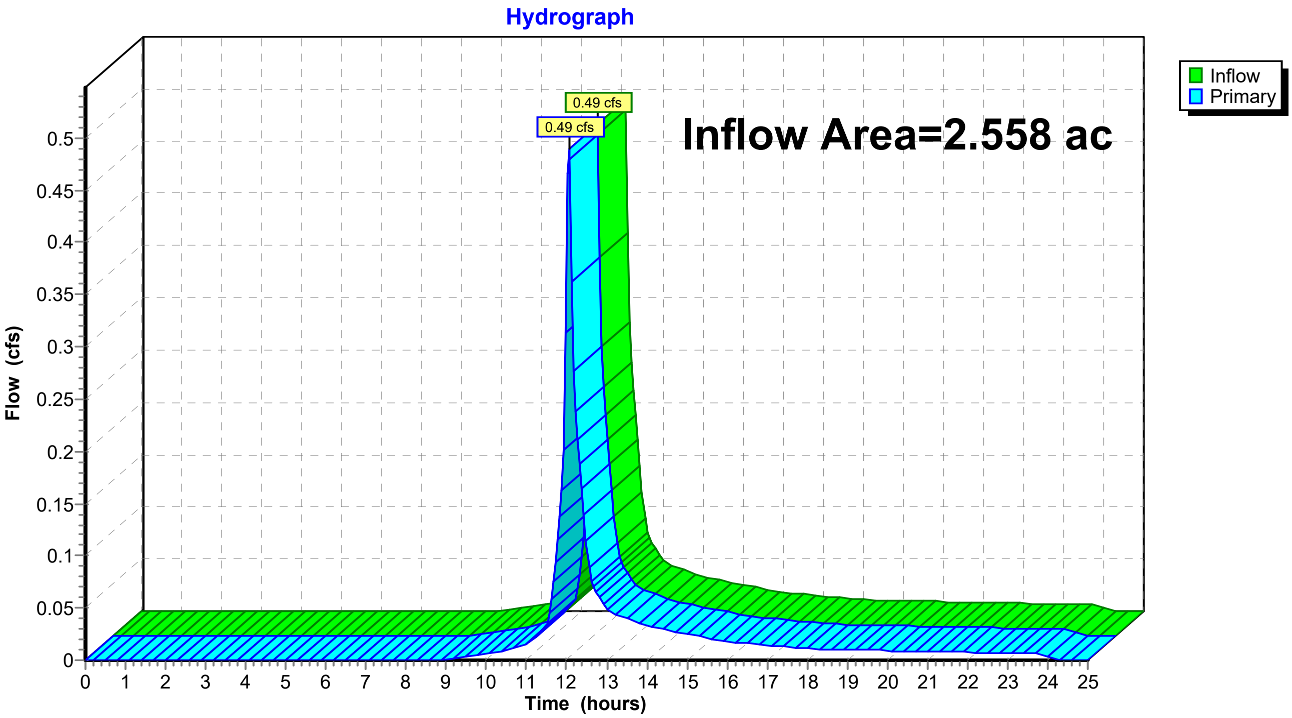


Summary for Link DP-2: Crafts Street

Inflow Area =	2.558 ac,	70.75% Impervious,	Inflow Depth = 0.16"	for 2-year event
Inflow =	0.49 cfs @	12.08 hrs,	Volume=	0.035 af
Primary =	0.49 cfs @	12.08 hrs,	Volume=	0.035 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs

Link DP-2: Crafts Street



10-Year Storm Event – Proposed

Time span=0.00-25.00 hrs, dt=0.05 hrs, 501 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment10: Site Runoff Area=10,950 sf 48.49% Impervious Runoff Depth=2.38"
Tc=5.0 min CN=73 Runoff=0.70 cfs 0.050 af

Subcatchment11: Site Runoff Area=6,635 sf 13.34% Impervious Runoff Depth=1.11"
Tc=5.0 min CN=56 Runoff=0.17 cfs 0.014 af

Subcatchment20: Site Runoff Area=20,460 sf 41.79% Impervious Runoff Depth=2.05"
Tc=5.0 min CN=69 Runoff=1.11 cfs 0.080 af

Subcatchment21: Building Runoff Area=18,390 sf 100.00% Impervious Runoff Depth=4.89"
Tc=5.0 min CN=98 Runoff=2.13 cfs 0.172 af

Subcatchment22: Site Runoff Area=11,540 sf 67.33% Impervious Runoff Depth=3.20"
Tc=5.0 min CN=82 Runoff=0.99 cfs 0.071 af

Subcatchment23: Site Runoff Area=9,590 sf 61.26% Impervious Runoff Depth=2.91"
Tc=5.0 min CN=79 Runoff=0.75 cfs 0.053 af

Subcatchment24: Site Runoff Area=25,970 sf 49.17% Impervious Runoff Depth=2.38"
Tc=5.0 min CN=73 Runoff=1.66 cfs 0.118 af

Subcatchment25: Building Runoff Area=17,390 sf 100.00% Impervious Runoff Depth=4.89"
Tc=5.0 min CN=98 Runoff=2.02 cfs 0.163 af

Subcatchment26: Building Runoff Area=8,090 sf 100.00% Impervious Runoff Depth=4.89"
Tc=5.0 min CN=98 Runoff=0.94 cfs 0.076 af

Pond P-1: Subsurface Infiltration System "A" Peak Elev=33.42' Storage=0.016 af Inflow=0.70 cfs 0.050 af
Discarded=0.12 cfs 0.050 af Primary=0.00 cfs 0.000 af Outflow=0.12 cfs 0.050 af

Pond P-2: Subsurface Infiltration System "B" Peak Elev=33.78' Storage=0.092 af Inflow=5.26 cfs 0.415 af
Discarded=0.71 cfs 0.350 af Primary=2.95 cfs 0.065 af Outflow=3.66 cfs 0.415 af

Pond P-3: Subsurface Infiltration System "C" Peak Elev=32.66' Storage=0.059 af Inflow=3.34 cfs 0.248 af
Discarded=0.50 cfs 0.214 af Primary=1.09 cfs 0.033 af Outflow=1.59 cfs 0.248 af

Link DP-1: Court Street Inflow=0.17 cfs 0.014 af
Primary=0.17 cfs 0.014 af

Link DP-2: Crafts Street Inflow=4.18 cfs 0.169 af
Primary=4.18 cfs 0.169 af

Total Runoff Area = 2.962 ac Runoff Volume = 0.797 af Average Runoff Depth = 3.23"
34.09% Pervious = 1.010 ac 65.91% Impervious = 1.952 ac

Summary for Subcatchment 10: Site

[49] Hint: Tc<2dt may require smaller dt

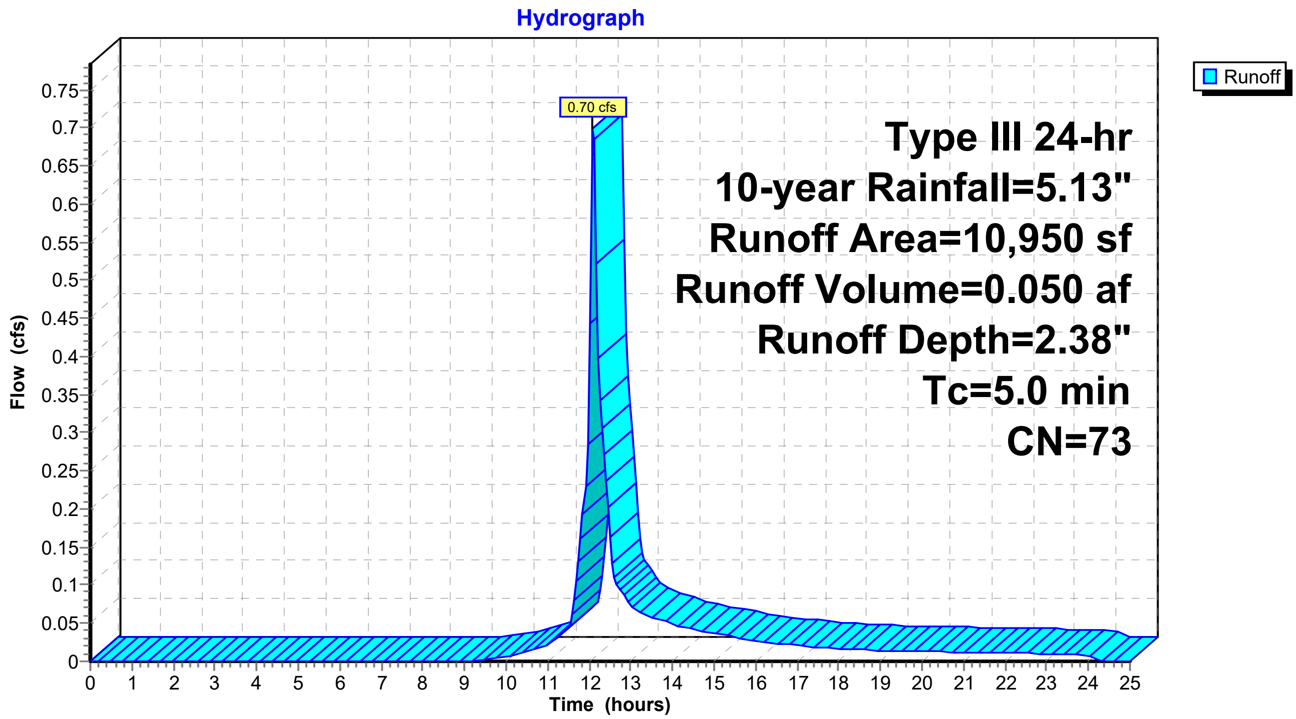
Runoff = 0.70 cfs @ 12.08 hrs, Volume= 0.050 af, Depth= 2.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-year Rainfall=5.13"

Area (sf)	CN	Description
5,310	98	Paved parking, HSG A
0	98	Roofs, HSG A
5,640	49	50-75% Grass cover, Fair, HSG A
10,950	73	Weighted Average
5,640		51.51% Pervious Area
5,310		48.49% Impervious Area

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

Subcatchment 10: Site



Summary for Subcatchment 11: Site

[49] Hint: Tc<2dt may require smaller dt

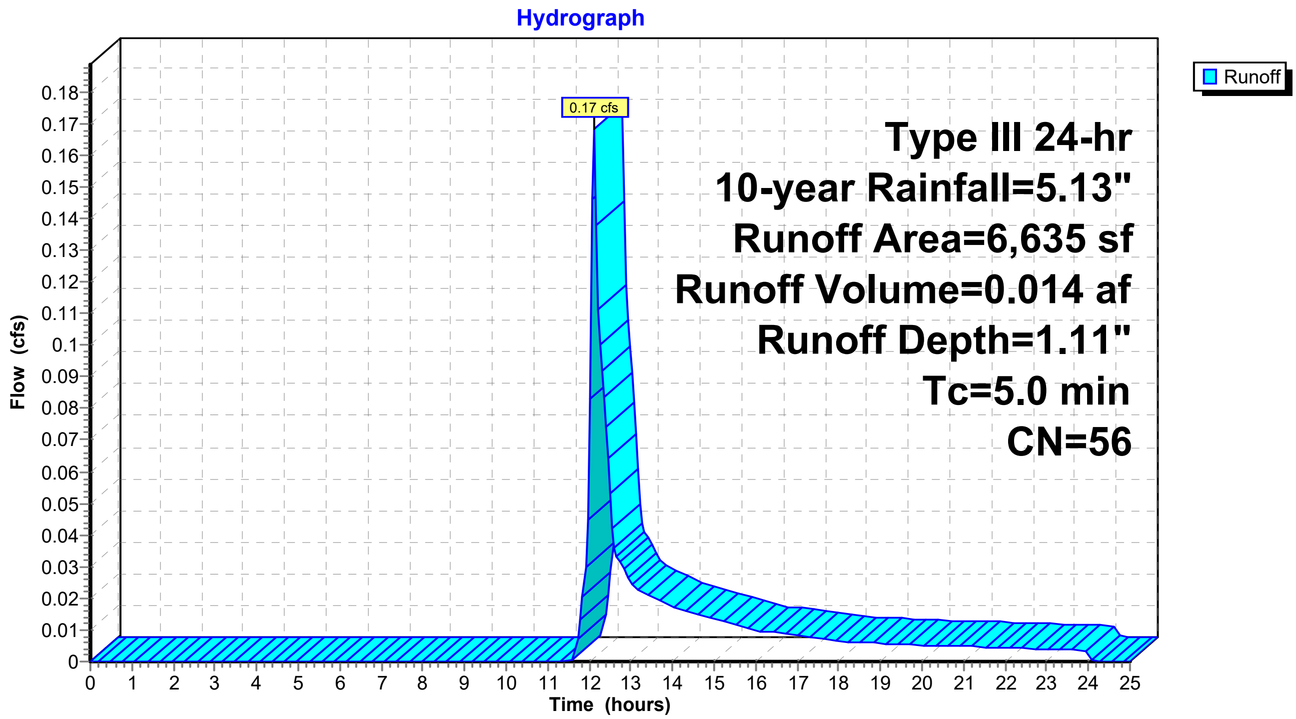
Runoff = 0.17 cfs @ 12.10 hrs, Volume= 0.014 af, Depth= 1.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-year Rainfall=5.13"

Area (sf)	CN	Description
885	98	Paved parking, HSG A
5,750	49	50-75% Grass cover, Fair, HSG A
6,635	56	Weighted Average
5,750		86.66% Pervious Area
885		13.34% Impervious Area

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

Subcatchment 11: Site



#260-22

Summary for Subcatchment 20: Site

[49] Hint: Tc<2dt may require smaller dt

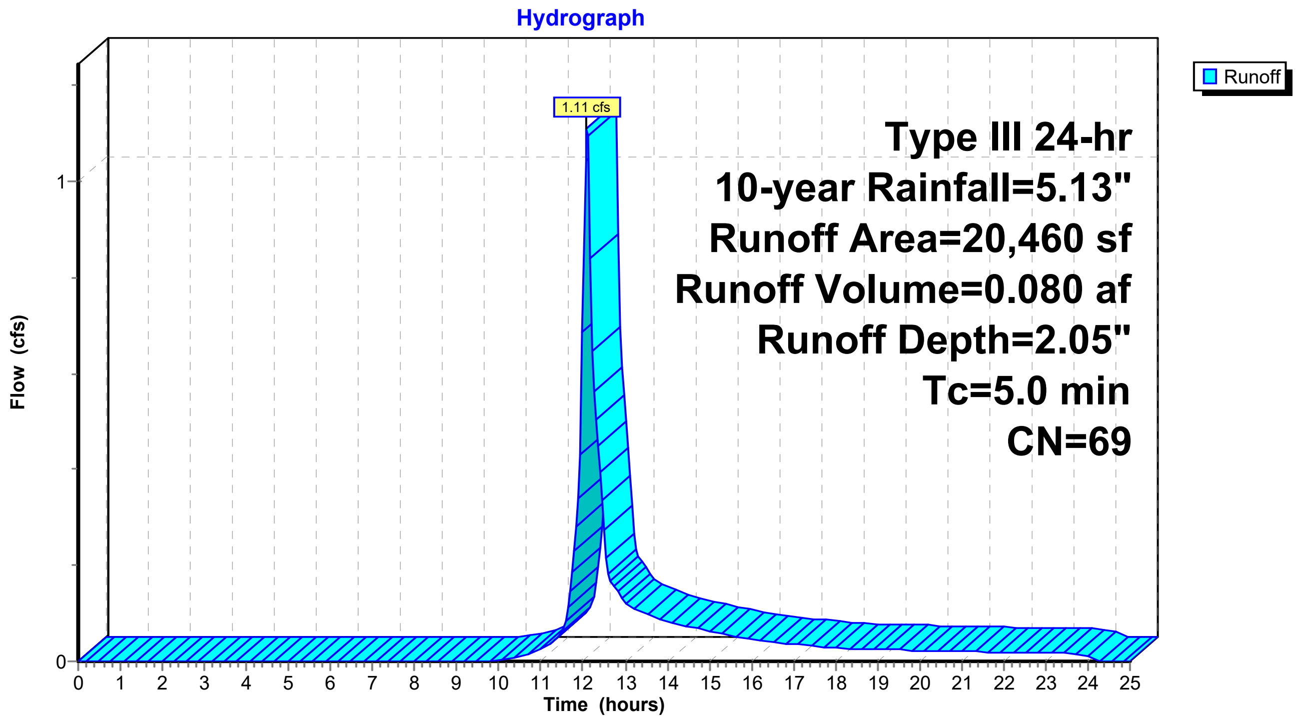
Runoff = 1.11 cfs @ 12.08 hrs, Volume= 0.080 af, Depth= 2.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-year Rainfall=5.13"

Area (sf)	CN	Description
8,550	98	Paved parking, HSG A
0	98	Roofs, HSG A
11,910	49	50-75% Grass cover, Fair, HSG A
20,460	69	Weighted Average
11,910		58.21% Pervious Area
8,550		41.79% Impervious Area

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

Subcatchment 20: Site



Summary for Subcatchment 21: Building

[49] Hint: Tc<2dt may require smaller dt

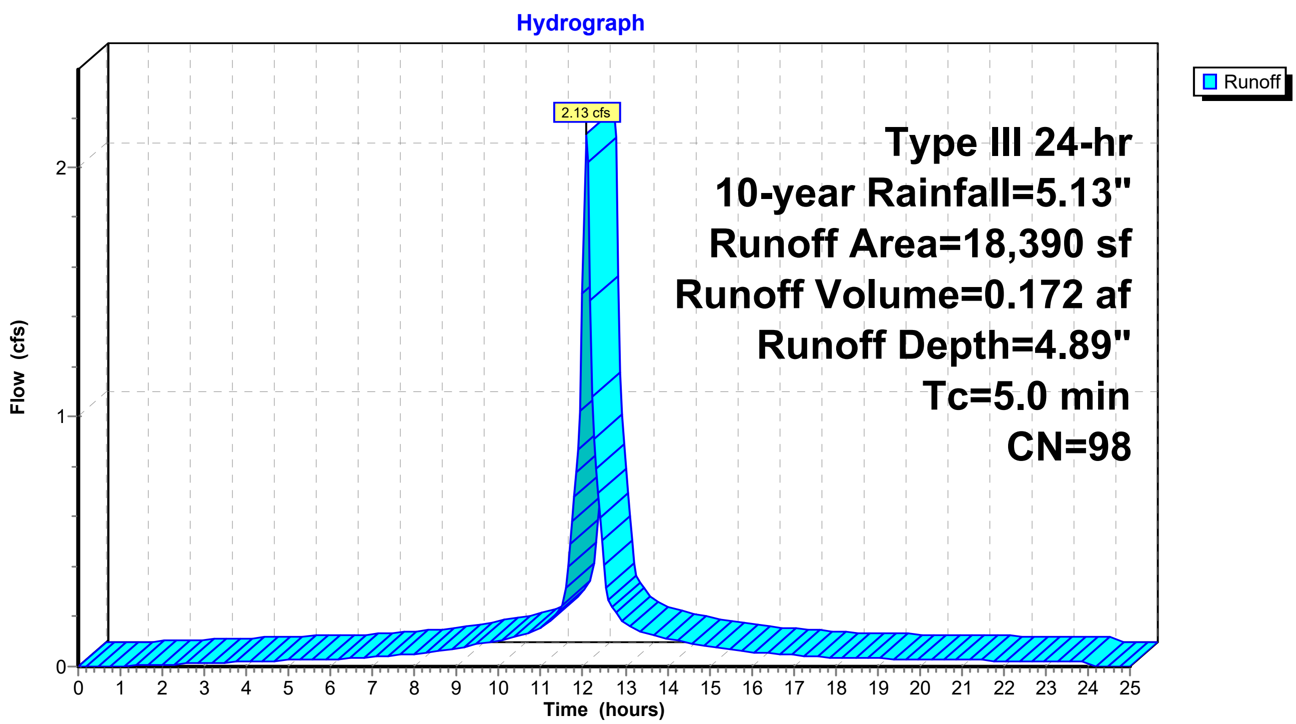
Runoff = 2.13 cfs @ 12.07 hrs, Volume= 0.172 af, Depth= 4.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-year Rainfall=5.13"

Area (sf)	CN	Description
0	98	Paved parking, HSG A
18,390	98	Roofs, HSG A
0	49	50-75% Grass cover, Fair, HSG A
18,390	98	Weighted Average
18,390		100.00% Impervious Area

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

Subcatchment 21: Building



Summary for Subcatchment 22: Site

[49] Hint: Tc<2dt may require smaller dt

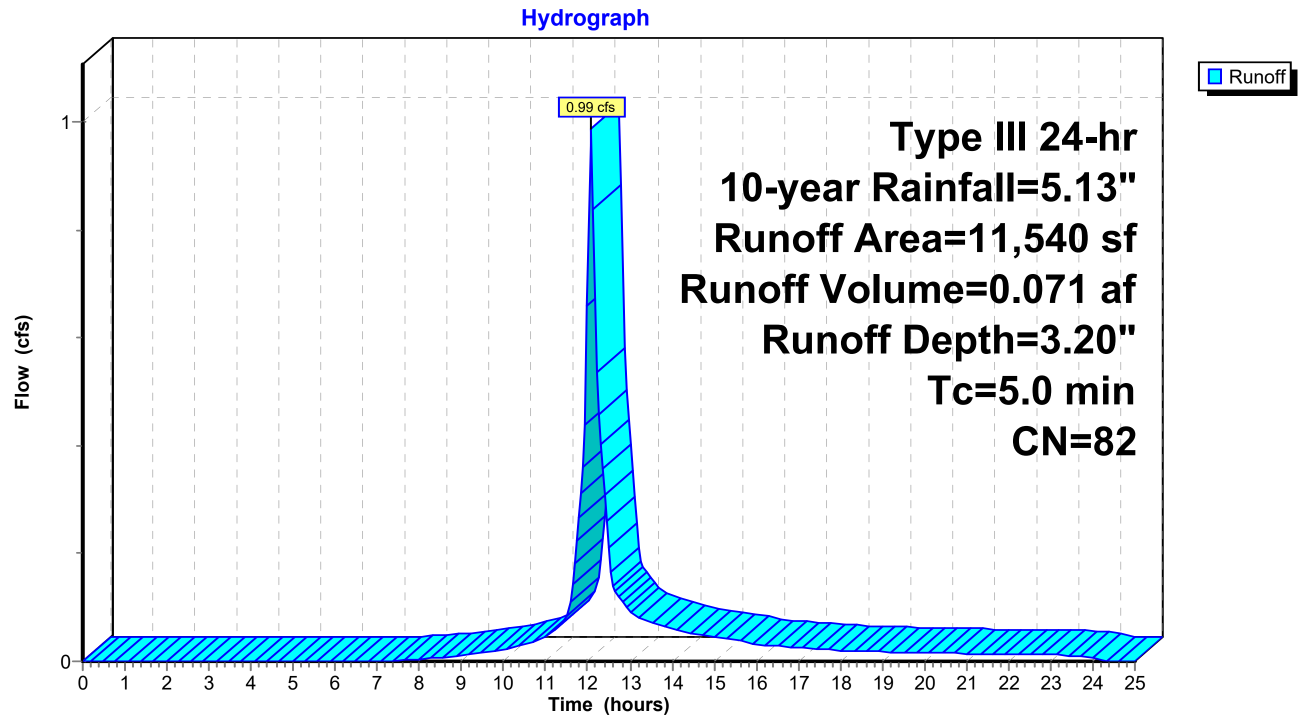
Runoff = 0.99 cfs @ 12.08 hrs, Volume= 0.071 af, Depth= 3.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-year Rainfall=5.13"

Area (sf)	CN	Description
7,770	98	Paved parking, HSG A
0	98	Roofs, HSG A
3,770	49	50-75% Grass cover, Fair, HSG A
11,540	82	Weighted Average
3,770		32.67% Pervious Area
7,770		67.33% Impervious Area

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

Subcatchment 22: Site



Summary for Subcatchment 23: Site

[49] Hint: Tc<2dt may require smaller dt

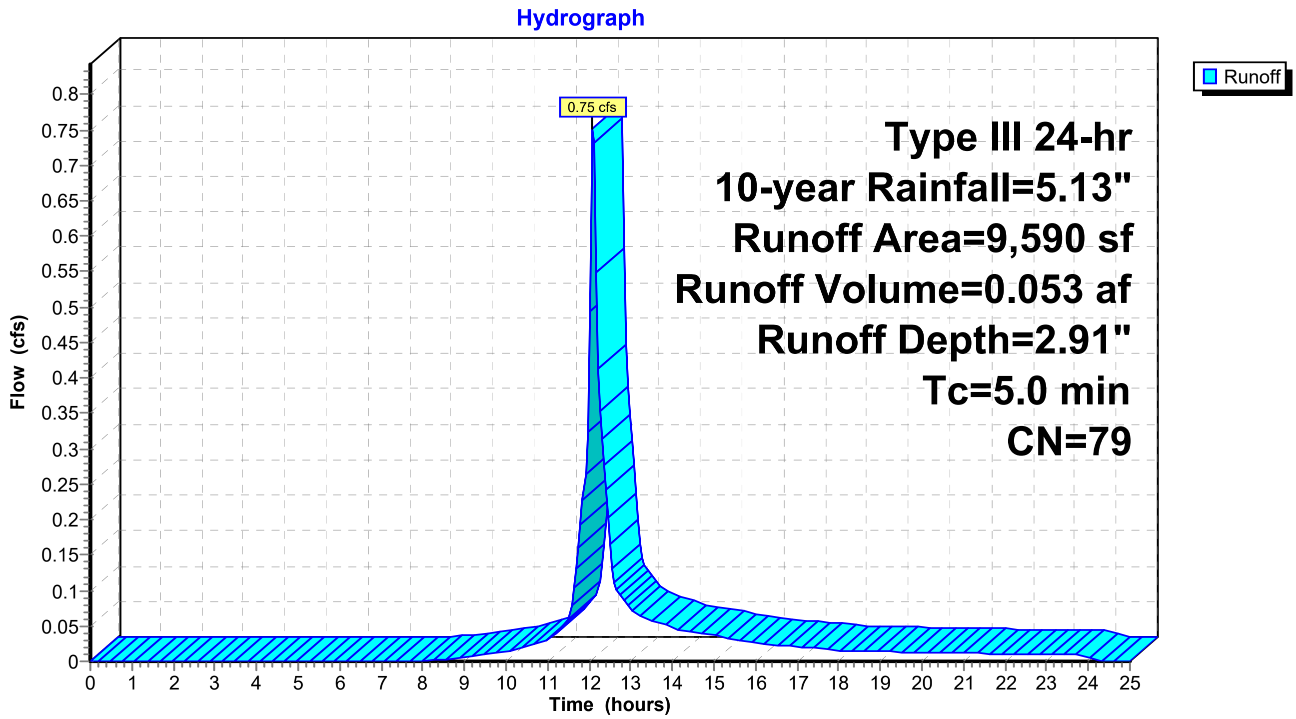
Runoff = 0.75 cfs @ 12.08 hrs, Volume= 0.053 af, Depth= 2.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-year Rainfall=5.13"

Area (sf)	CN	Description
5,875	98	Paved parking, HSG A
0	98	Roofs, HSG A
3,715	49	50-75% Grass cover, Fair, HSG A
9,590	79	Weighted Average
3,715		38.74% Pervious Area
5,875		61.26% Impervious Area

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

Subcatchment 23: Site



Summary for Subcatchment 24: Site

[49] Hint: Tc<2dt may require smaller dt

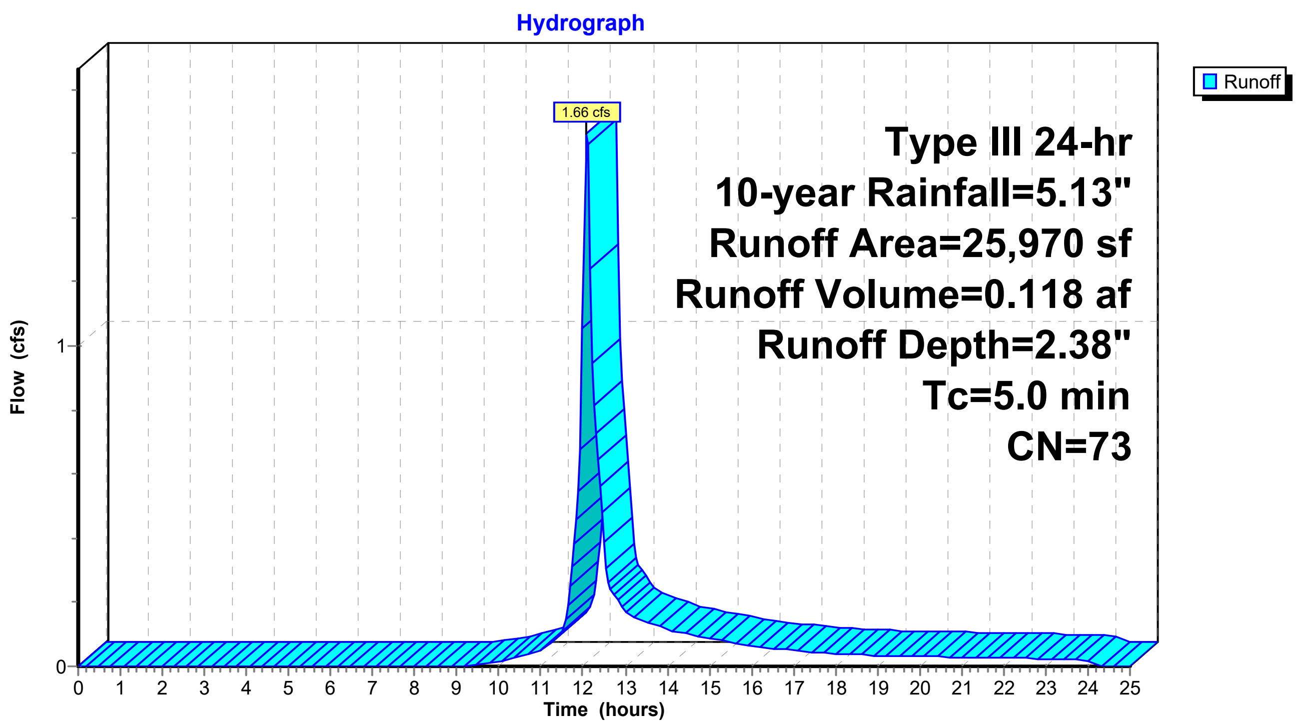
Runoff = 1.66 cfs @ 12.08 hrs, Volume= 0.118 af, Depth= 2.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-year Rainfall=5.13"

Area (sf)	CN	Description
12,770	98	Paved parking, HSG A
0	98	Roofs, HSG A
13,200	49	50-75% Grass cover, Fair, HSG A
25,970	73	Weighted Average
13,200		50.83% Pervious Area
12,770		49.17% Impervious Area

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

Subcatchment 24: Site



Summary for Subcatchment 25: Building

[49] Hint: Tc<2dt may require smaller dt

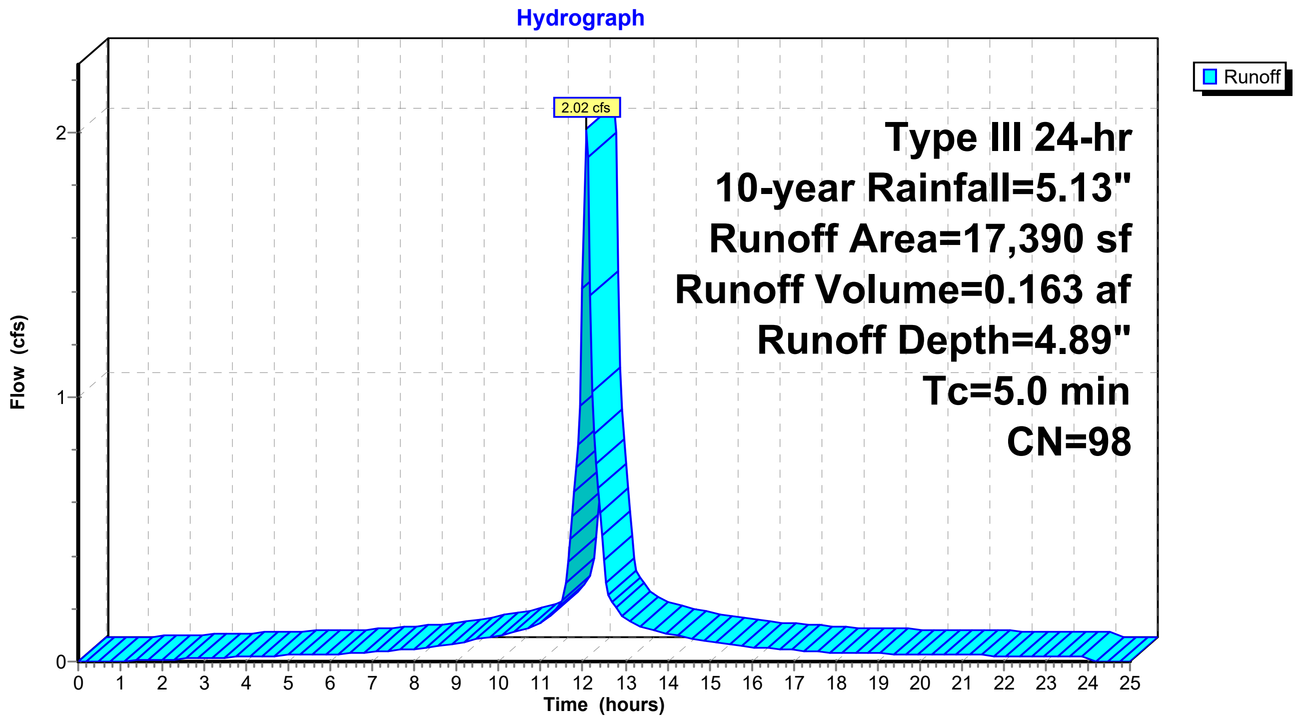
Runoff = 2.02 cfs @ 12.07 hrs, Volume= 0.163 af, Depth= 4.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-year Rainfall=5.13"

Area (sf)	CN	Description
0	98	Paved parking, HSG A
17,390	98	Roofs, HSG A
0	49	50-75% Grass cover, Fair, HSG A
17,390	98	Weighted Average
17,390		100.00% Impervious Area

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

Subcatchment 25: Building



Summary for Subcatchment 26: Building

[49] Hint: Tc<2dt may require smaller dt

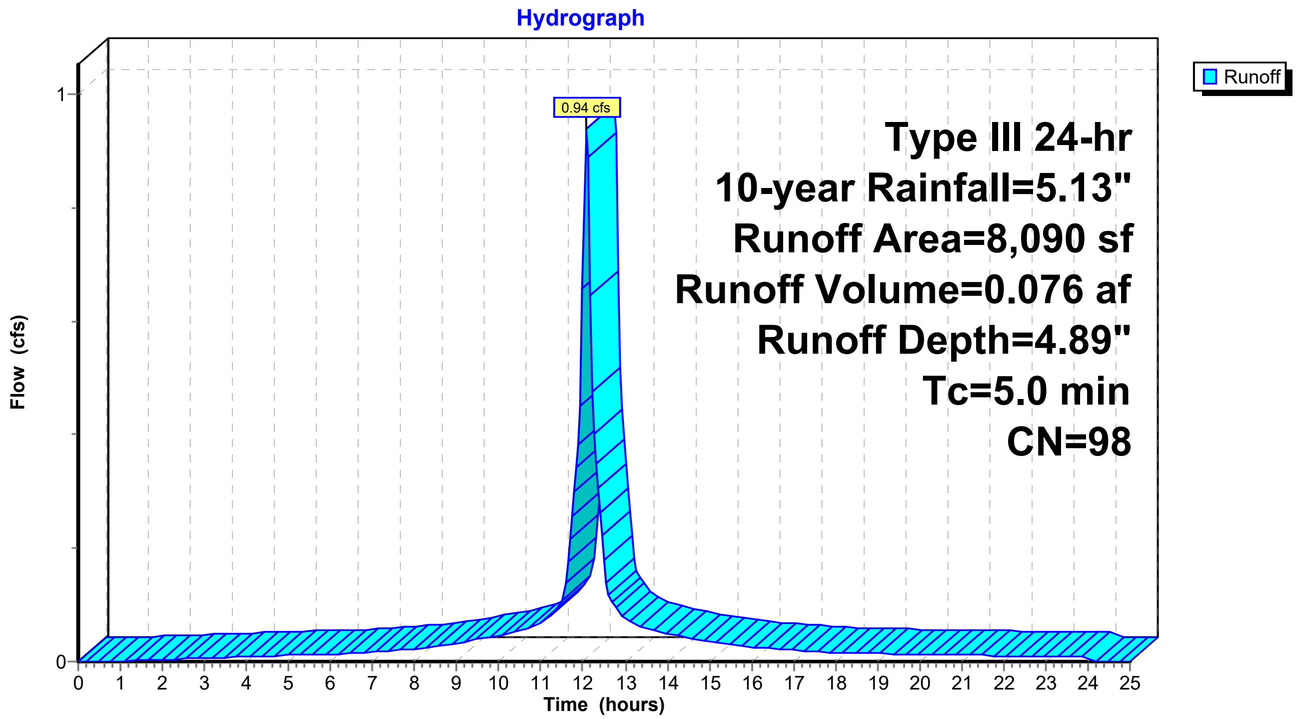
Runoff = 0.94 cfs @ 12.07 hrs, Volume= 0.076 af, Depth= 4.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-year Rainfall=5.13"

Area (sf)	CN	Description
0	98	Paved parking, HSG A
8,090	98	Roofs, HSG A
0	49	50-75% Grass cover, Fair, HSG A
8,090	98	Weighted Average
8,090		100.00% Impervious Area

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

Subcatchment 26: Building



Summary for Pond P-1: Subsurface Infiltration System "A"

Inflow Area = 0.251 ac, 48.49% Impervious, Inflow Depth = 2.38" for 10-year event
Inflow = 0.70 cfs @ 12.08 hrs, Volume= 0.050 af
Outflow = 0.12 cfs @ 12.58 hrs, Volume= 0.050 af, Atten= 83%, Lag= 29.7 min
Discarded = 0.12 cfs @ 12.58 hrs, Volume= 0.050 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs
Peak Elev= 33.42' @ 12.58 hrs Surf.Area= 0.007 ac Storage= 0.016 af

Plug-Flow detention time= 54.1 min calculated for 0.050 af (100% of inflow)
Center-of-Mass det. time= 54.0 min (891.8 - 837.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	30.60'	0.000 af	**6.90'W x 43.19'L x 5.67'H Field A**
			0.039 af Overall - 0.039 af Embedded = 0.000 af x 40.0% Voids
#2A	30.60'	0.029 af	**StormTrap ST1 SingleTrap 5-0** x 3 Inside #1
			Inside= 82.7"W x 60.0"H => 29.76 sf x 14.06'L = 418.5 cf
			Outside= 82.7"W x 68.0"H => 39.08 sf x 14.06'L = 549.5 cf
			6.90' x 42.19' Core + 0.00' x 0.50' Border = 6.90' x 43.19' System
		0.029 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	34.60'	**12.0" Round Culvert**
			L= 25.0' RCP, rounded edge headwall, Ke= 0.100
			Inlet / Outlet Invert= 34.60' / 34.30' S= 0.0120 '/' Cc= 0.900
			n= 0.013 Concrete pipe, bends & connections, Flow Area= 0.79 sf
#2	Device 1	34.60'	**6.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	35.60'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#4	Discarded	30.60'	**8.270 in/hr Exfiltration over Surface area**
			Conductivity to Groundwater Elevation = 28.00'

Discarded OutFlow Max=0.12 cfs @ 12.58 hrs HW=33.42' (Free Discharge)
└─**4=Exfiltration** (Controls 0.12 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=30.60' (Free Discharge)
└─**1=Culvert** (Controls 0.00 cfs)
  ├─**2=Orifice/Grate** (Controls 0.00 cfs)
  └─**3=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond P-1: Subsurface Infiltration System "A" - Chamber Wizard Field A

