Gaithersburg
A CHARACTER COUNTS! CITY

AMENDMENT #4

REQUEST FOR QUOTATIONS

Effective: September 8, 2016

Project: Rabbitt Road Culvert Repairs

Issued By: Becky Uebele, Civil Engineer
800 Rabbitt Road
Gaithersburg, Maryland 20878

Please be advised that the following in the Solicitation – Exhibit A has been revised to include computations for this project.

Amended Lists of Items for Exhibit A:

- General Requirements, References and Specifications
- Rabbitt Road Culvert Repair Plans
- Rabbitt Road Culvert Repair Project – Storm Drain Calculations
- Rabbitt Road Culvert Repair Project – Existing Riser Analysis
- Rabbitt Road Culvert Repair Project – 72-inch Slip Lined Riser Alternative
- Rabbitt Road Culvert Repair Project – 84-inch Slip Lined Riser Alternative
- Rabbitt Road Culvert Repair Project – 86-inch Slip Lined Riser Alternative
- Rabbitt Road Culvert Repair Project – 90-inch SpinCast Lined Riser Alternative
- Rabbitt Road Culvert Repair Project – 92-inch SpinCast Lined Riser Alternative

Original Lists of Items for Exhibit A:

- General Requirements, References and Specifications
- Rabbitt Road Culvert Repair Plans

The additional items have been included with this Amendment.

All other dates, times, locations, provisions, and terms and conditions of the Solicitation remain unchanged and in effect.

RABBITT ROAD CULVERT REPAIR PROJECT

Storm Drain Calculations

Rabbitt Road Culvert Repairs

CITY OF GAITHERSBURG

STORM DRAINAGE DESIGN CALCULATIONS

June 10, 2016

Owner/Applicant and Client

City of Gaithersburg

800 Rabbitt Road

Gaithersburg, Maryland 20878

Engineer and Prepared By:

A. Morton Thomas and Associates, Inc.

800 King Farm Boulevard, 4th Floor

Rockville, Maryland 20850

Tel: 301.881.2545

www.amtengineering.com

*"Professional Certification. I hereby certify that these documents were prepared or approved by me, and that I am a duly licensed professional engineer under the laws of the state of Maryland, License No. **32151** Expiration Date: **07/18/2017**"*

Seal and Signature

1. DESIGN SUMMARY

For the Rabbitt Road Culvert Repair project, the existing field connections into the existing corrugated metal pipe culverts will be remove and the storm drain will be rerouted to tie directly into the existing concrete riser. The new storm drain systems were designed in accordance with the *Montgomery County Drainage Design Criteria*, dated June 10, 2014.

For pipe sizing and hydraulic grade line calculations, AMT delineated the drainage area to the new inlet (SD-21). This inlet has a total drainage area of approximately 1.35 acres consisting 0.89 acres of impervious area (houses, roads, sidewalks, etc.) and 0.46 acres of open space lawn area. The time of concentration for the drainage area is 5 minutes.

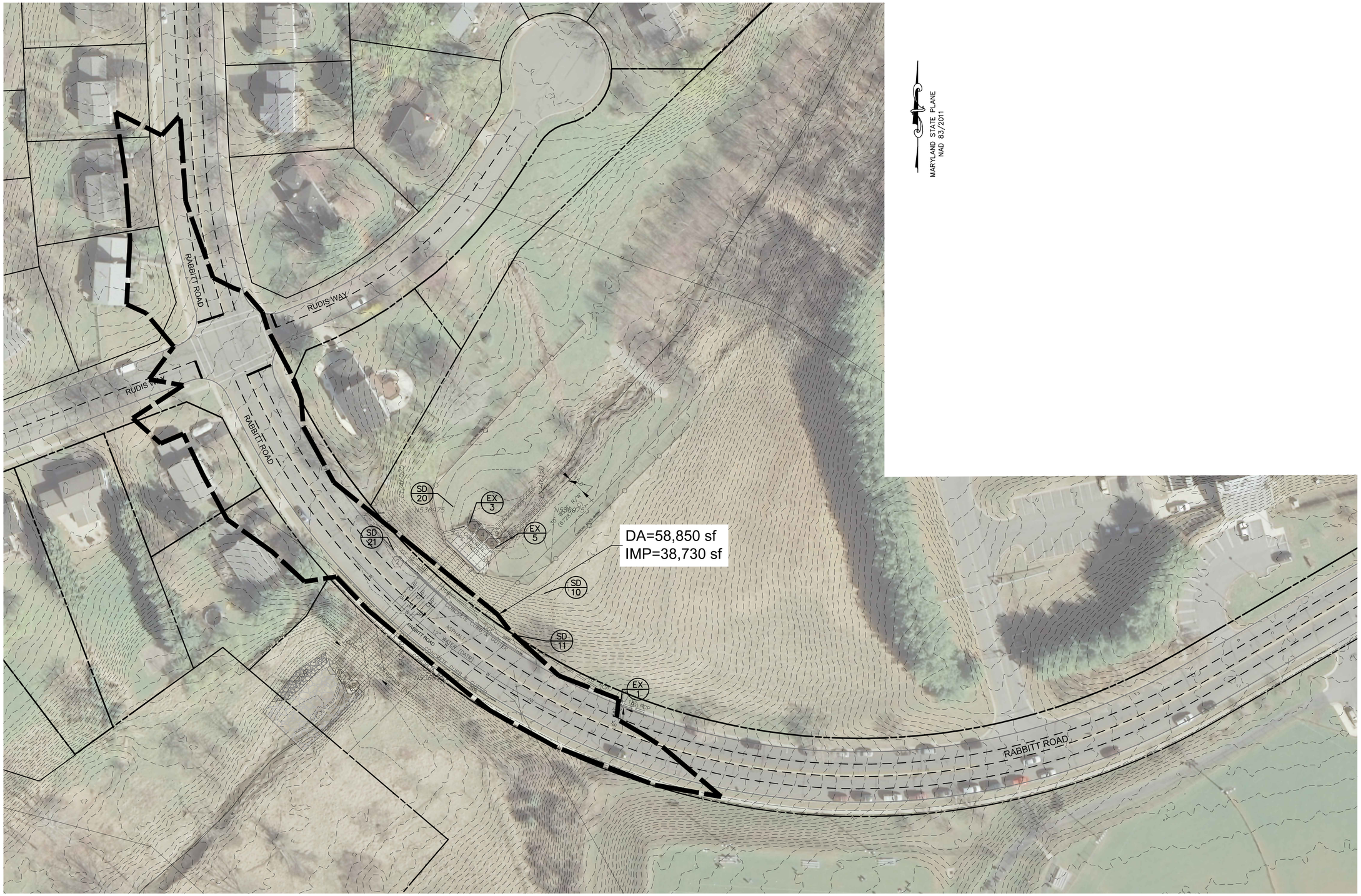
For pipe sizing and hydraulic grade line calculations, AMT utilized the flow presented in the existing design drainages for Rabbitt Road. The flow of 19.48 cfs was utilized as a direct flow in the storm drainage system.

For both new manhole structures, SD/20 and SD/10, they are located below the 10-year water surface elevation associated with stormwater management facility. Since the HGL is above the structure, AMT has indicated for the frame and covers to be bolted to the manhole structures.

APPENDIX A:

STORM DRAINAGE CALCULATIONS

Label	Start Node	Stop Node	Length (Unified) (ft)	Upstream Inlet C	Upstream Intensity (in/h)	Upstream Inlet Area (acres)	Upstream Structure Flow (Total Surface) (ft^3/s)	System CA (acres)	System Intensity (in/h)	System Rational Flow (ft^3/s)	Total Flow (ft^3/s)	Capacity (Full Flow) (ft^3/s)	Velocity (Average) (ft/s)	Invert (Upstream) (ft)	Invert (Downstream) (ft)	Slope (ft/ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)
Storm Drain System SD/21 to EX/3																		
SD-21 TO SD-20	SD-21	SD-20	64.3	0.713	7.07	1.35	6.86	0.962	7.07	6.86	6.86	42.01	17.52	369.34	359.05	0.16	370.35	363.87
SD-20 TO EX-3	SD-20	EX-3 (RISER	18.5	(N/A)	7.055	(N/A)	0	0.962	7.055	6.84	6.84	25.73	3.87	358.79	357.68	0.06	368.81	368.73
Storm Drain System SD/11 to EX/5																		
EX-1 TO SD-11	EX-1	SD-11	112.1	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	19.48	19.48	36.63	21.05	382.37	368.74	0.122	383.83	371.59
SD-11 TO SD-10	SD-11	SD-10	43.9	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	19.48	19.48	42.01	23.33	368.6	361.58	0.16	370.06	366.81
SD-10 TO EX-5	SD-10	EX-5 (RISER	58.5	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	(N/A)	19.48	19.48	25.73	11.02	361.33	357.82	0.06	370.74	368.73



AMT

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EMAIL: AMT1@AMTENGINEERING.COM

CONSULTANTS

KIM ENGINEERING
1500 Caton Center Drive, Suite C
Baltimore, MD 21227
(410) 501-3669 FAX:(410) 695-1615

PROFESSIONAL CERTIFICATION

"I HEREBY CERTIFY THAT THESE DOCUMENTS WERE PREPARED OR APPROVED BY ME, AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MARYLAND, LICENSE NO. 32151, EXPIRATION DATE 07/18/2017."

REGISTRATION STAMP

OWNER

CITY OF GAITHERSBURG

Gaithersburg
800 Rabbitt Road Gaithersburg, MD
20878-1600 (301) 258-6370
(301) 258-6375 FAX

PROJECT TITLE

RABBITT ROAD CULVERT REPAIRS
GAITHERSBURG, MARYLAND

REVISIONS

MARK	DATE	DESCRIPTION

AMT FILE NO.	15-0290.003
DATE:	JUNE 10, 2016
SCALE:	1"=40'
DESIGNED BY:	MAE
DRAWN BY:	SAL
CHECKED BY:	MAE

100% SUBMISSION

SHEET TITLE

EXHIBIT: DRAINAGE AREA MAP

SHEET

DA101

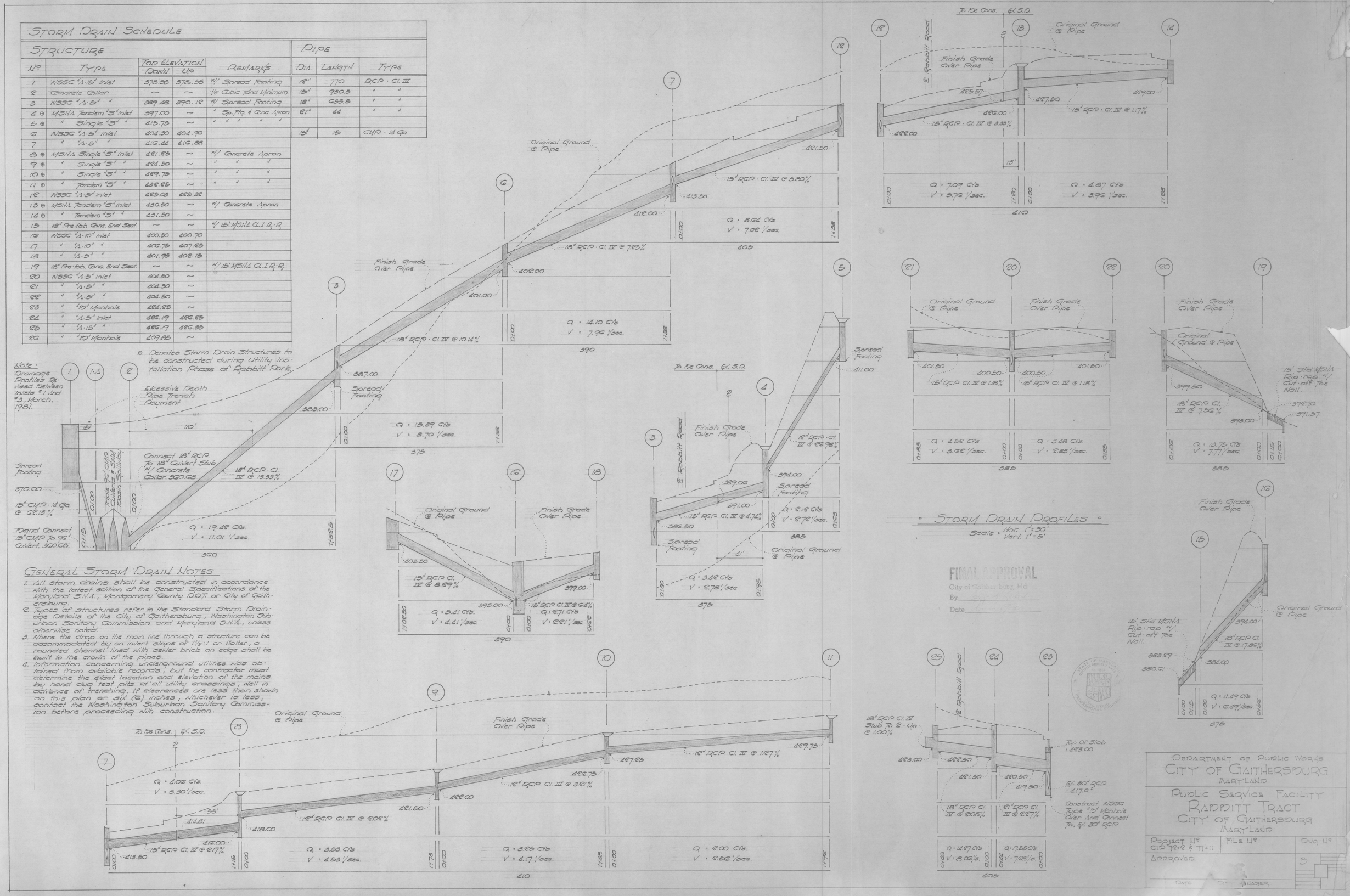
SHEET OF 15

STORM DRAIN SCHEDULE

STRUCTURE					PIPE		
No	TYPE	TOP ELEVATION DOWN	TOP ELEVATION UP	REMARKS	DIA.	LENGTH	TYPE
1	NSSC 4'x5.5' Inlet	378.56	378.56	W/ Spread Footing	18"	770	RCP · Cl. II
2	Concrete Collar	~	~	1/6 Cubic Yard Minimum	18"	930.5	" "
3	NSSC 4'x5.5' "	389.48	390.12	W/ Spread Footing	18"	655.5	" "
4 ⊕	M.S.H.A. Tandem 5' Inlet	397.00	~	" Sp. Flg. & Conc. Apron	21"	64	" "
5 ⊕	" Single 5' "	415.75	~	" " " " "			
6	NSSC 4'x5.5' Inlet	404.30	404.90		15"	15	CMP · 14 Ga
7	" 4'x5.5' "	416.44	416.88				
8 ⊕	M.S.H.A. Single 5' Inlet	421.25	~	W/ Concrete Apron			
9 ⊕	" Single 5' "	424.50	~	" " "			
10 ⊕	" Single 5' "	429.75	~	" " "			
11 ⊕	" Tandem 5' "	432.25	~	" " "			
12	NSSC 4'x5.5' Inlet	423.03	423.38				
13 ⊕	M.S.H.A. Tandem 5' Inlet	430.50	~	W/ Concrete Apron			
14 ⊕	" Tandem 5' "	431.50	~				
15	18" Pre-Fab Conc. End Sect.	~	~	W/ 15" M.S.H.A. Cl. I R.R.			
16	NSSC 4'x10' Inlet	400.50	400.70				
17	" 4'x10' "	406.75	407.25				
18	" 4'x5.5' "	401.95	402.15				
19	18" Pre-Fab. Conc. End Sect.	~	~	W/ 15" M.S.H.A. Cl. I R.R.			
20	NSSC 4'x5.5' Inlet	402.50	~				
21	" 4'x5.5' "	402.50	~				
22	" 4'x5.5' "	402.50	~				
23	" 4'x5' Manhole	422.25	~				
24	" 4'x5' Inlet	426.19	426.25				
25	" 4'x15' "	426.19	426.35				
26	" 4'x5' Manhole	429.25	~				

⊕ Denotes Storm Drain Structures to be constructed during Utility Installation Phase of Rabbitt Park.

Note: Drainage Profiles Revised Between Inlets #1 and #3, March, 1981.



STORM DRAIN PROFILES

Scale · Hor. 1" = 30'
Vert. 1" = 5'

GENERAL STORM DRAIN NOTES

1. All storm drains shall be constructed in accordance with the latest edition of the General Specifications of the Maryland S.H.A., Montgomery County D.O.T. or City of Gaithersburg.
2. Types of structures refer to the Standard Storm Drainage Details of the City of Gaithersburg, Washington Suburban Sanitary Commission and Maryland S.H.A., unless otherwise noted.
3. Where the drop on the main line through a structure can be accommodated by an invert slope of 1½:1 or flatter, a rounded channel lined with sewer brick on edge shall be built to the crown of the pipes.
4. Information concerning underground utilities was obtained from available records, but the contractor must determine the exact location and elevation of the mains by hand dug test pits at all utility crossings, well in advance of trenching. If clearances are less than shown on this plan or six (6) inches, whichever is less, contact the Washington Suburban Sanitary Commission before proceeding with construction.

FINAL APPROVAL
City of Gaithersburg, Md.
By _____
Date _____

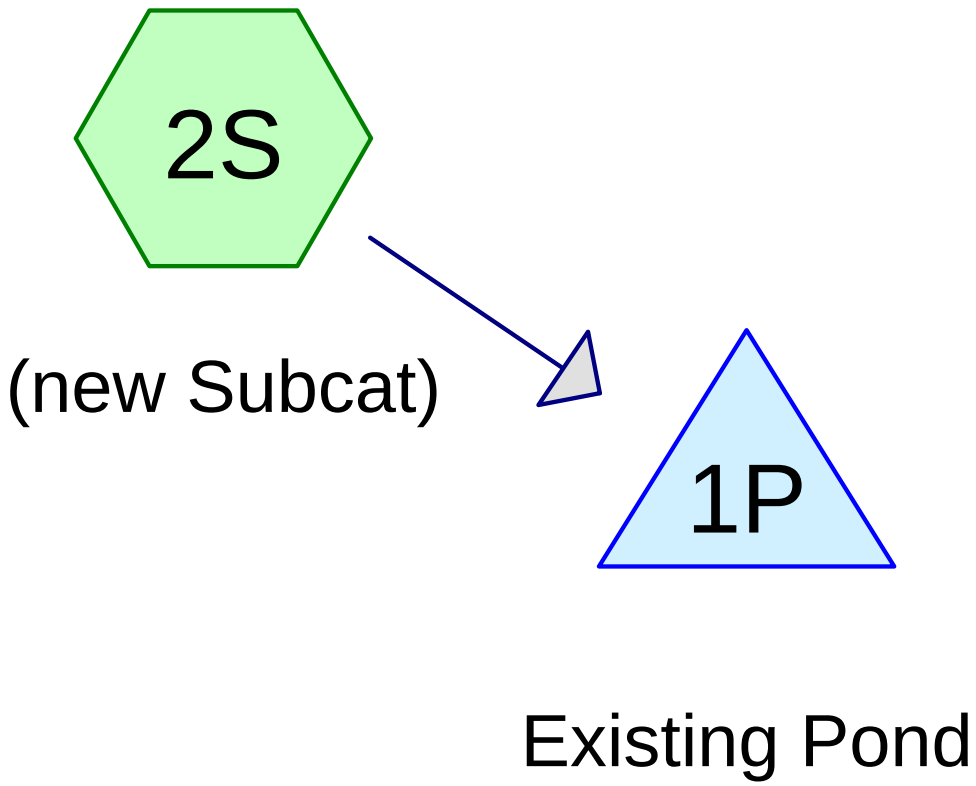
DEPARTMENT OF PUBLIC WORKS
CITY OF GAITHERSBURG
MARYLAND

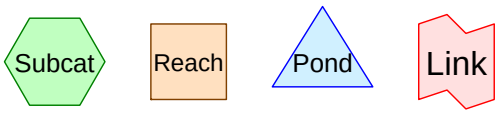
PUBLIC SERVICE FACILITY
RABBITT TRACT
CITY OF GAITHERSBURG
MARYLAND

PROJECT No.	FILE No.	DWG No.
C.I.P. 79-2 & 77-11		3
APPROVED		
DATE	CITY MANAGER	

RABBITT ROAD CULVERT REPAIR PROJECT

Existing Riser Analysis





Routing Diagram for Existing Riser Analysis
Prepared by Microsoft, Printed 4/25/2016
HydroCAD® 10.00-15 s/n 05119 © 2015 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
831.300	84	from existing report (2S)
831.300	**84**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
831.300	Other	2S
831.300		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	0.000	0.000	831.300	831.300	from existing report	2S
0.000	**0.000**	**0.000**	**0.000**	**831.300**	**831.300**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	1P	357.00	356.00	170.0	0.0059	0.024	96.0	0.0	0.0

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

Subcatchment 2S: (new Subcat) Runoff Area=831.300 ac 0.00% Impervious Runoff Depth>3.07"
Tc=67.0 min CN=84 Runoff=1,375.72 cfs 212.672 af

Pond 1P: Existing Pond Peak Elev=368.73' Storage=259,494 cf Inflow=1,375.72 cfs 212.672 af
Outflow=1,370.05 cfs 212.654 af

Total Runoff Area = 831.300 ac Runoff Volume = 212.672 af Average Runoff Depth = 3.07"
100.00% Pervious = 831.300 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 2S: (new Subcat)

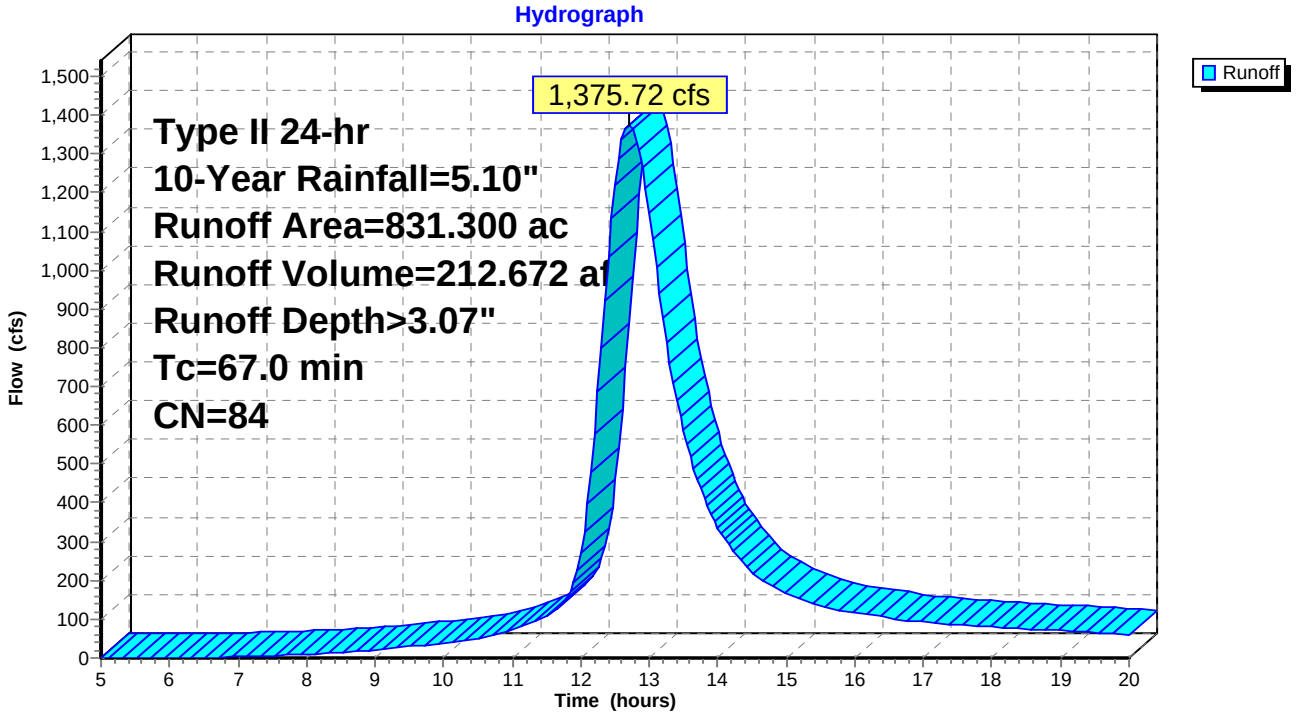
Runoff = 1,375.72 cfs @ 12.71 hrs, Volume= 212.672 af, Depth> 3.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-Year Rainfall=5.10"

	Area (ac)	CN	Description
*	831.300	84	from existing report
	831.300		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
67.0					**Direct Entry, This is Guess**

Subcatchment 2S: (new Subcat)



Summary for Pond 1P: Existing Pond

Inflow Area = 831.300 ac, 0.00% Impervious, Inflow Depth > 3.07" for 10-Year event
Inflow = 1,375.72 cfs @ 12.71 hrs, Volume= 212.672 af
Outflow = 1,370.05 cfs @ 12.75 hrs, Volume= 212.654 af, Atten= 0%, Lag= 2.4 min
Primary = 1,370.05 cfs @ 12.75 hrs, Volume= 212.654 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 368.73' @ 12.75 hrs Surf.Area= 97,834 sf Storage= 259,494 cf

Plug-Flow detention time= 3.3 min calculated for 211.947 af (100% of inflow)
Center-of-Mass det. time= 3.3 min (820.6 - 817.3)

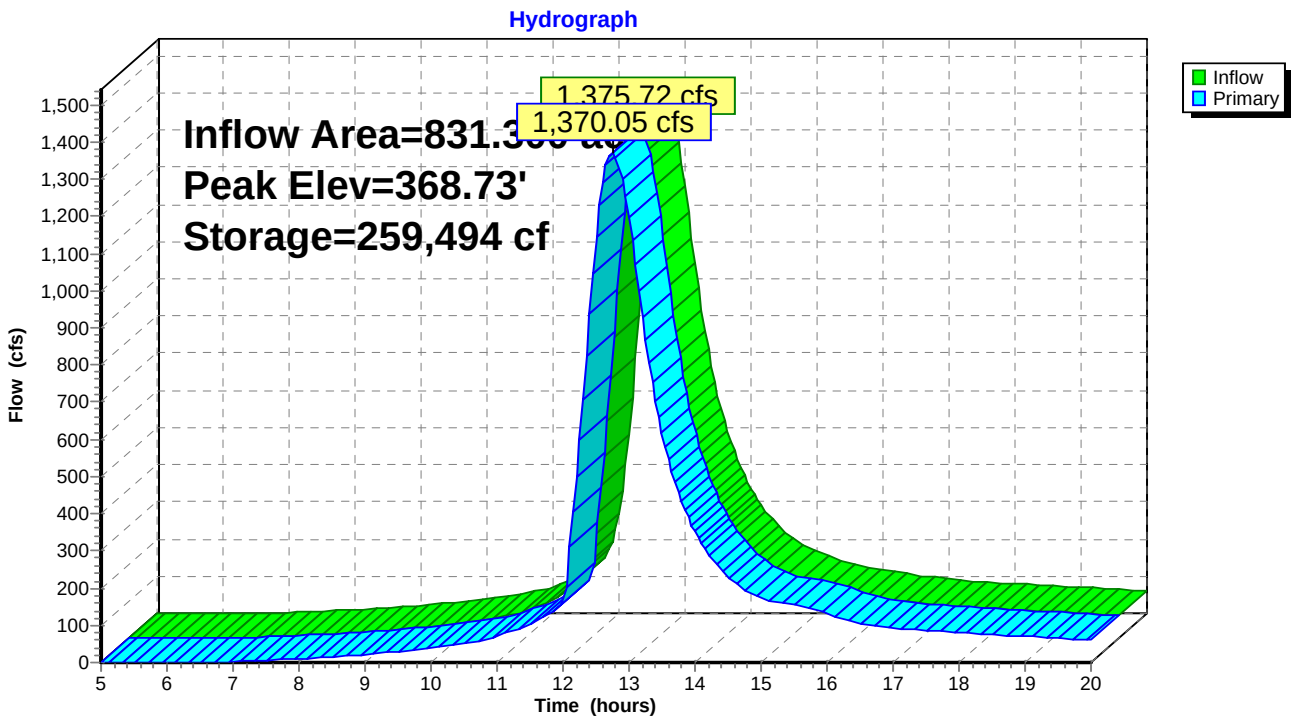
Volume	Invert	Avail.Storage	Storage Description
#1	357.00'	1,704,625 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
357.00	0	0	0
358.00	60	30	30
359.00	329	195	225
360.00	756	543	767
361.00	1,283	1,020	1,787
362.00	4,923	3,103	4,890
363.00	7,383	6,153	11,043
364.00	13,965	10,674	21,717
365.00	21,759	17,862	39,579
366.00	38,951	30,355	69,934
367.00	61,360	50,156	120,089
368.00	84,287	72,824	192,913
369.00	102,814	93,551	286,463
370.00	119,594	111,204	397,667
371.00	138,346	128,970	526,637
372.00	157,003	147,675	674,312
373.00	176,693	166,848	841,160
374.00	196,413	186,553	1,027,713
375.00	216,193	206,303	1,234,016
376.00	234,363	225,278	1,459,294
377.00	256,299	245,331	1,704,625

