

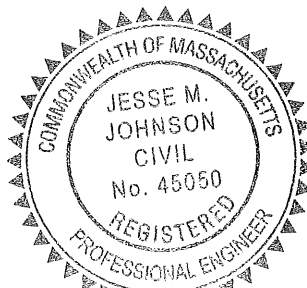
STORMWATER MANAGEMENT REPORT

FOR

**DLR REALTY TRUST
ASHBY, MA**

*SITE PLAN IN ASHBY, MA
873 MAIN STREET*

PREPARED BY DAVID E. ROSS ASSOCIATES, INC.



Jesse Johnson
12/30/10

DRAINAGE CALCULATIONS

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Narrative Summary

Drainage calculations have been prepared using the HydroCAD Stormwater Modeling System. HydroCAD uses the Soil Conservation Service (SCS) TR-20 methodology.

Pre-Development Conditions:

The locus property contains approximately 3.8 acres of varying terrain. The portion of the locus proposed for redevelopment is approximately 2.5 acres. The area proposed for redevelopment is comprised of an existing office building, access and parking, lawn area, and woods with light underbrush. A ponding area and associated bordering vegetated wetland (BVW) exists to the rear northeast portion of the property. The portions of the property proposed to remain undisturbed are wooded with light underbrush.

The Soil Survey of Middlesex County, issued by the USDA Soil Conservation Service (SCS), now the Natural Resources Conservation Service, includes delineation of soils in the vicinity of the locus by name and by hydrologic characteristics. The soils located within the drainage area are identified as Paxton Fine Sandy Loams. The Soil Survey identifies these soils within hydrologic soil group C. On August 13, 2010, a soil test hole (see Appendix A) was conducted to confirm soils shown by the USGS and the USDA and to establish groundwater elevations at the site. The test hole observations are consistent with the published reports and existing surface conditions.

The existing, predevelopment drainage area has been divided into three (3) drainage areas (subcatchments 1 through 3). Subcatchment 1 naturally flows southwest with a point of concentration along Main Street (Pond 1). Subcatchment 2 naturally flows southeast with a point of concentration at a ponding area and adjacent retaining wall. There is an existing 12" outfall pipe at this location that serves to convey any stormwater overflow to existing stormwater infrastructure southeast of the site. The pipe inlet was chosen as a point of analysis (Pond 2). Subcatchment 3 naturally flows easterly to the BVW adjacent to the ponded area at the rear of the property. This wetland was chosen as a point of analysis (Pond 3).

DRAINAGE CALCULATIONS

Post-Development Conditions:

The proposed redevelopment consists of two buildings. The front building is proposed for office, retail, and restaurant use. The rear building is proposed for municipal use. There will be associated parking, access, landscaping, and utilities for the new buildings. The existing building and impervious areas have no drainage infrastructure to treat and attenuate existing stormwater flows. The existing building will be razed and all existing pavement will be removed and replaced with loam and seed or new impervious surfaces that will be collected, treated, and attenuated. There is a net increase in impervious surface for the project of approximately 27,003 sq.ft. However, 16,325 sq.ft. of that is roof area that is considered "clean" runoff. Additionally, there is no runoff from impervious surfaces directed toward the wetland at the rear of the property. The new buildings will be serviced by a public water supply well that will be developed at the northeast end of the property. Also, an on-site sewage disposal system and stormwater collection system will be provided.

Proposed (post-development) runoff patterns will generally continue as in pre-development. The post-development points of analysis are Main Street (Pond 4), the pipe inlet at the existing retaining wall (Pond 10), and the BVW associated with the ponding area (Pond 8). Under post development conditions, the three predevelopment subcatchments have been divided into 6 subcatchments (4 through 9).

Runoff from developed areas will be collected by grassed channels or catch basins. The grassed channels and catch basins are designed to pre-treat the stormwater from non-roof areas prior to discharge to the rain gardens. The grassed channels will have stone check dams installed every 50 feet to increase treatment and infiltration.

Roof runoff will be directed to stone drip trenches sized to hold and recharge the first inch of stormwater.

The landscaped rain gardens are proposed along both sides of the property near Main Street. Rain gardens are proposed to provide Low Impact Development (LID) design elements to the project and improve aesthetics along the frontage. An outlet structure in each rain garden serves as the primary outlet. For stormwater control, there will be an underdrain along the bottom of the rain garden connected to the outlet structure and catch basin grates set 6" above the top surface. This will ensure that large storm events will be controlled and that down stream flooding will not occur. The overflow from Rain Garden #1 is directed to Rain Garden #2 in order to better equalize the site and prevent flooding on to Main Street. Additionally, wicks are proposed along the bottom of each rain garden to ensure infiltration during frozen ground conditions. For further consideration of snow events, catch basin inlets are proposed along the edge of pavement at low points. These will serve to convey stormwater that can not reach the grassed channels due to snow buildup along the shoulders.

Summary of Calculations

The following charts summarize the peak surface stormwater runoff (in cubic feet per second (CFS)) for each storm event using (SCS) TR-20 methodology. Calculations have been provided for the 2, 10, 25, and 100-year storm events to illustrate the collection systems performance under various design storm rates.

SUMMARY OF 2-YEAR STORM:

<u>(Pre / Post)</u>	<u>Pre-development</u>	<u>Post-development</u>
1P / 4P	0.46 CFS	0.12 CFS
2P / 10P	1.92 CFS	0.00 CFS
3P / 8P	0.79 CFS	0.73 CFS

DECEMBER, 2010
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ASHBY, MASS.
PROJECT NO. 24062

DRAINAGE CALCULATIONS

SUMMARY OF 10-YEAR STORM:

Pond No.		
(Pre / Post)	Pre-development	Post-development
1P / 4P	0.78 CFS	0.26 CFS
2P / 10P	3.76 CFS	1.32 CFS
3P / 8P	1.71 CFS	1.65 CFS

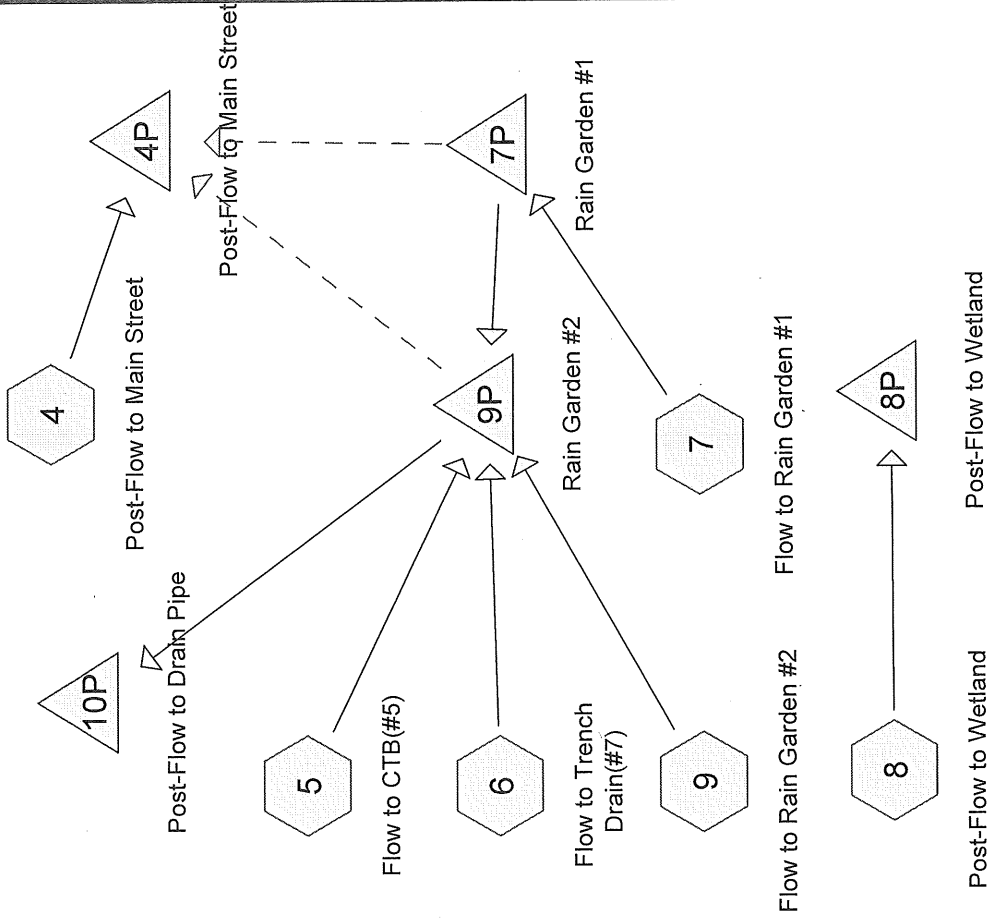
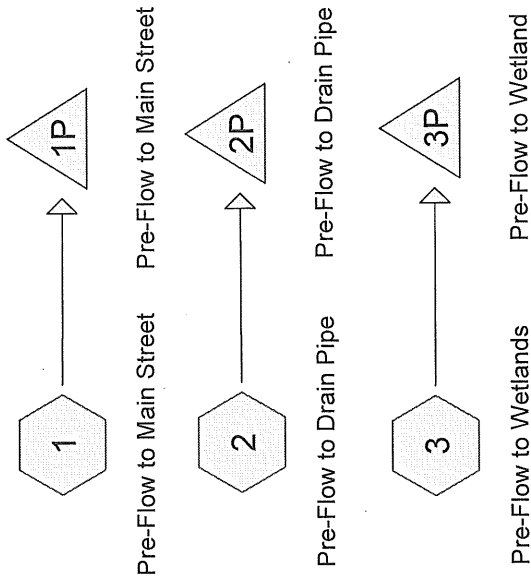
SUMMARY OF 25-YEAR STORM:

Pond No.		
(Pre / Post)	Pre-development	Post-development
1P / 4P	0.94 CFS	0.33 CFS
2P / 10P	4.75 CFS	2.58 CFS
3P / 8P	2.22 CFS	2.17 CFS

SUMMARY OF 100-YEAR STORM:

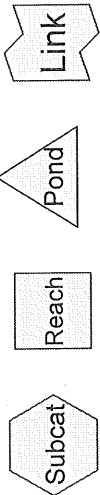
Pond No.		
(Pre / Post)	Pre-development	Post-development
1P / 4P	1.18 CFS	1.09 CFS
2P / 10P	6.21 CFS	3.62 CFS
3P / 8P	3.00 CFS	2.95 CFS

Under post development conditions, the results indicate that the three drainage areas will experience a decrease in peak rate of runoff for the calculated storm event. Accordingly, we do not anticipate adverse effects or flooding of neighboring or down gradient properties.



