September 23, 2024

El Paso County
Planning and Community Development
2880 International Circle, Suite 110
Colorado Springs, CO 80910

Attn.: Mr. Brad Walters, Inspection Supervisor

RE: STERLING RANCH FILING NO. 1 – POND CERTIFICATIONS

To whom it may concern,

This letter is intended to provide documentation with County Inspection Staff that the Pond facilities (PCM's) in Sterling Ranch Filing No. 1 have been constructed within reasonable conformance to the design. The Pond facilities for Sterling Ranch Filing No. 1 consists of two individual District owned Full Spectrum Extended Detention Basins and one District owned Water Quality Sand Filter Pond. These facilities are described by the following:

- Pond W-4 within Tract B (FSD)
- Pond 8 within Tract F (FSD)
- Pond W-9 within Tract I (Sand Filter)

All Terrain Engineering reviewed the final constructed facilities and recently gathered survey as-builts confirming the appropriate size and design. Based upon this information and information gathered during periodic site visits to the project under construction, All Terrain Engineering is of the opinion that the site and adjacent properties (as affected by work performed under the County permit) are stable with respect to settlement and subsidence, sloughing of cut and fill slopes, revegetation or other ground cover, and that the improvements (public improvements, common development improvements, site grading and paving) meet or exceed the minimum design requirements. The PCM(s) provide the required storage volume and meet the required release rates, stage areas, elevations, and outlet dimensions, as documented by the attached revised MHFD-Detention spreadsheet that shows the as-built conditions.

I hereby certify that Stormwater PCMs have been reasonably constructed, to the best of my knowledge and belief, per the approved design and Specifications as filed with El Paso County.

(See attached documents)

Statement Of Engineer In Responsible Charge:

To the best of my knowledge, information and belief, the referenced Sterling Ranch Filing No. 1 Pond facilities have been constructed in general compliance with the approved design plans and specifications as filed with El Paso County.

Respectfully submitted,

ALL TERRAIN ENGINEERING, LLC

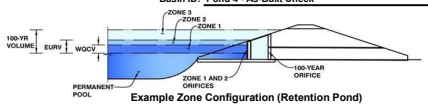
Ryan Burns, P.E.
Colorado No. 54412

AS-BUILT MHFD DETENTION WORKBOOK CHECKS

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

Project: Sterling Ranch Filing No. 1

Basin ID: Pond 4 - As-Built Check



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	EDB		
Watershed Area =	27.63	acres	
Watershed Length =	1,720	ft	
Watershed Slope =	0.030	ft/ft	
Watershed Imperviousness =	53.00%	percent	
Percentage Hydrologic Soil Group A =	0.0%	percent	
Percentage Hydrologic Soil Group B =	100.0%	percent	
Percentage Hydrologic Soil Groups C/D =	0.0%	percent	
Desired WQCV Drain Time =	40.0	hours	
Location for 1-hr Rainfall Depths =	UDFCD Default		
Water Quality Capture Volume (WQCV) =	0.494	acre-feet	
Excess Urban Runoff Volume (EURV) =	1.573	acre-feet	
2-yr Runoff Volume (P1 = 1.19 in.) =	1.312	acre-feet	1.19 inches
5-yr Runoff Volume (P1 = 1.5 in.) =	1.981	acre-feet	1.50 inches
10-yr Runoff Volume (P1 = 1.75 in.) =	2.542	acre-feet	1.75 inches
25-yr Runoff Volume (P1 = 2 in.) =	3.324	acre-feet	2.00 inches
50-yr Runoff Volume (P1 = 2.25 in.) =	3.977	acre-feet	2.25 inches
100-yr Runoff Volume (P1 = 2.52 in.) =	4.720	acre-feet	2.52 inches
500-yr Runoff Volume (P1 = 6.53 in.) =	13.005	acre-feet	6.53 inches
Approximate 2-yr Detention Volume =	1.241	acre-feet	
Approximate 5-yr Detention Volume =	1.821	acre-feet	
Approximate 10-yr Detention Volume =	1.991	acre-feet	
Approximate 25-yr Detention Volume =	2.082	acre-feet	
Approximate 50-yr Detention Volume =	2.317	acre-feet	
Approximate 100-yr Detention Volume =	2.781	acre-feet	

Optional User Override 1-hr Precipitation

Stage-Storage Calculation

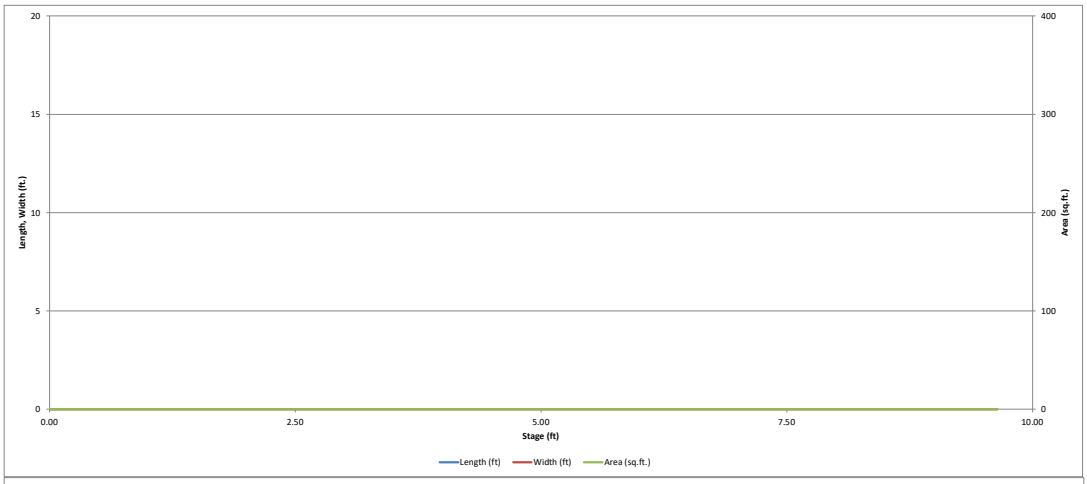
Zone 1 Volume (WQCV) =	0.494	acre-feet
Zone 2 Volume (EURV - Zone 1) =	1.079	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.209	acre-feet
Total Detention Basin Volume =	2.781	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (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

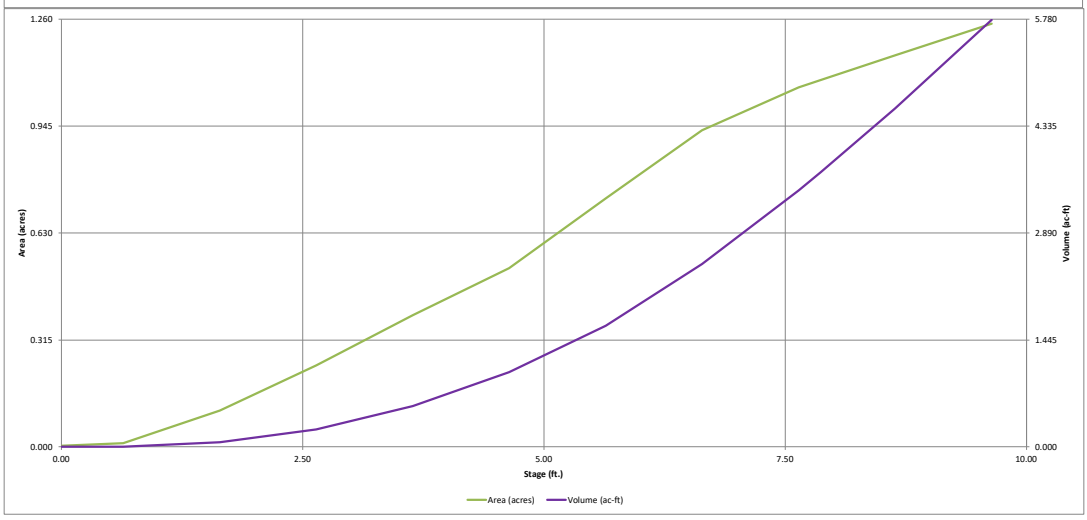
53.36

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)
Micropool	--	0.00	--	--	--	152	0.003		
7054	--	0.64	--	--	--	457	0.010	190	0.004
7055	--	1.64	--	--	--	4,686	0.108	2,720	0.062
7056	--	2.64	--	--	--	10,465	0.240	10,342	0.237
7057	--	3.64	--	--	--	16,903	0.388	24,026	0.552
7058	--	4.64	--	--	--	22,932	0.526	43,943	1.009
7059	--	5.64	--	--	--	31,877	0.732	71,348	1.638
7060	--	6.64	--	--	--	40,648	0.933	107,610	2.470
7061	--	7.64	--	--	--	46,128	1.059	150,998	3.466
7061.23	--	7.87	--	--	--	47,087	1.081	161,718	3.713
7062	--	8.64	--	--	--	50,241	1.153	199,189	4.573
7063	--	9.64	--	--	--	54,338	1.247	251,479	5.773

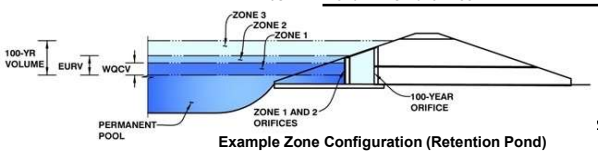
DETENTION BASIN STAGE-STORAGE TABLE BUILDER





Detention Basin Outlet Structure Design

Project: Sterling Ranch Filing No. 1
Basin ID: Pond 4 - As-Built Check



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.49	0.494	Orifice Plate
Zone 2 (EURV)	5.55	1.079	Orifice Plate
Zone 3 (100-year)	6.97	1.209	Weir&Pipe (Restrict)
		2.781	Total

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)

Invert 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 =	6.28	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	N/A	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	N/A	inches	Elliptical Slot Area =	N/A	ft^2

Calculated Parameters for Plate

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

	Row 1 (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)	0.07	1.87	3.68					
Orifice Area (sq. inches)	2.07	2.40	2.76					

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

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice

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

User Input: Overflow Weir (Dropbox) and Grate (Flat or Sloped)

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	5.45	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	9.00	N/A	feet
Overflow Weir Slope =	3.50	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	2.91	N/A	feet
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	6.28	N/A	feet
Over Flow Weir Slope Length =	3.03	N/A	feet
Grate Open Area / 100-yr Orifice Area =	10.40	N/A	should be ≥ 4
Overflow Grate Open Area w/o Debris =	19.07	N/A	ft^2
Overflow Grate Open Area w/ Debris =	9.53	N/A	ft^2

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 =	1.03	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	30.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	12.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	1.83	N/A	ft^2
Outlet Orifice Centroid =	0.58	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	1.37	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	7.87	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	34.00	feet
Spillway End Slopes =	6.66	H:V
Freeboard above Max Water Surface =	1.00	feet

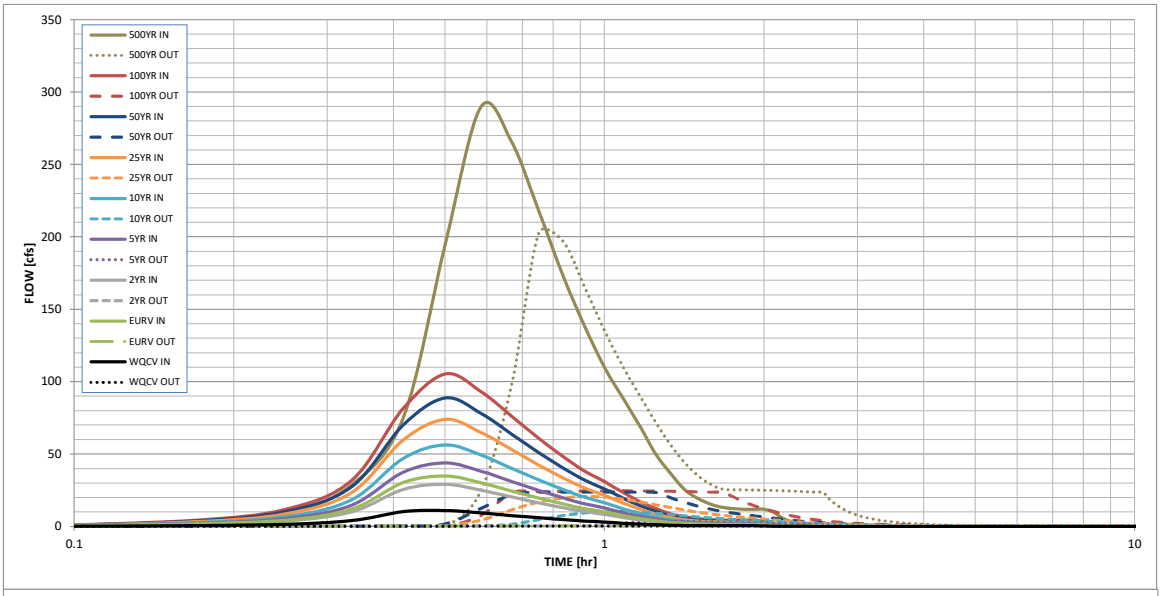
Calculated Parameters for Spillway

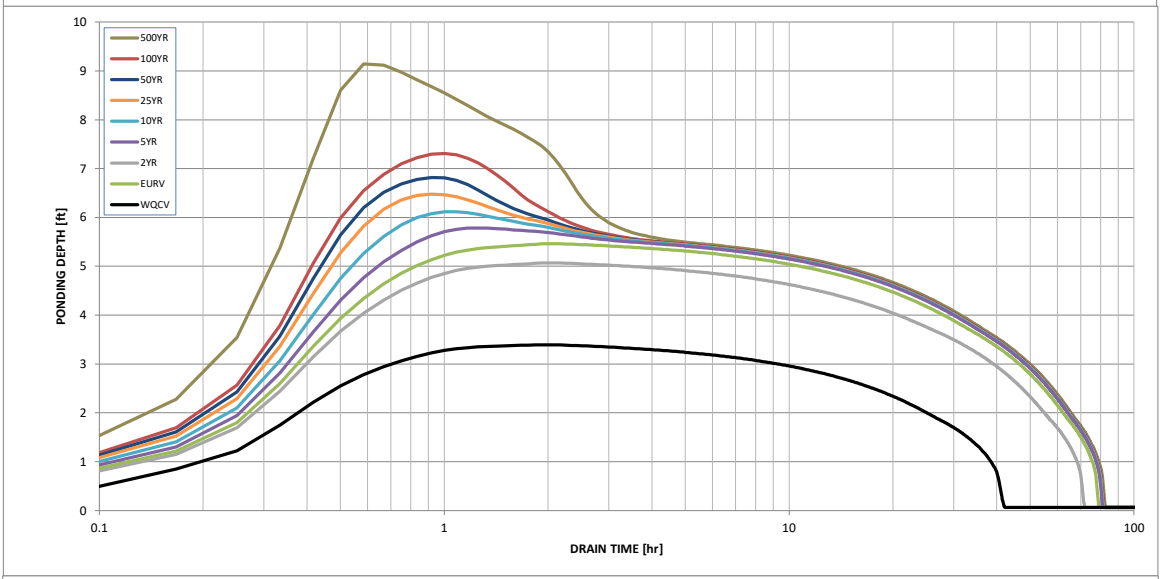
Spillway Design Flow Depth=	0.93	feet
Stage at Top of Freeboard =	9.80	feet
Basin Area at Top of Freeboard =	1.25	acres

