

# STORMWATER MANAGEMENT REPORT

FOR

## PROPOSED RESIDENTIAL RE-DEVELOPMENT 47 HUNTING STREET SOMERVILLE, MA

Prepared for:  
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Prepared by:

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Project 2013-094  
March 11, 2014



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## **INTRODUCTION**

FUD LLC proposes the development of the property at 47 Hunting Street in Somerville, MA. The existing parcels cover 5,565 square feet. There is currently a two-story, wood framed building on the subject site operating as a residential building. The remainder of the site is primarily paved or compacted gravel with asphalt in fair condition.

## **EXISTING CONDITION**

The runoff from the lot is one drainage area (subcatchment). (See Appendix B, *Figure 1*) The site is mostly impervious and slopes gently from the rear yard to the street. The wood framed building has downspouts that discharge to paved surfaces. The paved areas sheetflow directly onto the street where it is collected in the South Street & Hunting Street drainage system. There is a 36" diameter drain line in South Street where all stormwater from the site eventually flows. Aside from minor onsite infiltration through broken pavement and the compacted gravel, the entire site drains offsite without mitigation.

According to FEMA Flood Insurance Rate Map Number 25017C0577E with an effective date of June 4, 2010, the site is not located in a flood zone. (See Appendix A).

## **SOILS**

The NRCS Web Soil Survey characterizes the soil at the site as entirely Urban Land and does not specify a Hydrologic Soil Group.

For calculation purposes, a Hydrologic Soils Group of A was used for all subsurface soils. Per the Massachusetts Stormwater Handbook, Table 2.3.3 1982 Rawls Rates, an infiltration rate of 2.6 in/hr has been used in the hydrologic model. This is based on the infiltration chambers situated in the gravel fill material within 6'-8' of the surface as discovered in the test borings completed by McPhail Associates. Based upon observation well readings located within the footprint of the infiltration chambers, the high groundwater is estimated at 7 feet below grade. We have set the bottom of the infiltration system at 4 feet below grade. This maintains 3 feet separation from the bottom of the infiltration system to high groundwater.

## **PROPOSED CONDITION**

The proposed development includes the demolition of the existing building to accommodate a four-story building with ground level parking and 6 residential units above. The site is accessed by an existing curb cut. A landscape area is proposed in the very rear and side of the site, adding approximately 750 square feet of pervious area. The project additionally proposes permeable pavers in areas where the surface parking is open and not shielded by the building above.

The catchments in the proposed condition are very similar to the catchments in the existing condition. (See Appendix D, *Figure 2*)

## Drainage:

Drainage calculations were conducted to evaluate peak discharges from the project site under the pre-development and post-development conditions (See Appendix E). As required under the City of Somerville's Stormwater Management Policy, peak discharges under post development conditions will be less than the pre-development conditions.

The proposed stormwater management system includes roof drains and an infiltration chambers for detention and groundwater recharge of roof runoff that is collected internally and piped to the infiltration chambers. An overflow discharges a new connection to the 36" drain in South Street. The project additionally provides permeable pavers and new landscaped areas. A majority of the open area on the lot is proposed to be permeable surface. The proposed mitigation will substantially reduce the stormwater flow from the property exceeding the City's stormwater management requirements.

### 4:1 Infiltration/Inflow Removal:

The 4:1 I-I requirement stipulates that for every increased gallon of sewage flow per day, four gallons of stormwater are stored and infiltrated onsite. The volume of stormwater represents the required amount to be stored/infiltrated per year. Calculations for the 4:1 I-I requirement are provided as Appendix G of this report.

## HYDROLOGIC MODEL

The hydrologic model used for this analysis is based upon the SCS Method. Both existing and proposed conditions are modeled for the 2-year, 10-year, 25-year, and 100-year storm events. The SCS Method allows for variable rainfall intensity throughout the storm duration, peaking near the middle of the Type III, 24-hour storm. The drainage area's time of concentration ( $t_c$ ), assumed to be six minutes for this site.

The designed on-site stormwater management system collects and infiltrates site runoff reducing off-site flows for all storm events.