Drainage Diagram for 24062 - Rainville

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HYDROCAD DATA

- 2 Year Event - Summary Only
- 10 Year Event - Summary Only
- 25 Year Event - Summary Only
- 100 Year Event - Summary Only

24062 - Rainville

873 MAIN STREET - ASHBY, MA
Type III 24-hr 2-Year Storm Rainfall=2.95"

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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
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1: Pre-Flow to Main Street Runoff Area=9,475 sf 61.16% Impervious Runoff Depth>1.74"
Tc=6.0 min CN=89 Runoff=0.46 cfs 0.032 af

Subcatchment 2: Pre-Flow to Drain Pipe Runoff Area=84,015 sf 23.78% Impervious Runoff Depth>1.17"
Flow Length=435' Tc=19.7 min CN=81 Runoff=1.92 cfs 0.188 af

Subcatchment 3: Pre-Flow to Wetlands Runoff Area=35,845 sf 0.00% Impervious Runoff Depth>0.89"
Flow Length=166' Tc=9.6 min CN=76 Runoff=0.79 cfs 0.061 af

Subcatchment 4: Post-Flow to Main Street Runoff Area=4,445 sf 16.31% Impervious Runoff Depth>1.00"
Tc=6.0 min CN=78 Runoff=0.12 cfs 0.009 af

Subcatchment 5: Flow to CTB(#5) Runoff Area=3,300 sf 100.00% Impervious Runoff Depth>2.54"
Tc=6.0 min CN=98 Runoff=0.21 cfs 0.016 af

Subcatchment 6: Flow to Trench Drain(#7) Runoff Area=3,660 sf 91.80% Impervious Runoff Depth>2.36"
Tc=6.0 min CN=96 Runoff=0.23 cfs 0.017 af

Subcatchment 7: Flow to Rain Garden #1 Runoff Area=31,312 sf 51.40% Impervious Runoff Depth>1.51"
Flow Length=250' Slope=0.0200 '/' Tc=9.3 min CN=86 Runoff=1.20 cfs 0.090 af

Subcatchment 8: Post-Flow to Wetland Runoff Area=38,637 sf 0.00% Impervious Runoff Depth>0.84"
Flow Length=275' Tc=11.9 min CN=75 Runoff=0.73 cfs 0.062 af

Subcatchment 9: Flow to Rain Garden #2 Runoff Area=47,981 sf 54.81% Impervious Runoff Depth>1.58"
Flow Length=242' Tc=8.4 min CN=87 Runoff=1.99 cfs 0.145 af

Pond 1P: Pre-Flow to Main Street Inflow=0.46 cfs 0.032 af
Primary=0.46 cfs 0.032 af

Pond 2P: Pre-Flow to Drain Pipe Inflow=1.92 cfs 0.188 af
Primary=1.92 cfs 0.188 af

Pond 3P: Pre-Flow to Wetland Inflow=0.79 cfs 0.061 af
Primary=0.79 cfs 0.061 af

Pond 4P: Post-Flow to Main Street Inflow=0.12 cfs 0.009 af
Primary=0.12 cfs 0.009 af

Pond 7P: Rain Garden #1 Peak Elev=913.80' Storage=2,389 cf Inflow=1.20 cfs 0.090 af
Discarded=0.04 cfs 0.028 af Primary=0.04 cfs 0.015 af Secondary=0.00 cfs 0.000 af Outflow=0.07 cfs 0.043 af

Pond 8P: Post-Flow to Wetland Inflow=0.73 cfs 0.062 af
Primary=0.73 cfs 0.062 af

Pond 9P: Rain Garden #2 Peak Elev=909.27' Storage=5,354 cf Inflow=2.40 cfs 0.193 af
Discarded=0.08 cfs 0.074 af Primary=0.00 cfs 0.000 af Secondary=0.00 cfs 0.000 af Outflow=0.08 cfs 0.074 af

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Pond 10P: Post-Flow to Drain Pipe

Inflow=0.00 cfs 0.000 af
Primary=0.00 cfs 0.000 af

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Type III 24-hr 10-Year Storm Rainfall=4.39"

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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
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1: Pre-Flow to Main Street Runoff Area=9,475 sf 61.16% Impervious Runoff Depth>3.01"
Tc=6.0 min CN=89 Runoff=0.78 cfs 0.055 af

Subcatchment 2: Pre-Flow to Drain Pipe Runoff Area=84,015 sf 23.78% Impervious Runoff Depth>2.28"
Flow Length=435' Tc=19.7 min CN=81 Runoff=3.76 cfs 0.366 af

Subcatchment 3: Pre-Flow to Wetlands Runoff Area=35,845 sf 0.00% Impervious Runoff Depth>1.89"
Flow Length=166' Tc=9.6 min CN=76 Runoff=1.71 cfs 0.130 af

Subcatchment 4: Post-Flow to Main Street Runoff Area=4,445 sf 16.31% Impervious Runoff Depth>2.05"
Tc=6.0 min CN=78 Runoff=0.26 cfs 0.017 af

Subcatchment 5: Flow to CTB(#5) Runoff Area=3,300 sf 100.00% Impervious Runoff Depth>3.86"
Tc=6.0 min CN=98 Runoff=0.32 cfs 0.024 af

Subcatchment 6: Flow to Trench Drain(#7) Runoff Area=3,660 sf 91.80% Impervious Runoff Depth>3.69"
Tc=6.0 min CN=96 Runoff=0.34 cfs 0.026 af

Subcatchment 7: Flow to Rain Garden #1 Runoff Area=31,312 sf 51.40% Impervious Runoff Depth>2.72"
Flow Length=250' Slope=0.0200 '/' Tc=9.3 min CN=86 Runoff=2.13 cfs 0.163 af

Subcatchment 8: Post-Flow to Wetland Runoff Area=38,637 sf 0.00% Impervious Runoff Depth>1.81"
Flow Length=275' Tc=11.9 min CN=75 Runoff=1.65 cfs 0.134 af

Subcatchment 9: Flow to Rain Garden #2 Runoff Area=47,981 sf 54.81% Impervious Runoff Depth>2.82"
Flow Length=242' Tc=8.4 min CN=87 Runoff=3.48 cfs 0.259 af

Pond 1P: Pre-Flow to Main Street Inflow=0.78 cfs 0.055 af
Primary=0.78 cfs 0.055 af

Pond 2P: Pre-Flow to Drain Pipe Inflow=3.76 cfs 0.366 af
Primary=3.76 cfs 0.366 af

Pond 3P: Pre-Flow to Wetland Inflow=1.71 cfs 0.130 af
Primary=1.71 cfs 0.130 af

Pond 4P: Post-Flow to Main Street Inflow=0.26 cfs 0.017 af
Primary=0.26 cfs 0.017 af

Pond 7P: Rain Garden #1 Peak Elev=914.13' Storage=2,959 cf Inflow=2.13 cfs 0.163 af
Discarded=0.04 cfs 0.036 af Primary=0.97 cfs 0.075 af Secondary=0.00 cfs 0.000 af Outflow=1.01 cfs 0.111 af

Pond 8P: Post-Flow to Wetland Inflow=1.65 cfs 0.134 af
Primary=1.65 cfs 0.134 af

Pond 9P: Rain Garden #2 Peak Elev=910.06' Storage=7,882 cf Inflow=4.11 cfs 0.384 af
Discarded=0.10 cfs 0.093 af Primary=1.32 cfs 0.126 af Secondary=0.00 cfs 0.000 af Outflow=1.42 cfs 0.220 af

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Type III 24-hr 10-Year Storm Rainfall=4.39"

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Pond 10P: Post-Flow to Drain Pipe

Inflow=1.32 cfs 0.126 af
Primary=1.32 cfs 0.126 af

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Type III 24-hr 25-Year Storm Rainfall=5.13"

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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
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1: Pre-Flow to Main Street	Runoff Area=9,475 sf 61.16% Impervious Tc=6.0 min CN=89	Runoff Depth>3.68" Runoff=0.94 cfs 0.067 af
Subcatchment 2: Pre-Flow to Drain Pipe	Runoff Area=84,015 sf 23.78% Impervious Flow Length=435' Tc=19.7 min CN=81	Runoff Depth>2.89" Runoff=4.75 cfs 0.464 af
Subcatchment 3: Pre-Flow to Wetlands	Runoff Area=35,845 sf 0.00% Impervious Flow Length=166' Tc=9.6 min CN=76	Runoff Depth>2.45" Runoff=2.22 cfs 0.168 af
Subcatchment 4: Post-Flow to Main Street	Runoff Area=4,445 sf 16.31% Impervious Tc=6.0 min CN=78	Runoff Depth>2.63" Runoff=0.33 cfs 0.022 af
Subcatchment 5: Flow to CTB(#5)	Runoff Area=3,300 sf 100.00% Impervious Tc=6.0 min CN=98	Runoff Depth>4.54" Runoff=0.37 cfs 0.029 af
Subcatchment 6: Flow to Trench Drain(#7)	Runoff Area=3,660 sf 91.80% Impervious Tc=6.0 min CN=96	Runoff Depth>4.37" Runoff=0.41 cfs 0.031 af
Subcatchment 7: Flow to Rain Garden #1	Runoff Area=31,312 sf 51.40% Impervious Flow Length=250' Slope=0.0200 '/' Tc=9.3 min CN=86	Runoff Depth>3.38" Runoff=2.62 cfs 0.202 af
Subcatchment 8: Post-Flow to Wetland	Runoff Area=38,637 sf 0.00% Impervious Flow Length=275' Tc=11.9 min CN=75	Runoff Depth>2.37" Runoff=2.17 cfs 0.175 af
Subcatchment 9: Flow to Rain Garden #2	Runoff Area=47,981 sf 54.81% Impervious Flow Length=242' Tc=8.4 min CN=87	Runoff Depth>3.48" Runoff=4.25 cfs 0.319 af
Pond 1P: Pre-Flow to Main Street		Inflow=0.94 cfs 0.067 af Primary=0.94 cfs 0.067 af
Pond 2P: Pre-Flow to Drain Pipe		Inflow=4.75 cfs 0.464 af Primary=4.75 cfs 0.464 af
Pond 3P: Pre-Flow to Wetland		Inflow=2.22 cfs 0.168 af Primary=2.22 cfs 0.168 af
Pond 4P: Post-Flow to Main Street		Inflow=0.33 cfs 0.022 af Primary=0.33 cfs 0.022 af
Pond 7P: Rain Garden #1	Peak Elev=914.29' Storage=3,274 cf	Inflow=2.62 cfs 0.202 af Outflow=1.48 cfs 0.148 af
Discarded=0.05 cfs 0.038 af	Primary=1.43 cfs 0.110 af	Secondary=0.00 cfs 0.000 af
Pond 8P: Post-Flow to Wetland		Inflow=2.17 cfs 0.175 af Primary=2.17 cfs 0.175 af
Pond 9P: Rain Garden #2	Peak Elev=910.24' Storage=8,685 cf	Inflow=5.49 cfs 0.488 af Outflow=2.69 cfs 0.320 af
Discarded=0.11 cfs 0.098 af	Primary=2.58 cfs 0.222 af	Secondary=0.00 cfs 0.000 af

