ADDENDUM TO THE
FINAL DRAINAGE REPORT
FOR
HOMESTEAD AT STERLING RANCH FILING NO. 2

EPCD File No. SF-19-004 /CDR-20-012

Prepared For:

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

Engineering Review
10/26/2020 8:53:21 AM
dsdrice
JeffRice@elpasoco.com
(719) 520-7877
EPC Planning & Community Development Department

See comment letter also.

August 18, 2020
Project No. 25188.00

Prepared By:
JR Engineering, LLC
5475 Tech Center Drive, Suite 235
Colorado Springs, CO 80919
719-593-2593

J·R ENGINEERING

ADDENDUM TO THE FINAL DRAINAGE REPORT FOR HOMESTEAD AT STERLING RANCH FILING NO. 2

ENGINEER'S STATEMENT:

The attached drainage plan and report were 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 El Paso County for drainage reports and said report is in conformity with the master plan of the drainage basin. I accept responsibility for any liability caused by any negligent acts, errors, or omissions on my part in preparing this report.

_____

Mike Bramlett, Colorado P.E. # 32314
For and On Behalf of JR Engineering, LLC

DEVELOPER'S STATEMENT:

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

Business Name: SR Land, LLC

By: _____

Title: _____

Address: 20 Boulder Crescent, Suite 210
Colorado Springs, CO 80903

El Paso County:

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

_____ _____

Jennifer Irvine, P.E. Date
County Engineer/ ECM Administrator

Conditions:

Table of Contents

ADDENDUM TO THE FINAL DRAINAGE REPORT FOR HOMESTEAD AT STERLING RANCH FILING NO. 2

PURPOSE

This document is an Addendum to the Final Drainage Report for Homestead at Sterling Ranch Filing No. 2. The purpose of this report is to update the approved "Final Drainage Report for Homestead at Sterling Ranch Filing No. 2". The scope of the updates included in this addendum are limited to proposed Basins W1, X1, X2, & Y1. More specifically, this Addendum proposes to replace the proposed individual lot Sand Filters for lots 13-24, 28-35, and 36-41 with two common Sand Filters, one to serve basin X1, lots 36-41, and one to serve basins W1, X2, & Y1, lots 13-24 & 28-35.

The text below replaces the original corresponding text from the Final Drainage Report for Homestead at Sterling Ranch Filing No. 2. The revised sections of the original report are marked in the table of contents below, and also crossed out/highlighted in the attached original report. Crossed out text is replaced and highlighted text is modified or discussed further herein.

PROPSED DRAINAGE CHARACTERISTICS

DETAILED DRAINAGE DISCUSSION (DESIGN POINTS)

Are these needed or would a swale with rundown work in this sub-basin?

BASIN X1 (0.78 acres), consists of proposed residential backyards of lots 36-41 along the eastern boundary of the site with runoff coefficients of 0.22 for the 5 year and 0.46 for the 100 year. Runoff in this basin will be directed via backyard swales towards the rear of the lots where it will be collected in a 12" Nyoplast Drain Basin w/ a 12" dome grate placed in the rear southwest corner of each lot. The 12" Nyoplast Drain Basins are sized to collect all flows (Q5 = 0.8 cfs, Q100 = 2.8 cfs) in both the 5 and 100 year storms. Collected flows will then be piped to a proposed full-spectrum sand filter, with a 12-hour drain time and a 4" perforated underdrain. The treated flows from the sand filter will be discharged via an outlet structure to the adjacent Sand Creek.

BASIN X2 (1.04 acres), consists of proposed residential backyards of lots 28-35 along the southern boundary of the site with runoff coefficients of 0.22 for the 5 year and 0.46 for the 100 year. Runoff in this basin will be directed via backyard swales towards the rear of the lots where it will be collected in a 12" Nyoplast Drain Basin w/ a 12" dome grate placed in the rear southwest corner of each lot (DP2). The 12" Nyoplast Drain Basins are sized to collect all flows (Q5 = 1.1 cfs, Q100 = 3.7 cfs) in both the 5 and 100 year storms. Collected flows will then be piped west via 12" HDPE pipe following the rear lot lines towards DP3.1, where flows in the pipe combine with collected flows from Basin W1.

BASIN W1 (0.86 acres), consists of proposed residential backyards of lots 19-24 along the southeastern boundary of the site with runoff coefficients of 0.22 for the 5 year and 0.46 for the 100 year. Runoff in this basin will be directed via backyard swales towards the rear of the lots where it

will be collected in a 12" Nyoplast Drain Basin w/ a 12" dome grate placed in the rear corner of each lot (DP3). The 12" Nyoplast Drain Basins are sized to collect all flows (Q5 = 0.9 cfs, Q100 = 3.1 cfs) in both the 5 and 100 year storms. Collected flows will then be piped southwest via 12" HDPE pipe following the rear lot lines towards DP3.1, where flows in the pipe combine with collected flows from Basin X2 (Q5 = 1.5 cfs, Q100 = 5.5 cfs).

Flows in the pipe at DP3.1 are then piped to DP4.1 where they combine with collected flows from Basin Y1 (Q5 = 2.1 cfs, Q100 = 7.5 cfs).

BASIN Y1 (0.84 acres), consists of proposed residential backyards of lots 13-18 along the southeastern boundary of the site with runoff coefficients of 0.22 for the 5 year and 0.46 for the 100 year. Runoff in this basin will be directed via backyard swales towards the rear of the lots where it will be collected in a 12" Nyoplast Drain Basin w/ a 12" dome grate placed in the rear corner of each lot (DP4). The 12" Nyoplast Drain Basins are sized to collect all flows (Q5 = 0.8 cfs, Q100 = 3.0 cfs) in both the 5 and 100 year storms. Collected flows will then be piped southwest via 12" HDPE pipe following the rear lot lines to a proposed full spectrum sand filter at DP4.1, where flows combine with collected flows from Basin X2 and W1 (Q5 = 2.1 cfs, Q100 = 7.5 cfs).

The basin characteristics, hydrologic parameters, runoff and rational calcs for Basins X1, X2, W1, and Y1 have remained consistent with the approved Final Drainage Report for Homestead at Sterling Ranch Filing No. 2. However, the routing of the basins has changed and therefore revised SF-3 forms are included in the appendix section of this report. A revised basin map, showing the changes within the above described basins is also attached to this report.

WATER QUALITY PROVISIONS

Runoff produced within the residential backyard lots, of Basin X1 will be conveyed in backyard swales, collected in drain basins and directed to a full-spectrum sand filter (sand filter 1). The treated flows will be collected by private storm sewer systems and discharged into the Sand Creek Channel. Sand filter basin 1 is designed to provide 0.01 ac-ft of water quality storage (WQCV), 0.025 ac-feet of excess urban runoff volume (EURV) and 0.03 ac-ft of 100-year storage for a total design volume of 0.065 ac-ft. Sand filter basin 1 was designed to have a 12 hour WQCV drain time and a peak outflow for the 100 year design storm of 0.3 cfs. The sand filter will outfall via an orifice controlled 12" HDPE pipe and FES directly to the adjacent Sand Creek channel. Sand filter basin 1 will also include a 4" perforated underdrain system and emergency overflow spillway designed to pass the peak 100-yr flow rate with one foot of freeboard above the design water surface elevation. The peak discharge rate of the proposed sand filter is at or below the historic flows for the basin which it serves.

Runoff produced within the residential backyard lots, of Basins X2, W1, and Y1 will be conveyed in backyard swales, collected in drain basins and directed to a full-spectrum sand filter (sand filter 2). The treated flows will be collected by private storm sewer systems and discharged, ultimately, into

the Sand Creek Channel. The sand filter will outfall via an orifice controlled 12" HDPE pipe that is directly connected to the existing 60" RCP storm sewer outfall pipe of existing "Pond 4".

Sand filter basin 2 is designed to provide 0.035 ac-ft of water quality storage (WQCV), 0.095 ac-feet of excess urban runoff volume (EURV) and 0.107 ac-ft of 100-year storage for a total design volume of 0.238 ac-ft. Sand filter basin 2 was designed to have a 12 hour WQCV drain time and a peak outflow for the 100 year design storm of 1.8 cfs. The sand filter will outfall via an orifice controlled 12" HDPE pipe directly connected to the existing 60" RCP pipe to the south that serves as the outfall to "Pond 4" constructed with Sterling Ranch Filing No. 1. Sand filter basin 2 will also include a 4" perforated underdrain system and emergency overflow spillway designed to pass the peak 100-yr flow rate with one foot of freeboard above the design water surface elevation. The peak discharge rate of the proposed sand filter is at or below the historic flows for the basins which it serves.

Both proposed sand filters are contained within existing Tract D, of the Homestead at Sterling Ranch Filing No. 2 development. The proposed sand filter facilities are to be privately maintained by the Sterling Ranch Metropolitan District. Access to maintain these sand filter basins is from the regional trail along sand creek.

The proposed sand filters were sized using the MHFD Detention workbook and printouts are included in the Hydraulic Calculations section of this report.

CONSTRUCTION COST OPINION – HOMESTEAD AT STERLING RANCH FIL. NO. 2

Drainage improvements are planned with the development of Homestead at Sterling Ranch Filing No. 2. A majority of the construction costs have been accounted for in the "Master Development Drainage Report for Sterling Ranch Filing Nos. 1&2, and Final Drainage Report for Sterling Ranch Filing No.1" prepared by MS Civil Consultants, dated April 2017. Any additional improvements and costs are listed below.

The following list of drainage improvements is Non-Reimbursable. The Reimbursable facilities are outlined in the Sterling Ranch Filing No. 1 Final Drainage Report and Sterling Ranch MDDP. Refer to the MDDP for Sterling Ranch Cost and Fee Analysis Report (February 2019).

This was not resubmitted or approved.

Item	Description	Quantity Prev	Quantity Now	Unit	Unit Cost	Cost
1	18" RCP	31	31	LF	$ 40	$ 1,240
2	24" RCP	127	127	LF	$ 50	$ 6,350
3	30" RCP	998	998	LF	$ 85	$ 84,830
4	36" RCP	8	8	LF	$ 105	$ 840
5	42" RCP	699	699	LF	$ 185	$ 129,315
6	24" FES	1	1	EA	$ 750	$ 750
8	42" FES	1	1	EA	$ 1,250	$ 1,250
9	5.0'x4.5' CDOT Type R Sump Inlet	1	1	EA	$ 4,000	$ 4,000
10	10' CDOT Type R Sump Inlet	4	4	EA	$ 4,700	$ 18,800
11	15' CDOT Type R At-Grade Inlet	2	2	EA	$ 6,000	$ 12,000
12	4.0' Type II MH	1	1	EA	$ 3,500	$ 3,500
13	5.0' Type II MH	2	2	EA	$ 4,000	$ 8,000
14	6.0' Type II MH	1	1	EA	$ 4,500	$ 4,500
17	5.0'x6.0' MH	2	2	EA	$ 6,500	$ 13,000
18	5.5'x5.5' MH	1	1	EA	$ 6,500	$ 6,500
19	Headwall/Wingwall	1	1	EA	$ 6,000	$ 6,000
20	Full Spectrum Det. Pond 1	1	1	EA	$ 15,000	$ 15,000
21	FSD Pond 1 Outlet Structure	1	1	EA	$ 12,600	$ 12,600
22	Ind. Lot Sand filter	26	0	EA	$ 2,000	$ -
23	18" Drain basin MH	27	0	EA	$ 1,000	$ -
24	12" Storm pipe	1,658	2,433	LF	$ 26	$ 63,258
25	12" Nyloplast Drain basin w/ 12" dome grate	0	28	EA	$ 1,000	$ 28,000
26	Sand Filter Basin 1	0	1	LS	$ 4,000	$ 4,000
27	Sand Filter Basin 2	0	1	LS	$ 6,000	$ 6,000
28	12" FES	0	4	EA	$ 350	$ 1,400
					TOTAL	**$ 431,133**

REVISED APPENDIX MATERIALS

STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Homestead at Sterling Ranch Filing No. 2
Location: Colorado Springs
Design Storm: 5-Year

Project Name: Homestead at Sterling Ranch Filing No. 2
Project No.: 2000-5188.
Calculated By: REB
Checked By:
Date: 8/18/20

		DIRECT RUNOFF							TOTAL RUNOFF				PIPE				TRAVEL TIME			
STREET	Design Point	Basin ID	Area (Ac)	Runoff Coeff.	t_c (min)	C*A (Ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	REMARKS
	1	X1	0.78	0.22	7.3	0.17	4.60	0.8					0.8	0.17	2.0	18	250	2.6	1.6	Runoff from Basin X1, collected by private 12" Nyoplast Drain Basins, Piped via 12" HDPE to pvt. Full-specrum sand filter @ DP1.1
	2	X2	1.04	0.22	7.3	0.23	4.60	1.1					1.1	0.23	2.0	12	950	3.1	5.1	Runoff from Basin X2, collected by private 12" Nyoplast Drain Basins, Piped via 12" HDPE to DP3.1
	3	W1	0.86	0.22	7.3	0.19	4.60	0.9					0.9	0.19	2.0	12	250	2.8	1.5	Runoff from Basin W1, collected by private 12" Nyoplast Drain Basins, Piped via 12" HDPE to DP3.1
	3.1								13.9	0.42	3.64	1.5								Combined flow in private 12" HDPE pipe @ DP3.1, piped to private full-spectrum sand filter @ DP-4.1
	4	Y1	0.84	0.22	7.3	0.18	4.60	0.8					0.8	0.18	2.0	12	350	3.0	1.9	Runoff from Basin Y1, collected by private 12" Nyoplast Drain Basins, Piped via 12" HDPE to DP4.1
	4.1								15.8	0.60	3.44	2.1								Combined flow in private 12" HDPE pipe @ DP4.1, inflow to proposed private full-spectrum sand filter

Notes:
Street and Pipe C*A values are determined by Q/i using the catchment's intensity value.
All pipes are private and RCP unless otherwise noted. Pipe size shown in table column.

STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Homestead at Sterling Ranch Filing No. 2
Location: Colorado Springs
Design Storm: 100-Year

Project Name: Homestead at Sterling Ranch Filing No. 2
Project No.: 2000-5188.
Calculated By: REB
Checked By:
Date: 8/18/20

Description	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (ac)	Runoff Coeff.	t_c (min)	C*A (ac)	i (in/hr)	Q (cfs)	t_c (min)	C*A (ac)	i (in/hr)	Q (cfs)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	
	1	X1	0.78	0.46	7.3	0.36	7.72	2.8					2.8	0.36	1.5	12	250	3.2	1.3	Runoff from Basin X1, collected by private 12" Nyoplast Drain Basins, Piped via 12" HDPE to pvt. Full-specrum sand filter @ DP1.1
	2	X2	1.04	0.46	7.3	0.48	7.72	3.7					3.7	0.48	1.5	12	950	3.5	4.5	Runoff from Basin X2, collected by private 12" Nyoplast Drain Basins, Piped via 12" HDPE to DP3.1
	3	W1	0.86	0.46	7.3	0.40	7.72	3.1					3.1	0.40	1.5	12	250	3.3	1.2	Runoff from Basin W1, collected by private 12" Nyoplast Drain Basins, Piped via 12" HDPE to DP3.1
	3.1								13.1	0.88	6.26	5.5								Combined flow in private 12" HDPE pipe @ DP3.1, piped to private full-spectrum sand filter @ DP-4.1
	4	Y1	0.84	0.46	7.3	0.39	7.72	3.0					3.0	0.39	1.5	12	350	3.3	1.8	Runoff from Basin Y1, collected by private 12" Nyoplast Drain Basins, Piped via 12" HDPE to DP4.1
	4.1								14.8	1.27	5.94	7.5								Combined flow in private 12" HDPE pipe @ DP4.1, inflow to proposed private full-spectrum sand filter

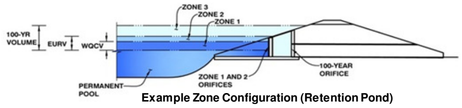
Notes:
Street and Pipe C*A values are determined by Q/i using the catchment's intensity value.
All pipes are private and RCP unless otherwise noted. Pipe size shown in table column.

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.00 (December 2019)

Project: Homestead at Sterling Ranch Filing No. 2

Basin ID: Sand Filter - Basin X1



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**SF**	
Watershed Area =	0.78	acres
Watershed Length =	450	ft
Watershed Length to Centroid =	225	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	42.00%	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
Target WQCV Drain Time =	12.0	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) =	0.010	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.035	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.033	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.049	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.063	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.083	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.099	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	0.119	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	0.160	acre-feet		inches
Approximate 2-yr Detention Volume =	0.026	acre-feet		
Approximate 5-yr Detention Volume =	0.036	acre-feet		
Approximate 10-yr Detention Volume =	0.049	acre-feet		
Approximate 25-yr Detention Volume =	0.054	acre-feet		
Approximate 50-yr Detention Volume =	0.057	acre-feet		
Approximate 100-yr Detention Volume =	0.065	acre-feet		

Define Zones and Basin Geometry

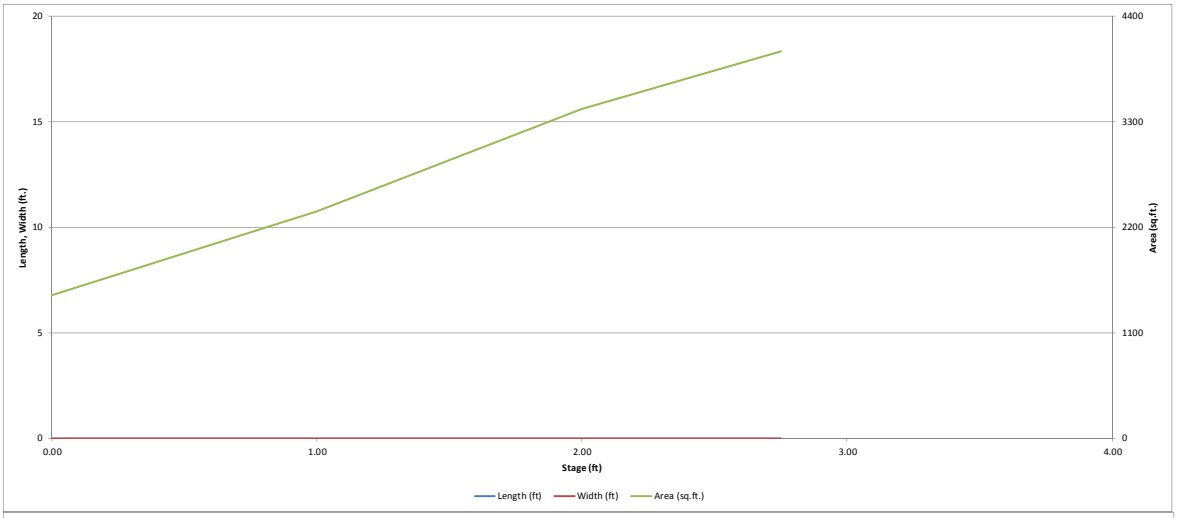
Zone 1 Volume (WQCV) =	0.010	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.025	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.030	acre-feet
Total Detention Basin Volume =	0.065	acre-feet
Initial Surcharge Volume (ISV) =	N/A	ft^3
Initial Surcharge Depth (ISD) =	N/A	ft
Total Available Detention Depth (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

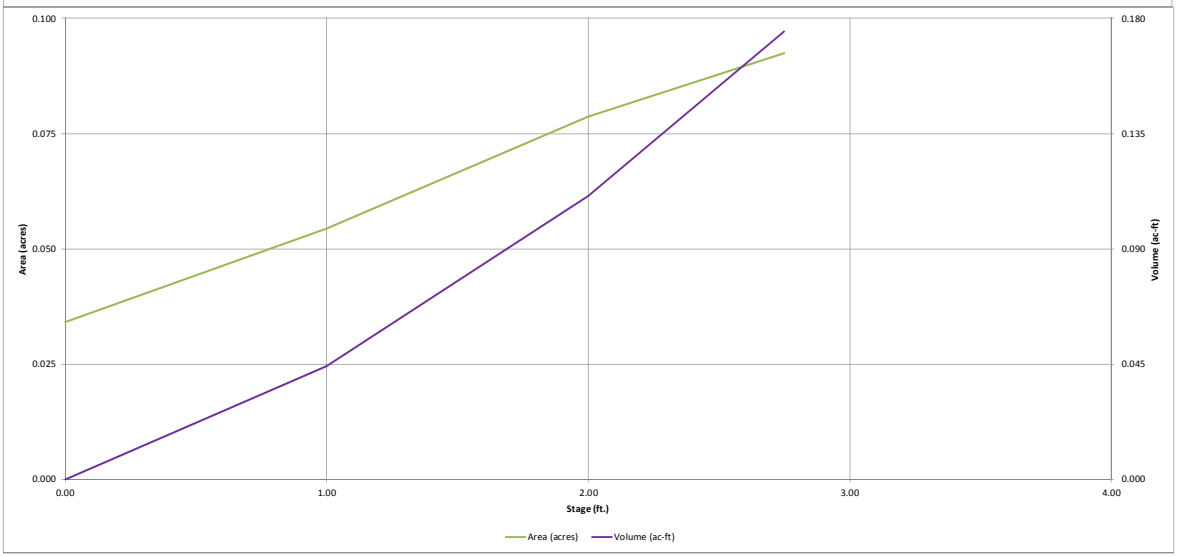
Depth Increment = ft

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)
Media Surface	--	0.00	--	--	--	1,488	0.034		
7090	--	1.00	--	--	--	2,367	0.054	1,927	0.044
7091	--	2.00	--	--	--	3,428	0.079	4,825	0.111
7091.75	--	2.75	--	--	--	4,028	0.092	7,621	0.175
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.00 (December 2019)



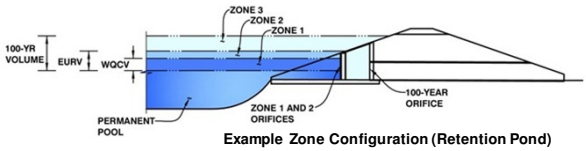


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.00 (December 2019)

Project: **Homestead at Sterling Ranch Filing No. 2**

Basin ID: **Sand Filter - Basin X1**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.27	0.010	Filtration Media
Zone 2 (EURV)	0.82	0.025	Circular Orifice
Zone 3 (100-year)	1.35	0.030	Circular Orifice
Total (all zones)		0.065	

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

Underdrain Orifice Invert Depth =	2.10	ft (distance below the filtration media surface)	Underdrain Orifice Area =	0.0	ft^2
Underdrain Orifice Diameter =	0.50	inches	Underdrain Orifice Centroid =	0.02	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 =	N/A	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 =	N/A	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 (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	Zone 3 Circular			Zone 2 Circular	Zone 3 Circular	
Invert of Vertical Orifice =	0.29	0.87	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	0.00	0.09	ft^2
Depth at top of Zone using Vertical Orifice =	0.87	1.42	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.02	0.17	feet
Vertical Orifice Diameter =	0.50	4.00	inches				

Calculated Parameters for Vertical Orifice

User Input: Overflow Weir (Dropbox with Flat or Sloped Grate and Outlet Pipe OR Rectangular/Trapezoidal Weir (and No Outlet Pipe))

	Not Selected	Not Selected			Not Selected	Not Selected	
Overflow Weir Front Edge Height, Ho =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	N/A	N/A	feet
Overflow Weir Front Edge Length =	N/A	N/A	feet	Overflow Weir Slope Length =	N/A	N/A	feet
Overflow Weir Grate Slope =	N/A	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	N/A	N/A	
Horiz. Length of Weir Sides =	N/A	N/A	feet	Overflow Grate Open Area w/o Debris =	N/A	N/A	ft^2
Overflow Grate Open Area % =	N/A	N/A	%, grate open area/total area	Overflow Grate Open Area w/ Debris =	N/A	N/A	ft^2
Debris Clogging % =	N/A	N/A	%				

Calculated Parameters for Overflow Weir

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

	Not Selected	Not Selected			Not Selected	Not Selected	
Depth to Invert of Outlet Pipe =	N/A	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	N/A	N/A	ft^2
Circular Orifice Diameter =	N/A	N/A	inches	Outlet Orifice Centroid =	N/A	N/A	feet
				Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	2.50	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.12	feet
Spillway Crest Length =	10.00	feet	Stage at Top of Freeboard =	4.12	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.09	acres
Freeboard above Max Water Surface =	1.50	feet	Basin Volume at Top of Freeboard =	0.17	acre-ft

Calculated Parameters for Spillway

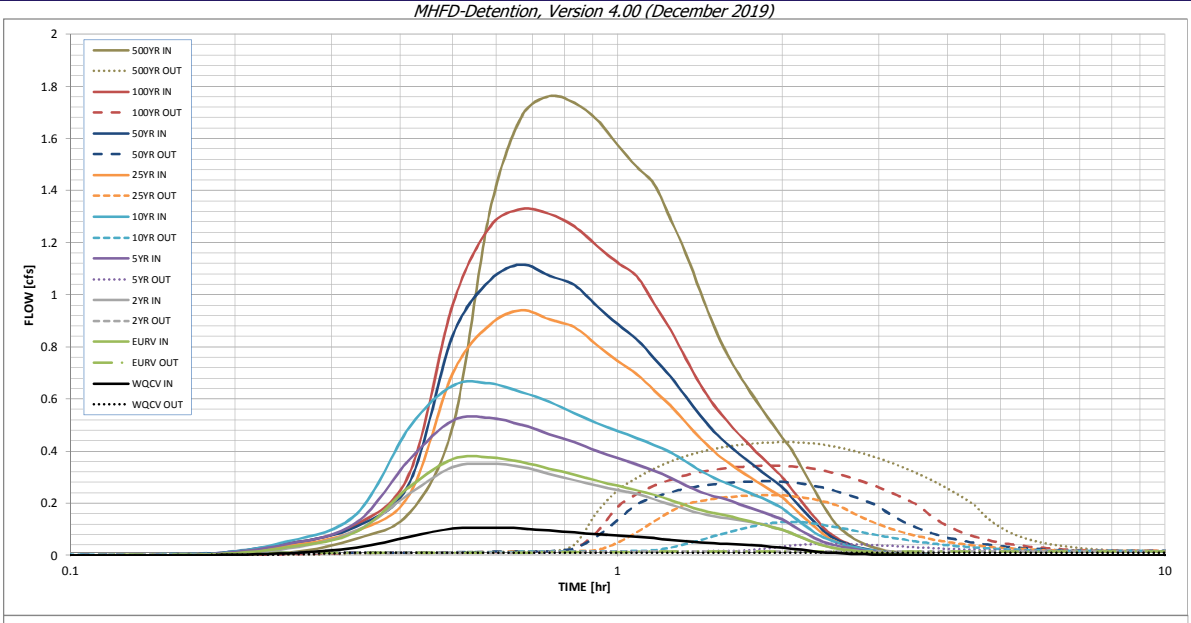
Routed Hydrograph Results

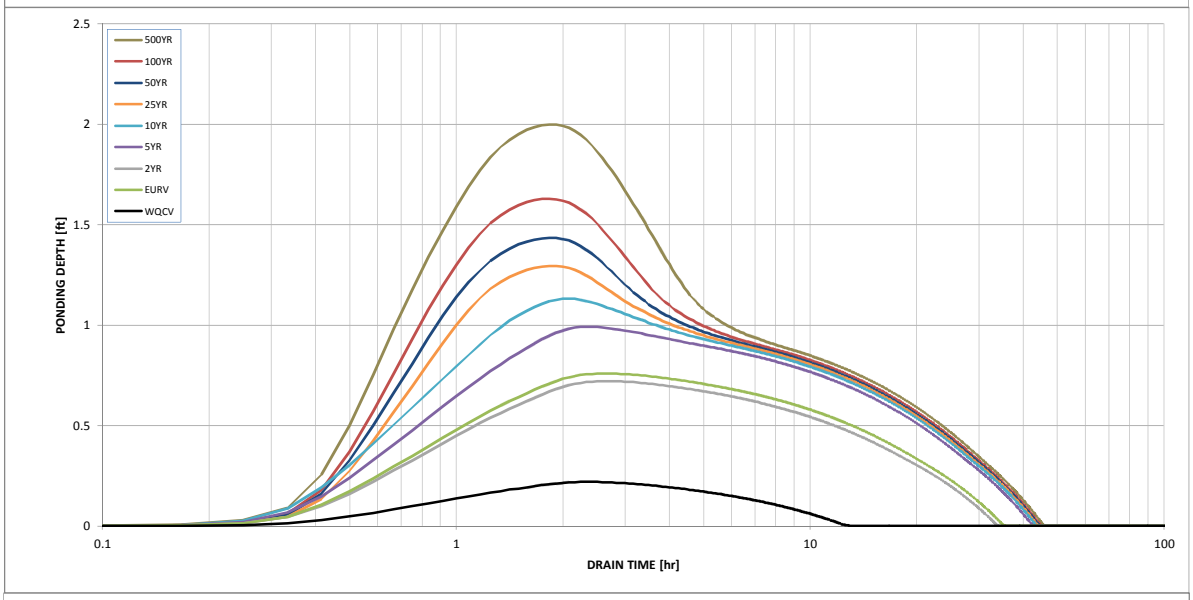
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

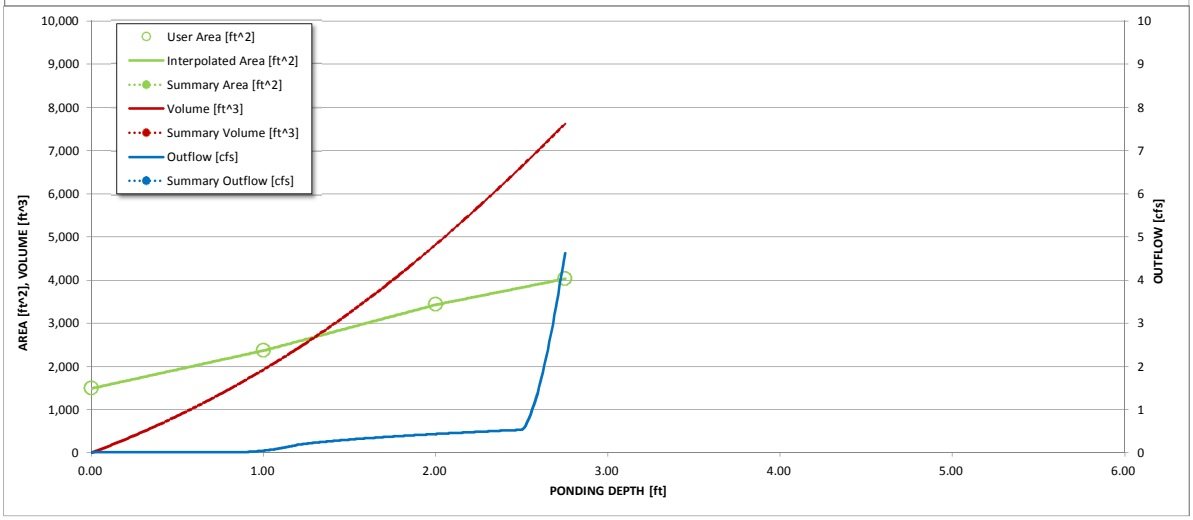
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	3.14
CUHP Runoff Volume (acre-ft) =	0.010	0.035	0.033	0.049	0.063	0.083	0.099	0.119	0.160
Inflow Hydrograph Volume (acre-ft) =	0.010	0.035	0.033	0.049	0.063	0.083	0.099	0.119	0.160
CUHP Predevelopment Peak Q (cfs) =	0.0	0.0	0.1	0.2	0.2	0.4	0.6	0.7	1.0
OPTIONAL Override Predevelopment Peak Q (cfs) =	0.0	0.0							
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.07	0.20	0.31	0.58	0.72	0.93	1.30
Peak Inflow Q (cfs) =	0.1	0.4	0.4	0.5	0.7	0.9	1.1	1.3	1.8
Peak Outflow Q (cfs) =	0.0	0.0	0.0	0.0	0.1	0.2	0.3	0.3	0.4
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.3	0.5	0.5	0.5	0.5	0.4
Structure Controlling Flow =	Filtration Media	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 2	Vertical Orifice 2	Vertical Orifice 2	Vertical Orifice 2	Vertical Orifice 2	Vertical Orifice 2
Max Velocity through Grate 1 (fps) =	N/A	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	N/A
Time to Drain 97% of Inflow Volume (hours) =	12	34	33	41	41	41	41	41	40
Time to Drain 99% of Inflow Volume (hours) =	**13**	35	34	42	43	43	43	44	44
Maximum Ponding Depth (ft) =	0.22	0.76	0.72	0.99	1.13	1.29	1.43	1.63	2.00
Area at Maximum Ponding Depth (acres) =	0.04	0.05	0.05	0.05	0.06	0.06	0.06	0.07	0.08
Maximum Volume Stored (acre-ft) =	0.008	0.031	0.030	0.044	0.052	0.061	0.070	0.083	0.110

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.00 (December 2019)







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

DETENTION BASIN 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	0.00	0.00	0.01
	0:15:00	0.01	0.03	0.03	0.04	0.05	0.04	0.05	0.04	0.06
	0:20:00	0.03	0.09	0.10	0.13	0.16	0.09	0.11	0.12	0.16
	0:25:00	0.07	0.26	0.24	0.37	0.49	0.23	0.28	0.31	0.50
	0:30:00	0.10	0.37	0.34	0.52	0.65	0.70	0.84	0.96	1.31
	0:35:00	0.11	0.38	0.35	0.53	0.66	0.88	1.05	1.26	1.68
	0:40:00	0.10	0.36	0.34	0.50	0.63	0.94	1.12	1.33	1.76
	0:45:00	0.09	0.33	0.31	0.46	0.59	0.91	1.07	1.31	1.74
	0:50:00	0.09	0.31	0.29	0.43	0.55	0.88	1.04	1.26	1.67
	0:55:00	0.08	0.29	0.27	0.40	0.51	0.81	0.96	1.19	1.57
	1:00:00	0.08	0.27	0.25	0.37	0.48	0.75	0.89	1.12	1.49
	1:05:00	0.07	0.25	0.24	0.35	0.45	0.70	0.83	1.07	1.42
	1:10:00	0.07	0.23	0.21	0.32	0.42	0.63	0.76	0.97	1.29
	1:15:00	0.06	0.21	0.19	0.30	0.40	0.57	0.69	0.86	1.16
	1:20:00	0.05	0.19	0.18	0.27	0.36	0.51	0.61	0.75	1.01
	1:25:00	0.05	0.17	0.16	0.24	0.32	0.45	0.54	0.65	0.88
	1:30:00	0.05	0.16	0.15	0.23	0.30	0.40	0.48	0.58	0.77
	1:35:00	0.04	0.15	0.14	0.21	0.28	0.36	0.43	0.52	0.69
	1:40:00	0.04	0.14	0.13	0.20	0.26	0.33	0.39	0.46	0.62
	1:45:00	0.04	0.13	0.13	0.18	0.24	0.30	0.35	0.42	0.56
	1:50:00	0.04	0.12	0.12	0.17	0.22	0.27	0.32	0.38	0.51
	1:55:00	0.03	0.11	0.11	0.15	0.20	0.25	0.29	0.34	0.45
	2:00:00	0.03	0.10	0.10	0.14	0.18	0.22	0.26	0.30	0.40
	2:05:00	0.03	0.08	0.08	0.12	0.15	0.19	0.22	0.25	0.34
	2:10:00	0.02	0.07	0.07	0.09	0.12	0.15	0.18	0.21	0.28
	2:15:00	0.02	0.05	0.06	0.08	0.10	0.12	0.14	0.16	0.22
	2:20:00	0.01	0.04	0.04	0.06	0.08	0.09	0.11	0.13	0.17
	2:25:00	0.01	0.03	0.03	0.05	0.06	0.07	0.08	0.09	0.12
	2:30:00	0.01	0.03	0.03	0.04	0.05	0.05	0.06	0.07	0.09
	2:35:00	0.01	0.02	0.02	0.03	0.04	0.04	0.05	0.05	0.07
	2:40:00	0.01	0.02	0.02	0.03	0.03	0.03	0.04	0.04	0.06
	2:45:00	0.00	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.04
	2:50:00	0.00	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.03
	2:55:00	0.00	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02
	3:00:00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02
	3:05:00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	3:10:00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	3:15:00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
	3:20:00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	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 4.00 (December 2019)

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 [ft²]	Area [acres]	Volume [ft³]	Volume [ac-ft]	Total Outflow [cfs]

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'.

