STORMWATER MANAGEMENT REPORT

FOR

Millbrook
9 and 39 Medford Street
Somerville, MA

Prepared for:
Berkley Investments
121 High Street, 3rd Floor
Boston, MA 02110

COMMONWEALTH OF MASSACHUSETTS
WAYNE A. KEEFNER
CIVIL
No. 41313
REGISTERED PROFESSIONAL ENGINEER
10-8-13

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Project 2013-033
October 8, 2013

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INTRODUCTION

Berkley Investments proposes the redevelopment of the property at 9 and 39 Medford Street in Somerville, MA. The project consists of the main site at 9 & 39 Medford Street as well as an ancillary lot separated from the main lot by the CSX railroad tracks. The ancillary lot is fully paved and the improvements to this lot will decrease the amount of impervious area. However, to be conservative in the approach to stormwater management, this lot was not included in the claculations.

EXISTING CONDITION

The property at 9 and 39 Medford Street is approximately 45,120± sf in area and bordered to the northwest by CSX railroad property, to the north and east by the Twin City Plaza and to the south by Medford Street. An ancillary lot, known as Lot 3, is separated from the main lot by the CSX railroad property.

The existing main site consists of the decommissioned Millbrook cold storage building site. The main building has 7 above grade floors and a basement. One story additions include office space, a loading dock and mechanical space. The site is nearly fully paved. The front of the property consists of maneuvering space for tractor trailers to access the loading docks as well as some parking spaces. Most the remaining paved areas around the building are utilized for parking.

The ancillary lot is fully paved and serves as parking for the adjacent office and retail space.

The majority of the existing site has no stormwater management system. Stormwater runoff from the site is tributary to three separate design points. See Figure 1 in the appendix for the existing catchment areas.

Design point 1 is the combined system in Medford Street. Stormwater runoff from approximately three-quarters of the site is tributary to this design point, including runoff from most of the existing building roof, the paved area in the front of the site and about half of the paved areas to the east and west of the existing building. The on-site drainage system tributary to this design point has not stormwater BMP's for either quality or quantity.

Design point 2 is the existing railroad property to the northwest of the existing building. A portion of the runoff from the existing building as well as the paved area west of the existing building is tributary to this design point. Runoff to this design point sheet flows from the project site onto the railroad property. There is no on-site drainage system associated with this catchment area.

Design point 3 is the northeast corner of the site. Stormwater at this design point enters the Twin City Plaza drainage system northeast of the site which is tributary to a 48" pipe behind the Twin City Plaza which flows northwest under the McGrath Highway and MBTA tracks. Based on our past research and recent investigations which noted the odor coming from manholes around this 48" pipe, we believe this connects to the MWRA combined sewer line. A portion of the paved area to the east of the existing building and a small area north of the building are tributary to this design point. The off-site drainage system tributary to this design point includes stormwater quality BMP's (deep sump hooded catch basins) but does not contain any quantity BMP's.

According to FEMA Flood Insurance Rate Map Number 25017C0577E, with an effective date of June 4, 2010, the site is located in Zone X, which is "areas determined to be outside the 0.2% annual chance floodplain". See firmette in the appendix for the Flood Insurance Rate Map.

SOILS

The NRCS Web Soil Survey was reviewed for subsurface soil information. Unfortunately, the site is temporarily unavailable due to the current partial government shutdown.

The Preliminary Subsurface Investigation and Existing Foundation Evaluation Report, prepared by Geotechnical Consultants, Inc., dated June 28, 2013 includes four boring logs. These logs show the existing site as generally fill over silt/organics to a depth varying between 13' and 21'. These soils are considered the immediate subsurface soils are and predominantly responsible for the amount of infiltration the site receives. The NRCS hydrologic soil type for this soil is HSG C, which has been used in the hydrologic calculations. See appendix for the complete report.

PROPOSED CONDITION

The project proposes to demolish the existing single story additions, renovate the building to include 100 residential units and redevelop the site to provide an inviting space between the building and the street. Site improvements include 100 parking spaces (including the spaces on the ancillary lot and spaces in the basement), benches, outdoor plaza space, open space and site lighting.

Building improvements include a 4,000 ± sf greenroof. Greenroofs comprise a shallow light weight aggregate which is the living media for sedum type plants. Benefits of greenroofs include stormwater runoff reduction by plant uptake and evapotranspiration and detention, flora and fauna biodiversity, reduced heat island effect and improved building performance due to increased roof insulation.

The same three design points are used for the proposed condition. See Figure 2 in the appendix for the proposed catchment areas.

Design point 1 in the proposed condition consists of all roof runoff, runoff from the new parking and outdoor plaza areas as well as runoff from a portion of the paved areas to the east and west of the building. Stormwater runoff to this design point is collected in a new closed drainage system which includes deep sump hooded catch basins.

Design point 2 in the proposed condition consists of runoff from the paved area west of the building and a portion of the pavement to the north of the building. Runoff to this design point sheet flows from the project site onto the railroad property, approximating the existing condition. There is no on-site drainage system associated with this catchment area.

Design point 3 in the proposed condition consists of runoff from a portion of the paved area north of the building. The off-site drainage system tributary to this design point includes stormwater quality BMP's (deep sump hooded catch basins) but does not contain any quantity BMP's.

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 five minutes for this site. Complete calculations, performed using the software HydroCad®, are included in the appendix.

The designed on-site stormwater management system reduces overall off-site flows for all storm events. Stormwater runoff to the individual design points is reduced, with the exception of Design Point 3. Runoff to this design point is slightly increased, but due to the size of the large culvert this catchment leads to, this increase is de minimus.

Table 1

Hydrologic Calculation Summary

		Design Point 1		Design Point 2		Design Point 3		Total Runoff	
Rainfall Event		Existing	Proposed	Existing	Proposed	Existing	Proposed	Existing	Proposed
2 Yr	Rate (cfs)	2.27	2.08	0.78	0.50	0.13	0.24	3.19	2.82
	Volume (af)	0.160	0.145	0.056	0.035	0.009	0.017	0.226	0.196
10 Yr	Rate (cfs)	3.35	3.10	1.15	0.74	0.19	0.35	4.69	4.19
	Volume (af)	0.240	0.219	0.083	0.052	0.014	0.025	0.337	0.297
25 Yr	Rate (cfs)	3.96	3.67	1.35	0.88	0.23	0.41	5.54	4.96
	Volume (af)	0.285	0.267	0.098	0.062	0.016	0.030	0.400	0.359
100 Yr	Rate (cfs)	4.88	4.53	1.66	1.08	0.28	0.51	6.82	6.12
	Volume (af)	0.353	0.339	0.121	0.078	0.020	0.037	0.495	0.453

INFILTRATION/INFLOW CALCULATION

"4 to 1" Infiltration/Inflow reductions, mandated by the City of Somerville for proposed sewer flows over 2,200 gallons per day, call for a reduction in runoff to the city combined system by four times the daily sewerage discharge from the proposed building.

The following infiltration/inflow removal calculations are based upon 310 CMR 15.203 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.

The proposed development included 100 units, consisting of 13 studio apartments, 63 one-bedroom units and 24 two-bedroom units. These calculations assume the studio apartments are equivalent to a one-bedroom unit (relative to Title V).

Existing Average Daily Sewer Flow	1,500 sf (office) x 75 gpd/1,000 sf = 112 gpd 15 persons[1] (warehouse) x 15 gpd/person = 225 gpd Total = 337 gpd
Proposed Average Daily Sewer Flow	13 (studios) x 110 gpd/bed = 1,430 gpd 63 (one-bedroom) x 110 gpd/bed = 6,930 gpd 24 (two-bedroom) x 110 gpd/bed x 2 = 5,280 gpd Total = 13,640
Additional Average Daily Flow	13,303 gpd
Four Times Additional Average Daily Flow	53,212 gpd = 0.082 cfs

1 Assume 15 employees on average working at facility (106,400 sf warehouse)

The required 0.082 cfs of infiltration/inflow will be removed from the combined sewer system by peak flow reduction in the storm drainage from the site. It is believed that Design Points 1 and 2 are eventually tributary to the combined system within Medford Street in the proximity of the site. However, to be conservative, only the reduction in peak rates to Design Point 1 (which is the existing sewer mahole directly in front of the site) has been considered. Subtraction of the proposed flow rates for Design Point 1 from the existing flow rates given in Table 1, gives flow

reductions of 0.19 cfs, 0.25 cfs, 0.29 cfs, and 0.35 cfs for the 2 year, 10 year, 25 year, and 100 year design storms respectively. All of these flow reductions exceed the required removal of 0.082 cfs.

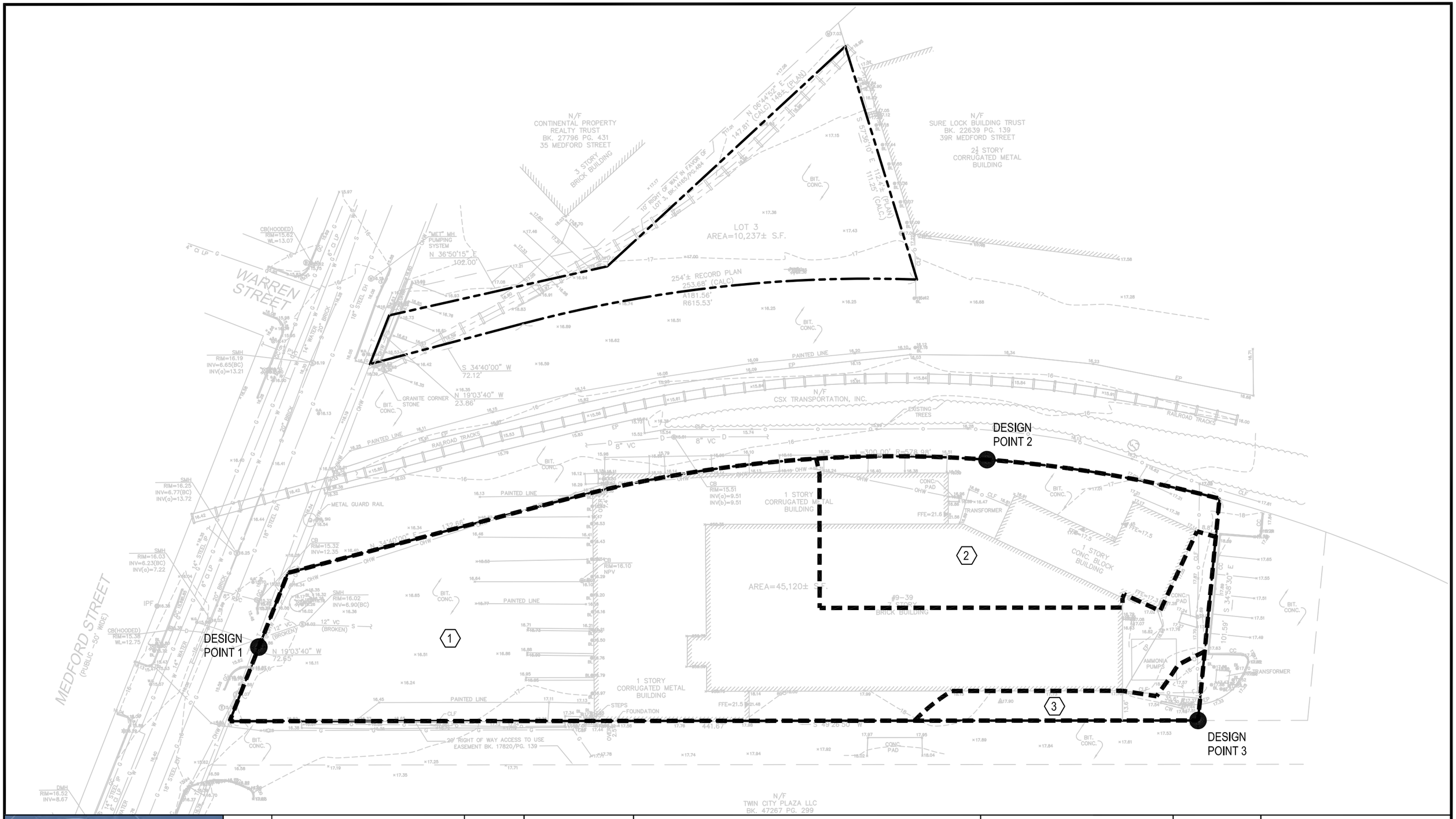
Because the storm drainage flow reductions provided by the project exceed the required infiltration/inflow removal rate we conclude that the proposed design meets and exceeds the requirement for infiltration/inflow removal.

CONCLUSION

Based on DCI's analysis of the existing and proposed conditions, the proposed site condition meets the criteria set forth by the City of Somerville. Overall off-site runoff volume and peak flow rate for the 2, 10, 25 and 100-year storm events is decreased. If an illicit stormwater connection to the sanitary sewer is found, it will be eliminated and a new connection will be made to the appropriate storm sewer. The 4:1 I/I requirement will be met. DCI concludes that the proposed development at 9 & 39 Medford Street, Somerville, MA adheres to all applicable stormwater management policies.

