MARTIN/MARTIN
CONSULTING ENGINEERS

October 24, 2023

City of Arvada
8101 Ralston Road
Arvada, Colorado 80002

Re: Candelas Indiana North – Joyce Street & Indiana Widening Pond Certification
DA2020-0107

To City of Arvada (Engineering):

This letter is regarding the construction of the Candelas Indiana North Detention Ponds, which are located to the west of Indiana Street, east of Candelas Parkway and north of Big Dry Creek. The detention ponds, outlet structures and other associated facilities were designed in the approved "CANDELAS INDIANA NORTH – JOYCE STREET AND INDIANA WIDENING", signed and sealed on September 10, 2021 and approved by the City of Arvada on February 26, 2022, both prepared by Martin/Martin, Inc. An as-built MHFD-Detention workbook has been prepared using as-built contours and elevations for both Pond A and Pond B. See the Detention Basin Summary table for details and a comparison to the approved values.

A field survey of the Detention Ponds was provided by Wagner Construction on June 14, 2023. Two following surveys were conducted by Martin/Martin Consulting Engineers on July 7, 2023 and August 17, 2023. An exhibit showing the as-constructed Detention Ponds is attached to this letter.

In the as-built condition, Pond A requires a total detention volume of 0.575 ac-ft and provides a total of 1.37 ac-ft below the overflow crest at 5622.00. In the as-built condition, Pond B requires a total detention volume of 2.47 ac-ft and provides a total of 2.93 ac-ft below the overflow crest at 5615.00.

Therefore, to the best of my knowledge, information, and belief, all water quality features (permanent control measures) have both been constructed in substantial compliance with the approved drainage report and construction drawings.

Sincerely,

David A. Lovato, PE
Principal

10-24-23

C: Jeff Nading, Gregg Bradbury, JCMD
Wes Back, IDES

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Table 1 - Detention Basin Summary

POND A	DESIGN			AS-BUILT		
STORAGE EVENT	Water Surface Elevation	Stage Volume Required (AC-FT)	Release Rate (CFS)	Water Surface Elevation	Stage Volume Constructed (AC-FT)	Release Rate (CFS)
WQCV	5618.00	0.119	0.10	5618.34	0.124	0.10
EURV	5618.80	0.187	0.10	5619.06	0.286	0.10
100- YEAR	5619.70	0.298	9.10	5619.87	0.577	6.90

POND B	DESIGN			AS-BUILT		
STORAGE EVENT	Water Surface Elevation	Stage Volume Required (AC-FT)	Release Rate (CFS)	Water Surface Elevation	Stage Volume Constructed (AC-FT)	Release Rate (CFS)
WQCV	5613.19	0.510	0.20	5613.15	0.522	0.20
EURV	5613.99	0.813	0.30	5613.98	1.353	0.30
100-YEAR	5615.11	1.154	33.40	5614.75	2.505	26.40

EXHIBIT A

PHOTOGRAPHIC DOCUMENTATION

Photograph 1 – Image of the Pond A Outlet Structure, taken by M/M Consulting Engineers on 07/20/2023

Photograph 2 – Image of the Pond B Outlet Structure, taken by M/M Consulting Engineers on 07/21/2023

Photograph 3 – Image of the Pond B Connecting Pipe, taken by M/M Consulting Engineers on 07/21/2023

EXHIBIT B

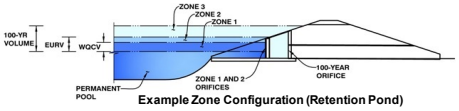
AS-BUILT MHFD DETENTION DESIGN SHEET

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: CANDELAS INDIANA NORTH

Basin ID: MAJOR BASIN A - POND CERTIFICATION



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	7.61	acres
Watershed Length =	832	ft
Watershed Length to Centroid =	415	ft
Watershed Slope =	0.025	ft/ft
Watershed Imperviousness =	42.70%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	100.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	Arvada - City Hall	