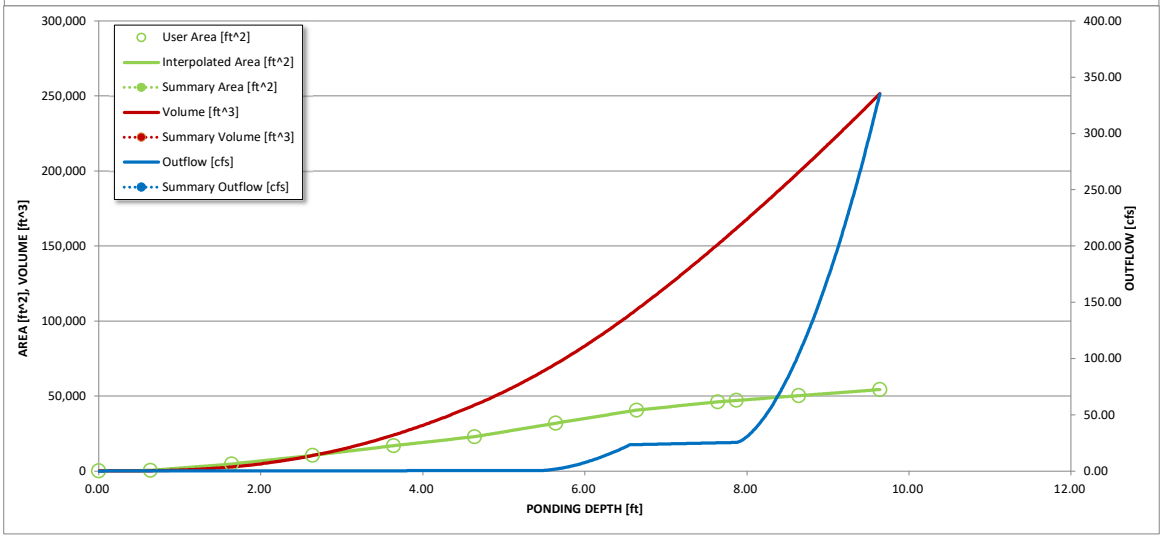
Routed Hydrograph Results

Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	6.53
Calculated Runoff Volume (acre-ft) =	0.494	1.573	1.312	1.981	2.542	3.324	3.977	4.720	13.005
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.494	1.573	1.312	1.982	2.543	3.326	3.980	4.723	13.012
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.20	0.40	0.90	1.16	1.48	2.09
Predevelopment Peak Q (cfs) =	0.0	0.0	0.4	5.5	11.0	24.8	32.1	40.9	57.7
Peak Inflow Q (cfs) =	11.0	34.8	29.1	43.8	56.3	73.9	88.6	105.3	289.7
Peak Outflow Q (cfs) =	0.2	0.5	0.4	3.6	10.3	20.7	23.8	24.6	202.5
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.7	0.9	0.8	0.7	0.6	3.5
Structure Controlling Flow =	Plate	Overflow Grate 1	Plate	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Outlet Plate 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	0.00	N/A	0.2	0.5	1.1	1.2	1.3	1.4
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	39	71	64	71	69	66	64	62	47
Time to Drain 99% of Inflow Volume (hours) =	41	76	69	77	76	75	74	73	64
Maximum Ponding Depth (ft) =	3.40	5.46	5.07	5.78	6.12	6.48	6.82	7.31	9.14
Area at Maximum Ponding Depth (acres) =	0.35	0.69	0.61	0.76	0.83	0.90	0.95	1.02	1.20
Maximum Volume Stored (acre-ft) =	0.459	1.510	1.254	1.742	2.004	2.315	2.631	3.124	5.161

Detention Basin Outlet Structure Design





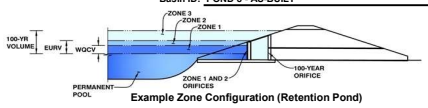


S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

Project: STERLING RANCH FILING NO. 1

Basin ID: POND 8 - AS-BUILT



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	EDB		
Watershed Area =	28.98	acres	
Watershed Length =	1,550	ft	
Watershed Slope =	0.021	ft/ft	
Watershed Imperviousness =	53.00%	percent	
Percentage Hydrologic Soil Group A =	0.0%	percent	
Percentage Hydrologic Soil Group B =	100.0%	percent	
Percentage Hydrologic Soil Groups C/D =	0.0%	percent	
Desired WQCV Drain Time =	40.0	hours	
Location for 1-hr Rainfall Depths =	User Input		
Water Quality Capture Volume (WQCV) =	0.518	acre-feet	
Excess Urban Runoff Volume (EURV) =	1.650	acre-feet	
2-yr Runoff Volume (P1 = 1.19 in.) =	1.376	acre-feet	1.19 inches
5-yr Runoff Volume (P1 = 1.5 in.) =	2.078	acre-feet	1.50 inches
10-yr Runoff Volume (P1 = 1.75 in.) =	2.666	acre-feet	1.75 inches
25-yr Runoff Volume (P1 = 2 in.) =	3.486	acre-feet	2.00 inches
50-yr Runoff Volume (P1 = 2.25 in.) =	4.171	acre-feet	2.25 inches
100-yr Runoff Volume (P1 = 2.52 in.) =	4.951	acre-feet	2.52 inches
500-yr Runoff Volume (P1 = 0 in.) =	0.000	acre-feet	inches
Approximate 2-yr Detention Volume =	1.302	acre-feet	
Approximate 5-yr Detention Volume =	1.910	acre-feet	
Approximate 10-yr Detention Volume =	2.089	acre-feet	
Approximate 25-yr Detention Volume =	2.184	acre-feet	
Approximate 50-yr Detention Volume =	2.430	acre-feet	
Approximate 100-yr Detention Volume =	2.917	acre-feet	

Optional User Input 1-hr Precipitation

Stage-Storage Calculation

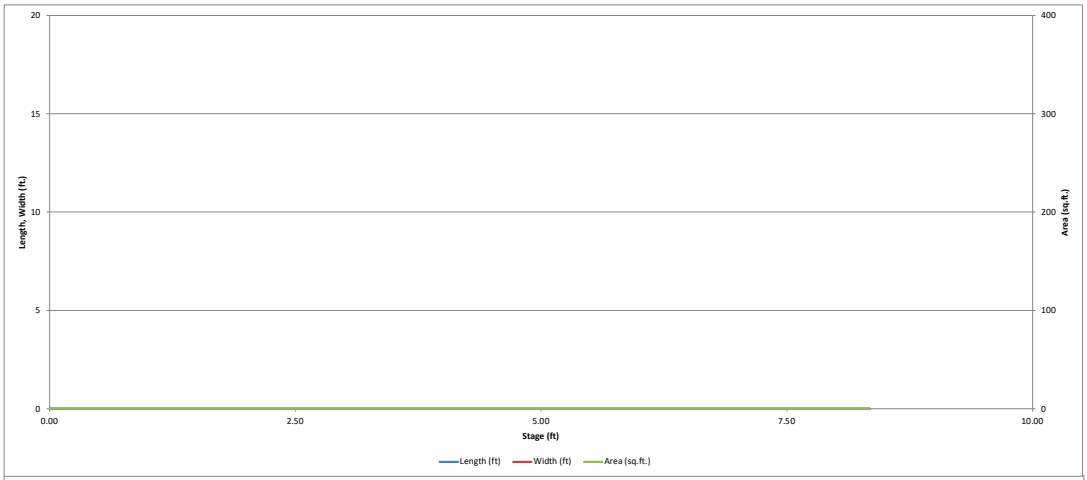
Zone 1 Volume (WQCV) =	0.518	acre-feet
Zone 2 Volume (EURV - Zone 1) =	1.131	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.268	acre-feet
Total Detention Basin Volume =	2.917	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (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}) =	6.54	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

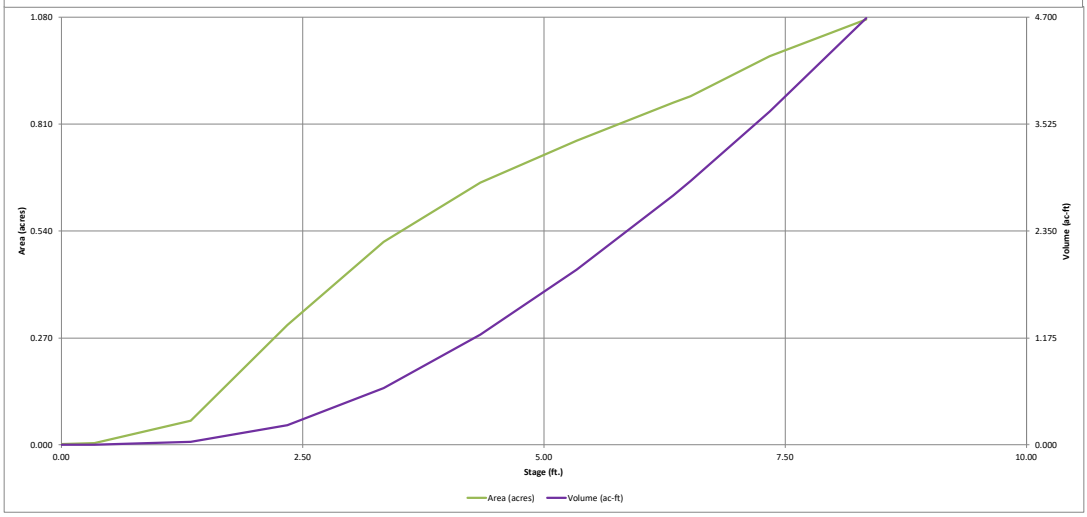
7014.66

Depth Increment = 1 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)
Micropool	--	0.00	--	--	--	98	0.002		
7015	--	0.34	--	--	--	205	0.005	49	0.001
7016	--	1.34	--	--	--	2,658	0.061	1,457	0.033
7017	--	2.34	--	--	--	13,186	0.303	9,405	0.216
7018	--	3.34	--	--	--	22,353	0.513	27,174	0.624
7019	--	4.34	--	--	--	28,855	0.662	52,778	1.212
7020	--	5.34	--	--	--	33,470	0.768	83,941	1.927
7021	--	6.34	--	--	--	37,643	0.864	119,497	2.743
7021.18	--	6.52	--	--	--	38,363	0.881	126,338	2.900
7022	--	7.34	--	--	--	42,748	0.981	159,593	3.664
7023	--	8.34	--	--	--	46,800	1.074	204,367	4.692

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

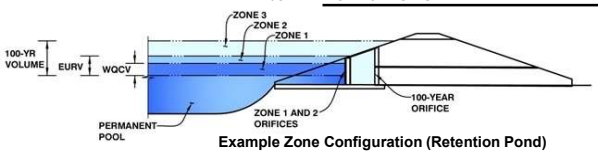




Detention Basin Outlet Structure Design

Project: STERLING RANCH FILING NO. 1

Basin ID: POND 8 - AS-BUILT



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.13	0.518	Orifice Plate
Zone 2 (EURV)	4.97	1.131	Orifice Plate
Zone 3 (100-year)	6.54	1.268	Weir&Pipe (Restrict)
		2.917	Total

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

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

Calculated Parameters for Underdrain

Underdrain Orifice Area =	N/A	ft^2
Underdrain Orifice Centroid =	N/A	feet

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	4.97	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	N/A	inches
Orifice Plate: Orifice Area per Row =	N/A	inches

Calculated Parameters for Plate

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

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.07	1.41	3.02					
Orifice Area (sq. inches)	2.07	2.07	5.40					

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

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice

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

User Input: Overflow Weir (Dropbox) and Grate (Flat or Sloped)

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	4.60	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	9.00	N/A	feet
Overflow Weir Slope =	3.50	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	2.91	N/A	feet
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	5.43	N/A	feet
Over Flow Weir Slope Length =	3.03	N/A	feet
Grate Open Area / 100-yr Orifice Area =	4.94	N/A	should be ≥ 4
Overflow Grate Open Area w/o Debris =	19.07	N/A	ft^2
Overflow Grate Open Area w/ Debris =	9.53	N/A	ft^2

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 Pipe Diameter =	30.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	22.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	3.86	N/A	ft^2
Outlet Orifice Centroid =	1.02	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	2.06	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	6.54	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	35.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

