STORMWATER SUMMARY

For
Activities Room Addition
at
Bethany Health Care Center
Framingham, MA

September 13, 2016

Prepared for:

Bethany Health Care Center
97 Bethany Road
Framingham, MA 01702

Prepared by:

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WHITMAN & BINGHAM
ASSOCIATES
REGISTERED ENGINEERS & LAND SURVEYORS

Summary

Whitman & Bingham Associates, LLC has performed an assessment of the stormwater flows relating to the improvements associated with the proposed Activities Room Addition of the Bethany Health Care Center. The proposed site improvements include:

- Building addition
- Walkways
- Courtyard
- Landscaped areas

The stormwater system for the improvements consists of collecting and routing stormwater, from the proposed roof and walkways, to two bio-retention areas. The retention areas outlet towards the western side of the building, consistent with the direction of the existing surface water flows. The stormwater run-off of the portion of the property consisting of the improvements, is tributary to the western portion of the property.

A summary of the existing and proposed stormwater flows are shown in the following tables:

TABLE I
Peak Flows to western area

Storm Event	Existing Conditions (cfs)	Proposed Conditions (cfs)
100 yr. storm	54.25	54.25
25 yr. storm	31.24	31.24
10-yr storm	21.74	21.74
2 yr. storm	8.82	8.82

Although there are small increases in impervious surface as part of the project, the increases are minor in comparison to the tributary watershed area, such that there is no calculated increase in peak rates of run-off leaving the site.

HYDROLOGICAL CALCULATIONS

PRE-WATERSHED

Trib. area to wet

Subcat Reach Pond Link

Drainage Diagram for bethany health add pre
Prepared by Whitman & Bingham Associates 9/13/2016

Time span=0.00-30.00 hrs, dt=0.04 hrs, 751 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Trib. area to wet Runoff Area=16.090 ac Runoff Depth=0.73"
Flow Length=540' Tc=15.0 min CN=68 Runoff=8.82 cfs 0.982 af

Total Runoff Area = 16.090 ac Runoff Volume = 0.982 af Average Runoff Depth = 0.73"

Subcatchment 1S: Trib. area to wet

Runoff = 8.82 cfs @ 12.24 hrs, Volume= 0.982 af, Depth= 0.73"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.04 hrs
Type III 24-hr 1 fram 2 yr Rainfall=3.20"

Area (ac)	CN	Description
2.922	98	Paved parking & roofs
0.038	89	Gravel roads, HSG C
0.306	39	>75% Grass cover, Good, HSG A
2.759	74	>75% Grass cover, Good, HSG C
3.309	30	Woods, Good, HSG A
3.843	70	Woods, Good, HSG C
2.913	77	Woods, Good, HSG D
16.090	68	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.0	50	0.0440	0.1		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
1.2	100	0.0800	1.4		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.1	145	0.1900	2.2		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
3.7	245	0.0490	1.1		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
15.0	540	Total			

Time span=0.00-30.00 hrs, dt=0.04 hrs, 751 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Trib. area to wet Runoff Area=16.090 ac Runoff Depth=1.60"
Flow Length=540' Tc=15.0 min CN=68 Runoff=21.74 cfs 2.146 af

Total Runoff Area = 16.090 ac Runoff Volume = 2.146 af Average Runoff Depth = 1.60"

Subcatchment 1S: Trib. area to wet

Runoff = 21.74 cfs @ 12.22 hrs, Volume= 2.146 af, Depth= 1.60"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.04 hrs
Type III 24-hr 2 fram 10 yr Rainfall=4.60"

Area (ac)	CN	Description
2.922	98	Paved parking & roofs
0.038	89	Gravel roads, HSG C
0.306	39	>75% Grass cover, Good, HSG A
2.759	74	>75% Grass cover, Good, HSG C
3.309	30	Woods, Good, HSG A
3.843	70	Woods, Good, HSG C
2.913	77	Woods, Good, HSG D
16.090	68	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.0	50	0.0440	0.1		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
1.2	100	0.0800	1.4		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.1	145	0.1900	2.2		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
3.7	245	0.0490	1.1		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
15.0	540	Total			

Time span=0.00-30.00 hrs, dt=0.04 hrs, 751 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Trib. area to wet Runoff Area=16.090 ac Runoff Depth=2.24"
Flow Length=540' Tc=15.0 min CN=68 Runoff=31.24 cfs 3.008 af

Total Runoff Area = 16.090 ac Runoff Volume = 3.008 af Average Runoff Depth = 2.24"

Subcatchment 1S: Trib. area to wet

Runoff = 31.24 cfs @ 12.22 hrs, Volume= 3.008 af, Depth= 2.24"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.04 hrs
Type III 24-hr 3 fram 25 yr Rainfall=5.50"

Area (ac)	CN	Description
2.922	98	Paved parking & roofs
0.038	89	Gravel roads, HSG C
0.306	39	>75% Grass cover, Good, HSG A
2.759	74	>75% Grass cover, Good, HSG C
3.309	30	Woods, Good, HSG A
3.843	70	Woods, Good, HSG C
2.913	77	Woods, Good, HSG D
16.090	68	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.0	50	0.0440	0.1		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
1.2	100	0.0800	1.4		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.1	145	0.1900	2.2		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
3.7	245	0.0490	1.1		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
15.0	540	Total			

Time span=0.00-30.00 hrs, dt=0.04 hrs, 751 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Trib. area to wet Runoff Area=16.090 ac Runoff Depth=3.82"
Flow Length=540' Tc=15.0 min CN=68 Runoff=54.25 cfs 5.120 af

Total Runoff Area = 16.090 ac Runoff Volume = 5.120 af Average Runoff Depth = 3.82"

Subcatchment 1S: Trib. area to wet

Runoff = 54.25 cfs @ 12.21 hrs, Volume= 5.120 af, Depth= 3.82"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.04 hrs
Type III 24-hr 4 fram 100 yr Rainfall=7.50"

Area (ac)	CN	Description
2.922	98	Paved parking & roofs
0.038	89	Gravel roads, HSG C
0.306	39	>75% Grass cover, Good, HSG A
2.759	74	>75% Grass cover, Good, HSG C
3.309	30	Woods, Good, HSG A
3.843	70	Woods, Good, HSG C
2.913	77	Woods, Good, HSG D
16.090	68	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.0	50	0.0440	0.1		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
1.2	100	0.0800	1.4		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.1	145	0.1900	2.2		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
3.7	245	0.0490	1.1		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
15.0	540	Total			

POST-WATERSHED

Trib. area to wet

Subcat Reach Pond Link

Drainage Diagram for bethany health add post
Prepared by Whitman & Bingham Associates 9/13/2016

Time span=0.00-30.00 hrs, dt=0.04 hrs, 751 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: Trib. area to wet Runoff Area=16.090 ac Runoff Depth=0.73"
Flow Length=540' Tc=15.0 min CN=68 Runoff=8.82 cfs 0.982 af

Total Runoff Area = 16.090 ac Runoff Volume = 0.982 af Average Runoff Depth = 0.73"

Subcatchment 1S: Trib. area to wet

Runoff = 8.82 cfs @ 12.24 hrs, Volume= 0.982 af, Depth= 0.73"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.04 hrs
Type III 24-hr 1 fram 2 yr Rainfall=3.20"