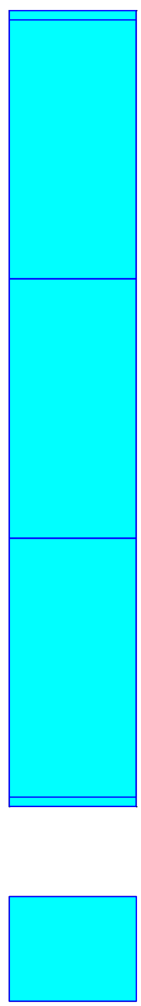
Chamber Model = StormTrap ST1 SingleTrap 5-0 (StormTrap ST1 SingleTrap®Type VI)
Inside= 82.7"W x 60.0"H => 29.76 sf x 14.06'L = 418.5 cf
Outside= 82.7"W x 68.0"H => 39.08 sf x 14.06'L = 549.5 cf

3 Chambers/Row x 14.06' Long = 42.19' Row Length +6.0" Border x 2 = 43.19' Base Length
1 Rows x 82.7" Wide = 6.90' Base Width
68.0" Chamber Height = 5.67' Field Height

3 Chambers x 418.5 cf = 1,255.5 cf Chamber Storage
3 Chambers x 549.5 cf + 39.1 cf Border = 1,687.6 cf Displacement

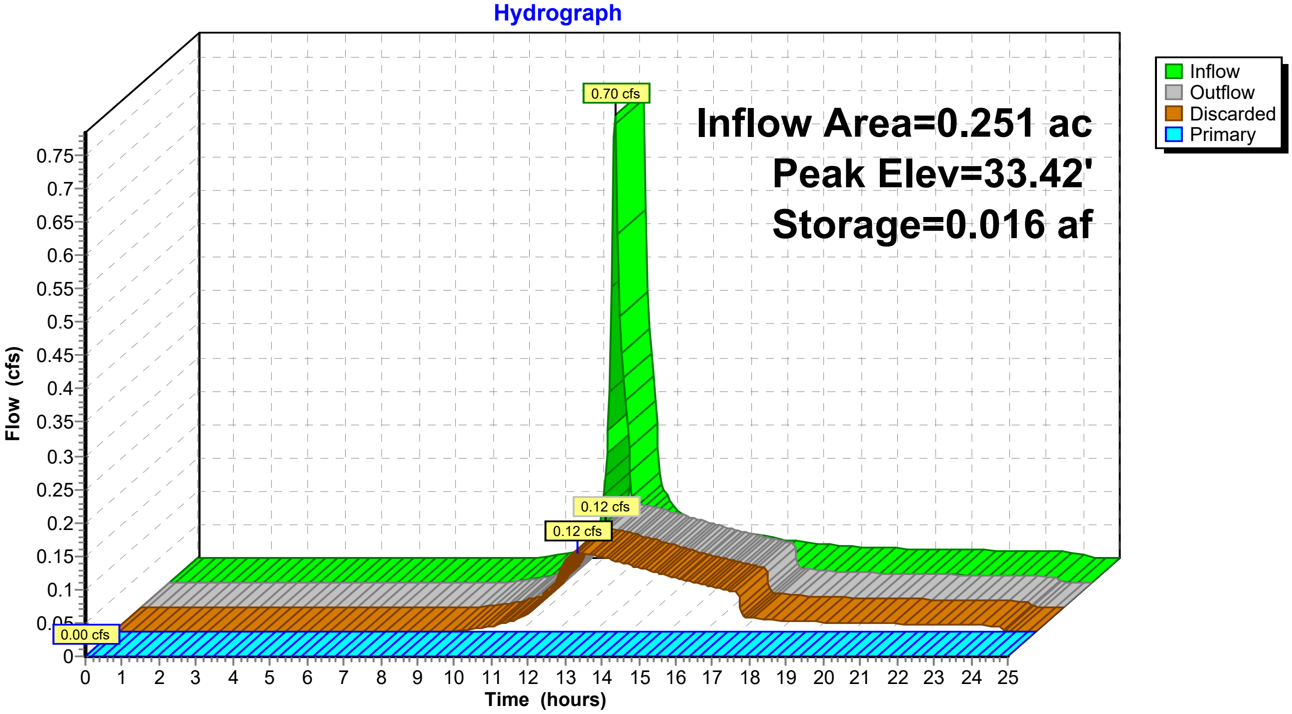
Chamber Storage = 1,255.5 cf = 0.029 af
Overall Storage Efficiency = 74.4%
Overall System Size = 43.19' x 6.90' x 5.67'

3 Chambers (plus border)
62.5 cy Field



#260-22

Pond P-1: Subsurface Infiltration System "A"



Summary for Pond P-2: Subsurface Infiltration System "B"

Inflow Area = 1.291 ac, 78.82% Impervious, Inflow Depth = 3.86" for 10-year event
Inflow = 5.26 cfs @ 12.07 hrs, Volume= 0.415 af
Outflow = 3.66 cfs @ 12.17 hrs, Volume= 0.415 af, Atten= 30%, Lag= 5.8 min
Discarded = 0.71 cfs @ 12.17 hrs, Volume= 0.350 af
Primary = 2.95 cfs @ 12.17 hrs, Volume= 0.065 af

Routing by Stor-Ind method, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs
Peak Elev= 33.78' @ 12.17 hrs Surf.Area= 0.031 ac Storage= 0.092 af

Plug-Flow detention time= 37.2 min calculated for 0.414 af (100% of inflow)
Center-of-Mass det. time= 37.2 min (803.4 - 766.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	30.10'	0.000 af	**89.65'W x 15.06'L x 4.67'H Field A** 0.145 af Overall - 0.145 af Embedded = 0.000 af x 40.0% Voids
#2A	30.10'	0.100 af	**StormTrap ST1 SingleTrap 4-0** x 13 Inside #1 Inside= 82.7"W x 48.0"H => 23.79 sf x 14.06'L = 334.5 cf Outside= 82.7"W x 56.0"H => 32.18 sf x 14.06'L = 452.5 cf 13 Chambers in 13 Rows 89.65' x 14.06' Core + 0.00' x 0.50' Border = 89.65' x 15.06' System
#3	33.30'	0.001 af	**4.00'D x 3.10'H Vertical Cone/Cylinder**-Impervious
		0.101 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	33.10'	**12.0" Round Culvert X 2.00** L= 5.0' RCP, rounded edge headwall, Ke= 0.100 Inlet / Outlet Invert= 33.10' / 33.00' S= 0.0200 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 0.79 sf
#2	Discarded	30.10'	**8.270 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 28.00'

Discarded OutFlow Max=0.71 cfs @ 12.17 hrs HW=33.74' (Free Discharge)
└─**2=Exfiltration** (Controls 0.71 cfs)

Primary OutFlow Max=2.72 cfs @ 12.17 hrs HW=33.74' (Free Discharge)
└─**1=Culvert** (Barrel Controls 2.72 cfs @ 3.64 fps)

Pond P-2: Subsurface Infiltration System "B" - Chamber Wizard Field A

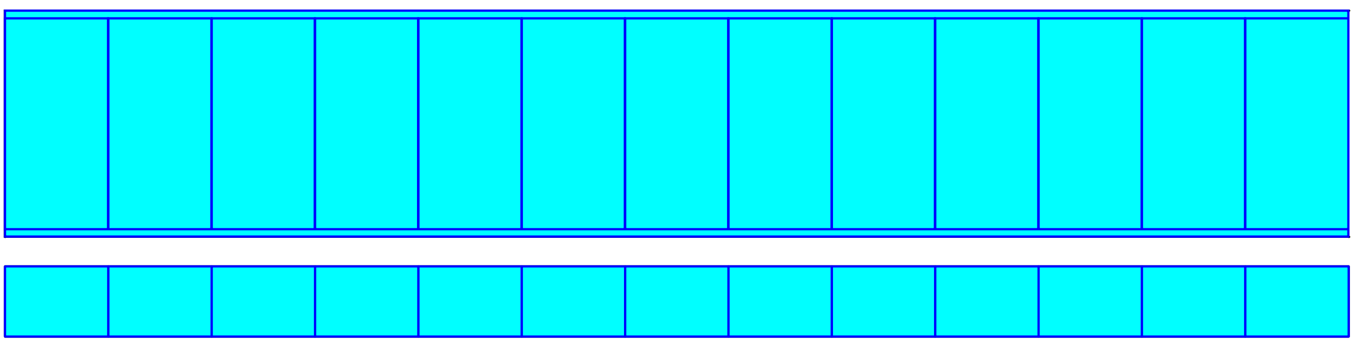
Chamber Model = StormTrap ST1 SingleTrap 4-0 (StormTrap ST1 SingleTrap®Type VI)
Inside= 82.7"W x 48.0"H => 23.79 sf x 14.06'L = 334.5 cf
Outside= 82.7"W x 56.0"H => 32.18 sf x 14.06'L = 452.5 cf

1 Chambers/Row x 14.06' Long = 14.06' Row Length +6.0" Border x 2 = 15.06' Base Length
13 Rows x 82.7" Wide = 89.65' Base Width
56.0" Chamber Height = 4.67' Field Height

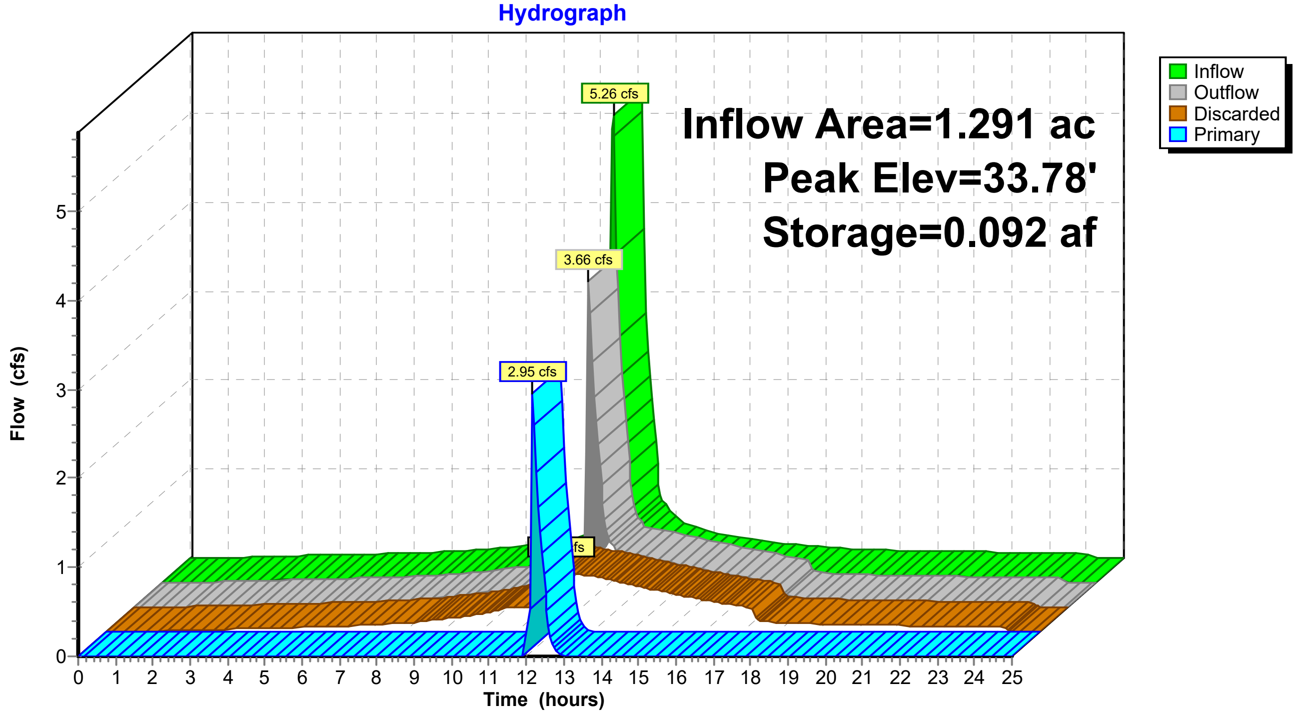
13 Chambers x 334.5 cf = 4,348.5 cf Chamber Storage
13 Chambers x 452.5 cf + 418.3 cf Border = 6,301.4 cf Displacement

Chamber Storage = 4,348.5 cf = 0.100 af
Overall Storage Efficiency = 69.0%
Overall System Size = 15.06' x 89.65' x 4.67'

13 Chambers (plus border)
233.4 cy Field



Pond P-2: Subsurface Infiltration System "B"



Summary for Pond P-3: Subsurface Infiltration System "C"

Inflow Area = 1.002 ac, 61.25% Impervious, Inflow Depth = 2.96" for 10-year event
Inflow = 3.34 cfs @ 12.08 hrs, Volume= 0.248 af
Outflow = 1.59 cfs @ 12.26 hrs, Volume= 0.248 af, Atten= 52%, Lag= 10.8 min
Discarded = 0.50 cfs @ 12.26 hrs, Volume= 0.214 af
Primary = 1.09 cfs @ 12.26 hrs, Volume= 0.033 af

Routing by Stor-Ind method, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs
Peak Elev= 32.66' @ 12.26 hrs Surf.Area= 0.027 ac Storage= 0.059 af

Plug-Flow detention time= 34.9 min calculated for 0.247 af (100% of inflow)
Center-of-Mass det. time= 34.8 min (841.4 - 806.6)

Volume	Invert	Avail.Storage	Storage Description
#1A	30.10'	0.000 af	**20.69'W x 57.25'L x 3.67'H Field A** 0.100 af Overall - 0.100 af Embedded = 0.000 af x 40.0% Voids
#2A	30.10'	0.069 af	**StormTrap ST1 SingleTrap 3-0** x 12 Inside #1 Inside= 82.7"W x 36.0"H => 17.81 sf x 14.06'L = 250.5 cf Outside= 82.7"W x 44.0"H => 25.28 sf x 14.06'L = 355.6 cf 12 Chambers in 3 Rows 20.69' x 56.25' Core + 0.00' x 0.50' Border = 20.69' x 57.25' System
#3	32.30'	0.001 af	**4.00'D x 5.10'H Vertical Cone/Cylinder**-Impervious
		0.070 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	32.10'	**12.0" Round Culvert** L= 5.0' RCP, rounded edge headwall, Ke= 0.100 Inlet / Outlet Invert= 32.10' / 32.00' S= 0.0200 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 0.79 sf
#2	Discarded	30.10'	**8.270 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 28.00'

Discarded OutFlow Max=0.50 cfs @ 12.26 hrs HW=32.66' (Free Discharge)
└─**2=Exfiltration** (Controls 0.50 cfs)

Primary OutFlow Max=1.08 cfs @ 12.26 hrs HW=32.66' (Free Discharge)
└─**1=Culvert** (Barrel Controls 1.08 cfs @ 3.46 fps)

Pond P-3: Subsurface Infiltration System "C" - Chamber Wizard Field A

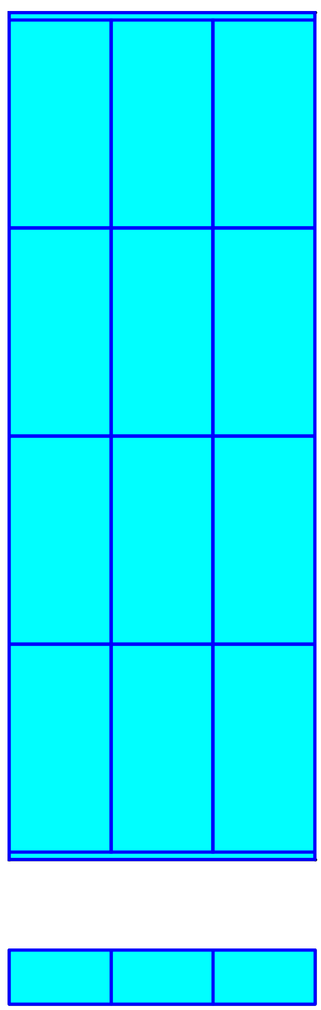
Chamber Model = StormTrap ST1 SingleTrap 3-0 (StormTrap ST1 SingleTrap®Type VI)
Inside= 82.7"W x 36.0"H => 17.81 sf x 14.06'L = 250.5 cf
Outside= 82.7"W x 44.0"H => 25.28 sf x 14.06'L = 355.6 cf

4 Chambers/Row x 14.06' Long = 56.25' Row Length +6.0" Border x 2 = 57.25' Base Length
3 Rows x 82.7" Wide = 20.69' Base Width
44.0" Chamber Height = 3.67' Field Height

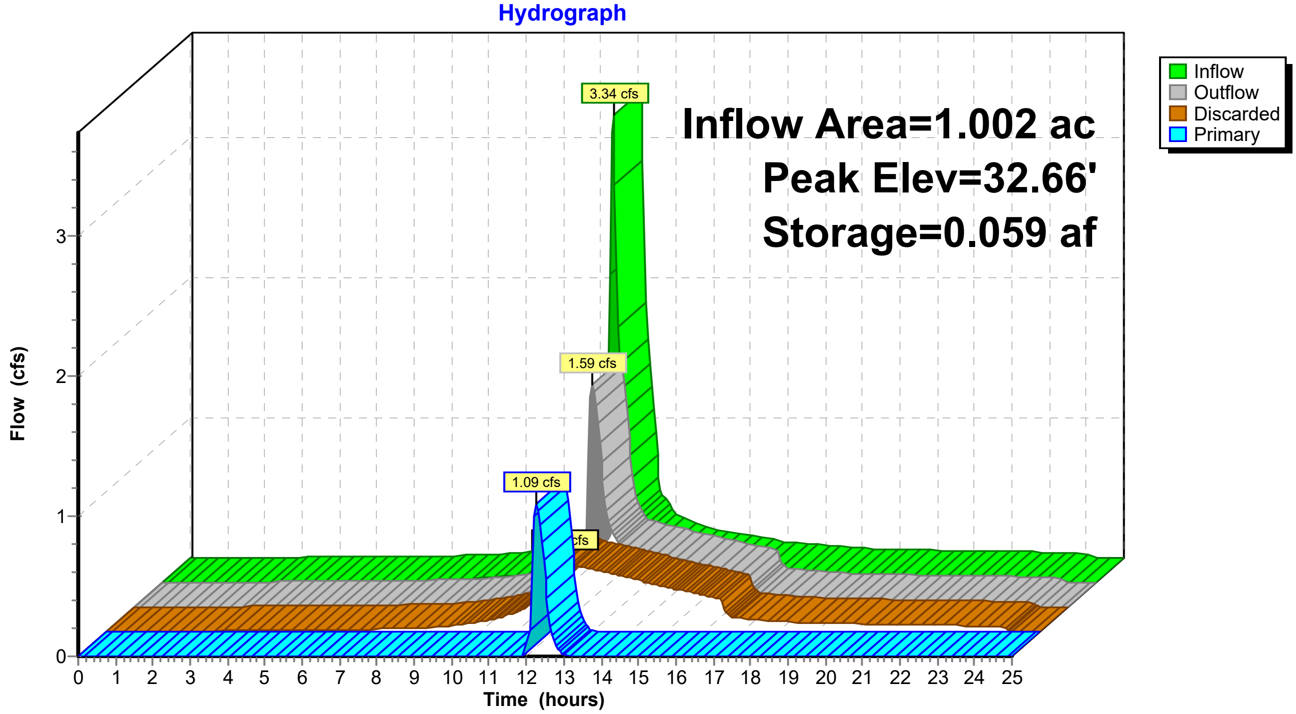
12 Chambers x 250.5 cf = 3,006.0 cf Chamber Storage
12 Chambers x 355.6 cf + 75.9 cf Border = 4,342.7 cf Displacement

Chamber Storage = 3,006.0 cf = 0.069 af
Overall Storage Efficiency = 69.2%
Overall System Size = 57.25' x 20.69' x 3.67'

12 Chambers (plus border)
160.8 cy Field



Pond P-3: Subsurface Infiltration System "C"

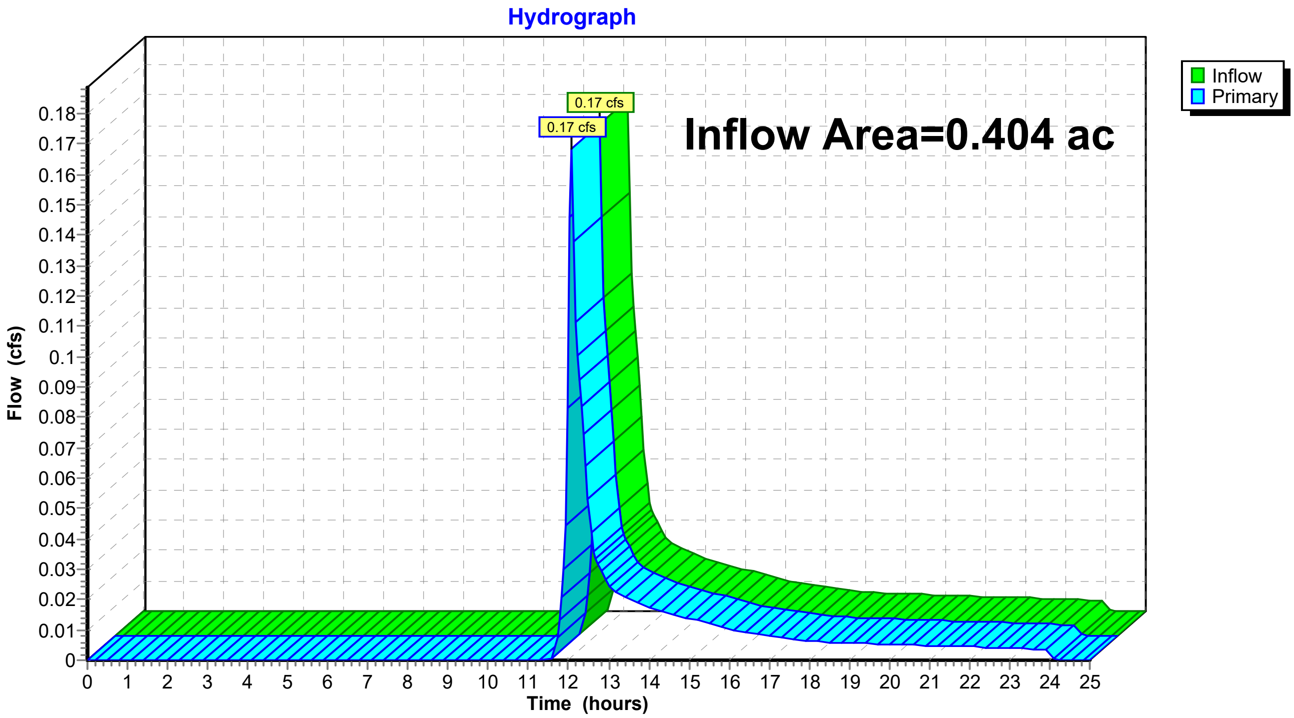


Summary for Link DP-1: Court Street

Inflow Area =	0.404 ac, 35.23% Impervious, Inflow Depth = 0.42"	for 10-year event	
Inflow =	0.17 cfs @ 12.10 hrs, Volume=	0.014 af	
Primary =	0.17 cfs @ 12.10 hrs, Volume=	0.014 af, Atten= 0%, Lag= 0.0 min	

Primary outflow = Inflow, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs

Link DP-1: Court Street

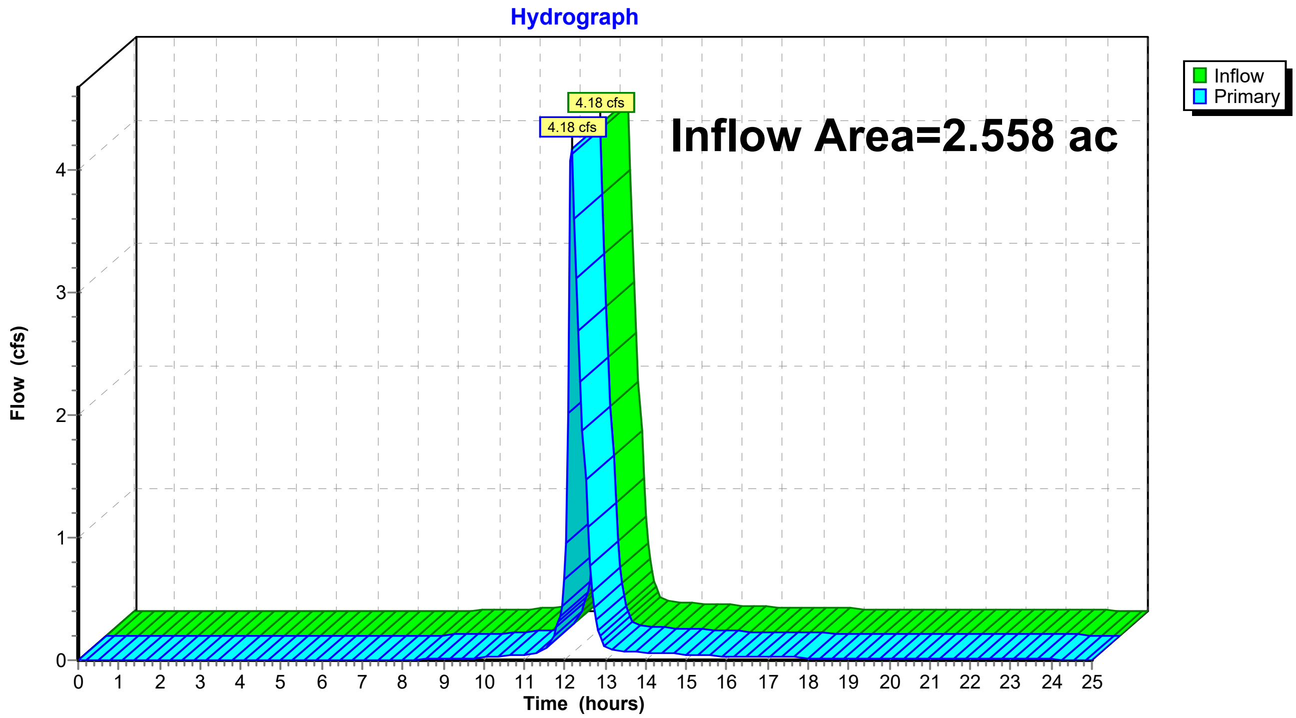


Summary for Link DP-2: Crafts Street

Inflow Area =	2.558 ac, 70.75% Impervious, Inflow Depth = 0.79"	for 10-year event		
Inflow =	4.18 cfs @	12.18 hrs, Volume=	0.169 af	
Primary =	4.18 cfs @	12.18 hrs, Volume=	0.169 af, Atten= 0%, Lag= 0.0 min	

Primary outflow = Inflow, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs

Link DP-2: Crafts Street



25-Year Storm Event – Proposed

Time span=0.00-25.00 hrs, dt=0.05 hrs, 501 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment10: Site Runoff Area=10,950 sf 48.49% Impervious Runoff Depth=3.34"
Tc=5.0 min CN=73 Runoff=0.98 cfs 0.070 af

Subcatchment11: Site Runoff Area=6,635 sf 13.34% Impervious Runoff Depth=1.78"
Tc=5.0 min CN=56 Runoff=0.29 cfs 0.023 af

Subcatchment20: Site Runoff Area=20,460 sf 41.79% Impervious Runoff Depth=2.95"
Tc=5.0 min CN=69 Runoff=1.62 cfs 0.115 af

Subcatchment21: Building Runoff Area=18,390 sf 100.00% Impervious Runoff Depth=6.06"
Tc=5.0 min CN=98 Runoff=2.62 cfs 0.213 af

Subcatchment22: Site Runoff Area=11,540 sf 67.33% Impervious Runoff Depth=4.26"
Tc=5.0 min CN=82 Runoff=1.32 cfs 0.094 af

Subcatchment23: Site Runoff Area=9,590 sf 61.26% Impervious Runoff Depth=3.95"
Tc=5.0 min CN=79 Runoff=1.01 cfs 0.072 af

Subcatchment24: Site Runoff Area=25,970 sf 49.17% Impervious Runoff Depth=3.34"
Tc=5.0 min CN=73 Runoff=2.34 cfs 0.166 af

Subcatchment25: Building Runoff Area=17,390 sf 100.00% Impervious Runoff Depth=6.06"
Tc=5.0 min CN=98 Runoff=2.48 cfs 0.202 af

Subcatchment26: Building Runoff Area=8,090 sf 100.00% Impervious Runoff Depth=6.06"
Tc=5.0 min CN=98 Runoff=1.15 cfs 0.094 af

Pond P-1: Subsurface Infiltration System "A" Peak Elev=34.77' Storage=0.024 af Inflow=0.98 cfs 0.070 af
Discarded=0.15 cfs 0.069 af Primary=0.08 cfs 0.001 af Outflow=0.23 cfs 0.070 af

Pond P-2: Subsurface Infiltration System "B" Peak Elev=34.07' Storage=0.099 af Inflow=6.72 cfs 0.530 af
Discarded=0.75 cfs 0.408 af Primary=5.22 cfs 0.123 af Outflow=5.97 cfs 0.530 af

Pond P-3: Subsurface Infiltration System "C" Peak Elev=33.07' Storage=0.068 af Inflow=4.49 cfs 0.332 af
Discarded=0.55 cfs 0.257 af Primary=2.59 cfs 0.075 af Outflow=3.13 cfs 0.332 af

Link DP-1: Court Street Inflow=0.29 cfs 0.024 af
Primary=0.29 cfs 0.024 af

Link DP-2: Crafts Street Inflow=8.41 cfs 0.292 af
Primary=8.41 cfs 0.292 af

Total Runoff Area = 2.962 ac Runoff Volume = 1.049 af Average Runoff Depth = 4.25"
34.09% Pervious = 1.010 ac 65.91% Impervious = 1.952 ac

Summary for Subcatchment 10: Site

[49] Hint: Tc<2dt may require smaller dt

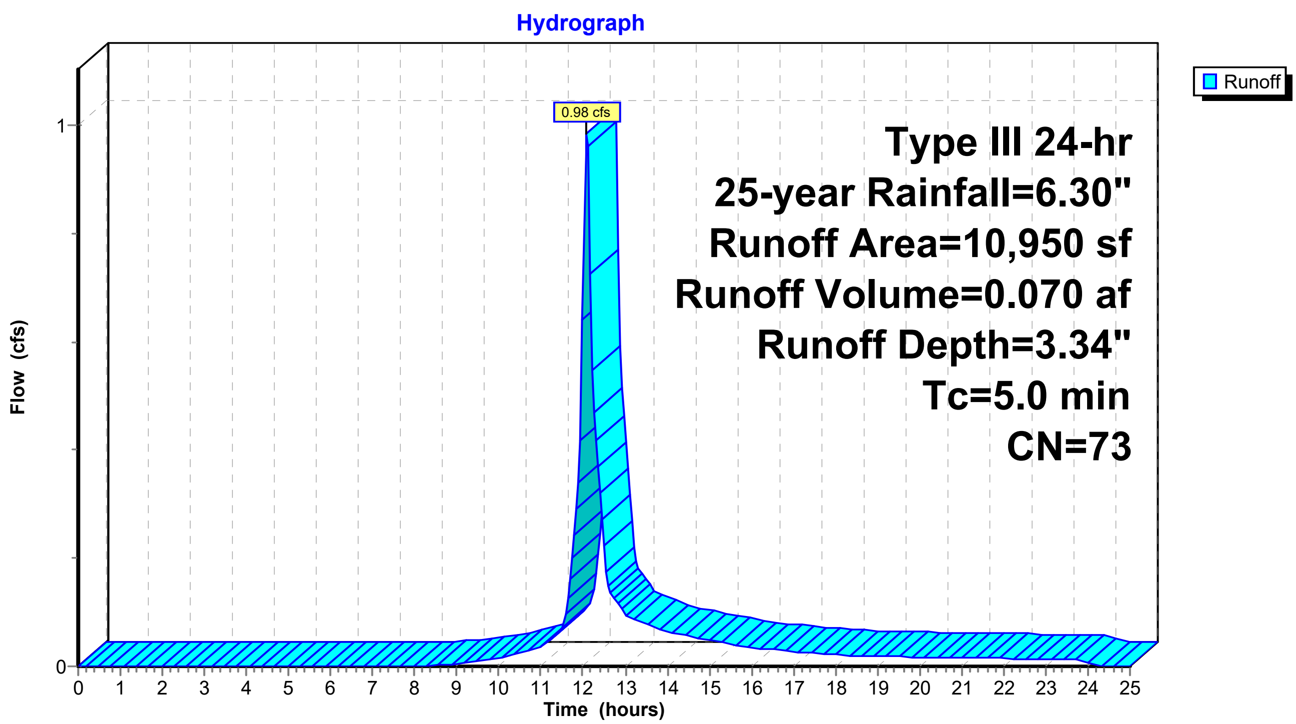
Runoff = 0.98 cfs @ 12.08 hrs, Volume= 0.070 af, Depth= 3.34"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-year Rainfall=6.30"

Area (sf)	CN	Description
5,310	98	Paved parking, HSG A
0	98	Roofs, HSG A
5,640	49	50-75% Grass cover, Fair, HSG A
10,950	73	Weighted Average
5,640		51.51% Pervious Area
5,310		48.49% Impervious Area

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

Subcatchment 10: Site



Summary for Subcatchment 11: Site

[49] Hint: Tc<2dt may require smaller dt

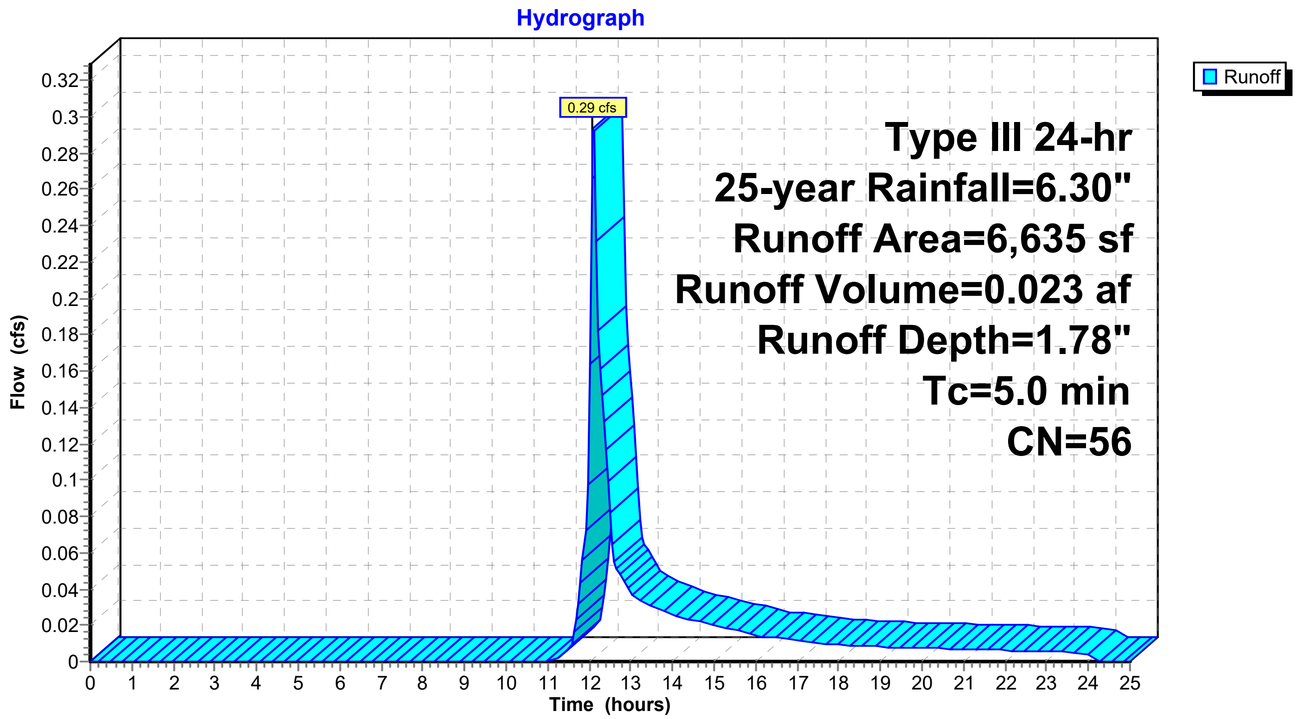
Runoff = 0.29 cfs @ 12.09 hrs, Volume= 0.023 af, Depth= 1.78"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-year Rainfall=6.30"

Area (sf)	CN	Description
885	98	Paved parking, HSG A
5,750	49	50-75% Grass cover, Fair, HSG A
6,635	56	Weighted Average
5,750		86.66% Pervious Area
885		13.34% Impervious Area

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

Subcatchment 11: Site



Summary for Subcatchment 20: Site

[49] Hint: Tc<2dt may require smaller dt

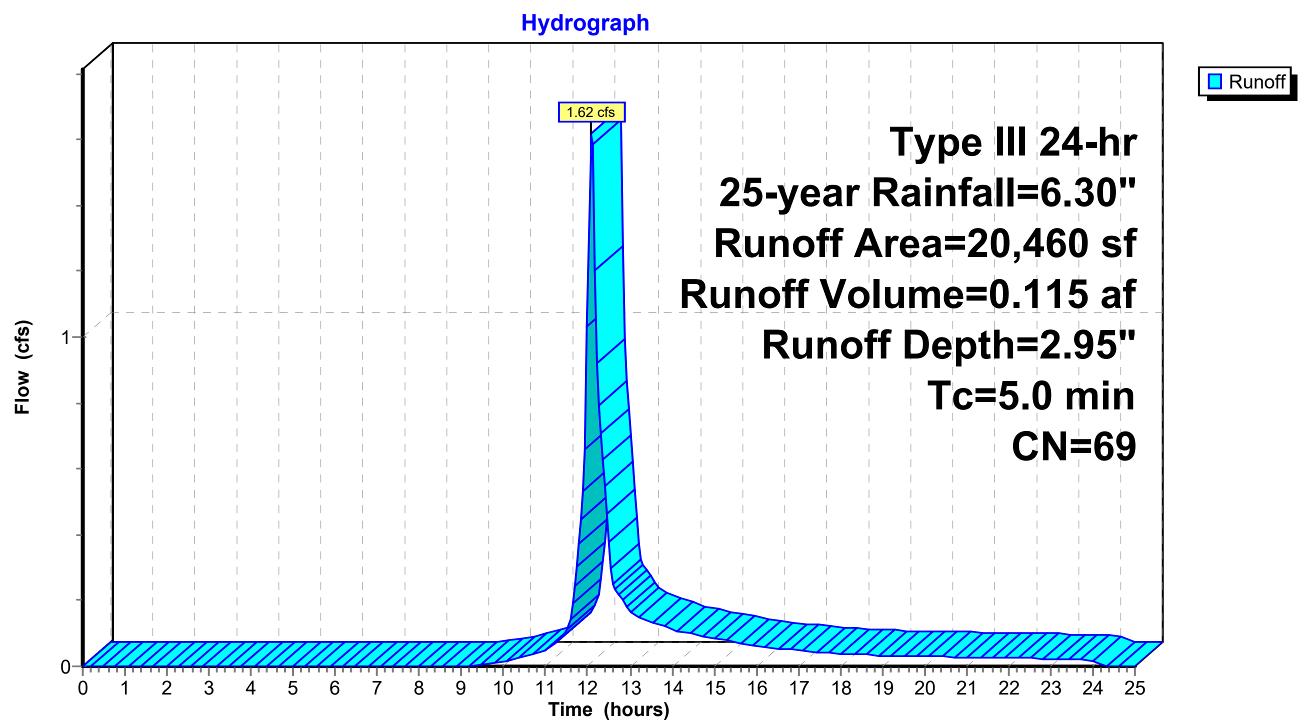
Runoff = 1.62 cfs @ 12.08 hrs, Volume= 0.115 af, Depth= 2.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-year Rainfall=6.30"

