

**MEMORANDUM**

**TO:** Mr. Frederick W. Russell, Water and Sewer Director, Town of Brookline  
**FROM:** Deborah M. Danik, PE, LEED AP BD+C, Nitsch Engineering  
 Brittney Veeck, PE, Nitsch Engineering  
**DATE:** January 11, 2019  
**RE:** 1299 Beacon Street, Brookline, MA  
 Drainage Analysis



**PROJECT SUMMARY**

The existing site at 1299 Beacon Street is approximately 18,630 square feet (sf) and is bounded by Beacon Street to the north, Sewall Avenue to the south, and private properties to the east and west. The existing site is covered by impervious area containing a parking lot, a building, and limited pedestrian-only impervious areas. The building fronts along Beacon Street and has a narrow alley along the west side of the building. The parking lot, which covers approximately 68% of the site, abuts Sewall Avenue to the south of the building.

Site stormwater runoff from the majority of the roof is collected and discharged below grade to an unknown main in Beacon Street. Given the location of dedicated drain mains in Beacon Street, it is assumed the drain is connected to the sewer main in Beacon Street. There is a small bump-out in the roof (approximately 130 sf) that is drained via a downspout which discharges at grade into the parking lot adjacent to Sewall Avenue. Site stormwater runoff from the parking lot is collected in two catch basins onsite. The existing catch basins are in poor condition which results in ponding in the parking area. Record information and the site survey do not show the catch basin connections to the Town drainage system, although there is a drainage manhole in Sewall Avenue adjacent to the site, so it is likely stormwater from the parking lot discharges into the drain main in Sewall Avenue. Stormwater runoff from the existing site is untreated prior to discharge into the Town's drainage system, either via a hard piped connection or overland flow. As the site design progresses, additional investigation will be conducted to determine drainage connection locations.

The proposed Project includes the construction of a new multi-use building with housing, restaurant space, retail space, and underground parking. The proposed parking garage covers the majority of the private site, with access to the parking garage provided by driveway connection to Sewall Avenue. There is a loading dock proposed along the southern side of the building, accessed from Sewall Avenue. Refer to Table 1 for a comparison of the existing and proposed land use.

**Table 1 - Land Use Comparison**

	Existing Site			Proposed Site			Change	
	Area (sf)	Area (acre)	Percent (%)	Area (sf)	Area (acre)	Percent (%)	Area (acre)	Percent (%)
Pavement for vehicular access	13,360	0.31	71.7%	6,050	0.14	32.5%	-0.17	40%
Roof	5,270	0.12	28.3%	12,320	0.28	66.1%	+0.16	37%
Pervious	0	0	0%	260	0.01	1.4%	+0.01	2%
<b>Total</b>	<b>18,630</b>	<b>0.43</b>	<b>100.0%</b>	<b>18,630</b>	<b>0.43</b>	<b>100.0%</b>	--	--

The proposed project results in a minor decrease in impervious area on the site and the area of pavement used for vehicular access is reduced by at least 40%. This change in use will decrease the associated stormwater runoff pollutant loads discharged from the site, including total suspended solids, phosphorus, and oils/grease. This results in a substantial improvement to the stormwater quality leaving the site.

The proposed project site utility design is shown on the attached plan C200 – Site Utility Plan. Stormwater runoff from the proposed building roof and the building site (above the parking garage) will be collected and discharged to the drain main in Sewall Avenue. Although part of the existing site currently drains to Beacon Street, the existing connection point is unknown, and is assumed to connect to the sewer main in Beacon Street. There is no drain main directly adjacent to the building in Beacon Street and therefore a connection to the drain main in Beacon Street may not be feasible. The drainage was therefore analyzed as a total site discharge with one design point: the Town of Brookline drainage system in order to remove the roof drain connection to the sewer main. The site was not split into subcatchments based on the drainage to Beacon Street and Sewall Avenue.

**HYDROLOGIC ANALYSIS**

Nitsch Engineering completed a hydrologic analysis of the existing project site utilizing Soil Conservation Service (SCS) Runoff Curve Number (CN) methodology and the HydroCAD stormwater modeling program. The existing site was analyzed using the plan entitled “Existing Conditions Plan” located at 1299 Beacon Street, Brookline, MA, prepared by RJ O’Connell and Associates dated 06/20/2018. The SCS method calculates the rate at which the runoff reaches the design point considering several factors: the slope and flow lengths of the subcatchment area, the soil type of the subcatchment area, and the type of surface cover in the subcatchment area. HydroCAD Version 10.00-12 computer modeling software was used in conjunction with the SCS method to determine the peak runoff rates and runoff volumes for the 2-, 10-, 25-, and 100-year, 24-hour storm events. National Oceanic and Atmospheric Administration (NOAA) Atlas 14 Precipitation Data was used for modelling the storm events. The proposed project site was analyzed with the same methodology. The HydroCAD analyses for the existing and proposed conditions are attached.

Nitsch Engineering analyzed the existing and proposed peak rates of runoff and runoff volume for the existing and proposed site. The results are summarized below in Table 2, in cubic feet per second (cfs) and cubic feet (cf). The amount of impervious area onsite is generally remaining the same. The project does not affect the overall peak runoff rates or volume from the total site.

The proposed Project includes a slight decrease in impervious area on the site of 260 square feet or 1.4% of the site. The minor decrease in impervious does not affect the peak runoff rates or runoff volume. See attached HydroCAD stormwater modeling program for calculations.

**Table 2 - Peak Rates of Runoff and Runoff Volume to Brookline Drainage System**

<b>Storm Event</b>	<b>2-year 3.26" depth</b>	<b>10-year 5.15" depth</b>	<b>25-year 6.33" depth</b>	<b>100-year 8.15" depth</b>
Existing Peak Rate (cfs)	1.32	2.10	2.59	3.34
Proposed Peak Rate (cfs)	1.32	2.10	2.59	3.34
Existing Volume (cf)	4,700	7,630	9,460	12,280
Proposed Volume (cf)	4,700	7,630	9,460	12,280

## **BROOKLINE STORMWATER STANDARDS**

Below is a summary of the Town of Brookline stormwater requirements and the project approach for compliance:

**On-site infiltration structures shall be designed to retain the 25-year storm. On-site infiltration systems shall be installed 10-feet off the building foundation, 10-feet off the property line and cannot be located under the building or Town sidewalks.**

Infiltration of stormwater was considered during the design process as part of the proposed stormwater management system. However, given the small site area due to the proposed building design, including the underground parking garage footprint, an infiltration system is not feasible. The proposed parking garage footprint encompasses the majority of the site except for an area of approximately 260 square feet at the southern edge of the site. The area is not large enough to allow for an infiltration system and meet the Town's offset requirements. Because of the underground parking, the only place to locate an infiltration system on is to locate the recharge system under the building. The Town of Brookline does not allow stormwater recharge systems under proposed buildings. The project will match existing conditions to the maximum extent practicable.

### **Phosphorous in stormwater should be reduced in the Post-Development Condition.**

The Massachusetts Department of Environmental Protection (MassDEP) has developed a Total Maximum Daily Load (TMDL) for phosphorus in the Charles River as part of the Clean Water Act and the U.S. Environmental Protection Agency's (EPA) Water Quality Planning and Management Regulations. In 2016, the EPA issued the *Massachusetts Small Municipal Separate Storm Sewer System (MS4) General Permit*, which includes provisions that contain TMDL-based requirements that permittees (such as the Town of Brookline) shall implement to be consistent with the terms of the approved TMDL.

The existing drain main in Sewall Avenue receives stormwater runoff from the Project site that eventually discharges to the Charles River. As such, Nitsch Engineering is providing calculations to estimate the phosphorus load reduction provided by the proposed Project. Phosphorus load reduction results from the change in land use from a commercial site with a large vehicular area to a residential building with minimal vehicular traveled area.

The phosphorus calculation guidelines developed by the EPA for the *Small MS4 Permit* provide phosphorus load export rate for various land uses. According to Table 2-1 in Attachment 2 to Appendix F of the *Small MS4 Permit*, the annual phosphorus load export rate is 1.78 pounds per acre per year (lbs/acre/yr) for commercial impervious surfaces, 2.32 lbs/acre/year for residential impervious surfaces, and 0.21 lbs/acre/year for pervious surfaces. Table 2-1 is provided as an attachment with this memo.

The EPA guidelines do not distinguish between roofs and at-grade pavement for the annual phosphorus load export rates. Nitsch Engineering has compiled research data that suggests phosphorus loads from roofs are generally less than that from roadways and parking areas for both commercial and residential areas. Table 3 summarizes the compiled research data for residential, commercial, and industrial roofs, as well as streets and parking lots. By averaging the estimated phosphorus load from the research for each land use, the phosphorus loads for commercial is 0.85 lbs/ac/yr and residential roofs is 0.67 lbs/ac/yr, respectively.

The phosphorus load for the existing commercial site and proposed residential project were estimated using the EPA loading rates for impervious and pervious surfaces located at-grade, and the researched loading rates for roofs (Table 3), as shown in Table 4. It is anticipated that the proposed change in land use and cover will reduce phosphorus loads by 0.14 lbs/year or a 22% reduction as shown in Table 4.

**Table 3 - Compiled Research Data for Phosphorus Loads from Impervious Surfaces**

Study Location	Land Use	Concentration (mg/L)	Average Annual TP Loading (lbs/acre)
Goldsboro, NC <sup>1</sup>	Residential/Rural Roof	0.05	0.56
Marquette, MI <sup>2</sup>	Residential Roof	0.06	0.43
Madison, WI <sup>3</sup>	Residential Roof	0.15	1.02
Kinston, NC <sup>1</sup>	Commercial Roof	0.09	1.08
Marquette, MI <sup>2</sup>	Commercial Roof	0.09	0.65
Madison, WI <sup>3</sup>	Commercial Roof	0.20	1.36
Allston, MA <sup>4</sup>	Commercial Roof	0.03	0.32
Madison, WI <sup>3</sup>	Industrial Roof	0.75	0.75
Madison, WI <sup>3</sup>	Industrial Parking Lot	0.39	2.65
Marquette, MI <sup>2</sup>	Commercial Parking Lot	0.20	1.45
Madison, WI <sup>3</sup>	Commercial Arterial Street	0.47	3.20
Marquette, MI <sup>2</sup>	High Traffic Street	0.31	2.24
Marquette, MI <sup>2</sup>	Low Traffic Street	0.14	1.01

<sup>1</sup>Moran, A. C. 2004. A North Carolina Field Study to Evaluate Greenroof Runoff Quantity, Runoff Quality, and Plant Growth. M.S. thesis, Biological and Agricultural Engineering Dept., Raleigh, North Carolina: North Carolina State University.  
<sup>2</sup>Center for Watershed Protection. Stormwater Pollution Source Areas Isolated in Marquette, Michigan. Article 15, Technical Note #105 from Watershed Protection Techniques. 3(1): 609-612.  
<sup>3</sup>Bannerman, R., D. Owens, R. Dodd and N. Hornewer. 1993. Sources of Pollutants in Wisconsin Stormwater. Water Science Technology. 28(3-5): 241:259.  
<sup>4</sup>Unpublished data collected for 5.95-acre rooftop in Allston, MA.

