Stormwater Management Report

440 Granite Avenue

Milton, MA

Prepared for:

Brenco Construction Co.
Oranmore Enterprises, LLC
36 Central Avenue
Milton, MA 02186

Prepared by: Horsley Witten Group, Inc.
July 23, 2021

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1.0 PROJECT NARRATIVE

This report provides a summary of the stormwater management proposed for 440 Granite Avenue which is located between Granite Avenue and Mechanic Street in Milton, Massachusetts. The proposed project is a new 5-story residential building with parking and retail space on the first floor.

The purpose of this report is to detail existing and proposed site conditions, including stormwater runoff volume and peak flows. The proposed stormwater management system for 440 Granite Avenue includes several dry wells to capture and infiltrate runoff from the surrounding impervious area.

This Stormwater Management Report was prepared in accordance with of the Town of Milton Chapter 21 Stormwater Management Bylaw. The project site is greater than 100 feet from a wetland resource area and therefore does not trigger compliance with the Massachusetts Stormwater Management Standards or Handbook. Furthermore, the project site and proposed limit of disturbance is less than one acre and therefore does not trigger compliance with EPA's National Pollutant Discharge Elimination System (NPDES) General Permit for Storm Water Discharges to a Small Municipal Separate Storm Sewer System (MS4).

1.1 Existing Conditions

The project site currently consists of three parcels including 29 Mechanic Street, 426 Granite Avenue, and 440 Granite Avenue with a combined area of 0.44 acres (19,283 square feet), located on the corner of Granite Avenue and Mechanic Street. The parcels currently consist of a combination of residential area and retail area, including a flower shop and cabinet store. Figures 1-4 illustrate the project locus, aerial view, and surrounding streets. Figure 4 confirms that the project site is not located within a 100-year floodplain per the Federal Emergency Management Agency (FEMA).

According to the U.S. Department of Agriculture Natural Resources Conservation Service (NRCS) soil survey of Norfolk and Suffolk Counties, Massachusetts, the site consists of Urban land and does not have a Hydrologic Soil Group (HSG) classification associated with the soil. The NRCS soils map is provided as **Figure 5**. Based on the test borings conducted in October 2020 the HSG of the project site was classified as HSG A soils. Groundwater was measured to be approximately 13-14 feet below grade (Approximately Elevation 29). The Test Boring Logs, elevations, and locations are provided in **Appendix C**.

Drainage Areas

For this project, two drainage areas were delineated based on the contributing areas of the project site to Granite Avenue and Mechanic Street. There are no external areas draining onto the project site. The drainage area maps, and surface cover types can be found in **Appendix A** and described below:

- Drainage Area 1 (DA1) consists of the portion of the project site draining to Granite Avenue. The drainage area includes paved driveways and paths, roofs, and grassed areas with a total area of 7,207 sf, of which approximately 79% is impervious. The runoff from this area collects in the catch basin located on Granite Avenue near the western end of the project site. This catch basin connects into the main 30-inch concrete drain pipe that continues west down Granite Avenue.

- Drainage Area 2 (DA2) consists of the portion of the project site draining to Mechanic Street. The drainage area includes paved driveways and paths, roofs, and grassed areas with a total area of 12,076 sf, of which approximately 75% is impervious. The runoff from this area collects in the catch basin located on Mechanic Street near the eastern end of the project site. This catch basin connects into the main 30-inch concrete drain pipe on Granite Avenue via a 12-inch PVC pipe that crosses the front corner of 440 Granite Avenue.

The site's existing total watershed area includes the following:

- 7,181 sf of pavement area (parking, driveways, and walkways);
- 7,630 sf of rooftop area; and
- 4,472 sf of grass area.

1.2 Proposed Conditions

The proposed development of the site consists of the following activities:

- Demolition of the existing structures and driveways located on the site.
- Construction of a new five-story mixed-use building with a below level parking garage occupying a footprint of approximately 14,360 sf.
- Minor grade changes to match the building's first floor elevation with the surrounding existing sidewalk.
- Construction of the driveway entrances on Mechanic Street.
- Construction of the concrete sidewalk on Granite Avenue and Mechanic Street.
- Construction of a street level parking area containing 4 parking spaces accessed from Mechanic Street.
- Installation of four dry wells to capture a portion of the runoff from the proposed sidewalks and parking area.
- Installation of six trees along the Granite Avenue sidewalk.
- Installation of a green roof above the street level parking area.
- Installation of below ground sewer, water, gas, and electric utilities.

Stormwater Management

The drainage design concept for the entire property is described below and the overall design and layout is provided on the project plan set in **Appendix G**.

Under proposed conditions, the project site area has been divided into six drainage areas, encompassing an overall drainage area of approximately 0.44 acres. Consistent with the existing conditions DA1 is draining to Granite Avenue while DA2 and DA2R are draining to Mechanic Street. DA3-DA6 consist of the contributing areas to the four dry wells. The four dry wells capture and infiltrate the majority of the 100-year storm event and therefore do not contribute to either the Mechanic Street or Granite Avenue existing drainage system. The total proposed impervious area (rooftops and pavement) is 17,548 sf with 1,496 sf of that impervious

area draining to the dry wells. The total percent impervious area contributing to the existing street drainage system increases from approximately 77% to 83%.

The proposed site's total watershed area includes the following:

- 3,186 sf of pavement area (parking, driveways, and walkways);
- 14,362 sf of rooftop area; and
- 1,734 sf of grass area.

The existing and proposed drainage area maps and surface cover types can be found in **Appendix A**.

Pre-development and post-development conditions were modeled using HydroCAD software (Version 10.10), which combines USDA Soil Conservation Service hydrology and hydraulic techniques (commonly known as SCS TR-55 and TR-20) to generate hydrographs. Rainfall volumes calculated for this development were based on the National Oceanic and Atmospheric Administration (NOAA) Atlas-14 Precipitation Tables for 24-hour storm event. The precipitation depths for the site are provided in **Appendix B**.

Storm event (24 hour)	Rainfall depth
2-year	3.38 inches
10-year	5.27 inches
25-year	6.45 inches
100-year	8.27 inches

Pre-development and post-development site hydrologic conditions were evaluated for the 2-, 10-, 25-, and 100-year Type III 24-hour storm events.

1.3 Drainage Design Objectives & Methodology

The stormwater management system has been designed to accomplish the following major objectives:

- To provide measures to prevent offsite discharge of sediment;
- To minimize peak runoff rates and volumes;
- To provide some groundwater recharge; and
- To implement a long term program of inspection and maintenance.

This is accomplished using the following stormwater management measures:

- Dry wells have been designed to capture and infiltrate runoff from paved areas including the parking areas and portions of the sidewalks/walkways. The dry wells have been sized to capture and infiltrate the majority of the 100-year storm event of the contributing area. The HydroCAD modeling results for existing and proposed conditions are provided in **Appendix D**. A summary of the peak flows and volumes are provided in the tables below.

Table 2: Summary of Pre- and Post-development Flow Rates for the Proposed Retrofits

Study Point		Flow, cfs			
		2-yr	10-yr	25-yr	100-yr
SP 1 – Granite Avenue	PRE	0.96	1.82	2.37	3.21
	POST	1.22	1.96	2.42	3.14
SP 2 – Mechanic Street	PRE	0.57	1.11	1.45	1.98
	POST	1.13	1.81	2.23	2.89

Table 3: Summary of Pre- and Post-development Volumes for the Proposed Retrofits

Study Point		Volume, acre-ft			
		2-yr	10-yr	25-yr	100-yr
SP 1 – Granite Avenue	PRE	0.068	0.130	0.171	0.235
	POST	0.094	0.153	0.191	0.252
SP 2 – Mechanic Street	PRE	0.041	0.079	0.104	0.144
	POST	0.088	0.142	0.176	0.232

1.4 Recharge

The dry wells are designed to recharge the majority of the 100-year storm event for the contributing drainage areas of the project site. Recharge calculations are provided in **Appendix E.**

1.5 Operation & Maintenance Plan

A long-term Operation & Maintenance (O&M) Plan has been prepared for the property owner to implement. The O&M Plan includes regular inspections and cleaning of the drywells and regular sweeping of the surface parking area. The O&M Plan has been provided in **Appendix F**.

1.6 Erosion Control

The plan set includes measures to prevent offsite discharge of sediment including an erosion control barrier surrounding the perimeter of the parcel and inlet protection proposed for all catch basins within 100 feet of land disturbance. Details and a suggested stockpile location have been included on the Site Preparation & Erosion Control Plan, provided in **Appendix G.**

2.0 REFERENCES

1. MassDEP (Massachusetts Department of Environmental Protection). 2008. Massachusetts Stormwater Standards Manual. See the website at: https://www.mass.gov/guides/massachusetts-stormwater-handbook-and-stormwater-standards

2. MassGIS (Massachusetts Office of Geographic and Environmental Information). 2019. See their homepage at: http://www.mass.gov/mgis/.

3. NOAA's National Weather Service: Hydrometeorological Design Studies Center, Precipitation Frequency Data Server for Atlas 14 Point Precipitation Frequency Estimates: MA https://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html?bkmrk=ma

4. USEPA (United States Environmental Protection Agency). 2021. National Pollutant Discharge Elimination System (NPDES) Massachusetts Small MS4 General Permit: https://www.epa.gov/npdes-permits/massachusetts-small-ms4-general-permit

5. Town of Milton. Chapter 21 Stormwater Management Bylaw.

FIGURES

Document Path: H:\Projects\2020\20130 440 Granite Ave Milton\GIS\Maps\440GraniteAve_USGS.mxd

Legend

Project Site

**USGS Boston South & Blue Hills Topographic Quadrangles*

N

0 1,000 Feet

1 " = 1,000 Feet

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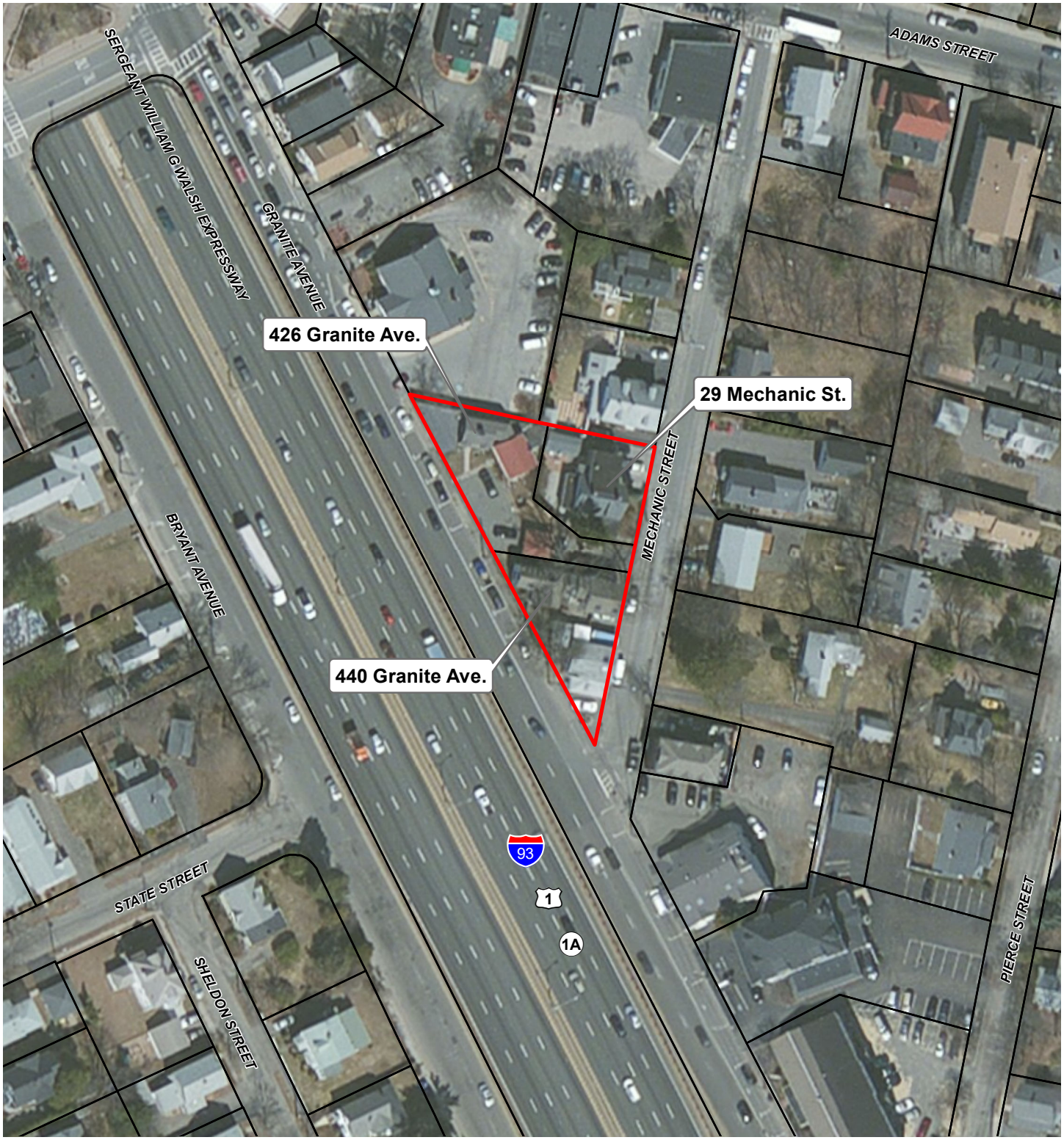
USGS Locus
440 Granite Ave
Milton, MA

Date: 7/12/2021

Figure 1



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Legend

- Project Site
- Parcel Boundary

**ESRI World Imagery*

N

0 100 Feet

1 " = 100 Feet

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Aerial Locus
440 Granite Ave
Milton, MA

Date: 7/12/2021

Figure 2

Document Path: H:\Projects\2020\20130 440 Granite Ave Milton\GIS\Maps\440GraniteAve_HalfMile.mxd

Legend

*ESRI World Street Map

- Project Site
- 1/2-Mile Buffer
- Protected and Recreational Open Space
- Area of Critical Environmental Concern
- Hazardous Material Sites with Activity and Use Limitations

N

0 800 Feet

1 " = 800 Feet

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Project Vicinity
440 Granite Ave
Milton, MA

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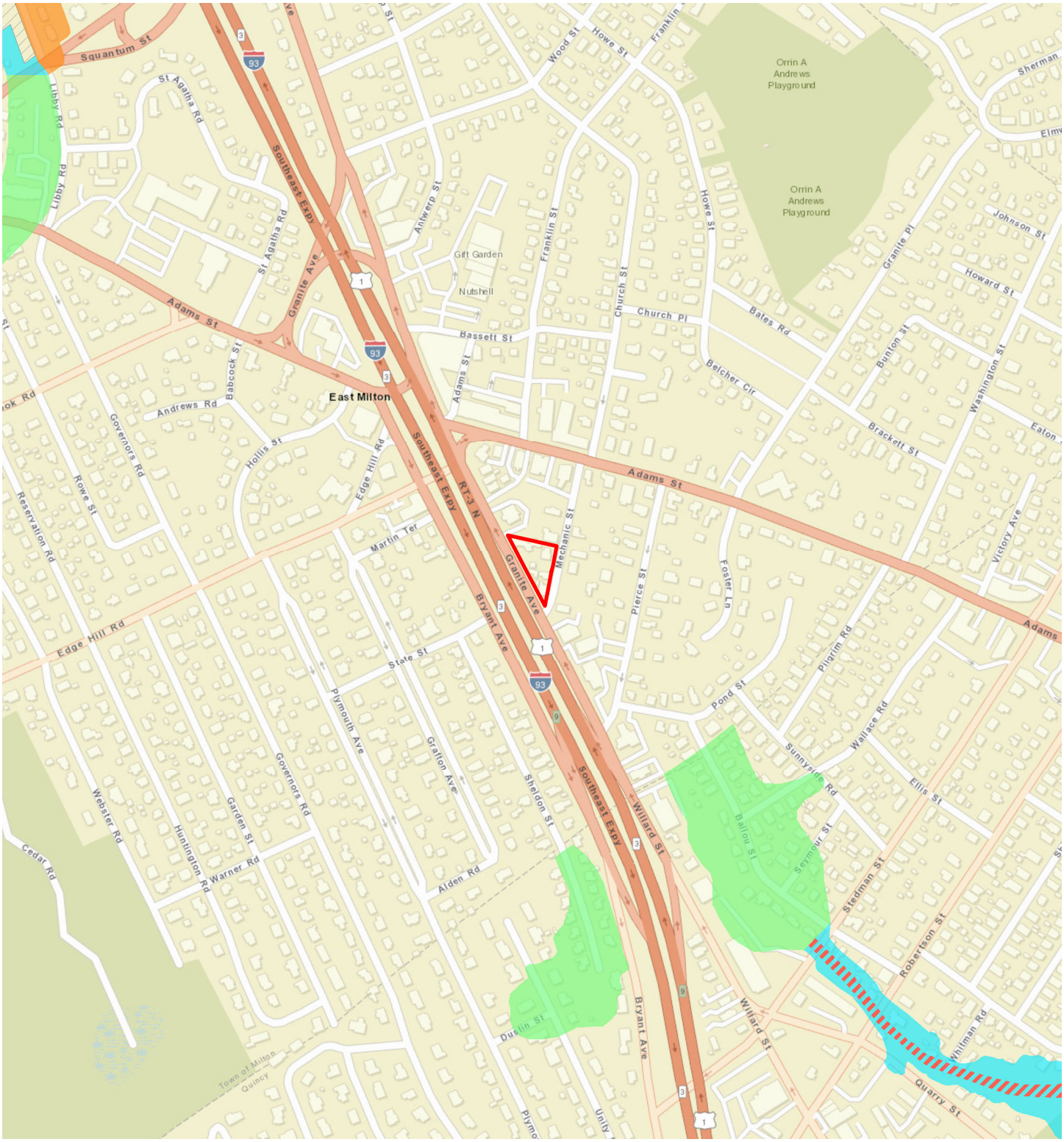
Figure 3



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Legend

*ESRI World Street Map

Project Site

FEMA National Flood Hazard Layer

- Zone A: 1% Annual Chance of Flooding, no BFE
- Zone AE: 1% Annual Chance of Flooding, with BFE
- Zone AE: Regulatory Floodway
- Zone X: 0.2% Annual Chance of Flooding
- Area Not Included

N

0 500 Feet

1 " = 500 Feet

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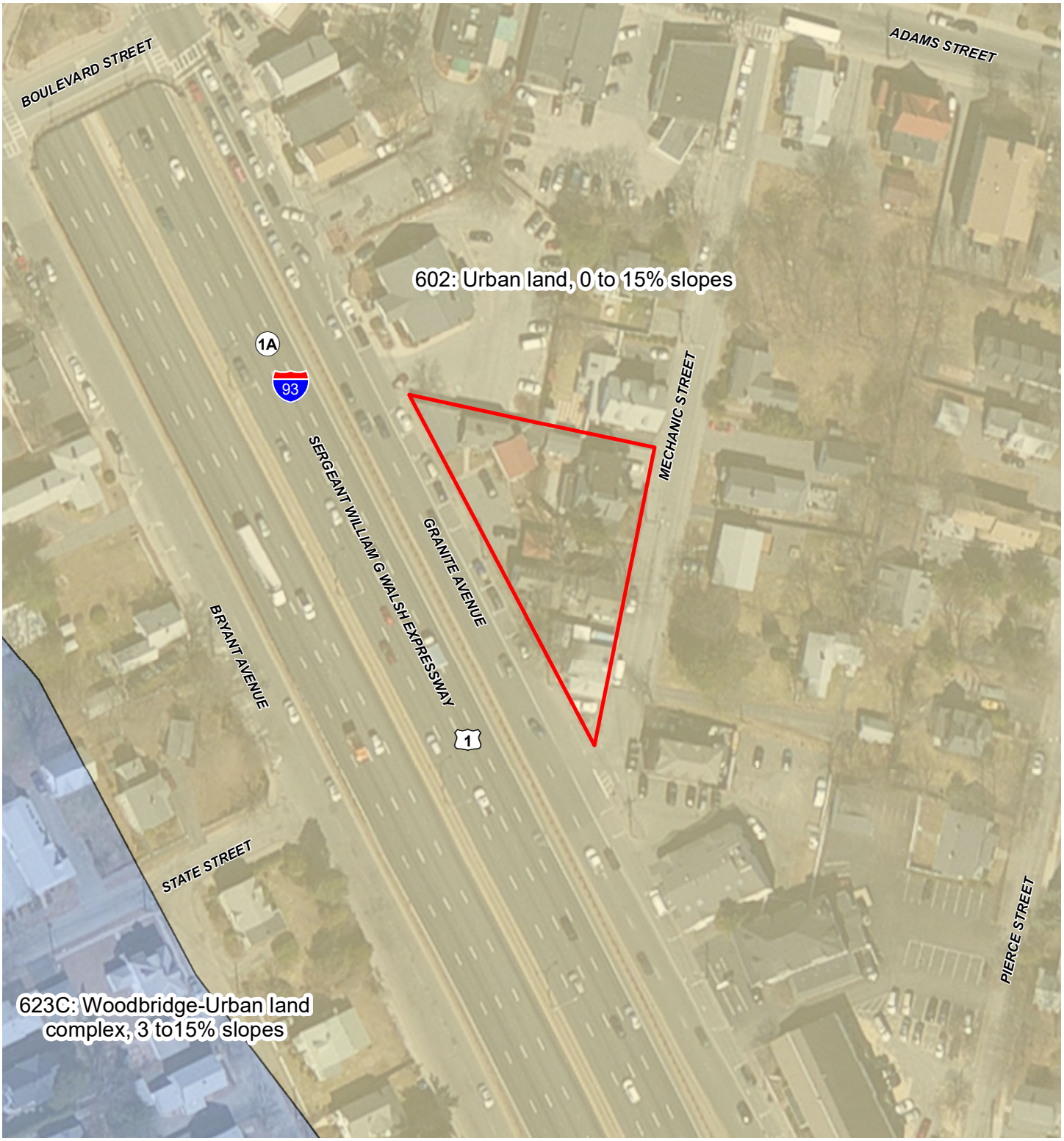
FEMA Floodplain
440 Granite Ave
Milton, MA

Date: 7/12/2021

Figure 4



Document Path: H:\Projects\2020\20130 440 Granite Ave Milton\GIS\Maps\440GraniteAve_Soils.mxd

Legend

Project Site

NRCS SSURGO-Certified Soils

602: Urban land, 0 to 15% slopes

623C: Woodbridge-Urban land complex, 3 to15% slopes

*ESRI World Imagery

N

0 100 Feet

1 " = 100 Feet

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Norfolk County Soils
440 Granite Ave
Milton, MA

Date: 7/12/2021

Figure 5

APPENDICES

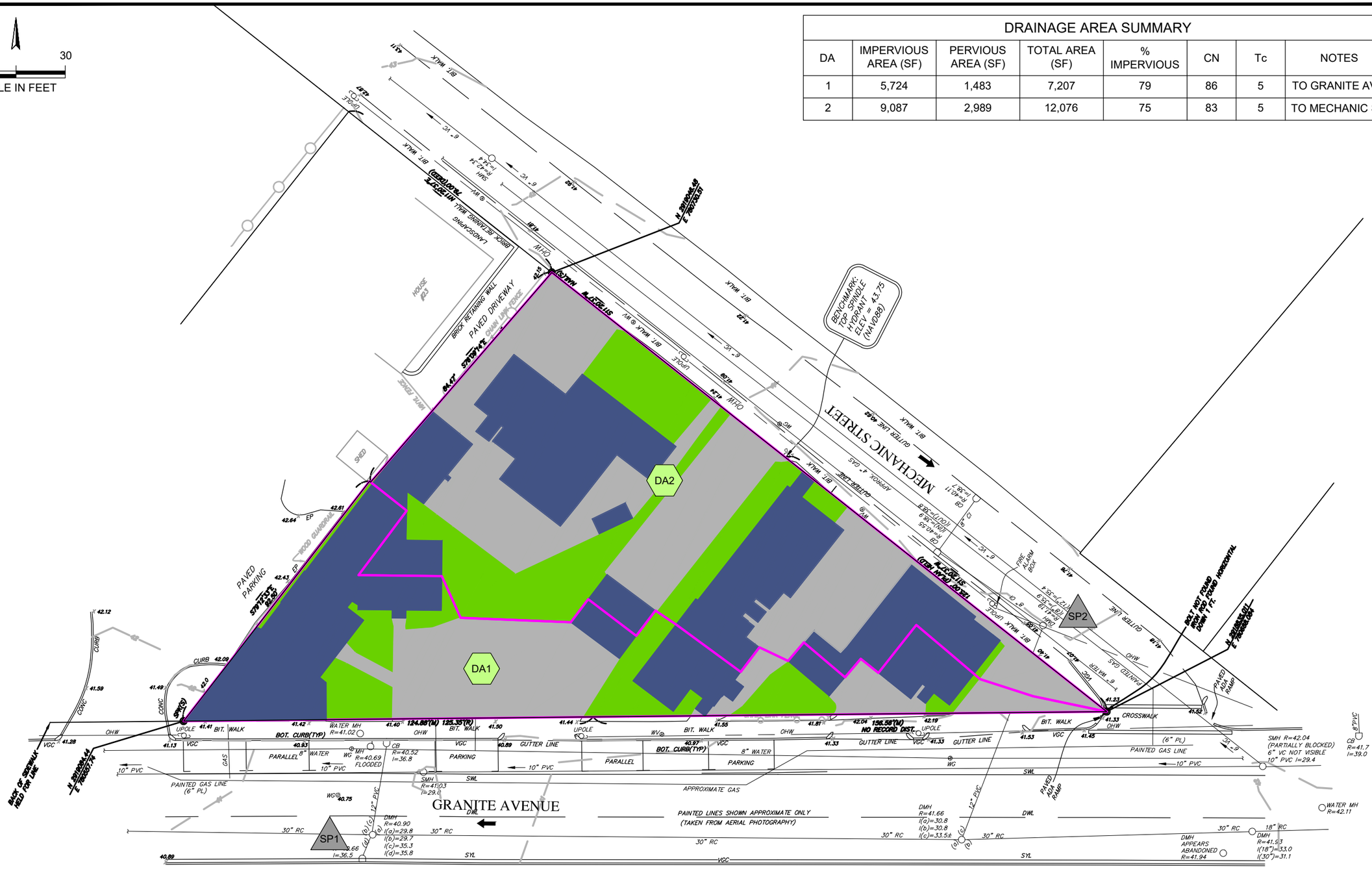
APPENDIX A
Pre- and Post-Drainage Area Maps

0 30

SCALE IN FEET

DRAINAGE AREA SUMMARY

DA	IMPERVIOUS AREA (SF)	PERVIOUS AREA (SF)	TOTAL AREA (SF)	% IMPERVIOUS	CN	Tc	NOTES
1	5,724	1,483	7,207	79	86	5	TO GRANITE AVE.
2	9,087	2,989	12,076	75	83	5	TO MECHANIC ST.



LEGEND

DRAINAGE AREA BOUNDARY

IMP. AREA / TOTAL AREA (SQUARE FEET) — 5,000 / 15,000

WOODS

ROOFTOPS

GRASS

PAVEMENT

DA1 DRAINAGE AREA

SP1 STUDY POINT

SOIL TYPES

FINE TO MEDIUM SAND (HSG A)

Revisions

Rev	Date	By	Appr	Description

Horsley Witten Group, Inc.
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508-833-6600 voice
508-833-3150 fax

Date: JULY 2021 | Design By: JLV | Drawn By: JLV | Checked By: JCB

Plan Set: 440 GRANITE AVENUE, MILTON, MA

Plan Title: EXISTING DRAINAGE MAP

Prepared For: Bronco Construction Co./ Oranmore Enterprises, LLC
36 Central Ave.
Milton, MA 02186
Phone:617-296-4548
Fax:----

Survey Provided By: DON ROSA PROFESSIONAL LAND SURVEYOR
80 MILLBROOK AVENUE
WALPOLE, MA 02081
Phone:781-603-8106
Fax:----
Dated: 3/30/2021

Registration:

Project Number: 20130

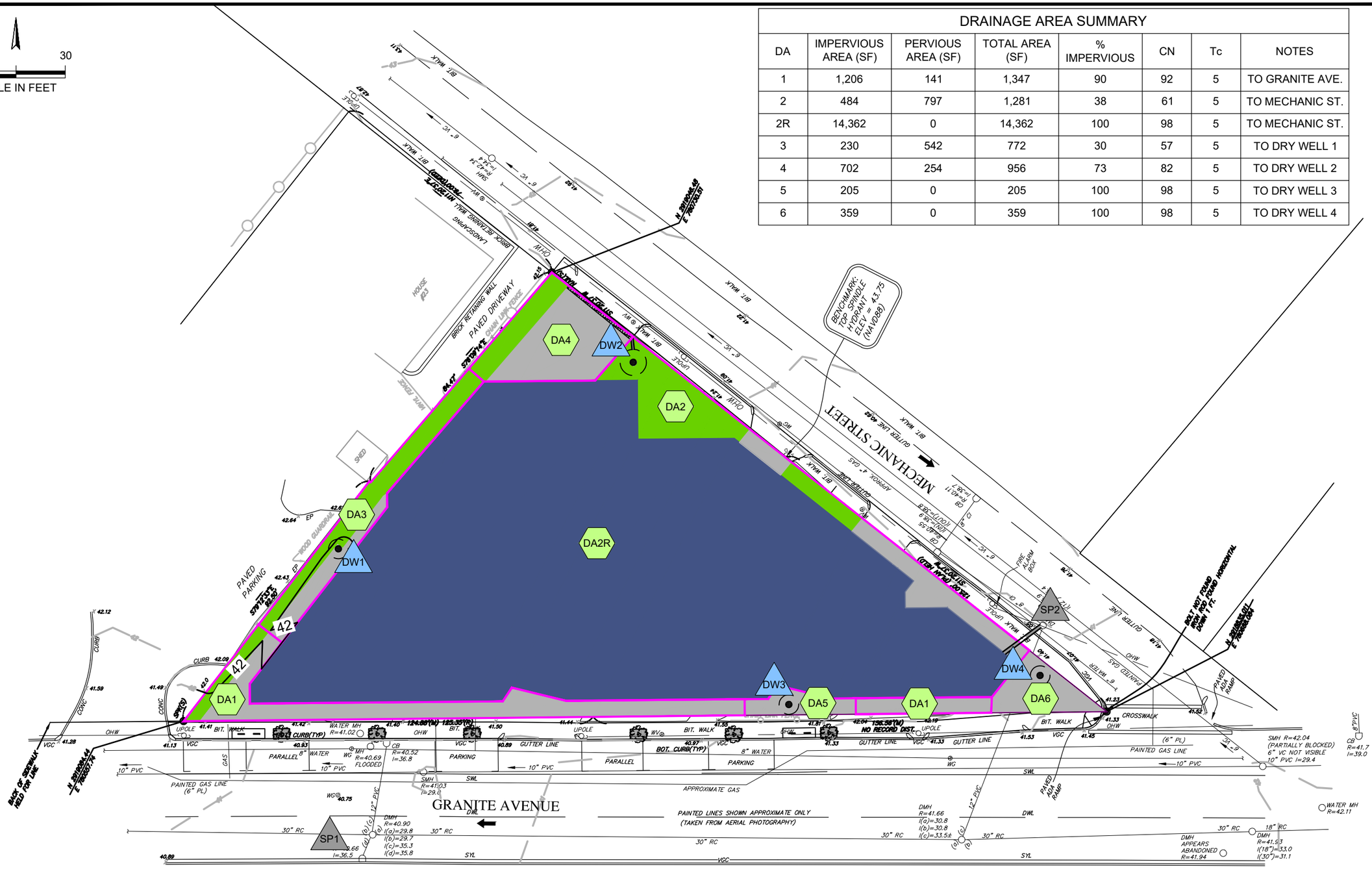
Sheet Number: 1 of 2

0 30

SCALE IN FEET

DRAINAGE AREA SUMMARY

DA	IMPERVIOUS AREA (SF)	PERVIOUS AREA (SF)	TOTAL AREA (SF)	% IMPERVIOUS	CN	Tc	NOTES
1	1,206	141	1,347	90	92	5	TO GRANITE AVE.
2	484	797	1,281	38	61	5	TO MECHANIC ST.
2R	14,362	0	14,362	100	98	5	TO MECHANIC ST.
3	230	542	772	30	57	5	TO DRY WELL 1
4	702	254	956	73	82	5	TO DRY WELL 2
5	205	0	205	100	98	5	TO DRY WELL 3
6	359	0	359	100	98	5	TO DRY WELL 4



LEGEND

- DRAINAGE AREA BOUNDARY
- IMP. AREA / TOTAL AREA (SQUARE FEET) — 5,000 / 15,000
- WOODS
- ROOFTOPS
- GRASS
- PAVEMENT
- DA1 DRAINAGE AREA
- SP1 STUDY POINT
- DW1 DRY WELL

SOIL TYPES

FINE TO MEDIUM SAND (HSG A)

Revisions

Rev	Date	By	Appr	Description

Horsley Witten Group, Inc.
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Date: JULY 2021 | Design By: JLV | Drawn By: JLV | Checked By: JCB

Plan Set: 440 GRANITE AVENUE MILTON, MA

Plan Title: PROPOSED DRAINAGE MAP

Prepared For: Brenco Construction Co./ Oranmore Enterprises, LLC
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Survey Provided By: DON ROSA PROFESSIONAL LAND SURVEYOR
80 MILLBROOK AVENUE
WALPOLE, MA 02081
Phone:781-603-8106
Fax: ----
Dated: 3/30/2021

Registration:

Project Number: 20130

Sheet Number: 2 of 2

APPENDIX B
Rainfall Data

NOAA Atlas 14, Volume 10, Version 3
Location name: Milton, Massachusetts, USA*
Latitude: 42.2568°, Longitude: -71.0401°
Elevation: 42.61 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

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

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.305** (0.248-0.373)	**0.378** (0.307-0.462)	**0.497** (0.402-0.611)	**0.596** (0.479-0.737)	**0.732** (0.567-0.962)	**0.833** (0.630-1.13)	**0.942** (0.690-1.34)	**1.07** (0.730-1.56)	**1.27** (0.825-1.92)	**1.44** (0.909-2.23)
10-min	**0.432** (0.352-0.528)	**0.536** (0.435-0.655)	**0.705** (0.571-0.866)	**0.845** (0.679-1.05)	**1.04** (0.803-1.36)	**1.18** (0.893-1.60)	**1.33** (0.977-1.90)	**1.52** (1.03-2.20)	**1.80** (1.17-2.72)	**2.04** (1.29-3.16)
15-min	**0.509** (0.414-0.621)	**0.630** (0.512-0.771)	**0.828** (0.670-1.02)	**0.993** (0.798-1.23)	**1.22** (0.944-1.60)	**1.39** (1.05-1.88)	**1.57** (1.15-2.23)	**1.79** (1.22-2.59)	**2.11** (1.37-3.20)	**2.39** (1.52-3.71)
30-min	**0.697** (0.567-0.852)	**0.866** (0.703-1.06)	**1.14** (0.923-1.40)	**1.37** (1.10-1.70)	**1.68** (1.30-2.21)	**1.92** (1.45-2.59)	**2.17** (1.59-3.08)	**2.47** (1.68-3.58)	**2.93** (1.90-4.43)	**3.32** (2.10-5.14)
60-min	**0.886** (0.721-1.08)	**1.10** (0.895-1.35)	**1.45** (1.18-1.79)	**1.75** (1.40-2.16)	**2.15** (1.66-2.82)	**2.44** (1.85-3.31)	**2.77** (2.03-3.93)	**3.15** (2.15-4.58)	**3.74** (2.43-5.66)	**4.24** (2.68-6.58)
2-hr	**1.13** (0.923-1.37)	**1.42** (1.16-1.73)	**1.90** (1.55-2.32)	**2.30** (1.86-2.83)	**2.85** (2.22-3.72)	**3.25** (2.48-4.38)	**3.69** (2.73-5.23)	**4.23** (2.89-6.09)	**5.07** (3.30-7.60)	**5.78** (3.67-8.88)
3-hr	**1.31** (1.08-1.58)	**1.65** (1.36-2.00)	**2.21** (1.81-2.69)	**2.68** (2.17-3.28)	**3.32** (2.60-4.32)	**3.79** (2.90-5.08)	**4.31** (3.19-6.07)	**4.94** (3.38-7.07)	**5.92** (3.87-8.83)	**6.77** (4.30-10.3)
6-hr	**1.72** (1.42-2.06)	**2.14** (1.77-2.58)	**2.84** (2.34-3.43)	**3.42** (2.79-4.16)	**4.22** (3.32-5.44)	**4.81** (3.69-6.38)	**5.45** (4.05-7.59)	**6.23** (4.28-8.82)	**7.43** (4.87-11.0)	**8.46** (5.40-12.8)
12-hr	**2.25** (1.87-2.68)	**2.76** (2.29-3.29)	**3.59** (2.97-4.30)	**4.28** (3.52-5.17)	**5.23** (4.13-6.68)	**5.93** (4.58-7.79)	**6.70** (4.99-9.22)	**7.61** (5.26-10.7)	**9.01** (5.93-13.2)	**10.2** (6.53-15.2)
24-hr	**2.74** (2.30-3.25)	**3.38** (2.83-4.01)	**4.41** (3.67-5.25)	**5.27** (4.36-6.32)	**6.45** (5.13-8.19)	**7.32** (5.68-9.55)	**8.27** (6.21-11.3)	**9.43** (6.54-13.1)	**11.2** (7.41-16.2)	**12.8** (8.20-18.9)
2-day	**3.13** (2.64-3.68)	**3.93** (3.31-4.63)	**5.24** (4.39-6.20)	**6.33** (5.27-7.54)	**7.83** (6.28-9.91)	**8.93** (6.99-11.6)	**10.1** (7.70-13.9)	**11.7** (8.13-16.1)	**14.2** (9.38-20.3)	**16.3** (10.5-23.9)
3-day	**3.43** (2.90-4.02)	**4.30** (3.63-5.04)	**5.72** (4.81-6.73)	**6.89** (5.76-8.17)	**8.51** (6.85-10.7)	**9.70** (7.62-12.6)	**11.0** (8.39-15.0)	**12.7** (8.85-17.4)	**15.4** (10.2-22.0)	**17.8** (11.5-25.9)
4-day	**3.72** (3.16-4.35)	**4.61** (3.91-5.40)	**6.08** (5.13-7.14)	**7.29** (6.11-8.62)	**8.96** (7.23-11.2)	**10.2** (8.02-13.1)	**11.5** (8.81-15.7)	**13.3** (9.27-18.1)	**16.1** (10.7-22.8)	**18.6** (12.0-26.9)
7-day	**4.53** (3.86-5.26)	**5.45** (4.64-6.34)	**6.96** (5.91-8.13)	**8.22** (6.92-9.65)	**9.94** (8.05-12.4)	**11.2** (8.86-14.3)	**12.6** (9.64-16.9)	**14.4** (10.1-19.5)	**17.3** (11.5-24.3)	**19.8** (12.8-28.4)
10-day	**5.27** (4.51-6.10)	**6.21** (5.31-7.20)	**7.76** (6.61-9.03)	**9.05** (7.64-10.6)	**10.8** (8.78-13.4)	**12.1** (9.59-15.4)	**13.5** (10.3-18.0)	**15.3** (10.8-20.6)	**18.2** (12.1-25.4)	**20.6** (13.4-29.4)
20-day	**7.40** (6.38-8.50)	**8.43** (7.26-9.70)	**10.1** (8.67-11.7)	**11.5** (9.80-13.4)	**13.5** (10.9-16.4)	**14.9** (11.8-18.5)	**16.4** (12.5-21.3)	**18.2** (12.9-24.1)	**20.7** (13.9-28.5)	**22.8** (14.8-32.1)
30-day	**9.14** (7.91-10.5)	**10.2** (8.85-11.7)	**12.1** (10.4-13.9)	**13.5** (11.6-15.7)	**15.6** (12.7-18.8)	**17.2** (13.6-21.1)	**18.8** (14.2-23.9)	**20.5** (14.5-27.0)	**22.7** (15.3-31.1)	**24.5** (16.0-34.3)
45-day	**11.3** (9.84-12.9)	**12.5** (10.8-14.3)	**14.4** (12.5-16.5)	**16.0** (13.7-18.5)	**18.2** (14.9-21.8)	**19.9** (15.8-24.3)	**21.6** (16.3-27.2)	**23.2** (16.6-30.4)	**25.3** (17.1-34.3)	**26.7** (17.4-37.2)
60-day	**13.2** (11.5-15.0)	**14.4** (12.5-16.4)	**16.4** (14.2-18.7)	**18.1** (15.5-20.8)	**20.4** (16.7-24.2)	**22.2** (17.6-26.9)	**23.9** (18.0-29.8)	**25.5** (18.2-33.2)	**27.4** (18.6-37.0)	**28.7** (18.7-39.7)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

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

Please refer to NOAA Atlas 14 document for more information.

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PF graphical

APPENDIX C
NRSC Soil Report and Test Pit Data

KEVIN M. MARTIN, P.E.
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Hampstead, NH 03841
603-489-5556 (p)/ 603-489-5558 (f)/781-718-4084(m)
kevinmartinpe@aol.com

MEMORANDUM

TO: Michael Moore
Brenco Construction
36 Central Avenue, Unit C2
Milton, MA 02186

FROM: Kevin M. Martin, P.E.
Geotechnical Engineer

DATE: October 22, 2020

RE: **GEOTECHNICAL SUMMARY REPORT**
PROPOSED MIXED-USE BUILDING
440 GRANITE AVENUE @ MECHANIC STREET
MILTON, MASSACHUSETTS

This memorandum serves as a Geotechnical Summary Report for the referenced project. The contents of this memorandum are subject to the attached ***Limitations***.

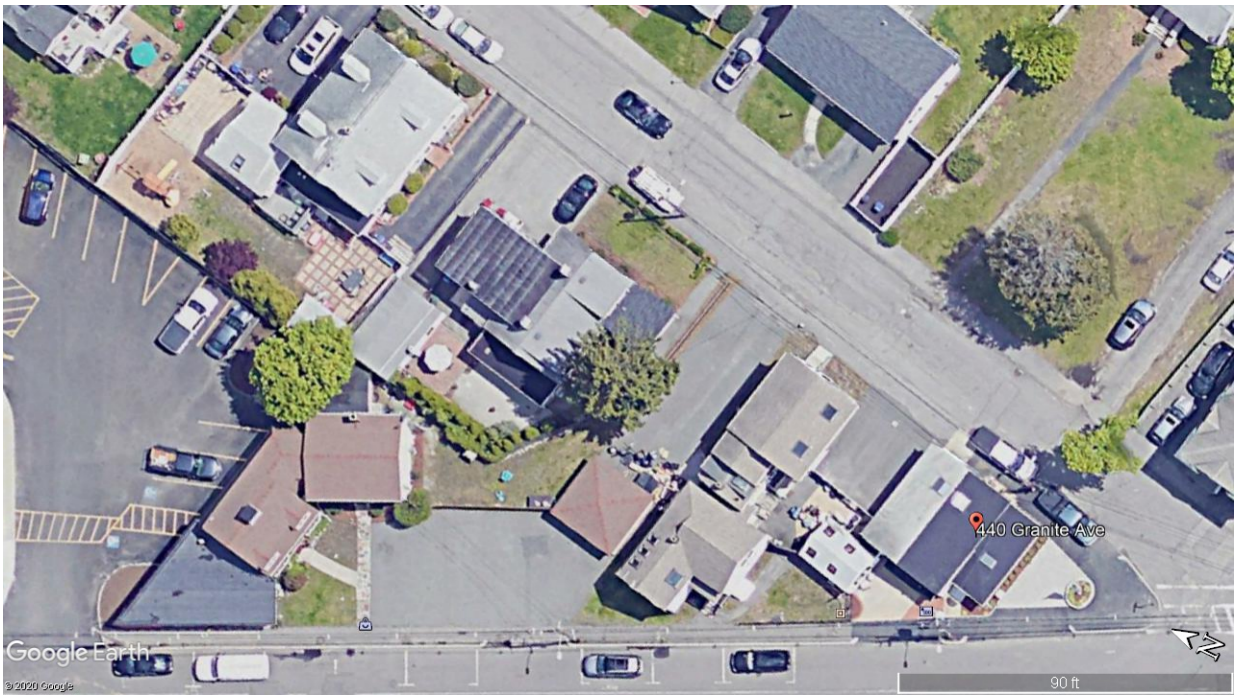
SITE & PROJECT DESCRIPTION

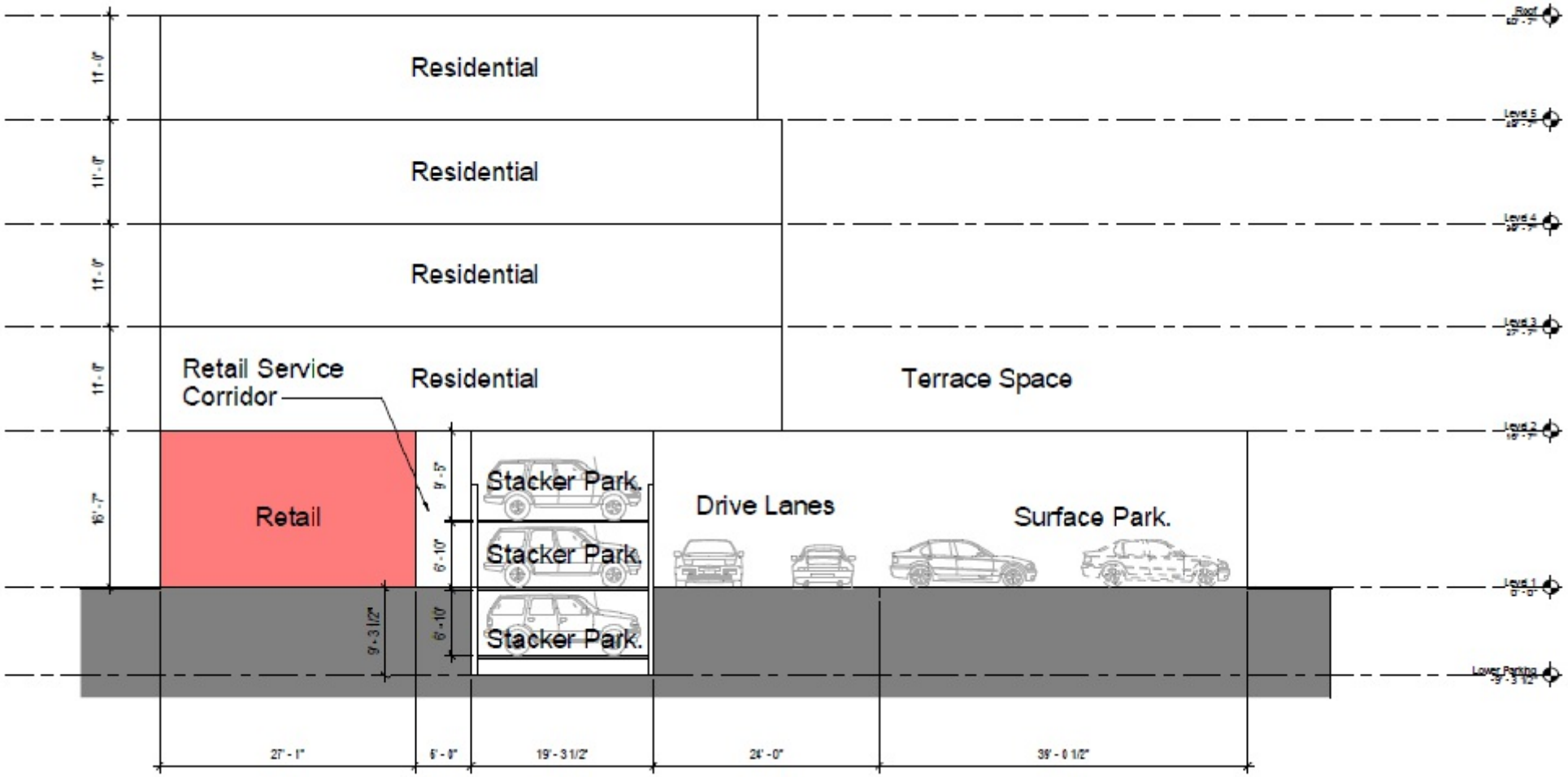
The triangular property includes four (4) contiguous lots at the intersection of Granite Avenue & Mechanic Street a bit less than 20,000 ft² in cumulative area. Present development includes several buildings which include residential, small retail and garages with associated pavement areas. These buildings and associated construction will be razed to accommodate the project. KMM has no knowledge of past construction, use and/or development of the property except what is visibly apparent or shown on the *Site Plan*. Based on the *Site Plan*, grades are relatively level being near elevation ≈42 ft.