Area (sf)	CN	Description
8,550	98	Paved parking, HSG A
0	98	Roofs, HSG A
11,910	49	50-75% Grass cover, Fair, HSG A
20,460	69	Weighted Average
11,910		58.21% Pervious Area
8,550		41.79% Impervious Area

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

Subcatchment 20: Site



Summary for Subcatchment 21: Building

[49] Hint: Tc<2dt may require smaller dt

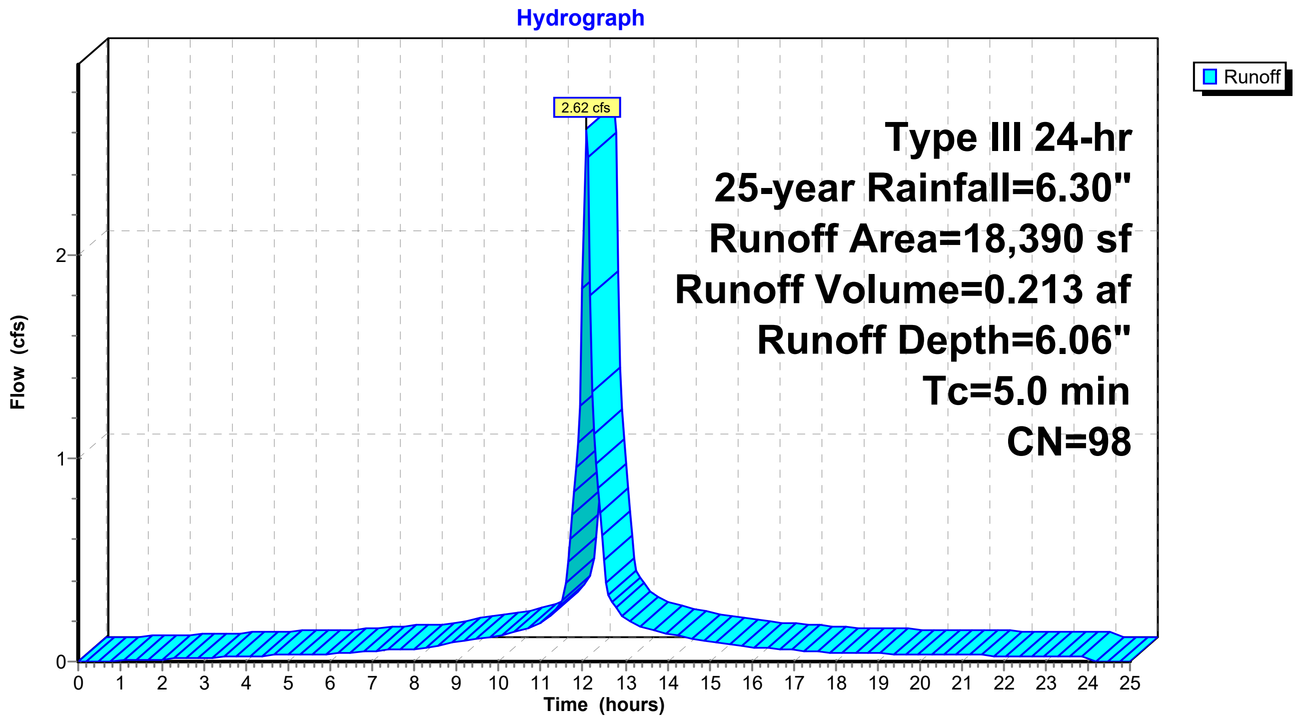
Runoff = 2.62 cfs @ 12.07 hrs, Volume= 0.213 af, Depth= 6.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-year Rainfall=6.30"

Area (sf)	CN	Description
0	98	Paved parking, HSG A
18,390	98	Roofs, HSG A
0	49	50-75% Grass cover, Fair, HSG A
18,390	98	Weighted Average
18,390		100.00% Impervious Area

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

Subcatchment 21: Building



Summary for Subcatchment 22: Site

[49] Hint: Tc<2dt may require smaller dt

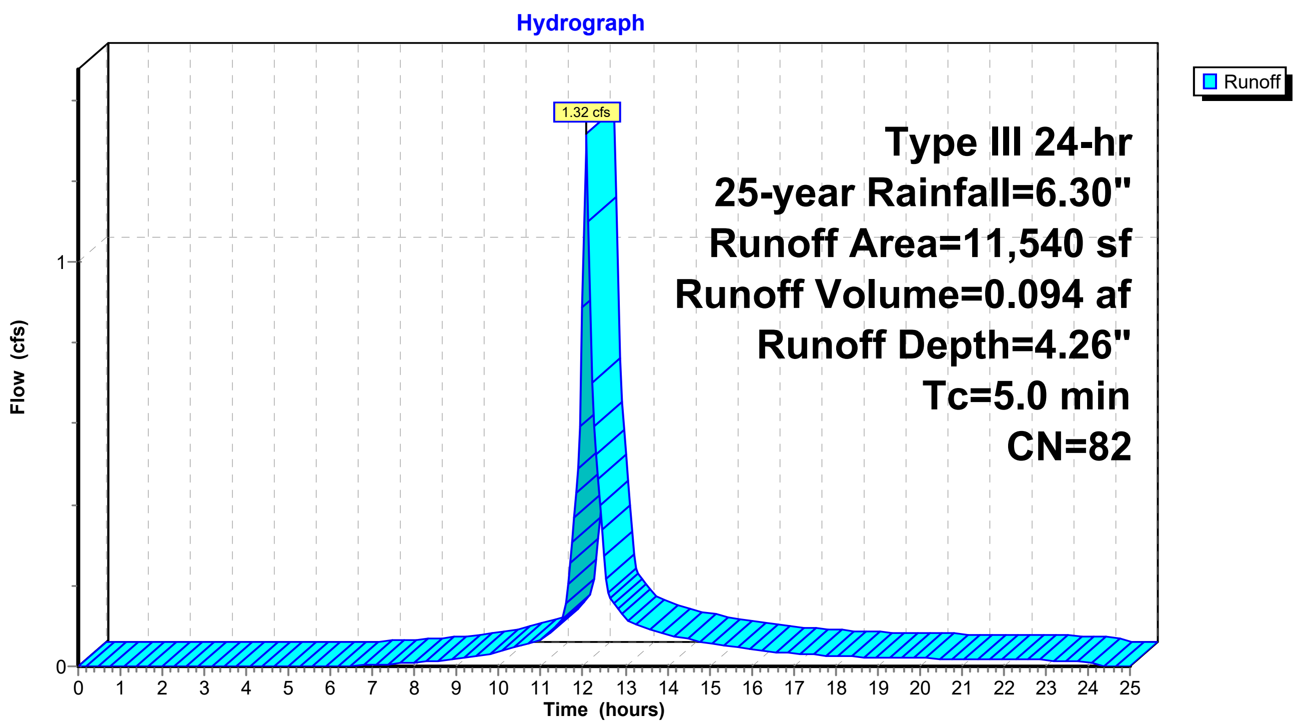
Runoff = 1.32 cfs @ 12.07 hrs, Volume= 0.094 af, Depth= 4.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-year Rainfall=6.30"

Area (sf)	CN	Description
7,770	98	Paved parking, HSG A
0	98	Roofs, HSG A
3,770	49	50-75% Grass cover, Fair, HSG A
11,540	82	Weighted Average
3,770		32.67% Pervious Area
7,770		67.33% Impervious Area

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

Subcatchment 22: Site



Summary for Subcatchment 23: Site

[49] Hint: Tc<2dt may require smaller dt

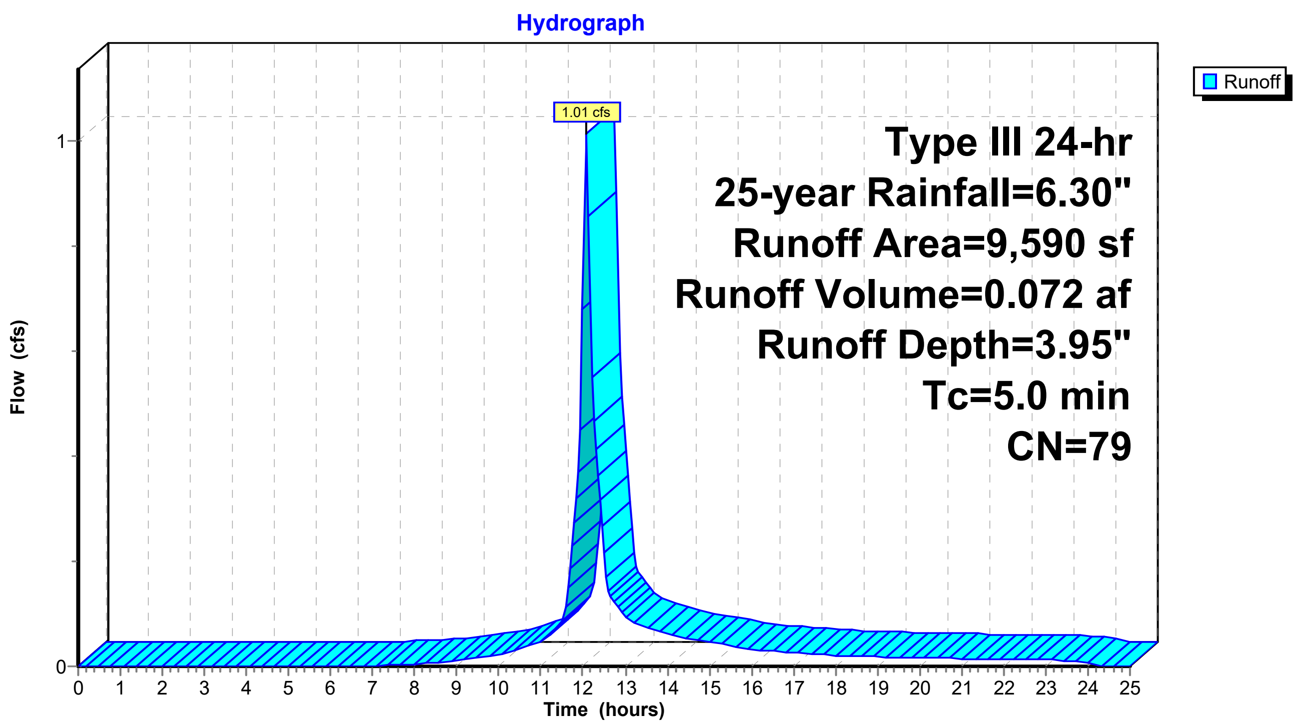
Runoff = 1.01 cfs @ 12.08 hrs, Volume= 0.072 af, Depth= 3.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-year Rainfall=6.30"

Area (sf)	CN	Description
5,875	98	Paved parking, HSG A
0	98	Roofs, HSG A
3,715	49	50-75% Grass cover, Fair, HSG A
9,590	79	Weighted Average
3,715		38.74% Pervious Area
5,875		61.26% Impervious Area

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

Subcatchment 23: Site



Summary for Subcatchment 24: Site

[49] Hint: Tc<2dt may require smaller dt

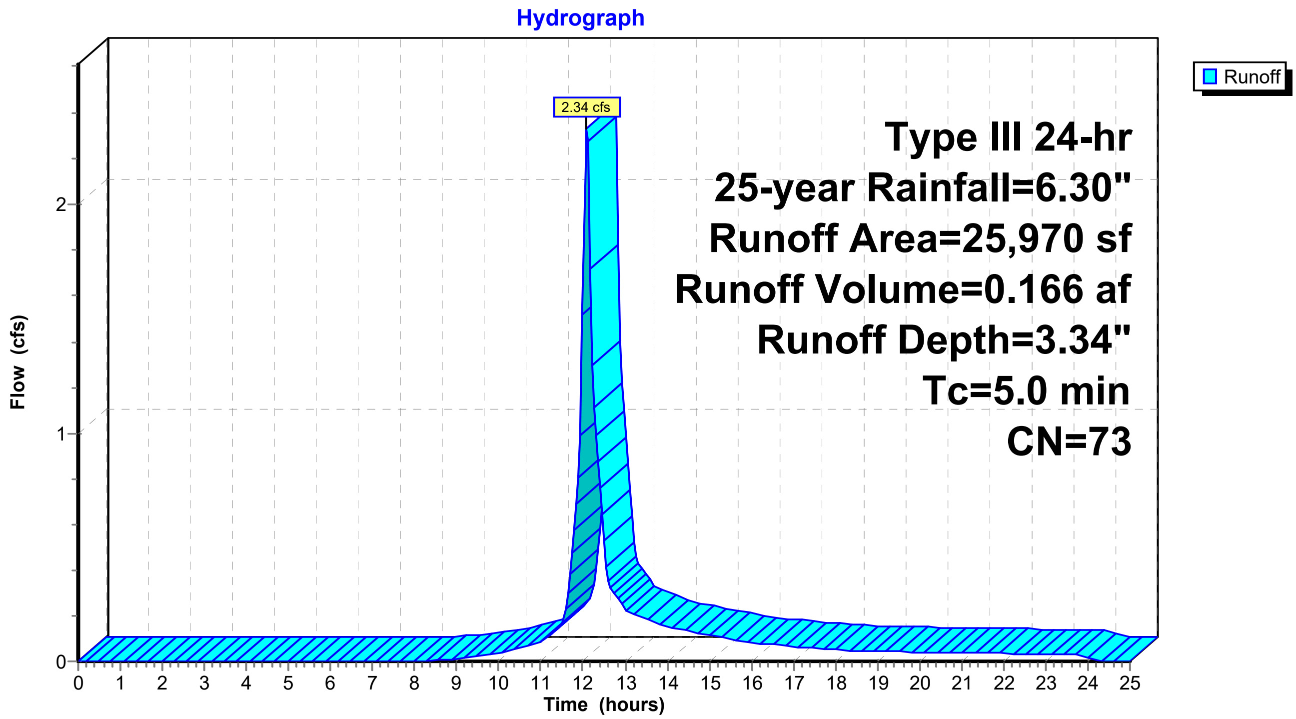
Runoff = 2.34 cfs @ 12.08 hrs, Volume= 0.166 af, Depth= 3.34"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-year Rainfall=6.30"

Area (sf)	CN	Description
12,770	98	Paved parking, HSG A
0	98	Roofs, HSG A
13,200	49	50-75% Grass cover, Fair, HSG A
25,970	73	Weighted Average
13,200		50.83% Pervious Area
12,770		49.17% Impervious Area

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

Subcatchment 24: Site



Summary for Subcatchment 25: Building

[49] Hint: Tc<2dt may require smaller dt

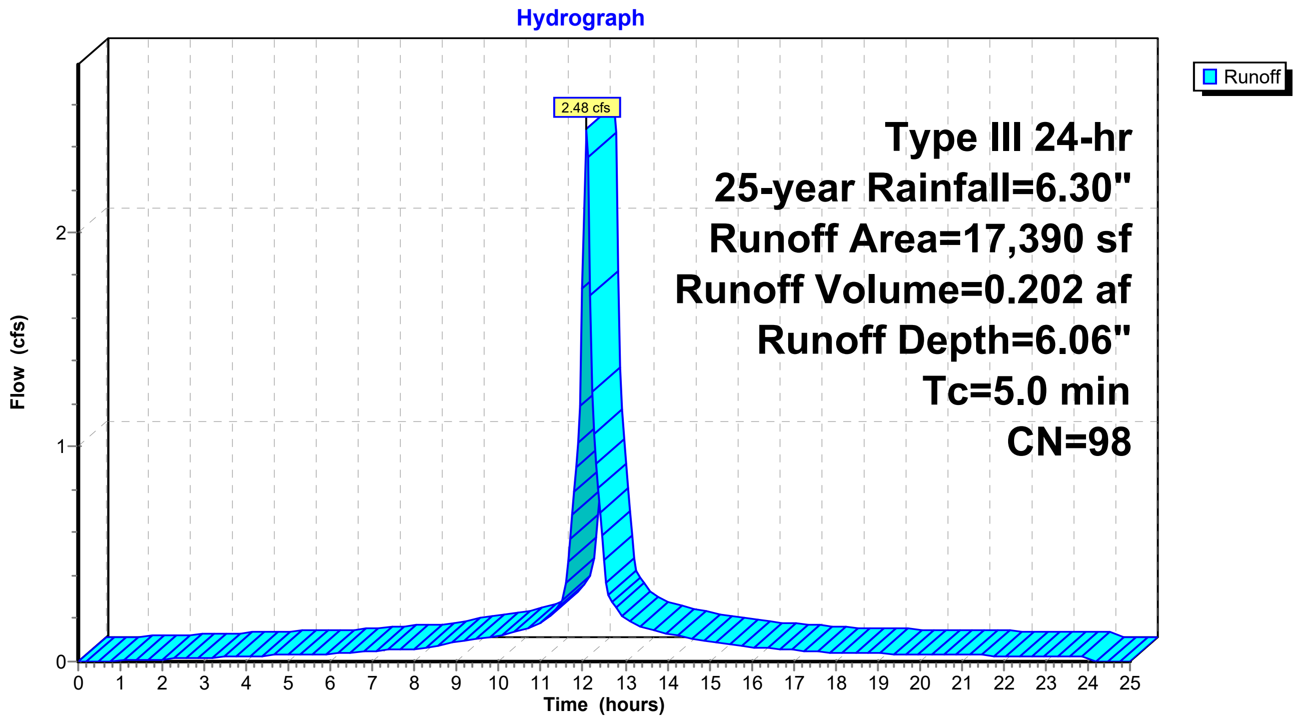
Runoff = 2.48 cfs @ 12.07 hrs, Volume= 0.202 af, Depth= 6.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-year Rainfall=6.30"

Area (sf)	CN	Description
0	98	Paved parking, HSG A
17,390	98	Roofs, HSG A
0	49	50-75% Grass cover, Fair, HSG A
17,390	98	Weighted Average
17,390		100.00% Impervious Area

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

Subcatchment 25: Building



Summary for Subcatchment 26: Building

[49] Hint: Tc<2dt may require smaller dt

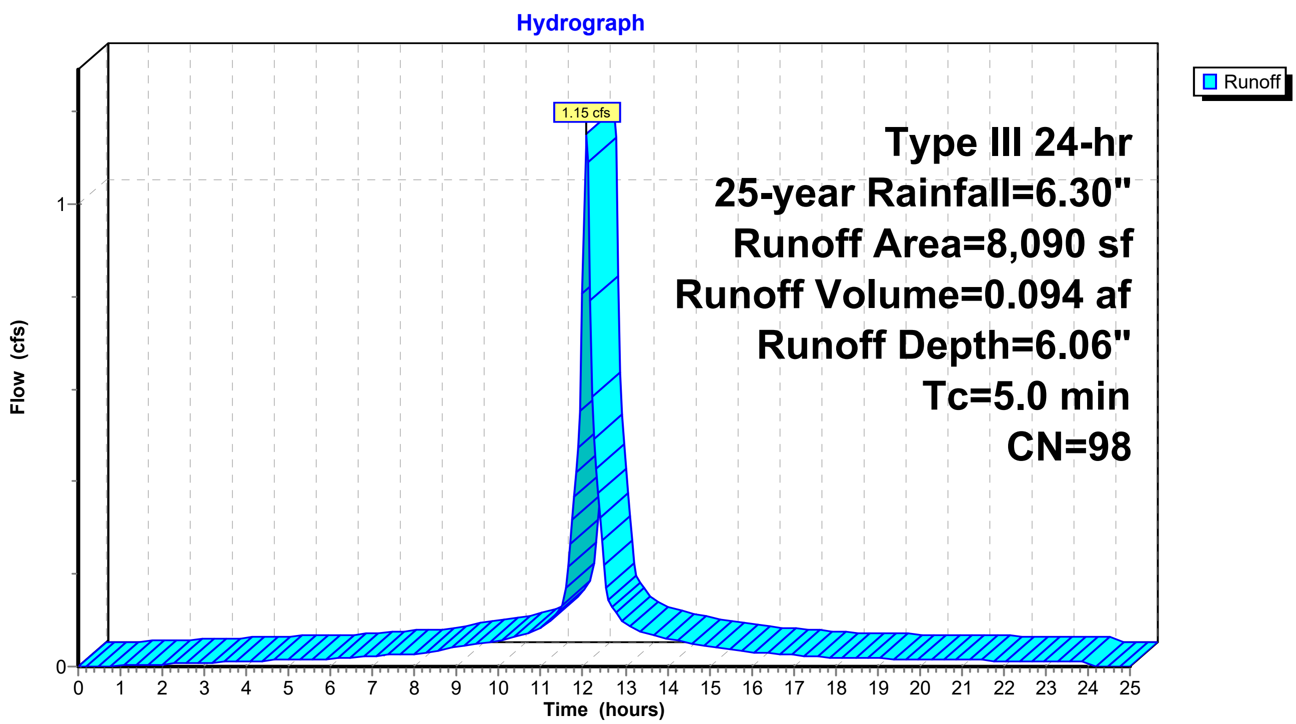
Runoff = 1.15 cfs @ 12.07 hrs, Volume= 0.094 af, Depth= 6.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-year Rainfall=6.30"

Area (sf)	CN	Description
0	98	Paved parking, HSG A
8,090	98	Roofs, HSG A
0	49	50-75% Grass cover, Fair, HSG A
8,090	98	Weighted Average
8,090		100.00% Impervious Area

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

Subcatchment 26: Building



Summary for Pond P-1: Subsurface Infiltration System "A"

Inflow Area = 0.251 ac, 48.49% Impervious, Inflow Depth = 3.34" for 25-year event
Inflow = 0.98 cfs @ 12.08 hrs, Volume= 0.070 af
Outflow = 0.23 cfs @ 12.50 hrs, Volume= 0.070 af, Atten= 77%, Lag= 25.4 min
Discarded = 0.15 cfs @ 12.50 hrs, Volume= 0.069 af
Primary = 0.08 cfs @ 12.50 hrs, Volume= 0.001 af

Routing by Stor-Ind method, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs
Peak Elev= 34.77' @ 12.50 hrs Surf.Area= 0.007 ac Storage= 0.024 af

Plug-Flow detention time= 67.5 min calculated for 0.070 af (100% of inflow)
Center-of-Mass det. time= 67.4 min (895.4 - 828.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	30.60'	0.000 af	**6.90'W x 43.19'L x 5.67'H Field A** 0.039 af Overall - 0.039 af Embedded = 0.000 af x 40.0% Voids
#2A	30.60'	0.029 af	**StormTrap ST1 SingleTrap 5-0** x 3 Inside #1 Inside= 82.7"W x 60.0"H => 29.76 sf x 14.06'L = 418.5 cf Outside= 82.7"W x 68.0"H => 39.08 sf x 14.06'L = 549.5 cf 6.90' x 42.19' Core + 0.00' x 0.50' Border = 6.90' x 43.19' System
		0.029 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	34.60'	**12.0" Round Culvert** L= 25.0' RCP, rounded edge headwall, Ke= 0.100 Inlet / Outlet Invert= 34.60' / 34.30' S= 0.0120 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 0.79 sf
#2	Device 1	34.60'	**6.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	35.60'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#4	Discarded	30.60'	**8.270 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 28.00'

Discarded OutFlow Max=0.15 cfs @ 12.50 hrs HW=34.76' (Free Discharge)
└─**4=Exfiltration** (Controls 0.15 cfs)

Primary OutFlow Max=0.08 cfs @ 12.50 hrs HW=34.76' (Free Discharge)
└─**1=Culvert** (Passes 0.08 cfs of 0.12 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.08 cfs @ 1.38 fps)
  └─**3=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond P-1: Subsurface Infiltration System "A" - Chamber Wizard Field A

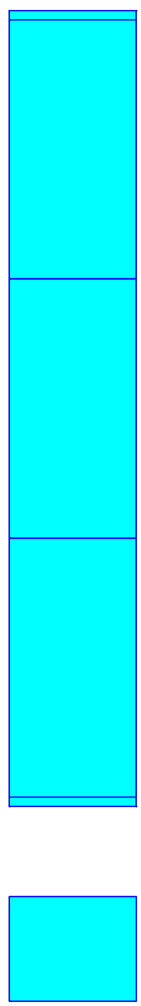
Chamber Model = StormTrap ST1 SingleTrap 5-0 (StormTrap ST1 SingleTrap®Type VI)
Inside= 82.7"W x 60.0"H => 29.76 sf x 14.06'L = 418.5 cf
Outside= 82.7"W x 68.0"H => 39.08 sf x 14.06'L = 549.5 cf

3 Chambers/Row x 14.06' Long = 42.19' Row Length +6.0" Border x 2 = 43.19' Base Length
1 Rows x 82.7" Wide = 6.90' Base Width
68.0" Chamber Height = 5.67' Field Height

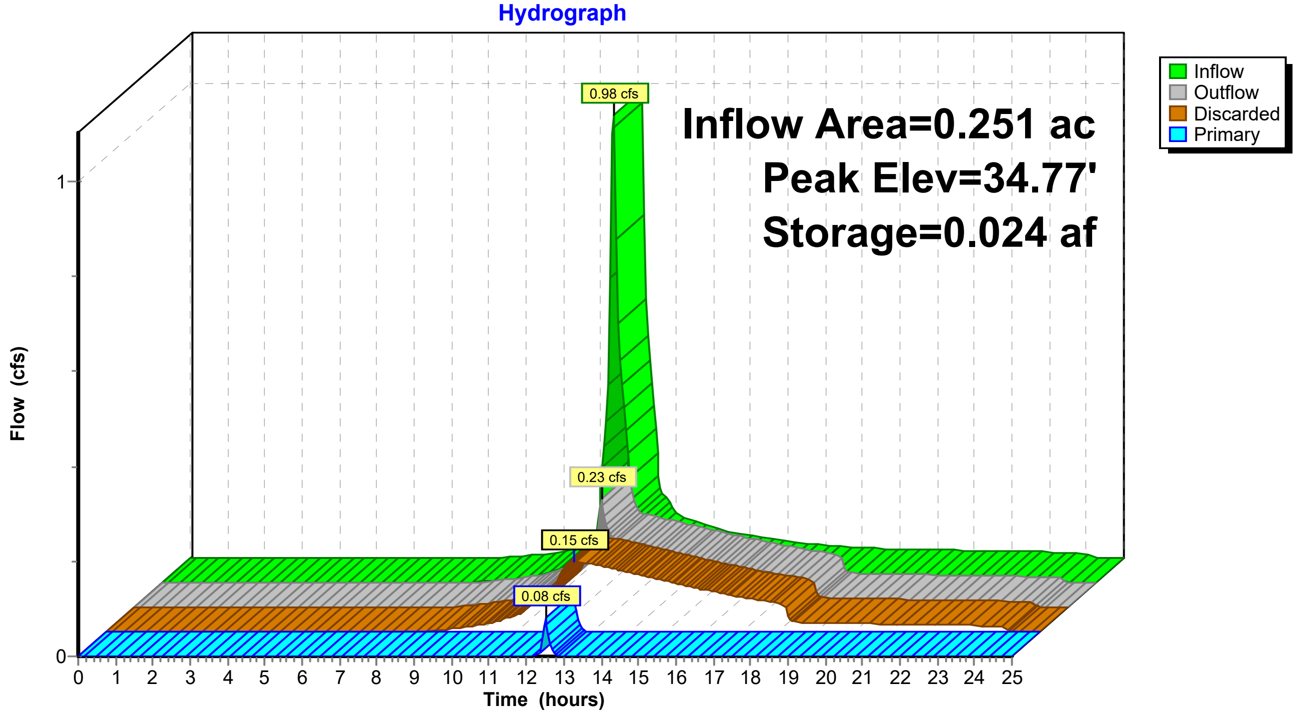
3 Chambers x 418.5 cf = 1,255.5 cf Chamber Storage
3 Chambers x 549.5 cf + 39.1 cf Border = 1,687.6 cf Displacement

Chamber Storage = 1,255.5 cf = 0.029 af
Overall Storage Efficiency = 74.4%
Overall System Size = 43.19' x 6.90' x 5.67'

3 Chambers (plus border)
62.5 cy Field



Pond P-1: Subsurface Infiltration System "A"



Summary for Pond P-2: Subsurface Infiltration System "B"

Inflow Area = 1.291 ac, 78.82% Impervious, Inflow Depth = 4.93" for 25-year event
Inflow = 6.72 cfs @ 12.07 hrs, Volume= 0.530 af
Outflow = 5.97 cfs @ 12.12 hrs, Volume= 0.530 af, Atten= 11%, Lag= 3.0 min
Discarded = 0.75 cfs @ 12.12 hrs, Volume= 0.408 af
Primary = 5.22 cfs @ 12.12 hrs, Volume= 0.123 af

Routing by Stor-Ind method, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs
Peak Elev= 34.07' @ 12.12 hrs Surf.Area= 0.031 ac Storage= 0.099 af

Plug-Flow detention time= 35.6 min calculated for 0.529 af (100% of inflow)
Center-of-Mass det. time= 35.6 min (799.5 - 763.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	30.10'	0.000 af	**89.65'W x 15.06'L x 4.67'H Field A** 0.145 af Overall - 0.145 af Embedded = 0.000 af x 40.0% Voids
#2A	30.10'	0.100 af	**StormTrap ST1 SingleTrap 4-0** x 13 Inside #1 Inside= 82.7"W x 48.0"H => 23.79 sf x 14.06'L = 334.5 cf Outside= 82.7"W x 56.0"H => 32.18 sf x 14.06'L = 452.5 cf 13 Chambers in 13 Rows 89.65' x 14.06' Core + 0.00' x 0.50' Border = 89.65' x 15.06' System
#3	33.30'	0.001 af	**4.00'D x 3.10'H Vertical Cone/Cylinder**-Impervious
		0.101 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	33.10'	**12.0" Round Culvert X 2.00** L= 5.0' RCP, rounded edge headwall, Ke= 0.100 Inlet / Outlet Invert= 33.10' / 33.00' S= 0.0200 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 0.79 sf
#2	Discarded	30.10'	**8.270 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 28.00'

Discarded OutFlow Max=0.74 cfs @ 12.12 hrs HW=34.03' (Free Discharge)
└─**2=Exfiltration** (Controls 0.74 cfs)

Primary OutFlow Max=4.90 cfs @ 12.12 hrs HW=34.03' (Free Discharge)
└─**1=Culvert** (Barrel Controls 4.90 cfs @ 4.18 fps)

Pond P-2: Subsurface Infiltration System "B" - Chamber Wizard Field A

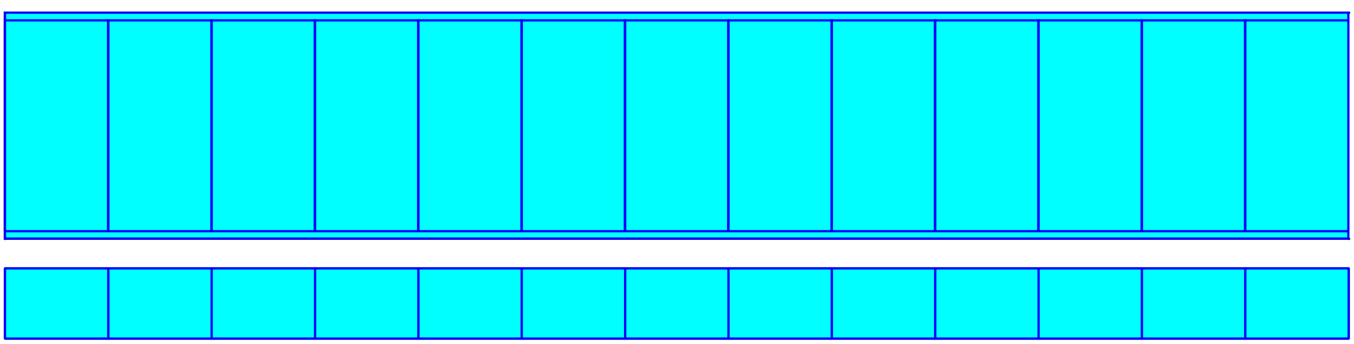
Chamber Model = StormTrap ST1 SingleTrap 4-0 (StormTrap ST1 SingleTrap®Type VI)
Inside= 82.7"W x 48.0"H => 23.79 sf x 14.06'L = 334.5 cf
Outside= 82.7"W x 56.0"H => 32.18 sf x 14.06'L = 452.5 cf

1 Chambers/Row x 14.06' Long = 14.06' Row Length +6.0" Border x 2 = 15.06' Base Length
13 Rows x 82.7" Wide = 89.65' Base Width
56.0" Chamber Height = 4.67' Field Height

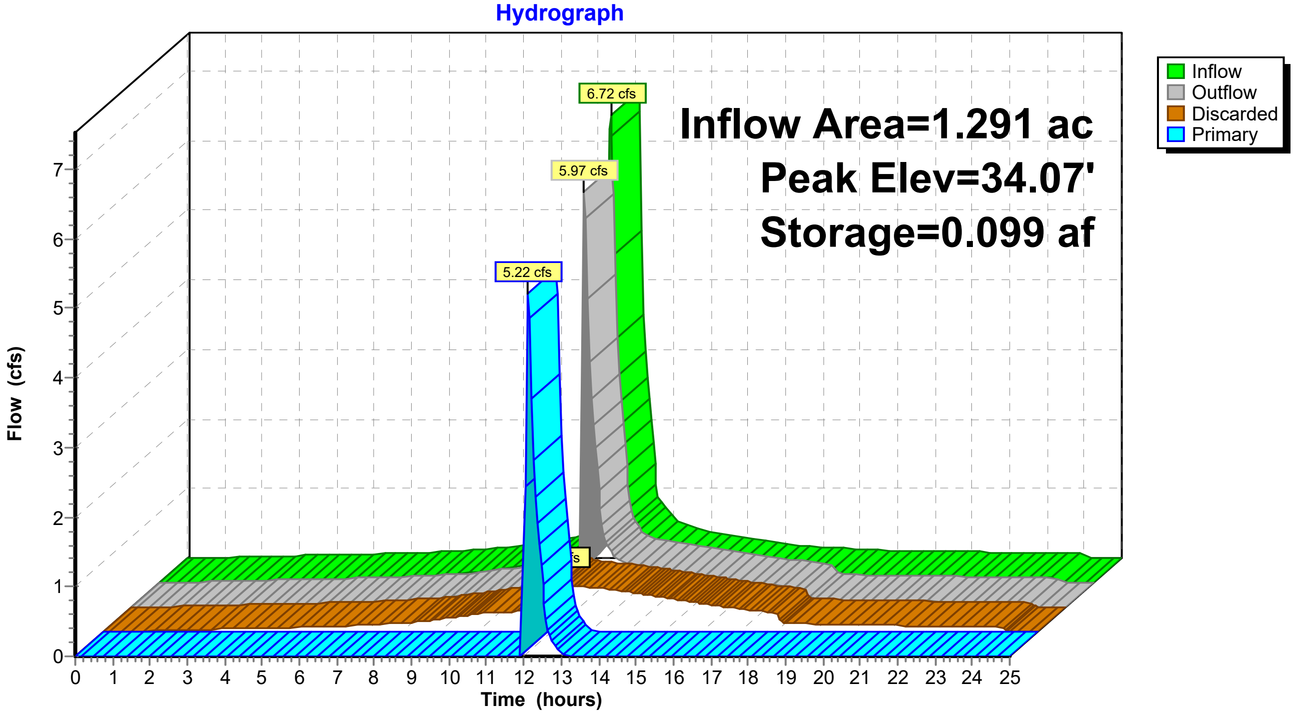
13 Chambers x 334.5 cf = 4,348.5 cf Chamber Storage
13 Chambers x 452.5 cf + 418.3 cf Border = 6,301.4 cf Displacement

Chamber Storage = 4,348.5 cf = 0.100 af
Overall Storage Efficiency = 69.0%
Overall System Size = 15.06' x 89.65' x 4.67'

13 Chambers (plus border)
233.4 cy Field



Pond P-2: Subsurface Infiltration System "B"



Summary for Pond P-3: Subsurface Infiltration System "C"

Inflow Area = 1.002 ac, 61.25% Impervious, Inflow Depth = 3.98" for 25-year event
Inflow = 4.49 cfs @ 12.08 hrs, Volume= 0.332 af
Outflow = 3.13 cfs @ 12.17 hrs, Volume= 0.332 af, Atten= 30%, Lag= 5.6 min
Discarded = 0.55 cfs @ 12.17 hrs, Volume= 0.257 af
Primary = 2.59 cfs @ 12.17 hrs, Volume= 0.075 af

Routing by Stor-Ind method, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs
Peak Elev= 33.07' @ 12.17 hrs Surf.Area= 0.027 ac Storage= 0.068 af

Plug-Flow detention time= 32.7 min calculated for 0.332 af (100% of inflow)
Center-of-Mass det. time= 32.7 min (833.7 - 801.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	30.10'	0.000 af	**20.69'W x 57.25'L x 3.67'H Field A** 0.100 af Overall - 0.100 af Embedded = 0.000 af x 40.0% Voids
#2A	30.10'	0.069 af	**StormTrap ST1 SingleTrap 3-0** x 12 Inside #1 Inside= 82.7"W x 36.0"H => 17.81 sf x 14.06'L = 250.5 cf Outside= 82.7"W x 44.0"H => 25.28 sf x 14.06'L = 355.6 cf 12 Chambers in 3 Rows 20.69' x 56.25' Core + 0.00' x 0.50' Border = 20.69' x 57.25' System
#3	32.30'	0.001 af	**4.00'D x 5.10'H Vertical Cone/Cylinder**-Impervious
		0.070 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	32.10'	**12.0" Round Culvert** L= 5.0' RCP, rounded edge headwall, Ke= 0.100 Inlet / Outlet Invert= 32.10' / 32.00' S= 0.0200 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 0.79 sf
#2	Discarded	30.10'	**8.270 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 28.00'

Discarded OutFlow Max=0.54 cfs @ 12.17 hrs HW=33.04' (Free Discharge)
└─**2=Exfiltration** (Controls 0.54 cfs)

Primary OutFlow Max=2.49 cfs @ 12.17 hrs HW=33.04' (Free Discharge)
└─**1=Culvert** (Barrel Controls 2.49 cfs @ 4.20 fps)

Pond P-3: Subsurface Infiltration System "C" - Chamber Wizard Field A

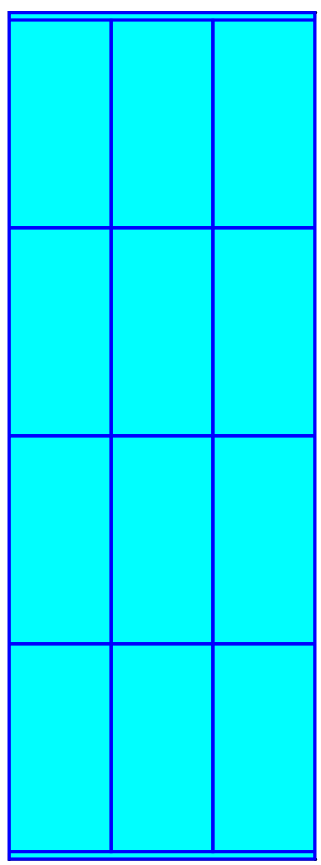
Chamber Model = StormTrap ST1 SingleTrap 3-0 (StormTrap ST1 SingleTrap®Type VI)
Inside= 82.7"W x 36.0"H => 17.81 sf x 14.06'L = 250.5 cf
Outside= 82.7"W x 44.0"H => 25.28 sf x 14.06'L = 355.6 cf

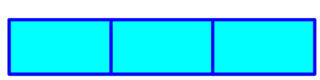
4 Chambers/Row x 14.06' Long = 56.25' Row Length +6.0" Border x 2 = 57.25' Base Length
3 Rows x 82.7" Wide = 20.69' Base Width
44.0" Chamber Height = 3.67' Field Height

