



JC Wilson Engineering & Consulting, LLC

Innovative - Practical - Strategic

LETTER

DATE: AUGUST 27, 2020

Reference: 2005

Red Moon Development & Construction, Inc
Attn: Brad Woodruff
6517 S Kings Ranch Rd.
Apache Junction, AZ 85118

Subject: Storm Drainage Mitigation Design – Bluffs Subdivision

Dear Brad:

JCW has completed drainage design calculations for proposed Bioretention LID facility proposed for this subdivision development. In this report package, JCW has completed design with SBUH analysis for all impervious area that will be placed on this site. Analysis was performed for asphalt surface for worst case option, though you do intend to utilize pavers that will greatly reduce peak flows.

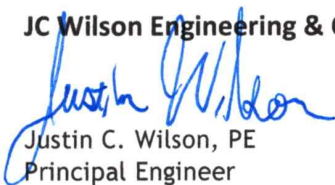
Drainage design must meet City of Coos Bay water quality standards, and North Bend City Engineer did not feel water quantity from larger storm overflows would be an issue to drain into existing 24-in storm main to outfall. Water quantities from larger storms was not of great concern because of projects close proximity to the Bay, time of concentration flow characteristics.

The water quality storm for ½ 2-yr 24-hr storm will be completely infiltrated in the proposed LID Bio-retention facility, with no flows draining to City of North Bend System. The 25-yr 24-hr storm will overflow approximately 1.41-cfs to City system, and the 100-yr 24-hr storm will overflow 1.71-cfs to the City system. The City's 24" storm main is calculated to have a capacity of 22.34-cfs at a conservative slope of 0.5% grade.

Please feel free to contact me at 208-553-6742 if you have any questions.

Respectfully submitted,

JC Wilson Engineering & Consulting, LLC


Justin C. Wilson, PE
Principal Engineer

JCW:jcw

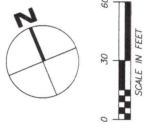
Attachments: 1. Drainage Design & Onsite Basin Map
2. Hydrologic Calculations & O&M Guide
3. USDA Soil Report



Drainage Design & Onsite Basin Map

1

GRADING & DRAINAGE PLAN



GRADING & DRAINAGE PLAN
BLUFFS SUBDIVISION
NORTH BEND, OREGON
RED MOON DEVELOPMENT

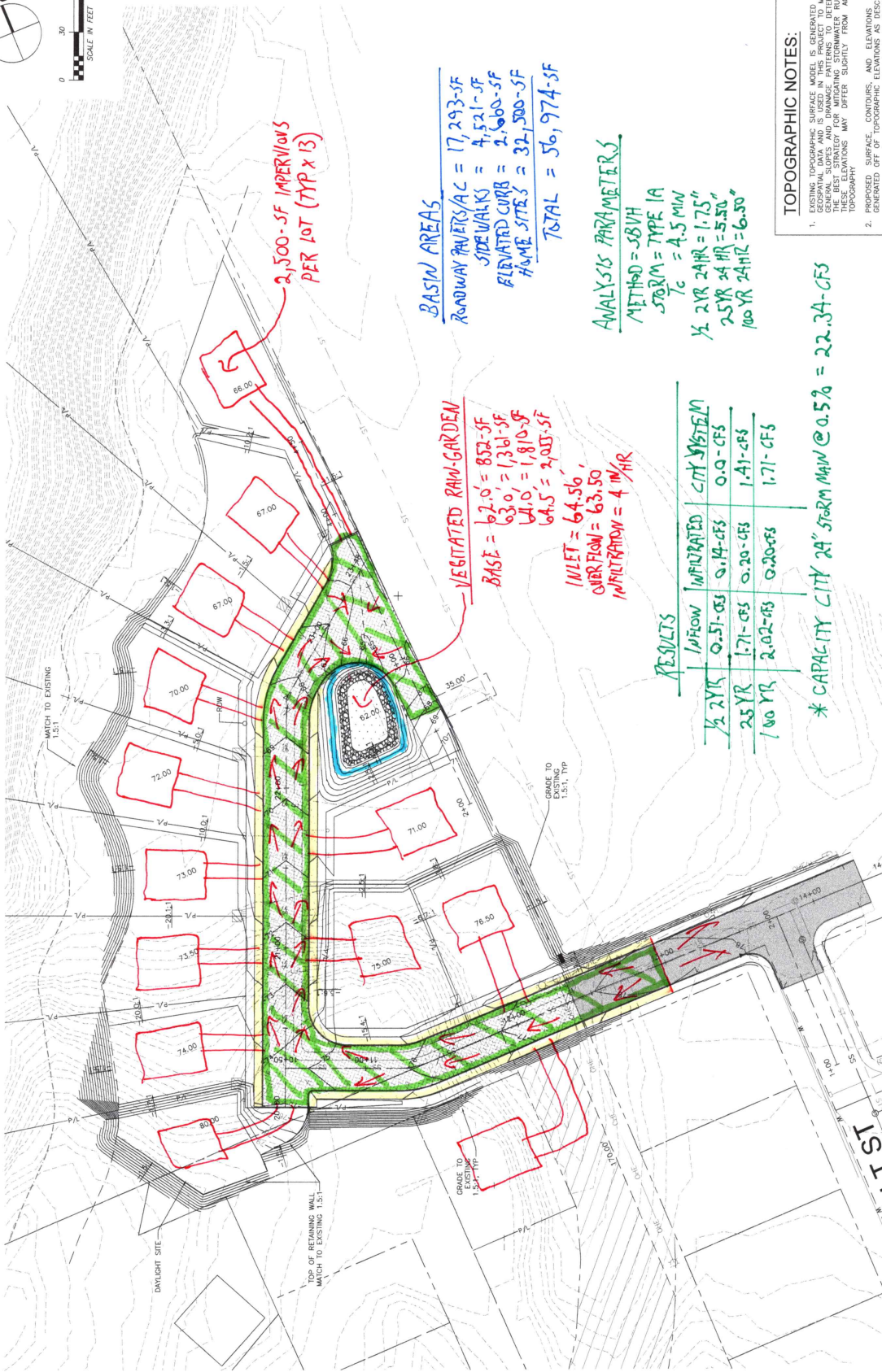
JC WILSON
ENGINEERING &
CONSULTING, LLC
PO BOX 186
NORTH BEND, OR 97459
WWW.JCWILSONENGINEERING.COM
P: (503) 553-0742



