

STORMWATER MANAGEMENT REPORT
51 TECHNOLOGY PARK ROAD
STURBRIDGE, MASSACHUSETTS
September 5, 2019

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Project Number:
G-565
Sturbridge, Massachusetts

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DRAINAGE NARRATIVE

Design Methods and Objectives

The following drainage analysis has been prepared in accordance with the most current rules and regulations of the Town of Sturbridge, Massachusetts. Watershed areas were calculated for both the pre-development and post-development conditions. Existing and proposed ground cover conditions as well as terrain slopes were evaluated. Based upon the increased peak runoff from pre-development to the post development, storm water management systems were designed to attenuate the post development peak flows and runoff to be less than or equal to the pre-development rates of runoff. These calculations were performed using Hydrocad Stormwater Modeling Software for determining peak runoff and sizing detention/infiltration facilities for the 2, 10, 25 and 100 year storm event frequencies. Runoff hydrographs are calculated using the SCS Runoff equation and the SCS unitless hydrograph.

Existing Site Conditions

The existing site conditions were analyzed to determine tributary site runoff areas, flow patterns, space including wooded areas, as well as existing soil types. The drainage area that was analyzed includes the site at 51 Technology Park Road to be developed. The existing study area includes wooded area. The total tributary drainage area is 3.50 acres. The existing slopes on site range from 5-30%. The site currently drains to the north.

Existing soils located on site were determined to be Chatfield-Hollis-Rock outcrop complex, Paxton fine sandy loam and Woodbridge fine sandy loam. Chatfield-Hollis-Rock outcrop complex is classified as Hydrologic Group C and has a drainage class rating of “well drained”. Paxton is classified as Hydrologic Group C and has a drainage class rating of “well drained”. Woodbridge is classified as Hydrologic Group C and has a drainage class rating of “moderately well drained”.

Proposed Site Conditions

In the post development condition, the property is proposed to be developed with a 10,000 sq.ft. industrial building, parking area and stormwater management facilities. The total impervious area in the post development condition is 1.03 acres. The total percentage of impervious area in the post development condition is 36.2%. The remaining portion of the site not developed is to remain in the existing condition.

The proposed site drainage is separated into five subcatchment drainage areas. These subcatchments are physically separate in the post development condition through the use of a sediment forebays, grass channels and an infiltration basin. These methods are used in order to reduce peak runoff rates and treat runoff from redeveloped paved areas in order to meet TSS removal requirements.

“Subcatchment P1” includes the southern parking area and adjacent lawn. The runoff from paved areas is directed via sediment forebay 1 and a grass channel into the infiltration basin. The infiltration basin provides 80% TSS removal.

“Subcatchment P2” includes the northern parking area and adjacent lawn. The runoff from paved areas is directed via sediment forebay 2 and a grass channel into the infiltration basin. The infiltration basin provides 80% TSS removal.

“Subcatchment P3” includes the proposed building. This clean runoff is directed into the infiltration basin to reduce peak rates of runoff.

“Subcatchment P4” includes lawn area directly tributary to the infiltration basin.

“Subcatchment P5” includes undetained lawn and woods. This clean runoff is flows to the north as it does in the existing condition.

The proposed drainage design for this redevelopment meets or exceeds all requirements by the Town of Sturbridge and the Department of Environmental Protection. As the calculations demonstrate the proposed drainage design provides attenuation of peak rates of runoff and improves the quality of site runoff that flows toward offsite areas and by achieving a minimum of 80% TSS removal for new paved areas.

Drainage Analysis Summary

Pre-Development Drainage Reach (1R) – Existing Conditions Runoff to North (E1)

Post-Development Drainage Reach (1R) – Combined Post Development Runoff to North (P1, P2, P3, P4, P5)

Note: (Peak Flow Rate in cfs)

	<u>2 Year</u>	<u>10 Year</u>	<u>25 Year</u>	<u>100 Year</u>
Storm Intensity	3.0 inches	4.5 inches	5.3 inches	6.5 inches
Pre-Development (E1)	2.85	6.11	8.00	10.90
Pre-Development (1R) To North	2.85	6.11	8.00	10.90
Post-Development (P1, P2, P3, P4 Routed Through Basin)	0.70	2.74	3.92	6.25
Post-Development (P5)	1.27	2.73	3.57	4.86
Post-Development (1R) To North	1.27	4.81	6.93	10.44
Reduction From Pre-Development to Post-Development	-1.58	-1.30	-1.07	-0.46

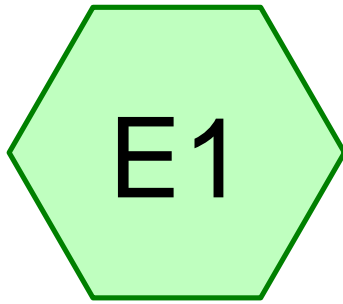


LOCUS PLAN

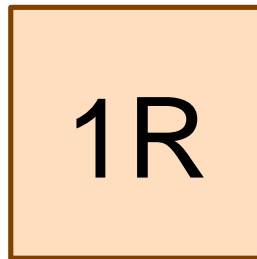
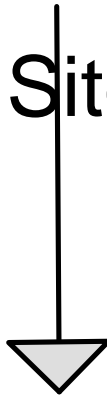
Source: USGS Quadrangles for
East Brookfield, MA
7.5 x 15 minute series (metric)
Scale: 1:25,000 or 1" = 2083.33'

51 Technology Park Road
Sturbridge, Massachusetts

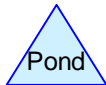
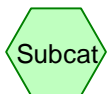
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Existing Site Runoff



North Property Line



Routing Diagram for G-565-PRE

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G-565-PRE

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.080	98	Ledge (E1)
3.420	77	Woods, Poor, HSG C (E1)
3.500	77	TOTAL AREA

G-565-PRE

Type III 24-hr 2-YR Rainfall=3.00"

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Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment E1: Existing Site Runoff

Runoff Area=3.500 ac 2.29% Impervious Runoff Depth>0.98"
Flow Length=517' Tc=19.6 min CN=77 Runoff=2.85 cfs 0.284 af

Reach 1R: North Property Line

Inflow=2.85 cfs 0.284 af
Outflow=2.85 cfs 0.284 af

Total Runoff Area = 3.500 ac Runoff Volume = 0.284 af Average Runoff Depth = 0.98"
97.71% Pervious = 3.420 ac 2.29% Impervious = 0.080 ac

Summary for Subcatchment E1: Existing Site Runoff

Runoff = 2.85 cfs @ 12.29 hrs, Volume= 0.284 af, Depth> 0.98"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Type III 24-hr 2-YR Rainfall=3.00"

Area (ac)	CN	Description
* 0.080	98	Ledge
3.420	77	Woods, Poor, HSG C
3.500	77	Weighted Average
3.420		97.71% Pervious Area
0.080		2.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.8	50	0.0300	0.08		Sheet Flow, Segment 1
					Woods: Light underbrush n= 0.400 P2= 3.00"
8.8	467	0.0310	0.88		Shallow Concentrated Flow, Segment 2
					Woodland Kv= 5.0 fps
19.6	517	Total			

Summary for Reach 1R: North Property Line

Inflow Area = 3.500 ac, 2.29% Impervious, Inflow Depth > 0.98" for 2-YR event

Inflow = 2.85 cfs @ 12.29 hrs, Volume= 0.284 af

Outflow = 2.85 cfs @ 12.29 hrs, Volume= 0.284 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

G-565-PRE

Type III 24-hr 10-YR Rainfall=4.50"

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Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment E1: Existing Site Runoff

Runoff Area=3.500 ac 2.29% Impervious Runoff Depth>2.04"
Flow Length=517' Tc=19.6 min CN=77 Runoff=6.11 cfs 0.595 af

Reach 1R: North Property Line

Inflow=6.11 cfs 0.595 af
Outflow=6.11 cfs 0.595 af

Total Runoff Area = 3.500 ac Runoff Volume = 0.595 af Average Runoff Depth = 2.04"
97.71% Pervious = 3.420 ac 2.29% Impervious = 0.080 ac

Summary for Subcatchment E1: Existing Site Runoff

Runoff = 6.11 cfs @ 12.28 hrs, Volume= 0.595 af, Depth> 2.04"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-YR Rainfall=4.50"

Area (ac)	CN	Description
* 0.080	98	Ledge
3.420	77	Woods, Poor, HSG C
3.500	77	Weighted Average
3.420		97.71% Pervious Area
0.080		2.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.8	50	0.0300	0.08		Sheet Flow, Segment 1
					Woods: Light underbrush n= 0.400 P2= 3.00"
8.8	467	0.0310	0.88		Shallow Concentrated Flow, Segment 2
					Woodland Kv= 5.0 fps
19.6	517	Total			

Summary for Reach 1R: North Property Line

Inflow Area = 3.500 ac, 2.29% Impervious, Inflow Depth > 2.04" for 10-YR event
 Inflow = 6.11 cfs @ 12.28 hrs, Volume= 0.595 af
 Outflow = 6.11 cfs @ 12.28 hrs, Volume= 0.595 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

G-565-PRE

Type III 24-hr 25-YR Rainfall=5.30"

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Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment E1: Existing Site Runoff

Runoff Area=3.500 ac 2.29% Impervious Runoff Depth>2.67"
Flow Length=517' Tc=19.6 min CN=77 Runoff=8.00 cfs 0.778 af

Reach 1R: North Property Line

Inflow=8.00 cfs 0.778 af
Outflow=8.00 cfs 0.778 af

Total Runoff Area = 3.500 ac Runoff Volume = 0.778 af Average Runoff Depth = 2.67"
97.71% Pervious = 3.420 ac 2.29% Impervious = 0.080 ac

Summary for Subcatchment E1: Existing Site Runoff

Runoff = 8.00 cfs @ 12.27 hrs, Volume= 0.778 af, Depth> 2.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Type III 24-hr 25-YR Rainfall=5.30"

Area (ac)	CN	Description
* 0.080	98	Ledge
3.420	77	Woods, Poor, HSG C
3.500	77	Weighted Average
3.420		97.71% Pervious Area
0.080		2.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.8	50	0.0300	0.08		Sheet Flow, Segment 1
					Woods: Light underbrush n= 0.400 P2= 3.00"
8.8	467	0.0310	0.88		Shallow Concentrated Flow, Segment 2
					Woodland Kv= 5.0 fps
19.6	517	Total			

Summary for Reach 1R: North Property Line

Inflow Area = 3.500 ac, 2.29% Impervious, Inflow Depth > 2.67" for 25-YR event

Inflow = 8.00 cfs @ 12.27 hrs, Volume= 0.778 af

Outflow = 8.00 cfs @ 12.27 hrs, Volume= 0.778 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

G-565-PRE

Type III 24-hr 100-YR Rainfall=6.50"

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Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment E1: Existing Site Runoff

Runoff Area=3.500 ac 2.29% Impervious Runoff Depth=3.65"
Flow Length=517' Tc=19.6 min CN=77 Runoff=10.90 cfs 1.065 af

Reach 1R: North Property Line

Inflow=10.90 cfs 1.065 af
Outflow=10.90 cfs 1.065 af

Total Runoff Area = 3.500 ac Runoff Volume = 1.065 af Average Runoff Depth = 3.65"
97.71% Pervious = 3.420 ac 2.29% Impervious = 0.080 ac

Summary for Subcatchment E1: Existing Site Runoff

Runoff = 10.90 cfs @ 12.27 hrs, Volume= 1.065 af, Depth> 3.65"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Type III 24-hr 100-YR Rainfall=6.50"

Area (ac)	CN	Description
* 0.080	98	Ledge
3.420	77	Woods, Poor, HSG C
3.500	77	Weighted Average
3.420		97.71% Pervious Area
0.080		2.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.8	50	0.0300	0.08		Sheet Flow, Segment 1
					Woods: Light underbrush n= 0.400 P2= 3.00"
8.8	467	0.0310	0.88		Shallow Concentrated Flow, Segment 2
					Woodland Kv= 5.0 fps
19.6	517	Total			