Area (ac)	CN	Description
3.073	98	Paved parking & roofs
0.038	89	Gravel roads, HSG C
0.306	39	>75% Grass cover, Good, HSG A
2.608	74	>75% Grass cover, Good, HSG C
3.309	30	Woods, Good, HSG A
3.843	70	Woods, Good, HSG C
2.913	77	Woods, Good, HSG D
16.090	68	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.0	50	0.0440	0.1		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
1.2	100	0.0800	1.4		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.1	145	0.1900	2.2		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
3.7	245	0.0490	1.1		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
15.0	540	Total			

Time span=0.00-30.00 hrs, dt=0.04 hrs, 751 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: Trib. area to wet Runoff Area=16.090 ac Runoff Depth=1.60"
Flow Length=540' Tc=15.0 min CN=68 Runoff=21.74 cfs 2.146 af

Total Runoff Area = 16.090 ac Runoff Volume = 2.146 af Average Runoff Depth = 1.60"

Subcatchment 1S: Trib. area to wet

Runoff = 21.74 cfs @ 12.22 hrs, Volume= 2.146 af, Depth= 1.60"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.04 hrs
Type III 24-hr 2 fram 10 yr Rainfall=4.60"

Area (ac)	CN	Description
3.073	98	Paved parking & roofs
0.038	89	Gravel roads, HSG C
0.306	39	>75% Grass cover, Good, HSG A
2.608	74	>75% Grass cover, Good, HSG C
3.309	30	Woods, Good, HSG A
3.843	70	Woods, Good, HSG C
2.913	77	Woods, Good, HSG D
16.090	68	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.0	50	0.0440	0.1		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
1.2	100	0.0800	1.4		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.1	145	0.1900	2.2		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
3.7	245	0.0490	1.1		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
15.0	540	Total			

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Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: Trib. area to wet Runoff Area=16.090 ac Runoff Depth=2.24"
Flow Length=540' Tc=15.0 min CN=68 Runoff=31.24 cfs 3.008 af

Total Runoff Area = 16.090 ac Runoff Volume = 3.008 af Average Runoff Depth = 2.24"

Subcatchment 1S: Trib. area to wet

Runoff = 31.24 cfs @ 12.22 hrs, Volume= 3.008 af, Depth= 2.24"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.04 hrs
Type III 24-hr 3 fram 25 yr Rainfall=5.50"

Area (ac)	CN	Description
3.073	98	Paved parking & roofs
0.038	89	Gravel roads, HSG C
0.306	39	>75% Grass cover, Good, HSG A
2.608	74	>75% Grass cover, Good, HSG C
3.309	30	Woods, Good, HSG A
3.843	70	Woods, Good, HSG C
2.913	77	Woods, Good, HSG D
16.090	68	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.0	50	0.0440	0.1		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
1.2	100	0.0800	1.4		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.1	145	0.1900	2.2		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
3.7	245	0.0490	1.1		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
15.0	540	Total			

Time span=0.00-30.00 hrs, dt=0.04 hrs, 751 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: Trib. area to wet Runoff Area=16.090 ac Runoff Depth=3.82"
Flow Length=540' Tc=15.0 min CN=68 Runoff=54.25 cfs 5.120 af

Total Runoff Area = 16.090 ac Runoff Volume = 5.120 af Average Runoff Depth = 3.82"

Subcatchment 1S: Trib. area to wet

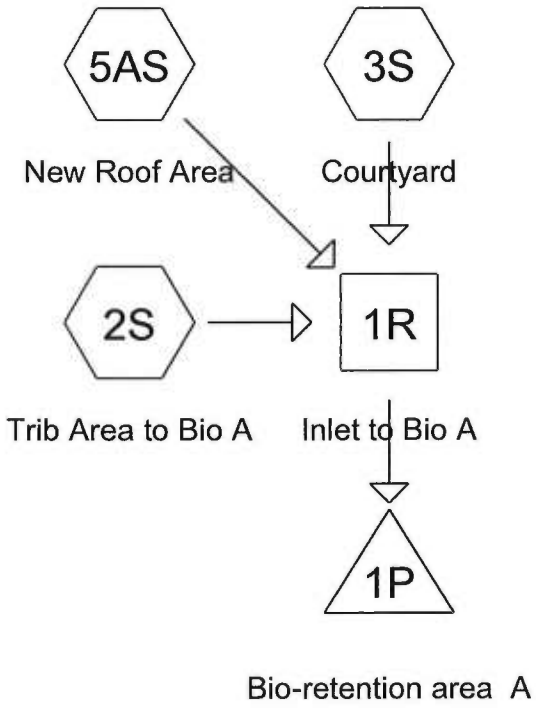
Runoff = 54.25 cfs @ 12.21 hrs, Volume= 5.120 af, Depth= 3.82"

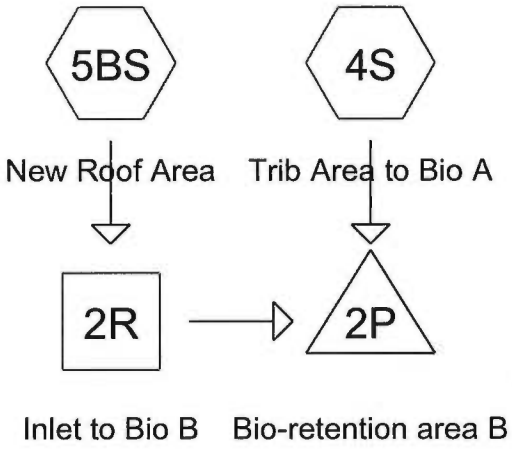
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.04 hrs
Type III 24-hr 4 fram 100 yr Rainfall=7.50"

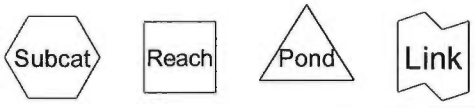
Area (ac)	CN	Description
3.073	98	Paved parking & roofs
0.038	89	Gravel roads, HSG C
0.306	39	>75% Grass cover, Good, HSG A
2.608	74	>75% Grass cover, Good, HSG C
3.309	30	Woods, Good, HSG A
3.843	70	Woods, Good, HSG C
2.913	77	Woods, Good, HSG D
16.090	68	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.0	50	0.0440	0.1		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
1.2	100	0.0800	1.4		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.1	145	0.1900	2.2		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
3.7	245	0.0490	1.1		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
15.0	540	Total			

PROJECT STORMWATER SYSTEM







Drainage Diagram for bethany health add storm system
Prepared by Whitman & Bingham Associates 9/13/2016

Time span=0.00-30.00 hrs, dt=0.04 hrs, 751 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 2S: Trib Area to Bio A Runoff Area=0.061 ac Runoff Depth=1.68"
Flow Length=35' Tc=6.0 min CN=84 Runoff=0.12 cfs 0.009 af

Subcatchment 3S: Courtyard Runoff Area=0.040 ac Runoff Depth=2.26"
Flow Length=10' Tc=6.0 min CN=91 Runoff=0.10 cfs 0.008 af

