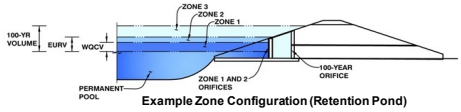
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Accepted for File
By: Christina Prete, PE
Stormwater Manager
Date: 07/01/2024 1:28:01 PM
El Paso County Department of Public Works

Project: Hay Creek Valley

Basin ID: Beaver Creek



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	35.31	acres
Watershed Length =	3,000	ft
Watershed Length to Centroid =	1,500	ft
Watershed Slope =	0.048	ft/ft
Watershed Imperviousness =	15.34%	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	

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) =	0.279	acre-feet	acre-feet
Excess Urban Runoff Volume (EURV) =	0.527	acre-feet	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.629	acre-feet	1.19 inches
5-yr Runoff Volume (P1 = 1.5 in.) =	1.236	acre-feet	1.50 inches
10-yr Runoff Volume (P1 = 1.75 in.) =	1.825	acre-feet	1.75 inches
25-yr Runoff Volume (P1 = 2 in.) =	2.823	acre-feet	2.00 inches
50-yr Runoff Volume (P1 = 2.25 in.) =	3.522	acre-feet	2.25 inches
100-yr Runoff Volume (P1 = 2.52 in.) =	4.509	acre-feet	2.52 inches
500-yr Runoff Volume (P1 = 3.55 in.) =	7.573	acre-feet	3.55 inches
Approximate 2-yr Detention Volume =	0.352	acre-feet	
Approximate 5-yr Detention Volume =	0.532	acre-feet	
Approximate 10-yr Detention Volume =	0.935	acre-feet	
Approximate 25-yr Detention Volume =	1.213	acre-feet	
Approximate 50-yr Detention Volume =	1.280	acre-feet	
Approximate 100-yr Detention Volume =	1.607	acre-feet	

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.279	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.247	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.081	acre-feet
Total Detention Basin Volume =	1.607	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	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

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)
Top of Micropool	--	0.00	--	--	--	60	0.001		
6865.5	--	0.90	--	--	--	60	0.001	54	0.001
6866	--	1.40	--	--	--	237	0.005	128	0.003
	--	1.90	--	--	--	1,096	0.025	461	0.011
6867	--	2.40	--	--	--	4,884	0.112	1,956	0.045
	--	2.90	--	--	--	12,158	0.279	6,217	0.143
6868	--	3.40	--	--	--	22,987	0.528	15,003	0.344
	--	3.90	--	--	--	33,167	0.761	29,042	0.667
6869	--	4.40	--	--	--	43,762	1.005	48,274	1.108
	--	4.90	--	--	--	49,829	1.144	71,672	1.645
6870	--	5.40	--	--	--	56,410	1.295	98,231	2.255
	--	5.90	--	--	--	59,443	1.365	127,195	2.920
6871	--	6.40	--	--	--	62,026	1.424	157,562	3.617
	--	6.90	--	--	--	64,682	1.485	189,239	4.344
6872	--	7.40	--	--	--	67,380	1.547	222,254	5.102
	--	7.90	--	--	--	70,161	1.611	256,640	5.892
6873	--	8.40	--	--	--	72,971	1.675	292,423	6.713

