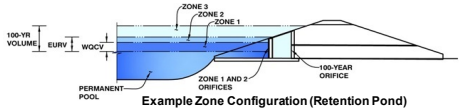
# DETENTION BASIN STAGE-STORAGE TABLE BUILDER

*MHFD-Detention, Version 4.06 (July 2022)*

**POND A: ULTIMATE DESIGN FOR REFERENCE ONLY**

**Project:** Falcon Field Filing 2

**Basin ID:** Pond A (with overdetention)




**Example Zone Configuration (Retention Pond)**

## Watershed Information

| | | |
|---|---|---|
| Selected BMP Type = | EDB | |
| Watershed Area = | 19.64 | acres |
| Watershed Length = | 1,100 | ft |
| Watershed Length to Centroid = | 380 | ft |
| Watershed Slope = | 0.025 | ft/ft |
| Watershed Imperviousness = | 53.60% | 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) = | 0.354 | acre-feet | acre-feet |
| Excess Urban Runoff Volume (EURV) = | 1.238 | acre-feet | acre-feet |
| 2-yr Runoff Volume (P1 = 1.19 in.) = | 0.890 | acre-feet | 1.19 inches |
| 5-yr Runoff Volume (P1 = 1.5 in.) = | 1.179 | acre-feet | 1.50 inches |
| 10-yr Runoff Volume (P1 = 1.75 in.) = | 1.410 | acre-feet | 1.75 inches |
| 25-yr Runoff Volume (P1 = 2 in.) = | 1.757 | acre-feet | 2.00 inches |
| 50-yr Runoff Volume (P1 = 2.25 in.) = | 2.096 | acre-feet | 2.25 inches |
| 100-yr Runoff Volume (P1 = 2.52 in.) = | 2.523 | acre-feet | 2.52 inches |
| 500-yr Runoff Volume (P1 = 3.49 in.) = | 4.000 | acre-feet | 3.49 inches |
| Approximate 2-yr Detention Volume = | 0.798 | acre-feet | |
| Approximate 5-yr Detention Volume = | 1.049 | acre-feet | |
| Approximate 10-yr Detention Volume = | 1.276 | acre-feet | |
| Approximate 25-yr Detention Volume = | 1.554 | acre-feet | |
| Approximate 50-yr Detention Volume = | 1.728 | acre-feet | |
| Approximate 100-yr Detention Volume = | 1.932 | acre-feet | |

## Define Zones and Basin Geometry

| | | |
|---|---|---|
| Zone 1 Volume (WQCV) = | 0.354 | acre-feet |
| Zone 2 Volume (EURV - Zone 1) = | 0.884 | acre-feet |
| Zone 3 Volume (100-year - Zones 1 & 2) = | 0.694 | acre-feet |
| Total Detention Basin Volume = | 1.932 | 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 |

In this slot, there should only be the calculations that will be uploaded to the state's SDI reporting. Only include the interim ponds under the conditions of Filing 1. TSBs do not need to be reported. If there are questions on what needs to be uploaded into the slot please reach out. There should be no reference sheets in this document slot on EDARP.

Also - these should reflect the actual areas draining to each pond for accuracy in reporting to the state.

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 | -- | -- | -- | 40 | 0.001 | | |
| **6826** | -- | 1.00 | -- | -- | -- | 10,828 | 0.249 | 5,434 | 0.125 |
| **6827** | -- | 2.00 | -- | -- | -- | 12,923 | 0.297 | 17,309 | 0.397 |
| **6828** | -- | 3.00 | -- | -- | -- | 15,137 | 0.347 | 31,339 | 0.719 |
| **6829** | -- | 4.00 | -- | -- | -- | 17,471 | 0.401 | 47,643 | 1.094 |
| **6830** | -- | 5.00 | -- | -- | -- | 19,925 | 0.457 | 66,341 | 1.523 |
| **6831** | -- | 6.00 | -- | -- | -- | 22,478 | 0.516 | 87,543 | 2.010 |
| **6832** | -- | 7.00 | -- | -- | -- | 25,157 | 0.578 | 111,360 | 2.556 |

# DETENTION BASIN STAGE-STORAGE TABLE BUILDER

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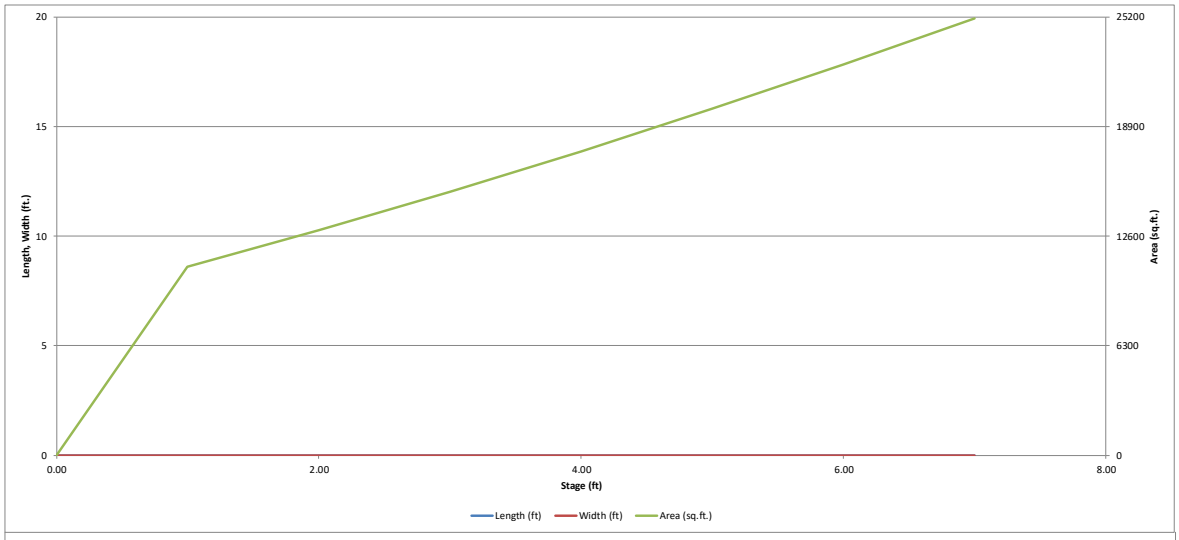
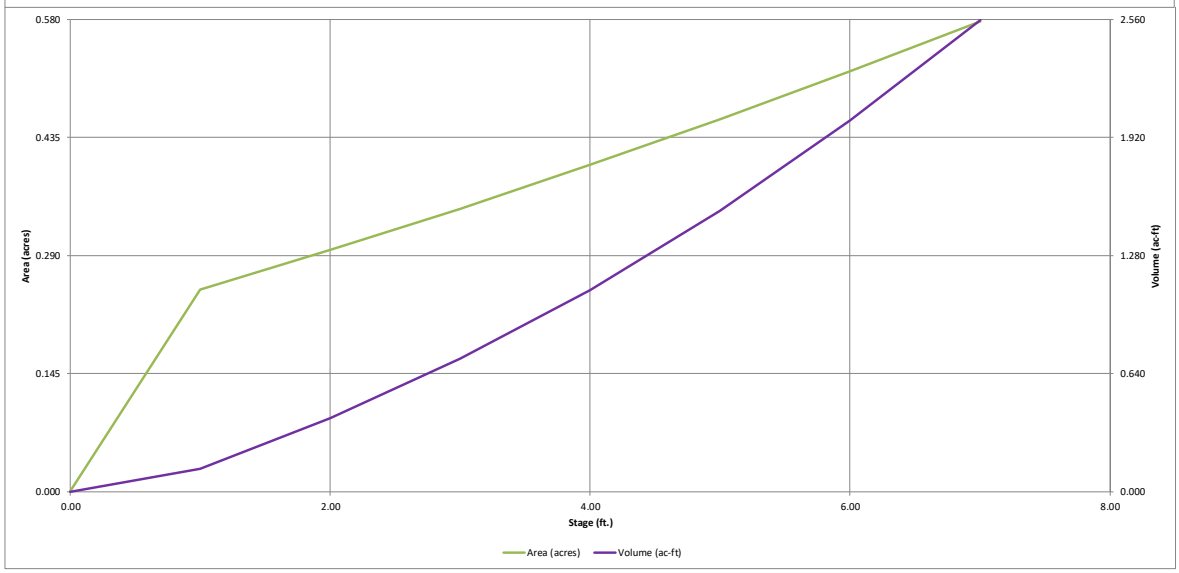
POND A: ULTIMATE DESIGN FOR REFERENCE ONLY



# DETENTION BASIN OUTLET STRUCTURE DESIGN

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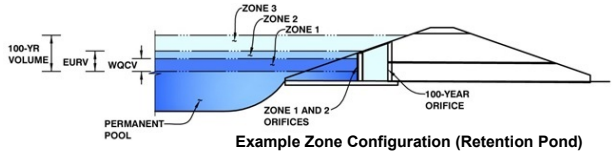
**Basin ID:** Pond A (with overdetention)




**Example Zone Configuration (Retention Pond)**

| | Estimated Stage (ft) | Estimated Volume (ac-ft) | Outlet Type |
|---|---|---|---|
| Zone 1 (WQCV) | 1.86 | 0.354 | Orifice Plate |
| Zone 2 (EURV) | 4.36 | 0.884 | Orifice Plate |
| Zone 3 (100-year) | 5.85 | 0.694 | Weir&Pipe (Restrict) |
| Total (all zones) | | 1.932 | |

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 Area = | N/A | $ft^2$ |
| Underdrain Orifice Diameter = | N/A | inches | Underdrain Orifice Centroid = | N/A | 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 = | N/A | $ft^2$ |
| Depth at top of Zone using Orifice Plate = | 4.36 | 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 | sq. 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 | 1.42 | 2.84 | | | | | |
| Orifice Area (sq. inches) | 2.95 | 2.95 | 2.00 | | | | | |

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

Calculated Parameters for Vertical Orifi

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 = | 4.56 | N/A | ft (relative to basin bottom at Stage = 0 ft) | Height of Grate Upper Edge, $H_t$ = | 4.56 | N/A |
| Overflow Weir Front Edge Length = | 4.30 | N/A | feet | Overflow Weir Slope Length = | 4.30 | N/A |
| Overflow Weir Grate Slope = | 0.00 | N/A | H:V | Grate Open Area / 100-yr Orifice Area = | 9.42 | N/A |
| Horiz. Length of Weir Sides = | 4.30 | N/A | feet | Overflow Grate Open Area w/o Debris = | 12.87 | N/A |
| Overflow Grate Type = | Type C Grate | N/A | | Overflow Grate Open Area w/ Debris = | 6.43 | N/A |
| Debris Clogging % = | 50% | N/A | % | | | |

Calculated Parameters for Overflow We

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 = | 0.00 | N/A | ft (distance below basin bottom at Stage = 0 ft) | Outlet Orifice Area = | 1.37 | N/A |
| Outlet Pipe Diameter = | 18.00 | N/A | inches | Outlet Orifice Centroid = | 0.60 | N/A |
| Restrictor Plate Height Above Pipe Invert = | 13.00 | | inches | Half-Central Angle of Restrictor Plate on Pipe = | 2.03 | N/A |

Calculated Parameters for Outlet Pipe w/ Flow Restriction Pla

User Input: Emergency Spillway (Rectangular or Trapezoidal)

| | | | | | |
|---|---|---|---|---|---|
| Spillway Invert Stage= | 5.44 | ft (relative to basin bottom at Stage = 0 ft) | Spillway Design Flow Depth= | 0.56 | feet |
| Spillway Crest Length = | 40.00 | feet | Stage at Top of Freeboard = | 7.00 | feet |
| Spillway End Slopes = | 4.00 | H:V | Basin Area at Top of Freeboard = | 0.58 | acres |
| Freeboard above Max Water Surface = | 1.00 | feet | Basin Volume at Top of Freeboard = | 2.56 | 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 |
|---|---|---|---|---|---|---|---|---|
| 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) = | 0.354 | 1.238 | 0.890 | 1.179 | 1.410 | 1.757 | 2.096 | 2.523 |
| Inflow Hydrograph Volume (acre-ft) = | N/A | N/A | 0.890 | 1.179 | 1.410 | 1.757 | 2.096 | 2.523 |
| CUHP Predevelopment Peak Q (cfs) = | N/A | N/A | 0.2 | 0.4 | 0.6 | 5.0 | 9.8 | 16.1 |
| 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 | 0.26 | 0.50 | 0.82 |
| Peak Inflow Q (cfs) = | N/A | N/A | 16.9 | 22.4 | 26.4 | 35.2 | 42.9 | 53.9 |
| Peak Outflow Q (cfs) = | 0.2 | 0.5 | 0.4 | 0.4 | 0.6 | 4.3 | 9.7 | 14.5 |
| Ratio Peak Outflow to Predevelopment Q = | N/A | N/A | N/A | 1.0 | 1.0 | 0.9 | 1.0 | 0.9 |
| Structure Controlling Flow = | Plate | Plate | Plate | Plate | Overflow Weir 1 | Overflow Weir 1 | Overflow Weir 1 | Outlet Plate 1 |
| Max Velocity through Grate 1 (fps) = | N/A | N/A | N/A | N/A | 0.0 | 0.3 | 0.7 | 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) = | 38 | 67 | 59 | 66 | 71 | 70 | 68 | 66 |
| Time to Drain 99% of Inflow Volume (hours) = | **40** | 71 | 63 | 70 | 76 | 76 | 75 | 74 |
| Maximum Ponding Depth (ft) = | 1.86 | 4.36 | 3.34 | 4.05 | 4.59 | 4.83 | 5.04 | 5.43 |
| Area at Maximum Ponding Depth (acres) = | 0.29 | 0.42 | 0.37 | 0.40 | 0.43 | 0.45 | 0.46 | 0.48 |
| Maximum Volume Stored (acre-ft) = | 0.356 | 1.242 | 0.837 | 1.114 | 1.336 | 1.442 | 1.537 | 1.725 |

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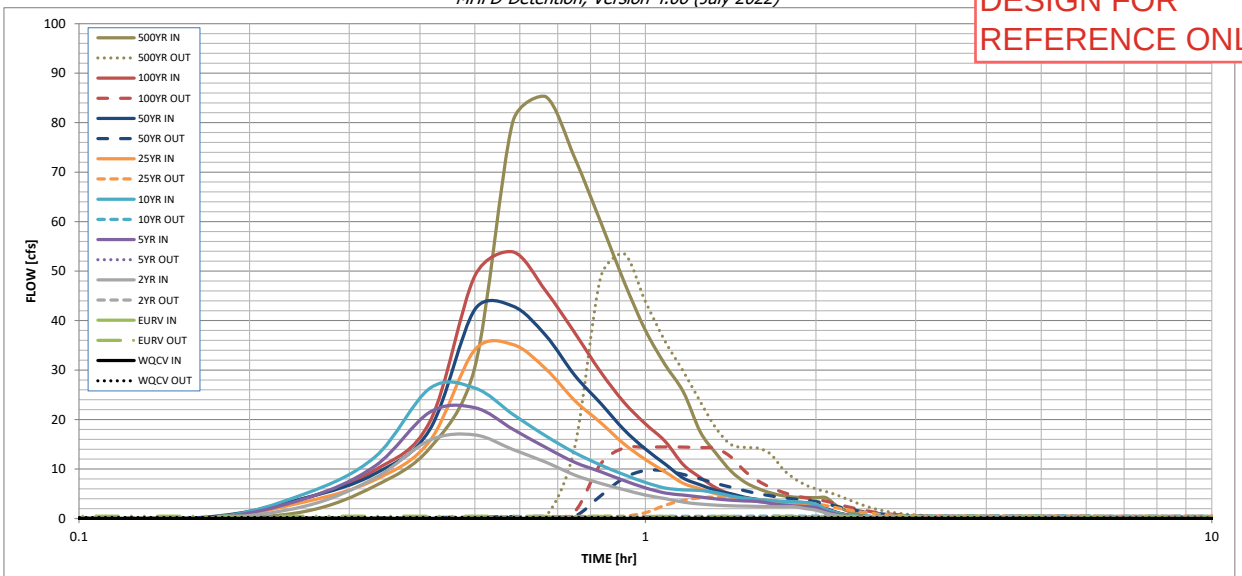
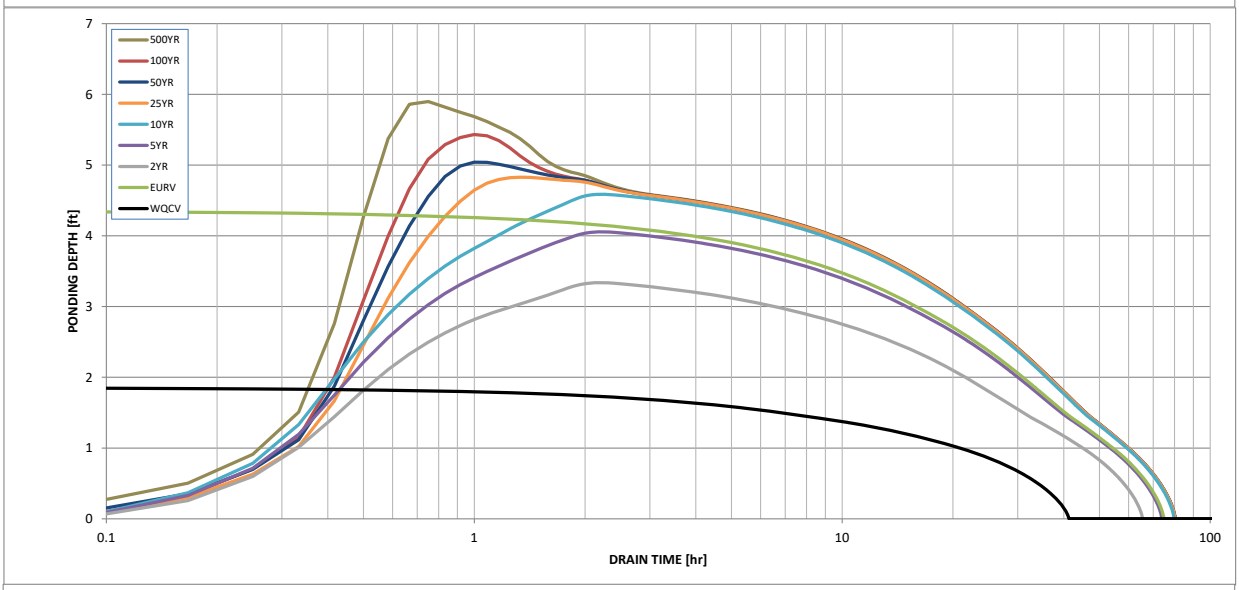
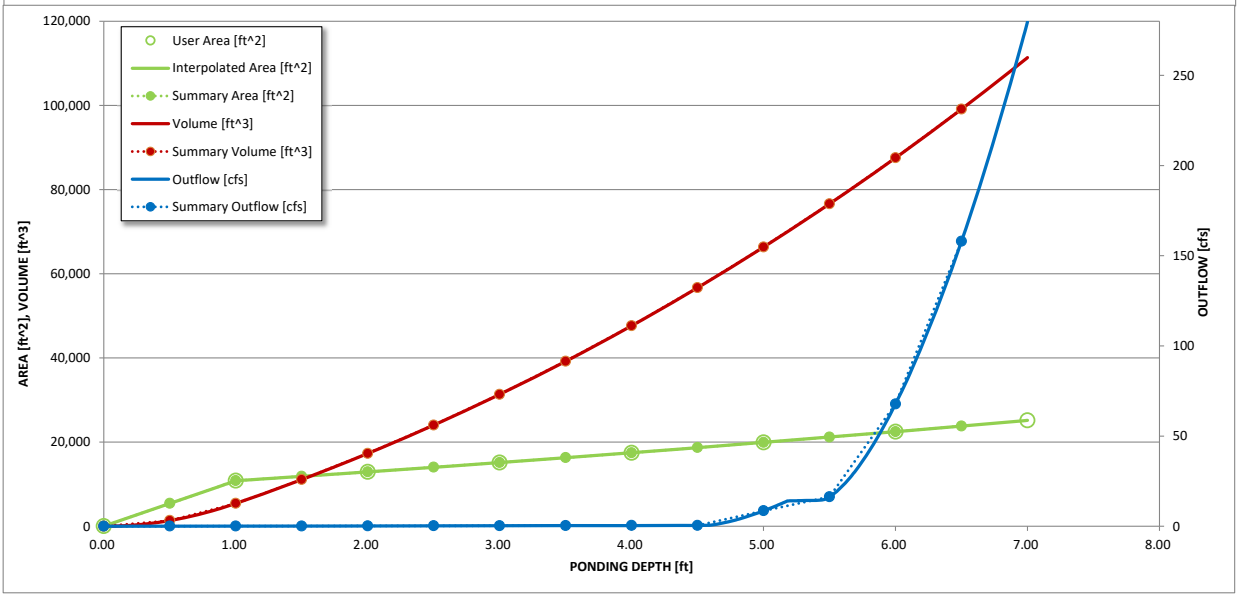



| S-A-V-D Chart Axis Override | X-axis | Left Y-Axis | Right Y-Axis |
|---|---|---|---|
| minimum bound | | | |
| maximum bound | | | |

