Preliminary Stormwater Management Report

for the

Federalsburg Park Watershed

in

The Town of Federalsburg, MD

April 30, 2014

Prepared by:

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&

The University of Maryland Environmental Finance Center

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Step 3: Calculate the Post-Development Load (L_{post})

A. New Development and Redevelopment:

L_{post} = (R_v) (C) (A) (8.16)

R_v = $0.05 + 0.009 (I_{post})$

= $0.05 + 0.009$ (30) = 0.32

L_{post} = (0.32) (0.30) (87.9) (8.16)

= 68.86 lbs/year of total phosphorus

Where:

L_{post} = Average annual load of total phosphorus exported from the post-development site (lbs/year)
R_v = Runoff coefficient, which expresses the fraction of rainfall which is converted into runoff
I_{post} = Post-development (proposed) site imperviousness (i.e., I = 75 if site is 75% impervious)
C = Flow-weighted mean concentration of the pollutant (total phosphorus) in urban runoff (mg/l) = 0.30 mg/l
A = Area of the site within the Critical Area IDA (acres)
8.16 = Includes regional constants and unit conversion factors

Step 4: Calculate the Pollutant Removal Requirement (RR)

RR = $L_{post} - (0.9) (L_{pre})$

= (68.86) - (0.9) (43.95)

= 29.3 lbs/year of total phosphorus

Where:

RR = Pollutant removal requirement (lbs/year)
L_{post} = Average annual load of total phosphorus exported from the post-development site (lbs/year)
L_{pre} = Average annual load of total phosphorus exported from the site prior to development (lbs/year)

Step 2: Calculate the Predevelopment Load (L_{pre})

A. New Development

L_{pre} = (0.5) (A)

= (0.5) (87.9)

= 43.95 lbs /year of total phosphorus

Where:

L_{pre} = Average annual load of total phosphorus exported from the site prior to development (lbs/year)
0.5 = Annual total phosphorus load from undeveloped lands (lbs/acre/year)
A = Area of the site within the Critical Area IDA (acres)

B. Redevelopment

L_{pre} = (R_v) (C) (A) (8.16)

R_v = 0.05 + 0.009 (I_{pre})

= 0.05 + 0.009 (_____) = _____

L_{pre} = (_____) (_____) (_____) (8.16)

= _____ lbs/year of total phosphorus

Where:

L_{pre} = Average annual load of total phosphorus exported from the site prior to development (lbs/year)
R_v = Runoff coefficient, which expresses the fraction of rainfall which is converted into runoff
I_{pre} = Pre-development (existing) site imperviousness (i.e., I = 75 if site is 75% impervious)
C = Flow-weighted mean concentration of the pollutant (total phosphorus) in urban runoff (mg/l) = 0.30 mg/l
A = Area of the site within the Critical Area IDA (acres)
8.16 = Includes regional constants and unit conversion factors

Worksheet A: Standard Application Process

Calculating Pollutant Removal Requirements[1]

Step 1: Calculate Existing and Proposed Site Imperviousness

A. Calculate Percent Imperviousness

1) Site Area within the Critical Area IDA, A = 87.9 acres

2) Site Impervious Surface Area, Existing and Proposed, (See Table 4.1 for details)

	(a) Existing (acres)	(b) Proposed (acres)
Roads		
Parking lots		
Driveways		
Sidewalks/paths		
Rooftops		
Decks		
Swimming pools/ponds		
Other		
Impervious Surface Area	.000	26.4

3) Imperviousness (I)

Existing Imperviousness, I_{pre} = Impervious Surface Area / Site Area
= (Step 2a) / (Step 1)
= (.000) / (87.9)
= 0.00 %

Proposed Imperviousness, I_{post} = Impervious Surface Area / Site Area
= (Step 2b) / (Step 1)
= (26.4) / (87.9)
= 30 %

B. Define Development Category (circle)

1) New Development: Existing imperviousness less than 15% I *(Go to Step 2A)*

2) Redevelopment: Existing imperviousness of 15% I or more *(Go to Step 2B)*

3) Single Lot Residential Development: Single lot being developed or improved; single family residential development; and more than 250 square feet of impervious area and associated disturbance (Go to Section 5, Residential Approach, for detailed criteria and requirements).