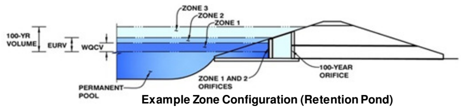
Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.00 (December 2019)

Project: **Homestead at Sterling Ranch Filing No. 2**

Basin ID: **Sand Filter - Basins Y1, W1, X2**



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**SF**			
Watershed Area =	2.74	acres		
Watershed Length =	750	ft		
Watershed Length to Centroid =	375	ft		
Watershed Slope =	0.020	ft/ft		
Watershed Imperviousness =	45.00%	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		
Target WQCV Drain Time =	12.0	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) =	0.035	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.131	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.124	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.181	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.232	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.302	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.358	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	0.429	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	0.574	acre-feet		inches
Approximate 2-yr Detention Volume =	0.098	acre-feet		
Approximate 5-yr Detention Volume =	0.135	acre-feet		
Approximate 10-yr Detention Volume =	0.182	acre-feet		
Approximate 25-yr Detention Volume =	0.201	acre-feet		
Approximate 50-yr Detention Volume =	0.210	acre-feet		
Approximate 100-yr Detention Volume =	0.238	acre-feet		

Define Zones and Basin Geometry

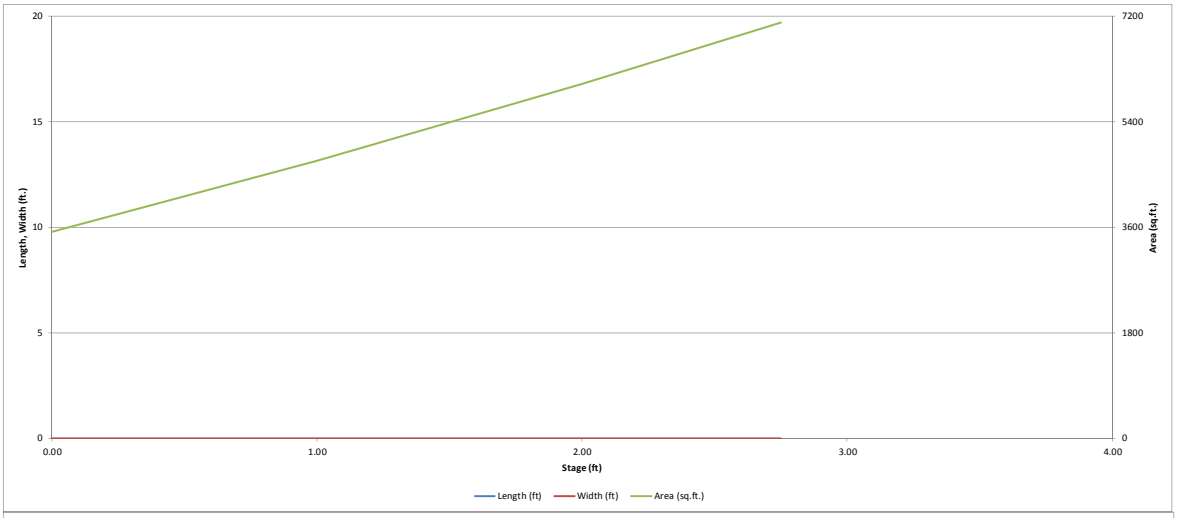
Zone 1 Volume (WQCV) =	0.035	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.095	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.107	acre-feet
Total Detention Basin Volume =	0.238	acre-feet
Initial Surcharge Volume (ISV) =	N/A	ft^3
Initial Surcharge Depth (ISD) =	N/A	ft
Total Available Detention Depth (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

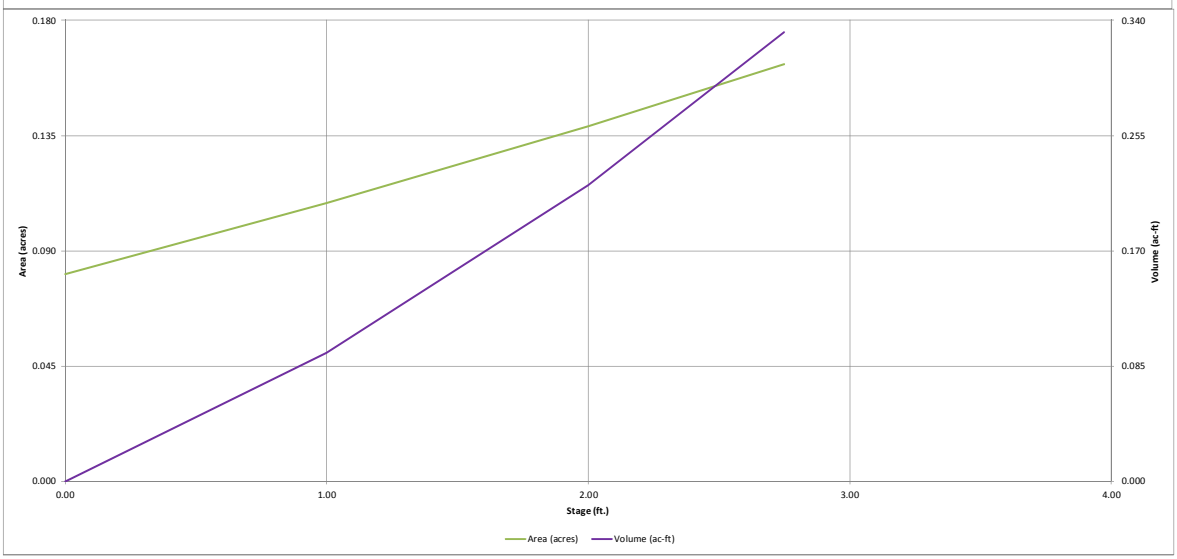
Depth Increment = ft

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)
Media Surface	--	0.00	--	--	--	3,524	0.081		
7057	--	1.00	--	--	--	4,732	0.109	4,128	0.095
7058	--	2.00	--	--	--	6,037	0.139	9,512	0.218
7058.75	--	2.75	--	--	--	7,090	0.163	14,435	0.331
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.00 (December 2019)



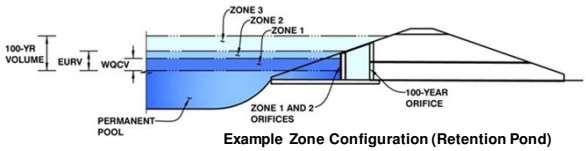


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.00 (December 2019)

Project: **Homestead at Sterling Ranch Filing No. 2**

Basin ID: **Sand Filter - Basins Y1, W1, X2**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.41	0.035	Filtration Media
Zone 2 (EURV)	1.32	0.095	Circular Orifice
Zone 3 (100-year)	2.14	0.107	Circular Orifice
Total (all zones)		0.238	

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

Underdrain Orifice Invert Depth =	2.10	ft (distance below the filtration media surface)	Underdrain Orifice Area =	0.0	ft^2
Underdrain Orifice Diameter =	0.95	inches	Underdrain Orifice Centroid =	0.04	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 =	N/A	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 =	N/A	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 (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	Zone 3 Circular			Zone 2 Circular	Zone 3 Circular	
Invert of Vertical Orifice =	0.60	1.75	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	0.00	0.79	ft^2
Depth at top of Zone using Vertical Orifice =	1.73	2.62	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.03	0.50	feet
Vertical Orifice Diameter =	0.80	12.00	inches				

Calculated Parameters for Vertical Orifice

User Input: Overflow Weir (Dropbox with Flat or Sloped Grate and Outlet Pipe OR Rectangular/Trapezoidal Weir (and No Outlet Pipe))

	Not Selected	Not Selected			Not Selected	Not Selected	
Overflow Weir Front Edge Height, Ho =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	N/A	N/A	feet
Overflow Weir Front Edge Length =	N/A	N/A	feet	Overflow Weir Slope Length =	N/A	N/A	feet
Overflow Weir Grate Slope =	N/A	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	N/A	N/A	
Horiz. Length of Weir Sides =	N/A	N/A	feet	Overflow Grate Open Area w/o Debris =	N/A	N/A	ft^2
Overflow Grate Open Area % =	N/A	N/A	%, grate open area/total area	Overflow Grate Open Area w/ Debris =	N/A	N/A	ft^2
Debris Clogging % =	N/A	N/A	%				

Calculated Parameters for Overflow Weir

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

	Not Selected	Not Selected			Not Selected	Not Selected	
Depth to Invert of Outlet Pipe =	N/A	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	N/A	N/A	ft^2
Circular Orifice Diameter =	N/A	N/A	inches	Outlet Orifice Centroid =	N/A	N/A	feet
				Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	2.75	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.21	feet
Spillway Crest Length =	16.67	feet	Stage at Top of Freeboard =	4.00	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.16	acres
Freeboard above Max Water Surface =	1.04	feet	Basin Volume at Top of Freeboard =	0.33	acre-ft

Calculated Parameters for Spillway

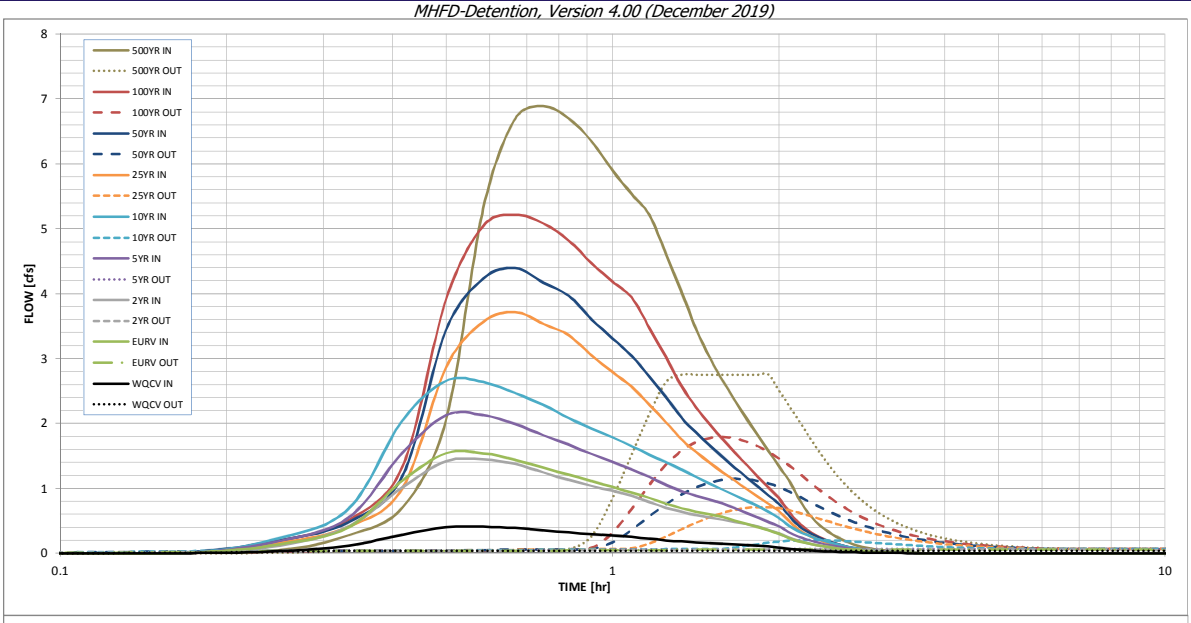
Routed Hydrograph Results

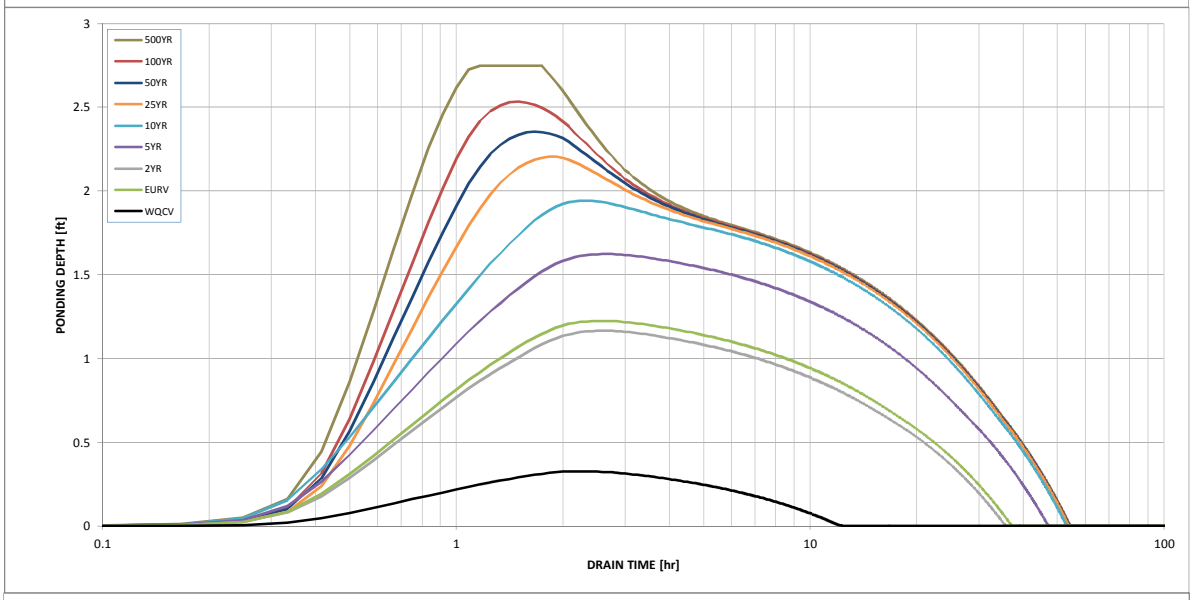
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

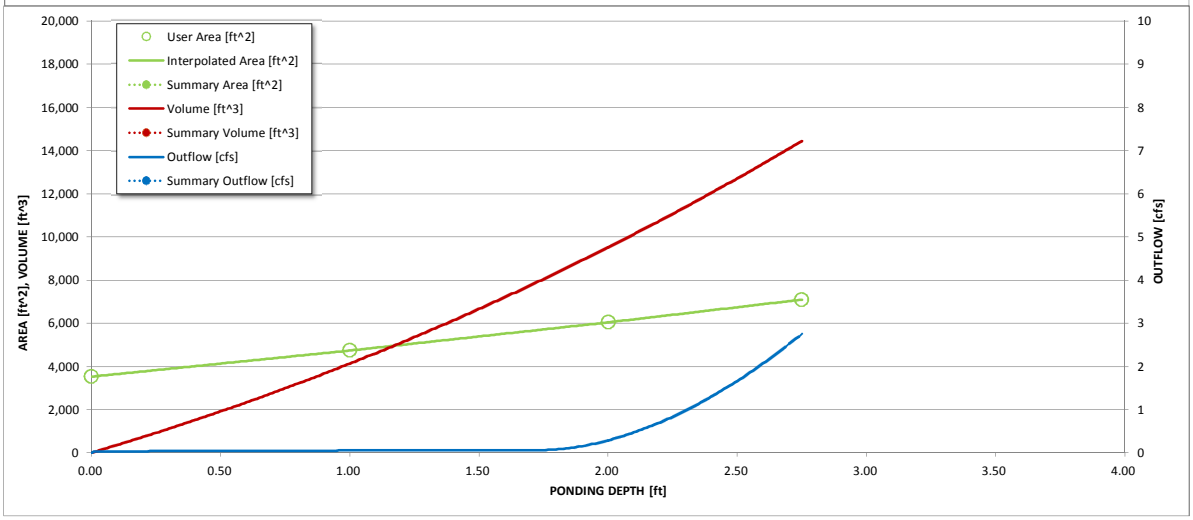
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	3.14
CUHP Runoff Volume (acre-ft) =	0.035	0.131	0.124	0.181	0.232	0.302	0.358	0.429	0.574
Inflow Hydrograph Volume (acre-ft) =	0.035	0.131	0.124	0.181	0.232	0.302	0.358	0.429	0.574
CUHP Predevelopment Peak Q (cfs) =	0.0	0.0	0.2	0.6	0.9	1.7	2.1	2.7	3.8
OPTIONAL Override Predevelopment Peak Q (cfs) =	0.0	0.0							
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.08	0.22	0.34	0.61	0.77	0.99	1.38
Peak Inflow Q (cfs) =	0.4	1.5	1.4	2.1	2.7	3.7	4.4	5.2	6.9
Peak Outflow Q (cfs) =	0.0	0.1	0.1	0.1	0.2	0.7	1.1	1.8	2.8
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.1	0.2	0.4	0.5	0.7	0.7
Structure Controlling Flow =	Filtration Media	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 2	Vertical Orifice 2	Vertical Orifice 2	Vertical Orifice 2	N/A
Max Velocity through Grate 1 (fps) =	N/A	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	N/A
Time to Drain 97% of Inflow Volume (hours) =	12	36	34	45	51	51	50	50	48
Time to Drain 99% of Inflow Volume (hours) =	**12**	37	35	47	52	53	53	53	52
Maximum Ponding Depth (ft) =	0.33	1.23	1.17	1.62	1.94	2.20	2.35	2.53	2.75
Area at Maximum Ponding Depth (acres) =	0.09	0.12	0.11	0.13	0.14	0.15	0.15	0.16	0.16
Maximum Volume Stored (acre-ft) =	0.027	0.119	0.113	0.168	0.210	0.247	0.269	0.296	0.331

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.00 (December 2019)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename: _____

Inflow Hydrographs

The user can override the calculated inflow hydrographs from this workbook with inflow hydrographs developed in a separate program.

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.04
	0:15:00	0.03	0.14	0.12	0.19	0.23	0.16	0.20	0.19	0.28
	0:20:00	0.12	0.40	0.42	0.55	0.69	0.41	0.48	0.51	0.71
	0:25:00	0.29	1.12	1.01	1.55	2.05	1.00	1.19	1.33	2.06
	0:30:00	0.40	1.54	1.42	2.13	2.66	2.87	3.44	3.91	5.31
	0:35:00	0.41	1.54	1.44	2.13	2.64	3.56	4.23	5.04	6.70
	0:40:00	0.39	1.44	1.37	1.99	2.47	3.72	4.39	5.22	6.89
	0:45:00	0.35	1.32	1.24	1.82	2.28	3.53	4.17	5.08	6.70
	0:50:00	0.32	1.21	1.13	1.67	2.08	3.36	3.97	4.82	6.35
	0:55:00	0.29	1.11	1.04	1.53	1.92	3.05	3.60	4.47	5.90
	1:00:00	0.27	1.02	0.96	1.41	1.79	2.79	3.31	4.19	5.54
	1:05:00	0.25	0.93	0.88	1.29	1.65	2.56	3.04	3.94	5.21
	1:10:00	0.22	0.85	0.79	1.17	1.52	2.28	2.72	3.47	4.61
	1:15:00	0.20	0.76	0.70	1.05	1.40	2.02	2.40	3.02	4.03
	1:20:00	0.18	0.69	0.63	0.96	1.29	1.75	2.09	2.58	3.45
	1:25:00	0.17	0.64	0.59	0.89	1.18	1.56	1.86	2.25	3.02
	1:30:00	0.16	0.60	0.55	0.82	1.07	1.39	1.66	1.98	2.66
	1:35:00	0.15	0.55	0.51	0.77	0.98	1.25	1.48	1.76	2.35
	1:40:00	0.14	0.50	0.48	0.69	0.89	1.11	1.32	1.55	2.07
	1:45:00	0.13	0.45	0.45	0.62	0.81	0.99	1.17	1.36	1.82
	1:50:00	0.12	0.40	0.41	0.55	0.72	0.87	1.03	1.18	1.57
	1:55:00	0.10	0.35	0.36	0.48	0.64	0.76	0.89	1.01	1.34
	2:00:00	0.09	0.30	0.31	0.42	0.54	0.65	0.76	0.85	1.13
	2:05:00	0.07	0.24	0.24	0.33	0.43	0.50	0.59	0.65	0.87
	2:10:00	0.05	0.19	0.19	0.26	0.34	0.37	0.43	0.48	0.64
	2:15:00	0.04	0.15	0.15	0.21	0.28	0.29	0.33	0.36	0.49
	2:20:00	0.04	0.12	0.13	0.17	0.23	0.22	0.26	0.28	0.38
	2:25:00	0.03	0.10	0.10	0.14	0.19	0.18	0.21	0.21	0.29
	2:30:00	0.02	0.08	0.09	0.11	0.15	0.14	0.16	0.16	0.22
	2:35:00	0.02	0.07	0.07	0.09	0.12	0.11	0.13	0.12	0.17
	2:40:00	0.02	0.05	0.06	0.07	0.10	0.09	0.10	0.09	0.13
	2:45:00	0.01	0.04	0.05	0.06	0.08	0.07	0.08	0.07	0.09
	2:50:00	0.01	0.03	0.04	0.05	0.06	0.05	0.06	0.05	0.07
	2:55:00	0.01	0.03	0.03	0.04	0.05	0.04	0.05	0.04	0.06
	3:00:00	0.01	0.02	0.02	0.03	0.04	0.03	0.04	0.03	0.05
	3:05:00	0.01	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.04
	3:10:00	0.00	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.03
	3:15:00	0.00	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.02
	3:20:00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	3:25:00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01
	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 4.00 (December 2019)

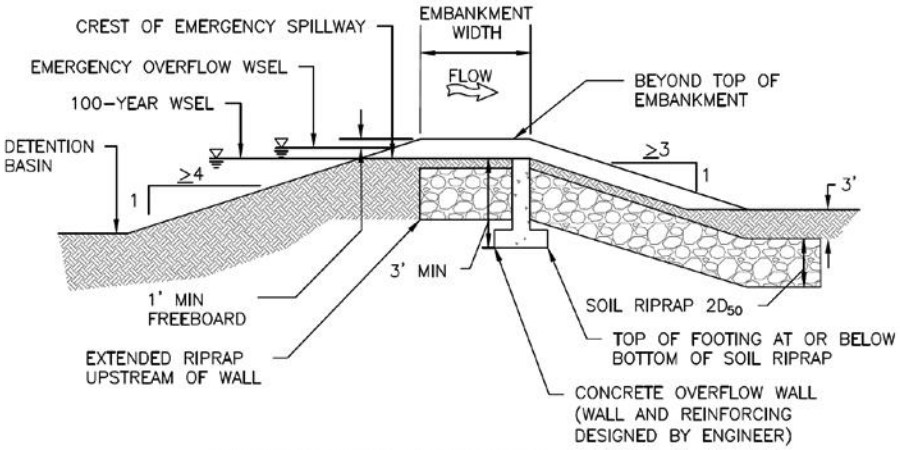
Summary Stage-Area-Volume-Discharge Relationships

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.

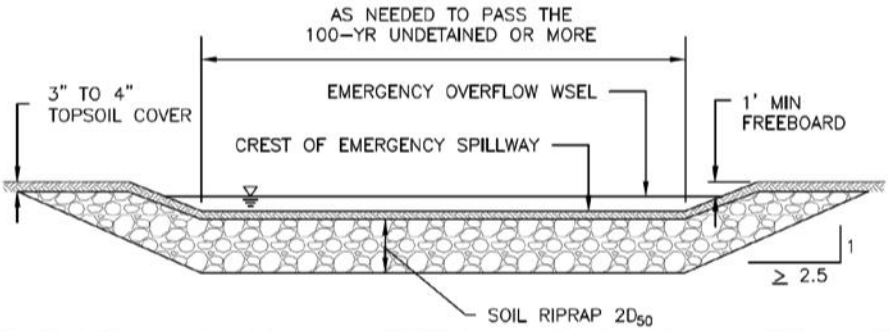
Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]

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).

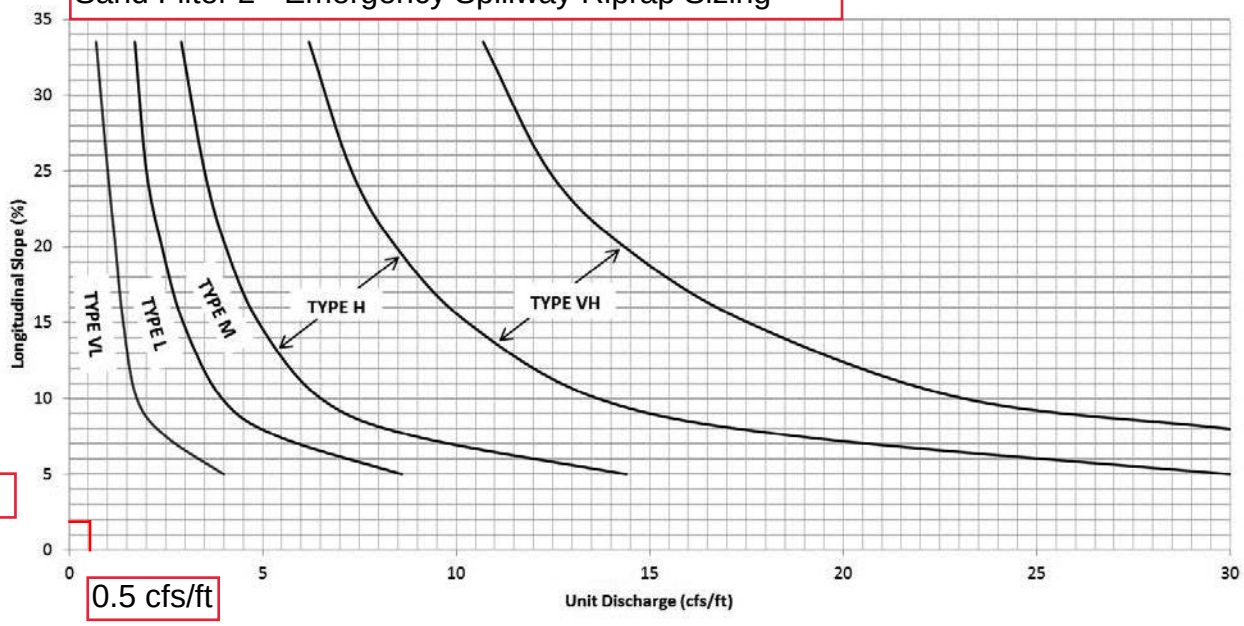


EMERGENCY SPILLWAY PROFILE



EMERGENCY SPILLWAY SECTION AND SPILLWAY CHANNEL

Sand Filter 2 - Emergency Spillway Riprap Sizing



2%

0.5 cfs/ft

Figure 12-21. Embankment protection details and rock sizing chart (adapted from Arapahoe County)

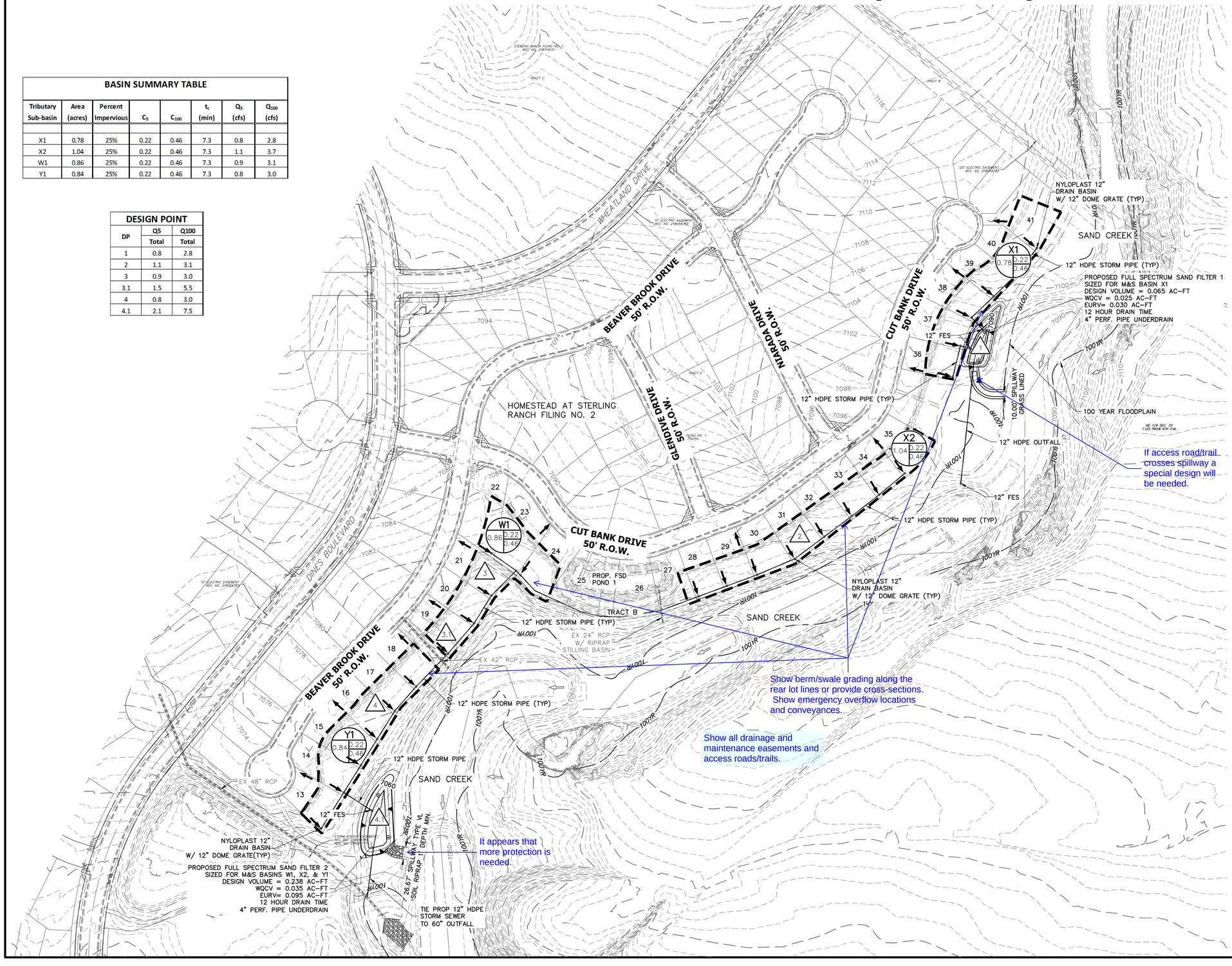
HOMESTEAD AT STERLING RANCH FILING NO. 2

COUNTY OF EL PASO, STATE OF COLORADO

PROPOSED DRAINAGE MAP (ADDENDUM)

BASIN SUMMARY TABLE							
Tributary Sub-basin	Area (acres)	Percent Impervious	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (cfs)
X1	0.78	25%	0.22	0.46	7.3	0.8	2.8
X2	1.04	25%	0.22	0.46	7.3	1.1	3.7
W1	0.86	25%	0.22	0.46	7.3	0.9	3.1
Y1	0.84	25%	0.22	0.46	7.3	0.8	3.0

DESIGN POINT		
DP	Q5 Total	Q100 Total
1	0.8	2.8
2	1.1	3.1
3	0.9	3.0
3.1	1.5	5.5
4	0.8	3.0
4.1	2.1	7.5



LEGEND

- BASIN ID (A: SUB-BASIN DESIGNATION; B: AREA (AC); C: 5 YEAR STORM COEFFICIENT; D: 100 YEAR STORM COEFFICIENT)
- DRAINAGE DISCHARGE DESIGN POINT
- PROPOSED FLOW DIRECTION
- HISTORIC FLOW DIRECTION
- EXISTING DRAINAGE BASIN
- PROPOSED DRAINAGE BASIN
- EXISTING STORM SEWER
- PROPOSED STORM SEWER

100 50 0 100

ORIGINAL SCALE: 1" = 100'

PROPOSED DRAINAGE MAP (ADDENDUM)
HOMESTEAD AT STERLING RANCH FILING NO. 2
JOB NO. 25188.00
08/18/2020
SHEET 1 OF 1

J·R ENGINEERING
A Westrian Company

Centennial 303-740-9393 • Colorado Springs 719-593-2593
Fort Collins 970-491-9888 • www.jrengineering.com

FINAL DRAINAGE REPORT FOR HOMESTEAD AT STERLING RANCH FILING NO.2

EL PASO COUNTY, COLORADO

March 2020

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

Prepared by:

CIVIL CONSULTANTS, INC.
102 E. Pikes Peak, Suite 500
Colorado Springs, CO 80903
(719) 955-5485

Project #09-007
SF-19-004

FINAL DRAINAGE REPORT FOR
HOMESTEAD AT STERLING RANCH FILING NO. 2

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. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparing this report.

