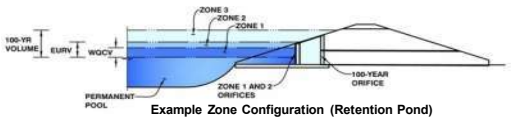
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: _____

Basin ID: _____



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	25.64	acres
Watershed Length =	1,521	ft
Watershed Length to Centroid =	760	ft
Watershed Slope =	0.013	ft/ft
Watershed Imperviousness =	79.00%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	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) =	0.688	acre-feet	acre-feet
Excess Urban Runoff Volume (EURV) =	2.655	acre-feet	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	1.908	acre-feet	1.19 inches
5-yr Runoff Volume (P1 = 1.5 in.) =	2.475	acre-feet	1.50 inches
10-yr Runoff Volume (P1 = 1.75 in.) =	2.930	acre-feet	1.75 inches
25-yr Runoff Volume (P1 = 2 in.) =	3.465	acre-feet	2.00 inches
50-yr Runoff Volume (P1 = 2.25 in.) =	3.988	acre-feet	2.25 inches
100-yr Runoff Volume (P1 = 2.52 in.) =	4.596	acre-feet	2.52 inches
500-yr Runoff Volume (P1 = 3.46 in.) =	6.652	acre-feet	3.46 inches
Approximate 2-yr Detention Volume =	1.742	acre-feet	
Approximate 5-yr Detention Volume =	2.266	acre-feet	
Approximate 10-yr Detention Volume =	2.706	acre-feet	
Approximate 25-yr Detention Volume =	3.217	acre-feet	
Approximate 50-yr Detention Volume =	3.516	acre-feet	
Approximate 100-yr Detention Volume =	3.795	acre-feet	

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.688	acre-feet
Zone 2 Volume (5-year - Zone 1) =	1.577	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.529	acre-feet
Total Detention Basin Volume =	3.795	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

Table 6-2. Rainfall Depths for Colorado Springs

Return Period	1-Hour Depth	6-Hour Depth	24-Hour Depth
2	1.19	1.70	2.10
5	1.50	2.10	2.70
10	1.75	2.40	3.20
25	2.00	2.90	3.60
50	2.25	3.20	4.20
100	2.52	3.50	4.60

Where Z= 6,840 ft/100

Stage 0 - 6790.65

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	--	--	--	385	0.009		
6791	--	0.35	--	--	--	385	0.009	135	0.003
	--	1.35	--	--	--	6,405	0.147	3,530	0.081
	--	2.35	--	--	--	21,188	0.486	17,326	0.398
	--	3.35	--	--	--	38,544	0.885	47,192	1.083
	--	4.05	--	--	--	50,064	1.149	78,204	1.795
	--	4.35	--	--	--	54,909	1.261	93,950	2.157
	--	4.55	--	--	--	57,947	1.330	105,236	2.416
	--	5.35	--	--	--	68,379	1.570	155,766	3.576
	--	5.55	--	--	--	70,555	1.620	169,659	3.895

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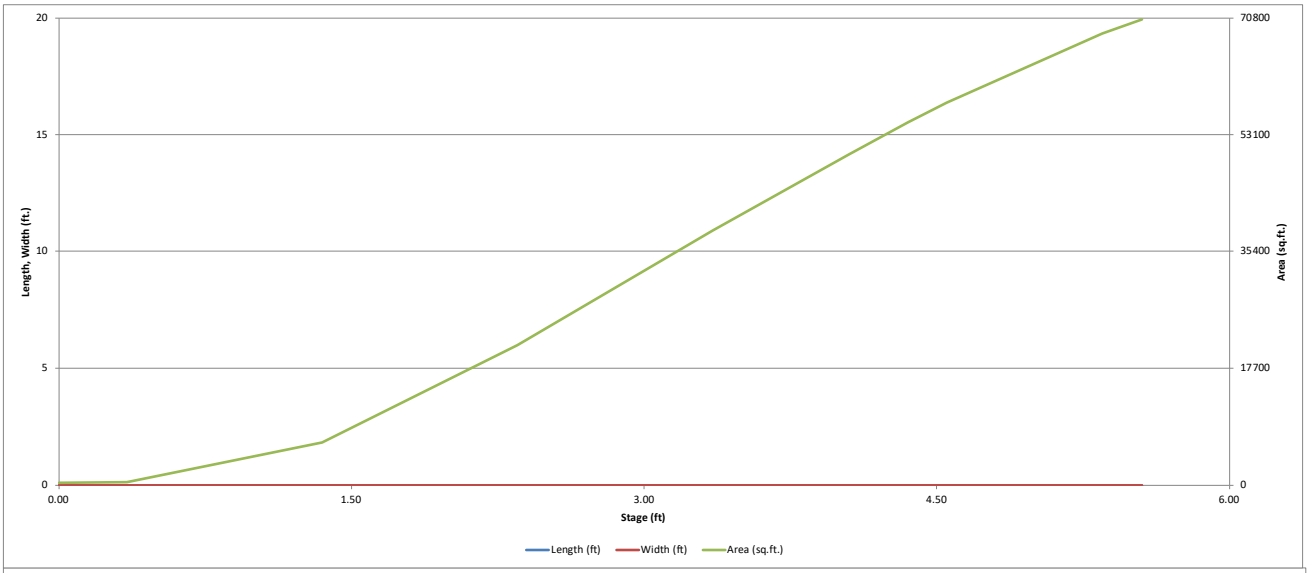
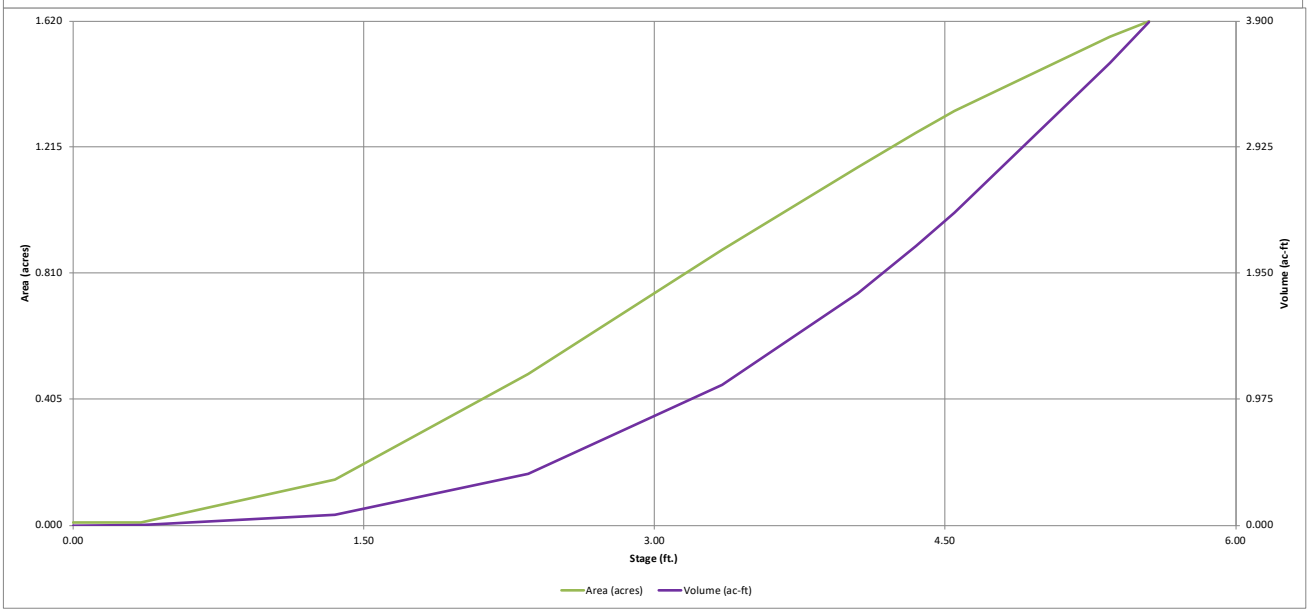


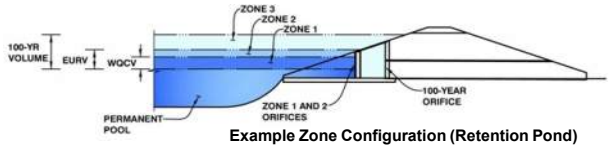


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project:

Basin ID:



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.85	0.688	Orifice Plate
Zone 2 (5-year)	4.44	1.577	Rectangular Orifice
Zone 3 (100-year)	5.49	1.529	Weir&Pipe (Circular)
Total (all zones)		3.795	

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

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

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	1.410E-02	ft^2
Depth at top of Zone using Orifice Plate =	2.85	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	8.60	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	2.03	sq. inches (diameter = 1-5/8 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 (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	0.70	1.40	2.10				
Orifice Area (sq. inches)	2.03	2.03	2.03	2.03				

	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 Rectangular	Not Selected			Zone 2 Rectangular	Not Selected
Invert of Vertical Orifice =	2.86	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	3.25	N/A
Depth at top of Zone using Vertical Orifice =	3.43	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.50	N/A
Vertical Orifice Height =	12.00	N/A	inches			
Vertical Orifice Width =	39.00		inches			

Calculated Parameters for Vertical Orif

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 =	3.85	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	3.85	N/A
Overflow Weir Front Edge Length =	11.33	N/A	feet	Overflow Weir Slope Length =	2.91	N/A
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	4.67	N/A
Horiz. Length of Weir Sides =	2.91	N/A	feet	Overflow Grate Open Area w/o Debris =	22.95	N/A
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	22.95	N/A
Debris Clogging % =	0%	N/A	%			

Calculated Parameters for Overflow W

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

	Zone 3 Circular	Not Selected			Zone 3 Circular	Not Selected
Depth to Invert of Outlet Pipe =	0.00	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	4.91	N/A
Circular Orifice Diameter =	30.00	N/A	inches	Outlet Orifice Centroid =	1.25	N/A
				Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A

Calculated Parameters for Outlet Pipe w/ Flow Restriction Pla

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	4.35	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	1.10	feet
Spillway Crest Length =	20.00	feet	Stage at Top of Freeboard =	6.45	feet
Spillway End Slopes =	3.00	H:V	Basin Area at Top of Freeboard =	1.62	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	3.89	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 AI

Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52
CUHP Runoff Volume (acre-ft) =	0.688	2.655	1.908	2.475	2.930	3.465	3.988	4.596
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	1.908	2.475	2.930	3.465	3.988	4.596
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.2	0.3	0.5	4.2	8.4	13.7
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A	40.6	58.5	69.8	75.1	88.9	121.0
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	1.58	2.28	2.72	2.93	3.47	4.72
Peak Inflow Q (cfs) =	N/A	N/A	31.7	40.4	46.8	57.6	66.7	78.7
Peak Outflow Q (cfs) =	0.4	50.9	6.4	10.5	14.6	25.6	33.8	41.5
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.2	0.2	0.3	0.4	0.3
Structure Controlling Flow =	Plate	Spillway	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1
Max Velocity through Grate 1 (fps) =	N/A	1.10	N/A	N/A	0.1	0.5	0.8	1.1
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	35	36	38	37	36	35	34	32
Time to Drain 99% of Inflow Volume (hours) =	**38**	41	43	42	42	41	41	40
Maximum Ponding Depth (ft) =	2.85	4.73	3.57	3.80	3.93	4.10	4.20	4.34
Area at Maximum Ponding Depth (acres) =	0.69	1.38	0.96	1.05	1.10	1.17	1.20	1.25
Maximum Volume Stored (acre-ft) =	0.691	2.660	1.278	1.520	1.660	1.853	1.960	2.132
WSE (Stage 0 = 6790.65)	6793.500	6795.380	6794.219	6794.452	6794.584	6794.752	6794.849	6794.987

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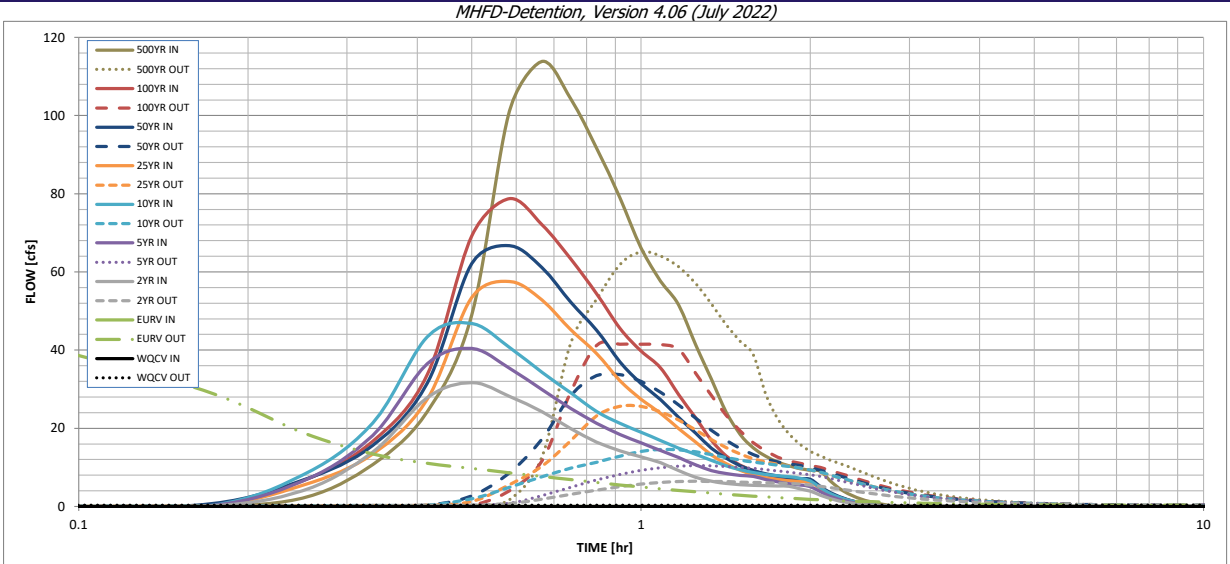

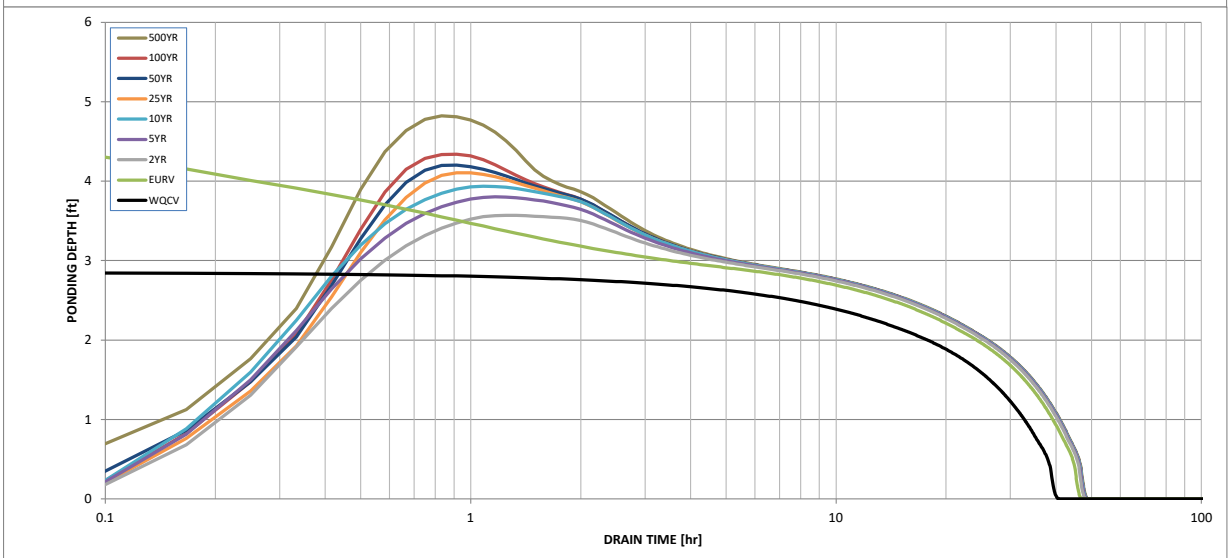

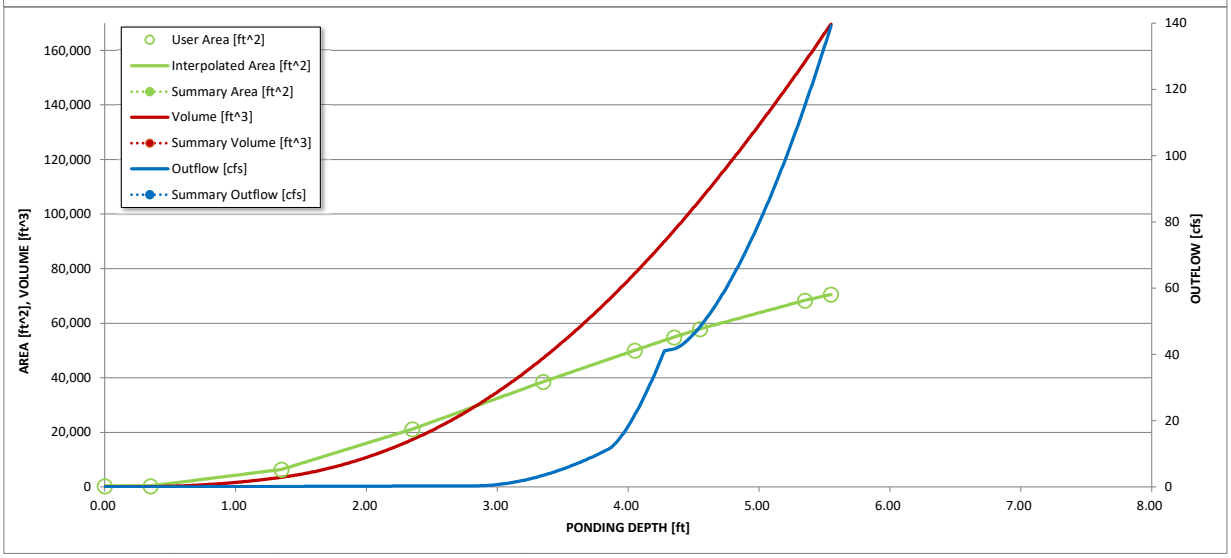

S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

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	0.45	0.04	2.16
	0:15:00	0.00	0.00	3.98	6.47	8.01	5.38	6.68	6.54	10.74
	0:20:00	0.00	0.00	13.94	18.20	21.33	13.42	15.59	16.74	24.25
	0:25:00	0.00	0.00	27.86	36.54	43.39	27.41	31.54	33.70	48.92
	0:30:00	0.00	0.00	31.70	40.42	46.82	53.48	62.16	69.20	101.13
	0:35:00	0.00	0.00	28.17	35.34	40.66	57.58	66.70	78.71	113.88
	0:40:00	0.00	0.00	24.24	29.86	34.31	52.77	61.10	72.06	104.19
	0:45:00	0.00	0.00	19.89	25.06	29.04	45.15	52.18	63.29	91.71
	0:50:00	0.00	0.00	16.48	21.29	24.28	39.15	45.14	54.45	79.03
	0:55:00	0.00	0.00	14.25	18.41	21.25	32.20	36.99	45.61	66.10
	1:00:00	0.00	0.00	12.65	16.25	19.00	27.45	31.47	39.75	57.65
	1:05:00	0.00	0.00	11.17	14.29	16.88	23.84	27.31	35.46	51.51
	1:10:00	0.00	0.00	9.15	12.49	14.92	19.91	22.75	28.57	41.33
	1:15:00	0.00	0.00	7.48	10.61	13.34	16.47	18.75	22.65	32.59
	1:20:00	0.00	0.00	6.44	9.19	11.81	13.15	14.90	16.91	24.17
	1:25:00	0.00	0.00	5.89	8.42	10.36	10.95	12.37	12.96	18.42
	1:30:00	0.00	0.00	5.59	7.97	9.37	9.25	10.43	10.58	14.94
	1:35:00	0.00	0.00	5.43	7.67	8.68	8.14	9.17	9.14	12.82
	1:40:00	0.00	0.00	5.32	6.89	8.19	7.39	8.33	8.15	11.35
	1:45:00	0.00	0.00	5.23	6.27	7.86	6.91	7.78	7.50	10.38
	1:50:00	0.00	0.00	5.17	5.83	7.62	6.57	7.39	7.03	9.69
	1:55:00	0.00	0.00	4.47	5.50	7.24	6.35	7.14	6.72	9.24
	2:00:00	0.00	0.00	3.91	5.09	6.55	6.20	6.97	6.58	9.03
	2:05:00	0.00	0.00	2.85	3.72	4.74	4.54	5.10	4.82	6.62
	2:10:00	0.00	0.00	2.01	2.61	3.33	3.19	3.58	3.40	4.66
	2:15:00	0.00	0.00	1.40	1.82	2.33	2.24	2.51	2.40	3.29
	2:20:00	0.00	0.00	0.96	1.23	1.61	1.54	1.73	1.66	2.27
	2:25:00	0.00	0.00	0.64	0.81	1.08	1.04	1.16	1.11	1.52
	2:30:00	0.00	0.00	0.41	0.54	0.72	0.71	0.79	0.76	1.03
	2:35:00	0.00	0.00	0.24	0.34	0.44	0.45	0.50	0.48	0.65
	2:40:00	0.00	0.00	0.12	0.19	0.23	0.24	0.27	0.26	0.35
	2:45:00	0.00	0.00	0.05	0.08	0.09	0.10	0.11	0.11	0.15
	2:50:00	0.00	0.00	0.01	0.02	0.02	0.02	0.02	0.02	0.03
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	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