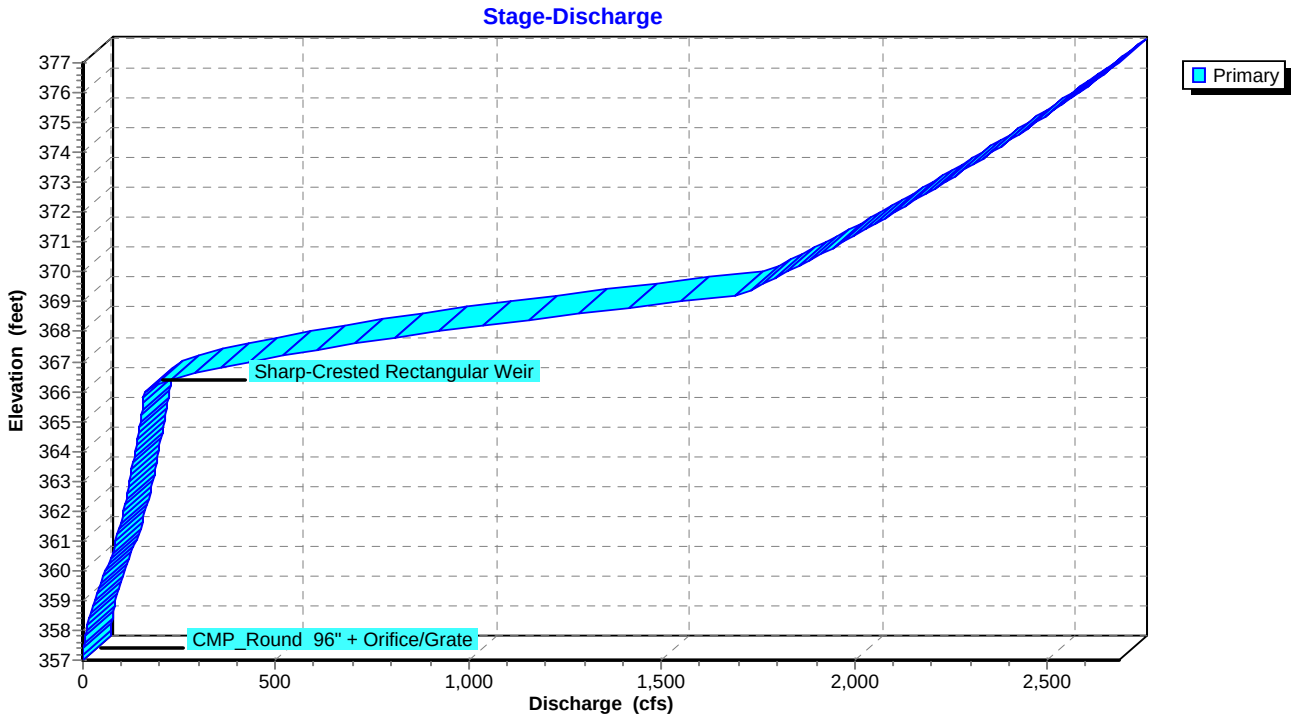
Device	Routing	Invert	Outlet Devices
#1	Primary	357.00'	**96.0" Round CMP_Round 96" X 3.00** L= 170.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 357.00' / 356.00' S= 0.0059 '/' Cc= 0.900 n= 0.024, Flow Area= 50.27 sf
#2	Device 1	357.00'	**48.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	366.00'	**80.0' long Sharp-Crested Rectangular Weir** 0 End Contraction(s)

Primary OutFlow Max=1,369.24 cfs @ 12.75 hrs HW=368.73' (Free Discharge)
└─**1=CMP_Round 96"** (Passes 1,369.24 cfs of 1,620.61 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 188.75 cfs @ 15.02 fps)
  └─**3=Sharp-Crested Rectangular Weir** (Weir Controls 1,180.49 cfs @ 5.40 fps)

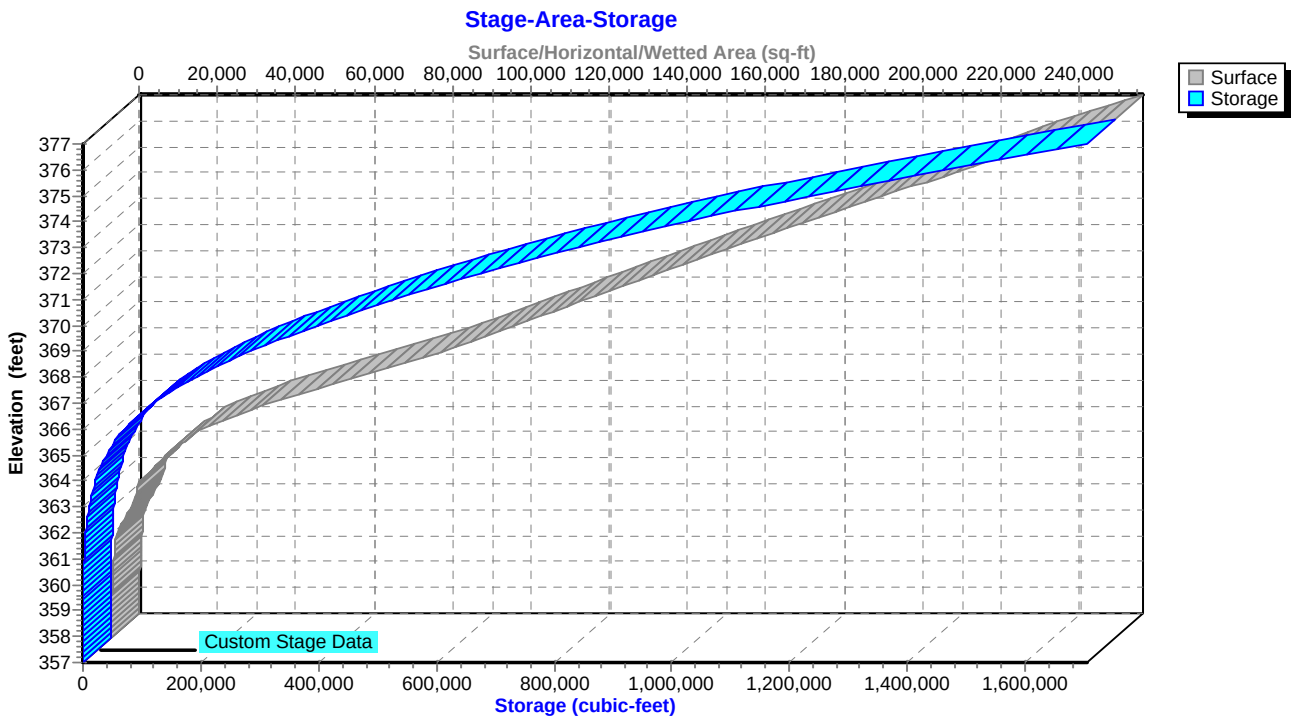
Pond 1P: Existing Pond



Pond 1P: Existing Pond



Pond 1P: Existing Pond



Stage-Discharge for Pond 1P: Existing Pond

Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)
357.00	0.00	367.60	706.88
357.20	0.36	367.80	811.24
357.40	1.41	368.00	921.44
357.60	3.12	368.20	1,037.16
357.80	5.45	368.40	1,158.16
358.00	8.36	368.60	1,284.20
358.20	11.83	368.80	1,415.09
358.40	15.79	369.00	1,550.65
358.60	20.22	369.20	1,690.73
358.80	25.05	369.40	1,731.45
359.00	30.25	369.60	1,763.23
359.20	35.76	369.80	1,794.44
359.40	41.52	370.00	1,825.11
359.60	47.47	370.20	1,855.28
359.80	53.53	370.40	1,884.97
360.00	59.62	370.60	1,914.19
360.20	65.64	370.80	1,942.98
360.40	71.47	371.00	1,971.35
360.60	76.95	371.20	1,999.31
360.80	81.84	371.40	2,026.89
361.00	85.57	371.60	2,054.10
361.20	89.75	371.80	2,080.95
361.40	93.74	372.00	2,107.46
361.60	97.56	372.20	2,133.64
361.80	101.25	372.40	2,159.50
362.00	104.80	372.60	2,185.06
362.20	108.24	372.80	2,210.32
362.40	111.57	373.00	2,235.30
362.60	114.80	373.20	2,260.00
362.80	117.95	373.40	2,284.43
363.00	121.01	373.60	2,308.61
363.20	124.00	373.80	2,332.53
363.40	126.92	374.00	2,356.21
363.60	129.77	374.20	2,379.66
363.80	132.56	374.40	2,402.87
364.00	135.30	374.60	2,425.87
364.20	137.98	374.80	2,448.65
364.40	140.61	375.00	2,471.21
364.60	143.19	375.20	2,493.58
364.80	145.72	375.40	2,515.74
365.00	148.21	375.60	2,537.72
365.20	150.66	375.80	2,559.50
365.40	153.07	376.00	2,581.10
365.60	155.44	376.20	2,602.52
365.80	157.78	376.40	2,623.76
366.00	160.09	376.60	2,644.84
366.20	185.75	376.80	2,665.75
366.40	230.78	377.00	**2,686.49**
366.60	288.39		
366.80	356.17		
367.00	432.74		
367.20	517.15		
367.40	608.71		

Stage-Area-Storage for Pond 1P: Existing Pond

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
357.00	0	0
357.20	12	1
357.40	24	5
357.60	36	11
357.80	48	19
358.00	60	30
358.20	114	47
358.40	168	76
358.60	221	114
358.80	275	164
359.00	329	225
359.20	414	299
359.40	500	390
359.60	585	499
359.80	671	624
360.00	756	767
360.20	861	929
360.40	967	1,112
360.60	1,072	1,315
360.80	1,178	1,540
361.00	1,283	1,787
361.20	2,011	2,116
361.40	2,739	2,591
361.60	3,467	3,212
361.80	4,195	3,978
362.00	4,923	4,890
362.20	5,415	5,923
362.40	5,907	7,055
362.60	6,399	8,286
362.80	6,891	9,615
363.00	7,383	11,043
363.20	8,699	12,651
363.40	10,016	14,522
363.60	11,332	16,657
363.80	12,649	19,055
364.00	13,965	21,717
364.20	15,524	24,665
364.40	17,083	27,926
364.60	18,641	31,498
364.80	20,200	35,383
365.00	21,759	39,579
365.20	25,197	44,274
365.40	28,636	49,657
365.60	32,074	55,728
365.80	35,513	62,487
366.00	38,951	69,934
366.20	43,433	78,172
366.40	47,915	87,307
366.60	52,396	97,338
366.80	56,878	108,265
367.00	61,360	120,089
367.20	65,945	132,820
367.40	70,531	146,467
367.60	75,116	161,032
367.80	79,702	176,514
368.00	84,287	192,913
368.20	87,992	210,140
368.40	91,698	228,109
368.60	95,403	246,820
368.80	99,109	266,271
369.00	102,814	286,463
369.20	106,170	307,361
369.40	109,526	328,931
369.60	112,882	351,172
369.80	116,238	374,084
370.00	119,594	397,667
370.20	123,344	421,961
370.40	127,095	447,005
370.60	130,845	472,799
370.80	134,596	499,343
371.00	138,346	526,637
371.20	142,077	554,679
371.40	145,809	583,468
371.60	149,540	613,003
371.80	153,272	643,284
372.00	157,003	674,312
372.20	160,941	706,106
372.40	164,879	738,688
372.60	168,817	772,058
372.80	172,755	806,215
373.00	176,693	841,160
373.20	180,637	876,892
373.40	184,581	913,414
373.60	188,525	950,725
373.80	192,469	988,824
374.00	196,413	1,027,713
374.20	200,369	1,067,391
374.40	204,325	1,107,860
374.60	208,281	1,149,121
374.80	212,237	1,191,173
375.00	216,193	1,234,016
375.20	219,827	1,277,617
375.40	223,461	1,321,946
375.60	227,095	1,367,002
375.80	230,729	1,412,784
376.00	234,363	1,459,294
376.20	238,750	1,506,605
376.40	243,137	1,554,794
376.60	247,525	1,603,860
376.80	251,912	1,653,803
377.00	**256,299**	**1,704,625**

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

Subcatchment 2S: (new Subcat) Runoff Area=831.300 ac 0.00% Impervious Runoff Depth>4.90"
Tc=67.0 min CN=84 Runoff=2,164.48 cfs 339.535 af

Pond 1P: Existing Pond Peak Elev=371.36' Storage=578,211 cf Inflow=2,164.48 cfs 339.535 af
Outflow=2,021.91 cfs 339.488 af

Total Runoff Area = 831.300 ac Runoff Volume = 339.535 af Average Runoff Depth = 4.90"
100.00% Pervious = 831.300 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 2S: (new Subcat)

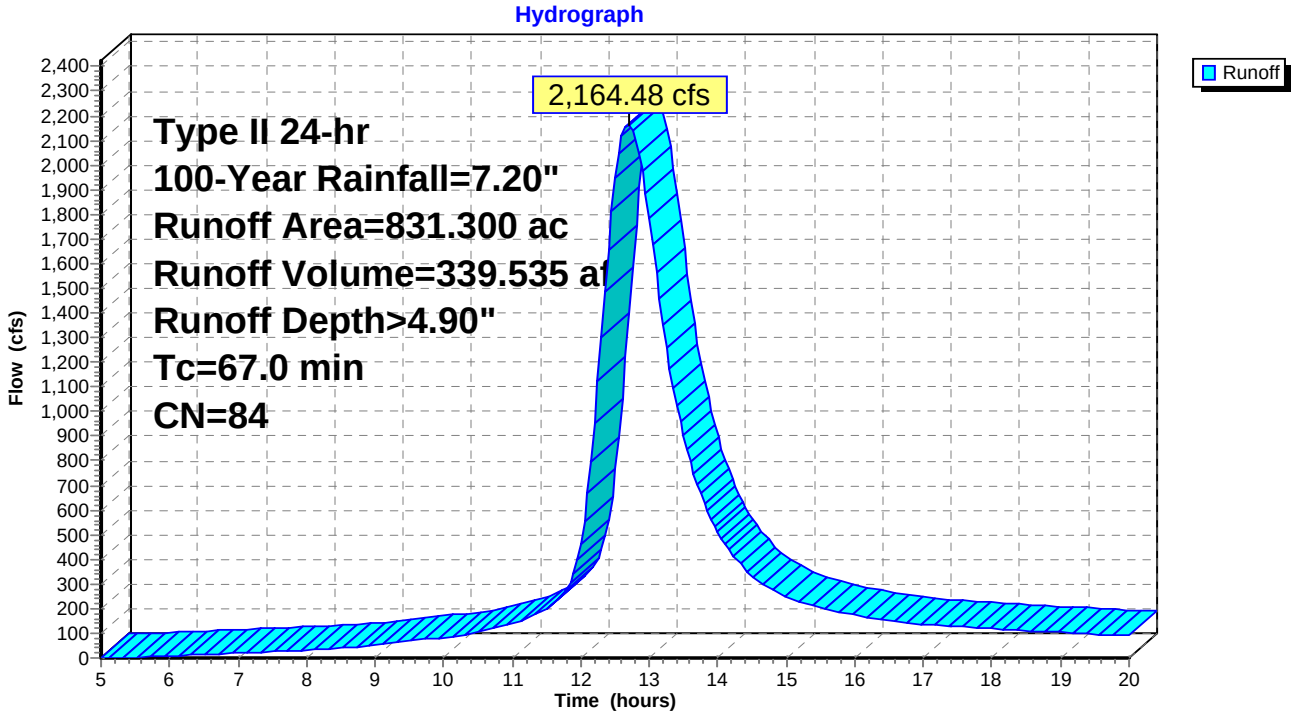
Runoff = 2,164.48 cfs @ 12.70 hrs, Volume= 339.535 af, Depth> 4.90"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-Year Rainfall=7.20"

	Area (ac)	CN	Description
*	831.300	84	from existing report
	831.300		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
67.0					**Direct Entry, This is Guess**

Subcatchment 2S: (new Subcat)



Summary for Pond 1P: Existing Pond

Inflow Area = 831.300 ac, 0.00% Impervious, Inflow Depth > 4.90" for 100-Year event
Inflow = 2,164.48 cfs @ 12.70 hrs, Volume= 339.535 af
Outflow = 2,021.91 cfs @ 12.87 hrs, Volume= 339.488 af, Atten= 7%, Lag= 10.2 min
Primary = 2,021.91 cfs @ 12.87 hrs, Volume= 339.488 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 371.36' @ 12.87 hrs Surf.Area= 145,135 sf Storage= 578,211 cf

Plug-Flow detention time= 3.9 min calculated for 339.487 af (100% of inflow)
Center-of-Mass det. time= 3.8 min (810.6 - 806.8)

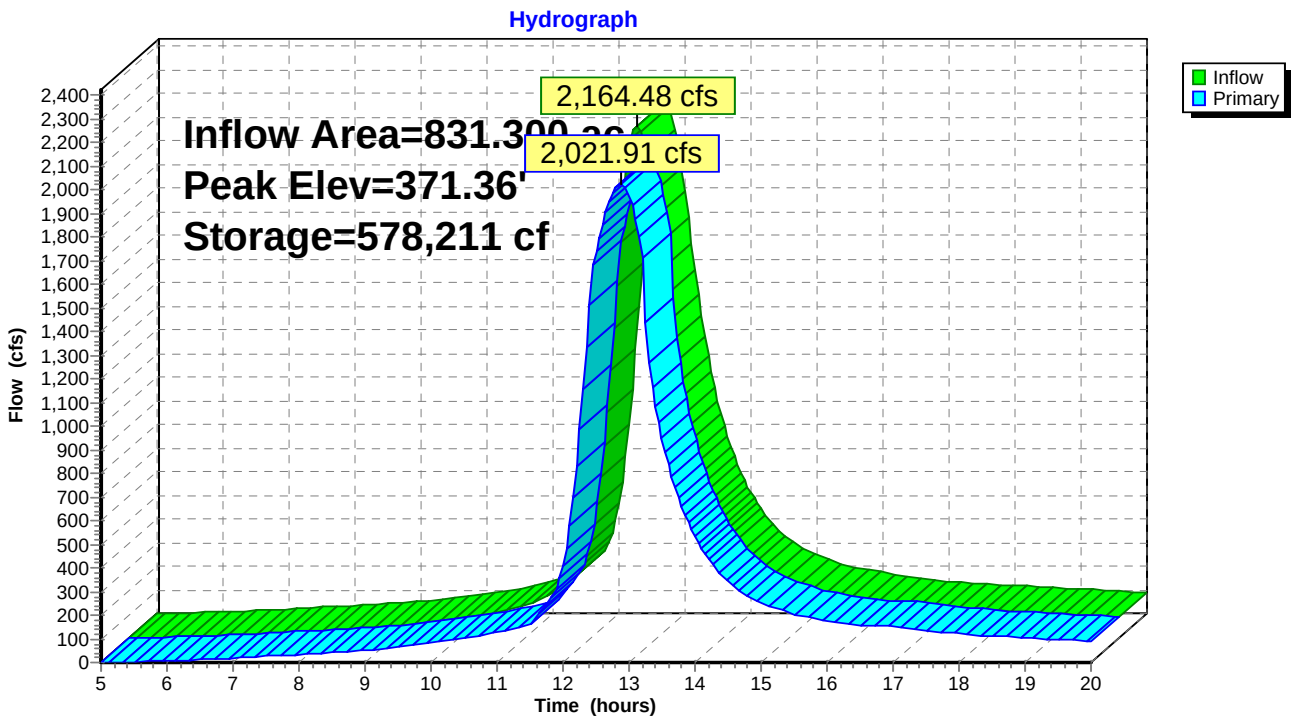
Volume	Invert	Avail.Storage	Storage Description
#1	357.00'	1,704,625 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
357.00	0	0	0
358.00	60	30	30
359.00	329	195	225
360.00	756	543	767
361.00	1,283	1,020	1,787
362.00	4,923	3,103	4,890
363.00	7,383	6,153	11,043
364.00	13,965	10,674	21,717
365.00	21,759	17,862	39,579
366.00	38,951	30,355	69,934
367.00	61,360	50,156	120,089
368.00	84,287	72,824	192,913
369.00	102,814	93,551	286,463
370.00	119,594	111,204	397,667
371.00	138,346	128,970	526,637
372.00	157,003	147,675	674,312
373.00	176,693	166,848	841,160
374.00	196,413	186,553	1,027,713
375.00	216,193	206,303	1,234,016
376.00	234,363	225,278	1,459,294
377.00	256,299	245,331	1,704,625

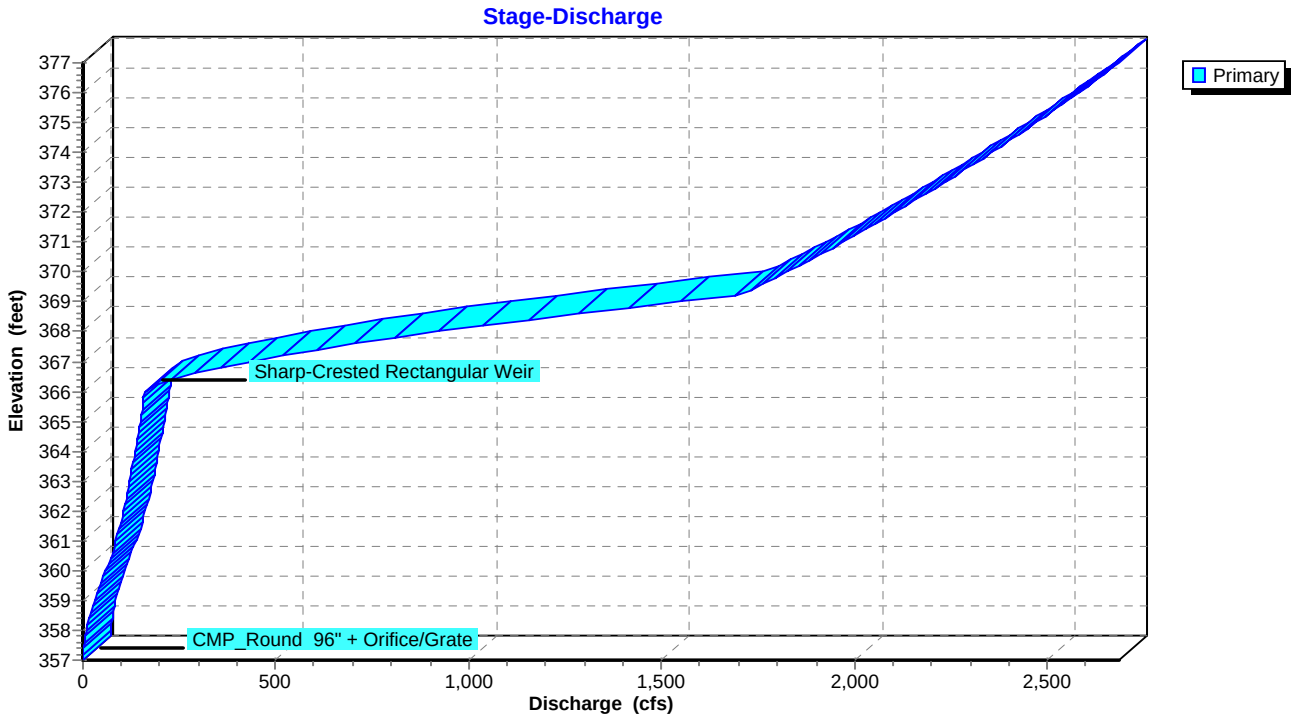
Device	Routing	Invert	Outlet Devices
#1	Primary	357.00'	**96.0" Round CMP_Round 96" X 3.00** L= 170.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 357.00' / 356.00' S= 0.0059 '/' Cc= 0.900 n= 0.024, Flow Area= 50.27 sf
#2	Device 1	357.00'	**48.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	366.00'	**80.0' long Sharp-Crested Rectangular Weir** 0 End Contraction(s)

Primary OutFlow Max=2,020.50 cfs @ 12.87 hrs HW=371.35' (Free Discharge)
└─**1=CMP_Round 96"** (Barrel Controls 2,020.50 cfs @ 13.40 fps)
  ├─**2=Orifice/Grate** (Passes < 212.67 cfs potential flow)
  └─**3=Sharp-Crested Rectangular Weir** (Passes < 3,240.27 cfs potential flow)