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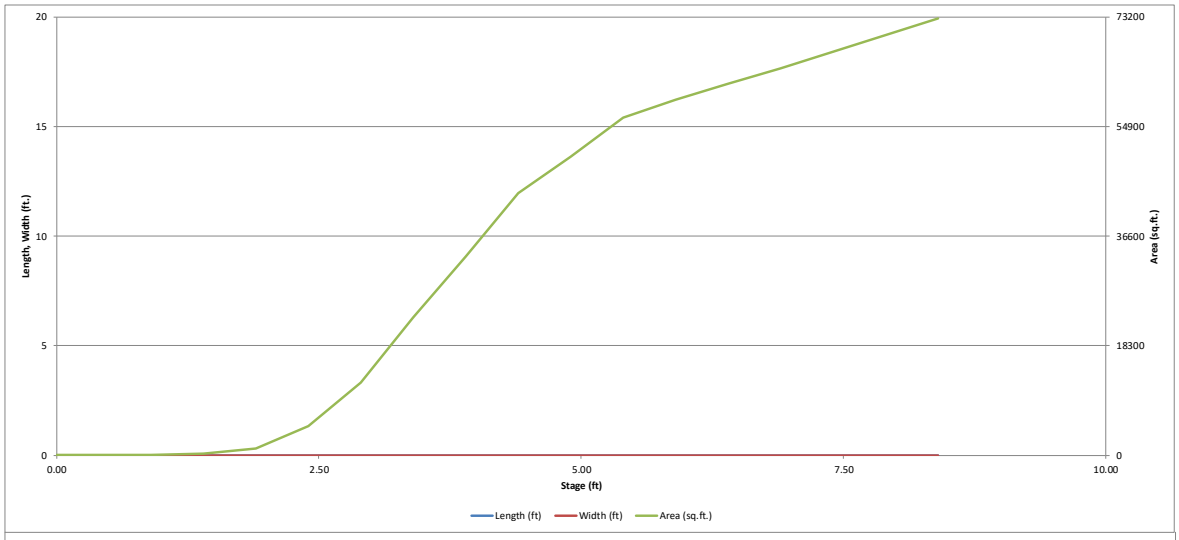

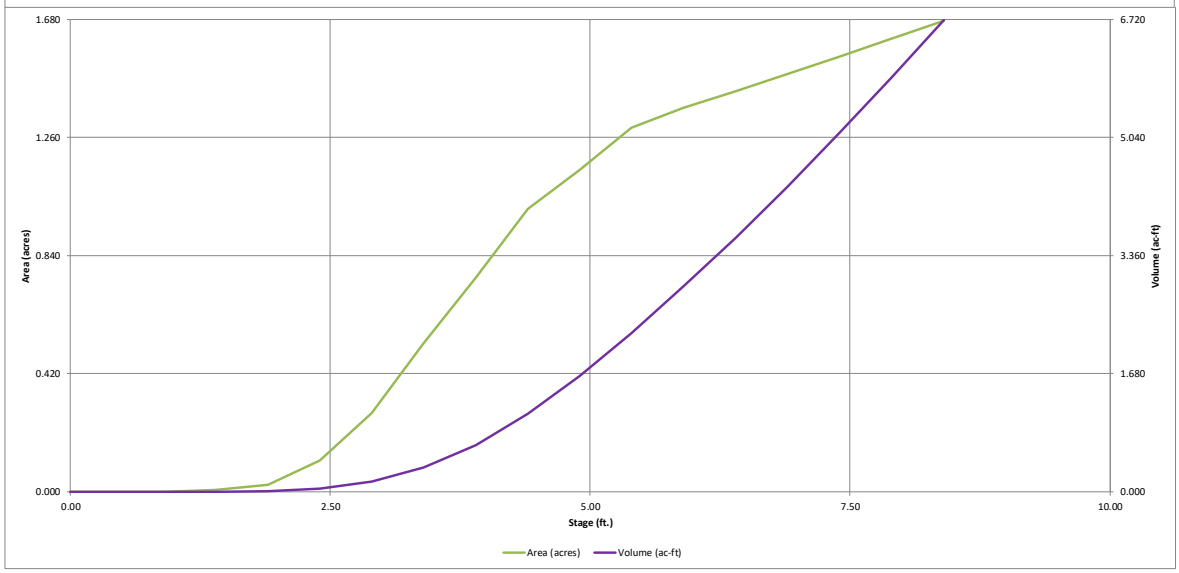

DETENTION BASIN OUTLET STRUCTURE DESIGN

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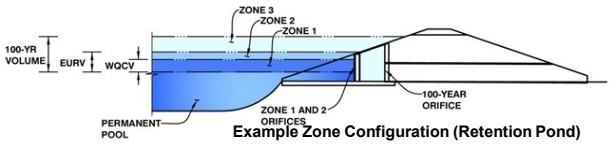
Project: Hay Creek Valley

Basin ID: Beaver Creek



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.27	0.279	Orifice Plate
Zone 2 (EURV)	3.71	0.247	Circular Orifice
Zone 3 (100-year)	4.87	1.081	Weir&Pipe (Restrict)
Total (all zones)		1.607	