12 Chambers x 250.5 cf = 3,006.0 cf Chamber Storage
12 Chambers x 355.6 cf + 75.9 cf Border = 4,342.7 cf Displacement

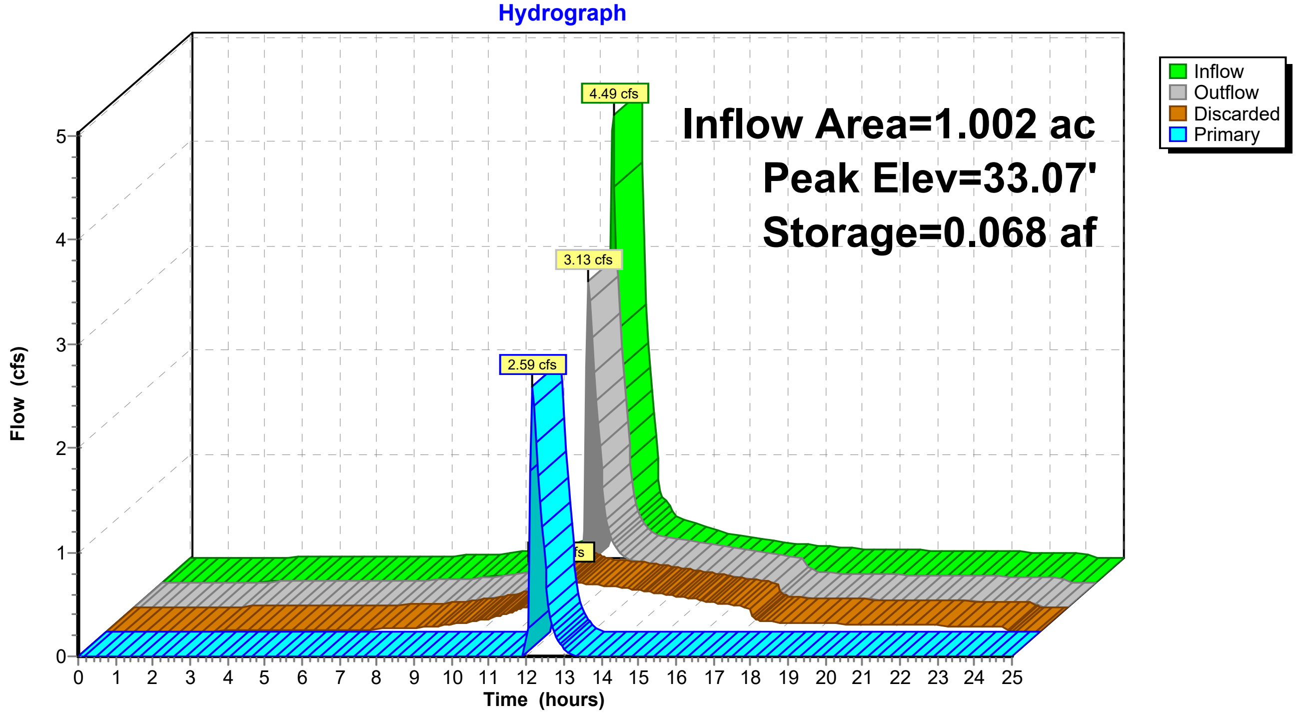
Chamber Storage = 3,006.0 cf = 0.069 af
Overall Storage Efficiency = 69.2%
Overall System Size = 57.25' x 20.69' x 3.67'

12 Chambers (plus border)
160.8 cy Field





Pond P-3: Subsurface Infiltration System "C"

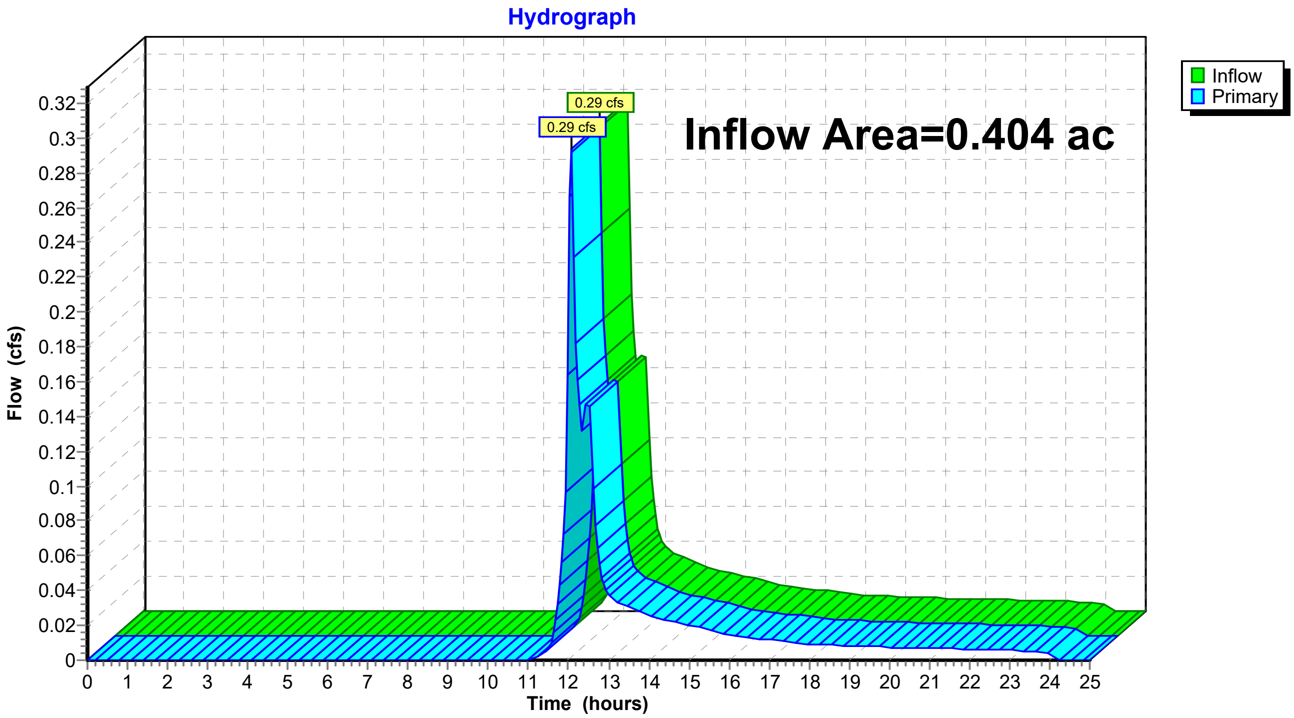


Summary for Link DP-1: Court Street

Inflow Area = 0.404 ac, 35.23% Impervious, Inflow Depth = 0.71" for 25-year event
Inflow = 0.29 cfs @ 12.09 hrs, Volume= 0.024 af
Primary = 0.29 cfs @ 12.09 hrs, Volume= 0.024 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs

Link DP-1: Court Street

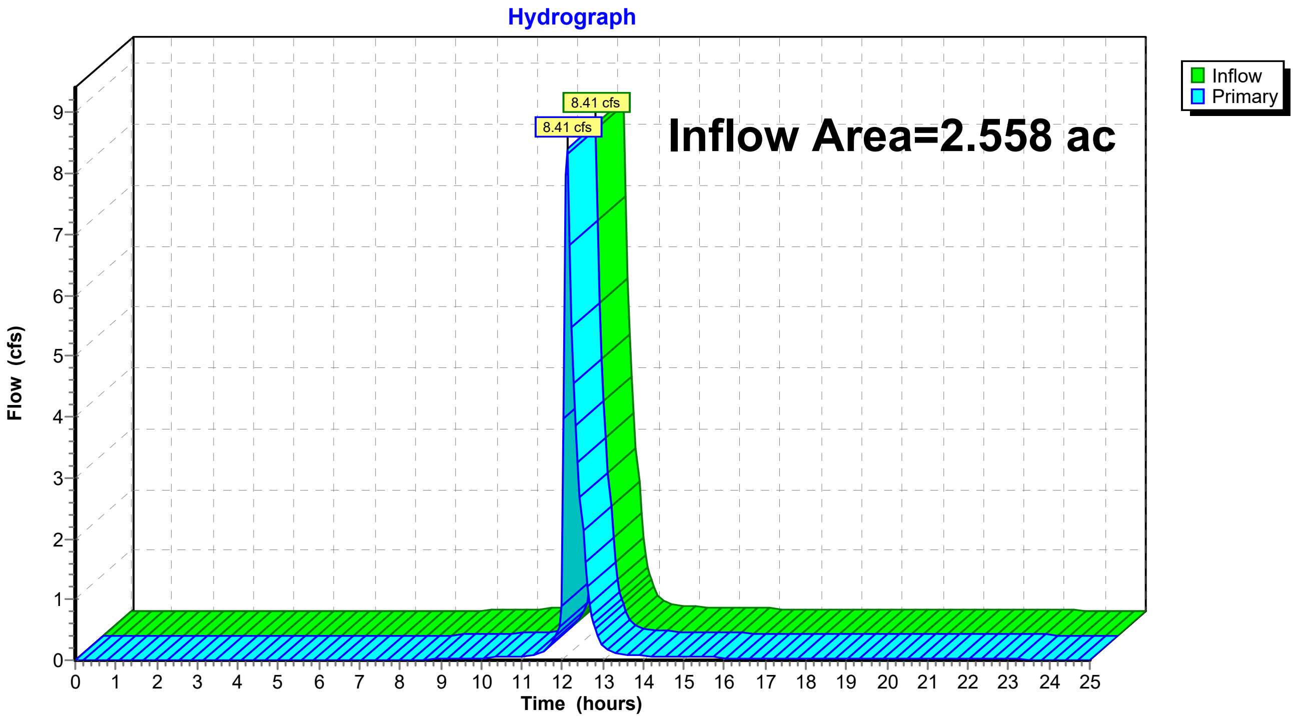


Summary for Link DP-2: Crafts Street

Inflow Area =	2.558 ac,	70.75% Impervious,	Inflow Depth = 1.37"	for 25-year event	
Inflow =	8.41 cfs @	12.13 hrs,	Volume=	0.292 af	
Primary =	8.41 cfs @	12.13 hrs,	Volume=	0.292 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs

Link DP-2: Crafts Street



100-Year Storm Event – Proposed

Time span=0.00-25.00 hrs, dt=0.05 hrs, 501 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment10: Site Runoff Area=10,950 sf 48.49% Impervious Runoff Depth=5.51"
Tc=5.0 min CN=73 Runoff=1.62 cfs 0.115 af

Subcatchment11: Site Runoff Area=6,635 sf 13.34% Impervious Runoff Depth=3.45"
Tc=5.0 min CN=56 Runoff=0.60 cfs 0.044 af

Subcatchment20: Site Runoff Area=20,460 sf 41.79% Impervious Runoff Depth=5.02"
Tc=5.0 min CN=69 Runoff=2.77 cfs 0.196 af

Subcatchment21: Building Runoff Area=18,390 sf 100.00% Impervious Runoff Depth=8.54"
Tc=5.0 min CN=98 Runoff=3.66 cfs 0.300 af

Subcatchment22: Site Runoff Area=11,540 sf 67.33% Impervious Runoff Depth=6.60"
Tc=5.0 min CN=82 Runoff=2.00 cfs 0.146 af

Subcatchment23: Site Runoff Area=9,590 sf 61.26% Impervious Runoff Depth=6.24"
Tc=5.0 min CN=79 Runoff=1.59 cfs 0.114 af

Subcatchment24: Site Runoff Area=25,970 sf 49.17% Impervious Runoff Depth=5.51"
Tc=5.0 min CN=73 Runoff=3.83 cfs 0.274 af

Subcatchment25: Building Runoff Area=17,390 sf 100.00% Impervious Runoff Depth=8.54"
Tc=5.0 min CN=98 Runoff=3.47 cfs 0.284 af

Subcatchment26: Building Runoff Area=8,090 sf 100.00% Impervious Runoff Depth=8.54"
Tc=5.0 min CN=98 Runoff=1.61 cfs 0.132 af

Pond P-1: Subsurface Infiltration System "A" Peak Elev=35.55' Storage=0.029 af Inflow=1.62 cfs 0.115 af
Discarded=0.17 cfs 0.091 af Primary=0.79 cfs 0.025 af Outflow=0.96 cfs 0.115 af

Pond P-2: Subsurface Infiltration System "B" Peak Elev=34.69' Storage=0.100 af Inflow=9.90 cfs 0.781 af
Discarded=0.82 cfs 0.518 af Primary=9.30 cfs 0.263 af Outflow=10.12 cfs 0.781 af

Pond P-3: Subsurface Infiltration System "C" Peak Elev=34.44' Storage=0.070 af Inflow=7.06 cfs 0.520 af
Discarded=0.70 cfs 0.339 af Primary=6.86 cfs 0.181 af Outflow=7.55 cfs 0.520 af

Link DP-1: Court Street Inflow=1.22 cfs 0.069 af
Primary=1.22 cfs 0.069 af

Link DP-2: Crafts Street Inflow=18.15 cfs 0.590 af
Primary=18.15 cfs 0.590 af

Total Runoff Area = 2.962 ac Runoff Volume = 1.606 af Average Runoff Depth = 6.51"
34.09% Pervious = 1.010 ac 65.91% Impervious = 1.952 ac

Summary for Subcatchment 10: Site

[49] Hint: Tc<2dt may require smaller dt

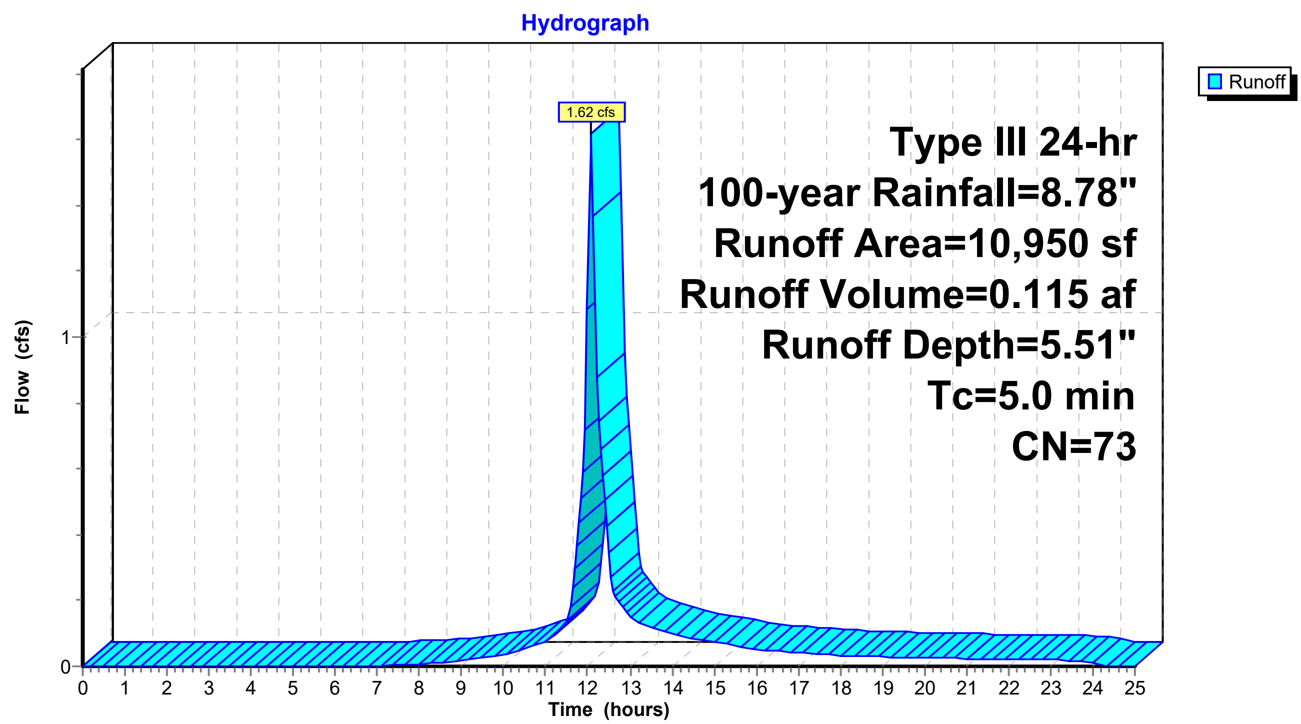
Runoff = 1.62 cfs @ 12.08 hrs, Volume= 0.115 af, Depth= 5.51"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=8.78"

Area (sf)	CN	Description
5,310	98	Paved parking, HSG A
0	98	Roofs, HSG A
5,640	49	50-75% Grass cover, Fair, HSG A
10,950	73	Weighted Average
5,640		51.51% Pervious Area
5,310		48.49% Impervious Area

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

Subcatchment 10: Site



Summary for Subcatchment 11: Site

[49] Hint: Tc<2dt may require smaller dt

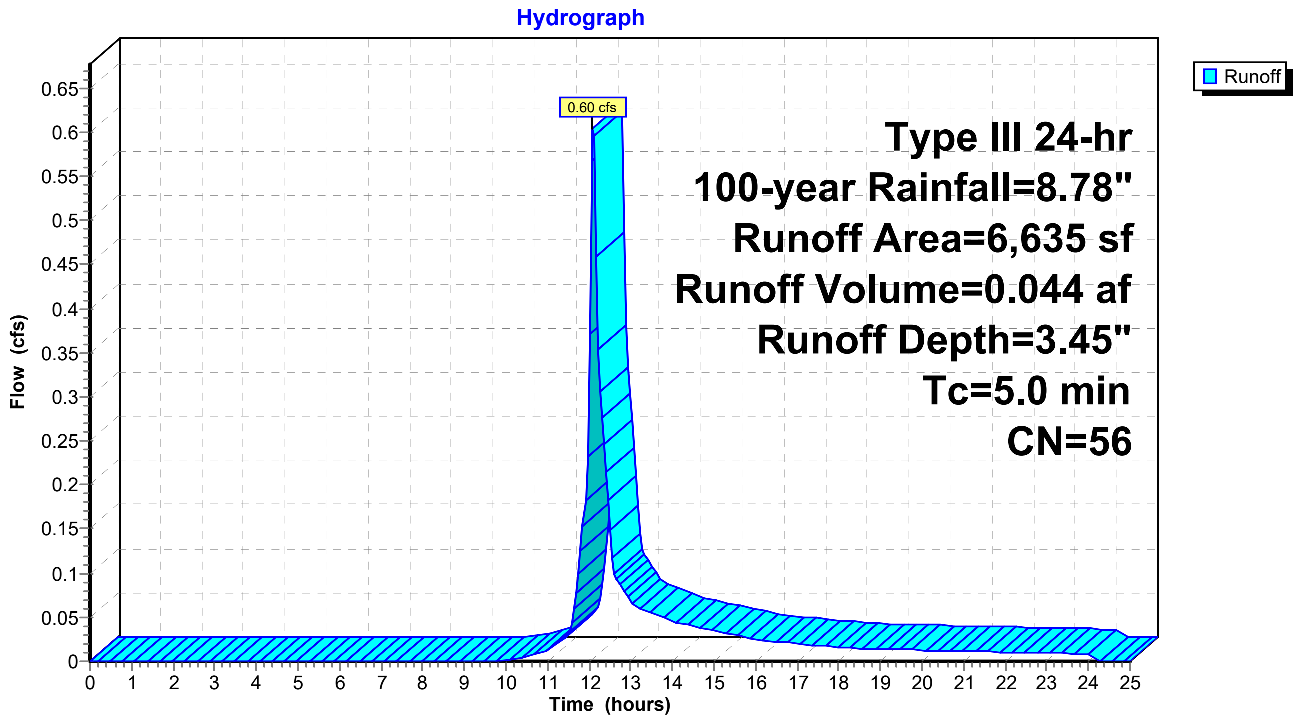
Runoff = 0.60 cfs @ 12.08 hrs, Volume= 0.044 af, Depth= 3.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=8.78"

Area (sf)	CN	Description
885	98	Paved parking, HSG A
5,750	49	50-75% Grass cover, Fair, HSG A
6,635	56	Weighted Average
5,750		86.66% Pervious Area
885		13.34% Impervious Area

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

Subcatchment 11: Site



Summary for Subcatchment 20: Site

[49] Hint: Tc<2dt may require smaller dt

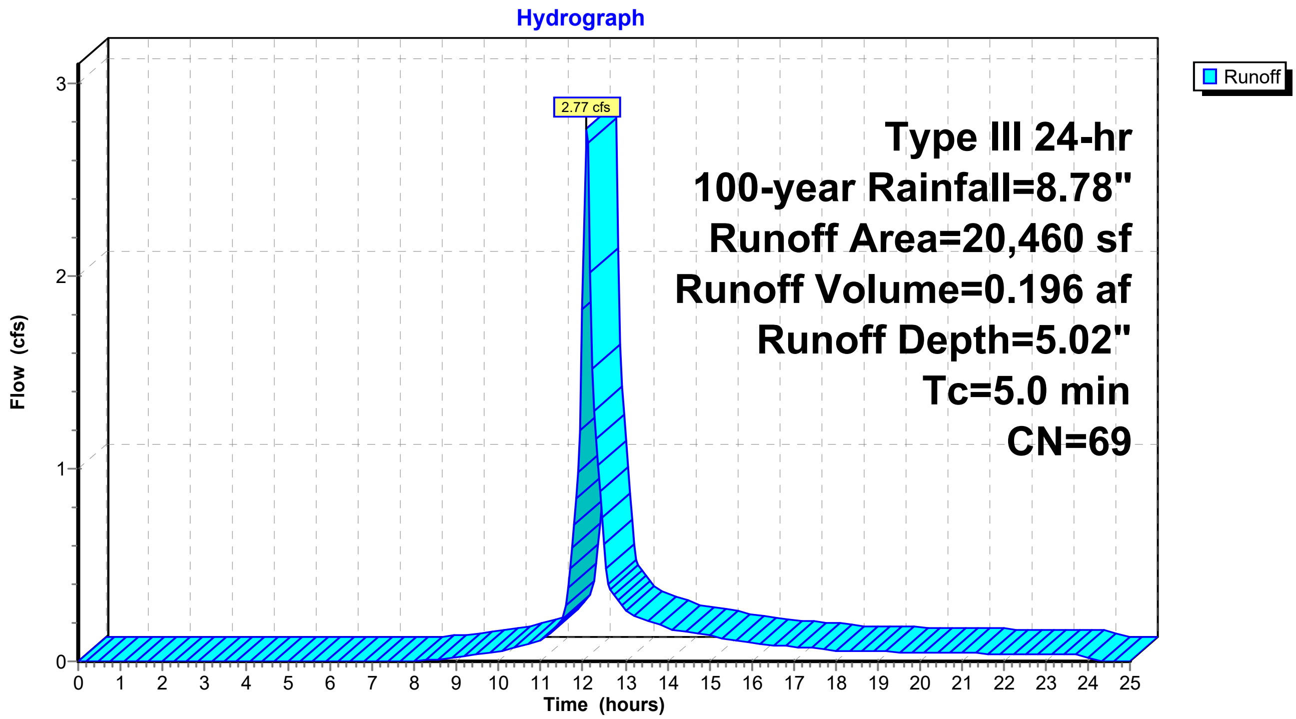
Runoff = 2.77 cfs @ 12.08 hrs, Volume= 0.196 af, Depth= 5.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=8.78"

Area (sf)	CN	Description
8,550	98	Paved parking, HSG A
0	98	Roofs, HSG A
11,910	49	50-75% Grass cover, Fair, HSG A
20,460	69	Weighted Average
11,910		58.21% Pervious Area
8,550		41.79% Impervious Area

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

Subcatchment 20: Site



Summary for Subcatchment 21: Building

[49] Hint: Tc<2dt may require smaller dt

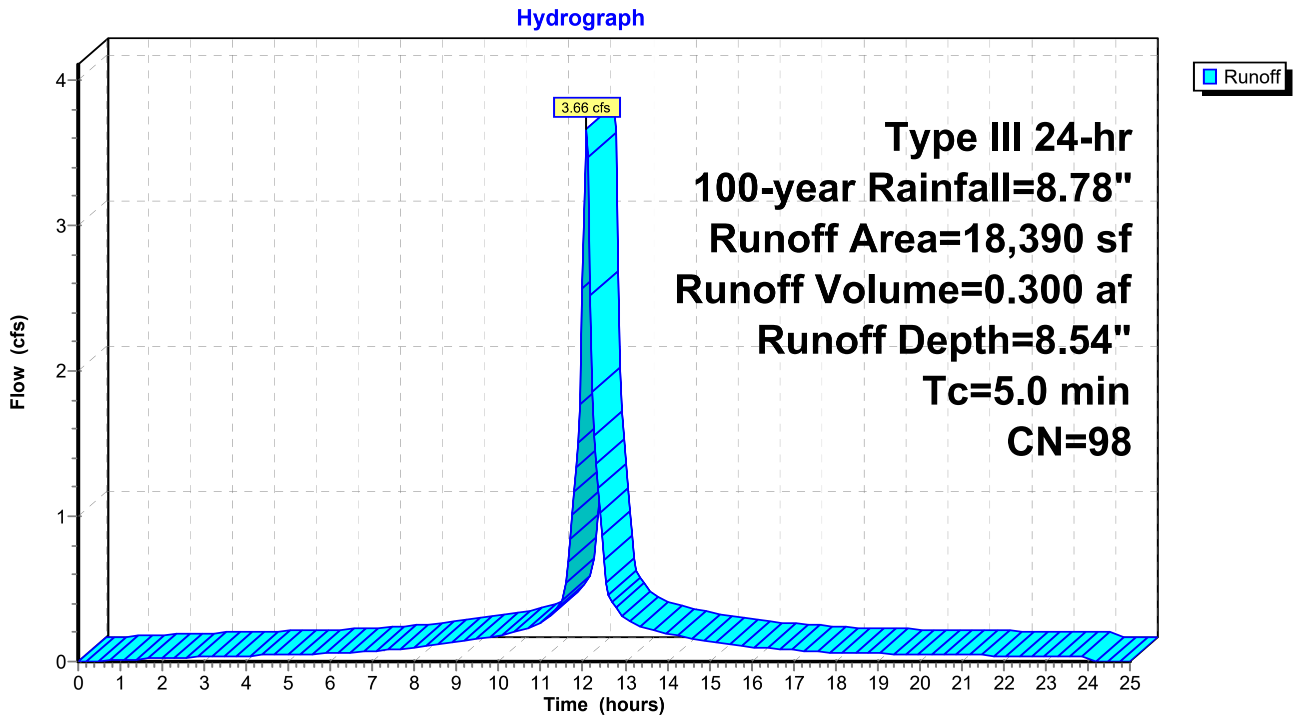
Runoff = 3.66 cfs @ 12.07 hrs, Volume= 0.300 af, Depth= 8.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=8.78"

Area (sf)	CN	Description
0	98	Paved parking, HSG A
18,390	98	Roofs, HSG A
0	49	50-75% Grass cover, Fair, HSG A
18,390	98	Weighted Average
18,390		100.00% Impervious Area

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

Subcatchment 21: Building



Summary for Subcatchment 22: Site

[49] Hint: Tc<2dt may require smaller dt

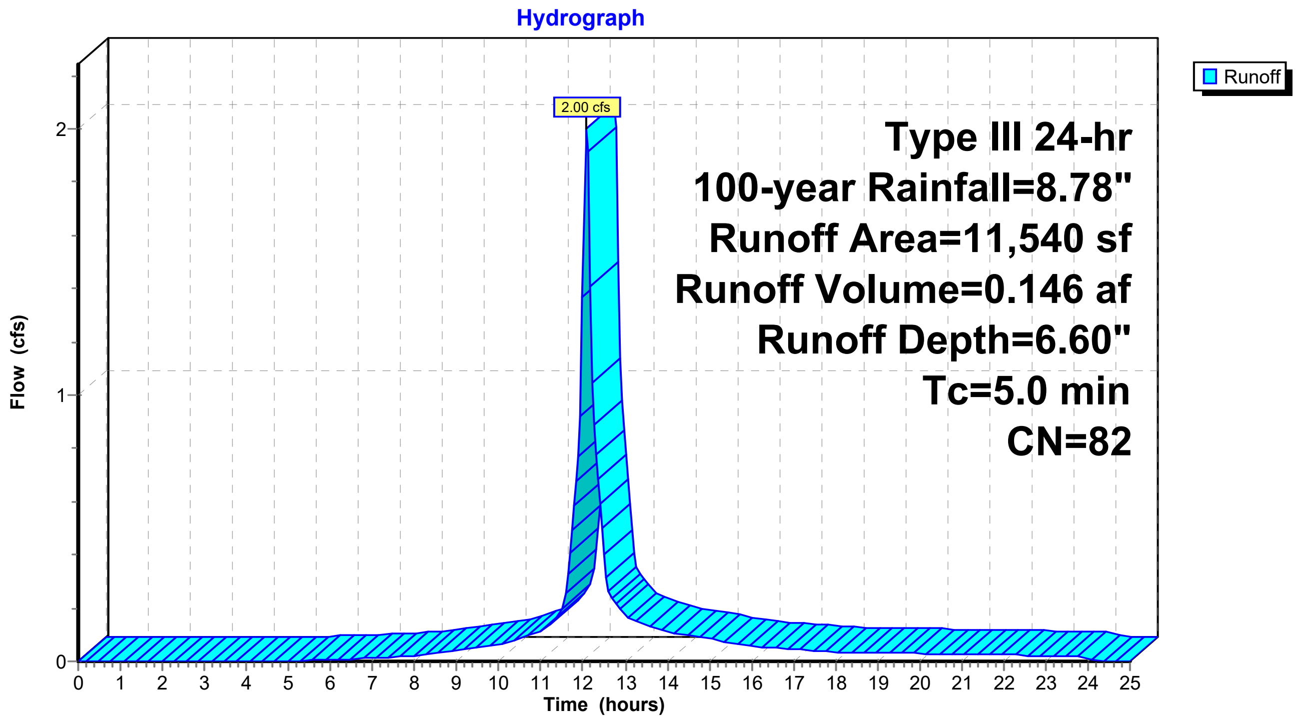
Runoff = 2.00 cfs @ 12.07 hrs, Volume= 0.146 af, Depth= 6.60"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=8.78"

Area (sf)	CN	Description
7,770	98	Paved parking, HSG A
0	98	Roofs, HSG A
3,770	49	50-75% Grass cover, Fair, HSG A
11,540	82	Weighted Average
3,770		32.67% Pervious Area
7,770		67.33% Impervious Area

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

Subcatchment 22: Site



Summary for Subcatchment 23: Site

[49] Hint: Tc<2dt may require smaller dt

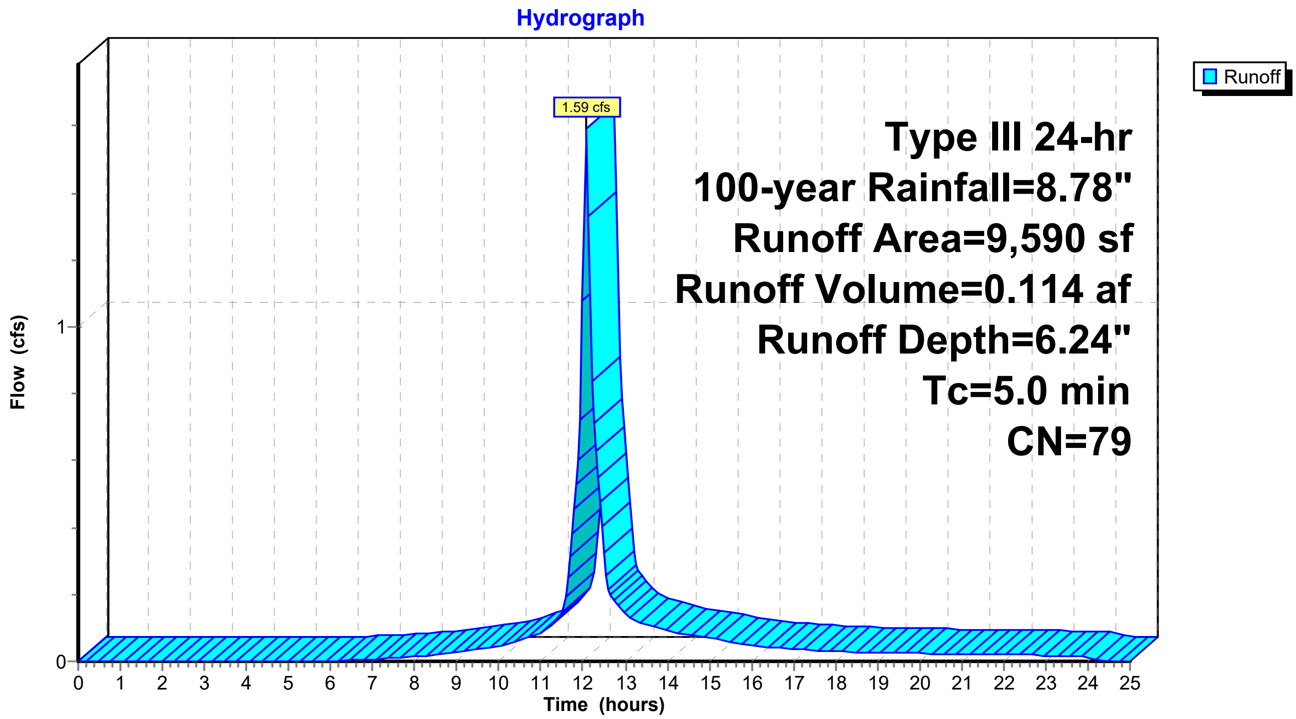
Runoff = 1.59 cfs @ 12.07 hrs, Volume= 0.114 af, Depth= 6.24"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=8.78"

Area (sf)	CN	Description
5,875	98	Paved parking, HSG A
0	98	Roofs, HSG A
3,715	49	50-75% Grass cover, Fair, HSG A
9,590	79	Weighted Average
3,715		38.74% Pervious Area
5,875		61.26% Impervious Area

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

Subcatchment 23: Site



Summary for Subcatchment 24: Site

[49] Hint: Tc<2dt may require smaller dt

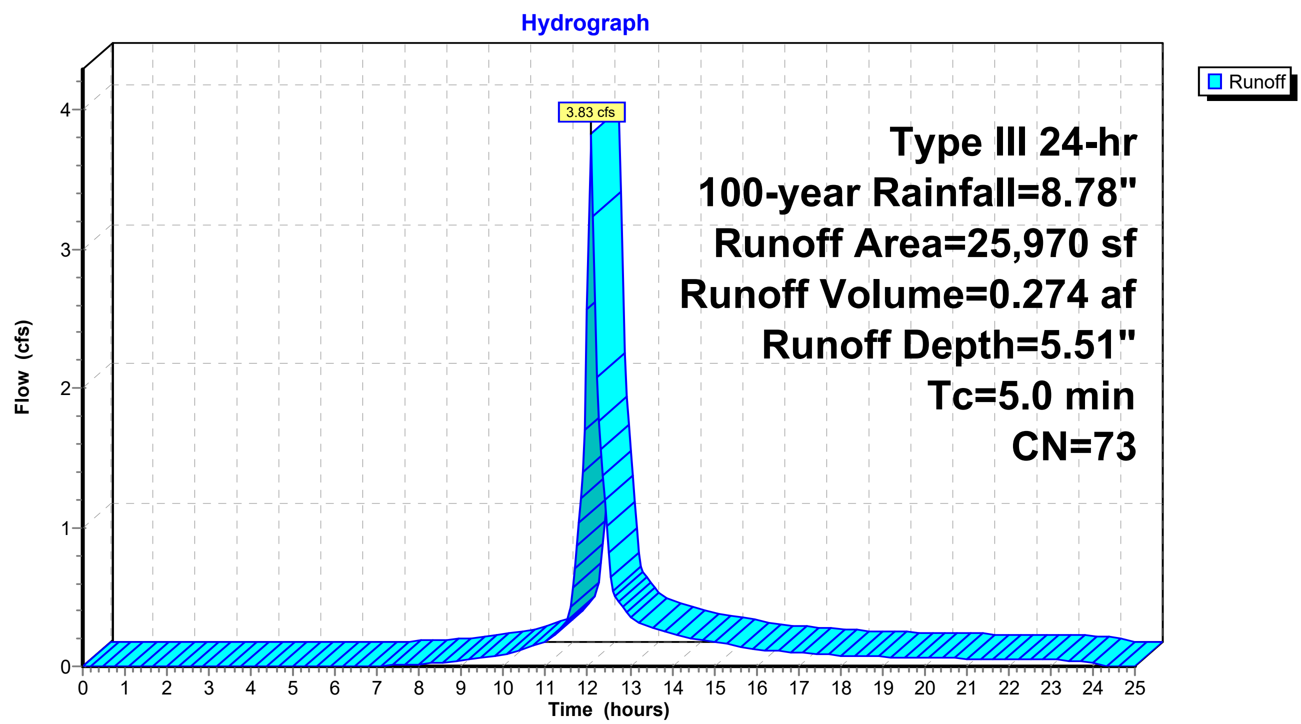
Runoff = 3.83 cfs @ 12.08 hrs, Volume= 0.274 af, Depth= 5.51"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=8.78"

Area (sf)	CN	Description
12,770	98	Paved parking, HSG A
0	98	Roofs, HSG A
13,200	49	50-75% Grass cover, Fair, HSG A
25,970	73	Weighted Average
13,200		50.83% Pervious Area
12,770		49.17% Impervious Area

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

Subcatchment 24: Site



Summary for Subcatchment 25: Building

[49] Hint: Tc<2dt may require smaller dt

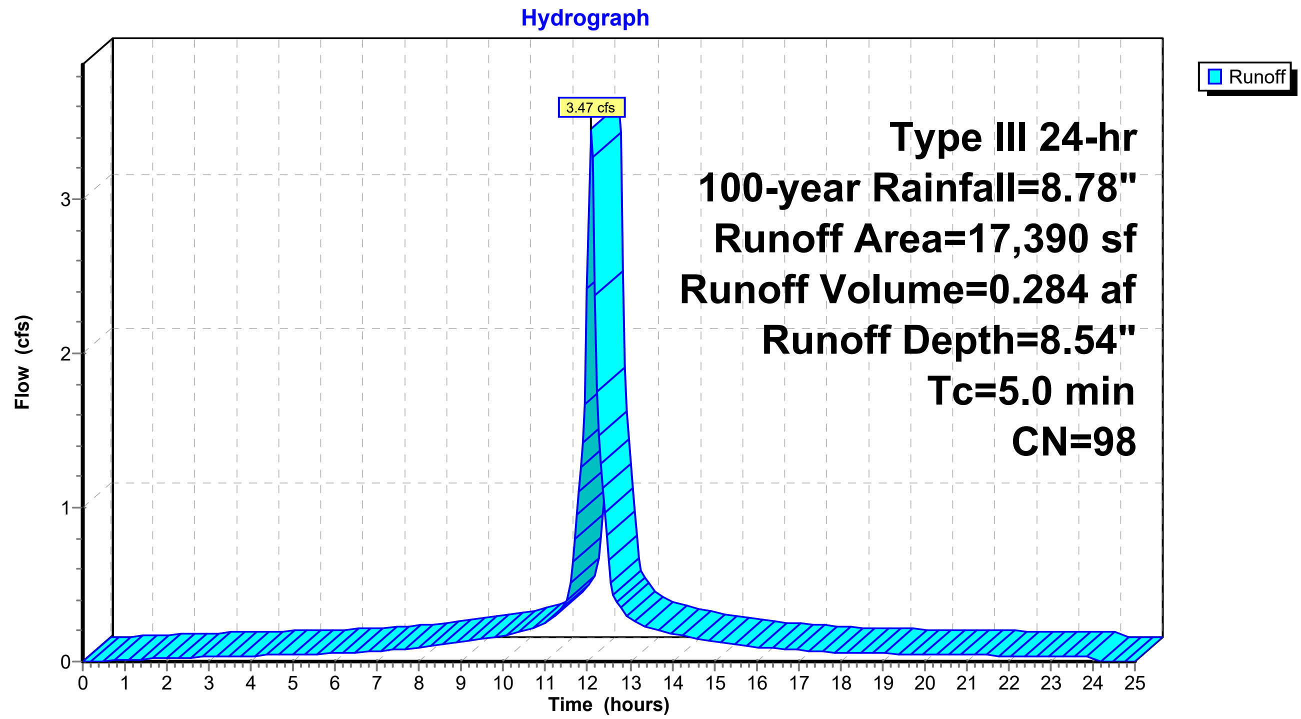
Runoff = 3.47 cfs @ 12.07 hrs, Volume= 0.284 af, Depth= 8.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=8.78"