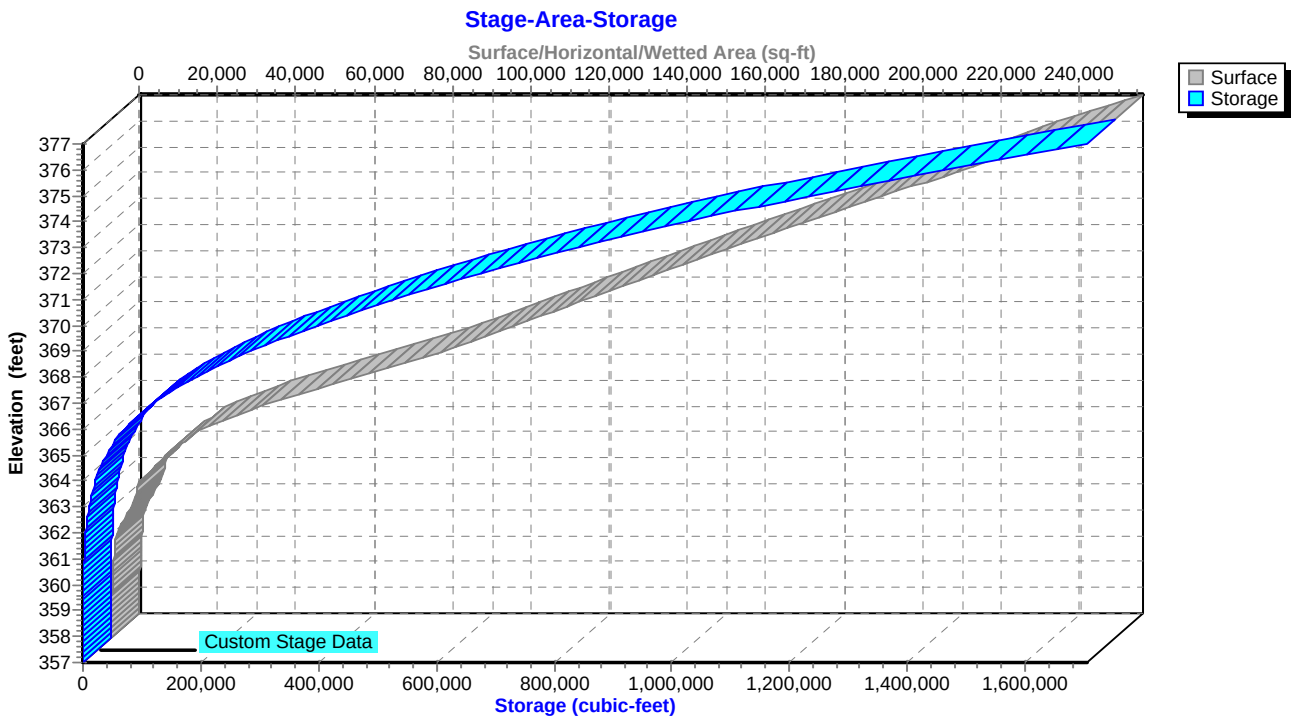
Pond 1P: Existing Pond



Pond 1P: Existing Pond



Pond 1P: Existing Pond



Stage-Discharge for Pond 1P: Existing Pond

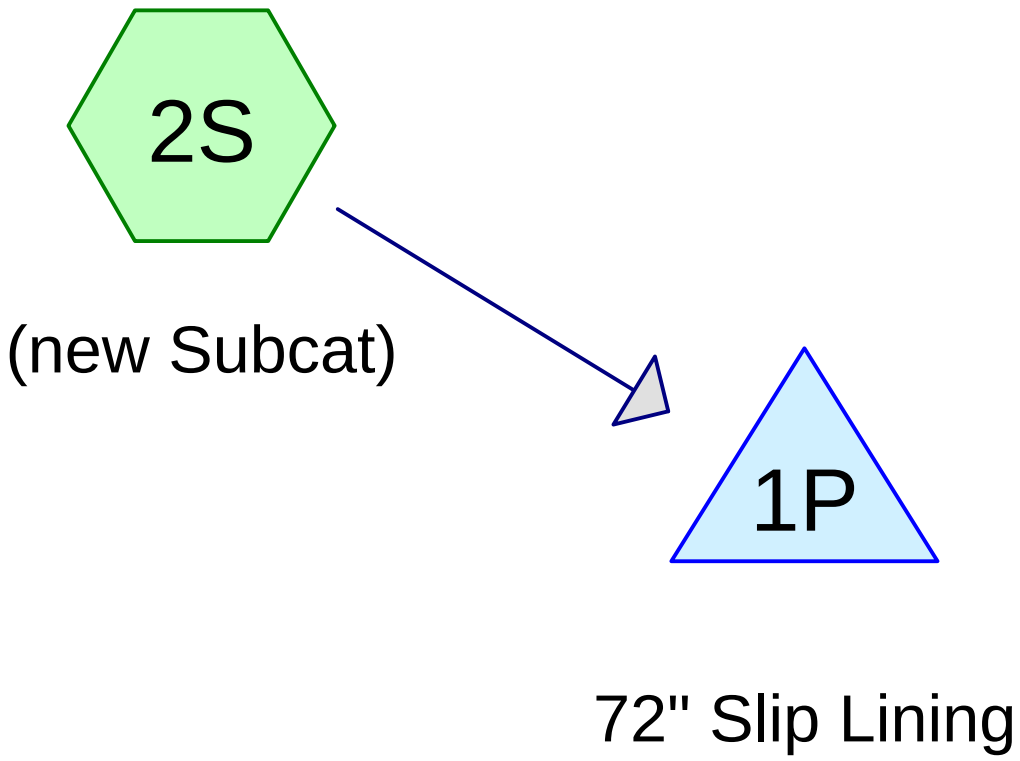
Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)
357.00	0.00	367.60	706.88
357.20	0.36	367.80	811.24
357.40	1.41	368.00	921.44
357.60	3.12	368.20	1,037.16
357.80	5.45	368.40	1,158.16
358.00	8.36	368.60	1,284.20
358.20	11.83	368.80	1,415.09
358.40	15.79	369.00	1,550.65
358.60	20.22	369.20	1,690.73
358.80	25.05	369.40	1,731.45
359.00	30.25	369.60	1,763.23
359.20	35.76	369.80	1,794.44
359.40	41.52	370.00	1,825.11
359.60	47.47	370.20	1,855.28
359.80	53.53	370.40	1,884.97
360.00	59.62	370.60	1,914.19
360.20	65.64	370.80	1,942.98
360.40	71.47	371.00	1,971.35
360.60	76.95	371.20	1,999.31
360.80	81.84	371.40	2,026.89
361.00	85.57	371.60	2,054.10
361.20	89.75	371.80	2,080.95
361.40	93.74	372.00	2,107.46
361.60	97.56	372.20	2,133.64
361.80	101.25	372.40	2,159.50
362.00	104.80	372.60	2,185.06
362.20	108.24	372.80	2,210.32
362.40	111.57	373.00	2,235.30
362.60	114.80	373.20	2,260.00
362.80	117.95	373.40	2,284.43
363.00	121.01	373.60	2,308.61
363.20	124.00	373.80	2,332.53
363.40	126.92	374.00	2,356.21
363.60	129.77	374.20	2,379.66
363.80	132.56	374.40	2,402.87
364.00	135.30	374.60	2,425.87
364.20	137.98	374.80	2,448.65
364.40	140.61	375.00	2,471.21
364.60	143.19	375.20	2,493.58
364.80	145.72	375.40	2,515.74
365.00	148.21	375.60	2,537.72
365.20	150.66	375.80	2,559.50
365.40	153.07	376.00	2,581.10
365.60	155.44	376.20	2,602.52
365.80	157.78	376.40	2,623.76
366.00	160.09	376.60	2,644.84
366.20	185.75	376.80	2,665.75
366.40	230.78	377.00	**2,686.49**
366.60	288.39		
366.80	356.17		
367.00	432.74		
367.20	517.15		
367.40	608.71		

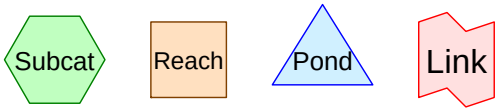
Stage-Area-Storage for Pond 1P: Existing Pond

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
357.00	0	0
357.20	12	1
357.40	24	5
357.60	36	11
357.80	48	19
358.00	60	30
358.20	114	47
358.40	168	76
358.60	221	114
358.80	275	164
359.00	329	225
359.20	414	299
359.40	500	390
359.60	585	499
359.80	671	624
360.00	756	767
360.20	861	929
360.40	967	1,112
360.60	1,072	1,315
360.80	1,178	1,540
361.00	1,283	1,787
361.20	2,011	2,116
361.40	2,739	2,591
361.60	3,467	3,212
361.80	4,195	3,978
362.00	4,923	4,890
362.20	5,415	5,923
362.40	5,907	7,055
362.60	6,399	8,286
362.80	6,891	9,615
363.00	7,383	11,043
363.20	8,699	12,651
363.40	10,016	14,522
363.60	11,332	16,657
363.80	12,649	19,055
364.00	13,965	21,717
364.20	15,524	24,665
364.40	17,083	27,926
364.60	18,641	31,498
364.80	20,200	35,383
365.00	21,759	39,579
365.20	25,197	44,274
365.40	28,636	49,657
365.60	32,074	55,728
365.80	35,513	62,487
366.00	38,951	69,934
366.20	43,433	78,172
366.40	47,915	87,307
366.60	52,396	97,338
366.80	56,878	108,265
367.00	61,360	120,089
367.20	65,945	132,820
367.40	70,531	146,467
367.60	75,116	161,032
367.80	79,702	176,514
368.00	84,287	192,913
368.20	87,992	210,140
368.40	91,698	228,109
368.60	95,403	246,820
368.80	99,109	266,271
369.00	102,814	286,463
369.20	106,170	307,361
369.40	109,526	328,931
369.60	112,882	351,172
369.80	116,238	374,084
370.00	119,594	397,667
370.20	123,344	421,961
370.40	127,095	447,005
370.60	130,845	472,799
370.80	134,596	499,343
371.00	138,346	526,637
371.20	142,077	554,679
371.40	145,809	583,468
371.60	149,540	613,003
371.80	153,272	643,284
372.00	157,003	674,312
372.20	160,941	706,106
372.40	164,879	738,688
372.60	168,817	772,058
372.80	172,755	806,215
373.00	176,693	841,160
373.20	180,637	876,892
373.40	184,581	913,414
373.60	188,525	950,725
373.80	192,469	988,824
374.00	196,413	1,027,713
374.20	200,369	1,067,391
374.40	204,325	1,107,860
374.60	208,281	1,149,121
374.80	212,237	1,191,173
375.00	216,193	1,234,016
375.20	219,827	1,277,617
375.40	223,461	1,321,946
375.60	227,095	1,367,002
375.80	230,729	1,412,784
376.00	234,363	1,459,294
376.20	238,750	1,506,605
376.40	243,137	1,554,794
376.60	247,525	1,603,860
376.80	251,912	1,653,803
377.00	**256,299**	**1,704,625**

RABBITT ROAD CULVERT REPAIR PROJECT

72-inch Slip Lined Riser Alternative





Routing Diagram for 72-Inch Slip Lined Riser Analysis
Prepared by Microsoft, Printed 4/25/2016
HydroCAD® 10.00-15 s/n 05119 © 2015 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
831.300	84	from existing report (2S)
831.300	**84**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
831.300	Other	2S
831.300		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	0.000	0.000	831.300	831.300	from existing report	2S
0.000	**0.000**	**0.000**	**0.000**	**831.300**	**831.300**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	1P	357.00	356.00	170.0	0.0059	0.010	72.0	0.0	0.0

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

Subcatchment 2S: (new Subcat) Runoff Area=831.300 ac 0.00% Impervious Runoff Depth>3.07"
Tc=67.0 min CN=84 Runoff=1,375.72 cfs 212.672 af

Pond 1P: 72" Slip Lining Peak Elev=369.72' Storage=364,938 cf Inflow=1,375.72 cfs 212.672 af
Outflow=1,273.37 cfs 212.654 af

Total Runoff Area = 831.300 ac Runoff Volume = 212.672 af Average Runoff Depth = 3.07"
100.00% Pervious = 831.300 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 2S: (new Subcat)

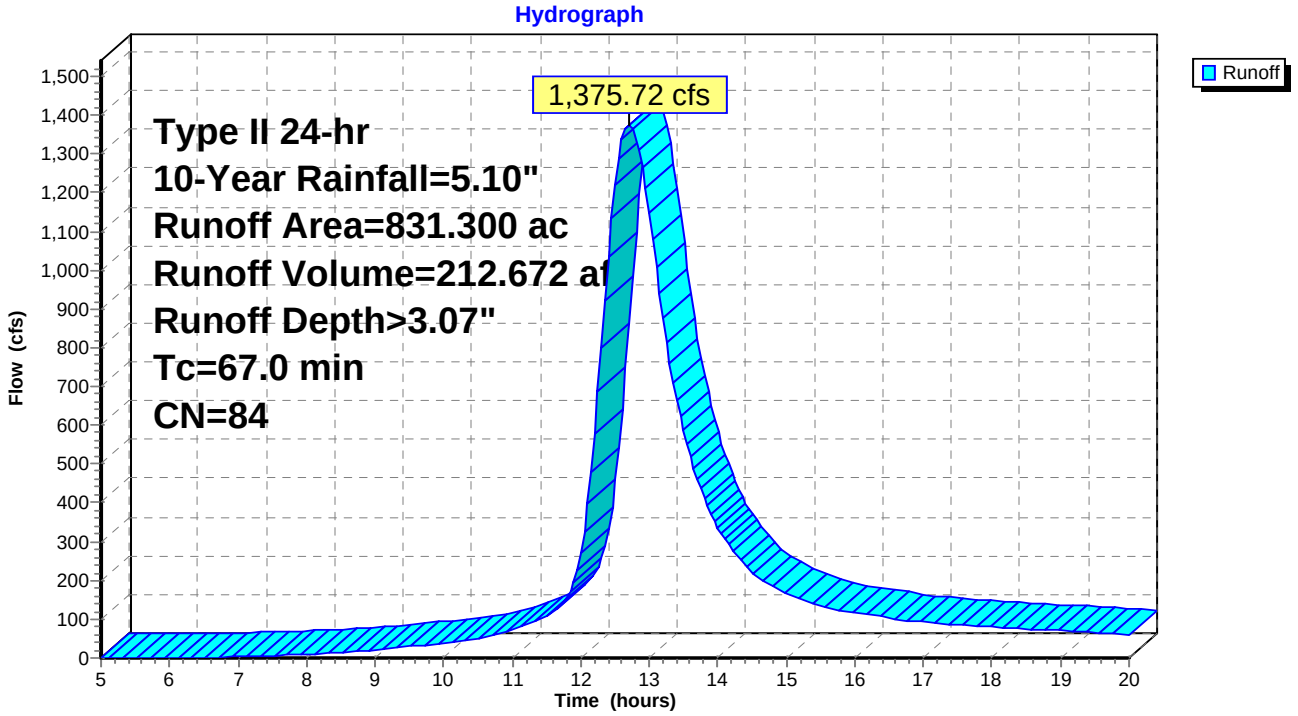
Runoff = 1,375.72 cfs @ 12.71 hrs, Volume= 212.672 af, Depth> 3.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-Year Rainfall=5.10"

	Area (ac)	CN	Description
*	831.300	84	from existing report
	831.300		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
67.0					**Direct Entry, This is Guess**

Subcatchment 2S: (new Subcat)



Summary for Pond 1P: 72" Slip Lining

Inflow Area = 831.300 ac, 0.00% Impervious, Inflow Depth > 3.07" for 10-Year event
Inflow = 1,375.72 cfs @ 12.71 hrs, Volume= 212.672 af
Outflow = 1,273.37 cfs @ 12.89 hrs, Volume= 212.654 af, Atten= 7%, Lag= 10.9 min
Primary = 1,273.37 cfs @ 12.89 hrs, Volume= 212.654 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 369.72' @ 12.89 hrs Surf.Area= 114,910 sf Storage= 364,938 cf

Plug-Flow detention time= 3.7 min calculated for 211.947 af (100% of inflow)
Center-of-Mass det. time= 3.6 min (820.9 - 817.3)

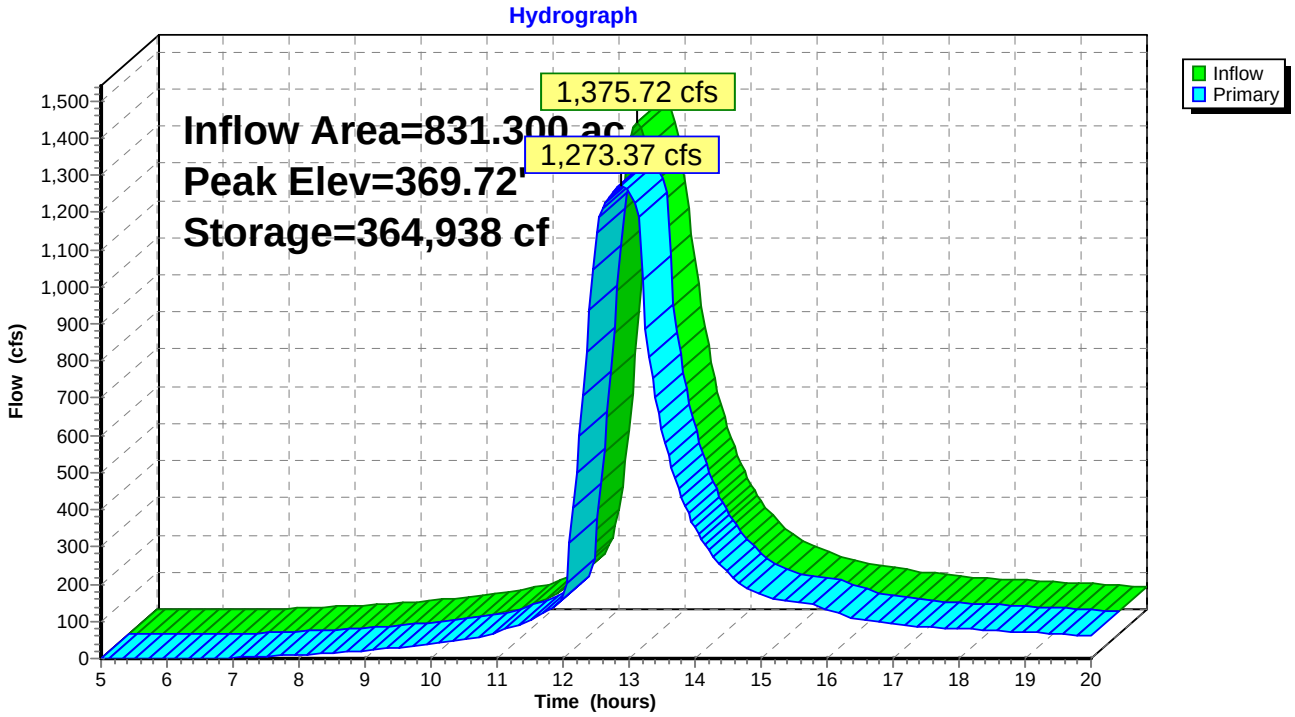
Volume	Invert	Avail.Storage	Storage Description
#1	357.00'	1,704,625 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
357.00	0	0	0
358.00	60	30	30
359.00	329	195	225
360.00	756	543	767
361.00	1,283	1,020	1,787
362.00	4,923	3,103	4,890
363.00	7,383	6,153	11,043
364.00	13,965	10,674	21,717
365.00	21,759	17,862	39,579
366.00	38,951	30,355	69,934
367.00	61,360	50,156	120,089
368.00	84,287	72,824	192,913
369.00	102,814	93,551	286,463
370.00	119,594	111,204	397,667
371.00	138,346	128,970	526,637
372.00	157,003	147,675	674,312
373.00	176,693	166,848	841,160
374.00	196,413	186,553	1,027,713
375.00	216,193	206,303	1,234,016
376.00	234,363	225,278	1,459,294
377.00	256,299	245,331	1,704,625

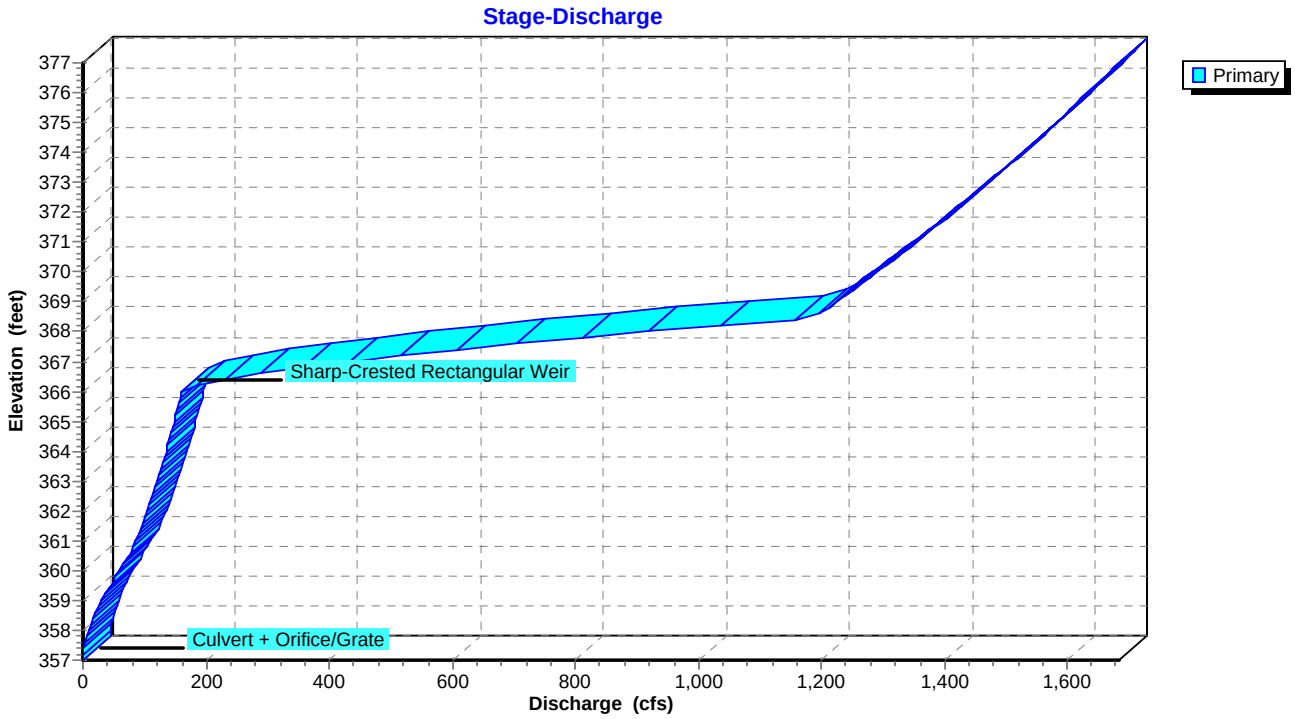
Device	Routing	Invert	Outlet Devices
#1	Primary	357.00'	**72.0" Round Culvert X 3.00** L= 170.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 357.00' / 356.00' S= 0.0059 '/' Cc= 0.900 n= 0.010, Flow Area= 28.27 sf
#2	Device 1	357.00'	**48.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	366.00'	**80.0' long Sharp-Crested Rectangular Weir** 0 End Contraction(s)

Primary OutFlow Max=1,273.02 cfs @ 12.89 hrs HW=369.72' (Free Discharge)
└─**1=Culvert** (Inlet Controls 1,273.02 cfs @ 15.01 fps)
  ├─**2=Orifice/Grate** (Passes < 198.06 cfs potential flow)
  └─**3=Sharp-Crested Rectangular Weir** (Passes < 1,873.36 cfs potential flow)

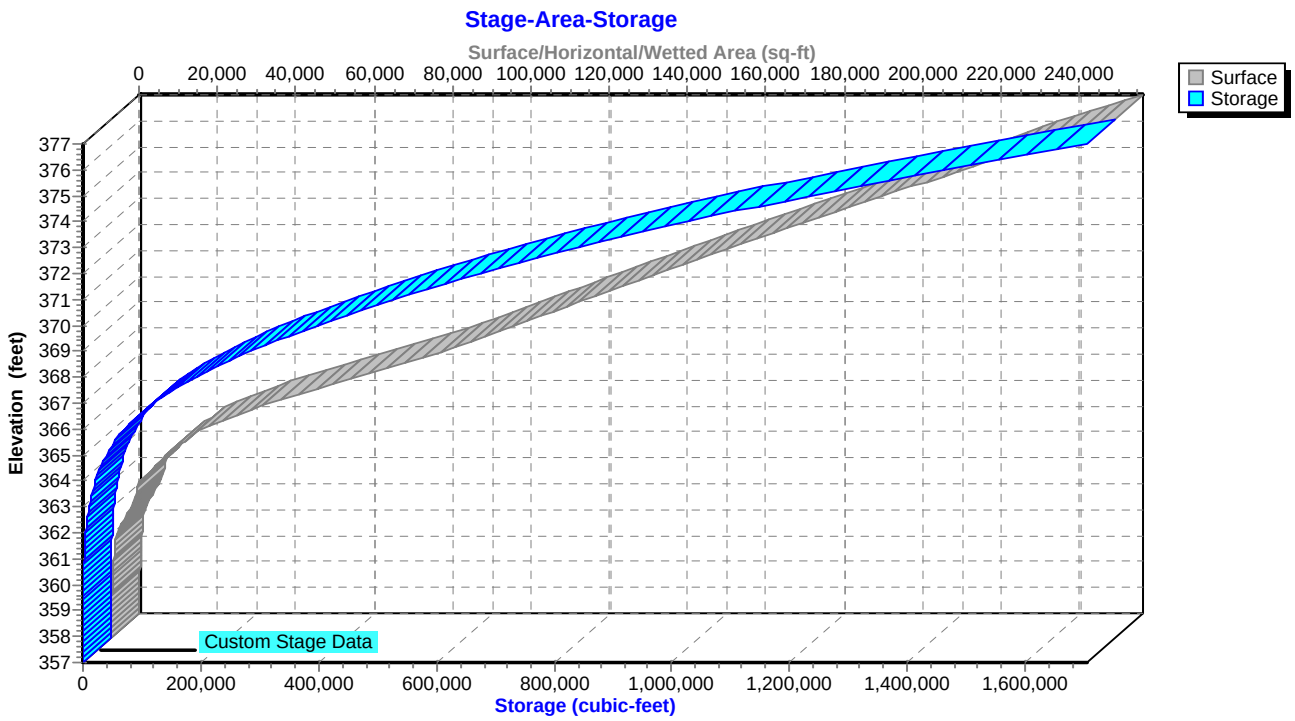
Pond 1P: 72" Slip Lining



Pond 1P: 72" Slip Lining



Pond 1P: 72" Slip Lining



Stage-Discharge for Pond 1P: 72" Slip Lining

Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)
357.00	0.00	367.60	706.88
357.20	0.36	367.80	811.24
357.40	1.41	368.00	921.44
357.60	3.12	368.20	1,037.16
357.80	5.45	368.40	1,158.16
358.00	8.36	368.60	1,197.72
358.20	11.83	368.80	1,211.57
358.40	15.79	369.00	1,225.26
358.60	20.22	369.20	1,238.80
358.80	25.05	369.40	1,252.19
359.00	30.25	369.60	1,265.45
359.20	35.76	369.80	1,278.56
359.40	41.52	370.00	1,291.54
359.60	47.47	370.20	1,304.39
359.80	53.53	370.40	1,317.12
360.00	59.62	370.60	1,329.72
360.20	65.64	370.80	1,342.21
360.40	71.47	371.00	1,354.58
360.60	76.95	371.20	1,366.84
360.80	81.84	371.40	1,378.99
361.00	85.57	371.60	1,391.03
361.20	89.75	371.80	1,402.97
361.40	93.74	372.00	1,414.81
361.60	97.56	372.20	1,426.55
361.80	101.25	372.40	1,438.20
362.00	104.80	372.60	1,449.75
362.20	108.24	372.80	1,461.21
362.40	111.57	373.00	1,472.58
362.60	114.80	373.20	1,483.87
362.80	117.95	373.40	1,495.07
363.00	121.01	373.60	1,506.18
363.20	124.00	373.80	1,517.22
363.40	126.92	374.00	1,528.17
363.60	129.77	374.20	1,539.05
363.80	132.56	374.40	1,549.85
364.00	135.30	374.60	1,560.57
364.20	137.98	374.80	1,571.23
364.40	140.61	375.00	1,581.81
364.60	143.19	375.20	1,592.32
364.80	145.72	375.40	1,602.76
365.00	148.21	375.60	1,613.13
365.20	150.66	375.80	1,623.44
365.40	153.07	376.00	1,633.68
365.60	155.44	376.20	1,643.86
365.80	157.78	376.40	1,653.98
366.00	160.09	376.60	1,664.03
366.20	185.75	376.80	1,674.03
366.40	230.78	377.00	**1,683.96**
366.60	288.39		
366.80	356.17		
367.00	432.74		
367.20	517.15		
367.40	608.71		