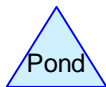
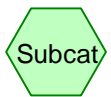
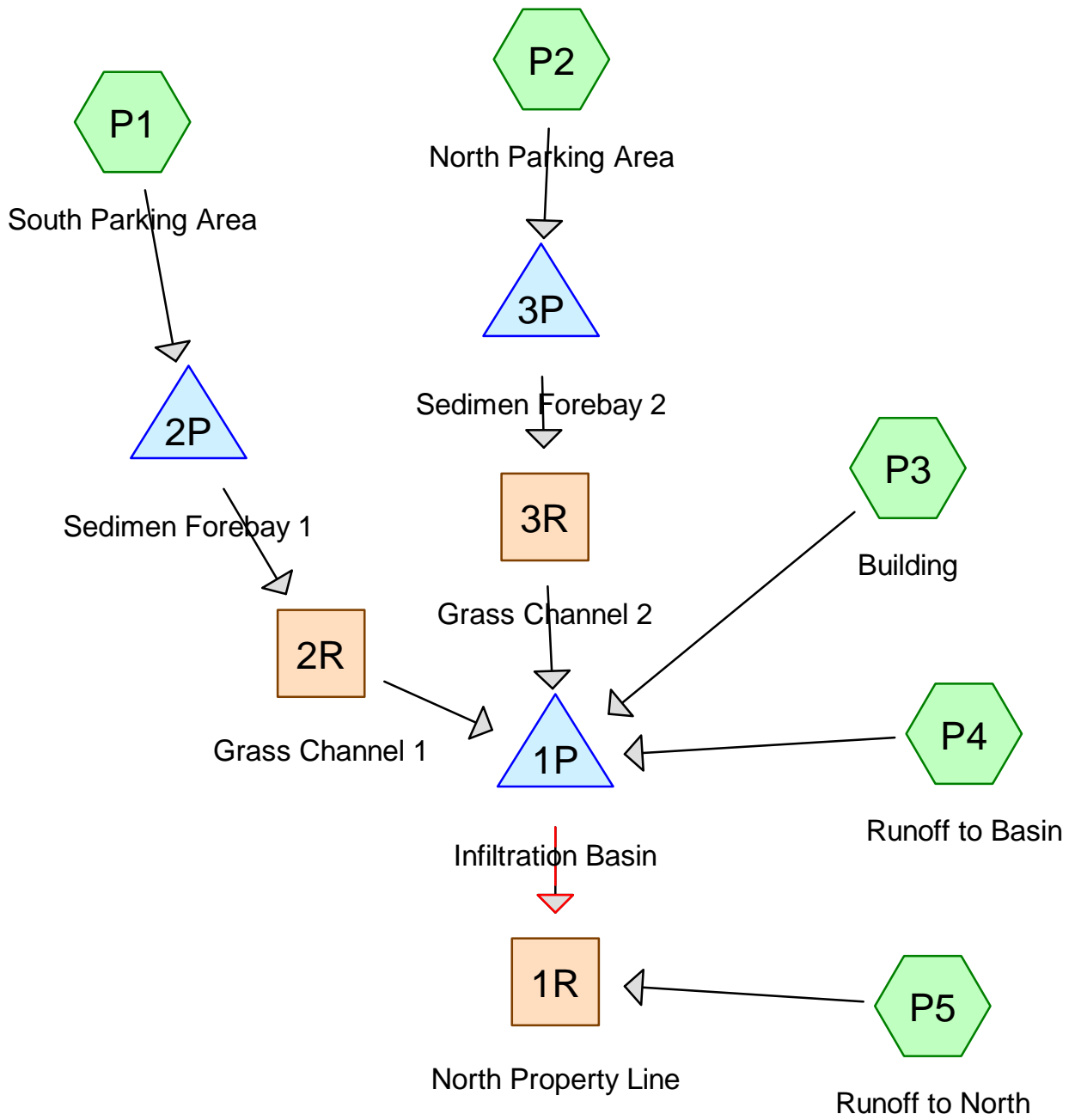
Summary for Reach 1R: North Property Line

Inflow Area = 3.500 ac, 2.29% Impervious, Inflow Depth > 3.65" for 100-YR event

Inflow = 10.90 cfs @ 12.27 hrs, Volume= 1.065 af

Outflow = 10.90 cfs @ 12.27 hrs, Volume= 1.065 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs



Routing Diagram for G-565-POST
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Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.050	89	Gravel, HSG C (P2)
1.270	98	Impervious (P1, P2, P3, P5)
1.230	74	Lawn, Good, HSG C (P1, P2, P4, P5)
0.030	98	Ledge (P1, P5)
0.920	77	Woods, Poor, HSG C (P1, P5)
3.500	84	TOTAL AREA

G-565-POST

Type III 24-hr 2-YR Rainfall=3.00"

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Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment P1: South Parking Area	Runoff Area=0.730 ac 46.58% Impervious Runoff Depth>1.48" Flow Length=185' Tc=6.0 min CN=85 Runoff=1.33 cfs 0.090 af
Subcatchment P2: North Parking Area	Runoff Area=0.900 ac 74.44% Impervious Runoff Depth>2.13" Flow Length=283' Tc=6.0 min CN=93 Runoff=2.26 cfs 0.160 af
Subcatchment P3: Building	Runoff Area=0.230 ac 100.00% Impervious Runoff Depth>2.59" Flow Length=357' Tc=6.0 min CN=98 Runoff=0.65 cfs 0.050 af
Subcatchment P4: Runoff to Basin	Runoff Area=0.260 ac 0.00% Impervious Runoff Depth>0.83" Flow Length=55' Tc=6.0 min CN=74 Runoff=0.25 cfs 0.018 af
Subcatchment P5: Runoff to North	Runoff Area=1.380 ac 4.35% Impervious Runoff Depth>0.98" Flow Length=173' Tc=14.3 min CN=77 Runoff=1.27 cfs 0.112 af
Reach 1R: North Property Line	Inflow=1.27 cfs 0.256 af Outflow=1.27 cfs 0.256 af
Reach 2R: Grass Channel 1	Avg. Flow Depth=0.16' Max Vel=1.11 fps Inflow=1.28 cfs 0.078 af n=0.030 L=300.0' S=0.0065 '/' Capacity=29.15 cfs Outflow=1.12 cfs 0.078 af
Reach 3R: Grass Channel 2	Avg. Flow Depth=0.19' Max Vel=1.34 fps Inflow=2.18 cfs 0.145 af n=0.030 L=120.0' S=0.0077 '/' Capacity=40.01 cfs Outflow=2.07 cfs 0.145 af
Pond 1P: Infiltration Basin	Peak Elev=725.46' Storage=6,719 cf Inflow=3.62 cfs 0.290 af Discarded=0.03 cfs 0.029 af Primary=0.70 cfs 0.143 af Secondary=0.00 cfs 0.000 af Outflow=0.73 cfs 0.173 af
Pond 2P: Sedimen Forebay 1	Peak Elev=731.19' Storage=472 cf Inflow=1.33 cfs 0.090 af Discarded=0.01 cfs 0.004 af Primary=1.28 cfs 0.078 af Outflow=1.28 cfs 0.082 af
Pond 3P: Sedimen Forebay 2	Peak Elev=729.03' Storage=528 cf Inflow=2.26 cfs 0.160 af Discarded=0.01 cfs 0.007 af Primary=2.18 cfs 0.145 af Outflow=2.19 cfs 0.153 af
Total Runoff Area = 3.500 ac Runoff Volume = 0.429 af Average Runoff Depth = 1.47"	
62.86% Pervious = 2.200 ac 37.14% Impervious = 1.300 ac	

Summary for Subcatchment P1: South Parking Area

Runoff = 1.33 cfs @ 12.09 hrs, Volume= 0.090 af, Depth> 1.48"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-YR Rainfall=3.00"

Area (ac)	CN	Description
* 0.020	98	Ledge
* 0.320	98	Impervious
0.020	77	Woods, Poor, HSG C
* 0.370	74	Lawn, Good, HSG C
0.730	85	Weighted Average
0.390		53.42% Pervious Area
0.340		46.58% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	185		0.51		Direct Entry, Segment 1

Summary for Subcatchment P2: North Parking Area

Runoff = 2.26 cfs @ 12.09 hrs, Volume= 0.160 af, Depth> 2.13"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-YR Rainfall=3.00"

Area (ac)	CN	Description
* 0.670	98	Impervious
0.050	89	Gravel, HSG C
* 0.180	74	Lawn, Good, HSG C
0.900	93	Weighted Average
0.230		25.56% Pervious Area
0.670		74.44% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	283		0.79		Direct Entry, Segment 1

Summary for Subcatchment P3: Building

Runoff = 0.65 cfs @ 12.09 hrs, Volume= 0.050 af, Depth> 2.59"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-YR Rainfall=3.00"

G-565-POST

Type III 24-hr 2-YR Rainfall=3.00"

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Area (ac)	CN	Description
* 0.230	98	Impervious
0.230		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	357		0.99		Direct Entry, Segment 1

Summary for Subcatchment P4: Runoff to Basin

Runoff = 0.25 cfs @ 12.10 hrs, Volume= 0.018 af, Depth> 0.83"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-YR Rainfall=3.00"

Area (ac)	CN	Description
* 0.260	74	Lawn, Good, HSG C
0.260		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	55		0.15		Direct Entry, Segment 1

Summary for Subcatchment P5: Runoff to North

Runoff = 1.27 cfs @ 12.21 hrs, Volume= 0.112 af, Depth> 0.98"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-YR Rainfall=3.00"

Area (ac)	CN	Description
* 0.010	98	Ledge
* 0.050	98	Impervious
0.900	77	Woods, Poor, HSG C
* 0.420	74	Lawn, Good, HSG C
1.380	77	Weighted Average
1.320		95.65% Pervious Area
0.060		4.35% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.7	50	0.0200	0.07		Sheet Flow, Segment 1 Woods: Light underbrush n= 0.400 P2= 3.00"
1.6	123	0.0330	1.27		Shallow Concentrated Flow, Segment 2 Short Grass Pasture Kv= 7.0 fps
14.3	173	Total			

Summary for Reach 1R: North Property Line

Inflow Area = 3.500 ac, 37.14% Impervious, Inflow Depth > 0.88" for 2-YR event
Inflow = 1.27 cfs @ 12.21 hrs, Volume= 0.256 af
Outflow = 1.27 cfs @ 12.21 hrs, Volume= 0.256 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Reach 2R: Grass Channel 1

Inflow Area = 0.730 ac, 46.58% Impervious, Inflow Depth > 1.29" for 2-YR event
Inflow = 1.28 cfs @ 12.12 hrs, Volume= 0.078 af
Outflow = 1.12 cfs @ 12.25 hrs, Volume= 0.078 af, Atten= 12%, Lag= 7.7 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Max. Velocity= 1.11 fps, Min. Travel Time= 4.5 min
Avg. Velocity = 0.39 fps, Avg. Travel Time= 12.8 min

Peak Storage= 310 cf @ 12.17 hrs
Average Depth at Peak Storage= 0.16'
Bank-Full Depth= 1.00' Flow Area= 9.0 sf, Capacity= 29.15 cfs

6.00' x 1.00' deep channel, n= 0.030
Side Slope Z-value= 3.0 '/' Top Width= 12.00'
Length= 300.0' Slope= 0.0065 '/'
Inlet Invert= 731.00', Outlet Invert= 729.05'



Summary for Reach 3R: Grass Channel 2

Inflow Area = 0.900 ac, 74.44% Impervious, Inflow Depth > 1.94" for 2-YR event
Inflow = 2.18 cfs @ 12.11 hrs, Volume= 0.145 af
Outflow = 2.07 cfs @ 12.16 hrs, Volume= 0.145 af, Atten= 5%, Lag= 2.7 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Max. Velocity= 1.34 fps, Min. Travel Time= 1.5 min
Avg. Velocity = 0.43 fps, Avg. Travel Time= 4.6 min

Peak Storage= 190 cf @ 12.13 hrs
Average Depth at Peak Storage= 0.19'
Bank-Full Depth= 1.00' Flow Area= 11.0 sf, Capacity= 40.01 cfs

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Type III 24-hr 2-YR Rainfall=3.00"

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8.00' x 1.00' deep channel, n= 0.030
 Side Slope Z-value= 3.0 '/' Top Width= 14.00'
 Length= 120.0' Slope= 0.0077 '/'
 Inlet Invert= 728.80', Outlet Invert= 727.88'



Summary for Pond 1P: Infiltration Basin

Inflow Area = 2.120 ac, 58.49% Impervious, Inflow Depth > 1.64" for 2-YR event
 Inflow = 3.62 cfs @ 12.16 hrs, Volume= 0.290 af
 Outflow = 0.73 cfs @ 12.71 hrs, Volume= 0.173 af, Atten= 80%, Lag= 33.1 min
 Discarded = 0.03 cfs @ 12.71 hrs, Volume= 0.029 af
 Primary = 0.70 cfs @ 12.71 hrs, Volume= 0.143 af
 Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Peak Elev= 725.46' @ 12.71 hrs Surf.Area= 5,432 sf Storage= 6,719 cf