**Table 1**

2 Year (3.20")	<i>Pre</i>	0.30	965
	<i>Post</i>	0.01	39
10 Year (4.60")	<i>Pre</i>	0.48	1,571
	<i>Post</i>	0.13	229
25 Year (5.50")	<i>Pre</i>	0.60	1,971
	<i>Post</i>	0.32	465
100 Year (6.60")	<i>Pre</i>	0.74	2,465
	<i>Post</i>	0.59	786

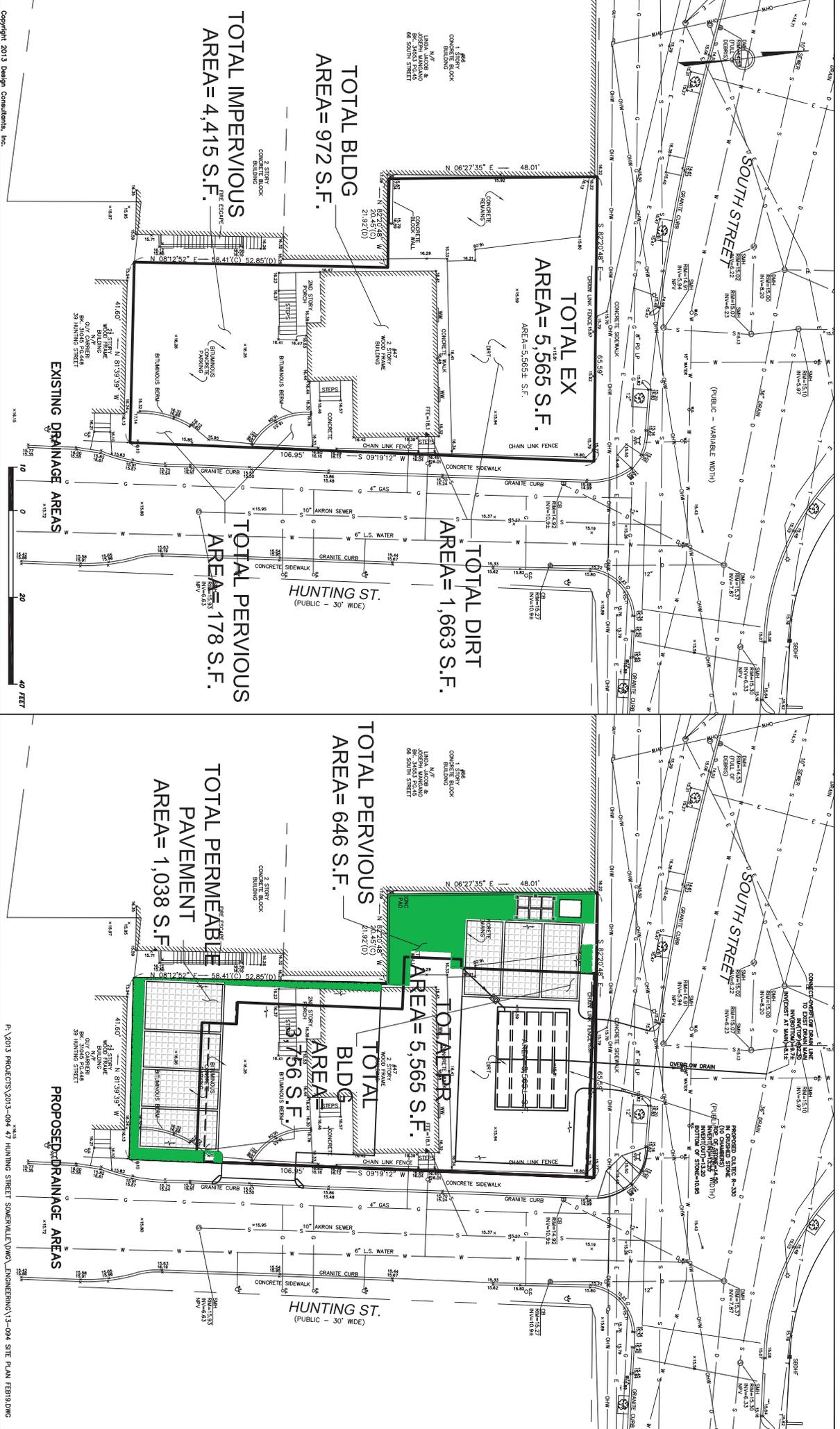
## **CONCLUSION**

Based on DCI's analysis of the existing and proposed conditions, the proposed site condition exceed the criteria set forth by the City of Somerville. Off-site runoff volume and peak flow rate for the 2, 10, 25 and 100-year storm events are substantially decreased. The 4:1 I/I requirement will be met. DCI concludes that the proposed development at 47, Somerville, MA adheres to all applicable stormwater management policies and will reduce flow to the drainage system located in South Street.