The project includes a new five-story, steel and wood-framed mixed-use building. The ground floor will be used for retail (≈6,000 ft²) and parking. The parking will include a below grade (≈10 ft) stacker system for 15 spots (≈3,200 ft²) within the building interior. The upper floor levels with be used for residential occupancy (≈12,700 ft²). It is intended to support the building on a conventional spread footing foundation. Minor grade change is expected for the project.

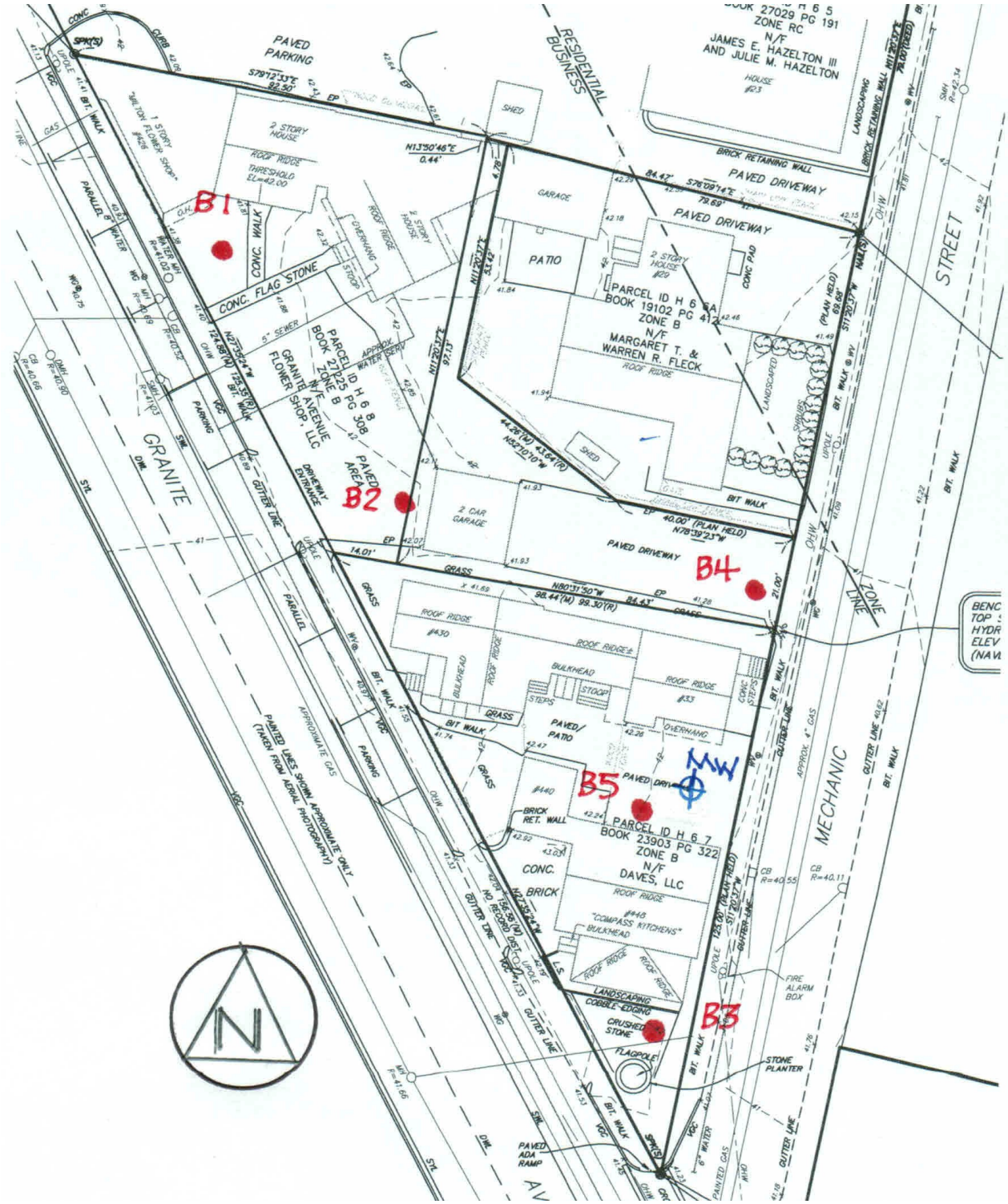
The purpose of this study is to review the subgrade conditions and provide a geotechnical evaluation related to foundation design and construction per the *Massachusetts State Building Code (MSBC)*.

This report does not include an environmental assessment relative to oil, gasoline, solid waste and/or other hazardous materials. The environmental conditions of the property should be addressed by others as necessary. This study also does not include review of site design or construction issues such as infiltration systems, dry wells, excavation support systems, underground utilities, protection of surrounding buildings/utilities, crane pads, temporary shoring, foundation water-proofing, underpinning or other site and/or temporary design unless specifically addressed herein.





PROPOSED SECTION DIAGRAM



TEST BORE LOCATIONS

SUBSURFACE EXPLORATION PROGRAM

Test Bores

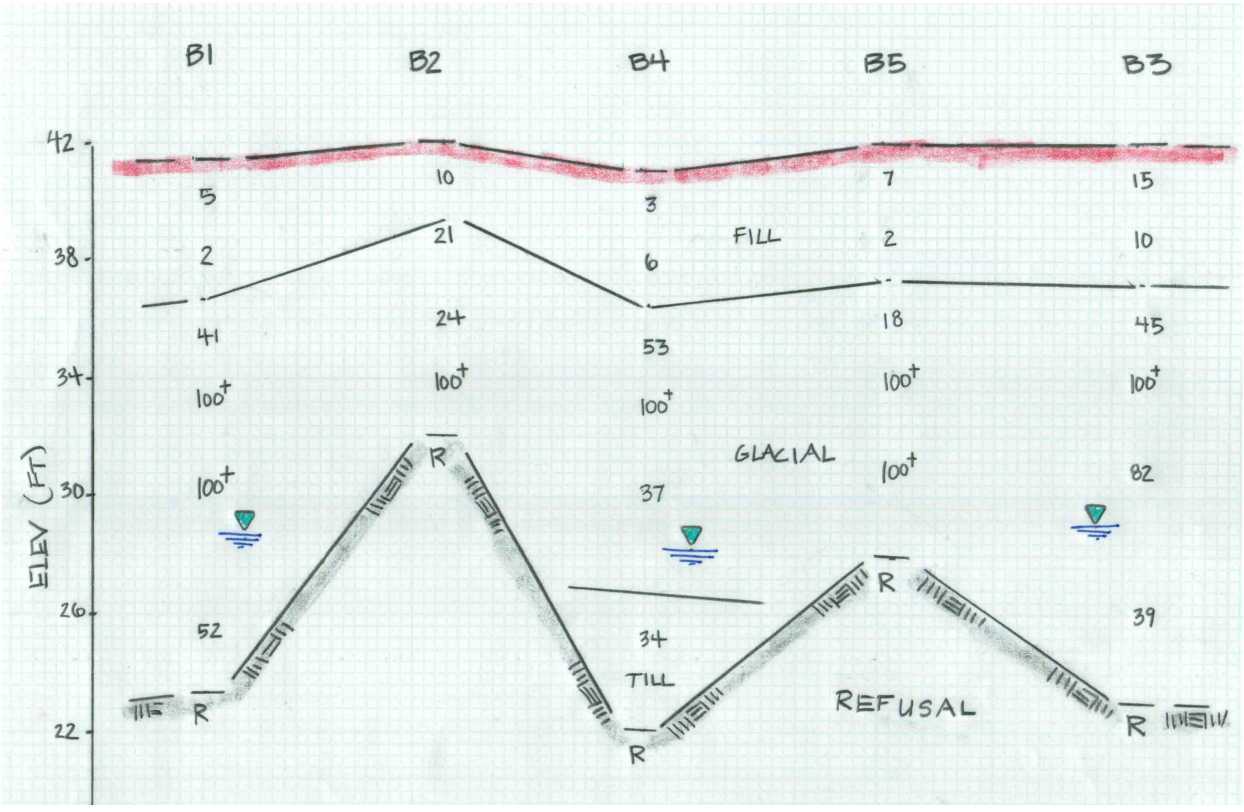
The exploration program involved five (5) test bores around the site where accessible. The test bores were advanced to refusal depths of ≈10-19 ft utilizing 3 inch pneumatically driven casing. Soil samples were typically retrieved at no greater than 5 ft intervals with a 2 inch diameter split-spoon sampler. Standard Penetration Tests (SPTs) were performed at the sampling intervals in general accordance with ASTM-D1586 (*Standard Method for Penetration Test and Split-Barrel Sampling of Soils*). Field descriptions and penetration resistance of the soils encountered, observed depth to groundwater, depth to apparent bedrock refusal and other pertinent data are contained on the attached *Test Boring Logs*. Locations are shown on the attached Sketch.

Observation Well

There is an observation well by others on the property. This well was measured to have groundwater at ≈12½ ft below grade. This well may continue to be gauged to evaluate fluctuations.

SUBSURFACE CONDITIONS

The subgrade conditions below (1) Shallow Fill include (2) stable Glacial soils then (3) apparent Bedrock refusal. A *Subsurface Profile* depicting the soil and groundwater conditions is attached.



Shallow Fill was encountered to depths of ≈4 ft below grade at most locations. The Fill varies in composition but generally includes a black to dark brown, loamy, silty Sand, little gravel. The Fill is generally loose and easy to identify given a dark color. Other Fill should be expected given the foundations, intersecting utilities and existing construction.

The parent site soils consist of Stratified Outwash soils. These soils include Clean Sand, gravelly Sand and/or sandy Gravel with layers of Fine Sand & Silt as well as silty Sand, little gravel. For the most part these soils are granular with frequently embedded cobbles and boulders based on the SPT refusals and difficulty drilling. These soils are granular, well-draining, stable and compact. The *USGS Surficial Geologic Map* indicates Granular deposits in the area.

Apparent Glacial Till was encountered at depth (B4) about ≈15 ft below grade. The Till includes a grey, well-graded, fine to medium Sand, some gravel, some silt.

Test bore refusal, presumably Bedrock, was encountered at depths of ≈10-19 ft across the site. The generally consistent depth to refusal would suggest Bedrock. Bedrock in the area is characteristically hard and of sound quality.

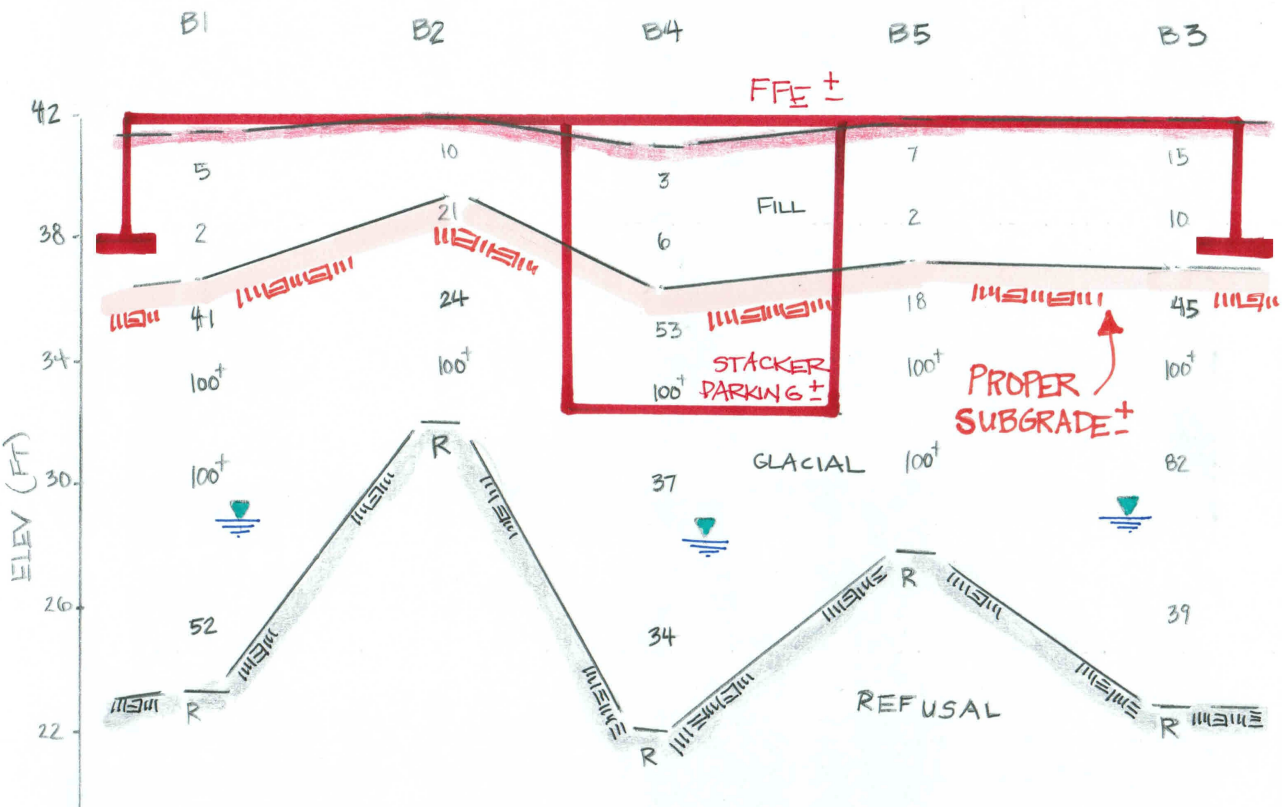
Groundwater was encountered in the test holes at depths of ≈13-14 ft below grade. Wet and saturated soils were encountered at these depths. A monitoring well had groundwater at 12½ ft below grade. It should be noted that fluctuations in the level of the groundwater may occur due to variations in rainfall, temperature, utilities, flooding and other factors differing from the time of the measurements. This study was completed at a time of seasonally low groundwater.

USGS SURFICIAL GEOLOGIC MAP - BOSTON SOUTH - 2018

Coarse deposits consist of *gravel deposits*, *sand and gravel deposits*, and *sand deposits*, not differentiated in this report. *Gravel deposits* are composed of at least 50 percent gravel-size clasts; cobbles and boulders predominate; minor amounts of sand occur within gravel beds, and sand comprises a few separate layers. Gravel layers generally are poorly sorted, and bedding commonly is distorted and faulted due to postdepositional collapse related to melting of ice. *Sand and gravel deposits* occur as mixtures of gravel and sand within individual layers and as layers of sand alternating with layers of gravel. Sand and gravel layers generally range between 25 and 50 percent gravel particles and between 50 and 75 percent sand particles. Layers are well sorted to poorly sorted; bedding may be distorted and faulted due to postdepositional collapse. *Sand deposits* are composed mainly of very coarse to fine sand, commonly in well-sorted layers. Coarser layers may contain up to 25 percent gravel particles, generally granules and pebbles; finer layers may contain some very fine sand, silt, and clay

FOUNDATION SUBGRADE RECOMMENDATIONS

The subgrade conditions are favorable for supporting the proposed building on a conventional spread footing foundation. The undocumented Fill is **not** considered suitable for foundation support. As such, these soils, abandoned foundations, intersecting utilities and other questionable matter should be fully removed from the building footprint including the *Footing Zone of Influence* (*FZOI*) to expose the parent Glacial subgrade. The *FZOI* is defined as that area extending laterally one foot from the edge of footing then outward and downward at a 1H:1V splay (up to ≈3 ft laterally beyond the edge of the foundation). The attached *Profile* illustrates "Proper Subgrade" in relation to the proposed construction. Excavations should be replaced with compacted Structural Fill (Table 1).



PROPOSED SPREAD FOOTING FOUNDATION

The parent subgrade soils should be exposed in the foundation areas prior to casting the footings or placing structural fill. It is recommended that the parent subgrade soils be proof-rolled with vibratory densification and exhibit stable and compact conditions. The purpose of the proof-rolling is to densify the site soils and identify potential loose or unstable areas which should be removed as necessary. Proof-rolling should involve at least 4-5 passes with a vibratory compactor (minimum 950 pound static weight) operating at peak energy. During the proof rolling process, the subgrade should be observed by an Engineer to identify areas exhibiting weaving or instability. It will be necessary to remove weakened or unstable soils and replace with a Structural Fill or stone. Proper groundwater control and storm water management are also necessary to maintain site stability.

Bedrock conditions may be encountered during the deeper excavations for the vehicle stacker system. In such cases, it is recommended that a minimum ≈6 inch lift of one inch minus crushed stone be placed between the footing and the bedrock surface to provide a more uniform and elastic bearing subgrade. The purpose of the gravel base ("cushion base") is to mitigate differential settlements throughout the foundation. Bedrock subgrades should be free of loose soil and rock. It is expected that localized bedrock may be removed with a hoe ram.

The subgrade should ultimately be stable, dewatered, compact and protected from frost throughout construction. Bearing subgrades that become weakened or disturbed due to wet conditions will be rendered unsuitable for structural support. The Contractor shall ultimately be responsible for the means and methods of temporary groundwater control, subgrade protection and site stability during construction. An Engineer from KMM should be scheduled to review the foundation subgrade conditions and preparation during construction.

FOUNDATION DESIGN RECOMMENDATIONS

The footings are expected to gain bearing support atop the parent soils and/or compacted structural fill. Footings may be designed using an allowable bearing capacity of 5 ksf (FS=3). The allowable bearing capacity may be increased a third (⅓) when considering transient loads such as wind or seismic. The bearing capacity is contingent upon the perimeter strip footings and isolated column footings being no less than 2 ft and 3 ft in width respectively. For footings less than 3 ft in lateral dimension, the allowable bearing capacity should be reduced to one-third and multiplied by the least lateral footing dimension in feet. Foundation settlement should be less than1 inch with differential settlement less than ½ inch. The settlement should be elastic and occur during construction.

Recommendations for the lateral earth pressure against the unbalanced walls and drainage control are outlined on Table 2. Proper drainage behind the unbalanced foundation walls will be necessary. Alternatively, the embedded foundations may be fully water-proofed and structurally designed for hydrostatic and buoyant load. This may be the case for vehicle stacker system which extends ≈9-10 ft below grade.

The subsurface conditions were reviewed with respect to seismic criteria set forth in the ***Massachusetts State Building Code***. Based on the relative density of the soils and the depth to groundwater, the site does not appear susceptible to liquefaction in the event of an earthquake. Based on interpretation of the *Building Code*, the *Site Classification* is "D" (Stable Soil Profile).

It is recommended that a minimum 10-inch base of *Gravel Base Fill* (Table 1) be placed below the garage level floor slab for strength, moisture and frost control. This can be reduced to 6 inches in the retail area. The gravel base shall be no less than 12 inches for exterior concrete slabs exposed to frost (≈15 inches at entrances and ramps). A subgrade modulus of 175 pci may be used for design of the floor slab. A vapor retarder should be used below the floor slab dependent upon the floor treatment. A vapor barrier should be specified by others per ACI Standards. Minimum 10-mil polyethylene or StegoWrap™ are often used as a vapor retarder.

Structural fill necessary within and below the foundation should conform to the attached *Specifications* (Table 1). The site soils (Granular Outwash) should be considered suitable for re-use as structural fill provided they are segregated from poor soils, screened of large stones and conform to Specification.

PROTECTION OF EXISTING FOUNDATION

It is recommended that where the new building is located near adjacent buildings that the footings be constructed at similar grade to mitigate the overlapping of stresses. This applies to surrounding buildings in close proximity to the proposed construction. The *Existing Footing Zone of Influence* of the existing foundation should not be encroached or disturbed without review by a Professional Engineer. The *Existing Footing Zone of Influence* is defined as that area extending laterally one foot from the edge of footing then outward and downward at a 1.5H:1V splay. Per the *Building Code (Section 1805.5)*, an imaginary line drawn between the lower edges of adjoining footings shall not have a steeper slope than 25° (2H:1V) with the horizontal unless the material supporting the higher footing is braced or otherwise retained. This study did not include verification of the adjacent foundations via test pits. It is expected the existing foundations include spread footers. KMM can provide additional technical assistance if the existing foundation needs to be shored or underpinned. It is expected that conventional concrete pit underpinning will be the most practical. It is recommended that an experienced Contractor be retained for the underpinning. A *Technical Submittal* prepared by a qualified Engineer should be provided to outline the proposed means and methods to protect the existing building and construct the new underpinning pits.

CONSTRUCTION CONCERNS

The contractor should be required to maintain a stable-dewatered subgrade for the building foundation and other concerned areas during construction. Subgrade disturbance may be influenced by excavation methods, moisture, precipitation, groundwater control and construction activities. The Granular soils are generally not vulnerable to disturbance when exposed to wet conditions and construction activities. Nonetheless, the contractor should take precautions to reduce subgrade disturbance. Such precautions may include diverting storm run-off away from construction areas, reducing traffic in sensitive areas, minimizing the extent of exposed subgrade if inclement weather is forecast, backfilling footings as soon as practicable and maintaining an effective dewatering program. Soils exhibiting weaving or instability should be over-excavated to a competent bearing subgrade then replaced with a free draining structural fill or crushed stone. The moisture concerns are typically more problematic if construction takes place during the winter to spring season or other periods of inclement weather. A protective base of ¾-inch minus crushed stone may be placed at least ≈6 inches below and laterally beyond the footing limits for protection during construction. The stone base is to protect the site soils, facilitate necessary dewatering and provide a dry/stable base upon which to progress foundation construction. The protective base should be considered elective and dependent upon the site conditions. The stone base should be considered necessary if wet conditions are present at footing grade. The protective stone base shall be tamped with a plate compactor and exhibit stable conditions.

The groundwater table will need to be temporarily controlled during construction to complete work in dry conditions and protect the competency of the subgrade. The groundwater table should be continuously maintained at least one foot below construction grade until backfilling is complete. The groundwater is expected to be controlled with conventional sumps and pumps. The temporary sumps should be filtered with stone and fabric and extend at least ≈18 inches below construction grade. A ≈6 inch lift of ¾-inch minus crushed stone should be placed atop the wet subgrade to protect its competency and facilitate dewatering. Adequate dewatering and storm water management are necessary for maintaining the competency of the site soils.

The subgrade should ultimately be stable, dewatered, compact and protected from frost throughout construction. Bearing subgrades that become weakened or disturbed due to wet conditions will be rendered unsuitable for structural support. The Contractor shall ultimately be responsible for the means and methods of temporary groundwater control, subgrade protection and site stability during construction. An Engineer from KMM should be scheduled to review the foundation subgrade conditions and preparation during construction.

LATERAL SUPPORT OF EXCAVATION

Deep excavations (greater than ≈10 ft) are expected for foundation construction and possibly for utility installation around the property. Excavations should be sloped and/or laterally supported in accordance with the *Occupational and Health Administration (OSHA)* regulations (29 CFR Part 1926) and the *Commonwealth of Massachusetts Department of Labor and Industries Division of Industrial Safety (DLIDIS) - Rules and Regulations for the Prevention of Accidents in Construction Operations* (454 CMR 10.00), Part 14. Should excavations be sloped, the minimum slope based on soil type (Granular Outwash) is 1.5H:1V. The foregoing slope requirement does not consider surcharge loads (stockpiled soils, equipment, materials, etc) which may be situated at the crest of the slope and vibration loads (soil compaction, sheet piling, etc). It should be noted that these slope requirements are minimums required by OSHA/DLIDIS regulations. The contractor should be ultimately responsible for design, maintenance and stability of the temporary slopes and/or shoring associated with construction activities.

Laterally supported earth systems should be designed by a qualified Professional Engineer retained by the contractor per OSHA Regulations. Cantilevered sheeting or soldier piles with lagging are expected to be feasible for depths of ≈8-10 ft. Excavation support is expected to impact the project from a budgetary perspective.

CONSTRUCTION MONITORING

It is recommended that a qualified engineer or representative be retained to review earthwork activities such as the preparation of the foundation bearing subgrade and the placement/compaction of Structural Fill. It is recommended that KMM be retained to provide construction monitoring services. This is to observe compliance with the design concepts presented herein.

We trust the contents of this memorandum report are responsive to your needs at this time. Should you have any questions or require additional assistance, please do not hesitate to contact our office.

Milton440GraniteAve.wpd

LIMITATIONS

Explorations

1. The analyses, recommendations and designs submitted in this report are based in part upon the data obtained from preliminary subsurface explorations. The nature and extent of variations between these explorations may not become evident until construction. If variations then appear evident, it will be necessary to re-evaluate the recommendations of this report.

2. The generalized soil profile described in the text is intended to convey trends in subsurface conditions. The boundaries between strata are approximate and idealized and have been developed by interpretation of widely spaced explorations and samples; actual soil transitions are probably more gradual. For specific information, refer to the individual test pit and/or boring logs.

3. Water level readings have been made in the test pits and/or test borings under conditions stated on the logs. These data have been reviewed and interpretations have been made in the text of this report. However, it must be noted that fluctuations in the level of the groundwater may occur due to variations in rainfall, temperature, and other factors differing from the time the measurements were made.

Review

4. It is recommended that this firm be given the opportunity to review final design drawings and specifications to evaluate the appropriate implementation of the recommendations provided herein.

5. In the event that any changes in the nature, design, or location of the proposed areas are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and conclusions of the report modified or verified in writing by KMM Geotechnical Consultants, LLC.

Construction

6. It is recommended that this firm be retained to provide geotechnical engineering services during the earthwork phases of the work. This is to observe compliance with the design concepts, specifications, and recommendations and to allow design changes in the event that subsurface conditions differ from those anticipated prior to the start of construction.

Use of Report

7. This report has been prepared for the exclusive use of Brenco Construction in accordance with generally accepted soil and foundation engineering practices. No other warranty, expressed or implied, is made.

8. This report has been prepared for this project by KMM Geotechnical Consultants, LLC. This report was completed for preliminary design purposes and may be limited in its scope to complete an accurate bid. Contractors wishing a copy of the report may secure it with the understanding that its scope is limited to preliminary geotechnical design considerations only.

TABLE 1

Proposed Building
440 Granite Avenue
Milton, MA

Recommended Soil Gradation & Compaction Specifications

Gravel Base Fill
(Crushed Gravel Fill)

SIEVE SIZE	PERCENT PASSING BY WEIGHT
3 inch	100
3/4 inch	60-90
No. 4	20-70
No. 200	2-8

NOTE: For minimum 10-inch base below Concrete Garage Floor Slab
For minimum 6-inch base below Concrete Floor Slab in Retail area
For minimum 12-inch base for exterior concrete slabs exposed to frost
For minimum 15-inch base for entrances, ramps, aprons, etc
Shall have less than 12% fines (No. 200 sieve) based on the Sand fraction

Structural Fill
(Gravelly SAND, trace Silt)

SIEVE SIZE	PERCENT PASSING BY WEIGHT
5 inch	100
3/4 inch	50-100
No. 4	20-80
No. 200	0-10

NOTE: For use as structural load support below the foundations
For use as backfill behind unbalanced foundation/retaining walls
A ¾-inch crushed stone may be used in wet conditions
Shall have less than 20% fines (No. 200 sieve) based on the Sand fraction

Structural Fill placed beneath the foundation should include the *Footing Zone of Influence* which is defined as that area extending laterally one foot from the edge of the footing then outward and downward at a 1H:1V splay. Structural Fill should be placed in loose lifts not exceeding 12 inches for heavy vibratory rollers and 8 inches for vibratory plate compactors. All Structural Fill should be compacted to at least 95 percent of maximum dry density as determined by the Modified Proctor Test (ASTM-D1557). Structural Fill should be compacted within ±3% of optimum moisture content. The adequacy of the compaction efforts should be verified by field density testing which is also a requirement of the *Massachusetts State Building Code*.

TABLE 2

Proposed Building
440 Granite Avenue
Milton, MA

Recommended Lateral Earth Pressures & Drainage for Unbalanced Walls

Lateral earth pressures for the structural design and stability analysis of unbalanced foundation walls (basement walls, retaining walls, elevator pit, etc) are provided herein. The following table outlines the recommended lateral earth pressure coefficients and equivalent fluid weights:

WALL CONDITION	LATERAL TRANSLATION (Δ/H)	EARTH PRESSURE COEFFICIENT (K)	EQUIVALENT FLUID WEIGHT (γ_{EFW})
restrained	0	K_o	60 pcf
no restraint	0.002	K_a	35 pcf
no restraint	0.02	K_p (FS=3)	125 pcf
seismic	n/a	K_{eq}	see note

where: Δ = movement at top of wall by tilting or lateral translation
H = height of wall

The above lateral earth pressures are based upon:

1. Rankine earth pressure theory;
2. Retaining wall backfilled with Structural Fill (Table 1)
3. Unit weight of backfill less than 125 pcf
4. No hydrostatic pressures
5. No surcharge loading;
6. A level backfill in front and behind of wall;
7. Seismic loads distributed as an inverse triangle over the height of wall (*MSBC*);
8. Dynamic/compaction stresses accounted for with seismic pressures;
9. Soil backfill densified with plate compactors within 3 ft lateral distance of wall;
10. Top 2 ft should not be considered for passive resistance.

The lateral load due to seismic pressure shall be in accordance with *Section 9.5.2.9* of the *MSBC*. *Equation 9.5.2.9* shall be used to estimate the seismic force (F_w). The unit weight of the backfill used in this equation is 125 pcf (Structural Fill). There are no soils subject to liquefaction below and/or behind the wall.

The lateral resistance of retaining walls should also accommodate surcharge loads. Uniformly distributed loads should be superimposed along the face of the wall at a magnitude equal to the surcharge pressure multiplied by the appropriate earth pressure coefficient. Surcharge loads should be considered where they are located within a horizontal distance equivalent to 1.0 times the height of the wall. Anticipated point or line loads situated behind the wall should be evaluated in accordance with linear elastic theory.

For frost and drainage concerns, it is recommended that *Structural Fill* (Table 1) be placed directly behind the unbalanced walls. The ground surface immediately adjacent to the unbalanced foundation should be sloped away from the building to allow for positive drainage. It is also recommended that the surficial materials adjacent to the building be relatively impermeable to reduce the volume of precipitation infiltrating into the subgrade. Such impermeable materials include Portland cement concrete, bituminous concrete, or a vegetated silty topsoil.

Unbalanced foundation walls (basement level) should be provided with adequate footing drains per the *MSBC*. The drains should be located along the periphery of the footprint. The perimeter foundation drain should be located at least ≈2-3 inches above the bottom of footing elevation and six inches outward from the edge of footing. The drains should not encroach within the *Footing Zone of Influence* defined as that area extending laterally one foot from the edge of footing then outward and downward at a 1H:1V splay. The invert elevation of the drain should be at least 14 inches below the underside of the adjacent floor slab. The drains should consist of minimum 4 inch diameter, perforated PVC-SDR 35 drain pipe encased within 12 inches of ¾-inch stone and wrapped with a filter fabric such as Mirafi 140N or equal. The Site Engineer should review the discharge of the drains. The drains should be provided with permanent clean-outs at convenient locations to facilitate access to all sections of the system. Alternatively, the foundation may be fully water-proofed and structurally designed for hydrostatic and buoyant load. This may be the case for vehicle stacker system which extends ≈9-10 ft below grade.

The drains should be provided with permanent clean-outs at convenient locations to facilitate access to all sections of the system. Clean-outs should be located at bends and no greater than 175 ft on-center. Roof gutters and other storm collection should not be discharged to the foundation drains. Recharge systems, infiltrators and/or dry wells shall be kept away from the basement level to prevent hydrostatic surcharge. This should also be reviewed by the Site Engineer.

If the unbalanced foundation walls can not be drained to alleviate hydrostatic forces, then the lateral earth pressure equivalent fluid weight should be increased to 90 pcf. Such earth pressures should be used for elevator pits, if necessary. This increased lateral load should also be used if infiltrators or dry wells are located adjacent and above BOF grade.

The recommended friction factors to be used for retaining wall design are as follows:

Recommended Friction Factor (f)
$f = \tan(\delta)$, where δ is the interface friction angle

- Concrete against the following soils

Structural Fill (Table 1)	0.50
Granular Outwash	0.50

TEST BORING LOG

SOIL X, Corp.
148 Pioneer Drive
Leominster, MA 01453

Proposed Building
440 Granite Ave
Milton, MA

BORING B-1

20-09045

Ground Elevation: 41.5 ft+/-
Date Started: 10/15/2020
Date Finished: 10/15/2020
Driller: DL
Soil Engineer/Geologist:

GROUNDWATER OBSERVATIONS

DATE	DEPTH	CASING AT	STABILIZATION
10/15/20	14 ft		

Depth Ft.	Casing bl/ft	Sample No.	Sample Pen/Rec	Sample Depth	Sample Blows/6"	Strata Break	Visual Identification of Soil and / or Rock Sample
1		1	7"	0'0"-2'0"	2-3-2-3		Dark Brown, fine to medium Sand, little silt, little gravel
		2	2"	2'0"-4'0"	2-1-1-2	4'	Same, loamy, dry (FILL)
5		3	20"	5'0"-7'0"	11-14-27-24		Brown, mottled, f-m Sand, little to trace silt, dry
		4	6"	7'0"-7'10"	37-100/4"		Brown, Sand & Gravel, cobbles, dry
10		5	0"	10'0"-10'1"	100/1"		Boulders (GLACIAL)
15		6	18"	15'0"-17'0"	21-15-37-30	18'	Brown, Gravel & Sand, cobbles, wet
20							Refusal at 18 ft Ground Water encountered 14 ft at completion
25							
30							

Notes: Geoprobe 7822

Cohesionless: 0 - 4 V. Loose, 4 - 10 Loose, 10 -30 M Dense, 30 -50 Dense, 50+ V Dense.
Cohesive: 0 -2 V Soft, 2 -4 Soft, 4 -8 M Stiff 8 -15 Stiff, 15 -30 V. Stiff, 30 + Hard.

Trace	0 to 10%
Little	10 to 20%
Some	20 to 35%
And	35% to 50%

	CASING	SAMPLE	CORE TYPE
ID SIZE (IN)		SS	
HAMMER WGT (LB)		140 lb.	
HAMMER FALL (IN)		30"	

TEST BORING LOG

SOIL X, Corp.
148 Pioneer Drive
Leominster, MA 01453

Proposed Building
440 Granite Ave
Milton, MA

BORING B-2

20-09045

Ground Elevation: 42 ft+/-
Date Started: 10/15/2020
Date Finished: 10/15/2020
Driller: DL
Soil Engineer/Geologist:

GROUNDWATER OBSERVATIONS

DATE	DEPTH	CASING AT	STABILIZATION
10/15/20	n/a		

Depth Ft.	Casing bl/ft	Sample No.	Pen/ Rec	Depth	Blows/6"	Strata Break	Visual Identification of Soil and / or Rock Sample
						1"	ASPHALT
1		1	4"	0'1"-2'1"	7-5-5-2	2'1"	Dark Brown, fine to medium Sand, little gravel, little silt (FILL)
		2	7"	2'1"-4'1"	7-7-14-15		Brown, f-m Sand, some gravel, little silt
5		3	9"	5'0"-7'0"	7-9-15-15		Brown-Grey, mottled, f-m Sand, some gravel, some to little silt
		4	10"	7'0"-8'2"	19-21-100/2"		Brown, fine to coarse Sand, little silt, little gravel, cobbles (GLACIAL)
10						10'	Refusal at 10 ft No Ground Water encountered at completion
15							
20							
25							
30							

Notes: Geoprobe 7822

Cohesionless: 0 - 4 V. Loose, 4 - 10 Loose, 10 -30 M Dense, 30 -50 Dense, 50+ V Dense.
Cohesive: 0 -2 V Soft, 2 -4 Soft, 4 -8 M Stiff 8 -15 Stiff, 15 -30 V. Stiff, 30 + Hard.

Trace	0 to 10%
Little	10 to 20%
Some	20 to 35%
And	35% to 50%

	CASING	SAMPLE	CORE TYPE
ID SIZE (IN)		SS	
HAMMER WGT (LB)		140 lb.	
HAMMER FALL (IN)		30"	

TEST BORING LOG

SOIL X, Corp.
148 Pioneer Drive
Leominster, MA 01453

Proposed Building
440 Granite Ave
Milton, MA

BORING B-3

20-09045

Ground Elevation: 42 ft+/-
Date Started: 10/15/2020
Date Finished: 10/15/2020
Driller: DL
Soil Engineer/Geologist:

GROUNDWATER OBSERVATIONS

DATE	DEPTH	CASING AT	STABILIZATION
10/15/20	14 ft		

Depth Ft.	Casing bl/ft	Sample No.	Sample Pen/Rec	Sample Depth	Sample Blows/6"	Strata Break	Visual Identification of Soil and / or Rock Sample
1		1	7"	0'0"-2'0"	3-7-8-5		Dark Brown, fine to medium Sand, little gravel, little silt, loam
		2	3"	2'0"-4'0"	6-7-3-10	4'	Same, trace wood (FILL)
5		3	18"	5'0"-7'0"	16-15-30-32		Brown, f-m Sand, little gravel, little silt
		4	12"	7'0"-8'3"	33-54-100/3"		Brown, f-m Sand & Gravel, trace silt, cobbles, dry
10		5	18"	10'0"-12'0"	35-43-39-52		Brown, fine to coarse Sand & Gravel, trace silt, cobbles, dry (GLACIAL)
15		6	3"	15'0"-17'0"	19-20-19-20		Same, wet
						19'	
20							Refusal at 19 ft Ground Water encountered 14 ft at completion
25							
30							

Notes: Geoprobe 7822

Cohesionless: 0 - 4 V. Loose, 4 - 10 Loose, 10 -30 M Dense, 30 -50 Dense, 50+ V Dense.
Cohesive: 0 -2 V Soft, 2 -4 Soft, 4 -8 M Stiff 8 -15 Stiff, 15 -30 V. Stiff, 30 + Hard.

Trace	0 to 10%
Little	10 to 20%
Some	20 to 35%
And	35% to 50%

	CASING	SAMPLE	CORE TYPE
ID SIZE (IN)		SS	
HAMMER WGT (LB)		140 lb.	
HAMMER FALL (IN)		30"	

TEST BORING LOG

SOIL X, Corp.
148 Pioneer Drive
Leominster, MA 01453

Proposed Building
440 Granite Ave
Milton, MA

BORING B-4

20-09045

Ground Elevation: 41 ft +/-
Date Started: 10/15/2020
Date Finished: 10/15/2020
Driller: DL
Soil Engineer/Geologist:

GROUNDWATER OBSERVATIONS

DATE	DEPTH	CASING AT	STABILIZATION
10/15/20	14 ft		

Depth Ft.	Casing bl/ft	Sample No.	Pen/ Rec	Depth	Blows/6"	Strata Break	Visual Identification of Soil and / or Rock Sample
1		1	3"	0'0"-2'0"	4-2-1-1		Black, silty Sand w/ gravel
		2	1"	2'0"-4'0"	1-1-5-7	4'	Dark Brown, loamy, silty Sand, little gravel (FILL)
5		3	12"	5'0"-7'0"	17-18-35-40		Brown, f-m Sand & Gravel, fractured rock, dry
		4	2"	7'0"-7'2"	100/2"		Same, boulders
10		5	17"	10'0"-12'0"	25-18-19-18		Brown, fine to medium Sand, trace silt, trace gravel, dry (GLACIAL)
15		6	14"	15'0"-17'0"	20-15-19-15	15'	Grey, f-m Sand, some gravel, some silt, wet
20						19'	Refusal at 19 ft Ground Water encountered 14 ft at completion
25							
30							

Notes: Geoprobe 7822

Cohesionless: 0 - 4 V. Loose, 4 - 10 Loose, 10 -30 M Dense, 30 -50 Dense, 50+ V Dense.
Cohesive: 0 -2 V Soft, 2 -4 Soft, 4 -8 M Stiff 8 -15 Stiff, 15 -30 V. Stiff, 30 + Hard.

Trace	0 to 10%
Little	10 to 20%
Some	20 to 35%
And	35% to 50%

	CASING	SAMPLE	CORE TYPE
ID SIZE (IN)		SS	
HAMMER WGT (LB)		140 lb.	
HAMMER FALL (IN)		30"	

TEST BORING LOG

SOIL X, Corp.
148 Pioneer Drive
Leominster, MA 01453

Proposed Building
440 Granite Ave
Milton, MA

BORING B-5

20-09045

Ground Elevation: 42 ft+/-
Date Started: 10/15/2020
Date Finished: 10/15/2020
Driller: DL
Soil Engineer/Geologist:

GROUNDWATER OBSERVATIONS

DATE	DEPTH	CASING AT	STABILIZATION
10/15/20	n/a		

Depth Ft.	Casing bl/ft	Sample No.	Pen/ Rec	Depth	Blows/6"	Strata Break	Visual Identification of Soil and / or Rock Sample
						1"	ASPHALT
1		1	12"	0'1"-2'1"	6-5-2-2		Dark Brown, loamy, silty Sand, gravel, brick, loam (FILL)
		2	2"	2'1"-4'1"	2-1-1-1	4'1"	
5		3	18"	5'0"-7'0"	14-10-8-14		Light Grey, mottled, Fine Sand w/ Silt
		4	12"	7'0"-8'2"	25-27-100/2"		Brown, fine to medium Sand, little silt, little gravel, cobbles, boulders
							(GLACIAL)
10		5	2"	10'0"-10'2"	100/2"		Brown, f-m Sand, little gravel, cobbles, boulders, dry
						14'	
15							Refusal at 14 ft No Ground Water encountered at completion
20							
25							
30							

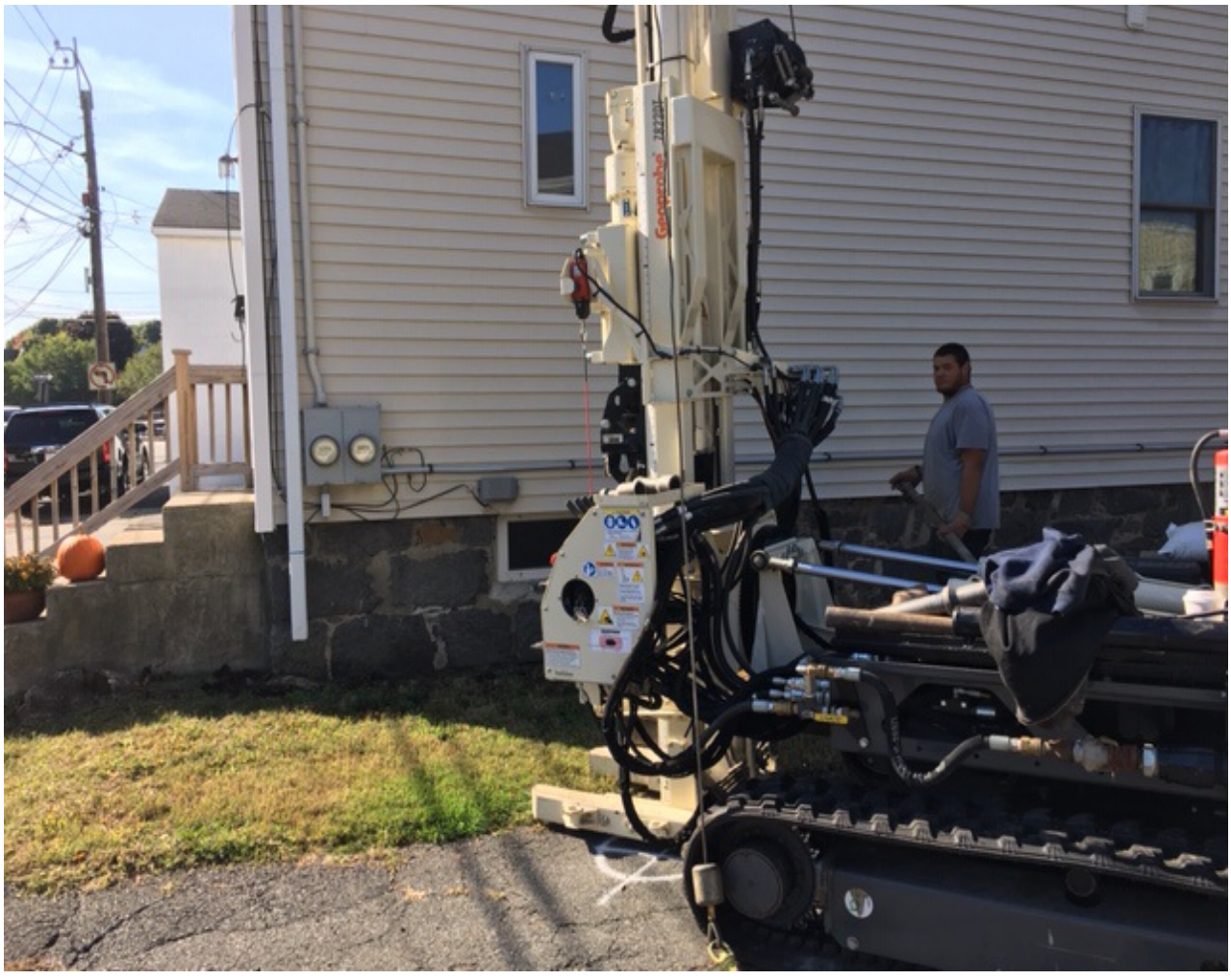
Notes: Geoprobe 7822

Cohesionless: 0 - 4 V. Loose, 4 - 10 Loose, 10 -30 M Dense, 30 -50 Dense, 50+ V Dense.
Cohesive: 0 -2 V Soft, 2 -4 Soft, 4 -8 M Stiff 8 -15 Stiff, 15 -30 V. Stiff, 30 + Hard.