APPENDIX

Figure 1 – Existing Catchment Areas



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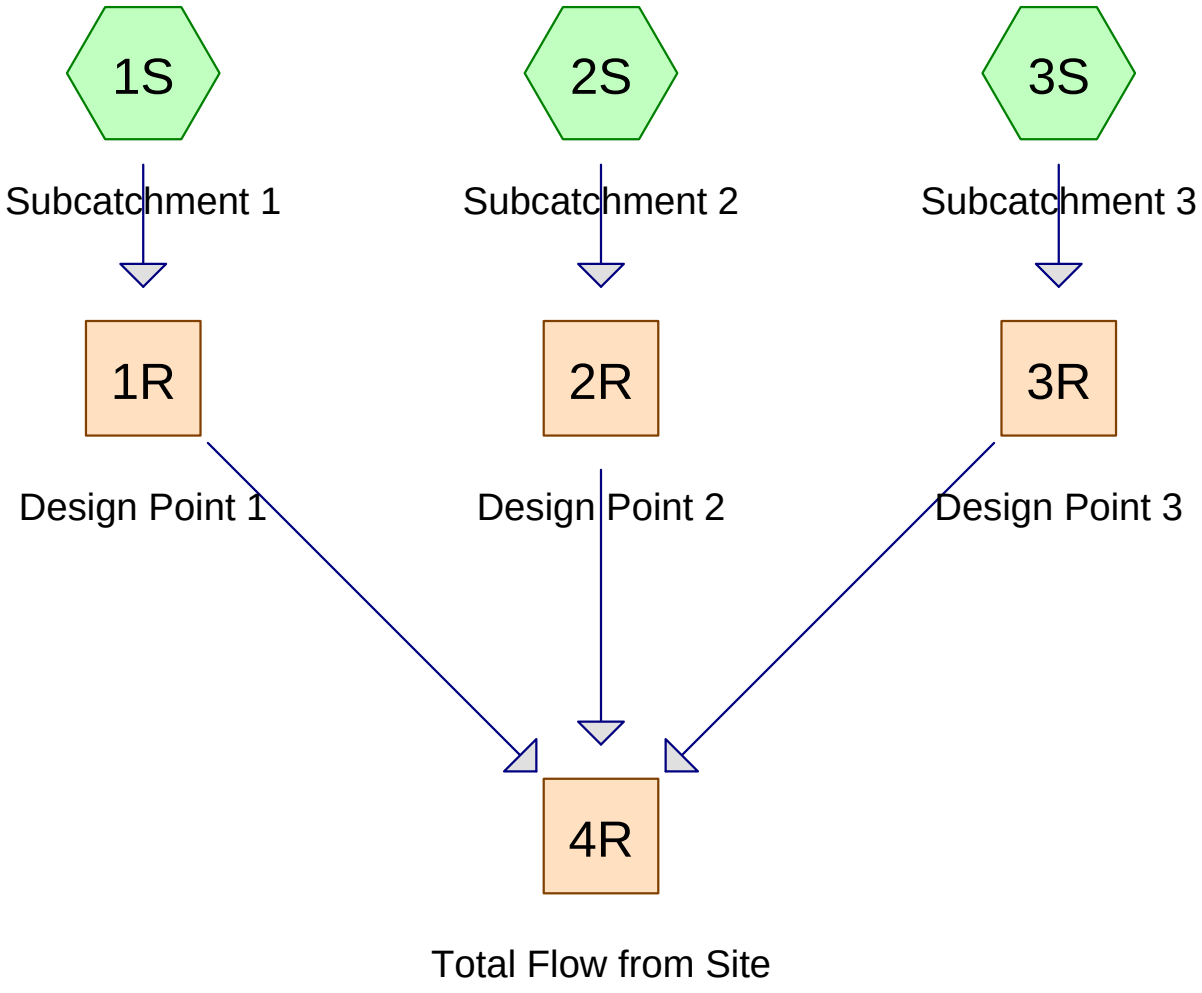
REV. No.	DESCRIPTION	DATE	STAMP

MILLBROOK
9 & 39 MEDFORD STREET
SOMERVILLE, MA

DATE: 10.7.13
SCALE: 1"=40'
DR. BY: WK
CHK. BY: WK
PROJECT No.: 2013-033

FIGURE 1 EXISTING CATCHMENT AREAS

Existing Hydrologic Calculations



Subcat Reach Pond Link

Drainage Diagram for EXISTING HYDROLOGY
Prepared by Design Consultants, Inc., Printed 10/7/2013
HydroCAD® 9.10 s/n 00884 © 2010 HydroCAD Software Solutions LLC

Time span=5.00-20.00 hrs, dt=0.01 hrs, 1501 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Subcatchment 1 Runoff Area=32,309 sf 95.41% Impervious Runoff Depth>2.59"
Tc=5.0 min CN=97 Runoff=2.27 cfs 0.160 af

Subcatchment 2S: Subcatchment 2 Runoff Area=10,966 sf 100.00% Impervious Runoff Depth>2.68"
Tc=5.0 min CN=98 Runoff=0.78 cfs 0.056 af

Subcatchment 3S: Subcatchment 3 Runoff Area=1,846 sf 90.14% Impervious Runoff Depth>2.59"
Tc=5.0 min CN=97 Runoff=0.13 cfs 0.009 af

Reach 1R: Design Point 1 Inflow=2.27 cfs 0.160 af
Outflow=2.27 cfs 0.160 af

Reach 2R: Design Point 2 Inflow=0.78 cfs 0.056 af
Outflow=0.78 cfs 0.056 af

Reach 3R: Design Point 3 Inflow=0.13 cfs 0.009 af
Outflow=0.13 cfs 0.009 af

Reach 4R: Total Flow from Site Inflow=3.19 cfs 0.226 af
Outflow=3.19 cfs 0.226 af

Summary for Subcatchment 1S: Subcatchment 1

Runoff = 2.27 cfs @ 12.07 hrs, Volume= 0.160 af, Depth> 2.59"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Yr Rainfall=3.10"

	Area (sf)	CN	Description
*	16,266	98	Roof Area
*	14,560	98	Pavement
	1,483	86	<50% Grass cover, Poor, HSG C
	32,309	97	Weighted Average
	1,483		4.59% Pervious Area
	30,826		95.41% Impervious Area

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

Summary for Subcatchment 2S: Subcatchment 2

Runoff = 0.78 cfs @ 12.07 hrs, Volume= 0.056 af, Depth> 2.68"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Yr Rainfall=3.10"

	Area (sf)	CN	Description
*	7,820	98	Roof Area
*	3,146	98	Pavement
	10,966	98	Weighted Average
	10,966		100.00% Impervious Area

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

Summary for Subcatchment 3S: Subcatchment 3

Runoff = 0.13 cfs @ 12.07 hrs, Volume= 0.009 af, Depth> 2.59"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Yr Rainfall=3.10"

	Area (sf)	CN	Description
*	1,664	98	Pavement
	182	86	<50% Grass cover, Poor, HSG C
	1,846	97	Weighted Average
	182		9.86% Pervious Area
	1,664		90.14% Impervious Area

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

Summary for Reach 1R: Design Point 1

Inflow Area = 0.742 ac, 95.41% Impervious, Inflow Depth > 2.59" for 2 Yr event
Inflow = 2.27 cfs @ 12.07 hrs, Volume= 0.160 af
Outflow = 2.27 cfs @ 12.07 hrs, Volume= 0.160 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs

Summary for Reach 2R: Design Point 2

Inflow Area = 0.252 ac,100.00% Impervious, Inflow Depth > 2.68" for 2 Yr event
Inflow = 0.78 cfs @ 12.07 hrs, Volume= 0.056 af
Outflow = 0.78 cfs @ 12.07 hrs, Volume= 0.056 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs

Summary for Reach 3R: Design Point 3

Inflow Area = 0.042 ac, 90.14% Impervious, Inflow Depth > 2.59" for 2 Yr event
Inflow = 0.13 cfs @ 12.07 hrs, Volume= 0.009 af
Outflow = 0.13 cfs @ 12.07 hrs, Volume= 0.009 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs

Summary for Reach 4R: Total Flow from Site

Inflow Area = 1.036 ac, 96.31% Impervious, Inflow Depth > 2.61" for 2 Yr event
Inflow = 3.19 cfs @ 12.07 hrs, Volume= 0.226 af
Outflow = 3.19 cfs @ 12.07 hrs, Volume= 0.226 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs

Time span=5.00-20.00 hrs, dt=0.01 hrs, 1501 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Subcatchment 1 Runoff Area=32,309 sf 95.41% Impervious Runoff Depth>3.88"
Tc=5.0 min CN=97 Runoff=3.35 cfs 0.240 af

Subcatchment 2S: Subcatchment 2 Runoff Area=10,966 sf 100.00% Impervious Runoff Depth>3.96"
Tc=5.0 min CN=98 Runoff=1.15 cfs 0.083 af

Subcatchment 3S: Subcatchment 3 Runoff Area=1,846 sf 90.14% Impervious Runoff Depth>3.88"
Tc=5.0 min CN=97 Runoff=0.19 cfs 0.014 af

Reach 1R: Design Point 1 Inflow=3.35 cfs 0.240 af
Outflow=3.35 cfs 0.240 af

Reach 2R: Design Point 2 Inflow=1.15 cfs 0.083 af
Outflow=1.15 cfs 0.083 af

Reach 3R: Design Point 3 Inflow=0.19 cfs 0.014 af
Outflow=0.19 cfs 0.014 af

Reach 4R: Total Flow from Site Inflow=4.69 cfs 0.337 af
Outflow=4.69 cfs 0.337 af

Summary for Subcatchment 1S: Subcatchment 1

Runoff = 3.35 cfs @ 12.07 hrs, Volume= 0.240 af, Depth> 3.88"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Yr Rainfall=4.50"

	Area (sf)	CN	Description
*	16,266	98	Roof Area
*	14,560	98	Pavement
	1,483	86	<50% Grass cover, Poor, HSG C
	32,309	97	Weighted Average
	1,483		4.59% Pervious Area
	30,826		95.41% Impervious Area

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

Summary for Subcatchment 2S: Subcatchment 2

Runoff = 1.15 cfs @ 12.07 hrs, Volume= 0.083 af, Depth> 3.96"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Yr Rainfall=4.50"

	Area (sf)	CN	Description
*	7,820	98	Roof Area
*	3,146	98	Pavement
	10,966	98	Weighted Average
	10,966		100.00% Impervious Area

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

Summary for Subcatchment 3S: Subcatchment 3

Runoff = 0.19 cfs @ 12.07 hrs, Volume= 0.014 af, Depth> 3.88"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Yr Rainfall=4.50"

	Area (sf)	CN	Description
*	1,664	98	Pavement
	182	86	<50% Grass cover, Poor, HSG C
	1,846	97	Weighted Average
	182		9.86% Pervious Area
	1,664		90.14% Impervious Area

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

Summary for Reach 1R: Design Point 1

Inflow Area = 0.742 ac, 95.41% Impervious, Inflow Depth > 3.88" for 10 Yr event
Inflow = 3.35 cfs @ 12.07 hrs, Volume= 0.240 af
Outflow = 3.35 cfs @ 12.07 hrs, Volume= 0.240 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs

Summary for Reach 2R: Design Point 2

Inflow Area = 0.252 ac,100.00% Impervious, Inflow Depth > 3.96" for 10 Yr event
Inflow = 1.15 cfs @ 12.07 hrs, Volume= 0.083 af
Outflow = 1.15 cfs @ 12.07 hrs, Volume= 0.083 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs

Summary for Reach 3R: Design Point 3

Inflow Area = 0.042 ac, 90.14% Impervious, Inflow Depth > 3.88" for 10 Yr event
Inflow = 0.19 cfs @ 12.07 hrs, Volume= 0.014 af
Outflow = 0.19 cfs @ 12.07 hrs, Volume= 0.014 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs

Summary for Reach 4R: Total Flow from Site

Inflow Area = 1.036 ac, 96.31% Impervious, Inflow Depth > 3.90" for 10 Yr event
Inflow = 4.69 cfs @ 12.07 hrs, Volume= 0.337 af
Outflow = 4.69 cfs @ 12.07 hrs, Volume= 0.337 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs

Time span=5.00-20.00 hrs, dt=0.01 hrs, 1501 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Subcatchment 1 Runoff Area=32,309 sf 95.41% Impervious Runoff Depth>4.61"
Tc=5.0 min CN=97 Runoff=3.96 cfs 0.285 af

Subcatchment 2S: Subcatchment 2 Runoff Area=10,966 sf 100.00% Impervious Runoff Depth>4.69"
Tc=5.0 min CN=98 Runoff=1.35 cfs 0.098 af

Subcatchment 3S: Subcatchment 3 Runoff Area=1,846 sf 90.14% Impervious Runoff Depth>4.61"
Tc=5.0 min CN=97 Runoff=0.23 cfs 0.016 af

Reach 1R: Design Point 1 Inflow=3.96 cfs 0.285 af
Outflow=3.96 cfs 0.285 af

Reach 2R: Design Point 2 Inflow=1.35 cfs 0.098 af
Outflow=1.35 cfs 0.098 af

Reach 3R: Design Point 3 Inflow=0.23 cfs 0.016 af
Outflow=0.23 cfs 0.016 af

Reach 4R: Total Flow from Site Inflow=5.54 cfs 0.400 af
Outflow=5.54 cfs 0.400 af