SCALE: AS SHOWN
DATE: 07-2020
DESIGNED BY: DSR
DRAWN BY: DSR
CHECKED: JOW
REVIEW: CITY

C:\AD\FILES\JOW\NB-BLUFFS\DWG\2020\05\05-BLUFFS.DWG

C-4



BASIN AREAS
ROADWAY PAVES/AC = 17,293-SF
SIDE WALKS = 4,521-SF
ELEVATED CURB = 2,600-SF
HOME SITES = 32,500-SF
TOTAL = 56,974-SF

ANALYSIS PARAMETERS

METHOD = SBUH
STORM = TYPE 1A
 $T_c = 4.5 \text{ MIN}$
 $\frac{1}{2} \text{ 2YR 24HR} = 1.75"$
 $\frac{2}{5} \text{ 2YR 24HR} = 5.50"$
 $100 \text{ YR 24HR} = 6.50"$

VEGETATED RAIN-GARDEN
BASE = 62.0' = 853-SF
63.0' = 1,361-SF
64.0' = 1,810-SF
64.5' = 2,035-SF
INLET = 64.56'
OVERFLOW = 63.50'
INFILTRATION = 4 IN/HR

RESULTS

	INFLOW	INFILTRATED	CITY SYSTEM
$\frac{1}{2}$ 2YR	0.51-CFS	0.14-CFS	0.0-CFS
25 YR	1.71-CFS	0.20-CFS	1.41-CFS
100 YR	2.02-CFS	0.20-CFS	1.71-CFS

* CAPACITY CITY 24" STORM MAIN @ 0.5% = 22.34-CFS

TOPOGRAPHIC NOTES:

- EXISTING TOPOGRAPHIC SURFACE MODEL IS GENERATED FROM GEOSPATIAL DATA AND IS USED IN THIS PROJECT TO MODEL THE PROPOSED DRAINAGE SYSTEM. THE BEST STRATEGY FOR MITIGATING STORMWATER RUNOFF, THESE ELEVATIONS MAY DIFFER SLIGHTLY FROM ACTUAL TOPOGRAPHY.
- EXISTING SURFACE CONTOURS AND ELEVATIONS WERE GENERATED OFF TOPOGRAPHIC ELEVATIONS AS DISCUSSED ABOVE IN NOTE #1.

Hydrologic Calculations & O&M Guide 2

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Type IA 24-hr 2-yr-QUAL Rainfall=1.75"

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Page 1

Summary for Subcatchment 2S: QUALITY

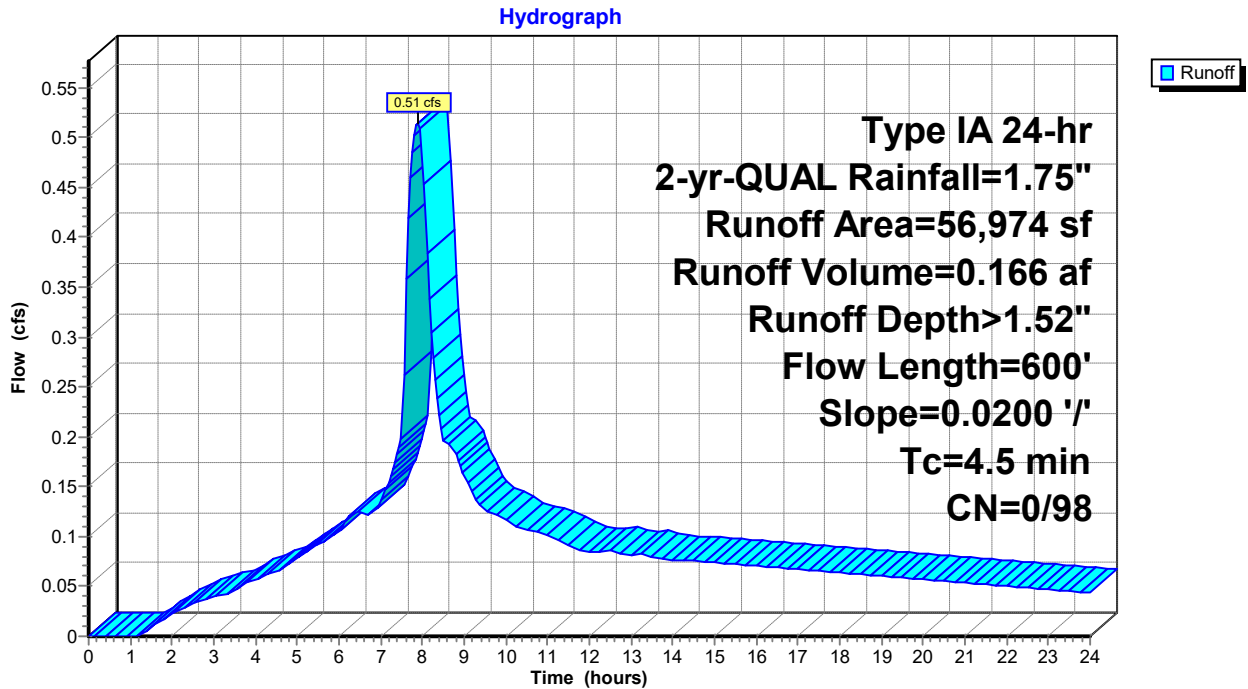
Runoff = 0.51 cfs @ 7.90 hrs, Volume= 0.166 af, Depth> 1.52"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Type IA 24-hr 2-yr-QUAL Rainfall=1.75"

	Area (sf)	CN	Description
*	17,293	98	Paved roads w/curbs & sewers, HSG A
	32,500	98	Roofs, HSG C
	2,660	98	Paved roads w/curbs & sewers, HSG A
	4,521	98	Paved parking, HSG A
	56,974	98	Weighted Average
	56,974	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.8	300	0.0200	1.79		Sheet Flow, IMPERV
					Smooth surfaces n= 0.011 P2= 3.50"
1.7	300	0.0200	2.87		Shallow Concentrated Flow,
					Paved Kv= 20.3 fps
4.5	600	Total			

Subcatchment 2S: QUALITY

BLUFFS - POST_quality

Type IA 24-hr 2-yr-QUAL Rainfall=1.75"

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Hydrograph for Subcatchment 2S: QUALITY