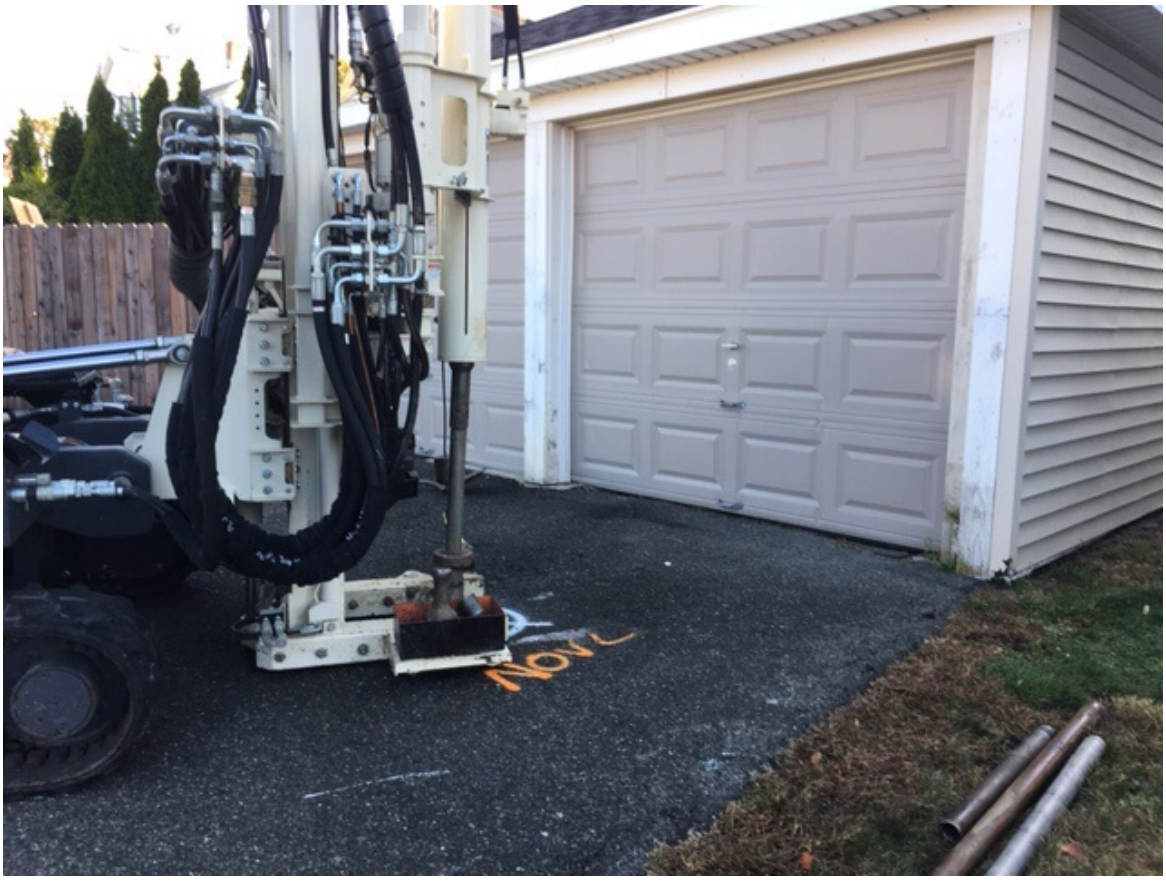
Trace	0 to 10%
Little	10 to 20%
Some	20 to 35%
And	35% to 50%

	CASING	SAMPLE	CORE TYPE
ID SIZE (IN)		SS	
HAMMER WGT (LB)		140 lb.	
HAMMER FALL (IN)		30"	

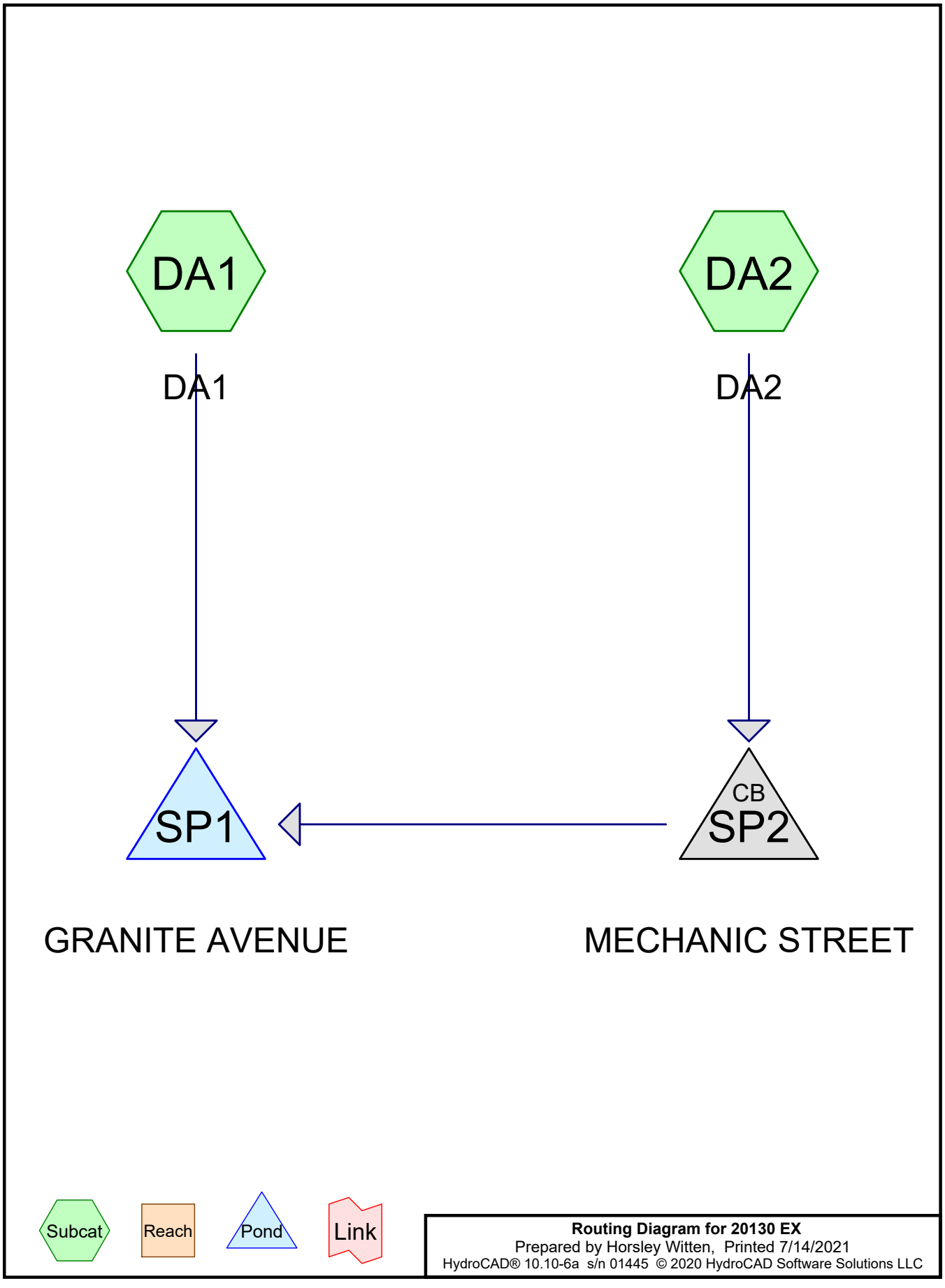

KITCHEN CABINETS
OPEN
COUNTERTOPS




DR103
Automatic
Drop Hamme



APPENDIX D
HydroCAD Drainage Calculations



Routing Diagram for 20130 EX
Prepared by Horsley Witten, Printed 7/14/2021

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2year	Type III 24-hr		Default	24.00	1	3.38	2
2	10year	Type III 24-hr		Default	24.00	1	5.27	2
3	25year	Type III 24-hr		Default	24.00	1	6.45	2
4	100year	Type III 24-hr		Default	24.00	1	8.27	2

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.103	39	>75% Grass cover, Good, HSG A (DA1, DA2)
0.165	98	Paved parking, HSG A (DA1, DA2)
0.175	98	Roofs, HSG A (DA1, DA2)
0.443	**84**	**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.103	0.000	0.000	0.000	0.000	0.103	>75% Grass cover, Good	DA1, DA2
0.165	0.000	0.000	0.000	0.000	0.165	Paved parking	DA1, DA2
0.175	0.000	0.000	0.000	0.000	0.175	Roofs	DA1, DA2
0.443	**0.000**	**0.000**	**0.000**	**0.000**	**0.443**	**TOTAL AREA**	

Summary for Subcatchment DA1: DA1

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

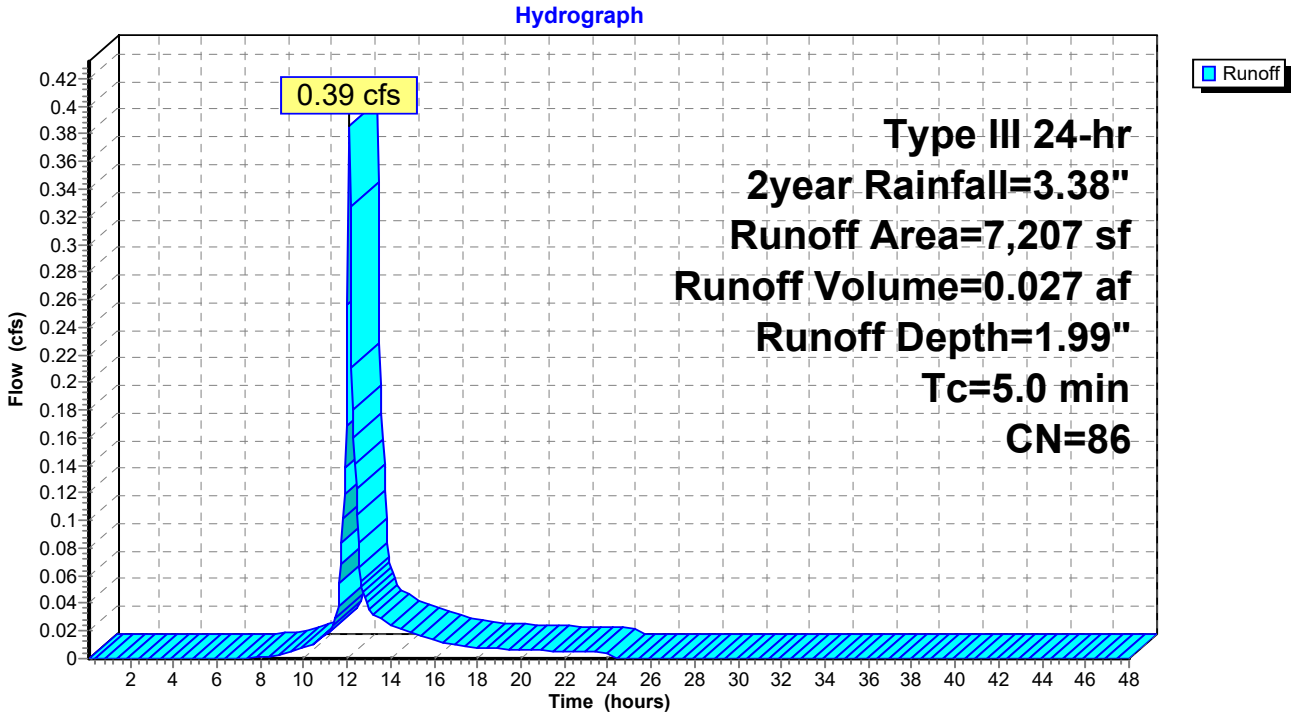
Runoff = 0.39 cfs @ 12.08 hrs, Volume= 0.027 af, Depth= 1.99"
Routed to Pond SP1 : GRANITE AVENUE

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2year Rainfall=3.38"

Area (sf)	CN	Description
2,576	98	Paved parking, HSG A
3,148	98	Roofs, HSG A
1,483	39	>75% Grass cover, Good, HSG A
7,207	86	Weighted Average
1,483		20.58% Pervious Area
5,724		79.42% Impervious Area

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

Subcatchment DA1: DA1



Summary for Subcatchment DA2: DA2

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

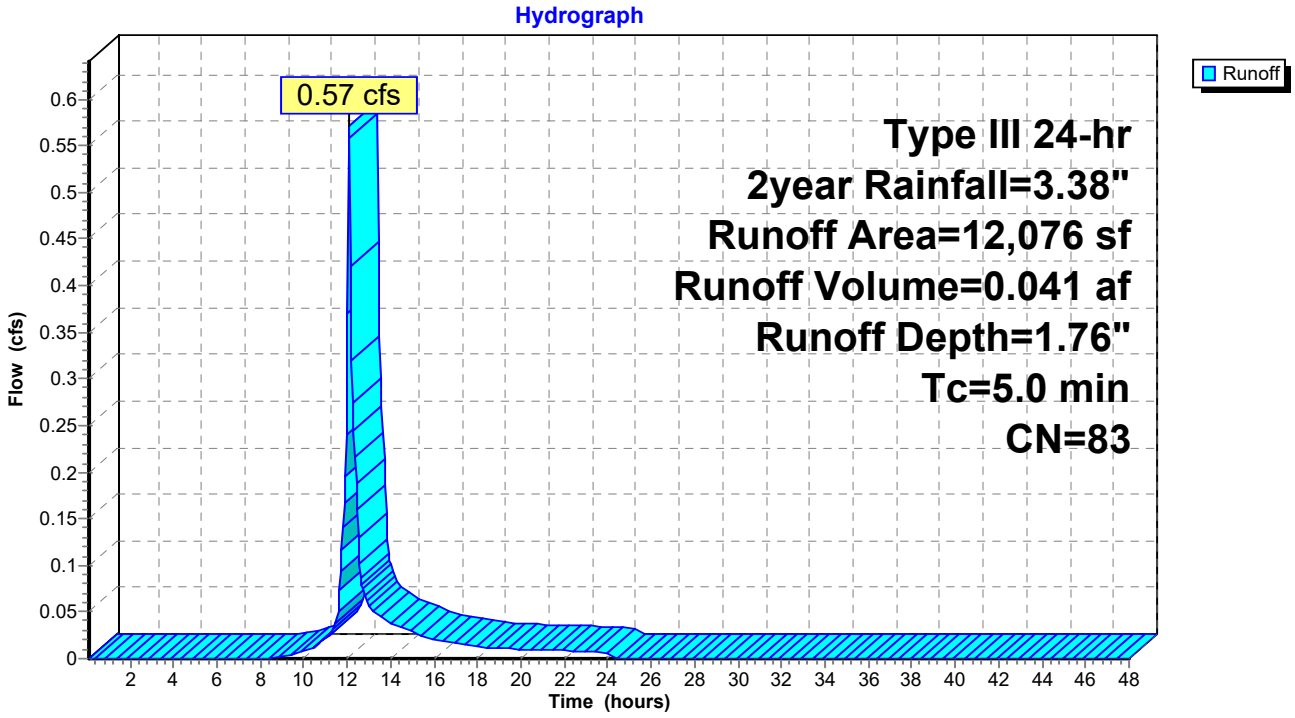
Runoff = 0.57 cfs @ 12.08 hrs, Volume= 0.041 af, Depth= 1.76"
Routed to Pond SP2 : MECHANIC STREET

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 2year Rainfall=3.38"

Area (sf)	CN	Description
4,605	98	Paved parking, HSG A
4,482	98	Roofs, HSG A
2,989	39	>75% Grass cover, Good, HSG A
12,076	83	Weighted Average
2,989		24.75% Pervious Area
9,087		75.25% Impervious Area

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

Subcatchment DA2: DA2



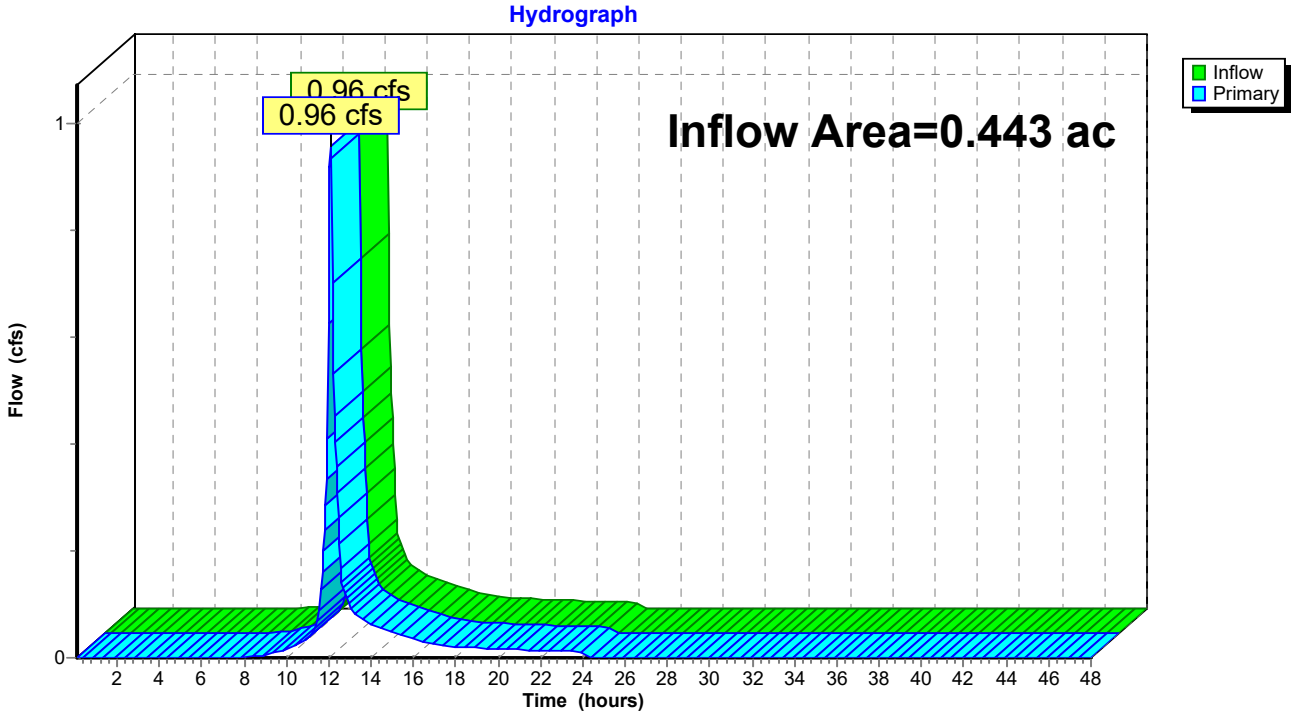
Summary for Pond SP1: GRANITE AVENUE

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.443 ac, 76.81% Impervious, Inflow Depth = 1.85" for 2year event
Inflow = 0.96 cfs @ 12.08 hrs, Volume= 0.068 af
Primary = 0.96 cfs @ 12.08 hrs, Volume= 0.068 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs

Pond SP1: GRANITE AVENUE



Summary for Pond SP2: MECHANIC STREET

[57] Hint: Peaked at 35.83' (Flood elevation advised)

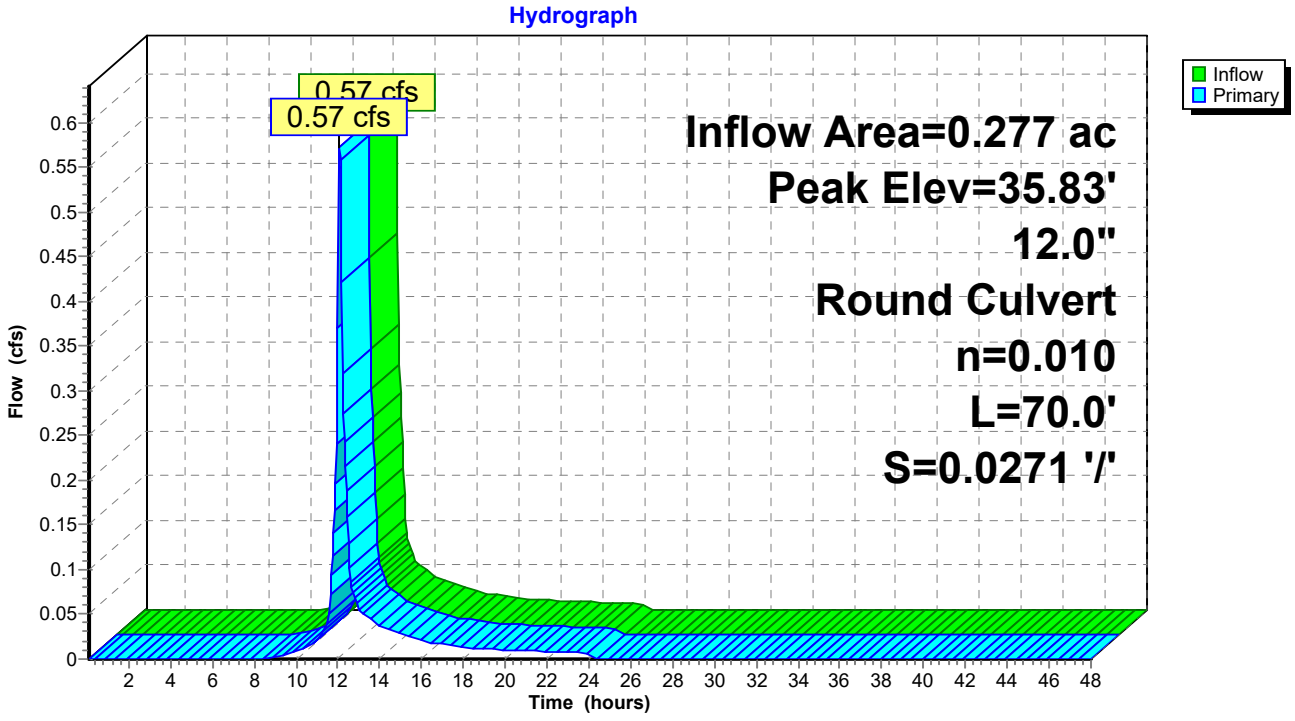
Inflow Area = 0.277 ac, 75.25% Impervious, Inflow Depth = 1.76" for 2year event
Inflow = 0.57 cfs @ 12.08 hrs, Volume= 0.041 af
Outflow = 0.57 cfs @ 12.08 hrs, Volume= 0.041 af, Atten= 0%, Lag= 0.0 min
Primary = 0.57 cfs @ 12.08 hrs, Volume= 0.041 af
Routed to Pond SP1 : GRANITE AVENUE

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs
Peak Elev= 35.83' @ 12.08 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	35.40'	**12.0" Round CMP_Round 12"** L= 70.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 35.40' / 33.50' S= 0.0271 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.55 cfs @ 12.08 hrs HW=35.82' TW=0.00' (Dynamic Tailwater)
1=CMP_Round 12" (Inlet Controls 0.55 cfs @ 1.75 fps)

Pond SP2: MECHANIC STREET



Summary for Subcatchment DA1: DA1

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

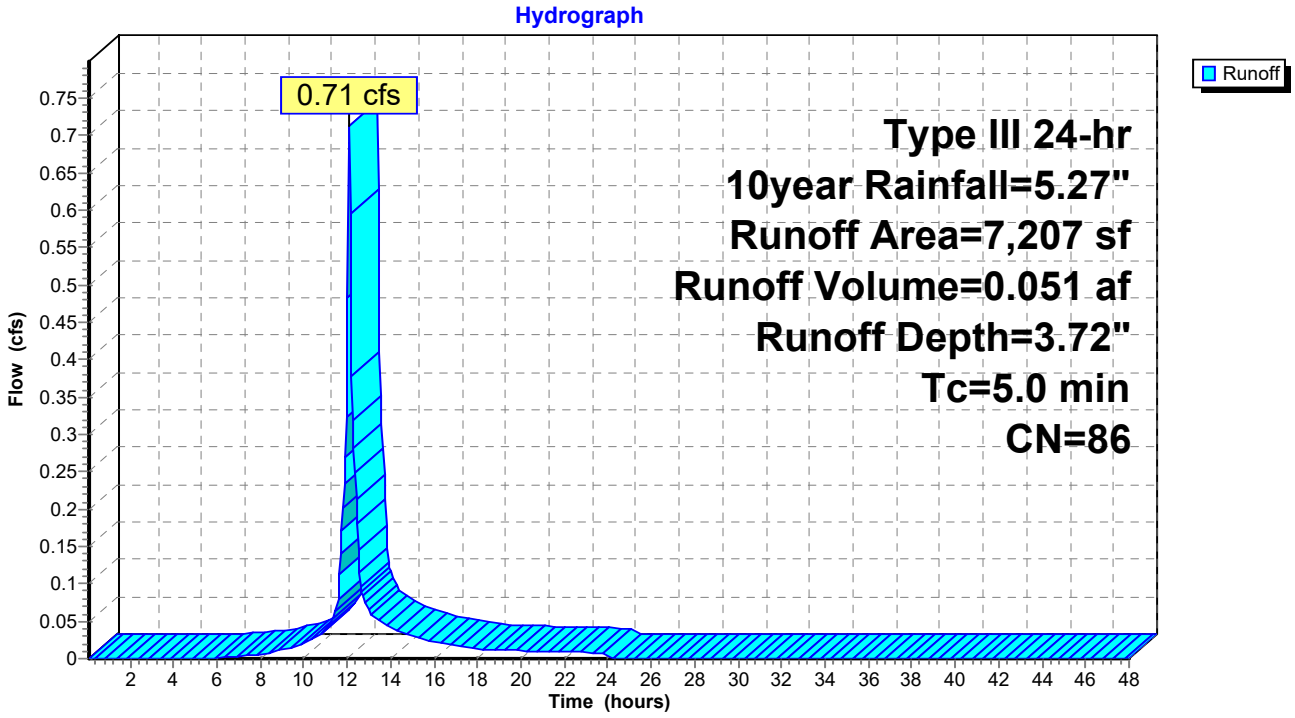
Runoff = 0.71 cfs @ 12.07 hrs, Volume= 0.051 af, Depth= 3.72"
Routed to Pond SP1 : GRANITE AVENUE

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10year Rainfall=5.27"

Area (sf)	CN	Description
2,576	98	Paved parking, HSG A
3,148	98	Roofs, HSG A
1,483	39	>75% Grass cover, Good, HSG A
7,207	86	Weighted Average
1,483		20.58% Pervious Area
5,724		79.42% Impervious Area

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

Subcatchment DA1: DA1



Summary for Subcatchment DA2: DA2

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

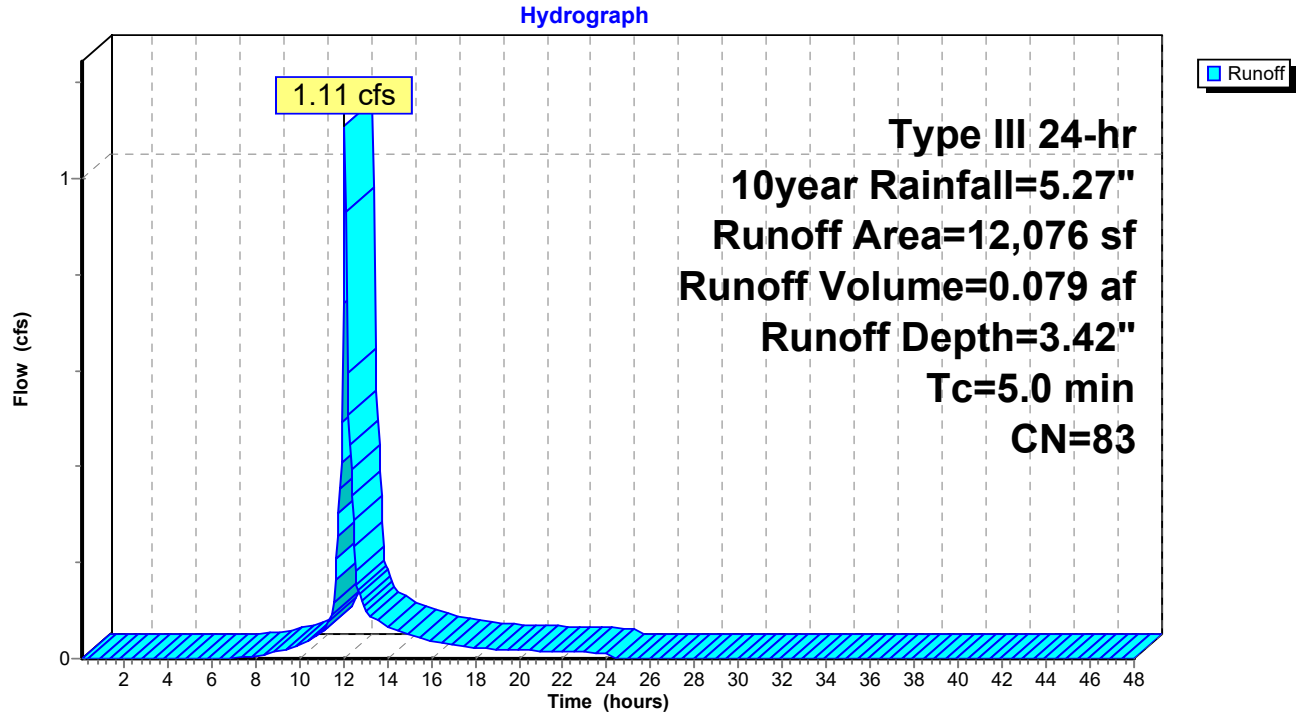
Runoff = 1.11 cfs @ 12.07 hrs, Volume= 0.079 af, Depth= 3.42"
Routed to Pond SP2 : MECHANIC STREET

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 10year Rainfall=5.27"

Area (sf)	CN	Description
4,605	98	Paved parking, HSG A
4,482	98	Roofs, HSG A
2,989	39	>75% Grass cover, Good, HSG A
12,076	83	Weighted Average
2,989		24.75% Pervious Area
9,087		75.25% Impervious Area

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

Subcatchment DA2: DA2



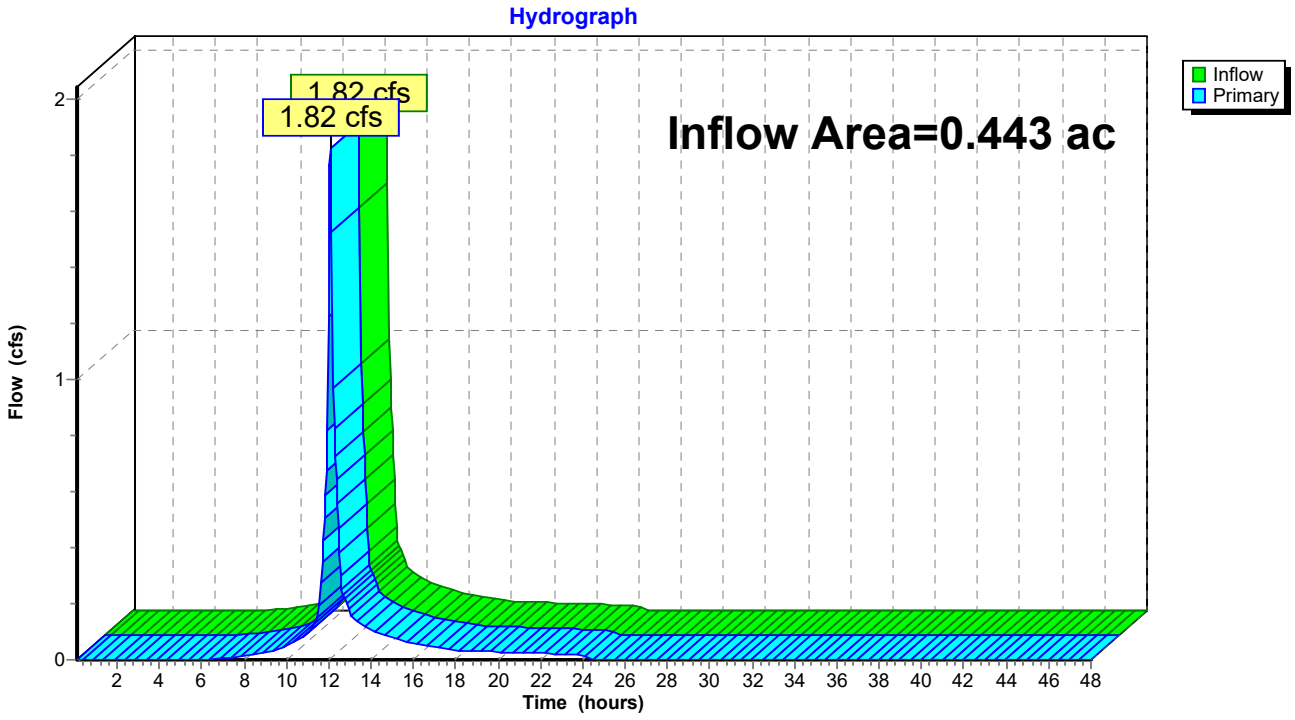
Summary for Pond SP1: GRANITE AVENUE

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.443 ac, 76.81% Impervious, Inflow Depth = 3.53" for 10year event
Inflow = 1.82 cfs @ 12.07 hrs, Volume= 0.130 af
Primary = 1.82 cfs @ 12.07 hrs, Volume= 0.130 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs

Pond SP1: GRANITE AVENUE



Summary for Pond SP2: MECHANIC STREET

[57] Hint: Peaked at 36.03' (Flood elevation advised)

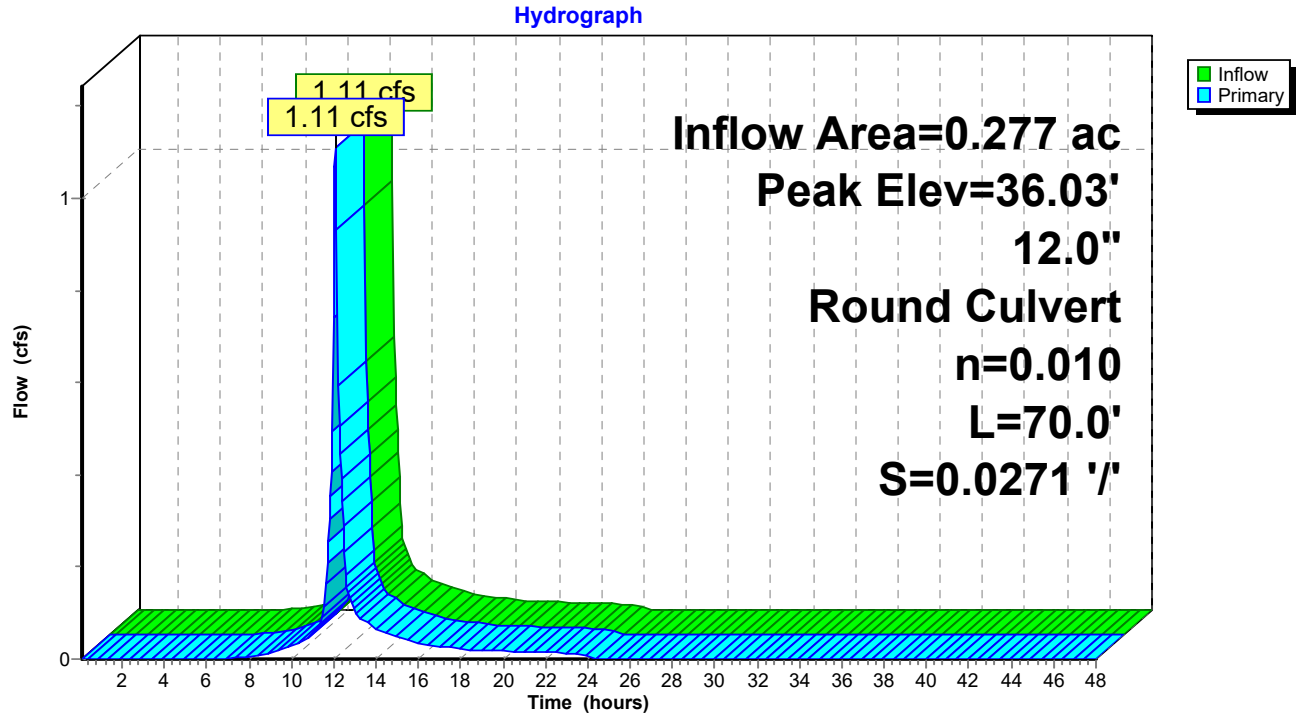
Inflow Area = 0.277 ac, 75.25% Impervious, Inflow Depth = 3.42" for 10year event
Inflow = 1.11 cfs @ 12.07 hrs, Volume= 0.079 af
Outflow = 1.11 cfs @ 12.07 hrs, Volume= 0.079 af, Atten= 0%, Lag= 0.0 min
Primary = 1.11 cfs @ 12.07 hrs, Volume= 0.079 af
Routed to Pond SP1 : GRANITE AVENUE

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs
Peak Elev= 36.03' @ 12.07 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	35.40'	**12.0" Round CMP_Round 12"** L= 70.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 35.40' / 33.50' S= 0.0271 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.07 cfs @ 12.07 hrs HW=36.02' TW=0.00' (Dynamic Tailwater)
1=CMP_Round 12" (Inlet Controls 1.07 cfs @ 2.11 fps)

Pond SP2: MECHANIC STREET



Summary for Subcatchment DA1: DA1

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

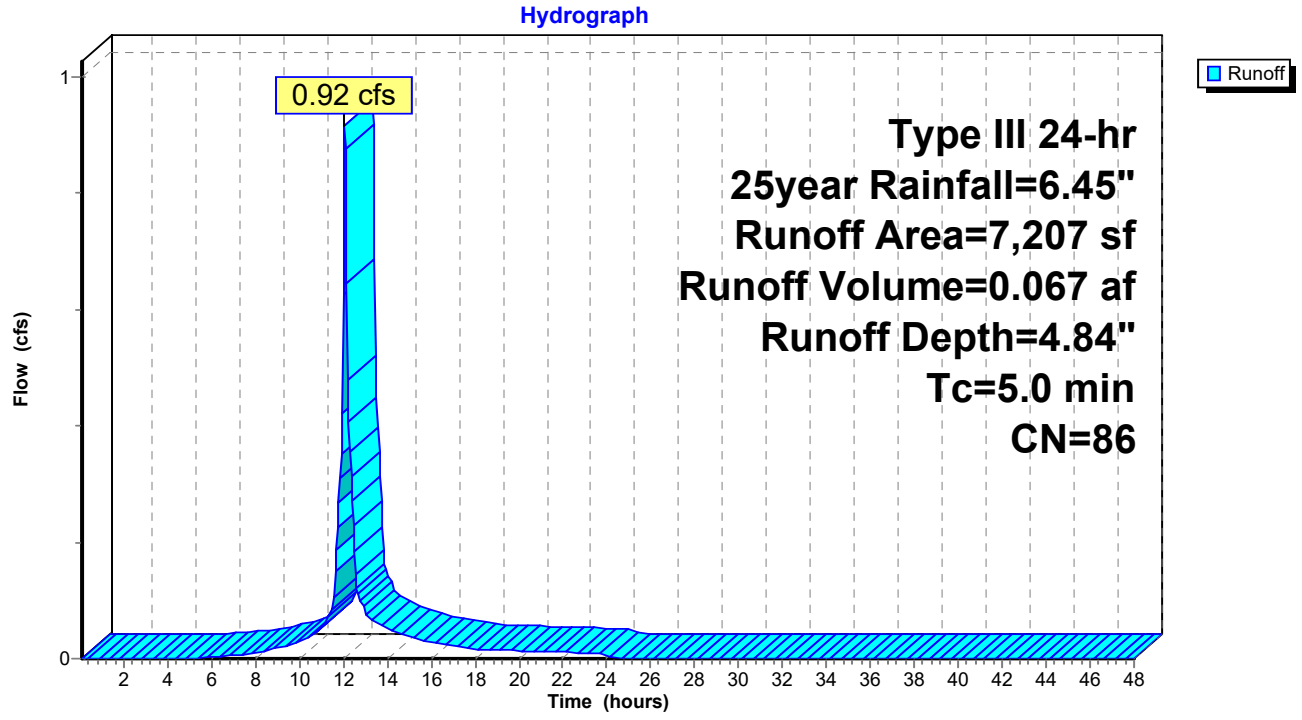
Runoff = 0.92 cfs @ 12.07 hrs, Volume= 0.067 af, Depth= 4.84"
Routed to Pond SP1 : GRANITE AVENUE

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 25year Rainfall=6.45"

Area (sf)	CN	Description
2,576	98	Paved parking, HSG A
3,148	98	Roofs, HSG A
1,483	39	>75% Grass cover, Good, HSG A
7,207	86	Weighted Average
1,483		20.58% Pervious Area
5,724		79.42% Impervious Area

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

Subcatchment DA1: DA1



Summary for Subcatchment DA2: DA2

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

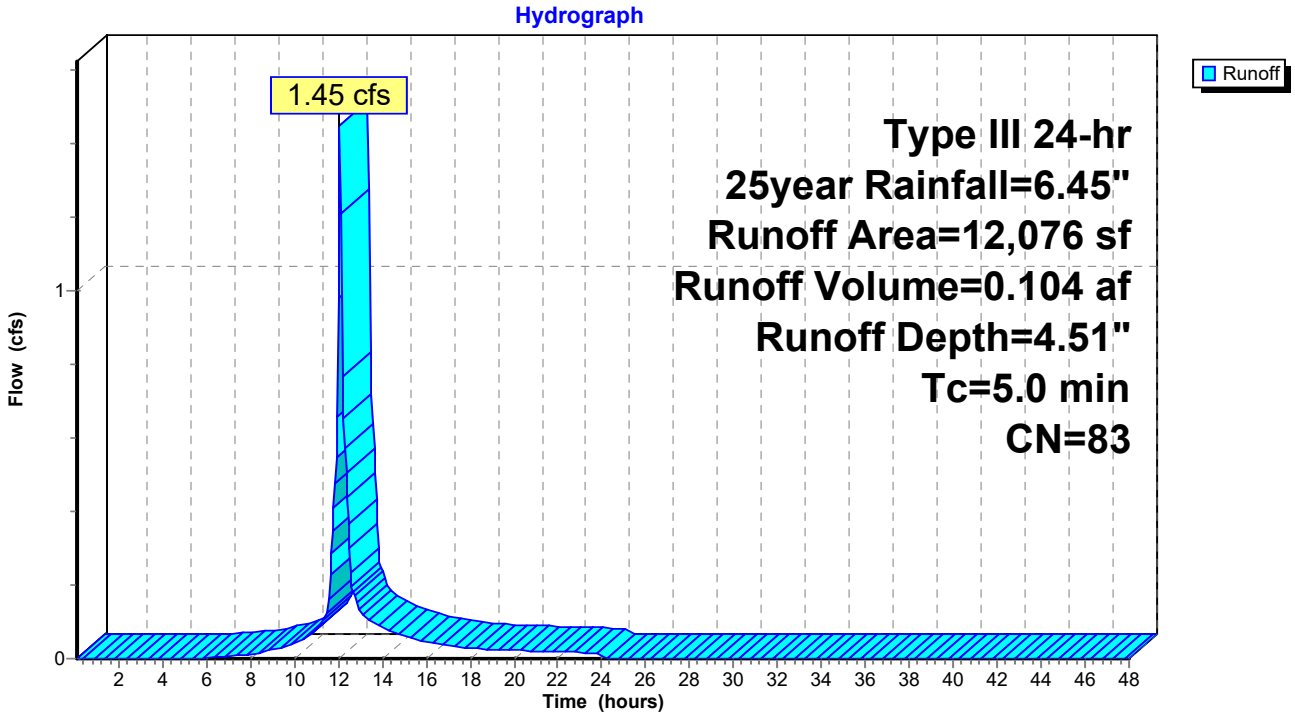
Runoff = 1.45 cfs @ 12.07 hrs, Volume= 0.104 af, Depth= 4.51"
Routed to Pond SP2 : MECHANIC STREET

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 25year Rainfall=6.45"

Area (sf)	CN	Description
4,605	98	Paved parking, HSG A
4,482	98	Roofs, HSG A
2,989	39	>75% Grass cover, Good, HSG A
12,076	83	Weighted Average
2,989		24.75% Pervious Area
9,087		75.25% Impervious Area

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

Subcatchment DA2: DA2



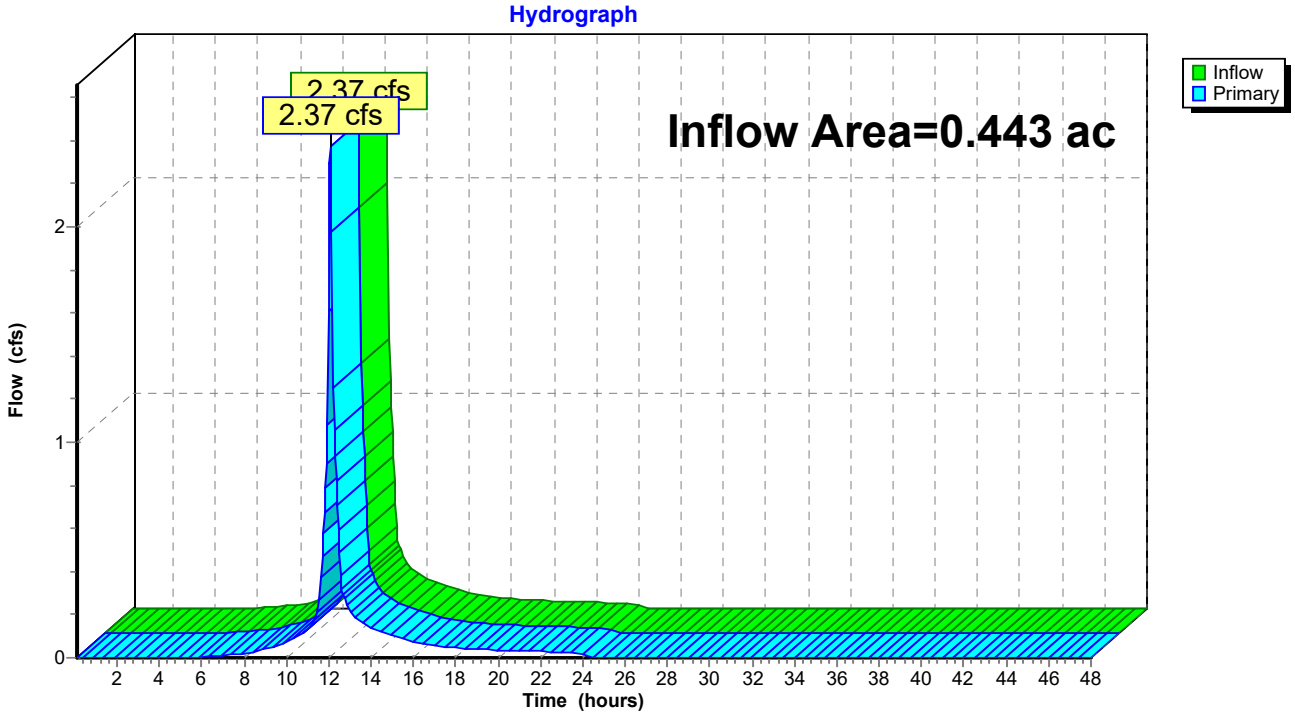
Summary for Pond SP1: GRANITE AVENUE

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.443 ac, 76.81% Impervious, Inflow Depth = 4.63" for 25year event
Inflow = 2.37 cfs @ 12.07 hrs, Volume= 0.171 af
Primary = 2.37 cfs @ 12.07 hrs, Volume= 0.171 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs

Pond SP1: GRANITE AVENUE



Summary for Pond SP2: MECHANIC STREET

[57] Hint: Peaked at 36.14' (Flood elevation advised)

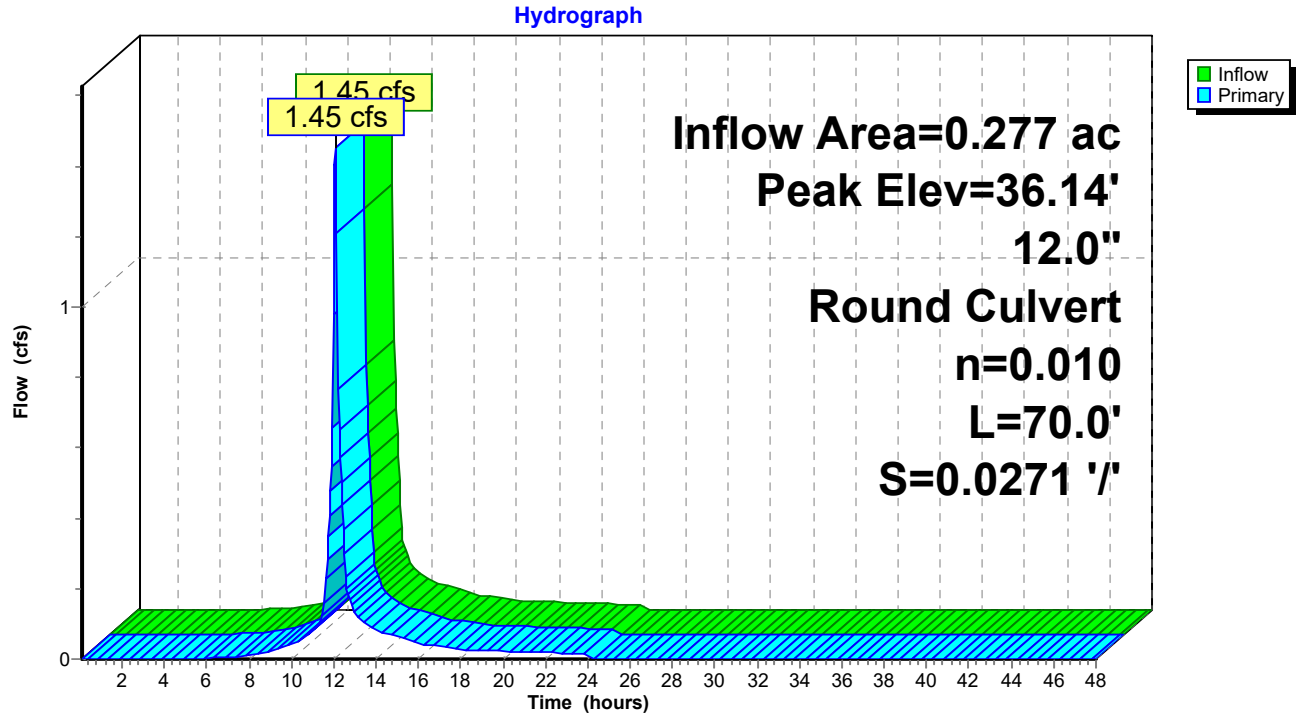
Inflow Area = 0.277 ac, 75.25% Impervious, Inflow Depth = 4.51" for 25year event
Inflow = 1.45 cfs @ 12.07 hrs, Volume= 0.104 af
Outflow = 1.45 cfs @ 12.07 hrs, Volume= 0.104 af, Atten= 0%, Lag= 0.0 min
Primary = 1.45 cfs @ 12.07 hrs, Volume= 0.104 af
Routed to Pond SP1 : GRANITE AVENUE