# DETENTION BASIN OUTLET STRUCTURE DESIGN

POND A: ULTIMATE DESIGN FOR REFERENCE ONLY

*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 | 0.28 | 0.03 | 1.40 |
| | 0:15:00 | 0.00 | 0.00 | 2.46 | 4.00 | 4.97 | 3.35 | 4.12 | 4.09 | 6.61 |
| | 0:20:00 | 0.00 | 0.00 | 8.24 | 10.64 | 12.47 | 7.84 | 9.07 | 9.82 | 14.28 |
| | 0:25:00 | 0.00 | 0.00 | 15.85 | 21.52 | 26.34 | 15.74 | 18.06 | 19.65 | 30.57 |
| | 0:30:00 | 0.00 | 0.00 | 16.89 | 22.38 | 26.37 | 34.11 | 42.25 | 49.03 | 80.15 |
| | 0:35:00 | 0.00 | 0.00 | 13.95 | 18.04 | 21.07 | 35.15 | 42.93 | 53.88 | 85.25 |
| | 0:40:00 | 0.00 | 0.00 | 11.38 | 14.37 | 16.70 | 30.26 | 37.00 | 45.98 | 72.90 |
| | 0:45:00 | 0.00 | 0.00 | 8.79 | 11.37 | 13.31 | 23.86 | 28.94 | 37.55 | 59.95 |
| | 0:50:00 | 0.00 | 0.00 | 7.10 | 9.46 | 10.82 | 19.40 | 23.29 | 29.64 | 47.89 |
| | 0:55:00 | 0.00 | 0.00 | 5.82 | 7.66 | 8.88 | 15.07 | 17.95 | 23.48 | 38.04 |
| | 1:00:00 | 0.00 | 0.00 | 4.75 | 6.19 | 7.28 | 11.91 | 14.03 | 19.11 | 31.08 |
| | 1:05:00 | 0.00 | 0.00 | 4.02 | 5.16 | 6.17 | 9.44 | 11.01 | 15.61 | 25.60 |
| | 1:10:00 | 0.00 | 0.00 | 3.30 | 4.74 | 5.79 | 7.11 | 8.16 | 10.87 | 17.51 |
| | 1:15:00 | 0.00 | 0.00 | 2.93 | 4.36 | 5.68 | 5.99 | 6.82 | 8.29 | 13.13 |
| | 1:20:00 | 0.00 | 0.00 | 2.70 | 3.96 | 5.21 | 5.01 | 5.66 | 6.18 | 9.54 |
| | 1:25:00 | 0.00 | 0.00 | 2.58 | 3.71 | 4.54 | 4.42 | 4.99 | 4.88 | 7.32 |
| | 1:30:00 | 0.00 | 0.00 | 2.50 | 3.55 | 4.10 | 3.79 | 4.27 | 4.12 | 6.03 |
| | 1:35:00 | 0.00 | 0.00 | 2.44 | 3.45 | 3.81 | 3.40 | 3.83 | 3.61 | 5.16 |
| | 1:40:00 | 0.00 | 0.00 | 2.40 | 3.02 | 3.61 | 3.15 | 3.54 | 3.29 | 4.61 |
| | 1:45:00 | 0.00 | 0.00 | 2.39 | 2.73 | 3.49 | 2.99 | 3.36 | 3.12 | 4.33 |
| | 1:50:00 | 0.00 | 0.00 | 2.39 | 2.54 | 3.40 | 2.90 | 3.26 | 3.06 | 4.24 |
| | 1:55:00 | 0.00 | 0.00 | 1.98 | 2.42 | 3.23 | 2.84 | 3.20 | 3.04 | 4.21 |
| | 2:00:00 | 0.00 | 0.00 | 1.70 | 2.25 | 2.89 | 2.82 | 3.17 | 3.04 | 4.21 |
| | 2:05:00 | 0.00 | 0.00 | 1.10 | 1.46 | 1.88 | 1.83 | 2.06 | 1.97 | 2.73 |
| | 2:10:00 | 0.00 | 0.00 | 0.69 | 0.92 | 1.20 | 1.18 | 1.32 | 1.26 | 1.74 |
| | 2:15:00 | 0.00 | 0.00 | 0.43 | 0.57 | 0.74 | 0.73 | 0.82 | 0.78 | 1.08 |
| | 2:20:00 | 0.00 | 0.00 | 0.24 | 0.34 | 0.44 | 0.44 | 0.49 | 0.47 | 0.64 |
| | 2:25:00 | 0.00 | 0.00 | 0.13 | 0.20 | 0.25 | 0.26 | 0.28 | 0.27 | 0.37 |
| | 2:30:00 | 0.00 | 0.00 | 0.05 | 0.09 | 0.11 | 0.12 | 0.13 | 0.13 | 0.17 |
| | 2:35:00 | 0.00 | 0.00 | 0.02 | 0.03 | 0.03 | 0.04 | 0.04 | 0.04 | 0.05 |
| | 2:40:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 2:45:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 2:50:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 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 |

POND A: ULTIMATE DESIGN FOR REFERENCE ONLY

# DETENTION BASIN OUTLET STRUCTURE DESIGN

*MHFD-Detention, Version 4.06 (July 2022)*

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

| Stage - Storage Description | Stage [ft] | Area [ft$^2$] | Area [acres] | Volume [ft$^3$] | Volume [ac-ft] | Total Outflow [cfs] |
|---|---|---|---|---|---|---|
| | 0.00 | 40 | 0.001 | 0 | 0.000 | 0.00 |
| | 0.50 | 5,434 | 0.125 | 1,368 | 0.031 | 0.07 |
| | 1.00 | 10,828 | 0.249 | 5,434 | 0.125 | 0.10 |
| | 1.50 | 11,876 | 0.273 | 11,110 | 0.255 | 0.15 |
| | 2.00 | 12,923 | 0.297 | 17,309 | 0.397 | 0.21 |
| | 2.50 | 14,030 | 0.322 | 24,047 | 0.552 | 0.26 |
| | 3.00 | 15,137 | 0.347 | 31,339 | 0.719 | 0.32 |
| | 3.50 | 16,304 | 0.374 | 39,199 | 0.900 | 0.38 |
| | 4.00 | 17,471 | 0.401 | 47,643 | 1.094 | 0.43 |
| | 4.50 | 18,698 | 0.429 | 56,685 | 1.301 | 0.47 |
| | 5.00 | 19,925 | 0.457 | 66,341 | 1.523 | 8.59 |
| | 5.50 | 21,201 | 0.487 | 76,623 | 1.759 | 16.33 |
| | 6.00 | 22,478 | 0.516 | 87,543 | 2.010 | 67.83 |
| | 6.50 | 23,817 | 0.547 | 99,117 | 2.275 | 158.05 |

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

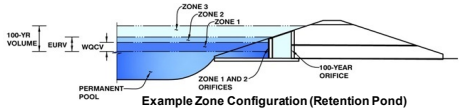
# DETENTION BASIN STAGE-STORAGE TABLE BUILDER

*MHFD-Detention, Version 4.06 (July 2022)*

**POND B: INTERIM DESIGN**

**Project:** Falcon Field Filing 1

**Basin ID:** Pond B INTERIM




**Example Zone Configuration (Retention Pond)**

## Watershed Information

| | | |
|---|---|---|
| Selected BMP Type = | EDB | |
| Watershed Area = | 15.87 | acres |
| Watershed Length = | 1,200 | ft |
| Watershed Length to Centroid = | 400 | ft |
| Watershed Slope = | 0.035 | ft/ft |
| Watershed Imperviousness = | 58.30% | 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) = | 0.305 | acre-feet | | acre-feet |
| Excess Urban Runoff Volume (EURV) = | 1.114 | acre-feet | | acre-feet |
| 2-yr Runoff Volume (P1 = 1.19 in.) = | 0.796 | acre-feet | 1.19 | inches |
| 5-yr Runoff Volume (P1 = 1.5 in.) = | 1.050 | acre-feet | 1.50 | inches |
| 10-yr Runoff Volume (P1 = 1.75 in.) = | 1.254 | acre-feet | 1.75 | inches |
| 25-yr Runoff Volume (P1 = 2 in.) = | 1.539 | acre-feet | 2.00 | inches |
| 50-yr Runoff Volume (P1 = 2.25 in.) = | 1.820 | acre-feet | 2.25 | inches |
| 100-yr Runoff Volume (P1 = 2.52 in.) = | 2.167 | acre-feet | 2.52 | inches |
| 500-yr Runoff Volume (P1 = 3.49 in.) = | 3.373 | acre-feet | 3.49 | inches |
| Approximate 2-yr Detention Volume = | 0.721 | acre-feet | | |
| Approximate 5-yr Detention Volume = | 0.945 | acre-feet | | |
| Approximate 10-yr Detention Volume = | 1.145 | acre-feet | | |
| Approximate 25-yr Detention Volume = | 1.388 | acre-feet | | |
| Approximate 50-yr Detention Volume = | 1.537 | acre-feet | | |
| Approximate 100-yr Detention Volume = | 1.702 | acre-feet | | |

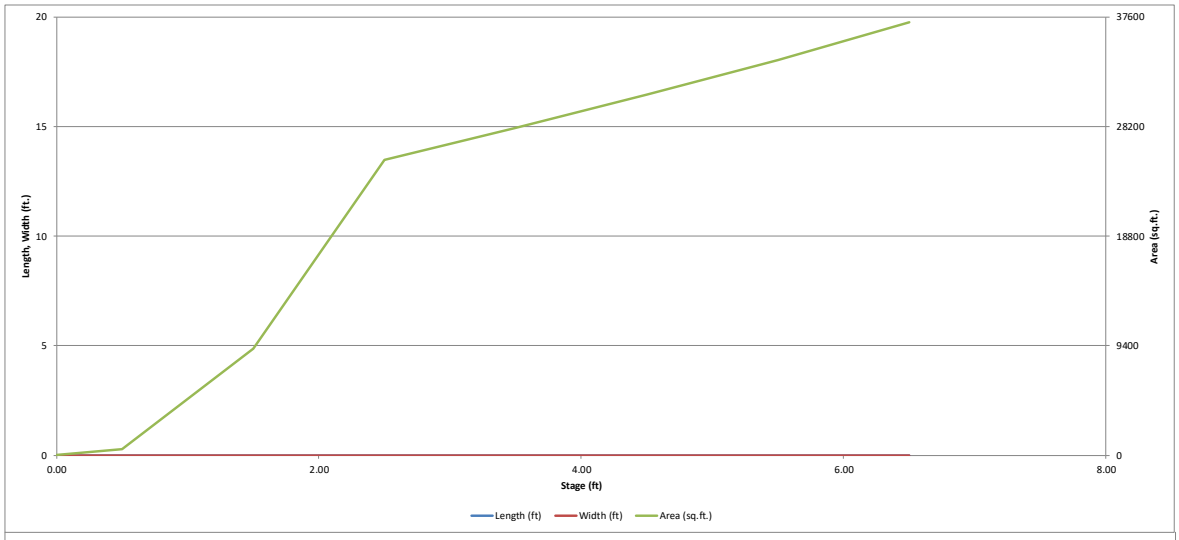
## Define Zones and Basin Geometry

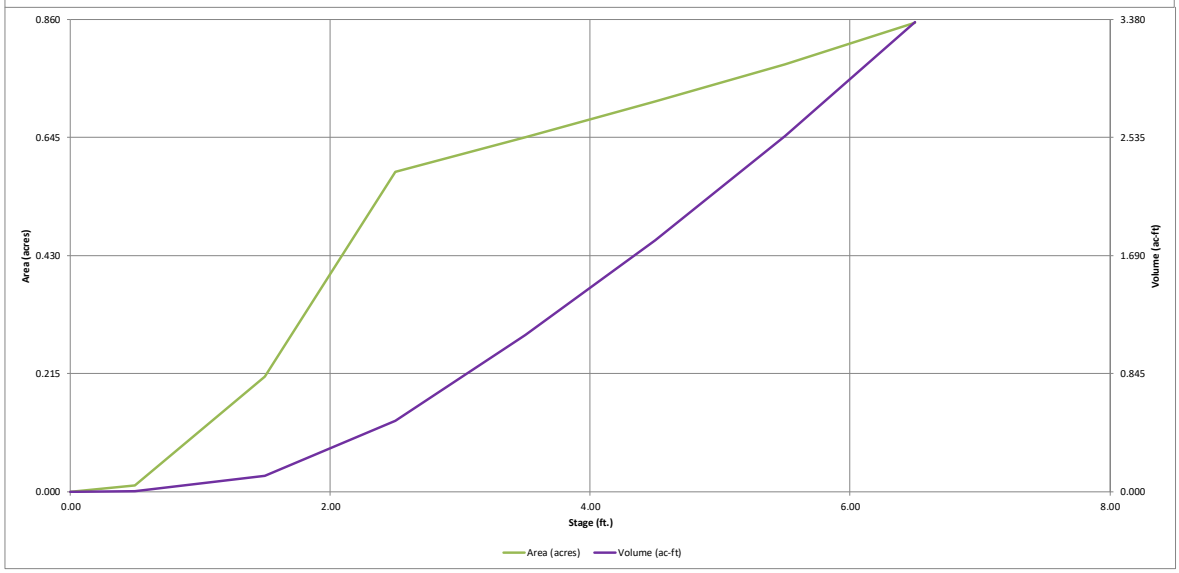
| | | |
|---|---|---|
| Zone 1 Volume (WQCV) = | 0.305 | acre-feet |
| Zone 2 Volume (EURV - Zone 1) = | 0.809 | acre-feet |
| Zone 3 Volume (100-year - Zones 1 & 2) = | 0.589 | acre-feet |
| Total Detention Basin Volume = | 1.702 | acre-feet |
| Initial Surcharge Volume (ISV) = | user | $ft^3$ |
| Initial 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 | -- | -- | -- | 40 | 0.001 | | |
| **6826** | -- | 0.50 | -- | -- | -- | 519 | 0.012 | 140 | 0.003 |
| **6827** | -- | 1.50 | -- | -- | -- | 9,130 | 0.210 | 4,964 | 0.114 |
| **6828** | -- | 2.50 | -- | -- | -- | 25,348 | 0.582 | 22,203 | 0.510 |
| **6829** | -- | 3.50 | -- | -- | -- | 28,102 | 0.645 | 48,928 | 1.123 |
| **6830** | -- | 4.50 | -- | -- | -- | 30,958 | 0.711 | 78,458 | 1.801 |
| **6831** | -- | 5.50 | -- | -- | -- | 33,914 | 0.779 | 110,894 | 2.546 |
| **6832** | -- | 6.50 | -- | -- | -- | 37,201 | 0.854 | 146,452 | 3.362 |


20
15
10
5
0
37600
28200
18800
9400
0
Length, Width (ft.)
Area (sq.ft.)
0.00
2.00
4.00
6.00
8.00
Stage (ft)
Length (ft)
Width (ft)
Area (sq.ft.)


0.860
0.645
0.430
0.215
0.000
3.380
2.535
1.690
0.845
0.000
Area (acres)
Volume (ac-ft)
0.00
2.00
4.00
6.00
8.00
Stage (ft.)
Area (acres)
Volume (ac-ft)

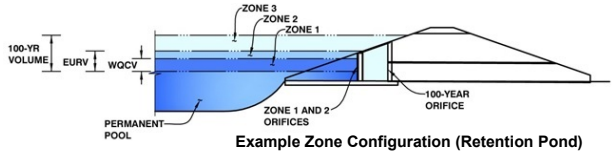
POND B: INTERIM DESIGN

# DETENTION BASIN OUTLET STRUCTURE DESIGN

*MHFD-Detention, Version 4.06 (July 2022)*

**Project: Falcon Field Filing 1**

**Basin ID: Pond B INTERIM**




**Example Zone Configuration (Retention Pond)**

| | Estimated Stage (ft) | Estimated Volume (ac-ft) | Outlet Type |
|---|---|---|---|
| Zone 1 (WQCV) | 2.10 | 0.305 | Orifice Plate |
| Zone 2 (EURV) | 3.49 | 0.809 | Orifice Plate |
| Zone 3 (100-year) | 4.37 | 0.589 | Weir&Pipe (Restrict) |
| Total (all zones) | | 1.702 | |

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 Area = | N/A | $ft^2$ |
| Underdrain Orifice Diameter = | N/A | inches | Underdrain Orifice Centroid = | N/A | 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 = | N/A | $ft^2$ |
| Depth at top of Zone using Orifice Plate = | 4.37 | 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 | sq. 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 | 1.00 | 2.00 | | | | | |
| Orifice Area (sq. inches) | 1.42 | 1.75 | 3.50 | | | | | |

| | 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) | Vertical Orifice Area = | N/A | N/A |
| Depth at top of Zone using Vertical Orifice = | N/A | N/A | ft (relative to basin bottom at Stage = 0 ft) | Vertical Orifice Centroid = | N/A | N/A |
| Vertical Orifice Diameter = | N/A | N/A | inches | | | |

Calculated Parameters for Vertical Orifi

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 = | 4.40 | N/A | ft (relative to basin bottom at Stage = 0 ft) | Height of Grate Upper Edge, $H_t$ = | 4.40 | N/A |
| Overflow Weir Front Edge Length = | 5.00 | N/A | feet | Overflow Weir Slope Length = | 5.00 | N/A |
| Overflow Weir Grate Slope = | 0.00 | N/A | H:V | Grate Open Area / 100-yr Orifice Area = | 16.26 | N/A |
| Horiz. Length of Weir Sides = | 5.00 | N/A | feet | Overflow Grate Open Area w/o Debris = | 17.40 | N/A |
| Overflow Grate Type = | Type C Grate | N/A | | Overflow Grate Open Area w/ Debris = | 8.70 | N/A |
| Debris Clogging % = | 50% | N/A | % | | | |

Calculated Parameters for Overflow We

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

| | Zone 3 Restrictor | Not Selected | | | | |
|---|---|---|---|---|---|---|
| Depth to Invert of Outlet Pipe = | 0.00 | N/A | ft (distance below basin bottom at Stage = 0 ft) | Outlet Orifice Area = | 1.07 | N/A |
| Outlet Pipe Diameter = | 18.00 | N/A | inches | Outlet Orifice Centroid = | 0.50 | N/A |
| Restrictor Plate Height Above Pipe Invert = | 10.50 | | inches | Half-Central Angle of Restrictor Plate on Pipe = | 1.74 | N/A |

Calculated Parameters for Outlet Pipe w/ Flow Restriction Pla

User Input: Emergency Spillway (Rectangular or Trapezoidal)

| | | | | | |
|---|---|---|---|---|---|
| Spillway Invert Stage= | 4.97 | ft (relative to basin bottom at Stage = 0 ft) | Spillway Design Flow Depth= | 0.53 | feet |
| Spillway Crest Length = | 50.00 | feet | Stage at Top of Freeboard = | 6.50 | feet |
| Spillway End Slopes = | 4.00 | H:V | Basin Area at Top of Freeboard = | 0.85 | acres |
| Freeboard above Max Water Surface = | 1.00 | feet | Basin Volume at Top of Freeboard = | 3.36 | acre-ft |