Time (hours)	Precip. (inches)	Perv.Excess (inches)	Imp.Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00	0.00
0.50	0.02	0.00	0.00	0.00
1.00	0.03	0.00	0.00	0.00
1.50	0.06	0.00	0.00	0.01
2.00	0.09	0.00	0.01	0.02
2.50	0.12	0.00	0.02	0.03
3.00	0.14	0.00	0.03	0.04
3.50	0.17	0.00	0.05	0.05
4.00	0.20	0.00	0.07	0.06
4.50	0.24	0.00	0.10	0.07
5.00	0.27	0.00	0.12	0.08
5.50	0.32	0.00	0.16	0.09
6.00	0.36	0.00	0.20	0.11
6.50	0.41	0.00	0.24	0.13
7.00	0.47	0.00	0.29	0.14
7.50	0.54	0.00	0.36	0.20
8.00	0.74	0.00	0.54	0.50
8.50	0.84	0.00	0.64	0.20
9.00	0.91	0.00	0.70	0.16
9.50	0.96	0.00	0.75	0.13
10.00	1.01	0.00	0.80	0.12
10.50	1.05	0.00	0.84	0.11
11.00	1.09	0.00	0.88	0.10
11.50	1.13	0.00	0.92	0.09
12.00	1.16	0.00	0.95	0.08
12.50	1.20	0.00	0.98	0.09
13.00	1.23	0.00	1.01	0.08
13.50	1.26	0.00	1.04	0.08
14.00	1.29	0.00	1.07	0.08
14.50	1.32	0.00	1.10	0.08
15.00	1.35	0.00	1.13	0.07
15.50	1.37	0.00	1.16	0.07
16.00	1.40	0.00	1.18	0.07
16.50	1.43	0.00	1.21	0.07
17.00	1.45	0.00	1.24	0.07
17.50	1.48	0.00	1.26	0.07
18.00	1.50	0.00	1.28	0.06
18.50	1.53	0.00	1.31	0.06
19.00	1.55	0.00	1.33	0.06
19.50	1.58	0.00	1.35	0.06
20.00	1.60	0.00	1.38	0.06
20.50	1.62	0.00	1.40	0.06
21.00	1.64	0.00	1.42	0.05
21.50	1.66	0.00	1.44	0.05
22.00	1.68	0.00	1.46	0.05
22.50	1.70	0.00	1.48	0.05
23.00	1.72	0.00	1.49	0.05
23.50	1.73	0.00	1.51	0.04
24.00	1.75	0.00	1.53	0.04

BLUFFS - POST_quality

Type IA 24-hr 2-yr-QUAL Rainfall=1.75"

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Summary for Pond 3P: (new Pond)

Inflow Area = 1.308 ac, 100.00% Impervious, Inflow Depth > 1.52" for 2-yr-QUAL event
 Inflow = 0.51 cfs @ 7.90 hrs, Volume= 0.166 af
 Outflow = 0.14 cfs @ 9.22 hrs, Volume= 0.166 af, Atten= 73%, Lag= 79.4 min
 Discarded = 0.14 cfs @ 9.22 hrs, Volume= 0.166 af
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
 Peak Elev= 63.13' @ 9.22 hrs Surf.Area= 1,422 sf Storage= 1,294 cf

Plug-Flow detention time= 75.6 min calculated for 0.166 af (100% of inflow)
 Center-of-Mass det. time= 74.3 min (759.4 - 685.1)

Volume	Invert	Avail.Storage	Storage Description
#1	62.00'	3,658 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
62.00	852	0	0
63.00	1,361	1,107	1,107
64.00	1,810	1,586	2,692
64.50	2,055	966	3,658

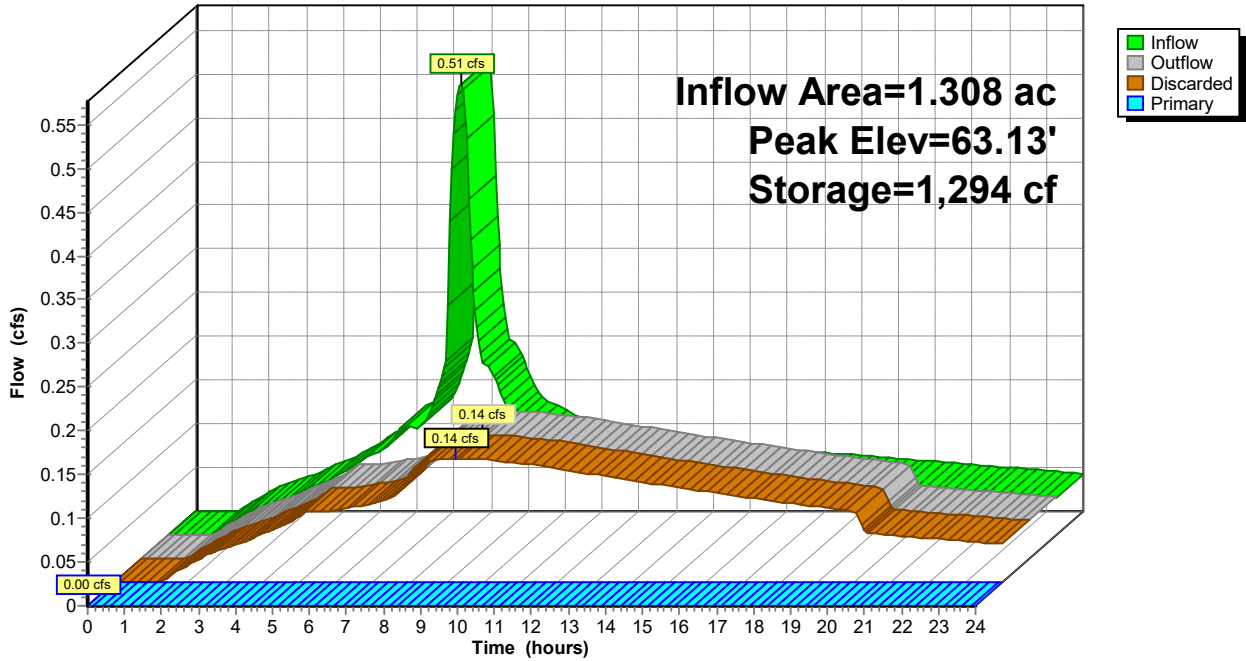
Device	Routing	Invert	Outlet Devices
#1	Discarded	62.00'	4.000 in/hr Exfiltration over Surface area Conductivity to Groundwater Elevation = 50.00'
#2	Primary	63.50'	12.0" Vert. Orifice/Grate C= 0.600

Discarded OutFlow Max=0.14 cfs @ 9.22 hrs HW=63.13' (Free Discharge)
 ↑ **1=Exfiltration** (Controls 0.14 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=62.00' (Free Discharge)
 ↑ **2=Orifice/Grate** (Controls 0.00 cfs)

Pond 3P: (new Pond)

Hydrograph



BLUFFS - POST_quality

Type IA 24-hr 2-yr-QUAL Rainfall=1.75"

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Hydrograph for Pond 3P: (new Pond)