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Type III 24-hr 25-Year Storm Rainfall=5.13"

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Pond 10P: Post-Flow to Drain Pipe

Inflow=2.58 cfs 0.222 af
Primary=2.58 cfs 0.222 af

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Type III 24-hr 100-Year Storm Rainfall=6.21"

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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

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1: Pre-Flow to Main Street Runoff Area=9,475 sf 61.16% Impervious Runoff Depth>4.67"
Tc=6.0 min CN=89 Runoff=1.18 cfs 0.085 af

Subcatchment 2: Pre-Flow to Drain Pipe Runoff Area=84,015 sf 23.78% Impervious Runoff Depth>3.81"
Flow Length=435' Tc=19.7 min CN=81 Runoff=6.21 cfs 0.613 af

Subcatchment 3: Pre-Flow to Wetlands Runoff Area=35,845 sf 0.00% Impervious Runoff Depth>3.32"
Flow Length=166' Tc=9.6 min CN=76 Runoff=3.00 cfs 0.228 af

Subcatchment 4: Post-Flow to Main Street Runoff Area=4,445 sf 16.31% Impervious Runoff Depth>3.52"
Tc=6.0 min CN=78 Runoff=0.44 cfs 0.030 af

Subcatchment 5: Flow to CTB(#5) Runoff Area=3,300 sf 100.00% Impervious Runoff Depth>5.52"
Tc=6.0 min CN=98 Runoff=0.45 cfs 0.035 af

Subcatchment 6: Flow to Trench Drain(#7) Runoff Area=3,660 sf 91.80% Impervious Runoff Depth>5.37"
Tc=6.0 min CN=96 Runoff=0.49 cfs 0.038 af

Subcatchment 7: Flow to Rain Garden #1 Runoff Area=31,312 sf 51.40% Impervious Runoff Depth>4.35"
Flow Length=250' Slope=0.0200 '/' Tc=9.3 min CN=86 Runoff=3.33 cfs 0.260 af

Subcatchment 8: Post-Flow to Wetland Runoff Area=38,637 sf 0.00% Impervious Runoff Depth>3.22"
Flow Length=275' Tc=11.9 min CN=75 Runoff=2.95 cfs 0.238 af

Subcatchment 9: Flow to Rain Garden #2 Runoff Area=47,981 sf 54.81% Impervious Runoff Depth>4.45"
Flow Length=242' Tc=8.4 min CN=87 Runoff=5.38 cfs 0.409 af

Pond 1P: Pre-Flow to Main Street Inflow=1.18 cfs 0.085 af
Primary=1.18 cfs 0.085 af

Pond 2P: Pre-Flow to Drain Pipe Inflow=6.21 cfs 0.613 af
Primary=6.21 cfs 0.613 af

Pond 3P: Pre-Flow to Wetland Inflow=3.00 cfs 0.228 af
Primary=3.00 cfs 0.228 af

Pond 4P: Post-Flow to Main Street Inflow=1.09 cfs 0.048 af
Primary=1.09 cfs 0.048 af

Pond 7P: Rain Garden #1 Peak Elev=914.75' Storage=3,739 cf Inflow=3.33 cfs 0.260 af
Discarded=0.05 cfs 0.041 af Primary=2.28 cfs 0.160 af Secondary=0.66 cfs 0.003 af Outflow=2.99 cfs 0.204 af

Pond 8P: Post-Flow to Wetland Inflow=2.95 cfs 0.238 af
Primary=2.95 cfs 0.238 af

Pond 9P: Rain Garden #2 Peak Elev=910.48' Storage=9,805 cf Inflow=7.79 cfs 0.642 af
Discarded=0.11 cfs 0.104 af Primary=3.62 cfs 0.350 af Secondary=0.89 cfs 0.015 af Outflow=4.62 cfs 0.469 af

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Type III 24-hr 100-Year Storm Rainfall=6.21"

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Pond 10P: Post-Flow to Drain Pipe

Inflow=3.62 cfs 0.350 af
Primary=3.62 cfs 0.350 af

2-YEAR STORM EVENT
Pre- and Post-Development

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873 MAIN STREET - ASHBY, MA
Type III 24-hr 2-Year Storm Rainfall=2.95"

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Summary for Subcatchment 1: Pre-Flow to Main Street

Runoff = 0.46 cfs @ 12.09 hrs, Volume= 0.032 af, Depth> 1.74"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Storm Rainfall=2.95"

Area (sf)	CN	Description
5,795	98	Paved parking & roofs
2,535	76	Woods/grass comb., Fair, HSG C
1,145	74	>75% Grass cover, Good, HSG C
9,475	89	Weighted Average
3,680		Pervious Area
5,795		Impervious Area

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

Summary for Subcatchment 2: Pre-Flow to Drain Pipe

Runoff = 1.92 cfs @ 12.28 hrs, Volume= 0.188 af, Depth> 1.17"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Storm Rainfall=2.95"

Area (sf)	CN	Description
19,975	98	Paved parking & roofs
55,916	76	Woods/grass comb., Fair, HSG C
8,124	74	>75% Grass cover, Good, HSG C
84,015	81	Weighted Average
64,040		Pervious Area
19,975		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.8	50	0.0200	0.06		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 2.95"
6.9	385	0.0350	0.94		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
19.7	435	Total			

Summary for Subcatchment 3: Pre-Flow to Wetlands

Runoff = 0.79 cfs @ 12.15 hrs, Volume= 0.061 af, Depth> 0.89"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Storm Rainfall=2.95"

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 Type III 24-hr 2-Year Storm Rainfall=2.95"

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Area (sf)	CN	Description
35,845	76	Woods/grass comb., Fair, HSG C
35,845		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.0	50	0.0650	0.10		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 2.95"
1.6	116	0.0600	1.22		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
9.6	166	Total			

Summary for Subcatchment 4: Post-Flow to Main Street

Runoff = 0.12 cfs @ 12.10 hrs, Volume= 0.009 af, Depth> 1.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Type III 24-hr 2-Year Storm Rainfall=2.95"

Area (sf)	CN	Description
725	98	Paved parking & roofs
3,720	74	>75% Grass cover, Good, HSG C
4,445	78	Weighted Average
3,720		Pervious Area
725		Impervious Area

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

Summary for Subcatchment 5: Flow to CTB(#5)

Runoff = 0.21 cfs @ 12.09 hrs, Volume= 0.016 af, Depth> 2.54"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Type III 24-hr 2-Year Storm Rainfall=2.95"

Area (sf)	CN	Description
3,300	98	Paved parking & roofs
3,300		Impervious Area

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

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Summary for Subcatchment 6: Flow to Trench Drain(#7)

Runoff = 0.23 cfs @ 12.09 hrs, Volume= 0.017 af, Depth> 2.36"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Storm Rainfall=2.95"

Area (sf)	CN	Description
3,360	98	Paved parking & roofs
300	74	>75% Grass cover, Good, HSG C
3,660	96	Weighted Average
300		Pervious Area
3,360		Impervious Area

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

Summary for Subcatchment 7: Flow to Rain Garden #1

Runoff = 1.20 cfs @ 12.14 hrs, Volume= 0.090 af, Depth> 1.51"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Storm Rainfall=2.95"

Area (sf)	CN	Description
16,095	98	Paved parking & roofs
15,217	74	>75% Grass cover, Good, HSG C
31,312	86	Weighted Average
15,217		Pervious Area
16,095		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.9	50	0.0200	0.14		Sheet Flow, Grass: Short n= 0.150 P2= 2.95"
3.4	200	0.0200	0.99		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
9.3	250	Total			

Summary for Subcatchment 8: Post-Flow to Wetland

Runoff = 0.73 cfs @ 12.18 hrs, Volume= 0.062 af, Depth> 0.84"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Storm Rainfall=2.95"

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Area (sf)	CN	Description
11,852	74	>75% Grass cover, Good, HSG C
26,785	76	Woods/grass comb., Fair, HSG C
38,637	75	Weighted Average
38,637		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.7	50	0.0100	0.11		Sheet Flow, Grass: Short n= 0.150 P2= 2.95"
2.4	100	0.0100	0.70		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
1.8	125	0.0510	1.13		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
11.9	275	Total			

Summary for Subcatchment 9: Flow to Rain Garden #2

Runoff = 1.99 cfs @ 12.12 hrs, Volume= 0.145 af, Depth> 1.58"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Type III 24-hr 2-Year Storm Rainfall=2.95"

Area (sf)	CN	Description
26,298	98	Paved parking & roofs
21,683	74	>75% Grass cover, Good, HSG C
47,981	87	Weighted Average
21,683		Pervious Area
26,298		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	50	0.0220	0.15		Sheet Flow, Grass: Short n= 0.150 P2= 2.95"
2.8	192	0.0260	1.13		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
8.4	242	Total			