Calculated Parameters for Spillway

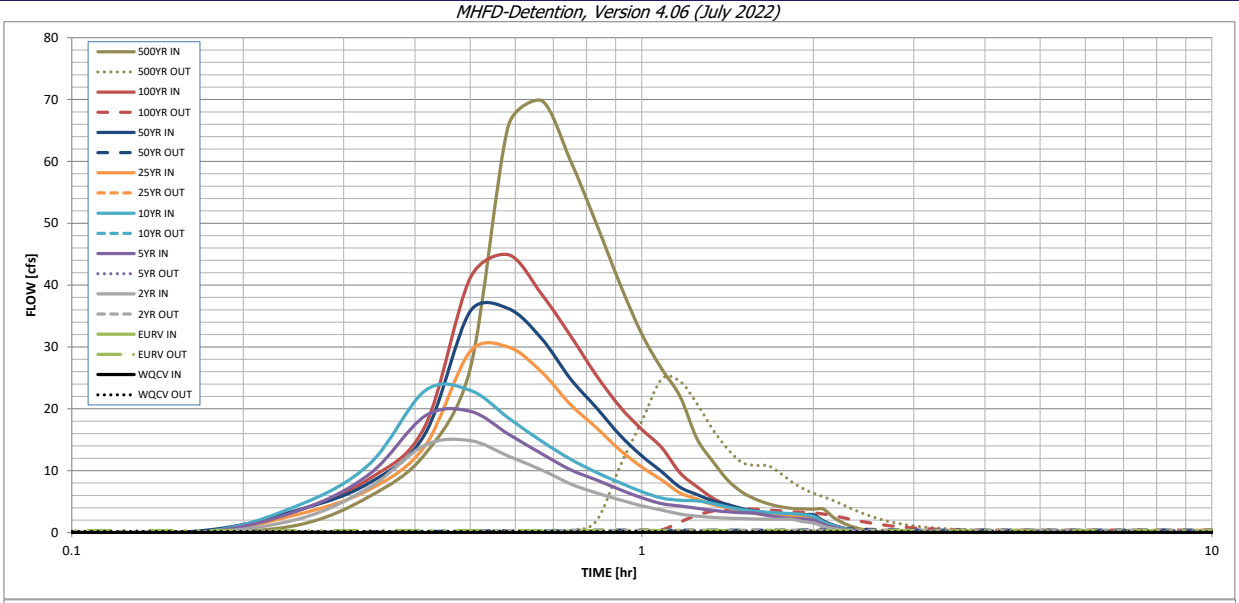
Routed Hydrograph Results

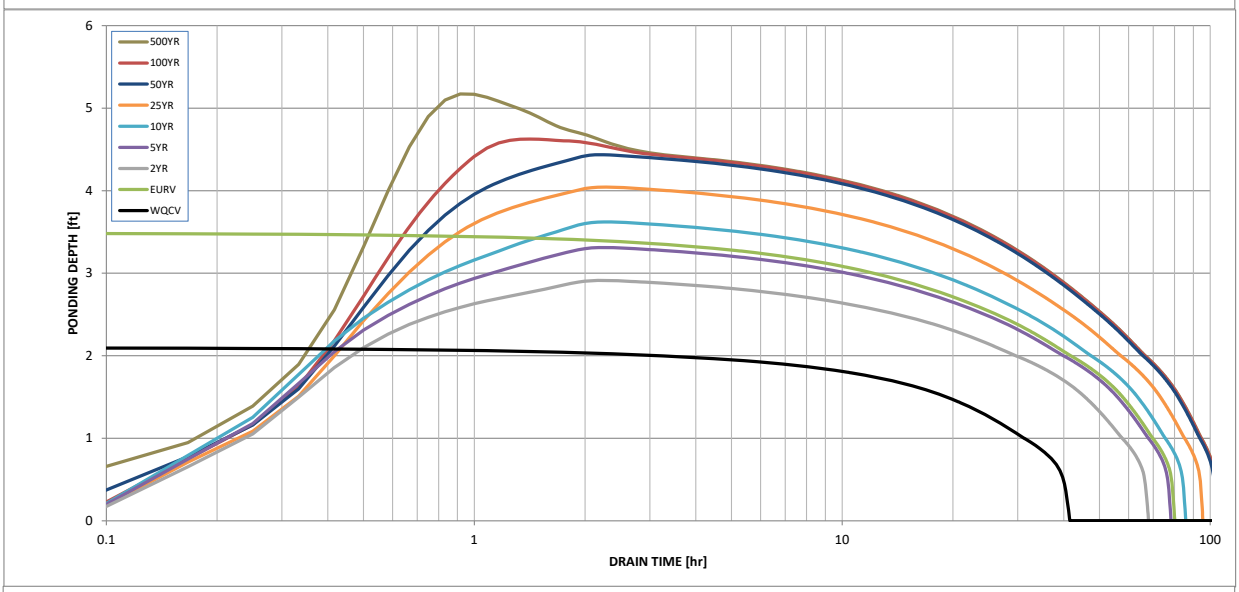
*The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).*

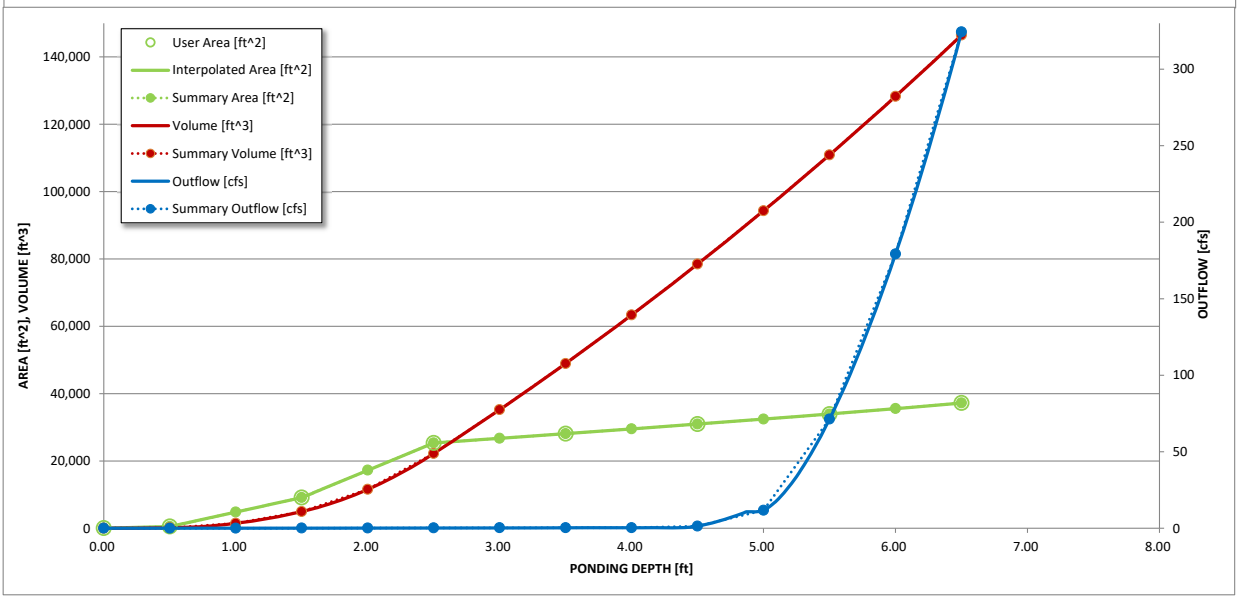
| Design Storm Return Period = | WQCV | EURV | 2 Year | 5 Year | 10 Year | 25 Year | 50 Year | 100 Year |
|---|---|---|---|---|---|---|---|---|
| One-Hour Rainfall Depth (in) = | N/A | N/A | 1.19 | 1.50 | 1.75 | 2.00 | 2.25 | 2.52 |
| CUHP Runoff Volume (acre-ft) = | 0.305 | 1.114 | 0.796 | 1.050 | 1.254 | 1.539 | 1.820 | 2.167 |
| Inflow Hydrograph Volume (acre-ft) = | N/A | N/A | 0.796 | 1.050 | 1.254 | 1.539 | 1.820 | 2.167 |
| CUHP Predevelopment Peak Q (cfs) = | N/A | N/A | 0.2 | 0.3 | 0.4 | 3.8 | 7.5 | 12.3 |
| 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 | 0.24 | 0.47 | 0.77 |
| Peak Inflow Q (cfs) = | N/A | N/A | 14.9 | 19.6 | 23.0 | 30.0 | 36.2 | 44.9 |
| Peak Outflow Q (cfs) = | 0.2 | 0.3 | 0.3 | 0.3 | 0.3 | 0.4 | 0.6 | 3.8 |
| Ratio Peak Outflow to Predevelopment Q = | N/A | N/A | N/A | 1.0 | 0.8 | 0.1 | 0.1 | 0.3 |
| Structure Controlling Flow = | Plate | Plate | Plate | Plate | Plate | Plate | Overflow Weir 1 | Overflow Weir 1 |
| Max Velocity through Grate 1 (fps) = | N/A | N/A | N/A | N/A | N/A | N/A | 0.0 | 0.2 |
| 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) = | 38 | 70 | 60 | 69 | 75 | 83 | 90 | 89 |
| Time to Drain 99% of Inflow Volume (hours) = | **40** | 76 | 65 | 74 | 81 | 90 | 98 | 98 |
| Maximum Ponding Depth (ft) = | 2.10 | 3.49 | 2.91 | 3.31 | 3.62 | 4.04 | 4.43 | 4.62 |
| Area at Maximum Ponding Depth (acres) = | 0.43 | 0.64 | 0.61 | 0.63 | 0.65 | 0.68 | 0.71 | 0.72 |
| Maximum Volume Stored (acre-ft) = | 0.307 | 1.117 | 0.754 | 1.002 | 1.201 | 1.481 | 1.752 | 1.887 |

# DETENTION BASIN OUTLET STRUCTURE DESIGN

*MHFD-Detention, Version 4.06 (July 2022)*




| 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 | 0.25 | 0.02 | 1.24 |
| | 0:15:00 | 0.00 | 0.00 | 2.19 | 3.56 | 4.42 | 2.97 | 3.66 | 3.62 | 5.86 |
| | 0:20:00 | 0.00 | 0.00 | 7.34 | 9.47 | 11.10 | 6.97 | 8.07 | 8.73 | 12.68 |
| | 0:25:00 | 0.00 | 0.00 | 14.13 | 18.84 | 22.92 | 14.01 | 15.94 | 17.22 | 26.48 |
| | 0:30:00 | 0.00 | 0.00 | 14.85 | 19.59 | 22.99 | 29.26 | 35.75 | 41.14 | 65.72 |
| | 0:35:00 | 0.00 | 0.00 | 12.36 | 15.92 | 18.53 | 29.98 | 36.21 | 44.92 | 69.85 |
| | 0:40:00 | 0.00 | 0.00 | 10.14 | 12.76 | 14.79 | 25.99 | 31.40 | 38.58 | 60.09 |
| | 0:45:00 | 0.00 | 0.00 | 7.86 | 10.14 | 11.85 | 20.68 | 24.83 | 31.81 | 49.84 |
| | 0:50:00 | 0.00 | 0.00 | 6.39 | 8.49 | 9.71 | 16.92 | 20.13 | 25.34 | 40.06 |
| | 0:55:00 | 0.00 | 0.00 | 5.27 | 6.92 | 8.02 | 13.27 | 15.68 | 20.26 | 32.11 |
| | 1:00:00 | 0.00 | 0.00 | 4.31 | 5.62 | 6.61 | 10.60 | 12.40 | 16.66 | 26.49 |
| | 1:05:00 | 0.00 | 0.00 | 3.64 | 4.67 | 5.58 | 8.49 | 9.84 | 13.76 | 22.02 |
| | 1:10:00 | 0.00 | 0.00 | 2.98 | 4.28 | 5.22 | 6.41 | 7.33 | 9.66 | 15.18 |
| | 1:15:00 | 0.00 | 0.00 | 2.64 | 3.93 | 5.11 | 5.41 | 6.14 | 7.41 | 11.47 |
| | 1:20:00 | 0.00 | 0.00 | 2.44 | 3.57 | 4.69 | 4.52 | 5.11 | 5.56 | 8.42 |
| | 1:25:00 | 0.00 | 0.00 | 2.32 | 3.35 | 4.10 | 4.00 | 4.51 | 4.40 | 6.52 |
| | 1:30:00 | 0.00 | 0.00 | 2.25 | 3.20 | 3.70 | 3.43 | 3.86 | 3.73 | 5.40 |
| | 1:35:00 | 0.00 | 0.00 | 2.20 | 3.11 | 3.44 | 3.08 | 3.46 | 3.27 | 4.65 |
| | 1:40:00 | 0.00 | 0.00 | 2.17 | 2.73 | 3.26 | 2.85 | 3.20 | 2.98 | 4.17 |
| | 1:45:00 | 0.00 | 0.00 | 2.15 | 2.47 | 3.15 | 2.70 | 3.03 | 2.82 | 3.90 |
| | 1:50:00 | 0.00 | 0.00 | 2.15 | 2.29 | 3.06 | 2.61 | 2.94 | 2.76 | 3.82 |
| | 1:55:00 | 0.00 | 0.00 | 1.78 | 2.18 | 2.91 | 2.56 | 2.88 | 2.73 | 3.79 |
| | 2:00:00 | 0.00 | 0.00 | 1.53 | 2.03 | 2.60 | 2.54 | 2.86 | 2.73 | 3.79 |
| | 2:05:00 | 0.00 | 0.00 | 1.00 | 1.32 | 1.71 | 1.66 | 1.87 | 1.79 | 2.48 |
| | 2:10:00 | 0.00 | 0.00 | 0.63 | 0.84 | 1.10 | 1.07 | 1.20 | 1.15 | 1.59 |
| | 2:15:00 | 0.00 | 0.00 | 0.40 | 0.52 | 0.68 | 0.68 | 0.76 | 0.73 | 1.00 |
| | 2:20:00 | 0.00 | 0.00 | 0.23 | 0.31 | 0.41 | 0.41 | 0.45 | 0.43 | 0.60 |
| | 2:25:00 | 0.00 | 0.00 | 0.12 | 0.18 | 0.23 | 0.24 | 0.27 | 0.26 | 0.35 |
| | 2:30:00 | 0.00 | 0.00 | 0.05 | 0.09 | 0.11 | 0.12 | 0.13 | 0.12 | 0.17 |
| | 2:35:00 | 0.00 | 0.00 | 0.02 | 0.03 | 0.03 | 0.04 | 0.04 | 0.04 | 0.05 |
| | 2:40:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 2:45:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 2:50:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 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 |

# DETENTION BASIN OUTLET STRUCTURE DESIGN

*MHFD-Detention, Version 4.06 (July 2022)*

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

| Stage - Storage Description | Stage [ft] | Area [ft$^2$] | Area [acres] | Volume [ft$^3$] | Volume [ac-ft] | Total Outflow [cfs] |
|---|---|---|---|---|---|---|
| | 0.00 | 40 | 0.001 | 0 | 0.000 | 0.00 |
| | 0.50 | 519 | 0.012 | 140 | 0.003 | 0.03 |
| | 1.00 | 4,825 | 0.111 | 1,476 | 0.034 | 0.05 |
| | 1.50 | 9,130 | 0.210 | 4,964 | 0.114 | 0.10 |
| | 2.00 | 17,239 | 0.396 | 11,556 | 0.265 | 0.13 |
| | 2.50 | 25,348 | 0.582 | 22,203 | 0.510 | 0.23 |
| | 3.00 | 26,725 | 0.614 | 35,221 | 0.809 | 0.28 |
| | 3.50 | 28,102 | 0.645 | 48,928 | 1.123 | 0.32 |
| | 4.00 | 29,530 | 0.678 | 63,336 | 1.454 | 0.36 |
| | 4.50 | 30,958 | 0.711 | 78,458 | 1.801 | 1.41 |
| | 5.00 | 32,436 | 0.745 | 94,307 | 2.165 | 11.71 |
| | 5.50 | 33,914 | 0.779 | 110,894 | 2.546 | 71.36 |
| | 6.00 | 35,557 | 0.816 | 128,262 | 2.944 | 179.22 |
| | 6.50 | 37,201 | 0.854 | 146,452 | 3.362 | 324.30 |

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

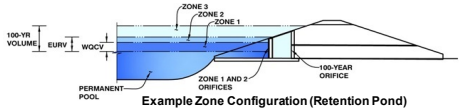
# DETENTION BASIN STAGE-STORAGE TABLE BUILDER

*MHFD-Detention, Version 4.06 (July 2022)*

POND B: ULTIMATE DESIGN FOR REFERENCE ONLY

**Project:** Falcon Field Filing 1

**Basin ID:** Pond B (with overdetention)




**Example Zone Configuration (Retention Pond)**

## Watershed Information

| | | |
|---|---|---|
| Selected BMP Type = | EDB | |
| Watershed Area = | 15.87 | acres |
| Watershed Length = | 1,200 | ft |
| Watershed Length to Centroid = | 400 | ft |
| Watershed Slope = | 0.035 | ft/ft |
| Watershed Imperviousness = | 79.70% | 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) = | 0.432 | acre-feet | acre-feet |
| Excess Urban Runoff Volume (EURV) = | 1.662 | acre-feet | acre-feet |
| 2-yr Runoff Volume (P1 = 1.19 in.) = | 1.142 | acre-feet | 1.19 inches |
| 5-yr Runoff Volume (P1 = 1.5 in.) = | 1.481 | acre-feet | 1.50 inches |
| 10-yr Runoff Volume (P1 = 1.75 in.) = | 1.753 | acre-feet | 1.75 inches |
| 25-yr Runoff Volume (P1 = 2 in.) = | 2.071 | acre-feet | 2.00 inches |
| 50-yr Runoff Volume (P1 = 2.25 in.) = | 2.382 | acre-feet | 2.25 inches |
| 100-yr Runoff Volume (P1 = 2.52 in.) = | 2.743 | acre-feet | 2.52 inches |
| 500-yr Runoff Volume (P1 = 3.49 in.) = | 4.004 | acre-feet | 3.49 inches |
| Approximate 2-yr Detention Volume = | 1.091 | acre-feet | |
| Approximate 5-yr Detention Volume = | 1.419 | acre-feet | |
| Approximate 10-yr Detention Volume = | 1.694 | acre-feet | |
| Approximate 25-yr Detention Volume = | 2.012 | acre-feet | |
| Approximate 50-yr Detention Volume = | 2.199 | acre-feet | |
| Approximate 100-yr Detention Volume = | 2.371 | acre-feet | |

## Define Zones and Basin Geometry

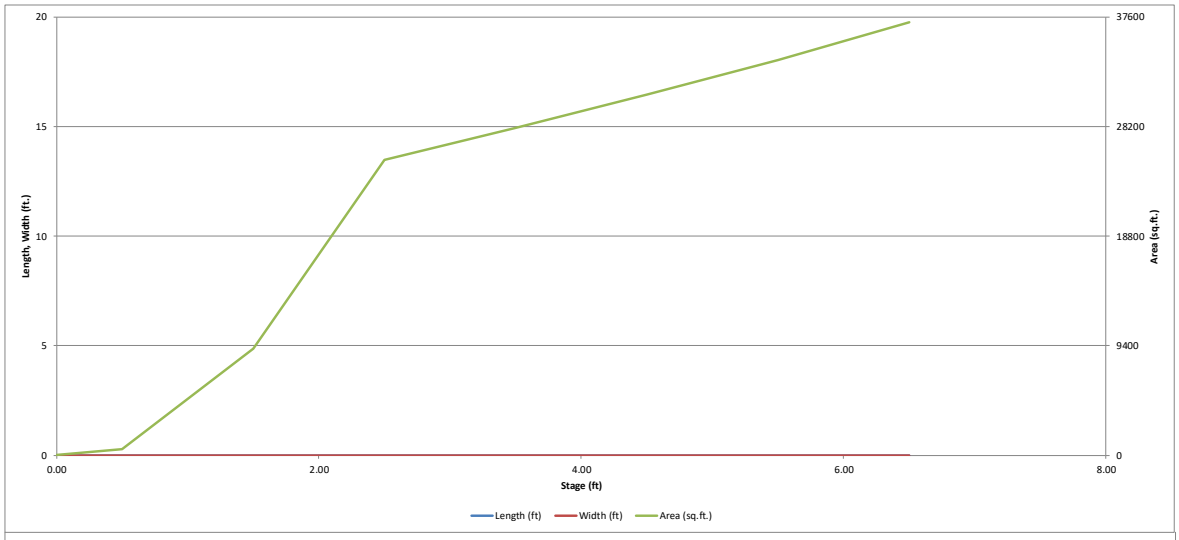
| | | |
|---|---|---|
| Zone 1 Volume (WQCV) = | 0.432 | acre-feet |
| Zone 2 Volume (EURV - Zone 1) = | 1.230 | acre-feet |
| Zone 3 Volume (100-year - Zones 1 & 2) = | 0.710 | acre-feet |
| Total Detention Basin Volume = | 2.371 | acre-feet |
| Initial Surcharge Volume (ISV) = | user | $ft^3$ |
| Initial 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 | |