Subcatchment 4S: Trib Area to Bio A Runoff Area=0.107 ac Runoff Depth=2.00"
Flow Length=50' Tc=8.6 min CN=88 Runoff=0.23 cfs 0.018 af

Subcatchment 5AS: New Roof Area Runoff Area=0.057 ac Runoff Depth=2.97"
Flow Length=50' Tc=6.0 min CN=98 Runoff=0.18 cfs 0.014 af

Subcatchment 5BS: New Roof Area Runoff Area=0.045 ac Runoff Depth=2.97"
Flow Length=50' Tc=6.0 min CN=98 Runoff=0.14 cfs 0.011 af

Reach 1R: Inlet to Bio A Peak Depth=0.29' Max Vel=2.4 fps Inflow=0.40 cfs 0.030 af
D=10.0" n=0.013 L=60.0' S=0.0050 '/' Capacity=1.55 cfs Outflow=0.40 cfs 0.030 af

Reach 2R: Inlet to Bio B Peak Depth=0.15' Max Vel=2.9 fps Inflow=0.14 cfs 0.011 af
D=6.0" n=0.010 L=44.0' S=0.0100 '/' Capacity=0.73 cfs Outflow=0.14 cfs 0.011 af

Pond 1P: Bio-retention area A Peak Elev=112.03' Storage=249 cf Inflow=0.40 cfs 0.030 af
Primary=0.40 cfs 0.025 af Secondary=0.00 cfs 0.000 af Outflow=0.40 cfs 0.025 af

Pond 2P: Bio-retention area B Peak Elev=112.02' Storage=249 cf Inflow=0.36 cfs 0.029 af
Primary=0.36 cfs 0.023 af Secondary=0.00 cfs 0.000 af Outflow=0.36 cfs 0.023 af

Total Runoff Area = 0.310 ac Runoff Volume = 0.059 af Average Runoff Depth = 2.29"

Subcatchment 2S: Trib Area to Bio A

Runoff = 0.12 cfs @ 12.09 hrs, Volume= 0.009 af, Depth= 1.68"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.04 hrs
Type III 24-hr 1 fram 2 yr Rainfall=3.20"

Area (ac)	CN	Description
0.026	98	Paved parking & roofs
0.035	74	>75% Grass cover, Good, HSG C
0.061	84	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.3	25	0.0250	0.1		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
0.1	5	0.0200	0.8		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"
1.3	5	0.0200	0.1		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
5.7	35	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 3S: Courtyard

Runoff = 0.10 cfs @ 12.09 hrs, Volume= 0.008 af, Depth= 2.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.04 hrs
Type III 24-hr 1 fram 2 yr Rainfall=3.20"

Area (ac)	CN	Description
0.028	98	Paved parking & roofs
0.012	74	>75% Grass cover, Good, HSG C
0.040	91	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.3	10	0.0200	0.1		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
2.3	10	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 4S: Trib Area to Bio A

Runoff = 0.23 cfs @ 12.12 hrs, Volume= 0.018 af, Depth= 2.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.04 hrs
Type III 24-hr 1 fram 2 yr Rainfall=3.20"

Area (ac)	CN	Description
0.064	98	Paved parking & roofs
0.043	74	>75% Grass cover, Good, HSG C
0.107	88	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.5	45	0.0150	0.1		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
0.1	5	0.0200	0.8		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"
8.6	50	Total			

Subcatchment 5AS: New Roof Area

Runoff = 0.18 cfs @ 12.08 hrs, Volume= 0.014 af, Depth= 2.97"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.04 hrs
Type III 24-hr 1 fram 2 yr Rainfall=3.20"

Area (ac)	CN	Description
0.057	98	Paved parking & roofs

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	50	0.0100	0.9		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"
0.9	50	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 5BS: New Roof Area

Runoff = 0.14 cfs @ 12.08 hrs, Volume= 0.011 af, Depth= 2.97"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.04 hrs
Type III 24-hr 1 fram 2 yr Rainfall=3.20"

Area (ac)	CN	Description
0.045	98	Paved parking & roofs

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	50	0.0100	0.9		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"
0.9	50	Total, Increased to minimum Tc = 6.0 min			

Reach 1R: Inlet to Bio A

Inflow Area = 0.158 ac, Inflow Depth = 2.29" for 1 fram 2 yr event
Inflow = 0.40 cfs @ 12.09 hrs, Volume= 0.030 af
Outflow = 0.40 cfs @ 12.09 hrs, Volume= 0.030 af, Atten= 0%, Lag= 0.3 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.04 hrs
Max. Velocity= 2.4 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 0.7 fps, Avg. Travel Time= 1.3 min

Peak Depth= 0.29' @ 12.09 hrs
Capacity at bank full= 1.55 cfs
Inlet Invert= 111.10', Outlet Invert= 110.80'
10.0" Diameter Pipe, n= 0.013
Length= 60.0' Slope= 0.0050 '/'

Reach 2R: Inlet to Bio B

Inflow Area = 0.045 ac, Inflow Depth = 2.97" for 1 fram 2 yr event
Inflow = 0.14 cfs @ 12.08 hrs, Volume= 0.011 af
Outflow = 0.14 cfs @ 12.09 hrs, Volume= 0.011 af, Atten= 0%, Lag= 0.2 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.04 hrs
Max. Velocity= 2.9 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 0.9 fps, Avg. Travel Time= 0.8 min

Peak Depth= 0.15' @ 12.09 hrs
Capacity at bank full= 0.73 cfs
Inlet Invert= 111.24', Outlet Invert= 110.80'
6.0" Diameter Pipe, n= 0.010
Length= 44.0' Slope= 0.0100 '/'

Pond 1P: Bio-retention area A

Inflow Area = 0.158 ac, Inflow Depth = 2.29" for 1 fram 2 yr event
Inflow = 0.40 cfs @ 12.09 hrs, Volume= 0.030 af
Outflow = 0.40 cfs @ 12.10 hrs, Volume= 0.025 af, Atten= 0%, Lag= 0.2 min
Primary = 0.40 cfs @ 12.10 hrs, Volume= 0.025 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.04 hrs
Peak Elev= 112.03' @ 12.10 hrs Surf.Area= 238 sf Storage= 249 cf
Flood Elev= 112.75' Surf.Area= 800 sf Storage= 625 cf
Plug-Flow detention time= 121.1 min calculated for 0.025 af (81% of inflow)
Center-of-Mass det. time= 47.9 min (837.4 - 789.5)

Volume	Invert	Avail.Storage	Storage Description
#1	110.00'	625 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
110.00	38	0	0
111.00	115	77	77
112.00	218	167	243
112.75	800	382	625

Device	Routing	Invert	Outlet Devices
#1	Primary	106.00'	**10.0" x 70.0' long Culvert** CPP, end-section conforming to fill, Ke= 0.500 Outlet Invert= 104.60' S= 0.0200 '/' Cc= 0.900 n= 0.012
#2	Device 1	112.00'	**0.10' x 0.50' Horiz. basin grate X 3.00 columns** X 8 rows Limited to weir flow C= 0.600
#3	Secondary	112.50'	**10.0' 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

Primary OutFlow Max=0.39 cfs @ 12.10 hrs HW=112.03' (Free Discharge)
↑—**1=Culvert** (Passes 0.39 cfs of 5.70 cfs potential flow)
↑—**2=basin grate** (Weir Controls 0.39 cfs @ 0.5 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=110.00' (Free Discharge)
↑—**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 2P: Bio-retention area B