[1] NOTE: All acreage used in this worksheet refers to areas within the IDA of the Critical Area only.

Step 5: Identify Feasible BMP(s)

Select BMP Options using the screening matrices provided in the Chapter 4 of the 2000 Maryland Stormwater Design Manual. Calculate the load removed for each option.

BMP Type	(L_{post})	x	(BMP_{RE})	x	(% DA Served)	=	LR	
DISCONN. OF ROOFTOP RUNOFF	68.86	x	25%	x	15%	=	2.58	lbs/year
GRASS SWALES	68.86	x	20%	x	50%	=	6.89	lbs/year
		x		x		=		lbs/year
		x		x		=		lbs/year

Load Removed, LR (total) = 9.47 lbs/year

Pollutant Removal Requirement, RR (from Step 4) = 29.3 lbs/year

Where:

Load Removed, LR = Annual total phosphorus load removed by the proposed BMP (lbs/year)

L_{post} = Average annual load of total phosphorus exported from the post-development site (lbs/year)

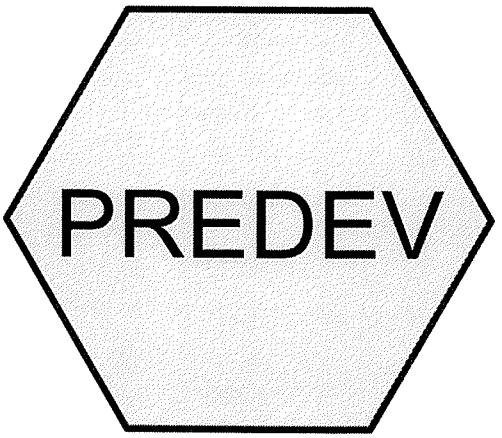
BMP_{RE} = BMP removal efficiency for total phosphorus, Table 4.8 (%)

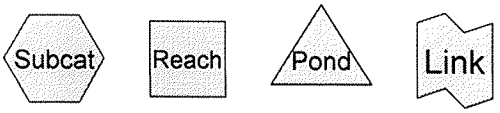
% DA Served = Fraction of the site area within the critical area IDA served by the BMP (%)

RR = Pollutant removal requirement (lbs/year)

If the Load Removed is equal to or greater than the Pollutant Removal Requirement computed in Step 4, then the on-site BMP complies with the 10% Rule.

Has the RR (pollutant removal requirement) been met? ☐ **Yes** ☒ **No**





Drainage Diagram for Federalsburg Prelim Pre Dev
Prepared by Robert D. Rauch & Assoc., Printed 4/29/2014

Summary for Subcatchment PREDEV:

Runoff = 6.72 cfs @ 13.05 hrs, Volume= 1.805 af, Depth> 0.25"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2yr Rainfall=3.40"

Area (ac)	CN	Description
87.900	55	Woods, Good, HSG B
87.900		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
36.3	100	0.0050	0.05		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.40"
33.2	2,669	0.0080	1.34		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
69.5	2,769	Total			

Summary for Subcatchment PREDEV:

Runoff = 37.90 cfs @ 12.88 hrs, Volume= 7.049 af, Depth> 0.96"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10yr Rainfall=5.30"

Area (ac)	CN	Description
87.900	55	Woods, Good, HSG B
87.900		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
36.3	100	0.0050	0.05		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.40"
33.2	2,669	0.0080	1.34		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
69.5	2,769	Total			