**Table 4 - Phosphorus Loading Calculation**

	Existing (Commercial)				Proposed (Residential)			
	Area (sf)	Area (ac)	Export Rate (lbs/ac/yr)	Phosphorus Load (lbs/yr)	Area (sf)	Area (acre)	Export Rate (lbs/ac/yr)	Phosphorus Load (lbs/yr)
Pavement for vehicular access	13,360	0.31	1.78	0.55	6,050	0.14	2.32	0.32
Roof	5,270	0.12	0.85	0.10	12,320	0.28	0.67	0.19
Pervious	0	0.00	0.21	0.00	260	0.01	0.21	0
Total	18,632	0.43		0.62	18,632	0.43		0.51
<b>Phosphorus Reduction (lbs/yr)</b>								<b>0.14</b>
<b>Phosphorus Reduction (%)</b>								<b>22%</b>

**Infiltration structures shall be designed in accordance with MassDEP Stormwater Management Standards.**

The stormwater management plan for this site has been designed in accordance with the Massachusetts Department of Environmental Protection (MassDEP) Stormwater Management Standards to the greatest extent practicable, as summarized in the following section.

**COMPLIANCE WITH MASSDEP STORMWATER MANAGEMENT STANDARDS**

Brookline Engineering requires projects to meet the MassDEP Stormwater Management Standards. Since the Project site is a developed site in an urban area, the Town of Brookline considers this project to be a redevelopment project. A redevelopment project is required to meet the following Stormwater Management Standards only to the maximum extent practicable: Standard 2, Standard 3, and the pretreatment and structural stormwater best management practice requirements of Standards 4, 5, and 6. Existing stormwater discharges shall comply with Standard 1 only to the maximum extent practicable. As required by MassDEP, this redevelopment project reflects a significant improvement over the existing condition.

**Standard 1: No New Untreated Discharges**

The Project will not discharge any untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth. Stormwater from the site will be collected and treated in accordance with the City of Brookline requirements and the MassDEP Stormwater Management Standards to the greatest extent practicable. Stormwater runoff from the roof is considered “clean” and therefore will not be treated.

**Standard 2: Peak Rate Attenuation**

The proposed stormwater management system has been designed so that the post-development peak discharge rates do not exceed pre-development peak discharge rates for the ultimate discharge to the Town’s system and the Charles River. To prevent storm damage and downstream flooding, the proposed stormwater management practices will maintain the existing peak runoff rates for the 2-, 10-, 25- and 100-year, 24-hour storm events. Due to the minimal changes in groundcover type, there is not overall change in peak runoff rates and runoff volume. A summary of the peak discharge rates is provided in Tables 2- Peak Rates of Runoff and Runoff Volume to Brookline Drainage System.

### **Standard 3: Groundwater Recharge**

As a redevelopment, the Project is required to comply with Standard 3 to the maximum extent practicable. No groundwater recharge is proposed as part of this project. The underground parking garage spans the entirety of the property and does not allow for any infiltration onsite. Brookline does not allow infiltration within the right-of-way and therefore, no groundwater recharge can be provided as part of this project.

### **Standard 4: Water Quality Treatment**

The proposed stormwater management system will be designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS) for all proposed vehicular access areas to the greatest extent practicable.

### **Standard 5: Land Uses with Higher Potential Pollutant Loads**

The Project is not anticipated to be classified as a Land Use with Higher Potential Pollutant Loads (LUHPPLs) as defined by MassDEP. Therefore, this standard is not applicable.

### **Standard 6: Critical Areas**

The Project is not located within any critical areas. Therefore, this standard is not applicable.

### **Standard 7: Redevelopments**

The Project is a redevelopment under the Town of Brookline standards. A redevelopment project is required to meet the following Stormwater Management Standards only to the maximum extent practicable: Standard 2, Standard 3, and the pretreatment and structural stormwater best management practice requirements of Standards 4, 5, and 6. Existing stormwater discharges shall comply with Standards 1 and 3 only to the maximum extent practicable. A redevelopment project shall also comply with all other requirements of the Stormwater Management Standards and improve existing conditions. The Project meets the requirements of Standard 7.

### **Standard 8: Construction Period Pollution Prevention and Sedimentation Control**

A plan to control construction-related impacts, including erosion, sedimentation, and other pollutant sources during construction and land disturbance activities (construction period erosion, sedimentation, and pollution prevention plan) will be developed prior to the start of construction.

### **Standard 9: Operation and Maintenance Plan**

A post-construction operation and maintenance plan will be prepared prior to construction and will be implemented to ensure that stormwater management systems function as designed. Source control and stormwater BMP operation requirements will be summarized in the Long-Term Pollution Prevention Plan and Operation and Maintenance Plan.

### **Standard 10: Prohibition of Illicit Discharges**

There will be no illicit discharges to the stormwater management system associated with the Project.

## **ATTACHMENTS**

- Table 2-1 in Appendix F, Attachment 2 of the *Massachusetts Small Municipal Separate Storm Sewer System (MS4) General Permit*
- Existing HydroCAD Calculations

**Table 2-1: Proposed average annual distinct P Load export rates for use in estimating P Load reduction credits in the MA MS4 Permit**

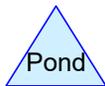
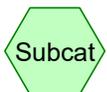
Phosphorus Source Category by Land Use	Land Surface Cover	P Load Export Rate, lbs/acre/year	P Load Export Rate, kg/ha/yr
Commercial (Com) and Industrial (Ind)	Directly connected impervious	1.78	2.0
	Pervious	See* DevPERV	See* DevPERV
Multi-Family (MFR) and High-Density Residential (HDR)	Directly connected impervious	2.32	2.6
	Pervious	See* DevPERV	See* DevPERV
Medium -Density Residential (MDR)	Directly connected impervious	1.96	2.2
	Pervious	See* DevPERV	See* DevPERV
Low Density Residential (LDR) - "Rural"	Directly connected impervious	1.52	1.7
	Pervious	See* DevPERV	See* DevPERV
Highway (HWY)	Directly connected impervious	1.34	1.5
	Pervious	See* DevPERV	See* DevPERV
Forest (For)	Directly connected impervious	1.52	1.7
	Pervious	0.13	0.13
Open Land (Open)	Directly connected impervious	1.52	1.7
	Pervious	See* DevPERV	See* DevPERV
Agriculture (Ag)	Directly connected impervious	1.52	1.7
	Pervious	0.45	0.5
*Developed Land Pervious (DevPERV) – HSG A	Pervious	0.03	0.03
*Developed Land Pervious (DevPERV) – HSG B	Pervious	0.12	0.13
*Developed Land Pervious (DevPERV) – HSG C	Pervious	0.21	0.24
*Developed Land Pervious (DevPERV) – HSG C/D	Pervious	0.29	0.33
*Developed Land Pervious (DevPERV) – HSG D	Pervious	0.37	0.41
Notes:			
<ul style="list-style-type: none"> <li>For pervious areas, if the hydrologic soil group (HSG) is known, use the appropriate value from this table. If the HSG is not known, assume HSG C conditions for the phosphorus load export rate.</li> <li>Agriculture includes row crops. Actively managed hay fields and pasture lands. Institutional land uses such as government properties, hospitals and schools are to be included in the commercial and industrial land use grouping for the purpose of calculating phosphorus loading.</li> <li>Impervious surfaces within the forest land use category are typically roadways adjacent to forested pervious areas.</li> </ul>			



DA1



Total



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Page 2

### Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
13,360	98	Paved parking, HSG C (DA1)
5,270	98	Roofs, HSG C (DA1)
<b>18,630</b>	<b>98</b>	<b>TOTAL AREA</b>

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Page 3

## Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
0	HSG A	
0	HSG B	
18,630	HSG C	DA1
0	HSG D	
0	Other	
<b>18,630</b>		<b>TOTAL AREA</b>

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Page 4

## Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Subcatchmen Numbers
0	0	13,360	0	0	13,360	Paved parking	
0	0	5,270	0	0	5,270	Roofs	
<b>0</b>	<b>0</b>	<b>18,630</b>	<b>0</b>	<b>0</b>	<b>18,630</b>	<b>TOTAL AREA</b>	

**12693-Existing HydroCAD**

Type III 24-hr 2-Year Rainfall=3.26"

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Page 5

Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points  
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**SubcatchmentDA1: DA1**

Runoff Area=18,630 sf 100.00% Impervious Runoff Depth=3.03"  
Tc=6.0 min CN=98 Runoff=1.32 cfs 4,700 cf

**Reach DPT: Total**

Inflow=1.32 cfs 4,700 cf  
Outflow=1.32 cfs 4,700 cf

**Total Runoff Area = 18,630 sf Runoff Volume = 4,700 cf Average Runoff Depth = 3.03"**  
**0.00% Pervious = 0 sf 100.00% Impervious = 18,630 sf**

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Type III 24-hr 2-Year Rainfall=3.26"

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Page 6

## Summary for Subcatchment DA1: DA1

Runoff = 1.32 cfs @ 12.09 hrs, Volume= 4,700 cf, Depth= 3.03"

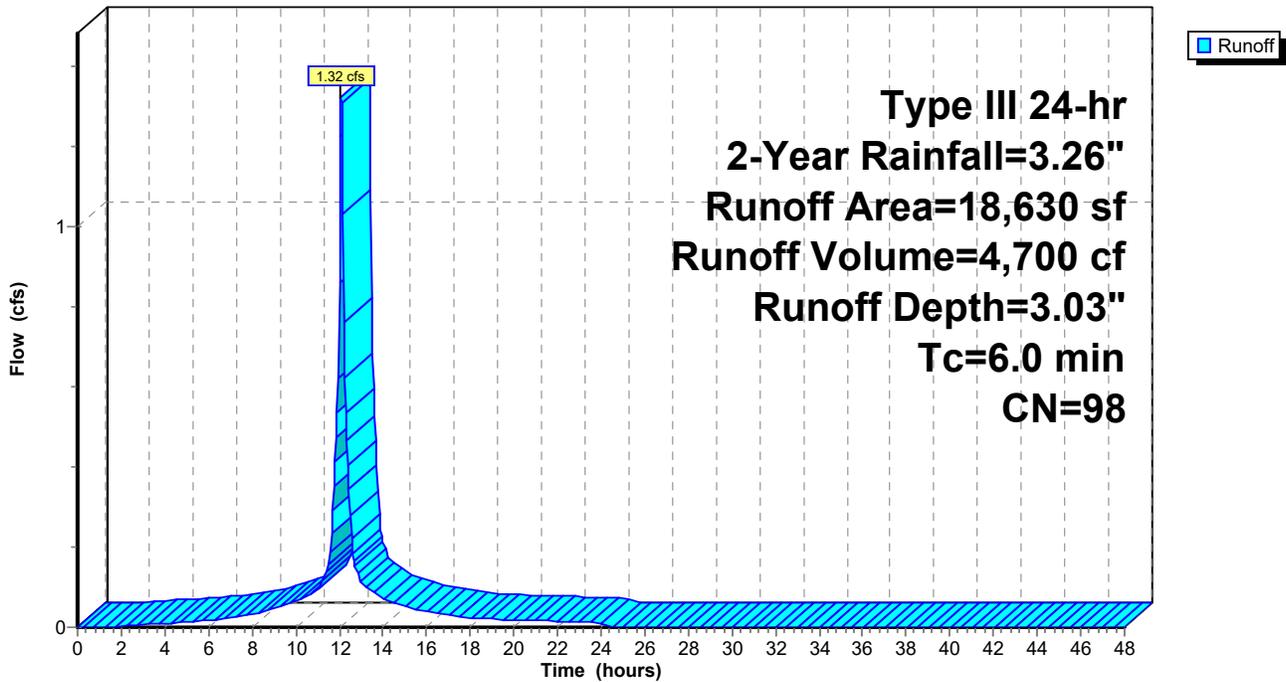
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-Year Rainfall=3.26"

Area (sf)	CN	Description
5,270	98	Roofs, HSG C
13,360	98	Paved parking, HSG C
18,630	98	Weighted Average
18,630		100.00% Impervious Area

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

## Subcatchment DA1: DA1

Hydrograph



### Summary for Reach DPT: Total

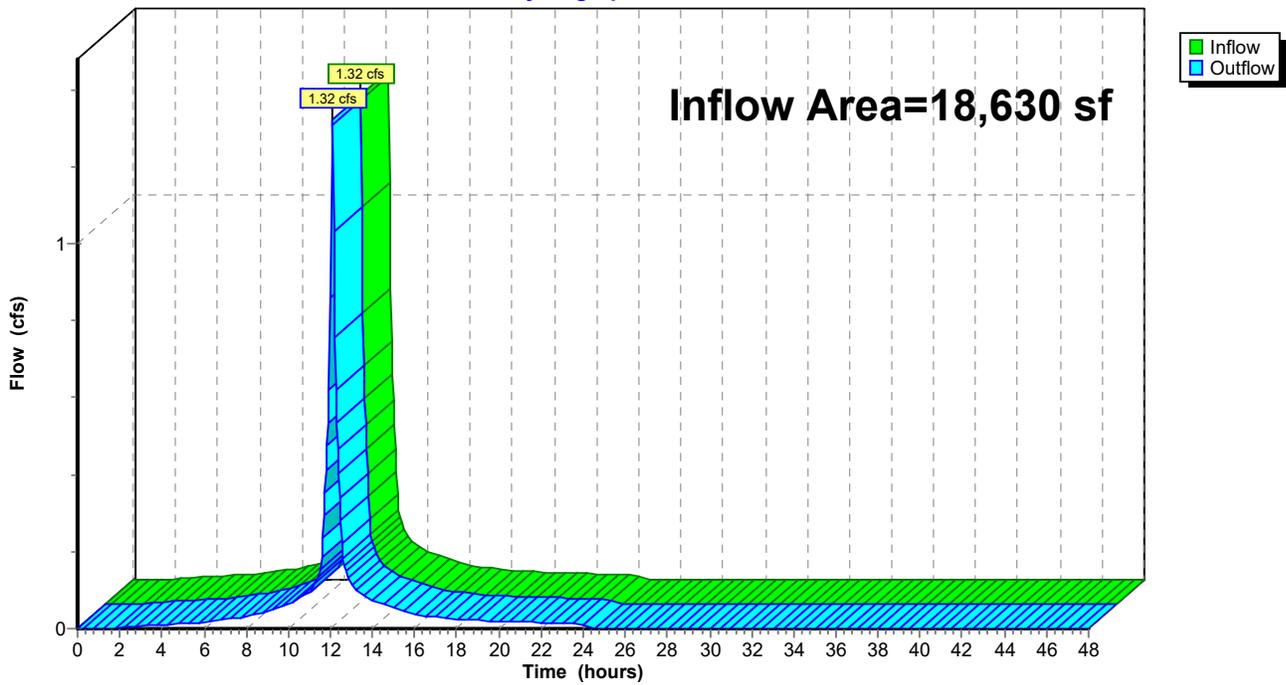
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 18,630 sf, 100.00% Impervious, Inflow Depth = 3.03" for 2-Year event  
Inflow = 1.32 cfs @ 12.09 hrs, Volume= 4,700 cf  
Outflow = 1.32 cfs @ 12.09 hrs, Volume= 4,700 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

### Reach DPT: Total

#### Hydrograph



**12693-Existing HydroCAD**

Type III 24-hr 10-Year Rainfall=5.15"

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Page 8

Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points  
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**SubcatchmentDA1: DA1**

Runoff Area=18,630 sf 100.00% Impervious Runoff Depth=4.91"  
Tc=6.0 min CN=98 Runoff=2.10 cfs 7,627 cf

**Reach DPT: Total**

Inflow=2.10 cfs 7,627 cf  
Outflow=2.10 cfs 7,627 cf

**Total Runoff Area = 18,630 sf Runoff Volume = 7,627 cf Average Runoff Depth = 4.91"**  
**0.00% Pervious = 0 sf 100.00% Impervious = 18,630 sf**

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Type III 24-hr 10-Year Rainfall=5.15"

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Page 9

## Summary for Subcatchment DA1: DA1

Runoff = 2.10 cfs @ 12.09 hrs, Volume= 7,627 cf, Depth= 4.91"

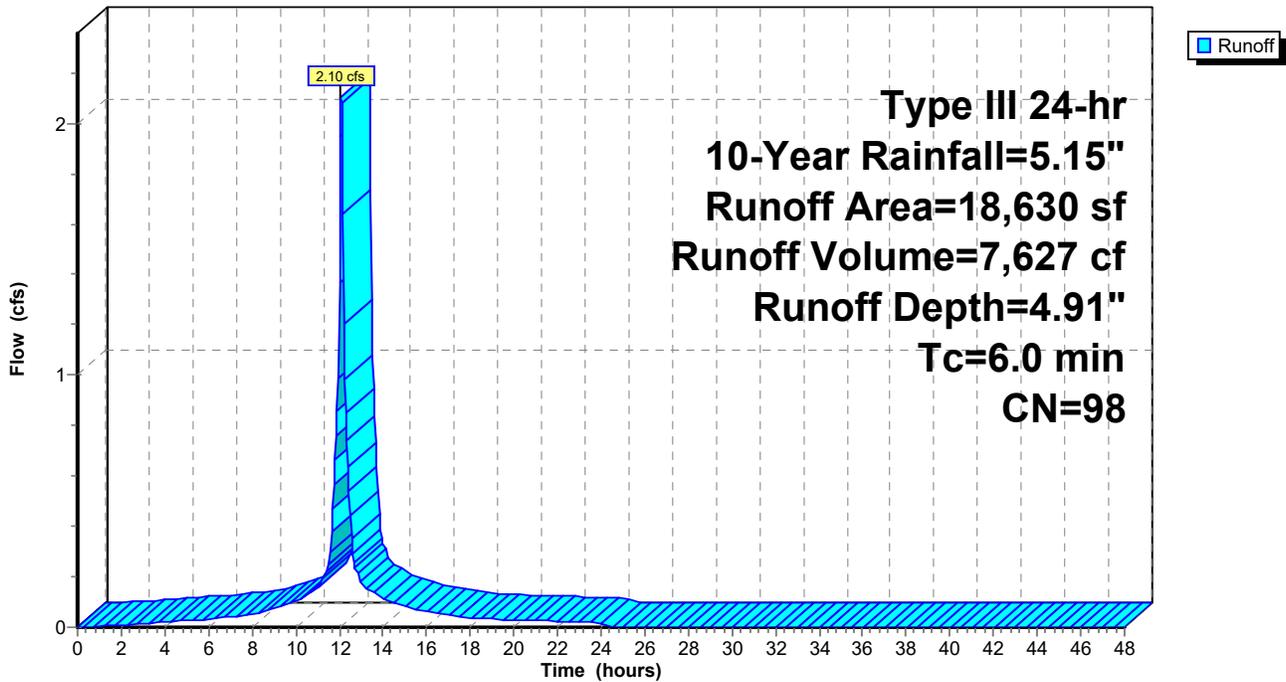
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-Year Rainfall=5.15"

Area (sf)	CN	Description
5,270	98	Roofs, HSG C
13,360	98	Paved parking, HSG C
18,630	98	Weighted Average
18,630		100.00% Impervious Area

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

## Subcatchment DA1: DA1

Hydrograph

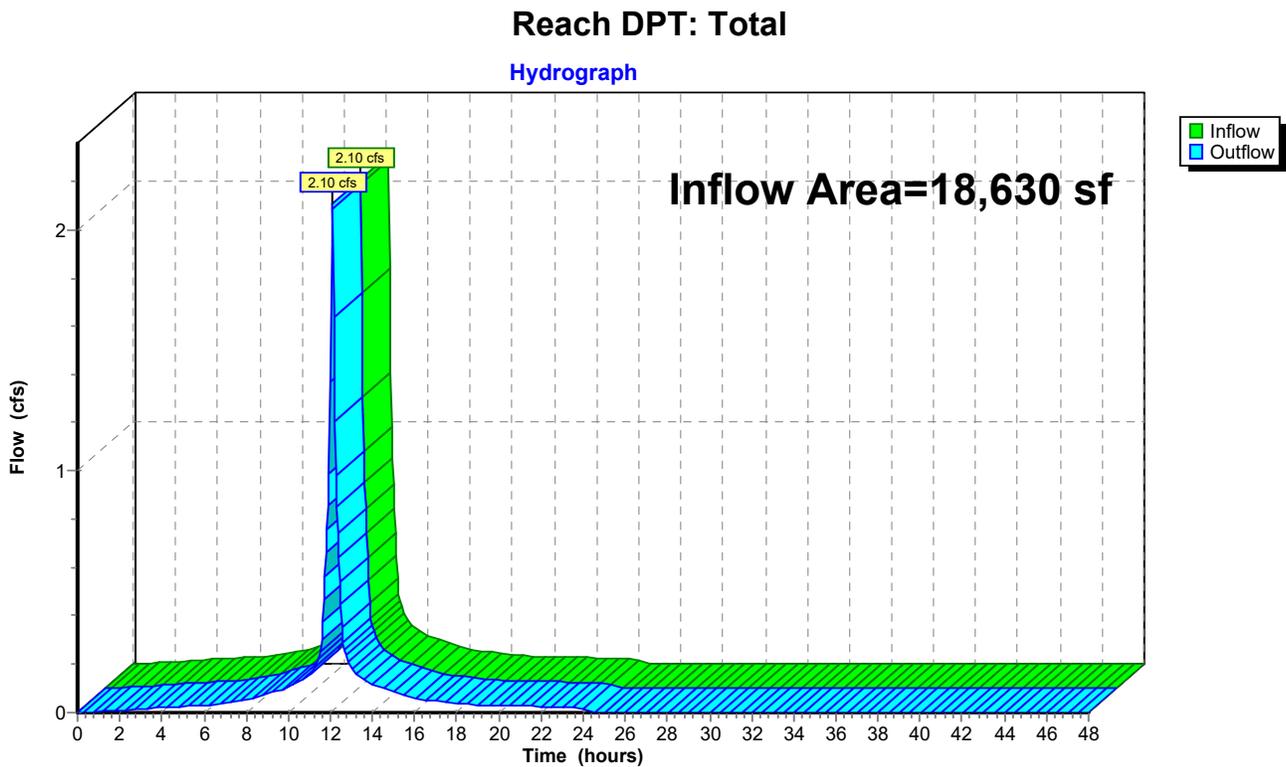


### Summary for Reach DPT: Total

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

Inflow Area = 18,630 sf, 100.00% Impervious, Inflow Depth = 4.91" for 10-Year event  
Inflow = 2.10 cfs @ 12.09 hrs, Volume= 7,627 cf  
Outflow = 2.10 cfs @ 12.09 hrs, Volume= 7,627 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs



**12693-Existing HydroCAD**

Type III 24-hr 25-Year Rainfall=6.33"

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Page 11

Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points  
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**SubcatchmentDA1: DA1**

Runoff Area=18,630 sf 100.00% Impervious Runoff Depth=6.09"  
Tc=6.0 min CN=98 Runoff=2.59 cfs 9,457 cf

**Reach DPT: Total**

Inflow=2.59 cfs 9,457 cf  
Outflow=2.59 cfs 9,457 cf

**Total Runoff Area = 18,630 sf Runoff Volume = 9,457 cf Average Runoff Depth = 6.09"**  
**0.00% Pervious = 0 sf 100.00% Impervious = 18,630 sf**

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Type III 24-hr 25-Year Rainfall=6.33"

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Page 12

## Summary for Subcatchment DA1: DA1

Runoff = 2.59 cfs @ 12.09 hrs, Volume= 9,457 cf, Depth= 6.09"

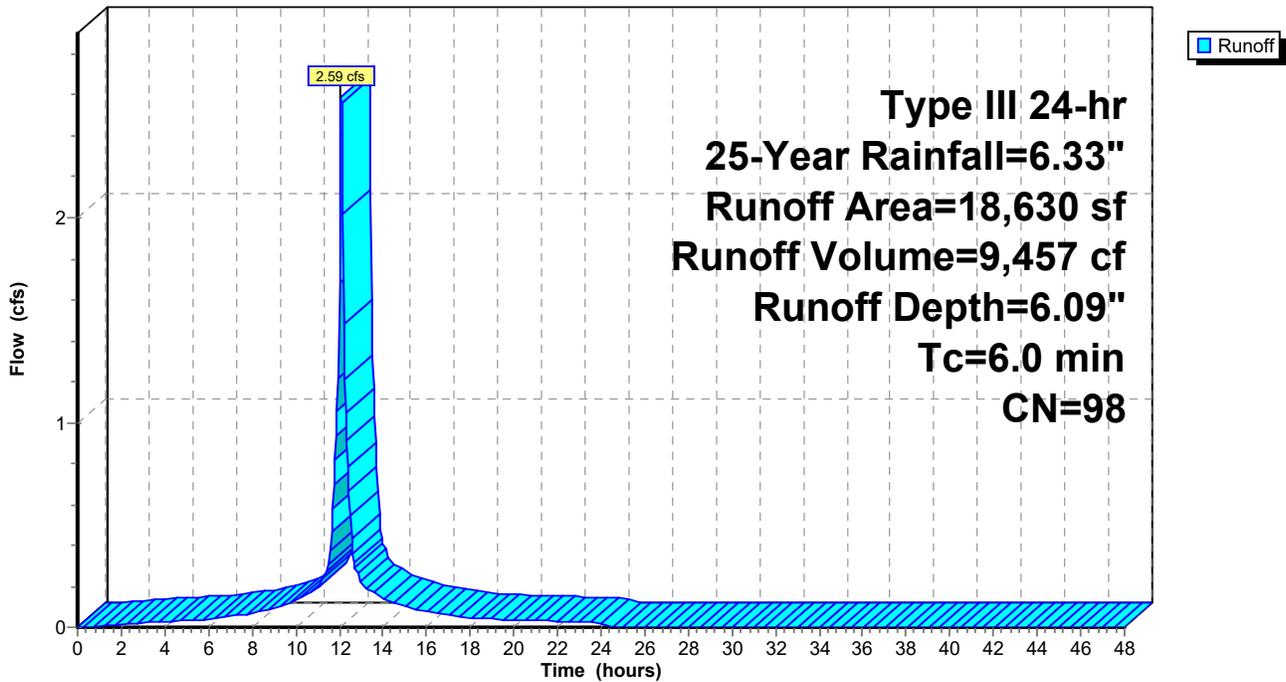
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs  
Type III 24-hr 25-Year Rainfall=6.33"

Area (sf)	CN	Description
5,270	98	Roofs, HSG C
13,360	98	Paved parking, HSG C
18,630	98	Weighted Average
18,630		100.00% Impervious Area

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

## Subcatchment DA1: DA1

Hydrograph



### Summary for Reach DPT: Total

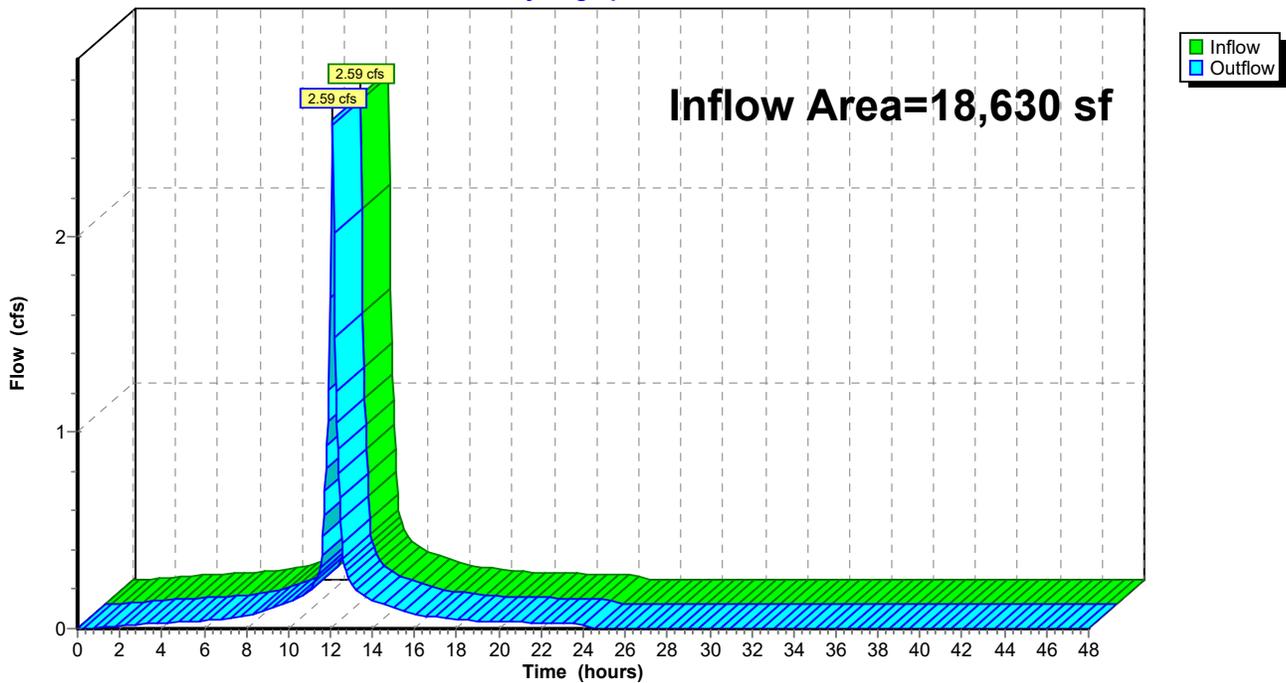
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 18,630 sf, 100.00% Impervious, Inflow Depth = 6.09" for 25-Year event  
Inflow = 2.59 cfs @ 12.09 hrs, Volume= 9,457 cf  
Outflow = 2.59 cfs @ 12.09 hrs, Volume= 9,457 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

### Reach DPT: Total

Hydrograph



**12693-Existing HydroCAD**

Type III 24-hr 100-Year Rainfall=8.15"

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Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points  
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**SubcatchmentDA1: DA1**

Runoff Area=18,630 sf 100.00% Impervious Runoff Depth=7.91"  
Tc=6.0 min CN=98 Runoff=3.34 cfs 12,280 cf

**Reach DPT: Total**

Inflow=3.34 cfs 12,280 cf  
Outflow=3.34 cfs 12,280 cf

**Total Runoff Area = 18,630 sf Runoff Volume = 12,280 cf Average Runoff Depth = 7.91"**  
**0.00% Pervious = 0 sf 100.00% Impervious = 18,630 sf**

# 12693-Existing HydroCAD

Type III 24-hr 100-Year Rainfall=8.15"

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Page 15

## Summary for Subcatchment DA1: DA1

Runoff = 3.34 cfs @ 12.09 hrs, Volume= 12,280 cf, Depth= 7.91"

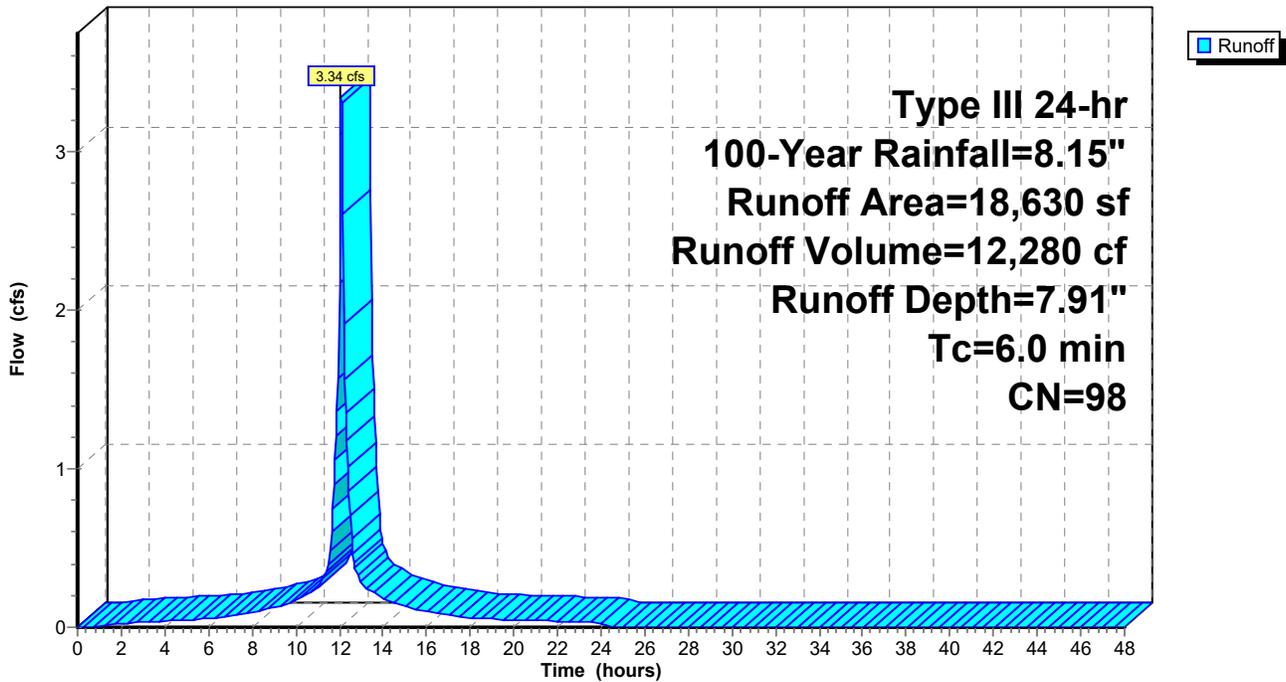
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-Year Rainfall=8.15"

Area (sf)	CN	Description
5,270	98	Roofs, HSG C
13,360	98	Paved parking, HSG C
18,630	98	Weighted Average
18,630		100.00% Impervious Area

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

## Subcatchment DA1: DA1

Hydrograph



### Summary for Reach DPT: Total

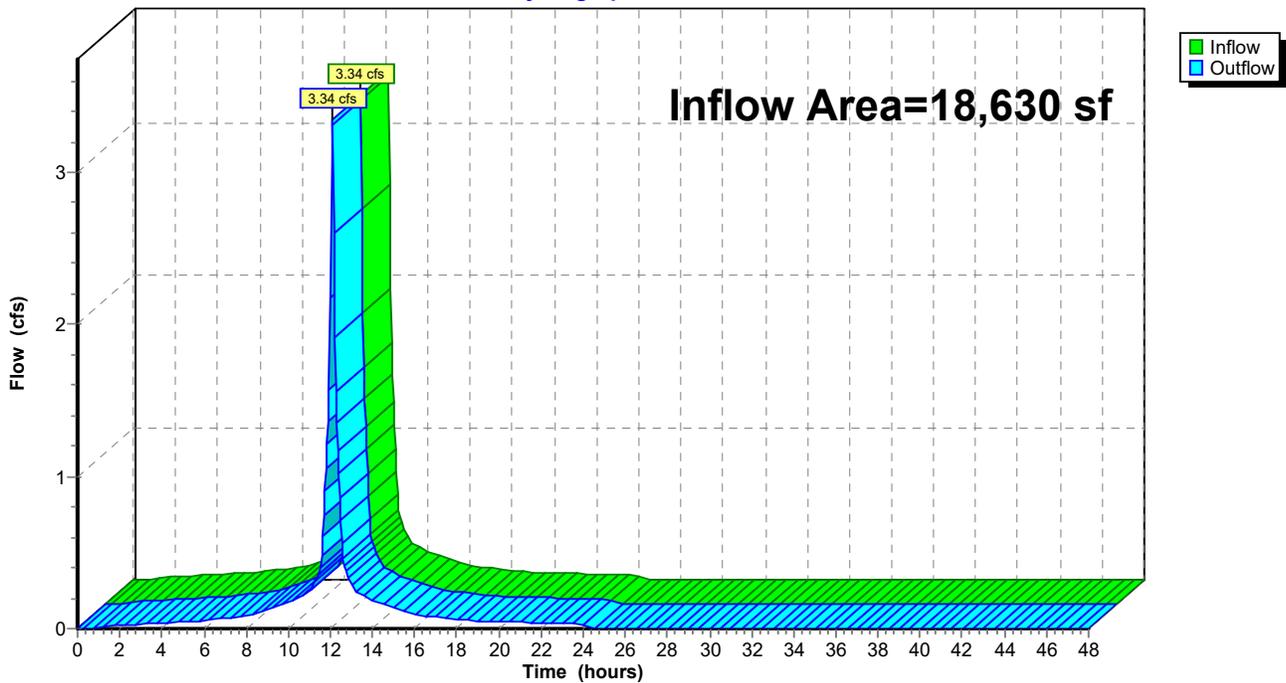
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 18,630 sf, 100.00% Impervious, Inflow Depth = 7.91" for 100-Year event  
Inflow = 3.34 cfs @ 12.09 hrs, Volume= 12,280 cf  
Outflow = 3.34 cfs @ 12.09 hrs, Volume= 12,280 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

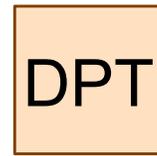
### Reach DPT: Total

Hydrograph

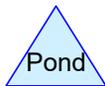
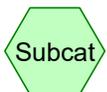




DA1



Total



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Page 2

## Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
260	74	>75% Grass cover, Good, HSG C (DA1)
6,050	98	Paved parking, HSG C (DA1)
12,320	98	Roofs, HSG C (DA1)
<b>18,630</b>	<b>98</b>	<b>TOTAL AREA</b>

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Page 3

## Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
0	HSG A	
0	HSG B	
18,630	HSG C	DA1
0	HSG D	
0	Other	
<b>18,630</b>		<b>TOTAL AREA</b>

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## Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover
0	0	260	0	0	260	>75% Grass cover, Good
0	0	6,050	0	0	6,050	Paved parking
0	0	12,320	0	0	12,320	Roofs
<b>0</b>	<b>0</b>	<b>18,630</b>	<b>0</b>	<b>0</b>	<b>18,630</b>	<b>TOTAL AREA</b>

**12693-Proposed HydroCAD**

Type III 24-hr 2-Year Rainfall=3.26"

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Page 5

Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points  
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**SubcatchmentDA1: DA1**

Runoff Area=18,630 sf 98.60% Impervious Runoff Depth=3.03"  
Tc=6.0 min CN=98 Runoff=1.32 cfs 4,700 cf

**Reach DPT: Total**

Inflow=1.32 cfs 4,700 cf  
Outflow=1.32 cfs 4,700 cf

**Total Runoff Area = 18,630 sf Runoff Volume = 4,700 cf Average Runoff Depth = 3.03"**  
**1.40% Pervious = 260 sf 98.60% Impervious = 18,370 sf**

**12693-Proposed HydroCAD**

Type III 24-hr 2-Year Rainfall=3.26"

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Page 6

**Summary for Subcatchment DA1: DA1**

Runoff = 1.32 cfs @ 12.09 hrs, Volume= 4,700 cf, Depth= 3.03"

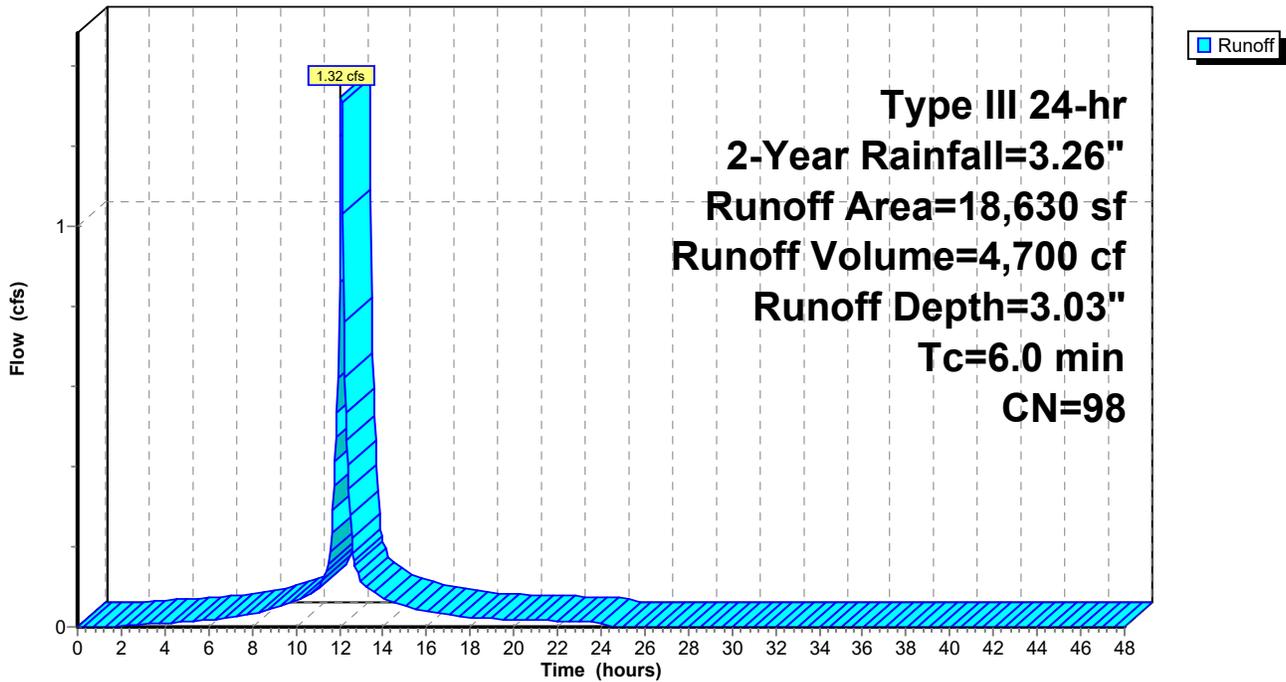
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-Year Rainfall=3.26"

Area (sf)	CN	Description
260	74	>75% Grass cover, Good, HSG C
12,320	98	Roofs, HSG C
6,050	98	Paved parking, HSG C
18,630	98	Weighted Average
260		1.40% Pervious Area
18,370		98.60% Impervious Area

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

**Subcatchment DA1: DA1**

Hydrograph

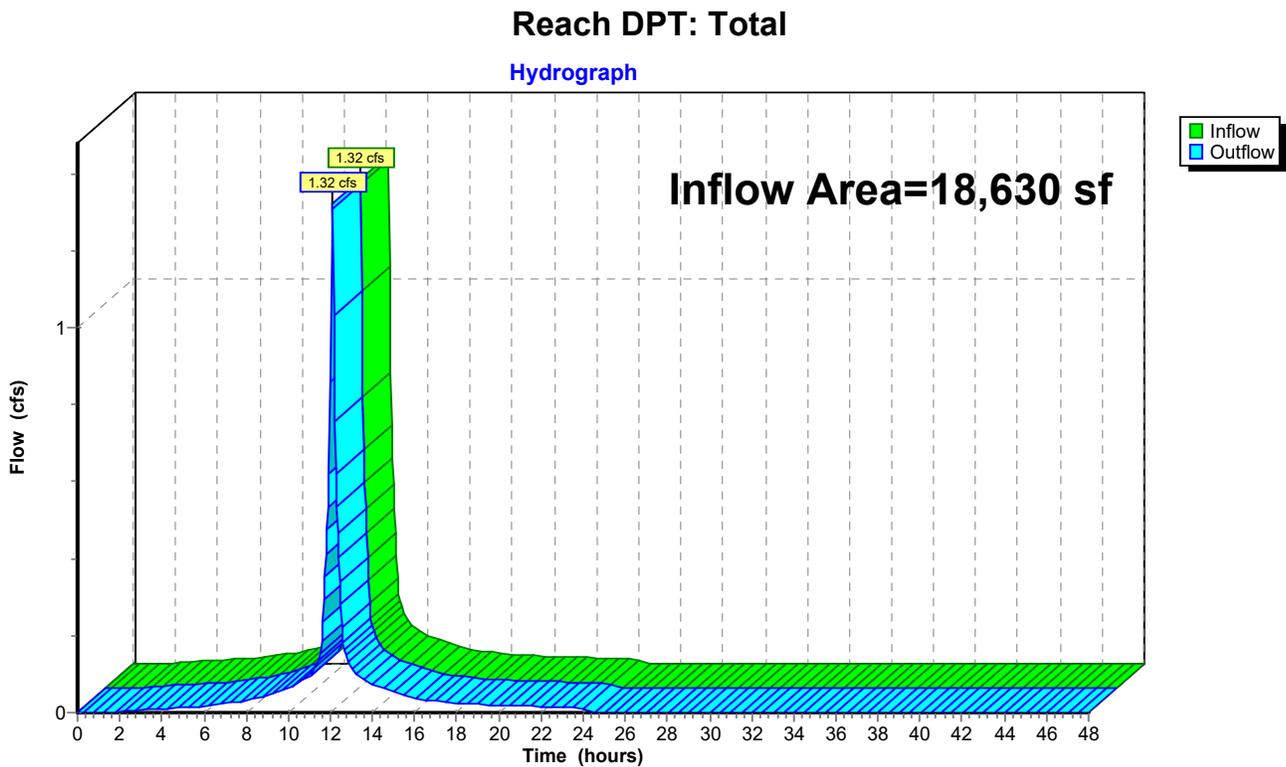


### Summary for Reach DPT: Total

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

Inflow Area = 18,630 sf, 98.60% Impervious, Inflow Depth = 3.03" for 2-Year event  
Inflow = 1.32 cfs @ 12.09 hrs, Volume= 4,700 cf  
Outflow = 1.32 cfs @ 12.09 hrs, Volume= 4,700 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs



**12693-Proposed HydroCAD**

Type III 24-hr 10-Year Rainfall=5.15"

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Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points  
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**SubcatchmentDA1: DA1**

Runoff Area=18,630 sf 98.60% Impervious Runoff Depth=4.91"  
Tc=6.0 min CN=98 Runoff=2.10 cfs 7,627 cf

**Reach DPT: Total**

Inflow=2.10 cfs 7,627 cf  
Outflow=2.10 cfs 7,627 cf

**Total Runoff Area = 18,630 sf Runoff Volume = 7,627 cf Average Runoff Depth = 4.91"**  
**1.40% Pervious = 260 sf 98.60% Impervious = 18,370 sf**

**12693-Proposed HydroCAD**

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Type III 24-hr 10-Year Rainfall=5.15"

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Page 9

**Summary for Subcatchment DA1: DA1**

Runoff = 2.10 cfs @ 12.09 hrs, Volume= 7,627 cf, Depth= 4.91"

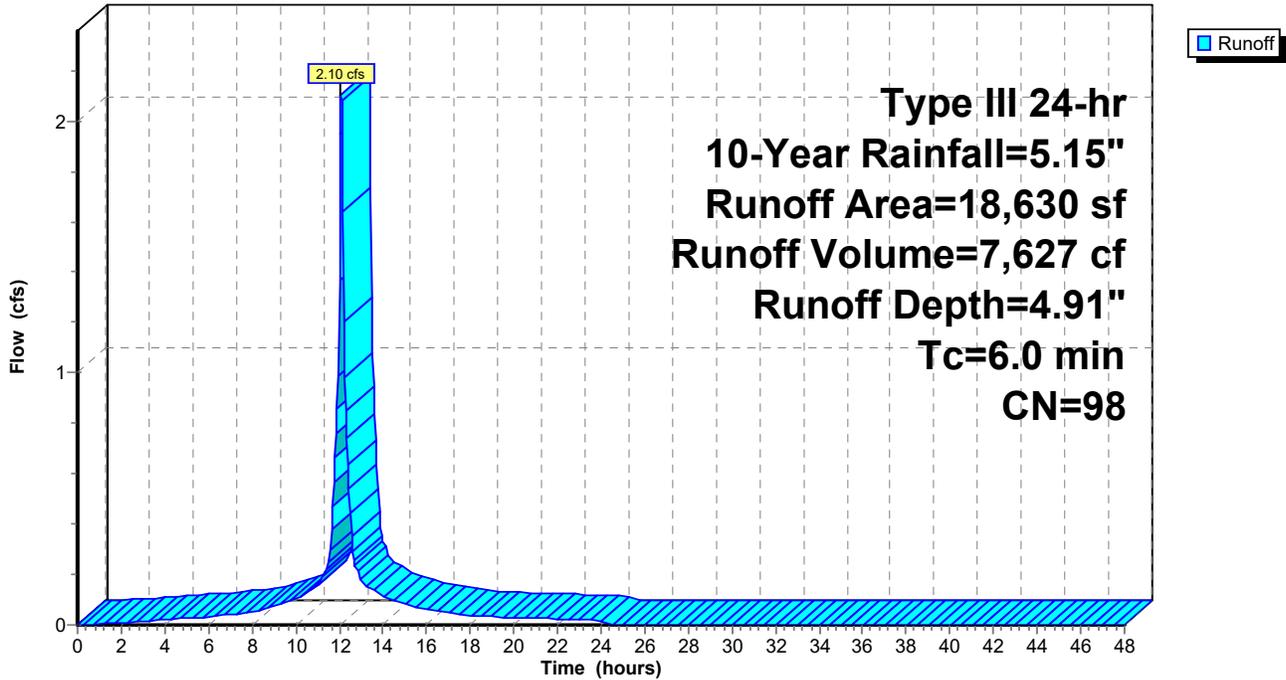
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-Year Rainfall=5.15"

Area (sf)	CN	Description
260	74	>75% Grass cover, Good, HSG C
12,320	98	Roofs, HSG C
6,050	98	Paved parking, HSG C
18,630	98	Weighted Average
260		1.40% Pervious Area
18,370		98.60% Impervious Area

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

**Subcatchment DA1: DA1**

Hydrograph

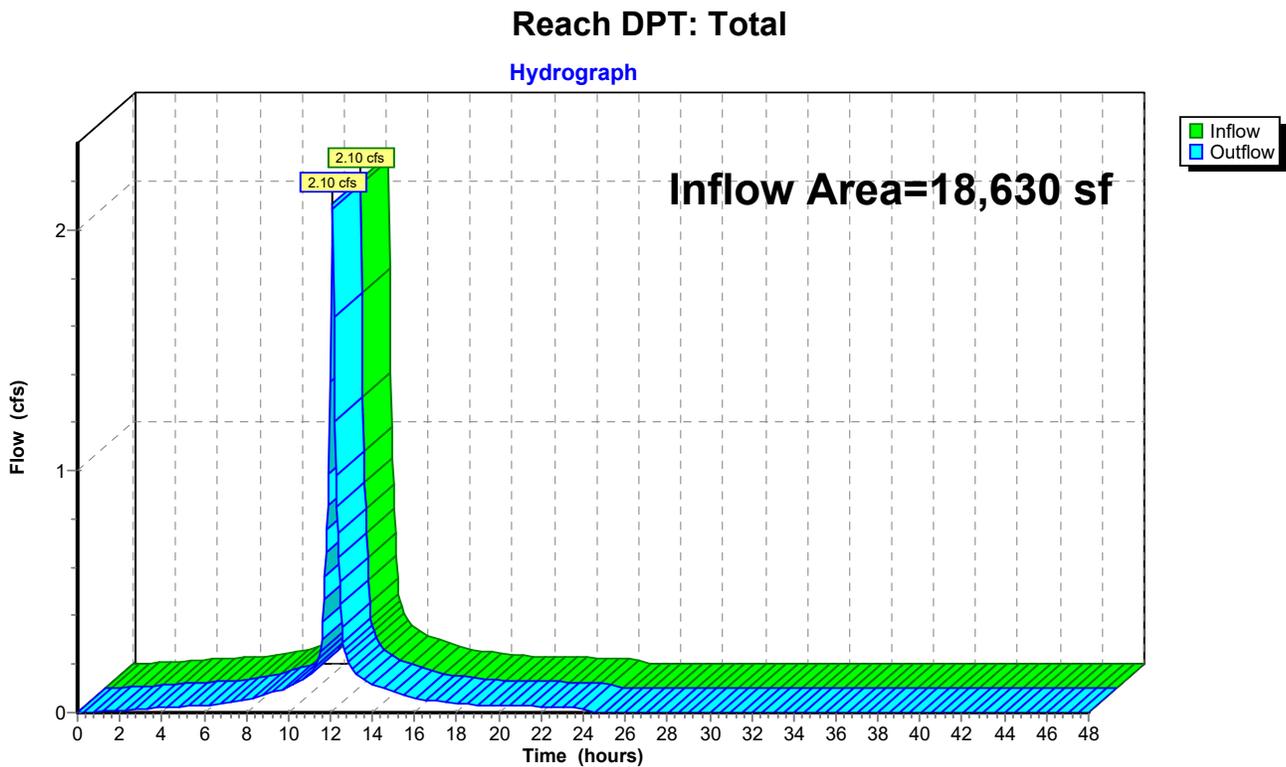


### Summary for Reach DPT: Total

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

Inflow Area = 18,630 sf, 98.60% Impervious, Inflow Depth = 4.91" for 10-Year event  
Inflow = 2.10 cfs @ 12.09 hrs, Volume= 7,627 cf  
Outflow = 2.10 cfs @ 12.09 hrs, Volume= 7,627 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs



**12693-Proposed HydroCAD**

Type III 24-hr 25-Year Rainfall=6.33"

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Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points  
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**SubcatchmentDA1: DA1**

Runoff Area=18,630 sf 98.60% Impervious Runoff Depth=6.09"  
Tc=6.0 min CN=98 Runoff=2.59 cfs 9,457 cf

**Reach DPT: Total**

Inflow=2.59 cfs 9,457 cf  
Outflow=2.59 cfs 9,457 cf

**Total Runoff Area = 18,630 sf Runoff Volume = 9,457 cf Average Runoff Depth = 6.09"**  
**1.40% Pervious = 260 sf 98.60% Impervious = 18,370 sf**

**12693-Proposed HydroCAD**

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Type III 24-hr 25-Year Rainfall=6.33"

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Page 12

**Summary for Subcatchment DA1: DA1**

Runoff = 2.59 cfs @ 12.09 hrs, Volume= 9,457 cf, Depth= 6.09"

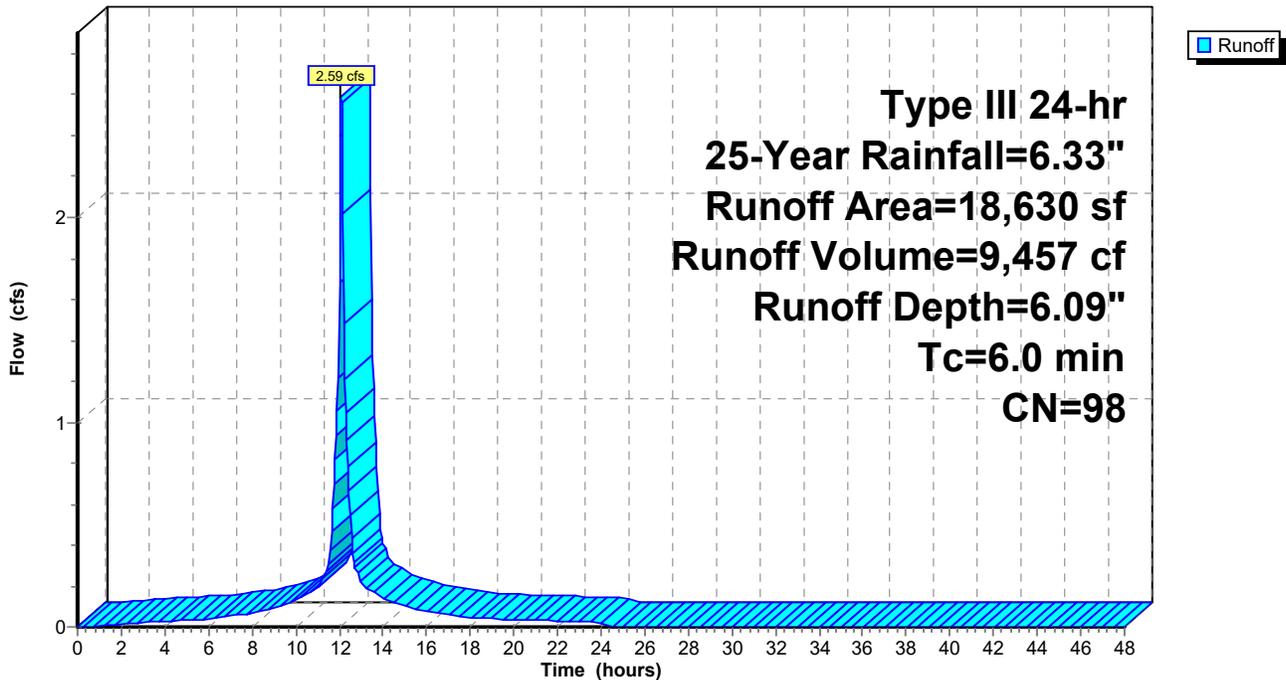
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs  
Type III 24-hr 25-Year Rainfall=6.33"

Area (sf)	CN	Description
260	74	>75% Grass cover, Good, HSG C
12,320	98	Roofs, HSG C
6,050	98	Paved parking, HSG C
18,630	98	Weighted Average
260		1.40% Pervious Area
18,370		98.60% Impervious Area

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

**Subcatchment DA1: DA1**

Hydrograph



### Summary for Reach DPT: Total

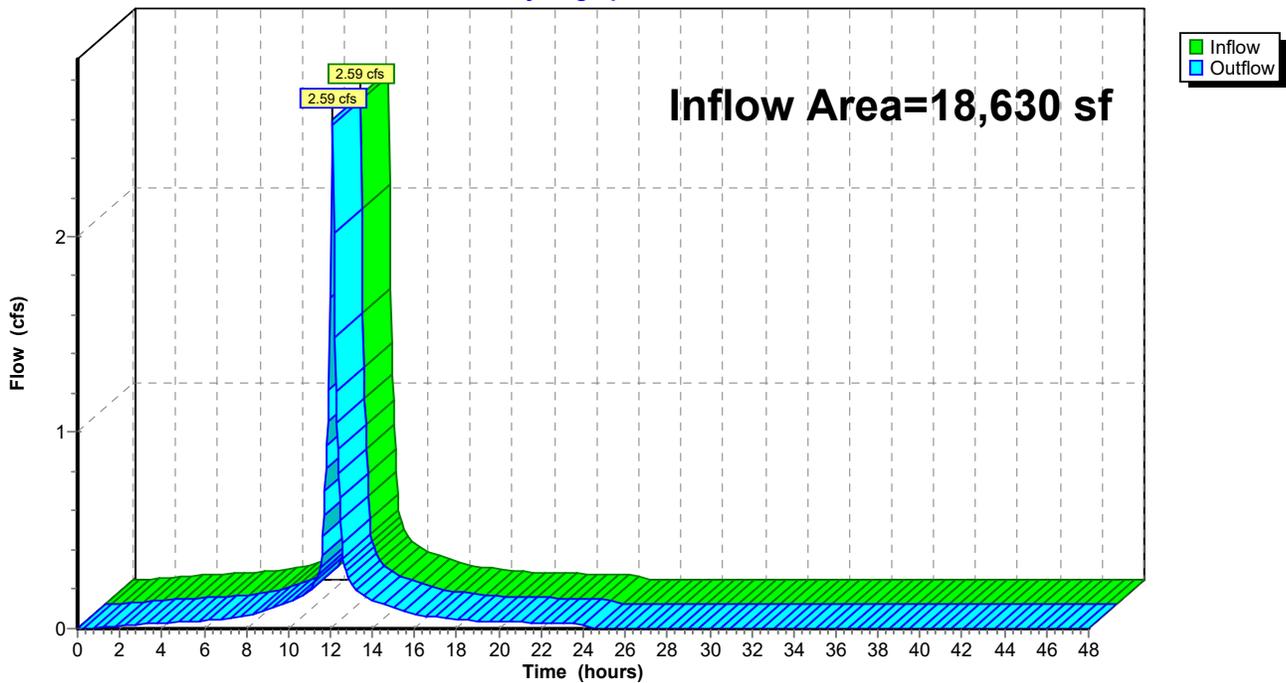
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 18,630 sf, 98.60% Impervious, Inflow Depth = 6.09" for 25-Year event  
Inflow = 2.59 cfs @ 12.09 hrs, Volume= 9,457 cf  
Outflow = 2.59 cfs @ 12.09 hrs, Volume= 9,457 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

### Reach DPT: Total

#### Hydrograph



**12693-Proposed HydroCAD**

Type III 24-hr 100-Year Rainfall=8.15"

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Page 14

Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points  
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**SubcatchmentDA1: DA1**

Runoff Area=18,630 sf 98.60% Impervious Runoff Depth=7.91"  
Tc=6.0 min CN=98 Runoff=3.34 cfs 12,280 cf

**Reach DPT: Total**

Inflow=3.34 cfs 12,280 cf  
Outflow=3.34 cfs 12,280 cf

**Total Runoff Area = 18,630 sf Runoff Volume = 12,280 cf Average Runoff Depth = 7.91"**  
**1.40% Pervious = 260 sf 98.60% Impervious = 18,370 sf**

# 12693-Proposed HydroCAD

Prepared by {enter your company name here}

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Type III 24-hr 100-Year Rainfall=8.15"

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Page 15

## Summary for Subcatchment DA1: DA1

Runoff = 3.34 cfs @ 12.09 hrs, Volume= 12,280 cf, Depth= 7.91"

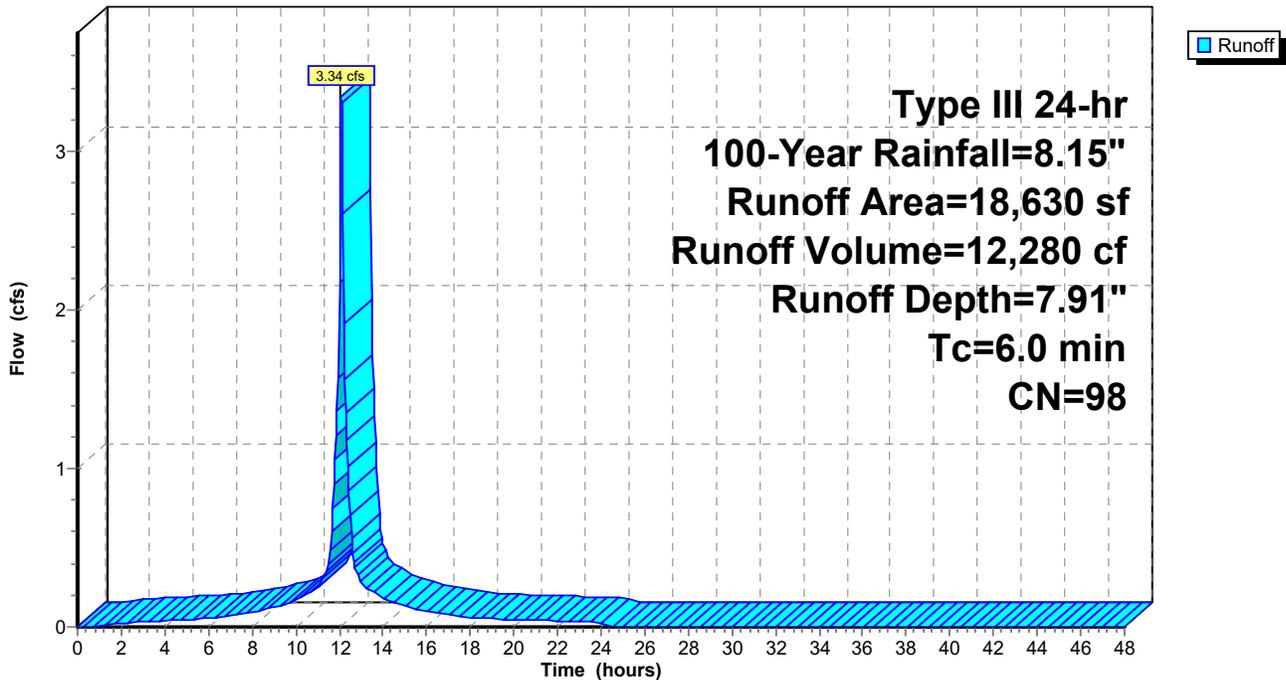
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-Year Rainfall=8.15"

Area (sf)	CN	Description
260	74	>75% Grass cover, Good, HSG C
12,320	98	Roofs, HSG C
6,050	98	Paved parking, HSG C
18,630	98	Weighted Average
260		1.40% Pervious Area
18,370		98.60% Impervious Area

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

## Subcatchment DA1: DA1

Hydrograph



### Summary for Reach DPT: Total

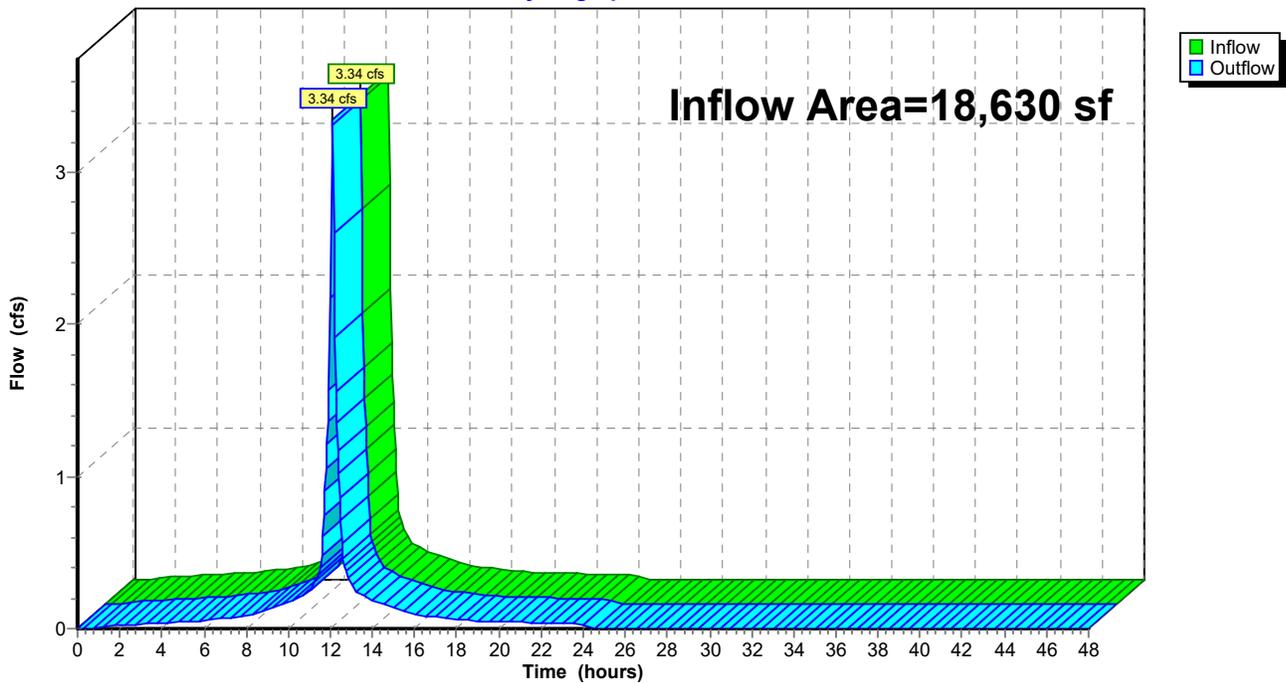
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 18,630 sf, 98.60% Impervious, Inflow Depth = 7.91" for 100-Year event  
Inflow = 3.34 cfs @ 12.09 hrs, Volume= 12,280 cf  
Outflow = 3.34 cfs @ 12.09 hrs, Volume= 12,280 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs

### Reach DPT: Total

Hydrograph





VICINITY SKETCH  
1"=400'

NOTES

- UNDERGROUND UTILITIES SHOWN ARE FROM OBSERVED SURFACE INDICATIONS, AND COMPILED FROM AVAILABLE RECORD PLANS OF UTILITY COMPANIES AND PUBLIC AGENCIES AND ARE APPROXIMATE ONLY. AS OF THE DATE OF THIS SURVEY, NO INFORMATION REGARDING RECORD UTILITIES HAS BEEN PROVIDED BY ELECTRIC AND GAS PROVIDERS. BEFORE CONSTRUCTION CALL "DIG SAFE" 811.
- THIS PLAN WAS PREPARED FROM AN ACTUAL SURVEY MADE ON THE GROUND USING TOTAL STATION METHODS ON OR BETWEEN 06/11/2018 AND 06/14/2018.
- THE HORIZONTAL DATUM IS NAD83  
THE VERTICAL DATUM IS TOWN OF BROOKLINE DATUM  
DATUM WAS ESTABLISHED USING RTK GPS METHODS.
- THE POSITIONAL ACCURACY OF THE DATA AND PHYSICAL IMPROVEMENTS ON THIS PLAN MAY BE APPROXIMATE. ANY USE OF ELECTRONIC DATA CONTAINED IN AUTOCAD VERSIONS OF THIS PLAN TO GENERATE COORDINATES OR DIMENSIONS NOT SHOWN ON THE PLAN IS NOT AUTHORIZED.
- THE PARCEL SHOWN IS LOCATED IN ZONE X (AREA OF MINIMAL FLOOD HAZARD), AS SHOWN ON "FLOOD INSURANCE RATE MAP, NORFOLK COUNTY, MASSACHUSETTS," PANEL 53 OF 430, MAP NUMBER 25021C0053E, EFFECTIVE DATE JULY 17, 2012.
- THERE ARE 28 STANDARD STRIPED PARKING SPACES AND 1 ACCESSIBLE PARKING SPACES OBSERVED ON THE SITE AT THE TIME OF THE SURVEY.
- CONTOUR INTERVAL IS ONE FOOT (1').

ZONING

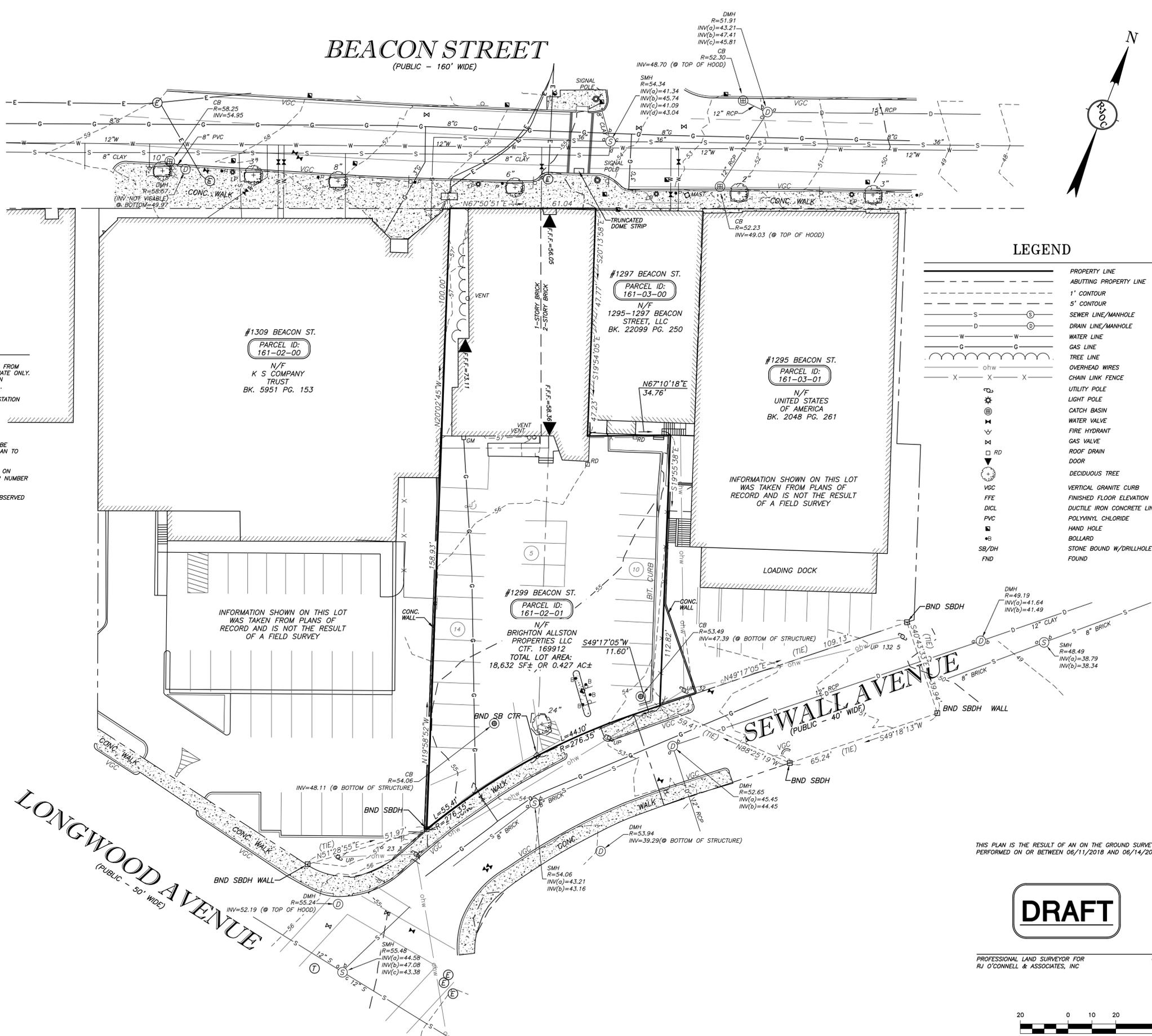
ZONE: G-1.75(CC) GENERAL BUSINESS

LOT SIZE MINIMUM	NONE
LOT WIDTH MINIMUM	NONE
MINIMUM FRONT YARD	NONE
MINIMUM SIDE YARD	NONE
MINIMUM REAR YARD	NONE
OPEN SPACE OF LOT	10+L/10*
MAX. BUILDING HEIGHT	45'
FLOOR AREA RATIO MAX.	2.25

\* L IS THE LENGTH OF A WALL PARALLEL (OR WITHIN 45° OF PARALLEL) TO THE LOT LINE, MEASURED PARALLEL TO THE LOT LINE, SUBJECT TO THE PROVISIONS OF §5-41 FOR BUILDINGS OF UNEVEN ALIGNMENT OF HEIGHT. H IS THE HEIGHT, MEASURED AS PROVIDED IN §5.30, OF THAT PART OF THE BUILDING FOR WHICH THE SETBACK OR YARD IS TO BE CALCULATED.

PLAN REFERENCES

- PLAN BOOK AND PAGES REFERENCE THE NORFOLK COUNTY REGISTRY OF DEEDS
- LAND COURT PLAN 24318-A
  - LAND COURT PLAN 26532-A
  - PLAN IN BOOK 2048 PAGE 261
  - PLAN 897 OF 1996



LEGEND

---	PROPERTY LINE
- - - -	ABUTTING PROPERTY LINE
---	1' CONTOUR
---	5' CONTOUR
S --- S	SEWER LINE/MANHOLE
D --- D	DRAIN LINE/MANHOLE
W --- W	WATER LINE
G --- G	GAS LINE
---	TREE LINE
---	OVERHEAD WIRES
X --- X	CHAIN LINK FENCE
○	UTILITY POLE
○	LIGHT POLE
○	CATCH BASIN
○	WATER VALVE
○	FIRE HYDRANT
○	GAS VALVE
○	ROOF DRAIN
○	DOOR
○	DECIDUOUS TREE
○	VERTICAL GRANITE CURB
○	FINISHED FLOOR ELEVATION
○	DUCTILE IRON CONCRETE LINED
○	POLYVINYL CHLORIDE
○	HAND HOLE
○	BOLLARD
○	STONE BOUND W/DRILLHOLE
○	FOUND



**DRAFT**

PROFESSIONAL LAND SURVEYOR FOR  
RJ O'CONNELL & ASSOCIATES, INC



Record Owner:  
BRIGHTON ALLSTON PROPERTIES LLC  
1299 BEACON STREET  
BROOKLINE, MA 02446  
L.C. CERT. 169912

Location:  
PARCEL ID: 161-02-01  
1299 BEACON STREET  
BROOKLINE, MA 02446

Drawn by: SML  
Checked by: KJK  
Scale: 1"=20'  
Date: 06/20/2018  
Field Crew: TDB/DPB  
Field Book: BK. 27 PG. 37

Prepared for:  
**BRIGHTON ALLSTON PROPERTIES LLC**  
c/o Ms. RACHNA BALAKRISHNA, ESQ.  
1299 BEACON STREET  
BROOKLINE, MA 02446

Prepared by:  
**RJO'CONNELL & ASSOCIATES, INC.**  
CIVIL ENGINEERS, SURVEYORS & LAND PLANNERS  
80 MONTVALE AVE  
STONEHAM, MA 02180  
781-279-0180  
www.rjoconnell.com

Project Name:  
**1299 BEACON ST. BROOKLINE, MA**  
Drawing Name:  
**EXISTING CONDITIONS PLAN**

Drawing No.:  
**EX-1**  
Project No.:  
18068

Town of Brookline: Nitsch Project #12693

1/11/2019

Page 7 of 7

- Proposed HydroCAD Calculations
- Existing Conditions Plan, 1299 Beacon Street, Brookline, MA, prepared by RJO'Connell and Associates, Inc., dated June 27, 2018.
- C000-C301 – Civil Plan Set