Inflow Area =	0.152 ac,	Inflow Depth =	2.28"	for 1 fram 2 yr event
Inflow =	0.36 cfs @	12.11 hrs,	Volume=	0.029 af
Outflow =	0.36 cfs @	12.11 hrs,	Volume=	0.023 af, Atten= 0%, Lag= 0.3 min
Primary =	0.36 cfs @	12.11 hrs,	Volume=	0.023 af
Secondary =	0.00 cfs @	0.00 hrs,	Volume=	0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.04 hrs
Peak Elev= 112.02' @ 12.11 hrs Surf.Area= 237 sf Storage= 249 cf
Flood Elev= 112.75' Surf.Area= 800 sf Storage= 625 cf
Plug-Flow detention time= 122.4 min calculated for 0.023 af (81% of inflow)
Center-of-Mass det. time= 47.1 min (841.3 - 794.2)

Volume	Invert	Avail.Storage	Storage Description
#1	110.00'	625 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
110.00	38	0	0
111.00	115	77	77
112.00	218	167	243
112.75	800	382	625

Device	Routing	Invert	Outlet Devices
#1	Primary	106.00'	**8.0" x 90.0' long Culvert** CPP, end-section conforming to fill, Ke= 0.500 Outlet Invert= 105.10' S= 0.0100 '/' Cc= 0.900 n= 0.012

#2	Device 1	112.00'	**0.10' x 0.50' Horiz. basin grate X 3.00 columns** X 8 rows Limited to weir flow C= 0.600
#3	Secondary	112.50'	**10.0' 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

Primary OutFlow Max=0.36 cfs @ 12.11 hrs HW=112.02' (Free Discharge)
↑—**1=Culvert** (Passes 0.36 cfs of 2.95 cfs potential flow)
↑—**2=basin grate** (Weir Controls 0.36 cfs @ 0.5 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=110.00' (Free Discharge)
↑—**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Time span=0.00-30.00 hrs, dt=0.04 hrs, 751 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 2S: Trib Area to Bio A Runoff Area=0.061 ac Runoff Depth=2.91"
Flow Length=35' Tc=6.0 min CN=84 Runoff=0.21 cfs 0.015 af

Subcatchment 3S: Courtyard Runoff Area=0.040 ac Runoff Depth=3.59"
Flow Length=10' Tc=6.0 min CN=91 Runoff=0.16 cfs 0.012 af

Subcatchment 4S: Trib Area to Bio A Runoff Area=0.107 ac Runoff Depth=3.29"
Flow Length=50' Tc=8.6 min CN=88 Runoff=0.37 cfs 0.029 af

Subcatchment 5AS: New Roof Area Runoff Area=0.057 ac Runoff Depth=4.36"
Flow Length=50' Tc=6.0 min CN=98 Runoff=0.25 cfs 0.021 af

Subcatchment 5BS: New Roof Area Runoff Area=0.045 ac Runoff Depth=4.36"
Flow Length=50' Tc=6.0 min CN=98 Runoff=0.20 cfs 0.016 af

Reach 1R: Inlet to Bio A Peak Depth=0.37' Max Vel=2.7 fps Inflow=0.62 cfs 0.047 af
D=10.0" n=0.013 L=60.0' S=0.0050 '/' Capacity=1.55 cfs Outflow=0.62 cfs 0.047 af

Reach 2R: Inlet to Bio B Peak Depth=0.18' Max Vel=3.2 fps Inflow=0.20 cfs 0.016 af
D=6.0" n=0.010 L=44.0' S=0.0100 '/' Capacity=0.73 cfs Outflow=0.20 cfs 0.016 af

Pond 1P: Bio-retention area A Peak Elev=112.04' Storage=251 cf Inflow=0.62 cfs 0.047 af
Primary=0.62 cfs 0.042 af Secondary=0.00 cfs 0.000 af Outflow=0.62 cfs 0.042 af

Pond 2P: Bio-retention area B Peak Elev=112.03' Storage=251 cf Inflow=0.56 cfs 0.046 af
Primary=0.56 cfs 0.040 af Secondary=0.00 cfs 0.000 af Outflow=0.56 cfs 0.040 af

Total Runoff Area = 0.310 ac Runoff Volume = 0.093 af Average Runoff Depth = 3.61"

Subcatchment 2S: Trib Area to Bio A

Runoff = 0.21 cfs @ 12.09 hrs, Volume= 0.015 af, Depth= 2.91"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.04 hrs
Type III 24-hr 2 fram 10 yr Rainfall=4.60"

Area (ac)	CN	Description
0.026	98	Paved parking & roofs
0.035	74	>75% Grass cover, Good, HSG C
0.061	84	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.3	25	0.0250	0.1		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
0.1	5	0.0200	0.8		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"
1.3	5	0.0200	0.1		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
5.7	35	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 3S: Courtyard

Runoff = 0.16 cfs @ 12.09 hrs, Volume= 0.012 af, Depth= 3.59"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.04 hrs
Type III 24-hr 2 fram 10 yr Rainfall=4.60"

Area (ac)	CN	Description
0.028	98	Paved parking & roofs
0.012	74	>75% Grass cover, Good, HSG C
0.040	91	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.3	10	0.0200	0.1		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
2.3	10	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 4S: Trib Area to Bio A

Runoff = 0.37 cfs @ 12.12 hrs, Volume= 0.029 af, Depth= 3.29"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.04 hrs
Type III 24-hr 2 fram 10 yr Rainfall=4.60"

Area (ac)	CN	Description
0.064	98	Paved parking & roofs
0.043	74	>75% Grass cover, Good, HSG C
0.107	88	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.5	45	0.0150	0.1		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
0.1	5	0.0200	0.8		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"
8.6	50	Total			

Subcatchment 5AS: New Roof Area

Runoff = 0.25 cfs @ 12.08 hrs, Volume= 0.021 af, Depth= 4.36"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.04 hrs
Type III 24-hr 2 fram 10 yr Rainfall=4.60"

Area (ac)	CN	Description
0.057	98	Paved parking & roofs

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	50	0.0100	0.9		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"
0.9	50	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 5BS: New Roof Area

Runoff = 0.20 cfs @ 12.08 hrs, Volume= 0.016 af, Depth= 4.36"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.04 hrs
Type III 24-hr 2 fram 10 yr Rainfall=4.60"

Area (ac)	CN	Description
0.045	98	Paved parking & roofs

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	50	0.0100	0.9		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"
0.9	50	Total, Increased to minimum Tc = 6.0 min			

Reach 1R: Inlet to Bio A

Inflow Area = 0.158 ac, Inflow Depth = 3.61" for 2 fram 10 yr event
Inflow = 0.62 cfs @ 12.09 hrs, Volume= 0.047 af
Outflow = 0.62 cfs @ 12.09 hrs, Volume= 0.047 af, Atten= 0%, Lag= 0.3 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.04 hrs
Max. Velocity= 2.7 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 0.9 fps, Avg. Travel Time= 1.2 min