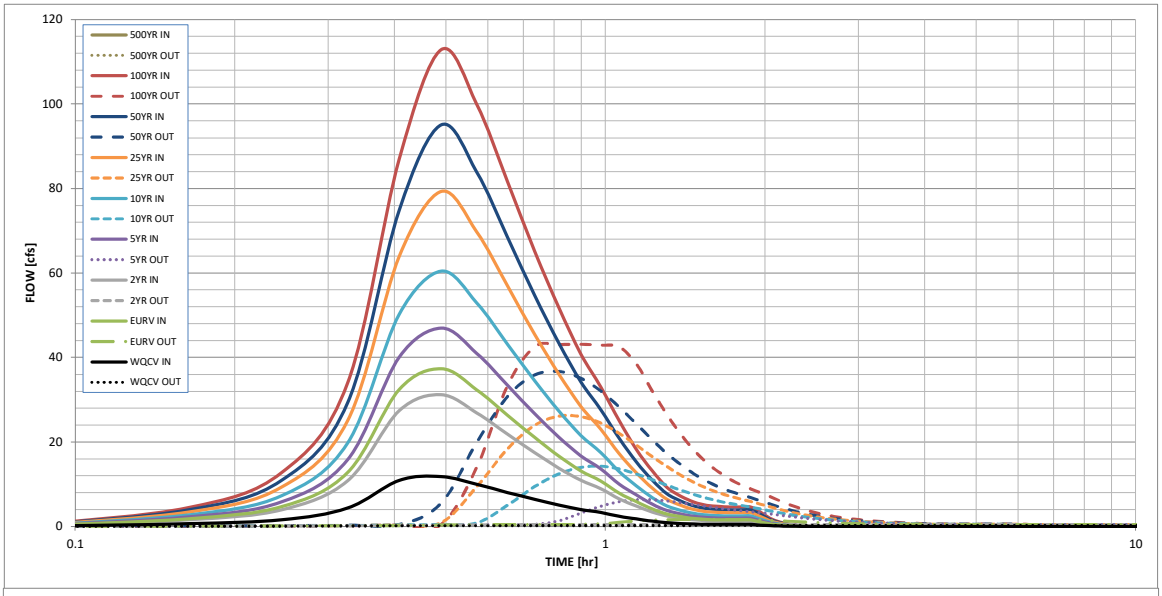
Calculated Parameters for Spillway

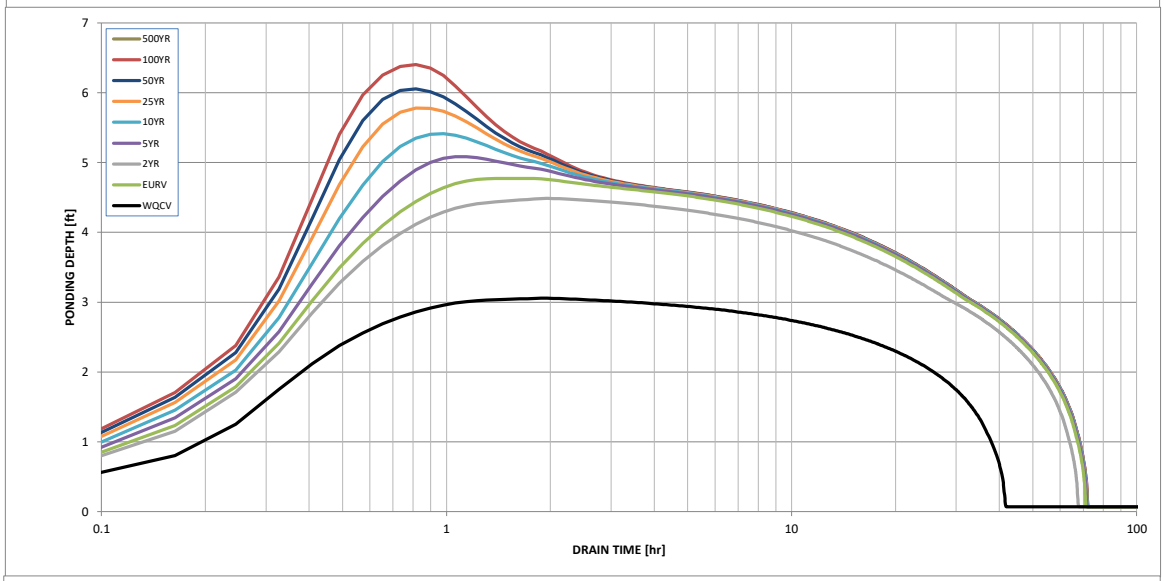
Spillway Design Flow Depth=	0.90	feet
Stage at Top of Freeboard =	8.44	feet
Basin Area at Top of Freeboard =	1.07	acres

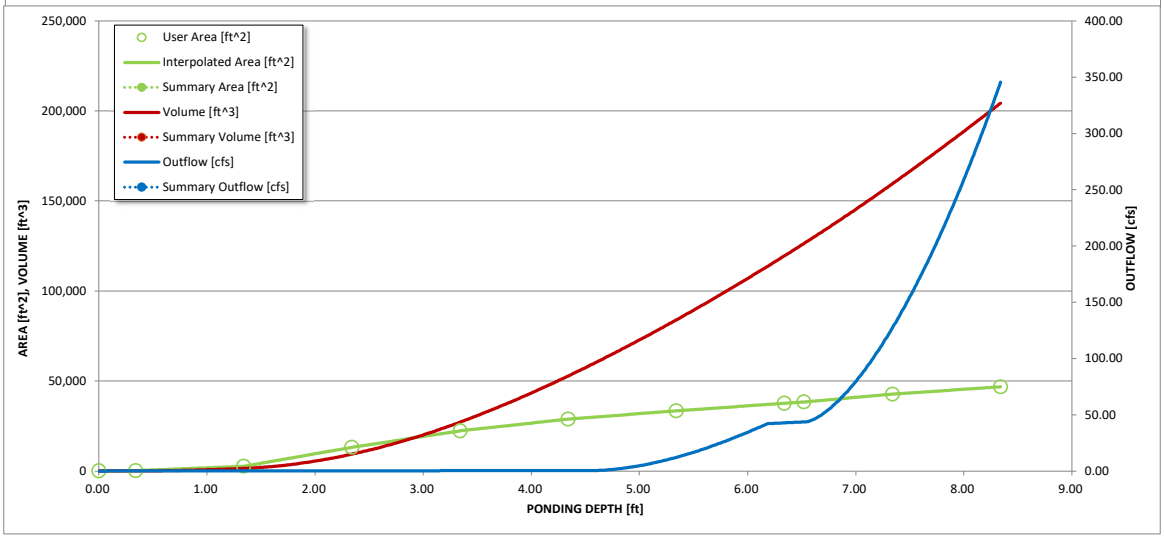
Routed Hydrograph Results

Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	0.00
Calculated Runoff Volume (acre-ft) =	0.518	1.650	1.376	2.078	2.666	3.486	4.171	4.951	0.000
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.519	1.650	1.376	2.080	2.667	3.489	4.174	4.948	#N/A
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.20	0.40	0.91	1.18	1.50	2.12
Predevelopment Peak Q (cfs) =	0.0	0.0	0.4	5.9	11.7	26.4	34.1	43.4	61.3
Peak Inflow Q (cfs) =	11.8	37.3	31.2	47.0	60.4	79.3	95.1	112.8	#N/A
Peak Outflow Q (cfs) =	0.2	1.6	0.5	6.3	14.3	26.1	36.7	43.1	#N/A
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.1	1.2	1.0	1.1	1.0	#N/A
Structure Controlling Flow =	Plate	Overflow Grate 1	Plate	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Outlet Plate 1	#N/A
Max Velocity through Grate 1 (fps) =	N/A	0.06	N/A	0.3	0.7	1.3	1.9	2.2	#N/A
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	#N/A
Time to Drain 97% of Inflow Volume (hours) =	38	63	60	62	60	58	56	55	#N/A
Time to Drain 99% of Inflow Volume (hours) =	**40**	68	65	67	66	65	64	64	#N/A
Maximum Ponding Depth (ft) =	3.06	4.77	4.49	5.08	5.41	5.78	6.05	6.40	#N/A
Area at Maximum Ponding Depth (acres) =	0.45	0.71	0.68	0.74	0.78	0.81	0.84	0.87	#N/A
Maximum Volume Stored (acre-ft) =	0.484	1.506	1.305	1.731	1.981	2.274	2.497	2.795	#N/A

Detention Basin Outlet Structure Design







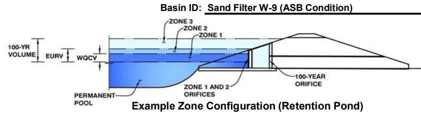
S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: Sterling Ranch Filing No. 1 - As-Builts

Basin ID: Sand Filter W-9 (ASB Condition)



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	**SF**			
Watershed Area =	5.87	acres		
Watershed Length =	585	ft		
Watershed Slope =	0.024	ft/ft		
Watershed Imperviousness =	70.00%	percent		
Percentage Hydrologic Soil Group A =	0.0%	percent		
Percentage Hydrologic Soil Group B =	100.0%	percent		
Percentage Hydrologic Soil Groups C/D =	0.0%	percent		
Desired WQCV Drain Time =	12.0	hours		
Location for 1-hr Rainfall Depths =	User Input			
Water Quality Capture Volume (WQCV) =	0.108	acre-feet	Optional User Override 1-hr Precipitation	
Excess Urban Runoff Volume (EURV) =	0.451	acre-feet		
2-yr Runoff Volume (P1 = 1.19 in.) =	0.376	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.500	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.634	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.799	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.922	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	1.083	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 0 in.) =	0.000	acre-feet		inches
Approximate 2-yr Detention Volume =	0.353	acre-feet		
Approximate 5-yr Detention Volume =	0.470	acre-feet		
Approximate 10-yr Detention Volume =	0.593	acre-feet		
Approximate 25-yr Detention Volume =	0.637	acre-feet		
Approximate 50-yr Detention Volume =	0.663	acre-feet		
Approximate 100-yr Detention Volume =	0.710	acre-feet		

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.108	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.344	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.259	acre-feet
Total Detention Basin Volume =	0.710	acre-feet
Initial Surcharge Volume (ISV) =	N/A	ft^3
Initial Surcharge Depth (ISD) =	N/A	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	N/A	ft
Slope of Trickle Channel (S_{TC}) =	N/A	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

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)
7086	**Media Surface**	--	0.00	--	--	--	5,129	0.118		
7087		--	1.00	--	--	--	9,428	0.216	7,184	0.165
7088		--	2.00	--	--	--	12,261	0.281	18,001	0.413
7088.50		--	2.50	--	--	--	13,703	0.315	24,614	0.565
7089.00		--	3.00	--	--	--	15,215	0.349	31,843	0.731
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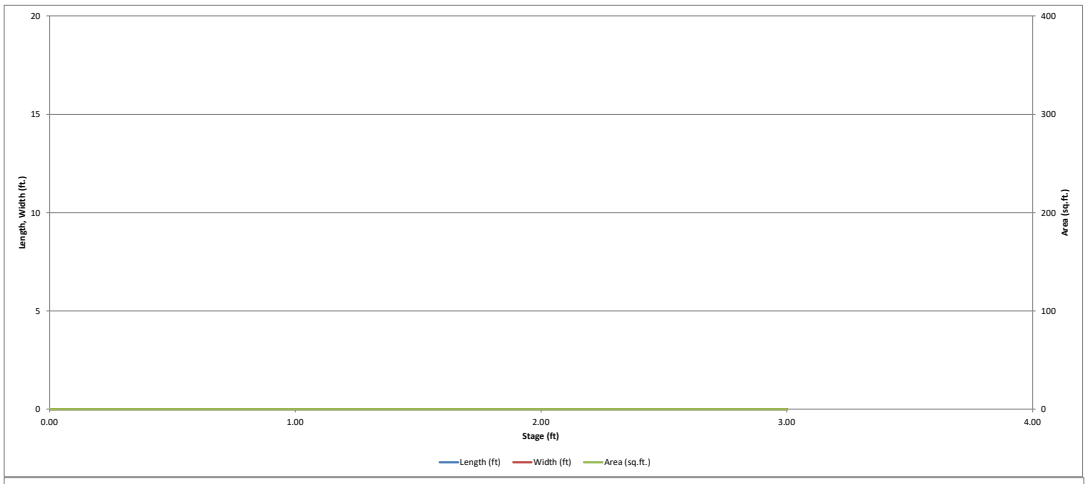
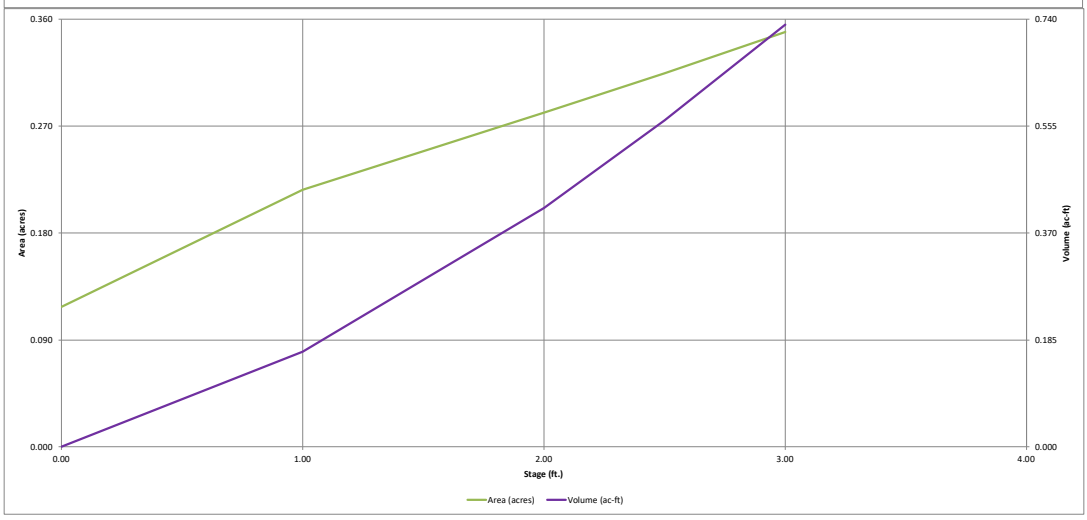
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)



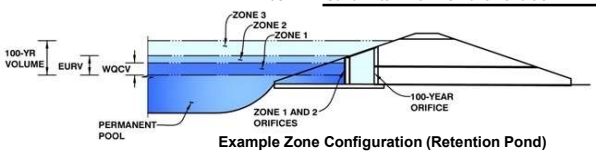


Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: Sterling Ranch Filing No. 1

Basin ID: Sand Filter W-9 - As Built Condition



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.71	0.108	Filtration Media
Zone 2 (EURV)	2.13	0.344	Circular Orifice
Zone 3 (100-year)	2.94	0.259	Weir&Pipe (Restrict)
		0.710	Total

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

Underdrain Orifice Invert Depth =	3.50	ft (distance below the filtration media surface)	
Underdrain Orifice Diameter =	1.49	inches	

Calculated Parameters for Underdrain

Underdrain Orifice Area =	0.0	ft^2
Underdrain Orifice Centroid =	0.06	feet

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

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

Calculated Parameters for Plate

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

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

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

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

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Circular	Not Selected	
Invert of Vertical Orifice =	0.69	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	2.13	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	6.00	N/A	inches

Calculated Parameters for Vertical Orifice

	Zone 2 Circular	Not Selected	
Vertical Orifice Area =	0.20	N/A	ft^2
Vertical Orifice Centroid =	0.25	N/A	feet

User Input: Overflow Weir (Dropbox) and Grate (Flat or Sloped)