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

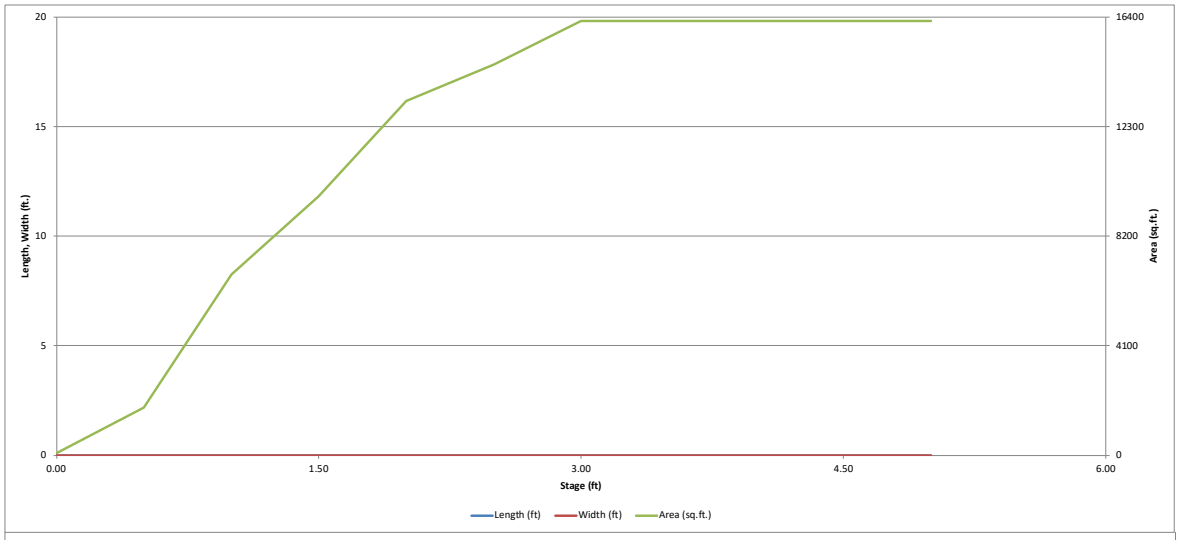
			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.119	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.304	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 0.78 in.) =	0.179	acre-feet	0.78	inches
5-yr Runoff Volume (P1 = 1.06 in.) =	0.283	acre-feet	1.06	inches
10-yr Runoff Volume (P1 = 1.31 in.) =	0.413	acre-feet	1.31	inches
25-yr Runoff Volume (P1 = 1.68 in.) =	0.671	acre-feet	1.68	inches
50-yr Runoff Volume (P1 = 2 in.) =	0.870	acre-feet	2.00	inches
100-yr Runoff Volume (P1 = 2.34 in.) =	1.112	acre-feet	2.34	inches
500-yr Runoff Volume (P1 = 3.24 in.) =	1.697	acre-feet	3.24	inches
Approximate 2-yr Detention Volume =	0.174	acre-feet		
Approximate 5-yr Detention Volume =	0.289	acre-feet		
Approximate 10-yr Detention Volume =	0.350	acre-feet		
Approximate 25-yr Detention Volume =	0.429	acre-feet		
Approximate 50-yr Detention Volume =	0.472	acre-feet		
Approximate 100-yr Detention Volume =	0.575	acre-feet		