Plug-Flow detention time= 157.2 min calculated for 0.172 af (59% of inflow)
 Center-of-Mass det. time= 84.9 min (870.4 - 785.4)

Volume	Invert	Avail.Storage	Storage Description
#1	724.00'	20,394 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
724.00	3,790	0	0
725.00	4,882	4,336	4,336
726.00	6,072	5,477	9,813
727.00	7,373	6,723	16,536
727.50	8,062	3,859	20,394

Device	Routing	Invert	Outlet Devices
#1	Discarded	724.00'	0.270 in/hr Exfiltration over Horizontal area
#2	Primary	723.00'	18.0" Round Culvert L= 40.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 723.00' / 722.30' S= 0.0175 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf
#3	Device 2	725.10'	12.0" W x 16.2" H Vert. Orifice/Grate C= 0.600
#4	Device 2	726.45'	48.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#5	Secondary	726.55'	10.0' long x 15.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

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Type III 24-hr 2-YR Rainfall=3.00"

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Discarded OutFlow Max=0.03 cfs @ 12.71 hrs HW=725.46' (Free Discharge)

↑1=Exfiltration (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=0.70 cfs @ 12.71 hrs HW=725.46' (Free Discharge)

↑2=Culvert (Passes 0.70 cfs of 11.13 cfs potential flow)

↑3=Orifice/Grate (Orifice Controls 0.70 cfs @ 1.93 fps)

↑4=Orifice/Grate (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=724.00' (Free Discharge)

↑5=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond 2P: Sedimen Forebay 1

Inflow Area = 0.730 ac, 46.58% Impervious, Inflow Depth > 1.48" for 2-YR event
 Inflow = 1.33 cfs @ 12.09 hrs, Volume= 0.090 af
 Outflow = 1.28 cfs @ 12.12 hrs, Volume= 0.082 af, Atten= 4%, Lag= 1.4 min
 Discarded = 0.01 cfs @ 12.12 hrs, Volume= 0.004 af
 Primary = 1.28 cfs @ 12.12 hrs, Volume= 0.078 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Peak Elev= 731.19' @ 12.12 hrs Surf.Area= 838 sf Storage= 472 cf

Plug-Flow detention time= 42.8 min calculated for 0.082 af (91% of inflow)
 Center-of-Mass det. time= 14.9 min (807.7 - 792.9)

Volume	Invert	Avail.Storage	Storage Description
#1	730.50'	764 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
730.50	606	0	0
731.00	690	324	324
731.50	1,071	440	764

Device	Routing	Invert	Outlet Devices
#1	Discarded	730.50'	0.270 in/hr Exfiltration over Horizontal area
#2	Primary	731.00'	6.0' long x 10.0' breadth Broad-Crested Rectangular Weir
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60
			Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Discarded OutFlow Max=0.01 cfs @ 12.12 hrs HW=731.19' (Free Discharge)

↑1=Exfiltration (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=1.24 cfs @ 12.12 hrs HW=731.19' (Free Discharge)

↑2=Broad-Crested Rectangular Weir (Weir Controls 1.24 cfs @ 1.09 fps)

Summary for Pond 3P: Sedimen Forebay 2

Inflow Area = 0.900 ac, 74.44% Impervious, Inflow Depth > 2.13" for 2-YR event
 Inflow = 2.26 cfs @ 12.09 hrs, Volume= 0.160 af
 Outflow = 2.19 cfs @ 12.11 hrs, Volume= 0.153 af, Atten= 3%, Lag= 1.3 min
 Discarded = 0.01 cfs @ 12.11 hrs, Volume= 0.007 af
 Primary = 2.18 cfs @ 12.11 hrs, Volume= 0.145 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Peak Elev= 729.03' @ 12.11 hrs Surf.Area= 1,165 sf Storage= 528 cf

Plug-Flow detention time= 29.6 min calculated for 0.153 af (96% of inflow)
 Center-of-Mass det. time= 13.3 min (777.6 - 764.3)

Volume	Invert	Avail.Storage	Storage Description
#1	728.50'	1,159 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
728.50	876	0	0
728.80	999	281	281
729.50	1,509	878	1,159

Device	Routing	Invert	Outlet Devices
#1	Discarded	728.50'	0.270 in/hr Exfiltration over Horizontal area
#2	Primary	728.80'	8.0' long x 10.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Discarded OutFlow Max=0.01 cfs @ 12.11 hrs HW=729.02' (Free Discharge)
 ↑1=Exfiltration (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=2.13 cfs @ 12.11 hrs HW=729.02' (Free Discharge)
 ↑2=Broad-Crested Rectangular Weir (Weir Controls 2.13 cfs @ 1.18 fps)

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Type III 24-hr 10-YR Rainfall=4.50"

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Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment P1: South Parking Area	Runoff Area=0.730 ac 46.58% Impervious Runoff Depth>2.73" Flow Length=185' Tc=6.0 min CN=85 Runoff=2.42 cfs 0.166 af
Subcatchment P2: North Parking Area	Runoff Area=0.900 ac 74.44% Impervious Runoff Depth>3.50" Flow Length=283' Tc=6.0 min CN=93 Runoff=3.62 cfs 0.263 af
Subcatchment P3: Building	Runoff Area=0.230 ac 100.00% Impervious Runoff Depth>3.96" Flow Length=357' Tc=6.0 min CN=98 Runoff=0.99 cfs 0.076 af
Subcatchment P4: Runoff to Basin	Runoff Area=0.260 ac 0.00% Impervious Runoff Depth>1.82" Flow Length=55' Tc=6.0 min CN=74 Runoff=0.58 cfs 0.039 af
Subcatchment P5: Runoff to North	Runoff Area=1.380 ac 4.35% Impervious Runoff Depth>2.05" Flow Length=173' Tc=14.3 min CN=77 Runoff=2.73 cfs 0.235 af
Reach 1R: North Property Line	Inflow=4.81 cfs 0.597 af Outflow=4.81 cfs 0.597 af
Reach 2R: Grass Channel 1	Avg. Flow Depth=0.23' Max Vel=1.40 fps Inflow=2.35 cfs 0.154 af n=0.030 L=300.0' S=0.0065 '/ Capacity=29.15 cfs Outflow=2.14 cfs 0.153 af
Reach 3R: Grass Channel 2	Avg. Flow Depth=0.25' Max Vel=1.59 fps Inflow=3.53 cfs 0.248 af n=0.030 L=120.0' S=0.0077 '/ Capacity=40.01 cfs Outflow=3.35 cfs 0.248 af
Pond 1P: Infiltration Basin	Peak Elev=726.00' Storage=9,812 cf Inflow=6.43 cfs 0.516 af Discarded=0.04 cfs 0.032 af Primary=2.74 cfs 0.362 af Secondary=0.00 cfs 0.000 af Outflow=2.78 cfs 0.394 af
Pond 2P: Sedimen Forebay 1	Peak Elev=731.29' Storage=555 cf Inflow=2.42 cfs 0.166 af Discarded=0.01 cfs 0.005 af Primary=2.35 cfs 0.154 af Outflow=2.36 cfs 0.158 af
Pond 3P: Sedimen Forebay 2	Peak Elev=729.11' Storage=629 cf Inflow=3.62 cfs 0.263 af Discarded=0.01 cfs 0.008 af Primary=3.53 cfs 0.248 af Outflow=3.54 cfs 0.256 af
Total Runoff Area = 3.500 ac Runoff Volume = 0.779 af Average Runoff Depth = 2.67"	
62.86% Pervious = 2.200 ac 37.14% Impervious = 1.300 ac	

Summary for Subcatchment P1: South Parking Area

Runoff = 2.42 cfs @ 12.09 hrs, Volume= 0.166 af, Depth> 2.73"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-YR Rainfall=4.50"

Area (ac)	CN	Description
* 0.020	98	Ledge
* 0.320	98	Impervious
0.020	77	Woods, Poor, HSG C
* 0.370	74	Lawn, Good, HSG C
0.730	85	Weighted Average
0.390		53.42% Pervious Area
0.340		46.58% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	185		0.51		Direct Entry, Segment 1

Summary for Subcatchment P2: North Parking Area

Runoff = 3.62 cfs @ 12.09 hrs, Volume= 0.263 af, Depth> 3.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-YR Rainfall=4.50"

Area (ac)	CN	Description
* 0.670	98	Impervious
0.050	89	Gravel, HSG C
* 0.180	74	Lawn, Good, HSG C
0.900	93	Weighted Average
0.230		25.56% Pervious Area
0.670		74.44% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	283		0.79		Direct Entry, Segment 1

Summary for Subcatchment P3: Building

Runoff = 0.99 cfs @ 12.09 hrs, Volume= 0.076 af, Depth> 3.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-YR Rainfall=4.50"

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Type III 24-hr 10-YR Rainfall=4.50"

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Area (ac)	CN	Description
* 0.230	98	Impervious
0.230		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	357		0.99		Direct Entry, Segment 1

Summary for Subcatchment P4: Runoff to Basin

Runoff = 0.58 cfs @ 12.10 hrs, Volume= 0.039 af, Depth> 1.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-YR Rainfall=4.50"

Area (ac)	CN	Description
* 0.260	74	Lawn, Good, HSG C
0.260		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	55		0.15		Direct Entry, Segment 1

Summary for Subcatchment P5: Runoff to North

Runoff = 2.73 cfs @ 12.20 hrs, Volume= 0.235 af, Depth> 2.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-YR Rainfall=4.50"

Area (ac)	CN	Description
* 0.010	98	Ledge
* 0.050	98	Impervious
0.900	77	Woods, Poor, HSG C
* 0.420	74	Lawn, Good, HSG C
1.380	77	Weighted Average
1.320		95.65% Pervious Area
0.060		4.35% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.7	50	0.0200	0.07		Sheet Flow, Segment 1 Woods: Light underbrush n= 0.400 P2= 3.00"
1.6	123	0.0330	1.27		Shallow Concentrated Flow, Segment 2 Short Grass Pasture Kv= 7.0 fps
14.3	173	Total			

Summary for Reach 1R: North Property Line

Inflow Area = 3.500 ac, 37.14% Impervious, Inflow Depth > 2.05" for 10-YR event
Inflow = 4.81 cfs @ 12.28 hrs, Volume= 0.597 af
Outflow = 4.81 cfs @ 12.28 hrs, Volume= 0.597 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Reach 2R: Grass Channel 1

Inflow Area = 0.730 ac, 46.58% Impervious, Inflow Depth > 2.53" for 10-YR event
Inflow = 2.35 cfs @ 12.11 hrs, Volume= 0.154 af
Outflow = 2.14 cfs @ 12.21 hrs, Volume= 0.153 af, Atten= 9%, Lag= 6.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Max. Velocity= 1.40 fps, Min. Travel Time= 3.6 min
Avg. Velocity = 0.48 fps, Avg. Travel Time= 10.4 min

Peak Storage= 465 cf @ 12.15 hrs
Average Depth at Peak Storage= 0.23'
Bank-Full Depth= 1.00' Flow Area= 9.0 sf, Capacity= 29.15 cfs

6.00' x 1.00' deep channel, n= 0.030
Side Slope Z-value= 3.0 '/' Top Width= 12.00'
Length= 300.0' Slope= 0.0065 '/'
Inlet Invert= 731.00', Outlet Invert= 729.05'



Summary for Reach 3R: Grass Channel 2

Inflow Area = 0.900 ac, 74.44% Impervious, Inflow Depth > 3.31" for 10-YR event
Inflow = 3.53 cfs @ 12.11 hrs, Volume= 0.248 af
Outflow = 3.35 cfs @ 12.15 hrs, Volume= 0.248 af, Atten= 5%, Lag= 2.3 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Max. Velocity= 1.59 fps, Min. Travel Time= 1.3 min
Avg. Velocity = 0.50 fps, Avg. Travel Time= 4.0 min

Peak Storage= 259 cf @ 12.12 hrs
Average Depth at Peak Storage= 0.25'
Bank-Full Depth= 1.00' Flow Area= 11.0 sf, Capacity= 40.01 cfs

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Type III 24-hr 10-YR Rainfall=4.50"

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8.00' x 1.00' deep channel, n= 0.030
 Side Slope Z-value= 3.0 '/' Top Width= 14.00'
 Length= 120.0' Slope= 0.0077 '/'
 Inlet Invert= 728.80', Outlet Invert= 727.88'