Summary for Pond 1P: Pre-Flow to Main Street

Inflow Area = 0.218 ac, 61.16% Impervious, Inflow Depth > 1.74" for 2-Year Storm event
 Inflow = 0.46 cfs @ 12.09 hrs, Volume= 0.032 af
 Primary = 0.46 cfs @ 12.09 hrs, Volume= 0.032 af, Atten= 0%, Lag= 0.0 min

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

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Summary for Pond 2P: Pre-Flow to Drain Pipe

Inflow Area = 1.929 ac, 23.78% Impervious, Inflow Depth > 1.17" for 2-Year Storm event
Inflow = 1.92 cfs @ 12.28 hrs, Volume= 0.188 af
Primary = 1.92 cfs @ 12.28 hrs, Volume= 0.188 af, Atten= 0%, Lag= 0.0 min

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

Summary for Pond 3P: Pre-Flow to Wetland

Inflow Area = 0.823 ac, 0.00% Impervious, Inflow Depth > 0.89" for 2-Year Storm event
Inflow = 0.79 cfs @ 12.15 hrs, Volume= 0.061 af
Primary = 0.79 cfs @ 12.15 hrs, Volume= 0.061 af, Atten= 0%, Lag= 0.0 min

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

Summary for Pond 4P: Post-Flow to Main Street

Inflow Area = 0.102 ac, 16.31% Impervious, Inflow Depth > 1.00" for 2-Year Storm event
Inflow = 0.12 cfs @ 12.10 hrs, Volume= 0.009 af
Primary = 0.12 cfs @ 12.10 hrs, Volume= 0.009 af, Atten= 0%, Lag= 0.0 min

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

Summary for Pond 7P: Rain Garden #1

Inflow Area = 0.719 ac, 51.40% Impervious, Inflow Depth > 1.51" for 2-Year Storm event
Inflow = 1.20 cfs @ 12.14 hrs, Volume= 0.090 af
Outflow = 0.07 cfs @ 14.77 hrs, Volume= 0.043 af, Atten= 94%, Lag= 158.0 min
Discarded = 0.04 cfs @ 14.77 hrs, Volume= 0.028 af
Primary = 0.04 cfs @ 14.77 hrs, Volume= 0.015 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= 913.80' @ 14.77 hrs Surf.Area= 1,548 sf Storage= 2,389 cf
Flood Elev= 910.50' Surf.Area= 1,235 sf Storage= 494 cf

Plug-Flow detention time= 203.8 min calculated for 0.043 af (48% of inflow)
Center-of-Mass det. time= 120.9 min (914.1 - 793.1)

Volume	Invert	Avail.Storage	Storage Description	
#1	909.50'	3,739 cf	Custom Stage Data (Prismatic) Listed below (Recalc)	
Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
909.50	1,235	40.0	0	0
910.25	1,235	40.0	371	371
913.50	1,235	40.0	1,606	1,976
914.50	2,290	100.0	1,763	3,739

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Device	Routing	Invert	Outlet Devices
#1	Primary	911.00'	12.0" x 182.0' long Culvert CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 908.00' S= 0.0165 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior
#2	Device 1	909.50'	5.000 in/hr Exfiltration over Surface area above invert Excluded Surface area = 1,235 sf
#3	Device 1	914.00'	0.12' x 0.12' Horiz. Orifice/Grate X 36.00 Limited to weir flow C= 0.600
#4	Discarded	909.50'	1.020 in/hr Exfiltration over Surface area
#5	Secondary	914.70'	25.0' long x 5.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Discarded OutFlow Max=0.04 cfs @ 14.77 hrs HW=913.80' (Free Discharge)
 ↑**4=Exfiltration** (Exfiltration Controls 0.04 cfs)

Primary OutFlow Max=0.04 cfs @ 14.77 hrs HW=913.80' (Free Discharge)
 ↑**1=Culvert** (Passes 0.04 cfs of 4.52 cfs potential flow)
 ↑**2=Exfiltration** (Exfiltration Controls 0.04 cfs)
 ↓**3=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=909.50' (Free Discharge)
 ↑**5=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 8P: Post-Flow to Wetland

Inflow Area = 0.887 ac, 0.00% Impervious, Inflow Depth > 0.84" for 2-Year Storm event
 Inflow = 0.73 cfs @ 12.18 hrs, Volume= 0.062 af
 Primary = 0.73 cfs @ 12.18 hrs, Volume= 0.062 af, Atten= 0%, Lag= 0.0 min

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

Summary for Pond 9P: Rain Garden #2

Inflow Area = 1.980 ac, 56.87% Impervious, Inflow Depth > 1.17" for 2-Year Storm event
 Inflow = 2.40 cfs @ 12.11 hrs, Volume= 0.193 af
 Outflow = 0.08 cfs @ 10.75 hrs, Volume= 0.074 af, Atten= 97%, Lag= 0.0 min
 Discarded = 0.08 cfs @ 10.75 hrs, Volume= 0.074 af
 Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 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= 909.27' @ 17.56 hrs Surf.Area= 3,550 sf Storage= 5,354 cf
 Flood Elev= 910.50' Surf.Area= 4,850 sf Storage= 9,880 cf

Plug-Flow detention time= 186.7 min calculated for 0.074 af (38% of inflow)
 Center-of-Mass det. time= 81.8 min (876.1 - 794.3)

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Volume	Invert	Avail.Storage	Storage Description
#1	905.50'	9,880 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
905.50	3,550	40.0	0	0
906.25	3,550	40.0	1,065	1,065
909.50	3,550	40.0	4,615	5,680
910.50	4,850	100.0	4,200	9,880

Device	Routing	Invert	Outlet Devices
#1	Primary	904.45'	12.0" x 14.0' long Culvert CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 904.31' S= 0.0100 '/ Cc= 0.900 n= 0.010 PVC, smooth interior
#2	Device 1	905.50'	5.000 in/hr Exfiltration over Surface area above invert Excluded Surface area = 3,550 sf
#3	Device 1	910.00'	0.12' x 0.12' Horiz. Orifice/Grate X 72.00 Limited to weir flow C= 0.600
#4	Discarded	905.50'	1.020 in/hr Exfiltration over Surface area
#5	Secondary	910.40'	15.0' long x 5.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Discarded OutFlow Max=0.08 cfs @ 10.75 hrs HW=905.55' (Free Discharge)
 ↳4=Exfiltration (Exfiltration Controls 0.08 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=905.50' (Free Discharge)
 ↳1=Culvert (Passes 0.00 cfs of 2.21 cfs potential flow)
 ↳2=Exfiltration (Exfiltration Controls 0.00 cfs)
 ↳3=Orifice/Grate (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=905.50' (Free Discharge)
 ↳5=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond 10P: Post-Flow to Drain Pipe

Inflow Area = 1.980 ac, 56.87% Impervious, Inflow Depth = 0.00" for 2-Year Storm event
 Inflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af
 Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

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

10-YEAR STORM EVENT
Pre- and Post-Development

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Summary for Subcatchment 1: Pre-Flow to Main Street

Runoff = 0.78 cfs @ 12.09 hrs, Volume= 0.055 af, Depth> 3.01"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Storm Rainfall=4.39"

Area (sf)	CN	Description
5,795	98	Paved parking & roofs
2,535	76	Woods/grass comb., Fair, HSG C
1,145	74	>75% Grass cover, Good, HSG C
9,475	89	Weighted Average
3,680		Pervious Area
5,795		Impervious Area

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

Summary for Subcatchment 2: Pre-Flow to Drain Pipe

Runoff = 3.76 cfs @ 12.27 hrs, Volume= 0.366 af, Depth> 2.28"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Storm Rainfall=4.39"

Area (sf)	CN	Description
19,975	98	Paved parking & roofs
55,916	76	Woods/grass comb., Fair, HSG C
8,124	74	>75% Grass cover, Good, HSG C
84,015	81	Weighted Average
64,040		Pervious Area
19,975		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.8	50	0.0200	0.06		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 2.95"
6.9	385	0.0350	0.94		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
19.7	435	Total			

Summary for Subcatchment 3: Pre-Flow to Wetlands

Runoff = 1.71 cfs @ 12.14 hrs, Volume= 0.130 af, Depth> 1.89"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Storm Rainfall=4.39"

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Area (sf)	CN	Description
35,845	76	Woods/grass comb., Fair, HSG C
35,845		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.0	50	0.0650	0.10		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 2.95"
1.6	116	0.0600	1.22		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
9.6	166	Total			

Summary for Subcatchment 4: Post-Flow to Main Street

Runoff = 0.26 cfs @ 12.09 hrs, Volume= 0.017 af, Depth> 2.05"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Storm Rainfall=4.39"

Area (sf)	CN	Description
725	98	Paved parking & roofs
3,720	74	>75% Grass cover, Good, HSG C
4,445	78	Weighted Average
3,720		Pervious Area
725		Impervious Area

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

Summary for Subcatchment 5: Flow to CTB(#5)

Runoff = 0.32 cfs @ 12.09 hrs, Volume= 0.024 af, Depth> 3.86"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Storm Rainfall=4.39"

Area (sf)	CN	Description
3,300	98	Paved parking & roofs
3,300		Impervious Area

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

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Summary for Subcatchment 6: Flow to Trench Drain(#7)

Runoff = 0.34 cfs @ 12.09 hrs, Volume= 0.026 af, Depth> 3.69"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Storm Rainfall=4.39"

Area (sf)	CN	Description
3,360	98	Paved parking & roofs
300	74	>75% Grass cover, Good, HSG C
3,660	96	Weighted Average
300		Pervious Area
3,360		Impervious Area

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

Summary for Subcatchment 7: Flow to Rain Garden #1

Runoff = 2.13 cfs @ 12.13 hrs, Volume= 0.163 af, Depth> 2.72"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Storm Rainfall=4.39"

Area (sf)	CN	Description
16,095	98	Paved parking & roofs
15,217	74	>75% Grass cover, Good, HSG C
31,312	86	Weighted Average
15,217		Pervious Area
16,095		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.9	50	0.0200	0.14		Sheet Flow, Grass: Short n= 0.150 P2= 2.95"
3.4	200	0.0200	0.99		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
9.3	250	Total			