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs
Peak Elev= 36.14' @ 12.07 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	35.40'	**12.0" Round CMP_Round 12"** L= 70.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 35.40' / 33.50' S= 0.0271 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.40 cfs @ 12.07 hrs HW=36.13' TW=0.00' (Dynamic Tailwater)
└**1=CMP_Round 12"** (Inlet Controls 1.40 cfs @ 2.29 fps)

Pond SP2: MECHANIC STREET



Summary for Subcatchment DA1: DA1

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

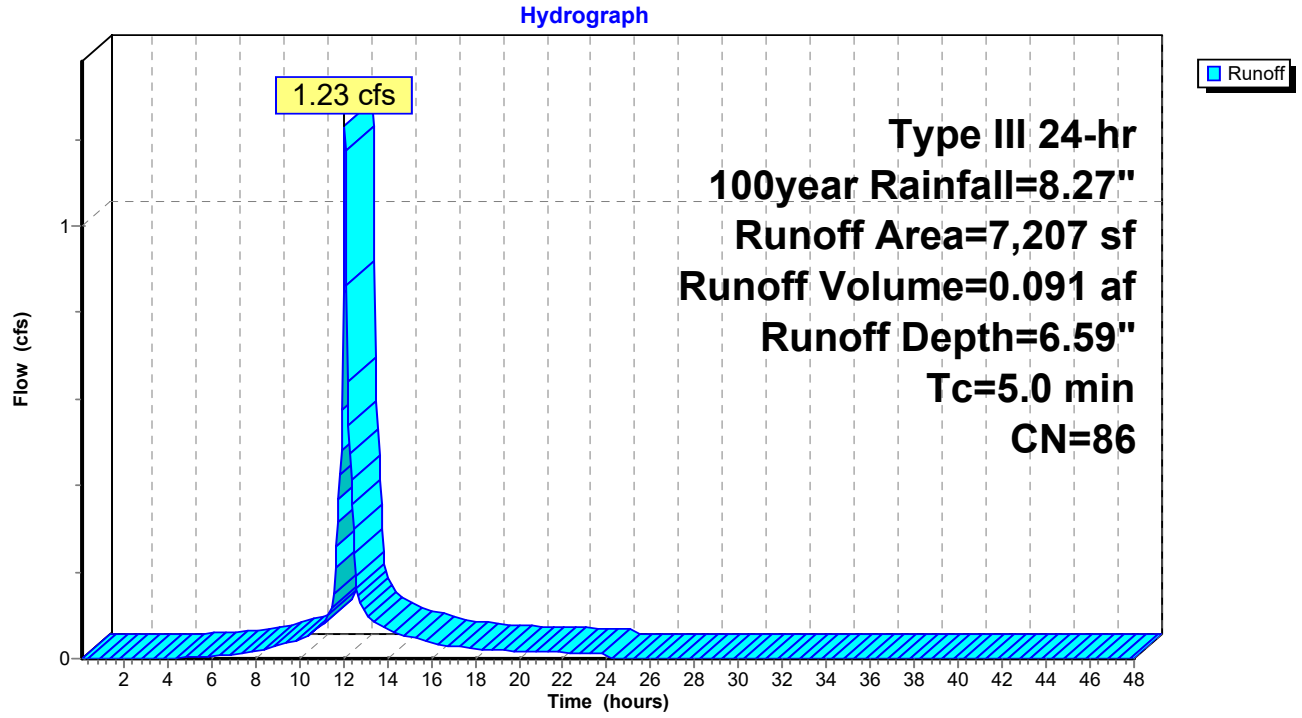
Runoff = 1.23 cfs @ 12.07 hrs, Volume= 0.091 af, Depth= 6.59"
Routed to Pond SP1 : GRANITE AVENUE

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100year Rainfall=8.27"

Area (sf)	CN	Description
2,576	98	Paved parking, HSG A
3,148	98	Roofs, HSG A
1,483	39	>75% Grass cover, Good, HSG A
7,207	86	Weighted Average
1,483		20.58% Pervious Area
5,724		79.42% Impervious Area

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

Subcatchment DA1: DA1



Summary for Subcatchment DA2: DA2

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

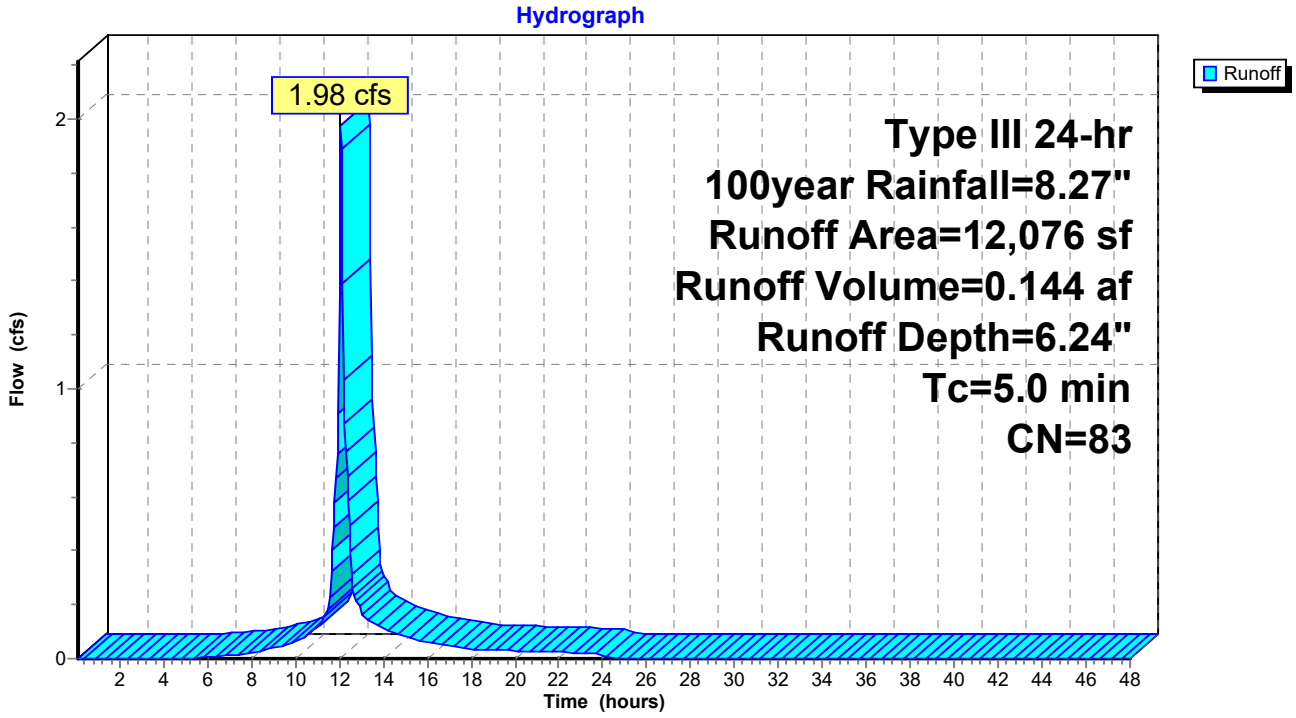
Runoff = 1.98 cfs @ 12.07 hrs, Volume= 0.144 af, Depth= 6.24"
Routed to Pond SP2 : MECHANIC STREET

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs
Type III 24-hr 100year Rainfall=8.27"

Area (sf)	CN	Description
4,605	98	Paved parking, HSG A
4,482	98	Roofs, HSG A
2,989	39	>75% Grass cover, Good, HSG A
12,076	83	Weighted Average
2,989		24.75% Pervious Area
9,087		75.25% Impervious Area

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

Subcatchment DA2: DA2



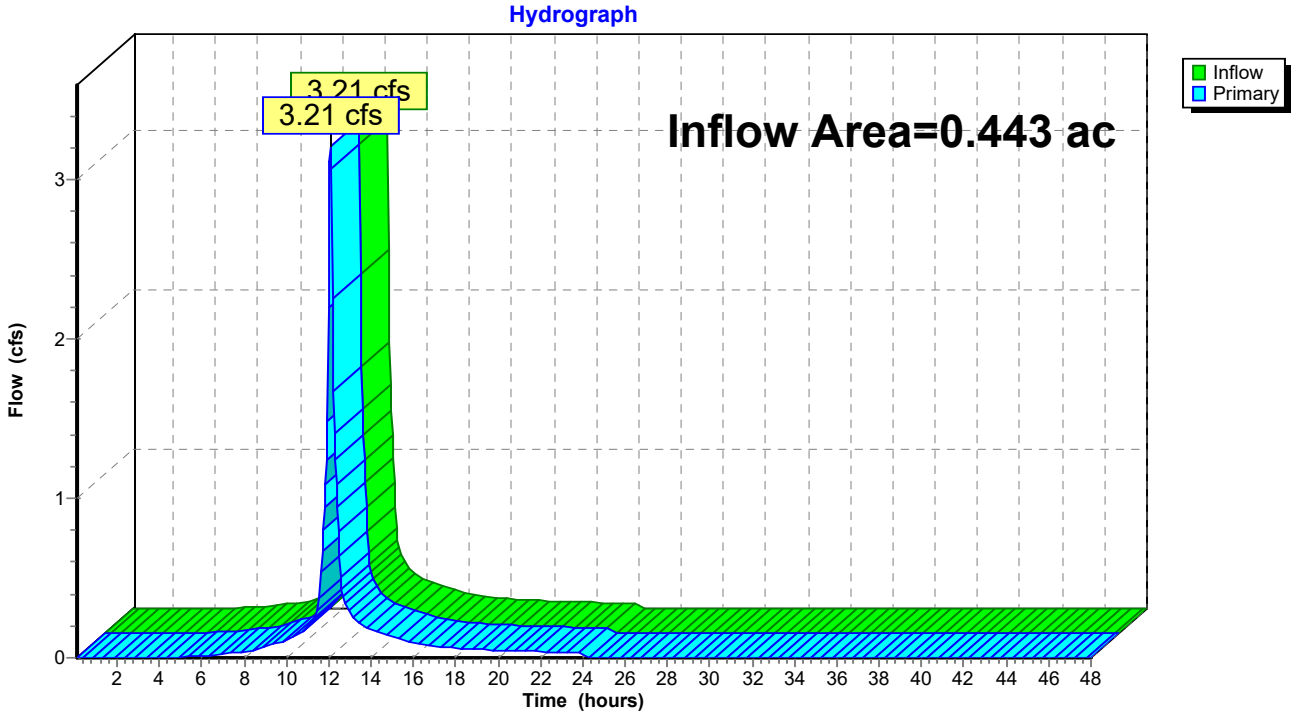
Summary for Pond SP1: GRANITE AVENUE

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.443 ac, 76.81% Impervious, Inflow Depth = 6.37" for 100year event
Inflow = 3.21 cfs @ 12.07 hrs, Volume= 0.235 af
Primary = 3.21 cfs @ 12.07 hrs, Volume= 0.235 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs

Pond SP1: GRANITE AVENUE



Summary for Pond SP2: MECHANIC STREET

[57] Hint: Peaked at 36.33' (Flood elevation advised)

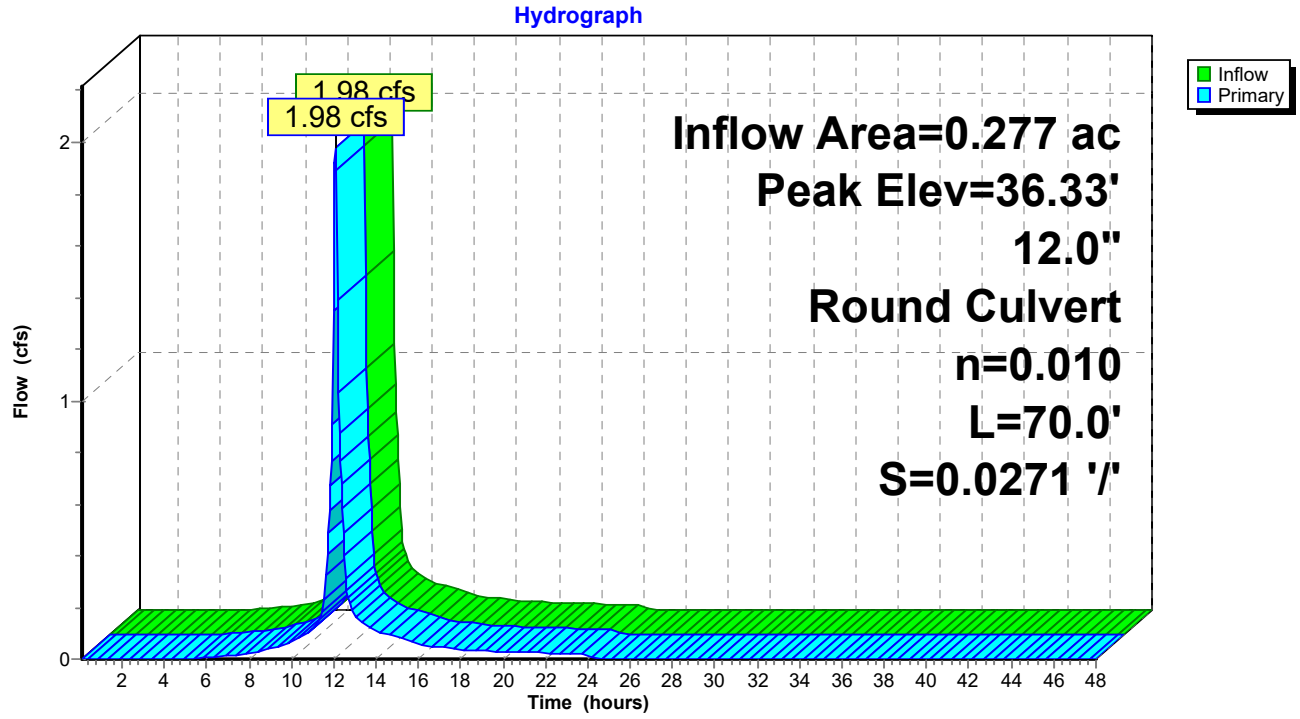
Inflow Area = 0.277 ac, 75.25% Impervious, Inflow Depth = 6.24" for 100year event
Inflow = 1.98 cfs @ 12.07 hrs, Volume= 0.144 af
Outflow = 1.98 cfs @ 12.07 hrs, Volume= 0.144 af, Atten= 0%, Lag= 0.0 min
Primary = 1.98 cfs @ 12.07 hrs, Volume= 0.144 af
Routed to Pond SP1 : GRANITE AVENUE

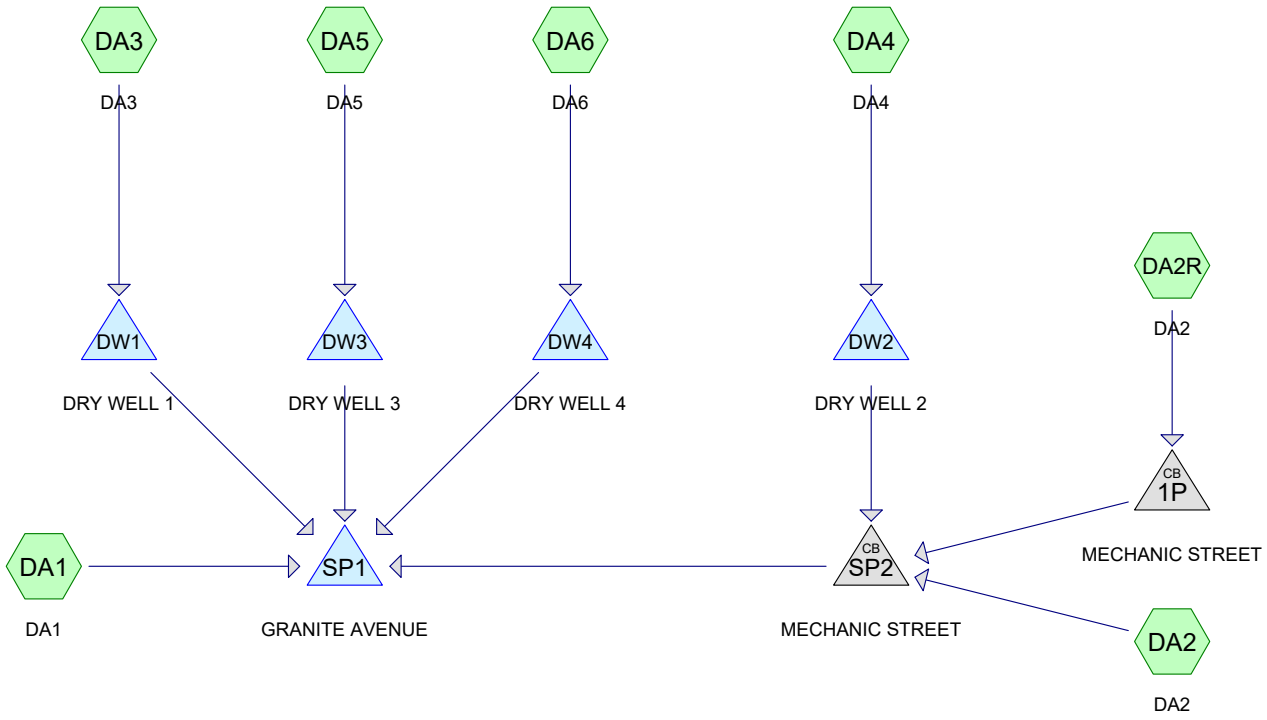
Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.05 hrs
Peak Elev= 36.33' @ 12.07 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	35.40'	**12.0" Round CMP_Round 12"** L= 70.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 35.40' / 33.50' S= 0.0271 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.91 cfs @ 12.07 hrs HW=36.30' TW=0.00' (Dynamic Tailwater)
↑**1=CMP_Round 12"** (Inlet Controls 1.91 cfs @ 2.55 fps)

Pond SP2: MECHANIC STREET





Subcat Reach Pond Link

Routing Diagram for 20130 PR
Prepared by Horsley Witten, Printed 7/14/2021

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2year	Type III 24-hr		Default	24.00	1	3.38	2
2	10year	Type III 24-hr		Default	24.00	1	5.27	2
3	25year	Type III 24-hr		Default	24.00	1	6.45	2
4	100year	Type III 24-hr		Default	24.00	1	8.27	2

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.040	39	>75% Grass cover, Good, HSG A (DA1, DA2, DA3, DA4)
0.073	98	Paved parking, HSG A (DA1, DA2, DA3, DA4, DA5, DA6)
0.330	98	Roofs, HSG A (DA2R)
0.443	**93**	**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.040	0.000	0.000	0.000	0.000	0.040	>75% Grass cover, Good	DA1, DA2, DA3, DA4
0.073	0.000	0.000	0.000	0.000	0.073	Paved parking	DA1, DA2, DA3, DA4, DA5, DA6
0.330	0.000	0.000	0.000	0.000	0.330	Roofs	DA2R
0.443	**0.000**	**0.000**	**0.000**	**0.000**	**0.443**	**TOTAL AREA**	

Summary for Subcatchment DA1: DA1

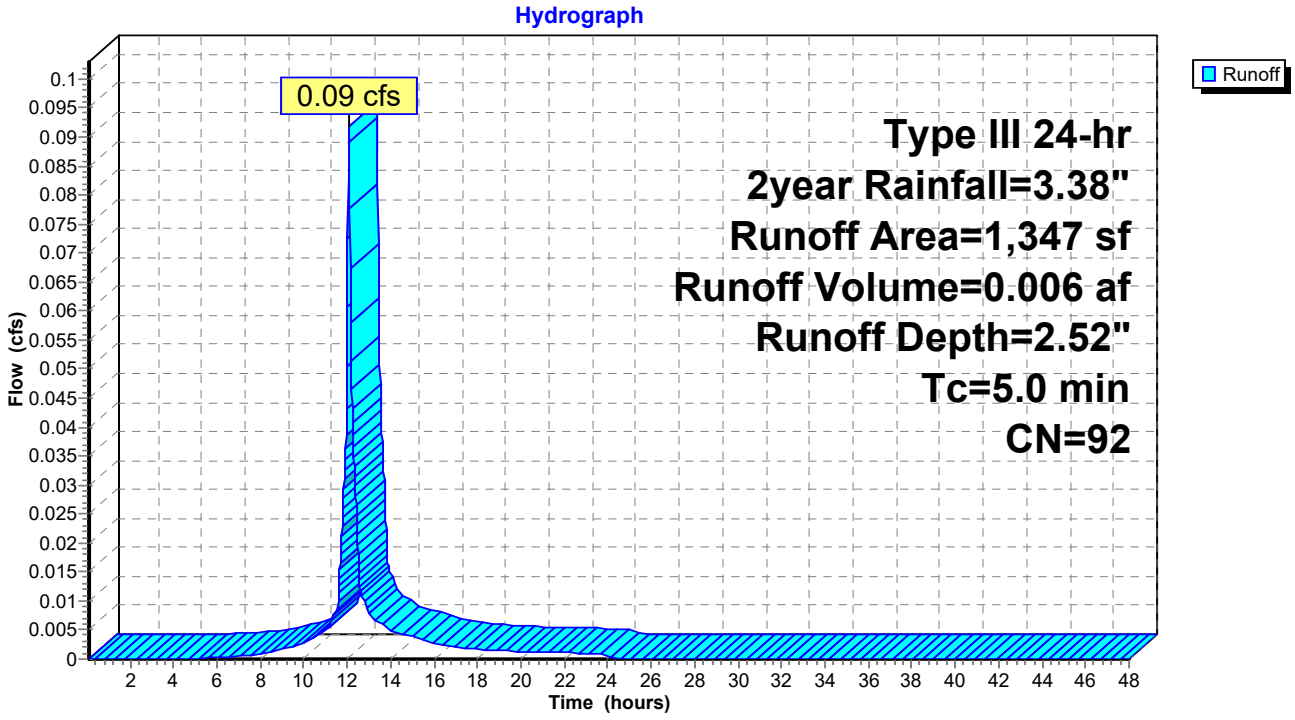
Runoff = 0.09 cfs @ 12.07 hrs, Volume= 0.006 af, Depth= 2.52"
Routed to Pond SP1 : GRANITE AVENUE

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 2year Rainfall=3.38"

Area (sf)	CN	Description
1,206	98	Paved parking, HSG A
141	39	>75% Grass cover, Good, HSG A
1,347	92	Weighted Average
141		10.47% Pervious Area
1,206		89.53% Impervious Area

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

Subcatchment DA1: DA1



Summary for Subcatchment DA2: DA2

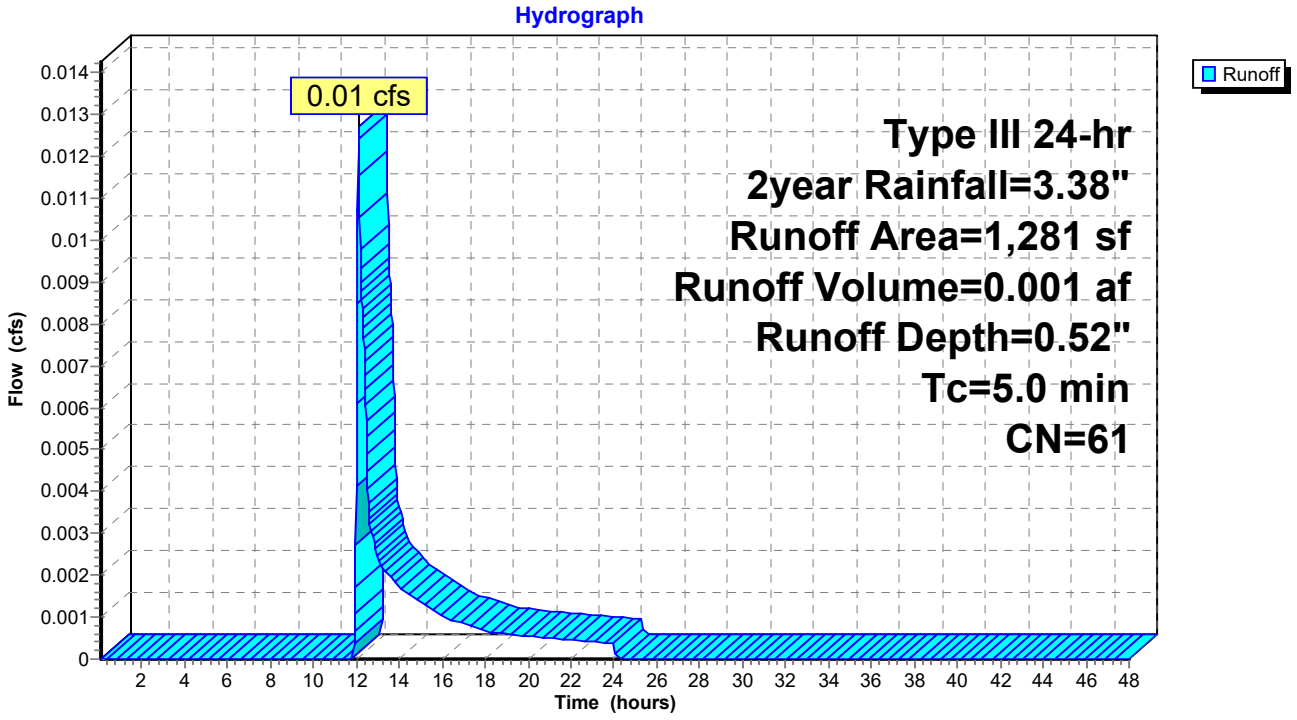
Runoff = 0.01 cfs @ 12.10 hrs, Volume= 0.001 af, Depth= 0.52"
Routed to Pond SP2 : MECHANIC STREET

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 2year Rainfall=3.38"

Area (sf)	CN	Description
484	98	Paved parking, HSG A
797	39	>75% Grass cover, Good, HSG A
1,281	61	Weighted Average
797		62.22% Pervious Area
484		37.78% Impervious Area

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

Subcatchment DA2: DA2



Summary for Subcatchment DA2R: DA2

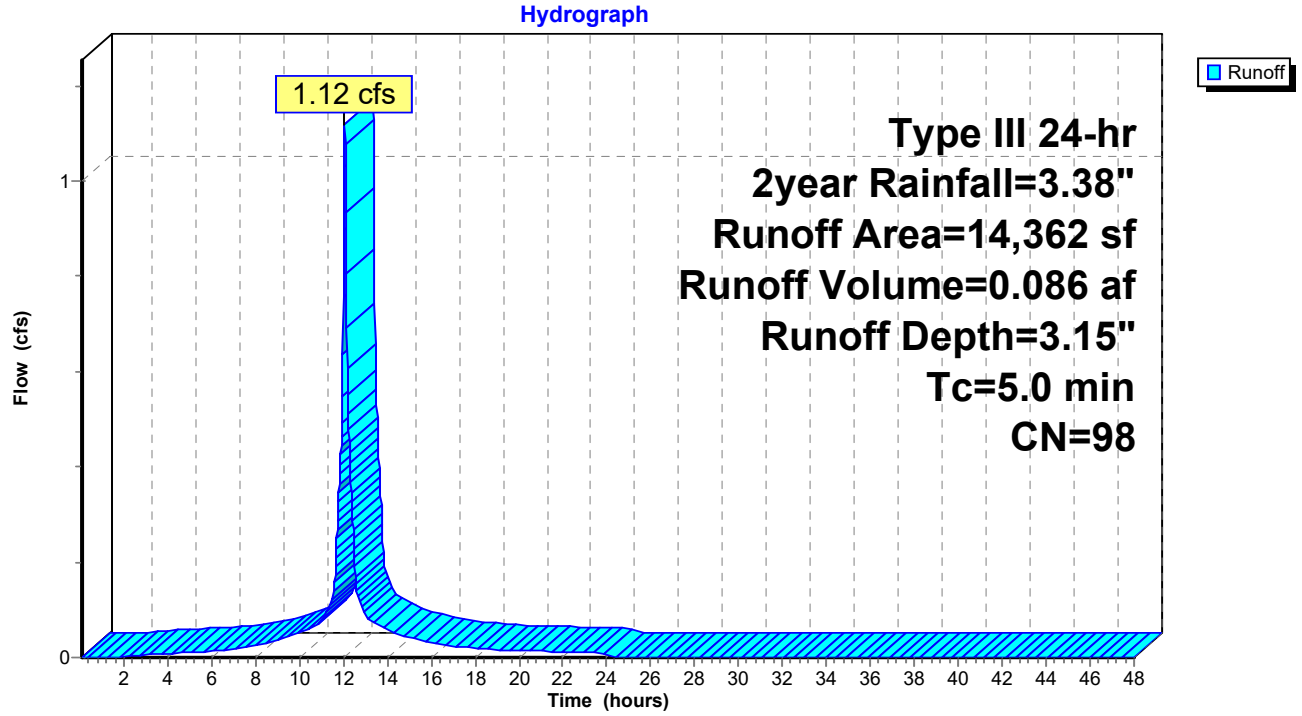
Runoff = 1.12 cfs @ 12.07 hrs, Volume= 0.086 af, Depth= 3.15"
Routed to Pond 1P : MECHANIC STREET

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 2year Rainfall=3.38"

Area (sf)	CN	Description
14,362	98	Roofs, HSG A
14,362		100.00% Impervious Area

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

Subcatchment DA2R: DA2



Summary for Subcatchment DA3: DA3

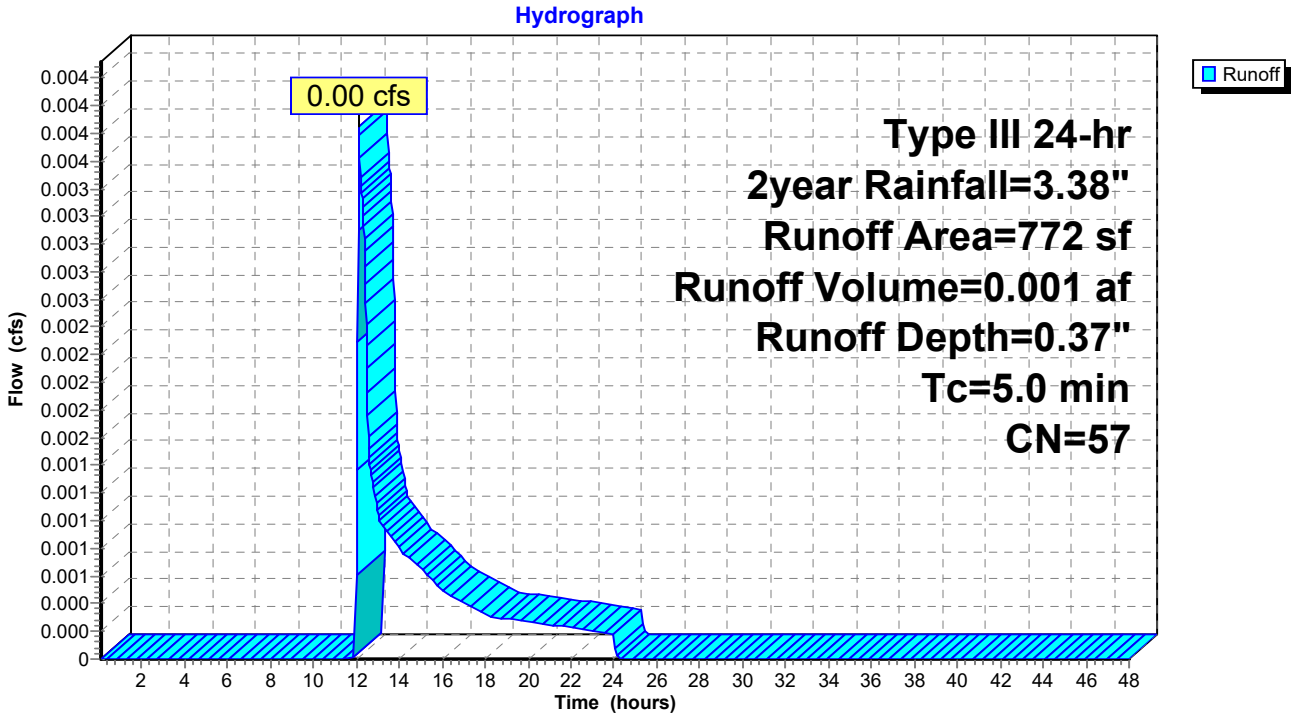
Runoff = 0.00 cfs @ 12.13 hrs, Volume= 0.001 af, Depth= 0.37"
Routed to Pond DW1 : DRY WELL 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 2year Rainfall=3.38"

Area (sf)	CN	Description
230	98	Paved parking, HSG A
542	39	>75% Grass cover, Good, HSG A
772	57	Weighted Average
542		70.21% Pervious Area
230		29.79% Impervious Area

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

Subcatchment DA3: DA3



Summary for Subcatchment DA4: DA4

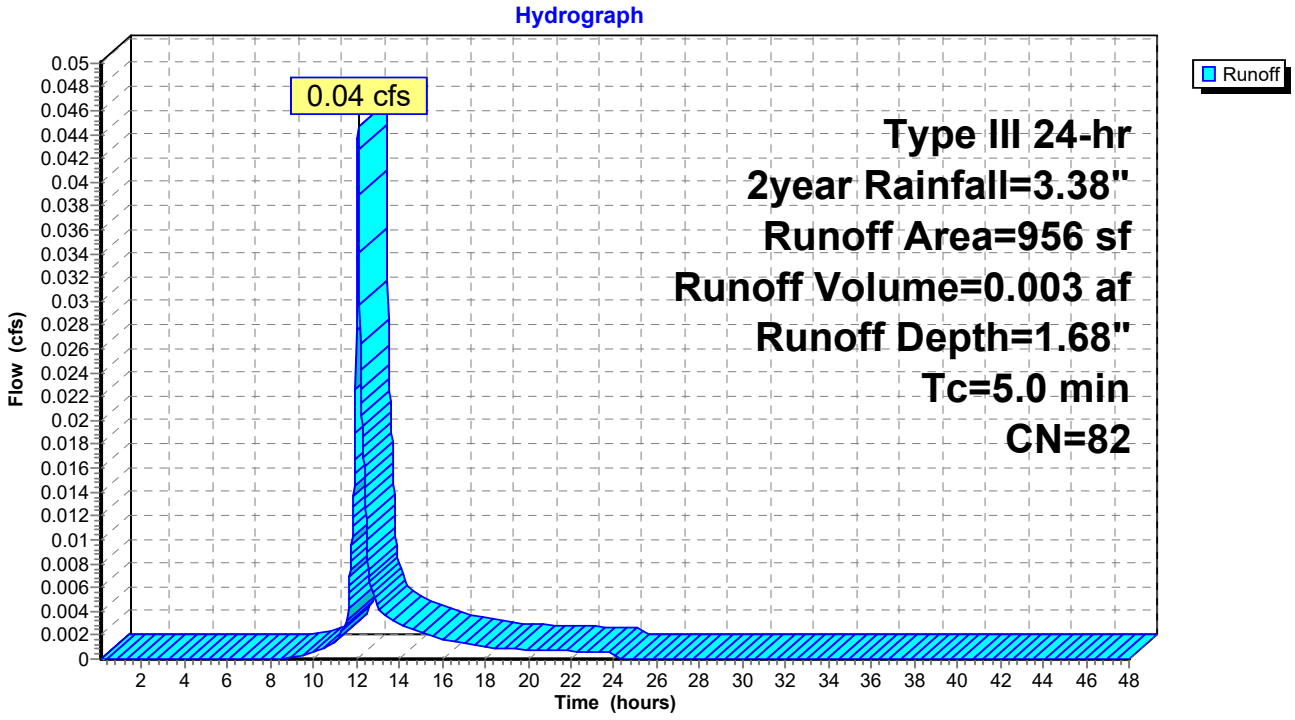
Runoff = 0.04 cfs @ 12.08 hrs, Volume= 0.003 af, Depth= 1.68"
Routed to Pond DW2 : DRY WELL 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 2year Rainfall=3.38"

Area (sf)	CN	Description
702	98	Paved parking, HSG A
254	39	>75% Grass cover, Good, HSG A
956	82	Weighted Average
254		26.57% Pervious Area
702		73.43% Impervious Area

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

Subcatchment DA4: DA4



Summary for Subcatchment DA5: DA5

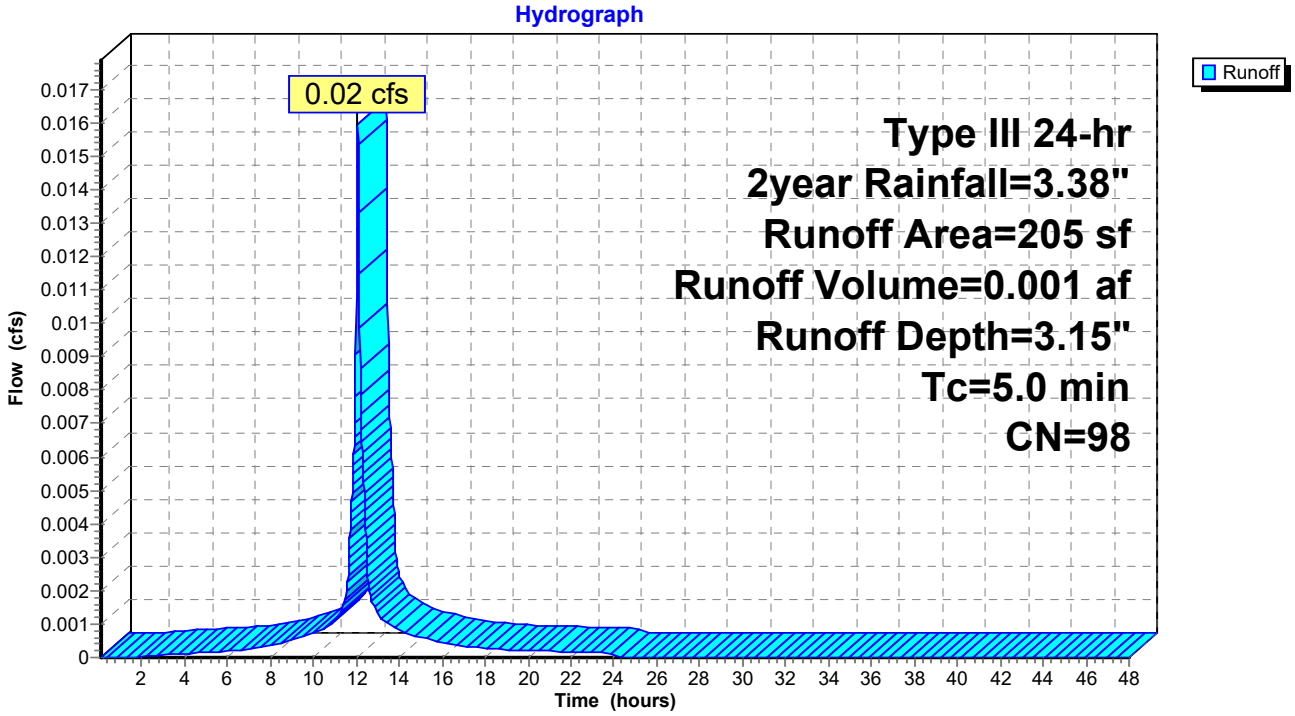
Runoff = 0.02 cfs @ 12.07 hrs, Volume= 0.001 af, Depth= 3.15"
Routed to Pond DW3 : DRY WELL 3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 2year Rainfall=3.38"

Area (sf)	CN	Description
205	98	Paved parking, HSG A
205		100.00% Impervious Area

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

Subcatchment DA5: DA5



Summary for Subcatchment DA6: DA6

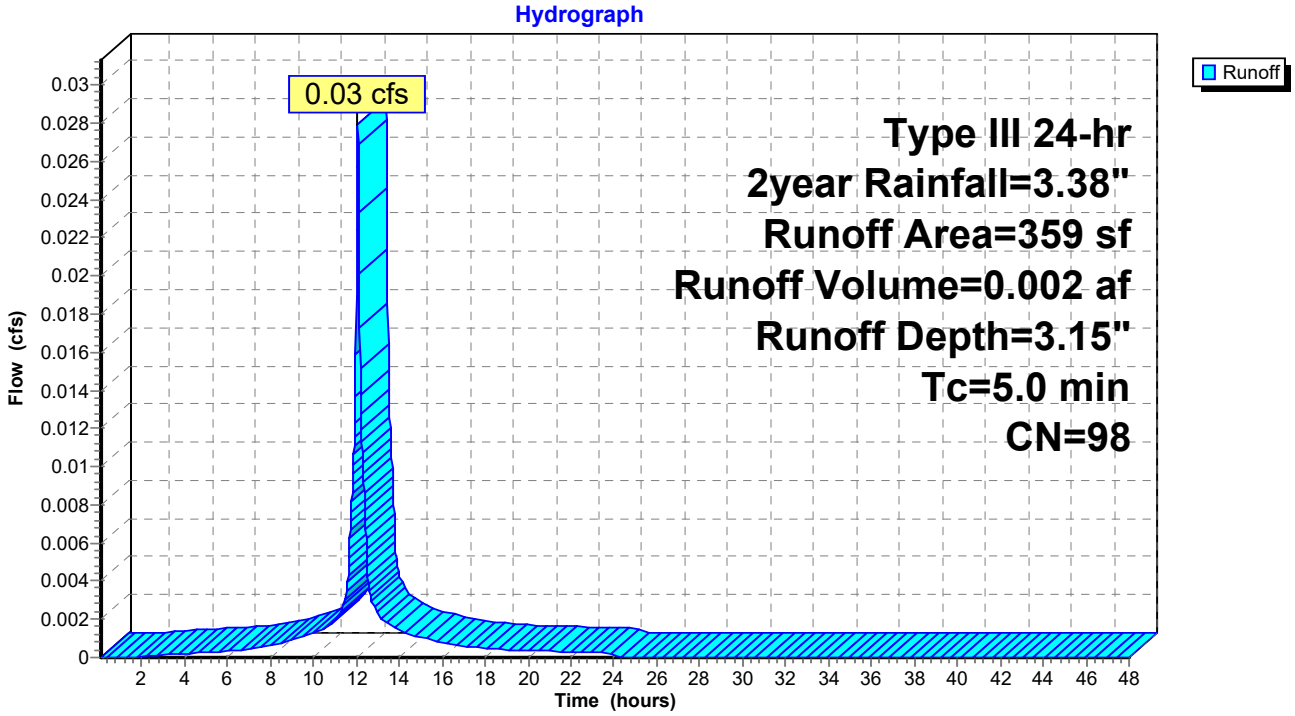
Runoff = 0.03 cfs @ 12.07 hrs, Volume= 0.002 af, Depth= 3.15"
Routed to Pond DW4 : DRY WELL 4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 2year Rainfall=3.38"

Area (sf)	CN	Description
359	98	Paved parking, HSG A
359		100.00% Impervious Area

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

Subcatchment DA6: DA6



Summary for Pond 1P: MECHANIC STREET

[57] Hint: Peaked at 38.88' (Flood elevation advised)

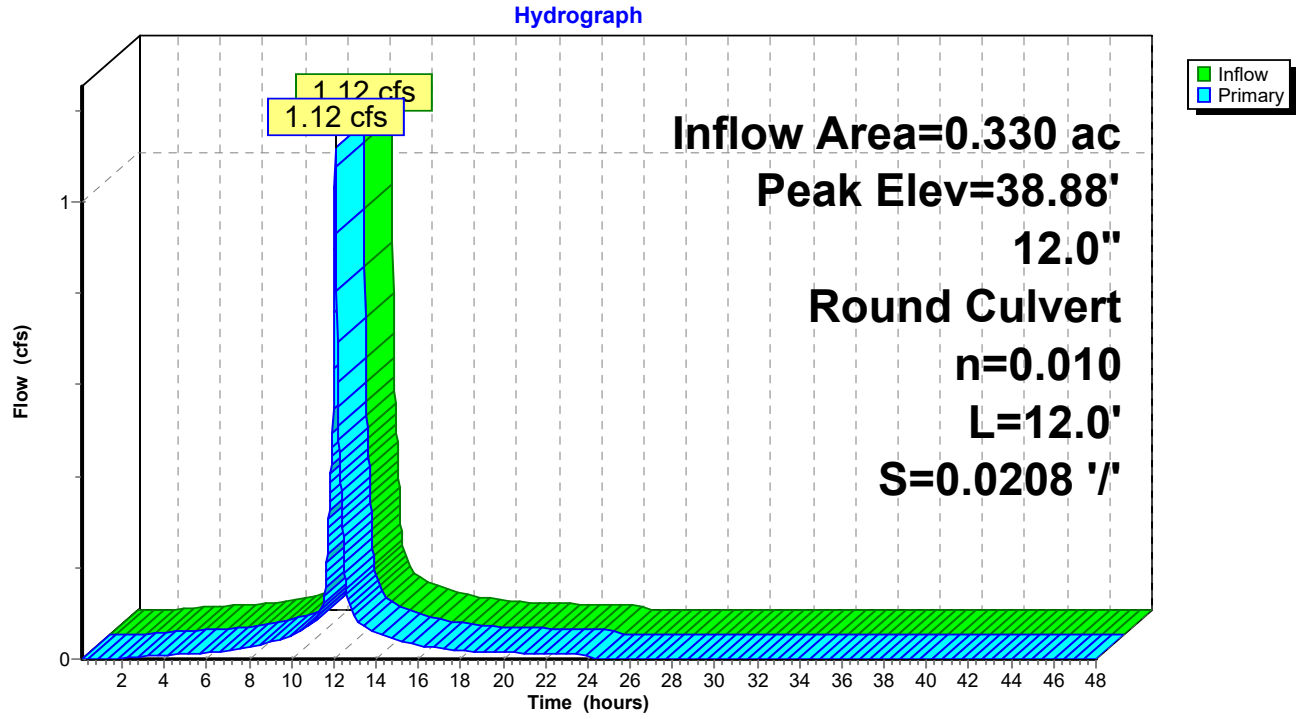
Inflow Area = 0.330 ac,100.00% Impervious, Inflow Depth = 3.15" for 2year event
Inflow = 1.12 cfs @ 12.07 hrs, Volume= 0.086 af
Outflow = 1.12 cfs @ 12.07 hrs, Volume= 0.086 af, Atten= 0%, Lag= 0.0 min
Primary = 1.12 cfs @ 12.07 hrs, Volume= 0.086 af
Routed to Pond SP2 : MECHANIC STREET

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 38.88' @ 12.07 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	38.25'	**12.0" Round CMP_Round 12"** L= 12.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 38.25' / 38.00' S= 0.0208 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.11 cfs @ 12.07 hrs HW=38.88' TW=36.03' (Dynamic Tailwater)
└**1=CMP_Round 12"** (Inlet Controls 1.11 cfs @ 2.13 fps)

Pond 1P: MECHANIC STREET



Summary for Pond DW1: DRY WELL 1

Inflow Area = 0.018 ac, 29.79% Impervious, Inflow Depth = 0.37" for 2year event
Inflow = 0.00 cfs @ 12.13 hrs, Volume= 0.001 af
Outflow = 0.00 cfs @ 12.16 hrs, Volume= 0.001 af, Atten= 59%, Lag= 2.1 min
Discarded = 0.00 cfs @ 12.16 hrs, Volume= 0.001 af
Primary = 0.00 cfs @ 0.10 hrs, Volume= 0.000 af
Routed to Pond SP1 : GRANITE AVENUE

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 34.93' @ 12.57 hrs Surf.Area= 28 sf Storage= 3 cf

Plug-Flow detention time= 7.8 min calculated for 0.001 af (100% of inflow)
Center-of-Mass det. time= 7.8 min (937.5 - 929.7)