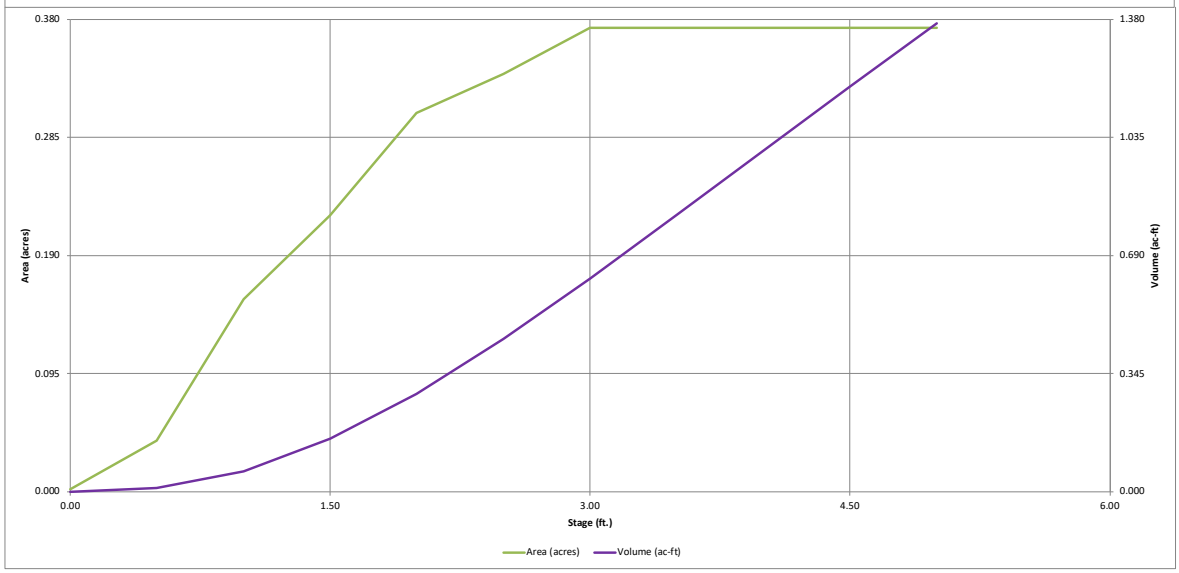
Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.119	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.185	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.271	acre-feet
Total Detention Basin Volume =	0.575	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 = 0.50 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	100	0.002		
5617.5	--	0.50	--	--	--	1,784	0.041	471	0.011
5618	--	1.00	--	--	--	6,753	0.155	2,605	0.060
5618.5	--	1.50	--	--	--	9,678	0.222	6,713	0.154
5619	--	2.00	--	--	--	13,269	0.305	12,450	0.286
5619.5	--	2.50	--	--	--	14,630	0.336	19,424	0.446
5620	--	3.00	--	--	--	16,263	0.373	27,148	0.623
5620.5	--	3.50	--	--	--	16,263	0.373	35,279	0.810
5621	--	4.00	--	--	--	16,263	0.373	43,411	0.997
5621.5	--	4.50	--	--	--	16,263	0.373	51,542	1.183
5622	--	5.00	--	--	--	16,263	0.373	59,674	1.370


20
15
10
5
0
16400
12300
8200
4100
0
0.00
1.50
3.00
4.50
6.00
Length, Width (ft.)
Area (sq.ft.)
Stage (ft)
Length (ft)
Width (ft)
Area (sq.ft.)

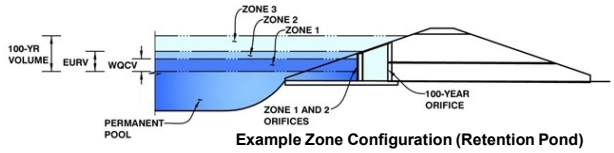

0.380
0.285
0.190
0.095
0.000
1.380
1.035
0.690
0.345
0.000
0.00
1.50
3.00
4.50
6.00
Area (acres)
Volume (ac-ft)
Stage (ft.)
Area (acres)
Volume (ac-ft)

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: CANDELAS INDIANA NORTH

Basin ID: MAJOR BASIN A - POND CERTIFICATION



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.34	0.119	Orifice Plate
Zone 2 (EURV)	2.06	0.185	Orifice Plate
Zone 3 (100-year)	2.87	0.271	Weir&Pipe (Restrict)
Total (all zones)		0.575	

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

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

Calculated Parameters for Underdrain

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

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	5.486E-03	ft^2
Depth at top of Zone using Orifice Plate =	2.29	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	9.20	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	0.79	sq. inches (diameter = 1 inch)	Elliptical Slot Area =	N/A	ft^2

Calculated Parameters for Plate

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.80	1.60					
Orifice Area (sq. inches)	0.79	0.79	0.79					

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

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orif

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

	Zone 3 Weir	Not Selected			Zone 3 Weir	Not Selected
Overflow Weir Front Edge Height, Ho =	2.29	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	3.02	N/A
Overflow Weir Front Edge Length =	3.00	N/A	feet	Overflow Weir Slope Length =	3.01	N/A
Overflow Weir Grate Slope =	4.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	5.93	N/A
Horiz. Length of Weir Sides =	2.92	N/A	feet	Overflow Grate Open Area w/o Debris =	7.14	N/A
Overflow Grate Type =	Close Mesh Grate	N/A		Overflow Grate Open Area w/ Debris =	3.57	N/A
Debris Clogging % =	50%	N/A	%			