Area (sf)	CN	Description
0	98	Paved parking, HSG A
17,390	98	Roofs, HSG A
0	49	50-75% Grass cover, Fair, HSG A
17,390	98	Weighted Average
17,390		100.00% Impervious Area

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

Subcatchment 25: Building



Summary for Subcatchment 26: Building

[49] Hint: Tc<2dt may require smaller dt

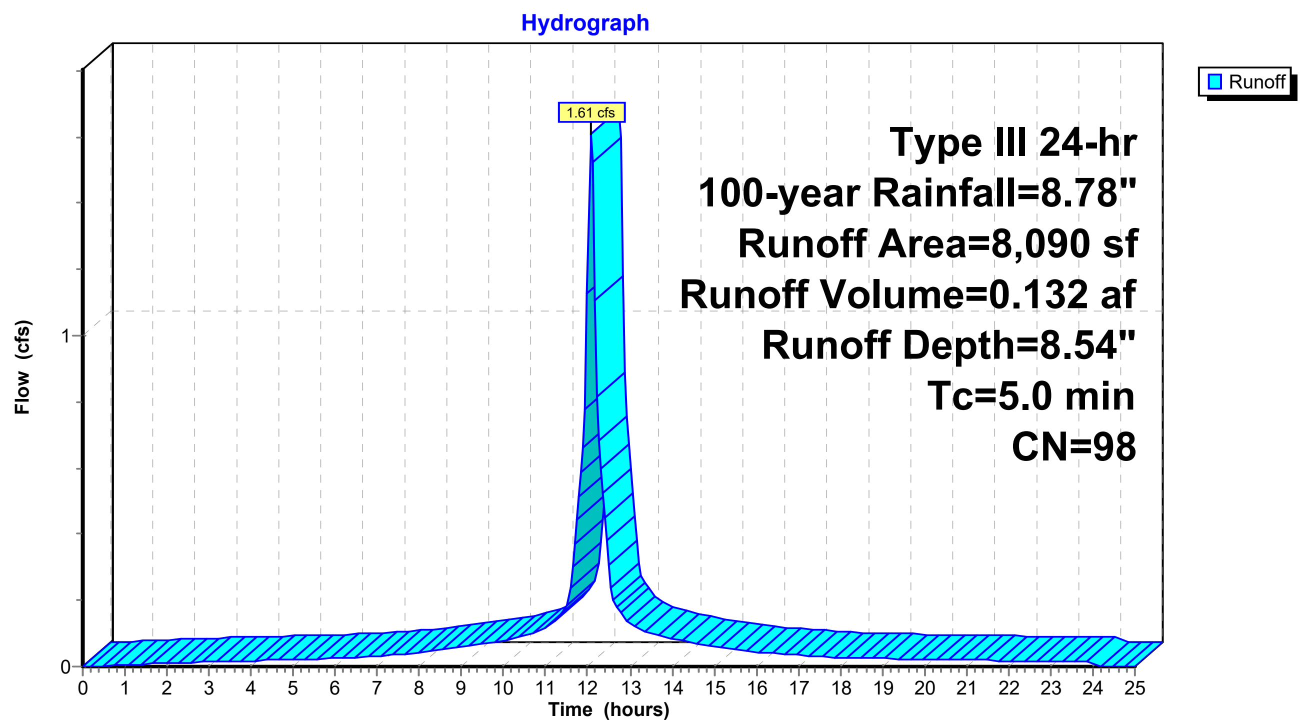
Runoff = 1.61 cfs @ 12.07 hrs, Volume= 0.132 af, Depth= 8.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=8.78"

Area (sf)	CN	Description
0	98	Paved parking, HSG A
8,090	98	Roofs, HSG A
0	49	50-75% Grass cover, Fair, HSG A
8,090	98	Weighted Average
8,090		100.00% Impervious Area

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

Subcatchment 26: Building



Summary for Pond P-1: Subsurface Infiltration System "A"

Inflow Area = 0.251 ac, 48.49% Impervious, Inflow Depth = 5.51" for 100-year event
Inflow = 1.62 cfs @ 12.08 hrs, Volume= 0.115 af
Outflow = 0.96 cfs @ 12.19 hrs, Volume= 0.115 af, Atten= 41%, Lag= 7.2 min
Discarded = 0.17 cfs @ 12.19 hrs, Volume= 0.091 af
Primary = 0.79 cfs @ 12.19 hrs, Volume= 0.025 af

Routing by Stor-Ind method, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs
Peak Elev= 35.55' @ 12.19 hrs Surf.Area= 0.007 ac Storage= 0.029 af

Plug-Flow detention time= 57.2 min calculated for 0.115 af (100% of inflow)
Center-of-Mass det. time= 57.1 min (870.8 - 813.7)

Volume	Invert	Avail.Storage	Storage Description
#1A	30.60'	0.000 af	**6.90'W x 43.19'L x 5.67'H Field A** 0.039 af Overall - 0.039 af Embedded = 0.000 af x 40.0% Voids
#2A	30.60'	0.029 af	**StormTrap ST1 SingleTrap 5-0** x 3 Inside #1 Inside= 82.7"W x 60.0"H => 29.76 sf x 14.06'L = 418.5 cf Outside= 82.7"W x 68.0"H => 39.08 sf x 14.06'L = 549.5 cf 6.90' x 42.19' Core + 0.00' x 0.50' Border = 6.90' x 43.19' System
		0.029 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	34.60'	**12.0" Round Culvert** L= 25.0' RCP, rounded edge headwall, Ke= 0.100 Inlet / Outlet Invert= 34.60' / 34.30' S= 0.0120 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 0.79 sf
#2	Device 1	34.60'	**6.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	35.60'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#4	Discarded	30.60'	**8.270 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 28.00'

Discarded OutFlow Max=0.17 cfs @ 12.19 hrs HW=35.55' (Free Discharge)
└─**4=Exfiltration** (Controls 0.17 cfs)

Primary OutFlow Max=0.79 cfs @ 12.19 hrs HW=35.55' (Free Discharge)
└─**1=Culvert** (Passes 0.79 cfs of 2.67 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.79 cfs @ 4.02 fps)
  └─**3=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond P-1: Subsurface Infiltration System "A" - Chamber Wizard Field A

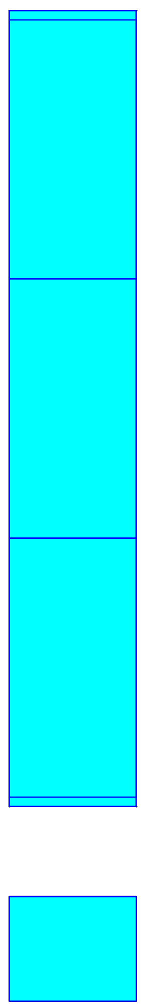
Chamber Model = StormTrap ST1 SingleTrap 5-0 (StormTrap ST1 SingleTrap®Type VI)
Inside= 82.7"W x 60.0"H => 29.76 sf x 14.06'L = 418.5 cf
Outside= 82.7"W x 68.0"H => 39.08 sf x 14.06'L = 549.5 cf

3 Chambers/Row x 14.06' Long = 42.19' Row Length +6.0" Border x 2 = 43.19' Base Length
1 Rows x 82.7" Wide = 6.90' Base Width
68.0" Chamber Height = 5.67' Field Height

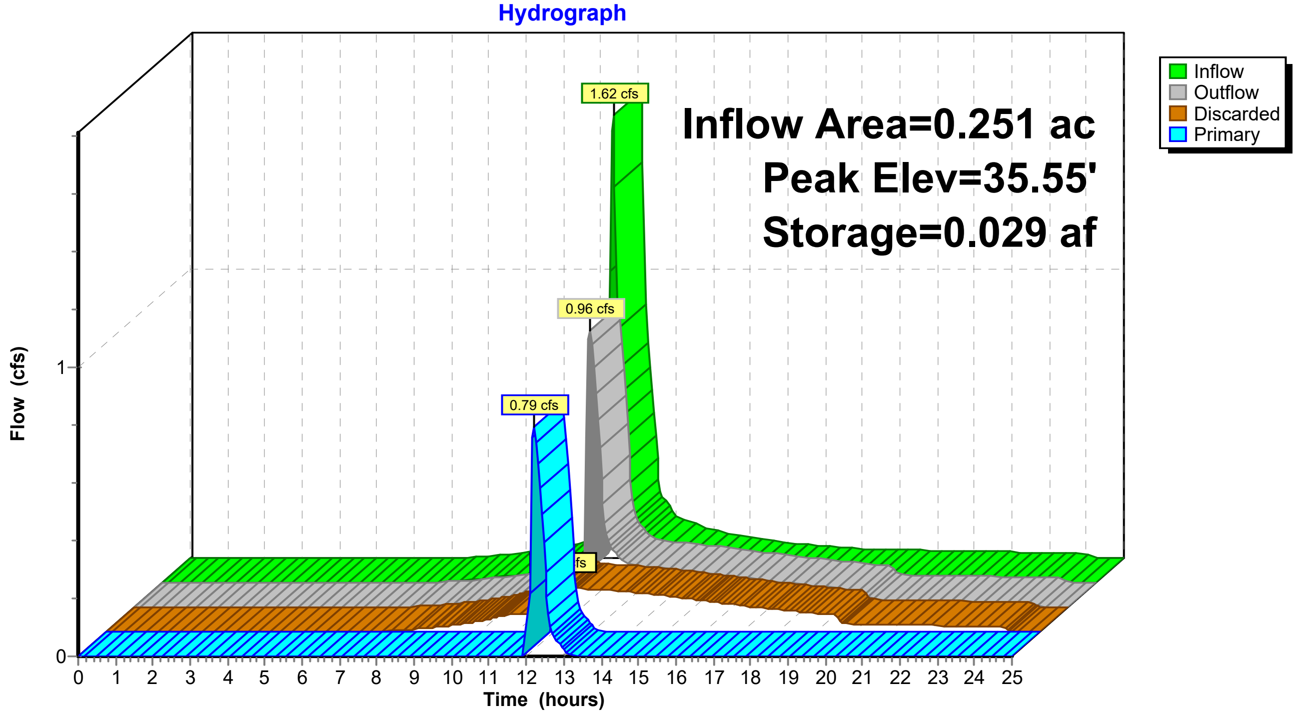
3 Chambers x 418.5 cf = 1,255.5 cf Chamber Storage
3 Chambers x 549.5 cf + 39.1 cf Border = 1,687.6 cf Displacement

Chamber Storage = 1,255.5 cf = 0.029 af
Overall Storage Efficiency = 74.4%
Overall System Size = 43.19' x 6.90' x 5.67'

3 Chambers (plus border)
62.5 cy Field



Pond P-1: Subsurface Infiltration System "A"



Summary for Pond P-2: Subsurface Infiltration System "B"

[88] Warning: Qout>Qin may require smaller dt or Finer Routing

Inflow Area = 1.291 ac, 78.82% Impervious, Inflow Depth = 7.26" for 100-year event
Inflow = 9.90 cfs @ 12.07 hrs, Volume= 0.781 af
Outflow = 10.12 cfs @ 12.07 hrs, Volume= 0.781 af, Atten= 0%, Lag= 0.0 min
Discarded = 0.82 cfs @ 12.07 hrs, Volume= 0.518 af
Primary = 9.30 cfs @ 12.07 hrs, Volume= 0.263 af

Routing by Stor-Ind method, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs
Peak Elev= 34.69' @ 12.07 hrs Surf.Area= 0.031 ac Storage= 0.100 af

Plug-Flow detention time= 34.0 min calculated for 0.781 af (100% of inflow)
Center-of-Mass det. time= 33.9 min (793.9 - 760.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	30.10'	0.000 af	**89.65'W x 15.06'L x 4.67'H Field A** 0.145 af Overall - 0.145 af Embedded = 0.000 af x 40.0% Voids
#2A	30.10'	0.100 af	**StormTrap ST1 SingleTrap 4-0** x 13 Inside #1 Inside= 82.7"W x 48.0"H => 23.79 sf x 14.06'L = 334.5 cf Outside= 82.7"W x 56.0"H => 32.18 sf x 14.06'L = 452.5 cf 13 Chambers in 13 Rows 89.65' x 14.06' Core + 0.00' x 0.50' Border = 89.65' x 15.06' System
#3	33.30'	0.001 af	**4.00'D x 3.10'H Vertical Cone/Cylinder**-Impervious
		0.101 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	33.10'	**12.0" Round Culvert X 2.00** L= 5.0' RCP, rounded edge headwall, Ke= 0.100 Inlet / Outlet Invert= 33.10' / 33.00' S= 0.0200 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 0.79 sf
#2	Discarded	30.10'	**8.270 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 28.00'

Discarded OutFlow Max=0.81 cfs @ 12.07 hrs HW=34.60' (Free Discharge)
└─**2=Exfiltration** (Controls 0.81 cfs)

Primary OutFlow Max=8.74 cfs @ 12.07 hrs HW=34.60' (Free Discharge)
└─**1=Culvert** (Barrel Controls 8.74 cfs @ 5.56 fps)

Pond P-2: Subsurface Infiltration System "B" - Chamber Wizard Field A

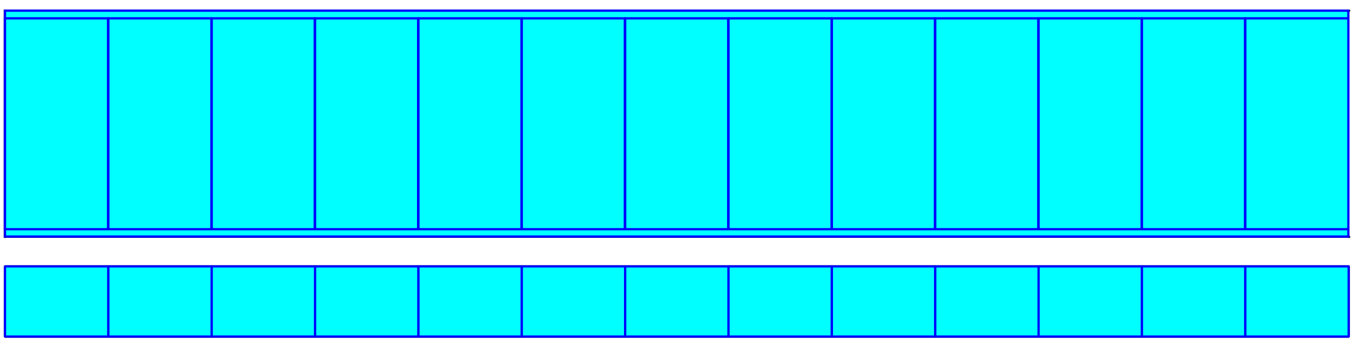
Chamber Model = StormTrap ST1 SingleTrap 4-0 (StormTrap ST1 SingleTrap®Type VI)
Inside= 82.7"W x 48.0"H => 23.79 sf x 14.06'L = 334.5 cf
Outside= 82.7"W x 56.0"H => 32.18 sf x 14.06'L = 452.5 cf

1 Chambers/Row x 14.06' Long = 14.06' Row Length +6.0" Border x 2 = 15.06' Base Length
13 Rows x 82.7" Wide = 89.65' Base Width
56.0" Chamber Height = 4.67' Field Height

13 Chambers x 334.5 cf = 4,348.5 cf Chamber Storage
13 Chambers x 452.5 cf + 418.3 cf Border = 6,301.4 cf Displacement

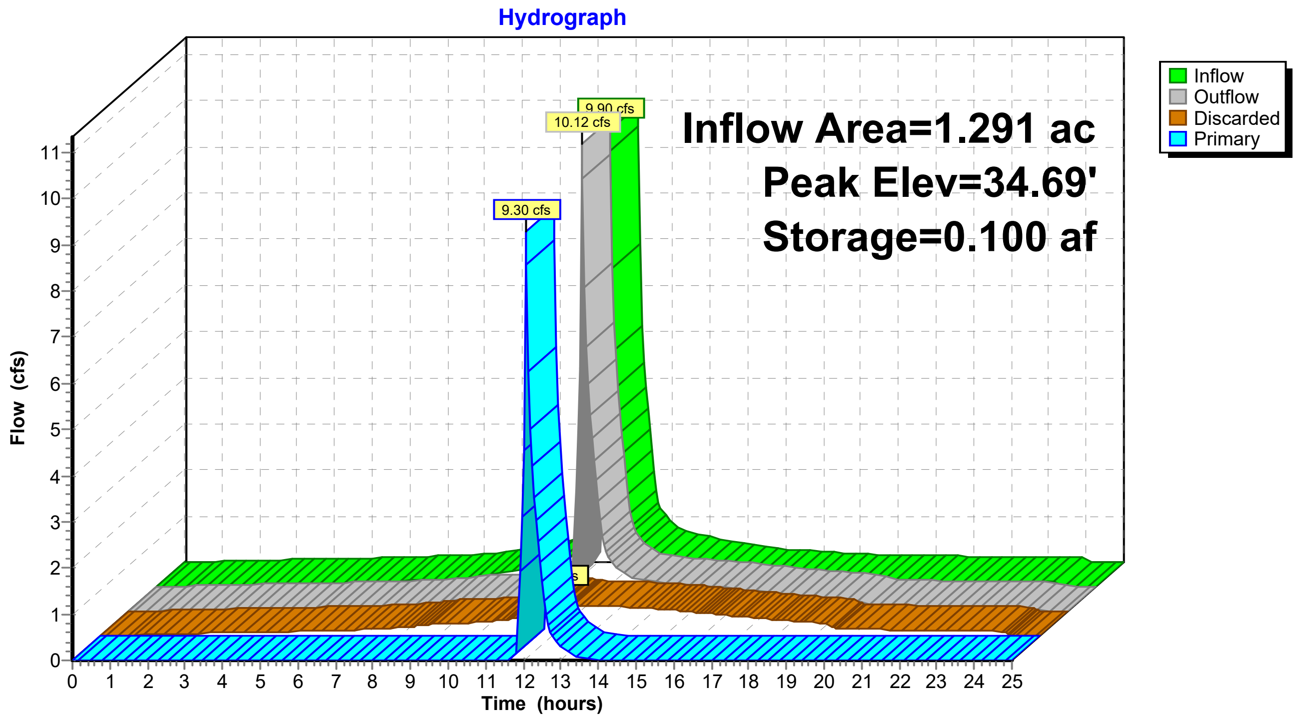
Chamber Storage = 4,348.5 cf = 0.100 af
Overall Storage Efficiency = 69.0%
Overall System Size = 15.06' x 89.65' x 4.67'

13 Chambers (plus border)
233.4 cy Field



#260-22

Pond P-2: Subsurface Infiltration System "B"



Summary for Pond P-3: Subsurface Infiltration System "C"

[88] Warning: Qout>Qin may require smaller dt or Finer Routing

Inflow Area =	1.002 ac, 61.25% Impervious, Inflow Depth = 6.23"	for 100-year event	
Inflow =	7.06 cfs @ 12.07 hrs, Volume=	0.520 af	
Outflow =	7.55 cfs @ 12.07 hrs, Volume=	0.520 af,	Atten= 0%, Lag= 0.0 min
Discarded =	0.70 cfs @ 12.07 hrs, Volume=	0.339 af	
Primary =	6.86 cfs @ 12.07 hrs, Volume=	0.181 af	

Routing by Stor-Ind method, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs
Peak Elev= 34.44' @ 12.07 hrs Surf.Area= 0.027 ac Storage= 0.070 af

Plug-Flow detention time= 30.1 min calculated for 0.520 af (100% of inflow)
Center-of-Mass det. time= 30.0 min (821.9 - 791.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	30.10'	0.000 af	**20.69'W x 57.25'L x 3.67'H Field A** 0.100 af Overall - 0.100 af Embedded = 0.000 af x 40.0% Voids
#2A	30.10'	0.069 af	**StormTrap ST1 SingleTrap 3-0** x 12 Inside #1 Inside= 82.7"W x 36.0"H => 17.81 sf x 14.06'L = 250.5 cf Outside= 82.7"W x 44.0"H => 25.28 sf x 14.06'L = 355.6 cf 12 Chambers in 3 Rows 20.69' x 56.25' Core + 0.00' x 0.50' Border = 20.69' x 57.25' System
#3	32.30'	0.001 af	**4.00'D x 5.10'H Vertical Cone/Cylinder**-Impervious
		0.070 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	32.10'	**12.0" Round Culvert** L= 5.0' RCP, rounded edge headwall, Ke= 0.100 Inlet / Outlet Invert= 32.10' / 32.00' S= 0.0200 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 0.79 sf
#2	Discarded	30.10'	**8.270 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 28.00'

Discarded OutFlow Max=0.68 cfs @ 12.07 hrs HW=34.26' (Free Discharge)
└─**2=Exfiltration** (Controls 0.68 cfs)

Primary OutFlow Max=6.29 cfs @ 12.07 hrs HW=34.25' (Free Discharge)
└─**1=Culvert** (Barrel Controls 6.29 cfs @ 8.01 fps)

Pond P-3: Subsurface Infiltration System "C" - Chamber Wizard Field A

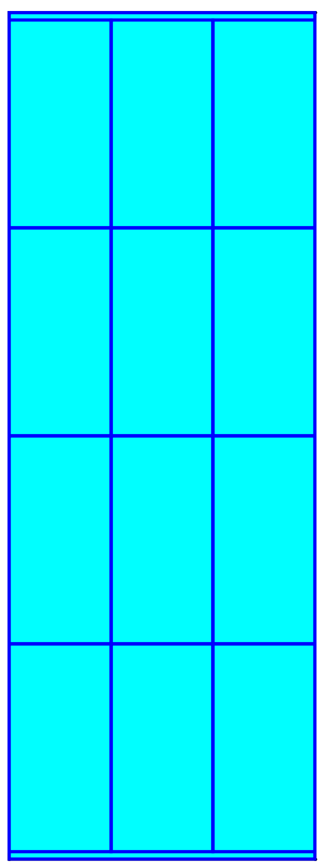
Chamber Model = StormTrap ST1 SingleTrap 3-0 (StormTrap ST1 SingleTrap® Type VI)
Inside= 82.7"W x 36.0"H => 17.81 sf x 14.06'L = 250.5 cf
Outside= 82.7"W x 44.0"H => 25.28 sf x 14.06'L = 355.6 cf

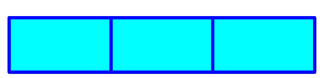
4 Chambers/Row x 14.06' Long = 56.25' Row Length +6.0" Border x 2 = 57.25' Base Length
3 Rows x 82.7" Wide = 20.69' Base Width
44.0" Chamber Height = 3.67' Field Height

12 Chambers x 250.5 cf = 3,006.0 cf Chamber Storage
12 Chambers x 355.6 cf + 75.9 cf Border = 4,342.7 cf Displacement

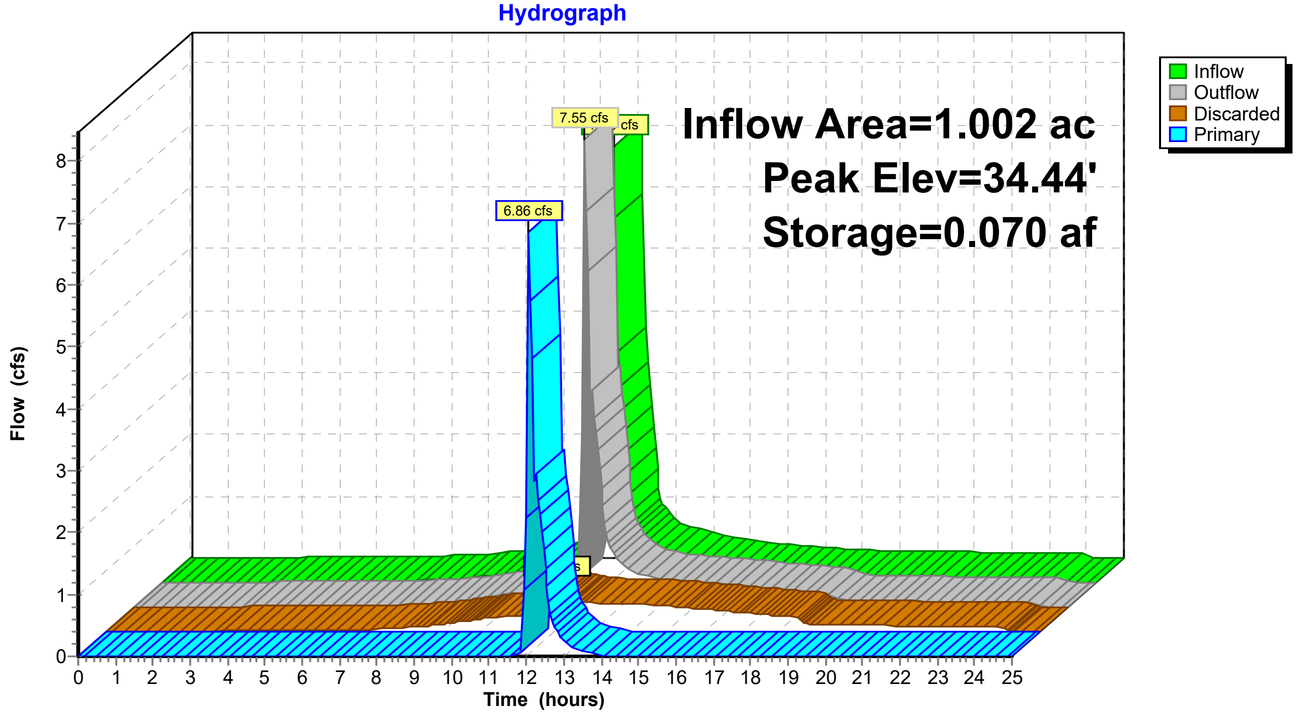
Chamber Storage = 3,006.0 cf = 0.069 af
Overall Storage Efficiency = 69.2%
Overall System Size = 57.25' x 20.69' x 3.67'

12 Chambers (plus border)
160.8 cy Field





Pond P-3: Subsurface Infiltration System "C"

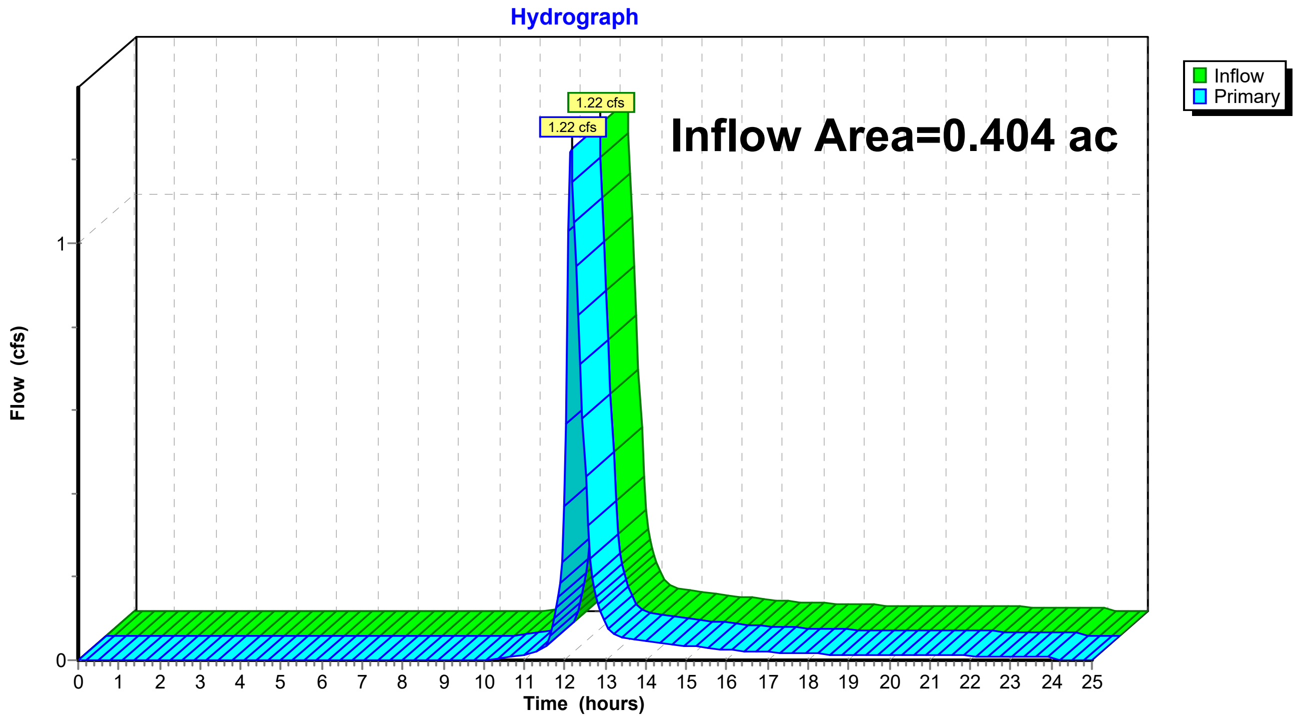


Summary for Link DP-1: Court Street

Inflow Area =	0.404 ac,	35.23% Impervious,	Inflow Depth = 2.04"	for 100-year event
Inflow =	1.22 cfs @	12.16 hrs, Volume=	0.069 af	
Primary =	1.22 cfs @	12.16 hrs, Volume=	0.069 af, Atten= 0%, Lag= 0.0 min	

Primary outflow = Inflow, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs

Link DP-1: Court Street

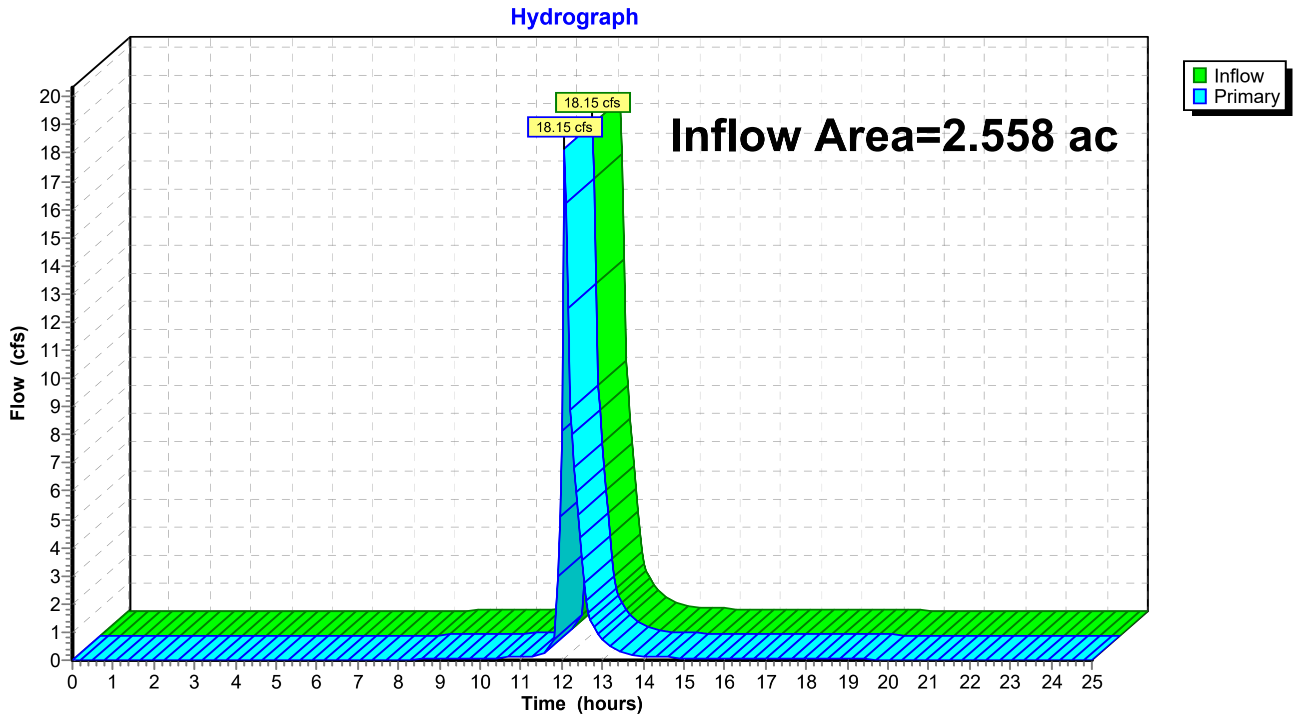


Summary for Link DP-2: Crafts Street

Inflow Area = 2.558 ac, 70.75% Impervious, Inflow Depth = 2.77" for 100-year event
Inflow = 18.15 cfs @ 12.07 hrs, Volume= 0.590 af
Primary = 18.15 cfs @ 12.07 hrs, Volume= 0.590 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs

Link DP-2: Crafts Street



Appendix C: Standard 3 Computations and Supporting Documentation

- NRCS Web Soil Survey
- Preliminary Geotechnical Due Diligence Evaluation, prepared by SHA, dated October 20, 2016
- Recharge Volume Calculations and Drawdown Analysis

NRCS Web Soil Survey

Hydrologic Soil Group—Middlesex County, Massachusetts

Map Scale: 1:3,480 if printed on A portrait (8.5" x 11") sheet.

Meters: 0, 50, 100, 200, 300

Feet: 0, 150, 300, 600, 900

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

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

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

Soil Rating Lines

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

Soil Rating Points

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

Water Features

- Streams and Canals

Transportation

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

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:25,000.

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: Middlesex County, Massachusetts
Survey Area Data: Version 21, Sep 2, 2021

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

Date(s) aerial images were photographed: Sep 25, 2020—Oct 4, 2020

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
602	Urban land		33.2	58.2%
626B	Merrimac-Urban land complex, 0 to 8 percent slopes	A	19.6	34.3%
656	Udorthents-Urban land complex		4.3	7.5%
Totals for Area of Interest			**57.1**	**100.0%**

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

Preliminary Geotechnical Due Diligence Evaluation

SANBORN | HEAD
Building Trust. Engineering Success.

DRAFT
MEMORANDUM

To: Mr. Robert Korff, Mr. David Roache, P.E. ~ Mark Development, LLC.

From: Kevin P. Stetson, P.E., Robert D. House, P.E.

File: 4103.00

Date: October 20, 2016

Re: Preliminary Geotechnical Due Diligence
Proposed Whole Foods Relocation and New Retail Spaces
641-661 Washington Street
34-50 Crafts Street
Newton, Massachusetts

Sanborn, Head & Associates, Inc. (Sanborn Head) has prepared this memorandum to provide preliminary geotechnical considerations to Mark Development, LLC (Mark) for design and construction of the proposed project located at the above-referenced addresses in Newton, Massachusetts (Project Area). Sanborn Head is preparing a draft Environmental Site Assessment (ESA) for the above-referenced properties which will be provided under separate cover. This memorandum does consider environmental conditions as it relates to below grade construction and foundation systems.

Project Description

Based on our discussions with you and our review of the concept plans prepared by Prellwitz Chilinski Associates (PCA) and dated August 17, 2016, we understand the proposed project consists of 4 phases to combine several parcels and redevelop the property. The approximate location of the proposed redevelopment is outlined on Figure 1.

The first phase includes demolishing the existing structures at 36 and 38 Crafts Street. Following demolition, a new 1-story above-grade Whole Foods building with associated 4-stories of above-grade residential to the northwest will be constructed. The proposed new Whole Foods building includes 1 level of below-grade parking beneath the proposed supermarket and a portion of the residential as shown on Figure 1. We understand the lower floor elevation of the proposed garage is approximately El. 30.

The second phase includes demolishing the existing Whole Foods, and preparing the area for a new parking lot which consists of approximately 100 parking spaces. The third phase consists of the construction of Retail Parcel No. 1, which is a one-story at-grade building. The fourth and final phase consists of the construction of a subsurface stormwater infiltration system and Retail Parcel No. 2, which is a one-story at-grade building.

Site Description

The existing Project Area is currently improved by a number of existing structures with associated utilities and paved parking areas. The existing Whole Foods building has a one-level basement below a majority of the existing building. The structure at 36 Crafts Street does not have a basement and the extent of a basement at 38 Crafts Street is unknown. Two utility easements cross the subject properties: a drain easement is located within the 50 Crafts Street parcel and sewer and gas utilities are present in an easement on the south side of the 641 Washington Street parcel.

Based on the existing conditions survey by Control Point Associates (CPA), dated October 13, 2016, we understand the existing grades generally slope to the northwest and range from approximately 50 feet near Washington Street to 37 feet along the 48 Crafts Street parcel. Elevations referenced herein are to the North American Vertical Datum of 1988 (NAVD88).

Subsurface Explorations

Sanborn Head observed the advancement of five test borings to depths ranging between 17 to 32 feet below ground surface (bgs) on September 30, 2016 using a truck-mounted drill rig. The approximate locations of the test borings are shown on Figure 1. Two of the five soil borings were completed as 2-inch diameter, PVC monitoring wells with flush-mounted road boxes, designated as SH-2(OW) and SH-4(OW). The explorations were advanced by Soil Exploration Corporation of Leominster, Massachusetts and were observed on a full time basis by Sanborn Head personnel.

Subsurface Conditions

Subsurface conditions at test borings SH-1 through SH-3 located in the vicinity of 641-661 Washington Street generally consist of a surface treatment of about 3-inches of asphalt, underlain by variable-density granular fill soils overlying a natural sand stratum. At test boring SH-1, an organic silt layer approximately 8 feet thick was encountered below the fill and above the natural sand. Varying amounts of coal and ash particles were observed in the granular fill.

Within the vicinity of 34 to 50 Crafts Street at test boring locations SH-4 and SH-5, subsurface conditions generally consisted of a crushed stone surface, underlain by an approximately 4 to 5 foot thick fill layer, which in turn is underlain by natural sand. Auger refusal was not encountered in these test borings.

In the two monitoring wells, stabilized groundwater levels were measured on October 4, 2016 at depths of 11.5 to 18.3 feet below ground surface (bgs), which correspond to approximately El. 26.7 at SH-2(OW), and about El. 26.5 at SH-4(OW).

The approximate locations of the explorations are included in Figure 1. Logs of the explorations and groundwater measurements are provided in Attachment A.

Geotechnical Considerations

Based on the subsurface conditions, we offer the following geotechnical considerations for the current proposed site concept. Recommendations for preparation of subgrades, backfill and compaction criteria and material specifications will be provided in a separate geotechnical engineering report once the concept is finalized.

Foundations and Excavation Support

Below-Grade Parking and Residential Construction

It is our opinion that the proposed below grade parking structure (with supermarket above) and 4-story residential building could be supported on shallow spread footings with the lowest floor level constructed as a slab-on-grade bearing on the natural, inorganic, sand deposits. Based on the groundwater measurements collected during our exploration program, the construction of 1 level of below-grade parking will require dewatering as the excavation for footings is anticipated to extend below the water table. In addition, given the depth to groundwater, waterproofing is recommended for the lowest-level parking structure with a perimeter drain.

Based on the current concept, the infiltration system may induce hydraulic loads on the southern foundation walls of the garage depending on the design location and the depth of the system relative to the lowest level. During the design process the civil engineer, structural engineer, project architect and Sanborn Head will evaluate the location of the infiltration system and the potential impacts to the below grade structure.

Depending on the phasing of construction, open-cut excavation technique may be feasible for a majority of the garage footprint. Driven or drilled in place soldiers piles and lagging (SP&L) or steel sheeting may be required for excavation support system, where an open-cut cannot be maintained due to site boundaries. Support of excavation may also be required along the existing Whole Foods building and the utility corridor along the southwestern portion of 34 and 48 Crafts Street depending, on construction phasing and the amount of utility protection required.