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

DEVELOPER'S STATEMENT

I,thedeveloper havereadand will complywithalltherequirementsspecified in this drainagereportand plan.

BY: James F Morley

TITLE: Manager
DATE: 3-31-2020

ADDRESS: SR Land, LLC
20 Boulder Crescent, Suite 210
ColoradoSprings, CO80903

EL PASO COUNTY'S STATEMENT

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

FINAL DRAINAGE REPORT FOR
HOMESTEAD AT STERLING RANCH FILING NO. 2

TABLE OF CONTENTS

APPENDIX

FINAL DRAINAGE REPORT FOR
HOMESTEAD AT STERLING RANCH FILING NO. 2

PURPOSE

Additional language added in Addendum above

This document is the Final Drainage Report for Homestead at Sterling Ranch Filing No. 2. This report was previously discussed, as a preliminary drainage report, in the "Master Development Drainage Report for Sterling Ranch Filing Nos. 1&2, and Final Drainage Report for Sterling Ranch Filing No.1" prepared by MS Civil Consultants, dated April 2017. The purpose of this document is to identify and analyze the on and offsite drainage patterns and to ensure that post development runoff is routed through the site safely and in a manner that satisfies the requirements set forth by the El Paso County Drainage Criteria Manual. The following report is an analysis of the drainage for Homestead at Sterling Ranch Filing No. 2, single family lots, onsite and offsite drainage.

GENERAL LOCATION AND DESCRIPTION

Homestead at Sterling Ranch Filing No. 2 is located in the SE ¼ of the NW ¼, the SW ¼ of the NE ¼, andthe NW ¼ of the NE ¼ of Section 33, Township 12 South, Range 65 West of the 6th Principal Meridian, and the NE ¼ of the SW ¼ of Section 33, Township 12 South, Range 65 West of the 6th Principal Meridianwithin unincorporated El Paso County, Colorado. The site is bound on the south by an existing detention pond, to the north by Briargate Parkway and to the east by Sand Creek. ExistingDines Boulevard runs along the western site boundary. An existing residential development, Homestead at Sterling Ranch Filing No. 1, bounds the site to the west and a future commercial parcel bounds the site to the northwest. Sterling Ranch lies within the Sand Creek Drainage Basin. Flows from this site are tributary to Sand Creek.

Homestead at Sterling Ranch Filing No. 2consists of 29.658 acresand ispresently undeveloped. Vegetation is sparse, consisting of native grasses. Existing site terrain generally slopes from north to southwest at grade rates that vary between 2% and 6%.

Land use for Homestead at Sterling Ranch Filing No. 2is currently listed as AG(Grazing Land).Improvements proposed for the site include pavedstreets, trails, a full spectrum detention pond, and utilitiesas normally constructed for a residential development.

SOILS

Soils for this project are delineated by the map in the appendix as Pring Coarse Sandy Loam (71) and is characterized as Hydrologic Soil Types "B".Soils in the study area are shown as mapped by S.C.S. in the "Soils Survey of El Paso County Area". Vegetation is sparse, consisting of native grasses and weeds.

HYDROLOGIC CALCULATIONS

Hydrologic calculations were performed using the El Paso County and City of Colorado Springs Storm Drainage Design Criteria manual and where applicable the Urban Storm Drainage Criteria Manual. The Rational Method was used to estimate stormwater runoff anticipated from design storms with 5-year and 100-year recurrence intervals.

HYDRAULIC CALCULATIONS

Hydraulic calculations were estimated using the Manning's Formula and the methods described in the El Paso County and City of Colorado Springs Storm Drainage Design Criteria manual. The relevant data sheets can be found in the "Master Development Drainage Report for Sterling Ranch Filing Nos. 1&2, and Final Drainage Report for Sterling Ranch Filing No.1" prepared by MS Civil Consultants, dated April 2017 and in the appendix of this report.

FLOODPLAIN STATEMENT

No portion of this site is within a designated F.E.M.A. floodplain as determined by the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) Panel No. 08041C0533G, effective date December 7, 2018.An annotated FIRM Panel is included in the Appendix.

DRAINAGE CRITERIA

This drainage analysis has been prepared in accordance with the current City of Colorado Springs/El Paso County Drainage Criteria Manual, Volumes I & II, dated November 1991, including subsequent updates. El Paso County has also adopted Chapter 6 and Section 3.2.1 of Chapter 13 in the City of Colorado Springs & El Paso County Drainage Criteria Manual Volumes I and II, dated May 2014. (Appendix I of the El Paso County's Engineering Criteria Manual (ECM), 2008). In addition to the ECM, the Urban Storm Drainage Criteria Manuals, Volumes 1-3, published by the Urban Drainage and Flood Control District (Volumes 1 & 2 dated January 2016, Volume 3 dated November 2010 and updates. Calculations were performed to determine runoff quantities for the 5-year and 100-year frequency storms for developed conditions using the Rational Method.July 2019 ECM updated for MS4 permit.

FOUR STEP PROCESS

Step 1 Employ Runoff Reduction Practices. Roof drains will be directed to side yard swales and as possible to grass lined swales to aid in minimizing direct connection of impervious surfaces.

Step 2 Implement BMPs that provide a water quality capture volume with slow release. – An existing Full Spectrum Detention Facility (see Sterling Ranch Filing Nos. 1&2 MDDP, Pond 4)was planned and constructed to handle tributary flows for the southwest portion of the site. All remaining tributary areas from the site will be treated in a proposed temporary Full Spectrum Detention Facility, Interim Pond 1. Both ponds will incorporate water quality capture volumes that are intended to slowly drain in 40 hours and excess urban runoff volumes that are intended to drain within 72 hours.

Step 3 Stabilize streams. – With the full spectrum detention facilities in place, the runoff from the proposed residential development will be reduced to predevelopment conditions.The developed discharge from the site is less that existing and therefore is not anticipated to have negative effects on downstream drainageways. Additionally, the Sand Creek Channel will be reinforced with selected areas of rip rap bank protection, vegetative slope stabilization, check structures and drop structures.

Step 4 Consider need for Industrial and Commercial BMPs. – No industrial or commercial land uses are proposed with this development. The proposed residential development area will implement a Stormwater Management Plan (SWMP) incorporation proper housekeeping procedures. Onsite drainage will be routed through proposedprivatetemporary Full Spectrum Detention Facility (FSD), Interim Pond 1, to minimize introduction of contaminates to the county's public drainage systems.

EXISTING DRAINAGE CONDITIONS

The Homestead at Sterling Ranch Filing No. 2 site consists of 29.658 acres and is situated west of the Sand Creek Watershed. This area was previously studied in the "Sand Creek Drainage Basin Planning Study" (DBPS) prepared by Kiowa Corporation, revised March 1996. More recently the area was studied in the "Master Development Drainage Report for Sterling Ranch Filing Nos. 1&2, and Final Drainage Report for Sterling Ranch Filing No.1" prepared by MS Civil Consultants, dated April 2017 (henceforth referred to as "Sterling Ranch Filing Nos. 1&2 MDDP").

See the Historic conditions map, the Homestead at Sterling Ranch Filing No. 2 site lies within the Basin EX-4 (Q5 = 71 cfs, Q100 = 352 cfs) and is a 330 acre area of land located on the western portion of the site, including the Sand Creek channel. A portion of this basin extends off-site to the northwest of Vollmer Road, and at the time this map was created was undeveloped property. Runoff from the basin generally travels from north to south until it reaches the northern boundary of the site, being conveyed in the Sand Creek channel.Homestead at Sterling Ranch Filing No. 2 and the surrounding areas, with the exception of the existing Barbarick Subdivision; have already been graded during the overlot of the subdivision. Please refer to the Sterling Ranch Filing Nos. 1&2 MDDP by MS Civil Consultants for information on existing conditions and overlot drainage patterns. A copy of the historic and existing conditions map has been provided in the appendix.

PROPOSED DRAINAGE CHARACTERISTICS

General Concept Drainage Discussion

The following is a description of the onsite basins, offsite bypass flows and the overall drainage characteristics for the development of Sterling Ranch Filing No. 2. The development ofSterling Ranch Filing No. 2consists of residential streets and cul-de-sacs, proposedstorm drainage improvements, and lots located within the filing boundary. The proposed development results in drainage patterns and flow values thatare the same or less thanthose in the Sterling Ranch Filing Nos. 1&2 MDDP. Surface flow is designated as Design Points (DP). The following DPs and Basins were determined using the Rational Method since this method offers a more conservative approach to drainage.It should be noted that all calculations and drainage basins have been revised to reflect the new criteria updates by the El Paso County/City of Colorado Springs Drainage Criteria Manual. For comparison, the **asterisk (*)** symbol in the detailed drainage discussions below represents each Basin or Design Point as labeled in the Sterling Ranch Filing Nos. 1&2 MDDP.Asterisk symbols on the Proposed Drainage Map in the appendix also represent Basins, Design Points and Pipe Runs as presented in the Sterling Ranch Filing Nos. 1&2 MDDP.

Detailed Drainage Discussion (Design Points)

DP2*, 5.39 acres, consists ofBasin B*planned residential lots and streets with runoff coefficients of 0.38 for the 5-year and 0.55 for the 100-year. Developed runoff of Q5=8.0 cfs and Q100=19.3 cfs has been calculated for DP2*. The surface runoff is routed via overlot grading and planned swales to two existing 15' CDOT Type R at-grade inlets. The flows are routed east via a 36" RCP to DP5.

DP3*, 2.92 acres, consists ofBasin C* residential lots within Homestead at Sterling Ranch Filing No. 1, and streets with runoff coefficients of 0.38 for the 5-year and 0.55 for the 100-year. Developed runoff of Q5=4.2 cfs and Q100=10.1 cfs has been calculated for DP3*. The surface runoff is routed via overlot grading and proposed swales to an existing 5' CDOT type R sump inlet. The flows captured by the inlet are routed to existing Detention Pond 4.

DP4*, 9.36 acres, consists ofBasin D* and Basin E*residential lots within Homestead at Sterling Ranch Filing No. 1 and streets with runoff coefficients of 0.38 for the 5-year and 0.55 for the 100-year and BasinF* (Dines Boulevard) with runoff coefficients of 0.90 for the 5-year and 0.96 for the 100-year. Developed runoff of Q5=16.1 cfs and Q100=36.7 cfs has been calculated for DP4. The surface runoff is routed via overlot grading and curb and gutter to DP4* which will be collected by a 15' CDOT type R at-grade inlet. The intercepted flow (Q5=13.3 cfs and Q100=20.0 cfs) will combine with flows from DP3* and be routed east via a 30" RCP (PR6*, Q5=16.8 cfs and Q100=29.4 cfs) to existing Detention Pond 4.
DP5*,0.80 acres, consists ofBasin G* residential lots with runoff coefficients of 0.22 for the 5-year and 0.46 for the 100-year, Basin H* existing Dines Boulevard, with runoff coefficients of 0.90 for the 5-year and 0.96 for the 100-year and flowby from Sterling Ranch Filing Nos. 1&2 MDDP DP4*. Developed runoff of Q5=4.2 and Q100=19.7cfs has been calculated for DP5*. The surface runoff is routed via overlot grading and curb and gutter to DP5* which is collected by an existing 15' CDOT type R at-grade inlet. DP5* has an intercepted flow of (Q5=4.2cfs and Q100=14.7cfs) and of flowby of (Q5=0.0cfs and Q100=5.0cfs). Flowby from DP5* continues on toPond FSD13, east of Dines Boulevard.See, Sterling Ranch Filing MDDP Proposed Hydrologic Conditions Map.

DP6*, 4.68 acres, consists ofSterling Ranch Filing Nos. 1&2 MDDP Basins J* and K*planned residential lots with runoff coefficients of 0.22 for the 5-year and 0.46 for the 100-year, Sterling Ranch Filing Nos. 1&2 MDDP Basin I* (Wheatland Drive) and Basin L*(Dines Boulevard) with runoff coefficients of 0.90 for the 5-year and 0.96 for the 100-year. Developed runoff of Q5=14.1 cfs and Q100=26.7cfs has been calculated for DP6*. The surface runoff is routed via overlot grading and curb and gutter to DP6* which is collected by an existing 15' CDOT type R at-grade inlet. DP6* has an intercepted flow of (Q5=12.1cfs and Q100=17.2cfs) and of flowby of (Q5=2.0 cfs and Q100=9.5cfs).Flowby from DP6* continues on to Pond FSD13, east of Dines Boulevard. See, Sterling Ranch Filing MDDP Proposed Hydrologic Conditions Map.

DP7,4.42 acres, consists ofBasin Pproposed residential lots with runoff coefficients of 0.38 for the 5-year and 0.55 for the 100-year. Developed runoff of Q5=5.7 and Q100=13.8cfs has been calculated for DP7. Surface runoff is routed via overlot grading and curb and gutter to DP7 which is collected by a proposed 10' CDOT type R sump inlet. Flows captured by the proposed 10' CDOT type R sump inlet are routed to existing Detention Pond 4 by proposed RCP storm sewer. The flows from DP7 were anticipated in the sizing of Pond 4 per the Sterling Ranch Filing No. 1 Final Drainage Report.

DP8,3.78, acres, consists ofBasin Qproposed residential lots with runoff coefficients of 0.38 for the 5-year and 0.55 for the 100-year. Developed runoff of Q5=4.9 and Q100=11.8cfs has been calculated for DP8. Surface runoff is routed via overlot grading and curb and gutter to DP8 which is collected by a proposed 10' CDOT type R sump inlet. Flows captured by the proposed 10' CDOT type R sump inlet are routed to existing Detention Pond 4 by proposed RCP storm sewer.The flows from DP8 were anticipated in the sizing of Pond 4 per the Sterling Ranch Filing No. 1 Final Drainage Report.

DP9, acres, consists ofBasin Rproposed residential lots with runoff coefficients of 0.38 for the 5-year and 0.55 for the 100-year. Developed runoff of Q5=2.2 and Q100=5.4cfs has been calculated for DP9. Surface runoff is routed via overlot grading and curb and gutter to DP9 which is collected by a proposed 5' CDOT type R sump inlet. Flows captured by the proposed 10' CDOT type R sump inletcombine with capturedflows contributed from Design Points 7 & 8 and are routed to existing Detention Pond 4 by Pipe Run 4 (Q5=12.4 and Q100=30.1cfs). Pipe Run 4 connects to existing Sterling Ranch Filing Nos. 1&2 MDDP Pipe Run 10* (Q5=12.5 and Q100=30.4 cfs) and is discharged into the forebay of existing Detention Pond 4. Flows contributed to the forebay of existing Pond 4 are approximately equal to those anticipated by the MDDP, therefore Pond 4 has the capacity for SWQ and Full Spectrum Detention for these flows.

DP10, 9.14, acres, consists ofBasin T proposed residential lots with runoff coefficients of 0.30 for the 5-year and 0.50 for the 100-year. Developed runoff of Q5=9.4 and Q100=15.6cfs has been calculated for

DP10. Surface runoff is routed via overlot grading and curb and gutter to DP10 which is collected by a proposed 15' CDOT type R at-grade inlet. DP10 has an intercepted flow of (Q5=9.1 cfs and Q100=12.7cfs) and of flowby of (Q5=0.3cfs and Q100=2.9cfs). Flows captured by the proposed 15' CDOT type R at-grade inletare routed southwest to the proposed full spectrum detention Pond 1 by proposed RCP storm sewer.

DP11,1.48, acres, consists ofBasin V1proposed residential lots with runoff coefficients of 0.38 for the 5-year and 0.55 for the 100-year. Developed runoff of Q5=1.9 and Q100=15.6 cfs has been calculated for DP11. Surface runoff is routed via overlot grading and curb and gutter to DP11 which is collected by a proposed 15' CDOT type R at-grade inlet. DP11 has an intercepted flow of (Q5=1.9cfs and Q100=12.7cfs) and of flowby of (Q5=0.0cfs and Q100=2.9cfs). Flows captured by the proposed 15' CDOT type R at-grade inlet are routed southwest to the proposed full spectrum detention Pond 1 by proposed RCP storm sewer.

DP12,4.50, acres, consists ofBasin Uproposed residential lots with runoff coefficients of 0.38 for the 5-year and 0.55 for the 100-year and flowby from DP10. Developed runoff of Q5=6.2cfs and Q100=17.2 cfs has been calculated for DP12. Surface runoff is routed via overlot grading and curb and gutter to DP12 which is collected by a proposed 10' CDOT type R sump inlet. Flows captured by the proposed 10' CDOT type R sump inlet are routed to the proposed full spectrum detention Pond 1 by proposed RCP storm sewer.

DP13,0.83, acres, consists ofBasin V2proposed residential lots with runoff coefficients of 0.38 for the 5-year and 0.55 for the 100-year and flowby from DP11. Developed runoff of Q5=1.2 and Q100=5.9cfs has been calculated for DP13. Surface runoff is routed via overlot grading and curb and gutter to DP13 which is collected by a proposed modified 5' length by 4.5’ wide CDOT type R sump inlet.

DP14,0.56, acres, consists ofBasin W3proposed full spectrum detention Pond 1with runoff coefficients of 0.08 for the 5-year and 0.35 for the 100-year and contributed flow from pipe run 9. Developed runoff of Q5=19.6cfs and Q100=52.4cfs has been calculated for DP14. All flows captured by inlets at Design Points DP10, DP11, DP12 and DP13 are routed by Pipe Run 9 (PR9, Q5=17.9 and Q100=47.1 cfs) to the forebay inPond 1 and combine withsurface runoff within Basin W1. An outlet structure with an orifice plate and restrictor plate regulates release rates and provides treatment to all flows tributary to DP14. See the Water Quality Provisions discussion in this report for more information on Pond 1.

Basins labeled on the Proposed Drainage Map marked with a "*", were previously analyzed and shown in the Final Drainage report for Sterling Ranch Filing No. 1. These basins are; B*, C*, D*, E*, F*, G*, H*, I*, L*, &S*. They are shown on the Proposed Drainage Map for continuity. Basins K & J additionally contribute to Design Points 3, 4, 5 &6. Therefore, the inlets sizing at these design points has been verified.

Detailed Drainage Discussion (Drainage Basins)

~~**Basins X1, X2,W1, and Y1**(0.78, 1.04, 0.86 and 0.084 acres respectively), consists of proposedresidential backyard lotslocated along the eastern boundary of the sitewith runoff coefficients of 0.22for the 5-year and 0.46for the 100-year.Developed runoff of (Q5=0.8, 1.1, 0.2, and 0.8cfs and Q100=2.8, 3.7, 1.7, and 3.0 cfsrespectively has been calculated for the basins. Runoff produced within the residential backyard lots, of Basins X1, X2, W1 and Y1 will be conveyed in backyard swalesand as sheet flow to a Sand Filter Basin within each lot. The treated flows will be collected by private storm sewer systems and discharged into the Sand Creek Channel. A 20’ wide typical drainage easement is provided within the lots to accommodate the BMP’s. The facilities constructed are to be privately maintained by the Sterling Ranch metro district.~~

Basins X, W2, and Y (0.22, 0.26, and 0.09 acres respectively), consists primarily of vegetated tracts and portion of residential backyards that will discharge as sheet flow to the Sand Creek Channel. The developed flow rates from Basins X, W2, and Y are Q5=0.2, 0.1, 0.1 cfs andQ100=0.8, 0.8, and 0.3respectively. The total combined developed area being discharge to the channel is less than one acre. It

is not practicable to provide WQCV for these areas, as stated earlier in this paragraph, areas consists primarily of vegetated tracts with no development.

CHANNEL IMPROVEMENTS

Slope grading and intermittent channel bank lining has been proposed for portions of the developable areas adjacent to Sand Creek to protect the developed lots and prevent excessive erosion until the DBPS recommended Sand Creek Channel improvements are installed. The proposed slope grading is intended to reduce outer bankgrades and bring uniformity to areas where significant riling and destabilization has occurred. Proposed channel stabilization improvements includes placement of soil riprap and turf reinforcement matting along embankment toes and along embankment slopes, both of which will function to retain soils and vegetation during heavy rains or larger flood flow events. All disturbed areas, not hardscaped will be re-vegetated with native species grasses, per El Paso County erosion control standards. Storm sewer outfalls into Sand Creek shall be protected by low-tailwater riprap basins. The outfall protection is shown on the accompanying drainage map in the appendix. Refer to the Homestead Filing No.2 Grading and Erosion Control Plans for riprap and turf reinforcement map placement and construction details.

Permanently installed check structures and rip-rap channel lining will be installed within Sand Creek Channel to handle the runoff from fully developed Sterling Ranch and up-gradient watershed in accordance with the Sand Creek DBPS. A discussion regarding the timing of these channel improvements is provided in a subsequent paragraph titled Sterling Ranch Filing No. 1 Subdivision Improvement agreement which follows the Construction Costs segment of this report. Financial Assurance shall be posted for the proposed Sand Creek Channel Improvements and Bank Stabilization (Slope Protection and grade control structures).

WATER QUALITY PROVISIONS

The proposed Full Spectrum Detention Facility, Pond 1functions to provide detention storage and water quality facilityfor runoff produced onsite from tributary Basins T, U, V1, V2 and W3. This water quality facility is designed to treat 0.245 ac-ft of water quality storage (WQCV), 0.741 ac-feet of excess urban runoff volume (EURV) and1.331 ac-ft of 100-year storage. A rolled erosion control blanketed emergency spillway, concrete forebay, trickle channel and outlet structure, and gravel maintenance access road has been designed for Pond 1.

A 24" RCP pipeextending from the proposed modified 6'x2.9' CDOT Type D sump inlet (see Design Point 13) will convey discharge from the pond to Sand Creek. Runoff discharged to Sand Creek is anticipated to reach peak flow rates of Q5=0.7 cfs and Q100=23.4 cfs. A soil riprap stilling basin has been provided at the termination of the pipe to arrest erosion.

~~Runoff produced within the residential backyard lots, of Basins X1, X2, W1 and Y1 will be conveyed in backyard swales and as sheet flow to a Sand Filter Basin within each lot. The treated flows will be collected by private storm sewer systems and discharged into the Sand Creek Channel. This water quality facility, for each Sand Filter Basin, is designed to treat 0.001 ac-ft of water quality storage (WQCV), 0.005 ac-feet of excess urban runoff volume (EURV) and 0.014 ac-ft of 100-year storage.A 20' wide typical drainage easement is provided within the lots to accommodate the BMP's. The facilities constructed are to be privately maintained by the Sterling Ranch Metropolitan District. Access to maintain these sand filter basins is from the regional trail along sand creek.~~

The WQCV and EURV required for the site has been determined using the guidelines set forth in the City of Colorado Springs/El Paso County Drainage Criteria Manual - Volume II. Refer to the water quality

facility sizing calculations located within the appendix of this report(see UD-Detention Worksheet in appendix).

As previously discussed, refer to Sterling Ranch Filing Nos. 1&2 MDDP for additional information regarding existing FSD Pond 4. The previously approved FSD Pond was constructed with the Sterling Ranch Filing No. 1 construction drawings in 2018-2019.

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 (July 2019). Grading and Erosion Control will cease with the final development of the site in the next 6-12 months.

CONSTRUCTION COST OPINION – HOMESTEAD AT STERLING RANCH FIL. NO. 2

Drainage Facilities: Updated Cost Opinion included in Addendum above

Drainage improvements are planned with the development of Homestead at Sterling Ranch Filing No. 2. A majority of the construction costs have been accounted for in the "Master Development Drainage Report for Sterling Ranch Filing Nos. 1&2, and Final Drainage Report for Sterling Ranch Filing No.1" prepared by MS Civil Consultants, dated April 2017. Any additional improvements and costs are listed below.

The following list of drainage improvements are **Non-Reimbursable.** The Reimbursable facilities are outlined in the Sterling Ranch Filing No. 1 Final Drainage Report and Sterling Ranch MDDP. Refer to the MDDP for Sterling Ranch Cost and Fee Analysis Report (February 2019).

Item	Description	Quantity		Unit Cost		Cost
1.	18" RCP	31	LF	$40	/LF	$1,240.00
2.	24" RCP	127	LF	$50	/LF	$6,350.00
3.	30" RCP	998	LF	$85	/LF	$84,830.00
4.	36" RCP	8	LF	$105	/LF	$840.00
5.	42" RCP	699	LF	$185	/LF	$129,315.00
6.	24" FES	1	EA	$750	/EA	$750.00
8.	42" FES	1	EA	$1,250	/EA	$1,250.00
9.	5.0'x4.5' CDOT Type R Sump Inlet	1	EA	$4,000	/EA	$4,000.00
10.	10' CDOT Type R Sump Inlet	4	EA	$4,700	/EA	$18,800.00
11.	15' CDOT Type R At-Grade Inlet	2	EA	$6,000	/EA	$12,000.00
12.	4.0' Type II MH	1	EA	$3,500	/EA	$3,500.00
13.	5.0' Type II MH	2	EA	$4,000	/EA	$8,000.00
14.	6.0' Type II MH	1	EA	$4,500	/EA	$4,500.00
17.	5.0'x6.0' MH	2	EA	$6,500	/EA	$13,000.00
18.	5.5'x5.5' MH	1	EA	$6,500	/EA	$6,500.00
19.	Headwall/Wingwall	1	EA	$6,000	/EA	$6,000.00
20.	Full Spectrum Det. Pond 1	1	EA	$15,000	/EA	$15,000.00

~~21.~~	~~FSD Pond 1 Outlet Structure~~	~~1~~	~~EA~~	~~$12,600~~	~~/EA~~	~~$12,600.00~~
~~22.~~	~~Ind. Lot Sand Filter Basins w/6" Pipe~~	~~26~~	~~EA~~	~~$2,000~~	~~/EA~~	~~$52,000.00~~
~~23~~	~~18" Drain Basin Manholes w/Lids~~	~~27~~	~~EA~~	~~$1,000~~	~~/EA~~	~~27,000.00~~
~~24~~	~~12" ADS Pipe~~	~~1,658~~		~~$26~~	~~/LF~~	~~43,108.00~~
					~~**Total $**~~	~~**$450,583.00**~~

The following list of drainage improvements are **Reimbursable** for the improvements to the Sand Creek Channel adjacent to Homestead at Sterling Ranch Filing No.2**.** The reimbursement is up to the amount as shown in the DBPS or as adjusted through the City/EPC Drainage Board.

Sand Creek Channel Improvements

Item	**Description**	**Quantity**		**Unit Cost**			**Cost**
1.	Rip Rap Protection	390	Ton	$80	/Ton		$31,200.00
2.	Drop/Check Structures	5	EA	$75,000	/EA		$375,000.00
3.	Slope Stabilization Blankets	7,435	SY	$6	/SY		$44,610.00
						Total	$450,810.00

DRAINAGE & BRIDGE FEES – HOMESTEAD AT STERLING RANCH FIL. NO. 2

This site is within the Sand Creek Drainage Basin. The 2019 Drainageand BridgeFees per El Paso County for the HOMESTEAD AT STERLING RANCH FILING NO. 2site are as follows:

Per Homesteadat Sterling Ranch Filing No. 2 Plat – **Total Area** **29.658 Acres**

HOMESTEAD AT STERLING RANCH FILING NO. 2 FEES:

Drainage Fees:	29.658	x	46%	$	18,940.00	=	$	258,392.36
Bridge Fees:	29.658	x	46%	$	5,559.00	=	$	75,839.66
						Total	**$**	**334,232.02**

STERLING RANCH FILING NO. 1 - SUBDIVISION IMPROVEMENTS AGREEEMENT

Sterling Ranch Filing No. 1 final plat and SIA has been recorded, and addressed the following drainage improvements Not located/and located in the Sand Creek Channel. The following SIA paragraphs outlined drainage for Sterling Ranch in the following manner;

2. Drainage and Landscaping Tracts*: Improvements on Tracts A, B, F, H, I, J, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z, AA and CC as identified on the final plat of Filing No. 1 will be completed to the satisfaction of the County and District and, upon said completion, the improvements will be dedicated to and accepted by the District. Improvements on Tract D (Sand Creek) will be completed to the satisfaction of the County and upon said completion; the improvements will be dedicated to and accepted by the County. The ownership and maintenance of storm drain facilities and structures not located on the foregoing tracts shall be determined as follows. All storm pipes shall be owned and maintained by the District except where located in County road rights of way (see Paragraph 5 below), in which case the County shall own and maintain the storm drain facilities and structures, including but not limited to, inlets and manholes. A typical cross section describing the ownership and maintenance responsibilities of drainage improvements within County rights of way is attached as Exhibit C hereto.*

7. Timing of Construction and Acceptance*:*

a. ***Drainage Improvements Not Located in Sand Creek Channel****: Except as set forth below in subsection 6.b. (drainage improvements located in Sand Creek Channel), all drainage improvements described in Exhibit A and constructed within the Drainage and Landscaping Tracts identified in paragraph 2 above shall be completed by the*

Subdivider and District, meeting all applicable standards for preliminary acceptance, prior to the recording of the first replat of Tracts C, E, G, K or BB. In the event that a portion of the drainage improvements are not completed prior to the recording of the first replat, then prior to such recording collateral sufficient in the opinion of the County to assure completion of the improvements must be posted by the Subdivider and a deadline by which such drainage improvements shall be completed shall be established by written agreement.

b. ***Drainage Improvements Located in Sand Creek Channel (Tract D):*** *The District agrees that it will construct or cause the construction of all drainage improvements to be located in Tract D as well as future tracts within Sterling Ranch containing the Sand Creek Channel in accordance with the following:*

i. Bank stabilization of the Sand Creek channel shall be required prior to any replats or other final plats adjacent to the channel. The design and installation of said improvements shall be accomplished and guaranteed through the normal subdivision review and collateralization process.

ii. Other drainage improvements in Tract D and future tracts containing the Sand Creek Channel, such as drop structures, check structures and similar stabilization or protection improvements, will be designed and constructed by the District with the final construction drawings to be approved by the County no later than the final platting of the 700th single family lot within the boundaries of the approved Sterling Ranch Sketch Plan and the completion of all said improvements no later than the 800th single family lot with the boundaries of the approved Sterling Ranch Sketch Plan.

iii. In order to assure completion of the drainage improvements required in Subsection 6.b.ii above as well as a fair apportionment of the costs of said drainage improvements amongst adjacent Sterling Ranch subdividers, the District agrees to establish a Sand Creek Channel Drainage Fee to be paid into a District Escrow Fund by adjacent subdividers at the time of final platting. The amount of the fee shall be a minimum of One Thousand Dollars ($1,000.00) per single family lot. The details of the proposed Sand Creek Channel Drainage Fee and the District Escrow Fund shall be agreed to by the parties in advance of the submittal of the first replat of or subdivision of the Master Pad Sites or other property located within Sterling Ranch.

A full copy of the recorded SIA is located in the files of El Paso County and EPC Clerk and Recorders office under Reception No. 218714151

SUMMARY

Development of this site will not adversely affect the surrounding development per this final drainage report with no negative impactsto the neighboring developments.The existingand proposed drainage facilities will adequately convey, detain and route runoff fromtributary and onsite flows to the Sand Creek Drainage channel. Full Spectrum Detention and Water Quality Ponds will be used to discharge developed flows into Sand Creek per the Urban Drainage criteria flow rates, which are at or less than the historic flow. Care will be taken during construction to accommodate overland flow routes onsite and temporary drainage conditions. The development of the HOMESTEAD AT STERLING RANCH FILING NO. 2project(s)shall not adversely affect adjacent or downstream property.

REFERENCES

1.) "El Paso County and City of Colorado Springs Drainage Criteria Manual, Vol I & II".

2.) "Urban Storm Drainage Criteria Manuals, Volumes 1-3"

3.) NRSC Web Soil Survey Map for El Paso County. http://websoilsurvey.nrcs.usda.gov

4.) Flood Insurance Rate Map (FIRM), Federal Emergency Management Agency, Effective date December 7, 2018.