Calculated Parameters for Overflow W

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

	Zone 3 Restrictor	Not Selected			Zone 3 Restrictor	Not Selected
Depth to Invert of Outlet Pipe =	0.00	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	1.20	N/A
Outlet Pipe Diameter =	18.00	N/A	inches	Outlet Orifice Centroid =	0.55	N/A
Restrictor Plate Height Above Pipe Invert =	11.60		inches	Half-Central Angle of Restrictor Plate on Pipe =	1.86	N/A

Calculated Parameters for Outlet Pipe w/ Flow Restriction Pla

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	5.00	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.18	feet
Spillway Crest Length =	65.00	feet	Stage at Top of Freeboard =	6.18	feet
Spillway End Slopes =	10.00	H:V	Basin Area at Top of Freeboard =	0.37	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	1.37	acre-ft

Calculated Parameters for Spillway

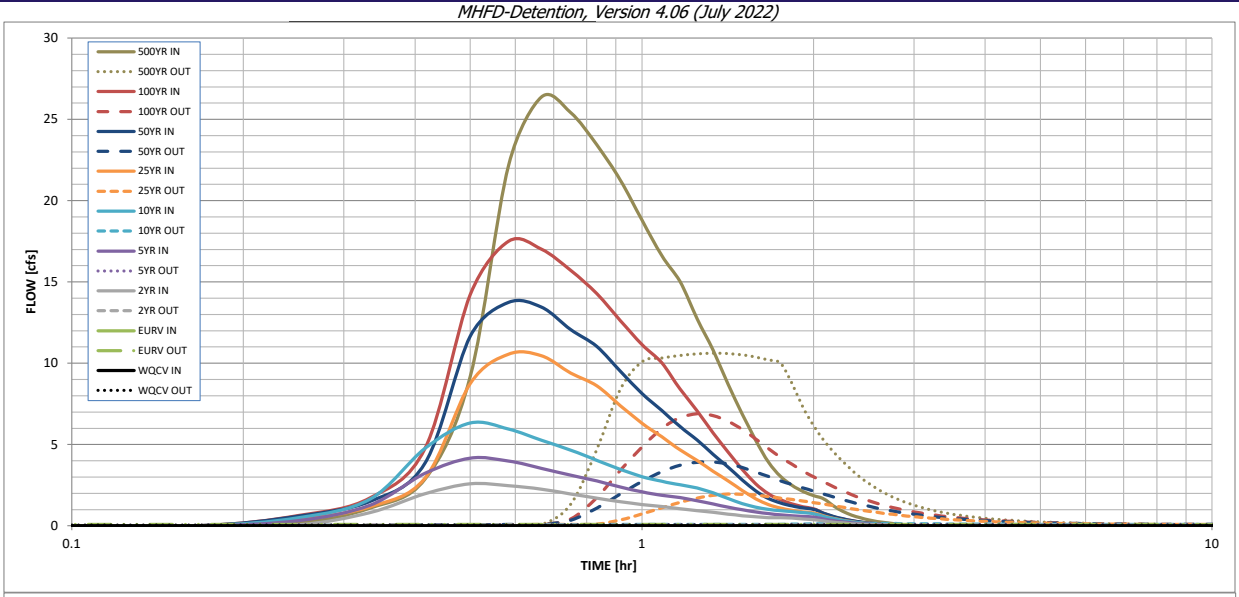
Routed Hydrograph Results

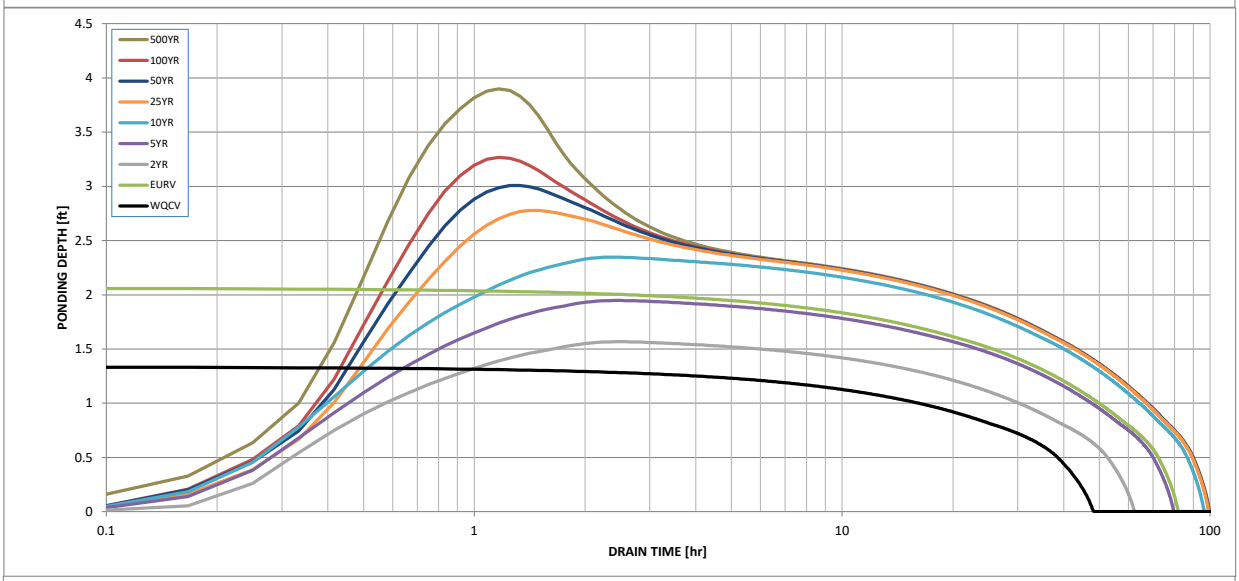
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through A

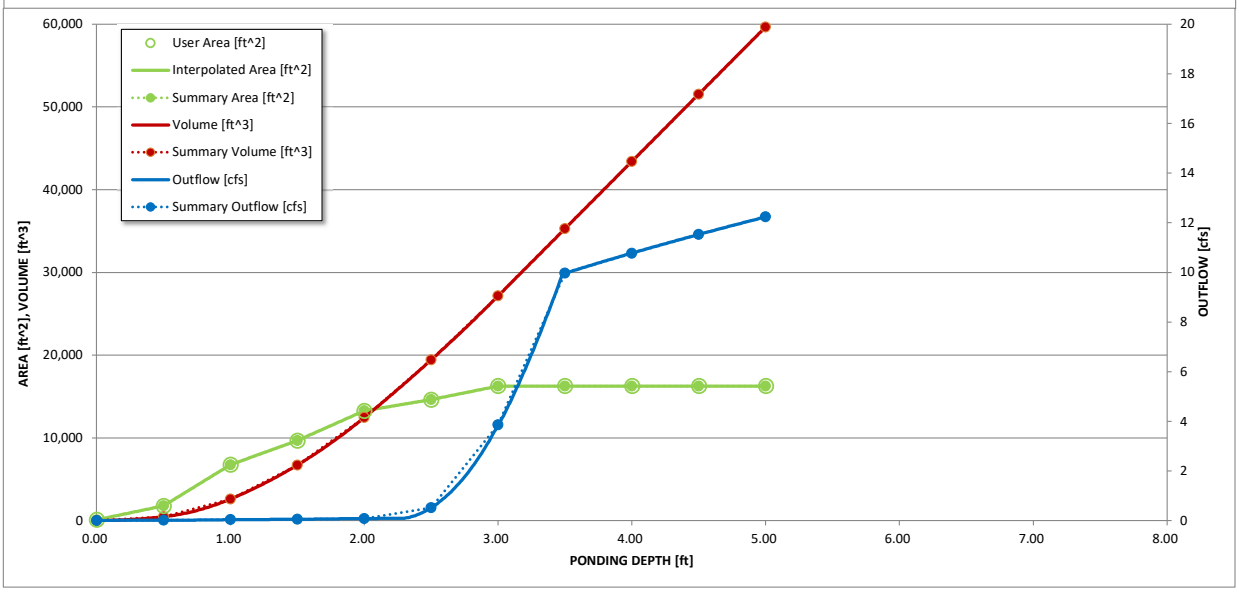
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	0.78	1.06	1.31	1.68	2.00	2.34
CUHP Runoff Volume (acre-ft) =	0.119	0.304	0.179	0.283	0.413	0.671	0.870	1.112
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.179	0.283	0.413	0.671	0.870	1.112
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.1	0.5	1.9	5.2	7.3	9.9
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A						
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.07	0.25	0.68	0.96	1.30
Peak Inflow Q (cfs) =	N/A	N/A	2.6	4.2	6.3	10.6	13.7	17.5
Peak Outflow Q (cfs) =	0.0	0.1	0.1	0.1	0.1	1.9	3.9	6.9
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.2	0.1	0.4	0.5	0.7
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.0	0.3	0.5	0.9
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	44	74	57	72	86	84	81	77
Time to Drain 99% of Inflow Volume (hours) =	**46**	78	60	76	92	92	91	90
Maximum Ponding Depth (ft) =	1.34	2.06	1.57	1.95	2.35	2.78	3.01	3.26
Area at Maximum Ponding Depth (acres) =	0.20	0.31	0.23	0.29	0.33	0.36	0.37	0.37
Maximum Volume Stored (acre-ft) =	0.120	0.304	0.168	0.268	0.393	0.539	0.623	0.720