Settlement monitoring should be anticipated along Washington Street, Crafts Street, and Maguire Court. The monitoring should also check for horizontal ground movement to protect existing utilities.

1 -Story At-Grade Retail Buildings

Variable-density fill/organic soils were encountered in borings SH-1 (about 2.5 to 10.5 feet), SH-2 (approximately 3.5-7 feet) and SH-3 (roughly 8-12 feet). These organic soils and the variable density granular fill above them are not suitable for support of the proposed buildings. We recommend the fill and organic soils be removed and replaced with compacted structural fill within the proposed building areas, where encountered. The buildings can be supported on shallow, spread footings bearing on compacted structural fill overlying the natural sand deposit. As an alternate, shallow ground improvement (such as rammed aggregate piers or stone columns) may be suitable for reinforcing the existing soils. We recommend you get quotes for both systems from interested contractors for preliminary pricing, however, in our experience, the excavate and replace option is expected to be more cost-effective for the concept as currently proposed. During the design phase, additional borings or test pits will be required to better delineate the extent of unsuitable fill and organics as the design is advanced.

Stormwater Management Area

We understand that the stormwater management area will be approximately 6,300 sq ft and be located within a portion of the area shown on Figure 1. As noted above, the location and depth of the system will be evaluated for potential impacts on the below grade foundation walls of the parking garage. We recommend existing soils within the stormwater management area be removed down to a natural, inorganic sand subgrade, corresponding to a depth of approximately 8.5 to 12 feet below existing grade. Two samples of the underlying sand were sent to GeoTesting Express of Acton, MA for sieve analysis, the results of which will be provided under separate cover, when available.

Utilities

Based on the existing conditions plan by PCA, a number of subsurface utilities are present onsite, including gas, telecommunication, sewer, water, electric and drain lines. Some of these lines may need to be relocated or abandoned for the proposed construction.

Soil Disposal

Based on concept sketch Underground Parking – P1 by PCA, dated August 17, 2016, we understand the underground parking structure has a footprint of approximately 50,000 sf. The total volume of exported soil will be based on a number factors, including potential for reuse, the extent of organics encountered during construction, proposed grading, as well as the final sizes of the proposed buildings and stormwater management areas. Based on the current concept and assuming an average depth of excavation of 8 feet and accounting for footing excavations, we estimate approximately 15,000 to 20,000 cubic yards, or about 25,000 to 35,000 tons of soil will need to disposed of off-site for the garage portion. We estimate an additional 8,000 cy may be required to be disposed off-site for the stormwater management area, as well as the variable density/organic soils observed in the vicinity of the retail parcels as shown below.

This volume estimate does not consider the approximate footprints of the existing basements (where no soil removal is required) within the footprint of the below grade garage, and re-use of onsite fill to backfill basements outside of the proposed garage footprint, as appropriate. Existing urban fill should be processed and re-used as backfill to the extent practical prior to re-use of natural soils to limit costs associated with exporting fill to a receiving facility. Excess soils that cannot be re-used on-site should be disposed of in accordance with the Massachusetts Department of Environmental Protection (MassDEP) Policy Comm-97-001, *Reuse and Disposal of Contaminated Soil at Massachusetts Landfills*, as well as applicable regulations.

Based on a limited number of pre-characterization samples collected during our environmental due diligence efforts, we anticipate that the majority of the excavated fill could be reused at an unlined landfill as daily cover. Prior to construction, additional soil pre-characterization will be required to allow for a dig-and-haul operation during construction. At this time, we estimate approximately 50 additional soil samples will be required to adequately characterize the soils that will be required to be disposed of offsite.

Demolition debris should be disposed of off-site in accordance with the solid waste regulations as well as local and federal regulations.

We trust this memorandum meets the needs of the project. Please call us at (978) 392-0900 if you have any questions.

encl. Figure 1 – Exploration Location Plan
Attachment A – Subsurface Exploration Logs by Sanborn Head

RDH/KPS/VRK: ceb

P:\4100s\4103.00\Source Files\GT Memo\20161024 Crafts Street GT Diligence Memo.docx

FIGURE

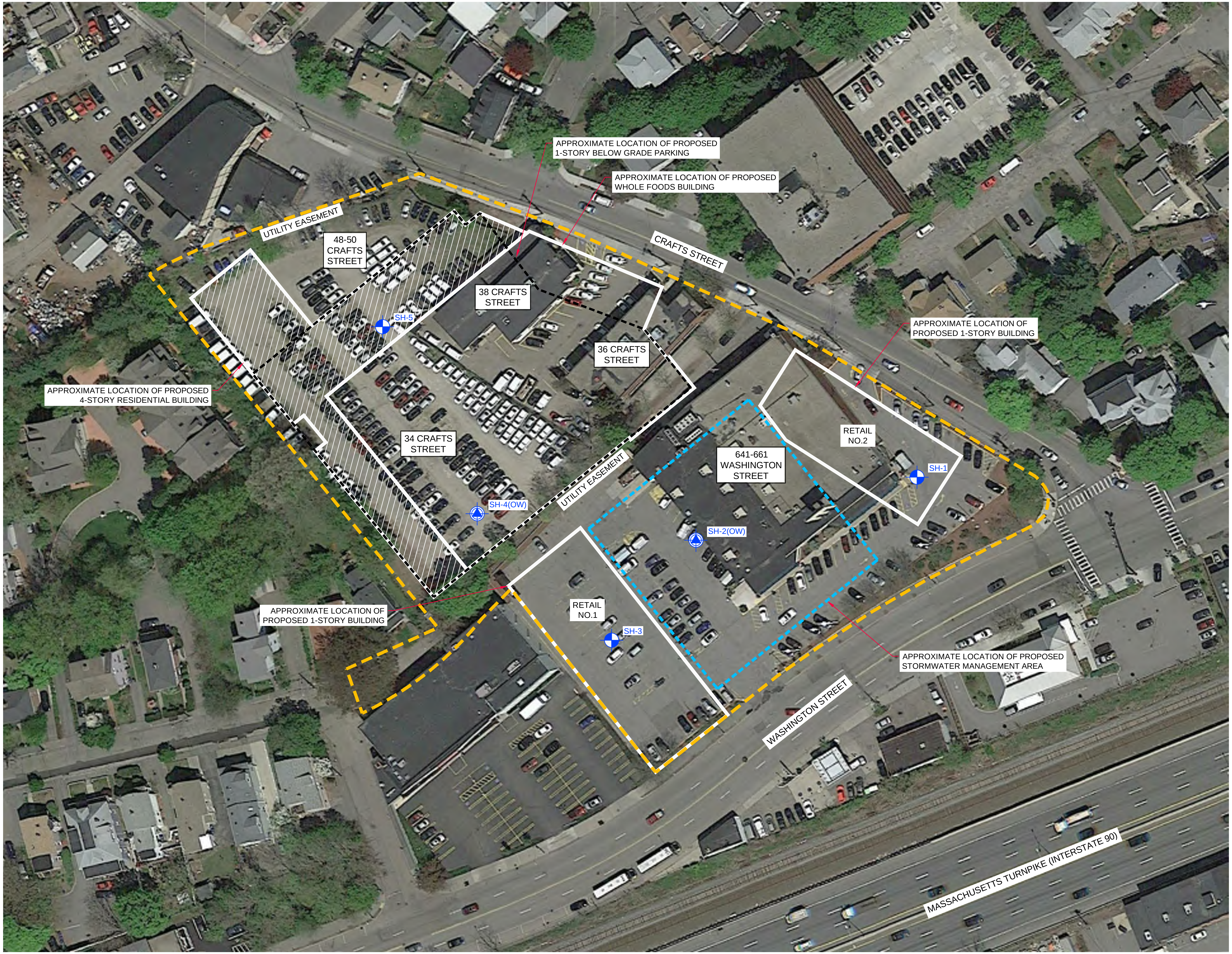


Figure No. 1

#260-22

Exploration Location Plan

Geotechnical Engineering Services

641-661 Washington Street &
34-50 Crafts Street
Newton, Massachusetts

Drawn By: C.Green
Designed By: R.House
Reviewed By: K.Stetson
Project No: 4103.00
Date: October 2016

Figure Narrative

The base map was taken from Google Earth. Imagery Date: (2016)

Explorations designated SH-1 through SH-5 were advanced by Soil Exploration Corp. of Leominster, MA and observed by Sanborn Head on September 30, 2016.

Approximate locations of explorations are based on taped measurements made in the field relative to prominent Site features. This data should be considered accurate only to the degree implied by the method used.

The proposed site features were based on sketches provided by Mark Development on August 31 and September 7, 2016.

Legend

Approximate Site boundary

SH-1 — Approximate location and designation of soil boring observed by Sanborn Heac (September 2016)

SH-2(OW) — Approximate location and designation of observation well observed by Sanborr Head (September 2016)

N W E S

40 20 0 40 80 Feet

SANBORN HEAD

File:P:\4100s\4103.00\Graphics Files\CAD\GT MEMO-OCT16\GT MEMO.dwg Plot Date: 10-24-16

APPENDIX A

DRAFT SUBSURFACE EXPLORATION LOGS
BY SANBORN HEAD

SANBORN HEAD

Sanborn, Head & Associates, Inc.

Project: 34 to 50 Crafts Street
Location: Newton, MA
Project No.: 4103.00

Log of Boring SH-1 #260-22

Ground Elevation: 46 ± feet
Datum: NAVD 1988

Drilling Method: Truck Mounted, 2¼" ID Hollow Stem Auger

Sampling Method: 2" O.D. Split Spoon with 140 lb Hammer

Drilling Company: Soil Exploration Corporation
Foreman: D. Leger
Date Started: 09/30/16 **Date Finished: 09/30/16**
Logged By: C. Bartlett **Checked By: R. House**

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Depth of Hole	Stab. Time
09/30/16	---	No Groundwater Encountered				

Depth (ft)	Sample No.	Depth (ft)	Spoon Blows per 6 in	Pen/ Rec (in)	Field Testing Data	Stratum Description	Geologic Description	Remarks
0						0' ASPHALT 0.5'	(0 to 0.5'): ASPHALT.	
	S-1	0.5 - 2.5	11 21 15 12	24/15	PID: ND	FILL 2.5'	S-1 (0.5 to 2.5'): Dense, light brown to dark brown, fine to coarse SAND, some Gravel, frequent Ash and Coal fragments. Moist. FILL.	
5	S-2	5 - 7	3 5 3 7	24/3	PID: ND	ORGANIC SILT	S-2 (5 to 7'): Loose, gray to black, Organic SILT, trace Sand. Wet. Faint organic odor.	
10	S-3	10 - 12	12 52 35 27	24/12	PID: ND PID: ND	10.5'	S-3A (10 to 10.5'): Very dense, dark brown, Organic SILT and Sand, very few Shell fragments. Moist. Faint organic odor. S-3B (10.5 to 12'): Very dense, brown, SAND, some Gravel. Moist.	Piece of Cobble observed in tip of spoon.
15	S-4	15 - 17	10 19 16 23	24/15	PID: ND	SAND 17'	S-4 (15 to 17'): Dense, brown, SAND, some Gravel. Moist. Iron oxide staining.	
17							Boring terminated at 17 feet. No refusal encountered.	

Depth scale (ft): 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42, 44

NOTES:

1. Soil samples were screened for volatile organic compounds (VOCs) using a MiniRAE 2000 Photoionization Detector (PID) with a 10.6 eV lamp, calibrated to a 100 parts per million by volume (ppmv) isobutylene-in-air standard using a response factor of 1.0. Results are presented in ppmv; the typical detection limit is 1 ppmv. ND indicates not detected. NA indicates not available. The PID measures relative levels of VOCs. Although PID screening cannot be used directly to quantify VOC concentrations or identify individual compounds, the results can serve as a relative indicator for the presence of VOCs.

SANBORN HEAD

Sanborn, Head & Associates, Inc.

Project: 34 to 50 Crafts Street
Location: Newton, MA
Project No.: 4103.00

Log of Monitoring Well S#260-22

Ground Elevation: 45 ± feet
Datum: NAVD 1988

Drilling Method: Truck Mounted, 2¼" ID Hollow Stem Auger

Sampling Method: 2" O.D. Split Spoon with 140 lb Hammer

Drilling Company: Soil Exploration Corporation
Foreman: D. Leger
Date Started: 09/30/16 **Date Finished: 09/30/16**
Logged By: C. Bartlett **Checked By: R. House**

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Depth of Hole	Stab. Time
09/30/16	---	15'	Ground Surface	N/A	N/A	N/A
10/04/16	---	18.3'	Ground Surface			4 Days

Depth (ft)	Sample No.	Depth (ft)	Spoon Blows per 6 in	Pen/ Rec (in)	Field Testing Data	Stratum Description	Geologic Description	Well Description
0	S-1	0 - 2	10 13 11 8	24/12	PID: ND	-0'- ASPHALT -0.3'-	(0 to 0.3'): ASPHALT. S-1 (0.3 to 2'): Medium dense, gray to dark brown, fine to coarse SAND, some Gravel, frequent Brick fragments. Moist. FILL.	6" Dia. Flushmounted Road Box Set in Concrete (0 to 0.3')
5	S-2	5 - 7	4 7 9 11	24/12	PID: ND	FILL	S-2 (5 to 7'): Medium dense, olive brown to gray, Clayey SILT, some Sand, some Gravel, trace Brick fragments. Moist. Black Organic Silt observed in top of sample.	Cuttings (0 to 12')
8.5						-----8.5'-----		
10	S-3	10 - 12	18 21 24 25	24/14	PID: ND		S-3 (10 to 12'): Dense, tan to gray, SAND. Moist. Iron oxide staining.	Bentonite Chips (12 to 13')
15	S-4	15 - 17	8 7 11 11	24/20	PID: ND	SAND	S-4 (15 to 17'): Medium dense, tan, fine SAND, some Silt. Moist to wet. Iron oxide staining.	2" Dia. Sch. 40 PVC Well Screen (0.010" Slots) (15 to 25')
20	S-5	20 - 22	5 7 12 15	24/20	PID: ND		S-5 (20 to 22'): Medium dense, tan, fine SAND. Wet. Iron oxide staining.	Filter Sand (13 to 27')
25	S-6	25 - 27	6 6 10 14	24/	PID: ND		S-6 (25 to 27'): Medium dense, tan, fine SAND. Wet. Iron oxide staining.	
27						-----27'-----	Boring terminated at 27 feet. No refusal encountered.	

NOTES:

1. Soil samples were screened for volatile organic compounds (VOCs) using a MiniRAE 2000 Photoionization Detector (PID) with a 10.6 eV lamp, calibrated to a 100 parts per million by volume (ppmv) isobutylene-in-air standard using a response factor of 1.0. Results are presented in ppmv; the typical detection limit is 1 ppmv. ND indicates not detected. NA indicates not available. The PID measures relative levels of VOCs. Although PID screening cannot be used directly to quantify VOC concentrations or identify individual compounds, the results can serve as a relative indicator for the presence of VOCs.

SANBORN ||| HEAD

Sanborn, Head & Associates, Inc.

Project: 34 to 50 Crafts Street
Location: Newton, MA
Project No.: 4103.00

Log of Boring SH-3 #260-22

Ground Elevation: 46 ± feet
Datum: NAVD 1988

Drilling Method: Truck Mounted, 2¼" ID Hollow Stem Auger

Sampling Method: 2" O.D. Split Spoon with 140 lb Hammer

Drilling Company: Soil Exploration Corporation
Foreman: D. Leger
Date Started: 09/30/16 Date Finished: 09/30/16
Logged By: C. Bartlett Checked By: R. House

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Depth of Hole	Stab. Time
09/30/16	---	20'	Ground Surface	N/A	N/A	N/A

Depth (ft)	Sample No.	Depth (ft)	Spoon Blows per 6 in	Pen/ Rec (in)	Field Testing Data	Stratum Log	Stratum Description	Geologic Description	Remarks
0	S-1	0 - 2	17 23 5 10	24/6	PID: ND		ASPHALT ---0'--- / ---0.3'---	(0 to 0.3'): ASPHALT. S-1 (0.3 to 2'): Medium dense, light brown to dark brown, medium to coarse SAND, some Gravel. Moist. FILL.	Piece of cobble observed in spoon tip.
5	S-2	5 - 6	8 21	12/6	PID: ND		FILL	S-2 (5 to 6'): Brown to black, SAND, some Gravel, trace Root particles. Moist. FILL.	Piece of cobble observed in spoon tip. Unable to advance sampler.
10	S-3	10 - 12	3 1 1 2	24/8	PID: ND		-----12'-----	S-3 (10 to 12'): Very loose, dark brown, SILT and Sand, frequent Wood pieces, frequent Coal fragments, frequent Ash particles, frequent Fibers particles. Moist. FILL.	
15	S-4	15 - 17	19 18 19 22	24/14	PID: ND			S-4 (15 to 17'): Dense, tan to gray, fine to coarse SAND, some Gravel. Moist.	
20	S-5	20 - 22	32 13 10 13	24/14	PID: ND PID: ND		SAND	S-5A (20 to 21'): Medium dense, tan to gray, fine to coarse SAND, some Silt, some Gravel. Wet. Iron oxide staining. S-5B (21 to 22'): Medium dense, tan to light brown, fine SAND, some Silt. Wet.	
25	S-6	25 - 27	42 13 15 9	24/	PID: ND		-----27'-----	S-6 (25 to 27'): Medium dense, tan, fine SAND. Wet.	

Depth scale (ft): 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42, 44

Boring terminated at 27 feet. No refusal encountered.

NOTES:

1. Soil samples were screened for volatile organic compounds (VOCs) using a MiniRAE 2000 Photoionization Detector (PID) with a 10.6 eV lamp, calibrated to a 100 parts per million by volume (ppmv) isobutylene-in-air standard using a response factor of 1.0. Results are presented in ppmv; the typical detection limit is 1 ppmv. ND indicates not detected. NA indicates not available. The PID measures relative levels of VOCs. Although PID screening cannot be used directly to quantify VOC concentrations or identify individual compounds, the results can serve as a relative indicator for the presence of VOCs.

SANBORN | HEAD

Sanborn, Head & Associates, Inc.

Project: 34 to 50 Crafts Street
Location: Newton, MA
Project No.: 4103.00

Log of Monitoring Well SH-4 (OW) #260-22

Ground Elevation: 38 ± feet
Datum: NAVD 1988

Drilling Method: Truck Mounted, 2¼" ID Hollow Stem Auger

Sampling Method: 2" O.D. Split Spoon with 140 lb Hammer

Drilling Company: Soil Exploration Corporation
Foreman: D. Leger
Date Started: 09/30/16 **Date Finished: 09/30/16**
Logged By: C. Bartlett **Checked By: R. House**

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Depth of Hole	Stab. Time
09/30/16	---	11'	Ground Surface	15'	17'	N/A
10/03/16	---	11.7'	Ground Surface			3 Days
10/04/16	---	11.5'	Ground Surface			4 Days

Depth (ft)	Sample No.	Sample Depth (ft)	Spoon Blows per 6 in	Pen/ Rec (in)	Field Testing Data	Stratum Description	Geologic Description	Well Description
0	S-1	0 - 2	18 16 25 22	24/8	PID: ND	-----0'----- FILL	S-1 (0 to 2'): Dense, tan to black, SAND, some Gravel. Moist. FILL.	6" Dia. Flushmounted Road Box with Locking Expansion Plug Set in Concrete (0 to 0.8'); 2" Dia. Sch. 40 PVC Riser (0 to 0.8'); Cuttings (0.8 to 3'); Bentonite Chips (3 to 4')
5	S-2	5 - 7	9 7 9 16	24/12	PID: ND	-----5'-----	S-2 (5 to 7'): Medium dense, tan, medium to coarse SAND, some Gravel. Moist.	2" Dia. Sch. 40 PVC Well Screen (0.010" Slots) (5 to 15')
10	S-3	10 - 12	9 10 10 9	24/20	PID: ND	SAND	S-3 (10 to 12'): Medium dense, tan, fine SAND. Moist to wet at 11 feet. Iron oxide staining.	#2 Filter Sand (4 to 17')
15	S-4	15 - 17	9 10 9 11	24/6	PID: ND	-----17'-----	S-4 (15 to 17'): Medium dense, tan, fine to coarse SAND, some Gravel. Wet.	

Boring terminated at 17 feet. No refusal encountered.

NOTES:

1. Soil samples were screened for volatile organic compounds (VOCs) using a MiniRAE 2000 Photoionization Detector (PID) with a 10.6 eV lamp, calibrated to a 100 parts per million by volume (ppmv) isobutylene-in-air standard using a response factor of 1.0. Results are presented in ppmv; the typical detection limit is 1 ppmv. ND indicates not detected. NA indicates not available. The PID measures relative levels of VOCs. Although PID screening cannot be used directly to quantify VOC concentrations or identify individual compounds, the results can serve as a relative indicator for the presence of VOCs.

Depth scale (ft): 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42, 44

SANBORN HEAD

Sanborn, Head & Associates, Inc.

Project: 34 to 50 Crafts Street
Location: Newton, MA
Project No.: 4103.00

Log of Boring SH-5 #260-22

Ground Elevation: 37 ± feet
Datum: NAVD 1988

Drilling Method: Truck Mounted, 2¼" ID Hollow Stem Auger

Sampling Method: 2" O.D. Split Spoon with 140 lb Hammer

Drilling Company: Soil Exploration Corporation
Foreman: D. Leger
Date Started: 09/30/16 Date Finished: 09/30/16
Logged By: C. Bartlett Checked By: R. House

Groundwater Readings

Date	Time	Depth to Water	Ref. Pt.	Depth of Casing	Depth of Hole	Stab. Time
09/30/16	---	15'	Ground Surface	N/A	N/A	N/A

Depth (ft)	Sample No.	Sample Depth (ft)	Spoon Blows per 6 in	Pen/Rec (in)	Field Testing Data	Stratum Description	Geologic Description	Remarks
0						-----0'-----		
	S-1	0 - 2	18 14 14 8	24/10	PID: ND	FILL	S-1 (0 to 2'): Medium dense, dark brown, SAND, some Gravel. Moist. FILL.	
4						-----4'-----		
	S-2	5 - 7	37 42 56 41	24/18	PID: ND	SAND	S-2 (5 to 7'): Very dense, tan to white, GRAVEL, some Sand. Moist.	
10	S-3	10 - 12	15 19 17 20	24/8	PID: ND	SAND	S-3 (10 to 12'): Dense, tan, SAND, some Gravel. Moist.	
	S-4	15 - 17	7 9 6 26	24/10	PID: ND	SAND	S-4 (15 to 17'): Medium dense, orangish brown, coarse SAND, some fine Gravel. Wet.	
20	S-5	20 - 22	4 5 13 15	12/12	PID: ND PID: ND	-----20'----- SILTY SAND -----22'-----	S-5A (20 to 21'): Medium dense, tan, SILT, some fine Sand. Wet. S-5B (21 to 22'): Medium dense, tan, fine SAND, some Silt. Wet.	
	S-6	25 - 27	2 3 4 3	24/20	PID: ND	SAND	S-6 (25 to 27'): Loose, tan, fine SAND, some Silt. Wet.	
30	S-7	30 - 32	6 7 15 11	24/20	PID: ND	SAND	S-7 (30 to 32'): Medium dense, tan, fine to coarse SAND, some Silt. Wet. Iron oxide staining.	
32						-----32'-----	Boring terminated at 32 feet. No refusal encountered.	

NOTES:

1. Soil samples were screened for volatile organic compounds (VOCs) using a MiniRAE 2000 Photoionization Detector (PID) with a 10.6 eV lamp, calibrated to a 100 parts per million by volume (ppmv) isobutylene-in-air standard using a response factor of 1.0. Results are presented in ppmv; the typical detection limit is 1 ppmv. ND indicates not detected. NA indicates not available. The PID measures relative levels of VOCs. Although PID screening cannot be used directly to quantify VOC concentrations or identify individual compounds, the results can serve as a relative indicator for the presence of VOCs.

DRAFT

BORING LOG P:\4100S\4103.00\WORK\LOGS\4103.00 LOGS.GPJ 2010 SANBORN HEAD V1.GLB 2010 SANBORN HEAD V1.GDT 10/24/16

Recharge Volumes and Drawdown Analysis

Recharge Calculations

Project	Elderly Housing with Services	Project #	15548.00
	Crafts St & Court St, Newton		
Calculated by	JK	Date	4/1/2022
Checked by		Date	

REQUIRED RECHARGE VOLUME

Hydrologic Soil Group (HSG)	Area (ft^2)	Inches of Runoff (in)	Volume (ft^3)
A	85,030	0.60	4,252
B	0	0.35	0
C	0	0.25	0
D	0	0.10	0
TOTAL			**4,252**

CAPTURE AREA ADJUSTMENT

Required Recharge Volume (ft^3)	4,252
Total Site Net Impervious Area (ft^2)	85,030
Total Site Impervious Area Draining to Recharge Facilities (ft^2)	76,375
Capture Area Adjustment Factor	1.11
Adjusted Required Recharge Volume (ft^3)	**4,733**

PROVIDED RECHARGE VOLUME

BASIN #SIS-A:

Subsurface Infiltration System, Stormtrap ST-1, 5'HT

Volumes provided below the lowest outlet at elevation: 34.6

Provided Volume:	Bottom Area (ft^2)	Volume (ft^3)
	291	**1,163**

Drawdown: $(V_{Infiltration}/A_{Bottom})$/Rawl's Rate

Rawls Recharge Rate:	**8.27**	(in/hr)
Drawdown Time:	5.80	(hours)

Recharge Calculations

Project	Elderly Housing with Services Crafts St & Court St, Newton	**Project #**	15548.00
Calculated by	JK	**Date**	4/1/2022
Checked by		**Date**	

BASIN #SIS-B:

Subsurface Infiltration System, Stormtrap ST-1, 4'HT

Volumes provided below the lowest outlet at elevation: 33.1

Provided Volume:	**Bottom Area (ft^2)**	**Volume (ft^3)**
	1,260	**3,779**

Drawdown: $(V_{Infiltration}/A_{Bottom})$/Rawl's Rate

Rawls Recharge Rate:	**8.27**	(in/hr)
Drawdown Time:	**4.35**	(hours)

BASIN #SIS-C:

Subsurface Infiltration System, Stormtrap ST-1, 3'HT

Volumes provided below the lowest outlet at elevation: 32.1

Provided Volume:	**Bottom Area (ft^2)**	**Volume (ft^3)**
	1,163	**2,326**

Drawdown: $(V_{Infiltration}/A_{Bottom})$/Rawl's Rate

Rawls Recharge Rate:	**8.27**	(in/hr)
Drawdown Time:	**2.90**	(hours)

RECHARGE VOLUME SUMMARY

Required Recharge Volume:	**4,733**	(ft^3)
Total Recharge Volume Provided:	**7,268**	(ft^3)

Appendix D: Standards 4, 8 and 9 Computations and Supporting Information

- Stormwater Management System Operations and Maintenance Manual
- Water Quality Volume Calculations
- TSS Removal Worksheets
- Phosphorus Load Removal Worksheets

Stormwater Management System Operations and Maintenance Manual

#260-22

STORMWATER MANAGEMENT SYSTEM OPERATIONS AND MAINTENANCE MANUAL

Elderly Housing with Services

Crafts Street & Court Street
Newton, MA

PREPARED FOR

Mark Development
275 Grove Street, Suite 2-150
Newton, MA 02466
617.614.9149

PREPARED BY

101 Walnut Street
PO Box 9151
Watertown, MA 02471
617.924.1770

APRIL 4, 2022

Table of Contents

Project Informtion

Site

Crafts Street Elderly Housing with Services
Crafts Street & Court Street
Newton, MA

Co-Petitioners

SRG HoldCo Investments, LLC
500 Stevens Avenue
Solana Beach, CA 92075
858.792.9300

Crafts Development, LLC
275 Grove Street
Suite 2-150
Newton, MA 02466
617.614.9149

Site Supervisor:

Name: ______________________________

Telephone: ______________________________

Cell phone: ______________________________

Email: ______________________________

Site Contact:

Name: ______________________________

Telephone: ______________________________

Cell phone: ______________________________

Email: ______________________________

Section A: Source Control

A Source Control

A comprehensive source control program will be implemented at the Crafts Street Elderly Housing with Services, which includes the following components:

- Pavement sweeping in the private way
- Catch basin and area drain cleaning
- Storwmater water quality unit cleaning
- Stormwater infiltration BMP systems cleaning
- Clearing litter from the parking area, islands, and perimeter landscape areas
- Spill Prevention training

Section B: Spill Prevention

B Spill Prevention

Spill prevention equipment and training will be provided by the property management company.

B.1 Initial Notification

In the event of a spill the facility and/or construction manager or supervisor will be notified immediately.

Facility Manager (name):	______________________
Facility Manager (phone):	______________________
Construction Manager (name) :	______________________
Construction Manager (phone):	______________________

The supervisor will first contact the Fire Department and then notify the Police Department, the Public Health Commission and the Conservation Commission. The Fire Department is ultimately responsible for matters of public health and safety and should be notified immediately.

B.2 Further Notification

Based on the assessment from the Fire Chief, additional notification to a cleanup contractor may be made. The MA Department of Environmental Protection (DEP) and the EPA may be notified depending upon the nature and severity of the spill. The Fire Chief will be responsible for determining the level of cleanup and notification required. The attached list of emergency phone numbers shall be posted in the main construction/facility office and readily accessible to all employees. A hazardous waste spill report shall be completed as necessary using the attached form.

Emergency Notification Phone Numbers

1. **FACILITY MANAGER**
   - Name: ______________ Phone: ______________
   - Beeper/Cell: ______________
   - Home Phone: ______________
   - Alternate Contact: ______________ Phone: ______________
   - Beeper/Cell: ______________
   - Home Phone: ______________

2. **FIRE & POLICE DEPARTMENT** Emergency: 911

3. **CLEANUP CONTRACTOR**
   - Address: ______________ Phone: ______________

4. **MA DEPARTMENT OF ENVIRONMENTAL PROTECTION (DEP) – NORTHEAST REGION** Emergency: (978) 694-3200

5. **NATIONAL RESPONSE CENTER** Phone: (800) 424-8802
   - Alternate: U.S. Environmental Protection Agency

6. **NEWTON HEALTH & HUMAN SERVICES DEPARTMENT** Phone: (617) 796-1420
   - Newton Conservation Office: Phone: (617) 796-1134

Hazardous Waste & Oil Spill Report

Date: ____________________ Time: ________________ AM / PM

Exact location (Transformer #): ________________________________

Type of equipment: ________________ Make: __________ Size: ______

S / N: ____________________ Weather Conditions: ______________

On or near water? ☐ Yes ☐ No If yes, name of body of water: ______________

Type of chemical / oil spilled: ____________________

Amount of chemical / oil spilled: ____________________

Cause of spill: ________________________________

Measures taken to contain or clean up spill: ________________________________

Amount of chemical / oil recovered: ______________ Method: ______________

Material collected as a result of cleanup:

______ drums containing ________________________________

______ drums containing ________________________________

______ drums containing ________________________________

Location and method of debris disposal: ________________________________

Name and address of any person, firm, or corporation suffering charges: ________________________________

Procedures, method, and precautions instituted to prevent a similar occurrence from recurring: ________________________________

Spill reported by General Office by: ______________ Time: ________ AM / PM

Spill reported to DEP / National Response Center by: ______________________

DEP Date: ____________ Time: ________ AM / PM Inspector: __________

NRC Date: ____________ Time: ________ AM / PM Inspector: __________

Additional comments: ________________________________

B.3 Assessment – Initial Containment

The supervisor or manager will assess the incident and initiate containment control measures with the appropriate spill containment equipment included in the spill kit kept on-site. A list of recommended spill equipment to be kept on site is included on the following page.

Fire / Police Department:	911
Health & Human Services Department:	(617) 796-1420
Conservation Office:	(617) 796-1134

Emergency Response Equipment

The following equipment and materials shall be maintained at all times and stored in a secure area for long-term emergency response need.

Supplies	Quantity	Recommended Suppliers
› Sorbent Pillows/"Pigs"	2	http://www.newpig.com Item # KIT276 — mobile container with two pigs
› Sorbent Boom/Sock	25 feet	http://www.forestry-suppliers.com
› Sorbent Pads	50	
› Lite-Dri® Absorbent	5 pounds	
› Shovel	1	Item # 33934 — Shovel (or equivalent)
› Pry Bar	1	Item # 43210 — Manhole cover pick (or equivalent)
› Goggles	1 pair	Item # 23334 — Goggles (or equivalent)
› Gloves – Heavy	1 pair	Item # 90926 — Gloves (or equivalent)

Section C: Snow Management

C Snow Management

Snow storage areas are shown on the attached Map.

- Snow storage areas will be managed to prevent blockage of storm drain catch basins and stormwater drainage swales. Snow combined with sand and debris may block a storm drainage system, diminishing the infiltration capacity of the system and causing localized flooding.
- Sand and debris deposited on vegetated or paved areas shall be cleared from the site and properly disposed of at the end of the snow season, no later than May 15.
- Snow shall not be dumped into any waterbody, pond, or wetland resource area.

Section D: Maintenance of Stormwater Management Systems

D Maintenance of Stormwater Management Systems

D.1 Pavement Systems

D.1.1 Standard Asphalt Pavement

- Sweep or vacuum standard asphalt pavement areas at least four times per year with a rotary brush sweeper, vacuum or regenerative air sweeper and properly dispose of removed material.
- Recommended sweeping schedule:
  - Oct/Nov
  - Feb/Mar
  - Apr/May
  - Aug/Sep
- More frequent sweeping of paved surfaces will result in less accumulation in catch basins, less cleaning of subsurface structures, and less disposal costs.
- Check loading docks and dumpster areas frequently for spillage and/or pavement staining and clean as necessary.

D.2 Structural Stormwater Management Devices

D.2.1 Catch Basins and Area Drains

The proper removal of sediments and associated pollutants and trash occurs only when catch basin inlets and sumps are cleaned out regularly. The more frequent the cleaning, the less likely sediments will be re-suspended and subsequently discharged. In addition, frequent cleaning also results in more volume available for future deposition and enhances the overall performance. As noted in the pavement Operation and Maintenance (O&M) section, more frequent sweeping of paved surfaces will result in less accumulation in catch basins, less cleaning of subsurface structures, and less disposal costs.

There are nine (9) catch basins and area drains at the Crafts Street Elderly Housing with Services facility. These catch basins are constructed with sumps (minimum 4 feet) and hooded outlets to trap debris, sediments, and floating contaminants. Disposal of all sediments must be in accordance with applicable local, state, and federal guidelines. A map of the catch basin locations is included in Section E.5 Maintenance Checklists and Device Location Maps.

Inspections and Cleaning

- All catch basins shall be inspected at least four times per year and cleaned a minimum of at least once per year.
- Sediment (if more than six inches deep) and/or floatable pollutants shall be pumped from the basin and disposed of at an approved offsite facility in accordance with all applicable regulations.
- Any structural damage or other indication of malfunction will be reported to the site manager and repaired as necessary
- During colder periods, the catch basin grates must be kept free of snow and ice.
- During warmer periods, the catch basin grates must be kept free of leaves, litter, sand, and debris.

D.2.2 Structural Water Quality Devices

The stormwater drainage system has three (3) structural water quality devices. These are intended to be Stormceptor STC Water Quality Units, which efficiently remove sediment and hydrocarbons from stormwater runoff. A map showing the locations is included in Maintenance Checklists and Device Location Maps.

- Inspect devices monthly for the first three months after construction.
- After initial three month period, all water quality units are to be inspected at least four times per year and cleaned a minimum of at least once per year (when sediment reaches 8” in depth).
- Follow manufacturer instructions and contact manufacturer if system is malfunctioning.

D.2.3 Subsurface Infiltration Basins

The subsurface infiltration/detention basins are used to detain and infiltrate roadway and rooftop runoff. There are three (3) subsurface infiltration basins at the Crafts Street Elderly Housing with Services facility. Each of these basins has a water quality pre-treatment device in the form of a subsurface sediment removal row to protect the infiltration bed from clogging. The sediment removal row is an integral part of the underground infiltration system and is comprised of a perforated pipe, wrapped in a filter fabric and surrounded with gravel. To maintain pre-treatment functionality, this sediment removal row requires regular inspection and cleaning. A map of the infiltration basin locations is included in Section E.5 Maintenance Checklists and Device Location Maps.

Inspections and Cleaning

- The subsurface infiltration systems will be inspected at least once each year by removing the manhole/access port covers and determining the thickness of sediment that has accumulated in the sediment removal row.
- If sediment is more than six inches deep, it must be suspended via flushing with clean water and removed using a vactor truck.
- Manufacturer's specifications and instructions for cleaning the sediment removal row are provided as an attachment to this section.
- Emergency overflow pipes will be examined at least once each year and verified that no blockage has occurred.
- System will be observed after rainfalls to see if it is properly draining.

D.2.4 Roof Drain Leader

Roof runoff from buildings and site drives at the Crafts Street Elderly Housing with Services facility are directed to the subsurface infiltration units.

- Perform routine roof inspections quarterly.
- Keep roofs clean and free of debris.
- Keep roof drainage systems clear.
- Keep roof access limited to authorized personnel.
- Clean inlets twice per year or as necessary.

D.3 Vegetated Stormwater Management Devices

D.3.1 Bioretention Basins

The Project intends to incorporate additional LID BMPs including bioretention basins at the Crafts Street Elderly Housing with Services facility. These basins are excavated shallow surface depressions planted with specially-selected native vegetation to treat and capture runoff. Each bioretention basins also has an overflow structure leading to the subsurface infiltration system to handle larger storm volumes. A location map for the bioretention basins can be found in Section E.5 Maintenance Checklists and Device Location Maps.

The vegetation in the bioretention basins serves to filter runoff — improving water quality and reducing runoff quantity — and the root systems can enhance infiltration. The soil medium filters out pollutants and allows storage and infiltration of stormwater runoff; and the infiltration bed provides additional volume control. Properly designed bioretention basins may mimic natural forest ecosystems through species diversity, density and distribution of vegetation, and the use of native species, resulting in a system that is resistant to insects, disease, pollution, and climatic stresses.

Bioretention basins require routine maintenance (similar to conventional landscaping maintenance) to ensure that the system both functions well as a stormwater management practice while also maintaining an aesthetic quality compatible with the surrounding land uses.

Replacement of mulch is an important part of bioretention basin maintenance. Mulch keeps the soil moist, allowing for easy infiltration of rain water. Un-mulched surfaces may develop into a hardpan, a condition in which the soil surface becomes cemented together, forming a hard, impervious layer. Mulching also protects plants and reduces weed growth.

Initial Post-Construction Inspection

- During the initial period of vegetation establishment pruning and weeding are required twice in first year by contractor.
- Any dead vegetation found after the first year must be replaced.
- Proper mulching is mandatory and regular watering may be required initially to ensure proper establishment of new vegetation.

Long-Term Maintenance

- Weeds and invasive plant species shall be removed by hand.
- Leaf litter and other detritus shall be removed twice per year.
- If needed to maintain aesthetic appearance, perennial plantings may be trimmed at the end of the growing season.
- Trees and shrubs should be inspected twice per year to evaluate health and attended to as necessary.
- Re-mulch bioretention basins with well aged hardwood mulch to a depth of 3 inches each spring or whenever erosion is evident. The entire area may require mulch replacement once every two to three years. Mulch depth shall not exceed 3 inches and the depth of the depression shall not be compromised by the accumulation of vegetation or old mulch.
- Seeded ground cover or grass areas shall not receive mulching.
- Fertilizers should not be used in the bioretention basin as excessive nutrients in the bioretention basin may migrate to the underdrain and be discharged to adjacent surface waters.
- Test pH of the soils in the planting bed annually. If the pH is below 5.2, limestone should be applied to increase it. If the pH is above 8.0, iron sulfate plus sulfur should be added to reduce it.
- Bioretention basins may require watering during periods of extended drought.