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	2.34	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	3.50	N/A	feet
Overflow Weir Slope =	0.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	3.00	N/A	feet
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	2.34	N/A	feet
Over Flow Weir Slope Length =	3.00	N/A	feet
Grate Open Area / 100-yr Orifice Area =	9.30	N/A	should be ≥ 4
Overflow Grate Open Area w/o Debris =	7.35	N/A	ft^2
Overflow Grate Open Area w/ Debris =	3.68	N/A	ft^2

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 =	3.50	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	18.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	8.25		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	0.79	N/A	ft^2
Outlet Orifice Centroid =	0.40	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	1.49	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	2.84	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	12.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

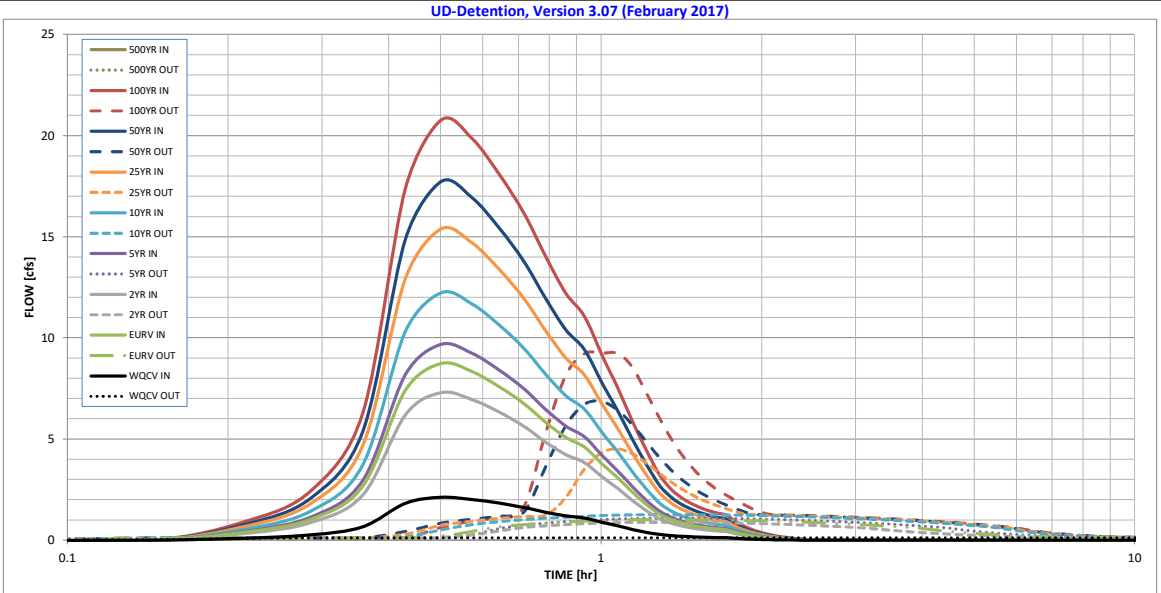
Spillway Design Flow Depth=	0.62	feet
Stage at Top of Freeboard =	4.46	feet
Basin Area at Top of Freeboard =	0.35	acres

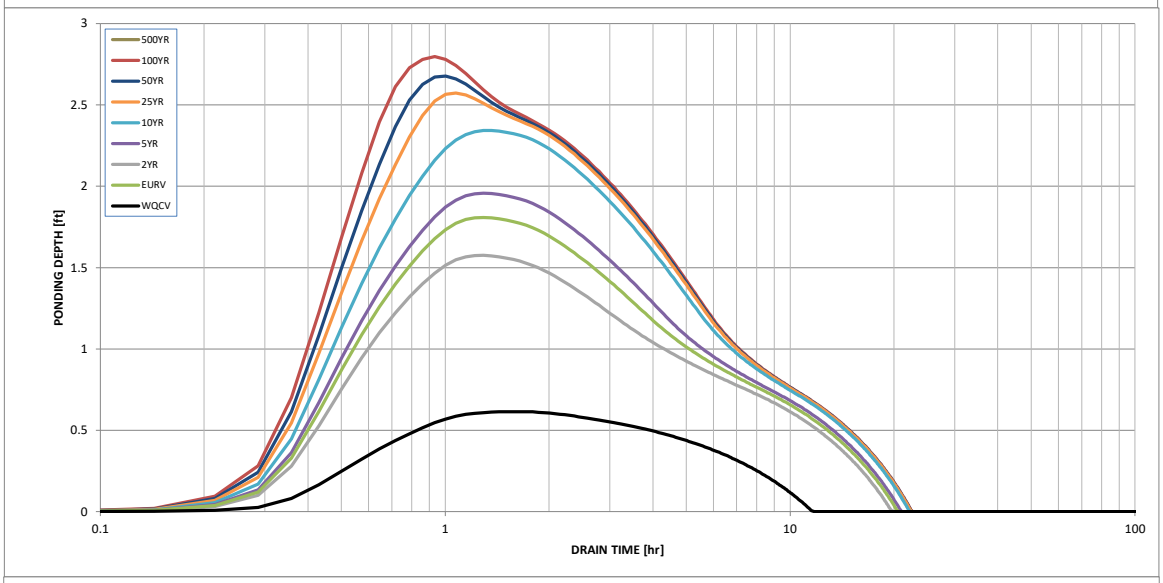
Routed Hydrograph Results

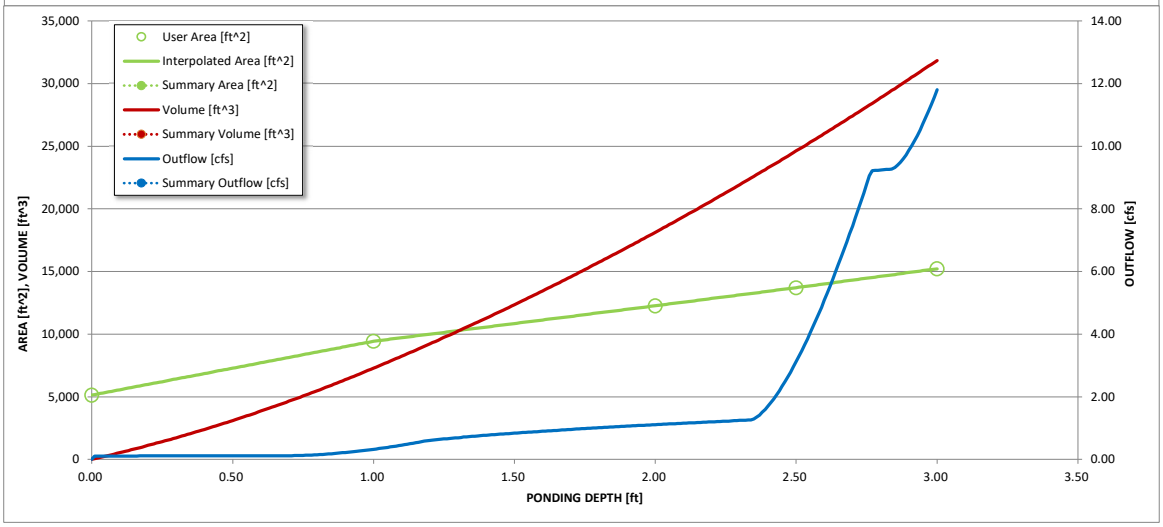
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	0.00
Calculated Runoff Volume (acre-ft) =	0.108	0.451	0.376	0.500	0.634	0.799	0.922	1.083	0.000
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.107	0.450	0.375	0.500	0.633	0.799	0.921	1.082	#N/A
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.03	0.25	0.80	1.10	1.47	0.00
Predevelopment Peak Q (cfs) =	0.0	0.0	0.1	0.1	1.5	4.7	6.5	8.6	0.0
Peak Inflow Q (cfs) =	2.1	8.7	7.3	9.7	12.2	15.4	17.7	20.8	#N/A
Peak Outflow Q (cfs) =	0.1	1.0	0.9	1.1	1.3	4.5	6.9	9.2	#N/A
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	7.4	0.9	1.0	1.1	1.1	#N/A
Structure Controlling Flow =	Filtration Media	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Outlet Plate 1	#N/A
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.0	0.4	0.8	1.1	#N/A
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	#N/A
Time to Drain 97% of Inflow Volume (hours) =	11	19	19	19	20	20	20	19	#N/A
Time to Drain 99% of Inflow Volume (hours) =	12	20	19	21	22	22	22	21	#N/A
Maximum Ponding Depth (ft) =	0.62	1.81	1.58	1.96	2.34	2.57	2.68	2.80	#N/A
Area at Maximum Ponding Depth (acres) =	0.18	0.27	0.25	0.28	0.30	0.32	0.33	0.33	#N/A
Maximum Volume Stored (acre-ft) =	0.090	0.361	0.301	0.402	0.516	0.587	0.620	0.659	#N/A

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)







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

REFERENCE INFORMATION

MASTER DEVELOPMENT DRAINAGE REPORT
FOR
STERLING RANCH FILING NOS. 1&2
AND
FINAL DRAINAGE REPORT FOR STERLING RANCH FILING NO. 1

EL PASO COUNTY, COLORADO

DECEMBER 2017

Prepared for:

SR Land, LLC
20 Boulder Crescent, Suite 210
Colorado Springs, CO 80903

Prepared by:

CIVIL CONSULTANTS, INC.
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Colorado Springs, CO 80903
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Project #09-002
DSD Project # SF-16-013

MASTER DEVELOPMENT DRAINAGE REPORT
FOR
STERLING RANCH FILING NOS. 1&2
AND
FINAL DRAINAGE REPORT FOR STERLING RANCH FILING NO. 1

DRAINAGE PLAN STATEMENTS

ENGINEERS STATEMENT

The attached drainage plan and report was prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the County for drainage reports and said report is in conformity with the master plan of the drainage basin.

COLORADO REGISTERED VIRGIL A. SANCHEZ II 37160 PROFESSIONAL ENGINEER

Virgil A. Sanchez, P.E. #37160
For and on Behalf of M&S Civil Consultants, Inc

DEVELOPER'S STATEMENT

I, the developer have read and will comply with all the requirements specified in this drainage report and plan.

BY: James F Morley

TITLE: Manager
DATE: 4/17/2017

ADDRESS: SR Land, LLC
20 Boulder Crescent, Suite 210
Colorado Springs, CO 80903

EL PASO COUNTY'S STATEMENT

Filed in accordance with the requirements of El Paso County Land Development Code, Drainage Criteria Manual Volumes 1 and 2, and the Engineering Criteria Manual, as amended.

BY: _____ DATE: 30 JAN 18
Jennifer Irvine, P.E.
County Engineer / ECM Administrator

calculated for DP50. In the undeveloped condition, runoff of Q5=2.0 cfs and Q100=15.0 cfs are routed via historic drainage patterns and proposed swales to DP50. The surface runoff will be collected by a 36" FES. The flows will routed south via a 36" RCP (PR64) to PR65. The accumulated flow in PR65 (Q5=32.0 cfs and Q100=309.7 cfs) will be routed south to PR67. Upon future development of this basin, full spectrum detention shall be required and will release to historic release rates of Q5=2.0 cfs and Q100=15.0 cfs.

DP53, 5.37 acres, consists of Basin JP-12 a future commercial parcel with runoff coefficients of 0.81 for the 5-year and 0.88 for the 100-year. Developed runoff of Q5=19.8 cfs and Q100=36.1 cfs has been calculated for DP53. In the undeveloped condition, runoff of Q5=1.4 cfs and Q100=10.0 cfs are routed via historic drainage patterns and proposed swales to DP53. The surface runoff will be collected by a 30" FES. The flows will routed south via a 30" RCP (PR66) to PR67. The accumulated flow in PR67 (Q5=39.1 cfs and Q100=322.5 cfs) will be routed via a 72" RCP south to Sand Creek. Upon future development of this basin, full spectrum detention shall be required and will release to historic release rates of Q5=1.4 cfs and Q100=10.0 cfs. The summed flows at DP68 (PR74, Q5=42.2 cfs and Q100=472.2 cfs) will outfall into Sand Creek. Impacts from the outfall into Sand Creek will be addressed in the revised TM-SCCS. A riprap apron will be constructed to dissipate energy and prevent local scour at the outlet.

DP54, 1.21 acres, consists of Basin RP-7D (Marksheffel Road) with runoff coefficients of 0.08 for the 5-year and 0.35 for the 100-year and DP51 flowby. Undeveloped runoff of Q5=0.4 cfs and Q100=3.5 cfs has been calculated for DP54. Undeveloped flows will be routed to a temporary sediment basin via overlot grading as shown on the "Sterling Ranch-Phase 1 Offsite Grading, Early Grading & Erosion Control Plans", prepared by M&S Civil Consultants, Inc., dated November 2015, which will route flows to Sand Creek. Erosion control will be provided.

DP55, 1.28 acres, consists of Basin RP-7C (Marksheffel Road) with runoff coefficients of 0.08 for the 5-year and 0.35 for the 100-year and DP51 flowby. Undeveloped runoff of Q5=0.4 cfs and Q100=4.9 cfs has been calculated for DP55. Undeveloped flows will be routed to a temporary sediment basin via overlot grading as shown on the "Sterling Ranch-Phase 1 Offsite Grading, Early Grading & Erosion Control Plans", prepared by M&S Civil Consultants, Inc., dated November 2015, which will route flows to Sand Creek. Erosion control will be provided.

Basin SSS, 1.21 acres, consists of the backyards of future residential lots with runoff coefficients of 0.22 for the 5-year and 0.46 for the 100-year. Developed runoff of Q5=1.1 cfs and Q100=3.8 cfs has been calculated for this basin. Developed flows will be sheet flow into Sand Creek. Erosion control will be provided.

There will be bank stabilization improvements to the Sand Creek Drainage Channel with the development of the STERLING RANCH FILING NOS. 1&2 site (Roadways and tracts) to maintain the integrity of roadways and ponds. However, channel improvements for Sand Creek (checks, drops, etc...) will be installed in accordance with the Subdivision Improvement Agreement.

DETENTION PONDS

Detention Pond 4, has combined upstream developed runoff of Q5=50.0 cfs and Q100=102.9 cfs. The proposed Detention Pond functions to provide full spectrum detention and water quality for runoff calculated onsite. The pond is designed to treat approx 27.5 acres, and provide 0.46 ac-ft of water quality storage and 2.90 ac-ft of 100-year storage. The forebay, trickle channel micropool, outlet structure and pipe have been designed per the UDFCD manual and per the Detention Design-UD-Detention v3.05 workbook.