Summary for Subcatchment 8: Post-Flow to Wetland

Runoff = 1.65 cfs @ 12.17 hrs, Volume= 0.134 af, Depth> 1.81"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Storm Rainfall=4.39"

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Area (sf)	CN	Description
11,852	74	>75% Grass cover, Good, HSG C
26,785	76	Woods/grass comb., Fair, HSG C
38,637	75	Weighted Average
38,637		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.7	50	0.0100	0.11		Sheet Flow, Grass: Short n= 0.150 P2= 2.95"
2.4	100	0.0100	0.70		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
1.8	125	0.0510	1.13		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
11.9	275	Total			

Summary for Subcatchment 9: Flow to Rain Garden #2

Runoff = 3.48 cfs @ 12.12 hrs, Volume= 0.259 af, Depth> 2.82"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Storm Rainfall=4.39"

Area (sf)	CN	Description
26,298	98	Paved parking & roofs
21,683	74	>75% Grass cover, Good, HSG C
47,981	87	Weighted Average
21,683		Pervious Area
26,298		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	50	0.0220	0.15		Sheet Flow, Grass: Short n= 0.150 P2= 2.95"
2.8	192	0.0260	1.13		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
8.4	242	Total			

Summary for Pond 1P: Pre-Flow to Main StreetInflow Area = 0.218 ac, 61.16% Impervious, Inflow Depth > 3.01" for 10-Year Storm event
Inflow = 0.78 cfs @ 12.09 hrs, Volume= 0.055 af
Primary = 0.78 cfs @ 12.09 hrs, Volume= 0.055 af, Atten= 0%, Lag= 0.0 min

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

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Summary for Pond 2P: Pre-Flow to Drain Pipe

Inflow Area = 1.929 ac, 23.78% Impervious, Inflow Depth > 2.28" for 10-Year Storm event
Inflow = 3.76 cfs @ 12.27 hrs, Volume= 0.366 af
Primary = 3.76 cfs @ 12.27 hrs, Volume= 0.366 af, Atten= 0%, Lag= 0.0 min

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

Summary for Pond 3P: Pre-Flow to Wetland

Inflow Area = 0.823 ac, 0.00% Impervious, Inflow Depth > 1.89" for 10-Year Storm event
Inflow = 1.71 cfs @ 12.14 hrs, Volume= 0.130 af
Primary = 1.71 cfs @ 12.14 hrs, Volume= 0.130 af, Atten= 0%, Lag= 0.0 min

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

Summary for Pond 4P: Post-Flow to Main Street

Inflow Area = 0.102 ac, 16.31% Impervious, Inflow Depth > 2.05" for 10-Year Storm event
Inflow = 0.26 cfs @ 12.09 hrs, Volume= 0.017 af
Primary = 0.26 cfs @ 12.09 hrs, Volume= 0.017 af, Atten= 0%, Lag= 0.0 min

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

Summary for Pond 7P: Rain Garden #1

Inflow Area = 0.719 ac, 51.40% Impervious, Inflow Depth > 2.72" for 10-Year Storm event
Inflow = 2.13 cfs @ 12.13 hrs, Volume= 0.163 af
Outflow = 1.01 cfs @ 12.37 hrs, Volume= 0.111 af, Atten= 53%, Lag= 14.3 min
Discarded = 0.04 cfs @ 12.37 hrs, Volume= 0.036 af
Primary = 0.97 cfs @ 12.37 hrs, Volume= 0.075 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= 914.13' @ 12.37 hrs Surf.Area= 1,897 sf Storage= 2,959 cf
Flood Elev= 910.50' Surf.Area= 1,235 sf Storage= 494 cf

Plug-Flow detention time= 138.3 min calculated for 0.111 af (68% of inflow)
Center-of-Mass det. time= 70.2 min (849.6 - 779.4)

Volume	Invert	Avail.Storage	Storage Description	
#1	909.50'	3,739 cf	Custom Stage Data (Prismatic) Listed below (Recalc)	
Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
909.50	1,235	40.0	0	0
910.25	1,235	40.0	371	371
913.50	1,235	40.0	1,606	1,976
914.50	2,290	100.0	1,763	3,739

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Device	Routing	Invert	Outlet Devices
#1	Primary	911.00'	12.0" x 182.0' long Culvert CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 908.00' S= 0.0165 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior
#2	Device 1	909.50'	5.000 in/hr Exfiltration over Surface area above invert Excluded Surface area = 1,235 sf
#3	Device 1	914.00'	0.12' x 0.12' Horiz. Orifice/Grate X 36.00 Limited to weir flow C= 0.600
#4	Discarded	909.50'	1.020 in/hr Exfiltration over Surface area
#5	Secondary	914.70'	25.0' long x 5.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Discarded OutFlow Max=0.04 cfs @ 12.37 hrs HW=914.13' (Free Discharge)↑**4=Exfiltration** (Exfiltration Controls 0.04 cfs)**Primary OutFlow** Max=0.96 cfs @ 12.37 hrs HW=914.13' (Free Discharge)↑**1=Culvert** (Passes 0.96 cfs of 4.84 cfs potential flow)↑**2=Exfiltration** (Exfiltration Controls 0.08 cfs)↑**3=Orifice/Grate** (Orifice Controls 0.88 cfs @ 1.71 fps)**Secondary OutFlow** Max=0.00 cfs @ 5.00 hrs HW=909.50' (Free Discharge)↑**5=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)**Summary for Pond 8P: Post-Flow to Wetland**

Inflow Area = 0.887 ac, 0.00% Impervious, Inflow Depth > 1.81" for 10-Year Storm event
 Inflow = 1.65 cfs @ 12.17 hrs, Volume= 0.134 af
 Primary = 1.65 cfs @ 12.17 hrs, Volume= 0.134 af, Atten= 0%, Lag= 0.0 min

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

Summary for Pond 9P: Rain Garden #2

Inflow Area = 1.980 ac, 56.87% Impervious, Inflow Depth > 2.33" for 10-Year Storm event
 Inflow = 4.11 cfs @ 12.11 hrs, Volume= 0.384 af
 Outflow = 1.42 cfs @ 12.59 hrs, Volume= 0.220 af, Atten= 66%, Lag= 28.6 min
 Discarded = 0.10 cfs @ 12.59 hrs, Volume= 0.093 af
 Primary = 1.32 cfs @ 12.59 hrs, Volume= 0.126 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= 910.06' @ 12.59 hrs Surf.Area= 4,281 sf Storage= 7,882 cf
 Flood Elev= 910.50' Surf.Area= 4,850 sf Storage= 9,880 cf

Plug-Flow detention time= 154.1 min calculated for 0.220 af (57% of inflow)
 Center-of-Mass det. time= 71.8 min (856.3 - 784.5)

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873 MAIN STREET - ASHBY, MA
 Type III 24-hr 10-Year Storm Rainfall=4.39"

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Volume	Invert	Avail.Storage	Storage Description	
#1	905.50'	9,880 cf	Custom Stage Data (Prismatic) Listed below (Recalc)	
Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
905.50	3,550	40.0	0	0
906.25	3,550	40.0	1,065	1,065
909.50	3,550	40.0	4,615	5,680
910.50	4,850	100.0	4,200	9,880

Device	Routing	Invert	Outlet Devices	
#1	Primary	904.45'	12.0" x 14.0' long Culvert CPP, projecting, no headwall, Ke = 0.900 Outlet Invert= 904.31' S= 0.0100 '/' Cc= 0.900 n= 0.010 PVC, smooth interior	
#2	Device 1	905.50'	5.000 in/hr Exfiltration over Surface area above invert Excluded Surface area = 3,550 sf	
#3	Device 1	910.00'	0.12' x 0.12' Horiz. Orifice/Grate X 72.00 Limited to weir flow C= 0.600	
#4	Discarded	905.50'	1.020 in/hr Exfiltration over Surface area	
#5	Secondary	910.40'	15.0' long x 5.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88	

Discarded OutFlow Max=0.10 cfs @ 12.59 hrs HW=910.06' (Free Discharge)
 ↳4=Exfiltration (Exfiltration Controls 0.10 cfs)

Primary OutFlow Max=1.32 cfs @ 12.59 hrs HW=910.06' (Free Discharge)
 ↳1=Culvert (Passes 1.32 cfs of 6.75 cfs potential flow)
 ↳2=Exfiltration (Exfiltration Controls 0.08 cfs)
 ↳3=Orifice/Grate (Orifice Controls 1.24 cfs @ 1.19 fps)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=905.50' (Free Discharge)
 ↳5=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond 10P: Post-Flow to Drain Pipe

Inflow Area = 1.980 ac, 56.87% Impervious, Inflow Depth > 0.77" for 10-Year Storm event
 Inflow = 1.32 cfs @ 12.59 hrs, Volume= 0.126 af
 Primary = 1.32 cfs @ 12.59 hrs, Volume= 0.126 af, Atten= 0%, Lag= 0.0 min

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

25-YEAR STORM EVENT
Pre- and Post-Development

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Summary for Subcatchment 1: Pre-Flow to Main Street

Runoff = 0.94 cfs @ 12.09 hrs, Volume= 0.067 af, Depth> 3.68"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Storm Rainfall=5.13"

Area (sf)	CN	Description
5,795	98	Paved parking & roofs
2,535	76	Woods/grass comb., Fair, HSG C
1,145	74	>75% Grass cover, Good, HSG C
9,475	89	Weighted Average
3,680		Pervious Area
5,795		Impervious Area

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

Summary for Subcatchment 2: Pre-Flow to Drain Pipe

Runoff = 4.75 cfs @ 12.27 hrs, Volume= 0.464 af, Depth> 2.89"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Storm Rainfall=5.13"

Area (sf)	CN	Description
19,975	98	Paved parking & roofs
55,916	76	Woods/grass comb., Fair, HSG C
8,124	74	>75% Grass cover, Good, HSG C
84,015	81	Weighted Average
64,040		Pervious Area
19,975		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.8	50	0.0200	0.06		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 2.95"
6.9	385	0.0350	0.94		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
19.7	435	Total			