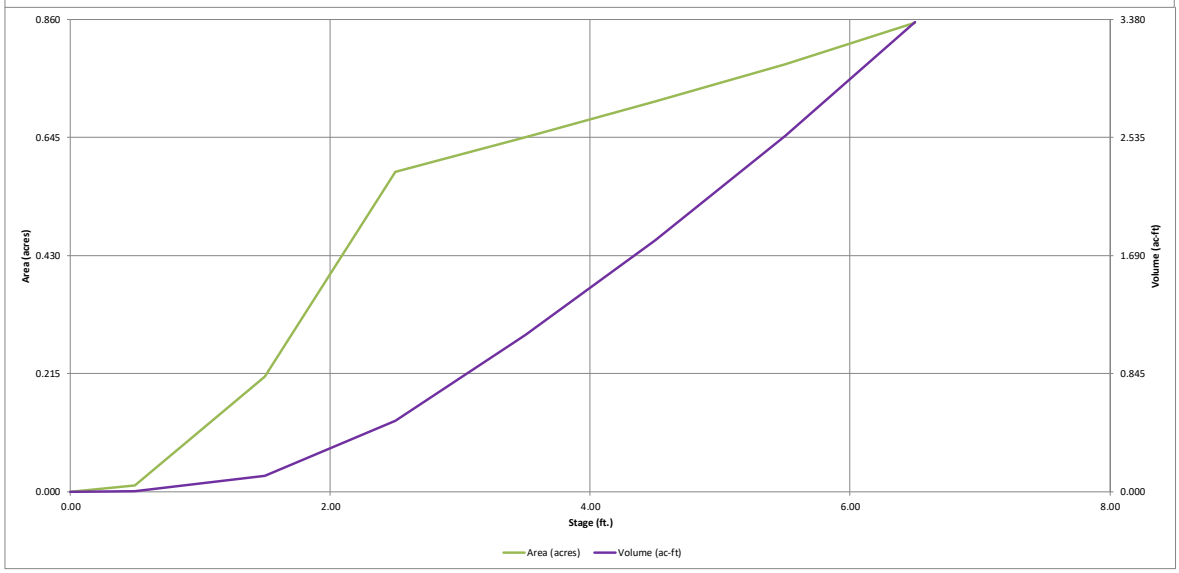
| | | |
|---|---|---|
| Initial Surcharge Area ($A_{ISV}$) = | user | $ft^2$ |
| Surcharge Volume Length ($L_{ISV}$) = | user | ft |
| Surcharge Volume Width ($W_{ISV}$) = | user | ft |
| Depth of Basin Floor ($H_{FLOOR}$) = | user | ft |
| Length of Basin Floor ($L_{FLOOR}$) = | user | ft |
| Width 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 | -- | -- | -- | 40 | 0.001 | | |
| **6826** | -- | 0.50 | -- | -- | -- | 519 | 0.012 | 140 | 0.003 |
| **6827** | -- | 1.50 | -- | -- | -- | 9,130 | 0.210 | 4,964 | 0.114 |
| **6828** | -- | 2.50 | -- | -- | -- | 25,348 | 0.582 | 22,203 | 0.510 |
| **6829** | -- | 3.50 | -- | -- | -- | 28,102 | 0.645 | 48,928 | 1.123 |
| **6830** | -- | 4.50 | -- | -- | -- | 30,958 | 0.711 | 78,458 | 1.801 |
| **6831** | -- | 5.50 | -- | -- | -- | 33,914 | 0.779 | 110,894 | 2.546 |
| **6832** | -- | 6.50 | -- | -- | -- | 37,201 | 0.854 | 146,452 | 3.362 |

POND B: ULTIMATE DESIGN FOR REFERENCE ONLY



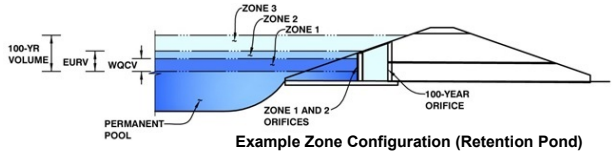
POND B: ULTIMATE DESIGN FOR REFERENCE ONLY

# DETENTION BASIN OUTLET STRUCTURE DESI

*MHFD-Detention, Version 4.06 (July 2022)*

**Project: Falcon Field Filing 1**

**Basin ID: Pond B (with overdetention)**




**Example Zone Configuration (Retention Pond)**

| | Estimated Stage (ft) | Estimated Volume (ac-ft) | Outlet Type |
|---|---|---|---|
| Zone 1 (WQCV) | 2.36 | 0.432 | Orifice Plate |
| Zone 2 (EURV) | 4.31 | 1.230 | Orifice Plate |
| Zone 3 (100-year) | 5.28 | 0.710 | Weir&Pipe (Restrict) |
| Total (all zones) | | 2.371 | |

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 Area = | N/A | $ft^2$ |
| Underdrain Orifice Diameter = | N/A | inches | Underdrain Orifice Centroid = | N/A | 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 = | N/A | $ft^2$ |
| Depth at top of Zone using Orifice Plate = | 4.31 | 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 | sq. 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 | 1.00 | 2.00 | | | | | |
| Orifice Area (sq. inches) | 1.72 | 1.97 | 4.25 | | | | | |

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

Calculated Parameters for Vertical Orifi

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 = | 4.40 | N/A | ft (relative to basin bottom at Stage = 0 ft) | Height of Grate Upper Edge, $H_t$ = | 4.40 | N/A |
| Overflow Weir Front Edge Length = | 5.00 | N/A | feet | Overflow Weir Slope Length = | 5.00 | N/A |
| Overflow Weir Grate Slope = | 0.00 | N/A | H:V | Grate Open Area / 100-yr Orifice Area = | 16.26 | N/A |
| Horiz. Length of Weir Sides = | 5.00 | N/A | feet | Overflow Grate Open Area w/o Debris = | 17.40 | N/A |
| Overflow Grate Type = | Type C Grate | N/A | | Overflow Grate Open Area w/ Debris = | 8.70 | N/A |
| Debris Clogging % = | 50% | N/A | % | | | |

Calculated Parameters for Overflow We

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 = | 0.00 | N/A | ft (distance below basin bottom at Stage = 0 ft) | Outlet Orifice Area = | 1.07 | N/A |
| Outlet Pipe Diameter = | 18.00 | N/A | inches | Outlet Orifice Centroid = | 0.50 | N/A |
| Restrictor Plate Height Above Pipe Invert = | 10.50 | | inches | Half-Central Angle of Restrictor Plate on Pipe = | 1.74 | N/A |

Calculated Parameters for Outlet Pipe w/ Flow Restriction Pla

User Input: Emergency Spillway (Rectangular or Trapezoidal)

| | | | | | |
|---|---|---|---|---|---|
| Spillway Invert Stage= | 4.97 | ft (relative to basin bottom at Stage = 0 ft) | Spillway Design Flow Depth= | 0.53 | feet |
| Spillway Crest Length = | 50.00 | feet | Stage at Top of Freeboard = | 6.50 | feet |
| Spillway End Slopes = | 4.00 | H:V | Basin Area at Top of Freeboard = | 0.85 | acres |
| Freeboard above Max Water Surface = | 1.00 | feet | Basin Volume at Top of Freeboard = | 3.36 | acre-ft |

Calculated Parameters for Spillway

Routed Hydrograph Results

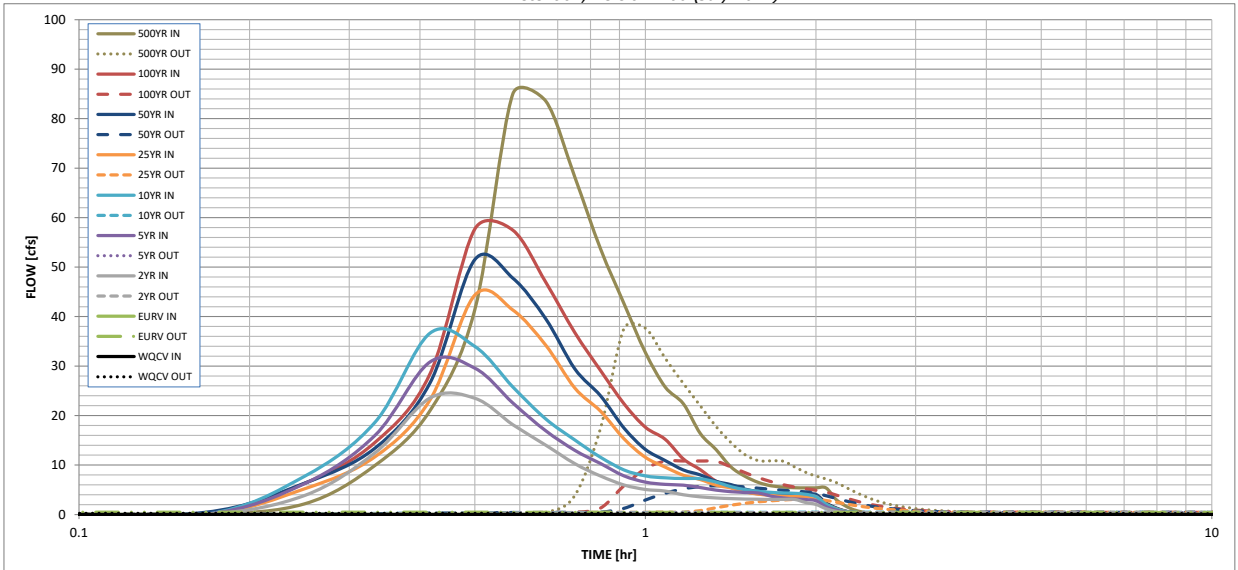
*The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).*

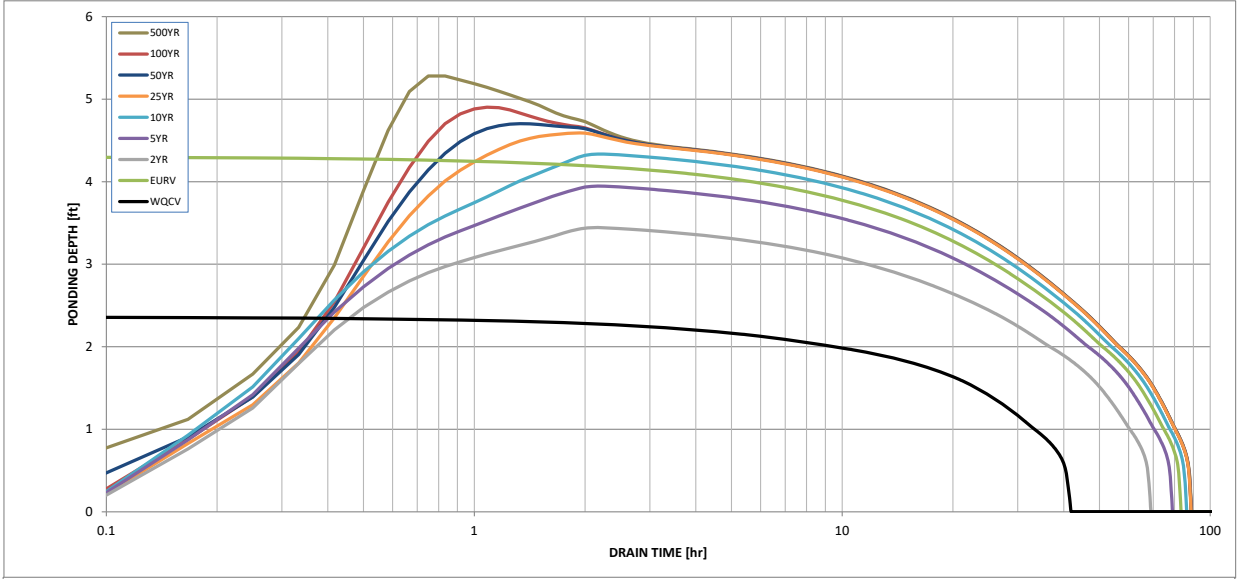
| Design Storm Return Period = | WQCV | EURV | 2 Year | 5 Year | 10 Year | 25 Year | 50 Year | 100 Year |
|---|---|---|---|---|---|---|---|---|
| One-Hour Rainfall Depth (in) = | N/A | N/A | 1.19 | 1.50 | 1.75 | 2.00 | 2.25 | 2.52 |
| CUHP Runoff Volume (acre-ft) = | 0.432 | 1.662 | 1.142 | 1.481 | 1.753 | 2.071 | 2.382 | 2.743 |
| Inflow Hydrograph Volume (acre-ft) = | N/A | N/A | 1.142 | 1.481 | 1.753 | 2.071 | 2.382 | 2.743 |
| CUHP Predevelopment Peak Q (cfs) = | N/A | N/A | 0.2 | 0.3 | 0.4 | 3.8 | 7.5 | 12.3 |
| 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 | 0.24 | 0.47 | 0.77 |
| Peak Inflow Q (cfs) = | N/A | N/A | 23.5 | 30.8 | 36.6 | 44.4 | 51.5 | 57.7 |
| Peak Outflow Q (cfs) = | 0.3 | 0.5 | 0.4 | 0.4 | 0.5 | 3.2 | 5.8 | 10.8 |
| Ratio Peak Outflow to Predevelopment Q = | N/A | N/A | N/A | 1.4 | 1.1 | 0.8 | 0.8 | 0.9 |
| Structure Controlling Flow = | Plate | Plate | Plate | Plate | Plate | Overflow Weir 1 | Overflow Weir 1 | Outlet Plate 1 |
| Max Velocity through Grate 1 (fps) = | N/A | N/A | N/A | N/A | N/A | 0.2 | 0.3 | 0.6 |
| 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) = | 38 | 72 | 60 | 69 | 75 | 76 | 75 | 74 |
| Time to Drain 99% of Inflow Volume (hours) = | **40** | 79 | 66 | 75 | 81 | 83 | 83 | 82 |
| Maximum Ponding Depth (ft) = | 2.37 | 4.31 | 3.44 | 3.95 | 4.33 | 4.59 | 4.70 | 4.90 |
| Area at Maximum Ponding Depth (acres) = | 0.53 | 0.70 | 0.64 | 0.67 | 0.70 | 0.72 | 0.72 | 0.74 |
| Maximum Volume Stored (acre-ft) = | 0.437 | 1.667 | 1.085 | 1.413 | 1.681 | 1.865 | 1.945 | 2.091 |

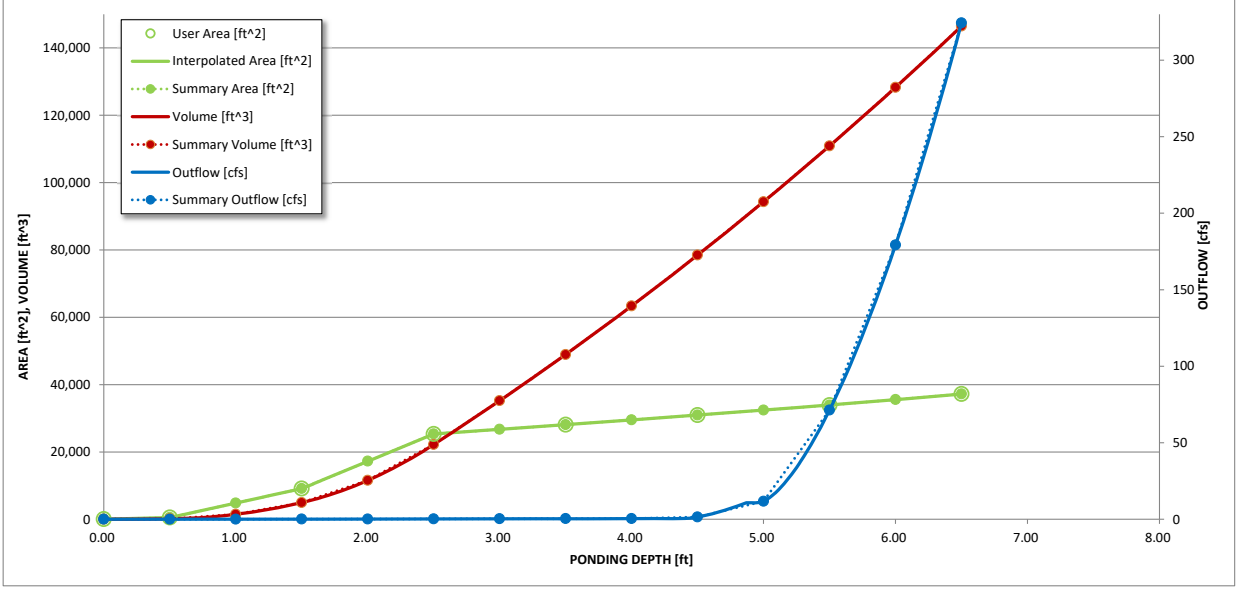
POND B: ULTIMATE DESIGN FOR REFERENCE ONLY

# DETENTION BASIN OUTLET STRUCTURE DESIGN

*MHFD-Detention, Version 4.06 (July 2022)*




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

POND B: ULTIMATE DESIGN FOR REFERENCE ONLY

# 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 | 0.43 | 0.04 | 2.14 |
| | 0:15:00 | 0.00 | 0.00 | 3.84 | 6.23 | 7.71 | 5.17 | 6.32 | 6.28 | 9.94 |
| | 0:20:00 | 0.00 | 0.00 | 12.50 | 16.02 | 18.68 | 11.67 | 13.45 | 14.58 | 21.00 |
| | 0:25:00 | 0.00 | 0.00 | 23.55 | 30.84 | 36.65 | 23.18 | 26.60 | 28.43 | 41.42 |
| | 0:30:00 | 0.00 | 0.00 | 23.50 | 29.58 | 33.95 | 44.36 | 51.51 | 57.70 | 84.97 |
| | 0:35:00 | 0.00 | 0.00 | 18.17 | 22.54 | 25.80 | 41.34 | 47.78 | 57.46 | 83.57 |
| | 0:40:00 | 0.00 | 0.00 | 14.02 | 16.93 | 19.31 | 34.23 | 39.56 | 46.96 | 68.26 |
| | 0:45:00 | 0.00 | 0.00 | 10.29 | 12.99 | 15.09 | 25.60 | 29.48 | 36.80 | 53.65 |
| | 0:50:00 | 0.00 | 0.00 | 7.78 | 10.29 | 11.56 | 20.86 | 23.96 | 29.09 | 42.63 |
| | 0:55:00 | 0.00 | 0.00 | 5.97 | 7.80 | 9.01 | 15.30 | 17.48 | 22.39 | 32.73 |
| | 1:00:00 | 0.00 | 0.00 | 5.07 | 6.56 | 7.79 | 11.56 | 13.16 | 17.64 | 25.80 |
| | 1:05:00 | 0.00 | 0.00 | 4.73 | 6.09 | 7.41 | 9.58 | 10.92 | 15.22 | 22.38 |
| | 1:10:00 | 0.00 | 0.00 | 3.98 | 5.92 | 7.28 | 7.93 | 8.99 | 11.24 | 16.38 |
| | 1:15:00 | 0.00 | 0.00 | 3.58 | 5.44 | 7.22 | 7.07 | 7.99 | 9.06 | 13.10 |
| | 1:20:00 | 0.00 | 0.00 | 3.34 | 4.92 | 6.56 | 5.94 | 6.70 | 6.71 | 9.58 |
| | 1:25:00 | 0.00 | 0.00 | 3.22 | 4.62 | 5.60 | 5.35 | 6.03 | 5.45 | 7.71 |
| | 1:30:00 | 0.00 | 0.00 | 3.13 | 4.45 | 5.02 | 4.56 | 5.14 | 4.63 | 6.48 |
| | 1:35:00 | 0.00 | 0.00 | 3.08 | 4.35 | 4.68 | 4.11 | 4.63 | 4.19 | 5.82 |
| | 1:40:00 | 0.00 | 0.00 | 3.07 | 3.72 | 4.48 | 3.85 | 4.33 | 3.99 | 5.54 |
| | 1:45:00 | 0.00 | 0.00 | 3.07 | 3.36 | 4.35 | 3.72 | 4.18 | 3.91 | 5.42 |
| | 1:50:00 | 0.00 | 0.00 | 3.07 | 3.14 | 4.29 | 3.65 | 4.10 | 3.90 | 5.39 |
| | 1:55:00 | 0.00 | 0.00 | 2.43 | 3.03 | 4.10 | 3.61 | 4.07 | 3.90 | 5.39 |
| | 2:00:00 | 0.00 | 0.00 | 2.05 | 2.79 | 3.61 | 3.61 | 4.06 | 3.90 | 5.39 |
| | 2:05:00 | 0.00 | 0.00 | 1.17 | 1.60 | 2.09 | 2.10 | 2.36 | 2.26 | 3.13 |
| | 2:10:00 | 0.00 | 0.00 | 0.67 | 0.92 | 1.19 | 1.21 | 1.36 | 1.30 | 1.80 |
| | 2:15:00 | 0.00 | 0.00 | 0.34 | 0.49 | 0.63 | 0.65 | 0.73 | 0.70 | 0.96 |
| | 2:20:00 | 0.00 | 0.00 | 0.16 | 0.26 | 0.32 | 0.35 | 0.39 | 0.37 | 0.51 |
| | 2:25:00 | 0.00 | 0.00 | 0.06 | 0.10 | 0.12 | 0.14 | 0.15 | 0.15 | 0.20 |
| | 2:30:00 | 0.00 | 0.00 | 0.01 | 0.02 | 0.02 | 0.02 | 0.03 | 0.02 | 0.03 |
| | 2:35:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 2:40:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 2:45:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 2:50:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 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 |