5.) "Sand Creek Drainage Basin Planning Study" (DBPS) prepared by Kiowa Corporation, revised March 1996

6.) "Sterling Ranch-Phase 1 Offsite Grading, Early Grading & Erosion Control Plans", prepared by M&S Civil Consultants, Inc., dated November 2015

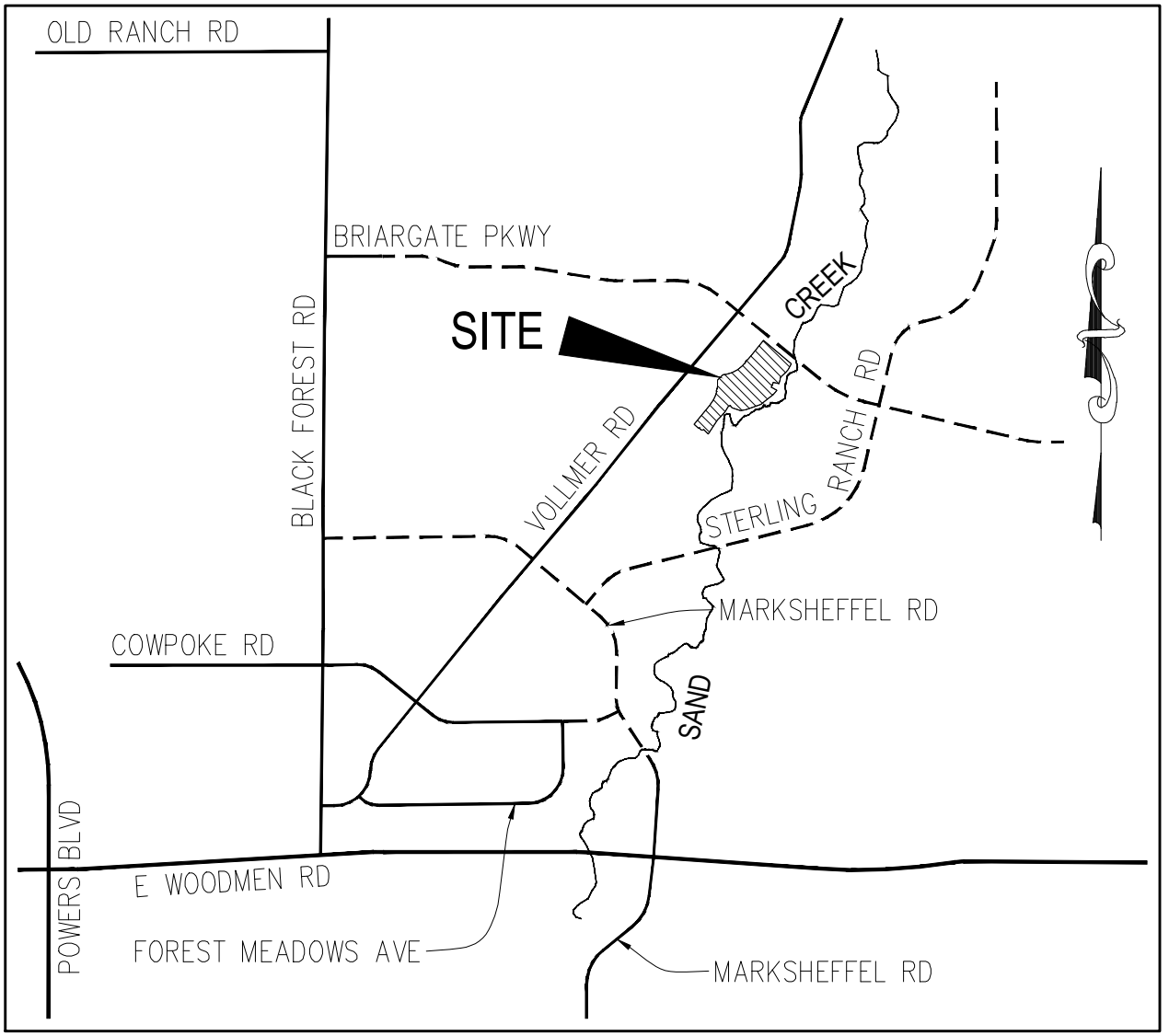
7.) "Sterling Ranch-Phase 1 Onsite Grading, Early Grading & Erosion Control Plans", prepared by M&S Civil Consultants, Inc., dated November 2015

8.) "Master Development Drainage Report for Sterling Ranch Filing Nos. 1&2 and Final Drainage Report for Sterling Ranch Filing No. 1", prepared by M&S Civil Consultants, Inc., dated April 2017

9.) "Sterling Ranch Filing Nos. 1&2 MDDP" prepared by MS Civil Consultants, Inc., dated October 2018.

APPENDIX

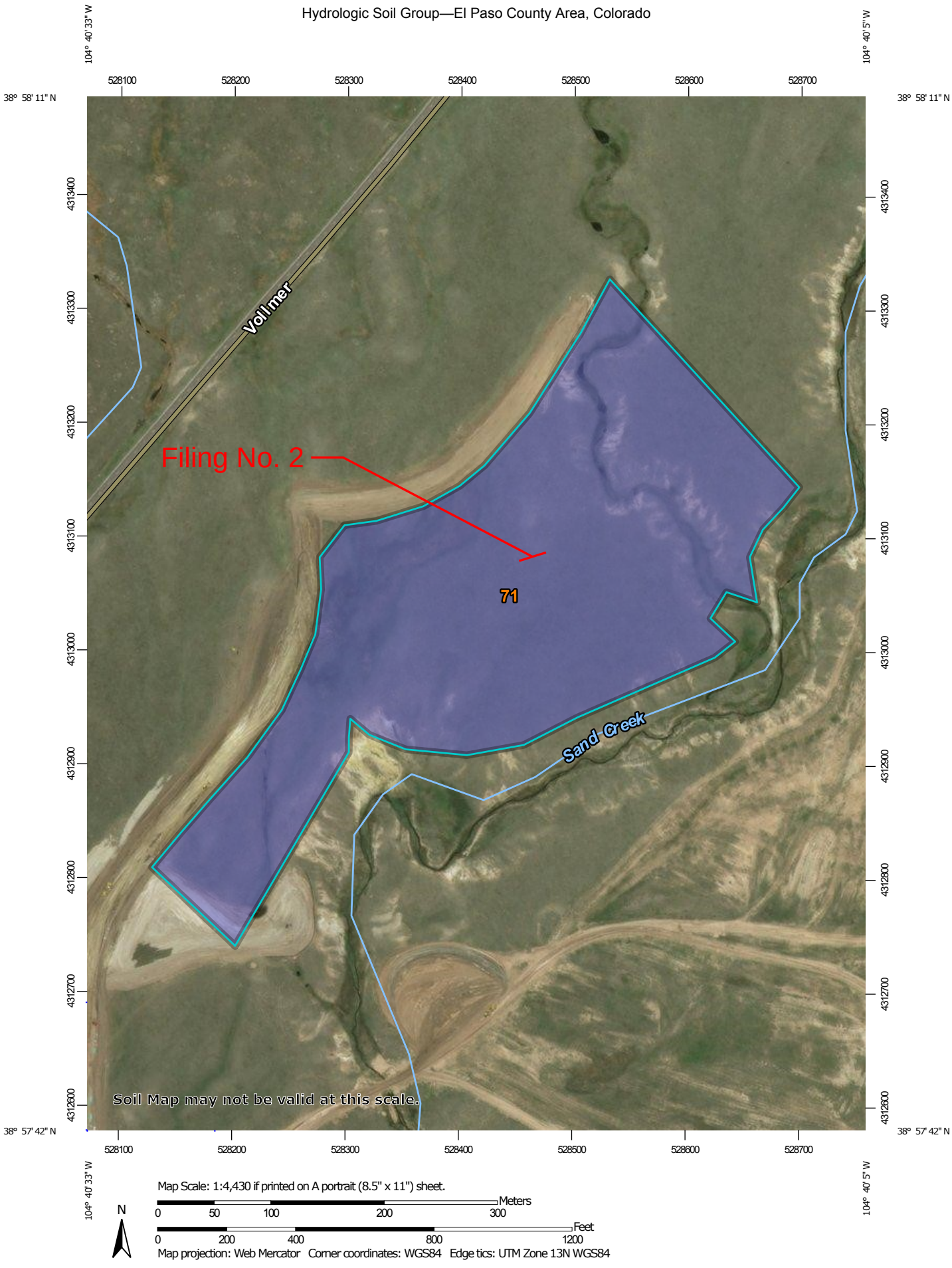
VICINITY MAP



VICINITY MAP

N.T.S.

SOILS MAP



Map Scale: 1:4,430 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 200 400 800 1200

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 15, Oct 10, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: May 22, 2016—Mar 9, 2017

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
71	Pring coarse sandy loam, 3 to 8 percent slopes	B	29.0	100.0%
Totals for Area of Interest			**29.0**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

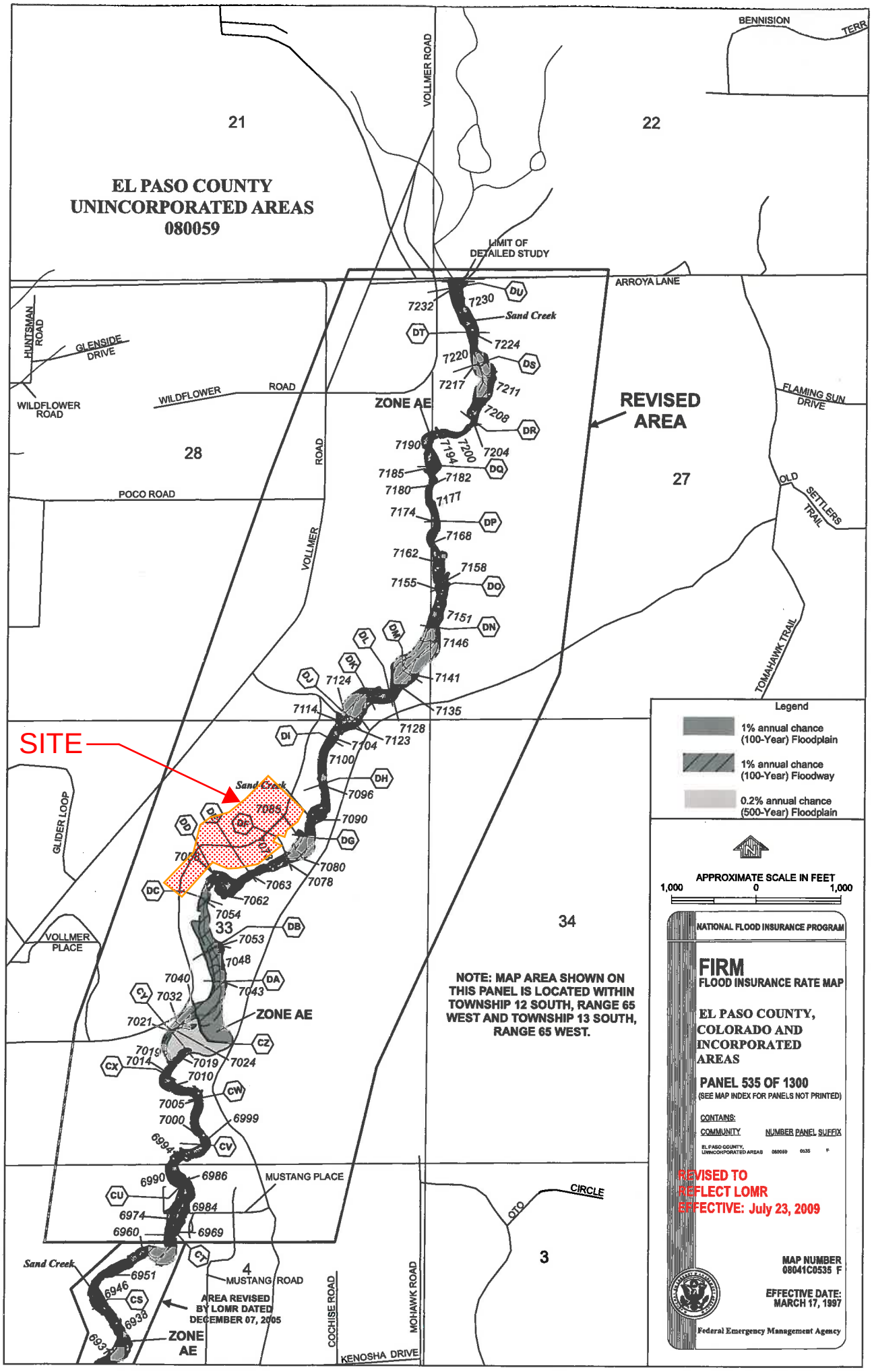
Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

FIRM PANEL W/ REVISED LOMR


EL PASO COUNTY
UNINCORPORATED AREAS
080059
21
22
28
27
34
3
4
33
VOLLMER ROAD
BENNISION TERR
LIMIT OF DETAILED STUDY
ARROYA LANE
HUNTSMAN ROAD
GLENSIDE DRIVE
WILDFLOWER ROAD
WILDFLOWER ROAD
POCO ROAD
VOLLMER ROAD
VOLLMER
REVISED AREA
FLAMING SUN DRIVE
OLD SETTLERS TRAIL
TOMAHAWK TRAIL
ZONE AE
Sand Creek
SITE
GLIDER LOOP
VOLLMER PLACE
ZONE AE
MUSTANG PLACE
MUSTANG ROAD
CIRCLE
OTO
COCHISE ROAD
MOHAWK ROAD
KENOSHA DRIVE
AREA REVISED BY LOMR DATED DECEMBER 07, 2005
ZONE AE
NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 12 SOUTH, RANGE 65 WEST AND TOWNSHIP 13 SOUTH, RANGE 65 WEST.
Legend
1% annual chance (100-Year) Floodplain
1% annual chance (100-Year) Floodway
0.2% annual chance (500-Year) Floodplain
APPROXIMATE SCALE IN FEET
1,000 0 1,000
NATIONAL FLOOD INSURANCE PROGRAM
FIRM
FLOOD INSURANCE RATE MAP
EL PASO COUNTY, COLORADO AND INCORPORATED AREAS
PANEL 535 OF 1300
(SEE MAP INDEX FOR PANELS NOT PRINTED)
CONTAINS:
COMMUNITY NUMBER PANEL SUFFIX
EL PASO COUNTY, UNINCORPORATED AREAS 080059 0535 F
REVISED TO REFLECT LOMR EFFECTIVE: July 23, 2009
MAP NUMBER 08041C0535 F
EFFECTIVE DATE: MARCH 17, 1997
Federal Emergency Management Agency

National Flood Hazard Layer FIRMette

FEMA

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN — Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 / 17.5 — Cross Sections with 1% Annual Chance / Water Surface Elevation
- Coastal Transect
- 513 — Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 1/23/2019 at 7:09:44 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

Questions concerning the VERTCON process may be mailed to NGS

Latitude: 38.964784

Longitude: 104.67180

NGVD 29 height:

Datum shift(NAVD 88 minus NGVD 29): 1.196 meter

1.196 meters = 3.92 feet

NAVD88 - 3.92 feet = NGVD29

STORM 4 Outfall to Sand Creek Channel

Cross Section DE = 7071.8 NAVD88

7071.8 NAVD88 - 3.92 feet = 7067.88 NGVD29

HYDROLOGIC CALCULATIONS

HOMESTEAD AT STERLING RANCH FILING NO. 2
FINAL DRAINAGE REPORT
(Area Drainage Summary)

From Area Runoff Coefficient Summary				*OVERLAND*				*STREET / CHANNEL FLOW*				*Time of Travel (T_t)*		*INTENSITY ***		*TOTAL FLOWS*	
BASIN	**AREA TOTAL** *(Acres)*	C_5 *From DCM Table 5-1*	C_{100}	C_5	**Length** *(ft)*	**Height** *(ft)*	T_C *(min)*	**Length** *(ft)*	**Slope** *(%)*	**Velocity** *(fps)*	T_t *(min)*	**TOTAL** *(min)*	**CHECK** *(min)*	I_5 *(in/hr)*	I_{100} *(in/hr)*	Q_5 *(c.f.s.)*	Q_{100} *(c.f.s.)*
Proposed Area Drainage Summary																	
ONSITE BASINS																	
J	0.43	0.22	0.46	0.22	90	1.8	12.0	0	2.0%	3.0	0.0	12.0	10.5	4.1	6.8	***0.4***	***1.3***
K	0.61	0.22	0.46	0.22	75	1.5	10.9	0	2.0%	3.0	0.0	10.9	10.4	4.1	6.8	***0.5***	***1.9***
P	4.42	0.38	0.55	0.38	100	2	10.3	1100	2.5%	3.0	6.0	16.4	16.7	3.4	5.7	***5.7***	***13.8***
Q	3.78	0.38	0.55	0.38	100	2	10.3	1100	2.5%	3.0	6.0	16.4	16.7	3.4	5.7	***4.9***	***11.8***
R	1.57	0.38	0.55	0.38	100	2	10.3	450	1.6%	3.0	2.5	12.8	13.1	3.8	6.3	***2.2***	***5.4***
T	9.14	0.30	0.50	0.30	100	2	11.5	942	2.1%	3.0	5.2	16.7	15.8	3.4	5.8	***9.4***	***26.4***
U	4.50	0.38	0.55	0.38	100	2	10.3	457	1.5%	3.0	2.5	12.9	13.1	3.8	6.3	***6.4***	***15.6***
V1	1.48	0.38	0.55	0.38	100	2	10.3	600	2.0%	3.0	3.3	13.6	13.9	3.7	6.2	***2.1***	***5.0***
V2	0.83	0.38	0.55	0.38	100	2	10.3	360	1.6%	3.0	2.0	12.3	12.6	3.8	6.4	***1.2***	***2.9***
W1	0.86	0.22	0.46	0.22	80	6	7.3	0	0.0%	2.3	0.0	7.3	10.4	4.6	7.7	***0.9***	***3.1***
W2	0.26	0.08	0.35	0.08	35	8	3.9	0	0.3%	2.3	0.0	5.0	10.2	5.2	8.7	***0.1***	***0.8***
W3	0.56	0.08	0.35	0.08	35	8	3.9	160	0.5%	2.3	1.2	5.1	11.1	5.2	8.7	***0.2***	***1.7***
X	0.22	0.22	0.46	0.22	80	6	7.3	0	2.5%	2.3	0.0	7.3	10.4	4.6	7.7	***0.2***	***0.8***
X1	0.78	0.22	0.46	0.22	80	6	7.3	0	2.5%	2.3	0.0	7.3	10.4	4.6	7.7	***0.8***	***2.8***
X2	1.04	0.22	0.46	0.22	80	6	7.3	0	2.5%	2.3	0.0	7.3	10.4	4.6	7.7	***1.1***	***3.7***
Y	0.09	0.22	0.46	0.22	80	6	7.3	0	2.5%	2.3	0.0	7.3	10.4	4.6	7.7	***0.1***	***0.3***
Y1	0.84	0.22	0.46	0.22	80	6	7.3	0	2.5%	2.3	0.0	7.3	10.4	4.6	7.7	***0.8***	***3.0***
Y2	0.21	0.22	0.46	0.22	80	6	7.3	0	2.5%	2.3	0.0	7.3	10.4	4.6	7.7	***0.2***	***0.7***
OFFSITE BASINS*																	
B*	5.39	0.38	0.55	0.38	60	1.2	8.0	1381	2.8%	3.0	7.6	16.3	18.0	3.4	5.7	***8.0***	***19.3***
C*	2.92	0.38	0.55	0.38	100	1.2	12.2	411	3.0%	3.0	2.3	14.5	12.8	3.8	6.3	***4.2***	***10.1***
D*	2.90	0.38	0.55	0.38	100	2	10.3	245	2.1%	3.0	1.3	11.7	11.9	3.9	6.5	***4.3***	***10.4***
E*	5.34	0.38	0.55	0.38	100	2	10.3	61	3.3%	3.0	0.3	10.7	10.9	4.0	6.8	***8.2***	***19.9***
F*	1.12	0.90	0.96	0.90	10	0.2	0.9	1525	2.8%	3.0	8.4	9.3	18.5	4.2	7.1	***4.3***	***7.7***
G*	0.61	0.22	0.46	0.22	100	2	12.6	0	2.2%	3.0	0.0	12.6	10.6	4.0	6.8	***0.5***	***1.9***
H*	0.19	0.90	0.96	0.90	10	0.2	0.9	280	2.1%	3.0	1.5	5.0	11.6	5.2	8.7	***0.9***	***1.6***
I*	2.10	0.90	0.96	0.90	10	0.2	0.9	1082	2.5%	3.0	5.9	6.9	16.1	4.7	7.9	***8.9***	***15.9***
L*	1.54	0.90	0.96	0.90	10	0.2	0.9	1805	2.1%	3.0	9.9	10.8	20.1	4.0	6.7	***5.6***	***10.0***
S*	1.97	0.08	0.35	0.08	60	10	5.6	270	0.5%	2.3	2.0	7.6	11.8	4.5	7.6	***0.7***	***5.3***

* For detailed information on Desing Points, Basins, Flowby, or Pipe Runs see Sterling Ranch Filing Nos. 1&2 MDDP prepared by MS Civil Consultants, dated April 2017

** Intensity equations assume a minimum travel time of 5 minutes.

Calculated by: ET/CMN
Date: 1/14/2020
Checked by: VAS

HOMESTEAD AT STERLING RANCH FILING NO. 2
FINAL DRAINAGE REPORT
(Basin Routing Summary)

From Area Runoff Coefficient Summary				*OVERLAND*				*PIPE / CHANNEL FLOW*				*Time of Travel (T_t)*	*INTENSITY* **		*TOTAL FLOWS*		
DESIGN POINT	**CONTRIBUTING BASINS**	**CA_5**	**CA_{100}**	**C_5**	**Length** *(ft)*	**Height** *(ft)*	**T_C** *(min)*	**Length** *(ft)*	**Slope** *(%)*	**Velocity** *(fps)*	**T_t** *(min)*	**TOTAL** *(min)*	**I_5** *(in/hr)*	**I_{100}** *(in/hr)*	**Q_5** *(c.f.s.)*	**Q_{100}** *(c.f.s.)*	COMMENTS
PROPOSED DRAINAGE BASIN ROUTING SUMMARY																	
2*	**B***	2.34	3.39									16.3	3.4	5.7	***8.0***	***19.3***	(2) EX. 15' AT-GRADE INLETS
3*	**C***	1.11	1.61									12.8	3.8	6.3	***4.2***	***10.1***	EX. 6' SUMP INLET
4*	**D*, E*, F***	4.14	5.61									11.7	3.9	6.5	***16.1***	***36.7***	EX. 15' AT-GRADE INLET
5*	**G*, H*, FLOWBY DP4***	1.07	3.02									11.7	3.9	6.5	***4.2***	***19.7***	EX. 15' AT-GRADE INLET
6*	**I*, J, K, L***	3.50	3.97									10.8	4.0	6.7	***14.1***	***26.7***	EX. 15' AT-GRADE INLET
7	**P**	1.68	2.43									16.4	3.4	5.7	***5.7***	***13.8***	PROP. 10' SUMP INLET
8	**Q**	1.44	2.08									16.4	3.4	5.7	***4.9***	***11.8***	PROP. 10' SUMP INLET
9	**R**	0.60	0.86									12.8	3.8	6.3	***2.2***	***5.4***	PROP. 10' SUMP INLET
10	**T**	2.74	2.69									15.8	3.4	5.8	***9.4***	***15.6***	PROP. 15' AT-GRADE INLET Total CA100=3.86 Split Between DP10 & DP11 For Crown Overflow
11	**V1**	0.56	2.69									15.8	3.4	5.8	***1.9***	***15.6***	PROP. 15' AT-GRADE INLET Total CA100=3.86 Split Between DP10 & DP11 For Crown Overflow
12	**U, FLOWBY DP10**	1.80	2.98									15.8	3.4	5.8	***6.2***	***17.2***	PROP. 10' SUMP INLET
13	**V2, FLOWBY DP11**	0.32	0.96									13.6	3.7	6.2	***1.2***	***5.9***	PROP. MODIFIED 5'x4.5' SUMP INLET
14	**W3, PR9**	5.35	8.52									13.6	3.7	6.2	***19.6***	***52.4***	CUMULATIVE DETENTION POND

* For detailed information on Desing Points, Basins, Flowby, or Pipe Runs see Sterling Ranch Filing Nos. 1&2 MDDP prepared by MS Civil Consultants, dated April 2017

** Intensity equations assume a minimum travel time of 5 minutes.

Calculated by: ET/CMN
Date: 1/14/2020
Checked by: VAS

HOMESTEAD AT STERLING RANCH FILING NO. 2
DRAINAGE CALCULATIONS
(Storm Sewer Routing Summary)

PIPE RUN	*Contributing Pipes/Design Points*	*Equivalent CA_5*	*Equivalent CA_{100}*	*Maximum T_C*	*Intensity***		*Flow*		PIPE SIZE
					I_5	*I_{100}*	*Q_5*	*Q_{100}*	
1	**DP7**	1.68	2.43	16.4	3.4	5.7	*5.7*	*13.8*	24" RCP
2	**DP8**	1.44	2.08	16.4	3.4	5.7	*4.9*	*11.8*	18" RCP
3	**PR1, PR2**	3.12	4.51	16.4	3.4	5.7	*10.6*	*25.7*	24" RCP
4	**DP9, PR3**	3.71	5.37	17.0	3.3	5.6	*12.4*	*30.1*	30" RCP
5	**DP10**	2.64	2.20	15.8	3.4	5.8	*9.1*	*12.7*	18" RCP
6	**DP11**	0.55	2.20	15.8	3.4	5.8	*1.9*	*12.7*	18" RCP
7	**PR5, PR6**	3.19	4.39	16.0	3.4	5.7	*10.9*	*25.3*	30" RCP
8	**DP12**	1.80	2.98	15.8	3.4	5.8	*6.2*	*17.2*	24" RCP
9	**DP13, PR7, PR8**	5.31	8.33	16.6	3.4	5.7	*17.9*	*47.1*	42" RCP
10	**UD-Detention _v3.07**						*0.7*	*23.4*	Outlet Structure & 18" CMP
11	**Pipe Run continued from MDDP DP15* to Sand Creek. Flow values are that of MDDP Pipe Run 15* (PR15*).**						*42.1*	*76.8*	42" RCP
~~*12*~~	~~**Lots 36-41**~~						~~*0.0*~~	~~*1.3*~~	~~12" ADS~~
~~*13*~~	~~**Lots 28-35**~~						~~*0.0*~~	~~*1.6*~~	~~12" ADS~~
~~*14*~~	~~**Lots 19-24**~~						~~*0.0*~~	~~*1.5*~~	~~12" ADS~~
~~*15*~~	~~**Lots 13-18**~~						~~*0.0*~~	~~*1.4*~~	~~12" ADS~~

* For detailed information on Desing Points, Basins, Flowby, or Pipe Runs see Sterling Ranch Filing Nos. 1&2 MDDP prepared by MS Civil Consultants, dated April 2017

** Intensity equations assume a minimum travel time of 5 minutes.

DP - Design Point
EX - Existing Design Point
FB- Flow By from Design Point
INT- Intercepted Flow from Design Point

Calculated by: CMN
Date: 1/14/2020
Checked by: VAS

Updated SF-3 routing for Basins X1, X2, W1, & Y1 included in Addendum above.

HYDRAULIC CALCULATIONS

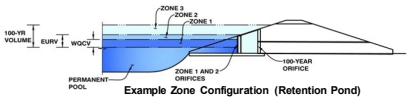
Weighted Percent Imperviousness of FSD Pond 1				
Contributing Basins	***Area (Acres)***	***C_5***	***Impervious % (I)***	***(Acres)*(I)***
T	9.14	0.30	40	365.60
U	4.50	0.38	53	238.50
V1	1.48	0.38	53	78.44
V2	0.83	0.38	53	43.99
W1	0.56	0.08	2	1.12
Totals	***16.51***			***727.65***
Imperviousness of FSD Pond 1	***44.1***	**%**		

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: Homestead At Sterling Ranch Filings Nos. 2

Basin ID: FSD Pond 1



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	EDB	
Watershed Area =	16.51	acres
Watershed Length =	875	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	44.10%	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) =	0.262	acre-feet
Excess Urban Runoff Volume (EURV) =	0.771	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.614	acre-feet
5-yr Runoff Volume (P1 = 1.5 in.) =	0.847	acre-feet
10-yr Runoff Volume (P1 = 1.75 in.) =	1.177	acre-feet
25-yr Runoff Volume (P1 = 2 in.) =	1.710	acre-feet
50-yr Runoff Volume (P1 = 2.25 in.) =	2.073	acre-feet
100-yr Runoff Volume (P1 = 2.52 in.) =	2.550	acre-feet
500-yr Runoff Volume (P1 = 0 in.) =	0.000	acre-feet
Approximate 2-yr Detention Volume =	0.574	acre-feet
Approximate 5-yr Detention Volume =	0.795	acre-feet
Approximate 10-yr Detention Volume =	1.075	acre-feet
Approximate 25-yr Detention Volume =	1.190	acre-feet
Approximate 50-yr Detention Volume =	1.247	acre-feet
Approximate 100-yr Detention Volume =	1.412	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

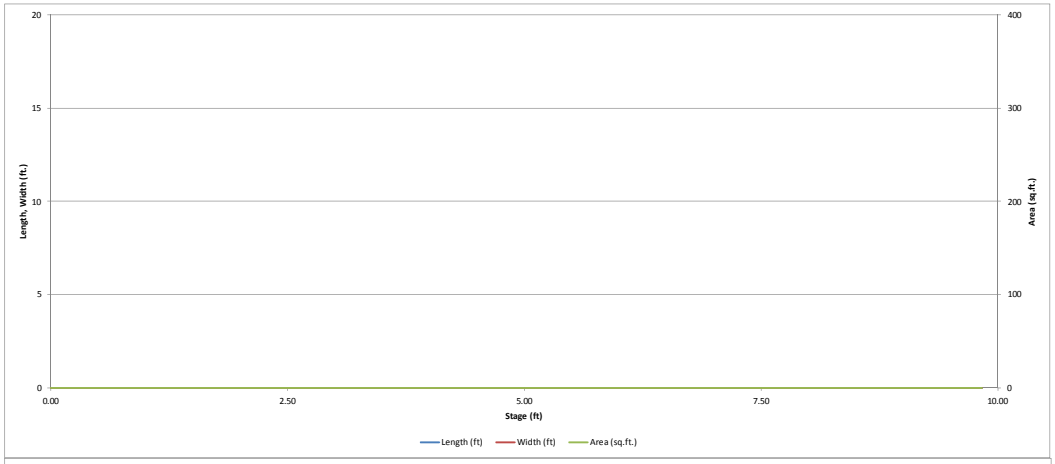
Zone 1 Volume (WQCV) =	0.262	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.508	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.642	acre-feet
Total Detention Basin Volume =	1.412	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (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

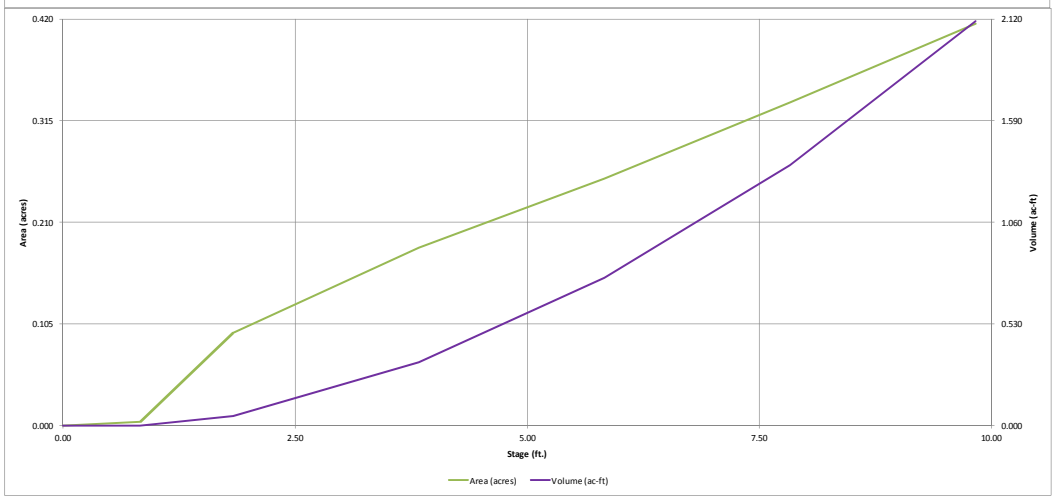
Depth Increment = ft

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)
76.17 **Top of Micropool**	--	0.00	--	--	--	0	0.000		
76.4	--	0.33	--	--	--	40	0.001	7	0.000
77	--	0.83	--	--	--	100	0.002	40	0.001
78.00	--	1.83	--	--	--	4,187	0.096	2,143	0.049
80.00	--	3.83	--	--	--	8,006	0.184	14,378	0.330
82.00	--	5.83	--	--	--	11,106	0.255	33,490	0.769
84.00	--	7.83	--	--	--	14,529	0.334	59,125	1.357
86.00	--	9.83	--	--	--	18,087	0.415	91,741	2.106

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)



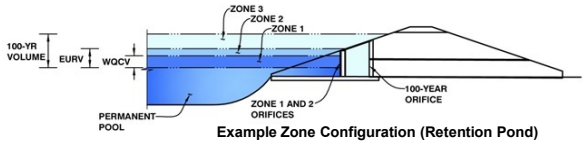


Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project:

Basin ID:



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.45	0.262	Orifice Plate
Zone 2 (EURV)	5.84	0.508	Orifice Plate
Zone 3 (100-year)	8.00	0.642	Weir&Pipe (Restrict)
		1.412	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 =	5.84	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	23.40	inches
Orifice Plate: Orifice Area per Row =	1.19	sq. inches (diameter = 1-3/16 inches)

Calculated Parameters for Plate

WQ Orifice Area per Row =	8.264E-03	ft^2
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft^2

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.95	3.89					
Orifice Area (sq. inches)	1.19	1.19	1.19					