Peak Depth= 0.37' @ 12.09 hrs
Capacity at bank full= 1.55 cfs
Inlet Invert= 111.10', Outlet Invert= 110.80'
10.0" Diameter Pipe, n= 0.013
Length= 60.0' Slope= 0.0050 '/'

Reach 2R: Inlet to Bio B

Inflow Area = 0.045 ac, Inflow Depth = 4.36" for 2 fram 10 yr event
Inflow = 0.20 cfs @ 12.08 hrs, Volume= 0.016 af
Outflow = 0.20 cfs @ 12.09 hrs, Volume= 0.016 af, Atten= 0%, Lag= 0.2 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.04 hrs
Max. Velocity= 3.2 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 1.1 fps, Avg. Travel Time= 0.7 min

Peak Depth= 0.18' @ 12.09 hrs
Capacity at bank full= 0.73 cfs
Inlet Invert= 111.24', Outlet Invert= 110.80'
6.0" Diameter Pipe, n= 0.010
Length= 44.0' Slope= 0.0100 '/'

Pond 1P: Bio-retention area A

Inflow Area = 0.158 ac, Inflow Depth = 3.61" for 2 fram 10 yr event
Inflow = 0.62 cfs @ 12.09 hrs, Volume= 0.047 af
Outflow = 0.62 cfs @ 12.09 hrs, Volume= 0.042 af, Atten= 0%, Lag= 0.2 min
Primary = 0.62 cfs @ 12.09 hrs, Volume= 0.042 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.04 hrs
Peak Elev= 112.04' @ 12.09 hrs Surf.Area= 245 sf Storage= 251 cf
Flood Elev= 112.75' Surf.Area= 800 sf Storage= 625 cf
Plug-Flow detention time= 93.0 min calculated for 0.042 af (88% of inflow)
Center-of-Mass det. time= 37.9 min (818.3 - 780.4)

Volume	Invert	Avail.Storage	Storage Description
#1	110.00'	625 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
110.00	38	0	0
111.00	115	77	77
112.00	218	167	243
112.75	800	382	625

Device	Routing	Invert	Outlet Devices
#1	Primary	106.00'	**10.0" x 70.0' long Culvert** CPP, end-section conforming to fill, Ke= 0.500 Outlet Invert= 104.60' S= 0.0200 '/' Cc= 0.900 n= 0.012
#2	Device 1	112.00'	**0.10' x 0.50' Horiz. basin grate X 3.00 columns** X 8 rows Limited to weir flow C= 0.600
#3	Secondary	112.50'	**10.0' 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

Primary OutFlow Max=0.60 cfs @ 12.09 hrs HW=112.03' (Free Discharge)
↑—**1=Culvert** (Passes 0.60 cfs of 5.70 cfs potential flow)
↑—**2=basin grate** (Weir Controls 0.60 cfs @ 0.6 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=110.00' (Free Discharge)
↑—**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 2P: Bio-retention area B

Inflow Area =	0.152 ac,	Inflow Depth =	3.61"	for 2 fram 10 yr event
Inflow =	0.56 cfs @	12.11 hrs,	Volume=	0.046 af
Outflow =	0.56 cfs @	12.11 hrs,	Volume=	0.040 af, Atten= 0%, Lag= 0.2 min
Primary =	0.56 cfs @	12.11 hrs,	Volume=	0.040 af
Secondary =	0.00 cfs @	0.00 hrs,	Volume=	0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.04 hrs
Peak Elev= 112.03' @ 12.11 hrs Surf.Area= 243 sf Storage= 251 cf
Flood Elev= 112.75' Surf.Area= 800 sf Storage= 625 cf
Plug-Flow detention time= 93.0 min calculated for 0.040 af (88% of inflow)
Center-of-Mass det. time= 37.3 min (821.5 - 784.2)

Volume	Invert	Avail.Storage	Storage Description
#1	110.00'	625 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
110.00	38	0	0
111.00	115	77	77
112.00	218	167	243
112.75	800	382	625

Device	Routing	Invert	Outlet Devices
#1	Primary	106.00'	**8.0" x 90.0' long Culvert** CPP, end-section conforming to fill, Ke= 0.500 Outlet Invert= 105.10' S= 0.0100 '/' Cc= 0.900 n= 0.012

#2	Device 1	112.00'	**0.10' x 0.50' Horiz. basin grate X 3.00 columns** X 8 rows Limited to weir flow C= 0.600
#3	Secondary	112.50'	**10.0' 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

Primary OutFlow Max=0.55 cfs @ 12.11 hrs HW=112.03' (Free Discharge)
↑—**1=Culvert** (Passes 0.55 cfs of 2.95 cfs potential flow)
↑—**2=basin grate** (Weir Controls 0.55 cfs @ 0.6 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=110.00' (Free Discharge)
↑—**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Time span=0.00-30.00 hrs, dt=0.04 hrs, 751 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 2S: Trib Area to Bio A Runoff Area=0.061 ac Runoff Depth=3.73"
Flow Length=35' Tc=6.0 min CN=84 Runoff=0.26 cfs 0.019 af

Subcatchment 3S: Courtyard Runoff Area=0.040 ac Runoff Depth=4.47"
Flow Length=10' Tc=6.0 min CN=91 Runoff=0.20 cfs 0.015 af

Subcatchment 4S: Trib Area to Bio A Runoff Area=0.107 ac Runoff Depth=4.15"
Flow Length=50' Tc=8.6 min CN=88 Runoff=0.46 cfs 0.037 af

Subcatchment 5AS: New Roof Area Runoff Area=0.057 ac Runoff Depth=5.26"
Flow Length=50' Tc=6.0 min CN=98 Runoff=0.30 cfs 0.025 af

Subcatchment 5BS: New Roof Area Runoff Area=0.045 ac Runoff Depth=5.26"
Flow Length=50' Tc=6.0 min CN=98 Runoff=0.24 cfs 0.020 af

Reach 1R: Inlet to Bio A Peak Depth=0.41' Max Vel=2.8 fps Inflow=0.76 cfs 0.059 af
D=10.0" n=0.013 L=60.0' S=0.0050 '/' Capacity=1.55 cfs Outflow=0.76 cfs 0.059 af

Reach 2R: Inlet to Bio B Peak Depth=0.20' Max Vel=3.3 fps Inflow=0.24 cfs 0.020 af
D=6.0" n=0.010 L=44.0' S=0.0100 '/' Capacity=0.73 cfs Outflow=0.24 cfs 0.020 af

Pond 1P: Bio-retention area A Peak Elev=112.04' Storage=252 cf Inflow=0.76 cfs 0.059 af
Primary=0.76 cfs 0.053 af Secondary=0.00 cfs 0.000 af Outflow=0.76 cfs 0.053 af

Pond 2P: Bio-retention area B Peak Elev=112.04' Storage=252 cf Inflow=0.69 cfs 0.057 af
Primary=0.69 cfs 0.051 af Secondary=0.00 cfs 0.000 af Outflow=0.69 cfs 0.051 af

Total Runoff Area = 0.310 ac Runoff Volume = 0.116 af Average Runoff Depth = 4.47"

Subcatchment 2S: Trib Area to Bio A

Runoff = 0.26 cfs @ 12.09 hrs, Volume= 0.019 af, Depth= 3.73"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.04 hrs
Type III 24-hr 3 fram 25 yr Rainfall=5.50"

Area (ac)	CN	Description
0.026	98	Paved parking & roofs
0.035	74	>75% Grass cover, Good, HSG C
0.061	84	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.3	25	0.0250	0.1		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
0.1	5	0.0200	0.8		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"
1.3	5	0.0200	0.1		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
5.7	35	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 3S: Courtyard

Runoff = 0.20 cfs @ 12.09 hrs, Volume= 0.015 af, Depth= 4.47"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.04 hrs
Type III 24-hr 3 fram 25 yr Rainfall=5.50"

Area (ac)	CN	Description
0.028	98	Paved parking & roofs
0.012	74	>75% Grass cover, Good, HSG C
0.040	91	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.3	10	0.0200	0.1		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
2.3	10	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 4S: Trib Area to Bio A

Runoff = 0.46 cfs @ 12.12 hrs, Volume= 0.037 af, Depth= 4.15"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.04 hrs
Type III 24-hr 3 fram 25 yr Rainfall=5.50"

Area (ac)	CN	Description
0.064	98	Paved parking & roofs
0.043	74	>75% Grass cover, Good, HSG C
0.107	88	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.5	45	0.0150	0.1		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
0.1	5	0.0200	0.8		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"
8.6	50	Total			

Subcatchment 5AS: New Roof Area

Runoff = 0.30 cfs @ 12.08 hrs, Volume= 0.025 af, Depth= 5.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.04 hrs
Type III 24-hr 3 fram 25 yr Rainfall=5.50"

Area (ac)	CN	Description
0.057	98	Paved parking & roofs

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	50	0.0100	0.9		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"
0.9	50	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 5BS: New Roof Area

Runoff = 0.24 cfs @ 12.08 hrs, Volume= 0.020 af, Depth= 5.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.04 hrs
Type III 24-hr 3 fram 25 yr Rainfall=5.50"

Area (ac)	CN	Description
0.045	98	Paved parking & roofs

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	50	0.0100	0.9		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"
0.9	50	Total, Increased to minimum Tc = 6.0 min			

Reach 1R: Inlet to Bio A

Inflow Area = 0.158 ac, Inflow Depth = 4.47" for 3 fram 25 yr event
Inflow = 0.76 cfs @ 12.09 hrs, Volume= 0.059 af
Outflow = 0.76 cfs @ 12.09 hrs, Volume= 0.059 af, Atten= 0%, Lag= 0.3 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.04 hrs
Max. Velocity= 2.8 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 0.9 fps, Avg. Travel Time= 1.1 min

Peak Depth= 0.41' @ 12.09 hrs
Capacity at bank full= 1.55 cfs
Inlet Invert= 111.10', Outlet Invert= 110.80'
10.0" Diameter Pipe, n= 0.013
Length= 60.0' Slope= 0.0050 '/'

Reach 2R: Inlet to Bio B

Inflow Area = 0.045 ac, Inflow Depth = 5.26" for 3 fram 25 yr event
Inflow = 0.24 cfs @ 12.08 hrs, Volume= 0.020 af
Outflow = 0.24 cfs @ 12.09 hrs, Volume= 0.020 af, Atten= 0%, Lag= 0.2 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.04 hrs
Max. Velocity= 3.3 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 1.1 fps, Avg. Travel Time= 0.7 min

Peak Depth= 0.20' @ 12.09 hrs
Capacity at bank full= 0.73 cfs
Inlet Invert= 111.24', Outlet Invert= 110.80'
6.0" Diameter Pipe, n= 0.010
Length= 44.0' Slope= 0.0100 '/'

Pond 1P: Bio-retention area A

Inflow Area = 0.158 ac, Inflow Depth = 4.47" for 3 fram 25 yr event
Inflow = 0.76 cfs @ 12.09 hrs, Volume= 0.059 af
Outflow = 0.76 cfs @ 12.09 hrs, Volume= 0.053 af, Atten= 0%, Lag= 0.2 min
Primary = 0.76 cfs @ 12.09 hrs, Volume= 0.053 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.04 hrs
Peak Elev= 112.04' @ 12.09 hrs Surf.Area= 249 sf Storage= 252 cf
Flood Elev= 112.75' Surf.Area= 800 sf Storage= 625 cf
Plug-Flow detention time= 80.7 min calculated for 0.053 af (90% of inflow)
Center-of-Mass det. time= 33.8 min (809.9 - 776.1)

Volume	Invert	Avail.Storage	Storage Description
#1	110.00'	625 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
110.00	38	0	0
111.00	115	77	77
112.00	218	167	243
112.75	800	382	625

Device	Routing	Invert	Outlet Devices
#1	Primary	106.00'	**10.0" x 70.0' long Culvert** CPP, end-section conforming to fill, Ke= 0.500 Outlet Invert= 104.60' S= 0.0200 '/' Cc= 0.900 n= 0.012
#2	Device 1	112.00'	**0.10' x 0.50' Horiz. basin grate X 3.00 columns** X 8 rows Limited to weir flow C= 0.600
#3	Secondary	112.50'	**10.0' 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

Primary OutFlow Max=0.74 cfs @ 12.09 hrs HW=112.04' (Free Discharge)
↑—**1=Culvert** (Passes 0.74 cfs of 5.71 cfs potential flow)
↑—**2=basin grate** (Weir Controls 0.74 cfs @ 0.7 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=110.00' (Free Discharge)
↑—**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 2P: Bio-retention area B

Inflow Area = 0.152 ac, Inflow Depth = 4.48" for 3 fram 25 yr event
Inflow = 0.69 cfs @ 12.11 hrs, Volume= 0.057 af
Outflow = 0.69 cfs @ 12.11 hrs, Volume= 0.051 af, Atten= 0%, Lag= 0.2 min
Primary = 0.69 cfs @ 12.11 hrs, Volume= 0.051 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.04 hrs
Peak Elev= 112.04' @ 12.11 hrs Surf.Area= 247 sf Storage= 252 cf
Flood Elev= 112.75' Surf.Area= 800 sf Storage= 625 cf
Plug-Flow detention time= 81.8 min calculated for 0.051 af (90% of inflow)
Center-of-Mass det. time= 33.4 min (812.9 - 779.5)

Volume	Invert	Avail.Storage	Storage Description
#1	110.00'	625 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
110.00	38	0	0
111.00	115	77	77
112.00	218	167	243
112.75	800	382	625

Device	Routing	Invert	Outlet Devices
#1	Primary	106.00'	**8.0" x 90.0' long Culvert** CPP, end-section conforming to fill, Ke= 0.500 Outlet Invert= 105.10' S= 0.0100 '/' Cc= 0.900 n= 0.012

#2	Device 1	112.00'	**0.10' x 0.50' Horiz. basin grate X 3.00 columns** X 8 rows Limited to weir flow C= 0.600
#3	Secondary	112.50'	**10.0' 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