Summary for Pond 1P: Infiltration Basin

Inflow Area = 2.120 ac, 58.49% Impervious, Inflow Depth > 2.92" for 10-YR event
 Inflow = 6.43 cfs @ 12.15 hrs, Volume= 0.516 af
 Outflow = 2.78 cfs @ 12.43 hrs, Volume= 0.394 af, Atten= 57%, Lag= 16.9 min
 Discarded = 0.04 cfs @ 12.43 hrs, Volume= 0.032 af
 Primary = 2.74 cfs @ 12.43 hrs, Volume= 0.362 af
 Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Peak Elev= 726.00' @ 12.43 hrs Surf.Area= 6,072 sf Storage= 9,812 cf

Plug-Flow detention time= 116.5 min calculated for 0.394 af (76% of inflow)
 Center-of-Mass det. time= 59.8 min (834.7 - 774.8)

Volume	Invert	Avail.Storage	Storage Description
#1	724.00'	20,394 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
724.00	3,790	0	0
725.00	4,882	4,336	4,336
726.00	6,072	5,477	9,813
727.00	7,373	6,723	16,536
727.50	8,062	3,859	20,394

Device	Routing	Invert	Outlet Devices
#1	Discarded	724.00'	0.270 in/hr Exfiltration over Horizontal area
#2	Primary	723.00'	18.0" Round Culvert L= 40.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 723.00' / 722.30' S= 0.0175 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf
#3	Device 2	725.10'	12.0" W x 16.2" H Vert. Orifice/Grate C= 0.600
#4	Device 2	726.45'	48.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#5	Secondary	726.55'	10.0' long x 15.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

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Type III 24-hr 10-YR Rainfall=4.50"

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Discarded OutFlow Max=0.04 cfs @ 12.43 hrs HW=726.00' (Free Discharge)

↑1=Exfiltration (Exfiltration Controls 0.04 cfs)

Primary OutFlow Max=2.73 cfs @ 12.43 hrs HW=726.00' (Free Discharge)

↑2=Culvert (Passes 2.73 cfs of 12.76 cfs potential flow)

↑3=Orifice/Grate (Orifice Controls 2.73 cfs @ 3.04 fps)

↑4=Orifice/Grate (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=724.00' (Free Discharge)

↑5=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond 2P: Sedimen Forebay 1

Inflow Area =	0.730 ac, 46.58% Impervious, Inflow Depth > 2.73" for 10-YR event
Inflow =	2.42 cfs @ 12.09 hrs, Volume= 0.166 af
Outflow =	2.36 cfs @ 12.11 hrs, Volume= 0.158 af, Atten= 3%, Lag= 1.2 min
Discarded =	0.01 cfs @ 12.11 hrs, Volume= 0.005 af
Primary =	2.35 cfs @ 12.11 hrs, Volume= 0.154 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 731.29' @ 12.11 hrs Surf.Area= 910 sf Storage= 555 cf

Plug-Flow detention time= 29.4 min calculated for 0.158 af (95% of inflow)
Center-of-Mass det. time= 12.0 min (790.7 - 778.6)

Volume	Invert	Avail.Storage	Storage Description
#1	730.50'	764 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
730.50	606	0	0
731.00	690	324	324
731.50	1,071	440	764

Device	Routing	Invert	Outlet Devices
#1	Discarded	730.50'	0.270 in/hr Exfiltration over Horizontal area
#2	Primary	731.00'	6.0' long x 10.0' breadth Broad-Crested Rectangular Weir
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60
			Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Discarded OutFlow Max=0.01 cfs @ 12.11 hrs HW=731.28' (Free Discharge)

↑1=Exfiltration (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=2.30 cfs @ 12.11 hrs HW=731.28' (Free Discharge)

↑2=Broad-Crested Rectangular Weir (Weir Controls 2.30 cfs @ 1.34 fps)

Summary for Pond 3P: Sedimen Forebay 2

Inflow Area = 0.900 ac, 74.44% Impervious, Inflow Depth > 3.50" for 10-YR event
 Inflow = 3.62 cfs @ 12.09 hrs, Volume= 0.263 af
 Outflow = 3.54 cfs @ 12.11 hrs, Volume= 0.256 af, Atten= 2%, Lag= 1.2 min
 Discarded = 0.01 cfs @ 12.11 hrs, Volume= 0.008 af
 Primary = 3.53 cfs @ 12.11 hrs, Volume= 0.248 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Peak Elev= 729.11' @ 12.11 hrs Surf.Area= 1,226 sf Storage= 629 cf

Plug-Flow detention time= 21.7 min calculated for 0.256 af (97% of inflow)
 Center-of-Mass det. time= 10.8 min (764.6 - 753.7)

Volume	Invert	Avail.Storage	Storage Description
#1	728.50'	1,159 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
728.50	876	0	0
728.80	999	281	281
729.50	1,509	878	1,159

Device	Routing	Invert	Outlet Devices
#1	Discarded	728.50'	0.270 in/hr Exfiltration over Horizontal area
#2	Primary	728.80'	8.0' long x 10.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Discarded OutFlow Max=0.01 cfs @ 12.11 hrs HW=729.11' (Free Discharge)
 ↑1=Exfiltration (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=3.46 cfs @ 12.11 hrs HW=729.11' (Free Discharge)
 ↑2=Broad-Crested Rectangular Weir (Weir Controls 3.46 cfs @ 1.40 fps)

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Type III 24-hr 25-YR Rainfall=5.30"

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Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment P1: South Parking Area	Runoff Area=0.730 ac 46.58% Impervious Runoff Depth>3.43" Flow Length=185' Tc=6.0 min CN=85 Runoff=3.01 cfs 0.209 af
Subcatchment P2: North Parking Area	Runoff Area=0.900 ac 74.44% Impervious Runoff Depth>4.24" Flow Length=283' Tc=6.0 min CN=93 Runoff=4.34 cfs 0.318 af
Subcatchment P3: Building	Runoff Area=0.230 ac 100.00% Impervious Runoff Depth>4.69" Flow Length=357' Tc=6.0 min CN=98 Runoff=1.17 cfs 0.090 af
Subcatchment P4: Runoff to Basin	Runoff Area=0.260 ac 0.00% Impervious Runoff Depth>2.42" Flow Length=55' Tc=6.0 min CN=74 Runoff=0.78 cfs 0.052 af
Subcatchment P5: Runoff to North	Runoff Area=1.380 ac 4.35% Impervious Runoff Depth>2.67" Flow Length=173' Tc=14.3 min CN=77 Runoff=3.57 cfs 0.307 af
Reach 1R: North Property Line	Inflow=6.93 cfs 0.790 af Outflow=6.93 cfs 0.790 af
Reach 2R: Grass Channel 1	Avg. Flow Depth=0.26' Max Vel=1.52 fps Inflow=2.94 cfs 0.196 af n=0.030 L=300.0' S=0.0065 '/ Capacity=29.15 cfs Outflow=2.71 cfs 0.195 af
Reach 3R: Grass Channel 2	Avg. Flow Depth=0.28' Max Vel=1.70 fps Inflow=4.24 cfs 0.303 af n=0.030 L=120.0' S=0.0077 '/ Capacity=40.01 cfs Outflow=4.03 cfs 0.303 af
Pond 1P: Infiltration Basin	Peak Elev=726.24' Storage=11,328 cf Inflow=7.96 cfs 0.640 af Discarded=0.04 cfs 0.034 af Primary=3.92 cfs 0.483 af Secondary=0.00 cfs 0.000 af Outflow=3.96 cfs 0.516 af
Pond 2P: Sedimen Forebay 1	Peak Elev=731.33' Storage=597 cf Inflow=3.01 cfs 0.209 af Discarded=0.01 cfs 0.005 af Primary=2.94 cfs 0.196 af Outflow=2.94 cfs 0.201 af
Pond 3P: Sedimen Forebay 2	Peak Elev=729.15' Storage=677 cf Inflow=4.34 cfs 0.318 af Discarded=0.01 cfs 0.008 af Primary=4.24 cfs 0.303 af Outflow=4.25 cfs 0.311 af
Total Runoff Area = 3.500 ac Runoff Volume = 0.976 af Average Runoff Depth = 3.35"	
62.86% Pervious = 2.200 ac 37.14% Impervious = 1.300 ac	

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Type III 24-hr 25-YR Rainfall=5.30"

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Summary for Subcatchment P1: South Parking Area

Runoff = 3.01 cfs @ 12.09 hrs, Volume= 0.209 af, Depth> 3.43"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YR Rainfall=5.30"

Area (ac)	CN	Description
* 0.020	98	Ledge
* 0.320	98	Impervious
0.020	77	Woods, Poor, HSG C
* 0.370	74	Lawn, Good, HSG C
0.730	85	Weighted Average
0.390		53.42% Pervious Area
0.340		46.58% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	185		0.51		Direct Entry, Segment 1

Summary for Subcatchment P2: North Parking Area

Runoff = 4.34 cfs @ 12.09 hrs, Volume= 0.318 af, Depth> 4.24"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YR Rainfall=5.30"

Area (ac)	CN	Description
* 0.670	98	Impervious
0.050	89	Gravel, HSG C
* 0.180	74	Lawn, Good, HSG C
0.900	93	Weighted Average
0.230		25.56% Pervious Area
0.670		74.44% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	283		0.79		Direct Entry, Segment 1

Summary for Subcatchment P3: Building

Runoff = 1.17 cfs @ 12.09 hrs, Volume= 0.090 af, Depth> 4.69"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YR Rainfall=5.30"

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Type III 24-hr 25-YR Rainfall=5.30"

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Area (ac)	CN	Description
* 0.230	98	Impervious
0.230		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	357		0.99		Direct Entry, Segment 1

Summary for Subcatchment P4: Runoff to Basin

Runoff = 0.78 cfs @ 12.09 hrs, Volume= 0.052 af, Depth> 2.42"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YR Rainfall=5.30"

Area (ac)	CN	Description
* 0.260	74	Lawn, Good, HSG C
0.260		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	55		0.15		Direct Entry, Segment 1

Summary for Subcatchment P5: Runoff to North

Runoff = 3.57 cfs @ 12.20 hrs, Volume= 0.307 af, Depth> 2.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YR Rainfall=5.30"

Area (ac)	CN	Description
* 0.010	98	Ledge
* 0.050	98	Impervious
0.900	77	Woods, Poor, HSG C
* 0.420	74	Lawn, Good, HSG C
1.380	77	Weighted Average
1.320		95.65% Pervious Area
0.060		4.35% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.7	50	0.0200	0.07		Sheet Flow, Segment 1 Woods: Light underbrush n= 0.400 P2= 3.00"
1.6	123	0.0330	1.27		Shallow Concentrated Flow, Segment 2 Short Grass Pasture Kv= 7.0 fps
14.3	173	Total			

Summary for Reach 1R: North Property Line

Inflow Area = 3.500 ac, 37.14% Impervious, Inflow Depth > 2.71" for 25-YR event
Inflow = 6.93 cfs @ 12.26 hrs, Volume= 0.790 af
Outflow = 6.93 cfs @ 12.26 hrs, Volume= 0.790 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Reach 2R: Grass Channel 1

Inflow Area = 0.730 ac, 46.58% Impervious, Inflow Depth > 3.22" for 25-YR event
Inflow = 2.94 cfs @ 12.11 hrs, Volume= 0.196 af
Outflow = 2.71 cfs @ 12.20 hrs, Volume= 0.195 af, Atten= 8%, Lag= 5.6 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Max. Velocity= 1.52 fps, Min. Travel Time= 3.3 min
Avg. Velocity = 0.52 fps, Avg. Travel Time= 9.7 min

Peak Storage= 540 cf @ 12.15 hrs
Average Depth at Peak Storage= 0.26'
Bank-Full Depth= 1.00' Flow Area= 9.0 sf, Capacity= 29.15 cfs

6.00' x 1.00' deep channel, n= 0.030
Side Slope Z-value= 3.0 '/' Top Width= 12.00'
Length= 300.0' Slope= 0.0065 '/'
Inlet Invert= 731.00', Outlet Invert= 729.05'



Summary for Reach 3R: Grass Channel 2

Inflow Area = 0.900 ac, 74.44% Impervious, Inflow Depth > 4.04" for 25-YR event
Inflow = 4.24 cfs @ 12.11 hrs, Volume= 0.303 af
Outflow = 4.03 cfs @ 12.14 hrs, Volume= 0.303 af, Atten= 5%, Lag= 2.2 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Max. Velocity= 1.70 fps, Min. Travel Time= 1.2 min
Avg. Velocity = 0.54 fps, Avg. Travel Time= 3.7 min