	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 =	5.84	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	6.00	N/A	feet
Overflow Weir Slope =	3.00	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 =	6.81	N/A	feet
Over Flow Weir Slope Length =	3.07	N/A	feet
Grate Open Area / 100-yr Orifice Area =	7.21	N/A	should be ≥ 4
Overflow Grate Open Area w/o Debris =	12.88	N/A	ft^2
Overflow Grate Open Area w/ Debris =	6.44	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 =	0.25	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	24.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	13.30		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	1.79	N/A	ft^2
Outlet Orifice Centroid =	0.63	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	1.68	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	7.80	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	17.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

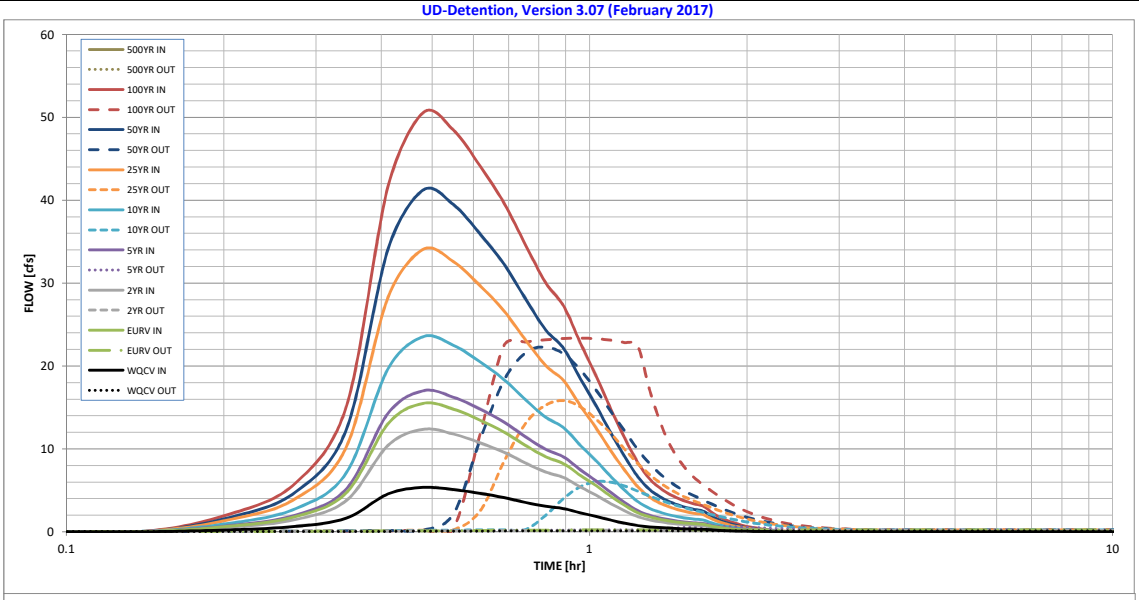
Spillway Design Flow Depth=	0.89	feet
Stage at Top of Freeboard =	9.69	feet
Basin Area at Top of Freeboard =	0.41	acres

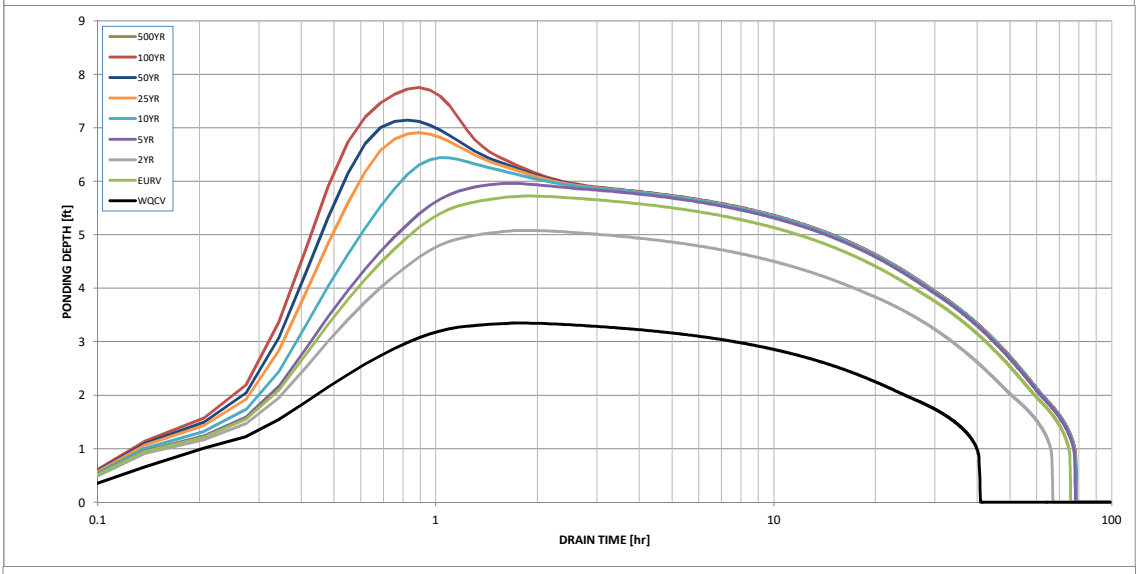
Routed Hydrograph Results

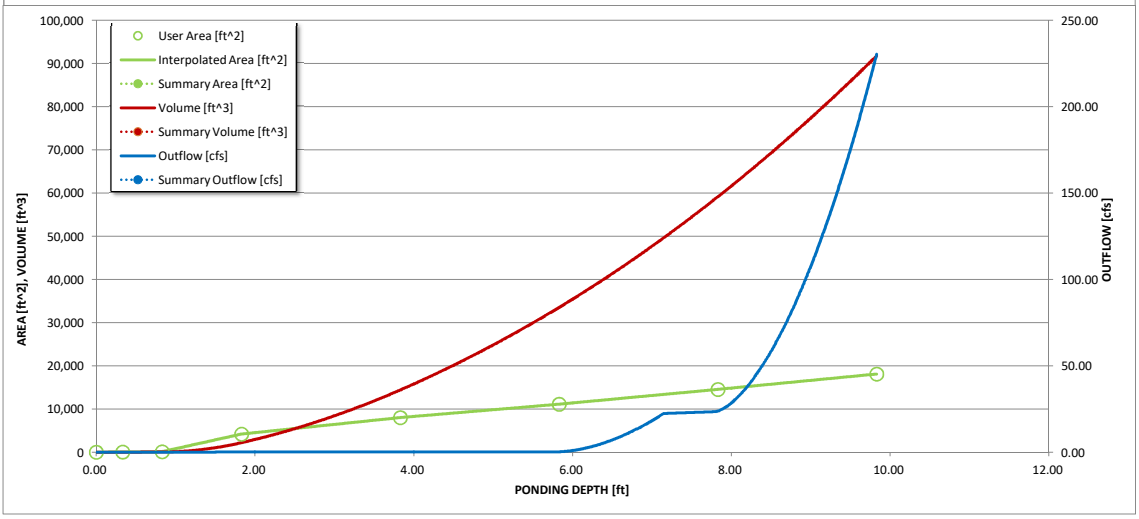
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	0.00
Calculated Runoff Volume (acre-ft) =	0.262	0.771	0.614	0.847	1.177	1.710	2.073	2.550	0.000
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.262	0.771	0.614	0.847	1.176	1.710	2.074	2.551	#N/A
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.02	0.03	0.27	0.84	1.16	1.55	0.00
Predevelopment Peak Q (cfs) =	0.0	0.0	0.3	0.4	4.4	13.9	19.2	25.5	0.0
Peak Inflow Q (cfs) =	5.3	15.5	12.4	17.0	23.5	34.1	41.2	50.5	#N/A
Peak Outflow Q (cfs) =	0.1	0.2	0.2	0.7	6.0	15.8	22.3	23.4	#N/A
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.5	1.4	1.1	1.2	0.9	#N/A
Structure Controlling Flow =	Plate	Plate	Plate	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Outlet Plate 1	Outlet Plate 1	#N/A
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.0	0.4	1.2	1.7	1.8	#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) =	39	69	62	71	69	66	63	61	#N/A
Time to Drain 99% of Inflow Volume (hours) =	**40**	73	65	76	75	74	73	72	#N/A
Maximum Ponding Depth (ft) =	3.35	5.72	5.08	5.96	6.44	6.91	7.15	7.75	#N/A
Area at Maximum Ponding Depth (acres) =	0.16	0.25	0.23	0.26	0.28	0.30	0.31	0.33	#N/A
Maximum Volume Stored (acre-ft) =	0.245	0.741	0.588	0.802	0.932	1.067	1.137	1.331	#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			

Detention Basin Outlet Structure Design

Outflow Hydrograph Workbook Filename:

Storm Inflow Hydrographs **UD-Detention, Version 3.07 (February 2017)**

The user can override the calculated inflow hydrographs from this workbook with inflow hydrographs developed in a separate program.

Time Interval	SOURCE	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	#N/A
	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]
4.12 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	0:04:07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
Hydrograph	0:08:14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
Constant	0:12:22	0.24	0.68	0.55	0.75	1.03	1.47	1.77	2.15	#N/A
1.214	0:16:29	0.64	1.85	1.48	2.02	2.79	4.01	4.84	5.91	#N/A
	0:20:36	1.65	4.74	3.79	5.20	7.16	10.30	12.42	15.18	#N/A
	0:24:43	4.55	13.03	10.43	14.28	19.66	28.29	34.10	41.64	#N/A
	0:28:50	5.34	15.51	12.37	17.02	23.54	34.08	41.22	50.54	#N/A
	0:32:58	5.08	14.81	11.80	16.25	22.50	32.61	39.48	48.45	#N/A
	0:37:05	4.62	13.48	10.75	14.80	20.49	29.69	35.94	44.09	#N/A
	0:41:12	4.11	12.05	9.59	13.23	18.35	26.64	32.27	39.64	#N/A
	0:45:19	3.53	10.41	8.28	11.44	15.90	23.13	28.07	34.53	#N/A
	0:49:26	3.08	9.07	7.22	9.96	13.83	20.09	24.40	30.06	#N/A
	0:53:34	2.79	8.22	6.54	9.03	12.54	18.22	22.11	27.22	#N/A
	0:57:41	2.28	6.79	5.39	7.47	10.41	15.18	18.44	22.73	#N/A
	1:01:48	1.84	5.56	4.40	6.12	8.55	12.50	15.21	18.77	#N/A
	1:05:55	1.40	4.29	3.39	4.73	6.64	9.78	11.93	14.77	#N/A
	1:10:02	1.02	3.21	2.52	3.54	5.01	7.43	9.10	11.31	#N/A
	1:14:10	0.75	2.32	1.83	2.56	3.64	5.45	6.70	8.37	#N/A
	1:18:17	0.59	1.79	1.42	1.97	2.79	4.15	5.08	6.32	#N/A
	1:22:24	0.48	1.47	1.16	1.62	2.29	3.38	4.13	5.12	#N/A
	1:26:31	0.41	1.25	0.99	1.38	1.94	2.86	3.49	4.32	#N/A
	1:30:38	0.36	1.10	0.87	1.21	1.70	2.50	3.05	3.77	#N/A
	1:34:46	0.33	0.99	0.78	1.09	1.52	2.24	2.73	3.38	#N/A
	1:38:53	0.30	0.91	0.72	1.00	1.40	2.06	2.51	3.10	#N/A
	1:43:00	0.22	0.67	0.53	0.73	1.03	1.52	1.85	2.29	#N/A
	1:47:07	0.16	0.49	0.39	0.54	0.75	1.11	1.35	1.67	#N/A
	1:51:14	0.12	0.36	0.28	0.40	0.55	0.81	0.99	1.23	#N/A
	1:55:22	0.09	0.26	0.21	0.29	0.41	0.60	0.74	0.91	#N/A
	1:59:29	0.06	0.19	0.15	0.21	0.30	0.44	0.53	0.66	#N/A
	2:03:36	0.04	0.13	0.11	0.15	0.21	0.31	0.38	0.47	#N/A
	2:07:43	0.03	0.10	0.08	0.11	0.15	0.23	0.28	0.34	#N/A
	2:11:50	0.02	0.06	0.05	0.07	0.10	0.15	0.19	0.24	#N/A
	2:15:58	0.01	0.04	0.03	0.04	0.06	0.10	0.12	0.15	#N/A
	2:20:05	0.00	0.02	0.01	0.02	0.03	0.05	0.06	0.08	#N/A
	2:24:12	0.00	0.01	0.00	0.01	0.01	0.02	0.03	0.04	#N/A
	2:28:19	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	#N/A
	2:32:26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	2:36:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	2:40:41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	2:44:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	2:48:55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	2:53:02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	2:57:10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:01:17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:05:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:09:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:13:38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:17:46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:21:53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:26:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:30:07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:34:14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:38:22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:42:29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:46:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:50:43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:54:50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:58:58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:03:05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:07:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:11:19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:15:26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:19:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:23:41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:27:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:31:55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:36:02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:40:10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:44:17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:48:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:52:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:56:38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A

MS CIVIL CONSULTANTS, INC.

20 BOULDER CRESCENT, STE 110
COLORADO SPRINGS, CO 80903
(719) 955-5485

PROJECT: Homestead Filing No. 2

DATE:

Micropool Surface Area

Tributary Area = 16.51 AC
Imperviousness = 44.1%

TIA I x A
(0.441 x 16.51)

TIA = 7.3 ~ 8.0

From Micropool Sizing Chart (SA) Micropool SA = 40 sf →

Forebay Volume for FSD Pond

Tributary Area = 16.51 AC
Min. Forebay Volume = 3.0% of WQCV (UDFCD T-5, EDB-4)
WQCV for FSD Pond = 0.262 Ac-Ft
Total Volume Req'd. = $0.03(0.262)\frac{43560}{1\ \text{AC-FT}}$ = 342 cf

Area = 283 − 7 (wall) = 276 sf

276 x 1.25 ht = 345 > 342 Forebay 15" depth →
(forebay area) (depth) (volume provided)

Size notch in forebay to accomodate 2% of 100 yr. (UDFCD T-5 EDB)
Q_{100} = 47.1 cfs ⇒ 0.02 x 47.1 = 0.94

Using Ref. Weir Eqn. $Q = \frac{3.247\,L \cdot H^{1.48} - 0.566 \cdot L^{1.9}}{1 + 2L^{1.87}}\,H^{1.9}$

Solve for L = 2.6" Q = 0.94

Use a 2.6" notch →

CIVIL CONSULTANTS, INC.
20 BOULDER CRESCENT, STE 110
COLORADO SPRINGS, CO 80903
(719) 955-5485

PROJECT: Homestead Filing No. 2

DATE:

Riprap Apron For Pond 1

Riprap Sizing

$Q_{100} = 47.1$ cfs (Pipe Run 9)

$D_c = 42" = 3.5'$

$\frac{Q}{D^{2.5}} < 6$ Then use Figure 9-38 (UDFCD Vol. 2)

$\frac{47.1}{(3.5)^{2.5}} = 2.05 < 6$ Therefore use Figure 9-38 and $Y_s/D_c = 0.40$ & $\frac{Q}{D^{1.5}} = \frac{47.1}{(3.5)^{1.5}} = 7.19$

Use Type L $D_{50} = 9"$

Riprap Depth

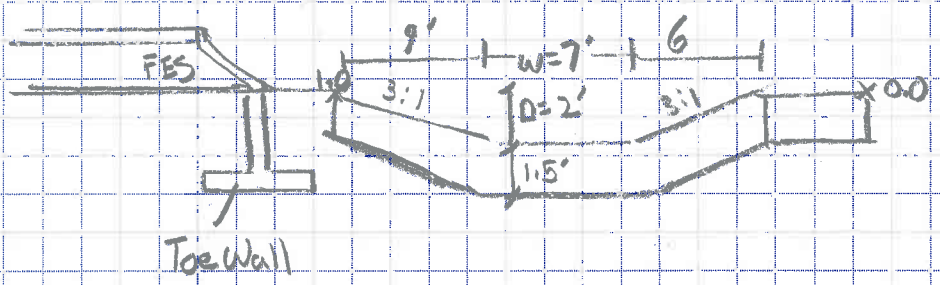
$T = 2D_{50}$

$= 2(9")$

$T = 18"$ or $1.5'$

Low Tailwater Riprap Basin

42" Pipe

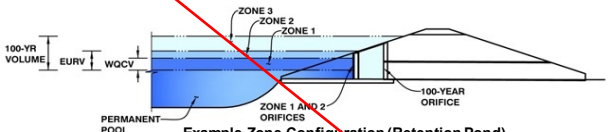


DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: Homestead at Sterling Ranch Filing No.2

Basin ID: Lots 14, 15, 21-24, 41 Lot size 10,319 sq ft-15,049 sq ft



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	SF	
Watershed Area =	0.18	acres
Watershed Length =	82	ft
Watershed Slope =	0.080	ft/ft
Watershed Imperviousness =	42.00%	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) =	0.002	acre-feet
Excess Urban Runoff Volume (EURV) =	0.008	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.006	acre-feet
5-yr Runoff Volume (P1 = 1.5 in.) =	0.009	acre-feet
10-yr Runoff Volume (P1 = 1.75 in.) =	0.012	acre-feet
25-yr Runoff Volume (P1 = 2 in.) =	0.018	acre-feet
50-yr Runoff Volume (P1 = 2.25 in.) =	0.022	acre-feet
100-yr Runoff Volume (P1 = 2.52 in.) =	0.027	acre-feet
500-yr Runoff Volume (P1 = 0 in.) =	0.000	acre-feet
Approximate 2-yr Detention Volume =	0.006	acre-feet
Approximate 5-yr Detention Volume =	0.008	acre-feet
Approximate 10-yr Detention Volume =	0.011	acre-feet
Approximate 25-yr Detention Volume =	0.012	acre-feet
Approximate 50-yr Detention Volume =	0.013	acre-feet
Approximate 100-yr Detention Volume =	0.015	acre-feet

Note: L / W Ratio =

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) =	0.002	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.006	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.007	acre-feet
Total Detention Basin Volume =	0.015	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

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)
Media Surface	--	0.00	--	--	--	77	0.002		
	--	0.50	--	--	--	152	0.003	56	0.001
	--	1.00	--	--	--	328	0.008	174	0.004
	--	1.50	--	--	--	543	0.012	390	0.009
	--	2.00	--	--	--	796	0.018	722	0.017

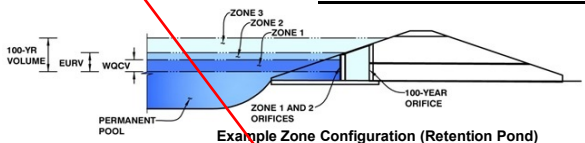
7065.27
7065.5
7066
7066.50
7067.00

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: Homestead at Sterling Ranch Filing No.2

Basin ID: Lot 14, 15, 21-24, 41



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.71	0.002	Filtration Media
Zone 2 (EURV)	1.41	0.006	Rectangular Orifice
Zone 3 (100-year)	1.90	0.007	Rectangular Orifice
		0.015	Total

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

Underdrain Orifice Invert Depth =	2.10	ft (distance below the filtration media surface)
Underdrain Orifice Diameter =	0.13	inches

Calculated Parameters for Underdrain

Underdrain Orifice Area =	0.0	ft^2
Underdrain Orifice Centroid =	0.01	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 Rectangular	Zone 3 Rectangular	
Invert of Vertical Orifice =	0.71	1.41	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	1.41	1.90	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Height =	2.00	2.00	inches
Vertical Orifice Width =	1.00	6.00	inches

Calculated Parameters for Vertical Orifice

	Zone 2 Rectangular	Zone 3 Rectangular	
Vertical Orifice Area =	0.01	0.08	ft^2
Vertical Orifice Centroid =	0.08	0.08	feet

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

	Not Selected	Not Selected	
Overflow Weir Front Edge Height, Ho =	1.88	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	1.00	N/A	feet
Overflow Weir Slope =	0.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	1.00	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

	Not Selected	Not Selected	
Height of Grate Upper Edge, H_t =	1.88	N/A	feet
Over Flow Weir Slope Length =	1.00	N/A	feet
Grate Open Area / 100-yr Orifice Area =	N/A	N/A	should be ≥ 4
Overflow Grate Open Area w/o Debris =	0.70	N/A	ft^2
Overflow Grate Open Area w/ Debris =	0.35	N/A	ft^2

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

	Not Selected	Not Selected	
Depth to Invert of Outlet Pipe =	N/A	N/A	ft (distance below basin bottom at Stage = 0 ft)
Circular Orifice Diameter =	N/A	N/A	inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

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

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	1.90	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	2.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	0.25	feet

Calculated Parameters for Spillway

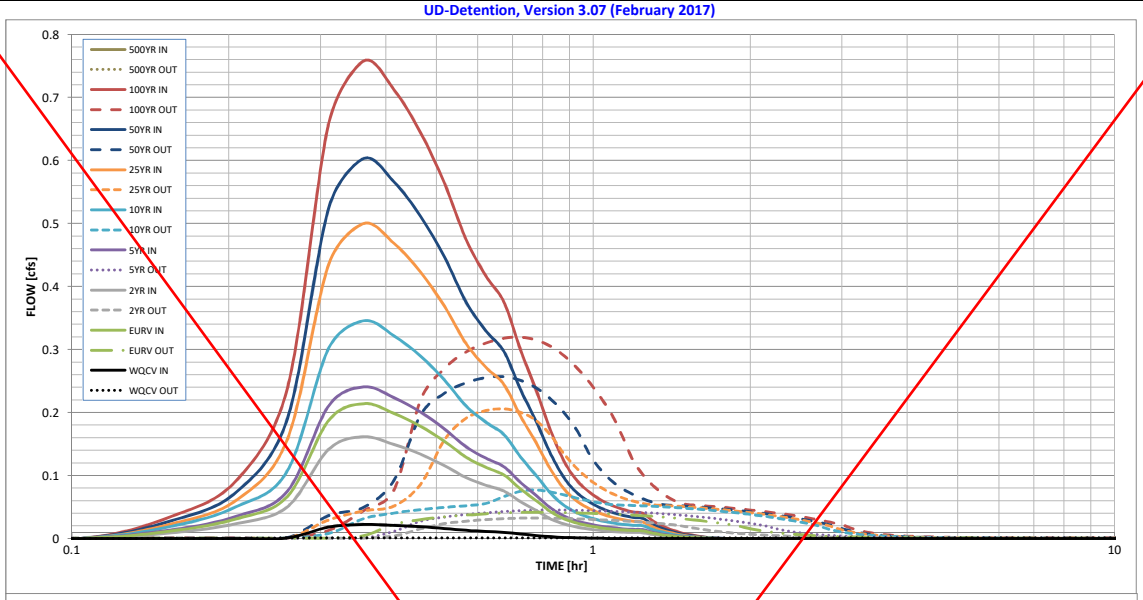
Spillway Design Flow Depth=	0.14	feet
Stage at Top of Freeboard =	2.29	feet
Basin Area at Top of Freeboard =	0.02	acres

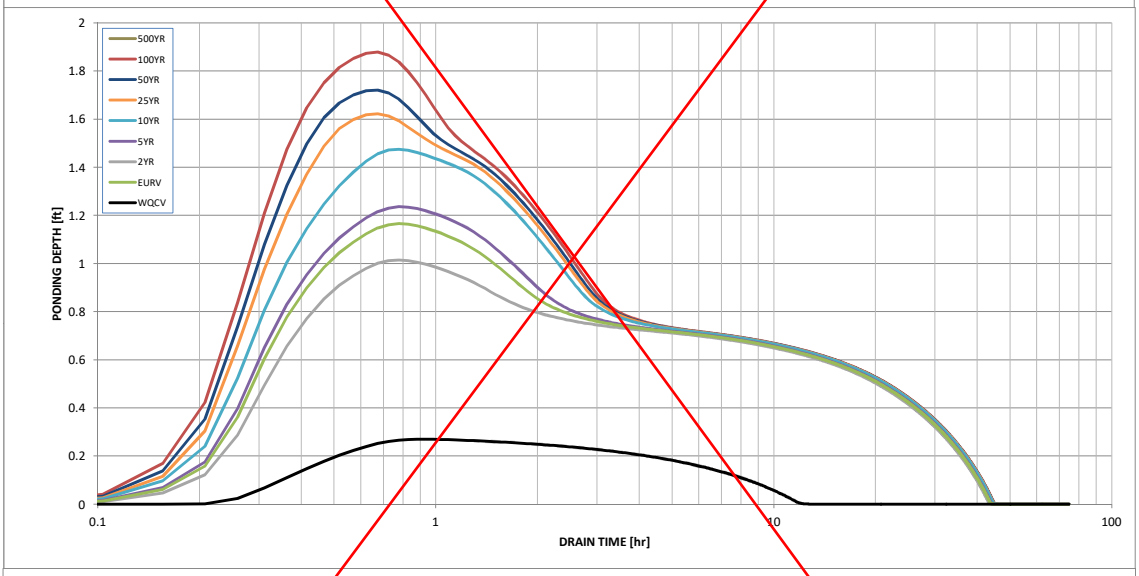
Routed Hydrograph Results

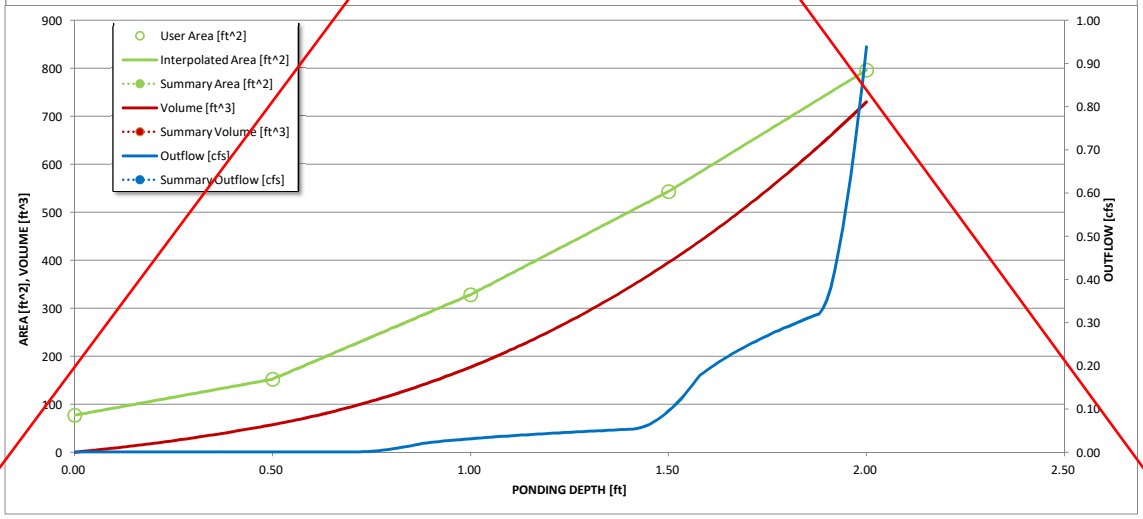
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	0.00
Calculated Runoff Volume (acre-ft) =	0.002	0.008	0.006	0.009	0.012	0.018	0.022	0.027	0.000
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.001	0.007	0.006	0.008	0.012	0.018	0.021	0.027	#N/A
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.02	0.03	0.32	0.97	1.34	1.78	0.00
Predevelopment Peak Q (cfs) =	0.0	0.0	0.0	0.0	0.1	0.2	0.2	0.3	0.0
Peak Inflow Q (cfs) =	0.0	0.2	0.2	0.2	0.3	0.5	0.6	0.8	#N/A
Peak Outflow Q (cfs) =	0.0	0.0	0.0	0.0	0.1	0.2	0.3	0.3	#N/A
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	8.1	1.4	1.2	1.1	1.0	#N/A
Structure Controlling Flow =	Filtration Media	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 2	Vertical Orifice 2	Vertical Orifice 2	Vertical Orifice 2	#N/A
Max Velocity through Grate 1 (fps) =	N/A	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	#N/A
Time to Drain 97% of Inflow Volume (hours) =	12	40	40	39	38	35	33	30	#N/A
Time to Drain 99% of Inflow Volume (hours) =	**12**	43	43	43	43	42	41	40	#N/A
Maximum Ponding Depth (ft) =	0.27	1.17	1.01	1.24	1.47	1.62	1.72	1.88	#N/A
Area at Maximum Ponding Depth (acres) =	0.00	0.01	0.01	0.01	0.01	0.01	0.02	0.02	#N/A
Maximum Volume Stored (acre-ft) =	0.001	0.005	0.004	0.006	0.009	0.011	0.012	0.014	#N/A

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)







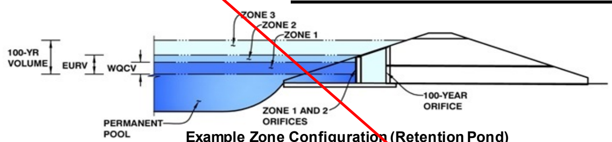
S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: Homestead at Sterling Ranch Filing No.2

Basin ID: Lots 13, 16-20, 28-40 Lots size 7,800 sq-ft -9830 sq-ft



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	SF	
Watershed Area =	0.12	acres
Watershed Length =	82	ft
Watershed Slope =	0.080	ft/ft
Watershed Imperviousness =	45.00%	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) =	0.002	acre-feet
Excess Urban Runoff Volume (EURV) =	0.006	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.004	acre-feet
5-yr Runoff Volume (P1 = 1.5 in.) =	0.006	acre-feet
10-yr Runoff Volume (P1 = 1.75 in.) =	0.008	acre-feet
25-yr Runoff Volume (P1 = 2 in.) =	0.012	acre-feet
50-yr Runoff Volume (P1 = 2.25 in.) =	0.015	acre-feet
100-yr Runoff Volume (P1 = 2.52 in.) =	0.018	acre-feet
500-yr Runoff Volume (P1 = 0 in.) =	0.000	acre-feet
Approximate 2-yr Detention Volume =	0.004	acre-feet
Approximate 5-yr Detention Volume =	0.006	acre-feet
Approximate 10-yr Detention Volume =	0.008	acre-feet
Approximate 25-yr Detention Volume =	0.009	acre-feet
Approximate 50-yr Detention Volume =	0.009	acre-feet
Approximate 100-yr Detention Volume =	0.010	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) =	0.002	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.004	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.005	acre-feet
Total Detention Basin Volume =	0.010	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

Depth Increment = 0.5 ft

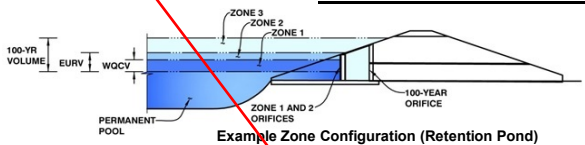
	Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
7098.66	**Media Surface**	--	0.00	--	--	--	88	0.002		
7099		--	0.34	--	--	--	223	0.005	51	0.001
7099.5		--	0.84	--	--	--	450	0.010	217	0.005
7100.00		--	1.34	--	--	--	711	0.016	504	0.012
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				
		--		--	--	--				

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: Homestead at Sterling Ranch Filing No.2

Basin ID: Lots 13, 16-20, 28-40 Lots size 7,800 sq-ft -9830 sq-ft



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.40	0.002	Filtration Media
Zone 2 (EURV)	0.89	0.004	Rectangular Orifice
Zone 3 (100-year)	1.24	0.005	Rectangular Orifice
		0.010	Total

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

Underdrain Orifice Invert Depth =	2.10	ft (distance below the filtration media surface)
Underdrain Orifice Diameter =	0.13	inches

Calculated Parameters for Underdrain

Underdrain Orifice Area =	0.0	ft^2
Underdrain Orifice Centroid =	0.01	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 Rectangular	Zone 3 Rectangular	
Invert of Vertical Orifice =	0.40	0.89	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	0.89	1.24	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Height =	2.00	2.00	inches
Vertical Orifice Width =	1.00	3.50	inches

Calculated Parameters for Vertical Orifice

	Zone 2 Rectangular	Zone 3 Rectangular	
Vertical Orifice Area =	0.01	0.05	ft^2
Vertical Orifice Centroid =	0.08	0.08	feet

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

	Not Selected	Not Selected	
Overflow Weir Front Edge Height, Ho =	1.24	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	1.00	N/A	feet
Overflow Weir Slope =	0.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	1.00	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

	Not Selected	Not Selected	
Height of Grate Upper Edge, H_t =	1.24	N/A	feet
Over Flow Weir Slope Length =	1.00	N/A	feet
Grate Open Area / 100-yr Orifice Area =	N/A	N/A	should be ≥ 4
Overflow Grate Open Area w/o Debris =	0.70	N/A	ft^2
Overflow Grate Open Area w/ Debris =	0.35	N/A	ft^2

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

	Not Selected	Not Selected	
Depth to Invert of Outlet Pipe =	N/A	N/A	ft (distance below basin bottom at Stage = 0 ft)
Circular Orifice Diameter =	N/A	N/A	inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

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

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	1.24	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	2.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	0.25	feet