Stage-Area-Storage for Pond 1P: 72" Slip Lining

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
357.00	0	0
357.20	12	1
357.40	24	5
357.60	36	11
357.80	48	19
358.00	60	30
358.20	114	47
358.40	168	76
358.60	221	114
358.80	275	164
359.00	329	225
359.20	414	299
359.40	500	390
359.60	585	499
359.80	671	624
360.00	756	767
360.20	861	929
360.40	967	1,112
360.60	1,072	1,315
360.80	1,178	1,540
361.00	1,283	1,787
361.20	2,011	2,116
361.40	2,739	2,591
361.60	3,467	3,212
361.80	4,195	3,978
362.00	4,923	4,890
362.20	5,415	5,923
362.40	5,907	7,055
362.60	6,399	8,286
362.80	6,891	9,615
363.00	7,383	11,043
363.20	8,699	12,651
363.40	10,016	14,522
363.60	11,332	16,657
363.80	12,649	19,055
364.00	13,965	21,717
364.20	15,524	24,665
364.40	17,083	27,926
364.60	18,641	31,498
364.80	20,200	35,383
365.00	21,759	39,579
365.20	25,197	44,274
365.40	28,636	49,657
365.60	32,074	55,728
365.80	35,513	62,487
366.00	38,951	69,934
366.20	43,433	78,172
366.40	47,915	87,307
366.60	52,396	97,338
366.80	56,878	108,265
367.00	61,360	120,089
367.20	65,945	132,820
367.40	70,531	146,467
367.60	75,116	161,032
367.80	79,702	176,514
368.00	84,287	192,913
368.20	87,992	210,140
368.40	91,698	228,109
368.60	95,403	246,820
368.80	99,109	266,271
369.00	102,814	286,463
369.20	106,170	307,361
369.40	109,526	328,931
369.60	112,882	351,172
369.80	116,238	374,084
370.00	119,594	397,667
370.20	123,344	421,961
370.40	127,095	447,005
370.60	130,845	472,799
370.80	134,596	499,343
371.00	138,346	526,637
371.20	142,077	554,679
371.40	145,809	583,468
371.60	149,540	613,003
371.80	153,272	643,284
372.00	157,003	674,312
372.20	160,941	706,106
372.40	164,879	738,688
372.60	168,817	772,058
372.80	172,755	806,215
373.00	176,693	841,160
373.20	180,637	876,892
373.40	184,581	913,414
373.60	188,525	950,725
373.80	192,469	988,824
374.00	196,413	1,027,713
374.20	200,369	1,067,391
374.40	204,325	1,107,860
374.60	208,281	1,149,121
374.80	212,237	1,191,173
375.00	216,193	1,234,016
375.20	219,827	1,277,617
375.40	223,461	1,321,946
375.60	227,095	1,367,002
375.80	230,729	1,412,784
376.00	234,363	1,459,294
376.20	238,750	1,506,605
376.40	243,137	1,554,794
376.60	247,525	1,603,860
376.80	251,912	1,653,803
377.00	**256,299**	**1,704,625**

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

Subcatchment 2S: (new Subcat) Runoff Area=831.300 ac 0.00% Impervious Runoff Depth>4.90"
Tc=67.0 min CN=84 Runoff=2,164.48 cfs 339.535 af

Pond 1P: 72" Slip Lining Peak Elev=376.06' Storage=1,473,130 cf Inflow=2,164.48 cfs 339.535 af
Outflow=1,636.68 cfs 339.488 af

Total Runoff Area = 831.300 ac Runoff Volume = 339.535 af Average Runoff Depth = 4.90"
100.00% Pervious = 831.300 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 2S: (new Subcat)

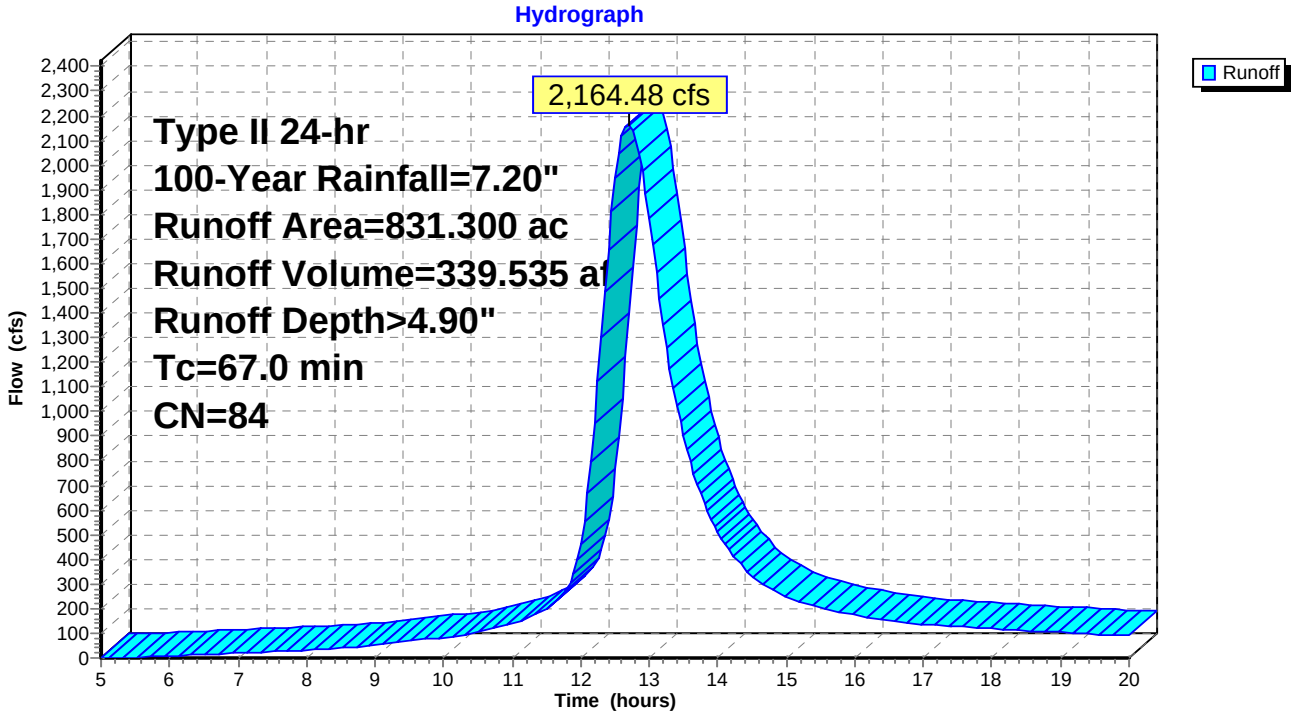
Runoff = 2,164.48 cfs @ 12.70 hrs, Volume= 339.535 af, Depth> 4.90"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-Year Rainfall=7.20"

	Area (ac)	CN	Description
*	831.300	84	from existing report
	831.300		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
67.0					**Direct Entry, This is Guess**

Subcatchment 2S: (new Subcat)



Summary for Pond 1P: 72" Slip Lining

Inflow Area = 831.300 ac, 0.00% Impervious, Inflow Depth > 4.90" for 100-Year event
Inflow = 2,164.48 cfs @ 12.70 hrs, Volume= 339.535 af
Outflow = 1,636.68 cfs @ 13.07 hrs, Volume= 339.488 af, Atten= 24%, Lag= 22.1 min
Primary = 1,636.68 cfs @ 13.07 hrs, Volume= 339.488 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 376.06' @ 13.07 hrs Surf.Area= 235,655 sf Storage= 1,473,130 cf

Plug-Flow detention time= 7.5 min calculated for 339.487 af (100% of inflow)
Center-of-Mass det. time= 7.5 min (814.3 - 806.8)

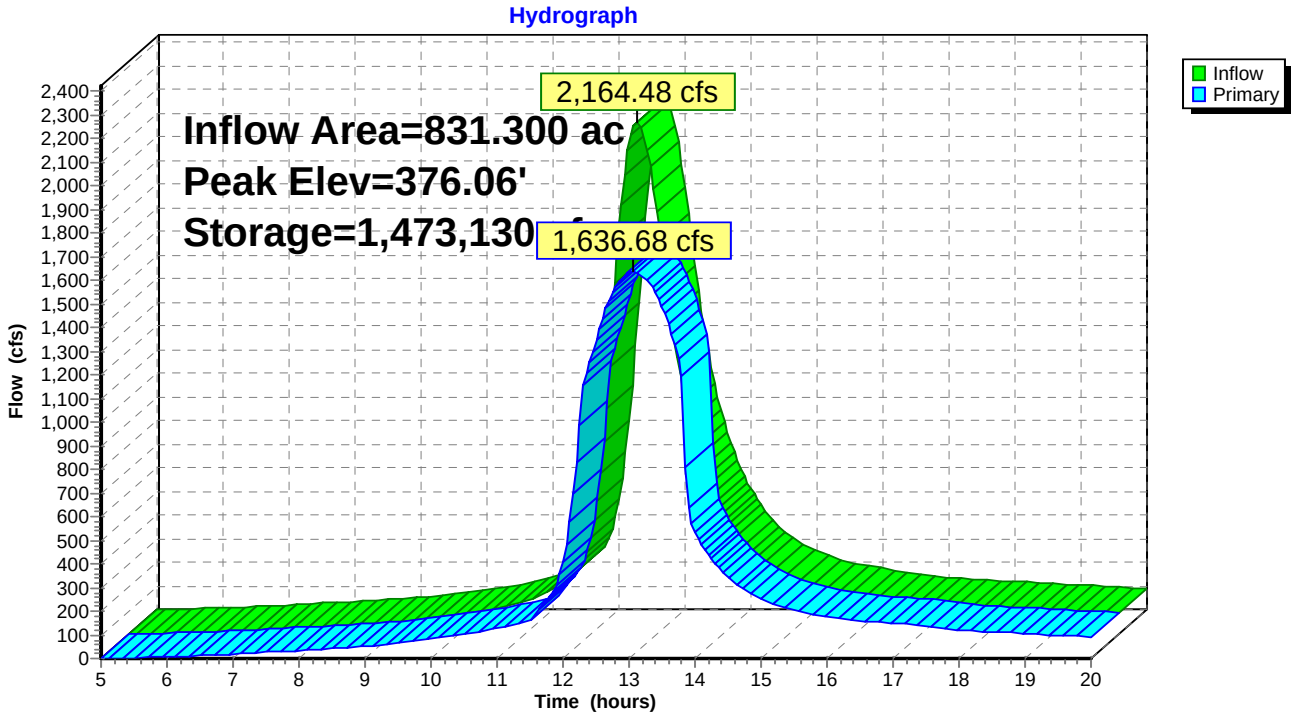
Volume	Invert	Avail.Storage	Storage Description
#1	357.00'	1,704,625 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
357.00	0	0	0
358.00	60	30	30
359.00	329	195	225
360.00	756	543	767
361.00	1,283	1,020	1,787
362.00	4,923	3,103	4,890
363.00	7,383	6,153	11,043
364.00	13,965	10,674	21,717
365.00	21,759	17,862	39,579
366.00	38,951	30,355	69,934
367.00	61,360	50,156	120,089
368.00	84,287	72,824	192,913
369.00	102,814	93,551	286,463
370.00	119,594	111,204	397,667
371.00	138,346	128,970	526,637
372.00	157,003	147,675	674,312
373.00	176,693	166,848	841,160
374.00	196,413	186,553	1,027,713
375.00	216,193	206,303	1,234,016
376.00	234,363	225,278	1,459,294
377.00	256,299	245,331	1,704,625

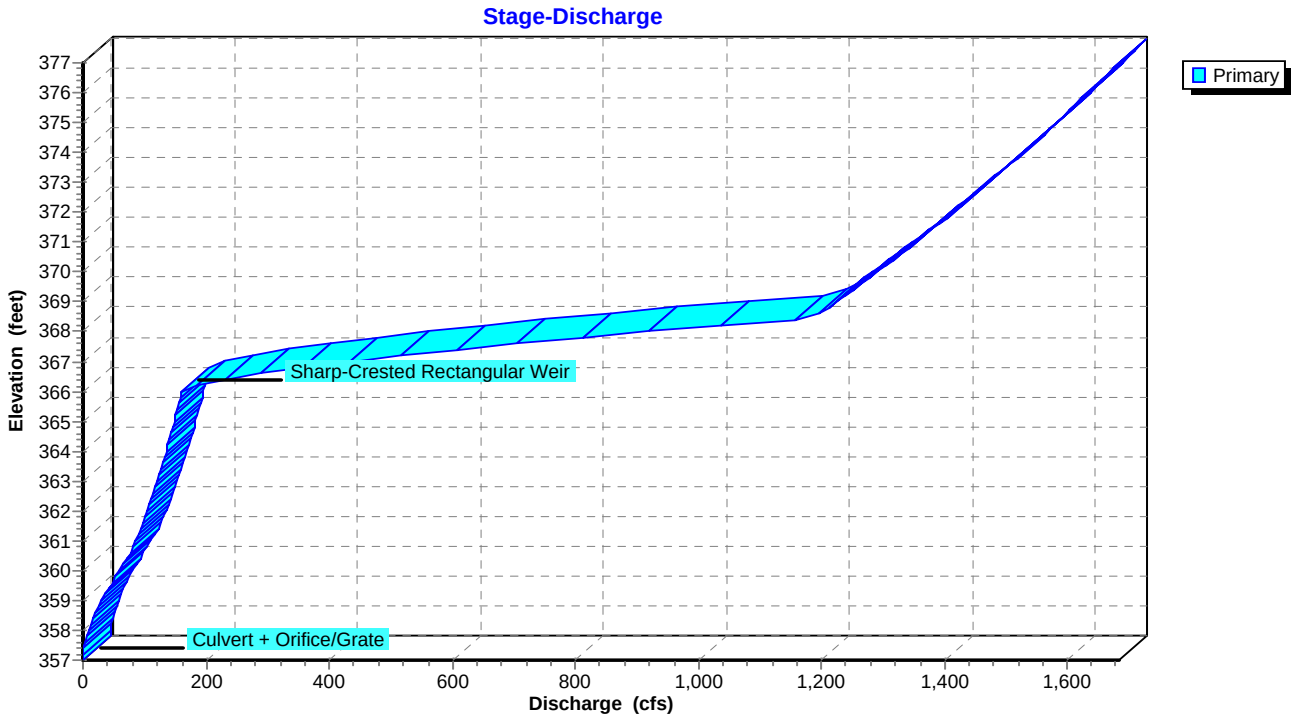
Device	Routing	Invert	Outlet Devices
#1	Primary	357.00'	**72.0" Round Culvert X 3.00** L= 170.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 357.00' / 356.00' S= 0.0059 '/' Cc= 0.900 n= 0.010, Flow Area= 28.27 sf
#2	Device 1	357.00'	**48.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	366.00'	**80.0' long Sharp-Crested Rectangular Weir** 0 End Contraction(s)

Primary OutFlow Max=1,636.17 cfs @ 13.07 hrs HW=376.05' (Free Discharge)
└─**1=Culvert** (Inlet Controls 1,636.17 cfs @ 19.29 fps)
  ├─**2=Orifice/Grate** (Passes < 249.83 cfs potential flow)
  └─**3=Sharp-Crested Rectangular Weir** (Passes < 8,333.11 cfs potential flow)

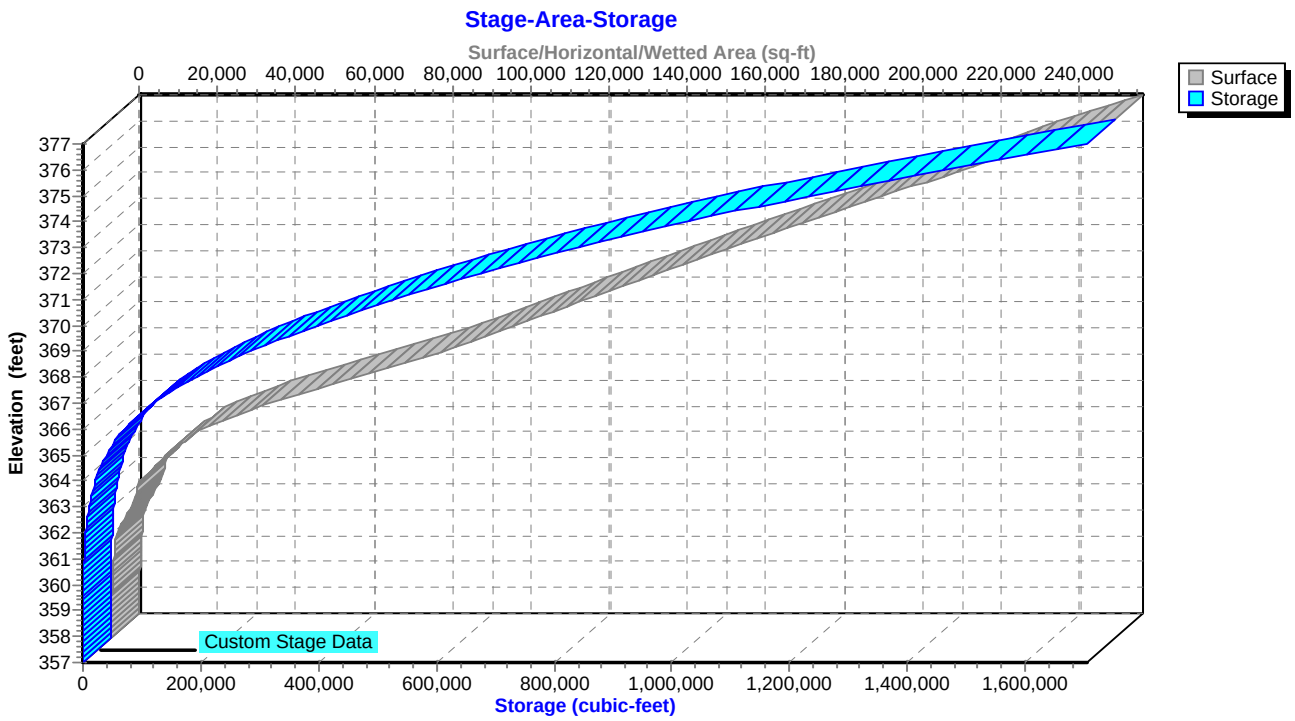
Pond 1P: 72" Slip Lining



Pond 1P: 72" Slip Lining



Pond 1P: 72" Slip Lining



Stage-Discharge for Pond 1P: 72" Slip Lining

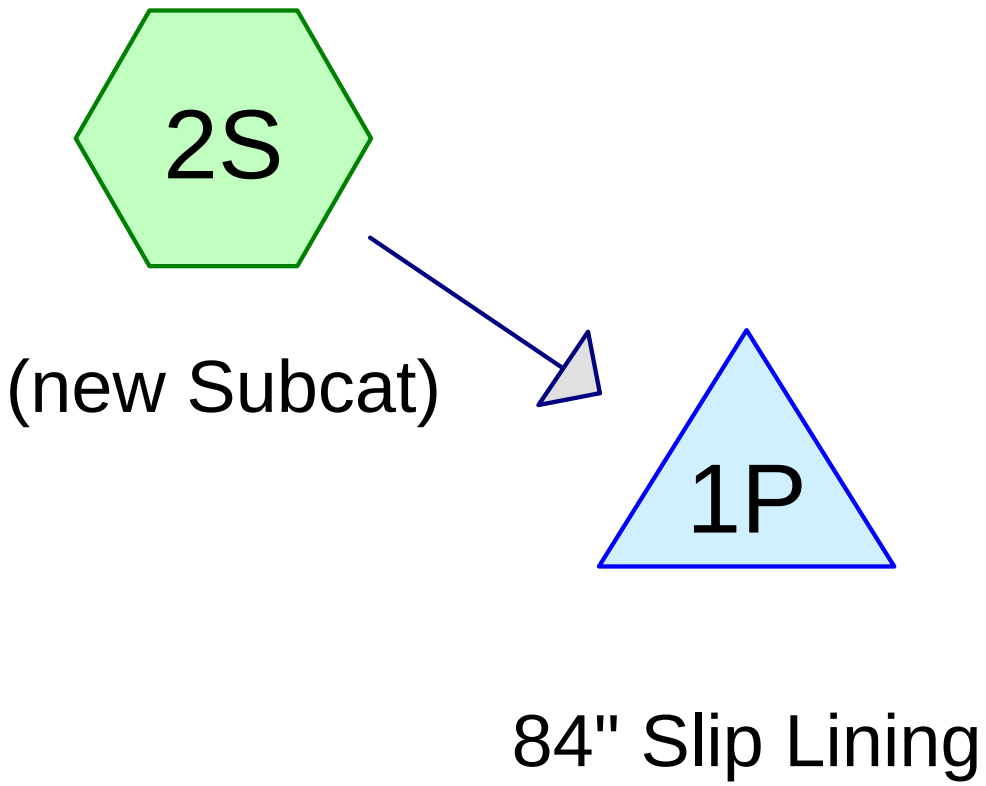
Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)
357.00	0.00	367.60	706.88
357.20	0.36	367.80	811.24
357.40	1.41	368.00	921.44
357.60	3.12	368.20	1,037.16
357.80	5.45	368.40	1,158.16
358.00	8.36	368.60	1,197.72
358.20	11.83	368.80	1,211.57
358.40	15.79	369.00	1,225.26
358.60	20.22	369.20	1,238.80
358.80	25.05	369.40	1,252.19
359.00	30.25	369.60	1,265.45
359.20	35.76	369.80	1,278.56
359.40	41.52	370.00	1,291.54
359.60	47.47	370.20	1,304.39
359.80	53.53	370.40	1,317.12
360.00	59.62	370.60	1,329.72
360.20	65.64	370.80	1,342.21
360.40	71.47	371.00	1,354.58
360.60	76.95	371.20	1,366.84
360.80	81.84	371.40	1,378.99
361.00	85.57	371.60	1,391.03
361.20	89.75	371.80	1,402.97
361.40	93.74	372.00	1,414.81
361.60	97.56	372.20	1,426.55
361.80	101.25	372.40	1,438.20
362.00	104.80	372.60	1,449.75
362.20	108.24	372.80	1,461.21
362.40	111.57	373.00	1,472.58
362.60	114.80	373.20	1,483.87
362.80	117.95	373.40	1,495.07
363.00	121.01	373.60	1,506.18
363.20	124.00	373.80	1,517.22
363.40	126.92	374.00	1,528.17
363.60	129.77	374.20	1,539.05
363.80	132.56	374.40	1,549.85
364.00	135.30	374.60	1,560.57
364.20	137.98	374.80	1,571.23
364.40	140.61	375.00	1,581.81
364.60	143.19	375.20	1,592.32
364.80	145.72	375.40	1,602.76
365.00	148.21	375.60	1,613.13
365.20	150.66	375.80	1,623.44
365.40	153.07	376.00	1,633.68
365.60	155.44	376.20	1,643.86
365.80	157.78	376.40	1,653.98
366.00	160.09	376.60	1,664.03
366.20	185.75	376.80	1,674.03
366.40	230.78	377.00	**1,683.96**
366.60	288.39		
366.80	356.17		
367.00	432.74		
367.20	517.15		
367.40	608.71		

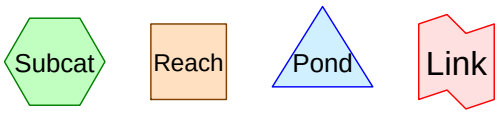
Stage-Area-Storage for Pond 1P: 72" Slip Lining

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
357.00	0	0
357.20	12	1
357.40	24	5
357.60	36	11
357.80	48	19
358.00	60	30
358.20	114	47
358.40	168	76
358.60	221	114
358.80	275	164
359.00	329	225
359.20	414	299
359.40	500	390
359.60	585	499
359.80	671	624
360.00	756	767
360.20	861	929
360.40	967	1,112
360.60	1,072	1,315
360.80	1,178	1,540
361.00	1,283	1,787
361.20	2,011	2,116
361.40	2,739	2,591
361.60	3,467	3,212
361.80	4,195	3,978
362.00	4,923	4,890
362.20	5,415	5,923
362.40	5,907	7,055
362.60	6,399	8,286
362.80	6,891	9,615
363.00	7,383	11,043
363.20	8,699	12,651
363.40	10,016	14,522
363.60	11,332	16,657
363.80	12,649	19,055
364.00	13,965	21,717
364.20	15,524	24,665
364.40	17,083	27,926
364.60	18,641	31,498
364.80	20,200	35,383
365.00	21,759	39,579
365.20	25,197	44,274
365.40	28,636	49,657
365.60	32,074	55,728
365.80	35,513	62,487
366.00	38,951	69,934
366.20	43,433	78,172
366.40	47,915	87,307
366.60	52,396	97,338
366.80	56,878	108,265
367.00	61,360	120,089
367.20	65,945	132,820
367.40	70,531	146,467
367.60	75,116	161,032
367.80	79,702	176,514
368.00	84,287	192,913
368.20	87,992	210,140
368.40	91,698	228,109
368.60	95,403	246,820
368.80	99,109	266,271
369.00	102,814	286,463
369.20	106,170	307,361
369.40	109,526	328,931
369.60	112,882	351,172
369.80	116,238	374,084
370.00	119,594	397,667
370.20	123,344	421,961
370.40	127,095	447,005
370.60	130,845	472,799
370.80	134,596	499,343
371.00	138,346	526,637
371.20	142,077	554,679
371.40	145,809	583,468
371.60	149,540	613,003
371.80	153,272	643,284
372.00	157,003	674,312
372.20	160,941	706,106
372.40	164,879	738,688
372.60	168,817	772,058
372.80	172,755	806,215
373.00	176,693	841,160
373.20	180,637	876,892
373.40	184,581	913,414
373.60	188,525	950,725
373.80	192,469	988,824
374.00	196,413	1,027,713
374.20	200,369	1,067,391
374.40	204,325	1,107,860
374.60	208,281	1,149,121
374.80	212,237	1,191,173
375.00	216,193	1,234,016
375.20	219,827	1,277,617
375.40	223,461	1,321,946
375.60	227,095	1,367,002
375.80	230,729	1,412,784
376.00	234,363	1,459,294
376.20	238,750	1,506,605
376.40	243,137	1,554,794
376.60	247,525	1,603,860
376.80	251,912	1,653,803
377.00	**256,299**	**1,704,625**

RABBITT ROAD CULVERT
REPAIR PROJECT

84-inch Slip Lined
Riser Alternative





Routing Diagram for Slip Lined Riser Analysis
Prepared by Microsoft, Printed 4/25/2016
HydroCAD® 10.00-15 s/n 05119 © 2015 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
831.300	84	from existing report (2S)
831.300	**84**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
831.300	Other	2S
831.300		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	0.000	0.000	831.300	831.300	from existing report	2S
0.000	**0.000**	**0.000**	**0.000**	**831.300**	**831.300**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	1P	357.00	356.00	170.0	0.0059	0.012	84.0	0.0	0.0

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

Subcatchment 2S: (new Subcat) Runoff Area=831.300 ac 0.00% Impervious Runoff Depth>3.07"
Tc=67.0 min CN=84 Runoff=1,375.72 cfs 212.672 af