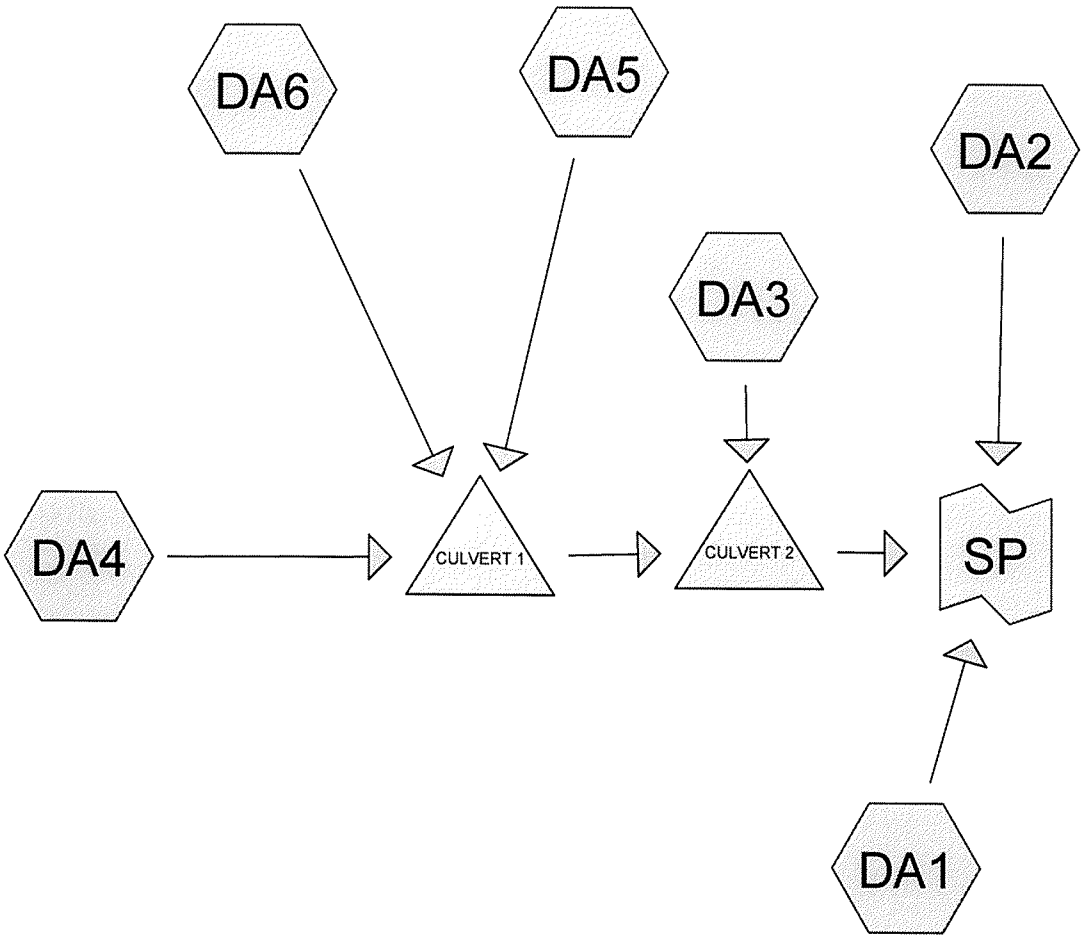
Summary for Subcatchment PREDEV:

Runoff = 97.03 cfs @ 12.79 hrs, Volume= 16.112 af, Depth> 2.20"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100yr Rainfall=7.60"

Area (ac)	CN	Description
87.900	55	Woods, Good, HSG B
87.900		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
36.3	100	0.0050	0.05		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.40"
33.2	2,669	0.0080	1.34		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
69.5	2,769	Total			



Subcat Reach Pond Link

Drainage Diagram for Federalsburg Prelim Post Dev
Prepared by Robert D. Rauch & Assoc., Printed 4/29/2014

Summary for Subcatchment DA1:

Runoff = 13.10 cfs @ 12.24 hrs, Volume= 1.184 af, Depth> 0.84"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2yr Rainfall=3.40"

Area (ac)	CN	Description
3.962	98	Paved parking & roofs
12.982	61	>75% Grass cover, Good, HSG B
16.944	70	Weighted Average
12.982		Pervious Area
3.962		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.5	100	0.0050	0.10		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.40"
11.2	780	0.0060	1.16		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
27.7	880	Total			

Summary for Subcatchment DA2:

Runoff = 3.47 cfs @ 12.21 hrs, Volume= 0.295 af, Depth> 0.84"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2yr Rainfall=3.40"

Area (ac)	CN	Description
1.030	98	Paved parking & roofs
3.180	61	>75% Grass cover, Good, HSG B
4.210	70	Weighted Average
3.180		Pervious Area
1.030		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.5	100	0.0050	0.10		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.40"
8.8	436	0.0030	0.82		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
25.3	536	Total			

Summary for Subcatchment DA3:

Runoff = 6.98 cfs @ 12.20 hrs, Volume= 0.565 af, Depth> 1.05"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2yr Rainfall=3.40"

Area (sf)	CN	Description
184,429	61	>75% Grass cover, Good, HSG B
96,678	98	Paved roads w/curbs & sewers
281,107	74	Weighted Average
184,429		Pervious Area
96,678		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.5	100	0.0050	0.10		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.40"
8.5	482	0.0040	0.95		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
25.0	582	Total			

Summary for Subcatchment DA4:

Runoff = 37.14 cfs @ 12.37 hrs, Volume= 3.953 af, Depth> 1.48"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2yr Rainfall=3.40"

Area (ac)	CN	Description
17.197	98	Paved parking & roofs
14.939	61	>75% Grass cover, Good, HSG B
32.136	81	Weighted Average
14.939		Pervious Area
17.197		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.5	100	0.0050	0.10		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.40"
20.0	1,224	0.0040	1.02		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
3.1	550	0.0010	2.98	21.09	**Circular Channel (pipe),** Diam= 36.0" Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.013 Corrugated PE, smooth interior
39.6	1,874	Total			

Summary for Subcatchment DA5:

Runoff = 10.62 cfs @ 12.31 hrs, Volume= 1.067 af, Depth> 0.84"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2yr Rainfall=3.40"

Area (ac)	CN	Description
15.312	70	1/2 acre lots, 25% imp, HSG B
11.484		Pervious Area
3.828		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.5	100	0.0050	0.10		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.40"
14.7	800	0.0020	0.91		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.3	340	0.0020	4.22	29.83	**Circular Channel (pipe),** Diam= 36.0" Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.013 Corrugated PE, smooth interior
32.5	1,240	Total			

Summary for Subcatchment DA6:

Runoff = 11.37 cfs @ 12.42 hrs, Volume= 1.302 af, Depth> 1.22"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2yr Rainfall=3.40"

Area (sf)	CN	Description
312,897	61	>75% Grass cover, Good, HSG B
246,638	98	Paved parking & roofs
559,535	77	Weighted Average
312,897		Pervious Area
246,638		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.5	100	0.0050	0.10		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.40"
23.5	1,340	0.0040	0.95		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
3.1	550	0.0010	2.98	21.09	**Circular Channel (pipe),** Diam= 36.0" Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.013 Corrugated PE, smooth interior
43.1	1,990	Total			

Summary for Pond CULVERT 1:

Inflow Area = 60.293 ac, 44.26% Impervious, Inflow Depth > 1.26" for 2yr event
Inflow = 58.52 cfs @ 12.37 hrs, Volume= 6.322 af
Outflow = 52.93 cfs @ 12.50 hrs, Volume= 6.279 af, Atten= 10%, Lag= 8.0 min
Primary = 52.93 cfs @ 12.50 hrs, Volume= 6.279 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 4.80' @ 12.50 hrs Surf.Area= 14,063 sf Storage= 25,787 cf

Plug-Flow detention time= 9.9 min calculated for 6.279 af (99% of inflow)
Center-of-Mass det. time= 7.3 min (828.9 - 821.6)

Volume	Invert	Avail.Storage	Storage Description
#1	1.50'	201,661 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1.50	369	0	0
2.00	4,596	1,241	1,241
4.00	10,244	14,840	16,081
6.00	19,808	30,052	46,133
8.00	37,193	57,001	103,134
9.00	159,860	98,527	201,661

Device	Routing	Invert	Outlet Devices
#1	Primary	1.50'	**48.0" x 60.0' long Culvert** RCP, groove end projecting, Ke= 0.200 Outlet Invert= 1.40' S= 0.0017 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished

Primary OutFlow Max=52.91 cfs @ 12.50 hrs HW=4.80' (Free Discharge)
↑**1=Culvert** (Barrel Controls 52.91 cfs @ 6.48 fps)

Summary for Pond CULVERT 2:

Inflow Area = 66.746 ac, 43.31% Impervious, Inflow Depth > 1.23" for 2yr event
Inflow = 56.27 cfs @ 12.48 hrs, Volume= 6.844 af
Outflow = 50.86 cfs @ 12.64 hrs, Volume= 6.812 af, Atten= 10%, Lag= 9.7 min
Primary = 50.86 cfs @ 12.64 hrs, Volume= 6.812 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 3.90' @ 12.64 hrs Surf.Area= 23,254 sf Storage= 27,371 cf

Plug-Flow detention time= 8.4 min calculated for 6.812 af (100% of inflow)
Center-of-Mass det. time= 6.7 min (834.8 - 828.2)

Volume	Invert	Avail.Storage	Storage Description
#1	1.50'	293,243 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1.50	1,783	0	0
2.00	4,020	1,451	1,451
4.00	24,259	28,279	29,730
6.00	112,260	136,519	166,249
7.00	141,728	126,994	293,243

Device	Routing	Invert	Outlet Devices
#1	Primary	1.50'	**36.0" x 104.0' long Culvert** RCP, groove end projecting, Ke= 0.200 Outlet Invert= 1.20' S= 0.0029 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished
#2	Primary	1.50'	**36.0" x 104.0' long Culvert** RCP, groove end projecting, Ke= 0.200 Outlet Invert= 1.20' S= 0.0029 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished

Primary OutFlow Max=50.79 cfs @ 12.64 hrs HW=3.90' (Free Discharge)
├─**1=Culvert** (Barrel Controls 25.40 cfs @ 5.74 fps)
└─**2=Culvert** (Barrel Controls 25.40 cfs @ 5.74 fps)

Summary for Link SP:

Inflow Area = 87.900 ac, 38.56% Impervious, Inflow Depth > 1.13" for 2yr event
Inflow = 57.90 cfs @ 12.58 hrs, Volume= 8.291 af
Primary = 57.90 cfs @ 12.58 hrs, Volume= 8.291 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Subcatchment DA1:

Runoff = 34.22 cfs @ 12.22 hrs, Volume= 2.893 af, Depth> 2.05"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10yr Rainfall=5.30"

Area (ac)	CN	Description
3.962	98	Paved parking & roofs
12.982	61	>75% Grass cover, Good, HSG B
16.944	70	Weighted Average
12.982		Pervious Area
3.962		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.5	100	0.0050	0.10		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.40"
11.2	780	0.0060	1.16		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
27.7	880	Total			

Summary for Subcatchment DA2:

Runoff = 9.01 cfs @ 12.20 hrs, Volume= 0.719 af, Depth> 2.05"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10yr Rainfall=5.30"

Area (ac)	CN	Description
1.030	98	Paved parking & roofs
3.180	61	>75% Grass cover, Good, HSG B
4.210	70	Weighted Average
3.180		Pervious Area
1.030		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.5	100	0.0050	0.10		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.40"
8.8	436	0.0030	0.82		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
25.3	536	Total			

Summary for Subcatchment DA3:

Runoff = 16.23 cfs @ 12.19 hrs, Volume= 1.280 af, Depth> 2.38"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10yr Rainfall=5.30"

Area (sf)	CN	Description
184,429	61	>75% Grass cover, Good, HSG B
96,678	98	Paved roads w/curbs & sewers
281,107	74	Weighted Average
184,429		Pervious Area
96,678		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.5	100	0.0050	0.10		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.40"
8.5	482	0.0040	0.95		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
25.0	582	Total			

Summary for Subcatchment DA4:

Runoff = 75.22 cfs @ 12.36 hrs, Volume= 8.000 af, Depth> 2.99"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10yr Rainfall=5.30"