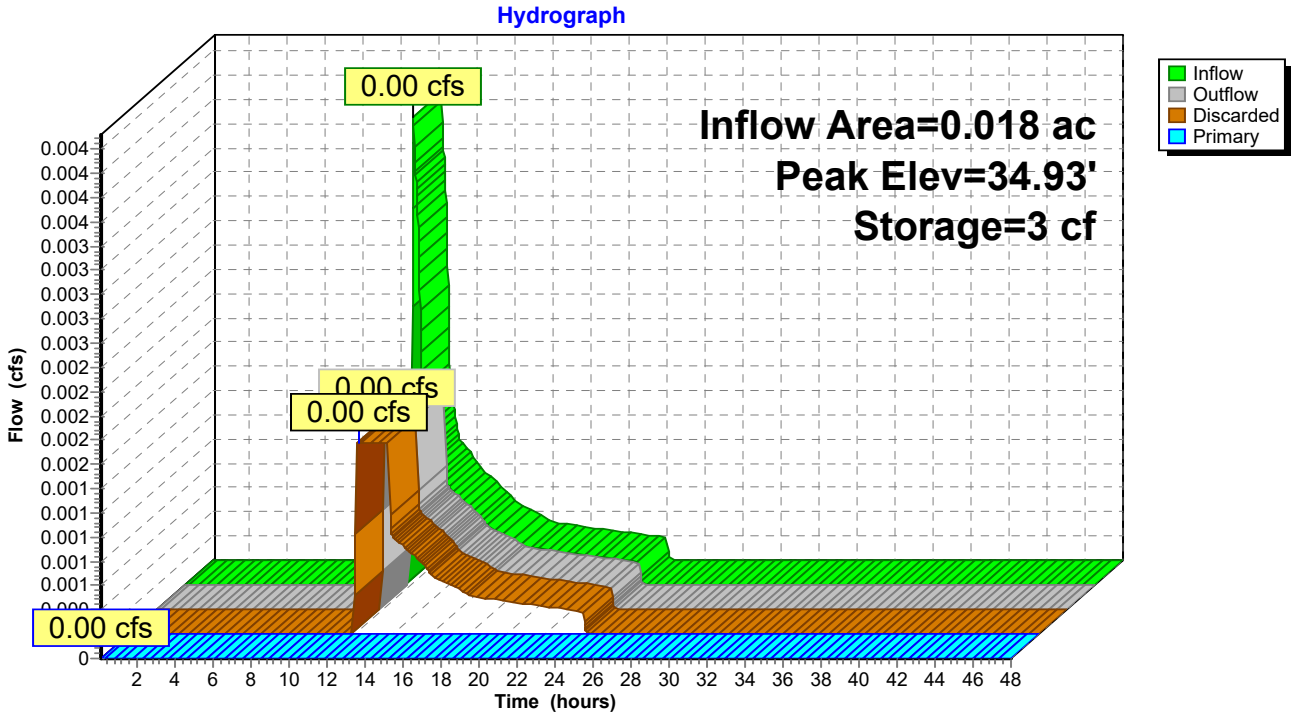
Volume	Invert	Avail.Storage	Storage Description
#1	34.65'	40 cf	**6.00'D x 7.00'H Stone** 198 cf Overall - 75 cf Embedded = 123 cf x 33.0% Voids
#2	35.65'	75 cf	**4.00'D x 6.00'H Dry Well** Inside #1
		116 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	34.65'	**2.410 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Primary	41.60'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.00 cfs @ 12.16 hrs HW=34.73' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.00 cfs @ 0.10 hrs HW=34.65' TW=0.00' (Dynamic Tailwater)
↑—**2=Orifice/Grate** (Controls 0.00 cfs)

Pond DW1: DRY WELL 1



Summary for Pond DW2: DRY WELL 2

Inflow Area = 0.022 ac, 73.43% Impervious, Inflow Depth = 1.68" for 2year event
Inflow = 0.04 cfs @ 12.08 hrs, Volume= 0.003 af
Outflow = 0.00 cfs @ 11.70 hrs, Volume= 0.003 af, Atten= 94%, Lag= 0.0 min
Discarded = 0.00 cfs @ 11.70 hrs, Volume= 0.003 af
Primary = 0.00 cfs @ 0.10 hrs, Volume= 0.000 af
Routed to Pond SP2 : MECHANIC STREET

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 37.01' @ 14.08 hrs Surf.Area= 50 sf Storage= 60 cf

Plug-Flow detention time= 205.7 min calculated for 0.003 af (100% of inflow)
Center-of-Mass det. time= 205.6 min (1,038.3 - 832.7)

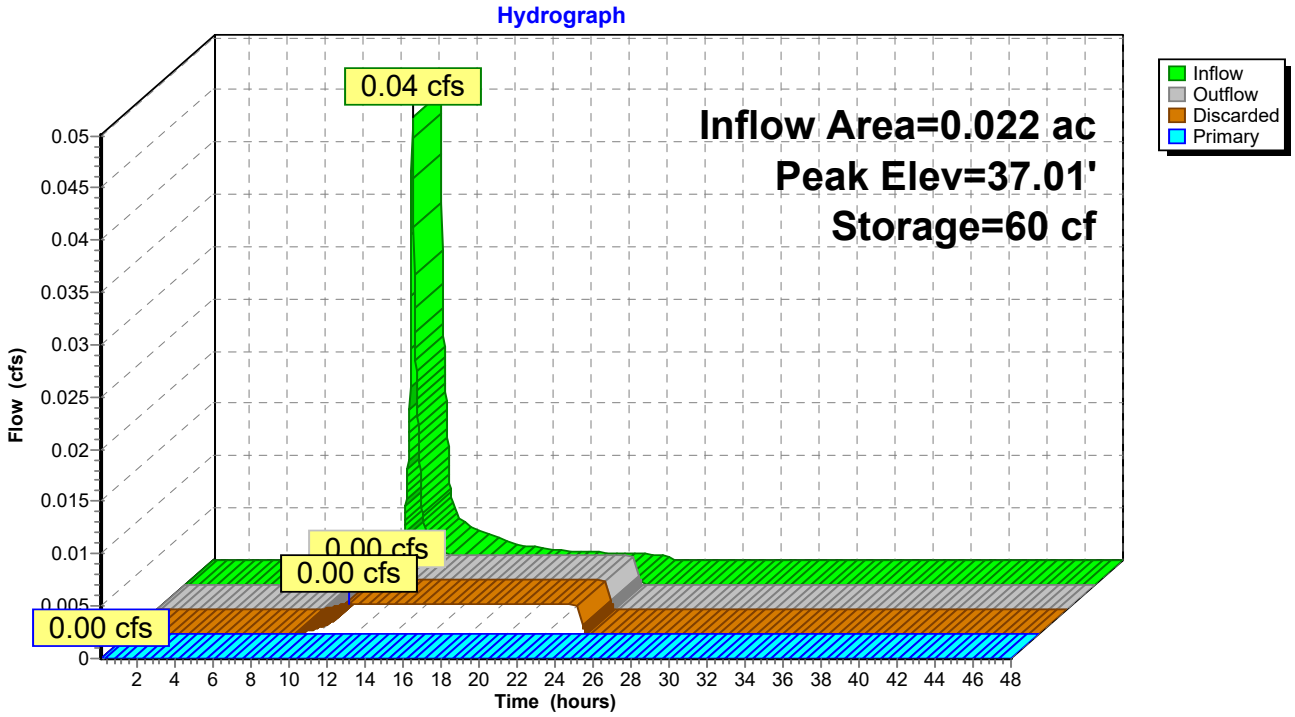
Volume	Invert	Avail.Storage	Storage Description
#1	34.80'	60 cf	**8.00'D x 7.00'H Stone**
			352 cf Overall - 170 cf Embedded = 182 cf x 33.0% Voids
#2	35.80'	170 cf	**6.00'D x 6.00'H Dry Well** Inside #1
		230 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	34.80'	**2.410 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Primary	41.75'	**24.0" Horiz. Orifice/Grate** C= 0.600
			Limited to weir flow at low heads

Discarded OutFlow Max=0.00 cfs @ 11.70 hrs HW=34.88' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.00 cfs @ 0.10 hrs HW=34.80' TW=35.40' (Dynamic Tailwater)
↑—**2=Orifice/Grate** (Controls 0.00 cfs)

Pond DW2: DRY WELL 2



Summary for Pond DW3: DRY WELL 3

Inflow Area = 0.005 ac,100.00% Impervious, Inflow Depth = 3.15" for 2year event
Inflow = 0.02 cfs @ 12.07 hrs, Volume= 0.001 af
Outflow = 0.00 cfs @ 11.70 hrs, Volume= 0.001 af, Atten= 90%, Lag= 0.0 min
Discarded = 0.00 cfs @ 11.70 hrs, Volume= 0.001 af
Primary = 0.00 cfs @ 0.10 hrs, Volume= 0.000 af
Routed to Pond SP1 : GRANITE AVENUE

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 36.12' @ 12.80 hrs Surf.Area= 28 sf Storage= 18 cf

Plug-Flow detention time= 73.6 min calculated for 0.001 af (100% of inflow)
Center-of-Mass det. time= 73.6 min (827.9 - 754.3)

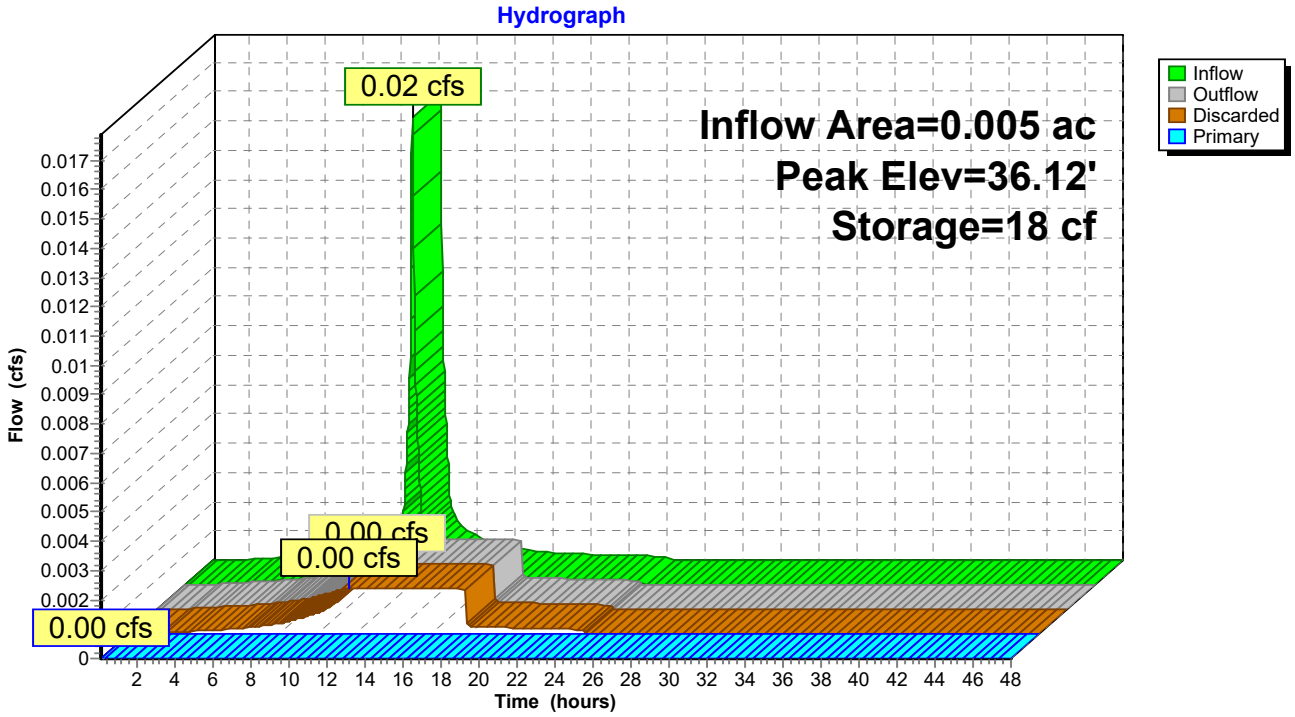
Volume	Invert	Avail.Storage	Storage Description
#1	34.65'	40 cf	**6.00'D x 7.00'H Stone** 198 cf Overall - 75 cf Embedded = 123 cf x 33.0% Voids
#2	35.65'	75 cf	**4.00'D x 6.00'H Dry Well** Inside #1
		116 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	34.65'	**2.410 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Primary	41.60'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.00 cfs @ 11.70 hrs HW=34.73' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.00 cfs @ 0.10 hrs HW=34.65' TW=0.00' (Dynamic Tailwater)
↑—**2=Orifice/Grate** (Controls 0.00 cfs)

Pond DW3: DRY WELL 3



Summary for Pond DW4: DRY WELL 4

Inflow Area = 0.008 ac,100.00% Impervious, Inflow Depth = 3.15" for 2year event
Inflow = 0.03 cfs @ 12.07 hrs, Volume= 0.002 af
Outflow = 0.00 cfs @ 11.18 hrs, Volume= 0.002 af, Atten= 94%, Lag= 0.0 min
Discarded = 0.00 cfs @ 11.18 hrs, Volume= 0.002 af
Primary = 0.00 cfs @ 0.10 hrs, Volume= 0.000 af
Routed to Pond SP1 : GRANITE AVENUE

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 37.27' @ 13.77 hrs Surf.Area= 28 sf Storage= 39 cf

Plug-Flow detention time= 198.7 min calculated for 0.002 af (100% of inflow)
Center-of-Mass det. time= 198.6 min (953.0 - 754.3)

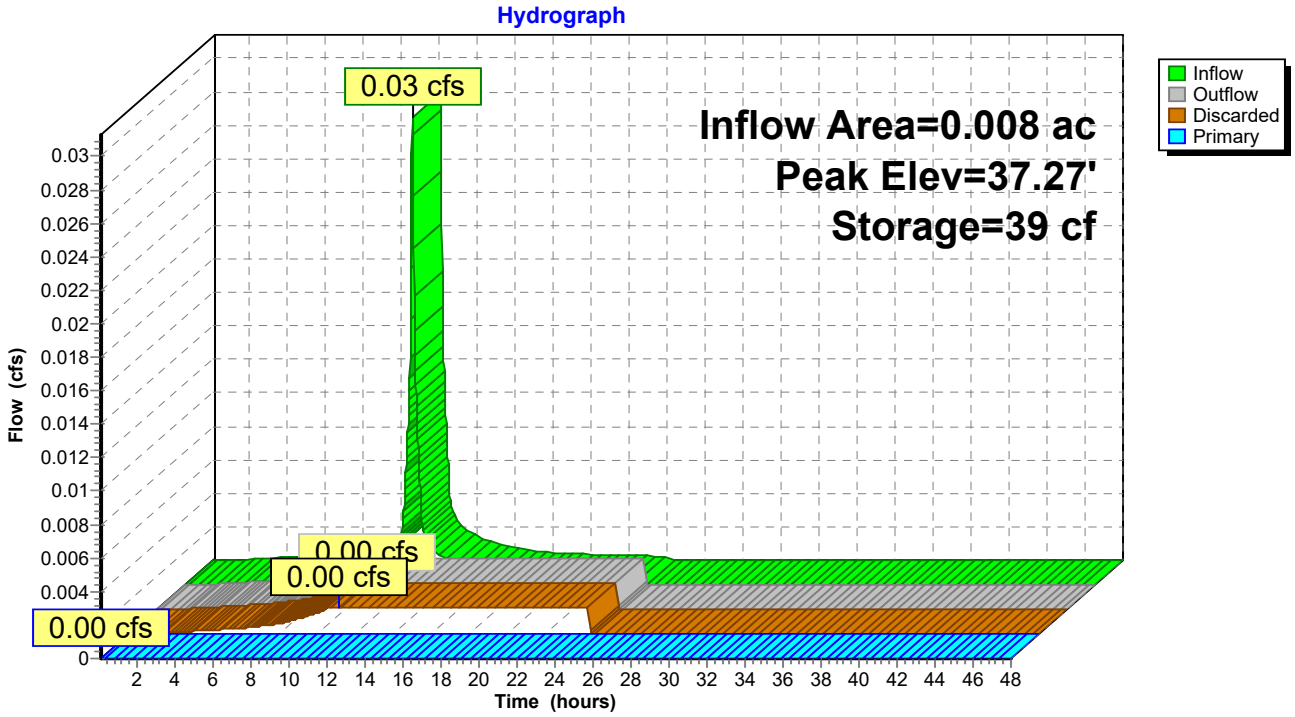
Volume	Invert	Avail.Storage	Storage Description
#1	34.57'	40 cf	**6.00'D x 7.00'H Stone** 198 cf Overall - 75 cf Embedded = 123 cf x 33.0% Voids
#2	35.57'	75 cf	**4.00'D x 6.00'H Dry Well** Inside #1
		116 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	34.57'	**2.410 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Primary	41.55'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.00 cfs @ 11.18 hrs HW=34.64' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.00 cfs @ 0.10 hrs HW=34.57' TW=0.00' (Dynamic Tailwater)
↑**2=Orifice/Grate** (Controls 0.00 cfs)

Pond DW4: DRY WELL 4



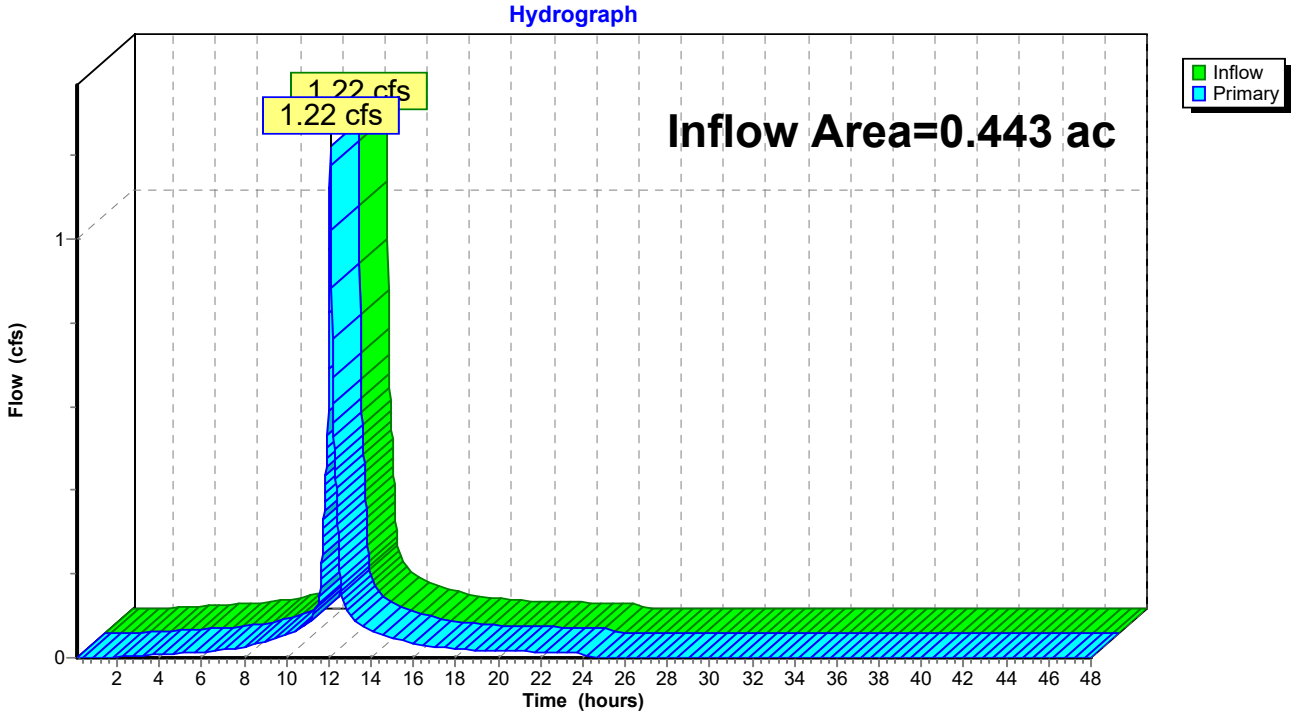
Summary for Pond SP1: GRANITE AVENUE

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.443 ac, 91.01% Impervious, Inflow Depth = 2.55" for 2year event
Inflow = 1.22 cfs @ 12.07 hrs, Volume= 0.094 af
Primary = 1.22 cfs @ 12.07 hrs, Volume= 0.094 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs / 2

Pond SP1: GRANITE AVENUE



Summary for Pond SP2: MECHANIC STREET

[57] Hint: Peaked at 36.04' (Flood elevation advised)

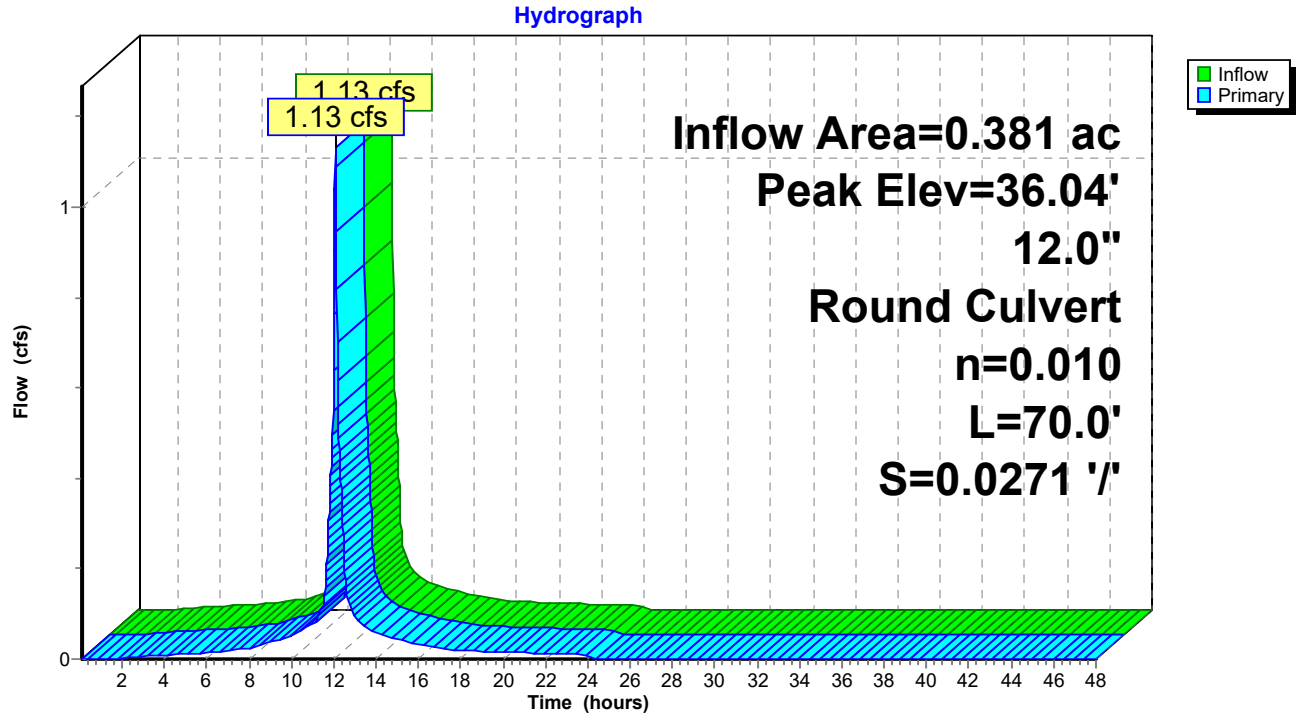
Inflow Area = 0.381 ac, 93.67% Impervious, Inflow Depth = 2.76" for 2year event
Inflow = 1.13 cfs @ 12.07 hrs, Volume= 0.088 af
Outflow = 1.13 cfs @ 12.07 hrs, Volume= 0.088 af, Atten= 0%, Lag= 0.0 min
Primary = 1.13 cfs @ 12.07 hrs, Volume= 0.088 af
Routed to Pond SP1 : GRANITE AVENUE

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 36.04' @ 12.07 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	35.40'	**12.0" Round CMP_Round 12"** L= 70.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 35.40' / 33.50' S= 0.0271 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.12 cfs @ 12.07 hrs HW=36.03' TW=0.00' (Dynamic Tailwater)
└**1=CMP_Round 12"** (Inlet Controls 1.12 cfs @ 2.14 fps)

Pond SP2: MECHANIC STREET



Summary for Subcatchment DA1: DA1

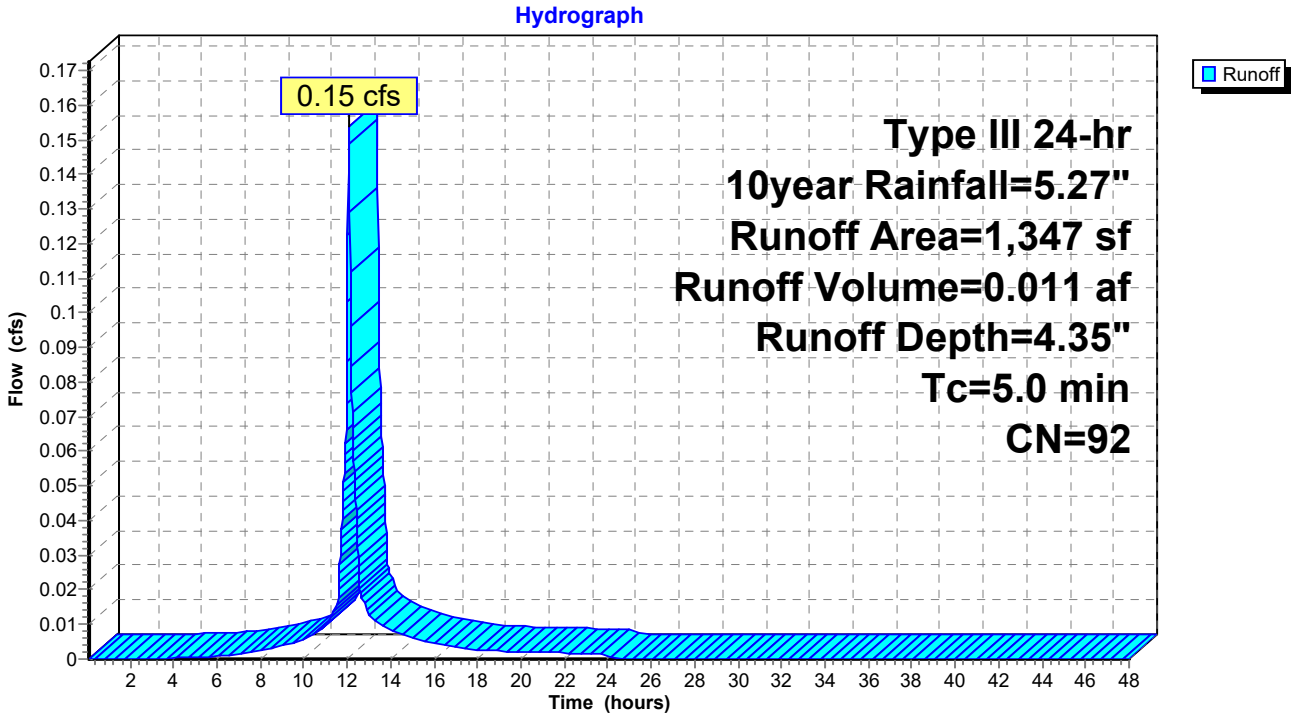
Runoff = 0.15 cfs @ 12.07 hrs, Volume= 0.011 af, Depth= 4.35"
Routed to Pond SP1 : GRANITE AVENUE

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10year Rainfall=5.27"

Area (sf)	CN	Description
1,206	98	Paved parking, HSG A
141	39	>75% Grass cover, Good, HSG A
1,347	92	Weighted Average
141		10.47% Pervious Area
1,206		89.53% Impervious Area

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

Subcatchment DA1: DA1



Summary for Subcatchment DA2: DA2

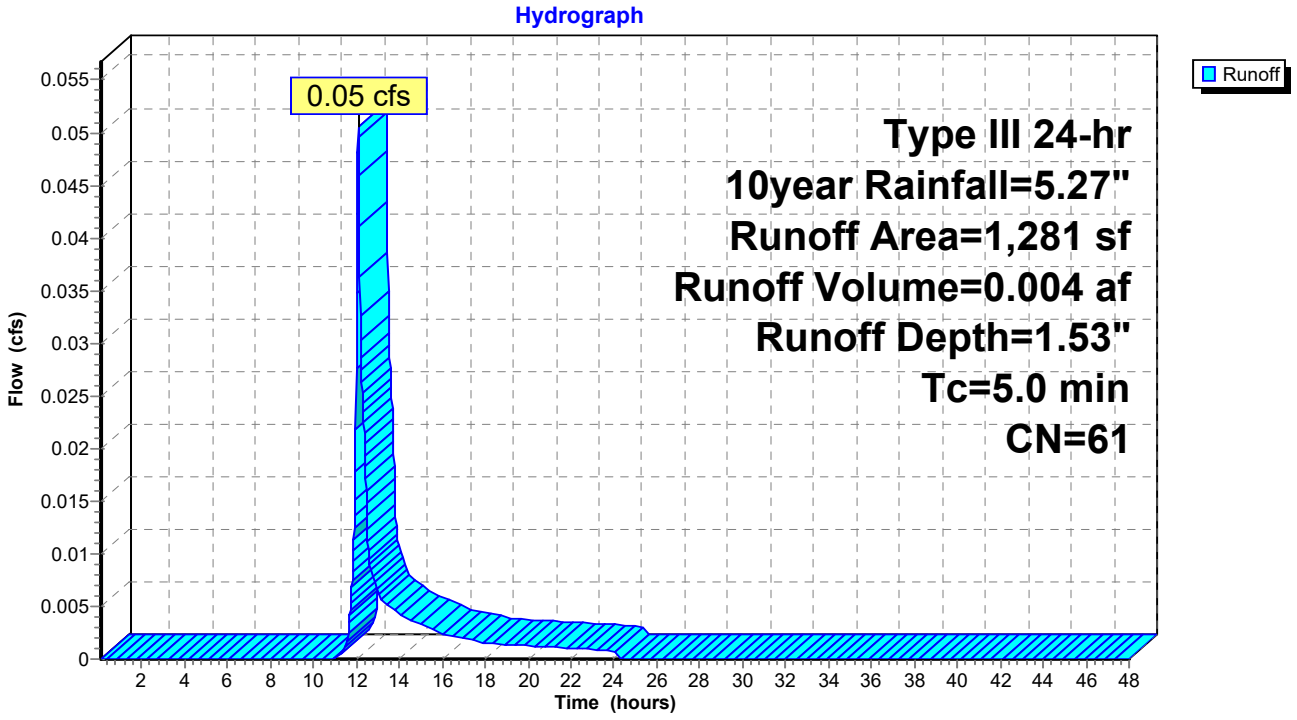
Runoff = 0.05 cfs @ 12.08 hrs, Volume= 0.004 af, Depth= 1.53"
Routed to Pond SP2 : MECHANIC STREET

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10year Rainfall=5.27"

Area (sf)	CN	Description
484	98	Paved parking, HSG A
797	39	>75% Grass cover, Good, HSG A
1,281	61	Weighted Average
797		62.22% Pervious Area
484		37.78% Impervious Area

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

Subcatchment DA2: DA2



Summary for Subcatchment DA2R: DA2

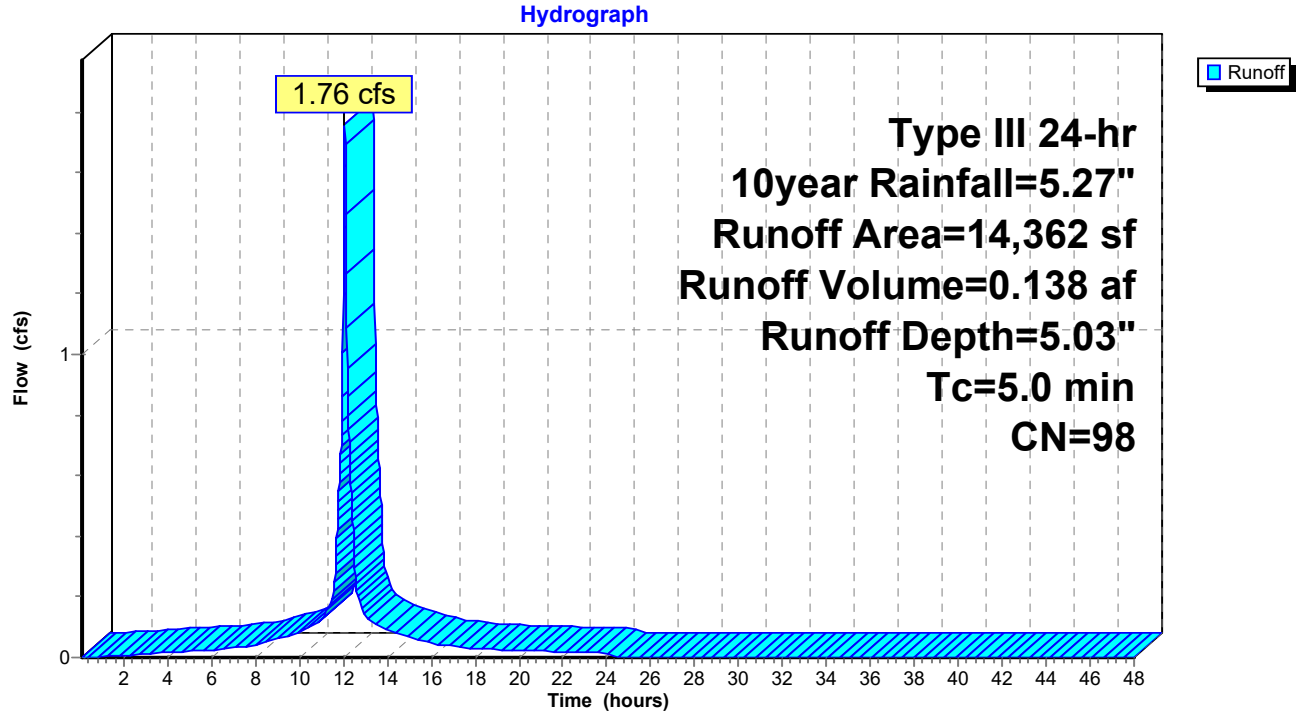
Runoff = 1.76 cfs @ 12.07 hrs, Volume= 0.138 af, Depth= 5.03"
Routed to Pond 1P : MECHANIC STREET

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10year Rainfall=5.27"

Area (sf)	CN	Description
14,362	98	Roofs, HSG A
14,362		100.00% Impervious Area

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

Subcatchment DA2R: DA2



Summary for Subcatchment DA3: DA3

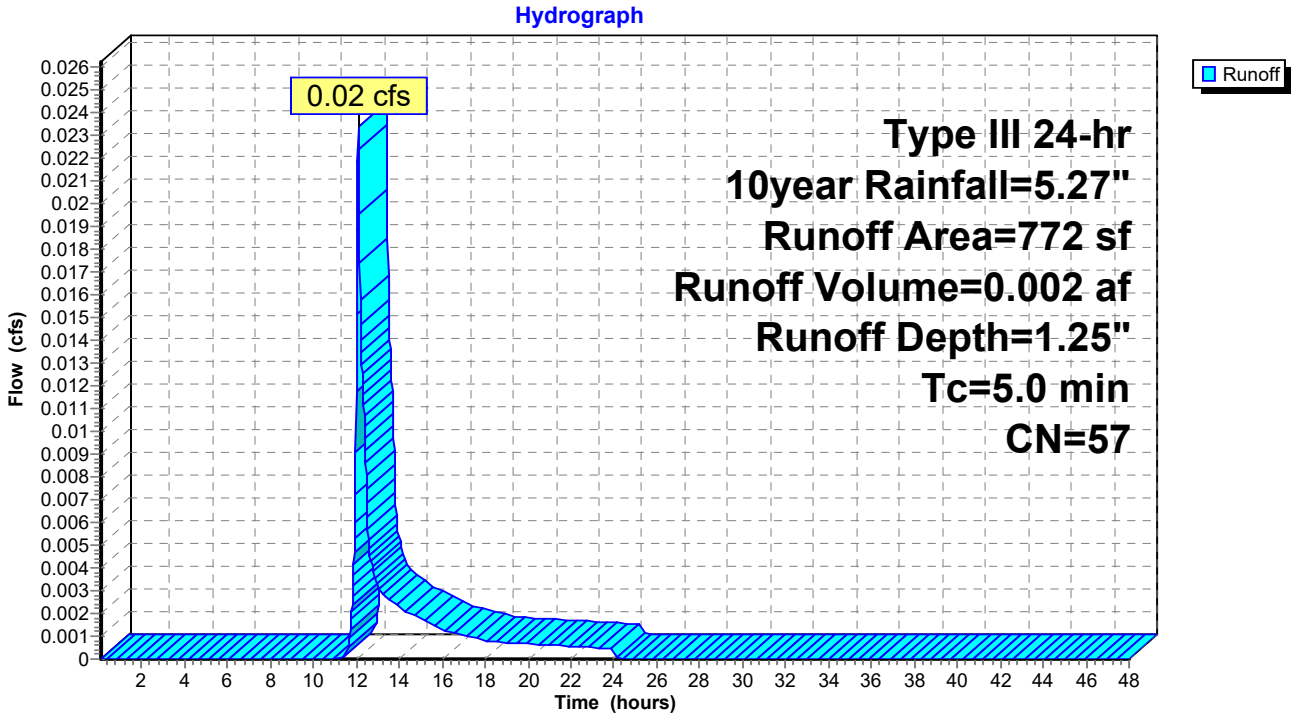
Runoff = 0.02 cfs @ 12.09 hrs, Volume= 0.002 af, Depth= 1.25"
Routed to Pond DW1 : DRY WELL 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10year Rainfall=5.27"

Area (sf)	CN	Description
230	98	Paved parking, HSG A
542	39	>75% Grass cover, Good, HSG A
772	57	Weighted Average
542		70.21% Pervious Area
230		29.79% Impervious Area

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

Subcatchment DA3: DA3



Summary for Subcatchment DA4: DA4

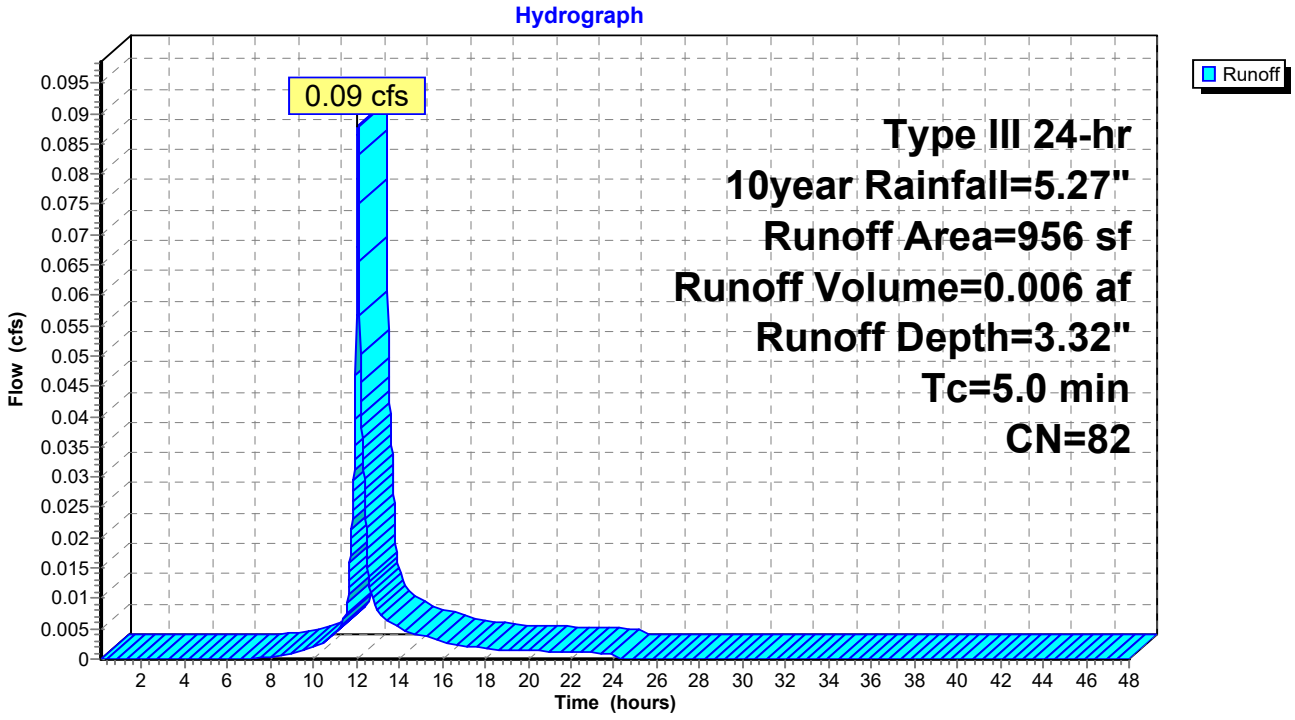
Runoff = 0.09 cfs @ 12.07 hrs, Volume= 0.006 af, Depth= 3.32"
Routed to Pond DW2 : DRY WELL 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10year Rainfall=5.27"

Area (sf)	CN	Description
702	98	Paved parking, HSG A
254	39	>75% Grass cover, Good, HSG A
956	82	Weighted Average
254		26.57% Pervious Area
702		73.43% Impervious Area

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

Subcatchment DA4: DA4



Summary for Subcatchment DA5: DA5

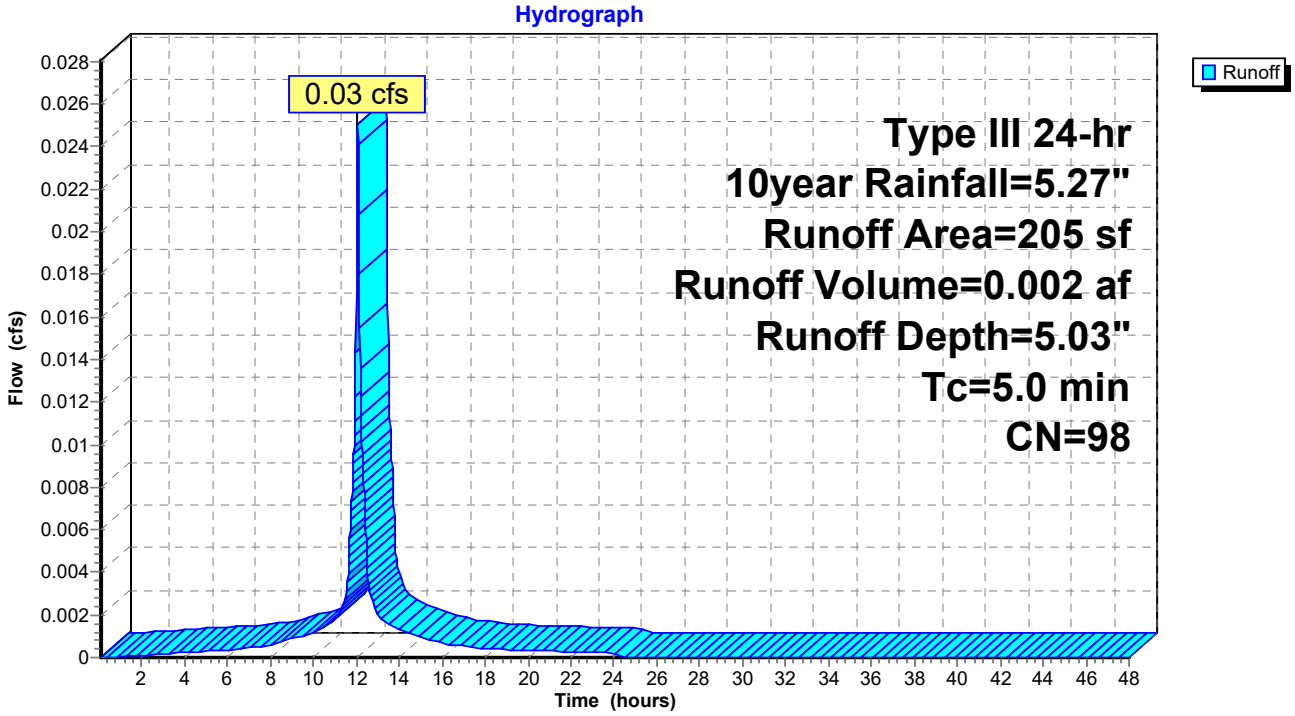
Runoff = 0.03 cfs @ 12.07 hrs, Volume= 0.002 af, Depth= 5.03"
Routed to Pond DW3 : DRY WELL 3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10year Rainfall=5.27"

Area (sf)	CN	Description
205	98	Paved parking, HSG A
205		100.00% Impervious Area

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

Subcatchment DA5: DA5



Summary for Subcatchment DA6: DA6

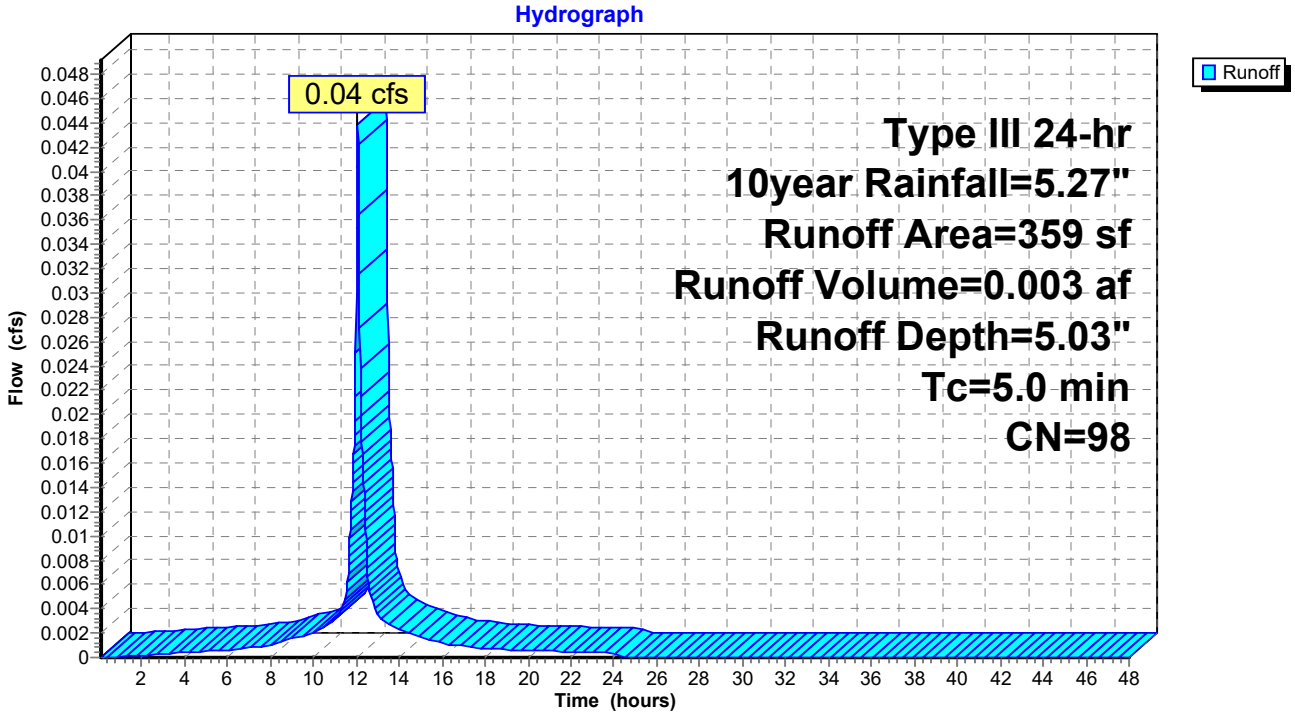
Runoff = 0.04 cfs @ 12.07 hrs, Volume= 0.003 af, Depth= 5.03"
Routed to Pond DW4 : DRY WELL 4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10year Rainfall=5.27"

Area (sf)	CN	Description
359	98	Paved parking, HSG A
359		100.00% Impervious Area

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

Subcatchment DA6: DA6



Summary for Pond 1P: MECHANIC STREET

[57] Hint: Peaked at 39.10' (Flood elevation advised)