Peak Storage= 291 cf @ 12.12 hrs
Average Depth at Peak Storage= 0.28'
Bank-Full Depth= 1.00' Flow Area= 11.0 sf, Capacity= 40.01 cfs

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Type III 24-hr 25-YR Rainfall=5.30"

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8.00' x 1.00' deep channel, n= 0.030
 Side Slope Z-value= 3.0 '/' Top Width= 14.00'
 Length= 120.0' Slope= 0.0077 '/'
 Inlet Invert= 728.80', Outlet Invert= 727.88'



Summary for Pond 1P: Infiltration Basin

Inflow Area = 2.120 ac, 58.49% Impervious, Inflow Depth > 3.62" for 25-YR event
 Inflow = 7.96 cfs @ 12.15 hrs, Volume= 0.640 af
 Outflow = 3.96 cfs @ 12.37 hrs, Volume= 0.516 af, Atten= 50%, Lag= 13.4 min
 Discarded = 0.04 cfs @ 12.37 hrs, Volume= 0.034 af
 Primary = 3.92 cfs @ 12.37 hrs, Volume= 0.483 af
 Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Peak Elev= 726.24' @ 12.37 hrs Surf.Area= 6,388 sf Storage= 11,328 cf

Plug-Flow detention time= 105.2 min calculated for 0.515 af (80% of inflow)
 Center-of-Mass det. time= 55.4 min (826.0 - 770.6)

Volume	Invert	Avail.Storage	Storage Description
#1	724.00'	20,394 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
724.00	3,790	0	0
725.00	4,882	4,336	4,336
726.00	6,072	5,477	9,813
727.00	7,373	6,723	16,536
727.50	8,062	3,859	20,394

Device	Routing	Invert	Outlet Devices
#1	Discarded	724.00'	0.270 in/hr Exfiltration over Horizontal area
#2	Primary	723.00'	18.0" Round Culvert L= 40.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 723.00' / 722.30' S= 0.0175 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf
#3	Device 2	725.10'	12.0" W x 16.2" H Vert. Orifice/Grate C= 0.600
#4	Device 2	726.45'	48.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#5	Secondary	726.55'	10.0' long x 15.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

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Type III 24-hr 25-YR Rainfall=5.30"

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Discarded OutFlow Max=0.04 cfs @ 12.37 hrs HW=726.24' (Free Discharge)

↑1=Exfiltration (Exfiltration Controls 0.04 cfs)

Primary OutFlow Max=3.91 cfs @ 12.37 hrs HW=726.24' (Free Discharge)

↑2=Culvert (Passes 3.91 cfs of 13.43 cfs potential flow)

↑3=Orifice/Grate (Orifice Controls 3.91 cfs @ 3.43 fps)

↑4=Orifice/Grate (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=724.00' (Free Discharge)

↑5=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond 2P: Sedimen Forebay 1

Inflow Area = 0.730 ac, 46.58% Impervious, Inflow Depth > 3.43" for 25-YR event
 Inflow = 3.01 cfs @ 12.09 hrs, Volume= 0.209 af
 Outflow = 2.94 cfs @ 12.11 hrs, Volume= 0.201 af, Atten= 2%, Lag= 1.2 min
 Discarded = 0.01 cfs @ 12.11 hrs, Volume= 0.005 af
 Primary = 2.94 cfs @ 12.11 hrs, Volume= 0.196 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 731.33' @ 12.11 hrs Surf.Area= 945 sf Storage= 597 cf

Plug-Flow detention time= 25.2 min calculated for 0.200 af (96% of inflow)
Center-of-Mass det. time= 11.1 min (784.3 - 773.2)

Volume	Invert	Avail.Storage	Storage Description
#1	730.50'	764 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
730.50	606	0	0
731.00	690	324	324
731.50	1,071	440	764

Device	Routing	Invert	Outlet Devices
#1	Discarded	730.50'	0.270 in/hr Exfiltration over Horizontal area
#2	Primary	731.00'	6.0' long x 10.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Discarded OutFlow Max=0.01 cfs @ 12.11 hrs HW=731.33' (Free Discharge)

↑1=Exfiltration (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=2.87 cfs @ 12.11 hrs HW=731.33' (Free Discharge)

↑2=Broad-Crested Rectangular Weir (Weir Controls 2.87 cfs @ 1.45 fps)

Summary for Pond 3P: Sedimen Forebay 2

Inflow Area = 0.900 ac, 74.44% Impervious, Inflow Depth > 4.24" for 25-YR event
 Inflow = 4.34 cfs @ 12.09 hrs, Volume= 0.318 af
 Outflow = 4.25 cfs @ 12.11 hrs, Volume= 0.311 af, Atten= 2%, Lag= 1.1 min
 Discarded = 0.01 cfs @ 12.11 hrs, Volume= 0.008 af
 Primary = 4.24 cfs @ 12.11 hrs, Volume= 0.303 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Peak Elev= 729.15' @ 12.11 hrs Surf.Area= 1,255 sf Storage= 677 cf

Plug-Flow detention time= 19.0 min calculated for 0.311 af (98% of inflow)
 Center-of-Mass det. time= 9.7 min (760.0 - 750.3)

Volume	Invert	Avail.Storage	Storage Description
#1	728.50'	1,159 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
728.50	876	0	0
728.80	999	281	281
729.50	1,509	878	1,159

Device	Routing	Invert	Outlet Devices
#1	Discarded	728.50'	0.270 in/hr Exfiltration over Horizontal area
#2	Primary	728.80'	8.0' long x 10.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Discarded OutFlow Max=0.01 cfs @ 12.11 hrs HW=729.15' (Free Discharge)
 ↑1=Exfiltration (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=4.17 cfs @ 12.11 hrs HW=729.15' (Free Discharge)
 ↑2=Broad-Crested Rectangular Weir (Weir Controls 4.17 cfs @ 1.50 fps)

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Type III 24-hr 100-YR Rainfall=6.50"

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Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment P1: South Parking Area	Runoff Area=0.730 ac 46.58% Impervious Runoff Depth>4.51" Flow Length=185' Tc=6.0 min CN=85 Runoff=3.90 cfs 0.274 af
Subcatchment P2: North Parking Area	Runoff Area=0.900 ac 74.44% Impervious Runoff Depth>5.35" Flow Length=283' Tc=6.0 min CN=93 Runoff=5.41 cfs 0.401 af
Subcatchment P3: Building	Runoff Area=0.230 ac 100.00% Impervious Runoff Depth>5.78" Flow Length=357' Tc=6.0 min CN=98 Runoff=1.43 cfs 0.111 af
Subcatchment P4: Runoff to Basin	Runoff Area=0.260 ac 0.00% Impervious Runoff Depth>3.37" Flow Length=55' Tc=6.0 min CN=74 Runoff=1.08 cfs 0.073 af
Subcatchment P5: Runoff to North	Runoff Area=1.380 ac 4.35% Impervious Runoff Depth>3.66" Flow Length=173' Tc=14.3 min CN=77 Runoff=4.86 cfs 0.421 af
Reach 1R: North Property Line	Inflow=10.44 cfs 1.088 af Outflow=10.44 cfs 1.088 af
Reach 2R: Grass Channel 1	Avg. Flow Depth=0.31' Max Vel=1.67 fps Inflow=3.82 cfs 0.261 af n=0.030 L=300.0' S=0.0065 '/ Capacity=29.15 cfs Outflow=3.58 cfs 0.260 af
Reach 3R: Grass Channel 2	Avg. Flow Depth=0.31' Max Vel=1.85 fps Inflow=5.30 cfs 0.386 af n=0.030 L=120.0' S=0.0077 '/ Capacity=40.01 cfs Outflow=5.04 cfs 0.386 af
Pond 1P: Infiltration Basin	Peak Elev=726.53' Storage=13,182 cf Inflow=10.29 cfs 0.829 af Discarded=0.04 cfs 0.035 af Primary=6.25 cfs 0.668 af Secondary=0.00 cfs 0.000 af Outflow=6.29 cfs 0.703 af
Pond 2P: Sedimen Forebay 1	Peak Elev=731.40' Storage=657 cf Inflow=3.90 cfs 0.274 af Discarded=0.01 cfs 0.005 af Primary=3.82 cfs 0.261 af Outflow=3.82 cfs 0.266 af
Pond 3P: Sedimen Forebay 2	Peak Elev=729.21' Storage=747 cf Inflow=5.41 cfs 0.401 af Discarded=0.01 cfs 0.008 af Primary=5.30 cfs 0.386 af Outflow=5.31 cfs 0.394 af
Total Runoff Area = 3.500 ac Runoff Volume = 1.280 af Average Runoff Depth = 4.39"	
62.86% Pervious = 2.200 ac 37.14% Impervious = 1.300 ac	

Summary for Subcatchment P1: South Parking Area

Runoff = 3.90 cfs @ 12.09 hrs, Volume= 0.274 af, Depth> 4.51"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-YR Rainfall=6.50"

Area (ac)	CN	Description
* 0.020	98	Ledge
* 0.320	98	Impervious
0.020	77	Woods, Poor, HSG C
* 0.370	74	Lawn, Good, HSG C
0.730	85	Weighted Average
0.390		53.42% Pervious Area
0.340		46.58% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	185		0.51		Direct Entry, Segment 1

Summary for Subcatchment P2: North Parking Area

Runoff = 5.41 cfs @ 12.09 hrs, Volume= 0.401 af, Depth> 5.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-YR Rainfall=6.50"

Area (ac)	CN	Description
* 0.670	98	Impervious
0.050	89	Gravel, HSG C
* 0.180	74	Lawn, Good, HSG C
0.900	93	Weighted Average
0.230		25.56% Pervious Area
0.670		74.44% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	283		0.79		Direct Entry, Segment 1

Summary for Subcatchment P3: Building

Runoff = 1.43 cfs @ 12.09 hrs, Volume= 0.111 af, Depth> 5.78"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-YR Rainfall=6.50"

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Type III 24-hr 100-YR Rainfall=6.50"

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Area (ac)	CN	Description
* 0.230	98	Impervious
0.230		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	357		0.99		Direct Entry, Segment 1

Summary for Subcatchment P4: Runoff to Basin

Runoff = 1.08 cfs @ 12.09 hrs, Volume= 0.073 af, Depth> 3.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-YR Rainfall=6.50"

Area (ac)	CN	Description
* 0.260	74	Lawn, Good, HSG C
0.260		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	55		0.15		Direct Entry, Segment 1

Summary for Subcatchment P5: Runoff to North

Runoff = 4.86 cfs @ 12.20 hrs, Volume= 0.421 af, Depth> 3.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-YR Rainfall=6.50"

Area (ac)	CN	Description
* 0.010	98	Ledge
* 0.050	98	Impervious
0.900	77	Woods, Poor, HSG C
* 0.420	74	Lawn, Good, HSG C
1.380	77	Weighted Average
1.320		95.65% Pervious Area
0.060		4.35% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.7	50	0.0200	0.07		Sheet Flow, Segment 1 Woods: Light underbrush n= 0.400 P2= 3.00"
1.6	123	0.0330	1.27		Shallow Concentrated Flow, Segment 2 Short Grass Pasture Kv= 7.0 fps
14.3	173	Total			

Summary for Reach 1R: North Property Line

Inflow Area = 3.500 ac, 37.14% Impervious, Inflow Depth > 3.73" for 100-YR event
Inflow = 10.44 cfs @ 12.27 hrs, Volume= 1.088 af
Outflow = 10.44 cfs @ 12.27 hrs, Volume= 1.088 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Reach 2R: Grass Channel 1

Inflow Area = 0.730 ac, 46.58% Impervious, Inflow Depth > 4.29" for 100-YR event
Inflow = 3.82 cfs @ 12.11 hrs, Volume= 0.261 af
Outflow = 3.58 cfs @ 12.19 hrs, Volume= 0.260 af, Atten= 6%, Lag= 5.2 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Max. Velocity= 1.67 fps, Min. Travel Time= 3.0 min
Avg. Velocity = 0.56 fps, Avg. Travel Time= 8.9 min

Peak Storage= 644 cf @ 12.14 hrs
Average Depth at Peak Storage= 0.31'
Bank-Full Depth= 1.00' Flow Area= 9.0 sf, Capacity= 29.15 cfs

6.00' x 1.00' deep channel, n= 0.030
Side Slope Z-value= 3.0 '/' Top Width= 12.00'
Length= 300.0' Slope= 0.0065 '/'
Inlet Invert= 731.00', Outlet Invert= 729.05'



Summary for Reach 3R: Grass Channel 2

Inflow Area = 0.900 ac, 74.44% Impervious, Inflow Depth > 5.15" for 100-YR event
Inflow = 5.30 cfs @ 12.11 hrs, Volume= 0.386 af
Outflow = 5.04 cfs @ 12.14 hrs, Volume= 0.386 af, Atten= 5%, Lag= 2.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Max. Velocity= 1.85 fps, Min. Travel Time= 1.1 min
Avg. Velocity = 0.58 fps, Avg. Travel Time= 3.5 min

Peak Storage= 337 cf @ 12.12 hrs
Average Depth at Peak Storage= 0.31'
Bank-Full Depth= 1.00' Flow Area= 11.0 sf, Capacity= 40.01 cfs

G-565-POST

Type III 24-hr 100-YR Rainfall=6.50"

Prepared by J.M. Grenier Associates Inc.

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8.00' x 1.00' deep channel, n= 0.030
 Side Slope Z-value= 3.0 '/' Top Width= 14.00'
 Length= 120.0' Slope= 0.0077 '/'
 Inlet Invert= 728.80', Outlet Invert= 727.88'



Summary for Pond 1P: Infiltration Basin

Inflow Area = 2.120 ac, 58.49% Impervious, Inflow Depth > 4.69" for 100-YR event
 Inflow = 10.29 cfs @ 12.14 hrs, Volume= 0.829 af
 Outflow = 6.29 cfs @ 12.30 hrs, Volume= 0.703 af, Atten= 39%, Lag= 9.6 min
 Discarded = 0.04 cfs @ 12.30 hrs, Volume= 0.035 af
 Primary = 6.25 cfs @ 12.30 hrs, Volume= 0.668 af
 Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Peak Elev= 726.53' @ 12.30 hrs Surf.Area= 6,755 sf Storage= 13,182 cf

Plug-Flow detention time= 95.0 min calculated for 0.703 af (85% of inflow)
 Center-of-Mass det. time= 51.3 min (816.9 - 765.6)

Volume	Invert	Avail.Storage	Storage Description
#1	724.00'	20,394 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
724.00	3,790	0	0
725.00	4,882	4,336	4,336
726.00	6,072	5,477	9,813
727.00	7,373	6,723	16,536
727.50	8,062	3,859	20,394

Device	Routing	Invert	Outlet Devices
#1	Discarded	724.00'	0.270 in/hr Exfiltration over Horizontal area
#2	Primary	723.00'	18.0" Round Culvert L= 40.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 723.00' / 722.30' S= 0.0175 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf
#3	Device 2	725.10'	12.0" W x 16.2" H Vert. Orifice/Grate C= 0.600
#4	Device 2	726.45'	48.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#5	Secondary	726.55'	10.0' long x 15.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

G-565-POST

Type III 24-hr 100-YR Rainfall=6.50"

Prepared by J.M. Grenier Associates Inc.

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Discarded OutFlow Max=0.04 cfs @ 12.30 hrs HW=726.52' (Free Discharge)

↑1=Exfiltration (Exfiltration Controls 0.04 cfs)

Primary OutFlow Max=6.21 cfs @ 12.30 hrs HW=726.52' (Free Discharge)

↑2=Culvert (Passes 6.21 cfs of 14.17 cfs potential flow)

↑3=Orifice/Grate (Orifice Controls 5.39 cfs @ 3.99 fps)

↑4=Orifice/Grate (Weir Controls 0.82 cfs @ 0.89 fps)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=724.00' (Free Discharge)

↑5=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond 2P: Sedimen Forebay 1

Inflow Area = 0.730 ac, 46.58% Impervious, Inflow Depth > 4.51" for 100-YR event
 Inflow = 3.90 cfs @ 12.09 hrs, Volume= 0.274 af
 Outflow = 3.82 cfs @ 12.11 hrs, Volume= 0.266 af, Atten= 2%, Lag= 1.1 min
 Discarded = 0.01 cfs @ 12.11 hrs, Volume= 0.005 af
 Primary = 3.82 cfs @ 12.11 hrs, Volume= 0.261 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Peak Elev= 731.40' @ 12.11 hrs Surf.Area= 991 sf Storage= 657 cf

Plug-Flow detention time= 21.2 min calculated for 0.265 af (97% of inflow)
 Center-of-Mass det. time= 10.0 min (776.6 - 766.7)

Volume	Invert	Avail.Storage	Storage Description
#1	730.50'	764 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
730.50	606	0	0
731.00	690	324	324
731.50	1,071	440	764

Device	Routing	Invert	Outlet Devices
#1	Discarded	730.50'	0.270 in/hr Exfiltration over Horizontal area
#2	Primary	731.00'	6.0' long x 10.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Discarded OutFlow Max=0.01 cfs @ 12.11 hrs HW=731.39' (Free Discharge)

↑1=Exfiltration (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=3.75 cfs @ 12.11 hrs HW=731.39' (Free Discharge)

↑2=Broad-Crested Rectangular Weir (Weir Controls 3.75 cfs @ 1.60 fps)

Summary for Pond 3P: Sedimen Forebay 2

Inflow Area = 0.900 ac, 74.44% Impervious, Inflow Depth > 5.35" for 100-YR event
 Inflow = 5.41 cfs @ 12.09 hrs, Volume= 0.401 af
 Outflow = 5.31 cfs @ 12.11 hrs, Volume= 0.394 af, Atten= 2%, Lag= 1.1 min
 Discarded = 0.01 cfs @ 12.11 hrs, Volume= 0.008 af
 Primary = 5.30 cfs @ 12.11 hrs, Volume= 0.386 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Peak Elev= 729.21' @ 12.11 hrs Surf.Area= 1,295 sf Storage= 747 cf

Plug-Flow detention time= 16.0 min calculated for 0.394 af (98% of inflow)
 Center-of-Mass det. time= 8.4 min (754.9 - 746.5)

Volume	Invert	Avail.Storage	Storage Description
#1	728.50'	1,159 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
728.50	876	0	0
728.80	999	281	281
729.50	1,509	878	1,159

Device	Routing	Invert	Outlet Devices
#1	Discarded	728.50'	0.270 in/hr Exfiltration over Horizontal area
#2	Primary	728.80'	8.0' long x 10.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Discarded OutFlow Max=0.01 cfs @ 12.11 hrs HW=729.20' (Free Discharge)
 ↑1=Exfiltration (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=5.23 cfs @ 12.11 hrs HW=729.20' (Free Discharge)
 ↑2=Broad-Crested Rectangular Weir (Weir Controls 5.23 cfs @ 1.62 fps)



Checklist for Stormwater Report

A. Introduction

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.



A Stormwater Report must be submitted with the Notice of Intent permit application to document compliance with the Stormwater Management Standards. The following checklist is NOT a substitute for the Stormwater Report (which should provide more substantive and detailed information) but is offered here as a tool to help the applicant organize their Stormwater Management documentation for their Report and for the reviewer to assess this information in a consistent format. As noted in the Checklist, the Stormwater Report must contain the engineering computations and supporting information set forth in Volume 3 of the [Massachusetts Stormwater Handbook](#). The Stormwater Report must be prepared and certified by a Registered Professional Engineer (RPE) licensed in the Commonwealth.

The Stormwater Report must include:

- The Stormwater Checklist completed and stamped by a Registered Professional Engineer (see page 2) that certifies that the Stormwater Report contains all required submittals.¹ This Checklist is to be used as the cover for the completed Stormwater Report.
- Applicant/Project Name
- Project Address
- Name of Firm and Registered Professional Engineer that prepared the Report
- Long-Term Pollution Prevention Plan required by Standards 4-6
- Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan required by Standard 8²
- Operation and Maintenance Plan required by Standard 9

In addition to all plans and supporting information, the Stormwater Report must include a brief narrative describing stormwater management practices, including environmentally sensitive site design and LID techniques, along with a diagram depicting runoff through the proposed BMP treatment train. Plans are required to show existing and proposed conditions, identify all wetland resource areas, NRCS soil types, critical areas, Land Uses with Higher Potential Pollutant Loads (LUHPPL), and any areas on the site where infiltration rate is greater than 2.4 inches per hour. The Plans shall identify the drainage areas for both existing and proposed conditions at a scale that enables verification of supporting calculations.

As noted in the Checklist, the Stormwater Management Report shall document compliance with each of the Stormwater Management Standards as provided in the Massachusetts Stormwater Handbook. The soils evaluation and calculations shall be done using the methodologies set forth in Volume 3 of the Massachusetts Stormwater Handbook.

To ensure that the Stormwater Report is complete, applicants are required to fill in the Stormwater Report Checklist by checking the box to indicate that the specified information has been included in the Stormwater Report. If any of the information specified in the checklist has not been submitted, the applicant must provide an explanation. The completed Stormwater Report Checklist and Certification must be submitted with the Stormwater Report.

¹ The Stormwater Report may also include the Illicit Discharge Compliance Statement required by Standard 10. If not included in the Stormwater Report, the Illicit Discharge Compliance Statement must be submitted prior to the discharge of stormwater runoff to the post-construction best management practices.

² For some complex projects, it may not be possible to include the Construction Period Erosion and Sedimentation Control Plan in the Stormwater Report. In that event, the issuing authority has the discretion to issue an Order of Conditions that approves the project and includes a condition requiring the proponent to submit the Construction Period Erosion and Sedimentation Control Plan before commencing any land disturbance activity on the site.



Checklist for Stormwater Report

B. Stormwater Checklist and Certification

The following checklist is intended to serve as a guide for applicants as to the elements that ordinarily need to be addressed in a complete Stormwater Report. The checklist is also intended to provide conservation commissions and other reviewing authorities with a summary of the components necessary for a comprehensive Stormwater Report that addresses the ten Stormwater Standards.

Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the item is not applicable (N.A.) and provide the reasons for that determination.

A complete checklist must include the Certification set forth below signed by the Registered Professional Engineer who prepared the Stormwater Report.

Registered Professional Engineer's Certification

I have reviewed the Stormwater Report, including the soil evaluation, computations, Long-term Pollution Prevention Plan, the Construction Period Erosion and Sedimentation Control Plan (if included), the Long-term Post-Construction Operation and Maintenance Plan, the Illicit Discharge Compliance Statement (if included) and the plans showing the stormwater management system, and have determined that they have been prepared in accordance with the requirements of the Stormwater Management Standards as further elaborated by the Massachusetts Stormwater Handbook. I have also determined that the information presented in the Stormwater Checklist is accurate and that the information presented in the Stormwater Report accurately reflects conditions at the site as of the date of this permit application.

Registered Professional Engineer Block and Signature

Signature and Date

Checklist

Project Type: Is the application for new development, redevelopment, or a mix of new and redevelopment?

- New development
- Redevelopment
- Mix of New Development and Redevelopment



Checklist for Stormwater Report

Checklist (continued)

LID Measures: Stormwater Standards require LID measures to be considered. Document what environmentally sensitive design and LID Techniques were considered during the planning and design of the project:

- No disturbance to any Wetland Resource Areas
- Site Design Practices (e.g. clustered development, reduced frontage setbacks)
- Reduced Impervious Area (Redevelopment Only)
- Minimizing disturbance to existing trees and shrubs
- LID Site Design Credit Requested:
 - Credit 1
 - Credit 2
 - Credit 3
- Use of “country drainage” versus curb and gutter conveyance and pipe
- Bioretention Cells (includes Rain Gardens)
- Constructed Stormwater Wetlands (includes Gravel Wetlands designs)
- Treebox Filter
- Water Quality Swale
- Grass Channel
- Green Roof
- Other (describe): _____

Standard 1: No New Untreated Discharges

- No new untreated discharges
- Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth
- Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.



Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

- Standard 2 waiver requested because the project is located in land subject to coastal storm flowage and stormwater discharge is to a wetland subject to coastal flooding.
- Evaluation provided to determine whether off-site flooding increases during the 100-year 24-hour storm.
- Calculations provided to show that post-development peak discharge rates do not exceed pre-development rates for the 2-year and 10-year 24-hour storms. If evaluation shows that off-site flooding increases during the 100-year 24-hour storm, calculations are also provided to show that post-development peak discharge rates do not exceed pre-development rates for the 100-year 24-hour storm.