Area (ac)	CN	Description
17.197	98	Paved parking & roofs
14.939	61	>75% Grass cover, Good, HSG B
32.136	81	Weighted Average
14.939		Pervious Area
17.197		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.5	100	0.0050	0.10		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.40"
20.0	1,224	0.0040	1.02		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
3.1	550	0.0010	2.98	21.09	**Circular Channel (pipe),** Diam= 36.0" Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.013 Corrugated PE, smooth interior
39.6	1,874	Total			

Summary for Subcatchment DA5:

Runoff = 27.79 cfs @ 12.28 hrs, Volume= 2.609 af, Depth> 2.04"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10yr Rainfall=5.30"

Area (ac)	CN	Description
15.312	70	1/2 acre lots, 25% imp, HSG B
11.484		Pervious Area
3.828		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.5	100	0.0050	0.10		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.40"
14.7	800	0.0020	0.91		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.3	340	0.0020	4.22	29.83	**Circular Channel (pipe),** Diam= 36.0" Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.013 Corrugated PE, smooth interior
32.5	1,240	Total			

Summary for Subcatchment DA6:

Runoff = 24.98 cfs @ 12.41 hrs, Volume= 2.806 af, Depth> 2.62"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10yr Rainfall=5.30"

Area (sf)	CN	Description
312,897	61	>75% Grass cover, Good, HSG B
246,638	98	Paved parking & roofs
559,535	77	Weighted Average
312,897		Pervious Area
246,638		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.5	100	0.0050	0.10		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.40"
23.5	1,340	0.0040	0.95		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
3.1	550	0.0010	2.98	21.09	**Circular Channel (pipe),** Diam= 36.0" Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.013 Corrugated PE, smooth interior
43.1	1,990	Total			

Summary for Pond CULVERT 1:

Inflow Area = 60.293 ac, 44.26% Impervious, Inflow Depth > 2.67" for 10yr event
Inflow = 126.30 cfs @ 12.35 hrs, Volume= 13.415 af
Outflow = 101.43 cfs @ 12.55 hrs, Volume= 13.346 af, Atten= 20%, Lag= 12.1 min
Primary = 101.43 cfs @ 12.55 hrs, Volume= 13.346 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 6.86' @ 12.55 hrs Surf.Area= 27,308 sf Storage= 66,460 cf

Plug-Flow detention time= 9.9 min calculated for 13.346 af (99% of inflow)
Center-of-Mass det. time= 7.9 min (814.3 - 806.5)

Volume	Invert	Avail.Storage	Storage Description
#1	1.50'	201,661 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1.50	369	0	0
2.00	4,596	1,241	1,241
4.00	10,244	14,840	16,081
6.00	19,808	30,052	46,133
8.00	37,193	57,001	103,134
9.00	159,860	98,527	201,661

Device	Routing	Invert	Outlet Devices
#1	Primary	1.50'	**48.0" x 60.0' long Culvert** RCP, groove end projecting, Ke= 0.200 Outlet Invert= 1.40' S= 0.0017 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished

Primary OutFlow Max=101.18 cfs @ 12.55 hrs HW=6.86' (Free Discharge)
↑—**1=Culvert** (Barrel Controls 101.18 cfs @ 8.05 fps)

Summary for Pond CULVERT 2:

Inflow Area = 66.746 ac, 43.31% Impervious, Inflow Depth > 2.63" for 10yr event
Inflow = 108.02 cfs @ 12.45 hrs, Volume= 14.625 af
Outflow = 89.09 cfs @ 12.82 hrs, Volume= 14.575 af, Atten= 18%, Lag= 21.9 min
Primary = 89.09 cfs @ 12.82 hrs, Volume= 14.575 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 5.06' @ 12.82 hrs Surf.Area= 70,916 sf Storage= 80,191 cf

Plug-Flow detention time= 10.5 min calculated for 14.575 af (100% of inflow)
Center-of-Mass det. time= 9.2 min (822.6 - 813.4)

Volume	Invert	Avail.Storage	Storage Description
#1	1.50'	293,243 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1.50	1,783	0	0
2.00	4,020	1,451	1,451
4.00	24,259	28,279	29,730
6.00	112,260	136,519	166,249
7.00	141,728	126,994	293,243