Summary for Subcatchment 3: Pre-Flow to Wetlands

Runoff = 2.22 cfs @ 12.14 hrs, Volume= 0.168 af, Depth> 2.45"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Storm Rainfall=5.13"

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Area (sf)	CN	Description
35,845	76	Woods/grass comb., Fair, HSG C
35,845		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.0	50	0.0650	0.10		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 2.95"
1.6	116	0.0600	1.22		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
9.6	166	Total			

Summary for Subcatchment 4: Post-Flow to Main Street

Runoff = 0.33 cfs @ 12.09 hrs, Volume= 0.022 af, Depth> 2.63"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Storm Rainfall=5.13"

Area (sf)	CN	Description
725	98	Paved parking & roofs
3,720	74	>75% Grass cover, Good, HSG C
4,445	78	Weighted Average
3,720		Pervious Area
725		Impervious Area

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

Summary for Subcatchment 5: Flow to CTB(#5)

Runoff = 0.37 cfs @ 12.09 hrs, Volume= 0.029 af, Depth> 4.54"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Storm Rainfall=5.13"

Area (sf)	CN	Description
3,300	98	Paved parking & roofs
3,300		Impervious Area

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

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873 MAIN STREET - ASHBY, MA
 Type III 24-hr 25-Year Storm Rainfall=5.13"

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Summary for Subcatchment 6: Flow to Trench Drain(#7)

Runoff = 0.41 cfs @ 12.09 hrs, Volume= 0.031 af, Depth> 4.37"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Type III 24-hr 25-Year Storm Rainfall=5.13"

Area (sf)	CN	Description
3,360	98	Paved parking & roofs
300	74	>75% Grass cover, Good, HSG C
3,660	96	Weighted Average
300		Pervious Area
3,360		Impervious Area

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

Summary for Subcatchment 7: Flow to Rain Garden #1

Runoff = 2.62 cfs @ 12.13 hrs, Volume= 0.202 af, Depth> 3.38"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Type III 24-hr 25-Year Storm Rainfall=5.13"

Area (sf)	CN	Description
16,095	98	Paved parking & roofs
15,217	74	>75% Grass cover, Good, HSG C
31,312	86	Weighted Average
15,217		Pervious Area
16,095		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.9	50	0.0200	0.14		Sheet Flow, Grass: Short n= 0.150 P2= 2.95"
3.4	200	0.0200	0.99		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
9.3	250	Total			

Summary for Subcatchment 8: Post-Flow to Wetland

Runoff = 2.17 cfs @ 12.17 hrs, Volume= 0.175 af, Depth> 2.37"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Type III 24-hr 25-Year Storm Rainfall=5.13"

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Area (sf)	CN	Description
11,852	74	>75% Grass cover, Good, HSG C
26,785	76	Woods/grass comb., Fair, HSG C
38,637	75	Weighted Average
38,637		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.7	50	0.0100	0.11		Sheet Flow, Grass: Short n= 0.150 P2= 2.95"
2.4	100	0.0100	0.70		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
1.8	125	0.0510	1.13		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
11.9	275	Total			

Summary for Subcatchment 9: Flow to Rain Garden #2

Runoff = 4.25 cfs @ 12.12 hrs, Volume= 0.319 af, Depth> 3.48"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Storm Rainfall=5.13"

Area (sf)	CN	Description
26,298	98	Paved parking & roofs
21,683	74	>75% Grass cover, Good, HSG C
47,981	87	Weighted Average
21,683		Pervious Area
26,298		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	50	0.0220	0.15		Sheet Flow, Grass: Short n= 0.150 P2= 2.95"
2.8	192	0.0260	1.13		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
8.4	242	Total			

Summary for Pond 1P: Pre-Flow to Main Street

Inflow Area = 0.218 ac, 61.16% Impervious, Inflow Depth > 3.68" for 25-Year Storm event
 Inflow = 0.94 cfs @ 12.09 hrs, Volume= 0.067 af
 Primary = 0.94 cfs @ 12.09 hrs, Volume= 0.067 af, Atten= 0%, Lag= 0.0 min

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

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Summary for Pond 2P: Pre-Flow to Drain Pipe

Inflow Area = 1.929 ac, 23.78% Impervious, Inflow Depth > 2.89" for 25-Year Storm event
 Inflow = 4.75 cfs @ 12.27 hrs, Volume= 0.464 af
 Primary = 4.75 cfs @ 12.27 hrs, Volume= 0.464 af, Atten= 0%, Lag= 0.0 min

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

Summary for Pond 3P: Pre-Flow to Wetland

Inflow Area = 0.823 ac, 0.00% Impervious, Inflow Depth > 2.45" for 25-Year Storm event
 Inflow = 2.22 cfs @ 12.14 hrs, Volume= 0.168 af
 Primary = 2.22 cfs @ 12.14 hrs, Volume= 0.168 af, Atten= 0%, Lag= 0.0 min

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

Summary for Pond 4P: Post-Flow to Main Street

Inflow Area = 0.102 ac, 16.31% Impervious, Inflow Depth > 2.63" for 25-Year Storm event
 Inflow = 0.33 cfs @ 12.09 hrs, Volume= 0.022 af
 Primary = 0.33 cfs @ 12.09 hrs, Volume= 0.022 af, Atten= 0%, Lag= 0.0 min

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

Summary for Pond 7P: Rain Garden #1

Inflow Area = 0.719 ac, 51.40% Impervious, Inflow Depth > 3.38" for 25-Year Storm event
 Inflow = 2.62 cfs @ 12.13 hrs, Volume= 0.202 af
 Outflow = 1.48 cfs @ 12.31 hrs, Volume= 0.148 af, Atten= 43%, Lag= 10.6 min
 Discarded = 0.05 cfs @ 12.31 hrs, Volume= 0.038 af
 Primary = 1.43 cfs @ 12.31 hrs, Volume= 0.110 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= 914.29' @ 12.31 hrs Surf.Area= 2,065 sf Storage= 3,274 cf
 Flood Elev= 910.50' Surf.Area= 1,235 sf Storage= 494 cf

Plug-Flow detention time= 116.5 min calculated for 0.148 af (73% of inflow)
 Center-of-Mass det. time= 55.0 min (829.3 - 774.3)

Volume	Invert	Avail.Storage	Storage Description
#1	909.50'	3,739 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
909.50	1,235	40.0	0	0
910.25	1,235	40.0	371	371
913.50	1,235	40.0	1,606	1,976
914.50	2,290	100.0	1,763	3,739

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Device	Routing	Invert	Outlet Devices
#1	Primary	911.00'	12.0" x 182.0' long Culvert CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 908.00' S= 0.0165 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior
#2	Device 1	909.50'	5.000 in/hr Exfiltration over Surface area above invert Excluded Surface area = 1,235 sf
#3	Device 1	914.00'	0.12' x 0.12' Horiz. Orifice/Grate X 36.00 Limited to weir flow C= 0.600
#4	Discarded	909.50'	1.020 in/hr Exfiltration over Surface area
#5	Secondary	914.70'	25.0' long x 5.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Discarded OutFlow Max=0.05 cfs @ 12.31 hrs HW=914.29' (Free Discharge)↑**4=Exfiltration** (Exfiltration Controls 0.05 cfs)**Primary OutFlow** Max=1.43 cfs @ 12.31 hrs HW=914.29' (Free Discharge)↑**1=Culvert** (Passes 1.43 cfs of 4.98 cfs potential flow)↑**2=Exfiltration** (Exfiltration Controls 0.10 cfs)↑**3=Orifice/Grate** (Orifice Controls 1.33 cfs @ 2.57 fps)**Secondary OutFlow** Max=0.00 cfs @ 5.00 hrs HW=909.50' (Free Discharge)↑**5=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)**Summary for Pond 8P: Post-Flow to Wetland**

Inflow Area = 0.887 ac, 0.00% Impervious, Inflow Depth > 2.37" for 25-Year Storm event
 Inflow = 2.17 cfs @ 12.17 hrs, Volume= 0.175 af
 Primary = 2.17 cfs @ 12.17 hrs, Volume= 0.175 af, Atten= 0%, Lag= 0.0 min

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

Summary for Pond 9P: Rain Garden #2

Inflow Area = 1.980 ac, 56.87% Impervious, Inflow Depth > 2.96" for 25-Year Storm event
 Inflow = 5.49 cfs @ 12.15 hrs, Volume= 0.488 af
 Outflow = 2.69 cfs @ 12.48 hrs, Volume= 0.320 af, Atten= 51%, Lag= 19.9 min
 Discarded = 0.11 cfs @ 12.48 hrs, Volume= 0.098 af
 Primary = 2.58 cfs @ 12.48 hrs, Volume= 0.222 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= 910.24' @ 12.48 hrs Surf.Area= 4,518 sf Storage= 8,685 cf
 Flood Elev= 910.50' Surf.Area= 4,850 sf Storage= 9,880 cf

Plug-Flow detention time= 121.9 min calculated for 0.320 af (66% of inflow)
 Center-of-Mass det. time= 50.1 min (828.8 - 778.7)

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 Type III 24-hr 25-Year Storm Rainfall=5.13"

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Volume	Invert	Avail.Storage	Storage Description	
#1	905.50'	9,880 cf	Custom Stage Data (Prismatic) Listed below (Recalc)	
Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
905.50	3,550	40.0	0	0
906.25	3,550	40.0	1,065	1,065
909.50	3,550	40.0	4,615	5,680
910.50	4,850	100.0	4,200	9,880

Device	Routing	Invert	Outlet Devices	
#1	Primary	904.45'	12.0" x 14.0' long Culvert CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 904.31' S= 0.0100 '/ Cc= 0.900 n= 0.010 PVC, smooth interior	
#2	Device 1	905.50'	5.000 in/hr Exfiltration over Surface area above invert Excluded Surface area = 3,550 sf	
#3	Device 1	910.00'	0.12' x 0.12' Horiz. Orifice/Grate X 72.00 Limited to weir flow C= 0.600	
#4	Discarded	905.50'	1.020 in/hr Exfiltration over Surface area	
#5	Secondary	910.40'	15.0' long x 5.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88	

Discarded OutFlow Max=0.11 cfs @ 12.48 hrs HW=910.24' (Free Discharge)
 ↳4=Exfiltration (Exfiltration Controls 0.11 cfs)

Primary OutFlow Max=2.57 cfs @ 12.48 hrs HW=910.24' (Free Discharge)
 ↳1=Culvert (Passes 2.57 cfs of 6.87 cfs potential flow)
 ↳2=Exfiltration (Exfiltration Controls 0.11 cfs)
 ↳3=Orifice/Grate (Orifice Controls 2.46 cfs @ 2.37 fps)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=905.50' (Free Discharge)
 ↳5=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond 10P: Post-Flow to Drain Pipe

Inflow Area = 1.980 ac, 56.87% Impervious, Inflow Depth > 1.35" for 25-Year Storm event
 Inflow = 2.58 cfs @ 12.48 hrs, Volume= 0.222 af
 Primary = 2.58 cfs @ 12.48 hrs, Volume= 0.222 af, Atten= 0%, Lag= 0.0 min

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

100-YEAR STORM EVENT
Pre- and Post-Development

24062 - Rainville

Prepared by DAVID E. ROSS ASSOCIATES, INC.