POND B: ULTIMATE DESIGN FOR REFERENCE ONLY

# DETENTION BASIN OUTLET STRUCTURE DESIGN

*MHFD-Detention, Version 4.06 (July 2022)*

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

| Stage - Storage Description | Stage [ft] | Area [ft$^2$] | Area [acres] | Volume [ft$^3$] | Volume [ac-ft] | Total Outflow [cfs] |
|---|---|---|---|---|---|---|
| | 0.00 | 40 | 0.001 | 0 | 0.000 | 0.00 |
| | 0.50 | 519 | 0.012 | 140 | 0.003 | 0.04 |
| | 1.00 | 4,825 | 0.111 | 1,476 | 0.034 | 0.06 |
| | 1.50 | 9,130 | 0.210 | 4,964 | 0.114 | 0.12 |
| | 2.00 | 17,239 | 0.396 | 11,556 | 0.265 | 0.15 |
| | 2.50 | 25,348 | 0.582 | 22,203 | 0.510 | 0.27 |
| | 3.00 | 26,725 | 0.614 | 35,221 | 0.809 | 0.33 |
| | 3.50 | 28,102 | 0.645 | 48,928 | 1.123 | 0.39 |
| | 4.00 | 29,530 | 0.678 | 63,336 | 1.454 | 0.43 |
| | 4.50 | 30,958 | 0.711 | 78,458 | 1.801 | 1.49 |
| | 5.00 | 32,436 | 0.745 | 94,307 | 2.165 | 11.71 |
| | 5.50 | 33,914 | 0.779 | 110,894 | 2.546 | 71.36 |
| | 6.00 | 35,557 | 0.816 | 128,262 | 2.944 | 179.22 |
| | 6.50 | 37,201 | 0.854 | 146,452 | 3.362 | 324.30 |

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

POND B: ULTIMATE DESIGN

Pond B

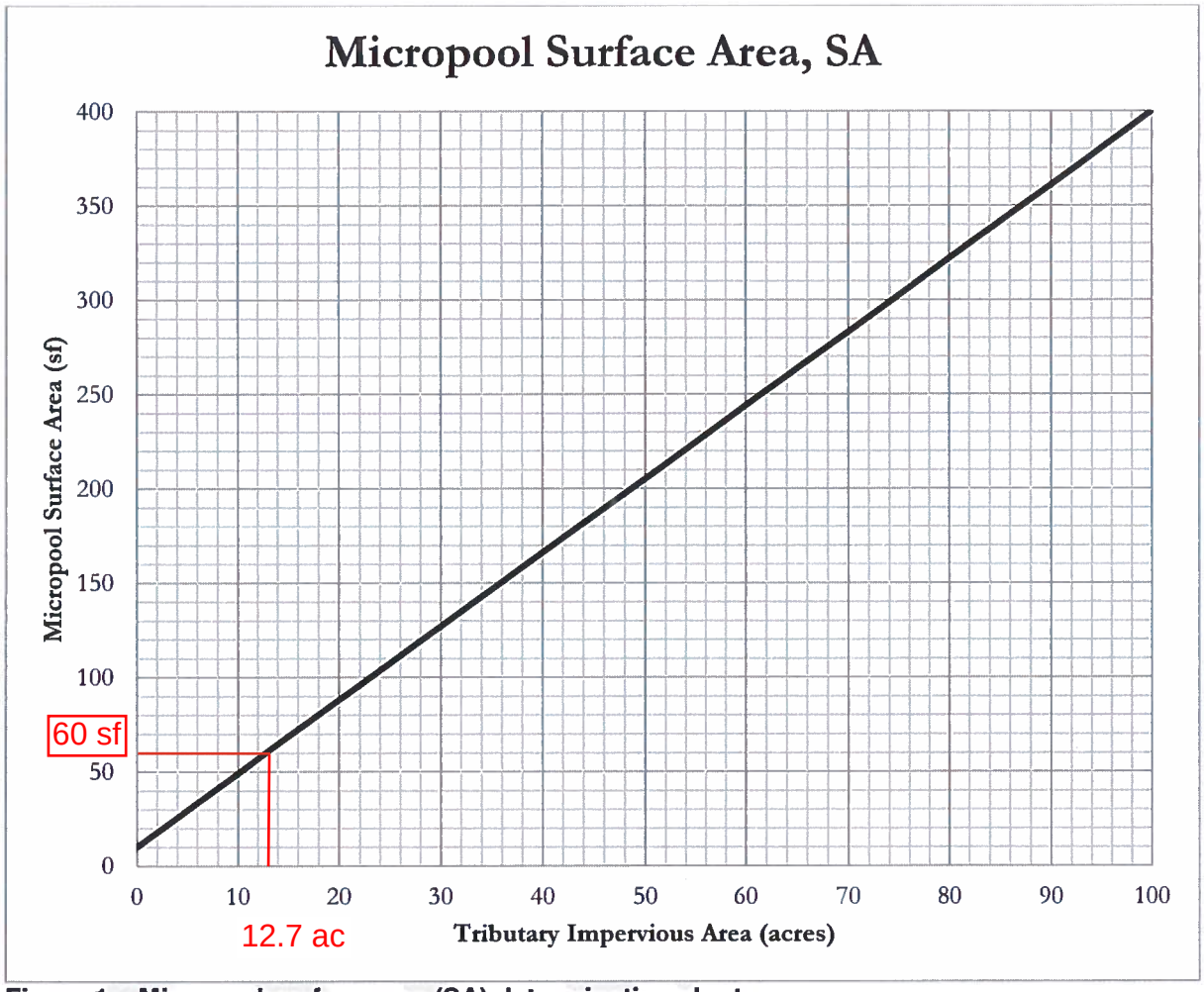



**Figure 1 – Micropool surface area (SA) determination chart**

The tributary impervious area is the effective number of impervious acres that will be treated by the extended detention basin (EDB). It is calculated by multiplying the tributary area to be treated by the impervious fraction of that area.

$$TIA = I \times A$$ = (79.7/100) x 15.9 ac = 12.7 ac

*TIA* = Tributary impervious area (acres)
*I* = Imperviousness (fraction)
*A* = Tributary catchment area upstream (acres)

For EDBs with tributary impervious areas greater than 100 acres, the micropool surface area is 400 sf. The initial surcharge depth (ISD) is defined as the depth of the initial surcharge volume (ISV). The surface area determined using Figure 1 assumes an ISD of 4 inches. The initial surcharge volume is thus calculated by multiplying the micropool surface area by 4 inches.

$$ISV = SA \times 4\ inches$$

*ISV* = Initial surcharge volume (cf)
*SA* = Surface area (from Figure 1, sf)

Pond B



POND B: ULTIMATE DESIGN

**Figure 13-12c. Emergency Spillway Protection**

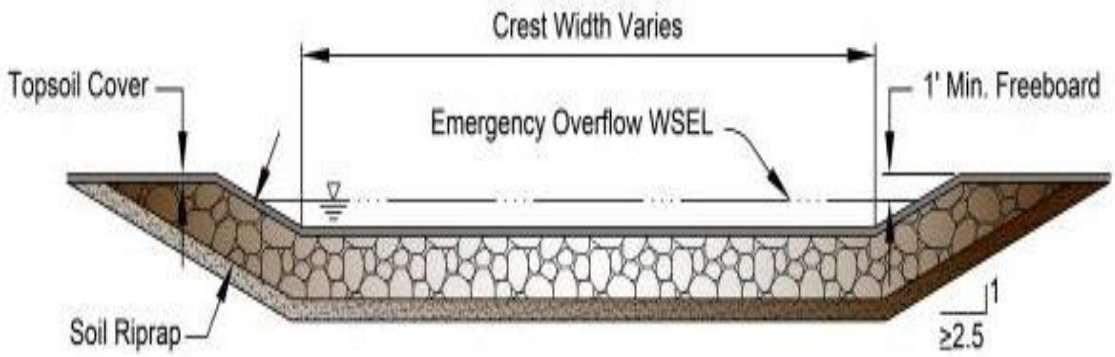
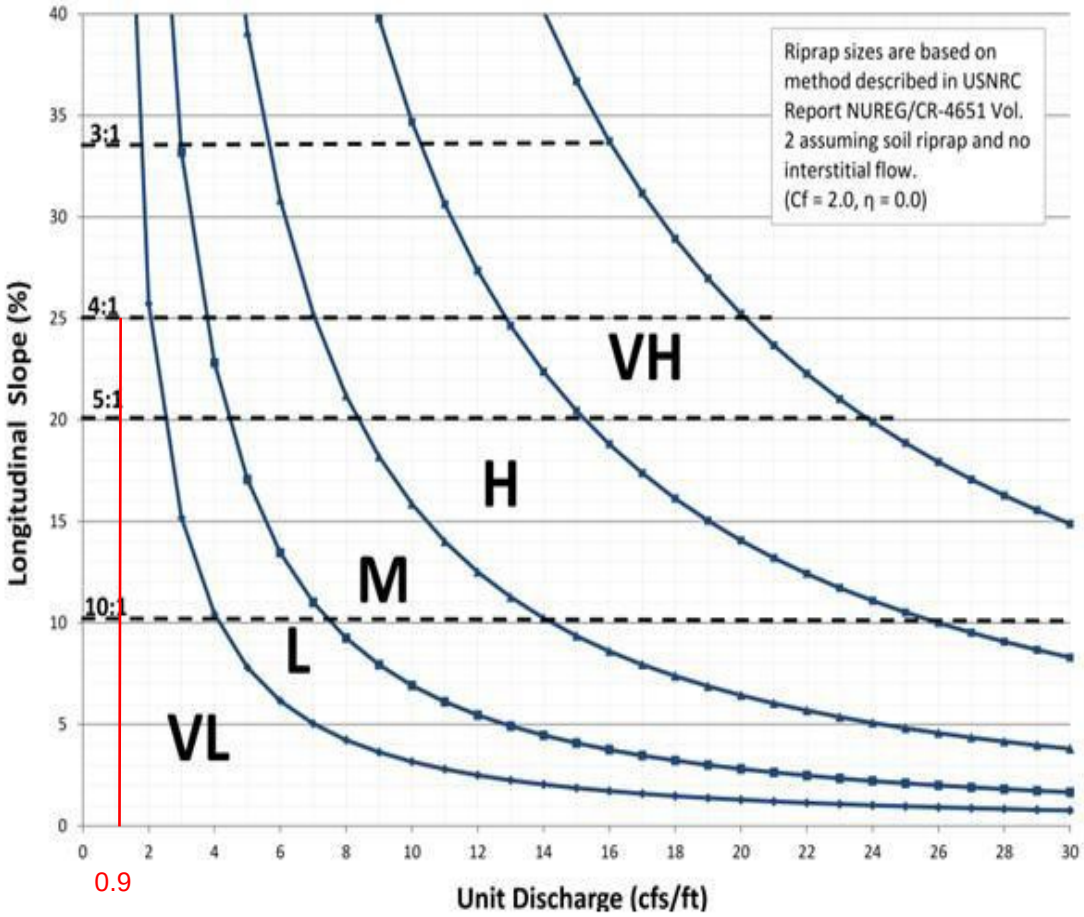



**Figure 13-12d. Riprap Types for Emergency Spillway Protection**




PEAK INFLOW Q100=57.7 cfs
Spillway length=50 ft
57.7 cfs/50 ft = 1.2 cfs/ft

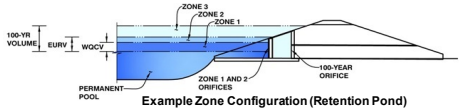
# DETENTION BASIN STAGE-STORAGE TABLE BUILDER

*MHFD-Detention, Version 4.06 (July 2022)*

**POND C: INTERIM DESIGN**

**Project:** Falcon Field Filing 1

**Basin ID:** Pond C INTERIM




**Example Zone Configuration (Retention Pond)**

## Watershed Information

| | | |
|---|---|---|
| Selected BMP Type = | **EDB** | |
| Watershed Area = | 26.38 | acres |
| Watershed Length = | 1,200 | ft |
| Watershed Length to Centroid = | 500 | ft |
| Watershed Slope = | 0.040 | ft/ft |
| Watershed Imperviousness = | 27.80% | 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) = | 0.317 | acre-feet | | acre-feet |
| Excess Urban Runoff Volume (EURV) = | 0.717 | acre-feet | | acre-feet |
| 2-yr Runoff Volume (P1 = 1.19 in.) = | 0.484 | acre-feet | 1.19 | inches |
| 5-yr Runoff Volume (P1 = 1.5 in.) = | 0.671 | acre-feet | 1.50 | inches |
| 10-yr Runoff Volume (P1 = 1.75 in.) = | 0.832 | acre-feet | 1.75 | inches |
| 25-yr Runoff Volume (P1 = 2 in.) = | 1.262 | acre-feet | 2.00 | inches |
| 50-yr Runoff Volume (P1 = 2.25 in.) = | 1.663 | acre-feet | 2.25 | inches |
| 100-yr Runoff Volume (P1 = 2.52 in.) = | 2.202 | acre-feet | 2.52 | inches |
| 500-yr Runoff Volume (P1 = 3.49 in.) = | 4.092 | acre-feet | 3.49 | inches |
| Approximate 2-yr Detention Volume = | 0.450 | acre-feet | | |
| Approximate 5-yr Detention Volume = | 0.601 | acre-feet | | |
| Approximate 10-yr Detention Volume = | 0.754 | acre-feet | | |
| Approximate 25-yr Detention Volume = | 0.957 | acre-feet | | |
| Approximate 50-yr Detention Volume = | 1.114 | acre-feet | | |
| Approximate 100-yr Detention Volume = | 1.377 | acre-feet | | |

## Define Zones and Basin Geometry

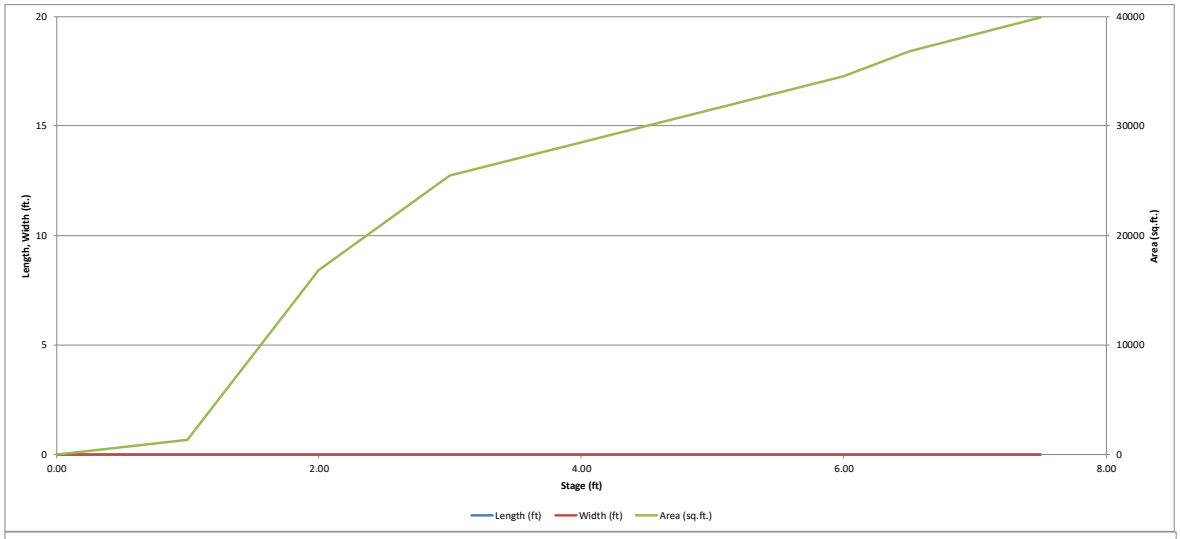
| | | |
|---|---|---|
| Zone 1 Volume (WQCV) = | 0.317 | acre-feet |
| Zone 2 Volume (EURV - Zone 1) = | 0.400 | acre-feet |
| Zone 3 Volume (100-year - Zones 1 & 2) = | 0.659 | acre-feet |
| Total Detention Basin Volume = | 1.377 | acre-feet |
| Initial Surcharge Volume (ISV) = | user | $ft^3$ |
| Initial 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 | |

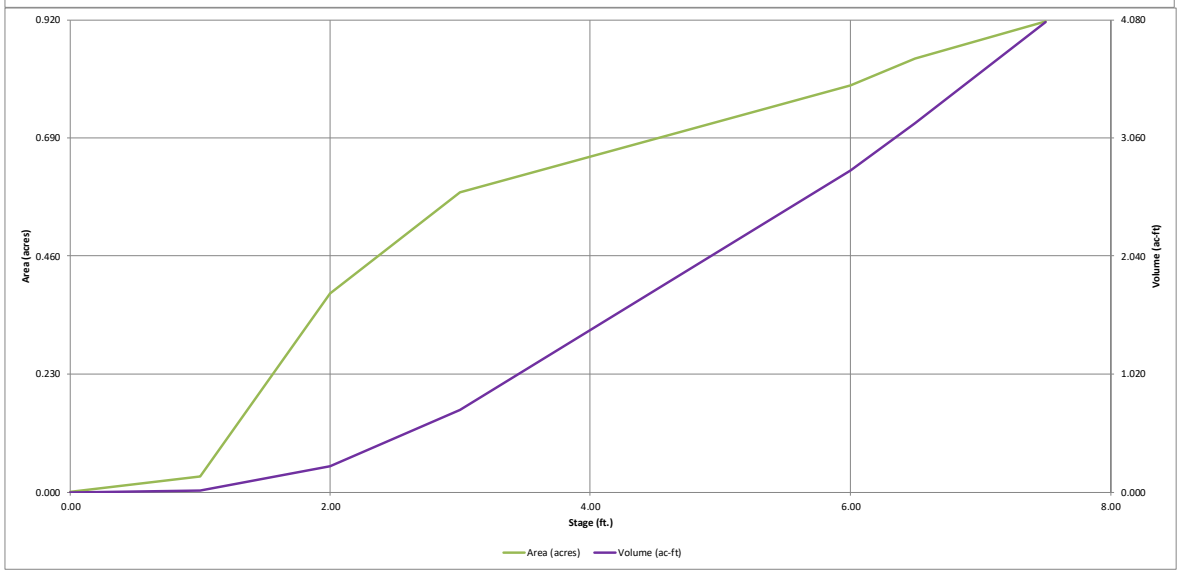
| | | |
|---|---|---|
| Initial Surcharge Area ($A_{ISV}$) = | user | $ft^2$ |
| Surcharge Volume Length ($L_{ISV}$) = | user | ft |
| Surcharge Volume Width ($W_{ISV}$) = | user | ft |
| Depth of Basin Floor ($H_{FLOOR}$) = | user | ft |
| Length of Basin Floor ($L_{FLOOR}$) = | user | ft |
| Width 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 | -- | -- | -- | 40 | 0.001 | | |
| **6801** | -- | 1.00 | -- | -- | -- | 1,320 | 0.030 | 680 | 0.016 |
| **6802** | -- | 2.00 | -- | -- | -- | 16,829 | 0.386 | 9,754 | 0.224 |
| **6803** | -- | 3.00 | -- | -- | -- | 25,446 | 0.584 | 30,892 | 0.709 |
| **6806** | -- | 6.00 | -- | -- | -- | 34,523 | 0.793 | 120,845 | 2.774 |
| **6806.5** | -- | 6.50 | -- | -- | -- | 36,800 | 0.845 | 138,676 | 3.184 |
| **6807.5** | -- | 7.50 | -- | -- | -- | 39,938 | 0.917 | 177,045 | 4.064 |