Device	Routing	Invert	Outlet Devices
#1	Primary	1.50'	**36.0" x 104.0' long Culvert** RCP, groove end projecting, Ke= 0.200 Outlet Invert= 1.20' S= 0.0029 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished
#2	Primary	1.50'	**36.0" x 104.0' long Culvert** RCP, groove end projecting, Ke= 0.200 Outlet Invert= 1.20' S= 0.0029 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished

Primary OutFlow Max=89.05 cfs @ 12.82 hrs HW=5.06' (Free Discharge)
├─**1=Culvert** (Barrel Controls 44.52 cfs @ 6.70 fps)
└─**2=Culvert** (Barrel Controls 44.52 cfs @ 6.70 fps)

Summary for Link SP:

Inflow Area = 87.900 ac, 38.56% Impervious, Inflow Depth > 2.48" for 10yr event
Inflow = 105.69 cfs @ 12.36 hrs, Volume= 18.187 af
Primary = 105.69 cfs @ 12.36 hrs, Volume= 18.187 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Subcatchment DA1:

Runoff = 63.60 cfs @ 12.22 hrs, Volume= 5.337 af, Depth> 3.78"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100yr Rainfall=7.60"

Area (ac)	CN	Description
3.962	98	Paved parking & roofs
12.982	61	>75% Grass cover, Good, HSG B
16.944	70	Weighted Average
12.982		Pervious Area
3.962		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.5	100	0.0050	0.10		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.40"
11.2	780	0.0060	1.16		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
27.7	880	Total			

Summary for Subcatchment DA2:

Runoff = 16.71 cfs @ 12.19 hrs, Volume= 1.327 af, Depth> 3.78"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100yr Rainfall=7.60"

Area (ac)	CN	Description
1.030	98	Paved parking & roofs
3.180	61	>75% Grass cover, Good, HSG B
4.210	70	Weighted Average
3.180		Pervious Area
1.030		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.5	100	0.0050	0.10		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.40"
8.8	436	0.0030	0.82		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
25.3	536	Total			

Summary for Subcatchment DA3:

Runoff = 28.61 cfs @ 12.18 hrs, Volume= 2.267 af, Depth> 4.22"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100yr Rainfall=7.60"

Area (sf)	CN	Description
184,429	61	>75% Grass cover, Good, HSG B
96,678	98	Paved roads w/curbs & sewers
281,107	74	Weighted Average
184,429		Pervious Area
96,678		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.5	100	0.0050	0.10		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.40"
8.5	482	0.0040	0.95		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
25.0	582	Total			

Summary for Subcatchment DA4:

Runoff = 123.37 cfs @ 12.35 hrs, Volume= 13.300 af, Depth> 4.97"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100yr Rainfall=7.60"

Area (ac)	CN	Description
17.197	98	Paved parking & roofs
14.939	61	>75% Grass cover, Good, HSG B
32.136	81	Weighted Average
14.939		Pervious Area
17.197		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.5	100	0.0050	0.10		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.40"
20.0	1,224	0.0040	1.02		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
3.1	550	0.0010	2.98	21.09	**Circular Channel (pipe),** Diam= 36.0" Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.013 Corrugated PE, smooth interior
39.6	1,874	Total			

Summary for Subcatchment DA5:

Runoff = 51.85 cfs @ 12.27 hrs, Volume= 4.814 af, Depth> 3.77"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100yr Rainfall=7.60"

Area (ac)	CN	Description
15.312	70	1/2 acre lots, 25% imp, HSG B
11.484		Pervious Area
3.828		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.5	100	0.0050	0.10		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.40"
14.7	800	0.0020	0.91		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.3	340	0.0020	4.22	29.83	**Circular Channel (pipe),** Diam= 36.0" Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.013 Corrugated PE, smooth interior
32.5	1,240	Total			

Summary for Subcatchment DA6:

Runoff = 42.79 cfs @ 12.40 hrs, Volume= 4.834 af, Depth> 4.52"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100yr Rainfall=7.60"