Detention Pond 8, has combined upstream developed runoff of Q5=42.3 cfs and Q100=112.8 cfs. The proposed Detention Pond functions to provide full spectrum detention and water quality for runoff

calculated onsite. The pond is designed to treat approximately 29.0 acres, and provide 0.48 ac-ft of water quality storage and 3.00 ac-ft of 100-year storage. The forebay, trickle channel micropool, outlet structure and pipe have been designed per the UDFCD manual and per the Detention Design-UD-Detention v3.05 workbook.

Detention Pond W-5, has combined upstream developed runoff of Q5=233.2 cfs and Q100=518.2 cfs. The proposed Detention Pond functions to provide full spectrum detention and water quality for runoff calculated onsite. The pond is designed to treat approx 175.6 acres, and provide 2.90 ac-ft of water quality storage and 17.16 ac-ft of 100-year storage. The forebay, trickle channel micropool, outlet structure and pipe have been designed per the UDFCD manual and per the Detention Design-UD-Detention v3.05 workbook. Design and calculations will be addressed in the Filing No. 2 Final Drainage Report. See Sand Creek Channel Study-Future Hydrologic Conditions Map in the appendix. Impacts from the outfall into Sand Creek will be addressed in the revised TM-SCCS.

Detention Pond B-B, has combined upstream developed runoff of Q5=4.7 cfs and Q100=15.0 cfs. The proposed temporary Detention Pond functions to provide full spectrum detention and water quality for runoff calculated onsite. The pond is designed to treat approximately 5.98 acres, and provide 0.04 ac-ft of water quality storage and 0.48 ac-ft of 100-year storage. The outlet structure and pipe have been designed to release the required rates per the UDFCD manual and per the Detention Design-UD-Detention v3.05 workbook.

Detention Pond W-9, has combined upstream developed runoff of Q5=8.9 cfs and Q100=21.2 cfs. The proposed Detention Pond functions to provide full spectrum detention and water quality for runoff calculated offsite. The pond is designed to treat approx 5.87 acres, and provide 0.092 ac-ft of water quality storage and 0.638 ac-ft of 100-year storage. The outlet structure, 18" filter layer(minimum), underdrain and pipe have been designed per the UDFCD manual and per the Detention Design-UD-Detention v3.07 workbook.

Conceptual Detention Pond W-4, has combined upstream developed runoff of Q5=72.9 cfs and Q100=368.4 cfs. The proposed Detention Pond functions to provide full spectrum detention and water quality for runoff calculated offsite. The pond is designed to treat approx 352.2 acres, and provide 1.73 ac-ft of water quality storage and 6.63 ac-ft of 100-year storage. The forebay, trickle channel micropool, outlet structure and pipe have been designed per the UDFCD manual and per the Detention Design-UD-Detention v3.05 workbook. Design and calculations will be addressed in the Filing No. 2 Final Drainage Report. See Sand Creek Channel Study-Future Hydrologic Conditions Map in the appendix. Impacts from the outfall into Sand Creek will be addressed in the revised TM-SCCS. The Conceptual Detention Pond W-4 is subject to El Paso County approval for the site shown.

The detention ponds will be private and shall be maintained by the Sterling Ranch Metropolitan District. Access shall be granted to the owner and El Paso County for access and maintenance of the private detention ponds. A private maintenance agreement documents shall accompany the submittal. In the event of clogging or total inlet failure, flows will over top the emergency spillway and outfall into Sand Creek. A rip rap apron will be constructed to dissipate energy and prevent local scour at the outlet.

The water quality volume and 100-year volume required for the site has been determined using the guidelines set forth in the City of Colorado Springs/El Paso County Drainage Criteria Manual Chapter 6 - Volume II. Refer to the Detention Basin Design sheets located within the appendix of this report.

EROSION CONTROL

It is the policy of the El Paso County that a grading and erosion control plan be submitted with the drainage report. EPC approved "Early Grading Plan for Sterling Ranch Phase 1 Onsite Grading &

POND 8 - SRF1 ORIGINAL APPROVED DESIGN

Stormwater Detention and Infiltration Design Data Sheet

Workbook Protected Worksheet Protected

Stormwater Facility Name: Sterling Ranch Filing No. 1, Pond 8

Facility Location & Jurisdiction: 600 Feet North of Dines Blvd. and Sterling Ranch Road

User Input: Watershed Characteristics

Watershed Slope =	0.021	ft/ft
Watershed Length =	1550	ft
Watershed Area =	28.98	acres
Watershed Imperviousness =	53.0%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	100.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent

Location for 1-hr Rainfall Depths (use dropdown): User Input

WQCV Treatment Method = Extended Detention

User Defined Stage [ft]	User Defined Area [ft^2]	User Defined Stage [ft]	User Defined Discharge [cfs]
0.00	0	0.00	0.00
0.50	457	0.50	0.06
1.50	7,423	1.50	0.11
2.50	20,206	2.50	0.22
3.50	28,371	3.50	0.41
4.50	33,351	4.50	0.63
5.50	37,998	5.50	21.55
6.50	41,980	6.50	43.50
7.50	46,012	7.50	91.85
8.50	50,147	8.50	326.38
9.50	54,386	9.50	741.90
10.50	58,728	10.50	1353.69

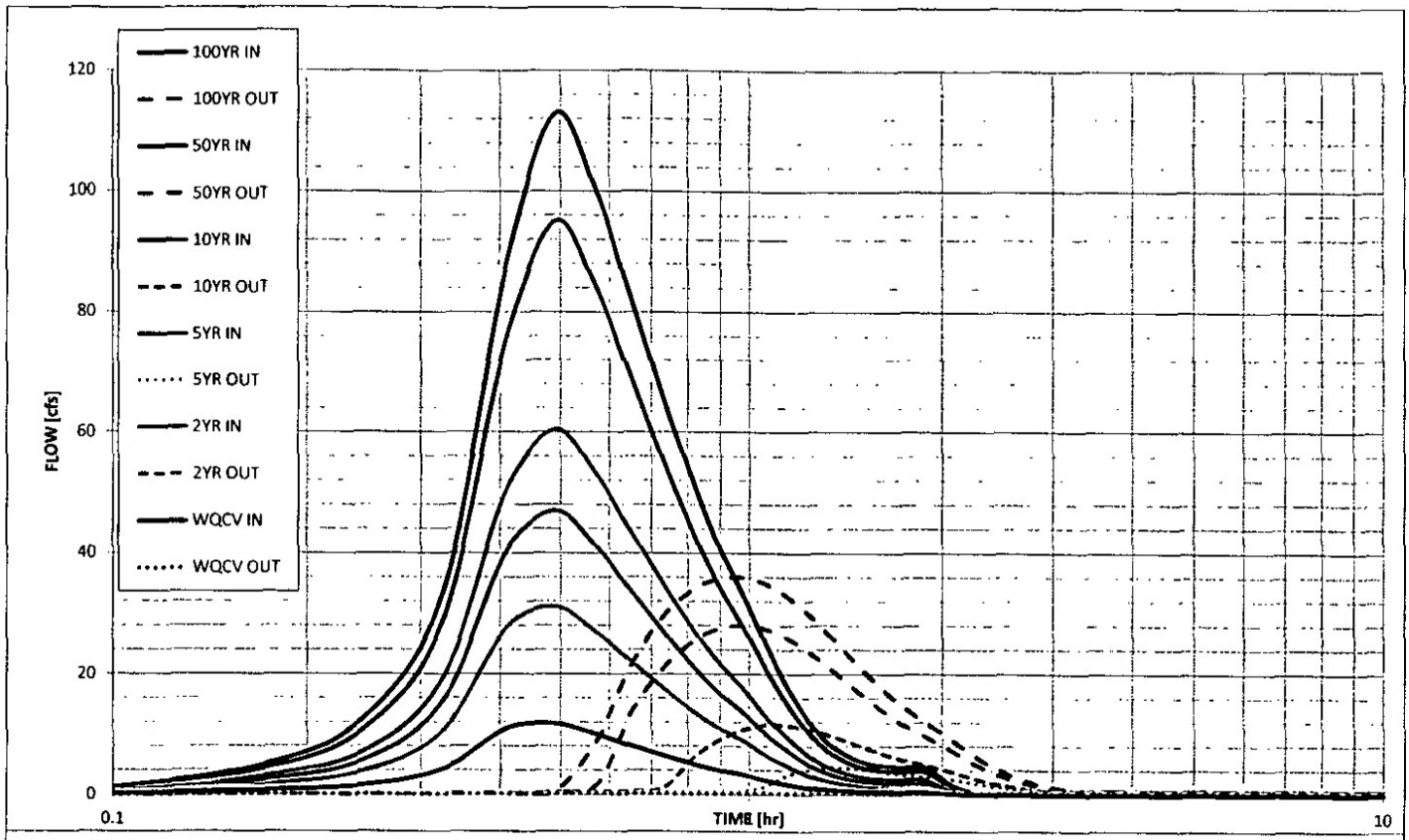
After completing and printing this worksheet to a pdf, go to:
https://maperture.digitaldataservices.com/gvh/?viewer=cswdif
create a new stormwater facility, and
attach the pdf of this worksheet to that record.

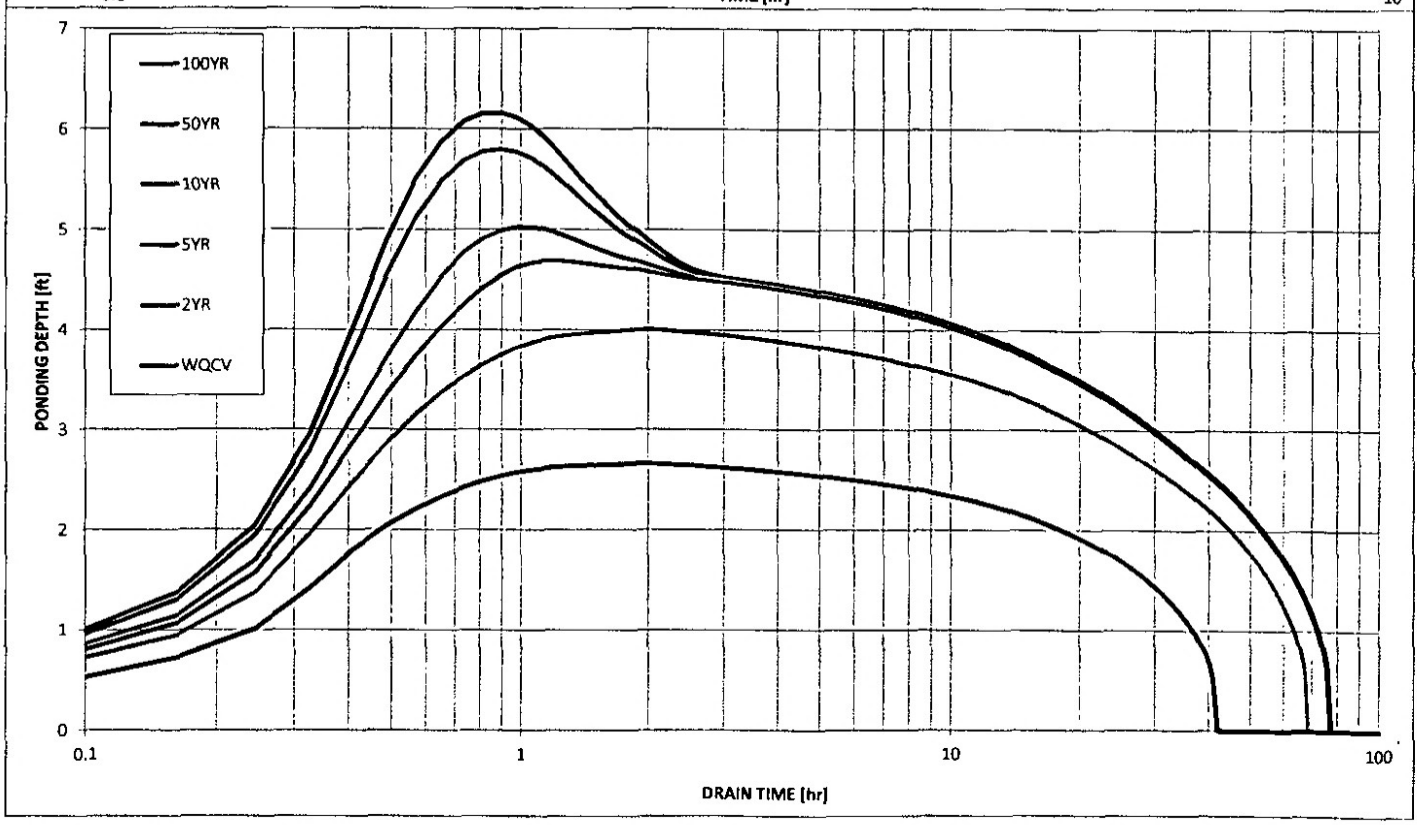
Routed Hydrograph Results

Design Storm Return Period =	WQCV	2 Year	5 Year	10 Year	50 Year	100 Year	
One-Hour Rainfall Depth =	0.53	1.19	1.50	1.75	2.25	2.52	in
Calculated Runoff Volume =	0.518	1.376	2.078	2.666	4.171	4.951	acre-ft
OPTIONAL Override Runoff Volume =							acre-ft
Inflow Hydrograph Volume =	0.518	1.376	2.078	2.665	4.171	4.945	acre-ft
Time to Drain 97% of Inflow Volume =	38.8	61.9	**67.5**	65.6	61.2	59.2	hours
Time to Drain 99% of Inflow Volume =	40.5	65.8	73.0	72.4	70.6	**69.7**	hours
Maximum Ponding Depth =	2.66	4.00	4.69	5.02	5.80	6.16	ft
Maximum Ponded Area =	0.49	0.71	0.78	0.82	0.90	**0.93**	acres
Maximum Volume Stored =	0.484	1.307	1.816	2.082	2.753	3.081	acre-ft

POND 8 - SRF1 ORIGINAL APPROVED DESIGN

Stormwater Detention and Infiltration Design Data Sheet





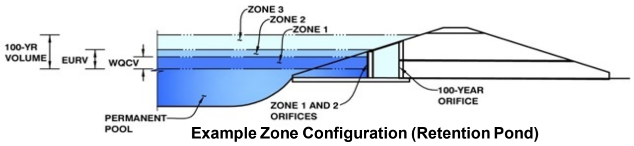
POND 8 - SRF1 ORIGINAL APPROVED DESIGN

STERLING RANCH FILING NOS. 1&2 MDDP **(PREVIOUS VERSION)**

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

Project: STERLING RANCH FILING NO. 1

Basin ID: POND 8



Example Zone Configuration (Retention Pond)