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

			Calculated Parameters for Underdrain		
Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)	Underdrain Orifice Area =	N/A	ft²
Underdrain Orifice Diameter =	N/A	inches	Underdrain Orifice Centroid =	N/A	feet

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)

			Calculated Parameters for Plate		
Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	5.764E-03	ft²
Depth at top of Zone using Orifice Plate =	2.44	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 =	0.83	sq. inches (diameter = 1 inch)	Elliptical Slot Area =	N/A	ft²

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

	Row 1 (required)	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)	0.00	1.50						
Orifice Area (sq. inches)	0.83	0.83						

	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)								
Orifice Area (sq. inches)								

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Circular	Not Selected		Calculated Parameters for Vertical Orifice	Zone 2 Circular	Not Selected	
Invert of Vertical Orifice =	3.00	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	0.07	N/A	ft²
Depth at top of Zone using Vertical Orifice =	3.15	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.15	N/A	feet
Vertical Orifice Diameter =	3.50	N/A	inches				

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		Calculated Parameters for Overflow Weir	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	3.86	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	3.86	N/A	feet
Overflow Weir Front Edge Length =	6.00	N/A	feet	Overflow Weir Slope Length =	4.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	11.25	N/A	
Horiz. Length of Weir Sides =	4.00	N/A	feet	Overflow Grate Open Area w/o Debris =	16.70	N/A	ft²
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	8.35	N/A	ft²
Debris Clogging % =	50%	N/A	%				

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

	Zone 3 Restrictor	Not Selected		Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.25	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	1.49	N/A	ft²
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

User Input: Emergency Spillway (Rectangular or Trapezoidal)

			Calculated Parameters for Spillway	
Spillway Invert Stage=	6.25	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.34 feet
Spillway Crest Length =	50.00	feet	Stage at Top of Freeboard =	8.40 feet
Spillway End Slopes =	10.00	H:V	Basin Area at Top of Freeboard =	1.68 acres
Freeboard above Max Water Surface =	1.81	feet	Basin Volume at Top of Freeboard =	6.71 acre-ft

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	3.55
CUHP Runoff Volume (acre-ft) =	0.279	0.527	0.629	1.236	1.825	2.823	3.522	4.509	7.573
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.629	1.236	1.825	2.823	3.522	4.509	7.573
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	2.9	8.1	12.4	22.7	28.6	36.6	61.3
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.08	0.23	0.35	0.64	0.81	1.04	1.74
Peak Inflow Q (cfs) =	N/A	N/A	6.0	11.6	16.1	26.4	32.4	40.6	65.9
Peak Outflow Q (cfs) =	0.2	0.3	0.3	4.0	8.3	14.5	15.1	15.9	35.5
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.5	0.7	0.6	0.5	0.4	0.6
Structure Controlling Flow =	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.2	0.5	0.8	0.9	0.9	1.0
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) =	38	48	52	52	49	45	41	37	26
Time to Drain 99% of Inflow Volume (hours) =	**40**	50	54	57	56	54	53	52	48
Maximum Ponding Depth (ft) =	3.27	3.71	3.75	4.09	4.25	4.51	4.83	5.35	6.49
Area at Maximum Ponding Depth (acres) =	0.46	0.67	0.69	0.85	0.93	1.03	1.12	1.28	1.43
Maximum Volume Stored (acre-ft) =	0.280	0.530	0.558	0.820	0.954	1.210	1.555	2.178	3.731

WE ARE OVER DETAINING TO REDUCE THE TOTAL DISCHARGE FROM THE SITE TO BELOW PRE DEVELOPMENT VALUES. BECAUSE WE ARE OVER DETAINING, THE PLATE ON THE OUTLET FROM THE POND IS SET TO AN ELEVATION THAT ALSO AFFECTS THESE MORE FREQUENT STORM EVENTS.

DETENTION BASIN OUTLET STRUCTURE DESIGN

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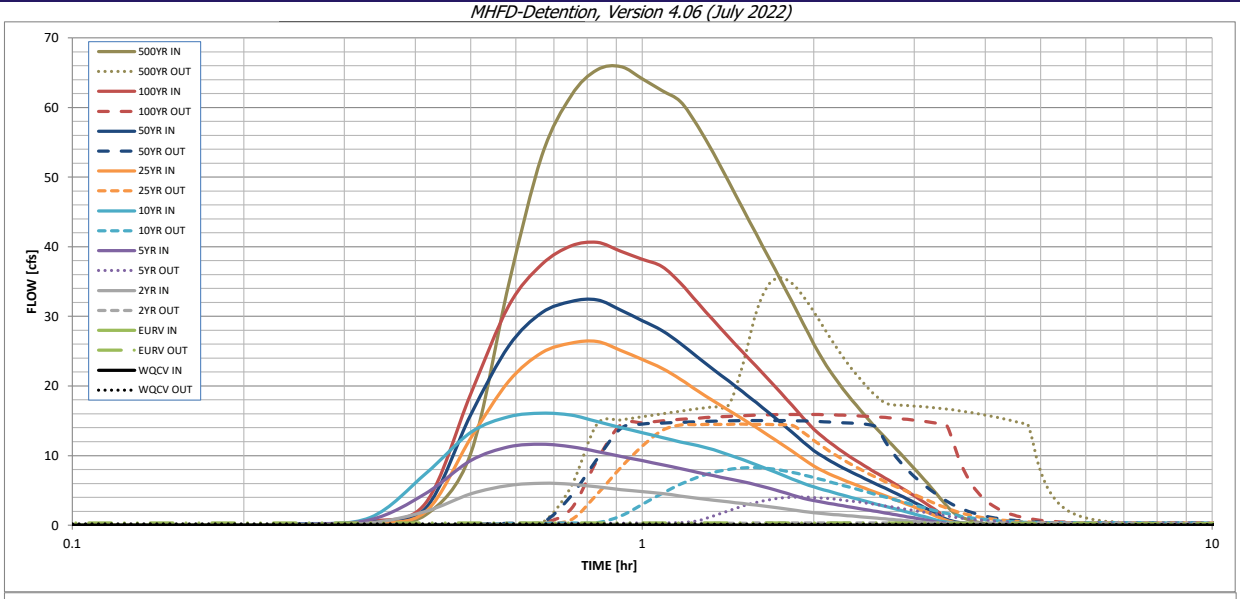

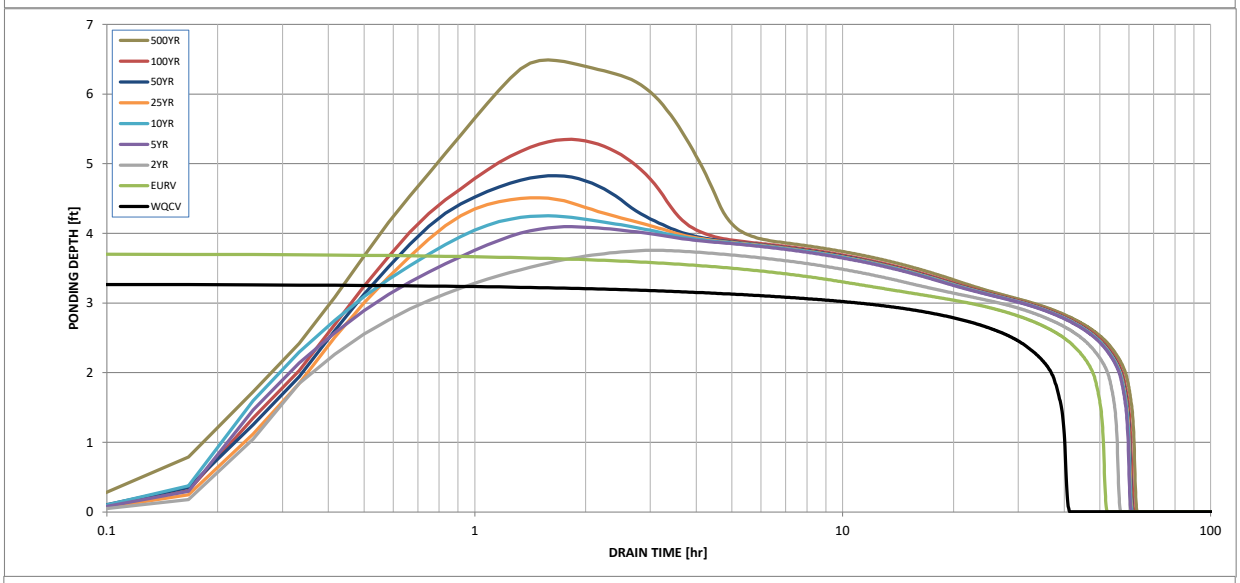

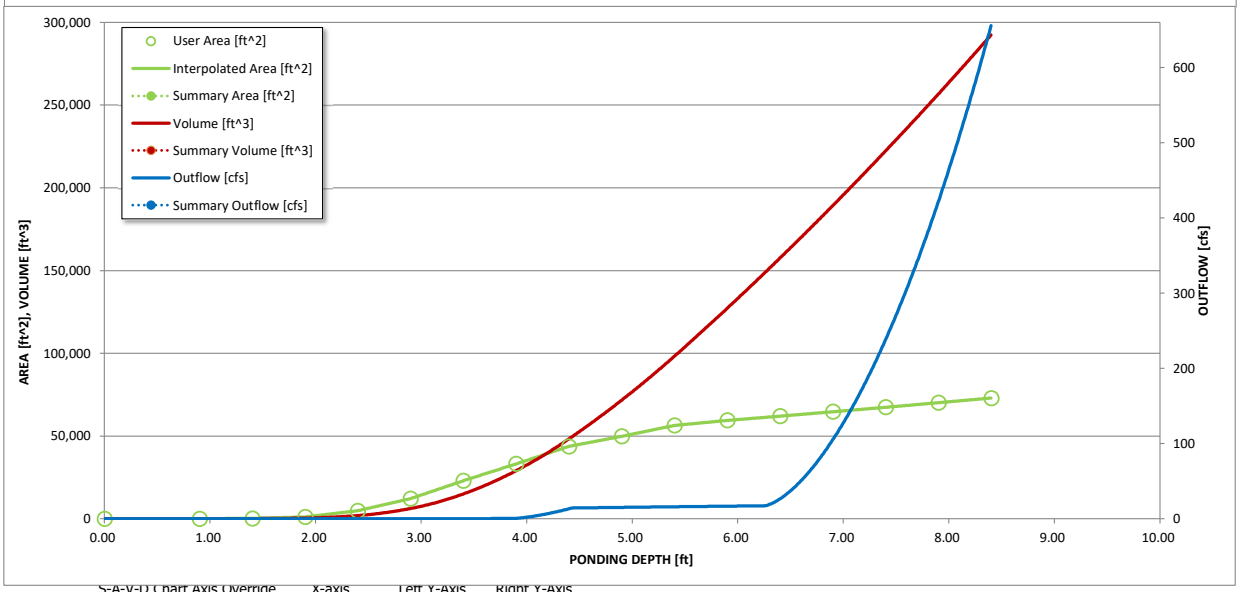

S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

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.