Summary for Subcatchment 1S: Subcatchment 1

Runoff = 3.96 cfs @ 12.07 hrs, Volume= 0.285 af, Depth> 4.61"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 Yr Rainfall=5.30"

	Area (sf)	CN	Description
*	16,266	98	Roof Area
*	14,560	98	Pavement
	1,483	86	<50% Grass cover, Poor, HSG C
	32,309	97	Weighted Average
	1,483		4.59% Pervious Area
	30,826		95.41% Impervious Area

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

Summary for Subcatchment 2S: Subcatchment 2

Runoff = 1.35 cfs @ 12.07 hrs, Volume= 0.098 af, Depth> 4.69"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 Yr Rainfall=5.30"

	Area (sf)	CN	Description
*	7,820	98	Roof Area
*	3,146	98	Pavement
	10,966	98	Weighted Average
	10,966		100.00% Impervious Area

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

Summary for Subcatchment 3S: Subcatchment 3

Runoff = 0.23 cfs @ 12.07 hrs, Volume= 0.016 af, Depth> 4.61"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 Yr Rainfall=5.30"

	Area (sf)	CN	Description
*	1,664	98	Pavement
	182	86	<50% Grass cover, Poor, HSG C
	1,846	97	Weighted Average
	182		9.86% Pervious Area
	1,664		90.14% Impervious Area

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

Summary for Reach 1R: Design Point 1

Inflow Area = 0.742 ac, 95.41% Impervious, Inflow Depth > 4.61" for 25 Yr event
Inflow = 3.96 cfs @ 12.07 hrs, Volume= 0.285 af
Outflow = 3.96 cfs @ 12.07 hrs, Volume= 0.285 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs

Summary for Reach 2R: Design Point 2

Inflow Area = 0.252 ac,100.00% Impervious, Inflow Depth > 4.69" for 25 Yr event
Inflow = 1.35 cfs @ 12.07 hrs, Volume= 0.098 af
Outflow = 1.35 cfs @ 12.07 hrs, Volume= 0.098 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs

Summary for Reach 3R: Design Point 3

Inflow Area = 0.042 ac, 90.14% Impervious, Inflow Depth > 4.61" for 25 Yr event
Inflow = 0.23 cfs @ 12.07 hrs, Volume= 0.016 af
Outflow = 0.23 cfs @ 12.07 hrs, Volume= 0.016 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs

Summary for Reach 4R: Total Flow from Site

Inflow Area = 1.036 ac, 96.31% Impervious, Inflow Depth > 4.63" for 25 Yr event
Inflow = 5.54 cfs @ 12.07 hrs, Volume= 0.400 af
Outflow = 5.54 cfs @ 12.07 hrs, Volume= 0.400 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs

Time span=5.00-20.00 hrs, dt=0.01 hrs, 1501 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Subcatchment 1 Runoff Area=32,309 sf 95.41% Impervious Runoff Depth>5.71"
Tc=5.0 min CN=97 Runoff=4.88 cfs 0.353 af

Subcatchment 2S: Subcatchment 2 Runoff Area=10,966 sf 100.00% Impervious Runoff Depth>5.78"
Tc=5.0 min CN=98 Runoff=1.66 cfs 0.121 af

Subcatchment 3S: Subcatchment 3 Runoff Area=1,846 sf 90.14% Impervious Runoff Depth>5.71"
Tc=5.0 min CN=97 Runoff=0.28 cfs 0.020 af

Reach 1R: Design Point 1 Inflow=4.88 cfs 0.353 af
Outflow=4.88 cfs 0.353 af

Reach 2R: Design Point 2 Inflow=1.66 cfs 0.121 af
Outflow=1.66 cfs 0.121 af

Reach 3R: Design Point 3 Inflow=0.28 cfs 0.020 af
Outflow=0.28 cfs 0.020 af

Reach 4R: Total Flow from Site Inflow=6.82 cfs 0.494 af
Outflow=6.82 cfs 0.494 af

Summary for Subcatchment 1S: Subcatchment 1

Runoff = 4.88 cfs @ 12.07 hrs, Volume= 0.353 af, Depth> 5.71"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Yr Rainfall=6.50"

	Area (sf)	CN	Description
*	16,266	98	Roof Area
*	14,560	98	Pavement
	1,483	86	<50% Grass cover, Poor, HSG C
	32,309	97	Weighted Average
	1,483		4.59% Pervious Area
	30,826		95.41% Impervious Area

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

Summary for Subcatchment 2S: Subcatchment 2

Runoff = 1.66 cfs @ 12.07 hrs, Volume= 0.121 af, Depth> 5.78"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Yr Rainfall=6.50"

	Area (sf)	CN	Description
*	7,820	98	Roof Area
*	3,146	98	Pavement
	10,966	98	Weighted Average
	10,966		100.00% Impervious Area

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

Summary for Subcatchment 3S: Subcatchment 3

Runoff = 0.28 cfs @ 12.07 hrs, Volume= 0.020 af, Depth> 5.71"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Yr Rainfall=6.50"

	Area (sf)	CN	Description
*	1,664	98	Pavement
	182	86	<50% Grass cover, Poor, HSG C
	1,846	97	Weighted Average
	182		9.86% Pervious Area
	1,664		90.14% Impervious Area

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

Summary for Reach 1R: Design Point 1

Inflow Area = 0.742 ac, 95.41% Impervious, Inflow Depth > 5.71" for 100 Yr event
Inflow = 4.88 cfs @ 12.07 hrs, Volume= 0.353 af
Outflow = 4.88 cfs @ 12.07 hrs, Volume= 0.353 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs

Summary for Reach 2R: Design Point 2

Inflow Area = 0.252 ac,100.00% Impervious, Inflow Depth > 5.78" for 100 Yr event
Inflow = 1.66 cfs @ 12.07 hrs, Volume= 0.121 af
Outflow = 1.66 cfs @ 12.07 hrs, Volume= 0.121 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs

Summary for Reach 3R: Design Point 3

Inflow Area = 0.042 ac, 90.14% Impervious, Inflow Depth > 5.71" for 100 Yr event
Inflow = 0.28 cfs @ 12.07 hrs, Volume= 0.020 af
Outflow = 0.28 cfs @ 12.07 hrs, Volume= 0.020 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs

Summary for Reach 4R: Total Flow from Site

Inflow Area = 1.036 ac, 96.31% Impervious, Inflow Depth > 5.73" for 100 Yr event
Inflow = 6.82 cfs @ 12.07 hrs, Volume= 0.494 af
Outflow = 6.82 cfs @ 12.07 hrs, Volume= 0.494 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs

FEMA Flood Insurance Rate Map

MAP SCALE 1" = 500'

250 0 500 1000

FEET

METER

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0577E

FIRM

FLOOD INSURANCE RATE MAP

MIDDLESEX COUNTY, MASSACHUSETTS
(ALL JURISDICTIONS)

PANEL 577 OF 656

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
CAMBRIDGE, CITY OF	250186	0577	E
SOMERVILLE, CITY OF	250214	0577	E

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
25017C0577E

EFFECTIVE DATE
JUNE 4, 2010

Federal Emergency Management Agency

Preliminary Subsurface Investigation and Existing Foundation Evaluation Report

Geotechnical Consultants, Inc.
(508)229-0900 FAX (508)229-2279

PRELIMINARY SUBSURFACE INVESTIGATION AND EXISTING FOUNDATION EVALUATION

MILLBROOK

9 Medford Street
Somerville, Massachusetts

for

Berkeley Investments, Inc.
121 High Street, 3rd Floor
Boston, Massachusetts

GEOTECHNICAL CONSULTANTS, INC.

Richard Pizzi, P.E.

GCI Project No. 2133577 **28 June 2013**

201 Boston Post Road West • Marlborough, Massachusetts 01752

Geotechnical Consultants, Inc.
(508)229-0900 FAX (508)229-2279

29 June 2013

Berkeley Investments, Inc.
121 High Street, 3rd Floor
Boston, MA 02110

Attention: Mr. Eric W. Ekman
Vice President, Development

RE: Preliminary Subsurface Investigation and Existing Foundation Evaluation
9 Medford Street - Somerville, Massachusetts
GCI Project No. 2133577

Dear Mr. Ekman:

In accordance with our proposal dated 17 April 2013, and your authorization to proceed, we have completed a preliminary subsurface investigation and evaluation of the existing building foundation. The purpose of the investigation was to determine the generalized subsurface conditions, use the information to evaluate both the existing foundation and provide preliminary recommendations for the design of the planned building modifications. As the investigation progressed, the scope of work was modified compared with our original proposal to accommodate the actual conditions and attain the requisite goal. Presented below and attached is a summary of our work along with our evaluation and recommendations.

Information used to prepare this report was obtained from several sources including:

- ALTA/ACSM Land Title Survey plan prepared by BL Companies dated 18 December 2000.
- Preliminary Architectural Layout drawings, sheets A101 through A103 prepared by Bergmann Hendrie +Archetype, Inc. with issue date of April 25, 2012.
- Preliminary “marked-up” copies of Structural Drawings prepared by Godlstein-Milano, LLC dated April 27, 2013.
- Report of Subsurface Investigation and Foundation Recommendations prepared for Public Storage, Inc. by Geotechnical Consultants, Inc. dated 19 February 2001.
- discussions with members of the project design and construction team.

201 Boston Post Road West • Marlborough, Massachusetts 01752

Site Location and Conditions

Located on the north side of Medford Street between the Twin City Mall to east and an existing CSX (Conrail) Railroad track in Somerville, Massachusetts, the subject site is nearly flat and level. The site is occupied by three existing Millbrook Cold Storage buildings including; the main seven-story storage building, an attached one-story building used for loading and distribution and a one-story building used to store mechanical equipment. Both the loading/distribution and one-story equipment buildings will be demolished as part of the planned development. No investigation of the foundation was undertaken on either of these buildings as part of this evaluation.

The main building was constructed in two phases between about 1916 and 1919 and both buildings are similarly constructed. At each floor, the round interior concrete columns have progressively smaller diameters moving from the basement up through the seventh floor. Each column has a conical column capital supporting the entablature with each of the supported floor slabs and roof constructed as two-way cast-in-place concrete slabs. Exterior walls are flat panel cast-in-place concrete with very few openings; mainly at the at the south stairway.

Surface grades at the exterior paved parking areas range between elevations 16± and 18± feet referenced to Mean Low Water Datum. Both main buildings are constructed with below-grade basements with the basement floor about seven to nine feet below grade. Portions of the concrete basement floor are covered with 1-inch thick clay brick pavers.

At the time of this investigation, the cold storage building was in the process of being decommissioned. Although some ice remained in parts of the building, the refrigeration equipment was no longer in service and significant quantities of ice-melt water was visible on most floors including the basement.

Proposed Development

Although the project is conceptual at this time, it is anticipated both the one-story loading/ distribution building and the one-story mechanical equipment building will be demolished. The main building will be modified and used for housing on floors one through seven. At the present roof level, a one story vertical addition will be constructed increasing the height to eight floors. The present basement level will be used for below grade parking with some limited storage space constructed for future tenants.

Based on our discussions, the change in use, including the additional of the eighth floor will reduce the combined vertical live loads and dead loads on the foundation compared with the previously imposed loading. However, the building will require the addition of a new lateral bracing system to resist seismic and wind loads. New bracing is anticipated to

be placed at the proposed elevator core and new stair towers planned for the building. Installation of new piles are anticipated to support the new lateral force resisting system.

Preliminary Boring Program
Three borings were made on the site as part of this preliminary investigation. The borings were done by Soil Exploration Corporation under the supervision and direction of Geotechnical Consultants, Inc. Each borehole was advanced using hollow-stem auger techniques to maintain an open and stable drill hole and sampling was done at each strata change and at five-foot intervals using a 2-inch diameter split-spoon sampler driven in accordance with ASTM D1586.

In January 2001, the site was investigated by Geotechnical Consultants, Inc. for the construction of a then-planned small office addition adjacent to the loading/distribution building. The office addition was part of a larger plan to re-purpose the property and buildings. Copies of both the recent boring logs and the 2001 logs (marked B-1(01) and B-2(01)) are appended for reference.

Based on the test boring information, the generalized subsurface profile at the site includes:

- **Urban Fill:** miscellaneous debris-laden granular fill soils containing various proportions of coarse to fine sand, inorganic silt, fine gravel, clay, cinders, brick and concrete;

- **Organic Silt & Peat:** organic silt and soft fibrous peat with trace amounts of fine sand and shell fragments;

- **Silty Sand:** natural layers of fine sand grading to coarse to fine sand containing varying proportions silt and layers and lenses of clay and minor proportions of fine gravel. This stratum is discontinuous and is not present at all borehole locations;

- **Boston Blue Clay**: clayey plastic silt containing occasional lens of sand;

- **Glacial Till:** a dense to very dense stratum of predominantly coarse to fine sand, silt and gravel;

- **Weather Bedrock/Cambridge Argillite:** gray argillite with minor proportions of quartzite.