Pond 1P: 84" Slip Lining Peak Elev=368.73' Storage=259,494 cf Inflow=1,375.72 cfs 212.672 af
Outflow=1,370.05 cfs 212.654 af

Total Runoff Area = 831.300 ac Runoff Volume = 212.672 af Average Runoff Depth = 3.07"
100.00% Pervious = 831.300 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 2S: (new Subcat)

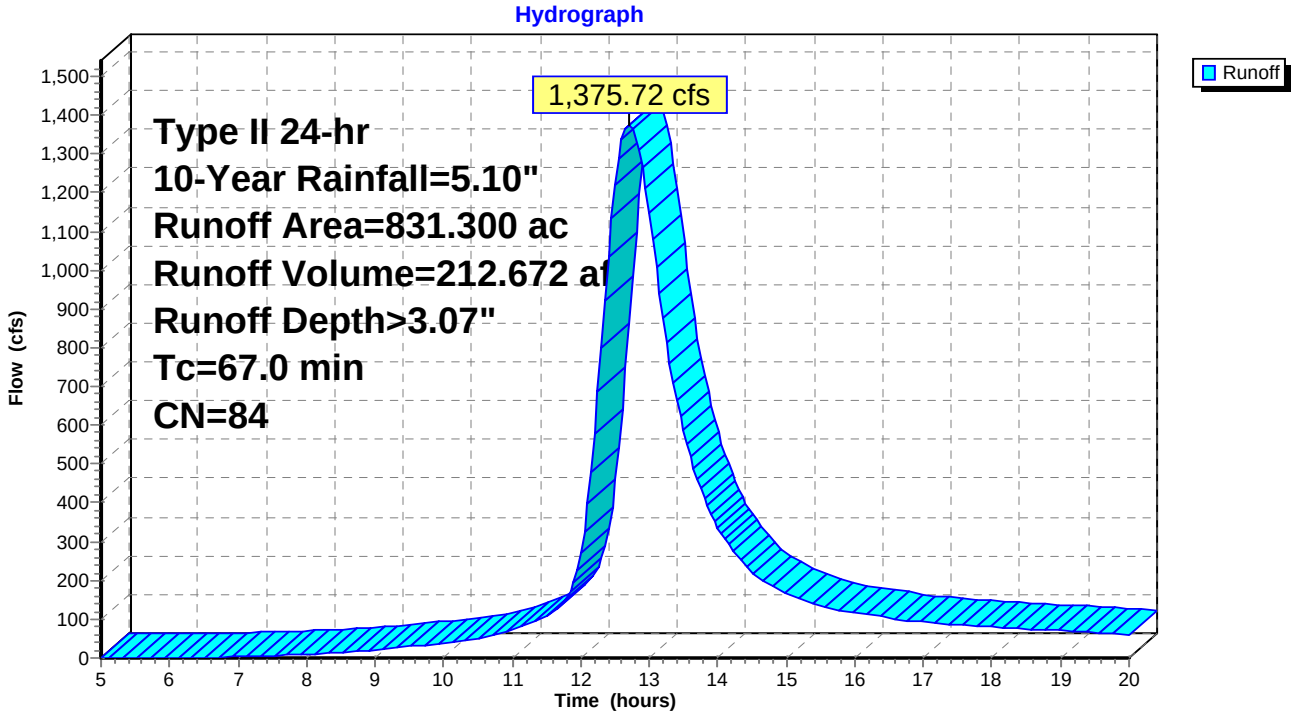
Runoff = 1,375.72 cfs @ 12.71 hrs, Volume= 212.672 af, Depth> 3.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-Year Rainfall=5.10"

	Area (ac)	CN	Description
*	831.300	84	from existing report
	831.300		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
67.0					**Direct Entry, This is Guess**

Subcatchment 2S: (new Subcat)



Summary for Pond 1P: 84" Slip Lining

Inflow Area = 831.300 ac, 0.00% Impervious, Inflow Depth > 3.07" for 10-Year event
Inflow = 1,375.72 cfs @ 12.71 hrs, Volume= 212.672 af
Outflow = 1,370.05 cfs @ 12.75 hrs, Volume= 212.654 af, Atten= 0%, Lag= 2.4 min
Primary = 1,370.05 cfs @ 12.75 hrs, Volume= 212.654 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 368.73' @ 12.75 hrs Surf.Area= 97,834 sf Storage= 259,494 cf

Plug-Flow detention time= 3.3 min calculated for 211.947 af (100% of inflow)
Center-of-Mass det. time= 3.3 min (820.6 - 817.3)

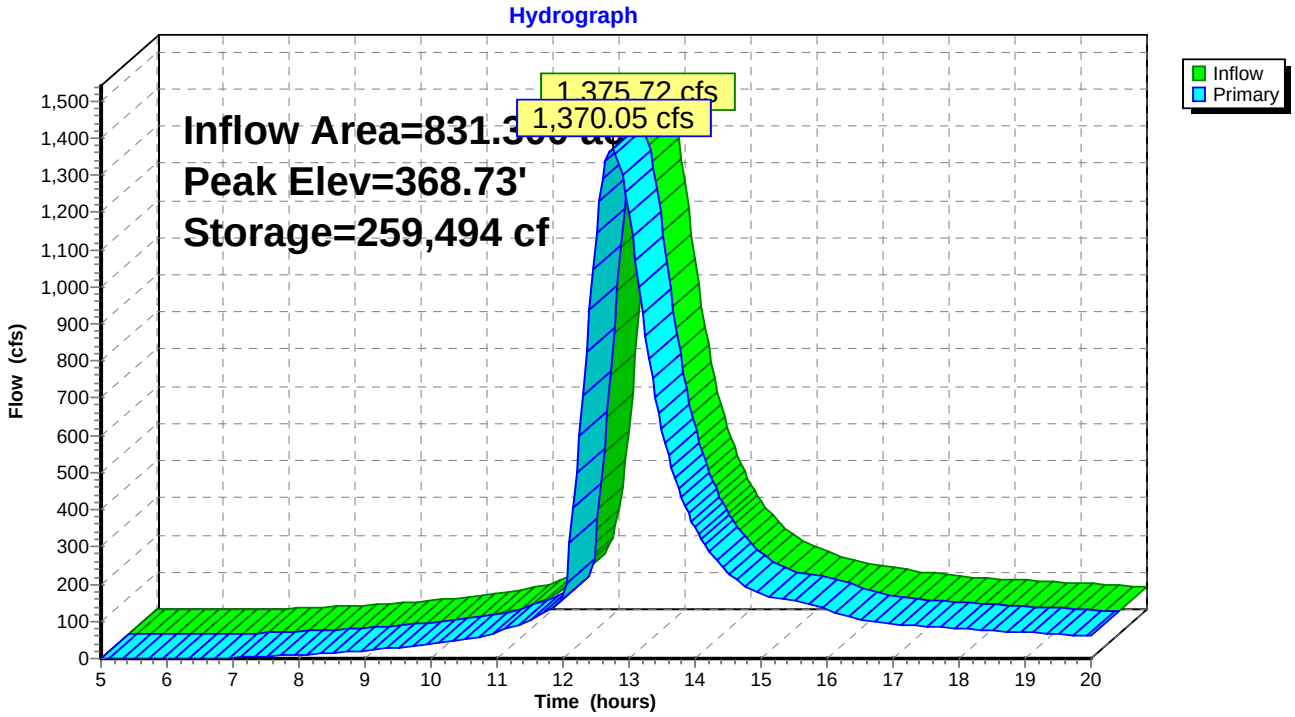
Volume	Invert	Avail.Storage	Storage Description
#1	357.00'	1,704,625 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
357.00	0	0	0
358.00	60	30	30
359.00	329	195	225
360.00	756	543	767
361.00	1,283	1,020	1,787
362.00	4,923	3,103	4,890
363.00	7,383	6,153	11,043
364.00	13,965	10,674	21,717
365.00	21,759	17,862	39,579
366.00	38,951	30,355	69,934
367.00	61,360	50,156	120,089
368.00	84,287	72,824	192,913
369.00	102,814	93,551	286,463
370.00	119,594	111,204	397,667
371.00	138,346	128,970	526,637
372.00	157,003	147,675	674,312
373.00	176,693	166,848	841,160
374.00	196,413	186,553	1,027,713
375.00	216,193	206,303	1,234,016
376.00	234,363	225,278	1,459,294
377.00	256,299	245,331	1,704,625

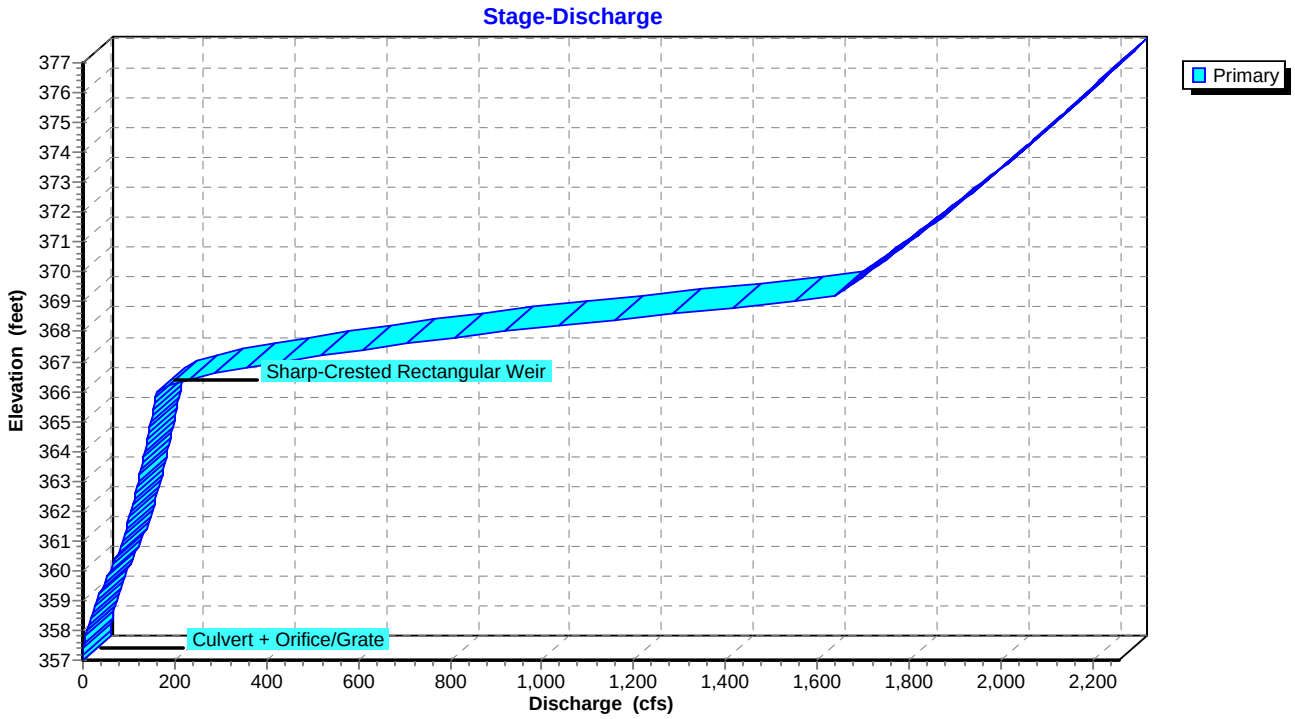
Device	Routing	Invert	Outlet Devices
#1	Primary	357.00'	**84.0" Round Culvert X 3.00** L= 170.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 357.00' / 356.00' S= 0.0059 '/' Cc= 0.900 n= 0.012, Flow Area= 38.48 sf
#2	Device 1	357.00'	**48.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	366.00'	**80.0' long Sharp-Crested Rectangular Weir** 0 End Contraction(s)

Primary OutFlow Max=1,369.24 cfs @ 12.75 hrs HW=368.73' (Free Discharge)
└─**1=Culvert** (Passes 1,369.24 cfs of 1,594.86 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 188.75 cfs @ 15.02 fps)
  └─**3=Sharp-Crested Rectangular Weir** (Weir Controls 1,180.49 cfs @ 5.40 fps)

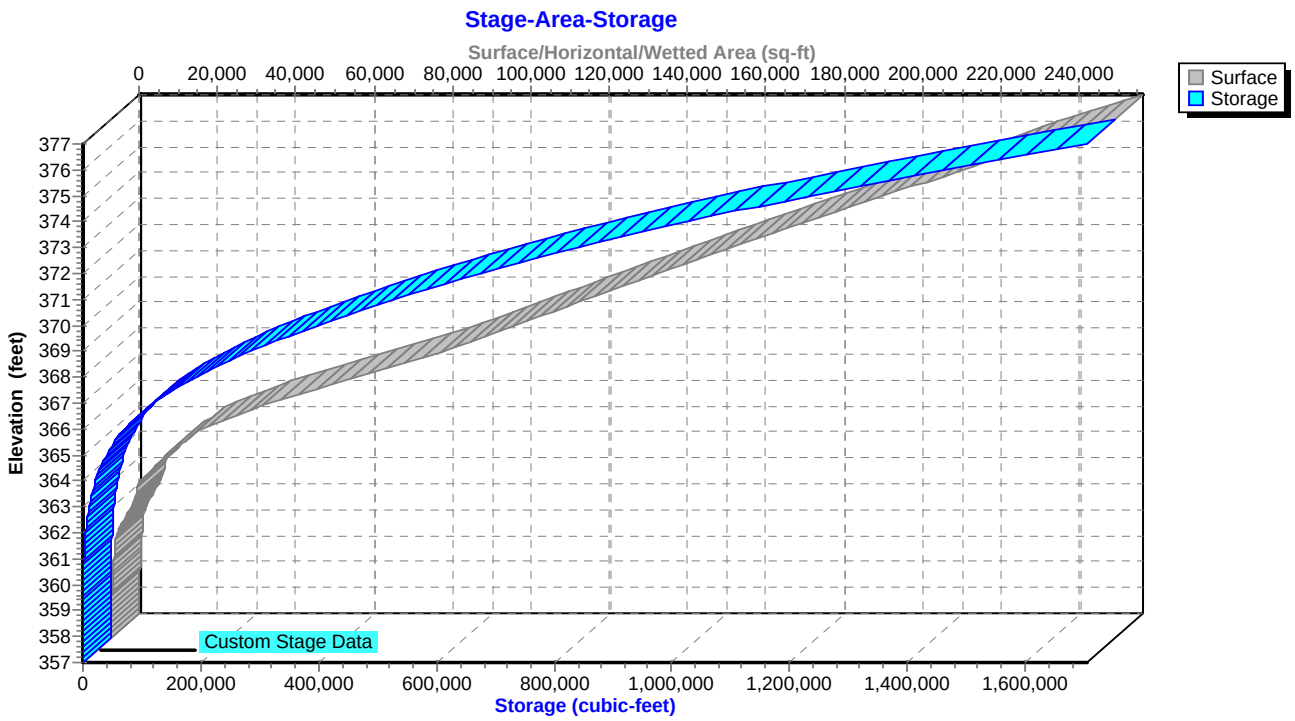
Pond 1P: 84" Slip Lining



Pond 1P: 84" Slip Lining



Pond 1P: 84" Slip Lining



Stage-Discharge for Pond 1P: 84" Slip Lining

Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)
357.00	0.00	367.60	706.88
357.20	0.36	367.80	811.24
357.40	1.41	368.00	921.44
357.60	3.12	368.20	1,037.16
357.80	5.45	368.40	1,158.16
358.00	8.36	368.60	1,284.20
358.20	11.83	368.80	1,415.09
358.40	15.79	369.00	1,550.65
358.60	20.22	369.20	1,639.69
358.80	25.05	369.40	1,658.43
359.00	30.25	369.60	1,676.96
359.20	35.76	369.80	1,695.29
359.40	41.52	370.00	1,713.42
359.60	47.47	370.20	1,731.36
359.80	53.53	370.40	1,749.12
360.00	59.62	370.60	1,766.70
360.20	65.64	370.80	1,784.10
360.40	71.47	371.00	1,801.34
360.60	76.95	371.20	1,818.42
360.80	81.84	371.40	1,835.33
361.00	85.57	371.60	1,852.09
361.20	89.75	371.80	1,868.70
361.40	93.74	372.00	1,885.17
361.60	97.56	372.20	1,901.49
361.80	101.25	372.40	1,917.67
362.00	104.80	372.60	1,933.72
362.20	108.24	372.80	1,949.64
362.40	111.57	373.00	1,965.42
362.60	114.80	373.20	1,981.09
362.80	117.95	373.40	1,996.62
363.00	121.01	373.60	2,012.04
363.20	124.00	373.80	2,027.34
363.40	126.92	374.00	2,042.53
363.60	129.77	374.20	2,057.60
363.80	132.56	374.40	2,072.57
364.00	135.30	374.60	2,087.43
364.20	137.98	374.80	2,102.18
364.40	140.61	375.00	2,116.83
364.60	143.19	375.20	2,131.38
364.80	145.72	375.40	2,145.83
365.00	148.21	375.60	2,160.18
365.20	150.66	375.80	2,174.44
365.40	153.07	376.00	2,188.60
365.60	155.44	376.20	2,202.68
365.80	157.78	376.40	2,216.66
366.00	160.09	376.60	2,230.56
366.20	185.75	376.80	2,244.37
366.40	230.78	377.00	**2,258.10**
366.60	288.39		
366.80	356.17		
367.00	432.74		
367.20	517.15		
367.40	608.71		

Stage-Area-Storage for Pond 1P: 84" Slip Lining

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
357.00	0	0
357.20	12	1
357.40	24	5
357.60	36	11
357.80	48	19
358.00	60	30
358.20	114	47
358.40	168	76
358.60	221	114
358.80	275	164
359.00	329	225
359.20	414	299
359.40	500	390
359.60	585	499
359.80	671	624
360.00	756	767
360.20	861	929
360.40	967	1,112
360.60	1,072	1,315
360.80	1,178	1,540
361.00	1,283	1,787
361.20	2,011	2,116
361.40	2,739	2,591
361.60	3,467	3,212
361.80	4,195	3,978
362.00	4,923	4,890
362.20	5,415	5,923
362.40	5,907	7,055
362.60	6,399	8,286
362.80	6,891	9,615
363.00	7,383	11,043
363.20	8,699	12,651
363.40	10,016	14,522
363.60	11,332	16,657
363.80	12,649	19,055
364.00	13,965	21,717
364.20	15,524	24,665
364.40	17,083	27,926
364.60	18,641	31,498
364.80	20,200	35,383
365.00	21,759	39,579
365.20	25,197	44,274
365.40	28,636	49,657
365.60	32,074	55,728
365.80	35,513	62,487
366.00	38,951	69,934
366.20	43,433	78,172
366.40	47,915	87,307
366.60	52,396	97,338
366.80	56,878	108,265
367.00	61,360	120,089
367.20	65,945	132,820
367.40	70,531	146,467
367.60	75,116	161,032
367.80	79,702	176,514
368.00	84,287	192,913
368.20	87,992	210,140
368.40	91,698	228,109
368.60	95,403	246,820
368.80	99,109	266,271
369.00	102,814	286,463
369.20	106,170	307,361
369.40	109,526	328,931
369.60	112,882	351,172
369.80	116,238	374,084
370.00	119,594	397,667
370.20	123,344	421,961
370.40	127,095	447,005
370.60	130,845	472,799
370.80	134,596	499,343
371.00	138,346	526,637
371.20	142,077	554,679
371.40	145,809	583,468
371.60	149,540	613,003
371.80	153,272	643,284
372.00	157,003	674,312
372.20	160,941	706,106
372.40	164,879	738,688
372.60	168,817	772,058
372.80	172,755	806,215
373.00	176,693	841,160
373.20	180,637	876,892
373.40	184,581	913,414
373.60	188,525	950,725
373.80	192,469	988,824
374.00	196,413	1,027,713
374.20	200,369	1,067,391
374.40	204,325	1,107,860
374.60	208,281	1,149,121
374.80	212,237	1,191,173
375.00	216,193	1,234,016
375.20	219,827	1,277,617
375.40	223,461	1,321,946
375.60	227,095	1,367,002
375.80	230,729	1,412,784
376.00	234,363	1,459,294
376.20	238,750	1,506,605
376.40	243,137	1,554,794
376.60	247,525	1,603,860
376.80	251,912	1,653,803
377.00	**256,299**	**1,704,625**

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

Subcatchment 2S: (new Subcat) Runoff Area=831.300 ac 0.00% Impervious Runoff Depth>4.90"
Tc=67.0 min CN=84 Runoff=2,164.48 cfs 339.535 af

Pond 1P: 84" Slip Lining Peak Elev=372.42' Storage=741,641 cf Inflow=2,164.48 cfs 339.535 af
Outflow=1,919.12 cfs 339.488 af

Total Runoff Area = 831.300 ac Runoff Volume = 339.535 af Average Runoff Depth = 4.90"
100.00% Pervious = 831.300 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 2S: (new Subcat)

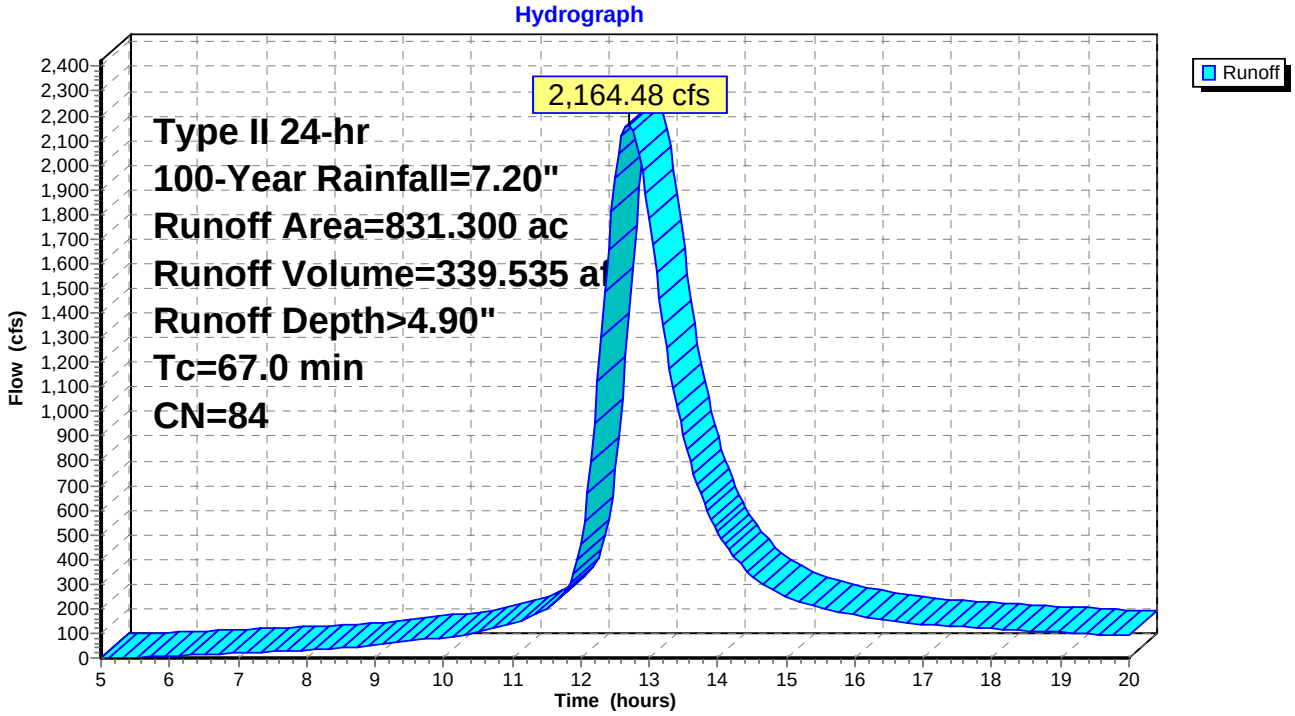
Runoff = 2,164.48 cfs @ 12.70 hrs, Volume= 339.535 af, Depth> 4.90"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-Year Rainfall=7.20"

	Area (ac)	CN	Description
*	831.300	84	from existing report
	831.300		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
67.0					**Direct Entry, This is Guess**

Subcatchment 2S: (new Subcat)



Summary for Pond 1P: 84" Slip Lining

Inflow Area = 831.300 ac, 0.00% Impervious, Inflow Depth > 4.90" for 100-Year event
Inflow = 2,164.48 cfs @ 12.70 hrs, Volume= 339.535 af
Outflow = 1,919.12 cfs @ 12.93 hrs, Volume= 339.488 af, Atten= 11%, Lag= 13.9 min
Primary = 1,919.12 cfs @ 12.93 hrs, Volume= 339.488 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 372.42' @ 12.93 hrs Surf.Area= 165,231 sf Storage= 741,641 cf

Plug-Flow detention time= 4.3 min calculated for 339.487 af (100% of inflow)
Center-of-Mass det. time= 4.3 min (811.1 - 806.8)

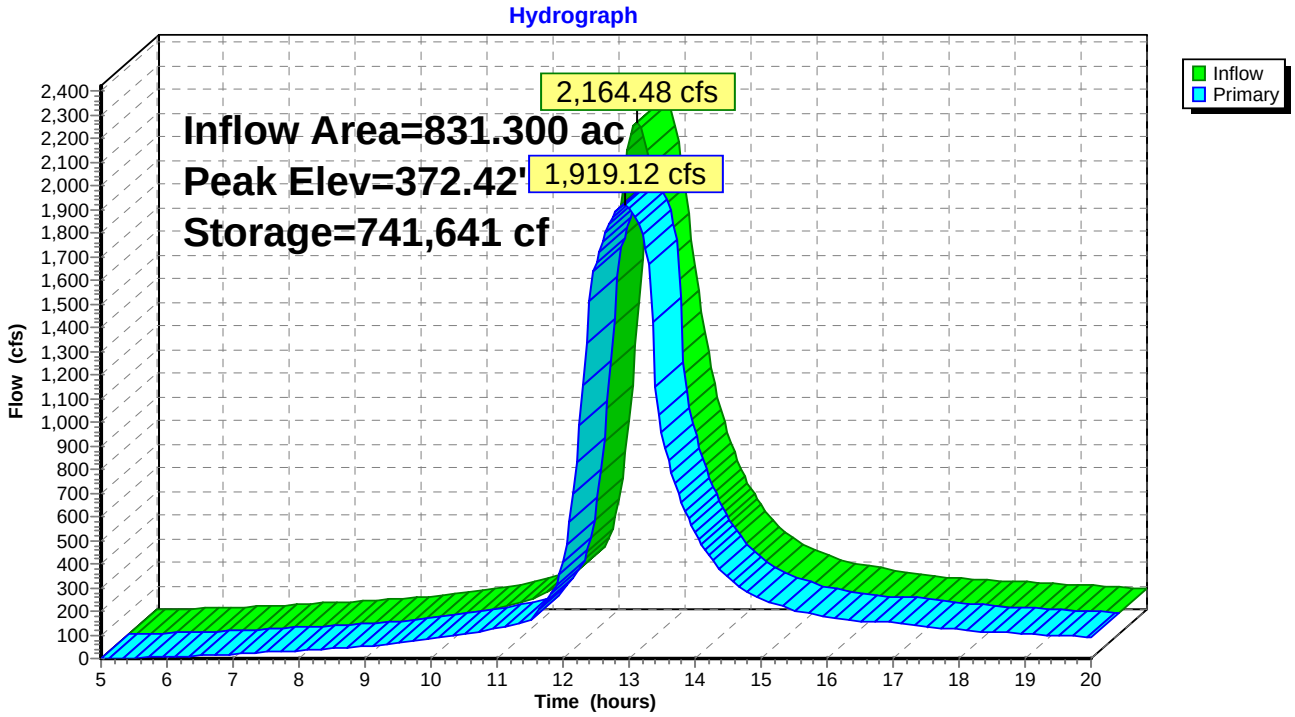
Volume	Invert	Avail.Storage	Storage Description
#1	357.00'	1,704,625 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
357.00	0	0	0
358.00	60	30	30
359.00	329	195	225
360.00	756	543	767
361.00	1,283	1,020	1,787
362.00	4,923	3,103	4,890
363.00	7,383	6,153	11,043
364.00	13,965	10,674	21,717
365.00	21,759	17,862	39,579
366.00	38,951	30,355	69,934
367.00	61,360	50,156	120,089
368.00	84,287	72,824	192,913
369.00	102,814	93,551	286,463
370.00	119,594	111,204	397,667
371.00	138,346	128,970	526,637
372.00	157,003	147,675	674,312
373.00	176,693	166,848	841,160
374.00	196,413	186,553	1,027,713
375.00	216,193	206,303	1,234,016
376.00	234,363	225,278	1,459,294
377.00	256,299	245,331	1,704,625