Area (sf)	CN	Description
312,897	61	>75% Grass cover, Good, HSG B
246,638	98	Paved parking & roofs
559,535	77	Weighted Average
312,897		Pervious Area
246,638		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.5	100	0.0050	0.10		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.40"
23.5	1,340	0.0040	0.95		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
3.1	550	0.0010	2.98	21.09	**Circular Channel (pipe),** Diam= 36.0" Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.013 Corrugated PE, smooth interior
43.1	1,990	Total			

Summary for Pond CULVERT 1:

Inflow Area = 60.293 ac, 44.26% Impervious, Inflow Depth > 4.57" for 100yr event
Inflow = 214.76 cfs @ 12.34 hrs, Volume= 22.948 af
Outflow = 149.49 cfs @ 12.61 hrs, Volume= 22.852 af, Atten= 30%, Lag= 16.0 min
Primary = 149.49 cfs @ 12.61 hrs, Volume= 22.852 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 8.59' @ 12.61 hrs Surf.Area= 109,929 sf Storage= 146,752 cf

Plug-Flow detention time= 11.6 min calculated for 22.776 af (99% of inflow)
Center-of-Mass det. time= 9.9 min (804.9 - 795.0)

Volume	Invert	Avail.Storage	Storage Description
#1	1.50'	201,661 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1.50	369	0	0
2.00	4,596	1,241	1,241
4.00	10,244	14,840	16,081
6.00	19,808	30,052	46,133
8.00	37,193	57,001	103,134
9.00	159,860	98,527	201,661

Device	Routing	Invert	Outlet Devices
#1	Primary	1.50'	**48.0" x 60.0' long Culvert** RCP, groove end projecting, Ke= 0.200 Outlet Invert= 1.40' S= 0.0017 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished

Primary OutFlow Max=149.46 cfs @ 12.61 hrs HW=8.59' (Free Discharge)
↑—**1=Culvert** (Barrel Controls 149.46 cfs @ 11.89 fps)

Summary for Pond CULVERT 2:

Inflow Area = 66.746 ac, 43.31% Impervious, Inflow Depth > 4.52" for 100yr event
Inflow = 159.99 cfs @ 12.46 hrs, Volume= 25.119 af
Outflow = 118.40 cfs @ 13.04 hrs, Volume= 25.046 af, Atten= 26%, Lag= 34.6 min
Primary = 118.40 cfs @ 13.04 hrs, Volume= 25.046 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 6.21' @ 13.04 hrs Surf.Area= 118,385 sf Storage= 190,221 cf

Plug-Flow detention time= 16.1 min calculated for 25.046 af (100% of inflow)
Center-of-Mass det. time= 15.0 min (818.6 - 803.7)

Volume	Invert	Avail.Storage	Storage Description
#1	1.50'	293,243 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1.50	1,783	0	0
2.00	4,020	1,451	1,451
4.00	24,259	28,279	29,730
6.00	112,260	136,519	166,249
7.00	141,728	126,994	293,243

Device	Routing	Invert	Outlet Devices
#1	Primary	1.50'	**36.0" x 104.0' long Culvert** RCP, groove end projecting, Ke= 0.200 Outlet Invert= 1.20' S= 0.0029 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished
#2	Primary	1.50'	**36.0" x 104.0' long Culvert** RCP, groove end projecting, Ke= 0.200 Outlet Invert= 1.20' S= 0.0029 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished

Primary OutFlow Max=118.36 cfs @ 13.04 hrs HW=6.21' (Free Discharge)
├─**1=Culvert** (Barrel Controls 59.18 cfs @ 8.37 fps)
└─**2=Culvert** (Barrel Controls 59.18 cfs @ 8.37 fps)

Summary for Link SP:

Inflow Area = 87.900 ac, 38.56% Impervious, Inflow Depth > 4.33" for 100yr event
Inflow = 158.96 cfs @ 12.27 hrs, Volume= 31.710 af
Primary = 158.96 cfs @ 12.27 hrs, Volume= 31.710 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs