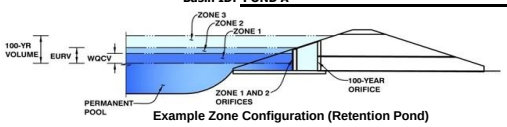
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

Accepted for File
By: Christina Prete, PE
Stormwater Engineer III
Date: 03/06/2024 1:29:47 PM
El Paso County Department of Public Works

Project: Joyful View

Basin ID: POND A



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	SF	
Watershed Area =	23.65	acres
Watershed Length =	2,000	ft
Watershed Length to Centroid =	900	ft
Watershed Slope =	0.010	ft/ft
Watershed Imperviousness =	9.00%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	100.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

Drain Time Too Long

After providing required inputs above including 1-hour rainfall depths, click 'Run CUHP' to generate runoff hydrographs using the embedded Colorado Urban Hydrograph Procedure.

			Optional User Overrides
Water Quality Capture Volume (WQCV) =	0.097	acre-feet	acre-feet
Excess Urban Runoff Volume (EURV) =	0.198	acre-feet	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.298	acre-feet	1.19 inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.675	acre-feet	1.50 inches
10-yr Runoff Volume (P1 = 1.75 in.) =	1.053	acre-feet	1.75 inches
25-yr Runoff Volume (P1 = 2 in.) =	1.735	acre-feet	2.00 inches
50-yr Runoff Volume (P1 = 2.25 in.) =	2.196	acre-feet	2.25 inches
100-yr Runoff Volume (P1 = 2.52 in.) =	2.864	acre-feet	2.52 inches
500-yr Runoff Volume (P1 = 3.14 in.) =	4.077	acre-feet	3.14 inches
Approximate 2-yr Detention Volume =	0.125	acre-feet	
Approximate 5-yr Detention Volume =	0.198	acre-feet	
Approximate 10-yr Detention Volume =	0.431	acre-feet	
Approximate 25-yr Detention Volume =	0.613	acre-feet	
Approximate 50-yr Detention Volume =	0.639	acre-feet	
Approximate 100-yr Detention Volume =	0.831	acre-feet	

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.097	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.102	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.632	acre-feet
Total Detention Basin Volume =	0.831	acre-feet
Initial Surcharge Volume (ISV) =	N/A	ft^3
Initial Surcharge Depth (ISD) =	N/A	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	N/A	ft
Slope of Trickle Channel (S_{TC}) =	N/A	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	

Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

6249.5

Depth Increment = ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Media Surface	--	0.00	--	--	--	1,344	0.031		
50	--	0.50	--	--	--	8,448	0.194	2,448	0.056
51	--	1.50	--	--	--	14,739	0.338	14,041	0.322
52	--	2.50	--	--	--	16,670	0.383	29,746	0.683
53	--	3.50	--	--	--	18,664	0.428	47,413	1.088
54	--	4.50	--	--	--	20,840	0.478	67,165	1.542

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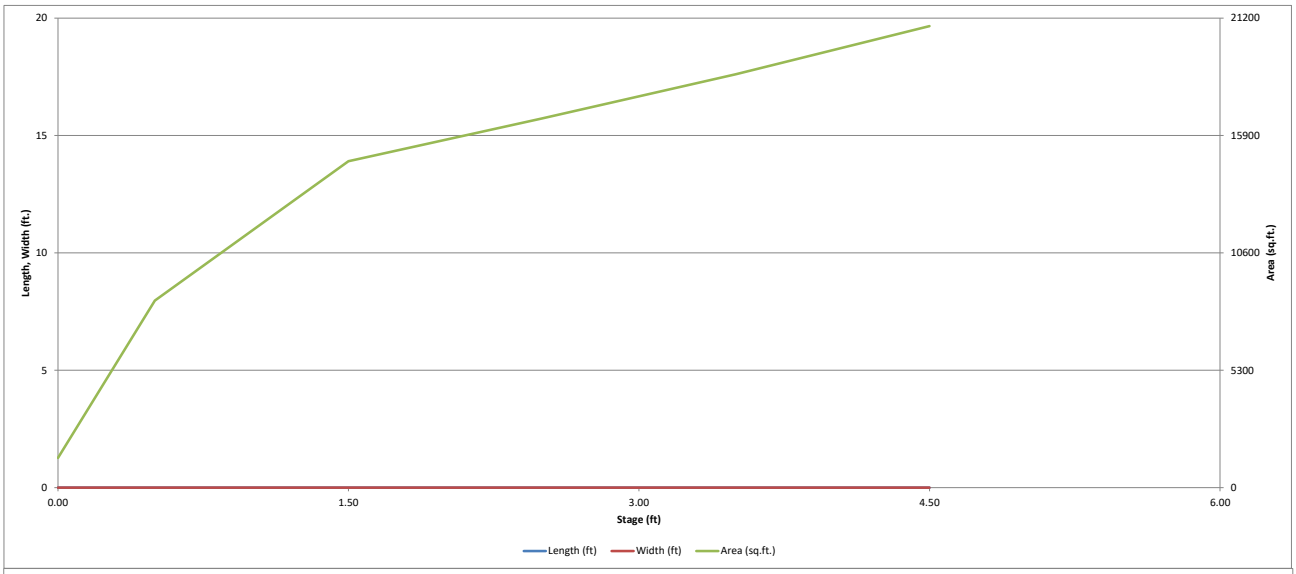
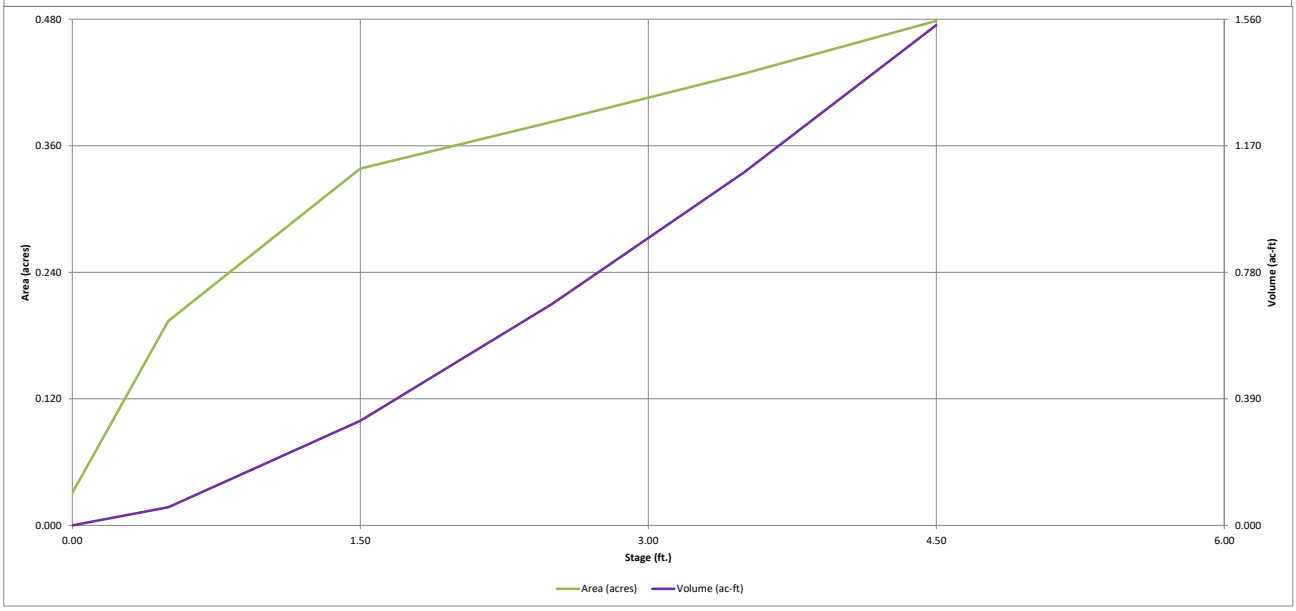


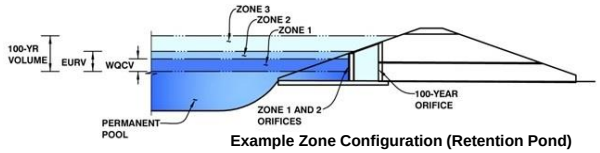


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Project: **Joyful View**

Basin ID: **POND A**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.70	0.097	Filtration Media
Zone 2 (EURV)	1.10	0.102	Rectangular Orifice
Zone 3 (100-year)	2.88	0.632	Weir&Pipe (Restrict)
Total (all zones)		0.831	

User Input: Orifice at Underdrain Outlet (typically used to drain WQCV in a Filtration BMP)

Underdrain Orifice Invert Depth =	2.72	ft (distance below the filtration media surface)	Underdrain Orifice Area =	0.0	ft^2
Underdrain Orifice Diameter =	0.79	inches	Underdrain Orifice Centroid =	0.03	feet

Calculated Parameters for Underdrain

User Input: Orifice Plate with one or more orifices or Elliptical Slot Weir (typically used to drain WQCV and/or EURV in a sedimentation BMP)

Invert of Lowest Orifice =	N/A	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	N/A	ft^2
Depth at top of Zone using Orifice Plate =	N/A	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	N/A	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	N/A	inches	Elliptical Slot Area =	N/A	ft^2

Calculated Parameters for Plate

User Input: Stage and Total Area of Each Orifice Row (numbered from lowest to highest)

	Row 1 (optional)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Rectangular	Not Selected			Zone 2 Rectangular	Not Selected	
Invert of Vertical Orifice =	0.84	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	0.22	N/A	ft^2
Depth at top of Zone using Vertical Orifice =	1.10	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.38	N/A	feet
Vertical Orifice Height =	9.00	N/A	inches				
Vertical Orifice Width =	3.50		inches				

Calculated Parameters for Vertical Orifice

User Input: Overflow Weir (Dropbox with Flat or Sloped Grate and Outlet Pipe OR Rectangular/Trapezoidal Weir (and No Outlet Pipe))

	Zone 3 Weir	Not Selected			Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	1.80	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	1.80	N/A	feet
Overflow Weir Front Edge Length =	3.00	N/A	feet	Overflow Weir Slope Length =	3.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	4.22	N/A	
Horiz. Length of Weir Sides =	3.00	N/A	feet	Overflow Grate Open Area w/o Debris =	6.26	N/A	ft^2
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	3.13	N/A	ft^2
Debris Clogging % =	50%	N/A	%				

Calculated Parameters for Overflow Weir

User Input: Outlet Pipe w/ Flow Restriction Plate (Circular Orifice, Restrictor Plate, or Rectangular Orifice)

	Zone 3 Restrictor	Not Selected			Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	2.74	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	1.49	N/A	ft^2
Outlet Pipe Diameter =	18.00	N/A	inches	Outlet Orifice Centroid =	0.64	N/A	feet
Restrictor Plate Height Above Pipe Invert =	14.10		inches	Half-Central Angle of Restrictor Plate on Pipe =	2.17	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	3.00	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.50	feet
Spillway Crest Length =	20.00	feet	Stage at Top of Freeboard =	4.50	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.48	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	1.54	acre-ft

Calculated Parameters for Spillway

Routed Hydrograph Results

The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.14
CUHP Runoff Volume (acre-ft) =	0.097	0.198	0.298	0.675	1.053	1.735	2.196	2.864	4.077
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.298	0.675	1.053	1.735	2.196	2.864	4.077
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	1.7	4.9	7.5	13.8	17.3	22.2	31.2
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.07	0.21	0.32	0.58	0.73	0.94	1.32
Peak Inflow Q (cfs) =	N/A	N/A	2.7	5.9	8.6	14.9	18.5	23.4	32.4
Peak Outflow Q (cfs) =	0.0	0.1	0.3	1.7	4.6	10.3	13.9	16.1	28.5
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.3	0.6	0.7	0.8	0.7	0.9
Structure Controlling Flow =	Filtration Media	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.1	0.6	1.4	2.0	2.3	2.4
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	39	66	72	71	67	58	53	45	30
Time to Drain 99% of Inflow Volume (hours) =	**40**	68	75	77	76	73	71	68	63
Maximum Ponding Depth (ft) =	0.70	1.10	1.29	1.91	2.12	2.40	2.56	2.98	3.33
Area at Maximum Ponding Depth (acres) =	0.22	0.28	0.31	0.36	0.37	0.38	0.38	0.40	0.42
Maximum Volume Stored (acre-ft) =	0.098	0.199	0.251	0.465	0.541	0.645	0.702	0.868	1.012
			2 max					16.1 max	

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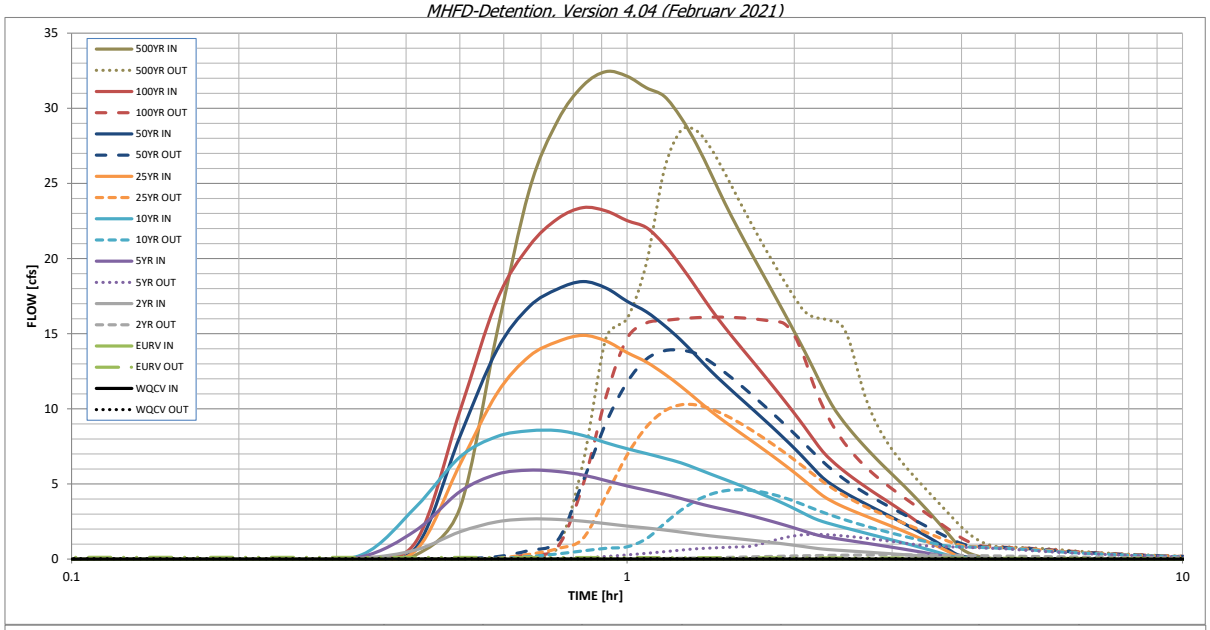

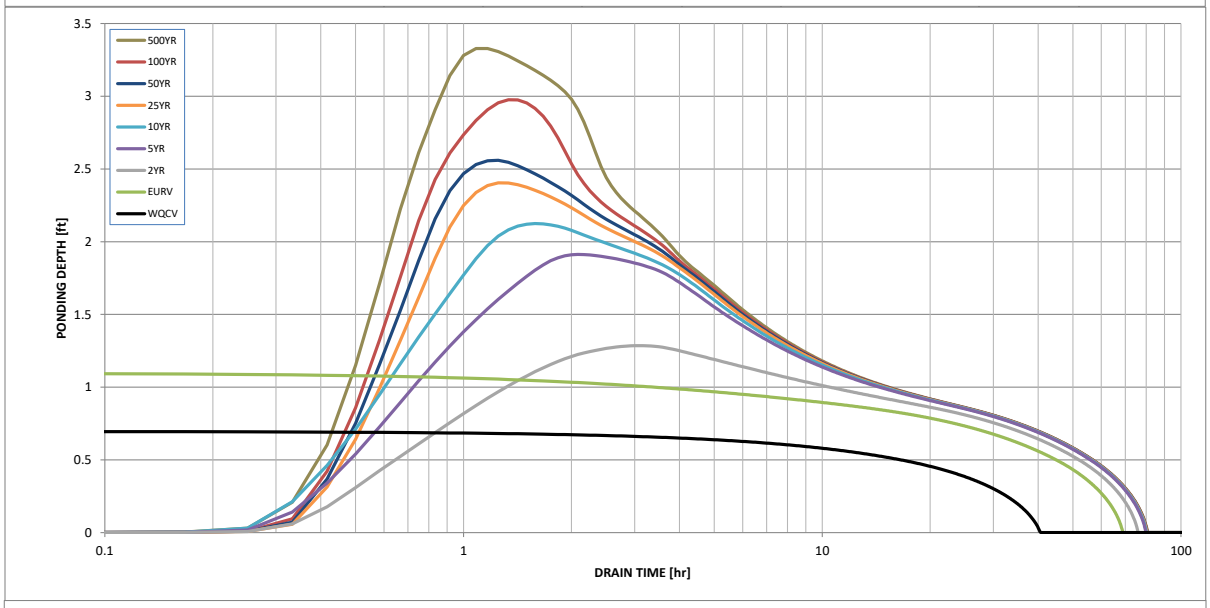

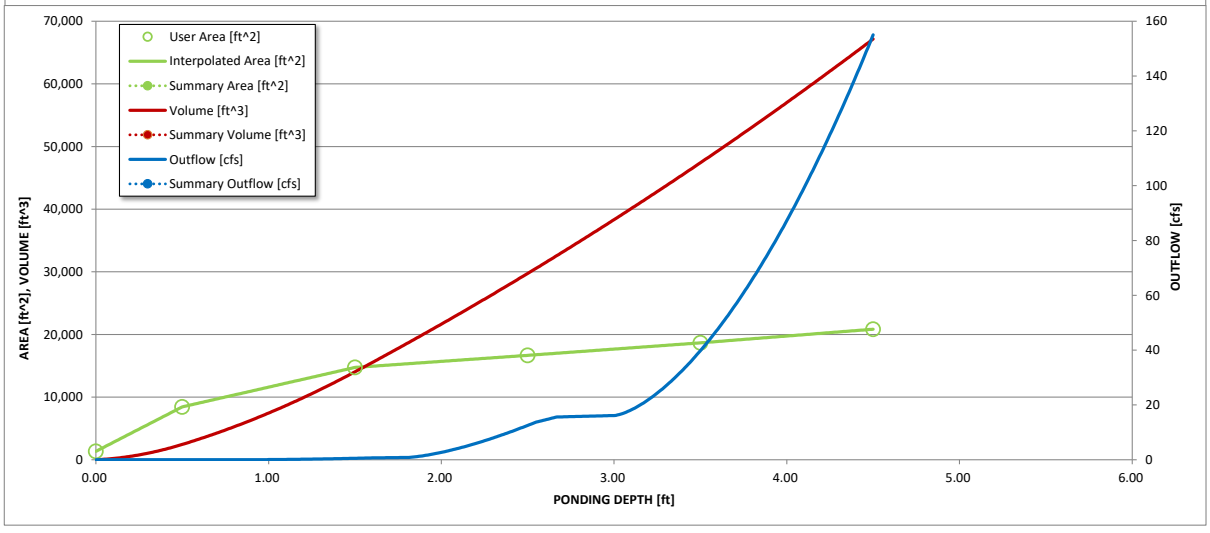

S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename: _____

Inflow Hydrographs

The user can override the calculated inflow hydrographs from this workbook with inflow hydrographs developed in a separate program.

Time Interval	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	0:15:00	0.00	0.00	0.02	0.03	0.03	0.02	0.03	0.03	0.04
	0:20:00	0.00	0.00	0.06	0.17	0.30	0.07	0.08	0.08	0.29
	0:25:00	0.00	0.00	0.61	1.91	3.48	0.59	0.77	1.16	3.39
	0:30:00	0.00	0.00	1.82	4.49	6.79	6.28	8.15	9.84	15.09
	0:35:00	0.00	0.00	2.48	5.65	8.16	11.04	13.93	17.24	24.54
	0:40:00	0.00	0.00	2.67	5.92	8.54	13.50	16.80	20.83	29.17
	0:45:00	0.00	0.00	2.64	5.83	8.55	14.48	17.98	22.65	31.51
	0:50:00	0.00	0.00	2.52	5.59	8.23	14.89	18.47	23.39	32.44
	0:55:00	0.00	0.00	2.36	5.22	7.74	14.51	18.04	23.17	32.14
	1:00:00	0.00	0.00	2.20	4.87	7.35	13.75	17.16	22.53	31.36
	1:05:00	0.00	0.00	2.08	4.59	7.03	13.12	16.46	22.07	30.80
	1:10:00	0.00	0.00	1.94	4.32	6.72	12.33	15.56	20.93	29.39
	1:15:00	0.00	0.00	1.80	4.04	6.41	11.50	14.57	19.51	27.62
	1:20:00	0.00	0.00	1.66	3.75	6.03	10.64	13.52	18.04	25.63
	1:25:00	0.00	0.00	1.54	3.50	5.65	9.84	12.51	16.63	23.69
	1:30:00	0.00	0.00	1.45	3.30	5.30	9.14	11.64	15.42	22.00
	1:35:00	0.00	0.00	1.36	3.11	4.97	8.51	10.85	14.34	20.48
	1:40:00	0.00	0.00	1.27	2.90	4.64	7.93	10.11	13.35	19.06
	1:45:00	0.00	0.00	1.18	2.69	4.32	7.37	9.40	12.40	17.71
	1:50:00	0.00	0.00	1.10	2.49	4.01	6.83	8.72	11.48	16.41
	1:55:00	0.00	0.00	1.01	2.28	3.69	6.30	8.05	10.58	15.14
	2:00:00	0.00	0.00	0.92	2.07	3.36	5.77	7.38	9.71	13.90
	2:05:00	0.00	0.00	0.83	1.87	3.03	5.24	6.71	8.84	12.65
	2:10:00	0.00	0.00	0.74	1.67	2.73	4.71	6.04	7.96	11.41
	2:15:00	0.00	0.00	0.67	1.52	2.50	4.22	5.42	7.16	10.31
	2:20:00	0.00	0.00	0.63	1.42	2.33	3.87	4.98	6.57	9.47
	2:25:00	0.00	0.00	0.59	1.33	2.18	3.59	4.62	6.08	8.77
	2:30:00	0.00	0.00	0.55	1.25	2.03	3.35	4.30	5.65	8.14
	2:35:00	0.00	0.00	0.52	1.17	1.90	3.13	4.01	5.26	7.57
	2:40:00	0.00	0.00	0.48	1.09	1.76	2.92	3.75	4.90	7.04
	2:45:00	0.00	0.00	0.45	1.01	1.64	2.73	3.49	4.56	6.55
	2:50:00	0.00	0.00	0.42	0.94	1.51	2.54	3.25	4.24	6.09
	2:55:00	0.00	0.00	0.38	0.86	1.39	2.36	3.01	3.95	5.65
	3:00:00	0.00	0.00	0.35	0.79	1.28	2.17	2.78	3.65	5.22
	3:05:00	0.00	0.00	0.32	0.72	1.16	2.00	2.55	3.35	4.80
	3:10:00	0.00	0.00	0.29	0.65	1.05	1.82	2.33	3.06	4.38
	3:15:00	0.00	0.00	0.26	0.58	0.94	1.64	2.10	2.77	3.96
	3:20:00	0.00	0.00	0.23	0.51	0.83	1.46	1.87	2.47	3.54
	3:25:00	0.00	0.00	0.20	0.44	0.73	1.29	1.65	2.18	3.12
	3:30:00	0.00	0.00	0.17	0.37	0.62	1.11	1.42	1.89	2.70
	3:35:00	0.00	0.00	0.14	0.30	0.51	0.93	1.20	1.60	2.28
	3:40:00	0.00	0.00	0.11	0.24	0.40	0.76	0.98	1.30	1.86
	3:45:00	0.00	0.00	0.08	0.17	0.30	0.58	0.75	1.01	1.45
	3:50:00	0.00	0.00	0.05	0.10	0.20	0.40	0.53	0.72	1.04
	3:55:00	0.00	0.00	0.03	0.06	0.14	0.24	0.33	0.46	0.70
	4:00:00	0.00	0.00	0.02	0.04	0.11	0.15	0.22	0.31	0.48
	4:05:00	0.00	0.00	0.01	0.03	0.08	0.10	0.15	0.21	0.34
	4:10:00	0.00	0.00	0.01	0.03	0.07	0.06	0.10	0.14	0.23
	4:15:00	0.00	0.00	0.01	0.02	0.05	0.04	0.07	0.09	0.16
	4:20:00	0.00	0.00	0.01	0.02	0.04	0.03	0.05	0.05	0.10
	4:25:00	0.00	0.00	0.01	0.01	0.03	0.02	0.03	0.03	0.06
	4:30:00	0.00	0.00	0.00	0.01	0.02	0.01	0.02	0.01	0.04
	4:35:00	0.00	0.00	0.00	0.01	0.02	0.01	0.02	0.01	0.03
	4:40:00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.02
	4:45:00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.02
	4:50:00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.01
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00