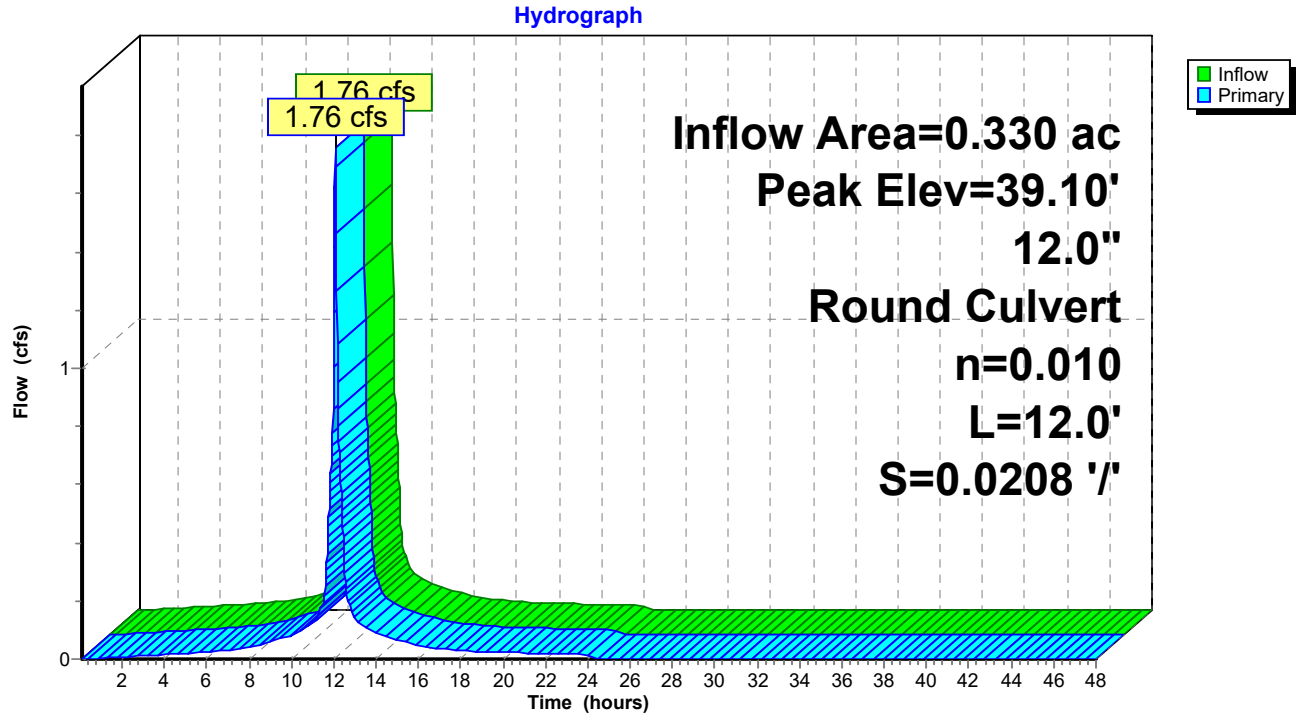
Inflow Area = 0.330 ac,100.00% Impervious, Inflow Depth = 5.03" for 10year event
Inflow = 1.76 cfs @ 12.07 hrs, Volume= 0.138 af
Outflow = 1.76 cfs @ 12.07 hrs, Volume= 0.138 af, Atten= 0%, Lag= 0.0 min
Primary = 1.76 cfs @ 12.07 hrs, Volume= 0.138 af
Routed to Pond SP2 : MECHANIC STREET

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 39.10' @ 12.07 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	38.25'	**12.0" Round CMP_Round 12"** L= 12.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 38.25' / 38.00' S= 0.0208 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.74 cfs @ 12.07 hrs HW=39.09' TW=36.26' (Dynamic Tailwater)
└**1=CMP_Round 12"** (Inlet Controls 1.74 cfs @ 2.47 fps)

Pond 1P: MECHANIC STREET



Summary for Pond DW1: DRY WELL 1

Inflow Area = 0.018 ac, 29.79% Impervious, Inflow Depth = 1.25" for 10year event
Inflow = 0.02 cfs @ 12.09 hrs, Volume= 0.002 af
Outflow = 0.00 cfs @ 11.90 hrs, Volume= 0.002 af, Atten= 93%, Lag= 0.0 min
Discarded = 0.00 cfs @ 11.90 hrs, Volume= 0.002 af
Primary = 0.00 cfs @ 0.10 hrs, Volume= 0.000 af
Routed to Pond SP1 : GRANITE AVENUE

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 37.12' @ 15.38 hrs Surf.Area= 28 sf Storage= 35 cf

Plug-Flow detention time= 246.0 min calculated for 0.002 af (100% of inflow)
Center-of-Mass det. time= 245.9 min (1,125.9 - 880.0)

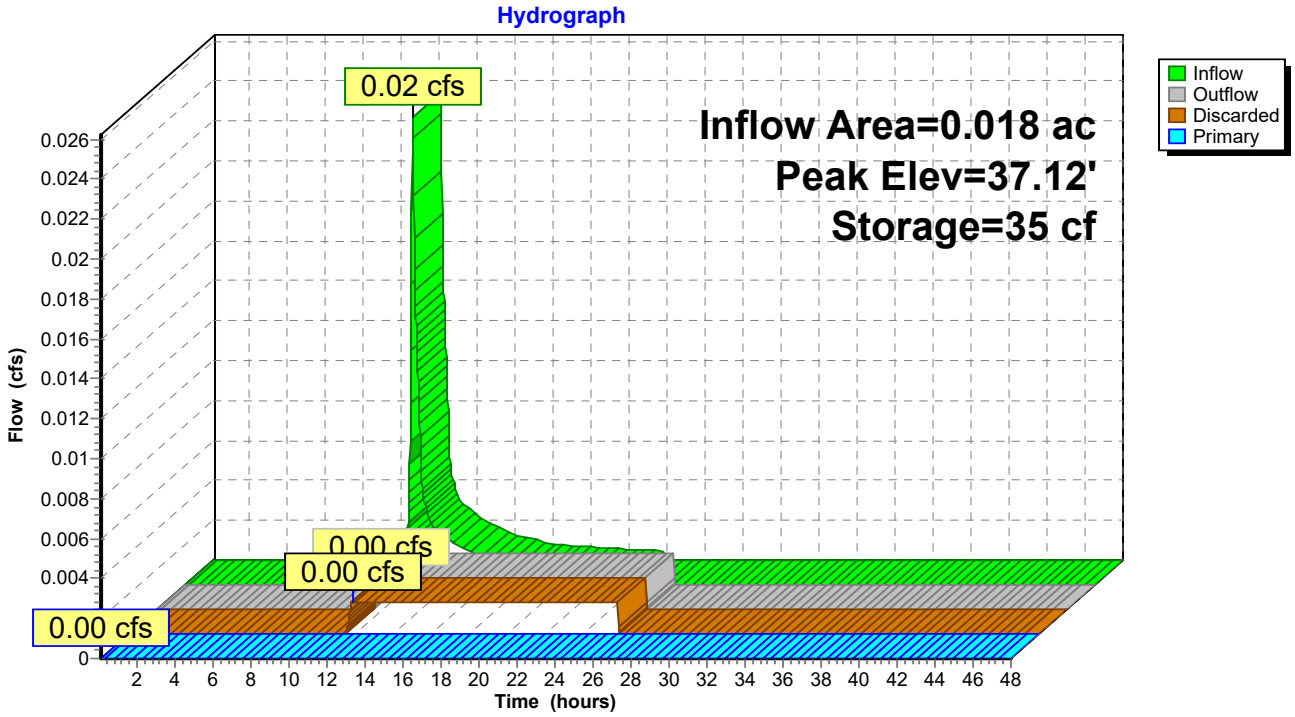
Volume	Invert	Avail.Storage	Storage Description
#1	34.65'	40 cf	**6.00'D x 7.00'H Stone** 198 cf Overall - 75 cf Embedded = 123 cf x 33.0% Voids
#2	35.65'	75 cf	**4.00'D x 6.00'H Dry Well** Inside #1
		116 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	34.65'	**2.410 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Primary	41.60'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.00 cfs @ 11.90 hrs HW=34.74' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.00 cfs @ 0.10 hrs HW=34.65' TW=0.00' (Dynamic Tailwater)
↑—**2=Orifice/Grate** (Controls 0.00 cfs)

Pond DW1: DRY WELL 1



Summary for Pond DW2: DRY WELL 2

Inflow Area = 0.022 ac, 73.43% Impervious, Inflow Depth = 3.32" for 10year event
Inflow = 0.09 cfs @ 12.07 hrs, Volume= 0.006 af
Outflow = 0.00 cfs @ 10.98 hrs, Volume= 0.006 af, Atten= 97%, Lag= 0.0 min
Discarded = 0.00 cfs @ 10.98 hrs, Volume= 0.006 af
Primary = 0.00 cfs @ 0.10 hrs, Volume= 0.000 af
Routed to Pond SP2 : MECHANIC STREET

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 39.64' @ 15.97 hrs Surf.Area= 50 sf Storage= 153 cf

Plug-Flow detention time= 527.5 min calculated for 0.006 af (100% of inflow)
Center-of-Mass det. time= 527.5 min (1,340.7 - 813.2)

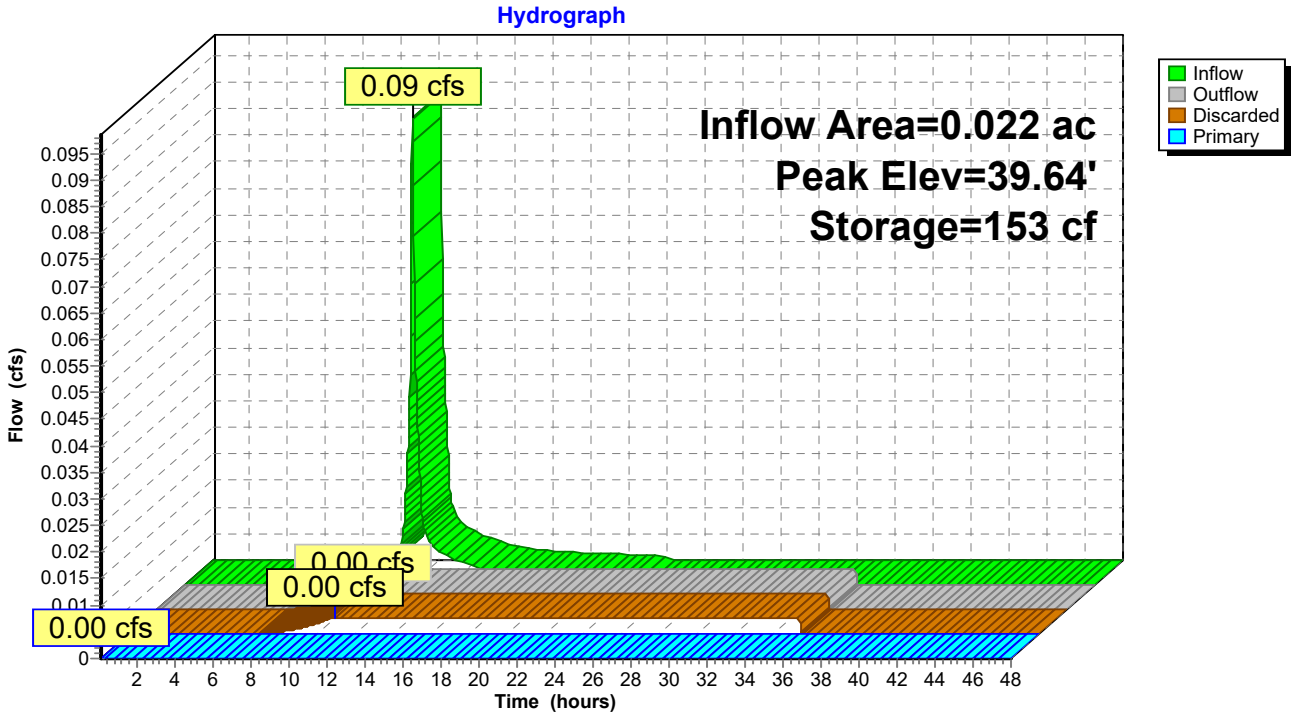
Volume	Invert	Avail.Storage	Storage Description
#1	34.80'	60 cf	**8.00'D x 7.00'H Stone** 352 cf Overall - 170 cf Embedded = 182 cf x 33.0% Voids
#2	35.80'	170 cf	**6.00'D x 6.00'H Dry Well** Inside #1
		230 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	34.80'	**2.410 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Primary	41.75'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.00 cfs @ 10.98 hrs HW=34.87' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.00 cfs @ 0.10 hrs HW=34.80' TW=35.40' (Dynamic Tailwater)
↑—**2=Orifice/Grate** (Controls 0.00 cfs)

Pond DW2: DRY WELL 2



Summary for Pond DW3: DRY WELL 3

Inflow Area = 0.005 ac,100.00% Impervious, Inflow Depth = 5.03" for 10year event
Inflow = 0.03 cfs @ 12.07 hrs, Volume= 0.002 af
Outflow = 0.00 cfs @ 11.32 hrs, Volume= 0.002 af, Atten= 94%, Lag= 0.0 min
Discarded = 0.00 cfs @ 11.32 hrs, Volume= 0.002 af
Primary = 0.00 cfs @ 0.10 hrs, Volume= 0.000 af
Routed to Pond SP1 : GRANITE AVENUE

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 37.03' @ 13.48 hrs Surf.Area= 28 sf Storage= 34 cf

Plug-Flow detention time= 161.5 min calculated for 0.002 af (100% of inflow)
Center-of-Mass det. time= 161.4 min (907.6 - 746.2)

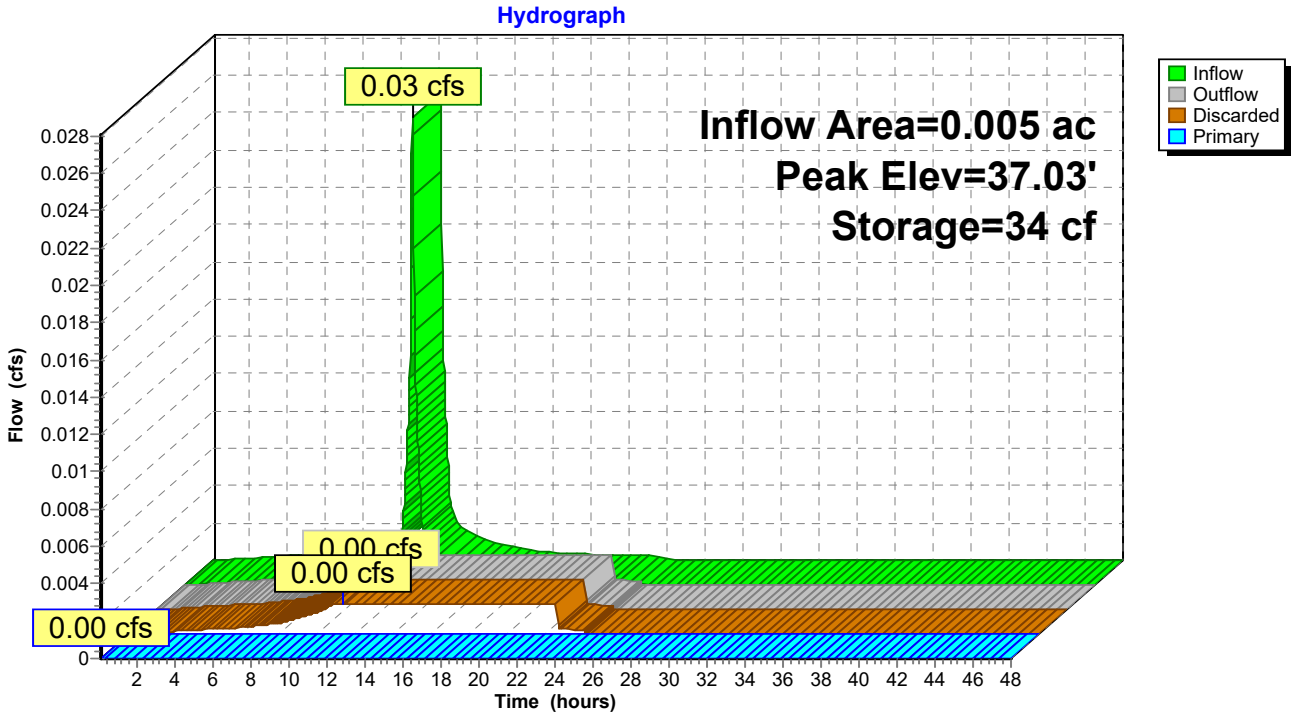
Volume	Invert	Avail.Storage	Storage Description
#1	34.65'	40 cf	**6.00'D x 7.00'H Stone** 198 cf Overall - 75 cf Embedded = 123 cf x 33.0% Voids
#2	35.65'	75 cf	**4.00'D x 6.00'H Dry Well** Inside #1
		116 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	34.65'	**2.410 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Primary	41.60'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.00 cfs @ 11.32 hrs HW=34.72' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.00 cfs @ 0.10 hrs HW=34.65' TW=0.00' (Dynamic Tailwater)
↑—**2=Orifice/Grate** (Controls 0.00 cfs)

Pond DW3: DRY WELL 3



Summary for Pond DW4: DRY WELL 4

Inflow Area = 0.008 ac,100.00% Impervious, Inflow Depth = 5.03" for 10year event
Inflow = 0.04 cfs @ 12.07 hrs, Volume= 0.003 af
Outflow = 0.00 cfs @ 9.90 hrs, Volume= 0.003 af, Atten= 96%, Lag= 0.0 min
Discarded = 0.00 cfs @ 9.90 hrs, Volume= 0.003 af
Primary = 0.00 cfs @ 0.10 hrs, Volume= 0.000 af
Routed to Pond SP1 : GRANITE AVENUE

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 39.36' @ 15.20 hrs Surf.Area= 28 sf Storage= 77 cf

Plug-Flow detention time= 407.7 min calculated for 0.003 af (100% of inflow)
Center-of-Mass det. time= 407.8 min (1,154.0 - 746.2)

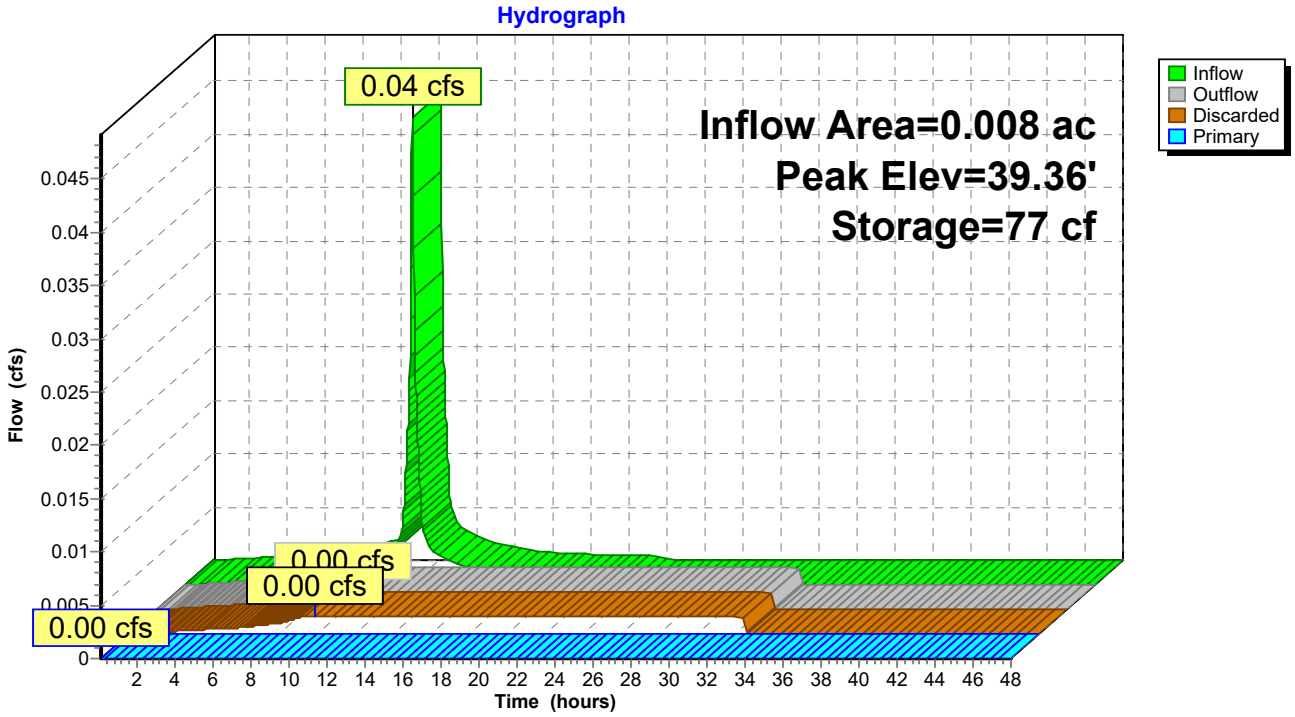
Volume	Invert	Avail.Storage	Storage Description
#1	34.57'	40 cf	**6.00'D x 7.00'H Stone** 198 cf Overall - 75 cf Embedded = 123 cf x 33.0% Voids
#2	35.57'	75 cf	**4.00'D x 6.00'H Dry Well** Inside #1
		116 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	34.57'	**2.410 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Primary	41.55'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.00 cfs @ 9.90 hrs HW=34.64' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.00 cfs @ 0.10 hrs HW=34.57' TW=0.00' (Dynamic Tailwater)
↑—**2=Orifice/Grate** (Controls 0.00 cfs)

Pond DW4: DRY WELL 4



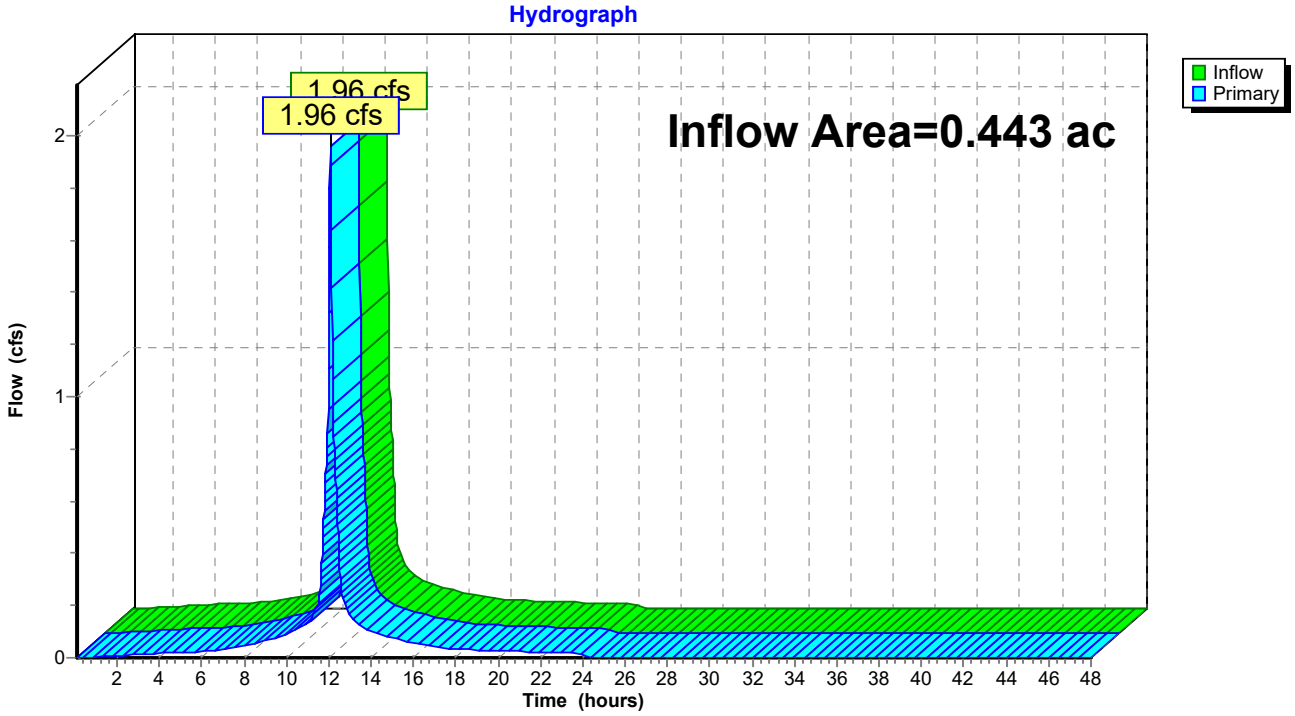
Summary for Pond SP1: GRANITE AVENUE

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.443 ac, 91.01% Impervious, Inflow Depth = 4.15" for 10year event
Inflow = 1.96 cfs @ 12.07 hrs, Volume= 0.153 af
Primary = 1.96 cfs @ 12.07 hrs, Volume= 0.153 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs / 2

Pond SP1: GRANITE AVENUE



Summary for Pond SP2: MECHANIC STREET

[57] Hint: Peaked at 36.27' (Flood elevation advised)

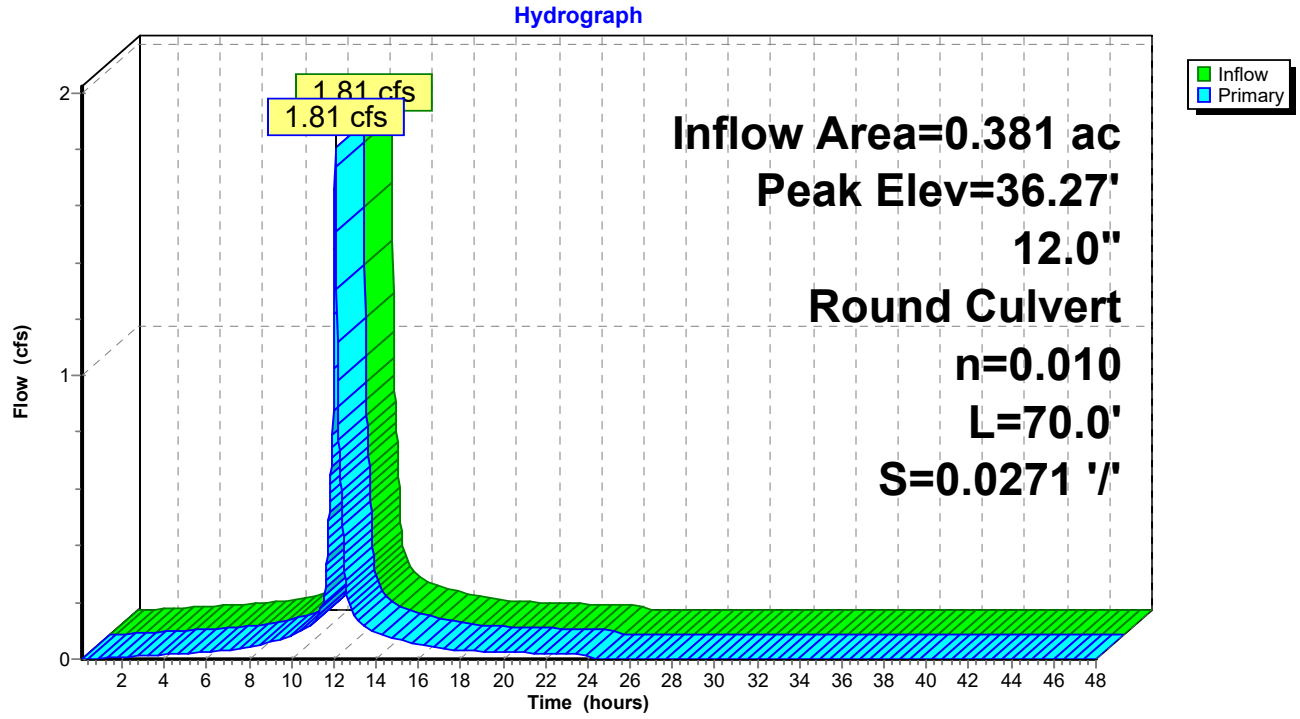
Inflow Area = 0.381 ac, 93.67% Impervious, Inflow Depth = 4.47" for 10year event
Inflow = 1.81 cfs @ 12.07 hrs, Volume= 0.142 af
Outflow = 1.81 cfs @ 12.07 hrs, Volume= 0.142 af, Atten= 0%, Lag= 0.0 min
Primary = 1.81 cfs @ 12.07 hrs, Volume= 0.142 af
Routed to Pond SP1 : GRANITE AVENUE

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 36.27' @ 12.07 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	35.40'	**12.0" Round CMP_Round 12"** L= 70.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 35.40' / 33.50' S= 0.0271 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.79 cfs @ 12.07 hrs HW=36.26' TW=0.00' (Dynamic Tailwater)
↳**1=CMP_Round 12"** (Inlet Controls 1.79 cfs @ 2.49 fps)

Pond SP2: MECHANIC STREET



Summary for Subcatchment DA1: DA1

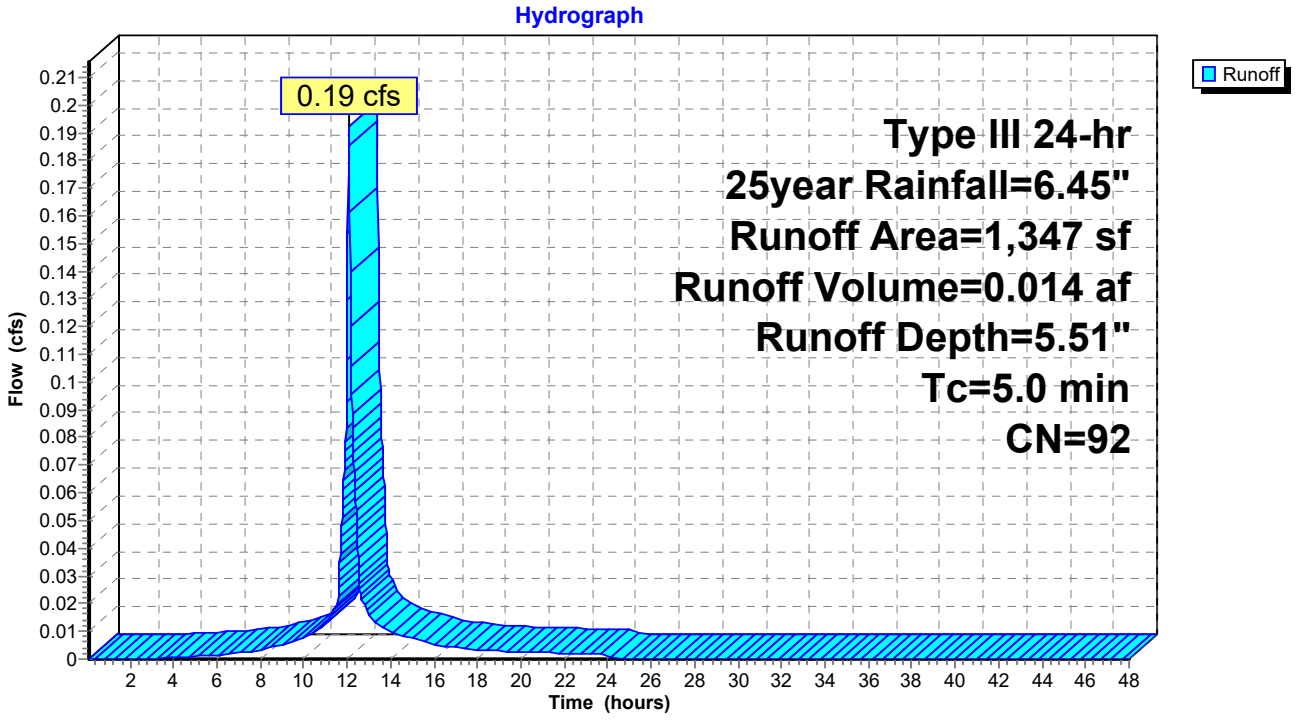
Runoff = 0.19 cfs @ 12.07 hrs, Volume= 0.014 af, Depth= 5.51"
Routed to Pond SP1 : GRANITE AVENUE

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 25year Rainfall=6.45"

Area (sf)	CN	Description
1,206	98	Paved parking, HSG A
141	39	>75% Grass cover, Good, HSG A
1,347	92	Weighted Average
141		10.47% Pervious Area
1,206		89.53% Impervious Area

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

Subcatchment DA1: DA1



Summary for Subcatchment DA2: DA2

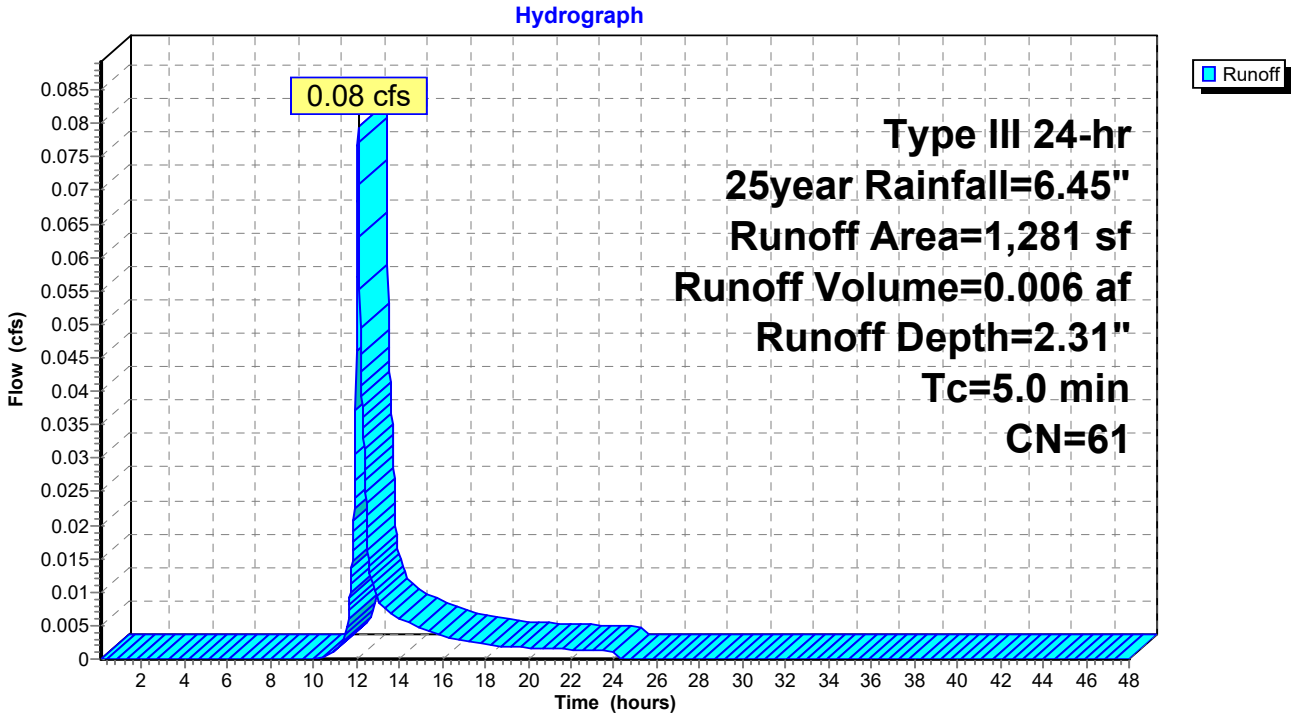
Runoff = 0.08 cfs @ 12.08 hrs, Volume= 0.006 af, Depth= 2.31"
Routed to Pond SP2 : MECHANIC STREET

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 25year Rainfall=6.45"

Area (sf)	CN	Description
484	98	Paved parking, HSG A
797	39	>75% Grass cover, Good, HSG A
1,281	61	Weighted Average
797		62.22% Pervious Area
484		37.78% Impervious Area

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

Subcatchment DA2: DA2



Summary for Subcatchment DA2R: DA2

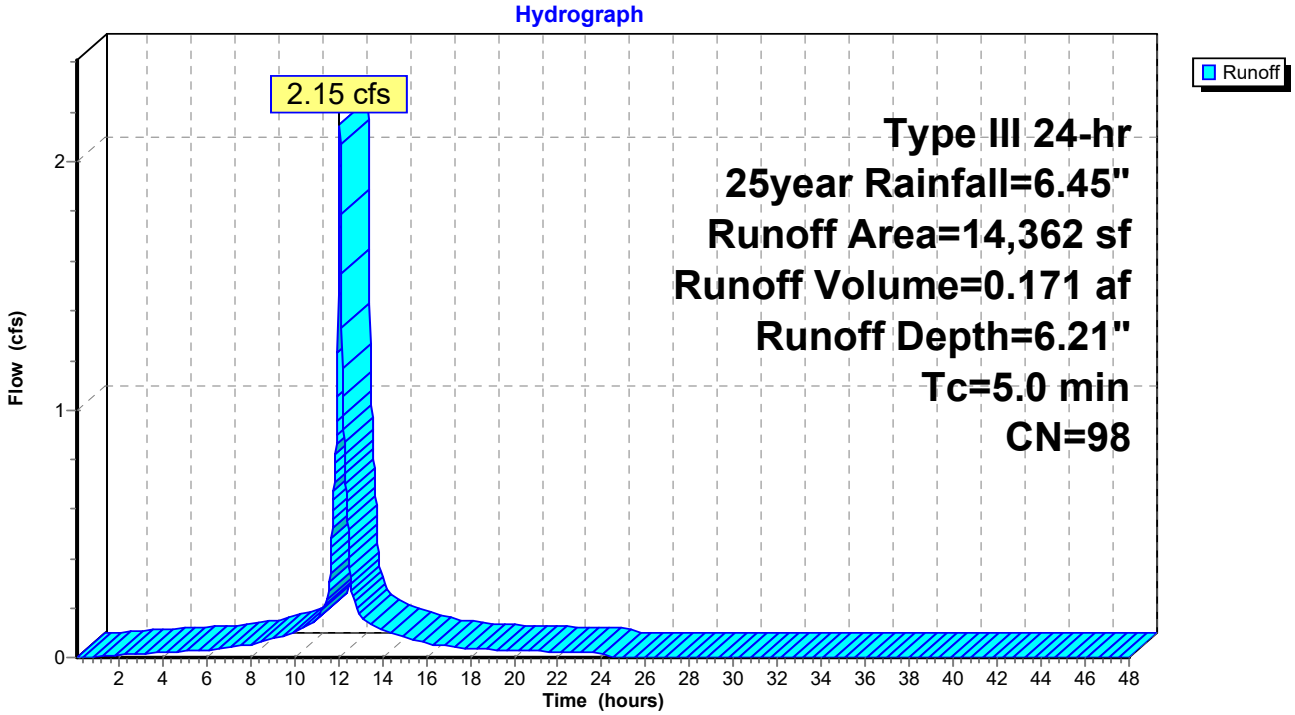
Runoff = 2.15 cfs @ 12.07 hrs, Volume= 0.171 af, Depth= 6.21"
Routed to Pond 1P : MECHANIC STREET

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 25year Rainfall=6.45"

Area (sf)	CN	Description
14,362	98	Roofs, HSG A
14,362		100.00% Impervious Area

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

Subcatchment DA2R: DA2



Summary for Subcatchment DA3: DA3

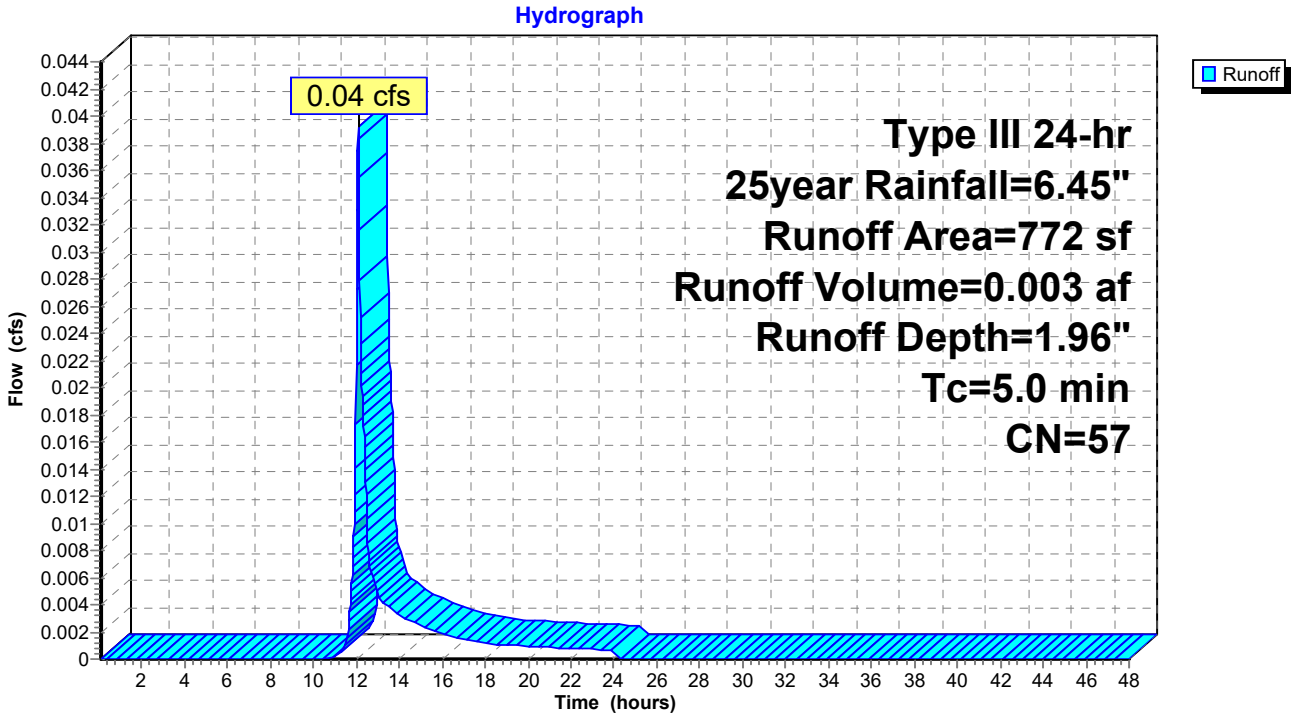
Runoff = 0.04 cfs @ 12.08 hrs, Volume= 0.003 af, Depth= 1.96"
Routed to Pond DW1 : DRY WELL 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 25year Rainfall=6.45"

Area (sf)	CN	Description
230	98	Paved parking, HSG A
542	39	>75% Grass cover, Good, HSG A
772	57	Weighted Average
542		70.21% Pervious Area
230		29.79% Impervious Area

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

Subcatchment DA3: DA3



Summary for Subcatchment DA4: DA4

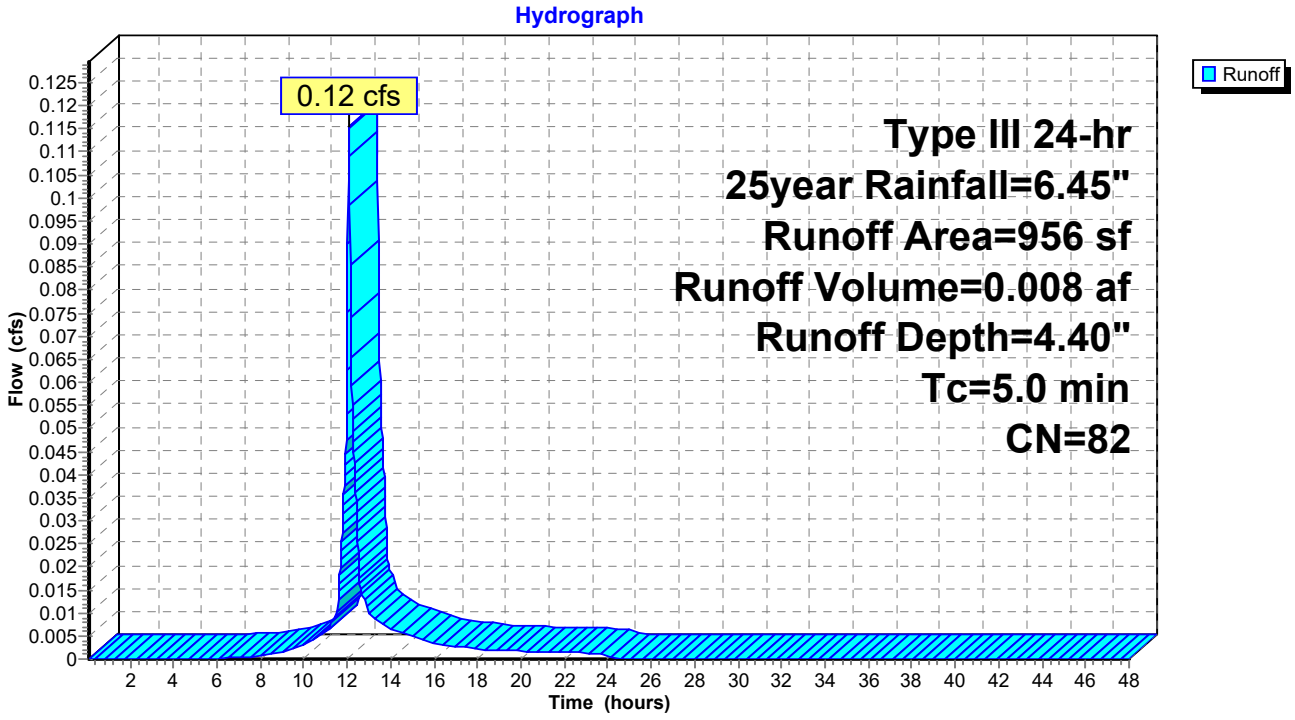
Runoff = 0.12 cfs @ 12.07 hrs, Volume= 0.008 af, Depth= 4.40"
Routed to Pond DW2 : DRY WELL 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 25year Rainfall=6.45"

Area (sf)	CN	Description
702	98	Paved parking, HSG A
254	39	>75% Grass cover, Good, HSG A
956	82	Weighted Average
254		26.57% Pervious Area
702		73.43% Impervious Area

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

Subcatchment DA4: DA4



Summary for Subcatchment DA5: DA5

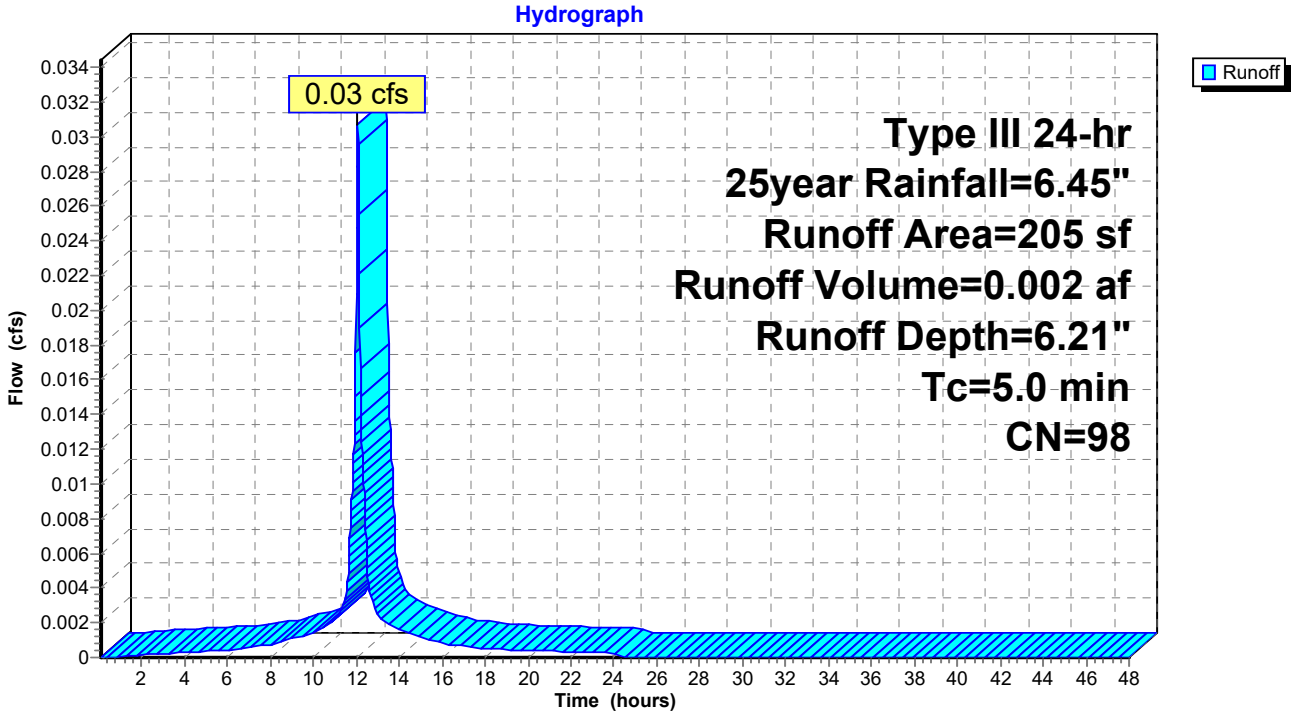
Runoff = 0.03 cfs @ 12.07 hrs, Volume= 0.002 af, Depth= 6.21"
Routed to Pond DW3 : DRY WELL 3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 25year Rainfall=6.45"

Area (sf)	CN	Description
205	98	Paved parking, HSG A
205		100.00% Impervious Area