Primary OutFlow Max=0.68 cfs @ 12.11 hrs HW=112.04' (Free Discharge)
↑—**1=Culvert** (Passes 0.68 cfs of 2.96 cfs potential flow)
↑—**2=basin grate** (Weir Controls 0.68 cfs @ 0.6 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=110.00' (Free Discharge)
↑—**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Time span=0.00-30.00 hrs, dt=0.04 hrs, 751 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 2S: Trib Area to Bio A Runoff Area=0.061 ac Runoff Depth=5.62"
Flow Length=35' Tc=6.0 min CN=84 Runoff=0.39 cfs 0.029 af

Subcatchment 3S: Courtyard Runoff Area=0.040 ac Runoff Depth=6.43"
Flow Length=10' Tc=6.0 min CN=91 Runoff=0.28 cfs 0.021 af

Subcatchment 4S: Trib Area to Bio A Runoff Area=0.107 ac Runoff Depth=6.08"
Flow Length=50' Tc=8.6 min CN=88 Runoff=0.66 cfs 0.054 af

Subcatchment 5AS: New Roof Area Runoff Area=0.057 ac Runoff Depth=7.26"
Flow Length=50' Tc=6.0 min CN=98 Runoff=0.42 cfs 0.034 af

Subcatchment 5BS: New Roof Area Runoff Area=0.045 ac Runoff Depth=7.26"
Flow Length=50' Tc=6.0 min CN=98 Runoff=0.33 cfs 0.027 af

Reach 1R: Inlet to Bio A Peak Depth=0.51' Max Vel=3.1 fps Inflow=1.08 cfs 0.084 af
D=10.0" n=0.013 L=60.0' S=0.0050 '/' Capacity=1.55 cfs Outflow=1.08 cfs 0.084 af

Reach 2R: Inlet to Bio B Peak Depth=0.24' Max Vel=3.6 fps Inflow=0.33 cfs 0.027 af
D=6.0" n=0.010 L=44.0' S=0.0100 '/' Capacity=0.73 cfs Outflow=0.33 cfs 0.027 af

Pond 1P: Bio-retention area A Peak Elev=112.05' Storage=255 cf Inflow=1.08 cfs 0.084 af
Primary=1.08 cfs 0.079 af Secondary=0.00 cfs 0.000 af Outflow=1.08 cfs 0.079 af

Pond 2P: Bio-retention area B Peak Elev=112.05' Storage=254 cf Inflow=0.97 cfs 0.081 af
Primary=0.97 cfs 0.076 af Secondary=0.00 cfs 0.000 af Outflow=0.97 cfs 0.076 af

Total Runoff Area = 0.310 ac Runoff Volume = 0.166 af Average Runoff Depth = 6.42"

Subcatchment 2S: Trib Area to Bio A

Runoff = 0.39 cfs @ 12.09 hrs, Volume= 0.029 af, Depth= 5.62"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.04 hrs
Type III 24-hr 4 fram 100 yr Rainfall=7.50"

Area (ac)	CN	Description
0.026	98	Paved parking & roofs
0.035	74	>75% Grass cover, Good, HSG C
0.061	84	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.3	25	0.0250	0.1		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
0.1	5	0.0200	0.8		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"
1.3	5	0.0200	0.1		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
5.7	35	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 3S: Courtyard

Runoff = 0.28 cfs @ 12.08 hrs, Volume= 0.021 af, Depth= 6.43"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.04 hrs
Type III 24-hr 4 fram 100 yr Rainfall=7.50"

Area (ac)	CN	Description
0.028	98	Paved parking & roofs
0.012	74	>75% Grass cover, Good, HSG C
0.040	91	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.3	10	0.0200	0.1		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
2.3	10	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 4S: Trib Area to Bio A

Runoff = 0.66 cfs @ 12.12 hrs, Volume= 0.054 af, Depth= 6.08"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.04 hrs
Type III 24-hr 4 fram 100 yr Rainfall=7.50"

Area (ac)	CN	Description
0.064	98	Paved parking & roofs
0.043	74	>75% Grass cover, Good, HSG C
0.107	88	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.5	45	0.0150	0.1		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
0.1	5	0.0200	0.8		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"
8.6	50	Total			

Subcatchment 5AS: New Roof Area

Runoff = 0.42 cfs @ 12.08 hrs, Volume= 0.034 af, Depth= 7.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.04 hrs
Type III 24-hr 4 fram 100 yr Rainfall=7.50"

Area (ac)	CN	Description
0.057	98	Paved parking & roofs

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	50	0.0100	0.9		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"
0.9	50	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 5BS: New Roof Area

Runoff = 0.33 cfs @ 12.08 hrs, Volume= 0.027 af, Depth= 7.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.04 hrs
Type III 24-hr 4 fram 100 yr Rainfall=7.50"

Area (ac)	CN	Description
0.045	98	Paved parking & roofs

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	50	0.0100	0.9		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"
0.9	50	Total, Increased to minimum Tc = 6.0 min			

Reach 1R: Inlet to Bio A

Inflow Area = 0.158 ac, Inflow Depth = 6.42" for 4 fram 100 yr event
Inflow = 1.08 cfs @ 12.09 hrs, Volume= 0.084 af
Outflow = 1.08 cfs @ 12.09 hrs, Volume= 0.084 af, Atten= 0%, Lag= 0.3 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.04 hrs
Max. Velocity= 3.1 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 1.0 fps, Avg. Travel Time= 1.0 min

Peak Depth= 0.51' @ 12.09 hrs
Capacity at bank full= 1.55 cfs
Inlet Invert= 111.10', Outlet Invert= 110.80'
10.0" Diameter Pipe, n= 0.013
Length= 60.0' Slope= 0.0050 '/'

Reach 2R: Inlet to Bio B

Inflow Area = 0.045 ac, Inflow Depth = 7.26" for 4 fram 100 yr event
Inflow = 0.33 cfs @ 12.08 hrs, Volume= 0.027 af
Outflow = 0.33 cfs @ 12.09 hrs, Volume= 0.027 af, Atten= 0%, Lag= 0.2 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.04 hrs
Max. Velocity= 3.6 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 1.2 fps, Avg. Travel Time= 0.6 min

Peak Depth= 0.24' @ 12.09 hrs
Capacity at bank full= 0.73 cfs
Inlet Invert= 111.24', Outlet Invert= 110.80'
6.0" Diameter Pipe, n= 0.010
Length= 44.0' Slope= 0.0100 '/'

Pond 1P: Bio-retention area A

Inflow Area = 0.158 ac, Inflow Depth = 6.42" for 4 fram 100 yr event
Inflow = 1.08 cfs @ 12.09 hrs, Volume= 0.084 af
Outflow = 1.08 cfs @ 12.09 hrs, Volume= 0.079 af, Atten= 0%, Lag= 0.1 min
Primary = 1.08 cfs @ 12.09 hrs, Volume= 0.079 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.04 hrs
Peak Elev= 112.05' @ 12.09 hrs Surf.Area= 257 sf Storage= 255 cf
Flood Elev= 112.75' Surf.Area= 800 sf Storage= 625 cf
Plug-Flow detention time= 63.3 min calculated for 0.079 af (93% of inflow)
Center-of-Mass det. time= 27.6 min (796.6 - 768.9)

Volume	Invert	Avail.Storage	Storage Description
#1	110.00'	625 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
110.00	38	0	0
111.00	115	77	77
112.00	218	167	243
112.75	800	382	625