Required Volume Calculation

			Optional User Input 1-hr Precipitation	
Selected BMP Type =	**EDB**			
Watershed Area =	28.98	acres		
Watershed Length =	1,550	ft		
Watershed Slope =	0.021	ft/ft		
Watershed Imperviousness =	53.00%	percent		
Percentage Hydrologic Soil Group A =	0.0%	percent		
Percentage Hydrologic Soil Group B =	100.0%	percent		
Percentage Hydrologic Soil Groups C/D =	0.0%	percent		
Desired WQCV Drain Time =	40.0	hours		
Location for 1-hr Rainfall Depths =	User Input			
Water Quality Capture Volume (WQCV) =	0.518	acre-feet		
Excess Urban Runoff Volume (EURV) =	1.650	acre-feet		
2-yr Runoff Volume (P1 = 1.19 in.) =	1.376	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	2.078	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	2.666	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	3.486	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	4.171	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	4.951	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 6.53 in.) =	13.638	acre-feet	6.53	inches
Approximate 2-yr Detention Volume =	1.302	acre-feet		
Approximate 5-yr Detention Volume =	1.910	acre-feet		
Approximate 10-yr Detention Volume =	2.089	acre-feet		
Approximate 25-yr Detention Volume =	2.184	acre-feet		
Approximate 50-yr Detention Volume =	2.430	acre-feet		
Approximate 100-yr Detention Volume =	2.917	acre-feet		

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.518	acre-feet
Zone 2 Volume (EURV - Zone 1) =	1.131	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.268	acre-feet
Total Detention Basin Volume =	2.917	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 = 1 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)
Micropool	--	0.00	--	--	--	10
	--	0.33	--	--	--	228
	--	0.50	--	--	--	457
	--	1.50	--	--	--	7,423
	--	2.50	--	--	--	20,206
	--	3.50	--	--	--	28,371
	--	4.50	--	--	--	33,351
	--	5.50	--	--	--	37,998
	--	6.50	--	--	--	41,980
	--	7.50	--	--	--	46,012
	--	8.50	--	--	--	50,147
	--	9.50	--	--	--	54,386
	--	10.50	--	--	--	58,728
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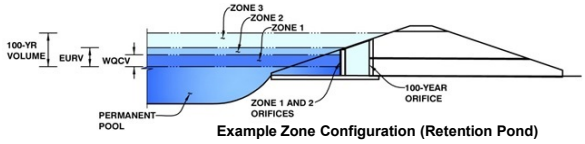
POND 8 - SRF1 ORIGINAL APPROVED DESIGN

STERLING RANCH FILING NOS. 1&2 MDDP (PREVIOUS VERSION)

Detention Basin Outlet Structure Design

Project: STERLING RANCH FILING NO. 1

Basin ID: POND 8



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.73	0.518	Orifice Plate
Zone 2 (EURV)	4.47	1.131	Orifice Plate
Zone 3 (100-year)	5.98	1.268	Weir&Pipe (Restrict)
		2.917	Total

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

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

Calculated Parameters for Underdrain

Underdrain Orifice Area =	N/A	ft^2
Underdrain Orifice Centroid =	N/A	feet

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	4.47	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	16.80	inches
Orifice Plate: Orifice Area per Row =	N/A	inches

Calculated Parameters for Plate

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

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.49	2.98					
Orifice Area (sq. inches)	2.49	2.49	5.50					

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

Calculated Parameters for Vertical Orifice

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

User Input: Overflow Weir (Dropbox) and Grate (Flat or Sloped)

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	4.47	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	9.00	N/A	feet
Overflow Weir Slope =	4.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	2.91	N/A	feet
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	5.20	N/A	feet
Over Flow Weir Slope Length =	3.00	N/A	feet
Grate Open Area / 100-yr Orifice Area =	4.90	N/A	should be ≥ 4
Overflow Grate Open Area w/o Debris =	18.90	N/A	ft^2
Overflow Grate Open Area w/ Debris =	9.45	N/A	ft^2

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 Pipe Diameter =	30.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	22.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	3.86	N/A	ft^2
Outlet Orifice Centroid =	1.02	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	2.06	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	7.00	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	38.00	feet
Spillway End Slopes =	10.00	H:V
Freeboard above Max Water Surface =	2.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	0.88	feet
Stage at Top of Freeboard =	9.88	feet
Basin Area at Top of Freeboard =	1.29	acres

Routed Hydrograph Results

Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	6.53
Calculated Runoff Volume (acre-ft) =	0.518	1.650	1.376	2.078	2.666	3.486	4.171	4.951	13.638
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.519	1.650	1.376	2.080	2.667	3.489	4.174	4.948	13.639
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.20	0.40	0.91	1.18	1.50	2.12
Predevelopment Peak Q (cfs) =	0.0	0.0	0.4	5.9	11.7	26.4	34.1	43.4	61.3
Peak Inflow Q (cfs) =	11.8	37.3	31.2	47.0	60.4	79.3	95.1	112.8	310.3
Peak Outflow Q (cfs) =	0.2	0.5	0.5	2.9	9.9	21.2	31.0	41.7	231.9
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.5	0.8	0.8	0.9	1.0	3.8
Structure Controlling Flow =	Plate	Plate	Plate	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.1	0.5	1.1	1.6	2.2	2.6
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	69	63	71	69	66	65	63	46
Time to Drain 99% of Inflow Volume (hours) =	**40**	73	68	76	76	75	74	73	64
Maximum Ponding Depth (ft) =	2.66	4.37	4.01	4.74	5.11	5.49	5.76	6.05	8.18
Area at Maximum Ponding Depth (acres) =	0.49	0.75	0.71	0.79	0.83	0.87	0.90	0.92	1.12
Maximum Volume Stored (acre-ft) =	0.482	1.577	1.307	1.863	2.154	2.477	2.716	2.988	5.152

FINAL DRAINAGE REPORT FOR HOMESTEAD AT STERLING RANCH FILING NO. 1

EL PASO COUNTY, COLORADO

July 2018

Prepared for:

SR Land, LLC
20 Boulder Crescent, Suite 210
Colorado Springs, CO 80903

Prepared by:

CIVIL CONSULTANTS, INC.
20 Boulder Crescent, Suite 110
Colorado Springs, CO 80903
(719) 955-5485

Project #09-005
DSD Project # SF-17-025

FINAL DRAINAGE REPORT FOR
HOMESTEAD AT STERLING RANCH FILING NO. 1

DRAINAGE PLAN STATEMENTS

ENGINEERS STATEMENT

The attached drainage plan and report was prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the County for drainage reports and said report is in conformity with the master plan of the drainage basin.

Virgil A. Sanchez, P.E. #37160
For and on Behalf of M&S Civil Consultants, Inc

DEVELOPER'S STATEMENT

I, the developer have read and will comply with all the requirements specified in this drainage report and plan.

BY: _____
James F Morley

TITLE: MANAGER
DATE: 10/24/18

ADDRESS: SR Land, LLC
20 Boulder Crescent, Suite 210
Colorado Springs, CO 80903

EL PASO COUNTY'S STATEMENT

Filed in accordance with the requirements of El Paso County Land Development Code, Drainage Criteria Manual Volumes 1 and 2, and the Engineering Criteria Manual, as amended.

Approved
by Elizabeth Nijkamp
El Paso County Planning and Community Development
on behalf of Jennifer Irvine, County Engineer, ECM Administrator
11/21/2018 1:30:34 PM

BY: _____ DATE: _____
Jennifer Irvine, P.E.
County Engineer / ECM Administrator

DP5, (**Aka DP5***) 0.80 acres, consists of 0.61 acres proposed backyards of residential lots (Basin G) that have assigned runoff coefficients of 0.22 for the 5-year and 0.46 for the 100-year, as well 0.19 acres of Dines Boulevard (Basin H) with runoff coefficients of 0.90 for the 5-year and 0.96 for the 100-year as well as flow by from DP4. Developed runoff of 4.2 and 19.7 cfs has been calculated to reach DP5 in the two events respectively. An existing 15' CDOT type R at-grade inlet at. DP5 will intercept flows of Q5=4.2 cfs and Q100=14.7 cfs. These flows are equivalent to the flows documented in the MDDPSR report (Q5=4.2 cfs and Q100=19.7 cfs). An existing 36" RCP will carry the collected runoff under existing Dines Boulevard towards DP6, while flow-by from DP5 will continue south within Dines Boulevard.

DP6, (**Aka DP5***) 4.68 acres, consists backyards of residential lots of 0.43 and 0.61 acres in size (Basins OS3 and OS4) that have been assigned runoff coefficients of 0.22 for the 5-year and 0.46 for the 100-year events and 2.1 acre portion of Wheatland Drive and 1.54 acre portion of Dines Boulevard, both with assigned runoff coefficients of 0.90 for the 5-year and 0.96 for the 100-year events. Developed runoff of Q5=14.1 cfs and Q100=26.7 cfs has been calculated to reach DP6. An existing 15' CDOT type R at-grade inlet. These flows are equivalent to the flows documented in the MDDPSR report (Q5=14.1 cfs and Q100=26.7 cfs). Flow-by from DP6 will continue south within Dines Boulevard.

DP7, (**Aka DP9***) 9.73 acres, consists of proposed residential lots of the planned development located east of the subject site (Basin 0S-6) that have been assigned runoff coefficients of 0.38 for the 5-year and 0.55 for the 100-year events. Developed runoff of Q5=12.6 cfs and Q100=30.5 cfs has been calculated to reach DP7. An existing 30" RCP will convey runoff to existing FSD Pond 4. The flows in PR7 are approximately equivalent to the flows documented in the MDDPSR report of Q5=12.5 cfs and Q100=30.4 cfs.

DP8,(**Aka DP10***) 1.97 acres, consists of Basin S (Existing FSD Pond 4) with runoff coefficients of 0.08 for the 5-year and 0.35 for the 100-year and runoff from PR4, PR6 and PR7. Based upon this drainage analysis the total combined developed runoff to reach DP10 at the existing pond will be Q5=49.2 cfs and Q100=105.39 cfs for the 5 and 100 year events respectively, which varies just slightly from the MDDPSR flows of Q5=50.0 cfs and Q100=102.9 cfs that the facility was designed for.

The existing privately maintained facility, as constructed, continues to provide full spectrum detention and water quality for the calculated runoff as planned. The pond will continue to treat approx 27.63 acres, and provide 0.46 ac-ft of water quality storage and 2.915 ac-ft of 100-year storage (refer to UD-Detention worksheet in appendix of this report). According to the updated UD detention worksheet, the slight inflow increase in results in only an increase in the ponding elevation of 0.03'and an increase of 0.6 cfs being released from the pond when compared to the initial design worksheets. Despite the minor increase the pond continues to meet the required drain times and pre-developed flow release rates as necessary with no negative impacts to downstream facilities.

In the event of clogging or total inlet failure, flows at DP8 will over top the existing emergency spillway and outfall into Sand Creek. The existing detention pond will be private and shall be maintained by the Sterling Ranch Metropolitan District (SRMD). Access has been granted to the SRMD and El Paso County for access and maintenance of the private detention pond.

DP9,(**Aka DP10***) 3.01 acres, consists of 2.71 acres of existing low density residential (Basin OS1A) that have assigned runoff coefficients of 0.08 for the 5-year and 0.35 for the 100-year and 0.31 acres of existing

bottom of the rundown provides to dissipate energy and prevent local scour. Runoff is conveyed southerly in an existing earthen swale that leads to existing Detention Pond W-9.

DP14 (Aka DP61*), 4.03 acres, consists 1.15 acres of rear residential lots with runoff coefficients of 0.22 for the 5-year and 0.46 for the 100-year and 1.60 acres of landscape area and an existing FSD pond (Basin M2) that has been assigned runoff coefficients of 0.08 for the 5-year and 0.35 for the 100-year and 2.04 acres of the eastern half of existing Vollmer Road and adjacent landscaped areas, which have been assigned runoff coefficients of 0.63 and 0.76 for the 5 and 100 year events respectively as well as flows from DP13. Runoff reaching the existing pond at DP 14 is calculated to be Q5=8.9 cfs and Q100=21.2 cfs, which matches the MDDPSR flows of Q5=8.9 cfs and Q100=21.2 cfs that the facility was designed for.

The existing facility functions to provide full spectrum detention and water quality for runoff calculated to reach DP14. The existing pond will treat approx 5.87 acres, and provide 0.092 ac-ft of water quality storage and 0.638 ac-ft of 100-year storage. As described within the MDDPSR the detention facility is private and shall be maintained by the Sterling Ranch Metropolitan District. Access shall be granted to the owner and El Paso County for access and maintenance of the private detention pond. In the event of clogging or total inlet failure, flows at DP14 will over top the emergency spillway and outfall into a proposed swale which will route flows to an existing Vollmer Road side swale. The peak release rates from Pond W-9 (PR13, Q5=0.6 cfs and Q100=8.7 cfs) are conveyed within an existing 18" RCP to and existing 30” RCP ((PR14) (Q5=7.6 cfs and Q100=47.2 cfs)). These flows will be combine with flows from PR12 and be routed east, within the Homestead Sterling Ranch Filing No. 1 subdivision, via a 54” RCP, PR15 (Q5=23.8 cfs and Q100=164.1 cfs). These flows will combine with flows from PR16 (Q5=2.8 cfs and Q100=36.8 cfs, release rate Pond 4) and be routed south via a 60” RCP, PR12 (Q5=26.6 cfs and Q100=200.9 cfs). These flows are nearly equivalent to the SRMDDP runoff rates of (Q5=26.5 cfs and Q100=200.3 cfs) which the pipe was designed. The collected runoff will outfall into an existing low tailwater riprap basin at Sand Creek.

Basin N 2.08 acres, consists of proposed residential backyard lots and part of Tract L located along the south boundary of Homestead at Sterling Ranch Filing No. 1 with runoff coefficients of 0.22 for the 5-year and 0.46 for the 100-year. Developed runoff of Q5=1.6 cfs and Q100=5.7 cfs have been calculated for the basin. Runoff from the proposed residential backyard lots will flow to an existing swale that falls along the east boundary of the Barbarick Subdivision. Basin N was part of a larger Basin YY* that was as discussed in the MDDPSR. The limited developed flows from Basin N that are discharged to the south are considerably less than the historic flows previously directed toward the Barbarick subdivision as can be seen by noting Basin EX-3A in the Sterling Ranch MDDP Existing Conditions Map. As the backyards are typically permeable, and roof drainage from the back of the house shall be directed to the front of the lot water quality treatment will be addressed in the paragraph below.