The urban fill and organic deposits have a combined thickness ranging between 13± feet

and 21± feet and are underlain by marine deposits. The marine deposits include a discontinuous layer of typically medium to fine silty sand with varying proportions of coarse sand and minor proportions of fine gravel overlying, and at some locations interbedded with, the Boston Blue Clay. Only borehole B-1 (13) was carried through the marine deposits.

The clay is underlain by a thin layer of glacial till overlying weathered bedrock. Based on our knowledge of the local geology the underlying bedrock consists of Cambridge Argillite. Only boring B-1 was drilled to sufficient depth to determine the elevation of the bedrock. Highly weathered Argillite was encountered at depths between 48 and 58 feet below ground surface. Called "refusal" was encountered at 58 feet bgs and we presume indicative of the elevation of the sound bedrock surface. Additional borings which include the recovery of rock cores will be required to confirm the elevation of the sound bedrock.

Based on the short duration measurements made in each of the recent boreholes, the groundwater level was observed at about nine feet below present exterior ground surface. We understand an environmental site assessment is being conducted by others which includes the installation of several groundwater monitoring wells and longer duration measurements of the groundwater levels.

Test Pit Excavation

Historically in the greater Boston area, timber piles have been used for the support of buildings since the mid 1800s. In fact, although still used, timber piles were the predominant deep foundation system in the Greater Boston area for buildings requiring deep foundations until the 1950s. Given the presence of the relatively deep urban fill and organic soils extending below the present basement level of the main building, it was presumed the 1916 era main building was founded on timber piles.

Prior to the 1940s, most timber piles installed in the Greater Boston area were untreated leaving the piles subject to decay as a result of continuous wetting and drying due to varying groundwater levels. For many buildings which remain in service, the decayed portions of the timber piles at the top have been removed and underpinned to the preserve the foundation of these older buildings. In order to evaluate the condition of the timber piles, a portion of the existing basement slab was removed and soil excavated to expose some of the piles supporting the main building.

Since the current plans will require the basement slab to be removed at the planned elevator core during construction, the test excavation to expose the timber piles was made at the proposed elevator. The location of the proposed elevator core is shown on the preliminary architectural floor plan, drawing A101 prepared by Bergmann Hendrie

+Archetype, Inc. Details of the conditions encountered in the test excavation are summarized below and several photographs are appended.

EVALUATION OF EXISTING FOUNDATION

Two cores were removed from the basement floor slab by others. At both cores locations, the slab was reported to be 16-inches thick and reinforcement was present in both cores. Additionally, two small diameter holes were made by others through the basement slab for the purpose of subslab soil gas sampling. At both of the hole locations (SV-1 and SV-3) the basement slab was reported to be 2'-11" thick and groundwater rose within the drill holes to 14" below top of slab indicating there is no unsaturated zone below the slab.

The core taken from B-line between column lines 1 and 2 was returned to our laboratory for inspection and testing. The core sample was free of significant defects and the concrete was well consolidated. Reinforcing steel was found in the bottom third of the 16-inch long sample. Although coarse stone aggregate was present throughout the sample, the top 2± inches contained only limited coarse aggregate; indicating the concrete was likely placed at a relatively high slump. The compressive strength of the concrete core was determined in accordance with ASTM C42 *Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.* The test results showed the concrete strength of the core was 3,310 psi.

At the test excavation, the mat is approximately 16-inches thick with a single layer of reinforcement in both directions. Concrete was removed from the test excavation area using pneumatic hammers. We observed the concrete to be dense and well consolidated with no significant corrosion of the reinforcing steel.

Observations made in the test excavation in the basement at the proposed elevator confirm the main building is supported on untreated timber piles. The basement floor is a pile supported reinforced concrete mat; apparently with varying thickness. Temporary dewatering was required to allow excavation of soil to expose the tops of the timber piles due groundwater that was found slightly above the bottom of the slab level.

Three timber piles were exposed within the excavation and all three timber piles were completely submerged below the groundwater table. We observed no decay at the tops of the exposed timber piles and found these piles to be in excellent condition. Since the groundwater has been confirmed to be at least to the level of the bottom of the slab, we anticipate the condition of the timber piles observed in the test excavation to be representative of the condition of other timber piles supporting the main building. No further investigation of the timber piles are warranted at this time.

PRELIMINARY RECOMMENDATIONS FOR NEW FOUNDATIONS

Due to the planned change in use and significant structural modifications required to re-purpose the main building, the building lateral force resisting system must be capable of resisting seismic lateral loads consistent with the current building code. It is anticipated a new braced frame or shear walls will be constructed in the proposed elevator shaft and at other locations within the existing main building. Foundation supporting the new LFRS must be supported on deep foundations.

Micropiles

We recommend new foundations be supported on micropiles due to the limited overhead clearance available for installation at the basement. For heavily loaded foundations, high capacity micropiles can be constructed with rock sockets in sound bedrock can develop both high compression and tension capacities. Rock-socketed micropiles are generally limited by their structural capacity of the composite cased, grouted and core bar sections. Provided permanent casing is installed to the top of sound bedrock and the full length core bar extends into the rock socket, micropile design capacities in the range of 125 to 240 tons in compression and up to 90 tons in tension can be attained.

Only boring B-1(13) was drilled to sufficient depth to determine the elevation of the bedrock. Highly weathered Argillite was encountered at depths between 48 and 58 feet below ground surface. Called "refusal" was encountered at 58 feet bgs and, for the purpose of preliminary planning, we assume indicates the top of sound bedrock. Additional borings which include recovery of rock cores must be done to provide adequate information for detailed design of high capacity micropiles.

New foundations requiring lower load capacity can be supported on micropiles at shallower depths. Lower capacity micropiles installed with casing through the fill and organic soils can be designed and constructed as friction units bearing in the top of the marine deposits. We recommend low capacity micropiles be limited to a design compression capacity of 40 tons.

As the design development progresses and more detailed subsurface information is obtained, recommendations for detailed design and installation specifications can be provided for both high capacity and lower capacity micropiles.

Seismic Site Classification

Earthquake loadings must be considered under requirements of Section 1613 of the *Massachusetts State Building Code*. In addition, the liquefaction potential of the underlying soils must be evaluated in accordance with Section 1806.4 of the Massachusetts Code *Amendments*. Site classifications are based on the average density

and strength, and hence the ability of the soil to transmit shear waves during a seismic event. The average density and strength of material, both soil and rock, within 100 feet below the building must be considered. The site classification is then used to determine the site coefficient and mapped spectral response for a given structure.

The response to earthquake loading is controlled by the characteristics of the marine deposits beneath the building. Although some additional testing of the marine deposits may be required during final design, we recommend the following site class be used for preliminary design at this time:

Site Class D: stiff soil profile.

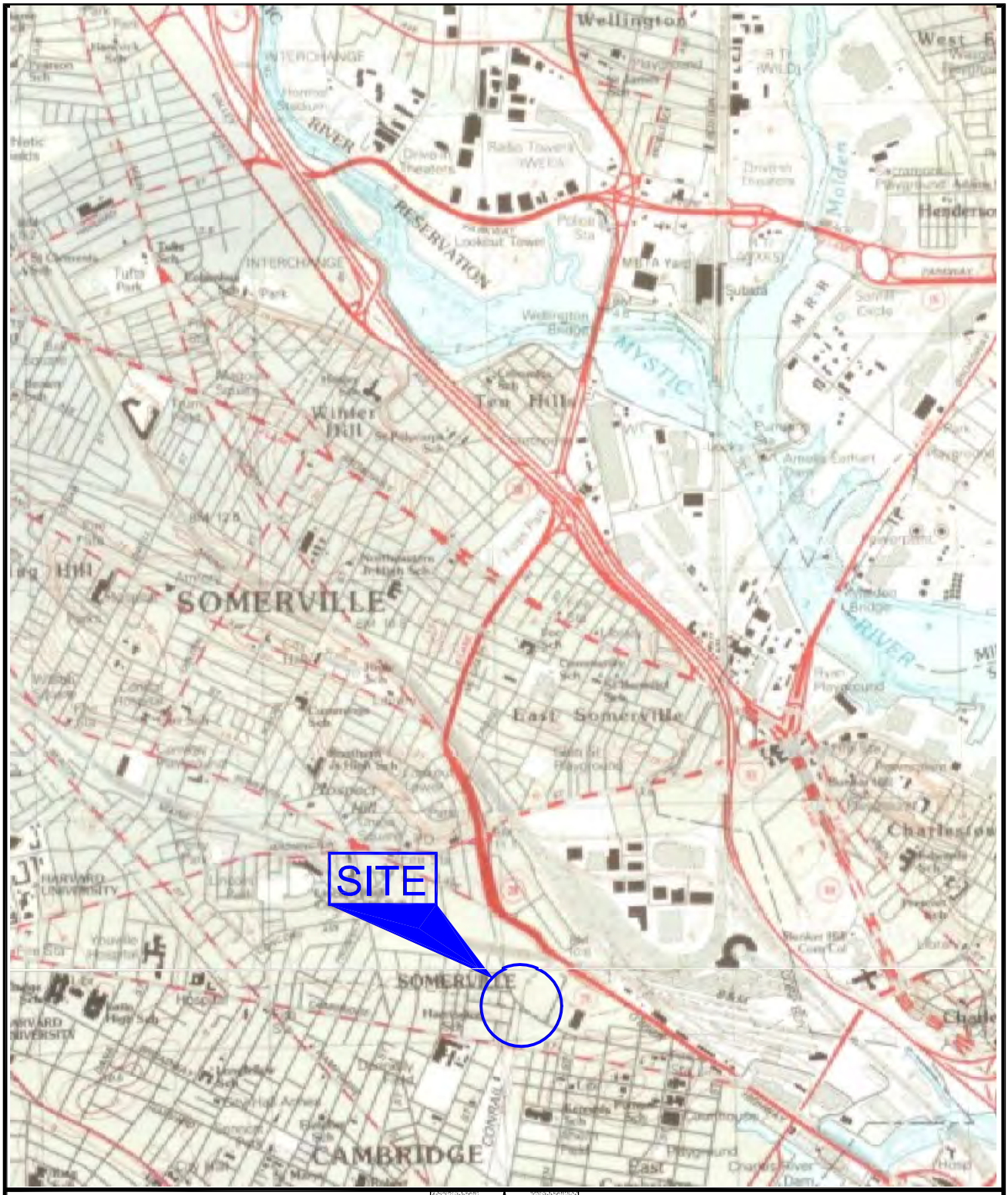
Liquefaction refers to the loss of strength in saturated cohesionless soils due to the build up of pore water pressures during cyclic seismic loading. Based on the limited subsurface information available at this time, the soils beneath the building are not liquefaction susceptible.

It has been our pleasure serving you and we trust that the foregoing and attached are sufficient for your immediate needs. Should you have any questions, or need further assistance, please do not hesitate to contact this office.

Sincerely,
GEOTECHNICAL CONSULTANTS, INC.

Richard Pizzi, P.E.
RP/prr

Attachments



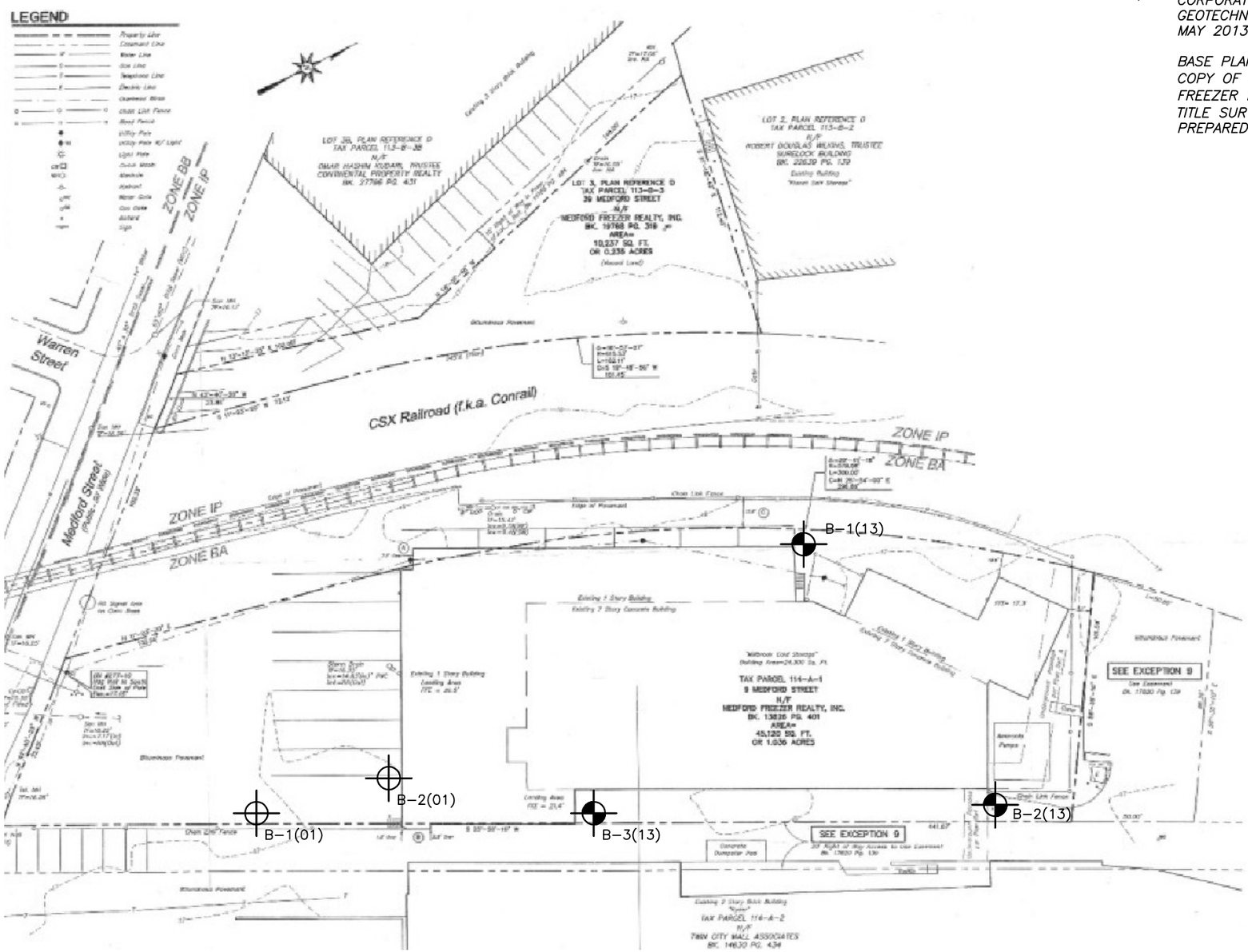
9 Medford Street
Somerville, Massachusetts