Calculated Parameters for Spillway

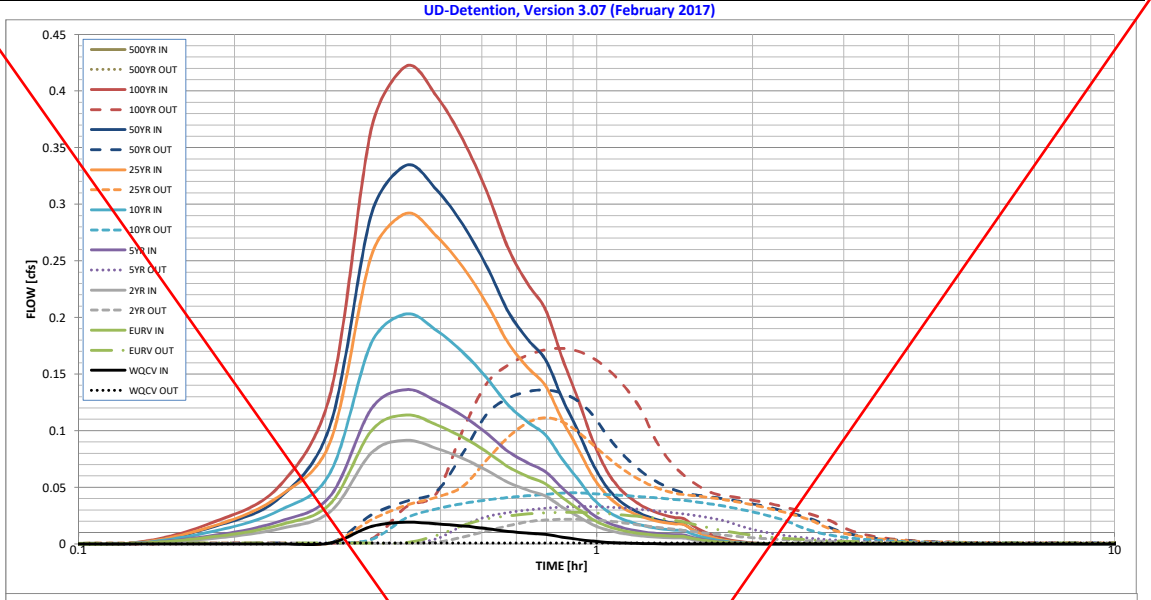
Spillway Design Flow Depth=	0.14	feet
Stage at Top of Freeboard =	1.63	feet
Basin Area at Top of Freeboard =	0.02	acres

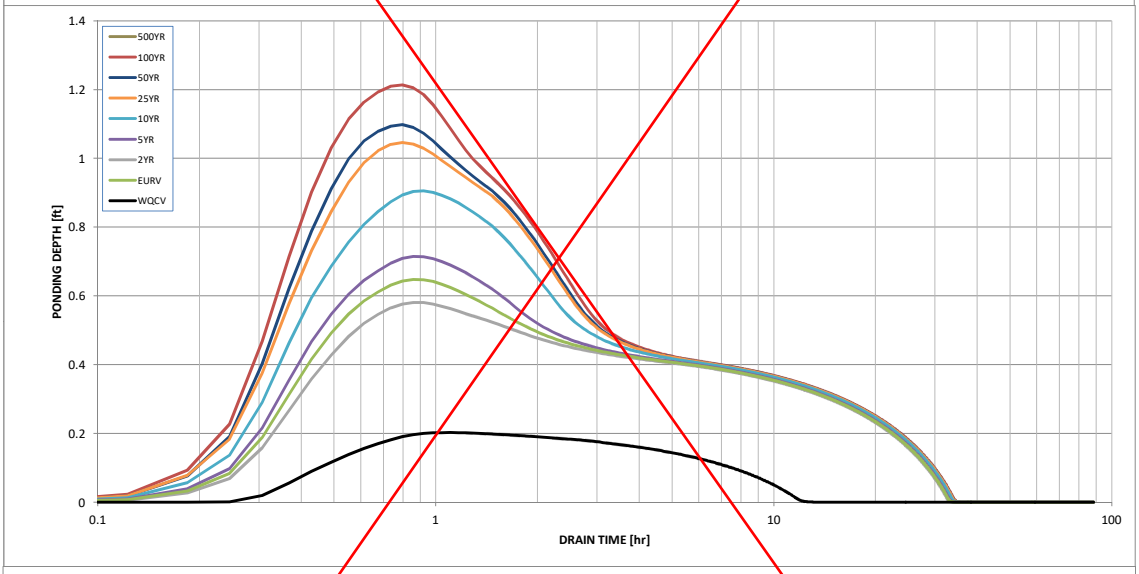
Routed Hydrograph Results

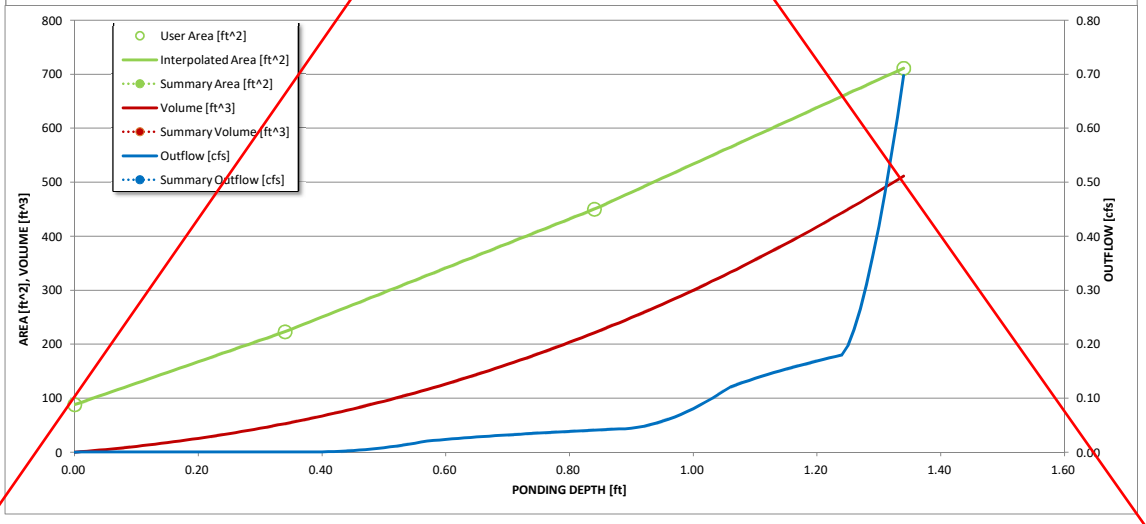
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.83	1.07	1.19	1.50	1.75	2.00	2.25	2.52	0.00
Calculated Runoff Volume (acre-ft) =	0.002	0.006	0.004	0.006	0.008	0.012	0.015	0.018	0.000
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.001	0.005	0.004	0.006	0.008	0.012	0.014	0.018	#N/A
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.02	0.03	0.28	0.88	1.21	1.61	0.00
Predevelopment Peak Q (cfs) =	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.0
Peak Inflow Q (cfs) =	0.0	0.1	0.1	0.1	0.2	0.3	0.3	0.4	#N/A
Peak Outflow Q (cfs) =	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.2	#N/A
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	10.1	1.4	1.1	1.0	0.9	#N/A
Structure Controlling Flow =	Filtration Media	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 2	Vertical Orifice 2	Vertical Orifice 2	Vertical Orifice 2	#N/A
Max Velocity through Grate 1 (fps) =	N/A	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	#N/A
Time to Drain 97% of Inflow Volume (hours) =	12	31	31	30	29	28	27	25	#N/A
Time to Drain 99% of Inflow Volume (hours) =	**12**	32	32	32	33	32	32	31	#N/A
Maximum Ponding Depth (ft) =	0.20	0.65	0.58	0.71	0.91	1.05	1.10	1.21	#N/A
Area at Maximum Ponding Depth (acres) =	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	#N/A
Maximum Volume Stored (acre-ft) =	0.001	0.003	0.003	0.004	0.006	0.007	0.008	0.010	#N/A

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)



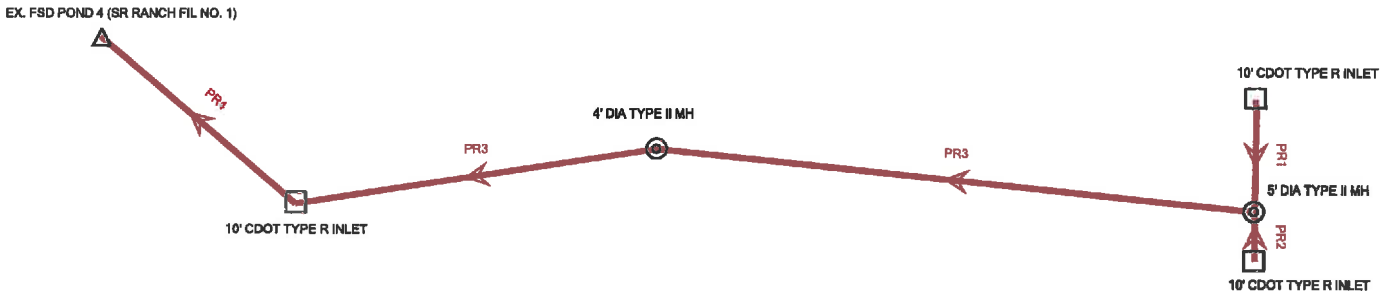




S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

Scenario: 100 yr

STRM 1 & 2

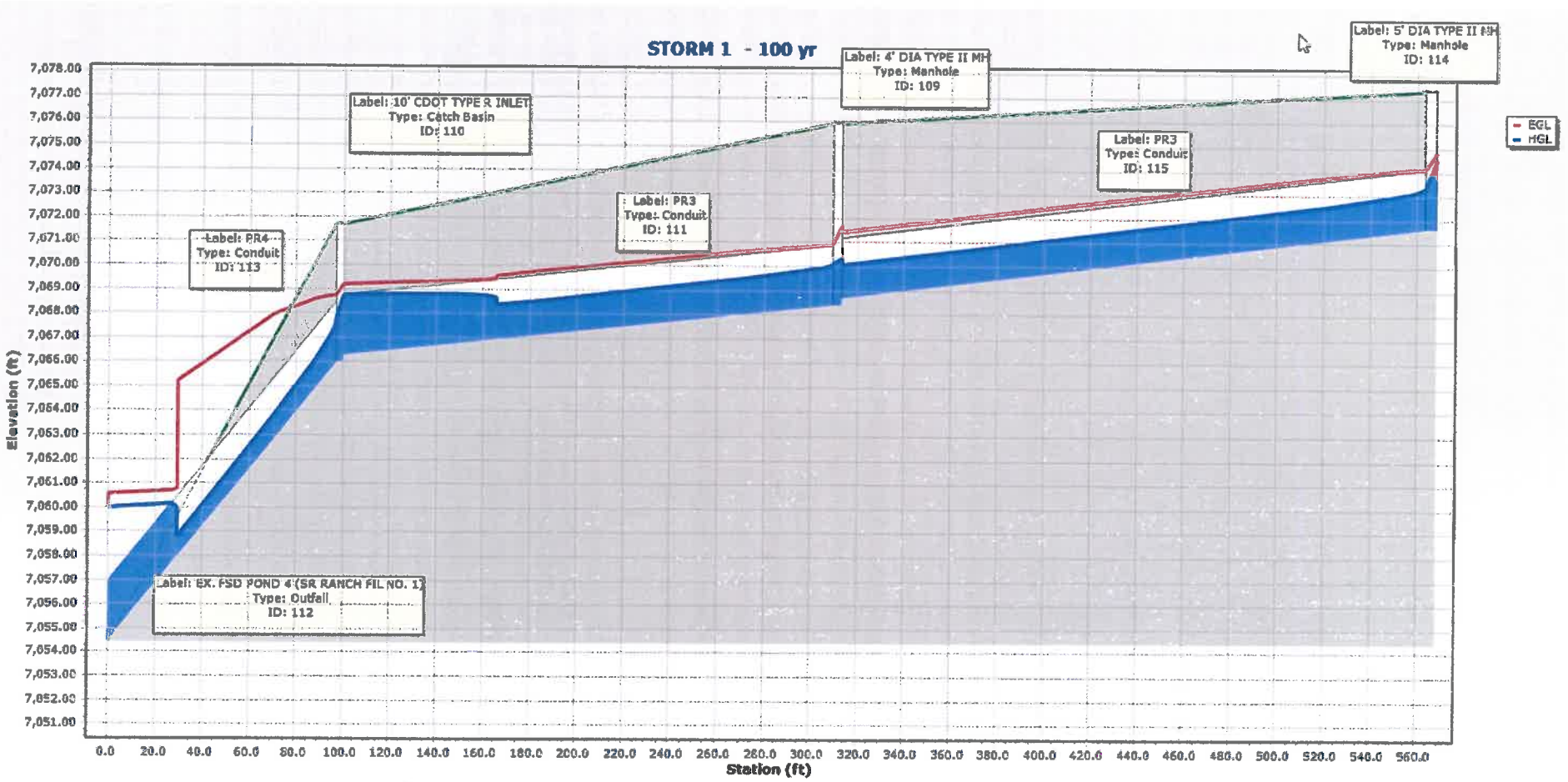


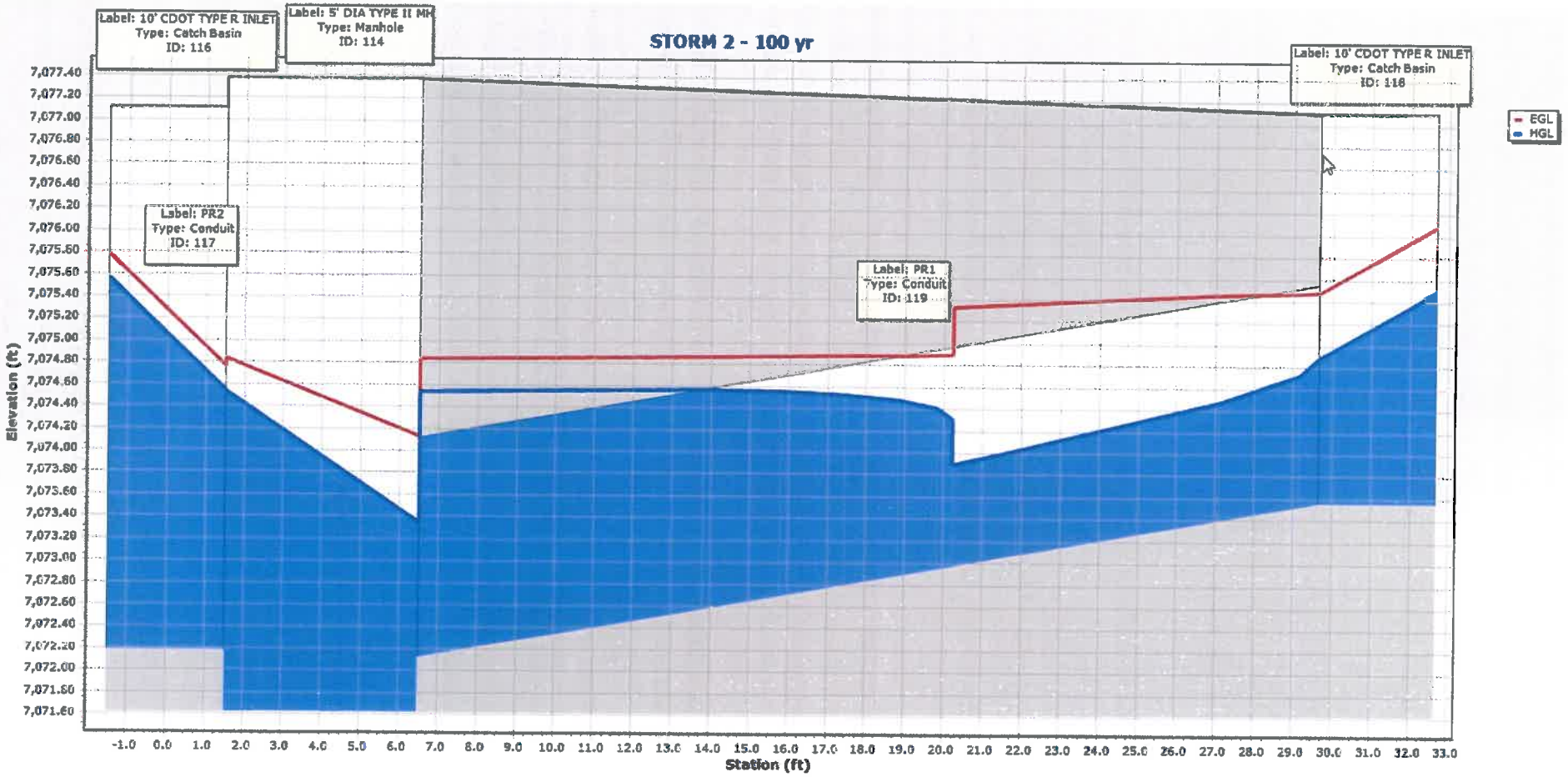
Bentley Systems, Inc. Haestad Methods Solution Center
27 Siemon Company Drive Suite 200 W Watertown, CT 06795 USA
+1-203-755-1666

Conduit FlexTable: Table - 1 STRM 1&2

Label	Upstream Structure	Rise (ft)	Flow (cfs)	Flow / Capacity (Design) (%)	Length (Unified) (ft)	Velocity (ft/s)	Froude Number (Normal)	Depth (Normal) (ft)	Depth (Critical) (ft)
PR3	4' DIA TYPE II MH		25.70	62.7	213.1	8.82	1.432	1.43	1.73
PR4	10' CDOT TYPE R INLET		30.10	21.5	98.7	22.71	5.300	0.79	1.87
PR3	5' DIA TYPE II MH		25.70	58.4	254.1	9.31	1.557	1.37	1.73
PR2	10' CDOT TYPE R INLET		11.80	37.9	3.2	3.76	2.023	0.85	1.23
PR1	10' CDOT TYPE R INLET		13.80	26.6	27.2	13.97	3.425	0.70	1.34

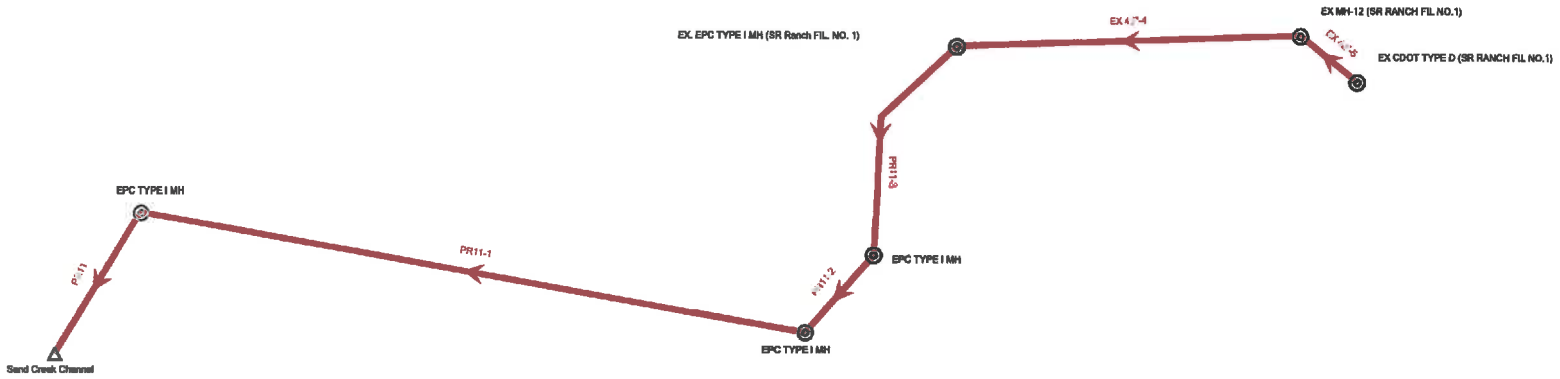
Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Headloss (ft)	Upstream Structure Hydraulic Grade Line (In) (ft)	Upstream Structure Velocity (In-Governing) (ft/s)	Upstream Structure Headloss Coefficient	Upstream Structure Headloss (ft)	Elevation Ground (Start) (ft)	Invert (Start) (ft)	Invert (Stop) (ft)
7,070.13	7,068.77	1.36	7,070.34	9.31	0.270	0.21	7,075.93	7,068.40	7,066.27
7,067.84	7,060.00	7.84	7,068.77	5.24	1.020	0.93	7,071.69	7,065.97	7,054.50
7,073.35	7,070.07	3.27	7,074.54	4.39	1.520	1.19	7,077.37	7,071.62	7,068.70
7,074.55	7,074.54	0.01	7,075.57	3.76	1.000	1.02	7,077.10	7,072.18	7,072.12
7,074.89	7,074.54	0.35	7,075.49	6.18	1.020	0.61	7,077.10	7,073.55	7,072.12


STORM 1 - 100 yr
Label: 10' CDOT TYPE R INLET
Type: Catch Basin
ID: 110
Label: 4' DIA TYPE II MH
Type: Manhole
ID: 109
Label: 5' DIA TYPE II MH
Type: Manhole
ID: 114
Label: PR4
Type: Conduit
ID: 113
Label: PR3
Type: Conduit
ID: 111
Label: PR3
Type: Conduit
ID: 115
Label: EX. FSD POND 4 (SR RANCH FIL NO. 1)
Type: Outfall
ID: 112
EGL
HGL
Elevation (ft)
Station (ft)
7,078.00
7,077.00
7,076.00
7,075.00
7,074.00
7,073.00
7,072.00
7,071.00
7,070.00
7,069.00
7,068.00
7,067.00
7,066.00
7,065.00
7,064.00
7,063.00
7,062.00
7,061.00
7,060.00
7,059.00
7,058.00
7,057.00
7,056.00
7,055.00
7,054.00
7,053.00
7,052.00
7,051.00
0.0
20.0
40.0
60.0
80.0
100.0
120.0
140.0
160.0
180.0
200.0
220.0
240.0
260.0
280.0
300.0
320.0
340.0
360.0
380.0
400.0
420.0
440.0
460.0
480.0
500.0
520.0
540.0
560.0


STORM 2 - 100 yr
Label: 10' CDOT TYPE R INLET
Type: Catch Basin
ID: 116
Label: 5' DIA TYPE II MH
Type: Manhole
ID: 114
Label: 10' CDOT TYPE R INLET
Type: Catch Basin
ID: 118
Label: PR2
Type: Conduit
ID: 117
Label: PR1
Type: Conduit
ID: 119
EGL
HGL
Elevation (ft)
7,077.40
7,077.20
7,077.00
7,076.80
7,076.60
7,076.40
7,076.20
7,076.00
7,075.80
7,075.60
7,075.40
7,075.20
7,075.00
7,074.80
7,074.60
7,074.40
7,074.20
7,074.00
7,073.80
7,073.60
7,073.40
7,073.20
7,073.00
7,072.80
7,072.60
7,072.40
7,072.20
7,072.00
7,071.80
7,071.60
-1.0 0.0 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 11.0 12.0 13.0 14.0 15.0 16.0 17.0 18.0 19.0 20.0 21.0 22.0 23.0 24.0 25.0 26.0 27.0 28.0 29.0 30.0 31.0 32.0 33.0
Station (ft)

Scenario: 100 yr

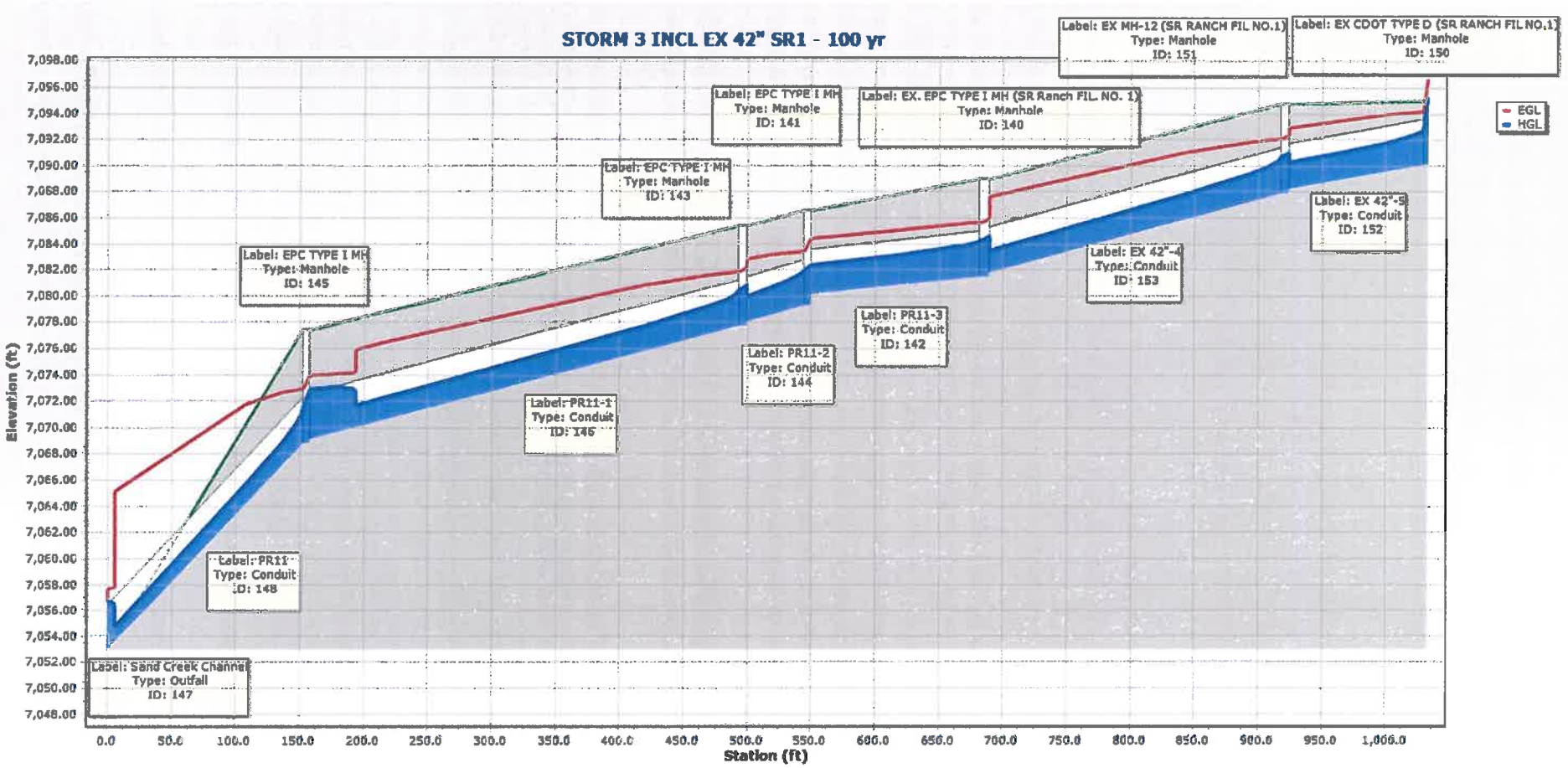
STORM 3 INCL EX 42" SR1



Conduit FlexTable: Table - 1 STRM 3 INCL 42" SR1

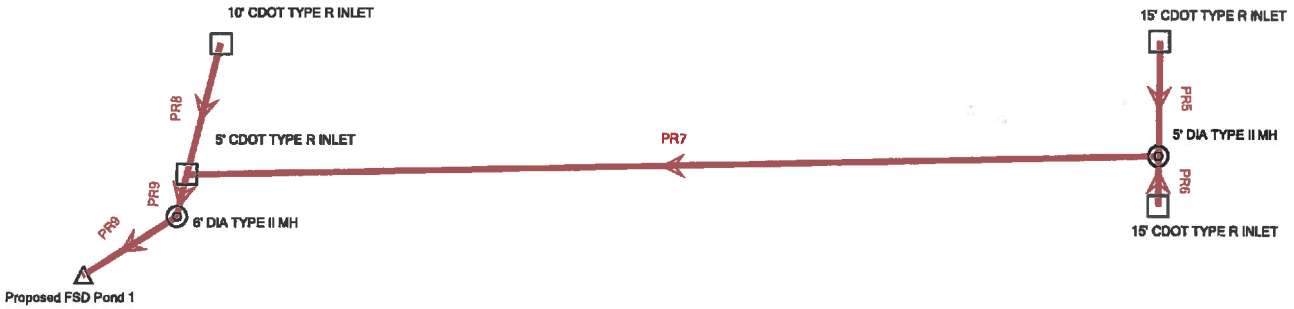
Label	Upstream Structure	Rise (ft)	Flow (cfs)	Flow / Capacity (Design) (%)	Length (Unified) (ft)	Velocity (ft/s)	Froude Number (Normal)	Depth (Normal) (ft)	Depth (Critical) (ft)
PR11-3	EX. EPC TYPE I MH (SR Ranch FIL. NO. 1)		76.80	76.4	138.4	11.50	1.432	2.29	2.74
PR11-2	EPC TYPE I MH		76.80	47.5	50.8	16.58	2.541	1.70	2.74
PR11-1	EPC TYPE I MH		76.80	48.1	341.2	16.43	2.507	1.71	2.74
PR11	EPC TYPE I MH		76.80	23.9	155.1	27.41	5.244	1.16	2.74
EX 42"-5	EX CDOT TYPE D (SR RANCH FIL NO.1)		76.80	58.8	110.4	14.12	1.992	1.93	2.74
EX 42"-4	EX MH-12 (SR RANCH FIL NO.1)		76.80	47.3	235.2	16.64	2.553	1.69	2.74

Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Headloss (ft)	Upstream Structure Hydraulic Grade Line (In) (ft)	Upstream Structure Velocity (In-Governing) (ft/s)	Upstream Structure Headloss Coefficient	Upstream Structure Headloss (ft)	Elevation Ground (Start) (ft)	Invert (Start) (ft)	Invert (Stop) (ft)
7,084.23	7,082.43	1.80	7,084.61	9.24	0.270	0.38	7,088.97	7,081.49	7,080.11
7,082.05	7,080.82	1.23	7,082.43	11.32	0.270	0.38	7,086.56	7,079.31	7,078.00
7,080.44	7,072.98	7.46	7,080.82	9.24	0.270	0.38	7,085.36	7,077.70	7,069.11
7,071.55	7,056.70	14.85	7,072.98	7.98	1.020	1.43	7,077.40	7,068.81	7,053.00
7,092.81	7,091.03	1.78	7,095.29	9.50	1.770	2.48	7,095.00	7,090.07	7,088.21
7,090.65	7,084.61	6.04	7,091.03	9.24	0.270	0.38	7,094.77	7,087.91	7,081.79


STORM 3 INCL EX 42" SR1 - 100 yr
Label: EX MH-12 (SR RANCH FIL NO.1)
Type: Manhole
ID: 151
Label: EX CDOT TYPE D (SR RANCH FIL NO.1)
Type: Manhole
ID: 150
Label: EPC TYPE I MH
Type: Manhole
ID: 141
Label: EX. EPC TYPE I MH (SR Ranch FIL NO. 1)
Type: Manhole
ID: 140
Label: EPC TYPE I MH
Type: Manhole
ID: 143
Label: EPC TYPE I MH
Type: Manhole
ID: 145
Label: EX 42"-5
Type: Conduit
ID: 152
Label: EX 42"-4
Type: Conduit
ID: 153
Label: PR11-3
Type: Conduit
ID: 142
Label: PR11-2
Type: Conduit
ID: 144
Label: PR11-1
Type: Conduit
ID: 146
Label: PR11
Type: Conduit
ID: 148
Label: Sand Creek Channel
Type: Outfall
ID: 147
EGL
HGL
Elevation (ft)
Station (ft)
7,098.00
7,096.00
7,094.00
7,092.00
7,090.00
7,088.00
7,086.00
7,084.00
7,082.00
7,080.00
7,078.00
7,076.00
7,074.00
7,072.00
7,070.00
7,068.00
7,066.00
7,064.00
7,062.00
7,060.00
7,058.00
7,056.00
7,054.00
7,052.00
7,050.00
7,048.00
0.0
50.0
100.0
150.0
200.0
250.0
300.0
350.0
400.0
450.0
500.0
550.0
600.0
650.0
700.0
750.0
800.0
850.0
900.0
950.0
1,000.0