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873 MAIN STREET - ASHBY, MA

Type III 24-hr 100-Year Storm Rainfall=6.21"

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Summary for Subcatchment 1: Pre-Flow to Main Street

Runoff = 1.18 cfs @ 12.09 hrs, Volume= 0.085 af, Depth> 4.67"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Storm Rainfall=6.21"

Area (sf)	CN	Description
5,795	98	Paved parking & roofs
2,535	76	Woods/grass comb., Fair, HSG C
1,145	74	>75% Grass cover, Good, HSG C
9,475	89	Weighted Average
3,680		Pervious Area
5,795		Impervious Area

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

Summary for Subcatchment 2: Pre-Flow to Drain Pipe

Runoff = 6.21 cfs @ 12.27 hrs, Volume= 0.613 af, Depth> 3.81"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Storm Rainfall=6.21"

Area (sf)	CN	Description
19,975	98	Paved parking & roofs
55,916	76	Woods/grass comb., Fair, HSG C
8,124	74	>75% Grass cover, Good, HSG C
84,015	81	Weighted Average
64,040		Pervious Area
19,975		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.8	50	0.0200	0.06		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 2.95"
6.9	385	0.0350	0.94		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
19.7	435	Total			

Summary for Subcatchment 3: Pre-Flow to Wetlands

Runoff = 3.00 cfs @ 12.14 hrs, Volume= 0.228 af, Depth> 3.32"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Storm Rainfall=6.21"

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Area (sf)	CN	Description
35,845	76	Woods/grass comb., Fair, HSG C
35,845		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.0	50	0.0650	0.10		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 2.95"
1.6	116	0.0600	1.22		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
9.6	166	Total			

Summary for Subcatchment 4: Post-Flow to Main Street

Runoff = 0.44 cfs @ 12.09 hrs, Volume= 0.030 af, Depth> 3.52"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Storm Rainfall=6.21"

Area (sf)	CN	Description
725	98	Paved parking & roofs
3,720	74	>75% Grass cover, Good, HSG C
4,445	78	Weighted Average
3,720		Pervious Area
725		Impervious Area

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

Summary for Subcatchment 5: Flow to CTB(#5)

Runoff = 0.45 cfs @ 12.09 hrs, Volume= 0.035 af, Depth> 5.52"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Storm Rainfall=6.21"

Area (sf)	CN	Description
3,300	98	Paved parking & roofs
3,300		Impervious Area

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

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873 MAIN STREET - ASHBY, MA
Type III 24-hr 100-Year Storm Rainfall=6.21"

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Summary for Subcatchment 6: Flow to Trench Drain(#7)

Runoff = 0.49 cfs @ 12.09 hrs, Volume= 0.038 af, Depth> 5.37"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Storm Rainfall=6.21"

Area (sf)	CN	Description
3,360	98	Paved parking & roofs
300	74	>75% Grass cover, Good, HSG C
3,660	96	Weighted Average
300		Pervious Area
3,360		Impervious Area

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

Summary for Subcatchment 7: Flow to Rain Garden #1

Runoff = 3.33 cfs @ 12.13 hrs, Volume= 0.260 af, Depth> 4.35"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Storm Rainfall=6.21"

Area (sf)	CN	Description
16,095	98	Paved parking & roofs
15,217	74	>75% Grass cover, Good, HSG C
31,312	86	Weighted Average
15,217		Pervious Area
16,095		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.9	50	0.0200	0.14		Sheet Flow, Grass: Short n= 0.150 P2= 2.95"
3.4	200	0.0200	0.99		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
9.3	250	Total			

Summary for Subcatchment 8: Post-Flow to Wetland

Runoff = 2.95 cfs @ 12.17 hrs, Volume= 0.238 af, Depth> 3.22"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Storm Rainfall=6.21"

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Area (sf)	CN	Description
11,852	74	>75% Grass cover, Good, HSG C
26,785	76	Woods/grass comb., Fair, HSG C
38,637	75	Weighted Average
38,637		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.7	50	0.0100	0.11		Sheet Flow, Grass: Short n= 0.150 P2= 2.95"
2.4	100	0.0100	0.70		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
1.8	125	0.0510	1.13		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
11.9	275	Total			

Summary for Subcatchment 9: Flow to Rain Garden #2

Runoff = 5.38 cfs @ 12.12 hrs, Volume= 0.409 af, Depth> 4.45"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Storm Rainfall=6.21"

Area (sf)	CN	Description
26,298	98	Paved parking & roofs
21,683	74	>75% Grass cover, Good, HSG C
47,981	87	Weighted Average
21,683		Pervious Area
26,298		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	50	0.0220	0.15		Sheet Flow, Grass: Short n= 0.150 P2= 2.95"
2.8	192	0.0260	1.13		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
8.4	242	Total			

Summary for Pond 1P: Pre-Flow to Main Street

Inflow Area = 0.218 ac, 61.16% Impervious, Inflow Depth > 4.67" for 100-Year Storm event
Inflow = 1.18 cfs @ 12.09 hrs, Volume= 0.085 af
Primary = 1.18 cfs @ 12.09 hrs, Volume= 0.085 af, Atten= 0%, Lag= 0.0 min

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

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Summary for Pond 2P: Pre-Flow to Drain Pipe

Inflow Area = 1.929 ac, 23.78% Impervious, Inflow Depth > 3.81" for 100-Year Storm event
 Inflow = 6.21 cfs @ 12.27 hrs, Volume= 0.613 af
 Primary = 6.21 cfs @ 12.27 hrs, Volume= 0.613 af, Atten= 0%, Lag= 0.0 min

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

Summary for Pond 3P: Pre-Flow to Wetland

Inflow Area = 0.823 ac, 0.00% Impervious, Inflow Depth > 3.32" for 100-Year Storm event
 Inflow = 3.00 cfs @ 12.14 hrs, Volume= 0.228 af
 Primary = 3.00 cfs @ 12.14 hrs, Volume= 0.228 af, Atten= 0%, Lag= 0.0 min

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

Summary for Pond 4P: Post-Flow to Main Street

Inflow Area = 0.102 ac, 16.31% Impervious, Inflow Depth > 5.59" for 100-Year Storm event
 Inflow = 1.09 cfs @ 12.25 hrs, Volume= 0.048 af
 Primary = 1.09 cfs @ 12.25 hrs, Volume= 0.048 af, Atten= 0%, Lag= 0.0 min

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

Summary for Pond 7P: Rain Garden #1

Inflow Area = 0.719 ac, 51.40% Impervious, Inflow Depth > 4.35" for 100-Year Storm event.
 Inflow = 3.33 cfs @ 12.13 hrs, Volume= 0.260 af
 Outflow = 2.99 cfs @ 12.25 hrs, Volume= 0.204 af, Atten= 10%, Lag= 7.2 min
 Discarded = 0.05 cfs @ 12.23 hrs, Volume= 0.041 af
 Primary = 2.28 cfs @ 12.25 hrs, Volume= 0.160 af
 Secondary = 0.66 cfs @ 12.25 hrs, Volume= 0.003 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Peak Elev= 914.75' @ 12.25 hrs Surf.Area= 2,290 sf Storage= 3,739 cf
 Flood Elev= 910.50' Surf.Area= 1,235 sf Storage= 494 cf

Plug-Flow detention time= 99.4 min calculated for 0.204 af (78% of inflow)
 Center-of-Mass det. time= 43.7 min (811.9 - 768.2)

Volume	Invert	Avail.Storage	Storage Description	
#1	909.50'	3,739 cf	Custom Stage Data (Prismatic) Listed below (Recalc)	
Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
909.50	1,235	40.0	0	0
910.25	1,235	40.0	371	371
913.50	1,235	40.0	1,606	1,976
914.50	2,290	100.0	1,763	3,739

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Device	Routing	Invert	Outlet Devices
#1	Primary	911.00'	12.0" x 182.0' long Culvert CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 908.00' S= 0.0165 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior
#2	Device 1	909.50'	5.000 in/hr Exfiltration over Surface area above invert Excluded Surface area = 1,235 sf
#3	Device 1	914.00'	0.12' x 0.12' Horiz. Orifice/Grate X 36.00 Limited to weir flow C= 0.600
#4	Discarded	909.50'	1.020 in/hr Exfiltration over Surface area
#5	Secondary	914.70'	25.0' long x 5.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Discarded OutFlow Max=0.05 cfs @ 12.23 hrs HW=914.64' (Free Discharge)
 ↳4=Exfiltration (Exfiltration Controls 0.05 cfs)

Primary OutFlow Max=2.26 cfs @ 12.25 hrs HW=914.73' (Free Discharge)
 ↳1=Culvert (Passes 2.26 cfs of 5.37 cfs potential flow)
 ↳2=Exfiltration (Exfiltration Controls 0.12 cfs)
 ↳3=Orifice/Grate (Orifice Controls 2.14 cfs @ 4.13 fps)

Secondary OutFlow Max=0.64 cfs @ 12.25 hrs HW=914.75' (Free Discharge)
 ↳5=Broad-Crested Rectangular Weir (Weir Controls 0.64 cfs @ 0.52 fps)