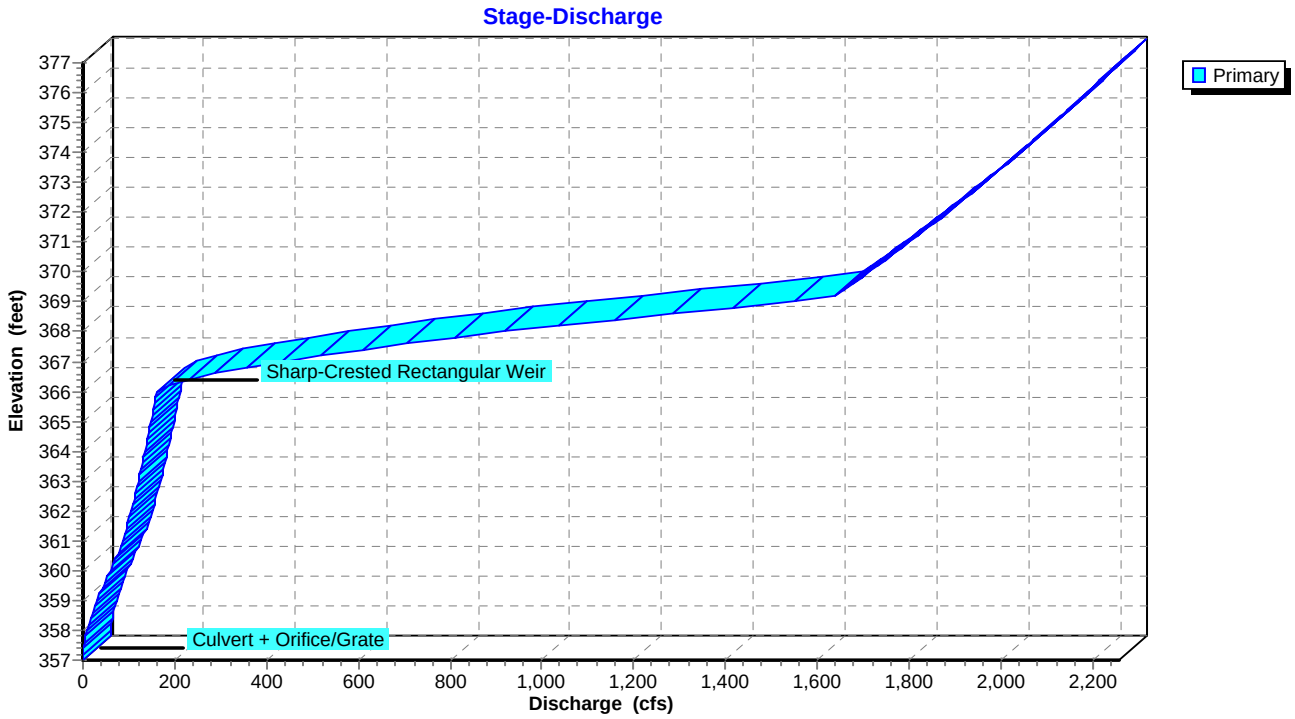
Device	Routing	Invert	Outlet Devices
#1	Primary	357.00'	**84.0" Round Culvert X 3.00** L= 170.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 357.00' / 356.00' S= 0.0059 '/' Cc= 0.900 n= 0.012, Flow Area= 38.48 sf
#2	Device 1	357.00'	**48.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	366.00'	**80.0' long Sharp-Crested Rectangular Weir** 0 End Contraction(s)

Primary OutFlow Max=1,918.18 cfs @ 12.93 hrs HW=372.41' (Free Discharge)
└─**1=Culvert** (Inlet Controls 1,918.18 cfs @ 16.61 fps)
  ├─**2=Orifice/Grate** (Passes < 221.54 cfs potential flow)
  └─**3=Sharp-Crested Rectangular Weir** (Passes < 4,241.82 cfs potential flow)

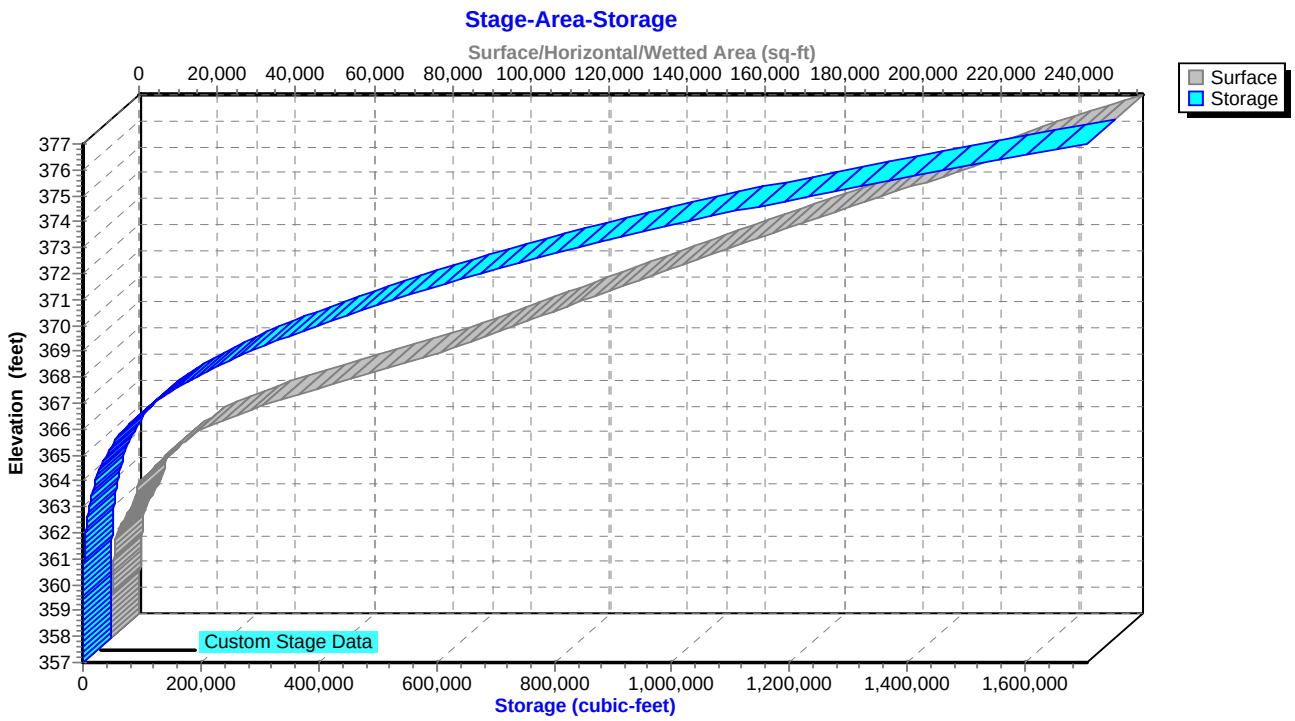
Pond 1P: 84" Slip Lining



Pond 1P: 84" Slip Lining



Pond 1P: 84" Slip Lining



Stage-Discharge for Pond 1P: 84" Slip Lining

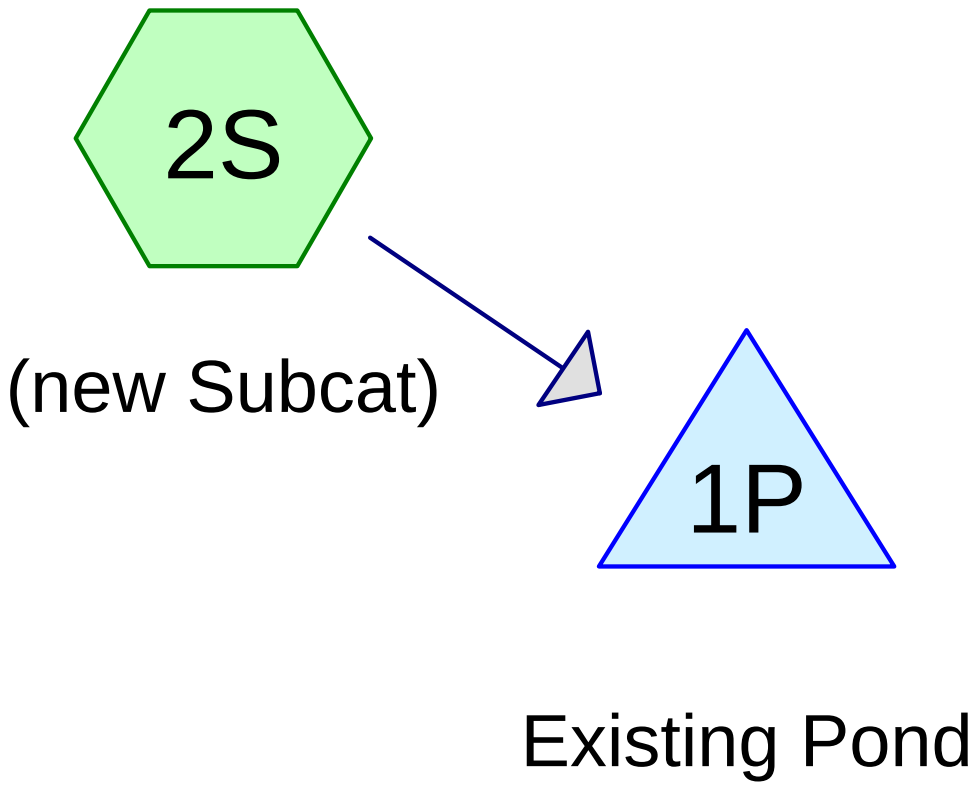
Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)
357.00	0.00	367.60	706.88
357.20	0.36	367.80	811.24
357.40	1.41	368.00	921.44
357.60	3.12	368.20	1,037.16
357.80	5.45	368.40	1,158.16
358.00	8.36	368.60	1,284.20
358.20	11.83	368.80	1,415.09
358.40	15.79	369.00	1,550.65
358.60	20.22	369.20	1,639.69
358.80	25.05	369.40	1,658.43
359.00	30.25	369.60	1,676.96
359.20	35.76	369.80	1,695.29
359.40	41.52	370.00	1,713.42
359.60	47.47	370.20	1,731.36
359.80	53.53	370.40	1,749.12
360.00	59.62	370.60	1,766.70
360.20	65.64	370.80	1,784.10
360.40	71.47	371.00	1,801.34
360.60	76.95	371.20	1,818.42
360.80	81.84	371.40	1,835.33
361.00	85.57	371.60	1,852.09
361.20	89.75	371.80	1,868.70
361.40	93.74	372.00	1,885.17
361.60	97.56	372.20	1,901.49
361.80	101.25	372.40	1,917.67
362.00	104.80	372.60	1,933.72
362.20	108.24	372.80	1,949.64
362.40	111.57	373.00	1,965.42
362.60	114.80	373.20	1,981.09
362.80	117.95	373.40	1,996.62
363.00	121.01	373.60	2,012.04
363.20	124.00	373.80	2,027.34
363.40	126.92	374.00	2,042.53
363.60	129.77	374.20	2,057.60
363.80	132.56	374.40	2,072.57
364.00	135.30	374.60	2,087.43
364.20	137.98	374.80	2,102.18
364.40	140.61	375.00	2,116.83
364.60	143.19	375.20	2,131.38
364.80	145.72	375.40	2,145.83
365.00	148.21	375.60	2,160.18
365.20	150.66	375.80	2,174.44
365.40	153.07	376.00	2,188.60
365.60	155.44	376.20	2,202.68
365.80	157.78	376.40	2,216.66
366.00	160.09	376.60	2,230.56
366.20	185.75	376.80	2,244.37
366.40	230.78	377.00	**2,258.10**
366.60	288.39		
366.80	356.17		
367.00	432.74		
367.20	517.15		
367.40	608.71		

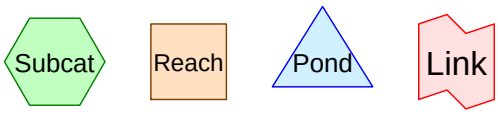
Stage-Area-Storage for Pond 1P: 84" Slip Lining

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
357.00	0	0
357.20	12	1
357.40	24	5
357.60	36	11
357.80	48	19
358.00	60	30
358.20	114	47
358.40	168	76
358.60	221	114
358.80	275	164
359.00	329	225
359.20	414	299
359.40	500	390
359.60	585	499
359.80	671	624
360.00	756	767
360.20	861	929
360.40	967	1,112
360.60	1,072	1,315
360.80	1,178	1,540
361.00	1,283	1,787
361.20	2,011	2,116
361.40	2,739	2,591
361.60	3,467	3,212
361.80	4,195	3,978
362.00	4,923	4,890
362.20	5,415	5,923
362.40	5,907	7,055
362.60	6,399	8,286
362.80	6,891	9,615
363.00	7,383	11,043
363.20	8,699	12,651
363.40	10,016	14,522
363.60	11,332	16,657
363.80	12,649	19,055
364.00	13,965	21,717
364.20	15,524	24,665
364.40	17,083	27,926
364.60	18,641	31,498
364.80	20,200	35,383
365.00	21,759	39,579
365.20	25,197	44,274
365.40	28,636	49,657
365.60	32,074	55,728
365.80	35,513	62,487
366.00	38,951	69,934
366.20	43,433	78,172
366.40	47,915	87,307
366.60	52,396	97,338
366.80	56,878	108,265
367.00	61,360	120,089
367.20	65,945	132,820
367.40	70,531	146,467
367.60	75,116	161,032
367.80	79,702	176,514
368.00	84,287	192,913
368.20	87,992	210,140
368.40	91,698	228,109
368.60	95,403	246,820
368.80	99,109	266,271
369.00	102,814	286,463
369.20	106,170	307,361
369.40	109,526	328,931
369.60	112,882	351,172
369.80	116,238	374,084
370.00	119,594	397,667
370.20	123,344	421,961
370.40	127,095	447,005
370.60	130,845	472,799
370.80	134,596	499,343
371.00	138,346	526,637
371.20	142,077	554,679
371.40	145,809	583,468
371.60	149,540	613,003
371.80	153,272	643,284
372.00	157,003	674,312
372.20	160,941	706,106
372.40	164,879	738,688
372.60	168,817	772,058
372.80	172,755	806,215
373.00	176,693	841,160
373.20	180,637	876,892
373.40	184,581	913,414
373.60	188,525	950,725
373.80	192,469	988,824
374.00	196,413	1,027,713
374.20	200,369	1,067,391
374.40	204,325	1,107,860
374.60	208,281	1,149,121
374.80	212,237	1,191,173
375.00	216,193	1,234,016
375.20	219,827	1,277,617
375.40	223,461	1,321,946
375.60	227,095	1,367,002
375.80	230,729	1,412,784
376.00	234,363	1,459,294
376.20	238,750	1,506,605
376.40	243,137	1,554,794
376.60	247,525	1,603,860
376.80	251,912	1,653,803
377.00	**256,299**	**1,704,625**

RABBITT ROAD CULVERT
REPAIR PROJECT

86-inch Slip Lined
Riser Alternative





Routing Diagram for 86-Inch Slip Lined Riser Analysis
Prepared by Microsoft, Printed 6/7/2016
HydroCAD® 10.00-15 s/n 05119 © 2015 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
831.300	84	from existing report (2S)
831.300	**84**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
831.300	Other	2S
831.300		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	0.000	0.000	831.300	831.300	from existing report	2S
0.000	**0.000**	**0.000**	**0.000**	**831.300**	**831.300**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	1P	357.00	356.00	170.0	0.0059	0.013	86.0	0.0	0.0

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

Subcatchment 2S: (new Subcat) Runoff Area=831.300 ac 0.00% Impervious Runoff Depth>4.90"
Tc=67.0 min CN=84 Runoff=2,164.48 cfs 339.535 af

Pond 1P: Existing Pond Peak Elev=371.87' Storage=654,442 cf Inflow=2,164.48 cfs 339.535 af
Outflow=1,957.79 cfs 339.488 af

Total Runoff Area = 831.300 ac Runoff Volume = 339.535 af Average Runoff Depth = 4.90"
100.00% Pervious = 831.300 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 2S: (new Subcat)

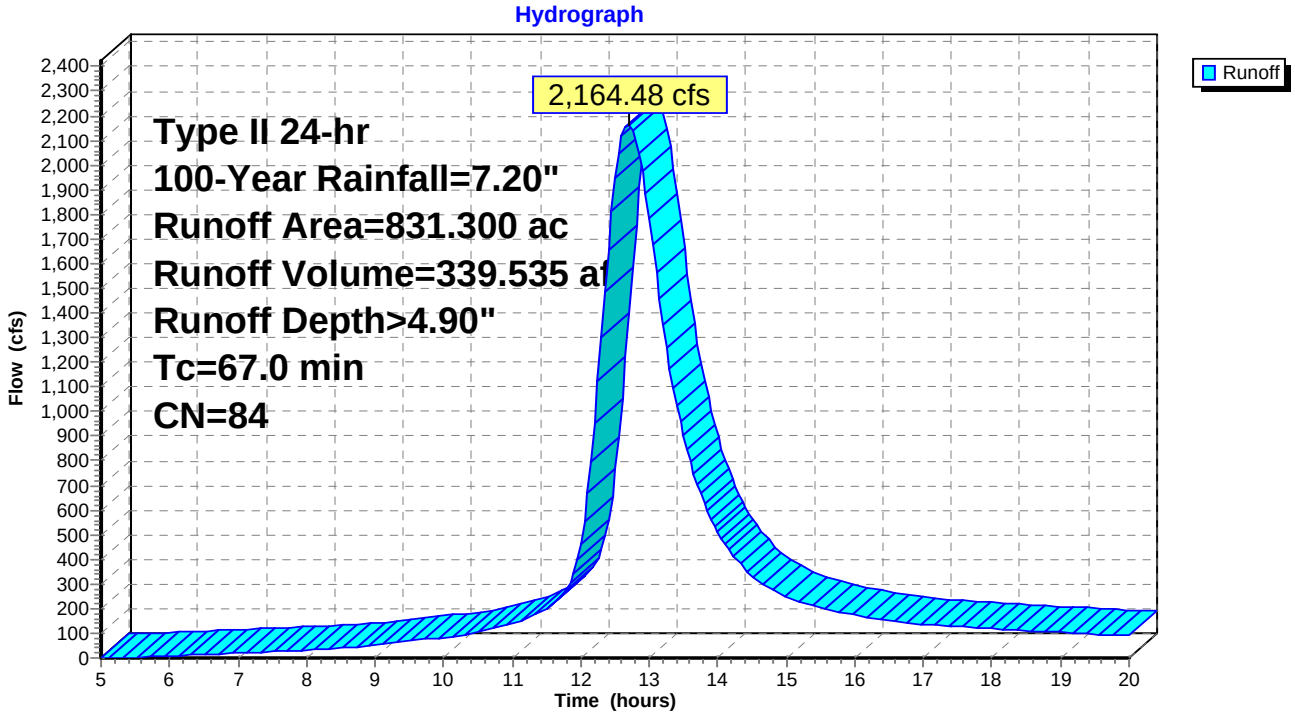
Runoff = 2,164.48 cfs @ 12.70 hrs, Volume= 339.535 af, Depth> 4.90"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-Year Rainfall=7.20"

	Area (ac)	CN	Description
*	831.300	84	from existing report
	831.300		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
67.0					**Direct Entry, This is Guess**

Subcatchment 2S: (new Subcat)



Summary for Pond 1P: Existing Pond

Inflow Area = 831.300 ac, 0.00% Impervious, Inflow Depth > 4.90" for 100-Year event
Inflow = 2,164.48 cfs @ 12.70 hrs, Volume= 339.535 af
Outflow = 1,957.79 cfs @ 12.91 hrs, Volume= 339.488 af, Atten= 10%, Lag= 12.6 min
Primary = 1,957.79 cfs @ 12.91 hrs, Volume= 339.488 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 371.87' @ 12.91 hrs Surf.Area= 154,624 sf Storage= 654,442 cf

Plug-Flow detention time= 4.1 min calculated for 339.487 af (100% of inflow)
Center-of-Mass det. time= 4.0 min (810.8 - 806.8)

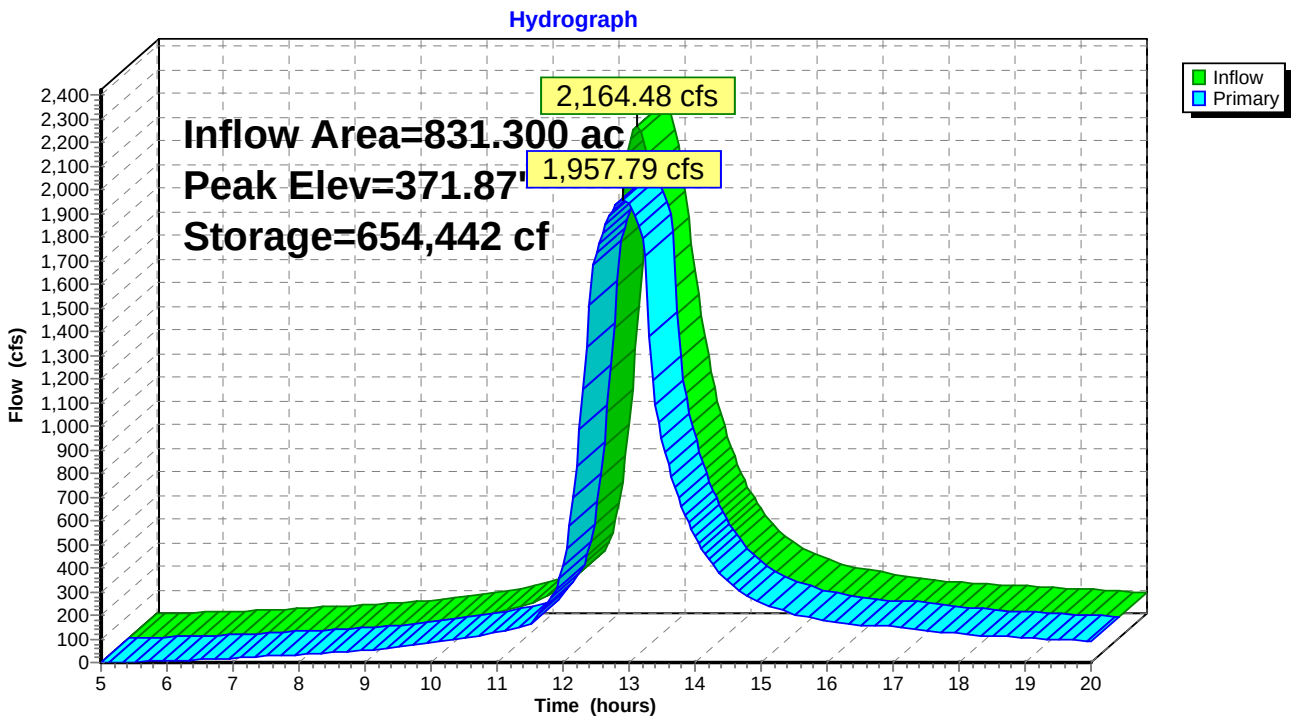
Volume	Invert	Avail.Storage	Storage Description
#1	357.00'	1,704,625 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
357.00	0	0	0
358.00	60	30	30
359.00	329	195	225
360.00	756	543	767
361.00	1,283	1,020	1,787
362.00	4,923	3,103	4,890
363.00	7,383	6,153	11,043
364.00	13,965	10,674	21,717
365.00	21,759	17,862	39,579
366.00	38,951	30,355	69,934
367.00	61,360	50,156	120,089
368.00	84,287	72,824	192,913
369.00	102,814	93,551	286,463
370.00	119,594	111,204	397,667
371.00	138,346	128,970	526,637
372.00	157,003	147,675	674,312
373.00	176,693	166,848	841,160
374.00	196,413	186,553	1,027,713
375.00	216,193	206,303	1,234,016
376.00	234,363	225,278	1,459,294
377.00	256,299	245,331	1,704,625

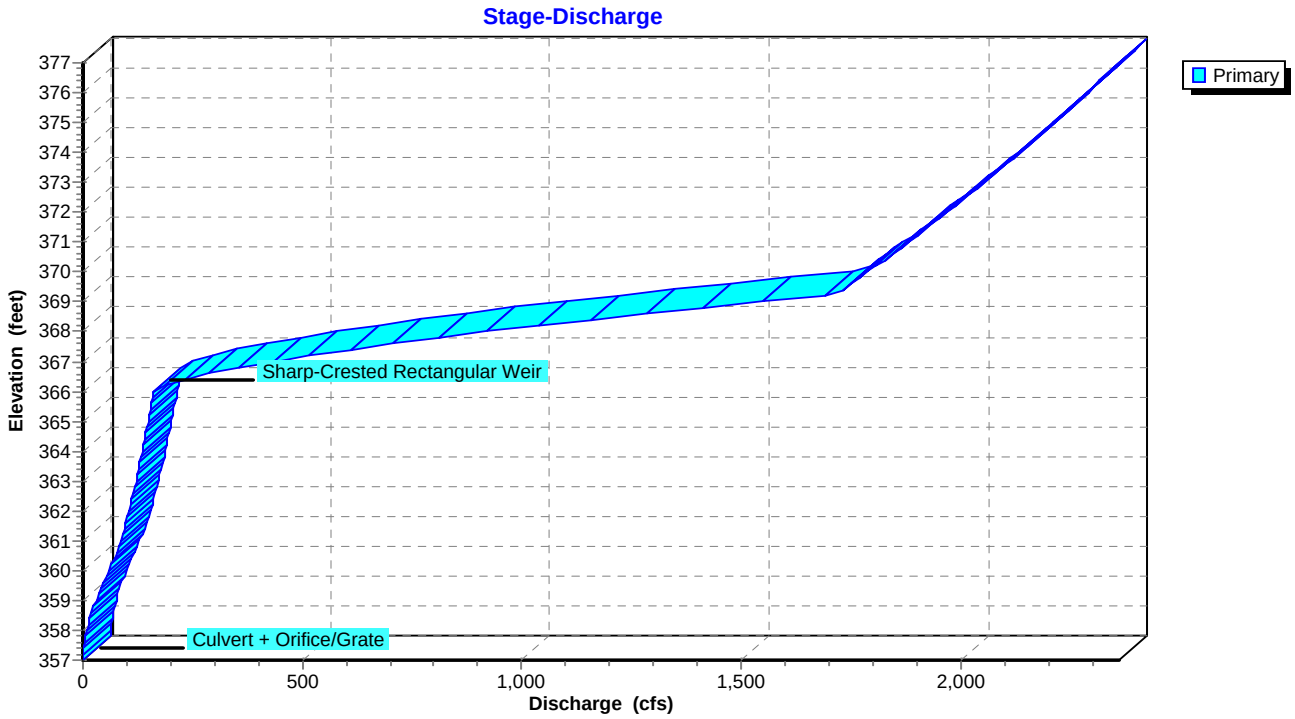
Device	Routing	Invert	Outlet Devices
#1	Primary	357.00'	**86.0" Round Culvert X 3.00** L= 170.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 357.00' / 356.00' S= 0.0059 '/' Cc= 0.900 n= 0.013, Flow Area= 40.34 sf
#2	Device 1	357.00'	**48.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	366.00'	**80.0' long Sharp-Crested Rectangular Weir** 0 End Contraction(s)