POND C: INTERIM DESIGN



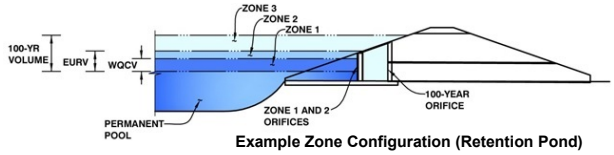
POND C: INTERIM DESIGN

# DETENTION BASIN OUTLET STRUCTURE DESIGN

*MHFD-Detention, Version 4.06 (July 2022)*

**Project: Falcon Field Filing 1**

**Basin ID: Pond C INTERIM**




**Example Zone Configuration (Retention Pond)**

| | Estimated Stage (ft) | Estimated Volume (ac-ft) | Outlet Type |
|---|---|---|---|
| Zone 1 (WQCV) | 2.23 | 0.317 | Orifice Plate |
| Zone 2 (EURV) | 3.02 | 0.400 | Orifice Plate |
| Zone 3 (100-year) | 4.08 | 0.659 | Weir&Pipe (Circular) |
| Total (all zones) | | 1.377 | |

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 = | N/A | $ft^2$ |
| Depth at top of Zone using Orifice Plate = | 4.08 | 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 | sq. 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 | 1.25 | 2.50 | 3.50 | | | | |
| Orifice Area (sq. inches) | 1.60 | 1.35 | 1.00 | 18.00 | | | | |

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

Calculated Parameters for Vertical Orifi

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 = | 5.09 | N/A | ft (relative to basin bottom at Stage = 0 ft) | Height of Grate Upper Edge, $H_t$ = | 5.09 | N/A |
| Overflow Weir Front Edge Length = | 5.00 | N/A | feet | Overflow Weir Slope Length = | 5.00 | N/A |
| Overflow Weir Grate Slope = | 0.00 | N/A | H:V | Grate Open Area / 100-yr Orifice Area = | 3.54 | N/A |
| Horiz. Length of Weir Sides = | 5.00 | N/A | feet | Overflow Grate Open Area w/o Debris = | 17.40 | N/A |
| Overflow Grate Type = | Type C Grate | N/A | | Overflow Grate Open Area w/ Debris = | 8.70 | N/A |
| Debris Clogging % = | 50% | N/A | % | | | |

Calculated Parameters for Overflow We

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= | 5.83 | ft (relative to basin bottom at Stage = 0 ft) | Spillway Design Flow Depth= | 0.65 | feet |
| Spillway Crest Length = | 50.00 | feet | Stage at Top of Freeboard = | 7.48 | feet |
| Spillway End Slopes = | 4.00 | H:V | Basin Area at Top of Freeboard = | 0.92 | acres |
| Freeboard above Max Water Surface = | 1.00 | feet | Basin Volume at Top of Freeboard = | 4.05 | acre-ft |

Calculated Parameters for Spillway

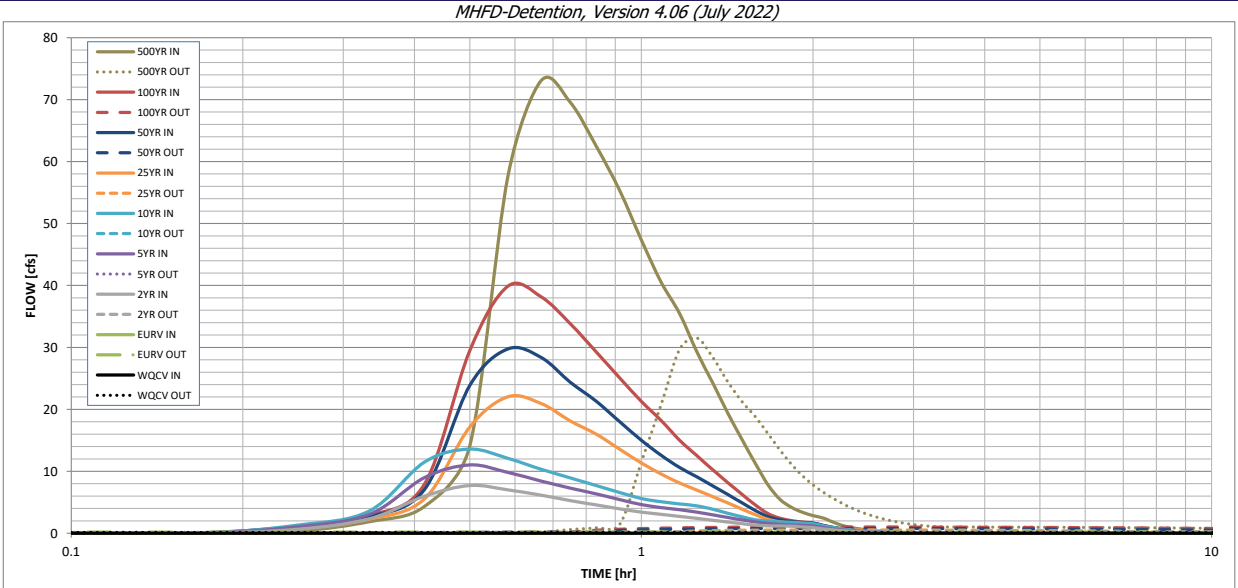
Routed Hydrograph Results

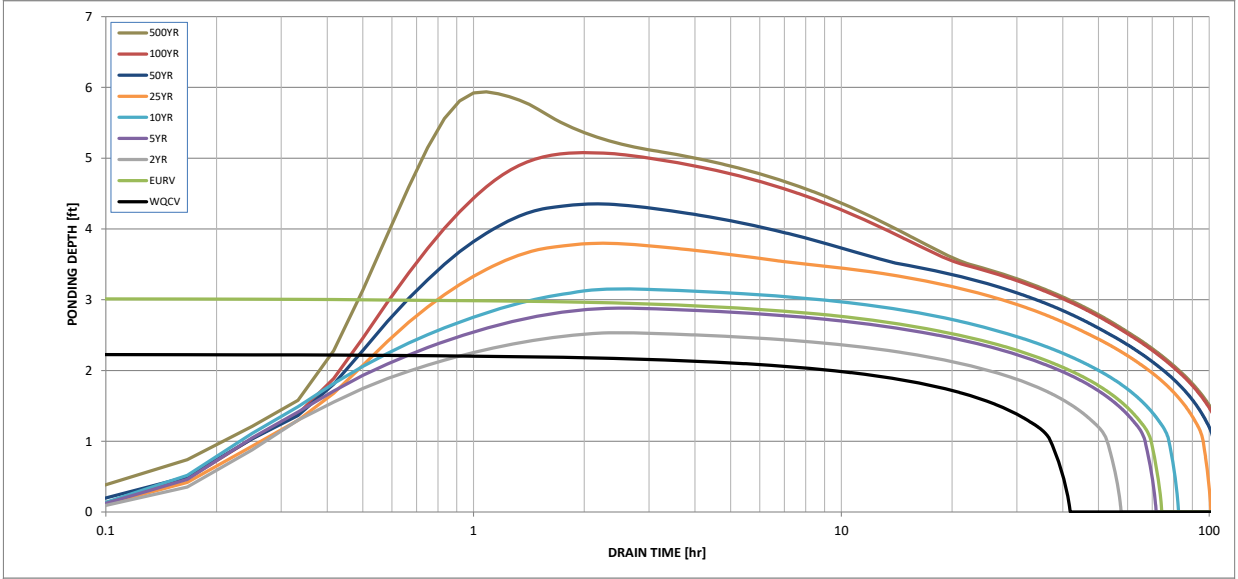
*The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).*

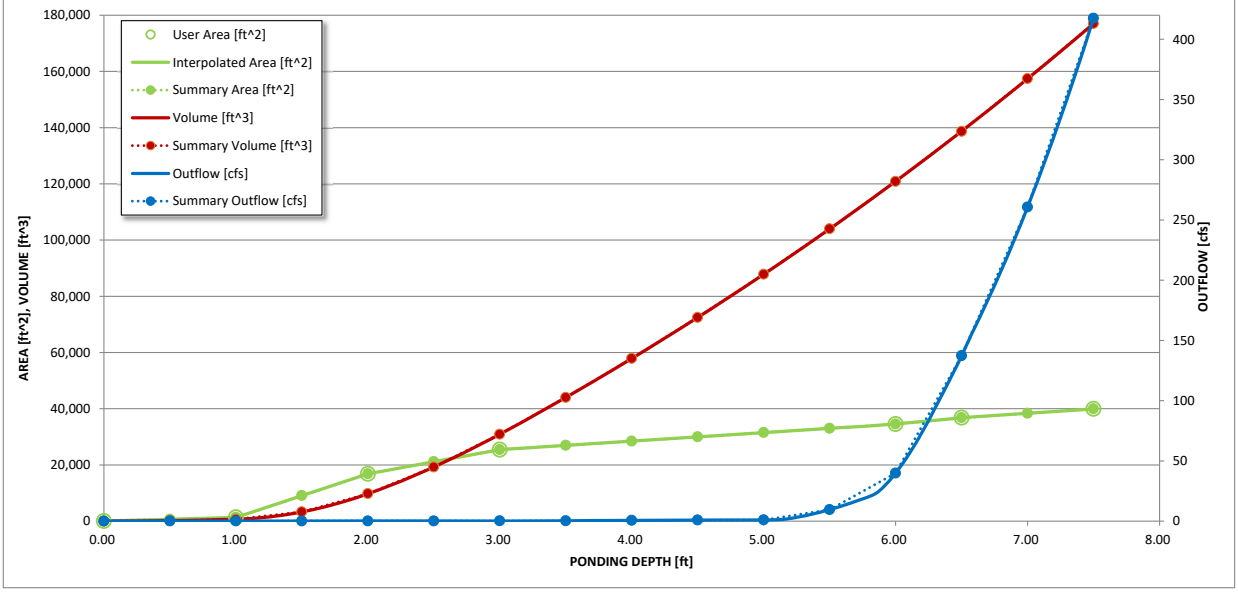
| Design Storm Return Period = | WQCV | EURV | 2 Year | 5 Year | 10 Year | 25 Year | 50 Year | 100 Year |
|---|---|---|---|---|---|---|---|---|
| One-Hour Rainfall Depth (in) = | N/A | N/A | 1.19 | 1.50 | 1.75 | 2.00 | 2.25 | 2.52 |
| CUHP Runoff Volume (acre-ft) = | 0.317 | 0.717 | 0.484 | 0.671 | 0.832 | 1.262 | 1.663 | 2.202 |
| Inflow Hydrograph Volume (acre-ft) = | N/A | N/A | 0.484 | 0.671 | 0.832 | 1.262 | 1.663 | 2.202 |
| CUHP Predevelopment Peak Q (cfs) = | N/A | N/A | 0.3 | 0.6 | 0.8 | 7.2 | 14.0 | 22.8 |
| 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 | 0.27 | 0.53 | 0.86 |
| Peak Inflow Q (cfs) = | N/A | N/A | 7.7 | 11.0 | 13.6 | 22.0 | 29.8 | 39.9 |
| Peak Outflow Q (cfs) = | 0.1 | 0.2 | 0.1 | 0.2 | 0.2 | 0.5 | 0.8 | 1.0 |
| Ratio Peak Outflow to Predevelopment Q = | N/A | N/A | N/A | 0.3 | 0.2 | 0.1 | 0.1 | 0.0 |
| Structure Controlling Flow = | Plate | Plate | Plate | Plate | Plate | Plate | Plate | Plate |
| Max Velocity through Grate 1 (fps) = | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| 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) = | 39 | 68 | 53 | 66 | 76 | 92 | 96 | 101 |
| Time to Drain 99% of Inflow Volume (hours) = | **40** | 72 | 56 | 69 | 80 | 97 | 103 | 108 |
| Maximum Ponding Depth (ft) = | 2.23 | 3.02 | 2.53 | 2.88 | 3.15 | 3.80 | 4.35 | 5.08 |
| Area at Maximum Ponding Depth (acres) = | 0.43 | 0.59 | 0.49 | 0.56 | 0.59 | 0.64 | 0.68 | 0.73 |
| Maximum Volume Stored (acre-ft) = | 0.318 | 0.721 | 0.456 | 0.641 | 0.798 | 1.192 | 1.561 | 2.067 |

# DETENTION BASIN OUTLET STRUCTURE DESIGN

*MHFD-Detention, Version 4.06 (July 2022)*




| 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 | 0.07 | 0.01 | 0.38 |
| | 0:15:00 | 0.00 | 0.00 | 0.65 | 1.06 | 1.32 | 0.89 | 1.11 | 1.09 | 1.87 |
| | 0:20:00 | 0.00 | 0.00 | 2.33 | 3.05 | 3.60 | 2.28 | 2.66 | 2.85 | 4.34 |
| | 0:25:00 | 0.00 | 0.00 | 5.99 | 9.00 | 11.51 | 5.56 | 7.09 | 7.97 | 14.13 |
| | 0:30:00 | 0.00 | 0.00 | 7.71 | 11.02 | 13.58 | 17.16 | 23.87 | 29.50 | 57.63 |
| | 0:35:00 | 0.00 | 0.00 | 7.00 | 9.81 | 12.09 | 22.03 | 29.75 | 39.88 | 73.05 |
| | 0:40:00 | 0.00 | 0.00 | 6.14 | 8.43 | 10.34 | 20.95 | 28.39 | 38.17 | 69.57 |
| | 0:45:00 | 0.00 | 0.00 | 5.28 | 7.29 | 8.94 | 18.14 | 24.40 | 33.84 | 62.48 |
| | 0:50:00 | 0.00 | 0.00 | 4.57 | 6.36 | 7.69 | 16.00 | 21.31 | 29.28 | 55.25 |
| | 0:55:00 | 0.00 | 0.00 | 3.94 | 5.44 | 6.57 | 13.54 | 17.98 | 25.03 | 47.36 |
| | 1:00:00 | 0.00 | 0.00 | 3.40 | 4.63 | 5.61 | 11.35 | 15.00 | 21.30 | 40.51 |
| | 1:05:00 | 0.00 | 0.00 | 3.06 | 4.15 | 5.09 | 9.57 | 12.57 | 18.20 | 35.47 |
| | 1:10:00 | 0.00 | 0.00 | 2.72 | 3.81 | 4.74 | 8.11 | 10.62 | 15.02 | 29.35 |
| | 1:15:00 | 0.00 | 0.00 | 2.40 | 3.41 | 4.42 | 6.99 | 9.13 | 12.55 | 24.29 |
| | 1:20:00 | 0.00 | 0.00 | 2.10 | 2.98 | 3.88 | 5.91 | 7.65 | 10.26 | 19.45 |
| | 1:25:00 | 0.00 | 0.00 | 1.81 | 2.55 | 3.24 | 4.90 | 6.27 | 8.20 | 15.18 |
| | 1:30:00 | 0.00 | 0.00 | 1.54 | 2.17 | 2.66 | 3.91 | 4.93 | 6.31 | 11.30 |
| | 1:35:00 | 0.00 | 0.00 | 1.32 | 1.85 | 2.19 | 3.00 | 3.68 | 4.58 | 7.83 |
| | 1:40:00 | 0.00 | 0.00 | 1.21 | 1.60 | 1.96 | 2.24 | 2.68 | 3.18 | 5.47 |
| | 1:45:00 | 0.00 | 0.00 | 1.17 | 1.45 | 1.84 | 1.84 | 2.17 | 2.44 | 4.18 |
| | 1:50:00 | 0.00 | 0.00 | 1.14 | 1.35 | 1.76 | 1.64 | 1.90 | 2.05 | 3.38 |
| | 1:55:00 | 0.00 | 0.00 | 1.02 | 1.27 | 1.67 | 1.52 | 1.75 | 1.80 | 2.84 |
| | 2:00:00 | 0.00 | 0.00 | 0.91 | 1.18 | 1.53 | 1.43 | 1.64 | 1.64 | 2.47 |
| | 2:05:00 | 0.00 | 0.00 | 0.71 | 0.93 | 1.20 | 1.12 | 1.28 | 1.24 | 1.80 |
| | 2:10:00 | 0.00 | 0.00 | 0.55 | 0.71 | 0.92 | 0.85 | 0.96 | 0.91 | 1.27 |
| | 2:15:00 | 0.00 | 0.00 | 0.42 | 0.55 | 0.70 | 0.65 | 0.73 | 0.68 | 0.93 |
| | 2:20:00 | 0.00 | 0.00 | 0.32 | 0.42 | 0.53 | 0.49 | 0.55 | 0.51 | 0.69 |
| | 2:25:00 | 0.00 | 0.00 | 0.24 | 0.31 | 0.39 | 0.37 | 0.41 | 0.39 | 0.52 |
| | 2:30:00 | 0.00 | 0.00 | 0.18 | 0.23 | 0.29 | 0.27 | 0.30 | 0.29 | 0.38 |
| | 2:35:00 | 0.00 | 0.00 | 0.13 | 0.17 | 0.21 | 0.20 | 0.22 | 0.21 | 0.28 |
| | 2:40:00 | 0.00 | 0.00 | 0.10 | 0.12 | 0.16 | 0.15 | 0.17 | 0.16 | 0.20 |
| | 2:45:00 | 0.00 | 0.00 | 0.07 | 0.08 | 0.11 | 0.11 | 0.12 | 0.11 | 0.14 |
| | 2:50:00 | 0.00 | 0.00 | 0.04 | 0.06 | 0.07 | 0.07 | 0.08 | 0.07 | 0.09 |
| | 2:55:00 | 0.00 | 0.00 | 0.02 | 0.03 | 0.04 | 0.04 | 0.05 | 0.04 | 0.05 |
| | 3:00:00 | 0.00 | 0.00 | 0.01 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 |
| | 3:05:00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 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 |

# DETENTION BASIN OUTLET STRUCTURE DESIGN

*MHFD-Detention, Version 4.06 (July 2022)*

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

| Stage - Storage Description | Stage [ft] | Area [ft$^2$] | Area [acres] | Volume [ft$^3$] | Volume [ac-ft] | Total Outflow [cfs] |
|---|---|---|---|---|---|---|
| | 0.00 | 40 | 0.001 | 0 | 0.000 | 0.00 |
| | 0.50 | 680 | 0.016 | 180 | 0.004 | 0.04 |
| | 1.00 | 1,320 | 0.030 | 680 | 0.016 | 0.05 |
| | 1.50 | 9,075 | 0.208 | 3,278 | 0.075 | 0.09 |
| | 2.00 | 16,829 | 0.386 | 9,754 | 0.224 | 0.11 |
| | 2.50 | 21,137 | 0.485 | 19,246 | 0.442 | 0.14 |
| | 3.00 | 25,446 | 0.584 | 30,892 | 0.709 | 0.18 |
| | 3.50 | 26,959 | 0.619 | 43,993 | 1.010 | 0.20 |
| | 4.00 | 28,472 | 0.654 | 57,851 | 1.328 | 0.65 |
| | 4.50 | 29,984 | 0.688 | 72,465 | 1.664 | 0.84 |
| | 5.00 | 31,497 | 0.723 | 87,835 | 2.016 | 1.00 |
| | 5.50 | 33,010 | 0.758 | 103,962 | 2.387 | 9.59 |
| | 6.00 | 34,523 | 0.793 | 120,845 | 2.774 | 39.84 |
| | 6.50 | 36,800 | 0.845 | 138,676 | 3.184 | 137.25 |
| | 7.00 | 38,369 | 0.881 | 157,468 | 3.615 | 260.72 |
| | 7.50 | 39,938 | 0.917 | 177,045 | 4.064 | 417.40 |