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Outflow (cfs)	Discarded (cfs)	Primary (cfs)
0.00	0.00	0	62.00	0.00	0.00	0.00
0.50	0.00	0	62.00	0.00	0.00	0.00
1.00	0.00	0	62.00	0.00	0.00	0.00
1.50	0.01	2	62.00	0.01	0.01	0.00
2.00	0.02	5	62.01	0.02	0.02	0.00
2.50	0.03	8	62.01	0.03	0.03	0.00
3.00	0.04	10	62.01	0.04	0.04	0.00
3.50	0.05	12	62.01	0.05	0.05	0.00
4.00	0.06	15	62.02	0.06	0.06	0.00
4.50	0.07	17	62.02	0.06	0.06	0.00
5.00	0.08	20	62.02	0.08	0.08	0.00
5.50	0.09	31	62.04	0.08	0.08	0.00
6.00	0.11	60	62.07	0.08	0.08	0.00
6.50	0.13	122	62.14	0.09	0.09	0.00
7.00	0.14	188	62.21	0.09	0.09	0.00
7.50	0.20	314	62.33	0.10	0.10	0.00
8.00	0.50	903	62.85	0.13	0.13	0.00
8.50	0.20	1,207	63.07	0.14	0.14	0.00
9.00	0.16	1,287	63.13	0.14	0.14	0.00
9.50	0.13	1,285	63.13	0.14	0.14	0.00
10.00	0.12	1,253	63.11	0.14	0.14	0.00
10.50	0.11	1,200	63.07	0.14	0.14	0.00
11.00	0.10	1,141	63.03	0.14	0.14	0.00
11.50	0.09	1,072	62.97	0.13	0.13	0.00
12.00	0.08	993	62.91	0.13	0.13	0.00
12.50	0.09	915	62.86	0.13	0.13	0.00
13.00	0.08	840	62.80	0.12	0.12	0.00
13.50	0.08	769	62.74	0.12	0.12	0.00
14.00	0.08	696	62.68	0.12	0.12	0.00
14.50	0.08	627	62.62	0.11	0.11	0.00
15.00	0.07	561	62.56	0.11	0.11	0.00
15.50	0.07	498	62.51	0.11	0.11	0.00
16.00	0.07	437	62.45	0.10	0.10	0.00
16.50	0.07	379	62.40	0.10	0.10	0.00
17.00	0.07	323	62.34	0.10	0.10	0.00
17.50	0.07	270	62.29	0.09	0.09	0.00
18.00	0.06	218	62.24	0.09	0.09	0.00
18.50	0.06	169	62.19	0.09	0.09	0.00
19.00	0.06	121	62.14	0.09	0.09	0.00
19.50	0.06	76	62.09	0.08	0.08	0.00
20.00	0.06	32	62.04	0.08	0.08	0.00
20.50	0.06	15	62.02	0.06	0.06	0.00
21.00	0.05	14	62.02	0.05	0.05	0.00
21.50	0.05	14	62.02	0.05	0.05	0.00
22.00	0.05	13	62.02	0.05	0.05	0.00
22.50	0.05	13	62.02	0.05	0.05	0.00
23.00	0.05	13	62.01	0.05	0.05	0.00
23.50	0.04	12	62.01	0.05	0.05	0.00
24.00	0.04	12	62.01	0.04	0.04	0.00

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Type IA 24-hr 25-yr Rainfall=5.50"

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Summary for Subcatchment 2S: QUALITY

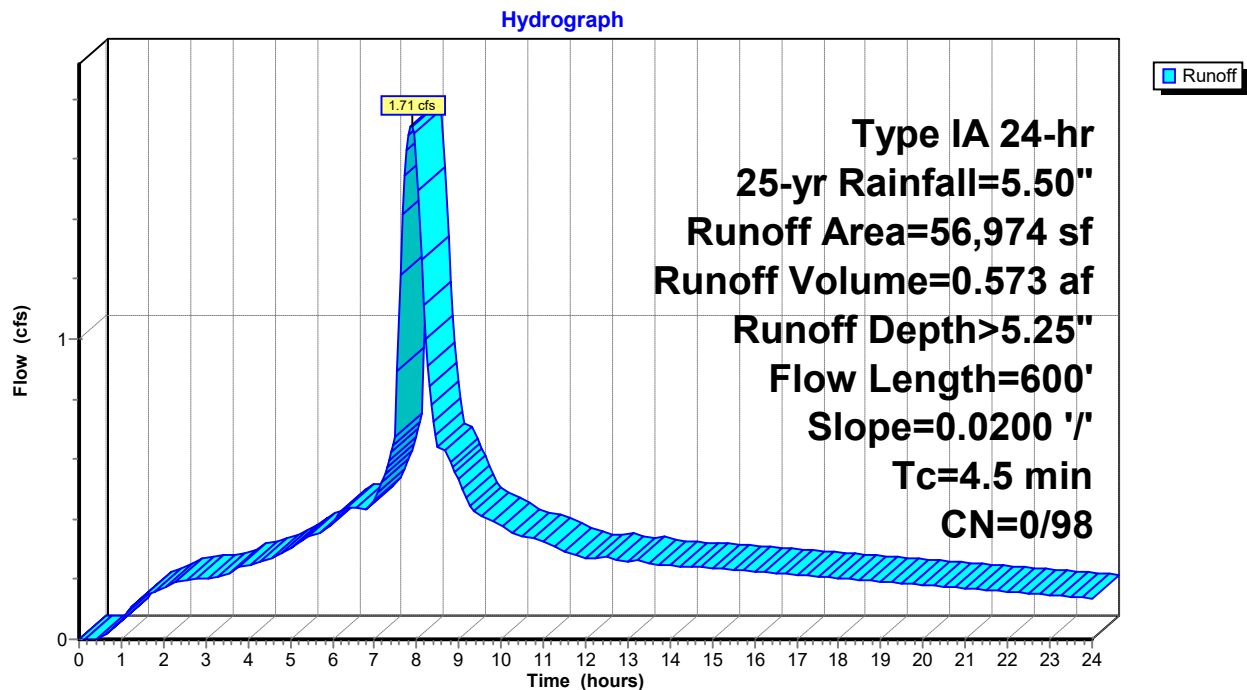
Runoff = 1.71 cfs @ 7.88 hrs, Volume= 0.573 af, Depth> 5.25"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Type IA 24-hr 25-yr Rainfall=5.50"

	Area (sf)	CN	Description
*	17,293	98	Paved roads w/curbs & sewers, HSG A
	32,500	98	Roofs, HSG C
	2,660	98	Paved roads w/curbs & sewers, HSG A
	4,521	98	Paved parking, HSG A
	56,974	98	Weighted Average
	56,974	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.8	300	0.0200	1.79		Sheet Flow, IMPERV
					Smooth surfaces n= 0.011 P2= 3.50"
1.7	300	0.0200	2.87		Shallow Concentrated Flow,
					Paved Kv= 20.3 fps
4.5	600	Total			

Subcatchment 2S: QUALITY

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Type IA 24-hr 25-yr Rainfall=5.50"

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Hydrograph for Subcatchment 2S: QUALITY

Time (hours)	Precip. (inches)	Perv.Excess (inches)	Imp.Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00	0.00
0.50	0.05	0.00	0.00	0.01
1.00	0.11	0.00	0.02	0.06
1.50	0.19	0.00	0.06	0.14
2.00	0.28	0.00	0.13	0.17
2.50	0.36	0.00	0.20	0.20
3.00	0.45	0.00	0.27	0.20
3.50	0.54	0.00	0.35	0.22
4.00	0.64	0.00	0.45	0.25
4.50	0.74	0.00	0.54	0.27
5.00	0.86	0.00	0.65	0.30
5.50	0.99	0.00	0.78	0.35
6.00	1.13	0.00	0.92	0.38
6.50	1.30	0.00	1.09	0.45
7.00	1.47	0.00	1.25	0.47
7.50	1.71	0.00	1.48	0.67
8.00	2.34	0.00	2.11	1.65
8.50	2.64	0.00	2.41	0.64
9.00	2.86	0.00	2.63	0.52
9.50	3.02	0.00	2.79	0.41
10.00	3.17	0.00	2.94	0.38
10.50	3.31	0.00	3.07	0.34
11.00	3.43	0.00	3.20	0.32
11.50	3.55	0.00	3.31	0.30
12.00	3.65	0.00	3.42	0.27
12.50	3.76	0.00	3.52	0.28
13.00	3.86	0.00	3.62	0.26
13.50	3.95	0.00	3.72	0.25
14.00	4.05	0.00	3.81	0.24
14.50	4.14	0.00	3.91	0.24
15.00	4.23	0.00	4.00	0.24
15.50	4.32	0.00	4.08	0.23
16.00	4.41	0.00	4.17	0.23
16.50	4.49	0.00	4.25	0.22
17.00	4.57	0.00	4.34	0.21
17.50	4.65	0.00	4.42	0.21
18.00	4.73	0.00	4.49	0.20
18.50	4.80	0.00	4.57	0.20
19.00	4.88	0.00	4.64	0.19
19.50	4.95	0.00	4.71	0.19
20.00	5.02	0.00	4.78	0.18
20.50	5.09	0.00	4.85	0.18
21.00	5.15	0.00	4.92	0.17
21.50	5.22	0.00	4.98	0.16
22.00	5.28	0.00	5.04	0.16
22.50	5.34	0.00	5.10	0.15
23.00	5.39	0.00	5.16	0.15
23.50	5.45	0.00	5.21	0.14
24.00	5.50	0.00	5.26	0.14

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Type IA 24-hr 25-yr Rainfall=5.50"

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Summary for Pond 3P: (new Pond)

Inflow Area = 1.308 ac, 100.00% Impervious, Inflow Depth > 5.25" for 25-yr event
 Inflow = 1.71 cfs @ 7.88 hrs, Volume= 0.573 af
 Outflow = 1.61 cfs @ 8.01 hrs, Volume= 0.532 af, Atten= 6%, Lag= 7.6 min
 Discarded = 0.20 cfs @ 8.01 hrs, Volume= 0.302 af
 Primary = 1.41 cfs @ 8.01 hrs, Volume= 0.230 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
 Peak Elev= 64.13' @ 8.01 hrs Surf.Area= 1,874 sf Storage= 2,934 cf

Plug-Flow detention time= 100.3 min calculated for 0.530 af (93% of inflow)
 Center-of-Mass det. time= 47.1 min (699.5 - 652.4)

Volume	Invert	Avail.Storage	Storage Description
#1	62.00'	3,658 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
62.00	852	0	0
63.00	1,361	1,107	1,107
64.00	1,810	1,586	2,692
64.50	2,055	966	3,658

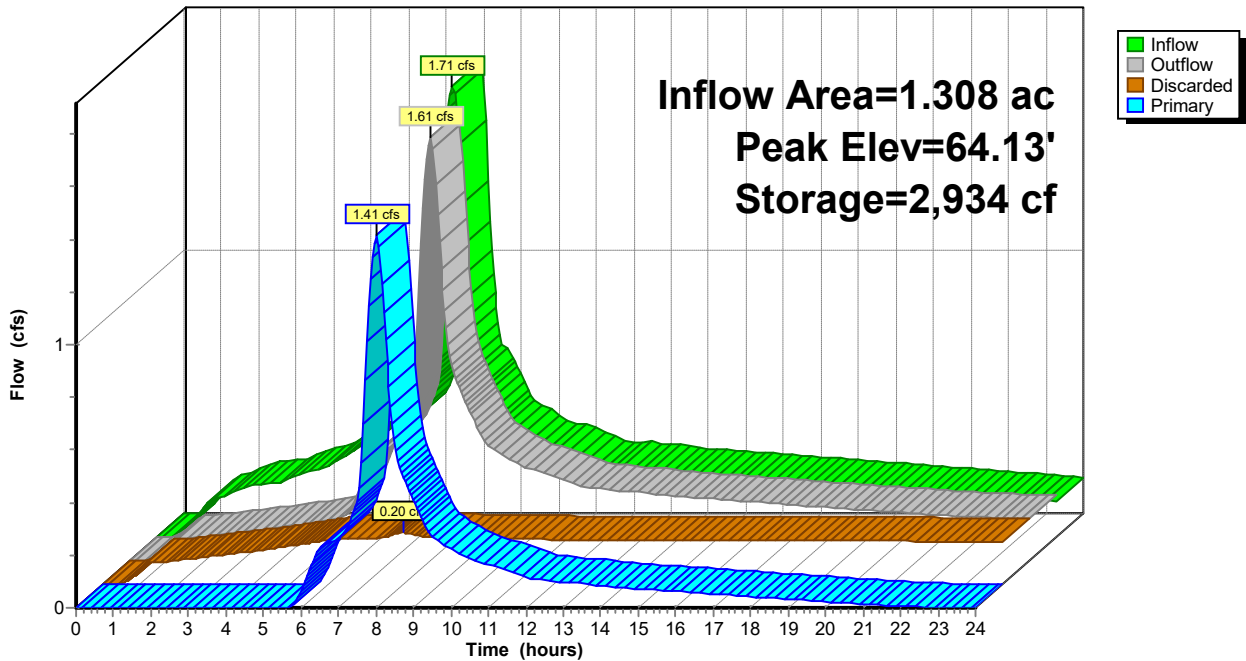
Device	Routing	Invert	Outlet Devices
#1	Discarded	62.00'	4.000 in/hr Exfiltration over Surface area Conductivity to Groundwater Elevation = 50.00'
#2	Primary	63.50'	12.0" Vert. Orifice/Grate C= 0.600