Primary OutFlow Max=1,957.14 cfs @ 12.91 hrs HW=371.86' (Free Discharge)
└─**1=Culvert** (Inlet Controls 1,957.14 cfs @ 16.17 fps)
  ├─**2=Orifice/Grate** (Passes < 217.02 cfs potential flow)
  └─**3=Sharp-Crested Rectangular Weir** (Passes < 3,715.42 cfs potential flow)

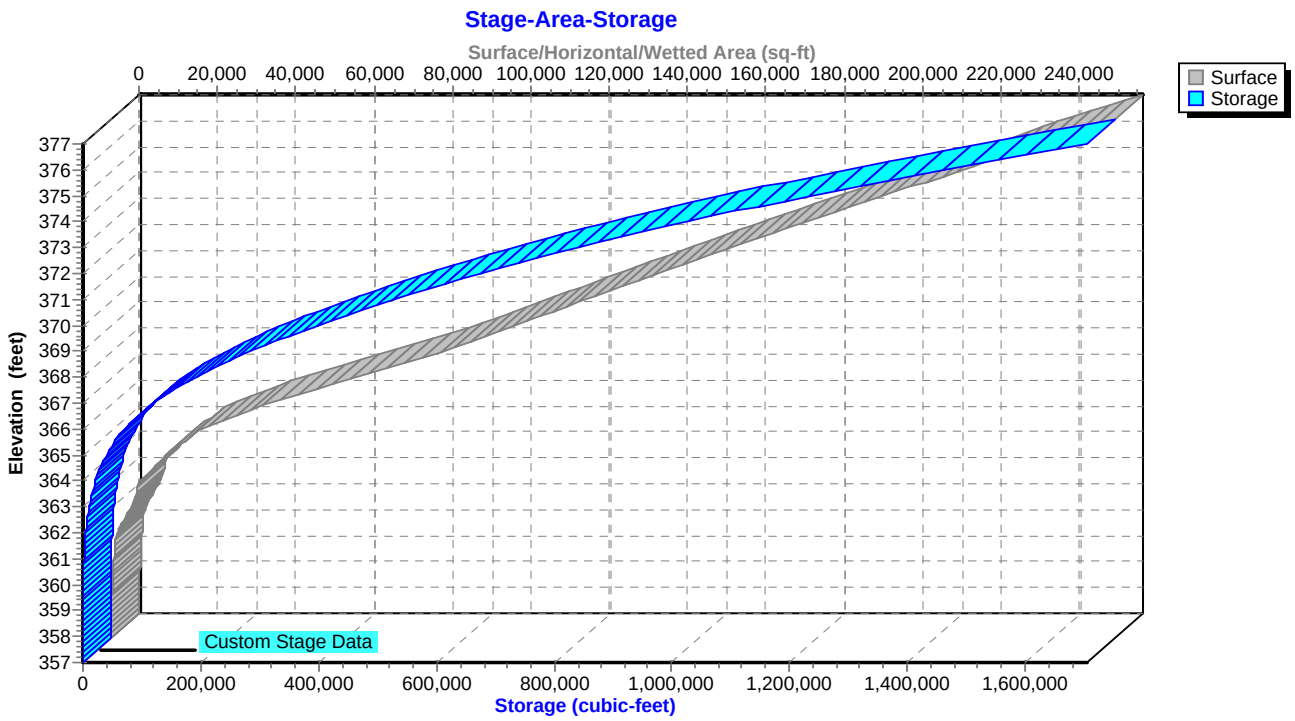
Pond 1P: Existing Pond



Pond 1P: Existing Pond



Pond 1P: Existing Pond



Stage-Discharge for Pond 1P: Existing Pond

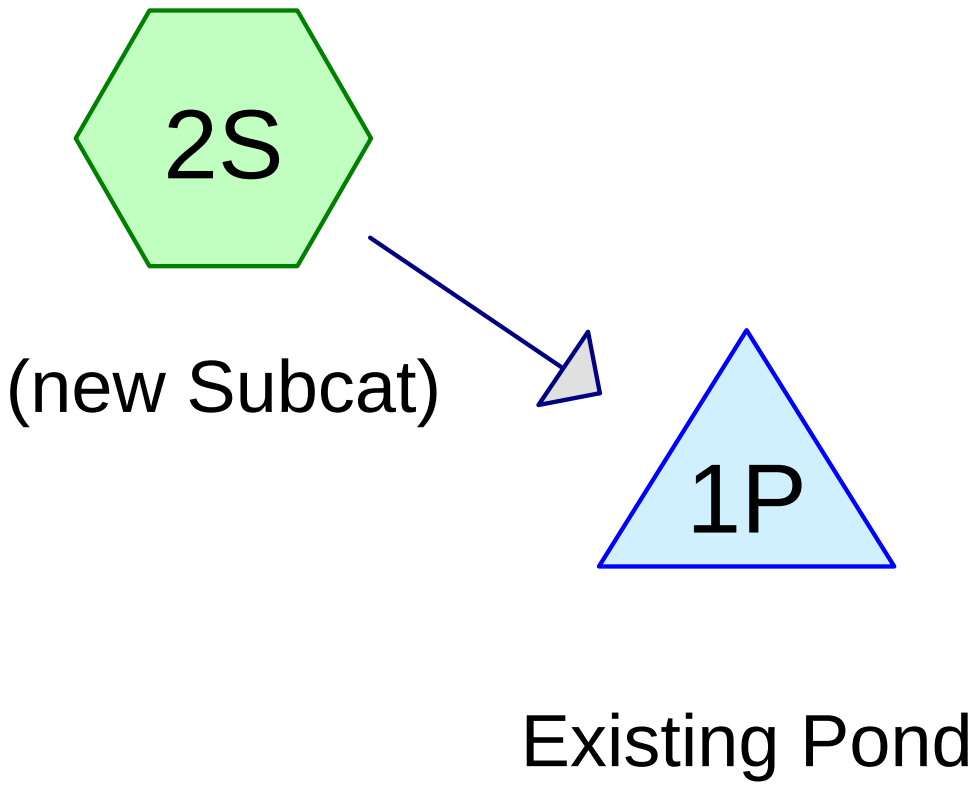
Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)
357.00	0.00	367.60	706.88
357.20	0.36	367.80	811.24
357.40	1.41	368.00	921.44
357.60	3.12	368.20	1,037.16
357.80	5.45	368.40	1,158.16
358.00	8.36	368.60	1,284.20
358.20	11.83	368.80	1,415.09
358.40	15.79	369.00	1,550.65
358.60	20.22	369.20	1,690.73
358.80	25.05	369.40	1,730.18
359.00	30.25	369.60	1,749.70
359.20	35.76	369.80	1,769.00
359.40	41.52	370.00	1,788.09
359.60	47.47	370.20	1,806.97
359.80	53.53	370.40	1,825.67
360.00	59.62	370.60	1,844.17
360.20	65.64	370.80	1,862.49
360.40	71.47	371.00	1,880.63
360.60	76.95	371.20	1,898.60
360.80	81.84	371.40	1,916.40
361.00	85.57	371.60	1,934.04
361.20	89.75	371.80	1,951.51
361.40	93.74	372.00	1,968.84
361.60	97.56	372.20	1,986.01
361.80	101.25	372.40	2,003.03
362.00	104.80	372.60	2,019.91
362.20	108.24	372.80	2,036.65
362.40	111.57	373.00	2,053.25
362.60	114.80	373.20	2,069.72
362.80	117.95	373.40	2,086.06
363.00	121.01	373.60	2,102.28
363.20	124.00	373.80	2,118.36
363.40	126.92	374.00	2,134.33
363.60	129.77	374.20	2,150.18
363.80	132.56	374.40	2,165.91
364.00	135.30	374.60	2,181.53
364.20	137.98	374.80	2,197.04
364.40	140.61	375.00	2,212.44
364.60	143.19	375.20	2,227.74
364.80	145.72	375.40	2,242.93
365.00	148.21	375.60	2,258.01
365.20	150.66	375.80	2,273.00
365.40	153.07	376.00	2,287.89
365.60	155.44	376.20	2,302.68
365.80	157.78	376.40	2,317.38
366.00	160.09	376.60	2,331.99
366.20	185.75	376.80	2,346.50
366.40	230.78	377.00	**2,360.93**
366.60	288.39		
366.80	356.17		
367.00	432.74		
367.20	517.15		
367.40	608.71		

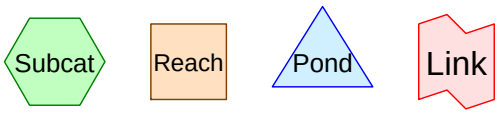
Stage-Area-Storage for Pond 1P: Existing Pond

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
357.00	0	0
357.20	12	1
357.40	24	5
357.60	36	11
357.80	48	19
358.00	60	30
358.20	114	47
358.40	168	76
358.60	221	114
358.80	275	164
359.00	329	225
359.20	414	299
359.40	500	390
359.60	585	499
359.80	671	624
360.00	756	767
360.20	861	929
360.40	967	1,112
360.60	1,072	1,315
360.80	1,178	1,540
361.00	1,283	1,787
361.20	2,011	2,116
361.40	2,739	2,591
361.60	3,467	3,212
361.80	4,195	3,978
362.00	4,923	4,890
362.20	5,415	5,923
362.40	5,907	7,055
362.60	6,399	8,286
362.80	6,891	9,615
363.00	7,383	11,043
363.20	8,699	12,651
363.40	10,016	14,522
363.60	11,332	16,657
363.80	12,649	19,055
364.00	13,965	21,717
364.20	15,524	24,665
364.40	17,083	27,926
364.60	18,641	31,498
364.80	20,200	35,383
365.00	21,759	39,579
365.20	25,197	44,274
365.40	28,636	49,657
365.60	32,074	55,728
365.80	35,513	62,487
366.00	38,951	69,934
366.20	43,433	78,172
366.40	47,915	87,307
366.60	52,396	97,338
366.80	56,878	108,265
367.00	61,360	120,089
367.20	65,945	132,820
367.40	70,531	146,467
367.60	75,116	161,032
367.80	79,702	176,514
368.00	84,287	192,913
368.20	87,992	210,140
368.40	91,698	228,109
368.60	95,403	246,820
368.80	99,109	266,271
369.00	102,814	286,463
369.20	106,170	307,361
369.40	109,526	328,931
369.60	112,882	351,172
369.80	116,238	374,084
370.00	119,594	397,667
370.20	123,344	421,961
370.40	127,095	447,005
370.60	130,845	472,799
370.80	134,596	499,343
371.00	138,346	526,637
371.20	142,077	554,679
371.40	145,809	583,468
371.60	149,540	613,003
371.80	153,272	643,284
372.00	157,003	674,312
372.20	160,941	706,106
372.40	164,879	738,688
372.60	168,817	772,058
372.80	172,755	806,215
373.00	176,693	841,160
373.20	180,637	876,892
373.40	184,581	913,414
373.60	188,525	950,725
373.80	192,469	988,824
374.00	196,413	1,027,713
374.20	200,369	1,067,391
374.40	204,325	1,107,860
374.60	208,281	1,149,121
374.80	212,237	1,191,173
375.00	216,193	1,234,016
375.20	219,827	1,277,617
375.40	223,461	1,321,946
375.60	227,095	1,367,002
375.80	230,729	1,412,784
376.00	234,363	1,459,294
376.20	238,750	1,506,605
376.40	243,137	1,554,794
376.60	247,525	1,603,860
376.80	251,912	1,653,803
377.00	**256,299**	**1,704,625**

RABBITT ROAD CULVERT
REPAIR PROJECT

90-inch SpinCast Lined Riser Alternative





Routing Diagram for 90-inch SpinCast Lined Riser Analysis
Prepared by Microsoft, Printed 6/6/2016
HydroCAD® 10.00-15 s/n 05119 © 2015 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
831.300	84	from existing report (2S)
831.300	**84**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
831.300	Other	2S
831.300		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	0.000	0.000	831.300	831.300	from existing report	2S
0.000	**0.000**	**0.000**	**0.000**	**831.300**	**831.300**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	1P	357.00	356.00	170.0	0.0059	0.013	90.0	0.0	0.0

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

Subcatchment 2S: (new Subcat) Runoff Area=831.300 ac 0.00% Impervious Runoff Depth>4.90"
Tc=67.0 min CN=84 Runoff=2,164.48 cfs 339.535 af

Pond 1P: Existing Pond Peak Elev=370.87' Storage=509,300 cf Inflow=2,164.48 cfs 339.535 af
Outflow=2,030.44 cfs 339.488 af

Total Runoff Area = 831.300 ac Runoff Volume = 339.535 af Average Runoff Depth = 4.90"
100.00% Pervious = 831.300 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 2S: (new Subcat)

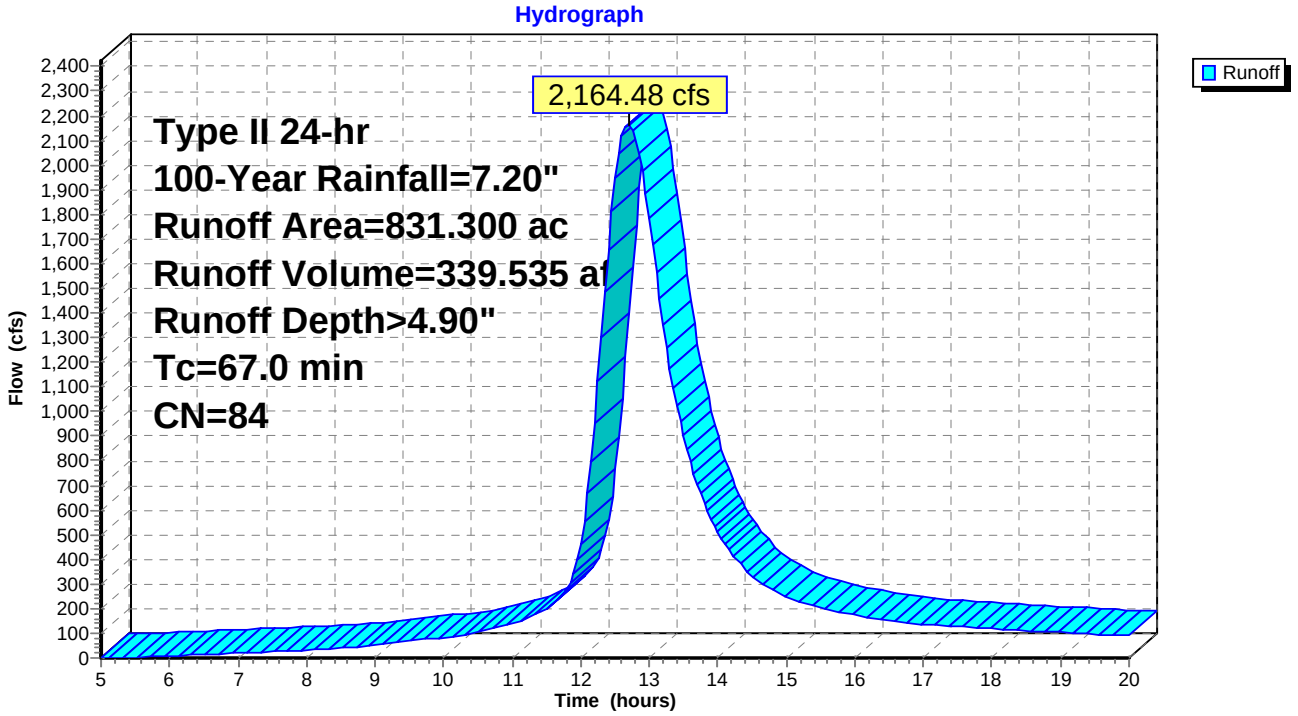
Runoff = 2,164.48 cfs @ 12.70 hrs, Volume= 339.535 af, Depth> 4.90"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-Year Rainfall=7.20"

	Area (ac)	CN	Description
*	831.300	84	from existing report
	831.300		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
67.0					**Direct Entry, This is Guess**

Subcatchment 2S: (new Subcat)



Summary for Pond 1P: Existing Pond

Inflow Area = 831.300 ac, 0.00% Impervious, Inflow Depth > 4.90" for 100-Year event
Inflow = 2,164.48 cfs @ 12.70 hrs, Volume= 339.535 af
Outflow = 2,030.44 cfs @ 12.86 hrs, Volume= 339.488 af, Atten= 6%, Lag= 9.8 min
Primary = 2,030.44 cfs @ 12.86 hrs, Volume= 339.488 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 370.87' @ 12.86 hrs Surf.Area= 135,976 sf Storage= 509,300 cf

Plug-Flow detention time= 3.7 min calculated for 338.360 af (100% of inflow)
Center-of-Mass det. time= 3.6 min (810.5 - 806.8)

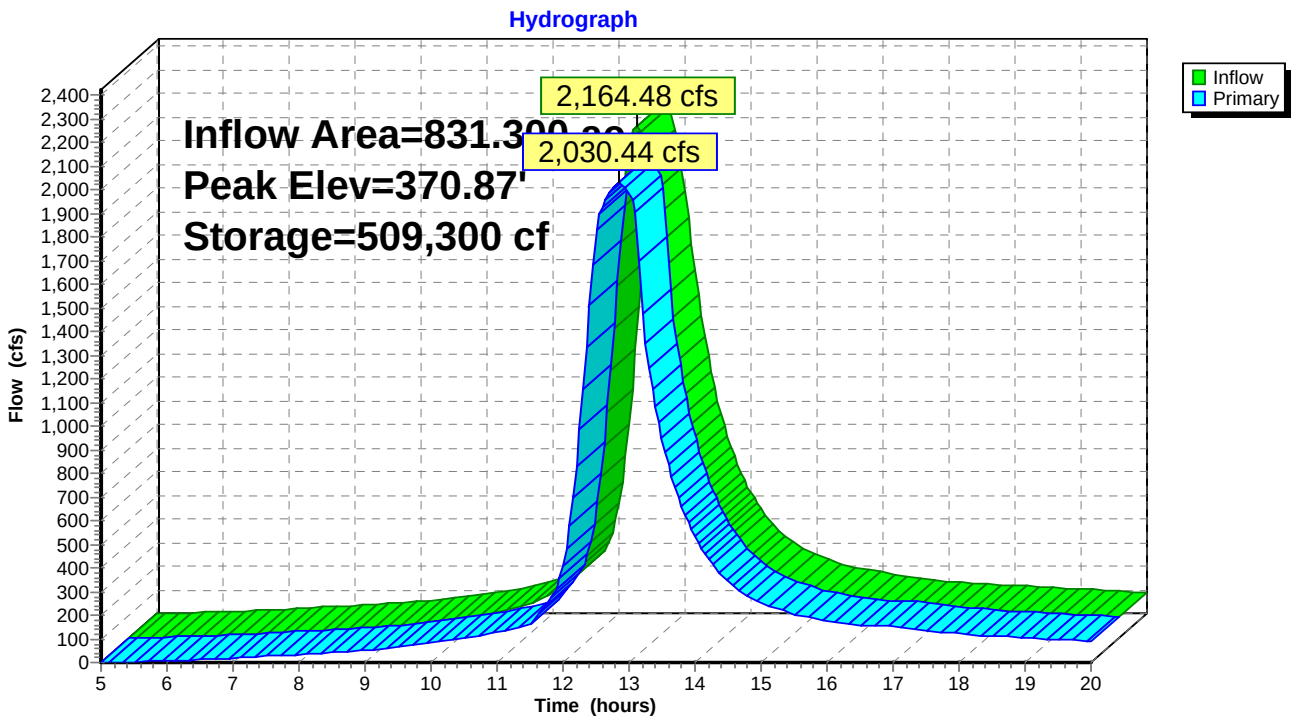
Volume	Invert	Avail.Storage	Storage Description
#1	357.00'	1,704,625 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
357.00	0	0	0
358.00	60	30	30
359.00	329	195	225
360.00	756	543	767
361.00	1,283	1,020	1,787
362.00	4,923	3,103	4,890
363.00	7,383	6,153	11,043
364.00	13,965	10,674	21,717
365.00	21,759	17,862	39,579
366.00	38,951	30,355	69,934
367.00	61,360	50,156	120,089
368.00	84,287	72,824	192,913
369.00	102,814	93,551	286,463
370.00	119,594	111,204	397,667
371.00	138,346	128,970	526,637
372.00	157,003	147,675	674,312
373.00	176,693	166,848	841,160
374.00	196,413	186,553	1,027,713
375.00	216,193	206,303	1,234,016
376.00	234,363	225,278	1,459,294
377.00	256,299	245,331	1,704,625

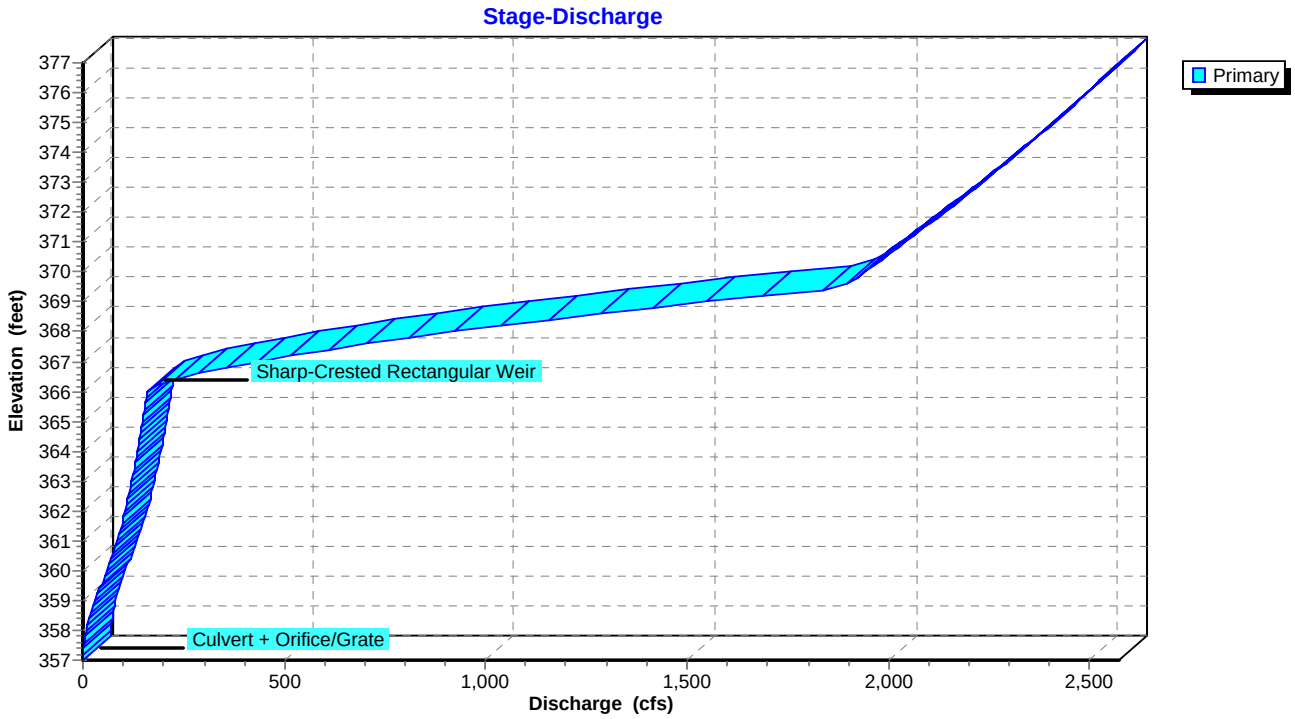
Device	Routing	Invert	Outlet Devices
#1	Primary	357.00'	**90.0" Round Culvert X 3.00** L= 170.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 357.00' / 356.00' S= 0.0059 '/' Cc= 0.900 n= 0.013, Flow Area= 44.18 sf
#2	Device 1	357.00'	**48.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	366.00'	**80.0' long Sharp-Crested Rectangular Weir** 0 End Contraction(s)

Primary OutFlow Max=2,029.60 cfs @ 12.86 hrs HW=370.86' (Free Discharge)
└─**1=Culvert** (Inlet Controls 2,029.60 cfs @ 15.31 fps)
  ├─**2=Orifice/Grate** (Passes < 208.42 cfs potential flow)
  └─**3=Sharp-Crested Rectangular Weir** (Passes < 2,807.10 cfs potential flow)