Summary for Pond 8P: Post-Flow to Wetland

Inflow Area = 0.887 ac, 0.00% Impervious, Inflow Depth > 3.22" for 100-Year Storm event
 Inflow = 2.95 cfs @ 12.17 hrs, Volume= 0.238 af
 Primary = 2.95 cfs @ 12.17 hrs, Volume= 0.238 af, Atten= 0%, Lag= 0.0 min

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

Summary for Pond 9P: Rain Garden #2

Inflow Area = 1.980 ac, 56.87% Impervious, Inflow Depth > 3.89" for 100-Year Storm event
 Inflow = 7.79 cfs @ 12.12 hrs, Volume= 0.642 af
 Outflow = 4.62 cfs @ 12.35 hrs, Volume= 0.469 af, Atten= 41%, Lag= 13.5 min
 Discarded = 0.11 cfs @ 12.35 hrs, Volume= 0.104 af
 Primary = 3.62 cfs @ 12.35 hrs, Volume= 0.350 af
 Secondary = 0.89 cfs @ 12.35 hrs, Volume= 0.015 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Peak Elev= 910.48' @ 12.35 hrs Surf.Area= 4,830 sf Storage= 9,805 cf
 Flood Elev= 910.50' Surf.Area= 4,850 sf Storage= 9,880 cf

Plug-Flow detention time= 97.9 min calculated for 0.467 af (73% of inflow)
 Center-of-Mass det. time= 37.0 min (809.8 - 772.8)

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Volume	Invert	Avail.Storage	Storage Description		
#1	905.50'	9,880 cf	Custom Stage Data (Prismatic) Listed below (Recalc)		
Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	
905.50	3,550	40.0	0	0	
906.25	3,550	40.0	1,065	1,065	
909.50	3,550	40.0	4,615	5,680	
910.50	4,850	100.0	4,200	9,880	

Device	Routing	Invert	Outlet Devices									
#1	Primary	904.45'	12.0" x 14.0' long Culvert CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 904.31' S= 0.0100 '/' Cc= 0.900 n= 0.010 PVC, smooth interior									
#2	Device 1	905.50'	5.000 in/hr Exfiltration over Surface area above invert Excluded Surface area = 3,550 sf									
#3	Device 1	910.00'	0.12' x 0.12' Horiz. Orifice/Grate X 72.00 Limited to weir flow C= 0.600									
#4	Discarded	905.50'	1.020 in/hr Exfiltration over Surface area									
#5	Secondary	910.40'	15.0' long x 5.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88									

Discarded OutFlow Max=0.11 cfs @ 12.35 hrs HW=910.48' (Free Discharge)
 ↳4=Exfiltration (Exfiltration Controls 0.11 cfs)

Primary OutFlow Max=3.62 cfs @ 12.35 hrs HW=910.48' (Free Discharge)
 ↳1=Culvert (Passes 3.62 cfs of 7.02 cfs potential flow)
 ↳2=Exfiltration (Exfiltration Controls 0.15 cfs)
 ↳3=Orifice/Grate (Orifice Controls 3.47 cfs @ 3.35 fps)

Secondary OutFlow Max=0.85 cfs @ 12.35 hrs HW=910.48' (Free Discharge)
 ↳5=Broad-Crested Rectangular Weir (Weir Controls 0.85 cfs @ 0.68 fps)

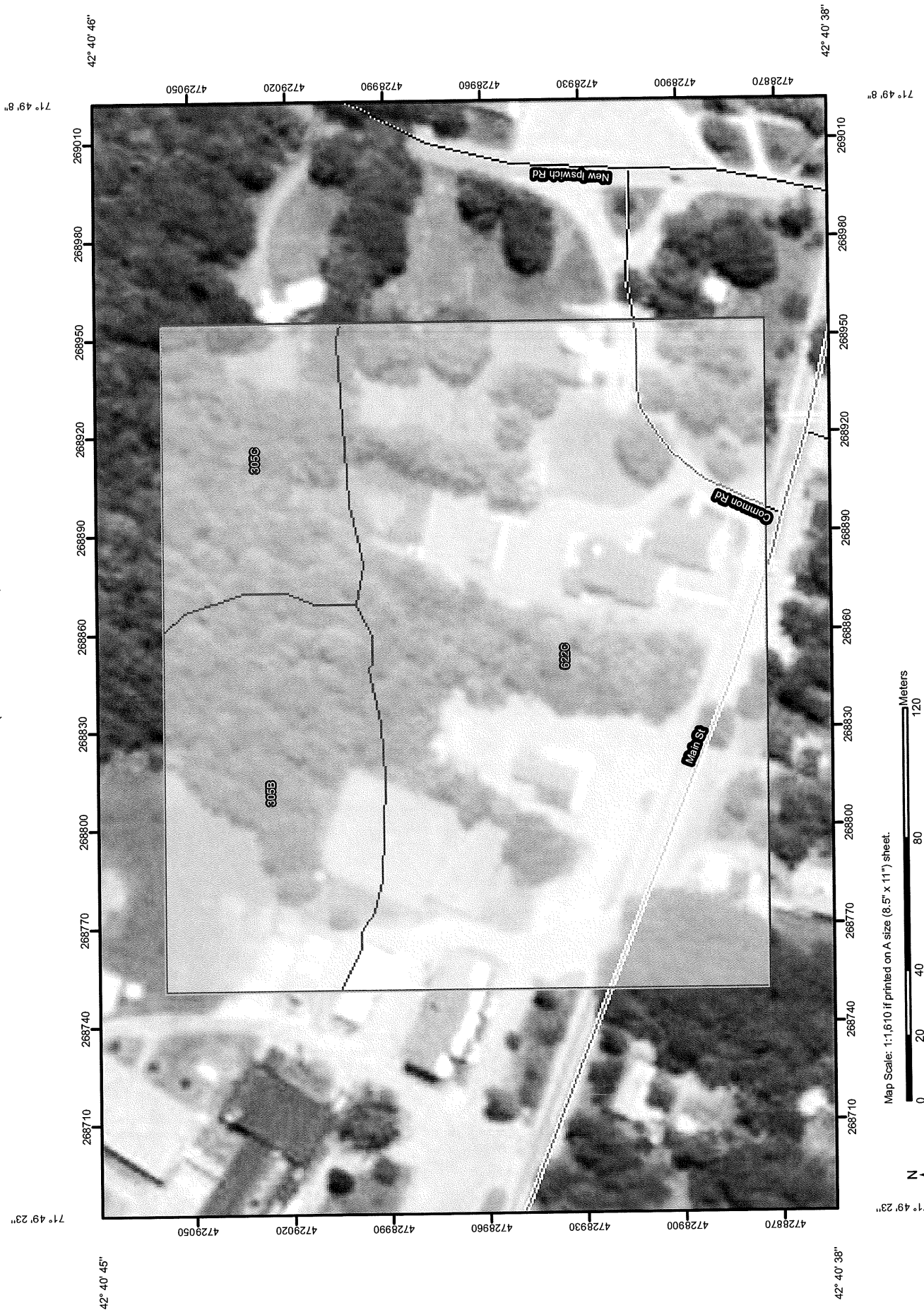
Summary for Pond 10P: Post-Flow to Drain Pipe

Inflow Area = 1.980 ac, 56.87% Impervious, Inflow Depth > 2.12" for 100-Year Storm event
 Inflow = 3.62 cfs @ 12.35 hrs, Volume= 0.350 af
 Primary = 3.62 cfs @ 12.35 hrs, Volume= 0.350 af, Atten= 0%, Lag= 0.0 min

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


APPENDIX A
SCS Soils Map
Soil Testing Log

Hydrologic Soil Group—Middlesex County, Massachusetts
(873 MAIN STREET)










MAP LEGEND

Area of Interest (AOI)
 Area of Interest (AOI)

Soils
 Soil Map Units

Soil Ratings



-  A
-  A/D
-  B
-  B/D
-  C
-  C/D
-  D

Not rated or not available






Political Features

 Cities

Water Features

 Oceans
 Streams and Canals

Transportation

 Rails
 Interstate Highways
 US Routes
 Major Roads
 Local Roads

MAP INFORMATION

Map Scale: 1:1,610 if printed on A size (8.5" x 11") sheet.
 The soil surveys that comprise your AOI were mapped at 1:25,000.
 Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
 Web Soil Survey URL: <http://websoilsurvey.nrcs.usda.gov>
 Coordinate System: UTM Zone 19N NAD83
 This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Middlesex County, Massachusetts
 Survey Area Data: Version 12, Feb 26, 2010

Date(s) aerial images were photographed: 7/20/2003

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.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Middlesex County, Massachusetts				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
305B	Paxton fine sandy loam, 3 to 8 percent slopes	C	1.9	20.1%
305C	Paxton fine sandy loam, 8 to 15 percent slopes	C	1.2	12.9%
622C	Paxton-Urban land complex, 3 to 15 percent slopes	C	6.2	66.9%
Totals for Area of Interest			9.3	100.0%

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Location Address or Lot No. 873 Main Street, Ashby

On-site Review

Deep Hole Number: 810-GW Date: 8/13/10 Time: 10:00 Weather: Sunny, 70s

Location (identify on site plan) See Plans

Land Use Site Plan Slope (%) +/- 3% Surface Stones _____

Vegetation Sparse Woods/Brush

Landform _____

Position on landscape (sketch on back) _____

Distances from:

Open Water Body >300 feet Drainage way 65 feet
 Possible Wet Area >300 feet Property Line 45 feet
 Drinking Water Well >500 feet Other _____

DEEP OBSERVATION HOLE LOG*					
Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0-8	Ap	FSL	10YR 3/2	NONE	<5% Gravel, Granular, Friable
8-18	Bw	LS	10YR 5/6	NONE	10% Gravel, Massive, Friable
18-120	C	Gravelly Sand	2.5Y 5/4	76"	30% Gravel, Massive, Friable

* MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic): _____ Depth to Bedrock: None observed

Depth to Groundwater: 76" Standing Water in Hole: None obs. Weeping from pit face: 108"

Estimated Seasonal High Groundwater: 76"

DRAINAGE DELINEATION SKETCHES

Pre-development

Post-development