Scenario: 100 yr

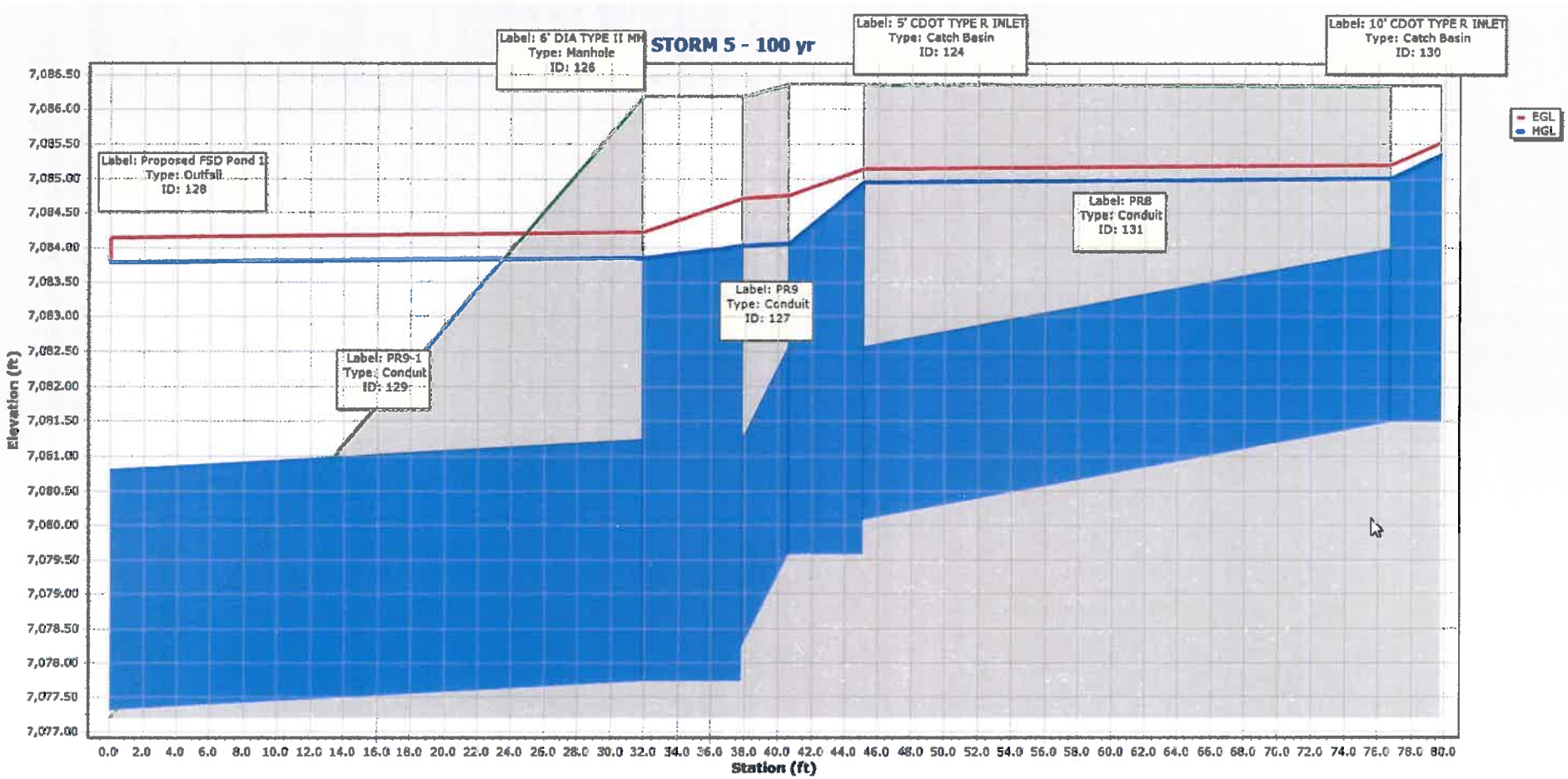
STRM 5,6,7

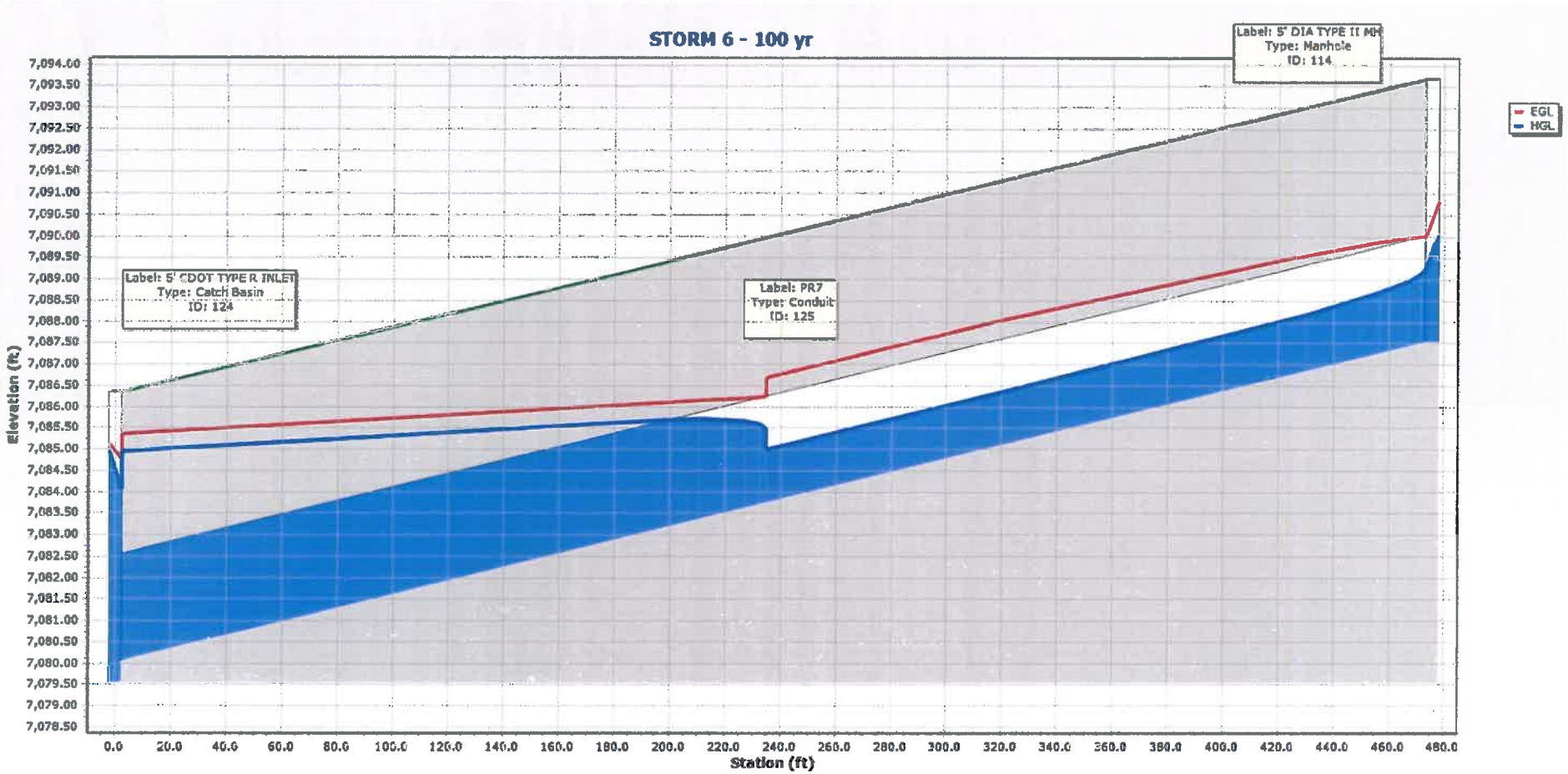


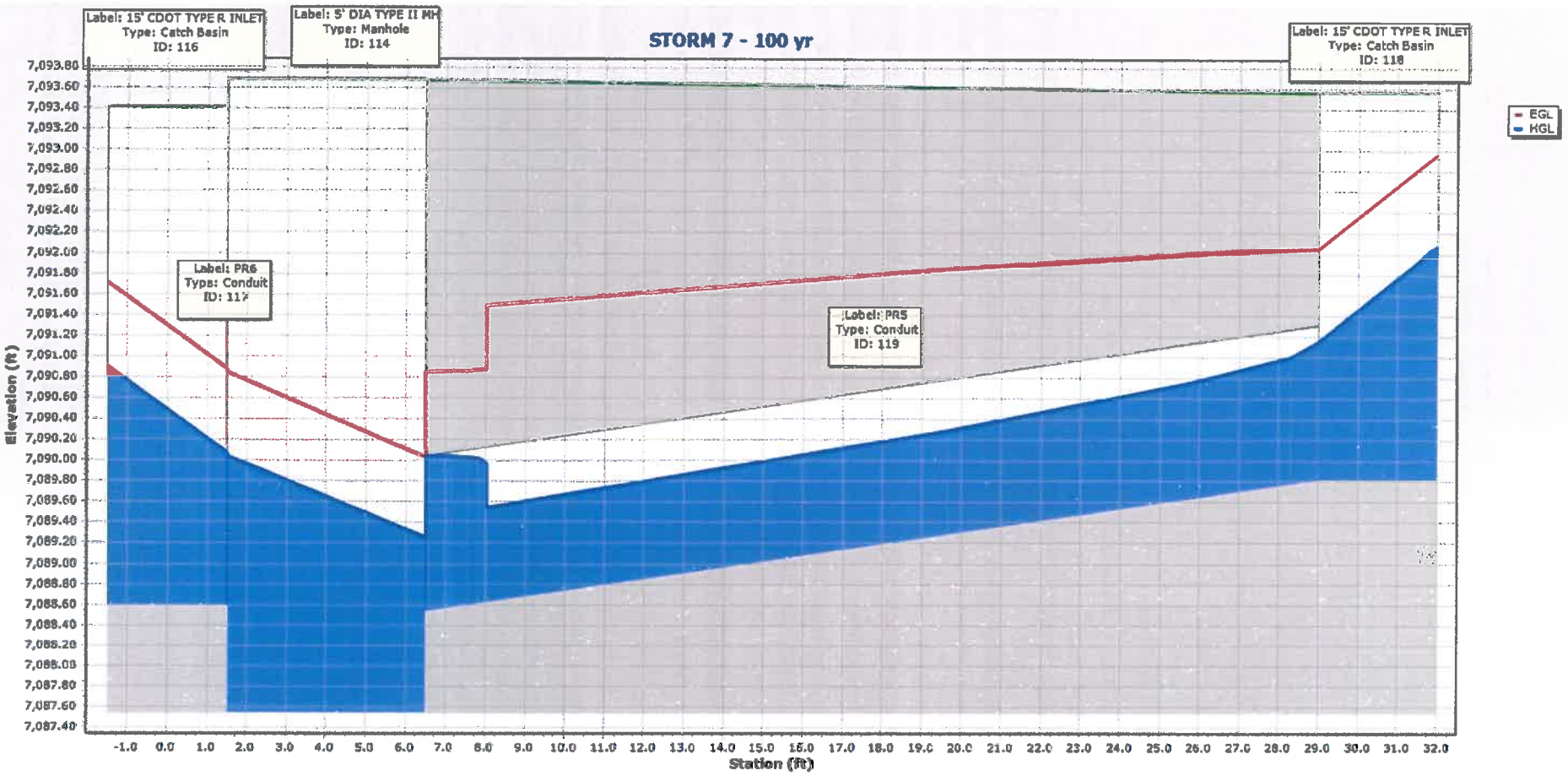
Conduit FlexTable: Table - 1 STRM 5,6,7

Label	Upstream Structure	Rise (ft)	Flow (cfs)	Flow / Capacity (Design) (%)	Length (Unified) (ft)	Velocity (ft/s)	Froude Number (Normal)	Depth (Normal) (ft)	Depth (Critical) (ft)
PR6	15' CDOT TYPE R INLET		12.70	85.5	2.5	7.19	1.674	1.07	1.34
PR5	15' CDOT TYPE R INLET		12.70	55.2	26.5	13.34	2.948	0.80	1.34
PR7	5' DIA TYPE II MH		25.30	49.2	475.5	10.43	1.867	1.24	1.71
PR9	5' CDOT TYPE R INLET		47.10	17.3	8.0	6.66	6.560	0.84	2.24
PR9-1	6' DIA TYPE II MH		47.10	42.6	34.9	4.90	1.755	1.60	2.14
PR8	10' CDOT TYPE R INLET		17.20	20.9	35.4	3.50	3.114	0.78	1.40

Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Headloss (ft)	Upstream Structure Hydraulic Grade Line (In) (ft)	Upstream Structure Velocity (In-Governing) (ft/s)	Upstream Structure Headloss Coefficient	Upstream Structure Headloss (ft)	Elevation Ground (Start) (ft)	Invert (Start) (ft)	Invert (Stop) (ft)
7,090.47	7,090.43	0.04	7,091.28	7.19	1.020	0.82	7,093.41	7,088.59	7,088.54
7,091.15	7,090.43	0.72	7,092.07	7.62	1.020	0.92	7,093.57	7,089.81	7,088.54
7,089.25	7,084.94	4.31	7,090.43	7.19	1.520	1.17	7,093.68	7,087.54	7,080.07
7,084.06	7,084.02	0.04	7,084.94	3.50	1.280	0.88	7,086.36	7,079.57	7,078.23
7,083.85	7,083.77	0.08	7,084.02	6.66	0.470	0.18	7,086.18	7,077.73	7,077.31
7,085.01	7,084.94	0.06	7,085.34	3.50	1.770	0.34	7,086.34	7,081.49	7,080.07


STORM 5 - 100 yr
Label: 6" DIA TYPE II MH
Type: Manhole
ID: 126
Label: 5' CDOT TYPE R INLET
Type: Catch Basin
ID: 124
Label: 10' CDOT TYPE R INLET
Type: Catch Basin
ID: 130
Label: Proposed FSD Pond 1
Type: Outfall
ID: 128
Label: PR8
Type: Conduit
ID: 131
Label: PR9
Type: Conduit
ID: 127
Label: PR9-1
Type: Conduit
ID: 129
EGL
HGL
Elevation (ft)
7,086.50
7,086.00
7,085.50
7,085.00
7,084.50
7,084.00
7,083.50
7,083.00
7,082.50
7,082.00
7,081.50
7,081.00
7,080.50
7,080.00
7,079.50
7,079.00
7,078.50
7,078.00
7,077.50
7,077.00
0.0 2.0 4.0 6.0 8.0 10.0 12.0 14.0 16.0 18.0 20.0 22.0 24.0 26.0 28.0 30.0 32.0 34.0 36.0 38.0 40.0 42.0 44.0 46.0 48.0 50.0 52.0 54.0 56.0 58.0 60.0 62.0 64.0 66.0 68.0 70.0 72.0 74.0 76.0 78.0 80.0
Station (ft)


STORM 6 - 100 yr
Label: 5' DIA TYPE II MH
Type: Manhole
ID: 114
Label: 5' CDOT TYPE R INLET
Type: Catch Basin
ID: 124
Label: PR7
Type: Conduit
ID: 125
EGL
HGL
Elevation (ft)
Station (ft)
7,094.00
7,093.50
7,093.00
7,092.50
7,092.00
7,091.50
7,091.00
7,090.50
7,090.00
7,089.50
7,089.00
7,088.50
7,088.00
7,087.50
7,087.00
7,086.50
7,086.00
7,085.50
7,085.00
7,084.50
7,084.00
7,083.50
7,083.00
7,082.50
7,082.00
7,081.50
7,081.00
7,080.50
7,080.00
7,079.50
7,079.00
7,078.50
0.0
20.0
40.0
60.0
80.0
100.0
120.0
140.0
160.0
180.0
200.0
220.0
240.0
260.0
280.0
300.0
320.0
340.0
360.0
380.0
400.0
420.0
440.0
460.0
480.0

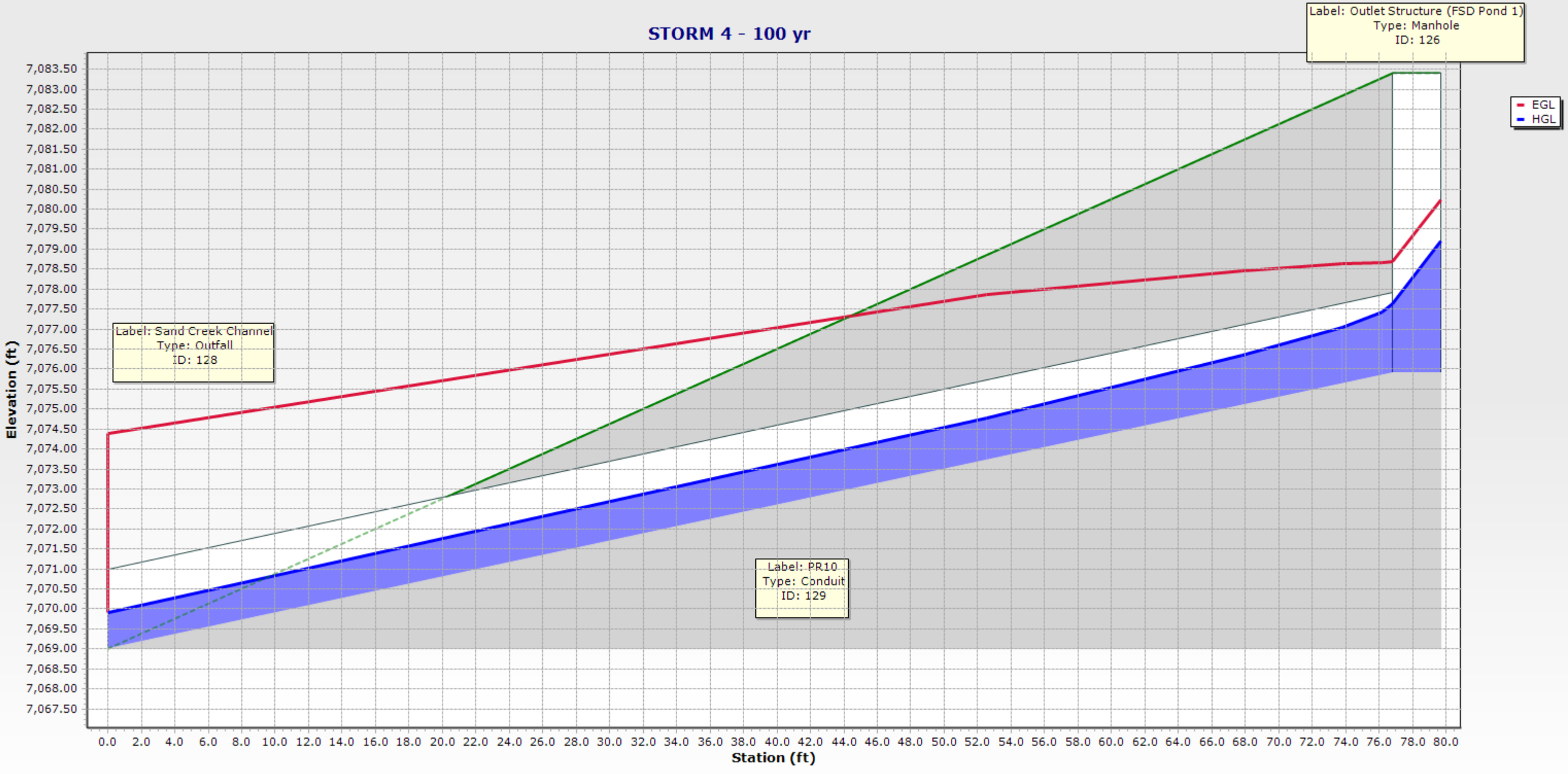

STORM 7 - 100 yr
Label: 15' CDOT TYPE R INLET
Type: Catch Basin
ID: 116
Label: 5' DIA TYPE II MH
Type: Manhole
ID: 114
Label: 15' CDOT TYPE R INLET
Type: Catch Basin
ID: 118
Label: PR6
Type: Conduit
ID: 117
Label: PR5
Type: Conduit
ID: 119
EGL
HGL
Elevation (ft)
Station (ft)

STRM 4 POND 1 OUTFALL INDEX MAP

Conduit FlexTable: STRM 4 POND 1 7-30-19

Label	ID	Upstream Structure	Flow (cfs)	Flow / Capacity (Design) (%)	Length (Unified) (ft)	Velocity (ft/s)	Froude Number (Normal)	Depth (Normal) (ft)	Depth (Critical) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Headloss (ft)	Upstream Structure Hydraulic Grade Line (In) (ft)
PR10	129	Outlet Structure (FSD Pond 1)	23.50	40.3	78.2	17.56	3.772	0.88	1.72	7,078.68	7,074.39	7,077.64	7,069.91	7.73	7,079.20

Upstream Structure Velocity (In-Governing) (ft/s)	Upstream Structure Headloss Coefficient	Upstream Structure Headloss (ft)	Elevation Ground (Start) (ft)	Invert (Start) (ft)	Invert (Stop) (ft)
8.17	1.500	1.56	7,083.40	7,075.92	7,069.00


STORM 4 - 100 yr
Label: Outlet Structure (FSD Pond 1)
Type: Manhole
ID: 126
EGL
HGL
Label: Sand Creek Channel
Type: Outfall
ID: 128
Label: PR10
Type: Conduit
ID: 129
Elevation (ft)
7,083.50
7,083.00
7,082.50
7,082.00
7,081.50
7,081.00
7,080.50
7,080.00
7,079.50
7,079.00
7,078.50
7,078.00
7,077.50
7,077.00
7,076.50
7,076.00
7,075.50
7,075.00
7,074.50
7,074.00
7,073.50
7,073.00
7,072.50
7,072.00
7,071.50
7,071.00
7,070.50
7,070.00
7,069.50
7,069.00
7,068.50
7,068.00
7,067.50
0.0 2.0 4.0 6.0 8.0 10.0 12.0 14.0 16.0 18.0 20.0 22.0 24.0 26.0 28.0 30.0 32.0 34.0 36.0 38.0 40.0 42.0 44.0 46.0 48.0 50.0 52.0 54.0 56.0 58.0 60.0 62.0 64.0 66.0 68.0 70.0 72.0 74.0 76.0 78.0 80.0
Station (ft)

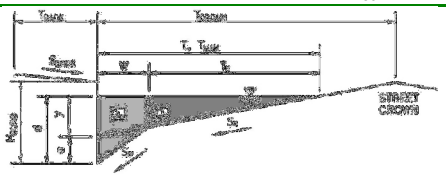
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: Enter Your Project Name Here

Inlet ID: Inlet DP 7



Gutter Geometry (Enter data in the blue cells)

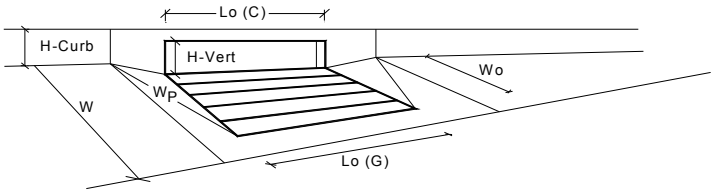
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.020	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.1	7.8	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	2	2	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	5.1	7.8	inches
Grate Information			MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)			MINOR	MAJOR	
Depth for Grate Midwidth		d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation		d_{Curb} =	0.26	0.48	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.48	0.74	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	0.88	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		**Q_a =**	**6.7**	**18.7**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	5.7	13.8	cfs

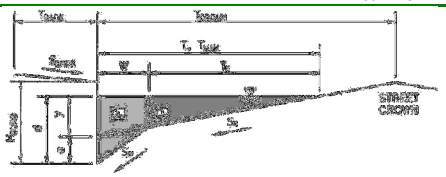
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: Enter Your Project Name Here

Inlet ID: Inlet DP 8



Gutter Geometry (Enter data in the blue cells)

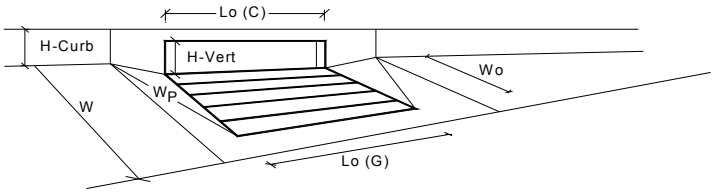
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.020	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.1	7.8	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	2	2	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	5.1	7.8	inches
Grate Information			MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)			MINOR	MAJOR	
Depth for Grate Midwidth		d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation		d_{Curb} =	0.26	0.48	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.48	0.74	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	0.88	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		**Q_a =**	**6.7**	**18.7**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	4.9	11.8	cfs

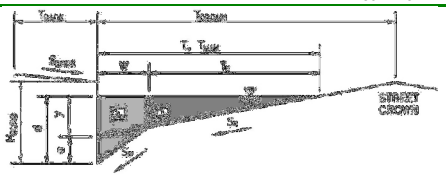
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: Enter Your Project Name Here

Inlet ID: Inlet DP 9



Gutter Geometry (Enter data in the blue cells)

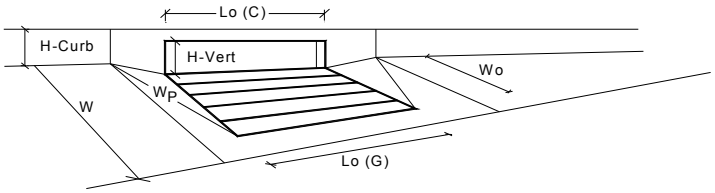
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.020	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.1	8.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	5.1	7.8	inches
Grate Information			MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)			MINOR	MAJOR	
Depth for Grate Midwidth		d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation		d_{Curb} =	0.26	0.48	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.65	1.00	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		**Q_a =**	**3.7**	**9.0**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	2.2	5.4	cfs

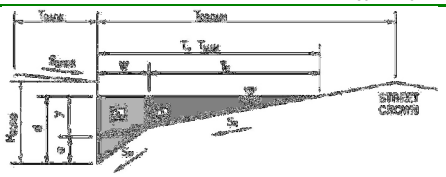
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: Enter Your Project Name Here

Inlet ID: Inlet DP 10



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.022	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.020	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.1	7.8	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☑	check = yes

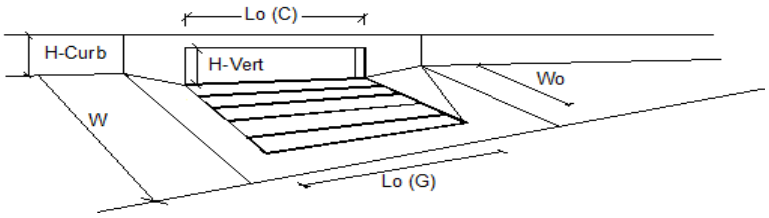
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**9.4**	**29.1**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening	Type =	CDOT Type R Curb Opening	
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	3.0	3.0 inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	1	1
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	15.00	15.00 ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f-G =	N/A	N/A
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f-C =	0.10	0.10

Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**9.1**	**12.7**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.3**	**2.9**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**97**	**82**	**%**

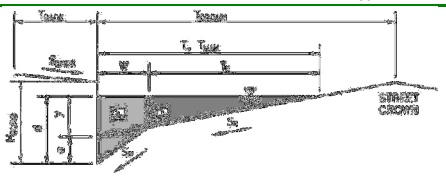
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: Enter Your Project Name Here

Inlet ID: Inlet DP 11



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.022	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.020	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.1	7.8	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☑	check = yes

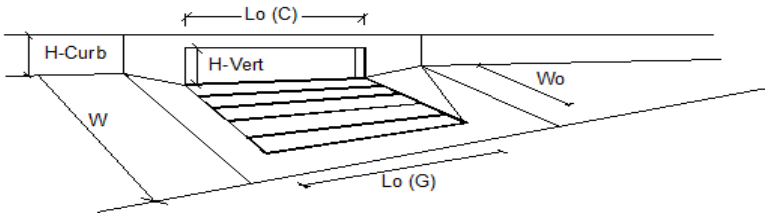
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**9.4**	**29.1**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening	Type =	CDOT Type R Curb Opening	
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	3.0	3.0 inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	1	1
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	15.00	15.00 ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f-G =	N/A	N/A
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f-C =	0.10	0.10

Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**1.9**	**12.7**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**2.9**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**82**	**%**

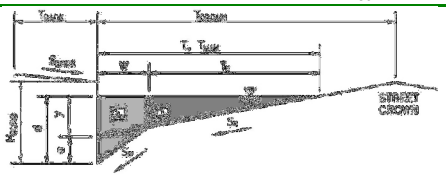
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: Enter Your Project Name Here

Inlet ID: Inlet DP 12



Gutter Geometry (Enter data in the blue cells)

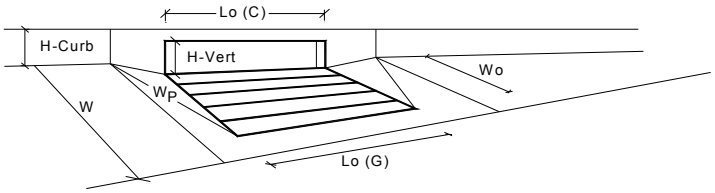
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.020	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.1	7.8	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	2	2	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	5.1	7.8	inches
Grate Information			MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)			MINOR	MAJOR	
Depth for Grate Midwidth		d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation		d_{Curb} =	0.26	0.48	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.48	0.74	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	0.88	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		**Q_a =**	**6.7**	**18.7**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	6.2	17.2	cfs

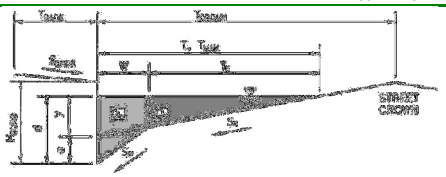
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: Enter Your Project Name Here

Inlet ID: Inlet DP 13



Gutter Geometry (Enter data in the blue cells)

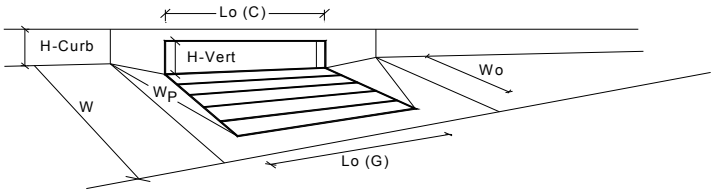
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.020	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.1	5.1	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	5.1	7.8	inches
Grate Information			MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)			MINOR	MAJOR	
Depth for Grate Midwidth		d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation		d_{Curb} =	0.26	0.48	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.65	1.00	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		**Q_a =**	**3.7**	**9.0**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	1.2	5.9	cfs