Device	Routing	Invert	Outlet Devices
#1	Primary	106.00'	**10.0" x 70.0' long Culvert** CPP, end-section conforming to fill, Ke= 0.500 Outlet Invert= 104.60' S= 0.0200 '/' Cc= 0.900 n= 0.012
#2	Device 1	112.00'	**0.10' x 0.50' Horiz. basin grate X 3.00 columns** X 8 rows Limited to weir flow C= 0.600
#3	Secondary	112.50'	**10.0' 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

Primary OutFlow Max=1.05 cfs @ 12.09 hrs HW=112.05' (Free Discharge)
↑—**1=Culvert** (Passes 1.05 cfs of 5.71 cfs potential flow)
↑—**2=basin grate** (Weir Controls 1.05 cfs @ 0.7 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=110.00' (Free Discharge)
↑—**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 2P: Bio-retention area B

Inflow Area =	0.152 ac,	Inflow Depth =	6.43"	for 4 fram 100 yr event
Inflow =	0.97 cfs @	12.11 hrs,	Volume=	0.081 af
Outflow =	0.97 cfs @	12.11 hrs,	Volume=	0.076 af, Atten= 0%, Lag= 0.2 min
Primary =	0.97 cfs @	12.11 hrs,	Volume=	0.076 af
Secondary =	0.00 cfs @	0.00 hrs,	Volume=	0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.04 hrs
Peak Elev= 112.05' @ 12.11 hrs Surf.Area= 255 sf Storage= 254 cf
Flood Elev= 112.75' Surf.Area= 800 sf Storage= 625 cf
Plug-Flow detention time= 64.4 min calculated for 0.076 af (93% of inflow)
Center-of-Mass det. time= 27.5 min (799.3 - 771.8)

Volume	Invert	Avail.Storage	Storage Description
#1	110.00'	625 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

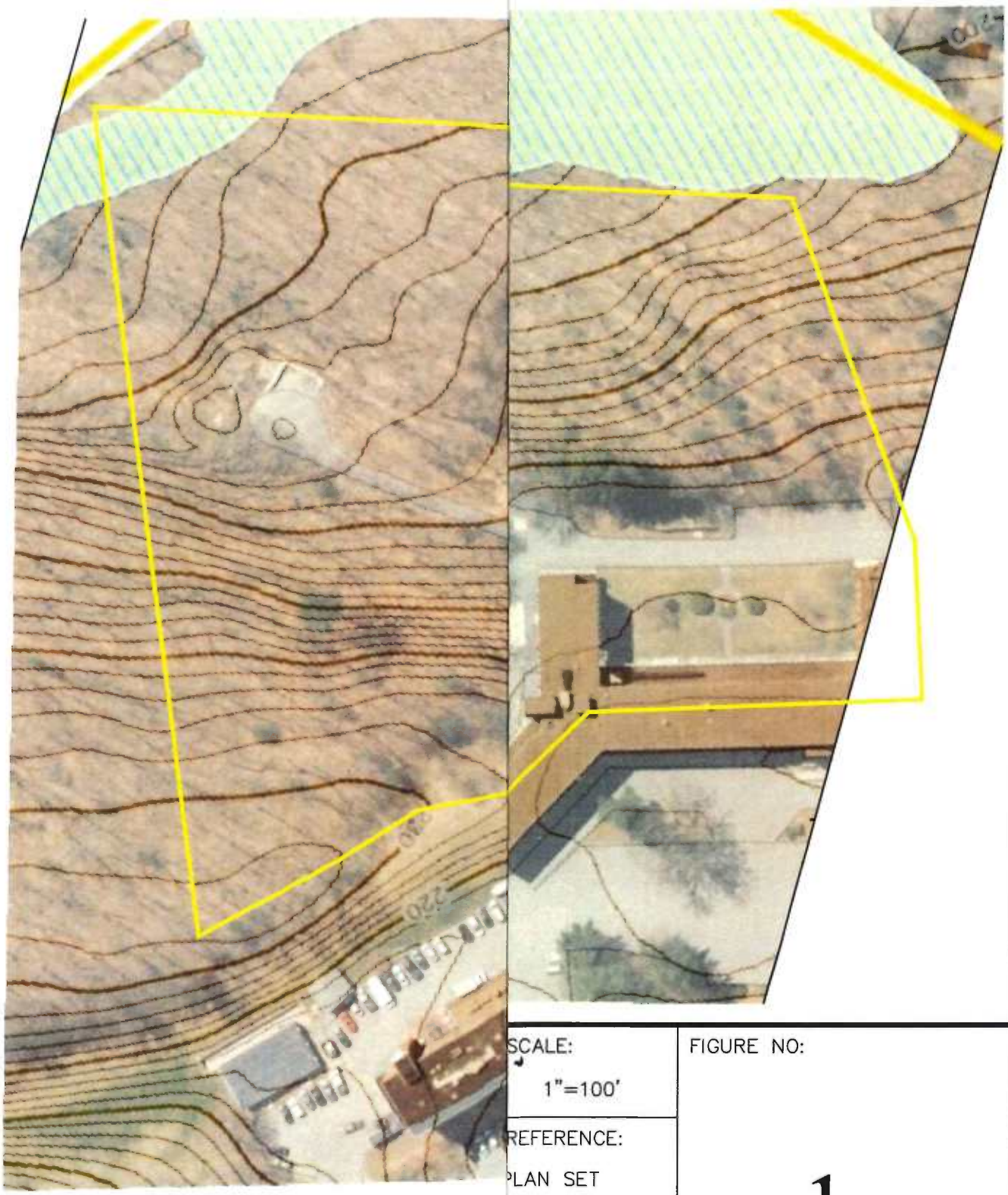
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
110.00	38	0	0
111.00	115	77	77
112.00	218	167	243
112.75	800	382	625

Device	Routing	Invert	Outlet Devices
#1	Primary	106.00'	**8.0" x 90.0' long Culvert** CPP, end-section conforming to fill, Ke= 0.500 Outlet Invert= 105.10' S= 0.0100 '/' Cc= 0.900 n= 0.012

#2	Device 1	112.00'	**0.10' x 0.50' Horiz. basin grate X 3.00 columns** X 8 rows Limited to weir flow C= 0.600
#3	Secondary	112.50'	**10.0' 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

Primary OutFlow Max=0.96 cfs @ 12.11 hrs HW=112.05' (Free Discharge)
↑—**1=Culvert** (Passes 0.96 cfs of 2.96 cfs potential flow)
↑—**2=basin grate** (Weir Controls 0.96 cfs @ 0.7 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=110.00' (Free Discharge)
↑—**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)



GRAPHIC SCALE

100 0 50 100 200

(IN FEET)
1 inch = 100 ft.

SCALE: 1"=100'	FIGURE NO: 1
REFERENCE: PLAN SET	
DATE: 9-13-16	
JOB NO: 13855	

GRAPHIC SCALE

100 0 50 100 200 400

(IN FEET)
1 inch = 100 ft.

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WATERSHED

ACTIVITIES ROOM ADDITION

BETHANY HEALTH CARE
FRAMINGHAM, MA 01702

SCALE: 1"=100'

REFERENCE: PLAN SET

DATE: 9-13-16

JOB NO: 13855

FIGURE NO: 1