Standard 3: Recharge

- Soil Analysis provided.
- Required Recharge Volume calculation provided.
- Required Recharge volume reduced through use of the LID site Design Credits.
- Sizing the infiltration, BMPs is based on the following method: Check the method used.
 - Static
 - Simple Dynamic
 - Dynamic Field¹
- Runoff from all impervious areas at the site discharging to the infiltration BMP.
- Runoff from all impervious areas at the site is *not* discharging to the infiltration BMP and calculations are provided showing that the drainage area contributing runoff to the infiltration BMPs is sufficient to generate the required recharge volume.
- Recharge BMPs have been sized to infiltrate the Required Recharge Volume.
- Recharge BMPs have been sized to infiltrate the Required Recharge Volume *only* to the maximum extent practicable for the following reason:
 - Site is comprised solely of C and D soils and/or bedrock at the land surface
 - M.G.L. c. 21E sites pursuant to 310 CMR 40.0000
 - Solid Waste Landfill pursuant to 310 CMR 19.000
 - Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.
- Calculations showing that the infiltration BMPs will drain in 72 hours are provided.
- Property includes a M.G.L. c. 21E site or a solid waste landfill and a mounding analysis is included.

¹ 80% TSS removal is required prior to discharge to infiltration BMP if Dynamic Field method is used.



Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

- The infiltration BMP is used to attenuate peak flows during storms greater than or equal to the 10-year 24-hour storm and separation to seasonal high groundwater is less than 4 feet and a mounding analysis is provided.
- Documentation is provided showing that infiltration BMPs do not adversely impact nearby wetland resource areas.

Standard 4: Water Quality

The Long-Term Pollution Prevention Plan typically includes the following:

- Good housekeeping practices;
 - Provisions for storing materials and waste products inside or under cover;
 - Vehicle washing controls;
 - Requirements for routine inspections and maintenance of stormwater BMPs;
 - Spill prevention and response plans;
 - Provisions for maintenance of lawns, gardens, and other landscaped areas;
 - Requirements for storage and use of fertilizers, herbicides, and pesticides;
 - Pet waste management provisions;
 - Provisions for operation and management of septic systems;
 - Provisions for solid waste management;
 - Snow disposal and plowing plans relative to Wetland Resource Areas;
 - Winter Road Salt and/or Sand Use and Storage restrictions;
 - Street sweeping schedules;
 - Provisions for prevention of illicit discharges to the stormwater management system;
 - Documentation that Stormwater BMPs are designed to provide for shutdown and containment in the event of a spill or discharges to or near critical areas or from LUHPPL;
 - Training for staff or personnel involved with implementing Long-Term Pollution Prevention Plan;
 - List of Emergency contacts for implementing Long-Term Pollution Prevention Plan.
- A Long-Term Pollution Prevention Plan is attached to Stormwater Report and is included as an attachment to the Wetlands Notice of Intent.
 - Treatment BMPs subject to the 44% TSS removal pretreatment requirement and the one inch rule for calculating the water quality volume are included, and discharge:
 - is within the Zone II or Interim Wellhead Protection Area
 - is near or to other critical areas
 - is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)
 - involves runoff from land uses with higher potential pollutant loads.
 - The Required Water Quality Volume is reduced through use of the LID site Design Credits.
 - Calculations documenting that the treatment train meets the 80% TSS removal requirement and, if applicable, the 44% TSS removal pretreatment requirement, are provided.



Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

- The BMP is sized (and calculations provided) based on:
 - The ½" or 1" Water Quality Volume or
 - The equivalent flow rate associated with the Water Quality Volume and documentation is provided showing that the BMP treats the required water quality volume.
- The applicant proposes to use proprietary BMPs, and documentation supporting use of proprietary BMP and proposed TSS removal rate is provided. This documentation may be in the form of the propriety BMP checklist found in Volume 2, Chapter 4 of the Massachusetts Stormwater Handbook and submitting copies of the TARP Report, STEP Report, and/or other third party studies verifying performance of the proprietary BMPs.
- A TMDL exists that indicates a need to reduce pollutants other than TSS and documentation showing that the BMPs selected are consistent with the TMDL is provided.

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

- The NPDES Multi-Sector General Permit covers the land use and the Stormwater Pollution Prevention Plan (SWPPP) has been included with the Stormwater Report.
- The NPDES Multi-Sector General Permit covers the land use and the SWPPP will be submitted **prior to** the discharge of stormwater to the post-construction stormwater BMPs.
- The NPDES Multi-Sector General Permit does **not** cover the land use.
- LUHPPLs are located at the site and industry specific source control and pollution prevention measures have been proposed to reduce or eliminate the exposure of LUHPPLs to rain, snow, snow melt and runoff, and been included in the long term Pollution Prevention Plan.
- All exposure has been eliminated.
- All exposure has **not** been eliminated and all BMPs selected are on MassDEP LUHPPL list.
- The LUHPPL has the potential to generate runoff with moderate to higher concentrations of oil and grease (e.g. all parking lots with >1000 vehicle trips per day) and the treatment train includes an oil grit separator, a filtering bioretention area, a sand filter or equivalent.

Standard 6: Critical Areas

- The discharge is near or to a critical area and the treatment train includes only BMPs that MassDEP has approved for stormwater discharges to or near that particular class of critical area.
- Critical areas and BMPs are identified in the Stormwater Report.



Checklist for Stormwater Report

Checklist (continued)

Standard 7: Redevelopments and Other Projects Subject to the Standards only to the maximum extent practicable

- The project is subject to the Stormwater Management Standards only to the maximum Extent Practicable as a:
 - Limited Project
 - Small Residential Projects: 5-9 single family houses or 5-9 units in a multi-family development provided there is no discharge that may potentially affect a critical area.
 - Small Residential Projects: 2-4 single family houses or 2-4 units in a multi-family development with a discharge to a critical area
 - Marina and/or boatyard provided the hull painting, service and maintenance areas are protected from exposure to rain, snow, snow melt and runoff
 - Bike Path and/or Foot Path
 - Redevelopment Project
 - Redevelopment portion of mix of new and redevelopment.
- Certain standards are not fully met (Standard No. 1, 8, 9, and 10 must always be fully met) and an explanation of why these standards are not met is contained in the Stormwater Report.
- The project involves redevelopment and a description of all measures that have been taken to improve existing conditions is provided in the Stormwater Report. The redevelopment checklist found in Volume 2 Chapter 3 of the Massachusetts Stormwater Handbook may be used to document that the proposed stormwater management system (a) complies with Standards 2, 3 and the pretreatment and structural BMP requirements of Standards 4-6 to the maximum extent practicable and (b) improves existing conditions.

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

A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan must include the following information:

- Narrative;
 - Construction Period Operation and Maintenance Plan;
 - Names of Persons or Entity Responsible for Plan Compliance;
 - Construction Period Pollution Prevention Measures;
 - Erosion and Sedimentation Control Plan Drawings;
 - Detail drawings and specifications for erosion control BMPs, including sizing calculations;
 - Vegetation Planning;
 - Site Development Plan;
 - Construction Sequencing Plan;
 - Sequencing of Erosion and Sedimentation Controls;
 - Operation and Maintenance of Erosion and Sedimentation Controls;
 - Inspection Schedule;
 - Maintenance Schedule;
 - Inspection and Maintenance Log Form.
- A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan containing the information set forth above has been included in the Stormwater Report.



Checklist for Stormwater Report

Checklist (continued)

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control (continued)

- The project is highly complex and information is included in the Stormwater Report that explains why it is not possible to submit the Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan with the application. A Construction Period Pollution Prevention and Erosion and Sedimentation Control has **not** been included in the Stormwater Report but will be submitted **before** land disturbance begins.
- The project is **not** covered by a NPDES Construction General Permit.
- The project is covered by a NPDES Construction General Permit and a copy of the SWPPP is in the Stormwater Report.
- The project is covered by a NPDES Construction General Permit but no SWPPP been submitted. The SWPPP will be submitted BEFORE land disturbance begins.

Standard 9: Operation and Maintenance Plan

- The Post Construction Operation and Maintenance Plan is included in the Stormwater Report and includes the following information:
 - Name of the stormwater management system owners;
 - Party responsible for operation and maintenance;
 - Schedule for implementation of routine and non-routine maintenance tasks;
 - Plan showing the location of all stormwater BMPs maintenance access areas;
 - Description and delineation of public safety features;
 - Estimated operation and maintenance budget; and
 - Operation and Maintenance Log Form.
- The responsible party is **not** the owner of the parcel where the BMP is located and the Stormwater Report includes the following submissions:
 - A copy of the legal instrument (deed, homeowner's association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of the project site stormwater BMPs;
 - A plan and easement deed that allows site access for the legal entity to operate and maintain BMP functions.

Standard 10: Prohibition of Illicit Discharges

- The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;
- An Illicit Discharge Compliance Statement is attached;
- NO Illicit Discharge Compliance Statement is attached but will be submitted **prior to** the discharge of any stormwater to post-construction BMPs.

STORMWATER MANAGEMENT CALCULATIONS

Total Impervious Area

Pavement: 45,260 sq.ft. /1.039 ac.
Buildings: 10,000 sq.ft. /0.230 ac.
Total 55,260 sq.ft. / 1.269 ac.

Standard #3: Recharge to Groundwater

Recharge Required: $(0.25''/12) * 55,260 \text{ sq. ft. "C" impervious} = 1,151 \text{ cu.ft.}$
Recharge Provided: 4,830 cu. ft. @ elev. 725.10 in infiltration basin

Drawdown within 72 hours

Time: $(4,830 \text{ cu.ft.}/(0.27''/\text{hr} * (1'/12'') * 5,001 \text{ sq.ft.})) = 42.9 \text{ hours in infiltration basin}$

Standard #4: Water Quality

Treatment Volume Required: $(0.5''/12) * 45,260 \text{ sq. ft. new pavement area} = 1,886 \text{ cu. ft.}$
Treatment Volume Provided: 4,830 cu. ft. @ elev. 725.10 in infiltration basin

Forebay Sizing

Forebay 1: Forebay Treatment Volume Required: $(0.1''/12) * 14,000 \text{ sq. ft.} = 117 \text{ cu. ft.}$
Forebay Treatment Volume Provided: 325 cu. ft. @ elev. 731.0 in forebay 1

Forebay 2: Forebay Treatment Volume Required: $(0.1''/12) * 29,120 \text{ sq. ft.} = 243 \text{ cu. ft.}$
Forebay Treatment Volume Provided: 3264 cu. ft. @ elev. 728.88 in forebay 2

STORMWATER NARRATIVE

Design Methods and Objectives

The design of this industrial site has been prepared in accordance with Stormwater Management Standards to the maximum extent practical as outlined in the Stormwater Management Handbook. In particular, the site has been designed to ensure:

1. No new stormwater conveyances will discharge untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth. All new pavement runoff from impervious area is routed through an infiltration basin.
2. Stormwater management systems are designed so that the post-development peak discharge rate does not exceed pre-development peak discharge rates. Drainage calculations demonstrate that the peak rate of runoff is reduced in the post development condition through the use of an infiltration basin.
3. Loss of annual recharge to ground water is minimized through the use of an infiltration basin. The basin and riser designed will provide 4,830 cu.ft. of storage volume which is greater than the required recharge volume required for "C" soils, 1,151 cu.ft.
4. Stormwater management systems are designed to remove a minimum of 80% TSS. The use of an infiltration basin provides a minimum of 80% TSS removal for new parking areas.
5. The use of the site for a office/general industrial use is not a risk for producing higher pollutant loads. Notwithstanding, the treatment of runoff from this portion of the site will ensure treatment of any potential pollutants.
6. This site is not within a Zone II or interim wellhead protection area.
7. This project is a new development and stormwater management guidelines are met.
8. For construction related activities, an operation and maintenance plan has been incorporated into the Stormwater Management Report to ensure that a protocol for runoff control is in place prior to any construction activities.
9. The operation and maintenance plan as provided provides a protocol to ensure that the stormwater management system will function as designed.
10. Prior to any construction related activities taking place, a certification regarding illicit discharges will be submitted.

INSTRUCTIONS:

1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Version 1, Automated: Mar. 4, 2008

Location:

	B	C	D	E	F
	BMP ¹	TSS Removal Rate ¹	Starting TSS Load*	Amount Removed (C*D)	Remaining Load (D-E)
TSS Removal Calculation Worksheet	Infiltration Basin	0.80	1.00	0.80	0.20
		0.00	0.20	0.00	0.20
		0.00	0.20	0.00	0.20
		0.00	0.20	0.00	0.20
		0.00	0.20	0.00	0.20

Total TSS Removal =

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project:
 Prepared By:
 Date:

*Equals remaining load from previous BMP (E) which enters the BMP

OPERATION AND MAINTENANCE PLAN

51 Technology Park Road, Sturbridge

September 5, 2019

The following are operation and maintenance instructions for both construction and post-development stormwater controls. The goal of these plans is to ensure that the stormwater system, as designed, will function properly during construction and for the future of the site. The developer of the parcel is Dileo Gas. Paul Dileo, Jr. is the contact person for work related to this project, and can be contacted at the following number: (508) 797-5878.