LOCUS PLAN
U.S.G.S. QUADRANGLE
Boston South/North
APPROX. SCALE 1:25 000

Geotechnical Consultants, Inc.
201 Boston Post Road West
Marlborough, MA 01752
(508)229-0900 FAX (508)229-2279

GCI Project # 2133577

Figure 1.



LEGEND

APPROXIMATE LOCATIONS OF TEST BORINGS DONE BY SOIL EXPLORATION CORPORATION UNDER THE DIRECTION OF GEOTECHNICAL CONSULTANTS, INC. ON 17 JANUARY 2001

APPROXIMATE LOCATIONS OF TEST BORINGS DONE BY SOIL EXPLORATION CORPORATION UNDER THE DIRECTION OF GEOTECHNICAL CONSULTANTS, INC. ON 17 MAY 2013

BASE PLAN WAS TAKEN FROM A SCANNED COPY OF A DRAWING ENTITLED "MEDFORD FREEZER REALITY INC. ALTA/ACSM LAND TITLE SURVEY" DATED 27 NOVEMBER 2000 PREPARED BY BL COMPANIES.

GCI Project No. 2133577

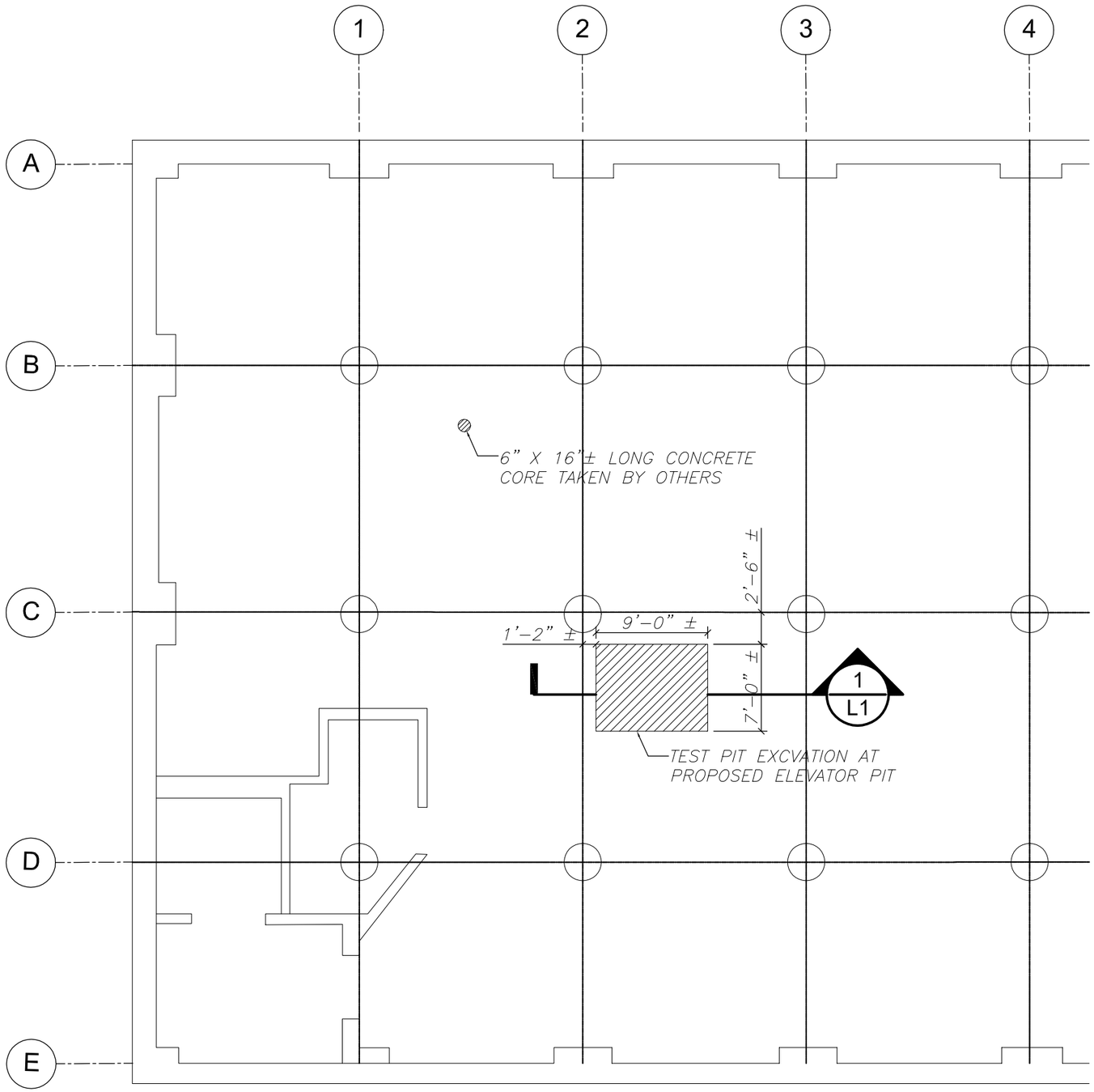
Geotechnical Consultants, Inc.
201 Boston Post Road West
Marlborough, MA 01752
(508)229-0900 FAX (508)229-2279

LOCATION PLAN

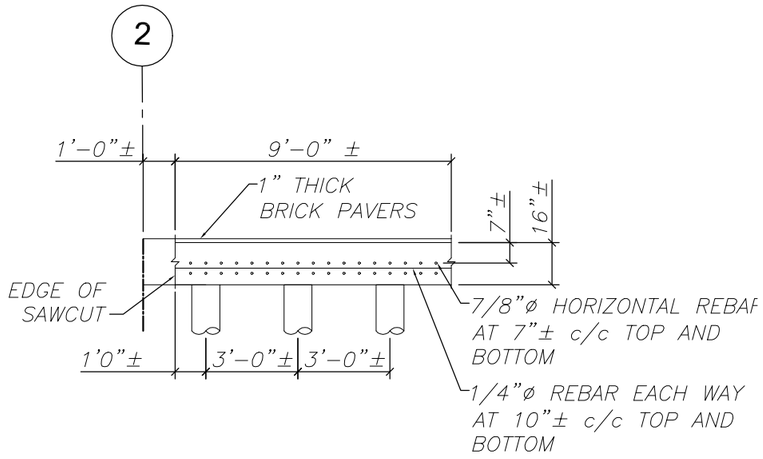
(feet) 0 25 50

2 July 2013

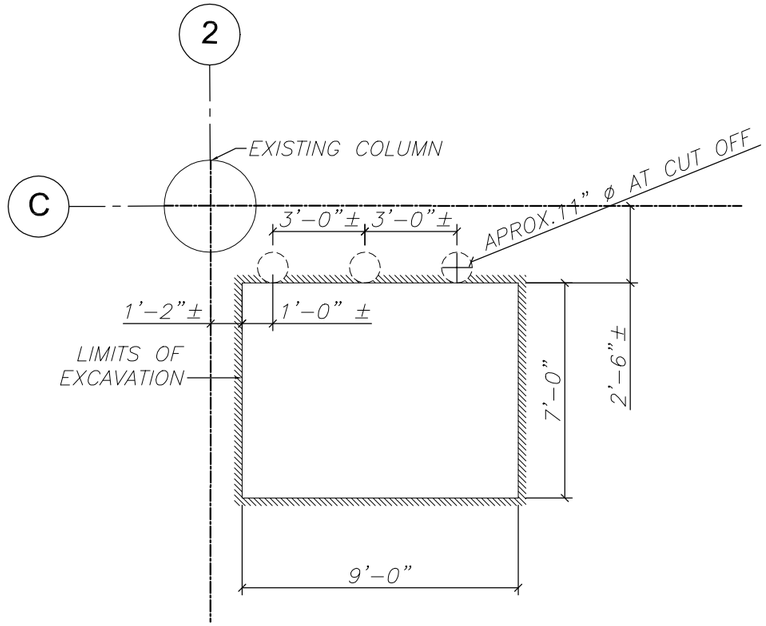
9 Medford Street
Somerville, Massachusetts



OVERALL PLAN VIEW
1" = 10'-0"



SECTION OF EXCAVATION
1" = 5'-0"



PLAN OF EXCAVATION
1" = 5'-0"

GCI Project No. 2133577

Geotechnical Consultants, Inc.
201 Boston Post Road West
Marlborough, MA 01752
(508)229-0900 FAX (508)229-2279

LOCATION PLAN

(feet) 0 5 10

20 June 2013

9 Medford Street
Somerville, Massachusetts

Photograph 1- Existing pile supported basement slab.

Photograph 2 – Exposed top of timber pile supporting slab

2001 & 2013 Boring Logs

TEST BORING LOG

SHEET 1of 1

Geotechnical Consultants, Inc.
201 Boston Post Road West
Marlborough, MA 01752
508 229-0900 FAX 978 840-0391

Proposed Public Storage Building
9 Medford Street
Somerville, Massachusetts

BORING B-1

PROJECT NO. 2011744

Ground Elevation: 17.0 +/-
Date Started: January 17, 2001
Date Finished: January 17, 2001
Driller: TF
Soil Engineer/Geologist: ESC

GROUNDWATER OBSERVATIONS			
DATE	DEPTH	CASING	STABILIZATION

Depth Ft.	Casing bl/ft	Sample No.	Pen/Rec	Sample Depth	Blows/6"	Strata	Visual Identification of Soil and / or Rock Sample
						0'5"	Asphalt-0'5"
1		1		1'0"-3'0"	10-10-8-13		FILL: Black, medium dense, dry, fine to coarse SAND, some fine to coarse gravel, trace inorganic silt, cinders, brick, concrete.
						3'6"	
5		2		5'0"-7'0"	7-8-7-10		FILL: Brown/grey, dense, wet, inorganic SILT, little coarse to fine sand, trace clay, brick, concrete.
						8'6"	
10		3		10'0"-12'0"	2-2-2-3		Dark grey, wet,organic SILT, some soft peat, trace fine sand, trace shells.
15		4		15'0"-17'0"	3-2-3-3		
						18'0"	
20		5		20'0"-22'0"	7-8-10-10		Grey, medium dense, wet, fine SAND, some inorganic silt, trace coarse to medium sand.
25		6		25'0"-27'0"	10-15-17-16	25'0"	Grey, dense, wet, coarse to fine SAND, some inorganic silt, trace fine gravel, trace clay.
30		7		30'0"-32'0"	9-18-18-22		
35		8		35'0"-37'0"	13-17-22-25		
						37'0"	
39							End of boring at 37'0" with hollow stem auger. Water level at 5'0 upon completion.