The flows generated by Basin N and Tract L will be routed south via overlot grading and swales to a temporary sediment basin (future Pond W-5), at the south end of the Sterling Ranch Development. Upon development of the Sterling Ranch Filing No. 2 infrastructure Pond W-5 will be constructed and flows from Basin N and Tract L will be treated as WQCV and Full Spectrum Detention. As such the proposed develop shall not adversely affect the downstream infrastructure.

Basin O 0.57 acres, consists of planned residential backyard lots located along the south boundary of Homestead at Sterling Ranch Filing No. 1 that have been assigned runoff coefficients of 0.22 for the 5-year and 0.46 for the 100-year storm events. Developed runoff of, Q5=0.5 cfs and Q100=1.8 cfs is anticipated to be produced by the basin. Runoff from the proposed residential backyard lots will sheet flows towards the planned Branding Iron at Sterling Ranch Filing No. 1 as discussed in the MDDPSR. Basin O was part of a larger Basin GG* in the MDDPSR. Runoff from basin O and the flow-by from DP1, 2, 5 and 6 will be collected within existing system within existing Dines Boulevard and detained and released at pre-developed flow rates from FSD Pond 4. Refer to Branding Iron at Sterling Ranch filing No.1 FDR for additional information.

DETENTION PONDS

Water Quality/Full Spectrum Detention Facilities

As discussed in the detained drainage summary, developed runoff from Homestead at Sterling Ranch Filing No. 1 is conveyed to existing Full Spectrum Detention Ponds No 4, 8 and W-9 in accordance with the Sterling Ranch Filing Nos. 1&2 MDDP. Based upon the provided analysis the ponds are adequate to serve their intended purpose and require no modification. This is because this final drainage report and the SR Filing 1 and 2 MDDP were nearly concurrent. Thus the larger scale concept planning was very finite and thus allowed for the developed flow rates to align between the two documents and thereby not requiring modifications to facility which is often common between conceptual and final design. The information provided in this report regarding Ponds 8 and W-9 shall supersede the information presented in the MDDP and should be re-referenced with future design.

The flows generated by Basin N and Tract L will be routed south via overlot grading and vegetated swales to a temporary sediment basin (future Pond W-5), at the south end of the Sterling Ranch Development. Upon development of the Sterling Ranch Filing No. 2 infrastructure Pond W-5 will be constructed and flows from Basin N and Tract L will be treated as WQCV (see WQCV deviation request) and Full Spectrum Detention. As such the proposed develop shall not adversely affect the downstream infrastructure.

EROSION CONTROL

It is the policy of the El Paso County that a grading and erosion control plan be submitted with the drainage report. EPC approved "Early Grading Plan for Sterling Ranch Phase I Onsite Grading & Erosion Control", November 18, 2015. And "Early Grading Plan for Sterling Ranch Phase I Offsite Grading & Erosion Control", December 3, 2015. Grading and Erosion control operations are currently underway (August 2016). Grading and Erosion Control will cease with the final development of the site in the next 12-36 months.

CONSTRUCTION COST OPINION – HOMESTEAD AT STERLING RANCH FILING NO. 1

Drainage Facilities:

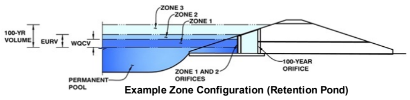
Minor improvements with the development of Homestead at Sterling Ranch Filing No. 1 are listed below. The majority of the infrastructure construction costs have been accounted for in the "Master Development

POND 4 - SRF1 ORIGINAL APPROVED DESIGN

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

Project: STERLING RANCH FILING NO. 1

Basin ID: POND 4



Example Zone Configuration (Retention Pond)

Depth Increment = 1 ft

Required Volume Calculation

Selected BMP Type =	EDB			
Watershed Area =	27.63	acres		
Watershed Length =	1,720	ft		
Watershed Slope =	0.030	ft/ft		
Watershed Imperviousness =	53.00%	percent		
Percentage Hydrologic Soil Group A =	0.0%	percent		
Percentage Hydrologic Soil Group B =	100.0%	percent		
Percentage Hydrologic Soil Groups C/D =	0.0%	percent		
Desired WQCV Drain Time =	40.0	hours		
Location for 1-hr Rainfall Depths =	User Input			
Water Quality Capture Volume (WQCV) =	0.494	acre-feet	Optional User Input 1-hr Precipitation	
Excess Urban Runoff Volume (EURV) =	1.573	acre-feet		
2-yr Runoff Volume (P1 = 1.19 in.) =	1.312	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	1.981	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	2.542	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	3.324	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	3.977	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	4.720	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 6.53 in.) =	13.003	acre-feet	6.53	inches
Approximate 2-yr Detention Volume =	1.241	acre-feet		
Approximate 5-yr Detention Volume =	1.821	acre-feet		
Approximate 10-yr Detention Volume =	1.991	acre-feet		
Approximate 25-yr Detention Volume =	2.082	acre-feet		
Approximate 50-yr Detention Volume =	2.317	acre-feet		
Approximate 100-yr Detention Volume =	2.781	acre-feet		

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.494	acre-feet
Zone 2 Volume (EURV - Zone 1) =	1.079	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.209	acre-feet
Total Detention Basin Volume =	2.781	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

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)
Micropool	--	0.00	--	--	--	10	0.000		
	--	0.33	--	--	--	406	0.009	65	0.001
	--	1.00	--	--	--	2,912	0.067	1,151	0.026
	--	3.00	--	--	--	12,934	0.297	17,026	0.391
	--	5.00	--	--	--	27,336	0.628	57,296	1.315
	--	7.00	--	--	--	52,589	1.207	137,221	3.150
	--	9.00	--	--	--	57,186	1.313	246,996	5.670
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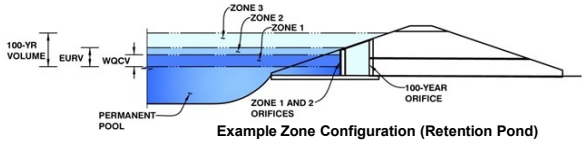
POND 4 - SRF1 ORIGINAL APPROVED DESIGN

Detention Basin Outlet Structure Design

Project: STERLING RANCH FILING NO. 1

Basin ID: POND 4



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.32	0.494	Orifice Plate
Zone 2 (EURV)	5.38	1.079	Orifice Plate
Zone 3 (100-year)	6.69	1.209	Weir&Pipe (Restrict)
		2.781	Total

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

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

Calculated Parameters for Underdrain

Underdrain Orifice Area =	N/A	ft^2
Underdrain Orifice Centroid =	N/A	feet

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	5.37	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	19.40	inches
Orifice Plate: Orifice Area per Row =	N/A	inches

Calculated Parameters for Plate

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

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.79	3.58					
Orifice Area (sq. inches)	2.33	2.33	2.60					

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

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice

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

User Input: Overflow Weir (Dropbox) and Grate (Flat or Sloped)

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	5.37	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	9.00	N/A	feet
Overflow Weir Slope =	4.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	2.91	N/A	feet
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	6.10	N/A	feet
Over Flow Weir Slope Length =	3.00	N/A	feet
Grate Open Area / 100-yr Orifice Area =	4.06	N/A	should be ≥ 4
Overflow Grate Open Area w/o Debris =	18.90	N/A	ft^2
Overflow Grate Open Area w/ Debris =	9.45	N/A	ft^2

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 Pipe Diameter =	30.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	27.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	4.65	N/A	ft^2
Outlet Orifice Centroid =	1.19	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	2.50	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	7.33	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	34.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

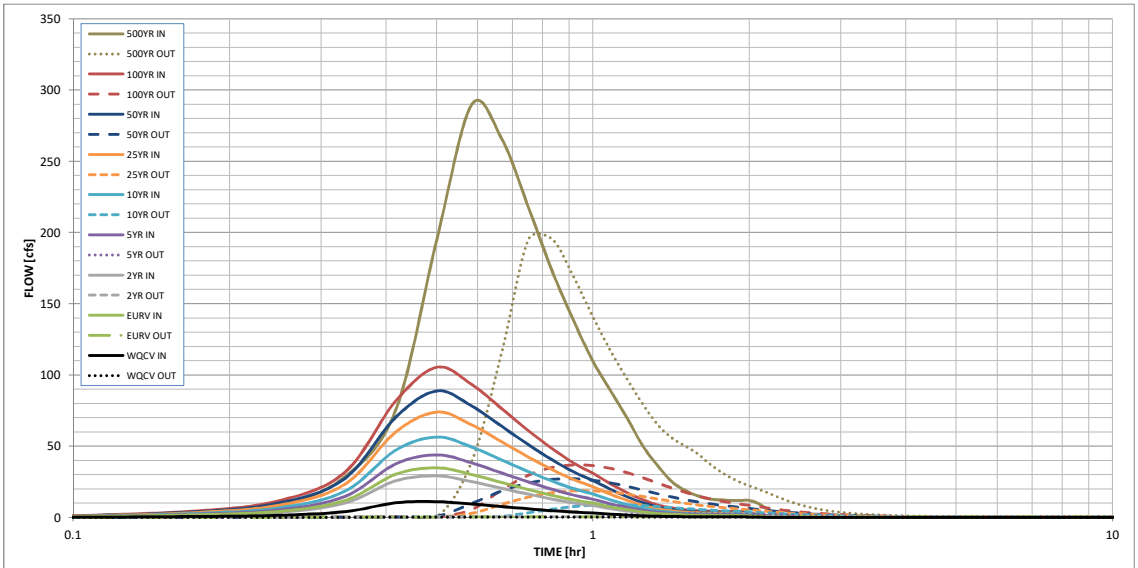
Spillway Design Flow Depth=	0.94	feet
Stage at Top of Freeboard =	9.27	feet
Basin Area at Top of Freeboard =	1.31	acres

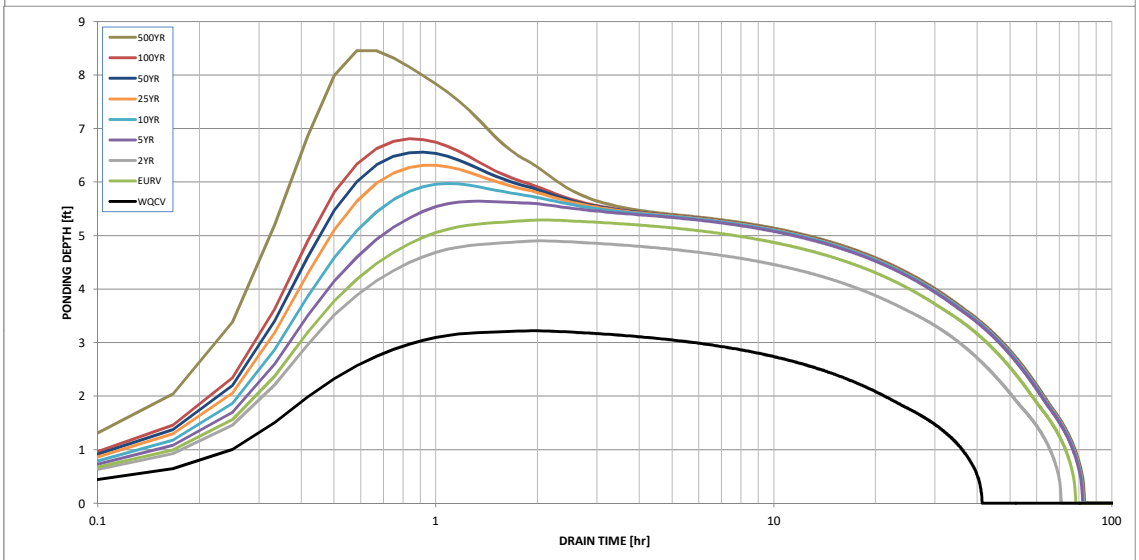
Routed Hydrograph Results

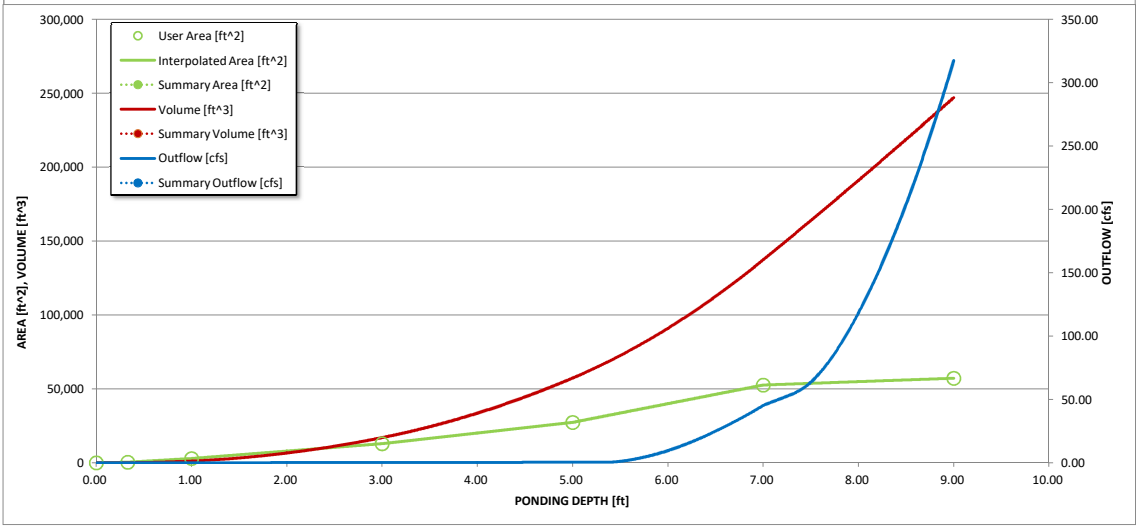
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	6.53
Calculated Runoff Volume (acre-ft) =	0.494	1.573	1.312	1.981	2.542	3.324	3.977	4.720	13.003
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.494	1.573	1.312	1.982	2.543	3.326	3.980	4.723	13.012
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.20	0.40	0.90	1.16	1.48	2.09
Predevelopment Peak Q (cfs) =	0.0	0.0	0.4	5.5	11.0	24.8	32.1	40.9	57.7
Peak Inflow Q (cfs) =	11.0	34.8	29.1	43.8	56.3	73.9	88.6	105.3	289.7
Peak Outflow Q (cfs) =	0.2	0.4	0.4	2.8	9.0	18.6	27.1	36.8	195.3
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.5	0.8	0.7	0.8	0.9	3.4
Structure Controlling Flow =	Plate	Plate	Plate	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.1	0.4	1.0	1.4	1.9	3.2
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	70	64	72	70	68	66	64	48
Time to Drain 99% of Inflow Volume (hours) =	**40**	75	68	78	77	76	76	75	65
Maximum Ponding Depth (ft) =	3.22	5.29	4.90	5.64	5.97	6.32	6.56	6.81	8.46
Area at Maximum Ponding Depth (acres) =	0.33	0.71	0.61	0.81	0.91	1.01	1.08	1.15	1.28
Maximum Volume Stored (acre-ft) =	0.460	1.510	1.253	1.776	2.060	2.386	2.647	2.915	4.956