Discarded OutFlow Max=0.20 cfs @ 8.01 hrs HW=64.13' (Free Discharge)
 ↗ **1=Exfiltration** (Controls 0.20 cfs)

Primary OutFlow Max=1.41 cfs @ 8.01 hrs HW=64.13' (Free Discharge)
 ↗ **2=Orifice/Grate** (Orifice Controls 1.41 cfs @ 2.70 fps)

Pond 3P: (new Pond)

Hydrograph



BLUFFS - POST_quality

Type IA 24-hr 25-yr Rainfall=5.50"

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Hydrograph for Pond 3P: (new Pond)

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Outflow (cfs)	Discarded (cfs)	Primary (cfs)
0.00	0.00	0	62.00	0.00	0.00	0.00
0.50	0.01	1	62.00	0.00	0.00	0.00
1.00	0.06	14	62.02	0.05	0.05	0.00
1.50	0.14	71	62.08	0.08	0.08	0.00
2.00	0.17	194	62.21	0.09	0.09	0.00
2.50	0.20	356	62.38	0.10	0.10	0.00
3.00	0.20	530	62.54	0.11	0.11	0.00
3.50	0.22	701	62.68	0.12	0.12	0.00
4.00	0.25	906	62.85	0.13	0.13	0.00
4.50	0.27	1,132	63.02	0.14	0.14	0.00
5.00	0.30	1,391	63.20	0.15	0.15	0.00
5.50	0.35	1,709	63.41	0.16	0.16	0.00
6.00	0.38	2,038	63.62	0.23	0.17	0.06
6.50	0.45	2,223	63.73	0.40	0.17	0.23
7.00	0.47	2,255	63.75	0.44	0.17	0.26
7.50	0.67	2,366	63.82	0.58	0.18	0.41
8.00	1.65	2,933	64.13	1.61	0.20	1.41
8.50	0.64	2,518	63.90	0.82	0.18	0.64
9.00	0.52	2,368	63.82	0.59	0.18	0.41
9.50	0.41	2,265	63.76	0.45	0.17	0.28
10.00	0.38	2,221	63.73	0.40	0.17	0.22
10.50	0.34	2,183	63.71	0.36	0.17	0.18
11.00	0.32	2,164	63.70	0.34	0.17	0.17
11.50	0.30	2,137	63.68	0.31	0.17	0.14
12.00	0.27	2,106	63.66	0.28	0.17	0.11
12.50	0.28	2,098	63.66	0.28	0.17	0.11
13.00	0.26	2,085	63.65	0.27	0.17	0.10
13.50	0.25	2,080	63.65	0.26	0.17	0.09
14.00	0.24	2,065	63.64	0.25	0.17	0.08
14.50	0.24	2,058	63.63	0.25	0.17	0.08
15.00	0.24	2,051	63.63	0.24	0.17	0.07
15.50	0.23	2,044	63.62	0.23	0.17	0.07
16.00	0.23	2,036	63.62	0.23	0.17	0.06
16.50	0.22	2,027	63.61	0.22	0.17	0.06
17.00	0.21	2,018	63.61	0.22	0.17	0.05
17.50	0.21	2,009	63.60	0.21	0.17	0.05
18.00	0.20	2,001	63.60	0.21	0.17	0.04
18.50	0.20	1,991	63.59	0.20	0.17	0.04
19.00	0.19	1,980	63.59	0.20	0.17	0.03
19.50	0.19	1,969	63.58	0.19	0.17	0.03
20.00	0.18	1,958	63.57	0.19	0.16	0.02
20.50	0.18	1,946	63.56	0.18	0.16	0.02
21.00	0.17	1,932	63.56	0.18	0.16	0.01
21.50	0.16	1,918	63.55	0.17	0.16	0.01
22.00	0.16	1,901	63.54	0.17	0.16	0.01
22.50	0.15	1,882	63.52	0.16	0.16	0.00
23.00	0.15	1,859	63.51	0.16	0.16	0.00
23.50	0.14	1,831	63.49	0.16	0.16	0.00
24.00	0.14	1,795	63.47	0.16	0.16	0.00

BLUFFS - POST_quality

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Type IA 24-hr 100-yr Rainfall=6.50"

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Summary for Subcatchment 2S: QUALITY

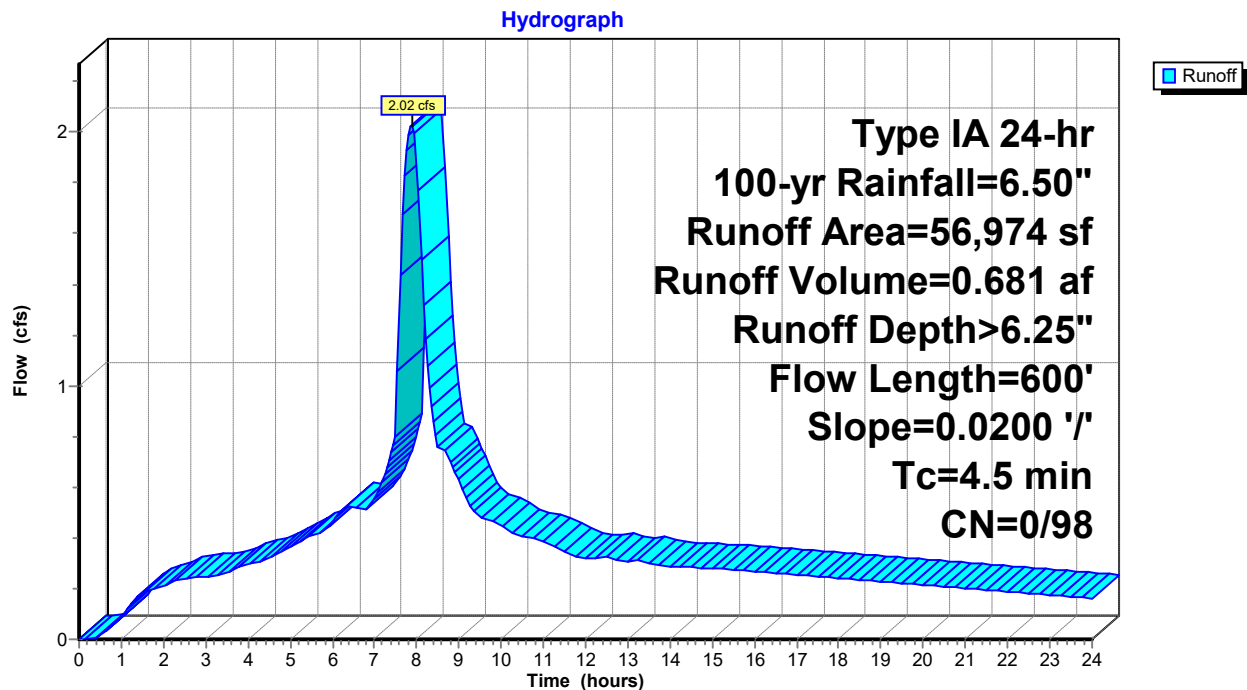
Runoff = 2.02 cfs @ 7.88 hrs, Volume= 0.681 af, Depth> 6.25"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Type IA 24-hr 100-yr Rainfall=6.50"