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	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	0.01	0.00	0.05
	0:15:00	0.00	0.00	0.08	0.13	0.17	0.11	0.14	0.14	0.26
	0:20:00	0.00	0.00	0.33	0.77	1.13	0.34	0.41	0.56	1.48
	0:25:00	0.00	0.00	1.99	4.56	7.40	1.93	2.42	3.20	10.28
	0:30:00	0.00	0.00	4.49	9.28	13.31	12.49	15.88	18.87	34.66
	0:35:00	0.00	0.00	5.71	11.25	15.59	20.67	25.74	31.52	53.05
	0:40:00	0.00	0.00	6.02	11.61	16.09	24.78	30.51	37.45	61.68
	0:45:00	0.00	0.00	5.87	11.27	15.81	26.16	32.13	40.11	65.41
	0:50:00	0.00	0.00	5.50	10.59	14.88	26.38	32.36	40.61	65.89
	0:55:00	0.00	0.00	5.12	9.87	14.01	25.12	30.88	39.36	64.10
	1:00:00	0.00	0.00	4.82	9.27	13.31	23.79	29.38	38.20	62.42
	1:05:00	0.00	0.00	4.54	8.68	12.62	22.54	27.96	37.15	60.85
	1:10:00	0.00	0.00	4.21	8.12	11.95	20.98	26.12	34.77	57.37
	1:15:00	0.00	0.00	3.88	7.58	11.43	19.30	24.14	31.97	53.41
	1:20:00	0.00	0.00	3.60	7.11	10.83	17.84	22.36	29.40	49.38
	1:25:00	0.00	0.00	3.35	6.67	10.13	16.53	20.72	27.05	45.51
	1:30:00	0.00	0.00	3.12	6.24	9.41	15.26	19.15	24.86	41.86
	1:35:00	0.00	0.00	2.89	5.81	8.70	14.05	17.63	22.85	38.46
	1:40:00	0.00	0.00	2.66	5.33	8.00	12.88	16.17	20.91	35.19
	1:45:00	0.00	0.00	2.44	4.84	7.31	11.73	14.74	19.02	32.02
	1:50:00	0.00	0.00	2.21	4.34	6.64	10.60	13.33	17.18	28.94
	1:55:00	0.00	0.00	1.99	3.88	6.00	9.50	11.97	15.40	26.02
	2:00:00	0.00	0.00	1.80	3.53	5.50	8.49	10.73	13.79	23.48
	2:05:00	0.00	0.00	1.66	3.27	5.08	7.72	9.77	12.53	21.41
	2:10:00	0.00	0.00	1.54	3.02	4.69	7.08	8.96	11.47	19.60
	2:15:00	0.00	0.00	1.42	2.79	4.32	6.52	8.24	10.52	17.97
	2:20:00	0.00	0.00	1.31	2.57	3.97	6.00	7.58	9.66	16.47
	2:25:00	0.00	0.00	1.21	2.36	3.63	5.53	6.98	8.87	15.09
	2:30:00	0.00	0.00	1.10	2.16	3.31	5.07	6.40	8.12	13.79
	2:35:00	0.00	0.00	1.00	1.96	3.00	4.64	5.85	7.43	12.58
	2:40:00	0.00	0.00	0.91	1.77	2.70	4.22	5.32	6.77	11.44
	2:45:00	0.00	0.00	0.82	1.58	2.42	3.81	4.80	6.13	10.33
	2:50:00	0.00	0.00	0.72	1.40	2.15	3.41	4.29	5.49	9.24
	2:55:00	0.00	0.00	0.63	1.22	1.88	3.01	3.79	4.85	8.16
	3:00:00	0.00	0.00	0.54	1.04	1.62	2.61	3.29	4.22	7.08
	3:05:00	0.00	0.00	0.45	0.87	1.36	2.21	2.79	3.58	6.01
	3:10:00	0.00	0.00	0.36	0.69	1.10	1.82	2.30	2.95	4.94
	3:15:00	0.00	0.00	0.28	0.52	0.84	1.43	1.80	2.33	3.88
	3:20:00	0.00	0.00	0.19	0.36	0.60	1.04	1.32	1.71	2.84
	3:25:00	0.00	0.00	0.13	0.25	0.44	0.67	0.86	1.13	1.96
	3:30:00	0.00	0.00	0.09	0.19	0.35	0.45	0.60	0.77	1.40
	3:35:00	0.00	0.00	0.07	0.15	0.29	0.31	0.43	0.54	1.03
	3:40:00	0.00	0.00	0.06	0.12	0.23	0.23	0.31	0.38	0.75
	3:45:00	0.00	0.00	0.05	0.10	0.19	0.16	0.23	0.26	0.53
	3:50:00	0.00	0.00	0.04	0.08	0.15	0.12	0.17	0.18	0.37
	3:55:00	0.00	0.00	0.03	0.06	0.12	0.09	0.13	0.11	0.25
	4:00:00	0.00	0.00	0.03	0.05	0.09	0.07	0.09	0.07	0.17
	4:05:00	0.00	0.00	0.02	0.04	0.07	0.05	0.07	0.06	0.13
	4:10:00	0.00	0.00	0.02	0.03	0.05	0.04	0.05	0.05	0.10
	4:15:00	0.00	0.00	0.01	0.02	0.04	0.03	0.04	0.04	0.08
	4:20:00	0.00	0.00	0.01	0.01	0.03	0.02	0.03	0.03	0.06
	4:25:00	0.00	0.00	0.01	0.01	0.02	0.02	0.02	0.02	0.05
	4:30:00	0.00	0.00	0.01	0.01	0.01	0.01	0.02	0.02	0.03
	4:35:00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.02
	4:40:00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	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