POND 4 - SRF1 ORIGINAL APPROVED DESIGN

Detention Basin Outlet Structure Design







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

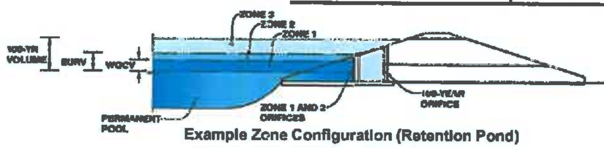
SF W-9 - SRF1 ORIGINAL APPROVED DESIGN

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: Pond W-9 Sterling Ranch Filing No. 1 MDDP

Basin ID: East Vollmer Road - 3:1 Pond slope



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	SF	
Watershed Area =	5.87	acres
Watershed Length =	565	ft
Watershed Slope =	0.024	ft/ft
Watershed Imperviousness =	70.00%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	100.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Desired WQCV Drain Time =	12.0	hours
Location for 1-hr Rainfall Depths =	User Input	
Water Quality Capture Volume (WQCV) =	0.108	acre-feet
Excess Urban Runoff Volume (EURV) =	0.451	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.376	acre-feet
5-yr Runoff Volume (P1 = 1.5 in.) =	0.500	acre-feet
10-yr Runoff Volume (P1 = 1.75 in.) =	0.634	acre-feet
25-yr Runoff Volume (P1 = 2 in.) =	0.799	acre-feet
50-yr Runoff Volume (P1 = 2.25 in.) =	0.922	acre-feet
100-yr Runoff Volume (P1 = 2.52 in.) =	1.083	acre-feet
500-yr Runoff Volume (P1 = 0 in.) =	0.000	acre-feet
Approximate 2-yr Detention Volume =	0.353	acre-feet
Approximate 5-yr Detention Volume =	0.470	acre-feet
Approximate 10-yr Detention Volume =	0.593	acre-feet
Approximate 25-yr Detention Volume =	0.637	acre-feet
Approximate 50-yr Detention Volume =	0.663	acre-feet
Approximate 100-yr Detention Volume =	0.710	acre-feet

Optional User Override 1-hr Precipitation

1.19	inches
1.50	inches
1.75	inches
2.00	inches
2.25	inches
2.52	inches
	inches

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.108	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.344	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.259	acre-feet
Total Detention Basin Volume =	0.710	acre-feet
Initial Surcharge Volume (ISV) =	N/A	ft^3
Initial Surcharge Depth (ISD) =	N/A	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	N/A	ft
Slope of Trickle Channel (S_{TC}) =	N/A	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	

Depth Increment = 0.5 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)
7086	Media Surface	--	0.00	--	--	--	6,035	0.139		
7087		--	1.00	--	--	--	8,554	0.196	7,209	0.165
7088		--	2.00	--	--	--	11,312	0.260	17,115	0.393
7089		--	3.00	--	--	--	14,295	0.328	30,031	0.689
7090		--	4.00	--	--	--	17,480	0.401	45,918	1.054
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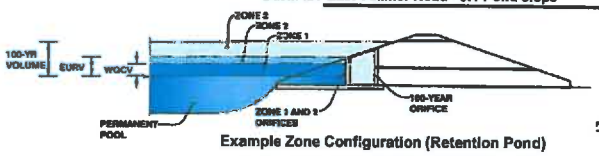
SF W-9 - SRF1 ORIGINAL APPROVED DESIGN

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: Pond W-9 Sterling Ranch Filing No.1 MDDP

Basin ID: East Vollmer Road - 3:1 Pond slope



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.69	0.108	Filtration Media
Zone 2 (EURV)	2.21	0.344	Circular Orifice
Zone 3 (100-year)	3.07	0.259	Weir&Pipe (Restrict)
		0.710	Total

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

Underdrain Orifice Invert Depth =	3.30	ft (distance below the filtration media surface)
Underdrain Orifice Diameter =	1.49	inches

Calculated Parameters for Underdrain

Underdrain Orifice Area =	0.0	ft^2
Underdrain Orifice Centroid =	0.06	feet

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

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

Calculated Parameters for Plate

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

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

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

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

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Circular	Not Selected	
Invert of Vertical Orifice =	0.69	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	2.21	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	3.92	N/A	inches

Calculated Parameters for Vertical Orifice

	Zone 2 Circular	Not Selected	
Vertical Orifice Area =	0.08	N/A	ft^2
Vertical Orifice Centroid =	0.16	N/A	feet

User Input: Overflow Weir (Dropbox) and Grate (Flat or Sloped)

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	2.21	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	2.91	N/A	feet
Overflow Weir Slope =	0.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	2.91	N/A	feet
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	2.21	N/A	feet
Over Flow Weir Slope Length =	2.91	N/A	feet
Grate Open Area / 100-yr Orifice Area =	7.94	N/A	should be ≥ 4
Overflow Grate Open Area w/o Debris =	5.93	N/A	ft^2
Overflow Grate Open Area w/ Debris =	2.96	N/A	ft^2

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 =	3.55	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	18.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	7.90		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	0.75	N/A	ft^2
Outlet Orifice Centroid =	0.38	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	1.45	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	3.08	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	12.00	feet
Spillway End Slopes =	3.00	H:V
Freeboard above Max Water Surface =	0.67	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	0.64	feet
Stage at Top of Freeboard =	4.39	feet
Basin Area at Top of Freeboard =	0.40	acres

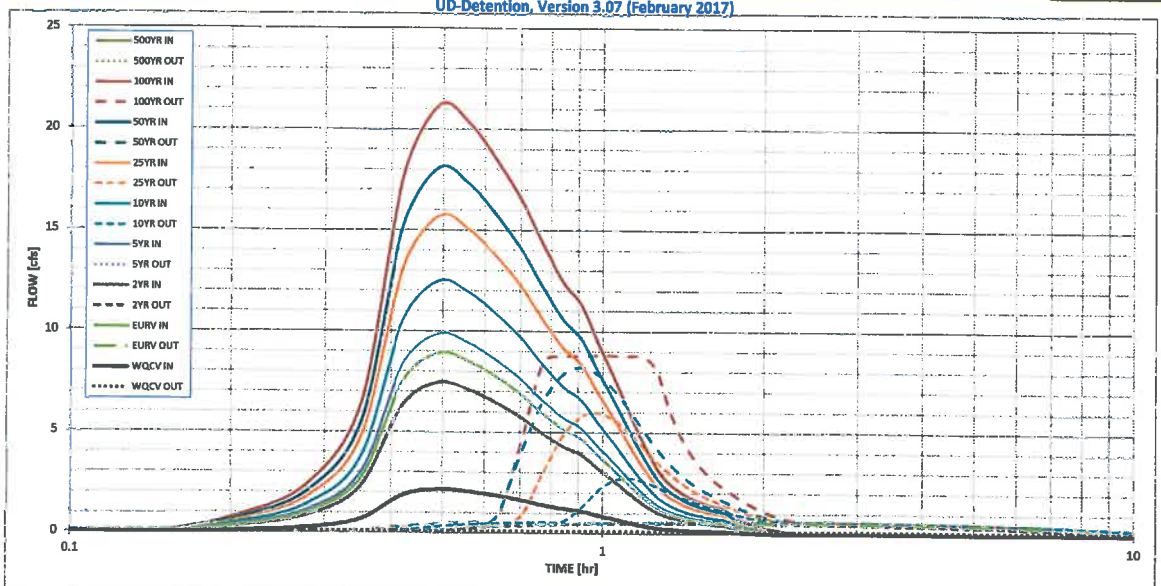
Routed Hydrograph Results

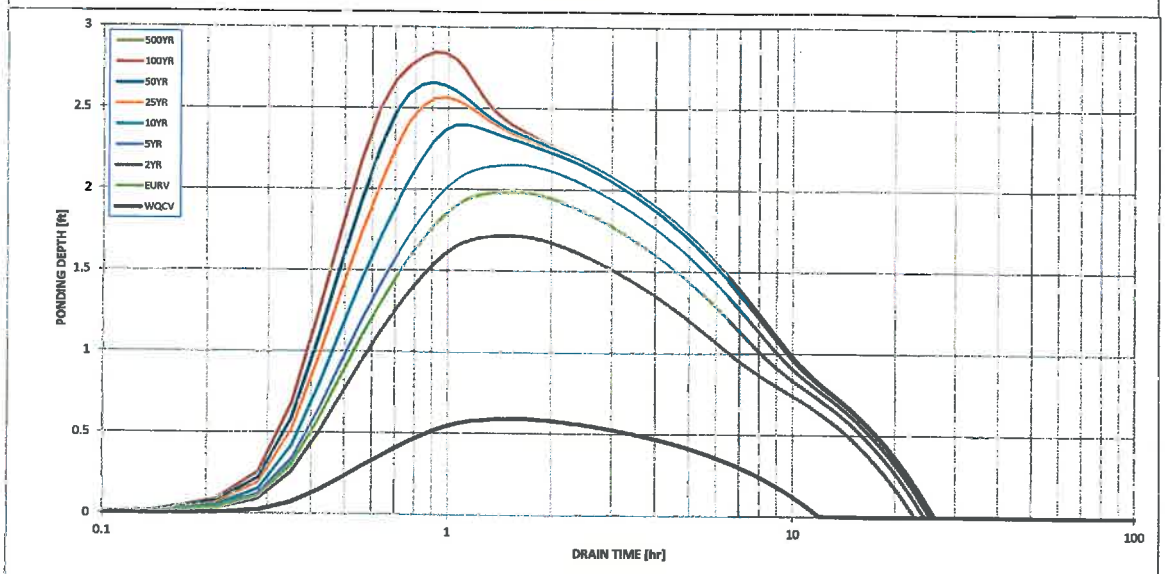
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	0.00
Calculated Runoff Volume (acre-ft) =	0.108	0.451	0.376	0.500	0.634	0.799	0.922	1.083	0.000
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.107	0.451	0.375	0.500	0.634	0.799	0.922	1.082	#N/A
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.02	0.03	0.26	0.82	1.13	1.51	0.00
Predevelopment Peak Q (cfs) =	0.0	0.0	0.1	0.2	1.5	4.8	6.6	8.8	0.0
Peak Inflow Q (cfs) =	2.2	8.9	7.4	9.9	12.5	15.7	18.1	21.2	#N/A
Peak Outflow Q (cfs) =	0.1	0.6	0.5	0.6	2.8	6.0	8.2	8.8	#N/A
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	3.9	1.8	1.2	1.2	1.0	#N/A
Structure Controlling Flow =	Filtration Media	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Outlet Plate 1	#N/A
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.4	0.9	1.3	1.4	#N/A
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	#N/A
Time to Drain 97% of Inflow Volume (hours) =	12	23	22	24	24	23	23	23	#N/A
Time to Drain 99% of Inflow Volume (hours) =	12	24	23	25	25	25	25	25	#N/A
Maximum Ponding Depth (ft) =	0.59	1.99	1.72	2.16	2.40	2.56	2.66	2.84	#N/A
Area at Maximum Ponding Depth (acres) =	0.17	0.26	0.24	0.27	0.29	0.30	0.30	0.32	#N/A
Maximum Volume Stored (acre-ft) =	0.092	0.390	0.323	0.435	0.505	0.552	0.579	0.638	#N/A

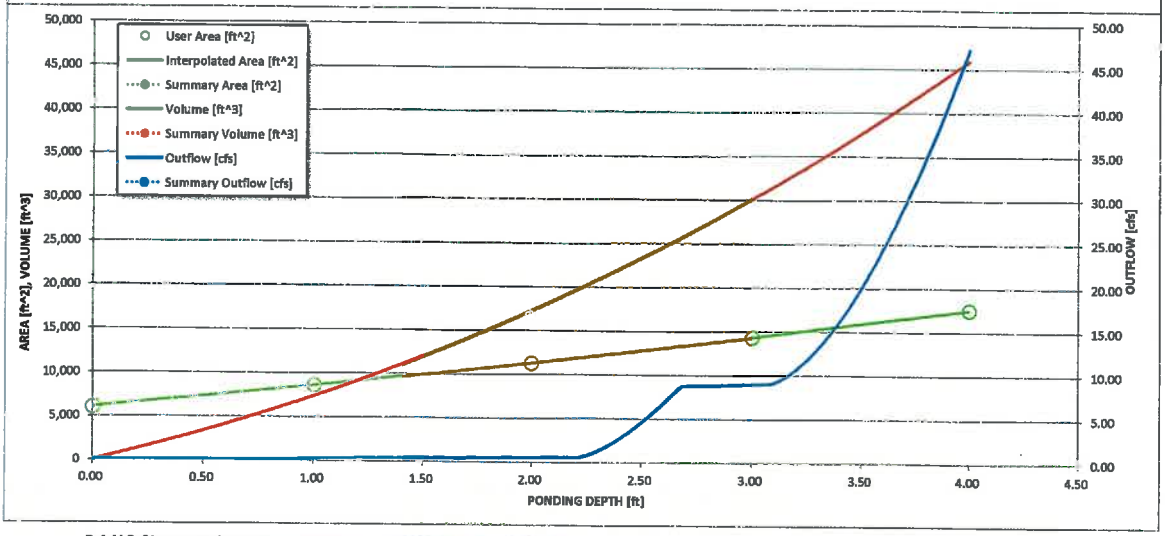
SF W-9 - SRF1 ORIGINAL APPROVED DESIGN

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)







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