Notes: Hollow Stem Auger Size - 4-1/4"

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)		S/S	
HAMMER WGT (LB)		140 Lb.	
HAMMER FALL (IN)		30"	

TEST BORING LOG

SHEET 1 of 1

Geotechnical Consultants, Inc.
201 Boston Post Road West
Marlborough, MA 01752
508 229-0900 FAX 978 840-0391

Proposed Public Storage Building
9 Medford Street
Somerville, Massachusetts

BORING B-2

PROJECT NO. 2011744

Ground Elevation: 17.0 +/-
Date Started: January 17, 2001
Date Finished: January 17, 2001
Driller: TF
Soil Engineer/Geologist: ESC

GROUNDWATER OBSERVATIONS

DATE	DEPTH	CASING	STABILIZATION

Depth Ft.	Casing bl/ft	Sample No.	Sample Pen/Rec	Sample Depth	Blows/6"	Strata	Visual Identification of Soil and / or Rock Sample
						0'5"	Asphalt-0'5"
1		1		1'0"-3'0"	4-6-6-11		FILL: Black medium dense to loose, dry to wet, fine to coarse SAND, some fine to coarse gravel, trace inorganic silt, cinders, brick, concrete.
5		2		5'0"-7'0"	5-5-4-3		
						8'6"	
10		3		10'0"-12'0"	1-1-1-1		Dark grey, wet,organic SILT, some soft peat, trace fine sand, trace shells.
15		4		15'0"-17'0"	2-2-2-3		
						17'6"	
20		5		20'0"-22'0"	8-10-8-11		Grey, medium dense, wet, coarse to fine SAND, some inorganic silt, trace fine gravel.
25		6		25'0"-27'0"	12-17-21-26	25'0"	Grey, dense, wet, fine SAND, some inorganic silt, trace coarse to medium sand, trace clay.
30		7		30'0"-32'0"	13-14-19-23		
						32'0"	End of boring at 32'0" with hollow stem auger. Water level at 5'0 upon completion.
35							
39							

Notes: Hollow Stem Auger Size - 4-1/4"

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)		S/S	
HAMMER WGT (LB)		140 Lb.	
HAMMER FALL (IN)		30"	

TEST BORING LOG

SHEET 1

Soil Exploration Corp.
Geotechnical Drilling
Groundwater Monitor Well
148 Pioneer Drive
Leominster, MA 01453
978 840-0391

Geotechnical Consultants

Site: 9 Medford Street

Somerville, MA

BORING B-1

PROJECT NO. 13-0506

DATE: May 9, 2013

Ground Elevation:
Date Started: May 7, 2013
Date Finished: May 7, 2013
Driller: GG
Soil Engineer/Geologist:

GROUNDWATER OBSERVATIONS			
DATE	DEPTH	CASING	STABILIZATION

Depth Ft.	Casing bl/ft	Sample No.	Pen/Rec	Sample Depth	Blows/6"	Strata	Visual Identification of Soil and / or Rock Sample
						6"	Asphalt.
1		1		6"-2'6"	4-5-5-5		
5		2		5'0"-7'0"	3-3-3-2		Medium dense to loose, dry to moist, coal cinders, fine to coarse sand, medium fill.
						8'0"	
10		3		10'0"-12'0"	WOH		Soft, wet organics.
						13'0"	
15		4		15'0"-16'0"	7-13		
		4A		16'0"-17'0"	5-4		Medium dense, wet, fine to coarse sand.
						16'0"	
20		5		20'0"-22'0"	3-6-9-12		
25		6		25'0"-27'0"	2-2-3-3		
							Stiff to soft, blue clay.
30		7		30'0"-32'0"	WOH		
35		8		35'0"-37'0"	WOH		
39						39'0"	

(Continued to Sheet 2)

Notes: Hollow Stem Auger Size - 4-1/4"

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

SHEET 2

Soil Exploration Corp.
Geotechnical Drilling
Groundwater Monitor Well
148 Pioneer Drive
Leominster, MA 01453
978 840-0391

Geotechnical Consultants

Site: 9 Medford Street

Somerville, MA

BORING B-1 (continued)

PROJECT NO. 13-0506

DATE: May 9, 2013

Ground Elevation:
Date Started: May 7, 2013
Date Finished: May 7, 2013
Driller: GG
Soil Engineer/Geologist:

GROUNDWATER OBSERVATIONS			
DATE	DEPTH	CASING	STABILIZATION

Depth Ft.	Casing bl/ft	Sample No.	Pen/Rec	Sample Depth	Blows/6"	Strata	Visual Identification of Soil and / or Rock Sample
40		9		40'0"-42'0"	18-7-7-13		Medium dense, wet, fine to coarse sand and gravel.
45		10		45'0"-47'0"	8-8-9-13		
						48'0"	
50		11		50'0"-52'0"	10-14-20-20		Very dense, wet, weathered rock.
55		12		55'0"-55'11"	35-100/5"		
						58'0"	
60							End of boring at 58'0". Refusal with hollow stem augers. Water encountered at 9'0" upon completion.
65							
70							
75							
79							

Notes: Hollow Stem Auger Size - 4-1/4"

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

SHEET 2

Soil Exploration Corp.
Geotechnical Drilling
Groundwater Monitor Well
148 Pioneer Drive
Leominster, MA 01453
978 840-0391

Geotechnical Consultants

Site: 9 Medford Street

Somerville, MA

BORING B-2

PROJECT NO. 13-0506

DATE: May 9, 2013

Ground Elevation:
Date Started: May 7, 2013
Date Finished: May 7, 2013
Driller: GG
Soil Engineer/Geologist:

GROUNDWATER OBSERVATIONS			
DATE	DEPTH	CASING	STABILIZATION

Depth Ft.	Casing bl/ft	Sample No.	Pen/Rec	Sample Depth	Blows/6"	Strata	Visual Identification of Soil and / or Rock Sample
1		1		6"-2'6"	3-5-5-5	6"	Asphalt.
5		2		5'0"-7'0"	3-5-6-4		Medium dense, dry to wet, fine to coarse sand and gravel, brick, metal, wood, etc., medium fill.
10		3		10'0"-12'0"	2-5-6-4		
15		4		15'0"-17'0"	WOH	13'0"	Soft, wet organics.
20		5 5A		20'0"-21'0" 21'0"-22'0"	WOH 5-4	21'0"	
25		6		25'0"-27'0"	2-3-4-5		Medium stiff to soft, wet blue clay.
30		7		30'0"-32'0"	WOH	32'0"	
35							End of boring at 32'0". Water encountered at 9'0" upon completion.
39							

Notes: Hollow Stem Auger Size - 4-1/4"

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

SHEET 3

Soil Exploration Corp.
Geotechnical Drilling
Groundwater Monitor Well
148 Pioneer Drive
Leominster, MA 01453
978 840-0391

Geotechnical Consultants

Site: 9 Medford Street

Somerville, MA

BORING B-3

PROJECT NO. 13-0506

DATE: May 9, 2013

Ground Elevation:
Date Started: May 7, 2013
Date Finished: May 7, 2013
Driller: GG
Soil Engineer/Geologist:

GROUNDWATER OBSERVATIONS			
DATE	DEPTH	CASING	STABILIZATION

Depth Ft.	Casing bl/ft	Sample No.	Pen/Rec	Sample Depth	Blows/6"	Strata	Visual Identification of Soil and / or Rock Sample
1		1		6"-2'6"	2-2-5-3	6"	Asphalt.
5		2		5'0"-7'0"	3-3-3-5		Loose, dry to wet, fine to coarse sand, wood, brick, metal, etc., medium fill.
10		3		10'0"-12'0"	2-3-3-3		
15		4		15'0"-17'0"	1-1-1-1	13'0"	Soft, wet organics.
20		5		20'0"-22'0"	3-3-5-5	19'0"	Medium stiff, wet blue clay.
25						22'0"	End of boring at 22'0". Water encountered at 9'0" upon completion.
30							
35							
39							

Notes: Hollow Stem Auger Size - 4-1/4"

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"	

Concrete Core Test Results

GEOTECHNICAL CONSULTANTS, INC.

201 BOSTON POST ROAD WEST
MARLBOROUGH, MA 01752

GCI Testing
Telephone: (508)229-0900
FAX: (508)229-2279

CONCRETE INSPECTION REPORT

Berkeley Investments, Inc.
121 High Street
Boston MA 02110

Job No: 2133577
Project: 9 Medford Street
Location: Somerville MA
Series ID#: 12776

TARGET STRENGTH: **CONCRETE SUPPLIER:** **ASTM:** Concrete- C-39, C-143, C-231
Grout- C-1019 Mortar- C-109
Drilled Cores - C-42

SAMPLES: 1 **SLUMP:**

LOCATION:
Core @ Basement Slab
Between Column Lines 1 & 2 - Along B Line

AIR TEMP: F **CONC TEMP:** F

AIR CONTENT: % **TRUCK NO.**

TIME CAST:

LAB NO.	SIZE	AREA (SQ.IN.)	DATE CAST	DATE TESTED	AGE DAYS	STRENGTH (PSI)	TYPE OF FRACTURE	REMARKS
54929	Other	24.35	6/18/2013	7/2/2013	14	3310		

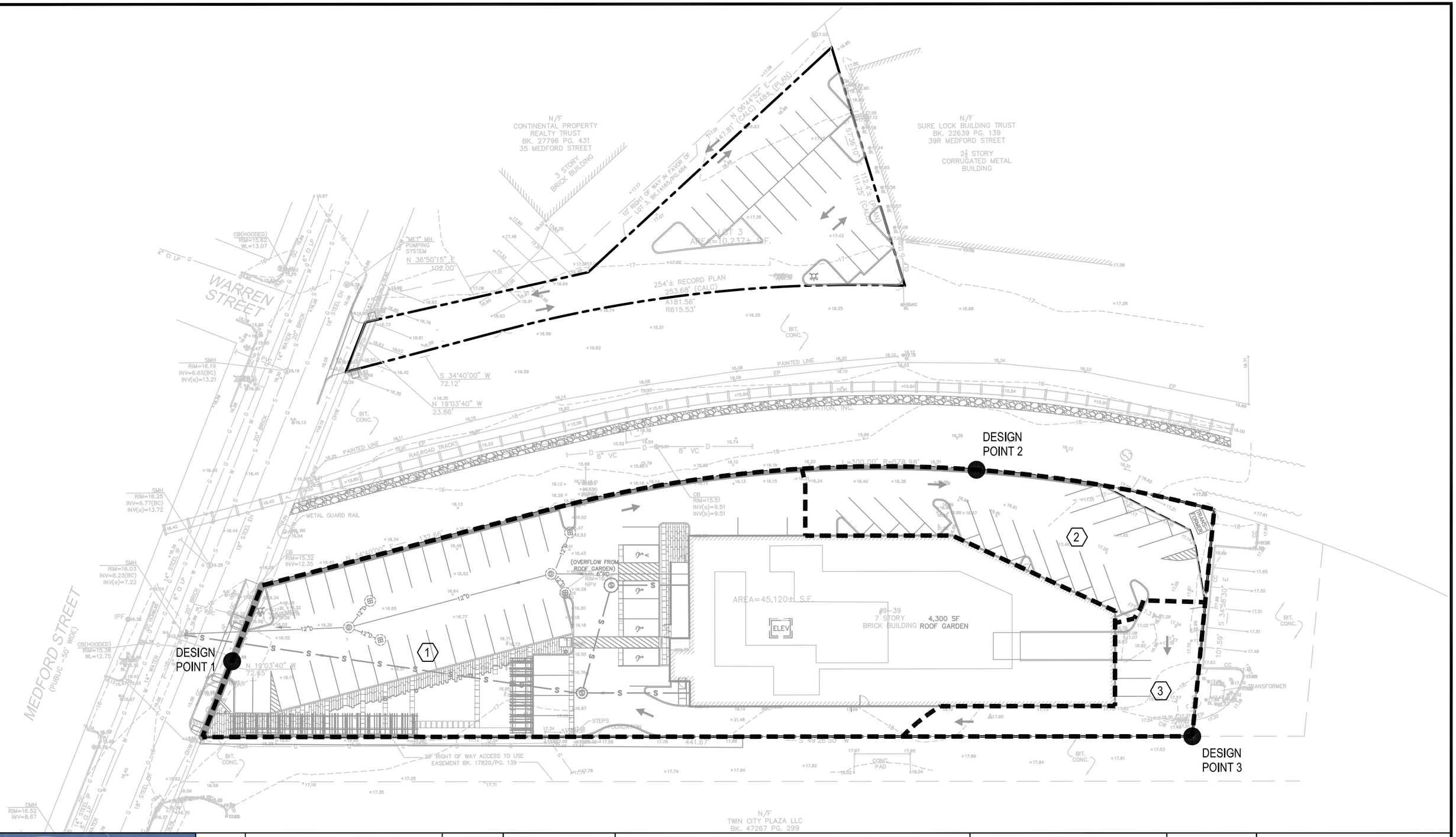
REMARKS:
Date cast = date retrieved

GEOTECHNICAL CONSULTANTS, INC.