	Area (sf)	CN	Description
*	17,293	98	Paved roads w/curbs & sewers, HSG A
	32,500	98	Roofs, HSG C
	2,660	98	Paved roads w/curbs & sewers, HSG A
	4,521	98	Paved parking, HSG A
	56,974	98	Weighted Average
	56,974	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.8	300	0.0200	1.79		Sheet Flow, IMPERV
					Smooth surfaces n= 0.011 P2= 3.50"
1.7	300	0.0200	2.87		Shallow Concentrated Flow,
					Paved Kv= 20.3 fps
4.5	600	Total			

Subcatchment 2S: QUALITY

BLUFFS - POST_quality

Type IA 24-hr 100-yr Rainfall=6.50"

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Hydrograph for Subcatchment 2S: QUALITY

Time (hours)	Precip. (inches)	Perv.Excess (inches)	Imp.Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00	0.00
0.50	0.06	0.00	0.00	0.02
1.00	0.13	0.00	0.03	0.09
1.50	0.23	0.00	0.09	0.19
2.00	0.33	0.00	0.17	0.21
2.50	0.43	0.00	0.25	0.24
3.00	0.53	0.00	0.35	0.25
3.50	0.64	0.00	0.44	0.26
4.00	0.75	0.00	0.55	0.30
4.50	0.88	0.00	0.67	0.32
5.00	1.01	0.00	0.80	0.36
5.50	1.17	0.00	0.96	0.41
6.00	1.34	0.00	1.12	0.46
6.50	1.54	0.00	1.32	0.53
7.00	1.74	0.00	1.52	0.56
7.50	2.02	0.00	1.79	0.80
8.00	2.76	0.00	2.53	1.96
8.50	3.12	0.00	2.89	0.76
9.00	3.38	0.00	3.15	0.62
9.50	3.57	0.00	3.34	0.48
10.00	3.75	0.00	3.52	0.45
10.50	3.91	0.00	3.67	0.40
11.00	4.06	0.00	3.82	0.38
11.50	4.19	0.00	3.96	0.35
12.00	4.32	0.00	4.08	0.32
12.50	4.44	0.00	4.20	0.33
13.00	4.56	0.00	4.32	0.31
13.50	4.67	0.00	4.44	0.30
14.00	4.78	0.00	4.55	0.29
14.50	4.89	0.00	4.66	0.29
15.00	5.00	0.00	4.76	0.28
15.50	5.10	0.00	4.87	0.27
16.00	5.21	0.00	4.97	0.27
16.50	5.31	0.00	5.07	0.26
17.00	5.40	0.00	5.17	0.25
17.50	5.50	0.00	5.26	0.25
18.00	5.59	0.00	5.35	0.24
18.50	5.68	0.00	5.44	0.23
19.00	5.77	0.00	5.53	0.23
19.50	5.85	0.00	5.61	0.22
20.00	5.93	0.00	5.69	0.21
20.50	6.01	0.00	5.77	0.21
21.00	6.09	0.00	5.85	0.20
21.50	6.16	0.00	5.93	0.19
22.00	6.24	0.00	6.00	0.19
22.50	6.31	0.00	6.07	0.18
23.00	6.37	0.00	6.13	0.18
23.50	6.44	0.00	6.20	0.17
24.00	6.50	0.00	6.26	0.16

BLUFFS - POST_quality

Type IA 24-hr 100-yr Rainfall=6.50"

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Summary for Pond 3P: (new Pond)

Inflow Area = 1.308 ac, 100.00% Impervious, Inflow Depth > 6.25" for 100-yr event
 Inflow = 2.02 cfs @ 7.88 hrs, Volume= 0.681 af
 Outflow = 1.91 cfs @ 8.01 hrs, Volume= 0.638 af, Atten= 6%, Lag= 7.5 min
 Discarded = 0.20 cfs @ 8.01 hrs, Volume= 0.310 af
 Primary = 1.71 cfs @ 8.01 hrs, Volume= 0.327 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
 Peak Elev= 64.21' @ 8.01 hrs Surf.Area= 1,913 sf Storage= 3,083 cf

Plug-Flow detention time= 89.6 min calculated for 0.638 af (94% of inflow)
 Center-of-Mass det. time= 41.4 min (690.9 - 649.5)

Volume	Invert	Avail.Storage	Storage Description
#1	62.00'	3,658 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
62.00	852	0	0
63.00	1,361	1,107	1,107
64.00	1,810	1,586	2,692
64.50	2,055	966	3,658