## **Appendix A**



## **Appendix B**



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**Design Consultants, Inc.**  
 Consulting Engineers and Surveyors  
 180 JUDASACK AVENUE  
 SOMERVILLE, MA 01906  
 817-770-5580

SCALE:  
 HORIZ.: 1" = 20'  
 VERT.: \_\_\_\_\_

NO.	DATE	BY

REVISIONS:

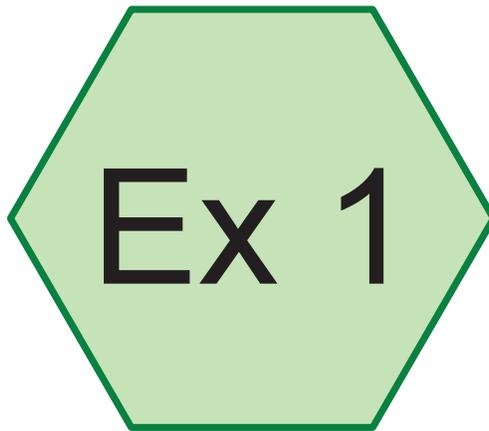
DESIGN: SSS	CHECKED: DC	APPROVED: SSS
DRAWING: SSM		

EXISTING & PROPOSED DRAINAGE AREAS  
 47 HUNTING STREET

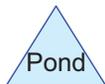
PLAN OF LAND IN SOMERVILLE, MASSACHUSETTS  
 PREPARED FOR FUD LLC

PROJECT NO. 2013-094  
 DATE: MARCH 11, 2014  
 FIGURE 1

## **Appendix C**



Ex 1



**13-094 Exist**

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Type III 24-hr 2-Year Rainfall=3.20"

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**Summary for Subcatchment Ex 1: Ex 1**

Runoff = 0.30 cfs @ 12.09 hrs, Volume= 965 cf, Depth&gt; 2.08"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Type III 24-hr 2-Year Rainfall=3.20"

Area (sf)	CN	Description
972	98	Roofs, HSG A
2,752	98	Paved parking, HSG A
1,663	72	Dirt roads, HSG A
178	68	<50% Grass cover, Poor, HSG A
5,565	89	Weighted Average
1,841		33.08% Pervious Area
3,724		66.92% Impervious Area

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

**13-094 Exist**

Type III 24-hr 10-Year Rainfall=4.60"

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**Summary for Subcatchment Ex 1: Ex 1**

Runoff = 0.48 cfs @ 12.09 hrs, Volume= 1,571 cf, Depth&gt; 3.39"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-Year Rainfall=4.60"

Area (sf)	CN	Description
972	98	Roofs, HSG A
2,752	98	Paved parking, HSG A
1,663	72	Dirt roads, HSG A
178	68	<50% Grass cover, Poor, HSG A
5,565	89	Weighted Average
1,841		33.08% Pervious Area
3,724		66.92% Impervious Area

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

**13-094 Exist**

Type III 24-hr 25-Year Rainfall=5.50"

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**Summary for Subcatchment Ex 1: Ex 1**

Runoff = 0.60 cfs @ 12.09 hrs, Volume= 1,971 cf, Depth&gt; 4.25"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 25-Year Rainfall=5.50"

Area (sf)	CN	Description
972	98	Roofs, HSG A
2,752	98	Paved parking, HSG A
1,663	72	Dirt roads, HSG A
178	68	<50% Grass cover, Poor, HSG A
5,565	89	Weighted Average
1,841		33.08% Pervious Area
3,724		66.92% Impervious Area

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

**13-094 Exist**

Type III 24-hr 100-Year Rainfall=6.60"