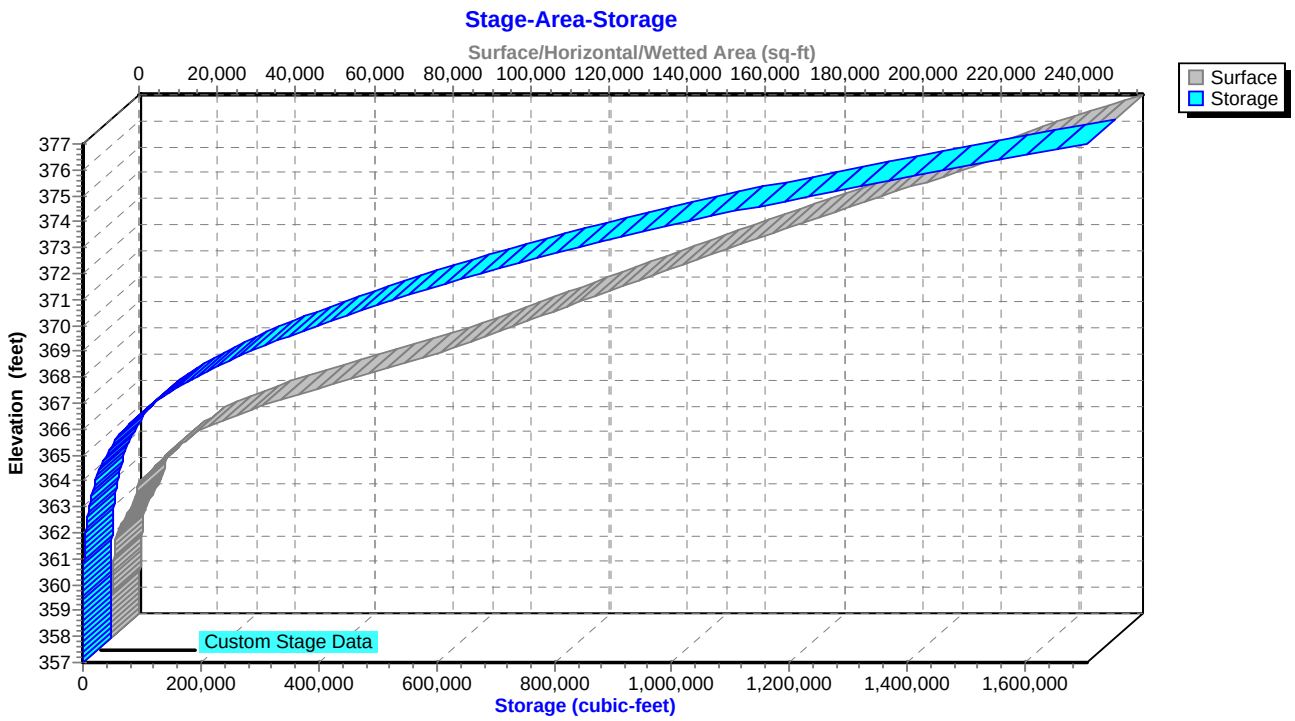
Pond 1P: Existing Pond



Pond 1P: Existing Pond



Pond 1P: Existing Pond



Stage-Discharge for Pond 1P: Existing Pond

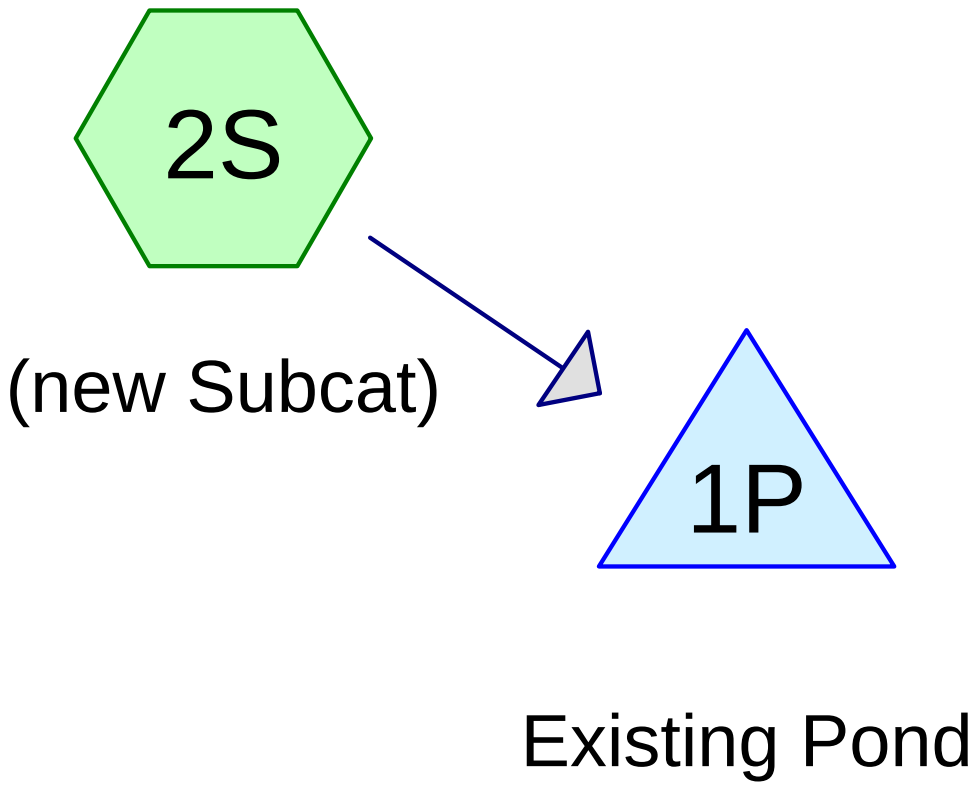
Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)
357.00	0.00	367.60	706.88
357.20	0.36	367.80	811.24
357.40	1.41	368.00	921.44
357.60	3.12	368.20	1,037.16
357.80	5.45	368.40	1,158.16
358.00	8.36	368.60	1,284.20
358.20	11.83	368.80	1,415.09
358.40	15.79	369.00	1,550.65
358.60	20.22	369.20	1,690.73
358.80	25.05	369.40	1,835.17
359.00	30.25	369.60	1,898.45
359.20	35.76	369.80	1,919.78
359.40	41.52	370.00	1,940.88
359.60	47.47	370.20	1,961.75
359.80	53.53	370.40	1,982.40
360.00	59.62	370.60	2,002.84
360.20	65.64	370.80	2,023.07
360.40	71.47	371.00	2,043.10
360.60	76.95	371.20	2,062.94
360.80	81.84	371.40	2,082.58
361.00	85.57	371.60	2,102.05
361.20	89.75	371.80	2,121.33
361.40	93.74	372.00	2,140.45
361.60	97.56	372.20	2,159.39
361.80	101.25	372.40	2,178.17
362.00	104.80	372.60	2,196.78
362.20	108.24	372.80	2,215.24
362.40	111.57	373.00	2,233.55
362.60	114.80	373.20	2,251.71
362.80	117.95	373.40	2,269.72
363.00	121.01	373.60	2,287.60
363.20	124.00	373.80	2,305.33
363.40	126.92	374.00	2,322.93
363.60	129.77	374.20	2,340.39
363.80	132.56	374.40	2,357.73
364.00	135.30	374.60	2,374.94
364.20	137.98	374.80	2,392.03
364.40	140.61	375.00	2,408.99
364.60	143.19	375.20	2,425.84
364.80	145.72	375.40	2,442.57
365.00	148.21	375.60	2,459.18
365.20	150.66	375.80	2,475.69
365.40	153.07	376.00	2,492.08
365.60	155.44	376.20	2,508.37
365.80	157.78	376.40	2,524.56
366.00	160.09	376.60	2,540.64
366.20	185.75	376.80	2,556.62
366.40	230.78	377.00	**2,572.49**
366.60	288.39		
366.80	356.17		
367.00	432.74		
367.20	517.15		
367.40	608.71		

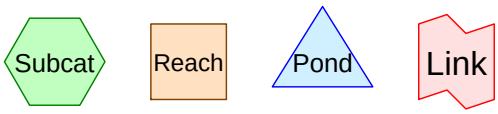
Stage-Area-Storage for Pond 1P: Existing Pond

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
357.00	0	0
357.20	12	1
357.40	24	5
357.60	36	11
357.80	48	19
358.00	60	30
358.20	114	47
358.40	168	76
358.60	221	114
358.80	275	164
359.00	329	225
359.20	414	299
359.40	500	390
359.60	585	499
359.80	671	624
360.00	756	767
360.20	861	929
360.40	967	1,112
360.60	1,072	1,315
360.80	1,178	1,540
361.00	1,283	1,787
361.20	2,011	2,116
361.40	2,739	2,591
361.60	3,467	3,212
361.80	4,195	3,978
362.00	4,923	4,890
362.20	5,415	5,923
362.40	5,907	7,055
362.60	6,399	8,286
362.80	6,891	9,615
363.00	7,383	11,043
363.20	8,699	12,651
363.40	10,016	14,522
363.60	11,332	16,657
363.80	12,649	19,055
364.00	13,965	21,717
364.20	15,524	24,665
364.40	17,083	27,926
364.60	18,641	31,498
364.80	20,200	35,383
365.00	21,759	39,579
365.20	25,197	44,274
365.40	28,636	49,657
365.60	32,074	55,728
365.80	35,513	62,487
366.00	38,951	69,934
366.20	43,433	78,172
366.40	47,915	87,307
366.60	52,396	97,338
366.80	56,878	108,265
367.00	61,360	120,089
367.20	65,945	132,820
367.40	70,531	146,467
367.60	75,116	161,032
367.80	79,702	176,514
368.00	84,287	192,913
368.20	87,992	210,140
368.40	91,698	228,109
368.60	95,403	246,820
368.80	99,109	266,271
369.00	102,814	286,463
369.20	106,170	307,361
369.40	109,526	328,931
369.60	112,882	351,172
369.80	116,238	374,084
370.00	119,594	397,667
370.20	123,344	421,961
370.40	127,095	447,005
370.60	130,845	472,799
370.80	134,596	499,343
371.00	138,346	526,637
371.20	142,077	554,679
371.40	145,809	583,468
371.60	149,540	613,003
371.80	153,272	643,284
372.00	157,003	674,312
372.20	160,941	706,106
372.40	164,879	738,688
372.60	168,817	772,058
372.80	172,755	806,215
373.00	176,693	841,160
373.20	180,637	876,892
373.40	184,581	913,414
373.60	188,525	950,725
373.80	192,469	988,824
374.00	196,413	1,027,713
374.20	200,369	1,067,391
374.40	204,325	1,107,860
374.60	208,281	1,149,121
374.80	212,237	1,191,173
375.00	216,193	1,234,016
375.20	219,827	1,277,617
375.40	223,461	1,321,946
375.60	227,095	1,367,002
375.80	230,729	1,412,784
376.00	234,363	1,459,294
376.20	238,750	1,506,605
376.40	243,137	1,554,794
376.60	247,525	1,603,860
376.80	251,912	1,653,803
377.00	**256,299**	**1,704,625**

RABBITT ROAD CULVERT
REPAIR PROJECT

92-inch SpinCast Lined Riser Alternative





Routing Diagram for 92-inch SpinCast Lined Riser Analysis
Prepared by Microsoft, Printed 6/6/2016
HydroCAD® 10.00-15 s/n 05119 © 2015 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
831.300	84	from existing report (2S)
831.300	**84**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
831.300	Other	2S
831.300		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	0.000	0.000	831.300	831.300	from existing report	2S
0.000	**0.000**	**0.000**	**0.000**	**831.300**	**831.300**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	1P	357.00	356.00	170.0	0.0059	0.013	92.0	0.0	0.0

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

Subcatchment 2S: (new Subcat) Runoff Area=831.300 ac 0.00% Impervious Runoff Depth>4.90"
Tc=67.0 min CN=84 Runoff=2,164.48 cfs 339.535 af

Pond 1P: Existing Pond Peak Elev=370.43' Storage=451,368 cf Inflow=2,164.48 cfs 339.535 af
Outflow=2,066.20 cfs 339.488 af

Total Runoff Area = 831.300 ac Runoff Volume = 339.535 af Average Runoff Depth = 4.90"
100.00% Pervious = 831.300 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 2S: (new Subcat)

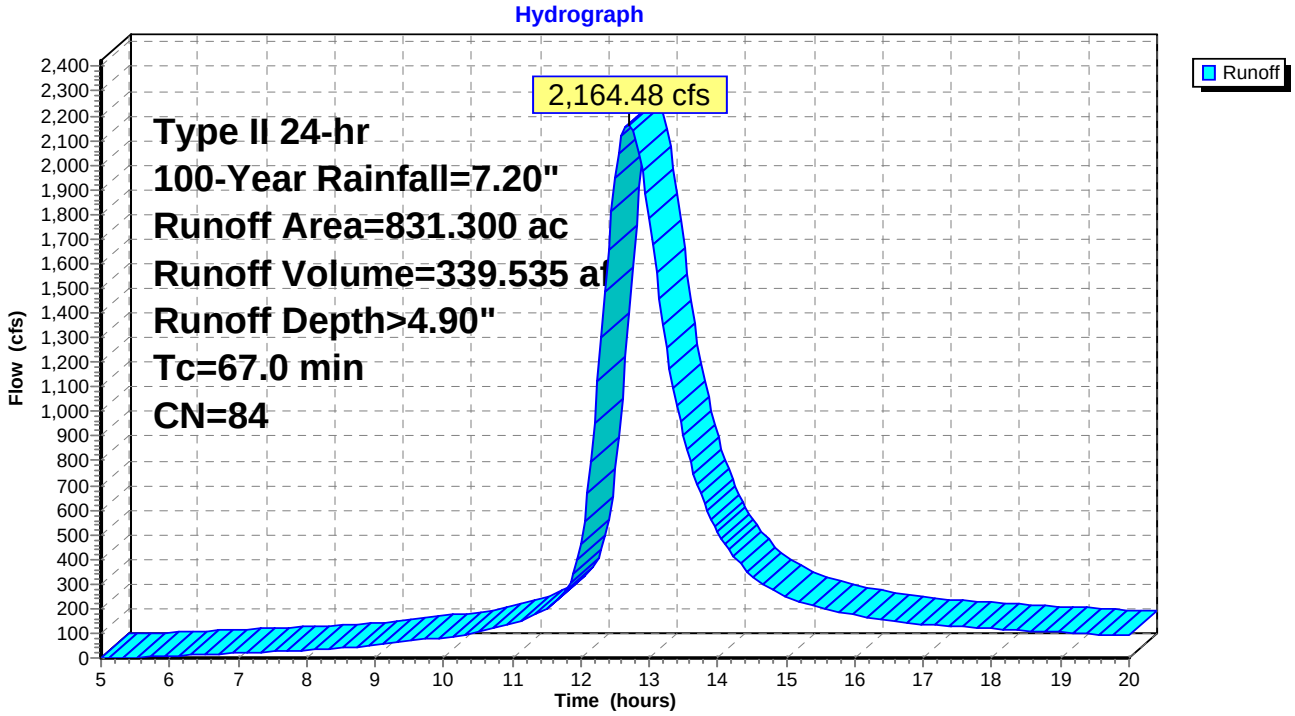
Runoff = 2,164.48 cfs @ 12.70 hrs, Volume= 339.535 af, Depth> 4.90"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-Year Rainfall=7.20"

	Area (ac)	CN	Description
*	831.300	84	from existing report
	831.300		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
67.0					**Direct Entry, This is Guess**

Subcatchment 2S: (new Subcat)



Summary for Pond 1P: Existing Pond

Inflow Area = 831.300 ac, 0.00% Impervious, Inflow Depth > 4.90" for 100-Year event
Inflow = 2,164.48 cfs @ 12.70 hrs, Volume= 339.535 af
Outflow = 2,066.20 cfs @ 12.84 hrs, Volume= 339.488 af, Atten= 5%, Lag= 8.1 min
Primary = 2,066.20 cfs @ 12.84 hrs, Volume= 339.488 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 370.43' @ 12.84 hrs Surf.Area= 127,737 sf Storage= 451,368 cf

Plug-Flow detention time= 3.6 min calculated for 339.487 af (100% of inflow)
Center-of-Mass det. time= 3.5 min (810.3 - 806.8)

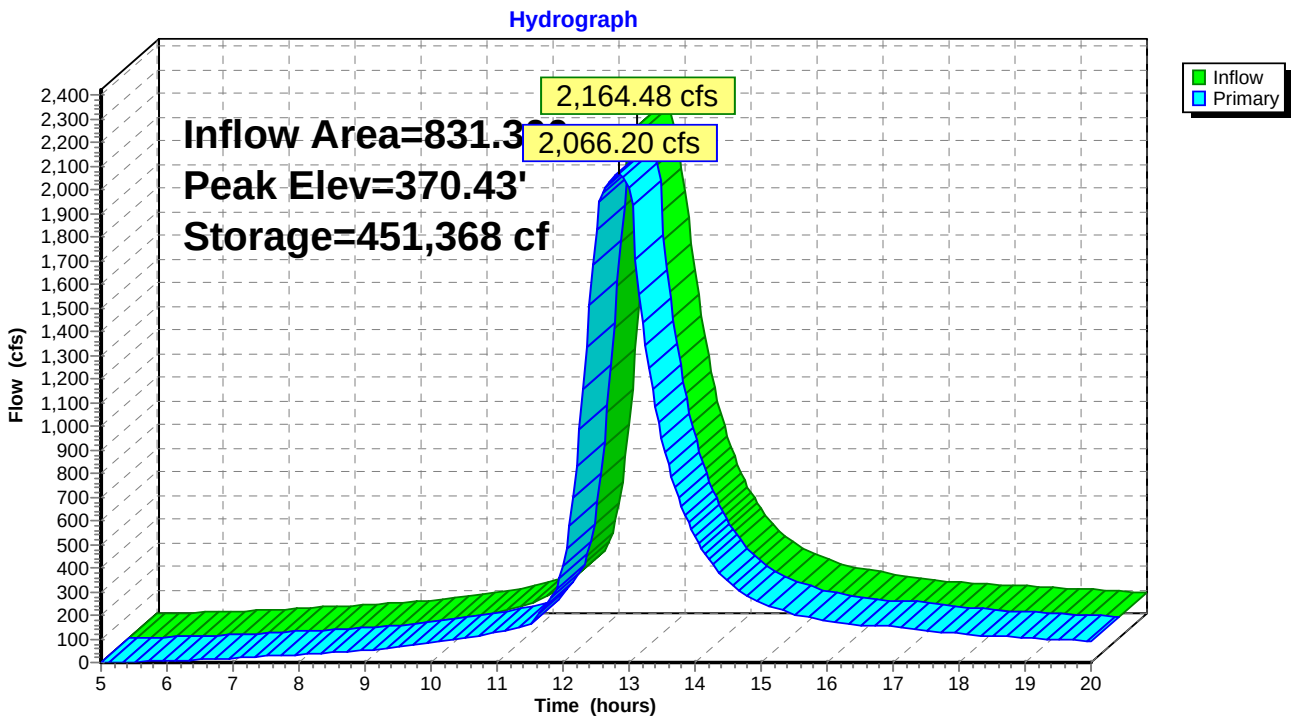
Volume	Invert	Avail.Storage	Storage Description
#1	357.00'	1,704,625 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
357.00	0	0	0
358.00	60	30	30
359.00	329	195	225
360.00	756	543	767
361.00	1,283	1,020	1,787
362.00	4,923	3,103	4,890
363.00	7,383	6,153	11,043
364.00	13,965	10,674	21,717
365.00	21,759	17,862	39,579
366.00	38,951	30,355	69,934
367.00	61,360	50,156	120,089
368.00	84,287	72,824	192,913
369.00	102,814	93,551	286,463
370.00	119,594	111,204	397,667
371.00	138,346	128,970	526,637
372.00	157,003	147,675	674,312
373.00	176,693	166,848	841,160
374.00	196,413	186,553	1,027,713
375.00	216,193	206,303	1,234,016
376.00	234,363	225,278	1,459,294
377.00	256,299	245,331	1,704,625

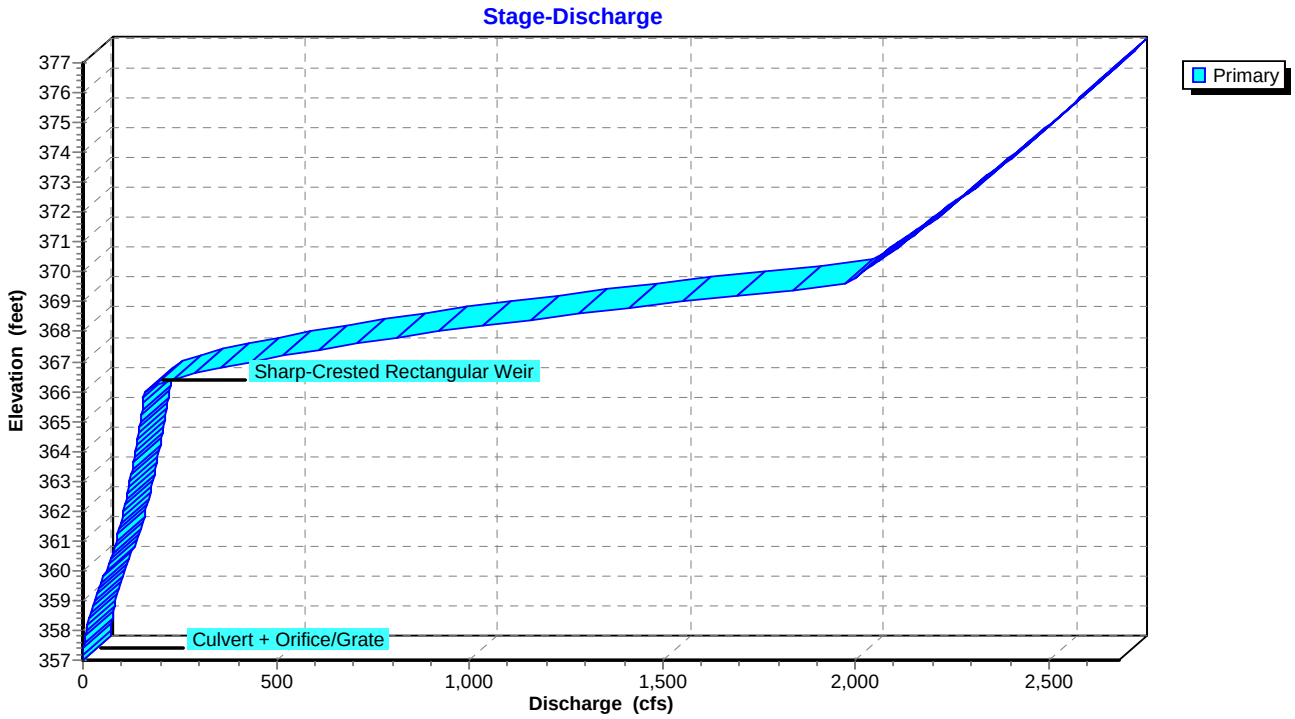
Device	Routing	Invert	Outlet Devices
#1	Primary	357.00'	**92.0" Round Culvert X 3.00** L= 170.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 357.00' / 356.00' S= 0.0059 '/' Cc= 0.900 n= 0.013, Flow Area= 46.16 sf
#2	Device 1	357.00'	**48.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	366.00'	**80.0' long Sharp-Crested Rectangular Weir** 0 End Contraction(s)

Primary OutFlow Max=2,065.24 cfs @ 12.84 hrs HW=370.43' (Free Discharge)
└─**1=Culvert** (Inlet Controls 2,065.24 cfs @ 14.91 fps)
  ├─**2=Orifice/Grate** (Passes < 204.52 cfs potential flow)
  └─**3=Sharp-Crested Rectangular Weir** (Passes < 2,435.19 cfs potential flow)

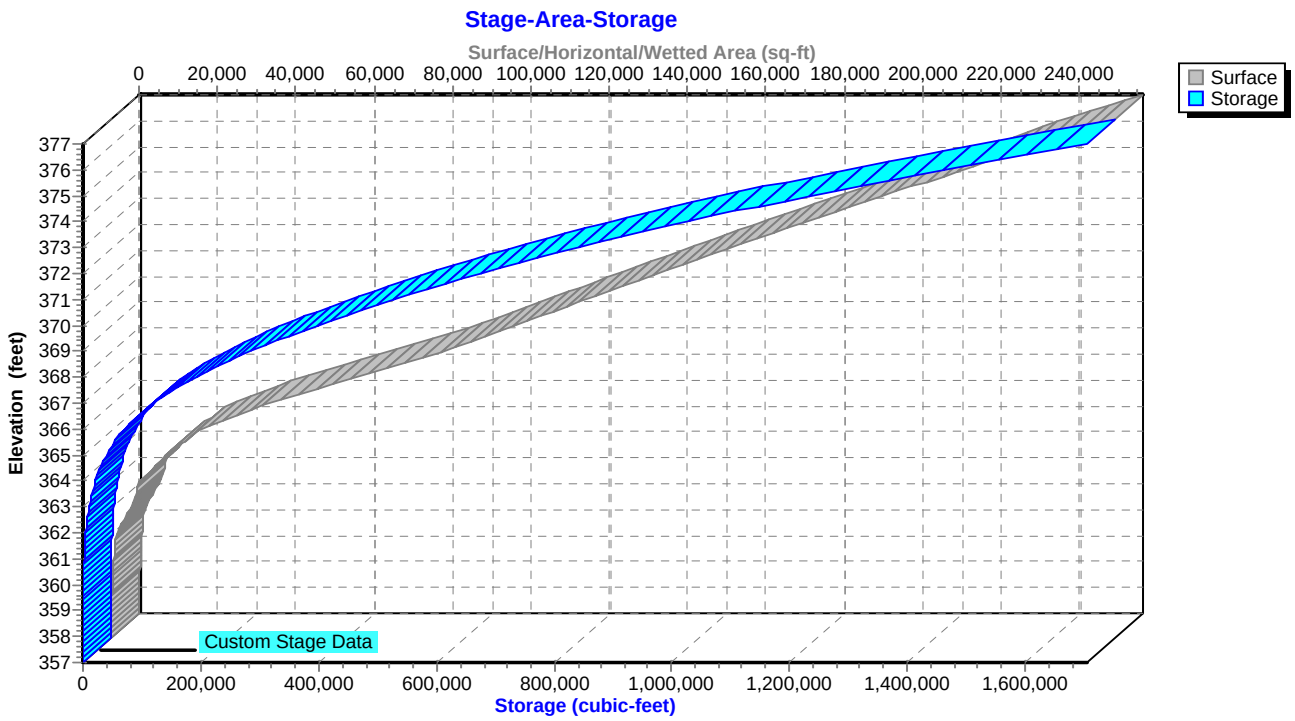
Pond 1P: Existing Pond



Pond 1P: Existing Pond



Pond 1P: Existing Pond



Stage-Discharge for Pond 1P: Existing Pond

Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)
357.00	0.00	367.60	706.88
357.20	0.36	367.80	811.24
357.40	1.41	368.00	921.44
357.60	3.12	368.20	1,037.16
357.80	5.45	368.40	1,158.16
358.00	8.36	368.60	1,284.20
358.20	11.83	368.80	1,415.09
358.40	15.79	369.00	1,550.65
358.60	20.22	369.20	1,690.73
358.80	25.05	369.40	1,835.17
359.00	30.25	369.60	1,974.40
359.20	35.76	369.80	1,996.80
359.40	41.52	370.00	2,018.94
359.60	47.47	370.20	2,040.85
359.80	53.53	370.40	2,062.52
360.00	59.62	370.60	2,083.97
360.20	65.64	370.80	2,105.20
360.40	71.47	371.00	2,126.22
360.60	76.95	371.20	2,147.03
360.80	81.84	371.40	2,167.64
361.00	85.57	371.60	2,188.06
361.20	89.75	371.80	2,208.29
361.40	93.74	372.00	2,228.33
361.60	97.56	372.20	2,248.20
361.80	101.25	372.40	2,267.89
362.00	104.80	372.60	2,287.42
362.20	108.24	372.80	2,306.77
362.40	111.57	373.00	2,325.97
362.60	114.80	373.20	2,345.01
362.80	117.95	373.40	2,363.90
363.00	121.01	373.60	2,382.63
363.20	124.00	373.80	2,401.22
363.40	126.92	374.00	2,419.67
363.60	129.77	374.20	2,437.98
363.80	132.56	374.40	2,456.15
364.00	135.30	374.60	2,474.19
364.20	137.98	374.80	2,492.10
364.40	140.61	375.00	2,509.88
364.60	143.19	375.20	2,527.53
364.80	145.72	375.40	2,545.06
365.00	148.21	375.60	2,562.48
365.20	150.66	375.80	2,579.77
365.40	153.07	376.00	2,596.95
365.60	155.44	376.20	2,614.02
365.80	157.78	376.40	2,630.97
366.00	160.09	376.60	2,647.82
366.20	185.75	376.80	2,664.56
366.40	230.78	377.00	**2,681.20**
366.60	288.39		
366.80	356.17		
367.00	432.74		
367.20	517.15		
367.40	608.71		

Stage-Area-Storage for Pond 1P: Existing Pond

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
357.00	0	0
357.20	12	1
357.40	24	5
357.60	36	11
357.80	48	19
358.00	60	30
358.20	114	47
358.40	168	76
358.60	221	114
358.80	275	164
359.00	329	225
359.20	414	299
359.40	500	390
359.60	585	499
359.80	671	624
360.00	756	767
360.20	861	929
360.40	967	1,112
360.60	1,072	1,315
360.80	1,178	1,540
361.00	1,283	1,787
361.20	2,011	2,116
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368.20	87,992	210,140
368.40	91,698	228,109
368.60	95,403	246,820
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