EDB AND SFB DETAILS

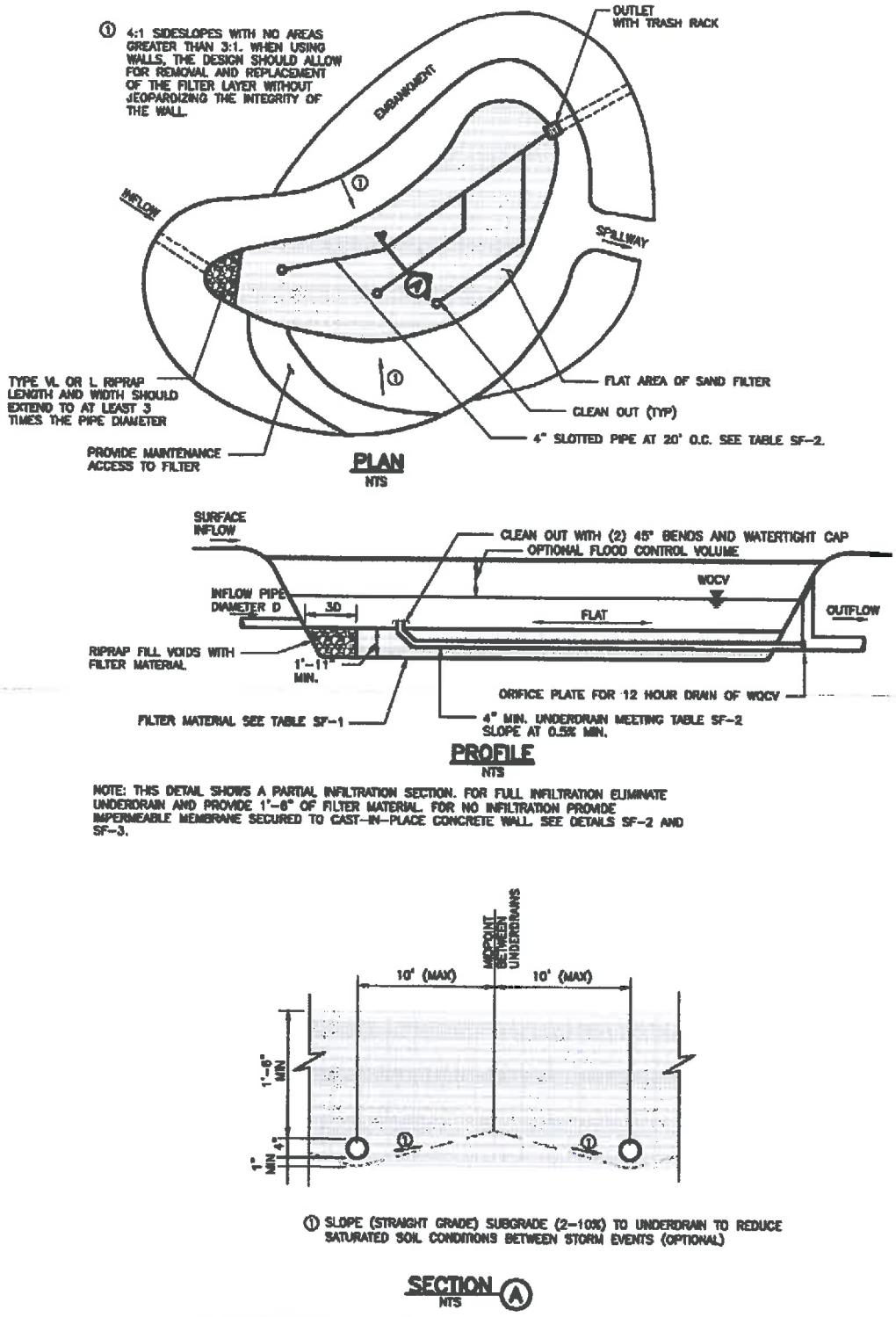


Figure SF-1. Sand Filter Plan and Sections

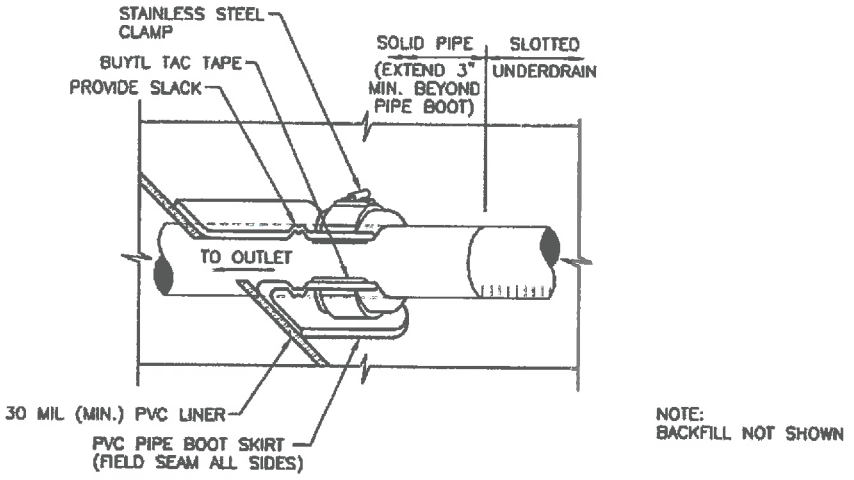


Figure SF-2. Geomembrane Liner/Underdrain Penetration Detail

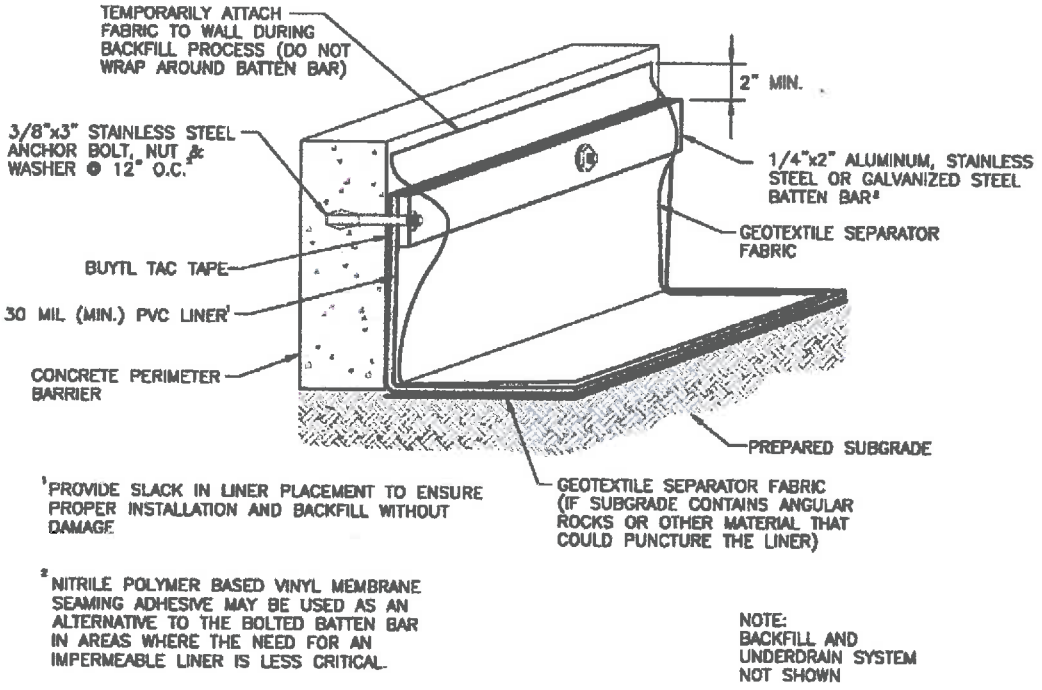


Figure SF-3. Geomembrane Liner/Concrete Connection Detail

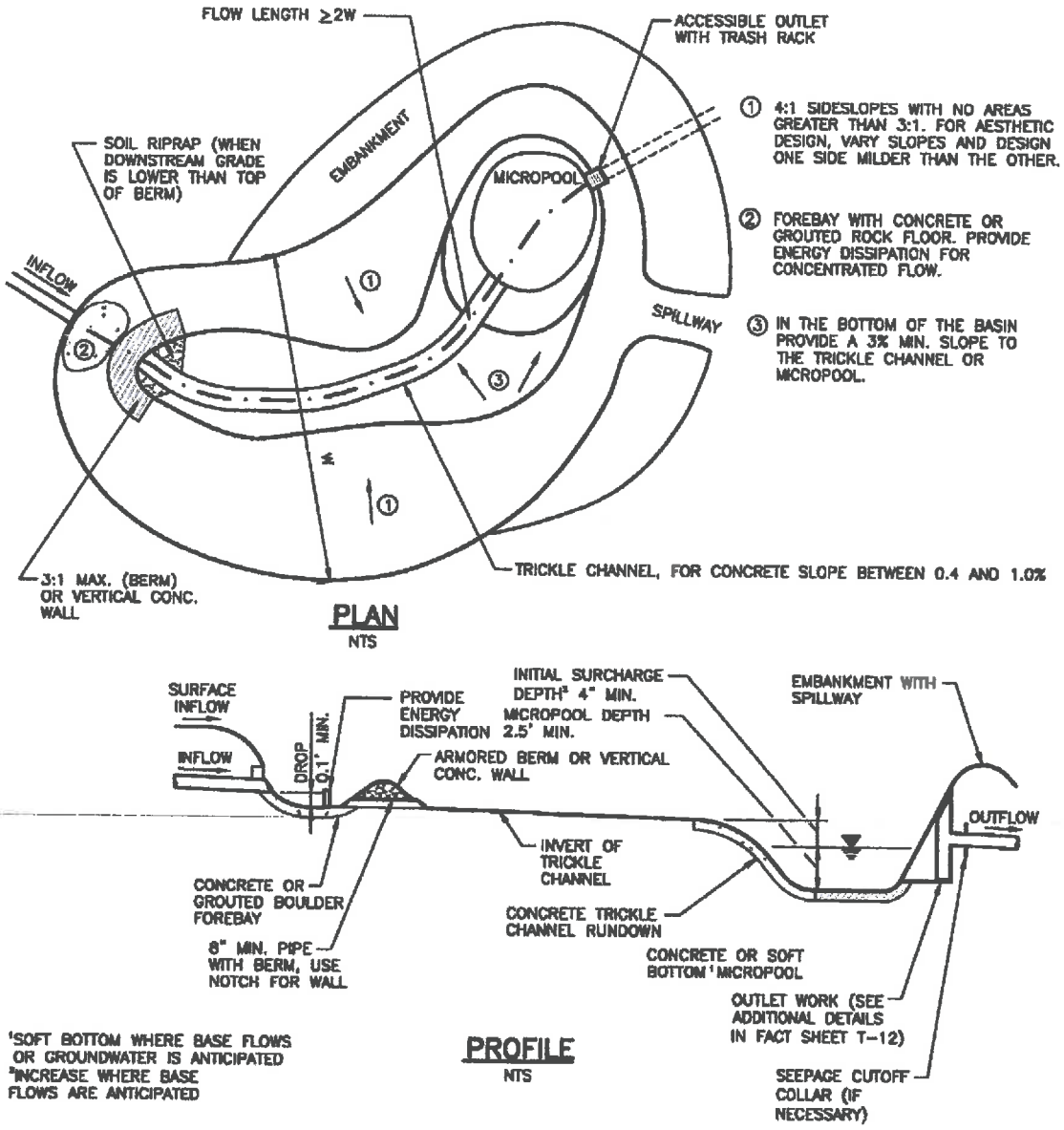
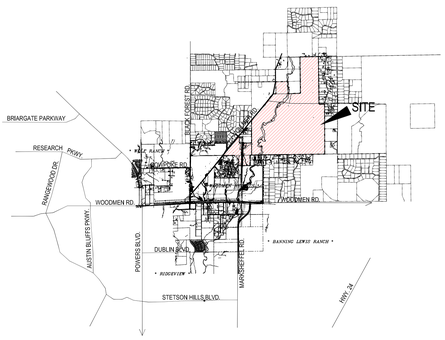


FIGURE EDB–3
EXTENDED DETENTION BASIN

Figure EDB-3. Extended Detention Basin (EDB) Plan and Profile

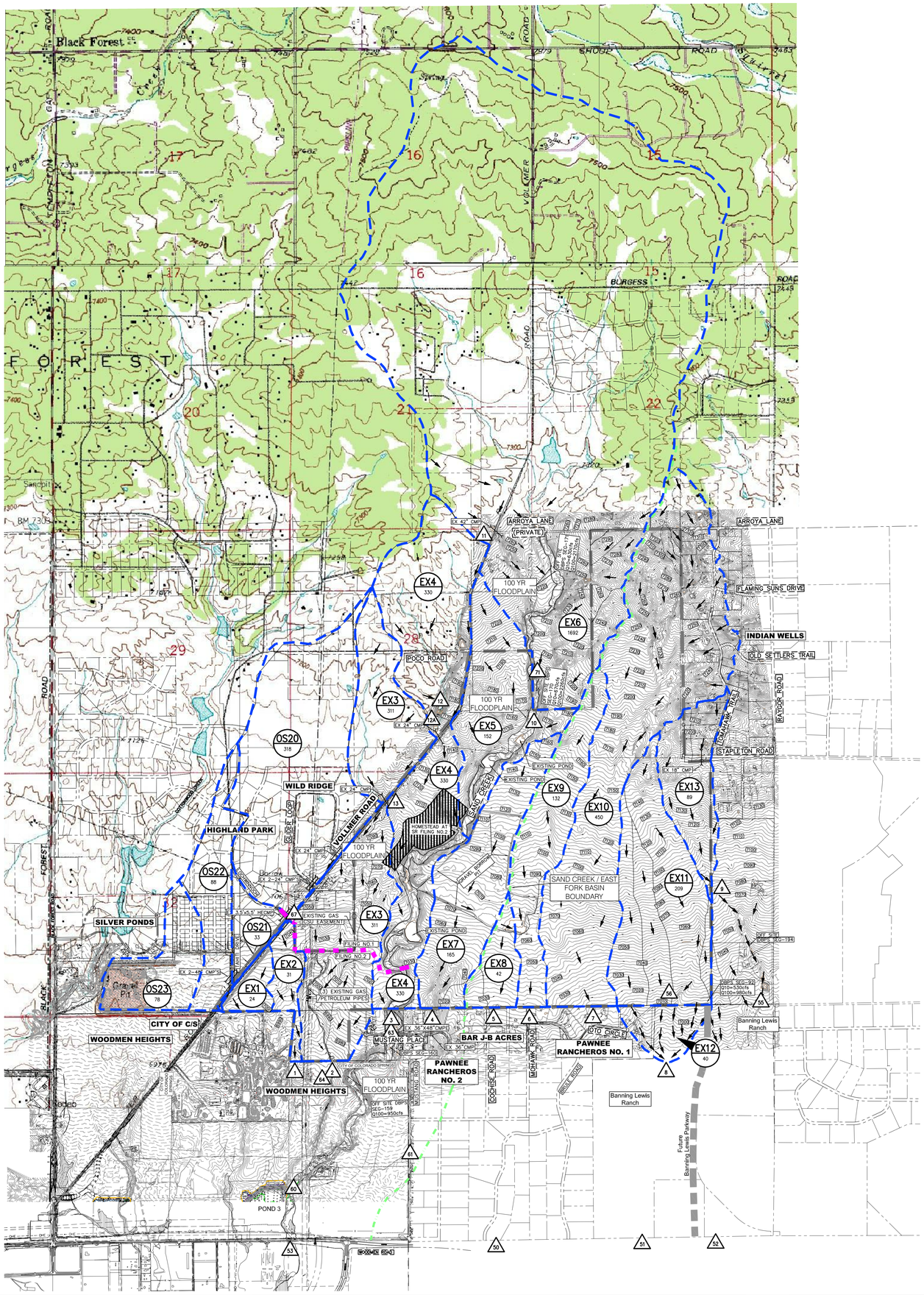
Additional Details are provided in BMP Fact Sheet T-12. This includes outlet structure details including orifice plates and trash racks.

HISTORIC, EXISTING AND PROPOSED DRAINAGE MAPS



STERLING RANCH

N.T.S.



HISTORIC CONDITION

BASIN SUMMARY

BASIN	AREA (ACRES)	Q_5 (CFS)	Q_{100} (CFS)
EX-1	24	3	40
EX-2	31	3	45
EX-3	311	49	341
EX-4	330	71	352
EX-5	152	14	209
EX-6	1692	118	2168
EX-7	165	12	197
EX-8	42	4	64
EX-9	132	11	149
EX-10	450	48	474
EX-11	209	17	261
EX-12	40	5	65
EX-13	89	6	114
OS-20	318	61	310
OS-21	33	8	38
OS-22	88	18	91
OS-23	78	34	84

* NOTE: BASIN S OS-22 & OS-23 NOT PART OF THIS REPORT, FLOWS FOLLOW HISTORIC PATTERNS ON THE WEST SIDE OF VOLLMER ROAD.

HISTORIC CONDITION

DESIGN POINTS

DESIGN POINT	SQ. MI.	Q_5 (CFS)	Q_{100} (CFS)	SQ. MI.	DBPS Q_{100}	DBPS DP/ID
1	0.09	5	84			
2	0.49	49	341	0.74	465	64
3	0.52	139	2610	4.33	2552	63
4	0.26	12	197			
5	0.07	4	64			
6	0.21	11	149			
7	0.70	48	474			
8	0.39	18	305			
9	0.14	6	114			
10	2.64	122	2245	3.27	2245	71
11	0.09	5	83			
12A	0.01	3	16			
12	0.27	10	200			
13	0.17	6	126			
				0.48	#	55
				0.53	1210	56
				5.38	2629	60

* NOTE: SQ. MI. ARE NOT CONSISTANT AT EACH DESIGN POINT DP-DBPS

1" = 1000'

0 250 500 1000 2000

Scale in Feet

LEGEND

- EX1 / 23.2 — EXISTING MDDP BASIN / ACREAGE
- E1 — EXISTING FLOW RELEASE POINT
- FLOW DIRECTION
- BASIN BOUNDARY
- FILING NO.1 & NO.2 DIVISION LINE
- PROPERTY BOUNDARY
- 6920 — EXISTING CONTOUR
- CULVERT PIPE

CIVIL CONSULTANTS, INC.
15 NORTH NEVADA AVENUE
COLORADO SPRINGS, CO 80903
(719) 955-5485, FAX (719) 471-4812

STERLING RANCH

HISTORIC - DRAINAGE MAP

PROJECT NO. 09-002		FILE: O:\\dwg\Eng Exhibits\MDDP HISTORIC	
DESIGNED BY:	VAS	SCALE	DATE: 2/6/17
DRAWN BY:	VAS	HORIZ: 1"=1000'	SHEET 1 OF 1
CHECKED BY:	VAS	VERT: N/A	

STERLING RANCH FILING NO. 1
PROPOSED FINAL DRAINAGE MAP

PROJECT NO. 09-002 | DESIGNED BY: ET | DRAWN BY: BB | CHECKED BY: GT
SCALE: HORIZONTAL: 1"=100' VERTICAL: N/A
DATE: 1/2/2018
SHEET 4 OF 4 | SHEET 4

20 BOULDER CRESCENT, SUITE 110
COLORADO SPRINGS, CO 80903
PHONE: 719.955.5485
CIVIL CONSULTANTS, INC.

FOR AND ON BEHALF OF M&S CIVIL CONSULTANTS, INC.
VIRGIL A. SANCHEZ, COLORADO P.E. NO. 37160

REVISIONS:

NO.	DATE:	BY:	DESCRIPTION:	APRV'D. BY:	DATE:

WILD RIDGE FILING NO. 2 EPC
SUB-BASIN EX3
EPC *UNPLATTED*
SUB-BASIN EX4
SR LAND, LLC *UNPLATTED*
EXISTING VOLLMER ROAD
BRIARGATE BOULEVARD
DINES BOULEVARD
FILING NO. 1
WHEATLAND DRIVE
TRACT 'A' TRACT 'B' TRACT 'C' TRACT 'D' TRACT 'E' TRACT 'F' TRACT 'G' TRACT 'I' TRACT 'J'
SEE SHEET 3
PROP MOD CDOT TYPE D INLET
PROP CDOT TYPE C INLET
PROP CDOT TYPE D INLET
EX 12" CMP CULVERT
EX 24" CMP TO BE REMOVED
PROP CDOT EMBANKMENT PROTECTOR TYPE 5
PROP 30" RCP STORM SEWER
PROP 18" RCP STORM SEWER
PROP 24" RCP STORM SEWER
FUTURE FULL SPECTRUM DETENTION/WATER QUALITY TO BE PROVIDED WITH DEVELOPMENT OF TRACT C
PIPE TO BE REMOVED
INSTALL RIPRAP
EX INTERIM CHANNEL TO BE FILLED FLOWS ROUTED THROUGH PROP 42" PIPE
EX AND PROP INTERIM CHANNEL TO PROTECT DOWN STREAM DEVELOPMENT
FULL SPECTRUM POND 4
RIPRAP EMERGENCY SPILLWAY AND OVERFLOW PATH WITH EROSION CONTROL FABRIC
100 YR FLOODPLAIN
CONCRETE TRAIL
INSTALL EROSION CONTROL FABRIC
BANK STABILIZATION
SAND CREEK
FUTURE BANK STABILIZATION
FUTURE FULL SPECTRUM POND
TEMP SEDIMENT BASIN & OUTFALL
APPROX. LOCATION OF 25' TRAIL EASEMENT TO BE DETERMINED UPON PLATTING OF FILINGS ADJACENT TO SAND CREEK
SAND CREEK CHANNEL IMPROVEMENTS PER SAND CREEK DBPS. SELECTIVE RIP RAP LININGS AND GRADE CONTROL STRUCTURES
PROPOSED TEMPORARY MAINTENANCE ACCESS EASEMENT
FUTURE ROAD CROSSING
TEMPORARY FULL SPECTRUM POND BB
SC-8 DBPS 187
FUT. CHECK
RIP RAP
1" = 100'
0 50 100 200
Scale in Feet

LEGEND
BASIN DESIGNATION (Z / 25 / .25 / .35 / C5 / C100 / ACRES)
PIPE RUN REFERENCE LABEL
SURFACE DESIGN POINT
BASIN BOUNDARY
EX CONTOUR (6920)
PROP CONTOUR 6920
STORM SEWER PIPE
CROSSPAN
INLET
EX FLOW DIRECTION ARROW
EMERGENCY OVERFLOW DIRECTION
FLOW DIRECTION
FLARED END SECTION
FILING LINE

NOTE:
GRADE CONTROL STRUCTURES IN SAND CREEK TO BE DESIGNED AND CONSTRUCTED BY DEVELOPER/METRO DISTRICT PRIOR TO DEVELOPMENT EAST OF SAND CREEK.

NOTE:
TRACTS BB, K, G, E, C TO BE RE-PLATTED FOR DEVELOPMENT. A FINAL DRAINAGE REPORT WILL BEPROVIDED FOR EACH FINAL PLAT.

FOR LOCATING & MARKING GAS, ELECTRIC, WATER & TELEPHONE LINES
FOR BURIED UTILITY INFORMATION
48 HRS BEFORE YOU DIG
CALL 1-800-922-1987

INDEX MAP
N.T.S.
BRIARGATE PKWY, BLACK FOREST RD, POWERS BLVD, MARKSHEFFEL RD, COWPOKE RD, E WOODMEN RD, FOREST MEADOWS AVE, STERLING RANCH RD, STERLING (FUTURE), SAND CREEK

DESIGN POINT SUMMARY

DESIGN POINT	Q5	Q100	BASIN	STRUCTURE
2	8.0	19.3	B	TSB/36" FES
3	4.2	10.1	C	TSB/18" FES
4	16.1	36.7	E,F	15" AT-GRADE INLET
5	4.2	19.7	G,H,FLOWBY DP4	15" AT-GRADE INLET
6	14.1	26.7	I,J,K,L	15" AT-GRADE INLET
9	12.5	30.4	R	TSB/30" FES
10	50.0	102.9	S,PR4,PR6,PR10	CUMMULATIVE DETENTION POND 2.91'x9' INLET
11	18.9	162.1	PR11,PR18	SUMMED PEAK OUTFLOW
15	42.1	76.8	WP-3	TEMP. SED POND
16	4.3	8.2	RP-2C	SHEET FLOW INTO POND W-9
17	4.9	9.9	RP-2B	PROP CDOT EMBANKMENT PROTEC.
58	4.7	15.0	EX4A	CUMMULATIVE DETENTION POND 36" CMP RISER
59	31.2	166.7	W-2,V2, DP65	4'x14' MOD CDOT TYPE D INLET
61	8.9	21.3	M,M2,DP16,DP17	CUMMULATIVE DETENTION POND 2.91'x2.91' INLET
62	1.6	6.9	SUB-BASIN OS1A,V1A	18" RCP
63	4.8	26.1	SUB-BASIN OS1B,V1B,DP62	2.9'x5.7' CDOT TYPE D INLET
64	2.2	12.3	SUB-BASIN OS1C,V1C	2.9'x2.9' CDOT TYPE C INLET
65	16.5	119.9	SUB-BASIN OS1D,V1D	EXISTING SWALE
66	26.4	193.7	SUB-BASIN EX-4B	PROPOSED SWALE
67	28.2	208.4	EX 4C,DP66,PR70	PROP SWALE OUTFALL SAND CREEK
DBPS 187	700	2380	SAND CREEK DRAINAGE BASIN PLANNING STUDY	

BASIN SUMMARY

BASIN	AREA (ACRES)	Q5	Q100
B	5.39	8.0	19.3
C	2.92	4.2	10.1
E	8.24	12.2	29.6
F	1.12	4.3	7.7
G	0.61	0.5	1.9
H	0.19	0.9	1.6
I	2.1	8.9	15.9
J	0.43	0.4	1.3
K	0.61	0.5	1.9
L	1.54	5.6	10.0
M	1.15	1.0	3.6
M2	1.60	0.4	3.2
R	9.73	12.5	30.4
S	1.97	0.7	5.3
SUB-BASIN OS1A	2.7	0.7	5.3
SUB-BASIN OS1B	9.09	2.4	17.8
SUB-BASIN OS1C	5.64	1.5	11.1
SUB-BASIN OS1D	94.3	16.3	119.5
V1A	0.31	1.4	2.6
V1B	0.26	1.2	2.2
V1C	0.21	1.0	1.7
V1D	0.13	0.6	1.1
V2	0.32	1.5	2.7
RP-2B	2.04	4.9	9.9
RP-2C	1.28	4.3	8.2
W-2	10.0	2.7	19.7
WP-3	14.14	42.1	76.8
SUB-BASIN EX-4A	5.98	4.7	15.0
SUB-BASIN EX-4B	185.62	26.4	193.7
SUB-BASIN EX-4C	9.36	2.4	17.3

STORM SEWER SUMMARY

PIPE RUN	Q5	Q100	PIPE SIZE	CONTRIBUTING PIPES
2	8.0	19.3	36" RCP	DP2
3	11.6	27.6	36" RCP	DP5,PR2
4	21.8	42.1	36" RCP	DP6,PR3
5	4.2	10.1	18" RCP	DP3
6	16.8	29.4	30" RCP	DP4,PR5
10	12.5	30.4	30" RCP	DP9
11	2.7	36.2	30" RCP	OUTFLOW UD-DETv3.04
12	26.5	200.3	60" RCP	SUM PR11,PR18
15	42.1	76.8	42" RCP	DP15 DEVELOPED
18A	18.9	133.7	54" RCP	DP59
18	23.8	164.1	54" RCP	PR18,PR81
70	0.5	4.9	18" CMP	OUTFLOW UD-DETv3.04
72	0.7	5.3	EX 12" CMP	OS1A
77	4.8	26.1	24" RCP	DP63
78	2.2	12.3	18" RCP	DP64
79	7.0	38.2	30" RCP	PR77,PR78
80	0.6	8.8	18" RCP	DP61
81	7.6	46.8	30" RCP	PR79,PR80

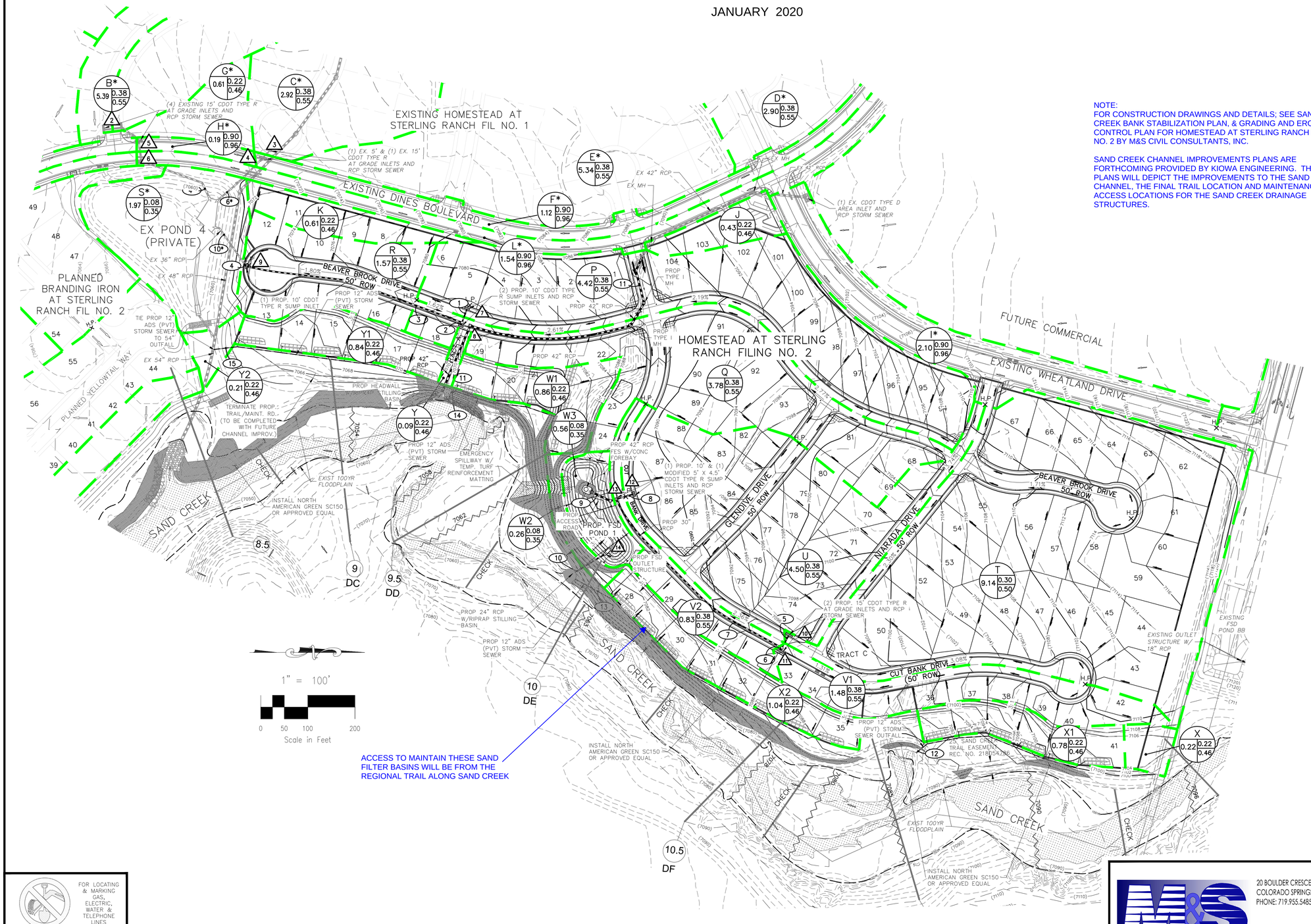
File: Q:\09002A\Sterling Ranch District\dwg\Eng Exhibits\FDP\SR Filing 1-Drainage Map SHEET 4.dwg Plotstamp: 1/13/2020 4:41 PM

HOMESTEAD AT STERLING RANCH FILING NO. 2

COUNTY OF EL PASO, STATE OF COLORADO

PROPOSED DRAINAGE MAP

JANUARY 2020



ACCESS TO MAINTAIN THESE SAND FILTER BASINS WILL BE FROM THE REGIONAL TRAIL ALONG SAND CREEK

NOTE:
FOR CONSTRUCTION DRAWINGS AND DETAILS; SEE SAND CREEK BANK STABILIZATION PLAN, & GRADING AND EROSION CONTROL PLAN FOR HOMESTEAD AT STERLING RANCH FILING NO. 2 BY M&S CIVIL CONSULTANTS, INC.

SAND CREEK CHANNEL IMPROVEMENTS PLANS ARE FORTHCOMING PROVIDED BY KIOWA ENGINEERING. THESE PLANS WILL DEPICT THE IMPROVEMENTS TO THE SAND CREEK CHANNEL, THE FINAL TRAIL LOCATION AND MAINTENANCE ACCESS LOCATIONS FOR THE SAND CREEK DRAINAGE STRUCTURES.

LEGEND

- BASIN DESIGNATION (Z; 25; .25; .35; C5; C100; ACRES)
- PIPE RUN REFERENCE LABEL
- SURFACE DESIGN POINT
- BASIN BOUNDARY
- EXISTING CONTOUR
- PROP CONTOUR
- HOMESTEAD FILING NOS. 2&3 BOUNDARY
- PROPOSED STORM SEWER PIPE
- EXISTING STORM SEWER PIPE
- CROSSPAN
- INLET
- EXISTING FLOW DIRECTION ARROW
- PROPOSED FLOW DIRECTION ARROW
- FLARED END SECTION
- H.P. HIGH POINT
- L.P. LOW POINT

STORM SEWER SUMMARY				
PIPE RUN	Q_5	Q_{100}	PIPE SIZE	CONTRIBUTING PIPES/DESIGN POINTS
1	5.7	13.8	18" RCP	DP7
2	4.9	11.8	18" RCP	DP8
3	10.6	25.7	24" RCP	PR1, PR2
4	12.4	30.1	30" RCP	DP9, PR3
5	9.1	12.7	18" RCP	DP10
6	1.9	12.7	18" RCP	DP11
7	10.9	25.3	30" RCP	PR5, PR6
8	6.2	17.2	24" RCP	DP12
9	17.9	47.1	42" RCP	DP13, PR7, PR8
10	0.7	23.5	24" RCP	OUTLET STRUC.
11	42.1	76.8	42" RCP	CONTINUED FROM MDDP DP15*
12	0.0	1.3	12" ADS	LOTS 36–41
13	0.0	1.6	12" ADS	LOTS 28–35
14	0.0	1.5	12" ADS	LOTS 19–24
15	0.0	1.4	12" ADS	LOTS 13–18
4*	21.8	42.1	36" RCP	SEE MDDP*
6*	16.8	29.4	30" RCP	SEE MDDP*
10*	12.5	30.4	30" RCP	SEE MDDP*

BASIN SUMMARY			
BASIN	AREA (ACRES)	Q_5	Q_{100}
ONSITE BASINS			
J	0.43	0.4	1.3
K	0.61	0.5	1.9
P	4.42	5.7	13.8
Q	3.78	4.9	11.8
R	1.57	2.2	5.4
T	9.14	9.4	26.4
U	4.50	6.4	15.6
V1	1.48	2.1	5.0
V2	0.83	1.2	2.9
W1	0.56	0.2	1.7
W2	0.26	0.1	0.8
W3	0.56	0.2	1.7
X	0.22	0.2	0.8
X1	0.78	0.8	2.8
X2	1.04	1.1	3.7
Y	0.09	0.1	0.3
Y1	0.84	0.8	3.0
Y2	0.21	0.2	0.7
B*	5.39	8.0	19.3
C*	2.92	4.2	10.1
D*	2.90	4.3	10.4
E*	5.34	8.2	19.9
F*	1.12	4.3	7.7
G*	0.61	0.5	1.9
H*	0.19	0.9	1.6
I*	2.10	8.9	15.9
L*	1.54	5.6	10.0
S*	1.97	0.7	5.3

FULL SPECTRUM DETENTION INTERIM POND 1	
WQ VOLUME	0.245 AC–FT
EURV VOLUME	0.741 AC–FT
100 YR STORAGE VOLUME	1.331 AC–FT
100 YR WATER SURFACE EL	7083.91
SPILLWAY CREST EL	7084.16
TOP OF EMBANKMENT EL	7086.00
SPILLWAY DESIGN FLOW DEPTH	0.84 FT

DESIGN POINT SUMMARY				
DESIGN POINT	Q_5	Q_{100}	BASIN	STRUCTURE
2*	8.0	19.3	B*	(2) EX. 15' AT–GRADE INLETS
3*	4.2	10.1	C*	EX. 6' SUMP INLET
4*	16.1	36.7	D*, E*, F*	EX. 15' AT–GRADE INLET
5*	4.2	19.7	G*, H*, FLOWBY DP4*	EX. 15' AT–GRADE INLET
6*	14.1	26.7	I*, J*, K*, L*	EX. 15' AT–GRADE INLET
7	5.7	13.8	P	PROP. 10' SUMP INLET
8	4.9	11.8	Q	PROP. 10' SUMP INLET
9	2.2	5.4	R	PROP. 5' SUMP INLET
10	9.4	15.6	T	PROP. 15' AT–GRADE INLET
11	1.9	15.6	V1	PROP. 15' AT–GRADE INLET
12	6.2	17.2	U, FLOWBY DP10	PROP. 10' SUMP INLET
13	1.2	5.9	V2, FLOWBY DP11	PROP. 5' SUMP INLET
14	19.6	52.4	W3, PR9	CUMULATIVE DETENTION POND

* For detailed information on Desing Points, Basins, Flowby, or Pipe Runs see Sterling Ranch Filing Nos. 1&2 MDDP prepared by MS Civil Consultants, dated April 2017

Refer to Homestead at Sterling Ranch Filing No. 2 Grading and Erosion Control Plan for additional interim channel stabilization improvements.

All elevations provided on map are referenced in NGVD29

FOR LOCATING & MARKING GAS, ELECTRIC, WATER & TELEPHONE LINES
FOR BURIED UTILITY INFORMATION
48 HRS BEFORE YOU DIG
CALL 1–800–922–1987

M&S CIVIL CONSULTANTS, INC.
20 BOULDER CRESCENT, SUITE 110
COLORADO SPRINGS, CO 80903
PHONE: 719.955.5485

HOMESTEAD AT STERLING RANCH FIL. NO. 2

PROPOSED DRAINAGE MAP

PROJECT NO. 09–007	SCALE:	DATE: 01/15/2020	
DESIGNED BY: CMN	HORIZONTAL: 1"=100'	SHEET 1 OF 1	PDM
DRAWN BY: CMN	VERTICAL: N/A		
CHECKED BY: VAS			

File: G:\09007A\Sterling Ranch No 6\Dwg\Eng Exhibits\Prop. Drain. Map Homestead Fil. No 2.dwg Plotstamp: 1/15/2020 11:17 AM