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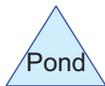
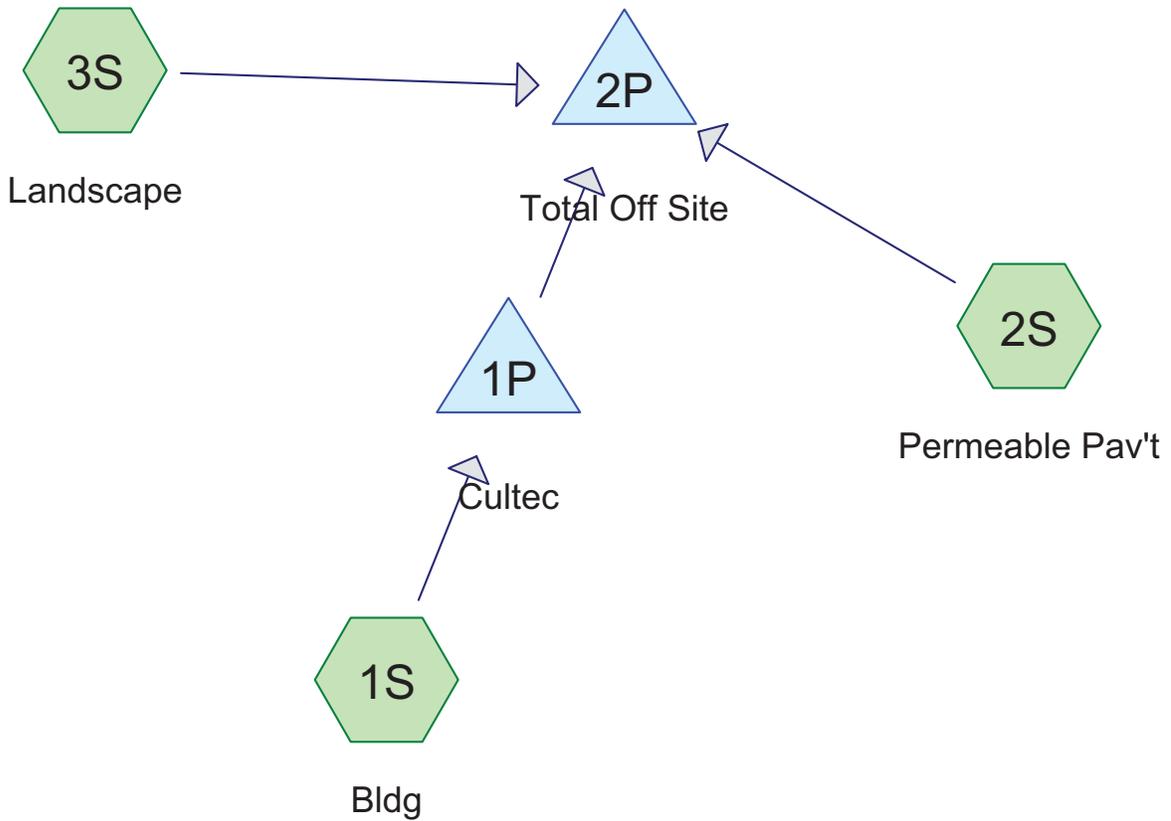
**Summary for Subcatchment Ex 1: Ex 1**

Runoff = 0.74 cfs @ 12.09 hrs, Volume= 2,465 cf, Depth&gt; 5.31"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-Year Rainfall=6.60"

Area (sf)	CN	Description
972	98	Roofs, HSG A
2,752	98	Paved parking, HSG A
1,663	72	Dirt roads, HSG A
178	68	<50% Grass cover, Poor, HSG A
5,565	89	Weighted Average
1,841		33.08% Pervious Area
3,724		66.92% Impervious Area

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



**13-094 Prop**

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Type III 24-hr 2-Year Rainfall=3.20"

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**Summary for Subcatchment 1S: Bldg**

Runoff = 0.26 cfs @ 12.09 hrs, Volume= 933 cf, Depth&gt; 2.97"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-Year Rainfall=3.20"

Area (sf)	CN	Description
3,776	98	Roofs, HSG A
3,776		100.00% Impervious Area

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

**Summary for Subcatchment 2S: Permeable Pav't**

Runoff = 0.01 cfs @ 12.14 hrs, Volume= 35 cf, Depth&gt; 0.41"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-Year Rainfall=3.20"

Area (sf)	CN	Description
* 1,038	60	Permeable pavement
1,038		100.00% Pervious Area

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

**Summary for Subcatchment 3S: Landscape**

Runoff = 0.00 cfs @ 15.05 hrs, Volume= 4 cf, Depth&gt; 0.06"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-Year Rainfall=3.20"

Area (sf)	CN	Description
668	39	>75% Grass cover, Good, HSG A
* 83	98	conc pad, dumpster area, HSG A
751	46	Weighted Average
668		88.95% Pervious Area
83		11.05% Impervious Area

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

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Type III 24-hr 2-Year Rainfall=3.20"

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**Summary for Pond 1P: Cultec**

Inflow Area = 3,776 sf, 100.00% Impervious, Inflow Depth > 2.97" for 2-Year event  
 Inflow = 0.26 cfs @ 12.09 hrs, Volume= 933 cf  
 Outflow = 0.03 cfs @ 12.50 hrs, Volume= 906 cf, Atten= 87%, Lag= 24.8 min  
 Discarded = 0.03 cfs @ 12.50 hrs, Volume= 906 cf  
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
 Peak Elev= 11.04' @ 12.65 hrs Surf.Area= 551 sf Storage= 378 cf

Plug-Flow detention time= 200.8 min calculated for 906 cf (97% of inflow)  
 Center-of-Mass det. time= 182.6 min ( 938.5 - 756.0 )

Volume	Invert	Avail.Storage	Storage Description
#1	10.95'	240 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc) 799 cf Overall x 30.0% Voids
#2A	0.00'	171 cf	<b>15.42'W x 16.00'L x 2.54'H Field A</b> 627 cf Overall - 199 cf Embedded = 428 cf x 40.0% Voids
#3A	0.50'	199 cf	<b>Cultec R-150 x 10 Inside #2</b> Effective Size= 29.8"W x 18.0"H => 2.65 sf x 7.50'L = 19.9 cf Overall Size= 33.0"W x 18.5"H x 8.50'L with 1.00' Overlap
		610 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
10.95	304	0	0
11.44	304	149	149
11.45	150	2	151
12.70	160	194	345
14.00	304	302	647
14.50	304	152	799

Device	Routing	Invert	Outlet Devices
#1	Discarded	0.00'	<b>2.600 in/hr Exfiltration over Surface area</b>
#2	Primary	13.20'	<b>6.0" Round Culvert</b> L= 43.0' Ke= 1.000 Inlet / Outlet Invert= 13.20' / 12.30' S= 0.0209 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior

**Discarded OutFlow** Max=0.03 cfs @ 12.50 hrs HW=10.99' (Free Discharge)  
 ↑1=Exfiltration (Exfiltration Controls 0.03 cfs)

**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=0.00' (Free Discharge)  
 ↑2=Culvert ( Controls 0.00 cfs)

**Summary for Pond 2P: Total Off Site**

Inflow Area = 5,565 sf, 69.34% Impervious, Inflow Depth > 0.08" for 2-Year event  
Inflow = 0.01 cfs @ 12.14 hrs, Volume= 39 cf  
Primary = 0.01 cfs @ 12.14 hrs, Volume= 39 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

**13-094 Prop**

Type III 24-hr 10-Year Rainfall=4.60"

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**Summary for Subcatchment 1S: Bldg**

Runoff = 0.38 cfs @ 12.09 hrs, Volume= 1,372 cf, Depth&gt; 4.36"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-Year Rainfall=4.60"

Area (sf)	CN	Description
3,776	98	Roofs, HSG A
3,776		100.00% Impervious Area

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

**Summary for Subcatchment 2S: Permeable Pav't**

Runoff = 0.03 cfs @ 12.11 hrs, Volume= 93 cf, Depth&gt; 1.07"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-Year Rainfall=4.60"

Area (sf)	CN	Description
* 1,038	60	Permeable pavement
1,038		100.00% Pervious Area

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

**Summary for Subcatchment 3S: Landscape**

Runoff = 0.00 cfs @ 12.33 hrs, Volume= 23 cf, Depth&gt; 0.36"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-Year Rainfall=4.60"

Area (sf)	CN	Description
668	39	>75% Grass cover, Good, HSG A
* 83	98	conc pad, dumpster area, HSG A
751	46	Weighted Average
668		88.95% Pervious Area
83		11.05% Impervious Area

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

**Summary for Pond 1P: Cultec**

Inflow Area = 3,776 sf, 100.00% Impervious, Inflow Depth > 4.36" for 10-Year event  
 Inflow = 0.38 cfs @ 12.09 hrs, Volume= 1,372 cf  
 Outflow = 0.14 cfs @ 12.36 hrs, Volume= 1,252 cf, Atten= 62%, Lag= 16.2 min  
 Discarded = 0.03 cfs @ 16.25 hrs, Volume= 1,139 cf  
 Primary = 0.11 cfs @ 12.36 hrs, Volume= 113 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
 Peak Elev= 13.43' @ 12.36 hrs Surf.Area= 488 sf Storage= 517 cf

Plug-Flow detention time= 181.9 min calculated for 1,252 cf (91% of inflow)  
 Center-of-Mass det. time= 136.6 min ( 885.6 - 749.0 )

Volume	Invert	Avail.Storage	Storage Description
#1	10.95'	240 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc) 799 cf Overall x 30.0% Voids
#2A	0.00'	171 cf	<b>15.42'W x 16.00'L x 2.54'H Field A</b> 627 cf Overall - 199 cf Embedded = 428 cf x 40.0% Voids
#3A	0.50'	199 cf	<b>Cultec R-150 x 10 Inside #2</b> Effective Size= 29.8"W x 18.0"H => 2.65 sf x 7.50'L = 19.9 cf Overall Size= 33.0"W x 18.5"H x 8.50'L with 1.00' Overlap
		610 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
10.95	304	0	0
11.44	304	149	149
11.45	150	2	151
12.70	160	194	345
14.00	304	302	647
14.50	304	152	799

Device	Routing	Invert	Outlet Devices
#1	Discarded	0.00'	<b>2.600 in/hr Exfiltration over Surface area</b>
#2	Primary	13.20'	<b>6.0" Round Culvert</b> L= 43.0' Ke= 1.000 Inlet / Outlet Invert= 13.20' / 12.30' S= 0.0209 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior

**Discarded OutFlow** Max=0.03 cfs @ 16.25 hrs HW=11.42' (Free Discharge)  
 ↑1=Exfiltration (Exfiltration Controls 0.03 cfs)

**Primary OutFlow** Max=0.11 cfs @ 12.36 hrs HW=13.43' (Free Discharge)  
 ↑2=Culvert (Inlet Controls 0.11 cfs @ 1.22 fps)

**Summary for Pond 2P: Total Off Site**

Inflow Area = 5,565 sf, 69.34% Impervious, Inflow Depth > 0.49" for 10-Year event  
Inflow = 0.13 cfs @ 12.35 hrs, Volume= 229 cf  
Primary = 0.13 cfs @ 12.35 hrs, Volume= 229 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

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Type III 24-hr 25-Year Rainfall=5.50"

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**Summary for Subcatchment 1S: Bldg**

Runoff = 0.46 cfs @ 12.09 hrs, Volume= 1,655 cf, Depth&gt; 5.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 25-Year Rainfall=5.50"

Area (sf)	CN	Description
3,776	98	Roofs, HSG A
3,776		100.00% Impervious Area

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

**Summary for Subcatchment 2S: Permeable Pav't**

Runoff = 0.04 cfs @ 12.10 hrs, Volume= 138 cf, Depth&gt; 1.60"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 25-Year Rainfall=5.50"

Area (sf)	CN	Description
* 1,038	60	Permeable pavement
1,038		100.00% Pervious Area

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

**Summary for Subcatchment 3S: Landscape**

Runoff = 0.01 cfs @ 12.15 hrs, Volume= 42 cf, Depth&gt; 0.67"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 25-Year Rainfall=5.50"

Area (sf)	CN	Description
668	39	>75% Grass cover, Good, HSG A
* 83	98	conc pad, dumpster area, HSG A
751	46	Weighted Average
668		88.95% Pervious Area
83		11.05% Impervious Area

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

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Type III 24-hr 25-Year Rainfall=5.50"

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**Summary for Pond 1P: Cultec**

Inflow Area = 3,776 sf, 100.00% Impervious, Inflow Depth > 5.26" for 25-Year event  
 Inflow = 0.46 cfs @ 12.09 hrs, Volume= 1,655 cf  
 Outflow = 0.32 cfs @ 12.20 hrs, Volume= 1,496 cf, Atten= 30%, Lag= 7.1 min  
 Discarded = 0.03 cfs @ 12.06 hrs, Volume= 1,211 cf  
 Primary = 0.29 cfs @ 12.20 hrs, Volume= 285 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
 Peak Elev= 13.62' @ 12.20 hrs Surf.Area= 508 sf Storage= 531 cf

Plug-Flow detention time= 159.4 min calculated for 1,496 cf (90% of inflow)  
 Center-of-Mass det. time= 111.1 min ( 857.1 - 746.1 )

Volume	Invert	Avail.Storage	Storage Description
#1	10.95'	240 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc) 799 cf Overall x 30.0% Voids
#2A	0.00'	171 cf	<b>15.42'W x 16.00'L x 2.54'H Field A</b> 627 cf Overall - 199 cf Embedded = 428 cf x 40.0% Voids
#3A	0.50'	199 cf	<b>Cultec R-150 x 10 Inside #2</b> Effective Size= 29.8"W x 18.0"H => 2.65 sf x 7.50'L = 19.9 cf Overall Size= 33.0"W x 18.5"H x 8.50'L with 1.00' Overlap
		610 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
10.95	304	0	0
11.44	304	149	149
11.45	150	2	151
12.70	160	194	345
14.00	304	302	647
14.50	304	152	799

Device	Routing	Invert	Outlet Devices
#1	Discarded	0.00'	<b>2.600 in/hr Exfiltration over Surface area</b>
#2	Primary	13.20'	<b>6.0" Round Culvert</b> L= 43.0' Ke= 1.000 Inlet / Outlet Invert= 13.20' / 12.30' S= 0.0209 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior

**Discarded OutFlow** Max=0.02 cfs @ 12.06 hrs HW=11.47' (Free Discharge)  
 ↑1=Exfiltration (Exfiltration Controls 0.02 cfs)

**Primary OutFlow** Max=0.28 cfs @ 12.20 hrs HW=13.61' (Free Discharge)  
 ↑2=Culvert (Inlet Controls 0.28 cfs @ 1.63 fps)

**Summary for Pond 2P: Total Off Site**

Inflow Area = 5,565 sf, 69.34% Impervious, Inflow Depth > 1.00" for 25-Year event  
Inflow = 0.32 cfs @ 12.20 hrs, Volume= 465 cf  
Primary = 0.32 cfs @ 12.20 hrs, Volume= 465 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

**13-094 Prop**

Type III 24-hr 100-Year Rainfall=6.60"

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**Summary for Subcatchment 1S: Bldg**

Runoff = 0.55 cfs @ 12.09 hrs, Volume= 2,000 cf, Depth&gt; 6.36"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-Year Rainfall=6.60"

Area (sf)	CN	Description
3,776	98	Roofs, HSG A
3,776		100.00% Impervious Area

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

**Summary for Subcatchment 2S: Permeable Pav't**

Runoff = 0.06 cfs @ 12.10 hrs, Volume= 201 cf, Depth&gt; 2.32"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-Year Rainfall=6.60"

Area (sf)	CN	Description
* 1,038	60	Permeable pavement
1,038		100.00% Pervious Area

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

**Summary for Subcatchment 3S: Landscape**

Runoff = 0.02 cfs @ 12.12 hrs, Volume= 71 cf, Depth&gt; 1.13"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-Year Rainfall=6.60"

Area (sf)	CN	Description
668	39	>75% Grass cover, Good, HSG A
* 83	98	conc pad, dumpster area, HSG A
751	46	Weighted Average
668		88.95% Pervious Area
83		11.05% Impervious Area

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

**13-094 Prop**

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Type III 24-hr 100-Year Rainfall=6.60"

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**Summary for Pond 1P: Cultec**