Construction Operation and Maintenance Plan:

1. All erosion and sediment control devices installed prior to construction shall be inspected on a daily basis. Any deficiencies in the siltation fence shall be corrected immediately. Any accumulated silt shall be removed manually from the silt fence. Silt barrier should be inspected daily to ensure that there is no accumulation of sediments.
2. The most important aspects of controlling erosion and sedimentation are limiting the extent of disturbance and stabilizing surfaces as soon as possible. Of secondary importance in erosion control is limiting the size and length of the tributary drainage area within the work site and drainage structures. These fundamental principles shall be the key factor in the control of erosion on the site.
3. All disturbed surfaces shall be stabilized a minimum of 14 days after construction in any portion of the site has ceased or is temporarily halted unless additional construction is intended to be initiated within 21 days.
4. Hydroseeding and hay mulching shall be performed immediately after construction to minimize erosion damage. Newly seeded slopes shall be inspected every two weeks for the first few months to ensure that revegetation has occurred. Repairs and reseeded shall be performed immediately as the need arises.
5. As noted on the site plans, a temporary settling basin shall be used to capture runoff from up-gradient areas during construction.
6. At no time shall silt laden water be allowed to enter sensitive areas (wetlands, and off-site areas). Any runoff from disturbed surfaces shall be directed through settling basins and erosion control barriers prior to entering any sensitive areas.
7. At the completion of construction all areas are to be loamed and seeded to ensure that the site is stabilized.

Post Development Operation and Maintenance Plan:

1. Seeding and repairs shall be performed as required. Sediment and debris shall be removed at least once a year, typically in early spring prior to the commencement of the growing season.
2. The drop inlet on the site shall be inspected annually. Unit shall be cleaned when accumulated sediments reach a depth of 6 inches. Accumulated sediment must be disposed of in accordance with applicable local state, and federal guidelines and regulations. The contractor will be responsible for the maintenance of the unit until such time as the site work is complete. The maintenance will then be the responsibility of the owner(s).
3. A contract with a licensed hauler shall be in place for maintenance of drainage structures to ensure the long term performance of the drainage system.
4. The infiltration basin and sediment forebays shall be inspected after every major storm for the first 3 months and on a semi-annual basis after to ensure that it is functioning properly and that the vegetation is adequately established. It shall be inspected for the following: slope integrity, soil moisture, vegetative health, soil stability, soil compaction, soil erosion, ponding, and sediment. Regular maintenance shall include: regular mowing (not shorter than 4”).
5. The drainage swales shall be inspected at least twice annually. Weeds and other vegetation shall be removed as necessary. The outlets shall be inspected twice annually and kept clear of debris. Sediment and debris shall be removed once a year. Grass height shall be between 3 and 6 inches.
6. The contractor will be responsible for the maintenance of all drainage structures and until such time as the site work is complete. The maintenance will then be the responsibility of the property owners.

LONG TERM POLLUTION PREVENTION PLAN

51 Technology Park Road, Sturbridge

September 5, 2019

This plan was developed in compliance with the Massachusetts Department of Environmental Protection Stormwater Requirements

Good Housekeeping

The proposed site is designed to maintain high quality water treatment for all runoff. A general maintenance plan has been prepared and will be followed in a strict and complete manner as required.

Spill Prevention Plan

No hazardous materials will be stored on site. However the flowing spill prevention plan will be incorporated into the Long Term Pollution Prevention Plan

1. Manufacturers recommended methods for spill cleanup will be clearly posted. Site personnel will be made aware of the procedures and location of the information and cleanup supplies.
2. Materials and equipment necessary for spill cleanup will be kept in the materials storage area. Equipment and materials will include, but is not limited to, brooms dust pans, mops, rags, gloves, sand and trash containers specifically for this purpose.
3. All spills will be cleaned up immediately after discovery.
4. The spill area will be kept will ventilated and personnel will wear appropriate protective clothing to prevent injury from contact with a hazardous substance.
5. Spills of toxic or hazardous material will be reported, regardless of size, to the Massachusetts Department of Environmental Protection (888) 304-1133
6. Should a spill occur, the spill prevention plan will be adjusted to include measures to prevent another spill and to cleanup the spill should another occur. A description of the spill along with the causes and cleanup measures will be included in the updated pollution prevention plan.
7. The construction superintendant responsible for daily operation on the site will be the spill prevention and cleanup coordinator. The superintendant will designate at least three site personnel to receive spill prevention cleanup training. The names of the responsible spill personnel will be posted in the material storage area.

Construction Inspection & Maintenance Schedule

1. Haybales and silt fence shall be inspected weekly and after storm events for damage and excessive silting. Damaged fence shall be replaced immediately.
2. Temporary construction entrance shall be inspected weekly and after heavy storm events or heavy use. The entrance shall be maintained in a condition that will prevent sediment tracking offsite. All sediment tracked onto Technology Park Road shall be swept up immediately
3. Stockpiled sediment shall be mulched if they are to remain for more than three weeks. The stockpiles shall be inspected weekly and after storm events for erosion damage. Additional mulch shall be added if needed.
4. Loamed and seeded area shall be inspected after final grading for areas that need to be reseeded or restabilized.
5. Temporary diversion swales shall be inspected weekly and after storm events for erosion damage and excessive silting. Silt shall be removed if necessary. Any erosion damage shall be repaired immediately.
6. The temporary construction basin shall be inspected weekly and after storm events for erosion damage and excessive silting.

Stormwater BMP Maintenance

A full BMP maintenance plan has been prepared (see Operation & Maintenance Plan) in order to ensure that the stormwater management system will function properly and as designed.

Landscape and Lawn Maintenance

Routine mowing and associated maintenance of all landscape features will occur weekly or as needed to prevent excessive growth of vegetation on site.

Fertilizers, Herbicides & Pesticides

Fertilizer, herbicide & pesticide use will be limited to that typically associated with commercial lawns. All fertilizer, herbicide & pesticide use will comply with local, state and federal requirements.

Solid Waste Maintenance

Solid waste is handled on site and will comply with all local, state and federal requirements.

Snow Disposal

Snow disposal areas are shown on the site plan. Snow disposal shall not be directed toward wetland resource areas.

Winter Salt & Sand Use

All winter salt and/or sand will comply with all local, state and federal requirements.

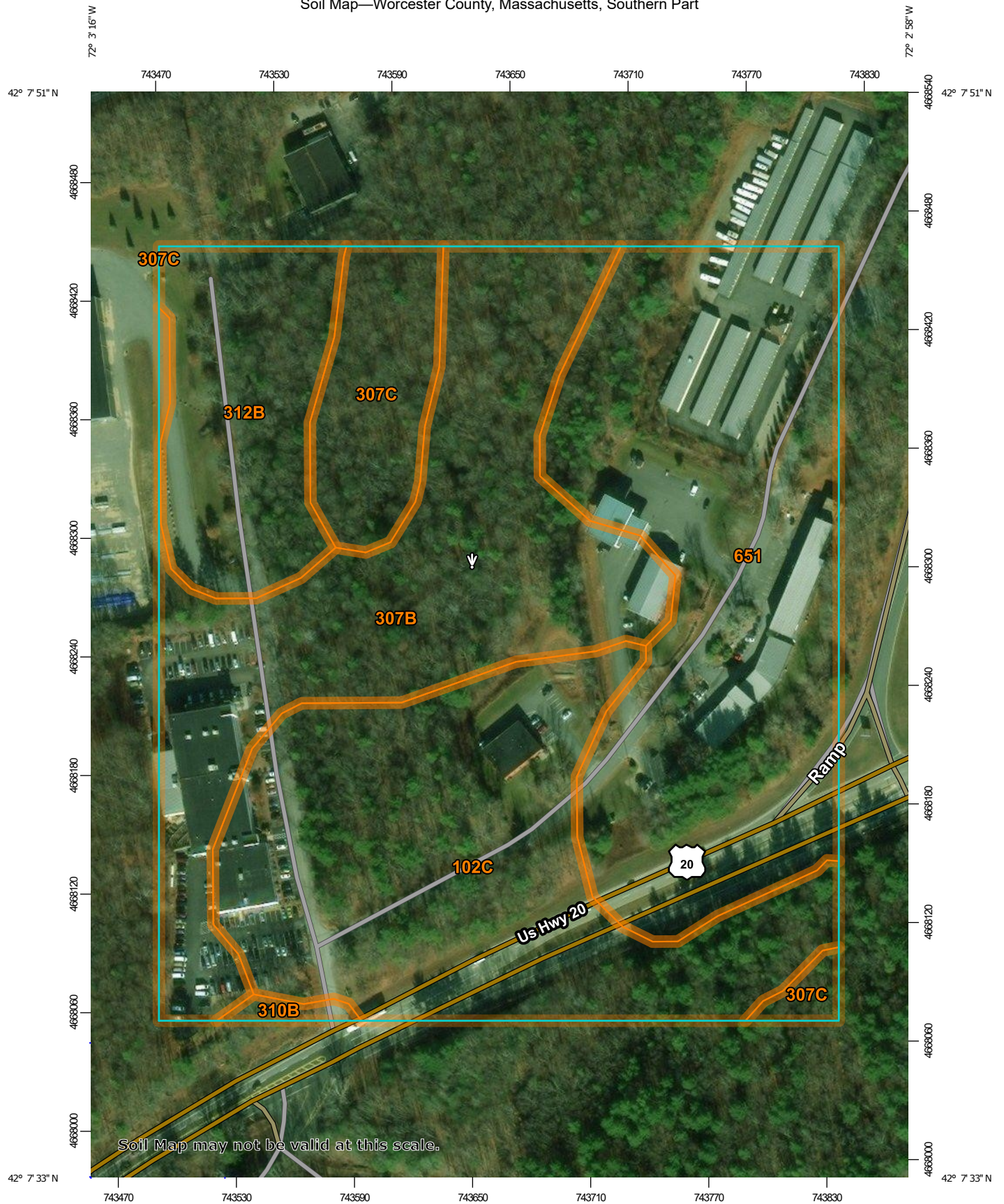
Training of Staff

All personnel on site will be briefed on all requirements for implementing the Long Term Pollution Prevention Plan

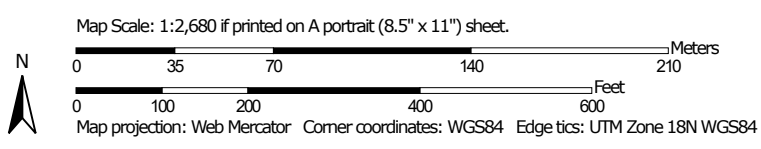
Emergency Contact for Long Term Pollution Prevention Plan

J.M. Grenier Associates, Inc.
787 Hartford Turnpike
Shrewsbury, MA 01545
(508) 845-2500

Soil Map—Worcester County, Massachusetts, Southern Part




Soil Map may not be valid at this scale.



MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

 Soil Map Unit Polygons

 Soil Map Unit Lines

 Soil Map Unit Points

Special Point Features



Blowout



Borrow Pit



Clay Spot



Closed Depression



Gravel Pit



Gravelly Spot



Landfill



Lava Flow



Marsh or swamp



Mine or Quarry



Miscellaneous Water



Perennial Water



Rock Outcrop



Saline Spot



Sandy Spot



Severely Eroded Spot



Sinkhole



Slide or Slip



Sodic Spot



Spoil Area



Stony Spot



Very Stony Spot



Wet Spot



Other



Special Line Features

Water Features



Streams and Canals

Transportation



Rails



Interstate Highways



US Routes



Major Roads



Local Roads

Background



Aerial Photography

MAP INFORMATION

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

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Worcester County, Massachusetts, Southern Part
Survey Area Data: Version 11, Sep 11, 2018

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

Date(s) aerial images were photographed: Apr 14, 2011—Aug 27, 2016

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
102C	Chatfield-Hollis-Rock outcrop complex, 0 to 15 percent slopes	9.0	27.0%
307B	Paxton fine sandy loam, 0 to 8 percent slopes, extremely stony	8.4	25.1%
307C	Paxton fine sandy loam, 8 to 15 percent slopes, extremely stony	2.2	6.7%
310B	Woodbridge fine sandy loam, 3 to 8 percent slopes	0.2	0.5%
312B	Woodbridge fine sandy loam, 0 to 8 percent slopes, extremely stony	3.5	10.4%
651	Udorthents, smoothed	10.2	30.4%
Totals for Area of Interest		33.6	100.0%