Inspections and Cleaning

- Bioretention basins shall be inspected twice during for the first year and annually thereafter for sediment buildup, erosion, vegetative conditions, etc. If sediment build-up is found, sediment removal and core aeration or cultivating of un-vegetated areas may be required to ensure adequate filtration.

- The inflow location should be inspected annually for clogging. Sediment build up is a common problem where runoff leaves an impervious surface and enters a vegetative or earthen surface. Any built-up sediment should be removed to prevent runoff from bypassing the facility. Sources of sediment should be prevented.
- The overflow structure and underdrain standpipes should be inspected annually to ensure that they are functioning.
- Inspect bioretention basins after a large storm event to ensure that proper drainage is occurring. Water that remains ponded on the surface of the bioretention basin after 48 hours of dry weather could indicate a problem with the subsurface drainage system or clogging of the underdrain. While the plants selected for the bioretention basin are tolerant of wet soils, they are not wetland species that can survive long periods of inundation. Immediate attention is required to prevent the loss of plant materials.

D.3.2 Vegetated Areas Maintenance

Although not a structural component of the drainage system, the maintenance of vegetated areas may affect the functioning of the stormwater management system. This includes the health/density of vegetative cover and activities such as the application and disposal of lawn and garden care products, disposal of leaves and yard trimmings and proper aeration of soils.

- Inspect planted areas on a semi-annual basis and remove any litter.
- Maintain planted areas adjacent to pavement to prevent soil washout.
- Immediately clean any soil deposited on pavement.
- Re-seed bare areas; install appropriate erosion control measures when native soil is exposed or erosion channels are forming.
- Plant alternative mixture of grass species in the event of unsuccessful establishment.
- The grass vegetation should be cut to a height between three and four inches.
- Pesticide/Herbicide Usage – No pesticides are to be used unless a single spot treatment is required for a specific control application.
- Fertilizer usage should be avoided. If deemed necessary, slow release fertilizer should be used. Fertilizer may be used to begin the establishment of vegetation in bare or damaged areas, but should not be applied on a regular basis unless necessary.
- Annual application of compost amendments and aeration are recommended.

Section E: Operations and Maintenance Plan Summary

E Operations and Maintenance Plan Summary

This Operation and Maintenance Plan has been prepared in accordance with the Stormwater Management Policy developed by the DEP regulations as applicable. It specifies operational practices and drainage system maintenance requirements for the Crafts Street Elderly Housing with Service facilty. Requirements should be adjusted by the site manager as necessary to ensure successful functioning of system components.

E.1 Routine Maintenance Checklists

Routine required maintenance is described in Sections A – D. The following checklists are to be used by the property manager to implement and document the required maintenance and inspection tasks.

E.2 Reporting and Documentation

The site supervisor shall be responsible for ensuring that the scheduled tasks as described in this plan are appropriately completed and recorded in the Maintenance Log. Accurate records of all inspections, routine maintenance and repairs shall be documented and these records shall be available for inspection by members of the Newton Department of Planning & Development, or their designated agent, upon request.

The Maintenance Log shall:

- Document the completion of required maintenance tasks.
- Identify the person responsible for the completion of tasks.
- Identify any outstanding problems, malfunctions or inconsistencies identified during the course of routine maintenance.
- Document specific repairs or replacements.

E.3 Construction Practices Maintenance/ Evaluation Checklist

Crafts Street Elderly Housing with Services – Newton, MA

Best Management Practice	Inspection Frequency	Date Inspected	Inspector Initials	Minimum Maintenance and Key Items to Check	Cleaning or Repair Needed ☐Yes/No (List Items)	Date of Cleaning or Repair	Performed by:
Hay Bales/ Silt Fencing	Weekly and after any rainfall			Sediment build up, broken bales or stakes			
Gravel Construction Entrance	Weekly and after any rainfall			Filled voids, runoff/sediments into street			
Catch Basin Protection	Weekly and after any rainfall			Clogged or sediment build-up at surface or in basin			
Diversion Channels	Weekly and after any rainfall			Maintained, moved as necessary to correct locations, Check for erosion or breakout			
Temporary Sedimentation Basins	Weekly and after any rainfall			Cracking, erosion, breakout, sediment buildup, contaminants			

Stormwater Control Manager: ______________________________

E.4 Long-term Maintenance/Evaluation Checklist

Crafts Street Elderly Housing with Services – Newton, MA

Best Management Practice	Minimum Maintenance and Key Items to Check	Inspection Frequency	Date Inspected	Inspector Initials	Cleaning Frequency	Cleaning or Repair Needed ☐Yes/No	Date of Cleaning or Repair	Performed by:
Street Sweeping	Vacuum sweeper	4X per year			4X per year* minimum			
Deep Sump and Hooded Catch basins	Remove sediment 1X per year or if >6 inches	4X per year			1X per year or as necessary			
Structural Water Quality Devices	Remove sediment from sediment storage facility (per manufacturer's guidelines). Remove oil and floatables in the oil/inspection port.	2X per year first year, annually thereafter			2X per year first year, annually thereafter			
Subsurface Infiltration Basins	Remove sediment 1X per year or if >6 inches	1X per year			1X per year			
Bioretention Basins	Inspect inlets, vegetation, overflow discharge pipes, drain time less than 4 days	2X per year first year, annually thereafter			2X per year first year, annually thereafter			
Roof Drains	Remove debris, clean inlets draining to subsurface bed	4x per year roof inspection			2x per year inlet cleaning, roof debris as necessary			

* Recommend sweeping Oct/Nov, Feb/Mar, Apr/May Jul/Aug with late winter most important

Stormwater Control Manager: ______________________________

E.5 Maintenance Checklists and Device Location Maps

These checklists are provided for the maintenance crew to photocopy and use when conducting inspections and cleaning activities to the stormwater management systems.

Maintenance Checklists

Catchbasins and Area Drains – Inspect 4 times per year, clean when sediment depth >6 inches or at least once per year.

Catch Basin	Inspected (Y/N)	Sediment Depth (inches)	Cleaning needed (Y/N)	Date Cleaned	Comments (Trash, Oil, Pet waste, Lawn Debris, Damage)
CB-B01				/ /	
CB-B02				/ /	
CB-C01				/ /	
CB-C02				/ /	
AD-A01				/ /	
AD-A02				/ /	
AD-B01				/ /	
AD-C01				/ /	
AD-C02				/ /	

Water Quality Units – Inspect 4 times per year, clean at least once per year or when sediment reaches a depth of 8 inches.

Water Quality Unit	Inspected (Y/N)	Sediment Depth (inches)	Cleaning needed (Y/N)	Date Cleaned	Comments (Trash, Oil, Pet waste, Lawn Debris, Damage)
WQU-A01				/ /	
WQU-B01				/ /	
WQU-C01				/ /	

Subsurface Infiltration Basins – Inspect once per year, remove sediment if more than 6 inches has accumulated in sediment forebay or sediment collection row.

Basin	Inspected (Y/N)	Sediment Depth (inches)	Cleaning needed (Y/N)	Date Cleaned	Comments (Trash, Oil, Pet waste, Lawn Debris, Damage)
SIS-A				/ /	
SIS-B				/ /	
SIS-C				/ /	

Bioretention Basins – Inspect twice during first year and annually thereafter for sediment buildup, erosion, vegetative conditions, etc. If sediment build-up is found, core aeration or cultivating of unvegetatd areas may be required to ensure adequate filtration. The overflow should be inspected annually to ensure that it is functioning.

Bioretention basin	Inspected (Y/N)	Sediment Depth (inches)	Cleaning needed (Y/N)	Date Cleaned	Comments (Trash, Oil, Pet waste, Lawn Debris, Damage)

Roof Runoff Downspouts – Inspect roof drains monthly, clean inlets draining to the subsurface bed twice per year.

Bldg #	Inspected (Y/N)	Sediment Depth (inches)	Cleaning needed (Y/N)	Date Cleaned	Comments (Trash, Oil, Pet waste, Lawn Debris, Damage)
BLD-01				/ /	
BLD-02				/ /	
BLD-03				/ /	

Device Location Maps

\\vhb\gbl\proj\Wat-LD\15548.00 MarkDev Crafts St Newton\Reports\Stormwater\05_Appendix D - Standards 4, 8 & 9 Compliance\15548.00 - O&M NEW.dwg

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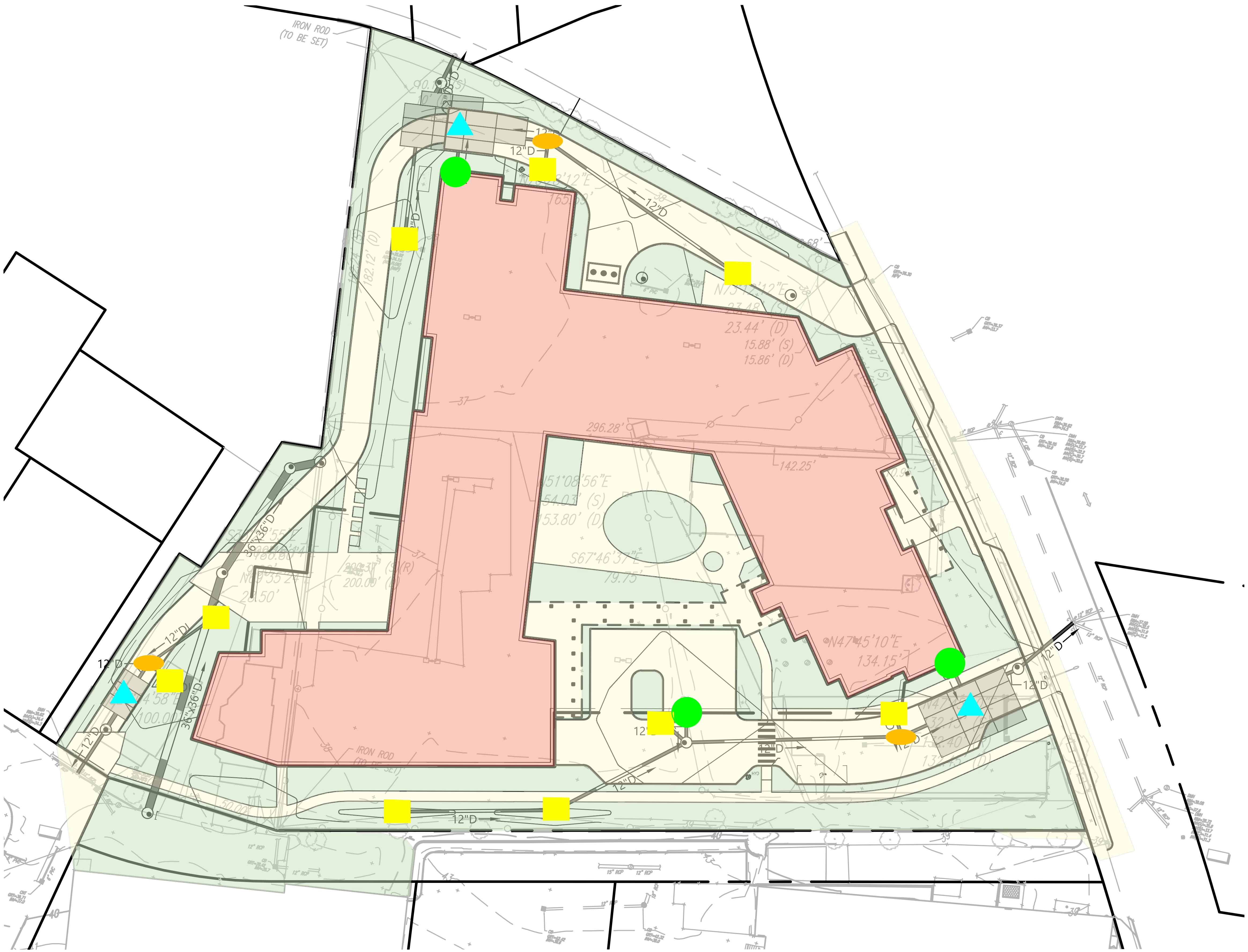


Legend

- DEEP SUMP AND HOODED CATCH BASIN
- STRUCTURAL WATER QUALITY DEVICE
- SUBSURFACE INFILTRATION BASIN
- BIORETENTION BASIN
- ROOF DRAIN

0 25 50 100Feet

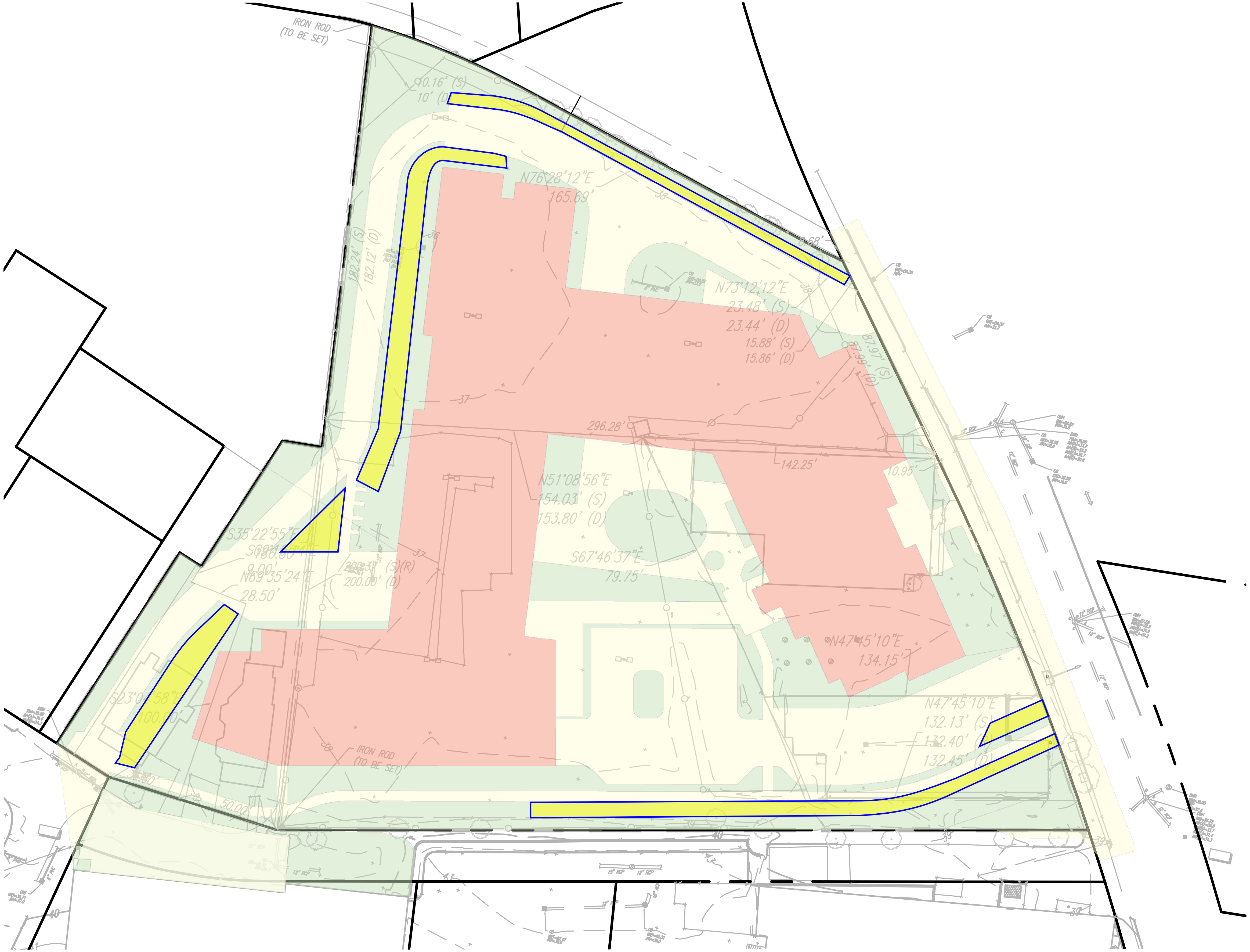
vhb

Operation and Maintenance Plan
Elderly Housing with Services
Crafts Street & Court Street
Newton, MA

Figure E.1

04/04/2022

Snow Storage Areas Map



Legend

APPROXIMATE LOCATION OF SNOW STORAGE

0 25 50 100Feet

Snow Storage Plan
Elderly Housing with Services
Crafts Street & Court Street
Newton, MA

Figure E.2

04/04/2022

Section F: Product Literature

F Product Literature

1. Stormceptor STC Water Quality Units
2. Stormtrap ST1 Subsurface Infiltration System

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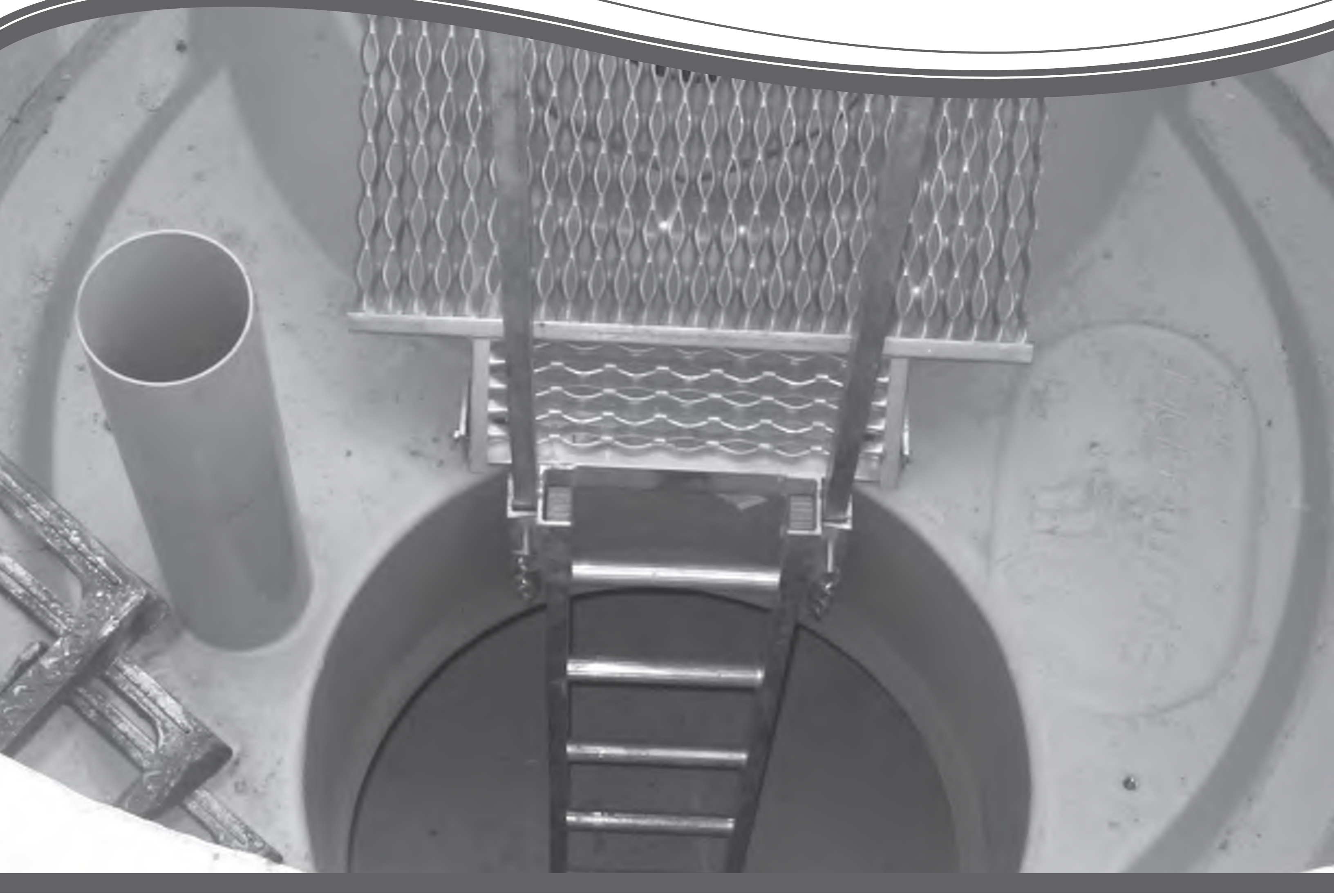
CONTECH ENGINEERED SOLUTIONS

Stormceptor® STC Operation and Maintenance Guide



Stormceptor® STC

Stormceptor Design Notes

- Only the STC 450i is adaptable to function with a catch basin inlet and/or inline pipes.
- Only the Stormceptor models STC 450i to STC 7200 may accommodate multiple inlet pipes.

Inlet and outlet invert elevation differences are as follows:

Inlet and Outlet Pipe Invert Elevations Differences			
Inlet Pipe Configuration	STC 450i	STC 900 to STC 7200	STC 11000 to STC 16000
Single inlet pipe	3 in. (75 mm)	1 in. (25 mm)	3 in. (75 mm)
Multiple inlet pipes	3 in. (75 mm)	3 in. (75 mm)	Only one inlet pipe.

Maximum inlet and outlet pipe diameters:

Inlet/Outlet Configuration	Inlet Unit STC 450i	In-Line Unit STC 900 to STC 7200	Series* STC 11000 to STC 16000
Straight Through	24 inch (600 mm)	42 inch (1050 mm)	60 inch (1500 mm)
Bend (90 degrees)	18 inch (450 mm)	33 inch (825 mm)	33 inch (825 mm)

- The inlet and in-line Stormceptor units can accommodate turns to a maximum of 90 degrees.
- Minimum distance from top of grade to crown is 2 feet (0.6 m)
- Submerged conditions. A unit is submerged when the standing water elevation at the proposed location of the Stormceptor unit is greater than the outlet invert elevation during zero flow conditions. In these cases, please contact your local Stormceptor representative and provide the following information:
- Top of grade elevation
- Stormceptor inlet and outlet pipe diameters and invert elevations
- Standing water elevation
- Stormceptor head loss, K = 1.3 (for submerged condition, K = 4)

Stormceptor® STC

OPERATION AND MAINTENANCE GUIDE
Table of Content

1. About Stormceptor

The Stormceptor® STC (Standard Treatment Cell) was developed by Imbrium™ Systems to address the growing need to remove and isolate pollution from the storm drain system before it enters the environment. The Stormceptor STC targets hydrocarbons and total suspended solids (TSS) in stormwater runoff. It improves water quality by removing contaminants through the gravitational settling of fine sediments and floatation of hydrocarbons while preventing the re-suspension or scour of previously captured pollutants.

The development of the Stormceptor STC revolutionized stormwater treatment, and created an entirely new category of environmental technology. Protecting thousands of waterways around the world, the Stormceptor System has set the standard for effective stormwater treatment.

1.1. Patent Information

The Stormceptor technology is protected by the following patents:

- Australia Patent No. 693,164 • 693,164 • 707,133 • 729,096 • 779401
- Austrian Patent No. 289647
- Canadian Patent No 2,009,208 •2,137,942 • 2,175,277 • 2,180,305 • 2,180,383 • 2,206,338 • 2,327,768 (Pending)
- China Patent No 1168439
- Denmark DK 711879
- German DE 69534021
- Indonesian Patent No 16688
- Japan Patent No 9-11476 (Pending)
- Korea 10-2000-0026101 (Pending)
- Malaysia Patent No PI9701737 (Pending)
- New Zealand Patent No 314646
- United States Patent No 4,985,148 • 5,498,331 • 5,725,760 • 5,753,115 • 5,849,181 • 6,068,765 • 6,371,690
- Stormceptor OSR Patent Pending • Stormceptor LCS Patent Pending

2. Stormceptor Design Overview

2.1. Design Philosophy

The patented Stormceptor System has been designed to focus on the environmental objective of providing long-term pollution control. The unique and innovative Stormceptor design allows for continuous positive treatment of runoff during all rainfall events, while ensuring that all captured pollutants are retained within the system, even during intense storm events.

An integral part of the Stormceptor design is PCSWMM for Stormceptor - sizing software developed in conjunction with Computational Hydraulics Inc. (CHI) and internationally acclaimed expert, Dr. Bill James. Using local historical rainfall data and continuous simulation modeling, this software allows a Stormceptor unit to be designed for each individual site and the corresponding water quality objectives.

By using PCSWMM for Stormceptor, the Stormceptor System can be designed to remove a wide range of particles (typically from 20 to 2,000 microns), and can also be customized to remove a specific particle size distribution (PSD). The specified PSD should accurately reflect what is in the stormwater runoff to ensure the device is achieving the desired water quality objective. Since stormwater runoff contains small particles (less than 75 microns), it is important to design a treatment system to remove smaller particles in addition to coarse particles.

2.2. Benefits

The Stormceptor System removes free oil and suspended solids from stormwater, preventing spills and non-point source pollution from entering downstream lakes and rivers. The key benefits, capabilities and applications of the Stormceptor System are as follows:

- Provides continuous positive treatment during all rainfall events
- Can be designed to remove over 80% of the annual sediment load
- Removes a wide range of particles
- Can be designed to remove a specific particle size distribution (PSD)
- Captures free oil from stormwater
- Prevents scouring or re-suspension of trapped pollutants
- Pre-treatment to reduce maintenance costs for downstream treatment measures (ponds, swales, detention basins, filters)
- Groundwater recharge protection
- Spills capture and mitigation
- Simple to design and specify
- Designed to your local watershed conditions
- Small footprint to allow for easy retrofit installations
- Easy to maintain (vacuum truck)
- Multiple inlets can connect to a single unit
- Suitable as a bend structure
- Pre-engineered for traffic loading (minimum AASHTO HS-20)
- Minimal elevation drop between inlet and outlet pipes
- Small head loss
- Additional protection provided by an 18” (457 mm) fiberglass skirt below the top of the insert, for the containment of hydrocarbons in the event of a spill.

2.3. Environmental Benefit

Freshwater resources are vital to the health and welfare of their surrounding communities. There is increasing public awareness, government regulations and corporate commitment to reducing the pollution entering our waterways. A major source of this pollution originates from stormwater runoff from urban areas. Rainfall runoff carries oils, sediment and other contaminants from roads and parking lots discharging directly into our streams, lakes and coastal waterways.

The Stormceptor System is designed to isolate contaminants from getting into the natural environment. The Stormceptor technology provides protection for the environment from spills that occur at service stations and vehicle accident sites, while also removing contaminated sediment in runoff that washes from roads and parking lots.

3. Key Operation Features

3.1. Scour Prevention

A key feature of the Stormceptor System is its patented scour prevention technology. This innovation ensures pollutants are captured and retained during all rainfall events, even extreme storms. The Stormceptor System provides continuous positive treatment for all rainfall events, including intense storms. Stormceptor slows incoming runoff, controlling and reducing velocities in the lower chamber to create a non-turbulent environment that promotes free oils and floatable debris to rise and sediment to settle.

The patented scour prevention technology, the fiberglass insert, regulates flows into the lower chamber through a combination of a weir and orifice while diverting high energy flows away through the upper chamber to prevent scouring. Laboratory testing demonstrated no scouring when tested up to 125% of the unit's operating rate, with the unit loaded to 100% sediment capacity (NJDEP, 2005). Second, the depth of the lower chamber ensures the sediment storage zone is adequately separated from the path of flow in the lower chamber to prevent scouring.

3.2. Operational Hydraulic Loading Rate

Designers and regulators need to evaluate the treatment capacity and performance of manufactured stormwater treatment systems. A commonly used parameter is the "operational hydraulic loading rate" which originated as a design methodology for wastewater treatment devices.

Operational hydraulic loading rate may be calculated by dividing the flow rate into a device by its settling area. This represents the critical settling velocity that is the prime determinant to quantify the influent particle size and density captured by the device. PCSWMM for Stormceptor uses a similar parameter that is calculated by dividing the hydraulic detention time in the device by the fall distance of the sediment.

$$v_{SC} = \frac{H}{6_H} = \frac{Q}{A_S}$$

Where:

v_{SC} = critical settling velocity, ft/s (m/s)

H = tank depth, ft (m)

$Ø_H$ = hydraulic detention time, ft/s (m/s)

Q = volumetric flow rate, ft3/s (m3/s)

A_S = surface area, ft^2 (m^2)

(Tchobanoglous, G. and Schroeder, E.D. 1987. Water Quality. Addison Wesley.)

Unlike designing typical wastewater devices, stormwater systems are designed for highly variable flow rates including intense peak flows. PCSWMM for Stormceptor incorporates all of the flows into its calculations, ensuring that the operational hydraulic loading rate is considered not only for one flow rate, but for all flows including extreme events.

3.3. Double Wall Containment

The Stormceptor System was conceived as a pollution identifier to assist with identifying illicit discharges. The fiberglass insert has a continuous skirt that lines the concrete barrel wall for a depth of 18 inches (457 mm) that provides double wall containment for hydrocarbons storage. This protective barrier ensures that toxic floatables do not migrate through the concrete wall into the surrounding soils.

4. Stormceptor Product Line

4.1. Stormceptor Models

A summary of Stormceptor models and capacities are listed in Table 1.

Table 1. Stormceptor Models

Stormceptor Model	Total Storage Volume U.S. Gal (L)	Hydrocarbon Storage Capacity U.S. Gal (L)	Maximum Sediment Capacity ft^3 (L)
STC 450i	470 (1,780)	86 (330)	46 (1,302)
STC 900	952 (3,600)	251 (950)	89 (2,520)
STC 1200	1,234 (4,670)	251 (950)	127 (3,596)
STC 1800	1,833 (6,940)	251 (950)	207 (5,861)
STC 2400	2,462 (9,320)	840 (3,180)	205 (5,805)
STC 3600	3,715 (1,406)	840 (3,180)	373 (10,562)
STC 4800	5,059 (1,950)	909 (3,440)	543 (15,376)
STC 6000	6,136 (23,230)	909 (3,440)	687 (19,453)
STC 7200	7,420 (28,090)	1,059 (4,010)	839 (23,757)
STC 11000	11,194 (42,370)	2,797 (10, 590)	1,086 (30,752)
STC 13000	13,348 (50,530)	2,797 (10, 590)	1,374 (38,907)
STC 16000	15,918 (60,260)	3,055 (11, 560)	1,677 (47,487)

NOTE: Storage volumes may vary slightly from region to region. For detailed information, contact your local Stormceptor representative.

4.2. Inline Stormceptor

The Inline Stormceptor, Figure 1, is the standard design for most stormwater treatment applications. The patented Stormceptor design allows the Inline unit to maintain continuous positive treatment of total suspended solids (TSS) year-round, regardless of flow rate. The Inline Stormceptor is composed of a precast concrete tank with a fiberglass insert situated at the invert of the storm sewer pipe, creating an upper chamber above the insert and a lower chamber below the insert.

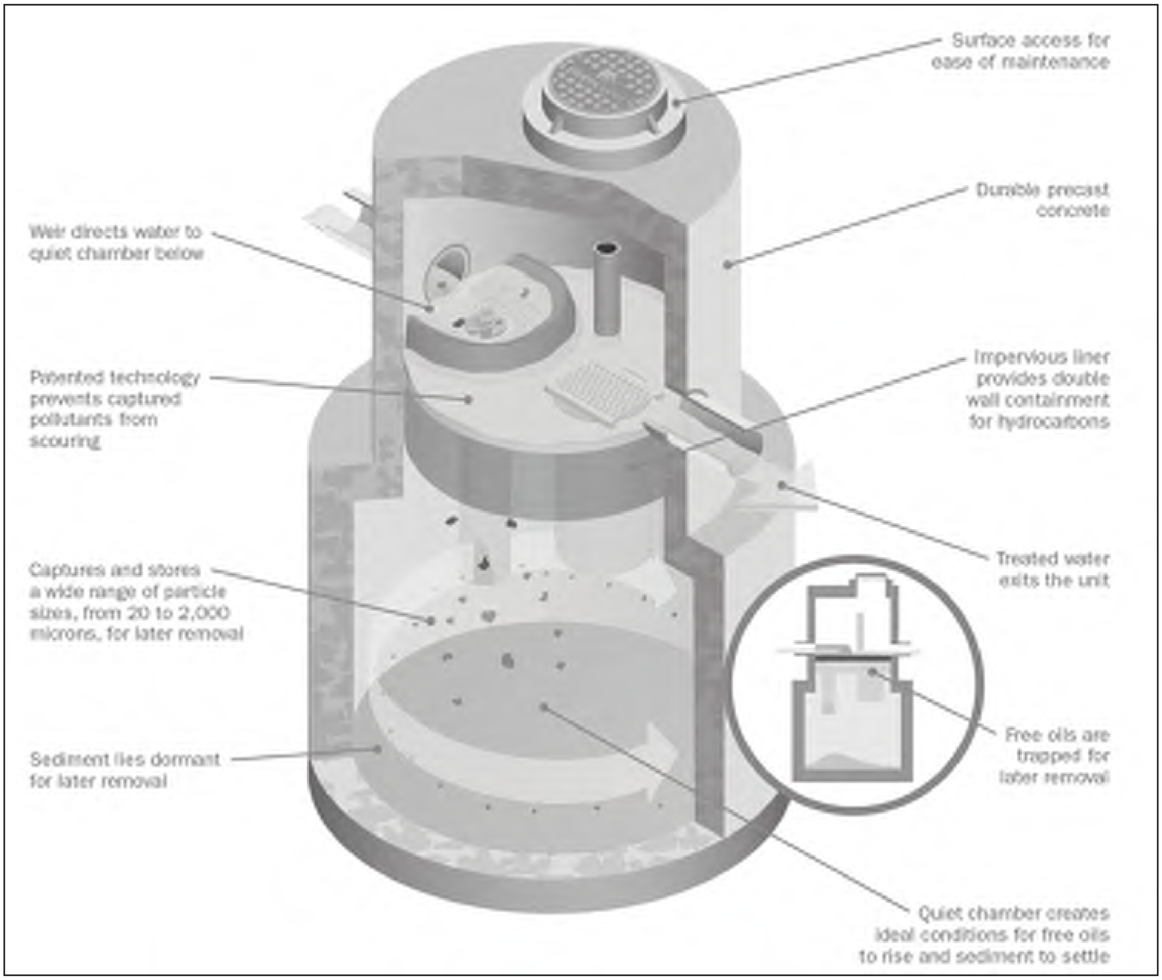


Figure 1. Inline Stormceptor

Operation

As water flows into the Stormceptor unit, it is slowed and directed to the lower chamber by a weir and drop tee. The stormwater enters the lower chamber, a non-turbulent environment, allowing free oils to rise and sediment to settle. The oil is captured underneath the fiberglass insert and shielded from exposure to the concrete walls by a fiberglass skirt. After the pollutants separate, treated water continues up a riser pipe, and exits the lower chamber on the downstream side of the weir before leaving the unit. During high flow events, the Stormceptor System's patented scour prevention technology ensures continuous pollutant removal and prevents re-suspension of previously captured pollutants.

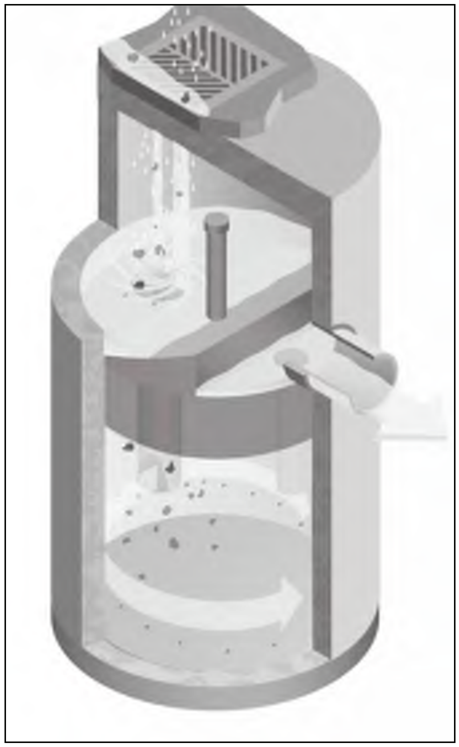


Figure 2. Inlet Stormceptor

4.3. Inlet Stormceptor

The Inlet Stormceptor System, Figure 2, was designed to provide protection for parking lots, loading bays, gas stations and other spill-prone areas. The Inlet Stormceptor is designed to remove sediment from stormwater introduced through a grated inlet, a storm sewer pipe, or both.

The Inlet Stormceptor design operates in the same manner as the Inline unit, providing continuous positive treatment, and ensuring that captured material is not re-suspended.

4.4. Series Stormceptor

Designed to treat larger drainage areas, the Series Stormceptor System, Figure 3, consists of two adjacent Stormceptor models that function in parallel. This design eliminates the need for additional structures and piping to reduce installation costs.

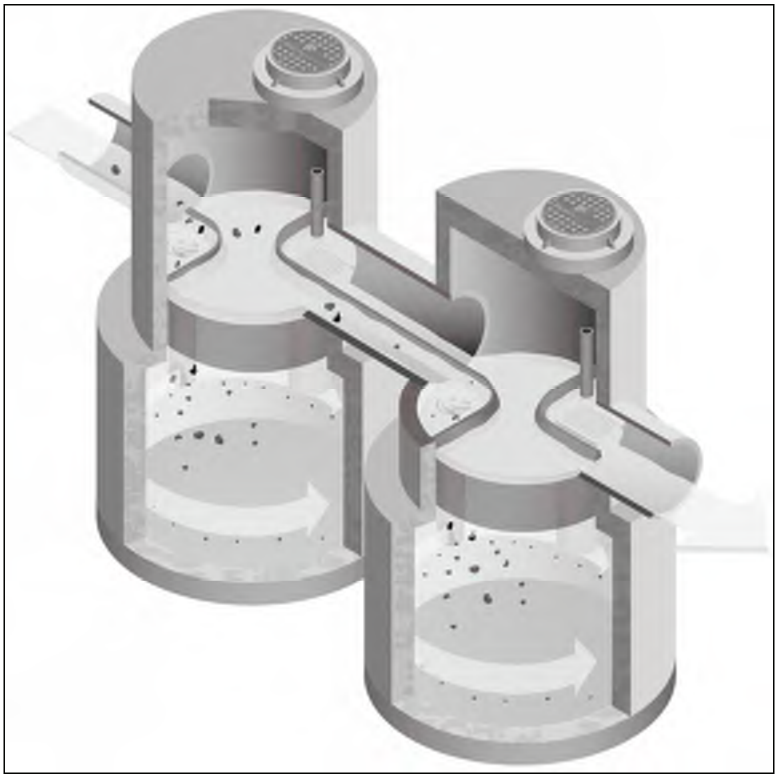


Figure 3. Series System

The Series Stormceptor design operates in the same manner as the Inline unit, providing continuous positive treatment, and ensuring that captured material is not re-suspended.

5. Sizing the Stormceptor System

The Stormceptor System is a versatile product that can be used for many different aspects of water quality improvement. While addressing these needs, there are conditions that the designer needs to be aware of in order to size the Stormceptor model to meet the demands of each individual site in an efficient and cost-effective manner.

PCSWMM for Stormceptor is the support tool used for identifying the appropriate Stormceptor model. In order to size a unit, it is recommended the user follow the seven design steps in the program. The steps are as follows:

STEP 1 – Project Details

The first step prior to sizing the Stormceptor System is to clearly identify the water quality objective for the development. It is recommended that a level of annual sediment (TSS) removal be identified and defined by a particle size distribution.

STEP 2 – Site Details

Identify the site development by the drainage area and the level of imperviousness. It is recommended that imperviousness be calculated based on the actual area of imperviousness based on paved surfaces, sidewalks and rooftops.

STEP 3 – Upstream Attenuation

The Stormceptor System is designed as a water quality device and is sometimes used in conjunction with onsite water quantity control devices such as ponds or underground detention systems. When possible, a greater benefit is typically achieved when installing a Stormceptor unit upstream of a detention facility. By placing the Stormceptor unit upstream of a detention structure, a benefit of less maintenance of the detention facility is realized.

STEP 4 – Particle Size Distribution

It is critical that the PSD be defined as part of the water quality objective. PSD is critical for the design of treatment system for a unit process of gravity settling and governs the size of a treatment system. A range of particle sizes has been provided and it is recommended that clays and silt-sized particles be considered in addition to sand and gravel-sized particles. Options and sample PSDs are provided in PCSWMM for Stormceptor. The default particle size distribution is the Fine Distribution, Table 2, option.

Table 2. Fine Distribution

Particle Size	Distribution	Specific Gravity
20	20%	1.3
60	20%	1.8
150	20%	2.2
400	20%	2.65
2000	20%	2.65

If the objective is the long-term removal of 80% of the total suspended solids on a given site, the PSD should be representative of the expected sediment on the site. For example, a system designed to remove 80% of coarse particles (greater than 75 microns) would provide relatively poor removal efficiency of finer particles that may be naturally prevalent in runoff from the site.

Since the small particle fraction contributes a disproportionately large amount of the total available particle surface area for pollutant adsorption, a system designed primarily for coarse particle capture will compromise water quality objectives.

STEP 5 – Rainfall Records

Local historical rainfall has been acquired from the U.S. National Oceanic and Atmospheric Administration, Environment Canada and regulatory agencies across North America. The rainfall data provided with PCSMM for Stormceptor provides an accurate estimation of small storm hydrology by modeling actual historical storm events including duration, intensities and peaks.

STEP 6 – Summary

At this point, the program may be executed to predict the level of TSS removal from the site. Once the simulation has completed, a table shall be generated identifying the TSS removal of each Stormceptor unit.

STEP 7 – Sizing Summary

Performance estimates of all Stormceptor units for the given site parameters will be displayed in a tabular format. The unit that meets the water quality objective, identified in Step 1, will be highlighted.

5.1. PCSWMM for Stormceptor

The Stormceptor System has been developed in conjunction with PCSWMM for Stormceptor as a technological solution to achieve water quality goals. Together, these two innovations model, simulate, predict and calculate the water quality objectives desired by a design engineer for TSS removal.

PCSWMM for Stormceptor is a proprietary sizing program which uses site specific inputs to a computer model to simulate sediment accumulation, hydrology and long-term total suspended solids removal. The model has been calibrated to field monitoring results from Stormceptor units that have been monitored in North America. The sizing methodology can be described by three processes:

1. Determination of real time hydrology
2. Buildup and wash off of TSS from impervious land areas
3. TSS transport through the Stormceptor (settling and discharge). The use of a calibrated model is the preferred method for sizing stormwater quality structures for the following reasons:
   - The hydrology of the local area is properly and accurately incorporated in the sizing (distribution of flows, flow rate ranges and peaks, back-to-back storms, inter-event times)
   - The distribution of TSS with the hydrology is properly and accurately considered in the sizing
   - Particle size distribution is properly considered in the sizing
   - The sizing can be optimized for TSS removal
   - The cost benefit of alternate TSS removal criteria can be easily assessed
   - The program assesses the performance of all Stormceptor models. Sizing may be selected based on a specific water quality outcome or based on the Maximum Extent Practicable

For more information regarding PCSWMM for Stormceptor, contact your local Stormceptor representative, or visit www.imbriumsystems.com to download a free copy of the program.

5.2. Sediment Loading Characteristics

The way in which sediment is transferred to stormwater can have a considerable effect on which type of system is implemented. On typical impervious surfaces (e.g. parking lots) sediment will build over time and wash off with the next rainfall. When rainfall patterns are examined, a short intense storm will have a higher concentration of sediment than a long slow drizzle. Together with rainfall data representing the site’s typical rainfall patterns, sediment loading characteristics play a part in the correct sizing of a stormwater quality device.

Typical Sites

For standard site design of the Stormceptor System, PCSWMM for Stormceptor is utilized to accurately assess the unit’s performance. As an integral part of the product’s design, the program can be used to meet local requirements for total suspended solid removal. Typical installations of manufactured stormwater treatment devices would occur on areas such as paved parking lots or paved roads. These are considered “stable” surfaces which have non – erodible surfaces.

Unstable Sites

While standard sites consist of stable concrete or asphalt surfaces, sites such as gravel parking lots, or maintenance yards with stockpiles of sediment would be classified as “unstable”. These types of sites do not exhibit first flush characteristics, are highly erodible and exhibit atypical sediment loading characteristics and must therefore be sized more carefully. Contact your local Stormceptor representative for assistance in selecting a proper unit sized for such unstable sites.

6. Spill Controls

When considering the removal of total petroleum hydrocarbons (TPH) from a storm sewer system there are two functions of the system: oil removal, and spill capture.

‘Oil Removal’ describes the capture of the minute volumes of free oil mobilized from impervious surfaces. In this instance relatively low concentrations, volumes and flow rates are considered. While the Stormceptor unit will still provide an appreciable oil removal function during higher flow events and/or with higher TPH concentrations, desired effluent limits may be exceeded under these conditions.

'Spill Capture' describes a manner of TPH removal more appropriate to recovery of a relatively high volume of a single phase deleterious liquid that is introduced to the storm sewer system over a relatively short duration. The two design criteria involved when considering this manner of introduction are overall volume and the specific gravity of the material. A standard Stormceptor unit will be able to capture and retain a maximum spill volume and a minimum specific gravity.

For spill characteristics that fall outside these limits, unit modifications are required. Contact your local Stormceptor Representative for more information.

One of the key features of the Stormceptor technology is its ability to capture and retain spills. While the standard Stormceptor System provides excellent protection for spill control, there are additional options to enhance spill protection if desired.

6.1. Oil Level Alarm

The oil level alarm is an electronic monitoring system designed to trigger a visual and audible alarm when a pre-set level of oil is reached within the lower chamber. As a standard, the oil

level alarm is designed to trigger at approximately 85% of the unit's available depth level for oil capture. The feature acts as a safeguard against spills caused by exceeding the oil storage capacity of the separator and eliminates the need for manual oil level inspection.

The oil level alarm installed on the Stormceptor insert is illustrated in Figure 4.

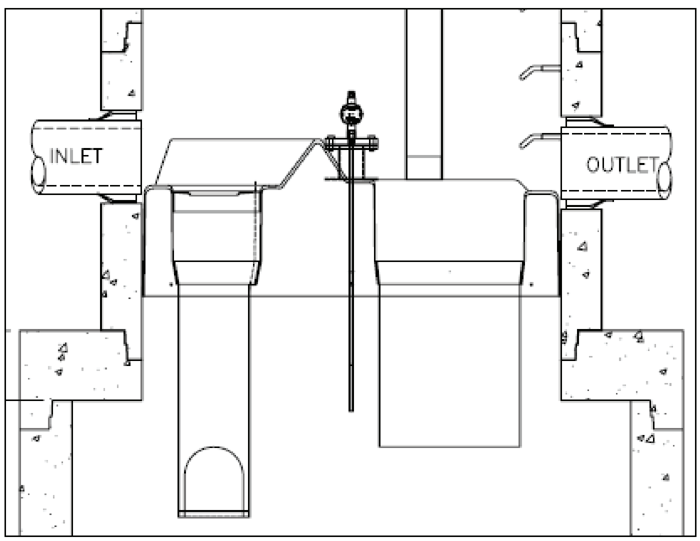


Figure 4. Oil level alarm

6.2. Increased Volume Storage Capacity

The Stormceptor unit may be modified to store a greater spill volume than is typically available. Under such a scenario, instead of installing a larger than required unit, modifications can be made to the recommended Stormceptor model to accommodate larger volumes. Contact your local Stormceptor representative for additional information and assistance for modifications.

7. Stormceptor Options

The Stormceptor System allows flexibility to incorporate to existing and new storm drainage infrastructure. The following section identifies considerations that should be reviewed when installing the system into a drainage network. For conditions that fall outside of the recommendations in this section, please contact your local Stormceptor representative for further guidance.

7.1. Installation Depth Minimum Cover

The minimum distance from the top of grade to the crown of the inlet pipe is 24 inches (600 mm). For situations that have a lower minimum distance, contact your local Stormceptor representative.

7.2. Maximum Inlet and Outlet Pipe Diameters

Maximum inlet and outlet pipe diameters are illustrated in Figure 5. Contact your local Stormceptor representative for larger pipe diameters

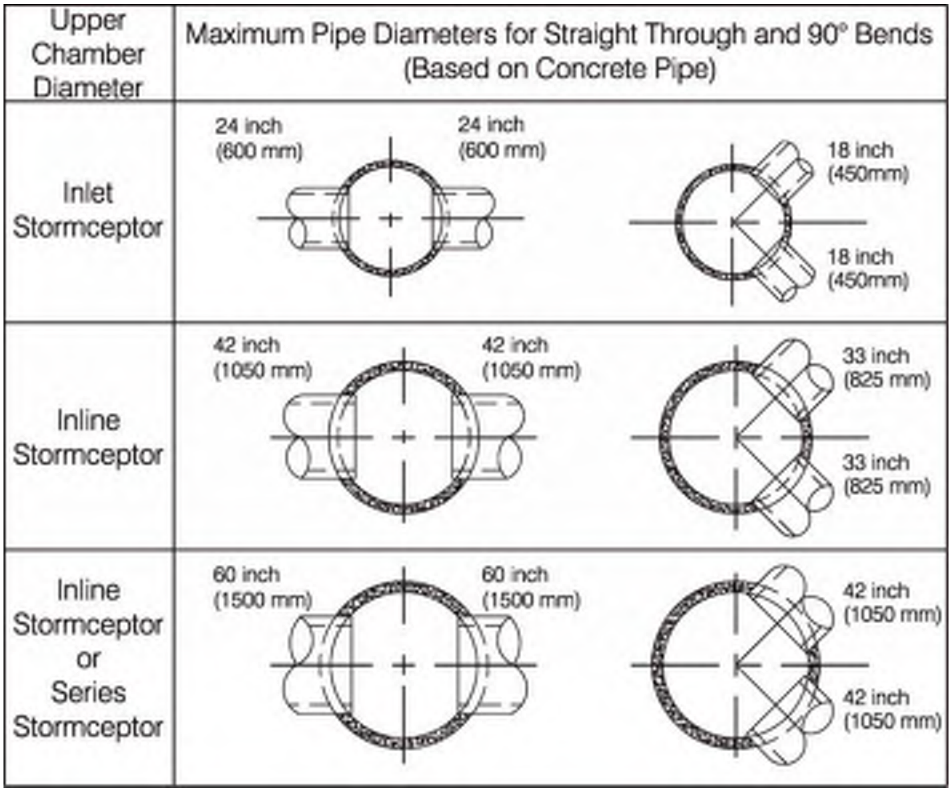


Figure 5. Maximum pipe diameters for straight through and bend applications

*The bend should only be incorporated into the second structure (downstream structure) of the Series Stormceptor System

7.3. Bends

The Stormceptor System can be used to change horizontal alignment in the storm drain network up to a maximum of 90 degrees. Figure 6 illustrates the typical bend situations of the Stormceptor System. Bends should only be applied to the second structure (downstream structure) of the Series Stormceptor System.

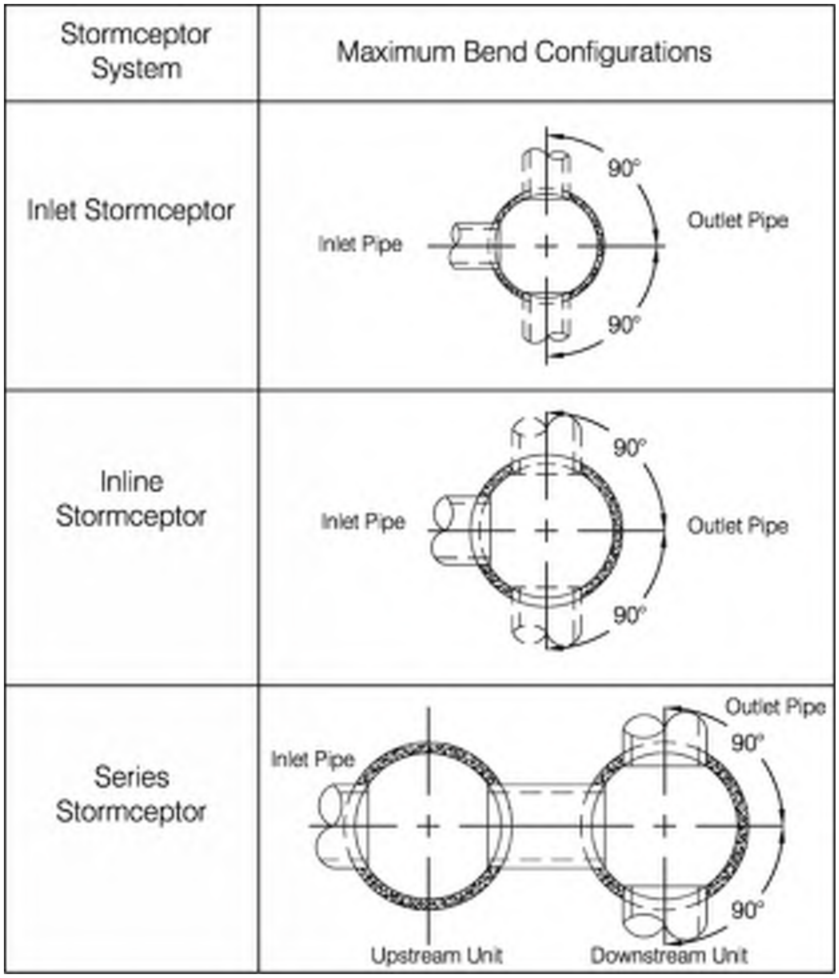


Figure 6. Maximum bend angles

7.4. Multiple Inlet Pipes

The Inlet and Inline Stormceptor System can accommodate two or more inlet pipes. The maximum number of inlet pipes that can be accommodated into a Stormceptor unit is a function of the number, alignment and diameter of the pipes and its effects on the structural integrity of the precast concrete. When multiple inlet pipes are used for new developments, each inlet pipe shall have an invert elevation 3 inches (75 mm) higher than the outlet pipe invert elevation.

7.5. Inlet/Outlet Pipe Invert Elevations

Recommended inlet and outlet pipe invert differences are listed in Table 3.

Table 3. Recommended Drops Between Inlet and Outlet Pipe Inverts

Number of Inlet Pipes	Inlet System	In-Line System	Series System
1	3 inches (75 mm)	1 inch (25 mm)	3 inches (75 mm)
>1	3 inches (75 mm)	3 inches (75 mm)	Not Applicable

7.6. Shallow Stormceptor

In cases where there may be restrictions to the depth of burial of storm sewer systems. In this situation, for selected Stormceptor models, the lower chamber components may be increased in diameter to reduce the overall depth of excavation required.

7.7. Customized Live Load

The Stormceptor system is typically designed for local highway truck loading (AASHTO HS- 20). When the project requires live loads greater than HS-20, the Stormceptor System may be customized structurally for a pre-specified live load. Contact your local Stormceptor representative for customized loading conditions.

7.8. Pre-treatment

The Stormceptor System may be sized to remove sediment and for spills control in conjunction with other stormwater BMPs to meet the water quality objective. For pretreatment applications, the Stormceptor System should be the first unit in a treatment train. The benefits of pre-treatment include the extension of the operational life (extension of maintenance frequency) of large stormwater management facilities, prevention of spills and lower total life- cycle maintenance cost.

7.9. Head loss

The head loss through the Stormceptor System is similar to a 60 degree bend at a manhole. The K value for calculating minor losses is approximately 1.3 (minor loss = k*1.3v2/2g).

However, when a Submerged modification is applied to a Stormceptor unit, the corresponding K value is 4.

7.10. Submerged

The Submerged modification, Figure 7, allows the Stormceptor System to operate in submerged or partially submerged storm sewers. This configuration can be installed on all models of the Stormceptor System by modifying the fiberglass insert. A customized weir height and a secondary drop tee are added.

Submerged instances are defined as standing water in the storm drain system during zero flow conditions. In these instances, the following information is necessary for the proper design and application of submerged modifications:

- Stormceptor top of grade elevation
- Stormceptor outlet pipe invert elevation
- Standing water elevation

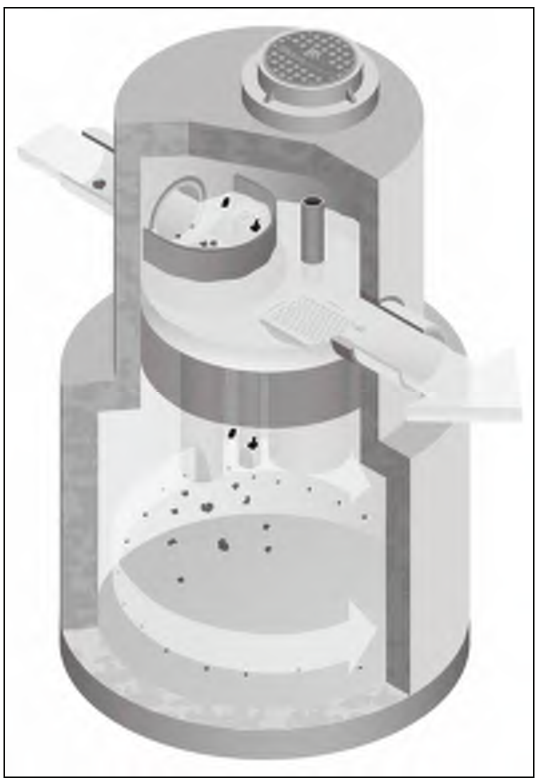


Figure 7. Submerged Stormceptor

8. Comparing Technologies

Designers have many choices available to achieve water quality goals in the treatment of stormwater runoff. Since many alternatives are available for use in stormwater quality treatment it is important to consider how to make an appropriate comparison between "approved alternatives". The following is a guide to assist with the accurate comparison of differing technologies and performance claims.

8.1. Particle Size Distribution (PSD)

The most sensitive parameter to the design of a stormwater quality device is the selection of the design particle size. While it is recommended that the actual particle size distribution (PSD) for sites be measured prior to sizing, alternative values for particle size should be selected to represent what is likely to occur naturally on the site. A reasonable estimate of a particle size distribution likely to be found on parking lots or other impervious surfaces should consist of a wide range of particles such as 20 microns to 2,000 microns (Ontario MOE, 1994).

There is no absolute right particle size distribution or specific gravity and the user is cautioned to review the site location, characteristics, material handling practices and regulatory requirements when selecting a particle size distribution. When comparing technologies, designs using different PSDs will result in incomparable TSS removal efficiencies. The PSD of the TSS removed needs to be standard between two products to allow for an accurate comparison.

8.2. Scour Prevention

In order to accurately predict the performance of a manufactured treatment device, there must be confidence that it will perform under all conditions. Since rainfall patterns cannot be predicted, stormwater quality devices placed in storm sewer systems must be able to withstand extreme events, and ensure that all pollutants previously captured are retained in the system.

In order to have confidence in a system's performance under extreme conditions, independent validation of scour prevention is essential when examining different technologies. Lack of independent verification of scour prevention should make a designer wary of accepting any product's performance claims.

8.3. Hydraulics

Full scale laboratory testing has been used to confirm the hydraulics of the Stormceptor System. Results of lab testing have been used to physically design the Stormceptor System and the sewer pipes entering and leaving the unit. Key benefits of Stormceptor are:

- Low head loss (typical k value of 1.3)
- Minimal inlet/outlet invert elevation drop across the structure
- Use as a bend structure
- Accommodates multiple inlets

The adaptability of the treatment device to the storm sewer design infrastructure can affect the overall performance and cost of the site.

8.4. Hydrology

Stormwater quality treatment technologies need to perform under varying climatic conditions. These can vary from long low intensity rainfall to short duration, high intensity storms. Since a treatment device is expected to perform under all these conditions, it makes sense that any system's design should accommodate those conditions as well.

Long-term continuous simulation evaluates the performance of a technology under the varying conditions expected in the climate of the subject site. Single, peak event design does not provide this information and is not equivalent to long-term simulation. Designers should request long-term simulation performance to ensure the technology can meet the long-term water quality objective.

9. Testing

The Stormceptor System has been the most widely monitored stormwater treatment technology in the world. Performance verification and monitoring programs are completed to the strictest standards and integrity. Since its introduction in 1990, numerous independent field tests and studies detailing the effectiveness of the Stormceptor System have been completed.

- Coventry University, UK – 97% removal of oil, 83% removal of sand and 73% removal of peat
- National Water Research Institute, Canada, - scaled testing for the development of the Stormceptor System identifying both TSS removal and scour prevention.
- New Jersey TARP Program – full scale testing of an STC 900 demonstrating 75% TSS removal of particles from 1 to 1000 microns. Scour testing completed demonstrated that the system does not scour. The New Jersey Department of Environmental Protection was followed.
- City of Indianapolis – full scale testing of an STC 900 demonstrating over 80% TSS removal of particles from 50 microns to 300 microns at 130% of the unit's operating rate. Scour testing completed demonstrated that the system does not scour.
- Westwood Massachusetts (1997), demonstrated >80% TSS removal
- Como Park (1997), demonstrated 76% TSS removal
- Ontario MOE SWAMP Program – 57% removal of 1 to 25 micron particles
- Laval Quebec – 50% removal of 1 to 25 micron particles

10. Installation

The installation of the concrete Stormceptor should conform in general to state highway, or local specifications for the installation of manholes. Selected sections of a general specification that are applicable are summarized in the following sections.

10.1. Excavation

Excavation for the installation of the Stormceptor should conform to state highway, or local specifications. Topsoil removed during the excavation for the Stormceptor should be stockpiled in designated areas and should not be mixed with subsoil or other materials.

Topsoil stockpiles and the general site preparation for the installation of the Stormceptor should conform to state highway or local specifications.

The Stormceptor should not be installed on frozen ground. Excavation should extend a minimum of 12 inches (300 mm) from the precast concrete surfaces plus an allowance for shoring and bracing where required. If the bottom of the excavation provides an unsuitable foundation additional excavation may be required.

In areas with a high water table, continuous dewatering may be required to ensure that the excavation is stable and free of water.

10.2. Backfilling

Backfill material should conform to state highway or local specifications. Backfill material should be placed in uniform layers not exceeding 12 inches (300mm) in depth and compacted to state highway or local specifications.

11. Stormceptor Construction Sequence

The concrete Stormceptor is installed in sections in the following sequence:

1. Aggregate base
2. Base slab
3. Lower chamber sections
4. Upper chamber section with fiberglass insert
5. Connect inlet and outlet pipes
6. Assembly of fiberglass insert components (drop tee, riser pipe, oil cleanout port and orifice plate
7. Remainder of upper chamber
8. Frame and access cover

The precast base should be placed level at the specified grade. The entire base should be in contact with the underlying compacted granular material. Subsequent sections, complete with joint seals, should be installed in accordance with the precast concrete manufacturer's recommendations.

Adjustment of the Stormceptor can be performed by lifting the upper sections free of the excavated area, re-leveling the base and re-installing the sections. Damaged sections and gaskets should be repaired or replaced as necessary. Once the Stormceptor has been constructed, any lift holes must be plugged with mortar.

12. Maintenance

12.1. Health and Safety

The Stormceptor System has been designed considering safety first. It is recommended that confined space entry protocols be followed if entry to the unit is required. In addition, the fiberglass insert has the following health and safety features:

- Designed to withstand the weight of personnel
- A safety grate is located over the 24 inch (600 mm) riser pipe opening
- Ladder rungs can be provided for entry into the unit, if required

12.2. Maintenance Procedures

Maintenance of the Stormceptor system is performed using vacuum trucks. No entry into the unit is required for maintenance (in most cases). The vacuum service industry is a well- established sector of the service industry that cleans underground tanks, sewers and catch basins. Costs to clean a Stormceptor will vary based on the size of unit and transportation distances.

The need for maintenance can be determined easily by inspecting the unit from the surface. The depth of oil in the unit can be determined by inserting a dipstick in the oil inspection/cleanout port.

Similarly, the depth of sediment can be measured from the surface without entry into the Stormceptor via a dipstick tube equipped with a ball valve. This tube would be inserted through the riser pipe. Maintenance should be performed once the sediment depth exceeds the guideline values provided in the Table 4.

Table 4. Sediment Depths Indicating Required Servicing*

Particle Size	Specific Gravity
Model	Sediment Depth inches (mm)
450i	8 (200)
900	8 (200)
1200	10 (250)
1800	15 (381)
2400	12 (300)
3600	17 (430)
4800	15 (380)
6000	18 (460)
7200	15 (381)
11000	17 (380)
13000	20 (500)
16000	17 (380)
* based on 15% of the Stormceptor unit's total storage	

Although annual servicing is recommended, the frequency of maintenance may need to be increased or reduced based on local conditions (i.e. if the unit is filling up with sediment more quickly than projected, maintenance may be required semi-annually; conversely once the site has stabilized maintenance may only be required every two or three years).

Oil is removed through the oil inspection/cleanout port and sediment is removed through the riser pipe. Alternatively oil could be removed from the 24 inches (600 mm) opening if water is removed from the lower chamber to lower the oil level below the drop pipes.

The following procedures should be taken when cleaning out Stormceptor:

1. Check for oil through the oil cleanout port
2. Remove any oil separately using a small portable pump
3. Decant the water from the unit to the sanitary sewer, if permitted by the local regulating authority, or into a separate containment tank
4. Remove the sludge from the bottom of the unit using the vacuum truck
5. Re-fill Stormceptor with water where required by the local jurisdiction

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12.3. Submerged Stormceptor

Careful attention should be paid to maintenance of the Submerged Stormceptor System. In cases where the storm drain system is submerged, there is a requirement to plug both the inlet and outlet pipes to economically clean out the unit.

12.4. Hydrocarbon Spills

The Stormceptor is often installed in areas where the potential for spills is great. The Stormceptor System should be cleaned immediately after a spill occurs by a licensed liquid waste hauler.

12.5. Disposal

Requirements for the disposal of material from the Stormceptor System are similar to that of any other stormwater Best Management Practice (BMP) where permitted. Disposal options for the sediment may range from disposal in a sanitary trunk sewer upstream of a sewage treatment plant, to disposal in a sanitary landfill site. Petroleum waste products collected in the Stormceptor (free oil/chemical/fuel spills) should be removed by a licensed waste management company.

12.6. Oil Sheens

With a steady influx of water with high concentrations of oil, a sheen may be noticeable at the Stormceptor outlet. This may occur because a rainbow or sheen can be seen at very small oil concentrations (<10 mg/L). Stormceptor will remove over 98% of all free oil spills from storm sewer systems for dry weather or frequently occurring runoff events.

The appearance of a sheen at the outlet with high influent oil concentrations does not mean the unit is not working to this level of removal. In addition, if the influent oil is emulsified the Stormceptor will not be able to remove it. The Stormceptor is designed for free oil removal and not emulsified conditions.

SUPPORT

Drawings and specifications are available at www.ContechES.com.
Site-specific design support is available from our engineers.

CONTECH ENGINEERED SOLUTIONS
800-925-5240
www.ContechES.com

SiteSaver® Manufacturer's Instruction Manual

Regular inspections are recommended to ensure that the system is functioning as designed. Please contact your Authorized SiteSaver Representative if you have questions regarding the inspection and maintenance of the SiteSaver system. SiteSaver does not require entry into the system for maintenance; however, it is prudent to note that prior to entry into any underground storm sewer or underground structure, appropriate OSHA and local safety regulations and guidelines should be followed.

Inspection Scheduling

The frequency of inspections and maintenance is site specific. Within the first year of operation, it is recommended that the unit be inspected every six months to determine the rate of pollutant accumulation. SiteSaver systems are recommended for inspection whenever the upstream and downstream catch basins and stormwater pipes of the stormwater collection system are inspected or maintained. This will minimize the cost of the inspection if it is done at the same time. If checked on an annual basis, the inspection should be conducted before the stormwater season begins to ensure that the system is functioning properly for the upcoming storm season.

Inspection Process

Inspections should be done such that a sufficient time has lapsed since the most recent rain event to allow for a static water condition. Visually inspect the system at all manhole locations. For debris accumulation, visually inspect the netting component (if utilized) to determine bag capacity. Nets containing only minor quantities of debris may be retained in place. It is recommended to replace the nets when they appear 1/2 - 2/3 full. Failure to replace nets and/or remove floatables from bypass screening (if applicable) will lead to hydraulic relief, drain down deficiencies, and decrease the long-term functionality of the system.

For sediment accumulation, utilize either a sludge sampler or a sediment pole to measure and document the amount of sediment accumulation. To determine the amount of sediment in the system with a sludge sampler follow the manufacturer's instructions. If utilizing a sediment pole, first insert the pole to the top of the sediment layer and record the depth. Then, insert the pole to the bottom of the system and record the depth. The difference in the two measurements corresponds to the amount of sediment in the system. Eight-inches of sediment accumulation corresponds to the designed sediment storage capacity, four-inches equates to 50% capacity, etc. Finally, inspect the inlet pipe opening to ensure that the silt level or any foreign objects are not blocking the pipe.

Maintenance Process – Debris Removal

Maintenance should be done utilizing proper personal protective equipment such as: safety glasses, hard-hat, gloves, first aid kit, etc. Maintenance should occur only when a sufficient time has lapsed since the most recent rain event to allow for a static water condition for the duration of the maintenance process.

For floatable debris removal, lift the netting bag by the frame, moving it upwards along the netting support frame. To ease lifting the nets to the surface, gaff hooks or a service vehicle (crane/hoist/boom truck) may be used. Slowly raise the netting frame allowing water in the net to drain as it is raised to allow it to drip dry. Once the netting component is fully removed from the system, it should be properly disposed of per local, state, and federal guidelines and regulations. Typically, the netting component can be disposed of in a common dumpster receptacle.

For sediment removal, the SiteSaver is designed with clear access at both the inlet and outlet. A vacuum truck, or similar trailer mounted equipment, can be used to remove the sediment, hydrocarbons, and water within the unit. For more effective removal, it is recommended to use sewer jetting equipment or a spray lance to force the sediment to the vacuum hose. When the floor is sufficiently cleaned, fill the system back to its normal water elevation (to the pipe inverts).

Maintenance Process – Net Replacement

Install a new net assembly by sliding the netting frame down the support frame and ensure the netting lays over the plate assembly. To order additional disposable nets, contact your local SiteSaver representative. New nets come with tie wraps temporarily holding the net material to the frame component for easy handling and storage. It is not recommended to remove the tie wraps until the net is ready to be installed. The frame is tapered from top (widest part) to bottom, and is also tapered from front (towards the sewer) to back. Cut the tie wraps that secures the netting material to the frame for shipment and lower the net down the guide rails. If debris has accumulated in the net support frame, remove the objects so the new net seats fully in the channel when installed. If utilizing oil sorption socks, insert them into the net cavity prior to lowering the net down the guide rails. The oil sorption socks are designed to absorb approx. ¼ gallon of hydrocarbons; it is typically recommended to use enough socks to absorb a gallon of hydrocarbons per treated cfs.

When lowering the net the following details should be exercised when placing the net:

- Watch the lowering to make sure that there are no unexpected entanglements.
- Be careful not to let the toe of the net get caught under the frame when it reaches the bottom of the support frame. This is typically accomplished by holding the toe of the net until after the net has started to prop into place.
- Finally, secure the access openings and properly dispose of the sediment per local, state, and federal guidelines and regulations.



In the case of only floatables removal, a vacuum truck is not required. However, a vacuum truck is required if the maintenance event is to include oil removal and/or sediment removal. Proof of inspections and maintenance is the responsibility of the owner. All inspection reports and data should be kept on site or at a location where they will be accessible for years in the future. Some municipalities require these inspection and cleaning reports to be forwarded to the proper governmental permitting agency on an annual basis. Refer to your local and national regulations for any additional maintenance requirements and schedules not contained herein. Inspections should be a part of the standard operating procedure. It is good practice to keep records of rainfall events between maintenance events and the weight of material removed, even if no report is required.

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Water Quality Volume Calculations

Water Quality Volume Calculations

Project	Elderly Housing with Services	**Project #**	15548.00
	Crafts St & Court ST, Newton		
Calculated by	SD	**Date**	3/31/2022
Checked by	JK	**Date**	3/31/2022

SUBSURFACE INFILTRATION SYSTEM "A"

2 UNITS

Runoff from subcatchment areas 10

Water Quality Storm Runoff Depth	(in)	1.0
Total Impervious Area	(ft^2)	5,310

<u>BASIN WQV:</u>

Required Volume:

Runoff Depth to be Treated (in)	**Required Volume (ft^3)**
1.0	**<u>443</u>**

Provided Volume:

Elevation	**Area (ft^2)**	**Cumulative Volume (ft^3)**
30.6	194	0
34.6	194	**<u>775</u>**

** Per MassDEP Treatment Requirement*

Water Quality Volume Calculations

Project	Elderly Housing with Services	**Project #**	15548.00
	Crafts St & Court ST, Newton		
Calculated by	SD	**Date**	3/31/2022
Checked by	JK	**Date**	3/31/2022

SUBSURFACE INFILTRATION SYSTEM "B"

13 UNITS

Runoff from subcatchment areas 20, 21, 25

Water Quality Storm Runoff Depth	(in)	1.0
Total Impervious Area	(ft^2)	44,330

BASIN WQV:

Required Volume:

Runoff Depth to be Treated (in)	**Required Volume (ft^3)**
1.0	**3,694**

Provided Volume:

Elevation	**Area (ft^2)**	**Cumulative Volume (ft^3)**
30.1	1,260	0
33.1	1,260	**3,779**

** Per MassDEP Treatment Requirement*

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Water Quality Volume Calculations

Project	Elderly Housing with Services	**Project #**	15548.00
	Crafts St & Court ST, Newton		
Calculated by	SD	**Date**	3/31/2022
Checked by	JK	**Date**	3/31/2022

SUBSURFACE INFILTRATION SYSTEM "C"

12 UNITS

Runoff from subcatchment areas 23, 24, 26

Water Quality Storm Runoff Depth	(in)	1.0
Total Impervious Area	(ft^2)	26,735

<u>BASIN WQV:</u>

Required Volume:

Runoff Depth to be Treated (in)	**Required Volume (ft^3)**
1.0	**<u>2,228</u>**

Provided Volume:

Elevation	**Area (ft^2)**	**Cumulative Volume (ft^3)**
30.1	1,163	0
32.1	1,163	**<u>2,326</u>**

** Per MassDEP Treatment Requirement*

TSS Removal Worksheets

Total Suspended Solids (TSS) Removal Worksheet

Project	Elderly Housing with Services Crafts St & Court St, Newton	Project #	15548.00
Calculated by	JK	Date	4/1/2022
Checked by		Date	

Discharge Point: DP-2
Drainage Areas: 21, 23, 25, 26 - Proposed Building Roof & Courtyard Areas

A	B	C	D	E
BMP	TSS Removal Rate*	Starting TSS Load**	Amount Removed (C*D)	Remaining Load (D-E)
Subsurface Infiltration Structure	80%	1.00	0.80	0.20
---	0%	0.20	0.00	0.20
---	0%	0.20	0.00	0.20
---	0%	0.20	0.00	0.20

Treatment Train TSS Removal =	80%

** BMP and TSS Removal Rate Values from the MassDEP Stormwater Handbook*
*** Equals Remaining Load from Previous BMP (E)*

Total Suspended Solids (TSS) Removal Worksheet

Project	Elderly Housing with Services Crafts St & Court St, Newton	Project #	15548.00
Calculated by	JK	Date	4/1/2022
Checked by		Date	

Discharge Point: DP-1 and DP-2

Drainage Areas: 10, 20, 24 - Proposed Site Impervious Areas

A	B	C	D	E
BMP	TSS Removal Rate*	Starting TSS Load**	Amount Removed (C*D)	Remaining Load (D-E)
1. Pre-Treatment Prior to Infiltration				
Deep Sump and Hooded Catch Basin	25%	1.00	0.25	0.75
Water Quality Unit	44%	0.75	0.33	0.42
			Pre-Treatment TSS Removal =	58%
2. Total TSS Removal including Pre-Treatment				
Subsurface Infiltration Structure	80%	0.42	0.34	0.08
---	0%	0.08	0.00	0.08
---	0%	0.08	0.00	0.08
---	0%	0.08	0.00	0.08
			Treatment Train TSS Removal =	92%

** BMP and TSS Removal Rate Values from the MassDEP Stormwater Handbook*

*** Equals Remaining Load from Previous BMP (E)*

Phosphorus Removal Worksheets

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Site Summary

Project	Elderly Housing with Services	Project #	15548.00
	Crafts St & Court St, Newton, MA		
Calculated by	JWK	Date	4/1/2022
Checked by		Date	

Treatment Category	Area to Treatment Category (ac)	Impervious Area to Treatement Category (ac)	P Load of Impervious Area (lb/yr)	P Load Removed (lb/yr)	Average Area Weighted P Reduction (%)	TSS Load of Impervious Area (lb/yr)	TSS Load Removed (lb/yr)	Average Area Weighted TSS Reduction (%)
Structural BMPs	2.5	1.8	4.1	4.1	100%	770	775	100%
Impervious Area Disconnection	-	-	-	-		-	-	
Porous Pavement (w/ underdrain)	-	-	-	-		-	-	
Untreated	0.3	0.2	0.4	0	0%	78	0	0%
TOTAL	**2.8**	**1.9**	**4.5**	**4.1**	**91%**	**848**	**775**	**91%**

Untreated Area Calculations

Project	Elderly Housing with Services	Project #	15548.00
	Crafts Street & Court Street, Newton, MA		
Calculated by	JWK	Date	4/1/2022
Checked by		Date	

User Inputs				Load Calculations			
Untreated Area ID	Impervious Area (ft^2)	Pervious Area (ft^2)	Land Use	Impervious TP Loading Rate (lb/ac/yr)	P Load of Impervious Area (lb/yr)	Impervious TSS Loading Rate (lb/ac/yr)	TSS Load of Impervious Area (lb/yr)
Catchment Area #22	7,770	3,770	Multi-Family and High Density Residential	2.3	0.4	439	78

Structural BMP Calculations

Project	Elderly Housing with Services Crafts Street & Court Street, Newton, MA	Project #	15548.00
Calculated by	JWK	Date	4/1/2022
Checked by		Date	

User Inputs										Water Quality Results													
										Phosphorus							Total Suspended Solids (TSS Reduction values can NOT be used for DEP Stormwater Standard 4 Compliance at this time.)						
BMP ID	BMP Type	BMP Soil Type	BMP Design Storage Volume (ft^3)	Impervious Catchment Area (ft^2)	Pervious Catchment Area (ft^2)	Catchment Primary Land Use	Catchment Primary HSG	Runoff Depth from Impervious Area (in)	EPA Water Quality Curve	Impervious P Loading Rate (lb/ac/yr)	Impervious P Load to BMP (lb/yr)	Pervious P Loading Rate (lb/ac/yr)	Pervious P Load to BMP (lb/yr)	Total P Load to BMP (lb/yr)	P Removal Credit (%)	P Load Reduction (lb/yr)	Impervious TSS Loading Rate (lb/ac/yr)	Impervious TSS Load to BMP (lb/yr)	Pervious TSS Loading Rate (lb/ac/yr)	Pervious TSS Load to BMP (lb/yr)	Total TSS Load to BMP (lb/yr)	TSS Removal Credit (%)	TSS Load Reduction (lb/yr)
SIS-A	Subsurface Infiltration System	Sand (8.27 in/hr)	1,163	5,310	5,640	Multi-Family and High Density Residenti	HSG A	2.6	Infiltration Trench	2.3	0.3	0.0	0.0	0.3	100%	0.3	439	54	7	1	54	100%	54
SIS-B	Subsurface Infiltration System	Sand (8.27 in/hr)	3,779	44,330	11,910	Multi-Family and High Density Residenti	HSG A	1.0	Infiltration Trench	2.3	2.4	0.0	0.0	2.4	100%	2.4	439	447	7	2	449	100%	449
SIS-C	Subsurface Infiltration System	Sand (8.27 in/hr)	2,326	26,735	16,915	Multi-Family and High Density Residenti	HSG A	1.0	Infiltration Trench	2.3	1.4	0.0	0.0	1.4	100%	1.4	439	269	7	3	272	100%	272