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

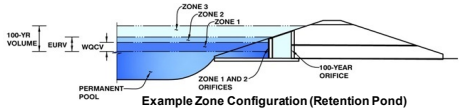
# DETENTION BASIN STAGE-STORAGE TABLE BUILDER

*MHFD-Detention, Version 4.06 (July 2022)*

**POND C: ULTIMATE DESIGN FOR REFERENCE ONLY**

**Project:** Falcon Field Filing 3

**Basin ID:** Pond C (with overdetention)




**Example Zone Configuration (Retention Pond)**

## Watershed Information

| | | |
|---|---|---|
| Selected BMP Type = | EDB | |
| Watershed Area = | 26.38 | acres |
| Watershed Length = | 1,200 | ft |
| Watershed Length to Centroid = | 500 | ft |
| Watershed Slope = | 0.040 | ft/ft |
| Watershed Imperviousness = | 60.20% | 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) = | 0.521 | acre-feet | acre-feet |
| Excess Urban Runoff Volume (EURV) = | 1.929 | acre-feet | acre-feet |
| 2-yr Runoff Volume (P1 = 1.19 in.) = | 1.379 | acre-feet | 1.19 inches |
| 5-yr Runoff Volume (P1 = 1.5 in.) = | 1.816 | acre-feet | 1.50 inches |
| 10-yr Runoff Volume (P1 = 1.75 in.) = | 2.165 | acre-feet | 1.75 inches |
| 25-yr Runoff Volume (P1 = 2 in.) = | 2.641 | acre-feet | 2.00 inches |
| 50-yr Runoff Volume (P1 = 2.25 in.) = | 3.110 | acre-feet | 2.25 inches |
| 100-yr Runoff Volume (P1 = 2.52 in.) = | 3.687 | acre-feet | 2.52 inches |
| 500-yr Runoff Volume (P1 = 3.49 in.) = | 5.698 | acre-feet | 3.49 inches |
| Approximate 2-yr Detention Volume = | 1.251 | acre-feet | |
| Approximate 5-yr Detention Volume = | 1.638 | acre-feet | |
| Approximate 10-yr Detention Volume = | 1.982 | acre-feet | |
| Approximate 25-yr Detention Volume = | 2.396 | acre-feet | |
| Approximate 50-yr Detention Volume = | 2.649 | acre-feet | |
| Approximate 100-yr Detention Volume = | 2.926 | acre-feet | |

## Define Zones and Basin Geometry

| | | |
|---|---|---|
| Zone 1 Volume (WQCV) = | 0.521 | acre-feet |
| Zone 2 Volume (EURV - Zone 1) = | 1.408 | acre-feet |
| Zone 3 Volume (100-year - Zones 1 & 2) = | 0.997 | acre-feet |
| Total Detention Basin Volume = | 2.926 | 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 |

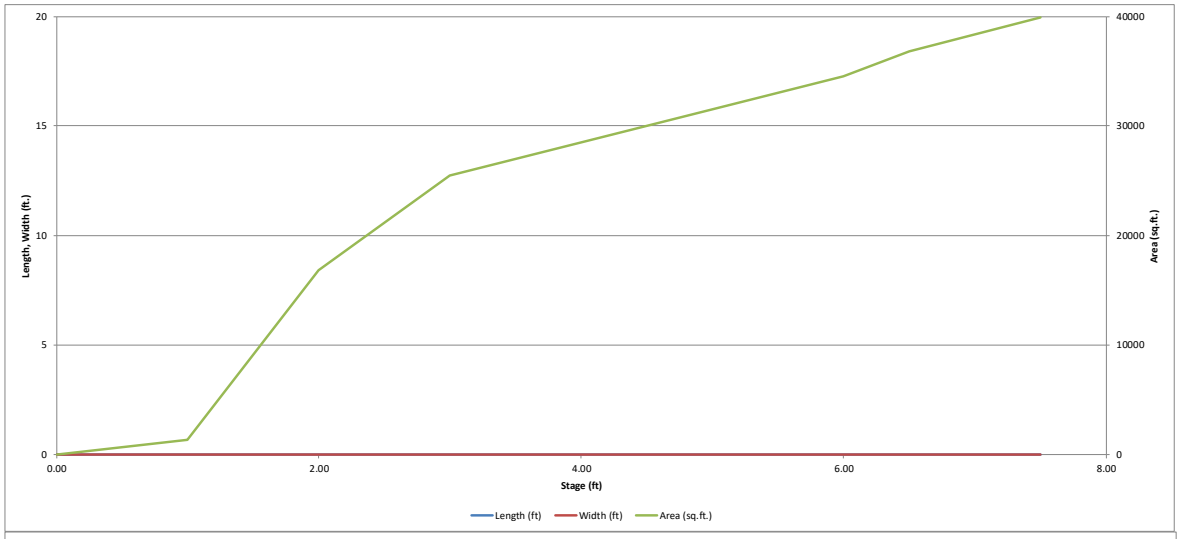
Depth Increment = ft

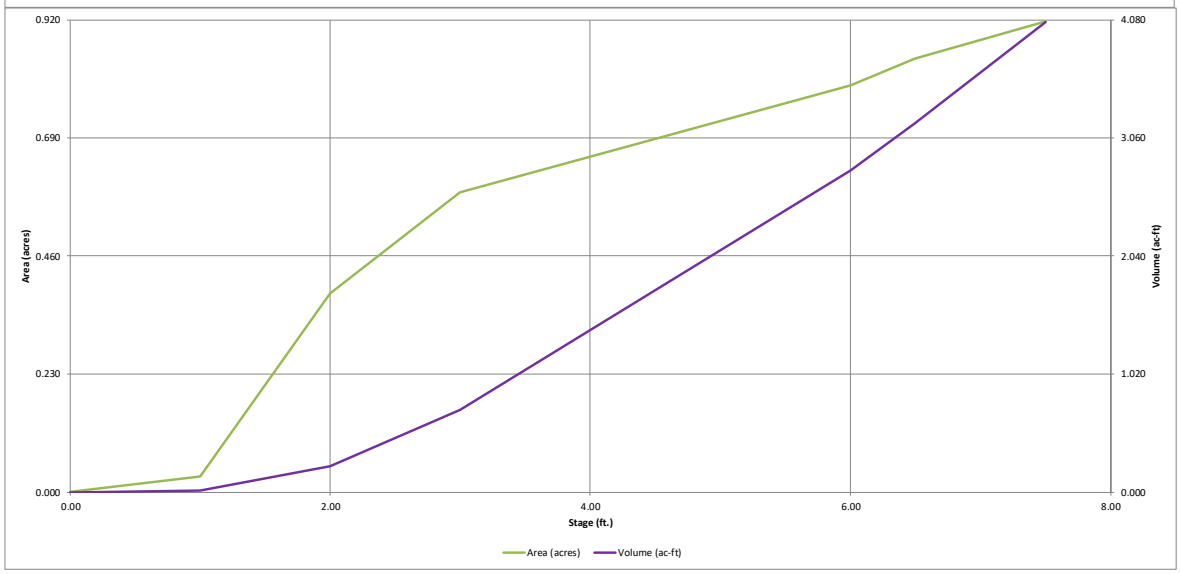
| Stage - Storage Description | Stage (ft) | Optional Override Stage (ft) | Length (ft) | Width (ft) | Area ($ft^2$) | Optional Override Area ($ft^2$) | Area (acre) | Volume ($ft^3$) | Volume (ac-ft) |
|---|---|---|---|---|---|---|---|---|---|
| **Top of Micropool** | -- | 0.00 | -- | -- | -- | 40 | 0.001 | | |
| **6801** | -- | 1.00 | -- | -- | -- | 1,320 | 0.030 | 680 | 0.016 |
| **6802** | -- | 2.00 | -- | -- | -- | 16,829 | 0.386 | 9,754 | 0.224 |
| **6803** | -- | 3.00 | -- | -- | -- | 25,446 | 0.584 | 30,892 | 0.709 |
| **6806** | -- | 6.00 | -- | -- | -- | 34,523 | 0.793 | 120,845 | 2.774 |
| **6806.5** | -- | 6.50 | -- | -- | -- | 36,800 | 0.845 | 138,676 | 3.184 |
| **6807.5** | -- | 7.50 | -- | -- | -- | 39,938 | 0.917 | 177,045 | 4.064 |

# DETENTION BASIN STAGE-STORAGE TABLE BUILDER

*MHFD-Detention, Version 4.06 (July 2022)*

POND C: ULTIMATE DESIGN FOR REFERENCE ONLY



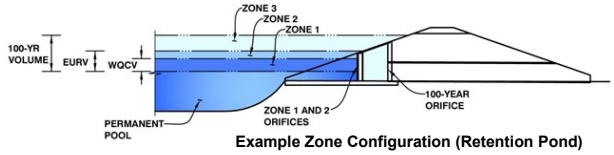
POND C: ULTIMATE DESIGN FOR REFERENCE ONLY

# DETENTION BASIN OUTLET STRUCTURE DESIGN

*MHFD-Detention, Version 4.06 (July 2022)*

**Project: Falcon Field Filing 3**

**Basin ID: Pond C (with overdetention)**




**Example Zone Configuration (Retention Pond)**

| | Estimated Stage (ft) | Estimated Volume (ac-ft) | Outlet Type |
|---|---|---|---|
| Zone 1 (WQCV) | 2.66 | 0.521 | Orifice Plate |
| Zone 2 (EURV) | 4.88 | 1.408 | Orifice Plate |
| Zone 3 (100-year) | 6.19 | 0.997 | Weir&Pipe (Circular) |
| Total (all zones) | | 2.926 | |

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 = | N/A | $ft^2$ |
| Depth at top of Zone using Orifice Plate = | 4.88 | 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 | sq. 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 | 1.25 | 2.50 | | | | | |
| Orifice Area (sq. inches) | 2.20 | 2.10 | 5.00 | | | | | |

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

Calculated Parameters for Vertical Orifi

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 = | 5.09 | N/A | ft (relative to basin bottom at Stage = 0 ft) | Height of Grate Upper Edge, $H_t$ = | 5.09 | N/A |
| Overflow Weir Front Edge Length = | 5.00 | N/A | feet | Overflow Weir Slope Length = | 5.00 | N/A |
| Overflow Weir Grate Slope = | 0.00 | N/A | H:V | Grate Open Area / 100-yr Orifice Area = | 3.54 | N/A |
| Horiz. Length of Weir Sides = | 5.00 | N/A | feet | Overflow Grate Open Area w/o Debris = | 17.40 | N/A |
| Overflow Grate Type = | Type C Grate | N/A | | Overflow Grate Open Area w/ Debris = | 8.70 | N/A |
| Debris Clogging % = | 50% | N/A | % | | | |

Calculated Parameters for Overflow We

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= | 5.83 | ft (relative to basin bottom at Stage = 0 ft) | Spillway Design Flow Depth= | 0.65 | feet |
| Spillway Crest Length = | 50.00 | feet | Stage at Top of Freeboard = | 7.48 | feet |
| Spillway End Slopes = | 4.00 | H:V | Basin Area at Top of Freeboard = | 0.92 | acres |
| Freeboard above Max Water Surface = | 1.00 | feet | Basin Volume at Top of Freeboard = | 4.05 | acre-ft |

Calculated Parameters for Spillway

Routed Hydrograph Results

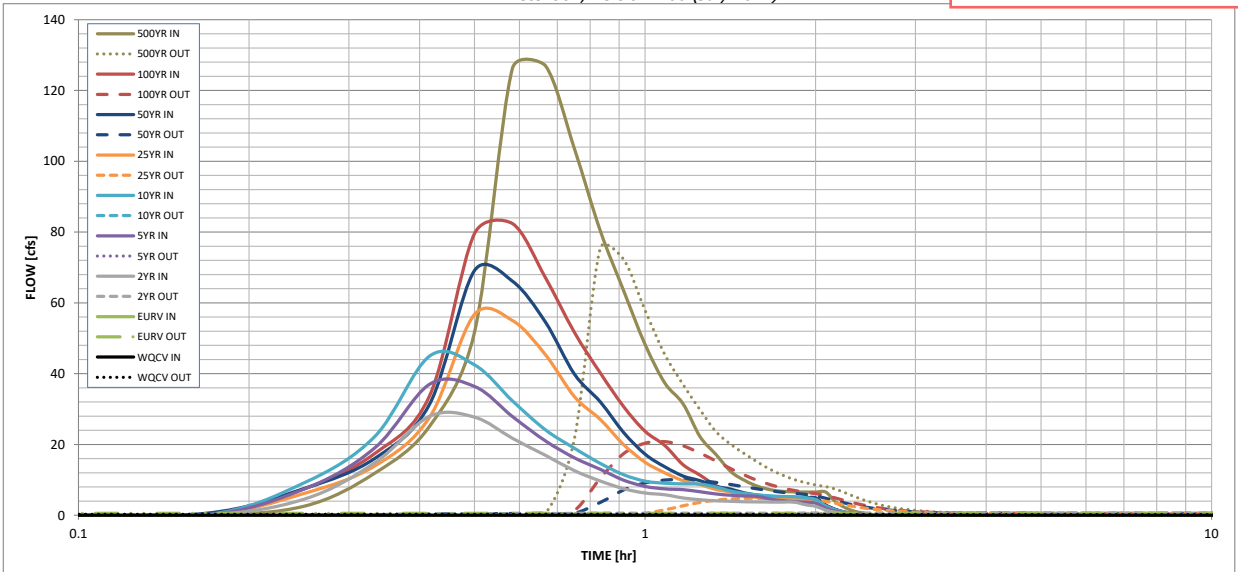
*The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).*

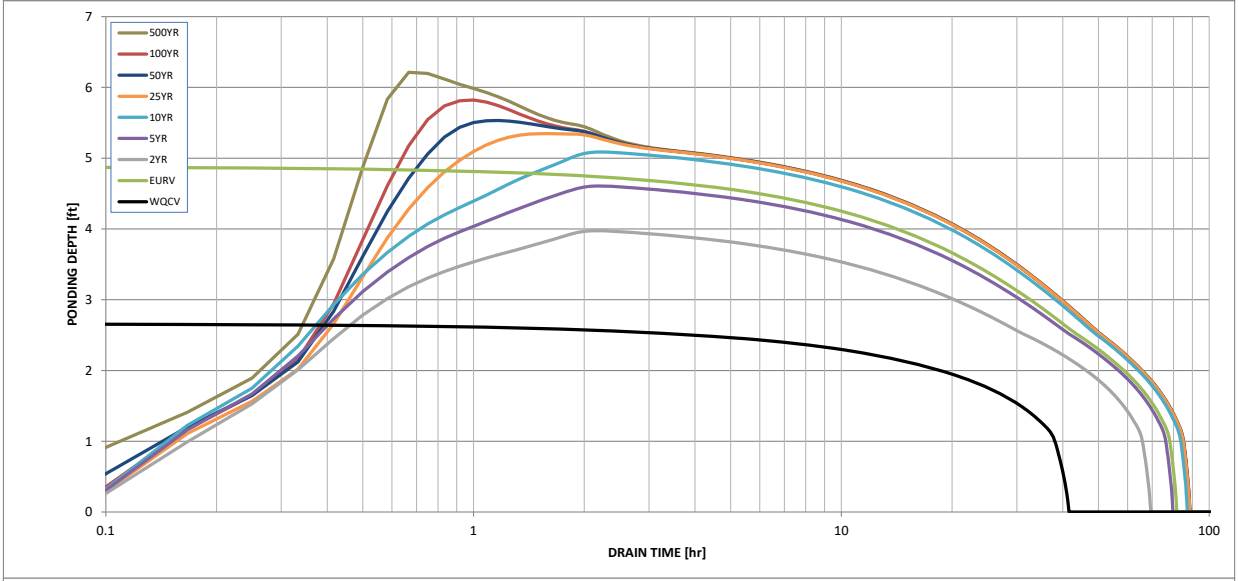
| Design Storm Return Period = | WQCV | EURV | 2 Year | 5 Year | 10 Year | 25 Year | 50 Year | 100 Year |
|---|---|---|---|---|---|---|---|---|
| One-Hour Rainfall Depth (in) = | N/A | N/A | 1.19 | 1.50 | 1.75 | 2.00 | 2.25 | 2.52 |
| CUHP Runoff Volume (acre-ft) = | 0.521 | 1.929 | 1.379 | 1.816 | 2.165 | 2.641 | 3.110 | 3.687 |
| Inflow Hydrograph Volume (acre-ft) = | N/A | N/A | 1.379 | 1.816 | 2.165 | 2.641 | 3.110 | 3.687 |
| CUHP Predevelopment Peak Q (cfs) = | N/A | N/A | 0.3 | 0.6 | 0.8 | 7.2 | 14.0 | 22.8 |
| 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 | 0.27 | 0.53 | 0.86 |
| Peak Inflow Q (cfs) = | N/A | N/A | 28.0 | 37.0 | 45.0 | 56.7 | 69.1 | 82.4 |
| Peak Outflow Q (cfs) = | 0.3 | 0.6 | 0.5 | 0.5 | 0.6 | 4.8 | 10.1 | 20.8 |
| Ratio Peak Outflow to Predevelopment Q = | N/A | N/A | N/A | 0.9 | 0.7 | 0.7 | 0.7 | 0.9 |
| Structure Controlling Flow = | Plate | Plate | Plate | Plate | Overflow Weir 1 | Overflow Weir 1 | Overflow Weir 1 | Overflow Weir 1 |
| Max Velocity through Grate 1 (fps) = | N/A | N/A | N/A | N/A | N/A | 0.2 | 0.5 | 1.2 |
| 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) = | 38 | 73 | 62 | 71 | 78 | 77 | 76 | 75 |
| Time to Drain 99% of Inflow Volume (hours) = | **40** | 78 | 66 | 76 | 83 | 83 | 83 | 82 |
| Maximum Ponding Depth (ft) = | 2.66 | 4.88 | 3.97 | 4.61 | 5.09 | 5.35 | 5.53 | 5.82 |
| Area at Maximum Ponding Depth (acres) = | 0.52 | 0.71 | 0.65 | 0.70 | 0.73 | 0.75 | 0.76 | 0.78 |
| Maximum Volume Stored (acre-ft) = | 0.522 | 1.930 | 1.308 | 1.733 | 2.074 | 2.266 | 2.409 | 2.633 |

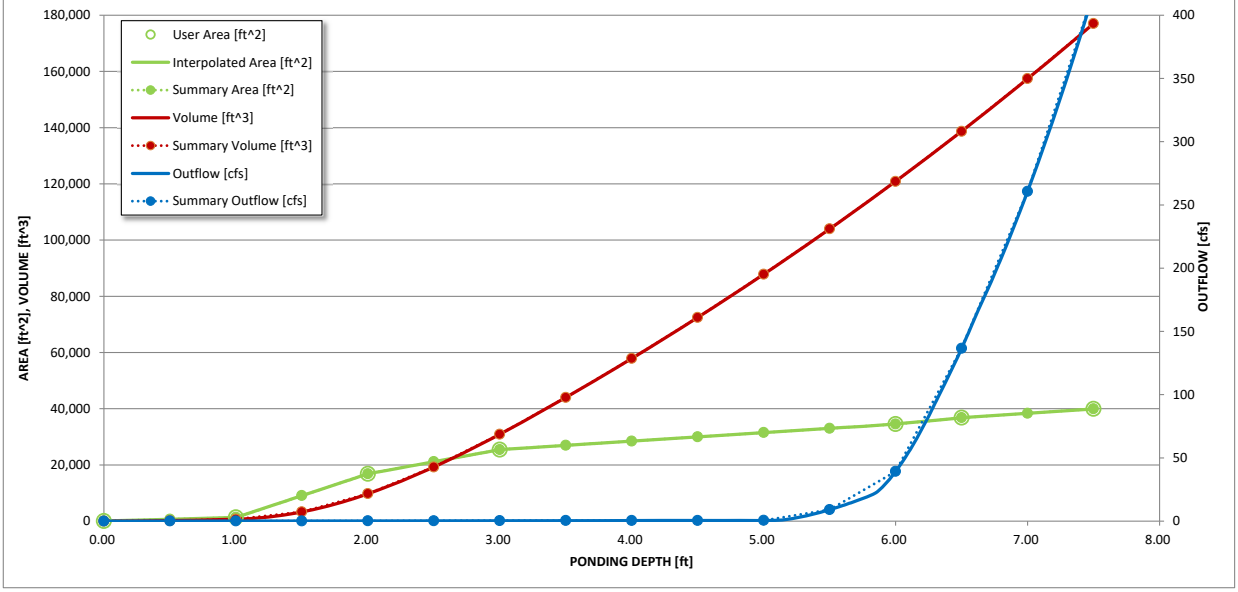
POND C: ULTIMATE DESIGN FOR REFERENCE ONLY