INSPECTED BY:

REVIEWED BY: Paul Sousa

Figure 2 – Proposed Catchment Areas



Design Consultants, Inc.
CIVIL ENGINEERS and LAND SURVEYORS
120 Middlesex Avenue, Suite 20
Somerville, MA 02145
617-776-3350p 617-776-7710f

REV. No.	DESCRIPTION	DATE

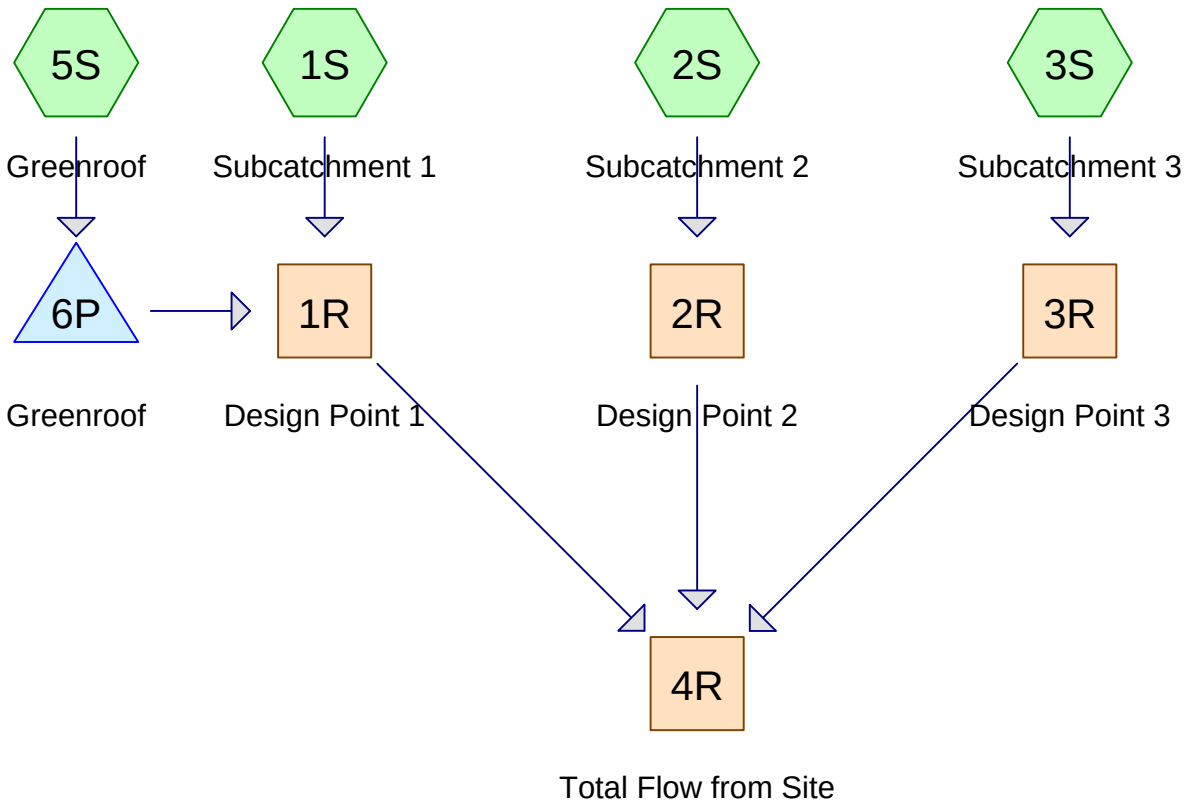
STAMP

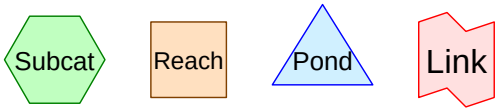
MILLBROOK
9 & 39 MEDFORD STREET
SOMERVILLE, MA

DATE: 10.7.13
SCALE: 1"=40'
DR. BY: WK
CHK. BY: WK
PROJECT No.: 2013-033

FIGURE 2 PROPOSED CATCHMENT AREAS

Proposed Hydrologic Calculations





Drainage Diagram for PROPOSED HYDROLOGY
Prepared by Design Consultants, Inc., Printed 10/7/2013
HydroCAD® 9.10 s/n 00884 © 2010 HydroCAD Software Solutions LLC

Time span=5.00-20.00 hrs, dt=0.01 hrs, 1501 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Subcatchment 1 Runoff Area=30,215 sf 88.70% Impervious Runoff Depth>2.50"
Tc=5.0 min CN=96 Runoff=2.08 cfs 0.145 af

Subcatchment 2S: Subcatchment 2 Runoff Area=7,213 sf 88.78% Impervious Runoff Depth>2.50"
Tc=5.0 min CN=96 Runoff=0.50 cfs 0.035 af

Subcatchment 3S: Subcatchment 3 Runoff Area=3,341 sf 98.32% Impervious Runoff Depth>2.68"
Tc=5.0 min CN=98 Runoff=0.24 cfs 0.017 af

Subcatchment 5S: Greenroof Runoff Area=4,352 sf 0.00% Impervious Runoff Depth>1.01"
Tc=77.0 min CN=77 Runoff=0.04 cfs 0.008 af

Reach 1R: Design Point 1 Inflow=2.08 cfs 0.145 af
Outflow=2.08 cfs 0.145 af

Reach 2R: Design Point 2 Inflow=0.50 cfs 0.035 af
Outflow=0.50 cfs 0.035 af

Reach 3R: Design Point 3 Inflow=0.24 cfs 0.017 af
Outflow=0.24 cfs 0.017 af

Reach 4R: Total Flow from Site Inflow=2.82 cfs 0.196 af
Outflow=2.82 cfs 0.196 af

Pond 6P: Greenroof Peak Elev=0.17' Storage=0.008 af Inflow=0.04 cfs 0.008 af
Outflow=0.00 cfs 0.000 af

Summary for Subcatchment 1S: Subcatchment 1

Runoff = 2.08 cfs @ 12.07 hrs, Volume= 0.145 af, Depth> 2.50"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Yr Rainfall=3.10"

	Area (sf)	CN	Description
*	9,335	98	Roof Area
*	17,465	98	Pavement
	1,588	87	Dirt roads, HSG C
	1,827	79	50-75% Grass cover, Fair, HSG C
	30,215	96	Weighted Average
	3,415		11.30% Pervious Area
	26,800		88.70% Impervious Area

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

Summary for Subcatchment 2S: Subcatchment 2

Runoff = 0.50 cfs @ 12.07 hrs, Volume= 0.035 af, Depth> 2.50"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Yr Rainfall=3.10"

	Area (sf)	CN	Description
*	6,404	98	Pavement
	809	79	50-75% Grass cover, Fair, HSG C
	7,213	96	Weighted Average
	809		11.22% Pervious Area
	6,404		88.78% Impervious Area

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

Summary for Subcatchment 3S: Subcatchment 3

Runoff = 0.24 cfs @ 12.07 hrs, Volume= 0.017 af, Depth> 2.68"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Yr Rainfall=3.10"

	Area (sf)	CN	Description
*	3,285	98	Pavement
	56	79	50-75% Grass cover, Fair, HSG C
	3,341	98	Weighted Average
	56		1.68% Pervious Area
	3,285		98.32% Impervious Area

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

Summary for Subcatchment 5S: Greenroof

Runoff = 0.04 cfs @ 13.09 hrs, Volume= 0.008 af, Depth> 1.01"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Yr Rainfall=3.10"

	Area (sf)	CN	Description
*	4,352	77	CN for Greenroof based on UNH CN methodology for porous pavement
	4,352		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
77.0					**Direct Entry, Proportional tc based on UNH methodology for Po**

Summary for Reach 1R: Design Point 1

Inflow Area = 0.794 ac, 77.53% Impervious, Inflow Depth > 2.19" for 2 Yr event
Inflow = 2.08 cfs @ 12.07 hrs, Volume= 0.145 af
Outflow = 2.08 cfs @ 12.07 hrs, Volume= 0.145 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs

Summary for Reach 2R: Design Point 2

Inflow Area = 0.166 ac, 88.78% Impervious, Inflow Depth > 2.50" for 2 Yr event
Inflow = 0.50 cfs @ 12.07 hrs, Volume= 0.035 af
Outflow = 0.50 cfs @ 12.07 hrs, Volume= 0.035 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs

Summary for Reach 3R: Design Point 3

Inflow Area = 0.077 ac, 98.32% Impervious, Inflow Depth > 2.68" for 2 Yr event
Inflow = 0.24 cfs @ 12.07 hrs, Volume= 0.017 af
Outflow = 0.24 cfs @ 12.07 hrs, Volume= 0.017 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs

Summary for Reach 4R: Total Flow from Site

Inflow Area = 1.036 ac, 80.87% Impervious, Inflow Depth > 2.27" for 2 Yr event
Inflow = 2.82 cfs @ 12.07 hrs, Volume= 0.196 af
Outflow = 2.82 cfs @ 12.07 hrs, Volume= 0.196 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs

Summary for Pond 6P: Greenroof

Inflow Area = 0.100 ac, 0.00% Impervious, Inflow Depth > 1.01" for 2 Yr event
Inflow = 0.04 cfs @ 13.09 hrs, Volume= 0.008 af
Outflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Peak Elev= 0.17' @ 20.00 hrs Surf.Area= 0.100 ac Storage= 0.008 af

Plug-Flow detention time= (not calculated: initial storage excedes outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.016 af	**43.52'W x 100.00'L x 0.33'H Prismatoid** 0.033 af Overall x 50.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.33'	**6.0" Horiz. Orifice/Grate X 4.00** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=0.00' (Free Discharge)
1=Orifice/Grate (Controls 0.00 cfs)

Time span=5.00-20.00 hrs, dt=0.01 hrs, 1501 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Subcatchment 1 Runoff Area=30,215 sf 88.70% Impervious Runoff Depth>3.79"
Tc=5.0 min CN=96 Runoff=3.10 cfs 0.219 af

Subcatchment 2S: Subcatchment 2 Runoff Area=7,213 sf 88.78% Impervious Runoff Depth>3.79"
Tc=5.0 min CN=96 Runoff=0.74 cfs 0.052 af

Subcatchment 3S: Subcatchment 3 Runoff Area=3,341 sf 98.32% Impervious Runoff Depth>3.96"
Tc=5.0 min CN=98 Runoff=0.35 cfs 0.025 af

Subcatchment 5S: Greenroof Runoff Area=4,352 sf 0.00% Impervious Runoff Depth>1.99"
Tc=77.0 min CN=77 Runoff=0.09 cfs 0.017 af

Reach 1R: Design Point 1 Inflow=3.10 cfs 0.219 af
Outflow=3.10 cfs 0.219 af

Reach 2R: Design Point 2 Inflow=0.74 cfs 0.052 af
Outflow=0.74 cfs 0.052 af

Reach 3R: Design Point 3 Inflow=0.35 cfs 0.025 af
Outflow=0.35 cfs 0.025 af

Reach 4R: Total Flow from Site Inflow=4.19 cfs 0.297 af
Outflow=4.19 cfs 0.297 af

Pond 6P: Greenroof Peak Elev=0.34' Storage=0.016 af Inflow=0.09 cfs 0.017 af
Outflow=0.01 cfs 0.000 af

Summary for Subcatchment 1S: Subcatchment 1

Runoff = 3.10 cfs @ 12.07 hrs, Volume= 0.219 af, Depth> 3.79"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Yr Rainfall=4.50"

	Area (sf)	CN	Description
*	9,335	98	Roof Area
*	17,465	98	Pavement
	1,588	87	Dirt roads, HSG C
	1,827	79	50-75% Grass cover, Fair, HSG C
	30,215	96	Weighted Average
	3,415		11.30% Pervious Area
	26,800		88.70% Impervious Area

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

Summary for Subcatchment 2S: Subcatchment 2

Runoff = 0.74 cfs @ 12.07 hrs, Volume= 0.052 af, Depth> 3.79"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Yr Rainfall=4.50"

	Area (sf)	CN	Description
*	6,404	98	Pavement
	809	79	50-75% Grass cover, Fair, HSG C
	7,213	96	Weighted Average
	809		11.22% Pervious Area
	6,404		88.78% Impervious Area

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

Summary for Subcatchment 3S: Subcatchment 3

Runoff = 0.35 cfs @ 12.07 hrs, Volume= 0.025 af, Depth> 3.96"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Yr Rainfall=4.50"

	Area (sf)	CN	Description
*	3,285	98	Pavement
	56	79	50-75% Grass cover, Fair, HSG C
	3,341	98	Weighted Average
	56		1.68% Pervious Area
	3,285		98.32% Impervious Area

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

Summary for Subcatchment 5S: Greenroof

Runoff = 0.09 cfs @ 13.09 hrs, Volume= 0.017 af, Depth> 1.99"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Yr Rainfall=4.50"

	Area (sf)	CN	Description
*	4,352	77	CN for Greenroof based on UNH CN methodology for porous pavement
	4,352		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
77.0					**Direct Entry, Proportional tc based on UNH methodology for Po**

Summary for Reach 1R: Design Point 1

Inflow Area = 0.794 ac, 77.53% Impervious, Inflow Depth > 3.32" for 10 Yr event
Inflow = 3.10 cfs @ 12.07 hrs, Volume= 0.219 af
Outflow = 3.10 cfs @ 12.07 hrs, Volume= 0.219 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs

Summary for Reach 2R: Design Point 2

Inflow Area = 0.166 ac, 88.78% Impervious, Inflow Depth > 3.79" for 10 Yr event
Inflow = 0.74 cfs @ 12.07 hrs, Volume= 0.052 af
Outflow = 0.74 cfs @ 12.07 hrs, Volume= 0.052 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs

Summary for Reach 3R: Design Point 3

Inflow Area = 0.077 ac, 98.32% Impervious, Inflow Depth > 3.96" for 10 Yr event
Inflow = 0.35 cfs @ 12.07 hrs, Volume= 0.025 af
Outflow = 0.35 cfs @ 12.07 hrs, Volume= 0.025 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs

Summary for Reach 4R: Total Flow from Site

Inflow Area = 1.036 ac, 80.87% Impervious, Inflow Depth > 3.44" for 10 Yr event
Inflow = 4.19 cfs @ 12.07 hrs, Volume= 0.297 af
Outflow = 4.19 cfs @ 12.07 hrs, Volume= 0.297 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs

Summary for Pond 6P: Greenroof

Inflow Area = 0.100 ac, 0.00% Impervious, Inflow Depth > 1.99" for 10 Yr event
Inflow = 0.09 cfs @ 13.09 hrs, Volume= 0.017 af
Outflow = 0.01 cfs @ 19.75 hrs, Volume= 0.000 af, Atten= 89%, Lag= 399.8 min
Primary = 0.01 cfs @ 19.75 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Peak Elev= 0.34' @ 19.75 hrs Surf.Area= 0.100 ac Storage= 0.016 af

Plug-Flow detention time= 567.6 min calculated for 0.000 af (1% of inflow)
Center-of-Mass det. time= 339.8 min (1,192.3 - 852.4)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.016 af	**43.52'W x 100.00'L x 0.33'H Prismatoid** 0.033 af Overall x 50.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.33'	**6.0" Horiz. Orifice/Grate X 4.00** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.01 cfs @ 19.75 hrs HW=0.34' (Free Discharge)
1=Orifice/Grate (Weir Controls 0.01 cfs @ 0.25 fps)

Time span=5.00-20.00 hrs, dt=0.01 hrs, 1501 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Subcatchment 1 Runoff Area=30,215 sf 88.70% Impervious Runoff Depth>4.53"
Tc=5.0 min CN=96 Runoff=3.67 cfs 0.262 af

Subcatchment 2S: Subcatchment 2 Runoff Area=7,213 sf 88.78% Impervious Runoff Depth>4.53"
Tc=5.0 min CN=96 Runoff=0.88 cfs 0.062 af

Subcatchment 3S: Subcatchment 3 Runoff Area=3,341 sf 98.32% Impervious Runoff Depth>4.69"
Tc=5.0 min CN=98 Runoff=0.41 cfs 0.030 af

Subcatchment 5S: Greenroof Runoff Area=4,352 sf 0.00% Impervious Runoff Depth>2.61"
Tc=77.0 min CN=77 Runoff=0.11 cfs 0.022 af

Reach 1R: Design Point 1 Inflow=3.67 cfs 0.267 af
Outflow=3.67 cfs 0.267 af

Reach 2R: Design Point 2 Inflow=0.88 cfs 0.062 af
Outflow=0.88 cfs 0.062 af

Reach 3R: Design Point 3 Inflow=0.41 cfs 0.030 af
Outflow=0.41 cfs 0.030 af

Reach 4R: Total Flow from Site Inflow=4.96 cfs 0.359 af
Outflow=4.96 cfs 0.359 af

Pond 6P: Greenroof Peak Elev=0.35' Storage=0.016 af Inflow=0.11 cfs 0.022 af
Outflow=0.05 cfs 0.005 af

Summary for Subcatchment 1S: Subcatchment 1

Runoff = 3.67 cfs @ 12.07 hrs, Volume= 0.262 af, Depth> 4.53"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 Yr Rainfall=5.30"

	Area (sf)	CN	Description
*	9,335	98	Roof Area
*	17,465	98	Pavement
	1,588	87	Dirt roads, HSG C
	1,827	79	50-75% Grass cover, Fair, HSG C
	30,215	96	Weighted Average
	3,415		11.30% Pervious Area
	26,800		88.70% Impervious Area

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

Summary for Subcatchment 2S: Subcatchment 2

Runoff = 0.88 cfs @ 12.07 hrs, Volume= 0.062 af, Depth> 4.53"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 Yr Rainfall=5.30"

	Area (sf)	CN	Description
*	6,404	98	Pavement
	809	79	50-75% Grass cover, Fair, HSG C
	7,213	96	Weighted Average
	809		11.22% Pervious Area
	6,404		88.78% Impervious Area

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

Summary for Subcatchment 3S: Subcatchment 3

Runoff = 0.41 cfs @ 12.07 hrs, Volume= 0.030 af, Depth> 4.69"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 Yr Rainfall=5.30"

	Area (sf)	CN	Description
*	3,285	98	Pavement
	56	79	50-75% Grass cover, Fair, HSG C
	3,341	98	Weighted Average
	56		1.68% Pervious Area
	3,285		98.32% Impervious Area

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

Summary for Subcatchment 5S: Greenroof

Runoff = 0.11 cfs @ 13.08 hrs, Volume= 0.022 af, Depth> 2.61"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 Yr Rainfall=5.30"

	Area (sf)	CN	Description
*	4,352	77	CN for Greenroof based on UNH CN methodology for porous pavement
	4,352		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
77.0					**Direct Entry, Proportional tc based on UNH methodology for Po**

Summary for Reach 1R: Design Point 1

Inflow Area = 0.794 ac, 77.53% Impervious, Inflow Depth > 4.04" for 25 Yr event
Inflow = 3.67 cfs @ 12.07 hrs, Volume= 0.267 af
Outflow = 3.67 cfs @ 12.07 hrs, Volume= 0.267 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs

Summary for Reach 2R: Design Point 2

Inflow Area = 0.166 ac, 88.78% Impervious, Inflow Depth > 4.53" for 25 Yr event
Inflow = 0.88 cfs @ 12.07 hrs, Volume= 0.062 af
Outflow = 0.88 cfs @ 12.07 hrs, Volume= 0.062 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs

Summary for Reach 3R: Design Point 3

Inflow Area = 0.077 ac, 98.32% Impervious, Inflow Depth > 4.69" for 25 Yr event
Inflow = 0.41 cfs @ 12.07 hrs, Volume= 0.030 af
Outflow = 0.41 cfs @ 12.07 hrs, Volume= 0.030 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs

Summary for Reach 4R: Total Flow from Site

Inflow Area = 1.036 ac, 80.87% Impervious, Inflow Depth > 4.16" for 25 Yr event
Inflow = 4.96 cfs @ 12.07 hrs, Volume= 0.359 af
Outflow = 4.96 cfs @ 12.07 hrs, Volume= 0.359 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs

Summary for Pond 6P: Greenroof

Inflow Area = 0.100 ac, 0.00% Impervious, Inflow Depth > 2.61" for 25 Yr event
Inflow = 0.11 cfs @ 13.08 hrs, Volume= 0.022 af
Outflow = 0.05 cfs @ 15.02 hrs, Volume= 0.005 af, Atten= 55%, Lag= 116.3 min
Primary = 0.05 cfs @ 15.02 hrs, Volume= 0.005 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Peak Elev= 0.35' @ 15.02 hrs Surf.Area= 0.100 ac Storage= 0.016 af

Plug-Flow detention time= 279.3 min calculated for 0.005 af (24% of inflow)
Center-of-Mass det. time= 169.1 min (1,015.9 - 846.8)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.016 af	**43.52'W x 100.00'L x 0.33'H Prismatoid** 0.033 af Overall x 50.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.33'	**6.0" Horiz. Orifice/Grate X 4.00** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.05 cfs @ 15.02 hrs HW=0.35' (Free Discharge)
1=Orifice/Grate (Weir Controls 0.05 cfs @ 0.44 fps)

Time span=5.00-20.00 hrs, dt=0.01 hrs, 1501 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Subcatchment 1 Runoff Area=30,215 sf 88.70% Impervious Runoff Depth>5.63"
Tc=5.0 min CN=96 Runoff=4.53 cfs 0.325 af

Subcatchment 2S: Subcatchment 2 Runoff Area=7,213 sf 88.78% Impervious Runoff Depth>5.63"
Tc=5.0 min CN=96 Runoff=1.08 cfs 0.078 af

Subcatchment 3S: Subcatchment 3 Runoff Area=3,341 sf 98.32% Impervious Runoff Depth>5.78"
Tc=5.0 min CN=98 Runoff=0.51 cfs 0.037 af

Subcatchment 5S: Greenroof Runoff Area=4,352 sf 0.00% Impervious Runoff Depth>3.58"
Tc=77.0 min CN=77 Runoff=0.15 cfs 0.030 af

Reach 1R: Design Point 1 Inflow=4.53 cfs 0.339 af
Outflow=4.53 cfs 0.339 af

Reach 2R: Design Point 2 Inflow=1.08 cfs 0.078 af
Outflow=1.08 cfs 0.078 af

Reach 3R: Design Point 3 Inflow=0.51 cfs 0.037 af
Outflow=0.51 cfs 0.037 af

Reach 4R: Total Flow from Site Inflow=6.12 cfs 0.453 af
Outflow=6.12 cfs 0.453 af

Pond 6P: Greenroof Peak Elev=0.37' Storage=0.016 af Inflow=0.15 cfs 0.030 af
Outflow=0.18 cfs 0.013 af

Summary for Subcatchment 1S: Subcatchment 1

Runoff = 4.53 cfs @ 12.07 hrs, Volume= 0.325 af, Depth> 5.63"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Yr Rainfall=6.50"

	Area (sf)	CN	Description
*	9,335	98	Roof Area
*	17,465	98	Pavement
	1,588	87	Dirt roads, HSG C
	1,827	79	50-75% Grass cover, Fair, HSG C
	30,215	96	Weighted Average
	3,415		11.30% Pervious Area
	26,800		88.70% Impervious Area

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

Summary for Subcatchment 2S: Subcatchment 2

Runoff = 1.08 cfs @ 12.07 hrs, Volume= 0.078 af, Depth> 5.63"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Yr Rainfall=6.50"

	Area (sf)	CN	Description
*	6,404	98	Pavement
	809	79	50-75% Grass cover, Fair, HSG C
	7,213	96	Weighted Average
	809		11.22% Pervious Area
	6,404		88.78% Impervious Area

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

Summary for Subcatchment 3S: Subcatchment 3

Runoff = 0.51 cfs @ 12.07 hrs, Volume= 0.037 af, Depth> 5.78"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Yr Rainfall=6.50"

	Area (sf)	CN	Description
*	3,285	98	Pavement
	56	79	50-75% Grass cover, Fair, HSG C
	3,341	98	Weighted Average
	56		1.68% Pervious Area
	3,285		98.32% Impervious Area

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

Summary for Subcatchment 5S: Greenroof

Runoff = 0.15 cfs @ 13.01 hrs, Volume= 0.030 af, Depth> 3.58"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Yr Rainfall=6.50"

	Area (sf)	CN	Description
*	4,352	77	CN for Greenroof based on UNH CN methodology for porous pavement
	4,352		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
77.0					**Direct Entry, Proportional tc based on UNH methodology for Po**

Summary for Reach 1R: Design Point 1

Inflow Area = 0.794 ac, 77.53% Impervious, Inflow Depth > 5.12" for 100 Yr event
Inflow = 4.53 cfs @ 12.07 hrs, Volume= 0.339 af
Outflow = 4.53 cfs @ 12.07 hrs, Volume= 0.339 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs

Summary for Reach 2R: Design Point 2

Inflow Area = 0.166 ac, 88.78% Impervious, Inflow Depth > 5.63" for 100 Yr event
Inflow = 1.08 cfs @ 12.07 hrs, Volume= 0.078 af
Outflow = 1.08 cfs @ 12.07 hrs, Volume= 0.078 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs

Summary for Reach 3R: Design Point 3

Inflow Area = 0.077 ac, 98.32% Impervious, Inflow Depth > 5.78" for 100 Yr event
Inflow = 0.51 cfs @ 12.07 hrs, Volume= 0.037 af
Outflow = 0.51 cfs @ 12.07 hrs, Volume= 0.037 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs

Summary for Reach 4R: Total Flow from Site

Inflow Area = 1.036 ac, 80.87% Impervious, Inflow Depth > 5.25" for 100 Yr event
Inflow = 6.12 cfs @ 12.07 hrs, Volume= 0.453 af
Outflow = 6.12 cfs @ 12.07 hrs, Volume= 0.453 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs

Summary for Pond 6P: Greenroof

Inflow Area = 0.100 ac, 0.00% Impervious, Inflow Depth > 3.58" for 100 Yr event
Inflow = 0.15 cfs @ 13.01 hrs, Volume= 0.030 af
Outflow = 0.18 cfs @ 13.65 hrs, Volume= 0.013 af, Atten= 0%, Lag= 38.2 min
Primary = 0.18 cfs @ 13.65 hrs, Volume= 0.013 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Peak Elev= 0.37' @ 13.65 hrs Surf.Area= 0.100 ac Storage= 0.016 af

Plug-Flow detention time= 182.9 min calculated for 0.013 af (45% of inflow)
Center-of-Mass det. time= 95.3 min (935.3 - 840.0)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.016 af	**43.52'W x 100.00'L x 0.33'H Prismatoid** 0.033 af Overall x 50.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	0.33'	**6.0" Horiz. Orifice/Grate X 4.00** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.18 cfs @ 13.65 hrs HW=0.37' (Free Discharge)
1=Orifice/Grate (Weir Controls 0.18 cfs @ 0.67 fps)