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

Subcatchment DA5: DA5



Summary for Subcatchment DA6: DA6

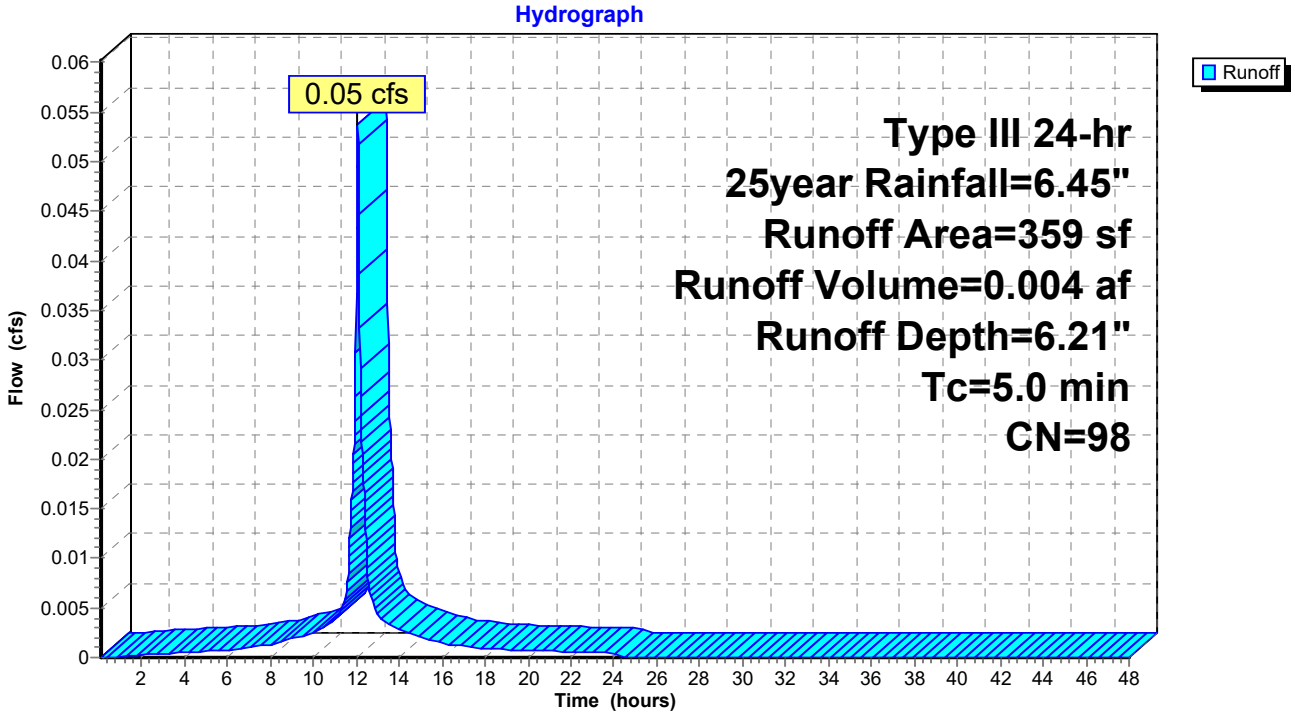
Runoff = 0.05 cfs @ 12.07 hrs, Volume= 0.004 af, Depth= 6.21"
Routed to Pond DW4 : DRY WELL 4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 25year Rainfall=6.45"

Area (sf)	CN	Description
359	98	Paved parking, HSG A
359		100.00% Impervious Area

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

Subcatchment DA6: DA6



Summary for Pond 1P: MECHANIC STREET

[57] Hint: Peaked at 39.27' (Flood elevation advised)

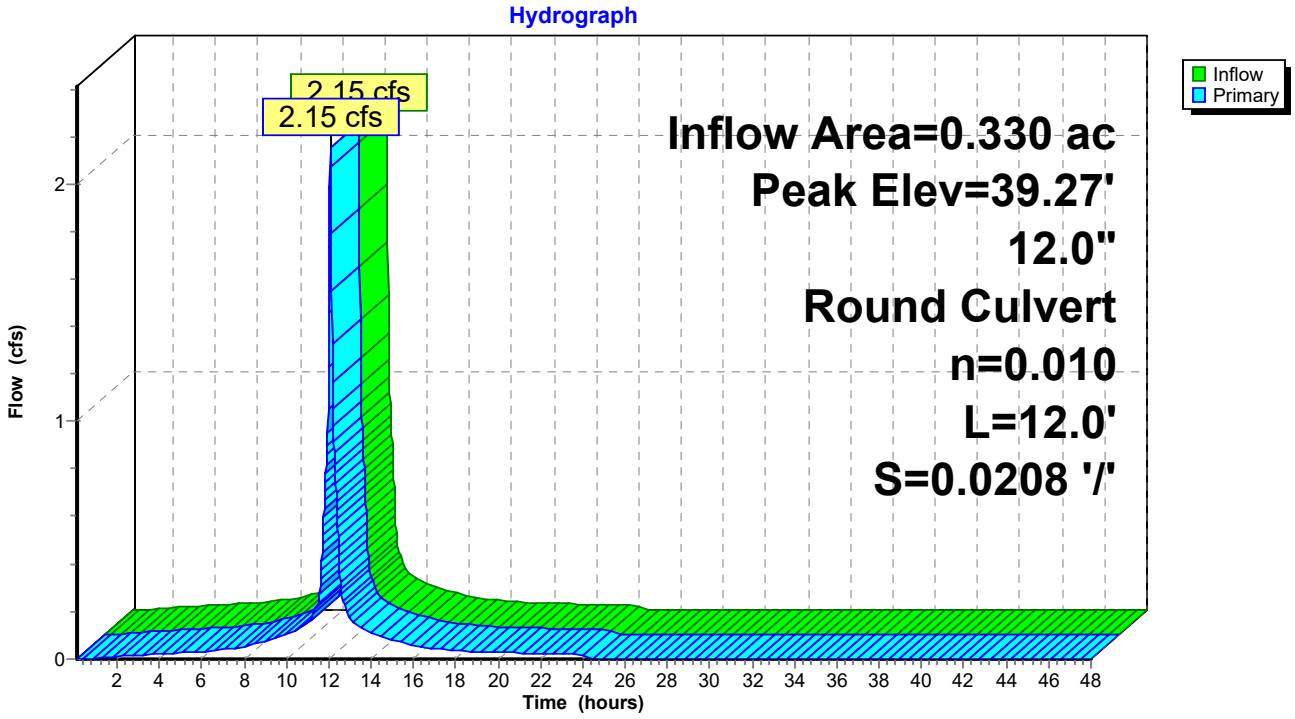
Inflow Area = 0.330 ac,100.00% Impervious, Inflow Depth = 6.21" for 25year event
Inflow = 2.15 cfs @ 12.07 hrs, Volume= 0.171 af
Outflow = 2.15 cfs @ 12.07 hrs, Volume= 0.171 af, Atten= 0%, Lag= 0.0 min
Primary = 2.15 cfs @ 12.07 hrs, Volume= 0.171 af
Routed to Pond SP2 : MECHANIC STREET

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 39.27' @ 12.07 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	38.25'	**12.0" Round CMP_Round 12"** L= 12.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 38.25' / 38.00' S= 0.0208 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=2.14 cfs @ 12.07 hrs HW=39.26' TW=36.45' (Dynamic Tailwater)
└**1=CMP_Round 12"** (Inlet Controls 2.14 cfs @ 2.72 fps)

Pond 1P: MECHANIC STREET



Summary for Pond DW1: DRY WELL 1

Inflow Area = 0.018 ac, 29.79% Impervious, Inflow Depth = 1.96" for 25year event
Inflow = 0.04 cfs @ 12.08 hrs, Volume= 0.003 af
Outflow = 0.00 cfs @ 11.74 hrs, Volume= 0.003 af, Atten= 96%, Lag= 0.0 min
Discarded = 0.00 cfs @ 11.74 hrs, Volume= 0.003 af
Primary = 0.00 cfs @ 0.10 hrs, Volume= 0.000 af
Routed to Pond SP1 : GRANITE AVENUE

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 39.08' @ 16.67 hrs Surf.Area= 28 sf Storage= 70 cf

Plug-Flow detention time= 480.1 min calculated for 0.003 af (100% of inflow)
Center-of-Mass det. time= 480.2 min (1,345.4 - 865.2)

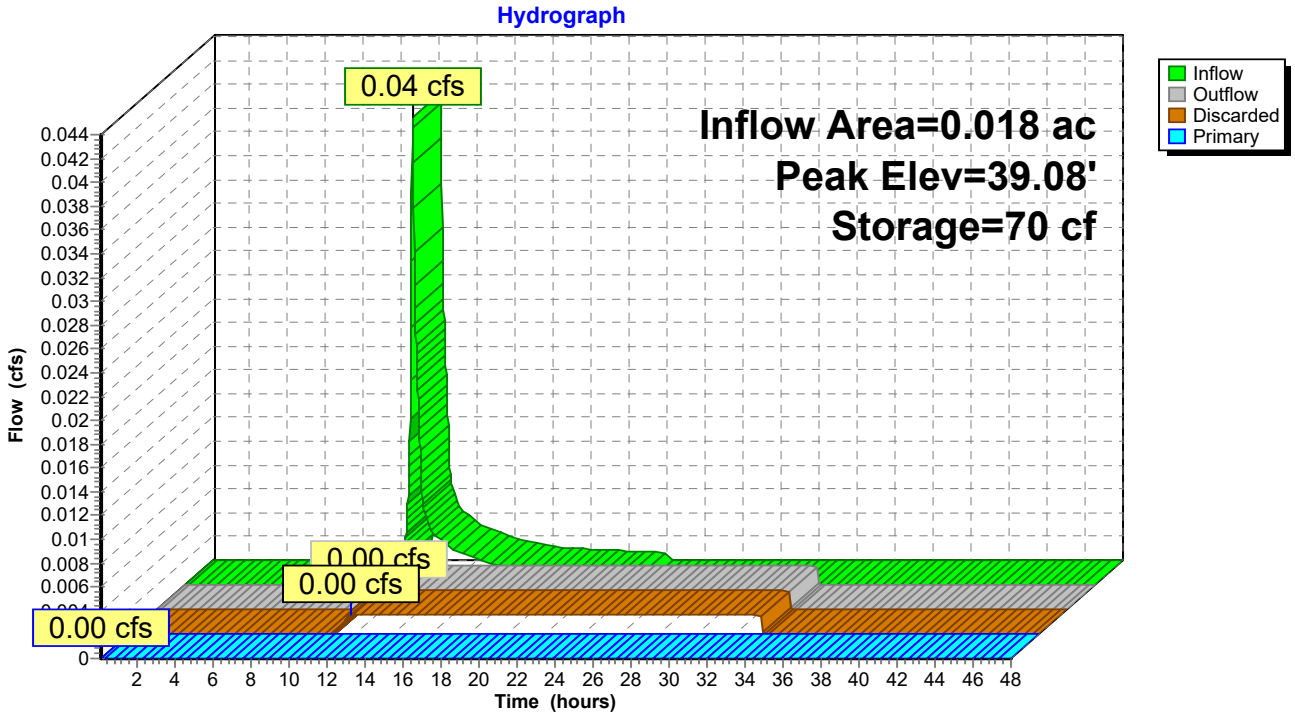
Volume	Invert	Avail.Storage	Storage Description
#1	34.65'	40 cf	**6.00'D x 7.00'H Stone** 198 cf Overall - 75 cf Embedded = 123 cf x 33.0% Voids
#2	35.65'	75 cf	**4.00'D x 6.00'H Dry Well** Inside #1
		116 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	34.65'	**2.410 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Primary	41.60'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.00 cfs @ 11.74 hrs HW=34.74' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.00 cfs @ 0.10 hrs HW=34.65' TW=0.00' (Dynamic Tailwater)
↑—**2=Orifice/Grate** (Controls 0.00 cfs)

Pond DW1: DRY WELL 1



Summary for Pond DW2: DRY WELL 2

Inflow Area = 0.022 ac, 73.43% Impervious, Inflow Depth = 4.40" for 25year event
Inflow = 0.12 cfs @ 12.07 hrs, Volume= 0.008 af
Outflow = 0.00 cfs @ 10.38 hrs, Volume= 0.008 af, Atten= 98%, Lag= 0.0 min
Discarded = 0.00 cfs @ 10.38 hrs, Volume= 0.008 af
Primary = 0.00 cfs @ 0.10 hrs, Volume= 0.000 af
Routed to Pond SP2 : MECHANIC STREET

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 41.56' @ 16.99 hrs Surf.Area= 50 sf Storage= 221 cf

Plug-Flow detention time= 745.9 min calculated for 0.008 af (100% of inflow)
Center-of-Mass det. time= 746.1 min (1,551.3 - 805.2)

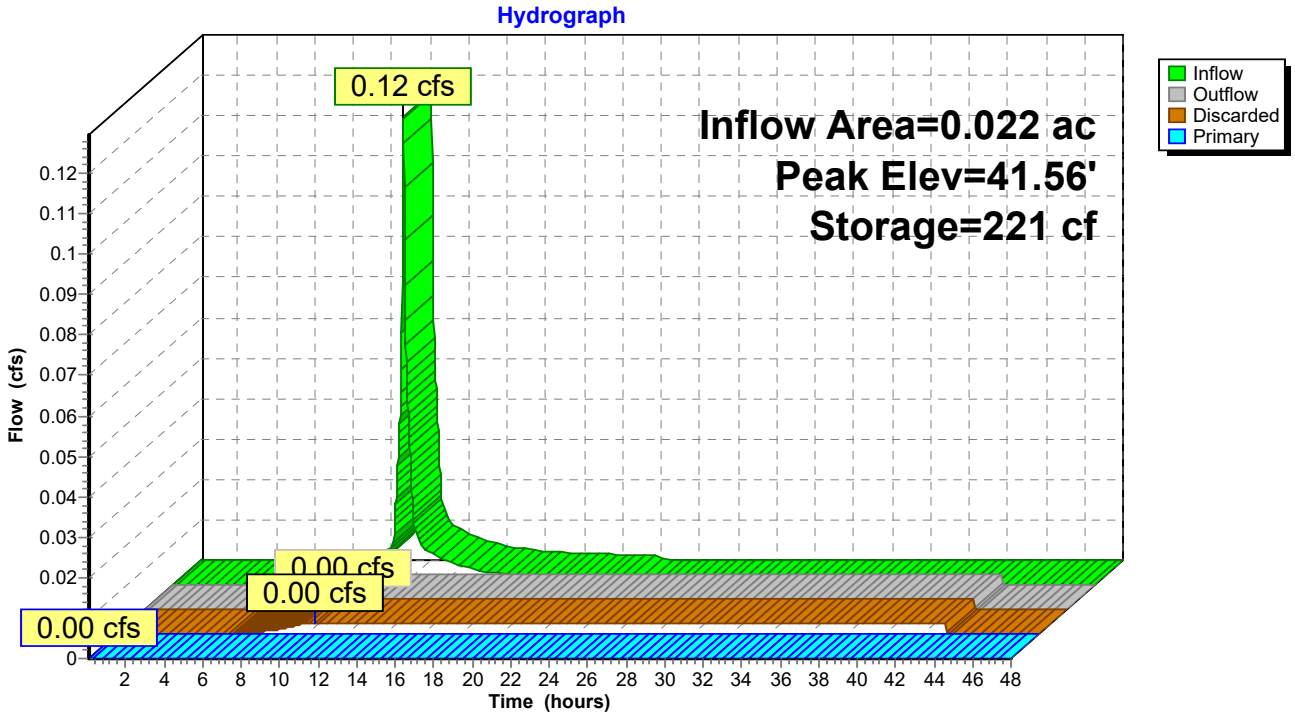
Volume	Invert	Avail.Storage	Storage Description
#1	34.80'	60 cf	**8.00'D x 7.00'H Stone** 352 cf Overall - 170 cf Embedded = 182 cf x 33.0% Voids
#2	35.80'	170 cf	**6.00'D x 6.00'H Dry Well** Inside #1
		230 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	34.80'	**2.410 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Primary	41.75'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.00 cfs @ 10.38 hrs HW=34.87' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.00 cfs @ 0.10 hrs HW=34.80' TW=35.40' (Dynamic Tailwater)
↑—**2=Orifice/Grate** (Controls 0.00 cfs)

Pond DW2: DRY WELL 2



Summary for Pond DW3: DRY WELL 3

Inflow Area = 0.005 ac,100.00% Impervious, Inflow Depth = 6.21" for 25year event
Inflow = 0.03 cfs @ 12.07 hrs, Volume= 0.002 af
Outflow = 0.00 cfs @ 10.88 hrs, Volume= 0.002 af, Atten= 95%, Lag= 0.0 min
Discarded = 0.00 cfs @ 10.88 hrs, Volume= 0.002 af
Primary = 0.00 cfs @ 0.10 hrs, Volume= 0.000 af
Routed to Pond SP1 : GRANITE AVENUE

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 37.69' @ 13.97 hrs Surf.Area= 28 sf Storage= 46 cf

Plug-Flow detention time= 229.1 min calculated for 0.002 af (100% of inflow)
Center-of-Mass det. time= 229.1 min (972.3 - 743.2)

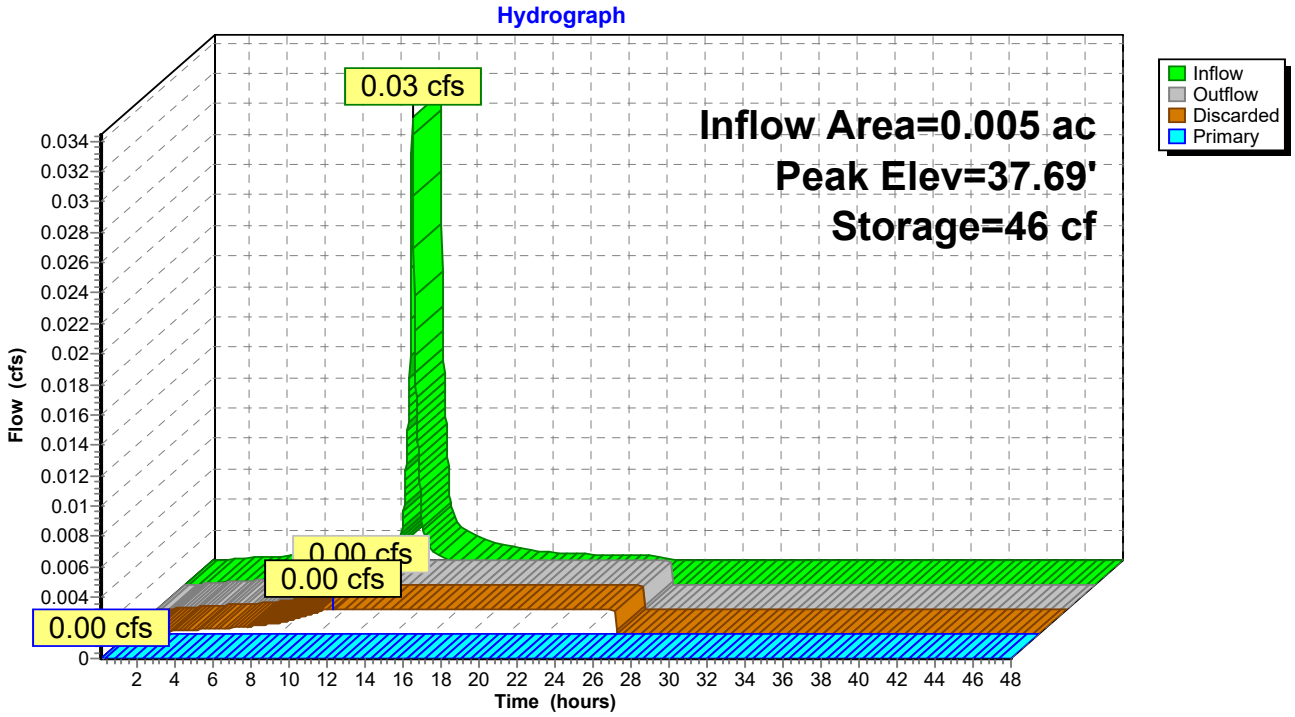
Volume	Invert	Avail.Storage	Storage Description
#1	34.65'	40 cf	**6.00'D x 7.00'H Stone** 198 cf Overall - 75 cf Embedded = 123 cf x 33.0% Voids
#2	35.65'	75 cf	**4.00'D x 6.00'H Dry Well** Inside #1
		116 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	34.65'	**2.410 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Primary	41.60'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.00 cfs @ 10.88 hrs HW=34.72' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.00 cfs @ 0.10 hrs HW=34.65' TW=0.00' (Dynamic Tailwater)
↑—**2=Orifice/Grate** (Controls 0.00 cfs)

Pond DW3: DRY WELL 3



Summary for Pond DW4: DRY WELL 4

Inflow Area = 0.008 ac,100.00% Impervious, Inflow Depth = 6.21" for 25year event
Inflow = 0.05 cfs @ 12.07 hrs, Volume= 0.004 af
Outflow = 0.00 cfs @ 9.20 hrs, Volume= 0.004 af, Atten= 97%, Lag= 0.0 min
Discarded = 0.00 cfs @ 9.20 hrs, Volume= 0.004 af
Primary = 0.00 cfs @ 0.10 hrs, Volume= 0.000 af
Routed to Pond SP1 : GRANITE AVENUE

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 40.83' @ 15.78 hrs Surf.Area= 28 sf Storage= 103 cf

Plug-Flow detention time= 550.4 min calculated for 0.004 af (100% of inflow)
Center-of-Mass det. time= 550.5 min (1,293.7 - 743.2)

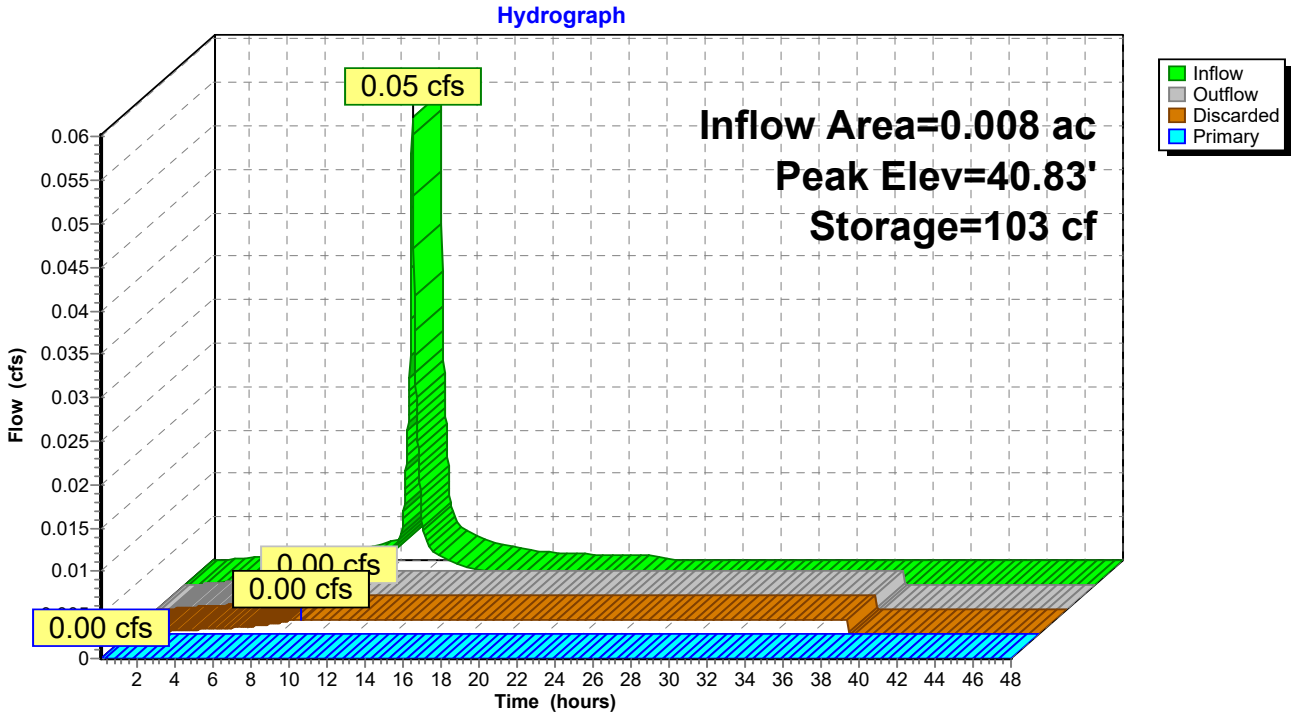
Volume	Invert	Avail.Storage	Storage Description
#1	34.57'	40 cf	**6.00'D x 7.00'H Stone** 198 cf Overall - 75 cf Embedded = 123 cf x 33.0% Voids
#2	35.57'	75 cf	**4.00'D x 6.00'H Dry Well** Inside #1
		116 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	34.57'	**2.410 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Primary	41.55'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.00 cfs @ 9.20 hrs HW=34.64' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.00 cfs @ 0.10 hrs HW=34.57' TW=0.00' (Dynamic Tailwater)
↑—**2=Orifice/Grate** (Controls 0.00 cfs)

Pond DW4: DRY WELL 4



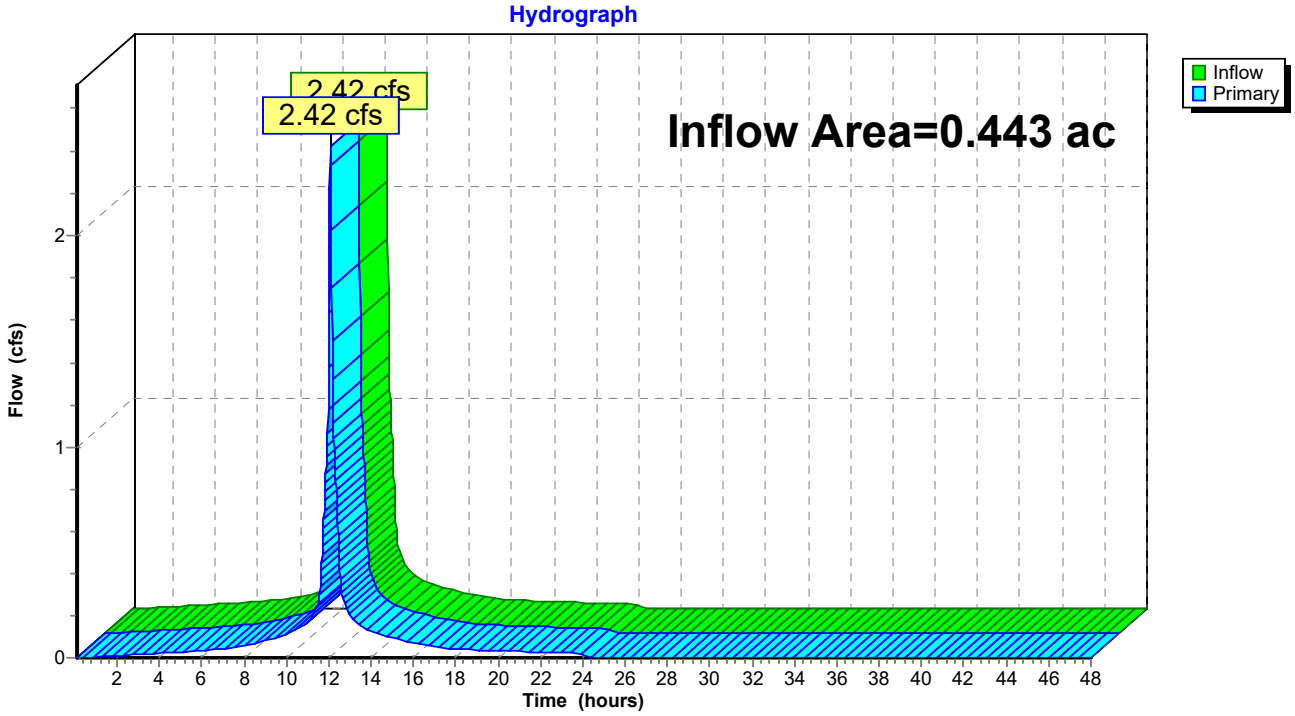
Summary for Pond SP1: GRANITE AVENUE

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.443 ac, 91.01% Impervious, Inflow Depth = 5.17" for 25year event
Inflow = 2.42 cfs @ 12.07 hrs, Volume= 0.191 af
Primary = 2.42 cfs @ 12.07 hrs, Volume= 0.191 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs / 2

Pond SP1: GRANITE AVENUE



Summary for Pond SP2: MECHANIC STREET

[57] Hint: Peaked at 36.46' (Flood elevation advised)

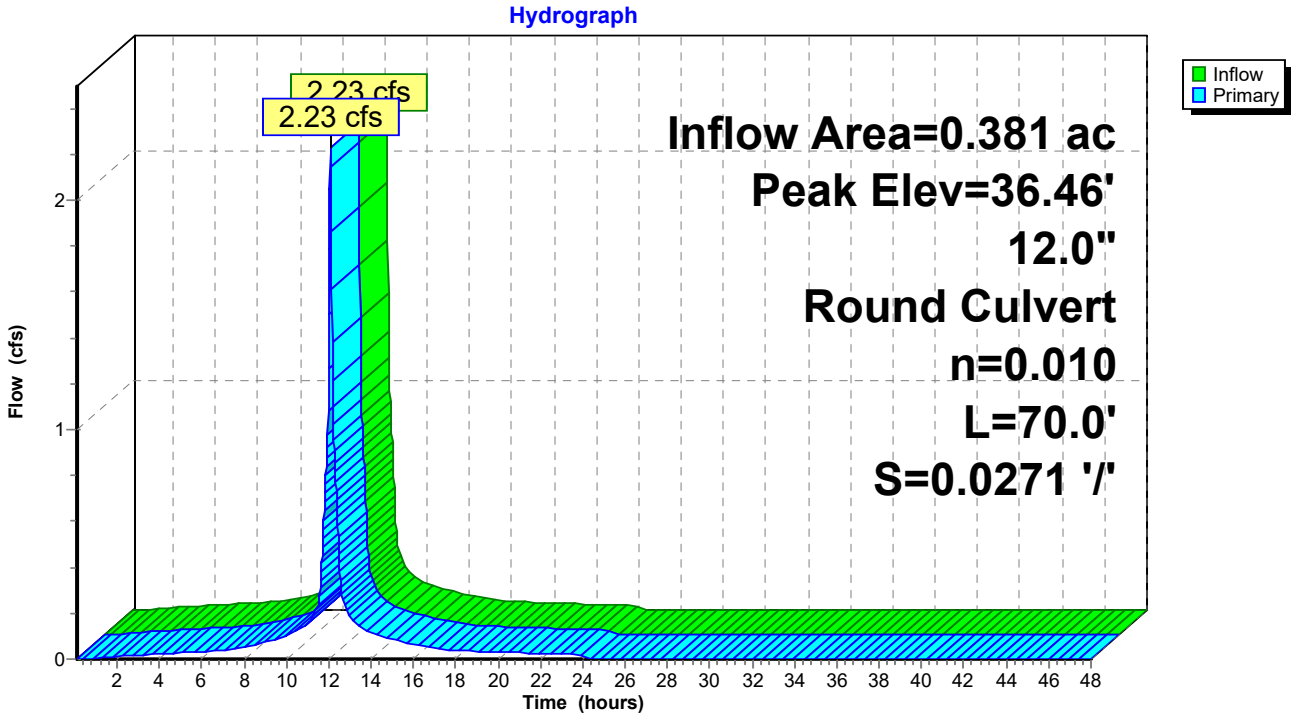
Inflow Area = 0.381 ac, 93.67% Impervious, Inflow Depth = 5.55" for 25year event
Inflow = 2.23 cfs @ 12.07 hrs, Volume= 0.176 af
Outflow = 2.23 cfs @ 12.07 hrs, Volume= 0.176 af, Atten= 0%, Lag= 0.0 min
Primary = 2.23 cfs @ 12.07 hrs, Volume= 0.176 af
Routed to Pond SP1 : GRANITE AVENUE

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 36.46' @ 12.07 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	35.40'	**12.0" Round CMP_Round 12"** L= 70.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 35.40' / 33.50' S= 0.0271 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=2.21 cfs @ 12.07 hrs HW=36.45' TW=0.00' (Dynamic Tailwater)
└**1=CMP_Round 12"** (Inlet Controls 2.21 cfs @ 2.82 fps)

Pond SP2: MECHANIC STREET



Summary for Subcatchment DA1: DA1

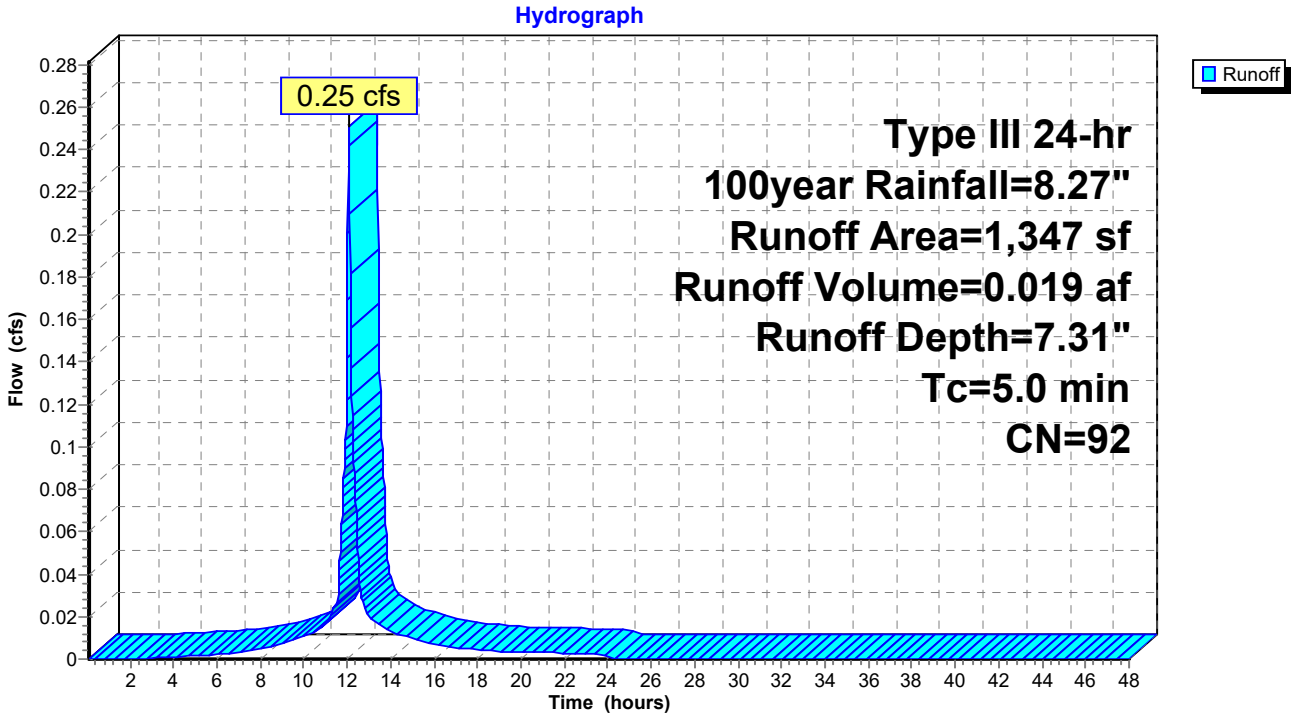
Runoff = 0.25 cfs @ 12.07 hrs, Volume= 0.019 af, Depth= 7.31"
Routed to Pond SP1 : GRANITE AVENUE

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100year Rainfall=8.27"

Area (sf)	CN	Description
1,206	98	Paved parking, HSG A
141	39	>75% Grass cover, Good, HSG A
1,347	92	Weighted Average
141		10.47% Pervious Area
1,206		89.53% Impervious Area

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

Subcatchment DA1: DA1



Summary for Subcatchment DA2: DA2

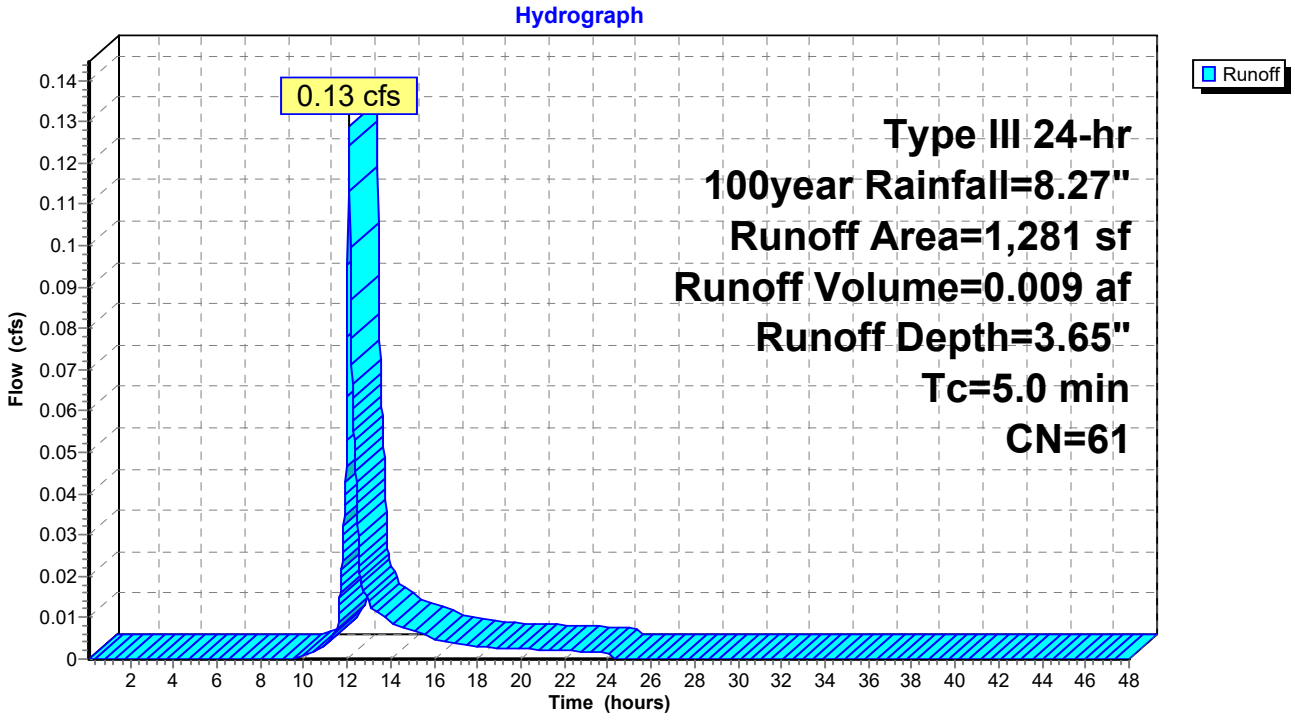
Runoff = 0.13 cfs @ 12.08 hrs, Volume= 0.009 af, Depth= 3.65"
Routed to Pond SP2 : MECHANIC STREET

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100year Rainfall=8.27"

Area (sf)	CN	Description
484	98	Paved parking, HSG A
797	39	>75% Grass cover, Good, HSG A
1,281	61	Weighted Average
797		62.22% Pervious Area
484		37.78% Impervious Area

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

Subcatchment DA2: DA2



Summary for Subcatchment DA2R: DA2

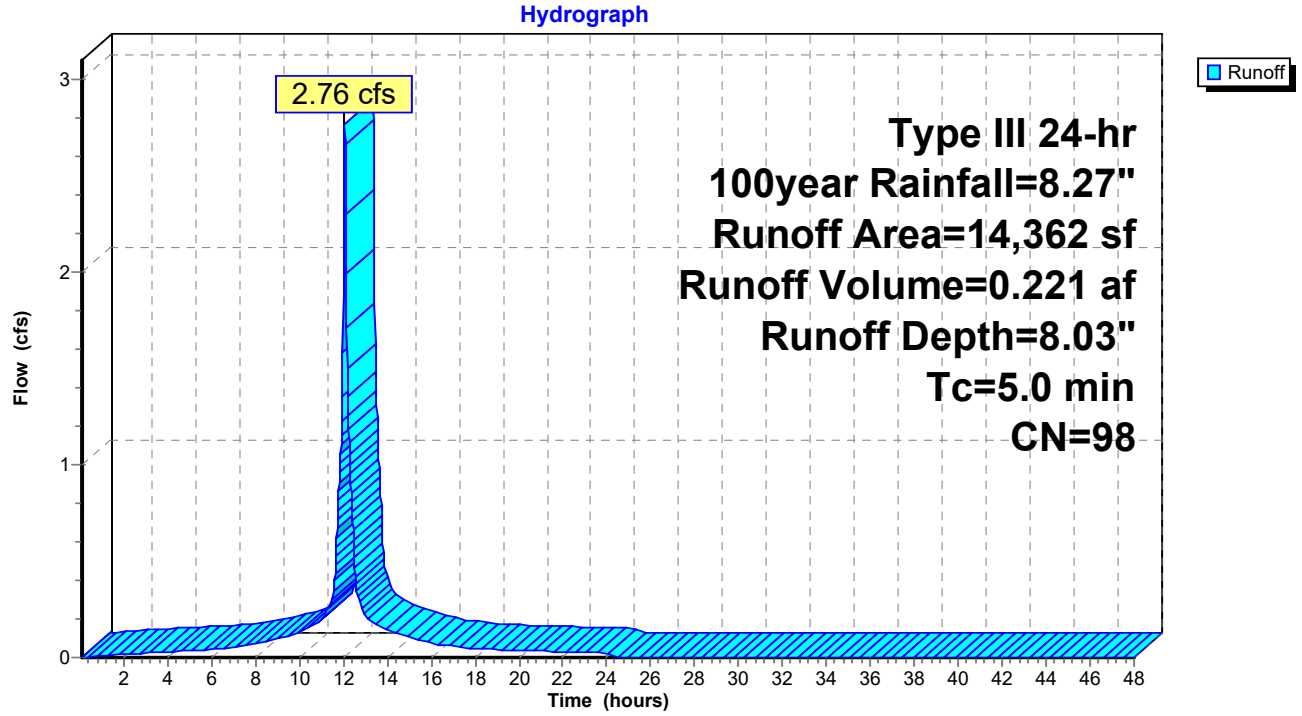
Runoff = 2.76 cfs @ 12.07 hrs, Volume= 0.221 af, Depth= 8.03"
Routed to Pond 1P : MECHANIC STREET

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100year Rainfall=8.27"

Area (sf)	CN	Description
14,362	98	Roofs, HSG A
14,362		100.00% Impervious Area

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

Subcatchment DA2R: DA2



Summary for Subcatchment DA3: DA3

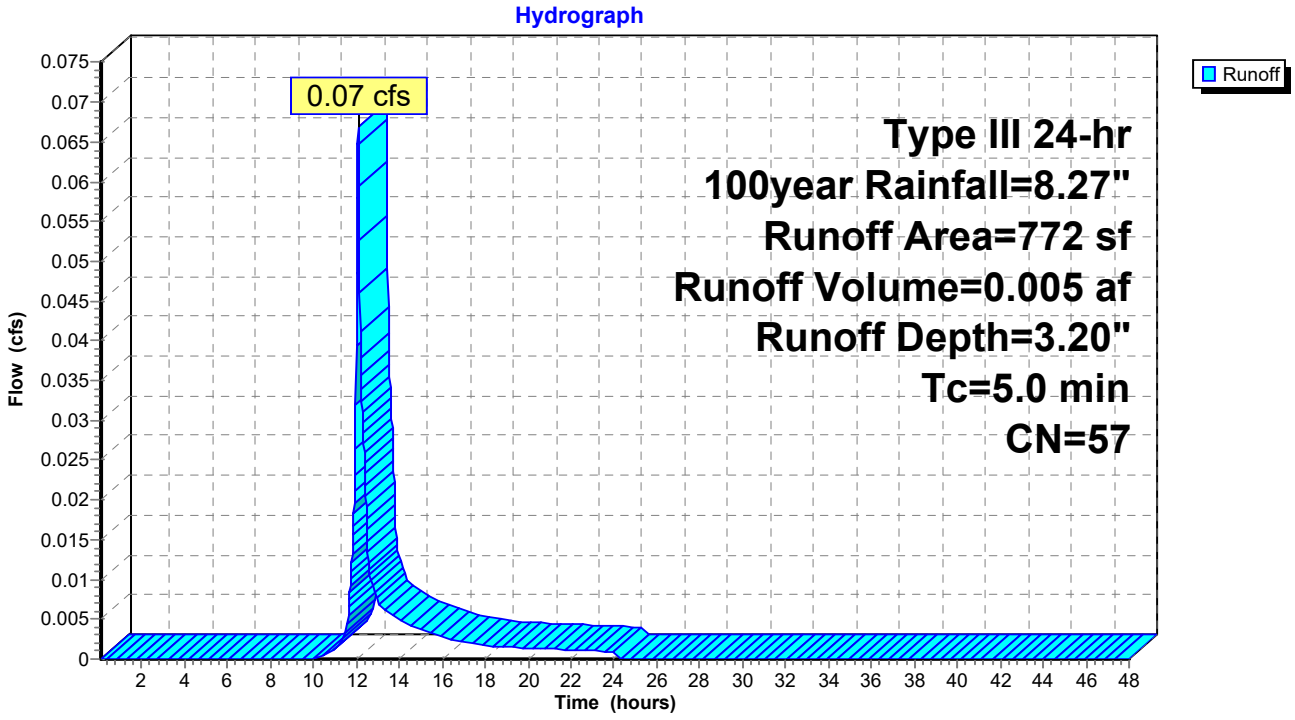
Runoff = 0.07 cfs @ 12.08 hrs, Volume= 0.005 af, Depth= 3.20"
Routed to Pond DW1 : DRY WELL 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100year Rainfall=8.27"

Area (sf)	CN	Description
230	98	Paved parking, HSG A
542	39	>75% Grass cover, Good, HSG A
772	57	Weighted Average
542		70.21% Pervious Area
230		29.79% Impervious Area

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

Subcatchment DA3: DA3



Summary for Subcatchment DA4: DA4

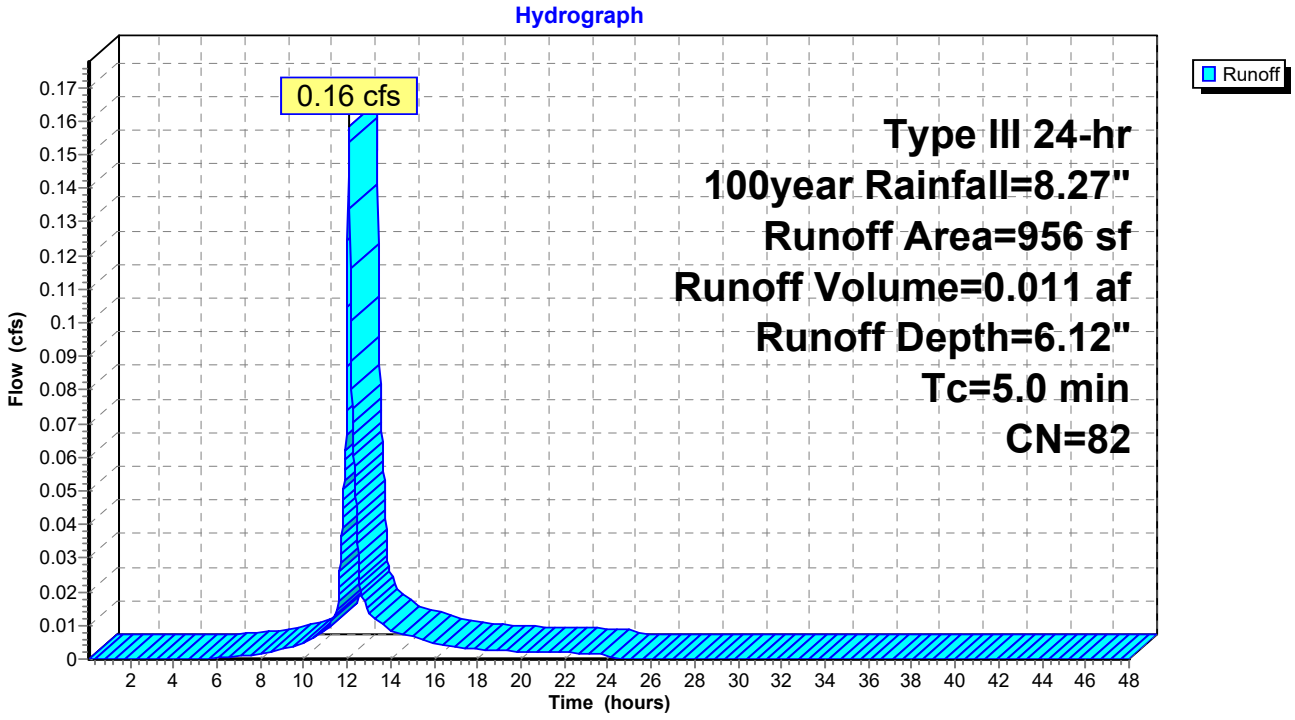
Runoff = 0.16 cfs @ 12.07 hrs, Volume= 0.011 af, Depth= 6.12"
Routed to Pond DW2 : DRY WELL 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100year Rainfall=8.27"