# DETENTION BASIN OUTLET STRUCTURE DESIGN

*MHFD-Detention, Version 4.06 (July 2022)*




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

POND C: ULTIMATE DESIGN FOR REFERENCE ONLY

# 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 | 0.51 | 0.05 | 2.55 |
| | 0:15:00 | 0.00 | 0.00 | 4.52 | 7.35 | 9.12 | 6.13 | 7.51 | 7.47 | 11.88 |
| | 0:20:00 | 0.00 | 0.00 | 14.82 | 19.02 | 22.24 | 13.93 | 16.07 | 17.43 | 25.17 |
| | 0:25:00 | 0.00 | 0.00 | 27.96 | 37.02 | 44.99 | 27.69 | 31.42 | 33.81 | 51.66 |
| | 0:30:00 | 0.00 | 0.00 | 27.72 | 36.40 | 42.47 | 56.71 | 69.10 | 79.54 | 126.18 |
| | 0:35:00 | 0.00 | 0.00 | 21.73 | 27.88 | 32.30 | 55.02 | 66.12 | 82.40 | 127.02 |
| | 0:40:00 | 0.00 | 0.00 | 16.93 | 21.02 | 24.16 | 45.39 | 54.60 | 67.15 | 103.65 |
| | 0:45:00 | 0.00 | 0.00 | 12.61 | 16.24 | 18.96 | 33.55 | 39.93 | 51.71 | 80.42 |
| | 0:50:00 | 0.00 | 0.00 | 9.68 | 12.98 | 14.66 | 27.08 | 32.07 | 40.22 | 63.45 |
| | 0:55:00 | 0.00 | 0.00 | 7.50 | 9.92 | 11.44 | 19.96 | 23.37 | 30.69 | 48.26 |
| | 1:00:00 | 0.00 | 0.00 | 6.28 | 8.15 | 9.64 | 14.98 | 17.27 | 23.73 | 37.38 |
| | 1:05:00 | 0.00 | 0.00 | 5.80 | 7.45 | 9.05 | 12.00 | 13.68 | 19.72 | 31.52 |
| | 1:10:00 | 0.00 | 0.00 | 4.88 | 7.22 | 8.86 | 9.79 | 11.08 | 14.27 | 22.25 |
| | 1:15:00 | 0.00 | 0.00 | 4.38 | 6.64 | 8.79 | 8.67 | 9.77 | 11.34 | 17.19 |
| | 1:20:00 | 0.00 | 0.00 | 4.09 | 6.02 | 7.99 | 7.29 | 8.20 | 8.36 | 12.35 |
| | 1:25:00 | 0.00 | 0.00 | 3.93 | 5.64 | 6.85 | 6.54 | 7.36 | 6.77 | 9.79 |
| | 1:30:00 | 0.00 | 0.00 | 3.82 | 5.43 | 6.14 | 5.59 | 6.28 | 5.73 | 8.12 |
| | 1:35:00 | 0.00 | 0.00 | 3.75 | 5.30 | 5.72 | 5.04 | 5.66 | 5.15 | 7.17 |
| | 1:40:00 | 0.00 | 0.00 | 3.73 | 4.55 | 5.47 | 4.70 | 5.29 | 4.87 | 6.75 |
| | 1:45:00 | 0.00 | 0.00 | 3.73 | 4.11 | 5.31 | 4.53 | 5.10 | 4.76 | 6.59 |
| | 1:50:00 | 0.00 | 0.00 | 3.73 | 3.84 | 5.23 | 4.44 | 4.99 | 4.73 | 6.55 |
| | 1:55:00 | 0.00 | 0.00 | 2.97 | 3.70 | 4.98 | 4.40 | 4.94 | 4.73 | 6.55 |
| | 2:00:00 | 0.00 | 0.00 | 2.52 | 3.41 | 4.40 | 4.38 | 4.93 | 4.73 | 6.55 |
| | 2:05:00 | 0.00 | 0.00 | 1.47 | 2.00 | 2.60 | 2.59 | 2.91 | 2.79 | 3.85 |
| | 2:10:00 | 0.00 | 0.00 | 0.85 | 1.16 | 1.50 | 1.51 | 1.69 | 1.62 | 2.23 |
| | 2:15:00 | 0.00 | 0.00 | 0.45 | 0.64 | 0.82 | 0.83 | 0.92 | 0.88 | 1.21 |
| | 2:20:00 | 0.00 | 0.00 | 0.22 | 0.35 | 0.43 | 0.46 | 0.51 | 0.49 | 0.66 |
| | 2:25:00 | 0.00 | 0.00 | 0.09 | 0.15 | 0.18 | 0.20 | 0.22 | 0.21 | 0.28 |
| | 2:30:00 | 0.00 | 0.00 | 0.02 | 0.04 | 0.04 | 0.05 | 0.05 | 0.05 | 0.06 |
| | 2:35:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 2:40:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 2:45:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 2:50:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 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 |

POND C: ULTIMATE DESIGN FOR REFERENCE ONLY

# DETENTION BASIN OUTLET STRUCTURE DESIGN

*MHFD-Detention, Version 4.06 (July 2022)*

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

| Stage - Storage Description | Stage [ft] | Area [ft$^2$] | Area [acres] | Volume [ft$^3$] | Volume [ac-ft] | Total Outflow [cfs] |
|---|---|---|---|---|---|---|
| | 0.00 | 40 | 0.001 | 0 | 0.000 | 0.00 |
| | 0.50 | 680 | 0.016 | 180 | 0.004 | 0.05 |
| | 1.00 | 1,320 | 0.030 | 680 | 0.016 | 0.07 |
| | 1.50 | 9,075 | 0.208 | 3,278 | 0.075 | 0.13 |
| | 2.00 | 16,829 | 0.386 | 9,754 | 0.224 | 0.16 |
| | 2.50 | 21,137 | 0.485 | 19,246 | 0.442 | 0.19 |
| | 3.00 | 25,446 | 0.584 | 30,892 | 0.709 | 0.34 |
| | 3.50 | 26,959 | 0.619 | 43,993 | 1.010 | 0.41 |
| | 4.00 | 28,472 | 0.654 | 57,851 | 1.328 | 0.47 |
| | 4.50 | 29,984 | 0.688 | 72,465 | 1.664 | 0.52 |
| | 5.00 | 31,497 | 0.723 | 87,835 | 2.016 | 0.56 |
| | 5.50 | 33,010 | 0.758 | 103,962 | 2.387 | 9.07 |
| | 6.00 | 34,523 | 0.793 | 120,845 | 2.774 | 39.24 |
| | 6.50 | 36,800 | 0.845 | 138,676 | 3.184 | 136.58 |
| | 7.00 | 38,369 | 0.881 | 157,468 | 3.615 | 260.72 |
| | 7.50 | 39,938 | 0.917 | 177,045 | 4.064 | 417.40 |

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

Pond C

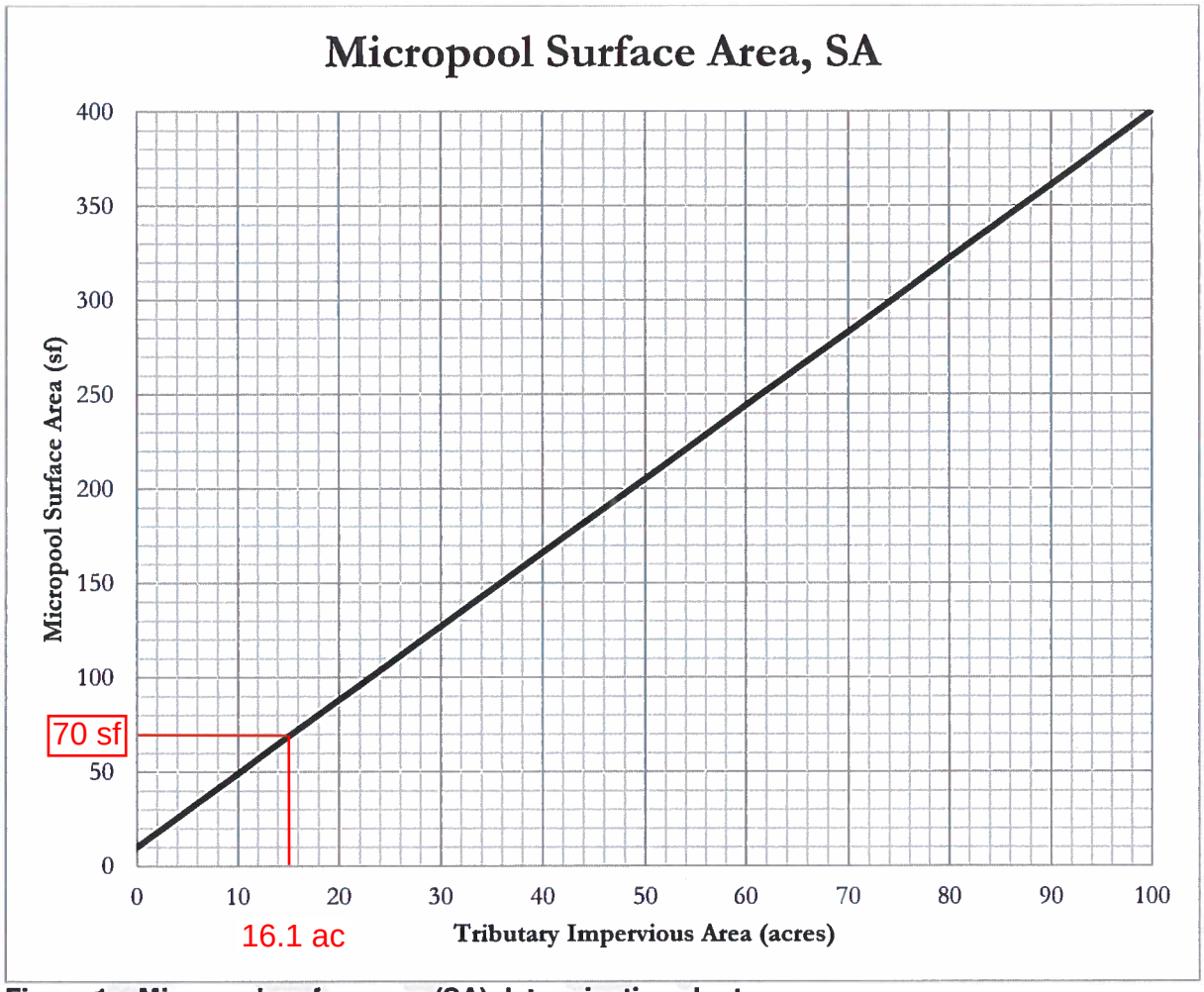



**Figure 1 – Micropool surface area (SA) determination chart**

The tributary impervious area is the effective number of impervious acres that will be treated by the extended detention basin (EDB). It is calculated by multiplying the tributary area to be treated by the impervious fraction of that area.

$$TIA = I \times A$$ = (60.2/100) x 26.4 ac = 15.9 ac

*TIA* = Tributary impervious area (acres)
*I* = Imperviousness (fraction)
*A* = Tributary catchment area upstream (acres)

For EDBs with tributary impervious areas greater than 100 acres, the micropool surface area is 400 sf. The initial surcharge depth (ISD) is defined as the depth of the initial surcharge volume (ISV). The surface area determined using Figure 1 assumes an ISD of 4 inches. The initial surcharge volume is thus calculated by multiplying the micropool surface area by 4 inches.

$$ISV = SA \times 4\ inches$$

*ISV* = Initial surcharge volume (cf)
*SA* = Surface area (from Figure 1, sf)

Pond C - ULTIMATE



**Figure 13-12c. Emergency Spillway Protection**

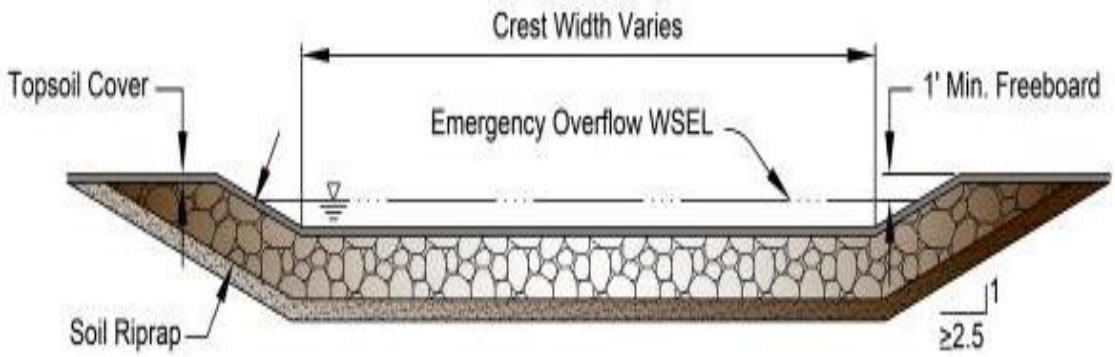
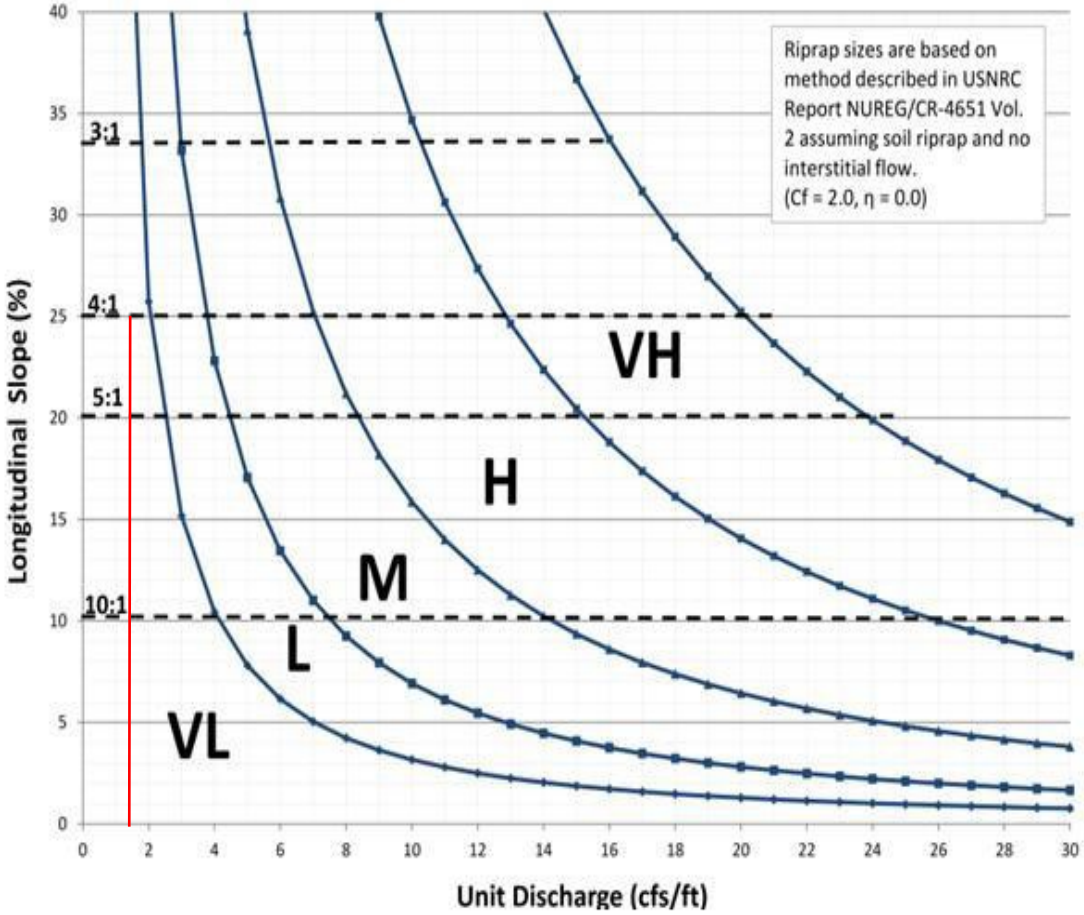



**Figure 13-12d. Riprap Types for Emergency Spillway Protection**




PEAK INFLOW Q100=82.4 cfs
Spillway length=50 ft
82.4 cfs/50 ft = 1.6 cfs/ft

## Pond B - ULTIMATE DESIGN

### FOREBAY VOLUME

Req'd V=3% x WQCV

| *West Forebay* | | | *East Forebay* | | |
|---|---|---|---|---|---|
| WQCV= | 0.432 | ac-ft | WQCV= | 0.432 | ac-ft |
| 70% of WQCV= | 0.302 | ac-ft | 30% of WQCV= | 0.130 | ac-ft |
| V= | 0.0091 | ac-ft | V= | 0.0039 | ac-ft |
| Actual V | 0.0099 | ac-ft | Actual V | 0.0072 | ac-ft |

### FOREBAY RELEASE NOTCH WIDTH

$Q=CLH^{3/2}$

| *West Forebay* | | | *East Forebay* | | |
|---|---|---|---|---|---|
| DP B7 $Q_{100}$= | 56.0 | cfs | DP B10 $Q_{100}$= | 31.0 | cfs |
| 2% of Q= | 1.12 | cfs | 2% of Q= | 0.62 | cfs |
| C= | 2.6 | | C= | 2.6 | |
| H (height of forebay wall)= | 1 | ft | H (height of forebay wall)= | 1 | ft |
| L= | 4 | in | L= | 2 | in |
| | | | | 3 | in (min) |

### TRICKLE CHANNEL FLOW DEPTH

Rectangular Channel

| *West Forebay* | | *East Forebay* | |
|---|---|---|---|
| Channel Slope (ft/ft) | 0.01 | Channel Slope (ft/ft) | 0.01 |
| Depth (ft) | 0.5 | Depth (ft) | 0.5 |
| Bottom Width (ft) | 6 | Bottom Width (ft) | 6 |
| 2% $Q_{100}$ (cfs)= | 1.12 | 2% $Q_{100}$ (cfs)= | 0.62 |
| **Flow Depth (ft)** | **0.11** | **Flow Depth (ft)** | **0.07** |

## Pond C - ULTIMATE DESIGN

### FOREBAY VOLUME

Req'd V=3% x WQCV

| *West Forebay* | | |
|---|---|---|
| WQCV= | 0.521 | ac-ft |
| 80% of WQCV= | 0.4168 | ac-ft |
| V= | 0.0125 | ac-ft |
| Actual V | 0.0149 | ac-ft |

### FOREBAY RELEASE NOTCH WIDTH

$Q=CLH^{3/2}$

| | | |
|---|---|---|
| $Q_{100}$= | 86.3 | cfs |
| 2% of Q= | 1.73 | cfs |
| C= | 2.6 | |
| H (height of forebay wall)= | 1.5 | ft |
| L= | 2 | in |
| | 3 | in (min) |

### TRICKLE CHANNEL FLOW DEPTH

Rectangular Channel

| *West Forebay* | |
|---|---|
| Channel Slope (ft/ft) | 0.01 |
| Depth (ft) | 0.5 |
| Bottom Width (ft) | 6 |
| 2% $Q_{100}$ (cfs)= | 1.73 |
| **Flow Depth (ft)** | **0.11** |