



Permanent Extended Detention Basin Certification Letter

March 17, 2025

Project: Electronic Storage

Site Location: 7717 Electronic Drive, Colorado Springs, CO

Sand Filter Location: Southeast corner of site

Discussion: The permanent full spectrum detention structure for Electronic Storage is an extended detention basin. The required storage volume was calculated to be 0.202 ac-ft. Based upon as-built surveys by Edward-James Surveying and site inspections, the extended detention basin provides the volume required.

The following notable discrepancies were identified when the surveyed/as-built pond was compared to the approved plans:

- Additional riprap was installed on the southeast side of the pond. The area downstream of the spillway to the property line is nearly flat and a path of riprap was placed between the spillway and property line.
 - The path of riprap after the spillway is 3-5' wide with D50=12" riprap set below the surrounding grade. Per the attached spillway riprap sizing chart, 12" is larger than required.
- The top of the outlet structure was constructed 6" high.
 - Per the design spreadsheet the storage volume and flow rates are still acceptable in this condition.
- The inlet orifice plate bottom orifice was constructed 0.2' high. This orifice was then enlarged to adjust flows for the higher elevation.
 - Per the design spreadsheet the storage volume and flow rates are acceptable in this condition.
- The outlet structure top grate installed is different from the plans and has a significantly different open area. The grate installed is heavy cast iron with relatively small openings.
 - On the design spreadsheet the grate open area was lowered to 40% to account for this different grate.

More detailed information about these discrepancies, and additional minor discrepancies, has been documented on the Extended Detention Basin As-Built.

Based on periodic site visits to the project during significant/key phases of the installation and the survey, Terra Nova Engineering is of the opinion that the extended detention basin has been constructed in general compliance with the approved Grading, Erosion, & Sediment Control Plan; Construction Plans; and Specifications as filed with this project.

All roads and stormwater infrastructure associated with this development are privately owned. As such as-builts for these facilities are not required and have not been prepared.

Statement of Engineer in Responsible Charge: I, Dane Frank, a registered Professional Engineer in the State of Colorado, in accordance with Sections 5.2 and 5.3 of the Bylaws and Rules of the State Board of Registration for Professional Engineers and Professional Land Surveyors, do hereby certify that I or a person under my responsible charge periodically observed the construction of the above mentioned project. Based on the on-site field observations and review of pertinent documentation, it is my professional opinion that the required stormwater treatment facilities have been installed and are in general compliance with the approved Grading, Erosion, & Sediment Control Plan; Construction Plans; and Specifications as filed with El Paso County; provide the required storage volume; and will meet the required release rates. The extended detention basin is stable with respect to settlement and subsidence, sloughing of cut and fill slopes, and ground cover. For structures with a Water Quality Capture Volume (WQCV), I have attached the post-construction As-Built drawings. The As-Built drawings accurately depict the final installation of the stormwater facilities and verify the WQCV.

PREPARED BY:
TERRA NOVA ENGINEERING, INC.

Dane Frank

Dane Frank, P.E.
Colorado #50207
Project Engineer



Jobs/197100/Drainage/Pond Cert/197100 Pond PE Cert.docx

Attachments

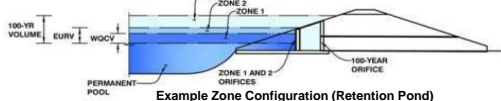
- Extended Detention Basin As-Built, 2025/03/13
- Original UD-Detention Spreadsheet
- As-Built UD-Detention Spreadsheet
- Pond Spillway Tail Riprap Sizing Chart

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.03 (May 2020)

Project: **Electronic Storage**

Basin ID: **EDB**



Original Design Spreadsheet

Watershed Information

Selected BMP Type =	EDB
Watershed Area =	1.77 acres
Watershed Length =	340 ft
Watershed Length to Centroid =	170 ft
Watershed Slope =	0.060 ft/ft
Watershed Imperviousness =	62.00% percent
Percentage Hydrologic Soil Group A =	98.0% percent
Percentage Hydrologic Soil Group B =	2.0% percent
Percentage Hydrologic Soil Groups C/D =	0.0% percent
Target WQCV Drain Time =	40.0 hours
Location for 1-hr Rainfall Depths =	Denver - Capitol Building

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

Water Quality Capture Volume (WQCV) =	0.036	acre-feet
Excess Urban Runoff Volume (EURV) =	0.134	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.091	acre-feet
5-yr Runoff Volume (P1 = 1.5 in.) =	0.120	acre-feet
10-yr Runoff Volume (P1 = 1.75 in.) =	0.143	acre-feet
25-yr Runoff Volume (P1 = 2 in.) =	0.175	acre-feet
50-yr Runoff Volume (P1 = 2.25 in.) =	0.205	acre-feet
100-yr Runoff Volume (P1 = 2.52 in.) =	0.242	acre-feet
500-yr Runoff Volume (P1 = 3 in.) =	0.305	acre-feet
Approximate 2-yr Detention Volume =	0.087	acre-feet
Approximate 5-yr Detention Volume =	0.114	acre-feet
Approximate 10-yr Detention Volume =	0.138	acre-feet
Approximate 25-yr Detention Volume =	0.167	acre-feet
Approximate 50-yr Detention Volume =	0.184	acre-feet
Approximate 100-yr Detention Volume =	0.202	acre-feet

Optional User Overrides

		acre-feet
		acre-feet
1.19		inches
1.50		inches
1.75		inches
2.00		inches
2.25		inches
2.52		inches
3.00		inches

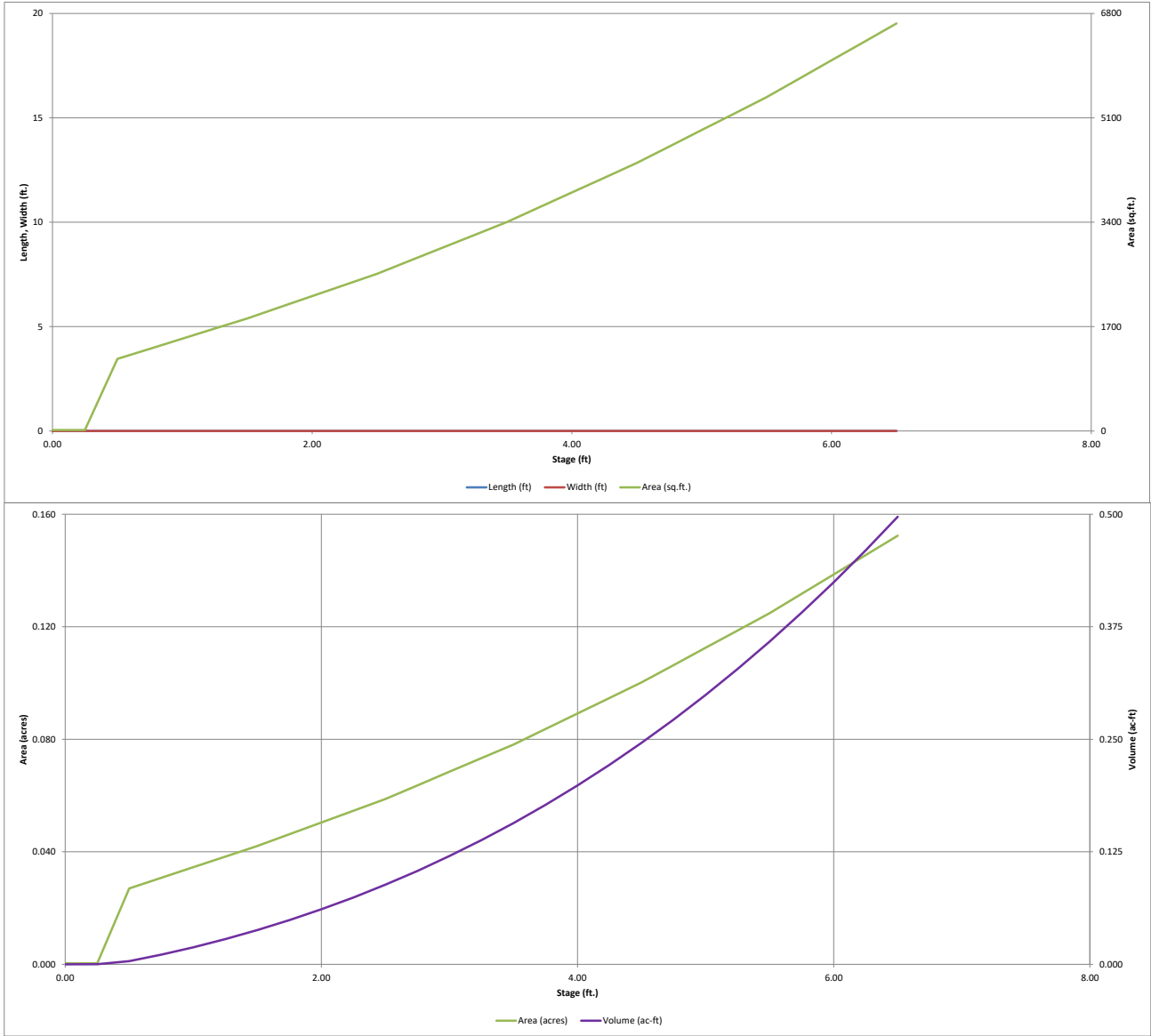
Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.036	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.098	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.068	acre-feet
Total Detention Basin Volume =	0.202	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 _{LW}) =	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

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	--	--	--	15	0.000		
		0.25				15	0.000	4	0.000
Bottom of Pond	--	0.50	--	--	--	1,174	0.027	152	0.003
		0.75				1,339	0.031	466	0.011
		1.00				1,504	0.035	822	0.019
		1.25				1,668	0.038	1,218	0.028
Top of WQ +/-	--	1.50	--	--	--	1,833	0.042	1,656	0.038
		1.75				2,015	0.046	2,137	0.049
		2.00				2,197	0.050	2,663	0.061
		2.25				2,378	0.055	3,235	0.074
		2.50				2,560	0.059	3,852	0.088
		2.75				2,771	0.064	4,519	0.104
		3.00				2,982	0.068	5,238	0.120
Top of EURV +/-	--	3.25	--	--	--	3,192	0.073	6,009	0.138
		3.50				3,403	0.078	6,834	0.157
		3.75				3,644	0.084	7,715	0.177
Top of 100 Yr +/-	--	4.00	--	--	--	3,884	0.089	8,656	0.199
		4.25				4,125	0.095	9,657	0.222
		4.50				4,365	0.100	10,718	0.246
		4.75				4,633	0.106	11,843	0.272
		5.00				4,901	0.113	13,034	0.299
		5.25				5,169	0.119	14,293	0.328
		5.50				5,437	0.125	15,619	0.359
		5.75				5,737	0.132	17,016	0.391
		6.00				6,037	0.139	18,487	0.424
		6.25				6,337	0.145	20,034	0.460
Top of Berm	--	6.50	--	--	--	6,637	0.152	21,656	0.497

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

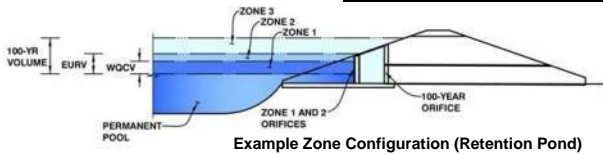
MHFD-Detention, Version 4.03 (May 2020)



DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.03 (May 2020)

Project: Electronic Storage
Basin ID: EDB



	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.45	0.036	Orifice Plate
Zone 2 (EURV)	3.20	0.098	Orifice Plate
Zone 3 (100-year)	4.04	0.068	Weir&Pipe (Rect.)
Total (all zones)		0.202	

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

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)
Underdrain Orifice Diameter =	N/A	inches

Underdrain Orifice Area =	N/A	ft ²
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)

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	3.20	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	14.60	inches
Orifice Plate: Orifice Area per Row =	0.31	sq. inches (diameter = 5/8 inch)

WQ Orifice Area per Row =	2.153E-03	ft ²
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft ²

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	1.07	2.13					
Orifice Area (sq. inches)	0.31	0.31	0.31					

	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)

	Not Selected	Not Selected	
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	N/A	N/A	inches

	Not Selected	Not Selected	
Vertical Orifice Area =	N/A	N/A	ft ²
Vertical Orifice Centroid =	N/A	N/A	feet

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	
Overflow Weir Front Edge Height, Ho =	3.25	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	2.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V
Horiz. Length of Weir Sides =	2.00	N/A	feet
Overflow Grate Open Area % =	70%	N/A	% , grate open area/total area
Debris Clogging % =	50%	N/A	%

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H _u =	3.25	N/A	feet
Overflow Weir Slope Length =	2.00	N/A	feet
Grate Open Area / 100-yr Orifice Area =	19.14	N/A	
Overflow Grate Open Area w/o Debris =	2.80	N/A	ft ²
Overflow Grate Open Area w/ Debris =	1.40	N/A	ft ²

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

	Zone 3 Rectangular	Not Selected	
Depth to Invert of Outlet Pipe =	0.50	N/A	ft (distance below basin bottom at Stage = 0 ft)
Rectangular Orifice Width =	4.90	N/A	inches
Rectangular Orifice Height =	4.30		inches

	Zone 3 Rectangular	Not Selected	
Outlet Orifice Area =	0.15	N/A	ft ²
Outlet Orifice Centroid =	0.18	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage =	4.50	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	5.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Spillway Design Flow Depth =	0.42	feet
Stage at Top of Freeboard =	5.92	feet
Basin Area at Top of Freeboard =	0.14	acres
Basin Volume at Top of Freeboard =	0.41	acre-ft

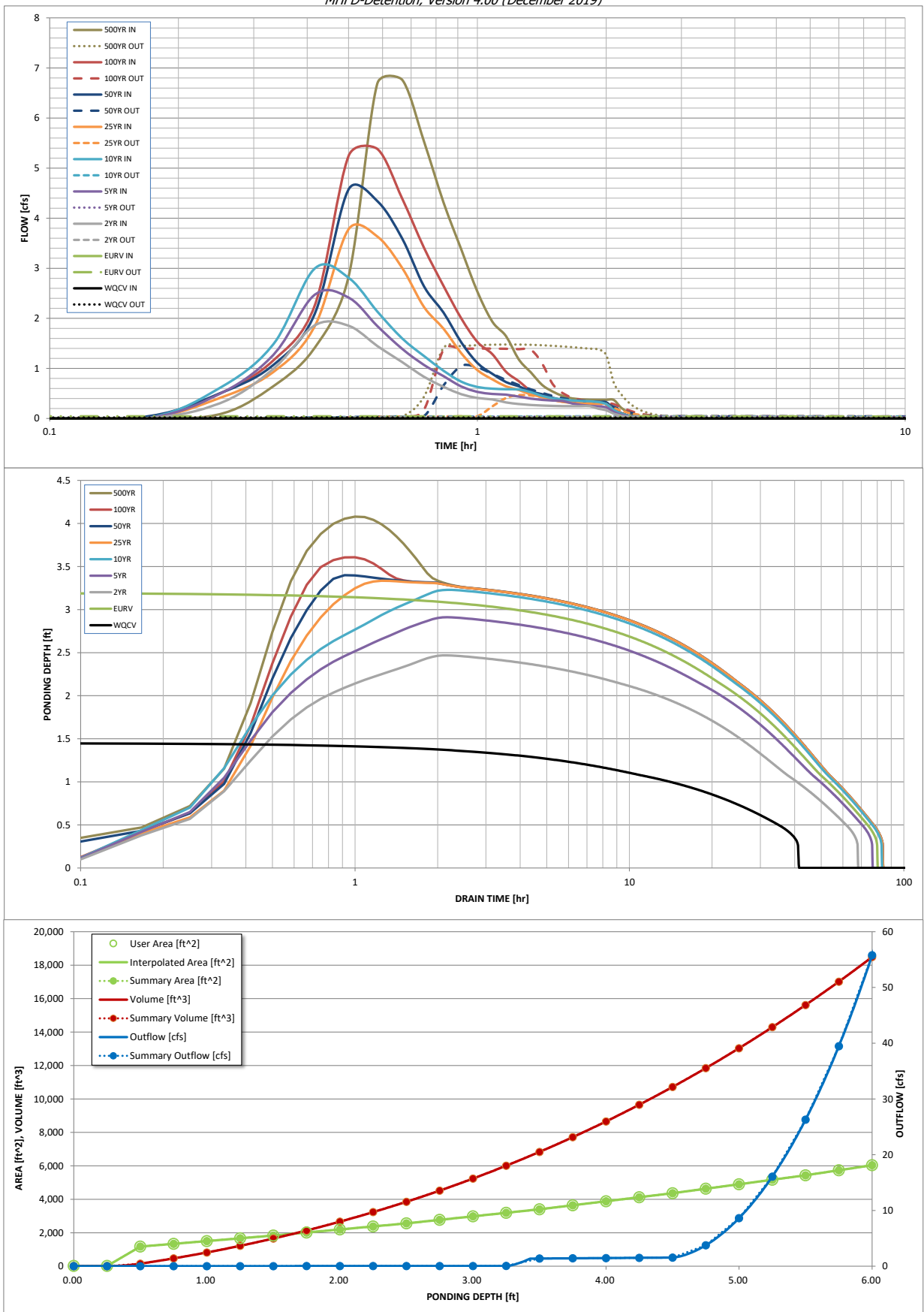
Routed Hydrograph Results

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

	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.00
One-Hour Rainfall Depth (in) =	0.036	0.134	0.091	0.120	0.143	0.175	0.205	0.242	0.305
CUHP Runoff Volume (acre-ft) =	N/A	N/A	0.091	0.120	0.143	0.175	0.205	0.242	0.305
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.0	0.0	0.1	0.5	1.0	1.5	2.4
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A							
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.02	0.03	0.30	0.55	0.87	1.37
Peak Inflow Q (cfs) =	N/A	N/A	1.9	2.5	3.0	3.8	4.6	5.4	6.8
Peak Outflow Q (cfs) =	0.0	0.0	0.0	0.0	0.0	0.5	1.0	1.4	1.5
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.0	0.8	0.9	1.1	0.9	0.6
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Plate	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	0.1	0.4	0.5	0.5
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	73	63	70	76	75	73	72	69
Time to Drain 99% of Inflow Volume (hours) =	41	78	66	75	80	81	80	79	78
Maximum Ponding Depth (ft) =	1.46	3.20	2.47	2.91	3.23	3.33	3.40	3.61	4.08
Area at Maximum Ponding Depth (acres) =	0.04	0.07	0.06	0.07	0.07	0.07	0.08	0.08	0.09
Maximum Volume Stored (acre-ft) =	0.036	0.134	0.086	0.114	0.136	0.144	0.148	0.165	0.205

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.00 (December 2019)



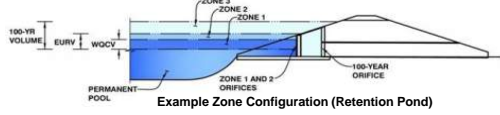
S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.03 (May 2020)

Project: **Electronic Storage**

Basin ID: **EDB - As-Built Check**



Example Zone Configuration (Retention Pond)

As-Built Design Spreadsheet

Watershed Information

Selected BMP Type =	EDB
Watershed Area =	1.77 acres
Watershed Length =	340 ft
Watershed Length to Centroid =	170 ft
Watershed Slope =	0.060 ft/ft
Watershed Imperviousness =	62.00% percent
Percentage Hydrologic Soil Group A =	98.0% percent
Percentage Hydrologic Soil Group B =	2.0% percent
Percentage Hydrologic Soil Groups C/D =	0.0% percent
Target WQCV Drain Time =	40.0 hours
Location for 1-hr Rainfall Depths =	Denver - Capitol Building

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

Water Quality Capture Volume (WQCV) =	0.036	acre-feet
Excess Urban Runoff Volume (EURV) =	0.134	acre-feet
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100-yr Runoff Volume (P1 = 2.52 in.) =	0.242	acre-feet
500-yr Runoff Volume (P1 = 3.0 in.) =	0.305	acre-feet
Approximate 2-yr Detention Volume =	0.087	acre-feet
Approximate 5-yr Detention Volume =	0.114	acre-feet
Approximate 10-yr Detention Volume =	0.138	acre-feet
Approximate 25-yr Detention Volume =	0.167	acre-feet
Approximate 50-yr Detention Volume =	0.184	acre-feet
Approximate 100-yr Detention Volume =	0.202	acre-feet

Optional User Overrides

		acre-feet
		acre-feet
	1.19	inches
	1.50	inches
	1.75	inches
	2.00	inches
	2.25	inches
	2.52	inches
	3.00	inches

Depth Increment = ft

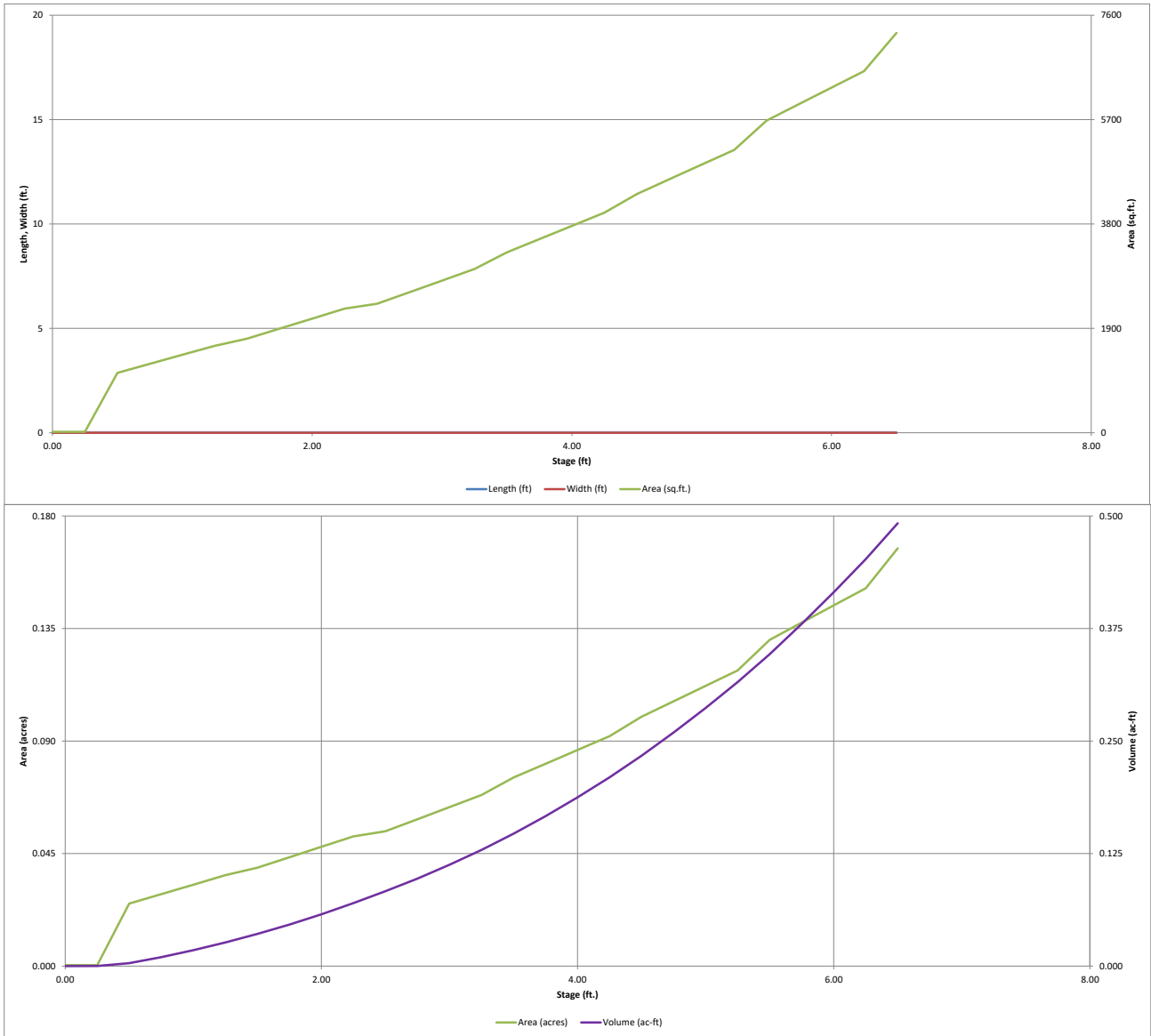
Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft ²)	Optional Override Area (ft ²)	Area (acre)	Volume (ft ³)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	17	0.000	4	0.000
	--	0.25	--	--	--	17	0.000	4	0.000
Bottom of Pond	--	0.50	--	--	--	1,089	0.025	142	0.003
	--	0.75	--	--	--	1,254	0.029	435	0.010
	--	1.00	--	--	--	1,419	0.033	769	0.018
	--	1.25	--	--	--	1,583	0.036	1,145	0.026
	--	1.50	--	--	--	1,714	0.039	1,557	0.036
Top of WQ +/-	--	1.75	--	--	--	1,896	0.044	2,008	0.046
	--	2.00	--	--	--	2,078	0.048	2,505	0.057
	--	2.25	--	--	--	2,259	0.052	3,047	0.070
	--	2.50	--	--	--	2,348	0.054	3,623	0.083
	--	2.75	--	--	--	2,559	0.059	4,236	0.097
	--	3.00	--	--	--	2,770	0.064	4,902	0.113
Top of EURV +/-	--	3.25	--	--	--	2,980	0.068	5,621	0.129
	--	3.50	--	--	--	3,284	0.075	6,404	0.147
	--	3.75	--	--	--	3,525	0.081	7,255	0.167
Top of 100 Yr +/-	--	4.00	--	--	--	3,765	0.086	8,166	0.187
	--	4.25	--	--	--	4,006	0.092	9,137	0.210
	--	4.50	--	--	--	4,345	0.100	10,181	0.234
	--	4.75	--	--	--	4,613	0.106	11,301	0.259
	--	5.00	--	--	--	4,881	0.112	12,488	0.287
	--	5.25	--	--	--	5,149	0.118	13,741	0.315
	--	5.50	--	--	--	5,683	0.130	15,095	0.347
	--	5.75	--	--	--	5,983	0.137	16,554	0.380
	--	6.00	--	--	--	6,283	0.144	18,087	0.415
	--	6.25	--	--	--	6,583	0.151	19,695	0.452
Top of Berm	--	6.50	--	--	--	7,278	0.167	21,428	0.492
	--		--	--	--				

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.036	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.098	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.068	acre-feet
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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
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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

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

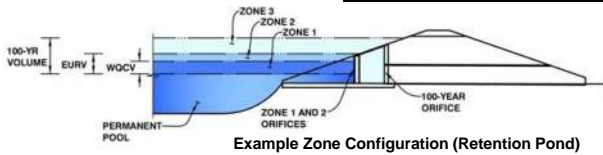
MHFD-Detention, Version 4.03 (May 2020)



DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.03 (May 2020)

Project: Electronic Storage
Basin ID: EDB - As-Built Check



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Zone 1 (WQCV)	1.51	0.036	Orifice Plate
Zone 2 (EURV)	3.33	0.098	Orifice Plate
Zone 3 (100-year)	4.17	0.068	Weir&Pipe (Rect.)
Total (all zones)		0.202	

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

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)
Underdrain Orifice Diameter =	N/A	inches

Calculated Parameters for Underdrain

Underdrain Orifice Area =	N/A	ft ²
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)

Invert of Lowest Orifice =	0.21	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	3.20	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	N/A	inches
Orifice Plate: Orifice Area per Row =	N/A	inches

Calculated Parameters for Plate

WQ Orifice Area per Row =	N/A	ft ²
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft ²

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)	0.21	1.20	2.40					
Orifice Area (sq. inches)	0.38	0.31	0.31					

	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)

	Not Selected	Not Selected	
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	N/A	N/A	inches

Calculated Parameters for Vertical Orifice

	Not Selected	Not Selected	
Vertical Orifice Area =	N/A	N/A	ft ²
Vertical Orifice Centroid =	N/A	N/A	feet

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	
Overflow Weir Front Edge Height, Ho =	3.50	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	2.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V
Horiz. Length of Weir Sides =	2.00	N/A	feet
Overflow Grate Open Area % =	40%	N/A	% , grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H _u =	3.50	N/A	feet
Overflow Weir Slope Length =	2.00	N/A	feet
Grate Open Area / 100-yr Orifice Area =	10.93	N/A	
Overflow Grate Open Area w/o Debris =	1.60	N/A	ft ²
Overflow Grate Open Area w/ Debris =	0.80	N/A	ft ²

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

	Zone 3 Rectangular	Not Selected	
Depth to Invert of Outlet Pipe =	0.50	N/A	ft (distance below basin bottom at Stage = 0 ft)
Rectangular Orifice Width =	4.90	N/A	inches
Rectangular Orifice Height =	4.30		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Rectangular	Not Selected	
Outlet Orifice Area =	0.15	N/A	ft ²
Outlet Orifice Centroid =	0.18	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage =	4.50	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	5.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth =	0.42	feet
Stage at Top of Freeboard =	5.92	feet
Basin Area at Top of Freeboard =	0.14	acres
Basin Volume at Top of Freeboard =	0.40	acre-ft

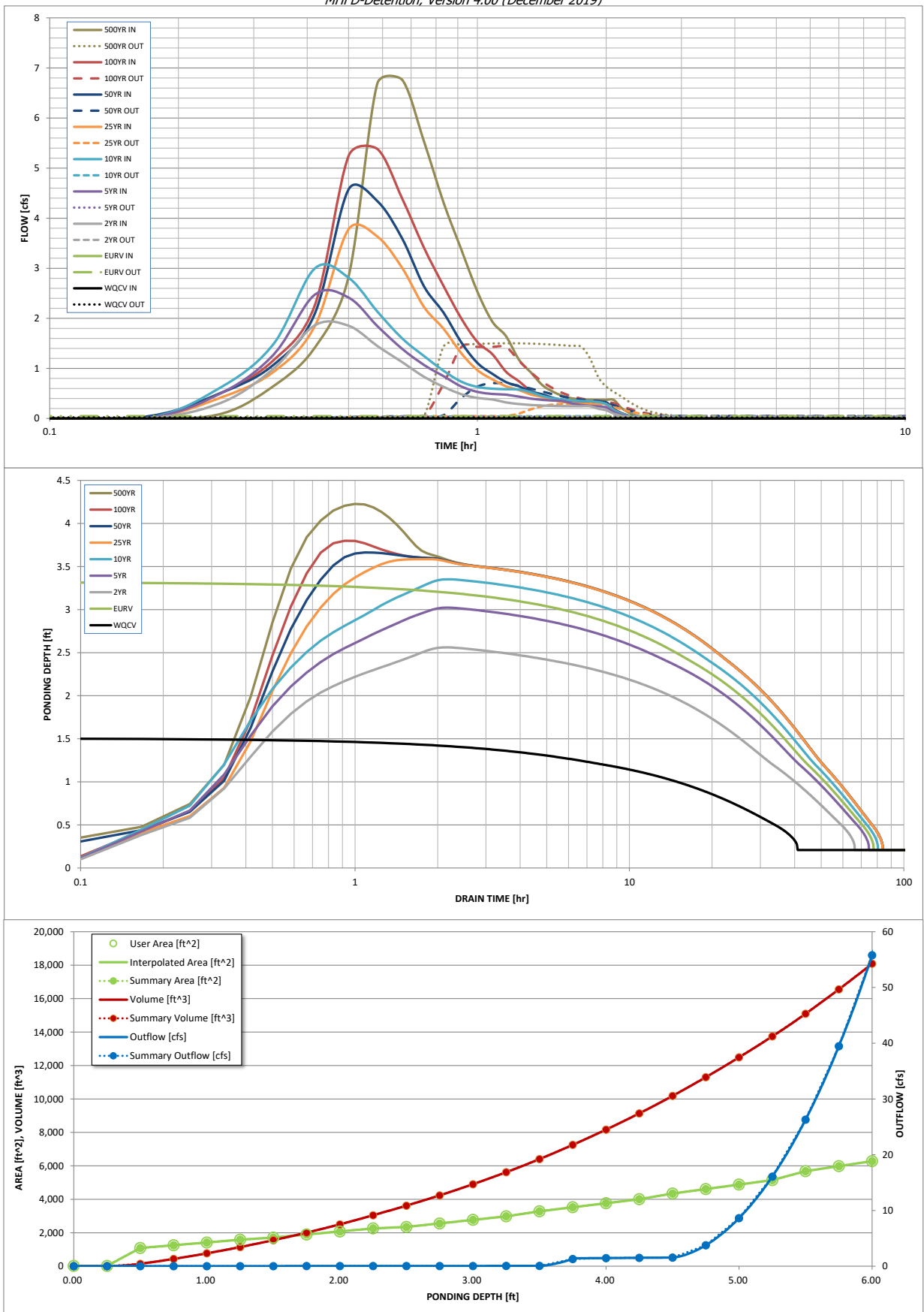
Routed Hydrograph Results

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

	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.00
One-Hour Rainfall Depth (in) =	0.036	0.134	0.091	0.120	0.143	0.175	0.205	0.242	0.305
CUHP Runoff Volume (acre-ft) =	N/A	N/A	0.091	0.120	0.143	0.175	0.205	0.242	0.305
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.0	0.0	0.1	0.5	1.0	1.5	2.4
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A							
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.02	0.03	0.30	0.55	0.87	1.37
Peak Inflow Q (cfs) =	N/A	N/A	1.9	2.5	3.0	3.8	4.6	5.4	6.8
Peak Outflow Q (cfs) =	0.0	0.0	0.0	0.0	0.0	0.3	0.7	1.4	1.5
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.1	0.9	0.6	0.7	0.9	0.6
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Plate	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	0.2	0.4	0.9	0.9
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	69	60	67	72	73	72	70	68
Time to Drain 99% of Inflow Volume (hours) =	40	74	64	72	77	80	79	78	77
Maximum Ponding Depth (ft) =	1.51	3.33	2.56	3.02	3.35	3.59	3.66	3.80	4.23
Area at Maximum Ponding Depth (acres) =	0.04	0.07	0.06	0.06	0.07	0.08	0.08	0.08	0.09
Maximum Volume Stored (acre-ft) =	0.036	0.135	0.086	0.114	0.136	0.153	0.159	0.170	0.207

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.00 (December 2019)



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

1971.00 Electronic Storage -
Pond Spillway Tail

Figure 13-12c. Emergency Spillway Protection

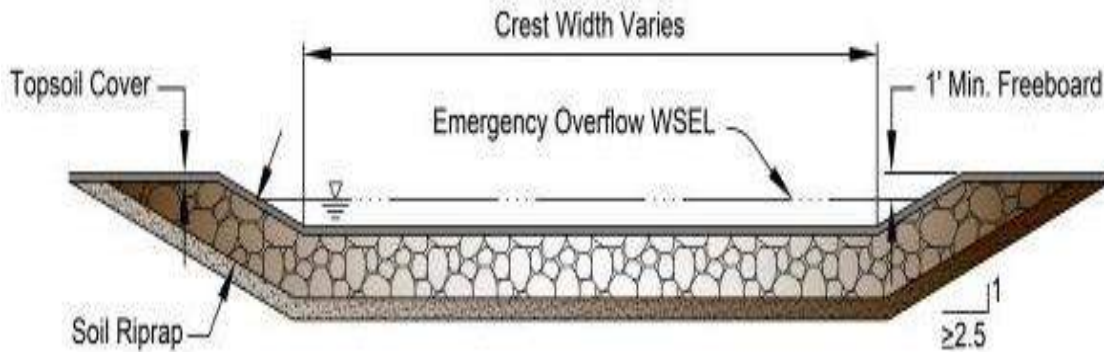
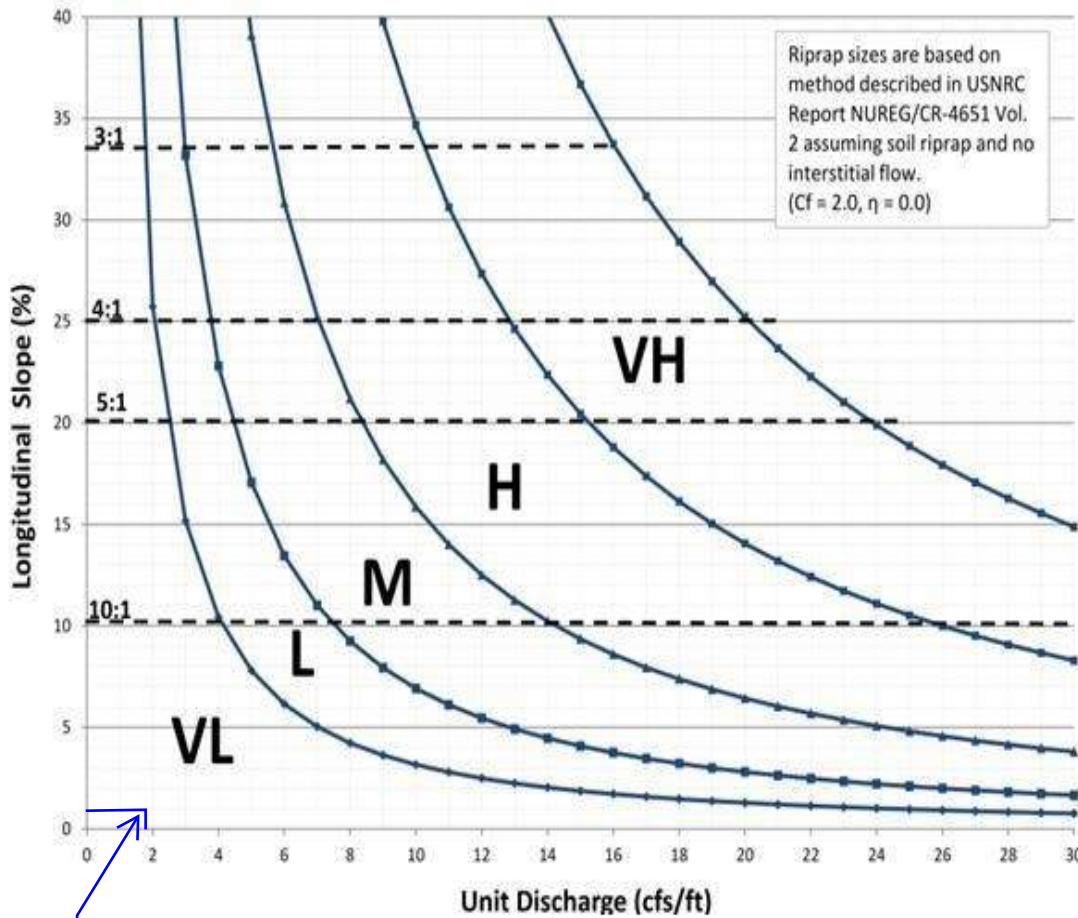


Figure 13-12d. Riprap Types for Emergency Spillway Protection



VL riprap required (6")

- 5.4 cfs / 3' wide channel = 1.8
- Channel is nearly flat, assuming 1% slope