Area (sf)	CN	Description
702	98	Paved parking, HSG A
254	39	>75% Grass cover, Good, HSG A
956	82	Weighted Average
254		26.57% Pervious Area
702		73.43% Impervious Area

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

Subcatchment DA4: DA4



Summary for Subcatchment DA5: DA5

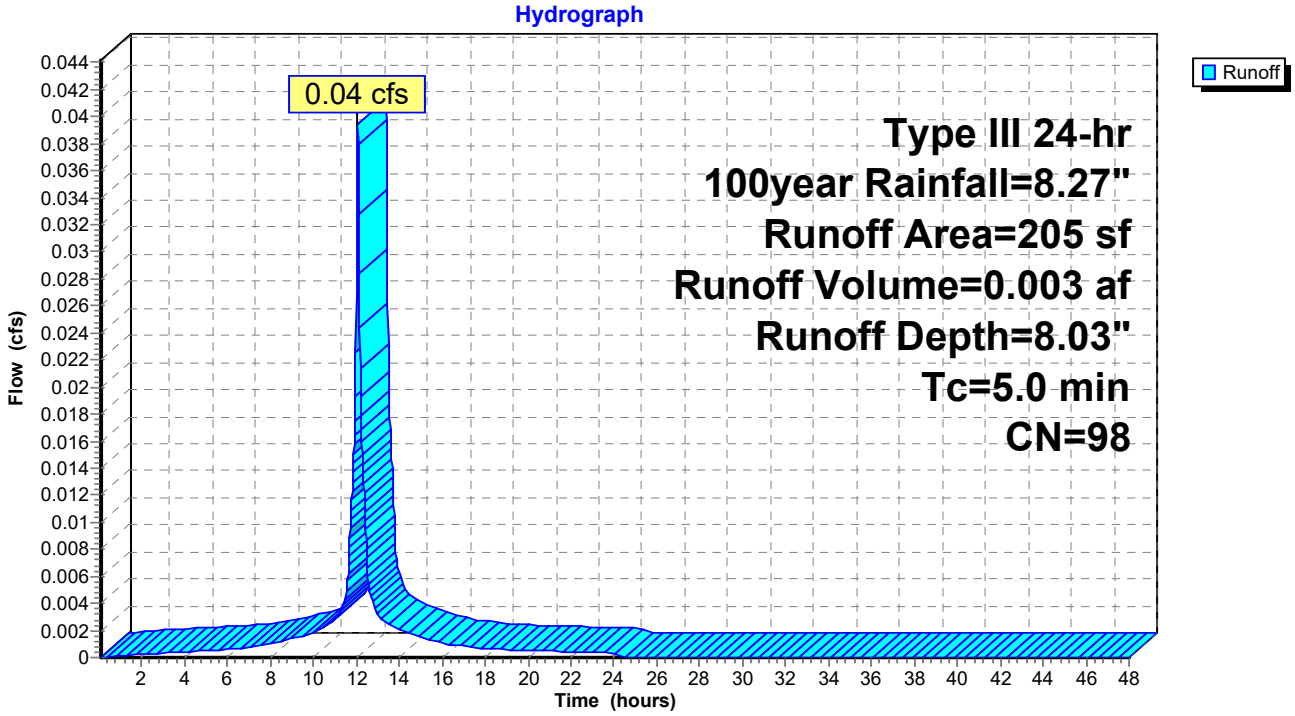
Runoff = 0.04 cfs @ 12.07 hrs, Volume= 0.003 af, Depth= 8.03"
Routed to Pond DW3 : DRY WELL 3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100year Rainfall=8.27"

Area (sf)	CN	Description
205	98	Paved parking, HSG A
205		100.00% Impervious Area

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

Subcatchment DA5: DA5



Summary for Subcatchment DA6: DA6

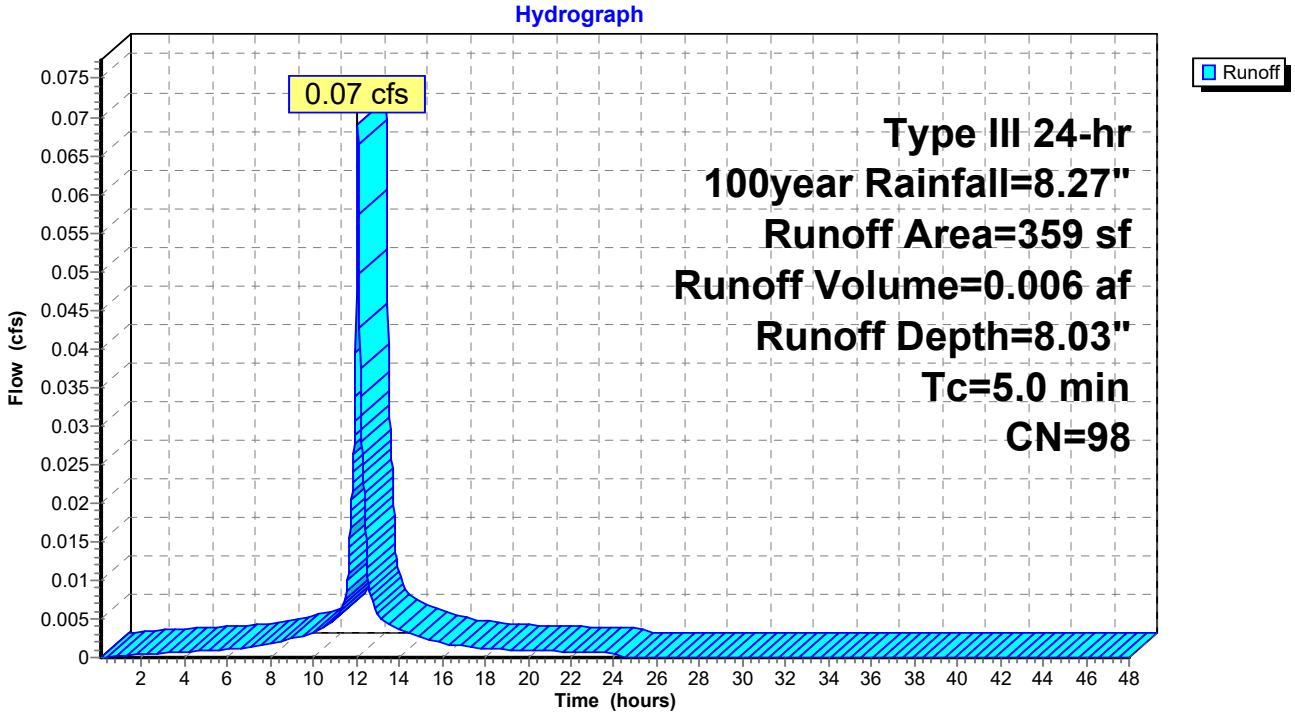
Runoff = 0.07 cfs @ 12.07 hrs, Volume= 0.006 af, Depth= 8.03"
Routed to Pond DW4 : DRY WELL 4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100year Rainfall=8.27"

Area (sf)	CN	Description
359	98	Paved parking, HSG A
359		100.00% Impervious Area

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

Subcatchment DA6: DA6



Summary for Pond 1P: MECHANIC STREET

[57] Hint: Peaked at 39.61' (Flood elevation advised)

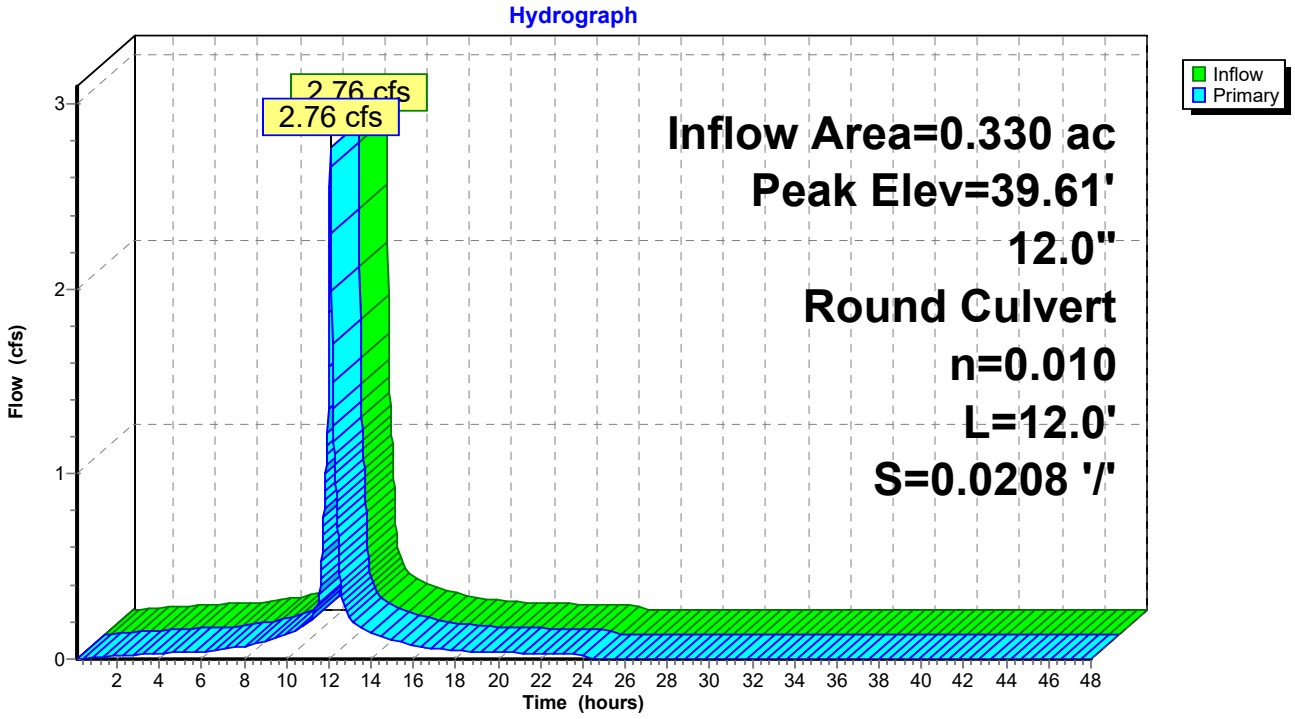
Inflow Area = 0.330 ac,100.00% Impervious, Inflow Depth = 8.03" for 100year event
Inflow = 2.76 cfs @ 12.07 hrs, Volume= 0.221 af
Outflow = 2.76 cfs @ 12.07 hrs, Volume= 0.221 af, Atten= 0%, Lag= 0.0 min
Primary = 2.76 cfs @ 12.07 hrs, Volume= 0.221 af
Routed to Pond SP2 : MECHANIC STREET

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 39.61' @ 12.07 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	38.25'	**12.0" Round CMP_Round 12"** L= 12.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 38.25' / 38.00' S= 0.0208 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=2.74 cfs @ 12.07 hrs HW=39.59' TW=36.82' (Dynamic Tailwater)
└**1=CMP_Round 12"** (Inlet Controls 2.74 cfs @ 3.49 fps)

Pond 1P: MECHANIC STREET



Summary for Pond DW1: DRY WELL 1

Inflow Area = 0.018 ac, 29.79% Impervious, Inflow Depth = 3.20" for 100year event
Inflow = 0.07 cfs @ 12.08 hrs, Volume= 0.005 af
Outflow = 0.01 cfs @ 13.93 hrs, Volume= 0.005 af, Atten= 92%, Lag= 110.8 min
Discarded = 0.00 cfs @ 11.42 hrs, Volume= 0.004 af
Primary = 0.00 cfs @ 13.93 hrs, Volume= 0.000 af
Routed to Pond SP1 : GRANITE AVENUE

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 41.60' @ 13.92 hrs Surf.Area= 28 sf Storage= 115 cf

Plug-Flow detention time= 689.3 min calculated for 0.005 af (100% of inflow)
Center-of-Mass det. time= 689.5 min (1,539.6 - 850.1)

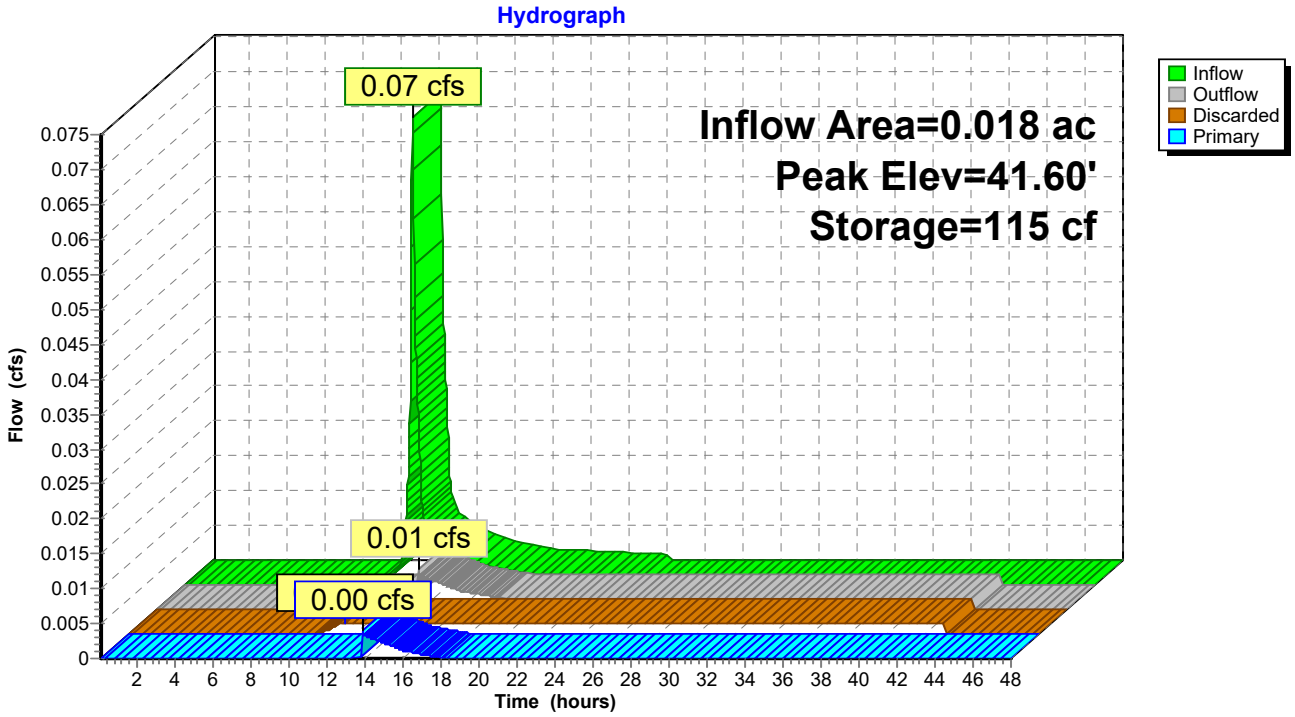
Volume	Invert	Avail.Storage	Storage Description
#1	34.65'	40 cf	**6.00'D x 7.00'H Stone** 198 cf Overall - 75 cf Embedded = 123 cf x 33.0% Voids
#2	35.65'	75 cf	**4.00'D x 6.00'H Dry Well** Inside #1
		116 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	34.65'	**2.410 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Primary	41.60'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.00 cfs @ 11.42 hrs HW=34.73' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.00 cfs @ 13.93 hrs HW=41.60' TW=0.00' (Dynamic Tailwater)
↑—**2=Orifice/Grate** (Weir Controls 0.00 cfs @ 0.18 fps)

Pond DW1: DRY WELL 1



Summary for Pond DW2: DRY WELL 2

Inflow Area = 0.022 ac, 73.43% Impervious, Inflow Depth = 6.12" for 100year event
Inflow = 0.16 cfs @ 12.07 hrs, Volume= 0.011 af
Outflow = 0.05 cfs @ 12.40 hrs, Volume= 0.011 af, Atten= 67%, Lag= 19.7 min
Discarded = 0.00 cfs @ 9.48 hrs, Volume= 0.009 af
Primary = 0.05 cfs @ 12.40 hrs, Volume= 0.002 af
Routed to Pond SP2 : MECHANIC STREET

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 41.77' @ 12.40 hrs Surf.Area= 50 sf Storage= 229 cf

Plug-Flow detention time= 614.2 min calculated for 0.011 af (100% of inflow)
Center-of-Mass det. time= 614.5 min (1,410.5 - 796.0)

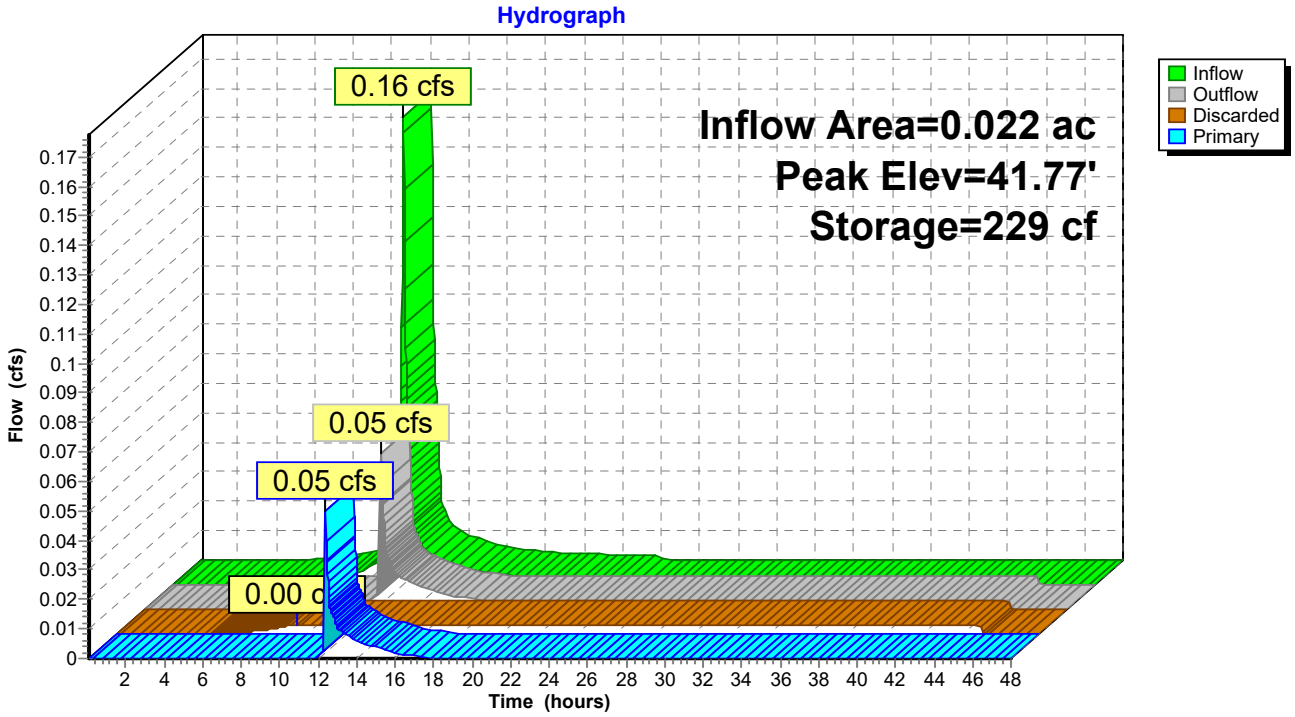
Volume	Invert	Avail.Storage	Storage Description
#1	34.80'	60 cf	**8.00'D x 7.00'H Stone**
			352 cf Overall - 170 cf Embedded = 182 cf x 33.0% Voids
#2	35.80'	170 cf	**6.00'D x 6.00'H Dry Well** Inside #1
		230 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	34.80'	**2.410 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Primary	41.75'	**24.0" Horiz. Orifice/Grate** C= 0.600
			Limited to weir flow at low heads

Discarded OutFlow Max=0.00 cfs @ 9.48 hrs HW=34.87' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.05 cfs @ 12.40 hrs HW=41.77' TW=35.94' (Dynamic Tailwater)
↑—**2=Orifice/Grate** (Weir Controls 0.05 cfs @ 0.44 fps)

Pond DW2: DRY WELL 2



Summary for Pond DW3: DRY WELL 3

Inflow Area = 0.005 ac,100.00% Impervious, Inflow Depth = 8.03" for 100year event
Inflow = 0.04 cfs @ 12.07 hrs, Volume= 0.003 af
Outflow = 0.00 cfs @ 10.20 hrs, Volume= 0.003 af, Atten= 96%, Lag= 0.0 min
Discarded = 0.00 cfs @ 10.20 hrs, Volume= 0.003 af
Primary = 0.00 cfs @ 0.10 hrs, Volume= 0.000 af
Routed to Pond SP1 : GRANITE AVENUE

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 38.83' @ 14.84 hrs Surf.Area= 28 sf Storage= 66 cf

Plug-Flow detention time= 342.4 min calculated for 0.003 af (100% of inflow)
Center-of-Mass det. time= 342.4 min (1,082.3 - 739.9)

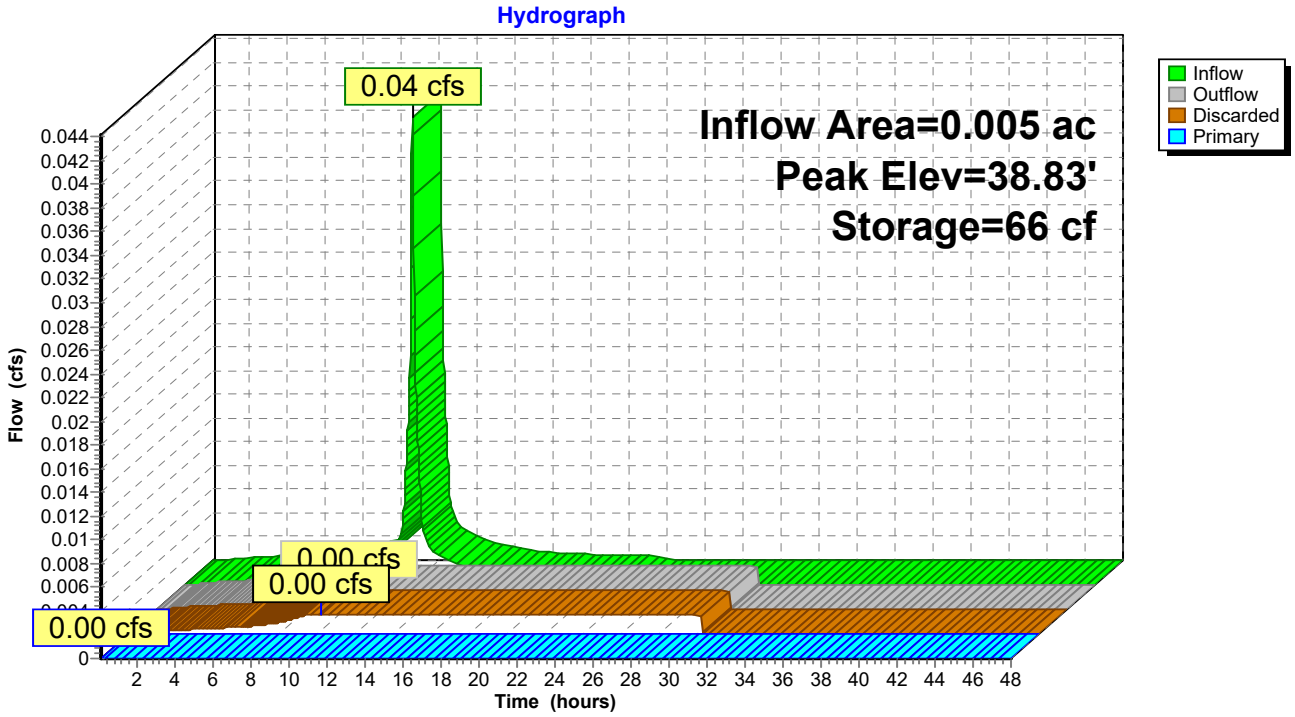
Volume	Invert	Avail.Storage	Storage Description
#1	34.65'	40 cf	**6.00'D x 7.00'H Stone** 198 cf Overall - 75 cf Embedded = 123 cf x 33.0% Voids
#2	35.65'	75 cf	**4.00'D x 6.00'H Dry Well** Inside #1
		116 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	34.65'	**2.410 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Primary	41.60'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.00 cfs @ 10.20 hrs HW=34.72' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.00 cfs @ 0.10 hrs HW=34.65' TW=0.00' (Dynamic Tailwater)
↑—**2=Orifice/Grate** (Controls 0.00 cfs)

Pond DW3: DRY WELL 3



Summary for Pond DW4: DRY WELL 4

[87] Warning: Oscillations may require smaller dt or Finer Routing (severity=2)

Inflow Area = 0.008 ac,100.00% Impervious, Inflow Depth = 8.03" for 100year event
Inflow = 0.07 cfs @ 12.07 hrs, Volume= 0.006 af
Outflow = 0.02 cfs @ 12.50 hrs, Volume= 0.006 af, Atten= 74%, Lag= 25.8 min
Discarded = 0.00 cfs @ 8.50 hrs, Volume= 0.005 af
Primary = 0.02 cfs @ 12.50 hrs, Volume= 0.001 af
Routed to Pond SP1 : GRANITE AVENUE

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 41.56' @ 12.50 hrs Surf.Area= 28 sf Storage= 116 cf

Plug-Flow detention time= 554.7 min calculated for 0.006 af (100% of inflow)
Center-of-Mass det. time= 554.9 min (1,294.8 - 739.9)

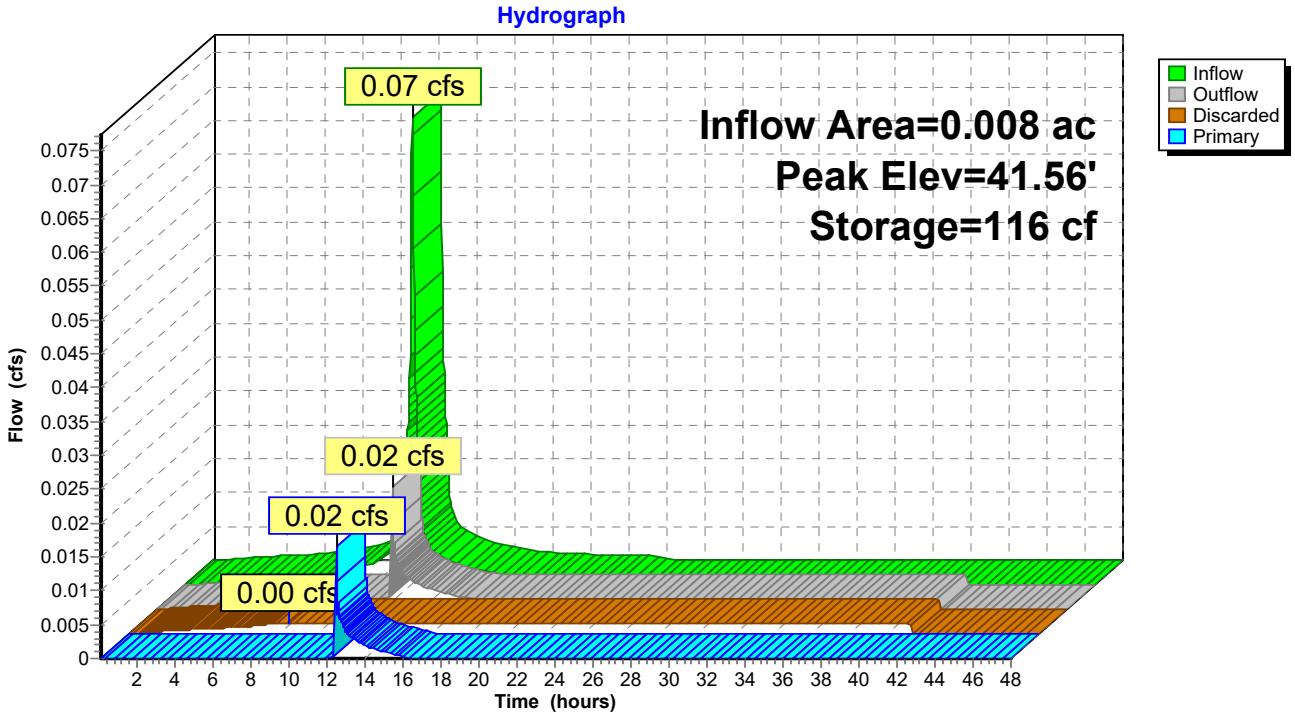
Volume	Invert	Avail.Storage	Storage Description
#1	34.57'	40 cf	**6.00'D x 7.00'H Stone** 198 cf Overall - 75 cf Embedded = 123 cf x 33.0% Voids
#2	35.57'	75 cf	**4.00'D x 6.00'H Dry Well** Inside #1
		116 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	34.57'	**2.410 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Primary	41.55'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.00 cfs @ 8.50 hrs HW=34.64' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.02 cfs @ 12.50 hrs HW=41.56' TW=0.00' (Dynamic Tailwater)
↑—**2=Orifice/Grate** (Weir Controls 0.02 cfs @ 0.30 fps)

Pond DW4: DRY WELL 4



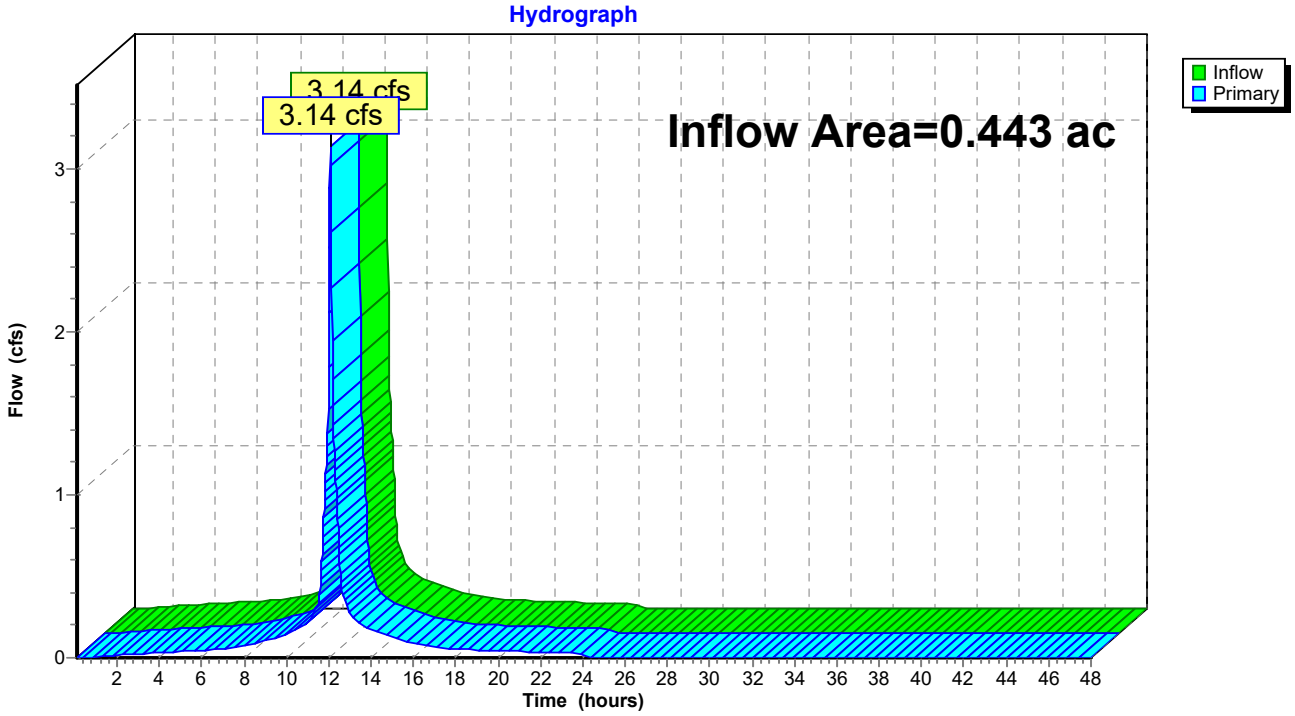
Summary for Pond SP1: GRANITE AVENUE

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.443 ac, 91.01% Impervious, Inflow Depth = 6.83" for 100year event
Inflow = 3.14 cfs @ 12.07 hrs, Volume= 0.252 af
Primary = 3.14 cfs @ 12.07 hrs, Volume= 0.252 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs / 2

Pond SP1: GRANITE AVENUE



Summary for Pond SP2: MECHANIC STREET

[57] Hint: Peaked at 36.84' (Flood elevation advised)

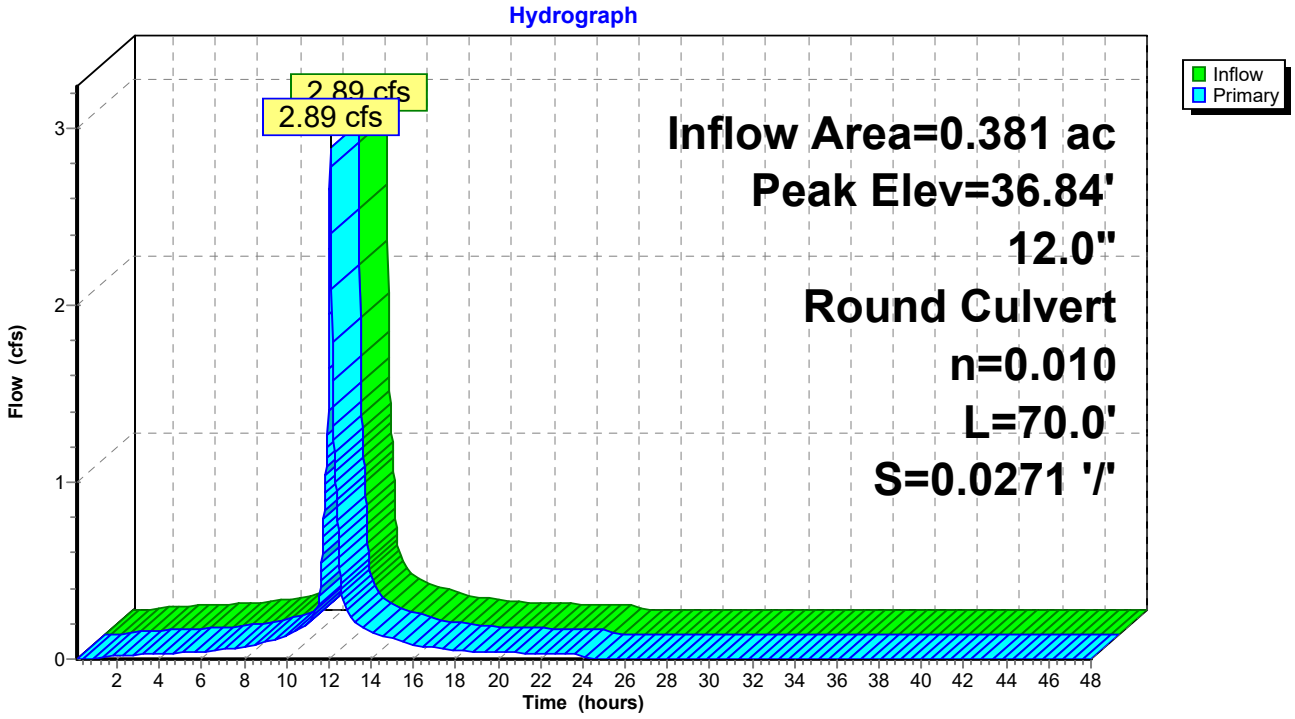
Inflow Area = 0.381 ac, 93.67% Impervious, Inflow Depth = 7.31" for 100year event
Inflow = 2.89 cfs @ 12.07 hrs, Volume= 0.232 af
Outflow = 2.89 cfs @ 12.07 hrs, Volume= 0.232 af, Atten= 0%, Lag= 0.0 min
Primary = 2.89 cfs @ 12.07 hrs, Volume= 0.232 af
Routed to Pond SP1 : GRANITE AVENUE

Routing by Dyn-Stor-Ind method, Time Span= 0.10-48.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 36.84' @ 12.07 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	35.40'	**12.0" Round CMP_Round 12"** L= 70.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 35.40' / 33.50' S= 0.0271 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=2.87 cfs @ 12.07 hrs HW=36.82' TW=0.00' (Dynamic Tailwater)
└**1=CMP_Round 12"** (Inlet Controls 2.87 cfs @ 3.65 fps)

Pond SP2: MECHANIC STREET



APPENDIX E
Recharge Calculations

Horsley Witten Group, Inc.
Sustainable Environmental Solutions
www.horsleywitten.com

Recharge Calculations

Project:	440 Granite Ave, Milton, MA
Project No:	20130
Calculated By:	JLV
Checked By:	JCB
Date:	7/12/2021

RECHARGE BASIN SCHEDULE:

Location	Dry Well Rim (ft)*	Dry Well Diameter (ft)	Dry Well Depth (ft)	Watershed Area (SF)	% Impervious	1 inch WQV (CF)	Provided WQV (CF)	Provided WQV w/ Stone (CF)*	% of 1" Imperv area treated	HSG	Infiltration Rate
Dry Well 1	41.65	4	6	772	30	19	75	116	3.906643714	HSG A	2.41
Dry Well 2	41.8	6	6	956	73	58	170	230	2.917051699	HSG A	2.41
Dry Well 3	41.65	4	6	205	100	17	75	116	4.413554557	HSG A	2.41
Dry Well 4	41.57	4	6	359	100	30	75	116	2.520274886	HSG A	2.41

*From HydroCAD

Input Value
Calculated
Standard Value

APPENDIX F
Operations and Maintenance Plan

APPENDIX G
Project Plan Set

Nitsch Engineering

2 Center Plaza, Suite 430
Boston, MA 02108-1928
T: 617-338-0063
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September 22, 2021

Ms. Marina Fernandes, PE, LEED
Town of Milton
AP Town Engineer
525 Canton Avenue
Milton, MA 02186

RE: Stormwater Peer Review 440 Granite Avenue

Dear Ms. Fernandes:

Nitsch Engineering received and reviewed the following updated information for 440 Granite Avenue in Milton, Massachusetts:

Response letter dated September 16, 2021, including:
- Green Roof Documentation;
- Proposed Drainage Map, revised September 16, 2021;
- HydroCAD model for the proposed conditions, revised September 16, 2021; and
- Plan Set, revised September 16, 2021.

Nitsch Engineering is providing comments with respect to Site Plan and Stormwater Management. For clarity, we have provided our initial comments from September 1, 2021 in normal font, the responses from Horsley Witten (HW) on September 16, 2021 are in red font, and Nitsch Engineering's updated responses are provided in **bold** font.

Town of Milton Chapter 21 Stormwater Management Bylaw

1. Chapter 21, Section 4 provides thresholds for stockpiling volumes and associated control measures. The Applicant should confirm the volume of material intended to be stockpiled onsite. If greater than 100 cubic yards or 1000 cubic yards, the Applicant should comply with applicable points in Section 4 Stormwater Management Requirements.

   HW Response: The Applicant/Owner/Developer has confirmed that there will not be greater than 100 cubic yards of material stockpiled on the site during construction at any time. A Construction Management Plan (CMP) has been submitted to the Town for review by the Applicant under separate cover.

   Nitsch Response: Based on the response from the Applicant, the project will not be subject to the additional requirements for sites stockpiling greater than 100 cubic yards. We defer to the Town for review of the CMP and construction-related phasing concerns. Comment closed.

2. Per Section 4, *All Projects shall prevent the discharge of polluted stormwater to the Municipal Storm Drain System of the Town*. It does not appear that the Project provides treatment for some of the impervious areas on the site before runoff is routed to the street. Additionally, vehicular impervious area should be treated prior to discharging to the dry wells.

HW Response: Permeable pavement will be utilized on the two proposed driveway entrances to treat and manage the stormwater runoff. HW understands that all impermeable sidewalk areas do not need to be treated prior to sheet flowing onto the street.

Nitsch Response: The revised plans include the new permeable pavement limits at the drive aisles. Comment closed.

3. Based on the Stormwater Report, the existing site is 77% impervious and the proposed design would increase it to 83% impervious. The Applicant is proposing to reduce the impact of this increase through the incorporation of dry wells around the site perimeter. However, the Stormwater Report indicates that the project will increase runoff rates in the proposed condition, which will result in increased flow to the municipal drainage system. At a minimum, the project should mitigate stormwater rates and volumes such that the proposed condition does not exceed the existing condition.

HW Response: To reduce the peak flows, HW made the following adjustments:

- Permeable pavement has been proposed for the parking lot and the two driveway surfaces. A Curve Number (CN) of 76 was utilized for the permeable pavement.
- The CN for the green roof has been adjusted from a CN of 98 to a CN of 74 to account for the stormwater benefit provided by the green roof.
- Two 20-foot-long by 8-foot-wide tree trench filters with three feet of crushed stone have been added along Granite Avenue to capture the runoff from 4,000 square feet of the proposed roof.

The revised peak flow table is below:

Table 2: Summary of the Pre- and Post-Development Flow Rates from the Site

Study Point		**Flow, cfs**			
		2-yr	**10-yr**	**25-yr**	**100-yr**
SP 1 – Granite Avenue	PRE	0.96	1.82	2.37	3.21
	POST	0.84	1.79	2.27	2.94
SP 2 – Mechanic Street	PRE	0.57	1.11	1.45	1.98
	POST	0.04	0.07	0.10	0.15

Table 3: Summary of Pre- and Post-development Volumes from the Site

Study Point		**Volume, acre-ft**			
		2-yr	**10-yr**	**25-yr**	**100-yr**
SP 1 – Granite Avenue	PRE	0.068	0.130	0.171	0.235
	POST	0.068	0.118	0.150	0.201
SP 2 – Mechanic Street	PRE	0.041	0.079	0.104	0.144
	POST	0.002	0.005	0.007	0.010

Nitsch Response: Nitsch Engineering has reviewed the updated HydroCAD calculations and they incorporate the dry wells, porous pavement, green roof, and tree trench filters. These updates have addressed our previous comment with respect to mitigating peak runoff rates such that the proposed rates do not exceed the existing rates. The detail provided for the enhanced stormwater tree trench, labeled as "Cross Section B-B" "Cross Section C-C" on Sheet C004, should be reviewed as pertinent dimensions are not provided. The Applicant should confirm the dimensions match the assumptions provided for the tree trench in the HydroCAD model. Comment closed pending incorporation of this information in the final plan set.

4. In accordance with Section 4, the Applicant shall *implement other stormwater management measures at the direction of the DPW*. Additional stormwater management strategies – including a blue roof or additional green roof around/beneath the proposed solar panels and other roof equipment, infiltration of roof runoff, or porous pavement around the building perimeter – should be considered to reduce the proposed peak runoff rates. We note that there may also be an opportunity to utilize the proposed street trees as a tree filter (owned and maintained by the Property Owner) and promote treatment and infiltration.

   HW Response: Two 20-foot-long tree trench filters have been added along Granite Avenue to capture the runoff from 4,000 square feet of the proposed roof.

   Nitsch Response: The Applicant has included new tree trench filters in the plans and HydroCAD model. Comment closed.

General Stormwater Comments

5. The existing 12-inch PVC drain pipe connecting the drain manholes within Mechanic St and Granite Ave is within approximately 3-4 feet of the proposed building face and appears to be underneath the proposed roof overhang. The plans indicate that this is to be protected during construction, however it is unclear if this is actually feasible given the proximity and the subsurface portion of the building to be constructed. Additionally, this location does not allow for future maintenance of this pipe by the Town. The Applicant should evaluate alternatives including rerouting the pipe or adjust building footprint to provide a minimum 4' clearance from the roof line on both sides of drain line (from outer wall of pipe) for Town access. We note that a maintenance easement may also be required.

   HW Response: A portion of the 12" existing pipe will be rerouted with two drain manhole structures and approximately 50 feet of new 12" pipe. The Applicant/Owner/Developer will work with the Town of Milton to create an easement for future maintenance over the newly installed pipe.

   Nitsch Response: The re-routing of the drainage line provides an offset of approximately 9 to 10 feet from the building face and 4 feet from the roof overhang. The new drain manhole is approximately 3 feet from the building overhang, though the access point (cover) is approximately 5 feet from the building overhang. Comment closed pending approval of this routing by the Town. The Applicant shall obtain a maintenance easement for the drainage line and shall survey and record the easement on the deed at the end of the project.

6. For the drain pipe discharging roof drainage to Mechanic Street, the Applicant should confirm whether the existing pipe will be maintained or replaced in consultation with the Town Engineer. If it is replaced, the drain pipe should be ductile iron or reinforced concrete pipe.

   HW Response: The existing 12" PVC pipe will be replaced with approximately 50 feet of 12" pipe. The proposed pipe material will be confirmed with the Milton Engineering Department.

   Nitsch Response: Per the Town of Milton Department of Public Works, the drain pipe material shall be ductile iron, which is already provided in the revised plan set. Comment closed.

7. The proposed green roof area is not represented on drainage areas plan or included in the HydroCAD model (making the model a conservative estimate of runoff leaving the site). Additional information is needed to understand the intent of the green roof and its benefit in reducing stormwater. We note that the green roof may assist in reducing peak runoff rates, depending on the design of the system.

   HW Response: HW has included the proposed green roof with a CN of 74 on the drainage plan. The roof downspout will be directed to a drywell for larger storm events. Documentation for the green roof is included as an attachment.

   Nitsch Response: We have reviewed the submitted information supporting the modeling of the green roof. Comment closed.

8. Given the limited site area around the building, the Applicant should provide the intended locations for snow storage.

   HW Response: The Owner/Applicant/Developer has agreed to remove snow of 4-inches or more. Snow events with lighter precipitation will be hand shoveled to locations around the building that will not encumber the sidewalks or doorways.

   Nitsch Response: We recommend that this process for snow removal be documented in the Operation and Maintenance Plan for the project, as snow operations will be the ongoing responsibility of the Owner and Property Manager. Comment closed.

If the Town or Applicant has any questions, please call.

Very truly yours,

Nitsch Engineering, Inc.

Jennifer Johnson, PE, CFM, CPSWQ, LEED AP
Project Manager

Marianna Zak Hill, PE
Environmental Engineer/Planner

MZH/JLJ/ajc

Q:\14706 440 Granite Ave\Civil\Project Data\2021-09-22 440 Granite Ave LTReview2.docx

TOWN OF MILTON

DEPARTMENT OF PUBLIC WORKS
629 RANDOLPH AVENUE
MILTON, MA 02186
www.townofmilton.org

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THOMAS MCCARTHY
Assistant Director of Public Works
JOHN CALABRO
Manager of Wires and Maintenance

TIMOTHY INACIO
Civil Engineer
ALLAN BISHOP, GISP
Engineering Department/GIS
ERICA DeDONATO
Environmental Coordinator
KATHLEEN M.BOWEN
Senior Administrative Clerk – Conservation

September 22, 2021

Milton Planning Board
525 Canton Avenue
Milton, MA 02186

Re: Site Plan Proposal Review
440 Granite Ave, Milton MA

To the Members of the Planning Board:

The Engineering Department has reviewed the following documents:

- Site Plan and Stormwater Management comments dated September 1, 2021; prepared by Nitsch Engineering;
- letter response dated September 16, 2021 prepared by Horsley Witten Group; and
- subsequent letter response dated September 22, 2021 and prepared by Nitsch Engineering.

I believe that all comments have been sufficiently address according to the above documentation inclusive of any enclosed information. Additional notes:

General Comment #5: Developer shall survey and record the easement on the deed at the end of the project.

General Comment #6: DI pipe is hereby confirmed. The actual location, added manhole location, inverts and angles shall be provided by the developer for Engineering to review and approve.

Please do not hesitate to contact me directly at 617-898-4870 or mfernandes@townofmilton.org if you have any questions.

Sincerely,

Marina Fernandes

Marina Fernandes, PE, LEED AP
Town Engineer

cc: Chase Berkeley, PE; DPW Director, Town of Milton
Tim Czerwienski, AICP; Director of Planning, Town of Milton