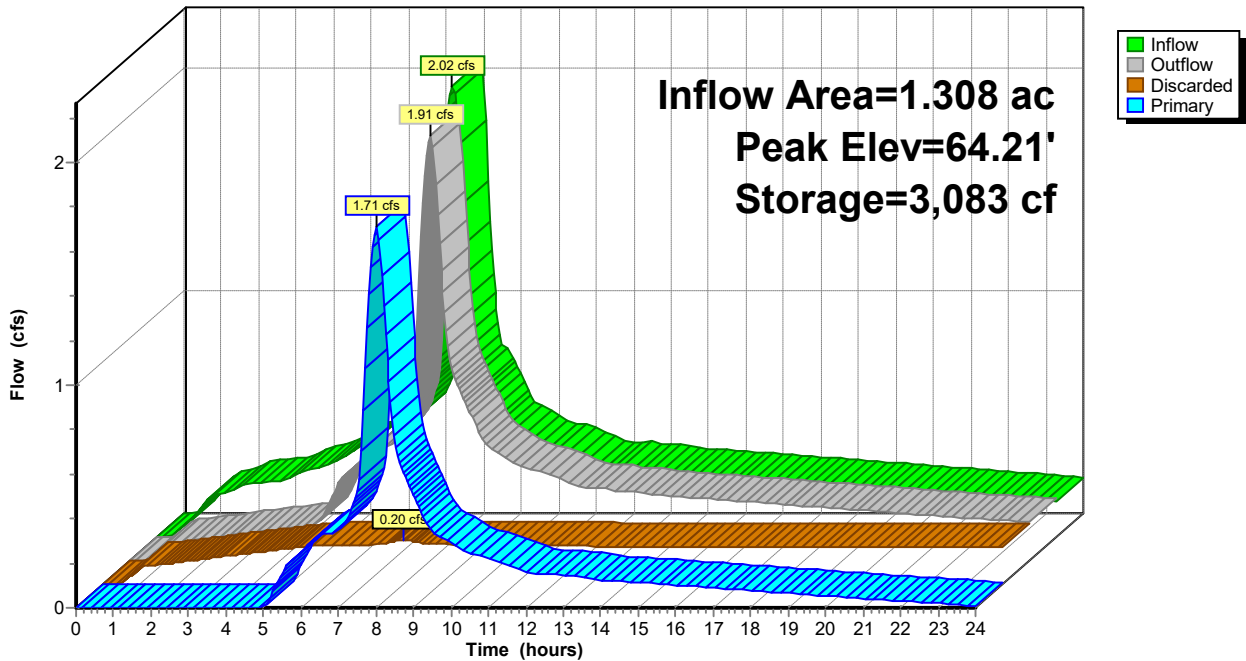
Device	Routing	Invert	Outlet Devices
#1	Discarded	62.00'	4.000 in/hr Exfiltration over Surface area Conductivity to Groundwater Elevation = 50.00'
#2	Primary	63.50'	12.0" Vert. Orifice/Grate C= 0.600

Discarded OutFlow Max=0.20 cfs @ 8.01 hrs HW=64.21' (Free Discharge)
 ↗ **1=Exfiltration** (Controls 0.20 cfs)

Primary OutFlow Max=1.71 cfs @ 8.01 hrs HW=64.21' (Free Discharge)
 ↗ **2=Orifice/Grate** (Orifice Controls 1.71 cfs @ 2.87 fps)

Pond 3P: (new Pond)

Hydrograph



BLUFFS - POST_quality

Type IA 24-hr 100-yr Rainfall=6.50"

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Hydrograph for Pond 3P: (new Pond)

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Outflow (cfs)	Discarded (cfs)	Primary (cfs)
0.00	0.00	0	62.00	0.00	0.00	0.00
0.50	0.02	3	62.00	0.01	0.01	0.00
1.00	0.09	20	62.02	0.07	0.07	0.00
1.50	0.19	130	62.15	0.09	0.09	0.00
2.00	0.21	319	62.34	0.10	0.10	0.00
2.50	0.24	545	62.55	0.11	0.11	0.00
3.00	0.25	780	62.75	0.12	0.12	0.00
3.50	0.26	1,007	62.93	0.13	0.13	0.00
4.00	0.30	1,273	63.12	0.14	0.14	0.00
4.50	0.32	1,564	63.32	0.15	0.15	0.00
5.00	0.36	1,892	63.53	0.17	0.16	0.00
5.50	0.41	2,156	63.69	0.33	0.17	0.16
6.00	0.46	2,241	63.74	0.42	0.17	0.25
6.50	0.53	2,312	63.78	0.51	0.18	0.33
7.00	0.56	2,323	63.79	0.53	0.18	0.35
7.50	0.80	2,443	63.86	0.70	0.18	0.52
8.00	1.96	3,083	64.21	1.91	0.20	1.71
8.50	0.76	2,599	63.95	0.96	0.19	0.78
9.00	0.62	2,436	63.86	0.69	0.18	0.51
9.50	0.48	2,325	63.79	0.53	0.18	0.35
10.00	0.45	2,279	63.77	0.47	0.18	0.29
10.50	0.40	2,239	63.74	0.42	0.17	0.24
11.00	0.38	2,220	63.73	0.40	0.17	0.22
11.50	0.35	2,192	63.71	0.37	0.17	0.19
12.00	0.32	2,160	63.69	0.33	0.17	0.16
12.50	0.33	2,153	63.69	0.33	0.17	0.15
13.00	0.31	2,139	63.68	0.31	0.17	0.14
13.50	0.30	2,135	63.68	0.31	0.17	0.14
14.00	0.29	2,120	63.67	0.30	0.17	0.13
14.50	0.29	2,113	63.67	0.29	0.17	0.12
15.00	0.28	2,106	63.66	0.28	0.17	0.11
15.50	0.27	2,099	63.66	0.28	0.17	0.11
16.00	0.27	2,091	63.65	0.27	0.17	0.10
16.50	0.26	2,083	63.65	0.26	0.17	0.10
17.00	0.25	2,075	63.64	0.26	0.17	0.09
17.50	0.25	2,066	63.64	0.25	0.17	0.08
18.00	0.24	2,058	63.63	0.25	0.17	0.08
18.50	0.23	2,049	63.63	0.24	0.17	0.07
19.00	0.23	2,040	63.62	0.23	0.17	0.07
19.50	0.22	2,030	63.62	0.23	0.17	0.06
20.00	0.21	2,020	63.61	0.22	0.17	0.05
20.50	0.21	2,009	63.60	0.21	0.17	0.05
21.00	0.20	1,999	63.60	0.21	0.17	0.04
21.50	0.19	1,987	63.59	0.20	0.17	0.04
22.00	0.19	1,974	63.58	0.20	0.17	0.03
22.50	0.18	1,962	63.57	0.19	0.16	0.02
23.00	0.18	1,947	63.57	0.18	0.16	0.02
23.50	0.17	1,932	63.56	0.18	0.16	0.01
24.00	0.16	1,915	63.54	0.17	0.16	0.01

Manning Formula Uniform Pipe Flow at Given Slope and Depth

Check out our spreadsheet version of this calculator [Download Spreadsheet](#) [Open Google Sheets version](#) [View All Spreadsheets](#)

Bluffs Subdivision

NB 24-in Storm Main - 0.5% slope

Inputs

Pipe diameter, d_0	2	ft
Manning roughness, n	0.01	
Pressure slope (possibly ? equal to pipe slope), S_0	0.005	rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	0.95	fraction

Results

Flow, Q	22.3434	cfs
Velocity, v	7.2477	ft/sec
Velocity head, h_v	0.8164	ft H2O
Flow area	3.0830	ft^2
Wetted perimeter	5.3811	ft
Hydraulic radius	0.5729	ft
Top width, T	0.8718	ft
Froude number, F	0.68	
Shear stress (tractive force), τ	0.1788	psf