Inflow Area = 3,776 sf, 100.00% Impervious, Inflow Depth > 6.36" for 100-Year event  
 Inflow = 0.55 cfs @ 12.09 hrs, Volume= 2,000 cf  
 Outflow = 0.54 cfs @ 12.12 hrs, Volume= 1,803 cf, Atten= 1%, Lag= 2.3 min  
 Discarded = 0.03 cfs @ 11.96 hrs, Volume= 1,288 cf  
 Primary = 0.51 cfs @ 12.12 hrs, Volume= 515 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs  
 Peak Elev= 13.94' @ 12.12 hrs Surf.Area= 544 sf Storage= 559 cf

Plug-Flow detention time= 138.8 min calculated for 1,799 cf (90% of inflow)  
 Center-of-Mass det. time= 89.7 min ( 833.1 - 743.3 )

Volume	Invert	Avail.Storage	Storage Description
#1	10.95'	240 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc) 799 cf Overall x 30.0% Voids
#2A	0.00'	171 cf	<b>15.42'W x 16.00'L x 2.54'H Field A</b> 627 cf Overall - 199 cf Embedded = 428 cf x 40.0% Voids
#3A	0.50'	199 cf	<b>Cultec R-150 x 10 Inside #2</b> Effective Size= 29.8"W x 18.0"H => 2.65 sf x 7.50'L = 19.9 cf Overall Size= 33.0"W x 18.5"H x 8.50'L with 1.00' Overlap
		610 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
10.95	304	0	0
11.44	304	149	149
11.45	150	2	151
12.70	160	194	345
14.00	304	302	647
14.50	304	152	799

Device	Routing	Invert	Outlet Devices
#1	Discarded	0.00'	<b>2.600 in/hr Exfiltration over Surface area</b>
#2	Primary	13.20'	<b>6.0" Round Culvert</b> L= 43.0' Ke= 1.000 Inlet / Outlet Invert= 13.20' / 12.30' S= 0.0209 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior

**Discarded OutFlow** Max=0.03 cfs @ 11.96 hrs HW=11.27' (Free Discharge)  
 ↑1=Exfiltration (Exfiltration Controls 0.03 cfs)

**Primary OutFlow** Max=0.46 cfs @ 12.12 hrs HW=13.87' (Free Discharge)  
 ↑2=Culvert (Inlet Controls 0.46 cfs @ 2.34 fps)

**Summary for Pond 2P: Total Off Site**

Inflow Area = 5,565 sf, 69.34% Impervious, Inflow Depth > 1.70" for 100-Year event  
Inflow = 0.59 cfs @ 12.12 hrs, Volume= 786 cf  
Primary = 0.59 cfs @ 12.12 hrs, Volume= 786 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

## **Appendix D**

## INFILTRATION/INFLOW REMOVAL CALCULATIONS

### I. INTRODUCTION

The following infiltration/inflow removal calculations are based upon 310 CMR 15.203, the sewer calculations presented above, and the storm drainage calculations summarized in Table I. The City of Somerville requires that infiltration/inflow removal of four times the proposed additional average daily sewer flow must be provided by the project.

### II. CALCULATIONS

Existing Average Daily Sewer Flow	6 x 110gpd/bed = 660gpd Total = 660 gpd
Proposed Average Daily Sewer Flow	12 x 110gpd/bed = 1,320gpd Total = 1,320
Additional Average Daily Flow	660 gpd
Four Times Additional Average Daily Flow	2,640 gpd = 0.004 cfs

### III. REMOVAL

The required 0.004 cfs of infiltration/ inflow will be removed from the combined sewer system by peak flow reduction in the storm drainage from the site. Subtraction of the proposed flow rates from the existing flow rates given in Table 1 indicates flow reductions of 0.29 cfs, 0.35 cfs, 0.28 cfs, and 0.42 cfs for the 2 yr., 10yr., 25 yr., and 100 yr. Storms respectively. All of these flow reductions exceed the required removal of 0.004 cfs.

### IV. CONCLUSION

Because the storm drainage flow reductions provided by the project exceed the required infiltration/inflow removal rate we conclude that the proposed design meets and exceeds the requirement for infiltration/inflow removal.