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename: _____

Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18
	0:15:00	0.00	0.00	0.07	0.32	0.50	0.40	0.59	0.63	1.09
	0:20:00	0.00	0.00	0.82	1.27	1.65	1.18	1.51	1.71	2.88
	0:25:00	0.00	0.00	1.97	3.23	4.77	2.93	3.86	4.77	9.17
	0:30:00	0.00	0.00	2.59	4.17	6.33	8.74	11.66	14.22	22.16
	0:35:00	0.00	0.00	2.47	3.98	5.95	10.56	13.74	17.51	26.38
	0:40:00	0.00	0.00	2.25	3.54	5.27	10.46	13.45	17.02	25.42
	0:45:00	0.00	0.00	1.96	3.11	4.66	9.40	12.06	15.71	23.42
	0:50:00	0.00	0.00	1.71	2.76	4.03	8.60	11.03	14.28	21.27
	0:55:00	0.00	0.00	1.48	2.38	3.47	7.40	9.51	12.63	18.80
	1:00:00	0.00	0.00	1.31	2.08	3.03	6.31	8.14	11.14	16.62
	1:05:00	0.00	0.00	1.19	1.88	2.74	5.47	7.09	10.02	15.02
	1:10:00	0.00	0.00	1.06	1.73	2.52	4.67	6.10	8.42	12.74
	1:15:00	0.00	0.00	0.94	1.55	2.32	4.02	5.28	7.08	10.80
	1:20:00	0.00	0.00	0.83	1.34	2.03	3.36	4.40	5.72	8.71
	1:25:00	0.00	0.00	0.72	1.15	1.68	2.77	3.61	4.53	6.88
	1:30:00	0.00	0.00	0.62	0.98	1.37	2.18	2.83	3.48	5.26
	1:35:00	0.00	0.00	0.55	0.86	1.14	1.66	2.14	2.58	3.92
	1:40:00	0.00	0.00	0.51	0.75	1.01	1.30	1.68	1.97	3.03
	1:45:00	0.00	0.00	0.49	0.67	0.93	1.09	1.40	1.60	2.49
	1:50:00	0.00	0.00	0.48	0.62	0.87	0.95	1.22	1.35	2.12
	1:55:00	0.00	0.00	0.43	0.58	0.82	0.86	1.10	1.18	1.86
	2:00:00	0.00	0.00	0.38	0.54	0.74	0.80	1.02	1.05	1.67
	2:05:00	0.00	0.00	0.30	0.42	0.58	0.61	0.78	0.78	1.24
	2:10:00	0.00	0.00	0.23	0.32	0.44	0.46	0.58	0.56	0.89
	2:15:00	0.00	0.00	0.17	0.24	0.33	0.34	0.43	0.42	0.66
	2:20:00	0.00	0.00	0.13	0.18	0.25	0.26	0.32	0.31	0.49
	2:25:00	0.00	0.00	0.10	0.14	0.18	0.19	0.24	0.23	0.37
	2:30:00	0.00	0.00	0.07	0.10	0.13	0.14	0.17	0.17	0.27
	2:35:00	0.00	0.00	0.05	0.07	0.10	0.10	0.13	0.13	0.20
	2:40:00	0.00	0.00	0.04	0.05	0.07	0.07	0.09	0.09	0.14
	2:45:00	0.00	0.00	0.03	0.03	0.05	0.05	0.06	0.06	0.10
	2:50:00	0.00	0.00	0.02	0.02	0.03	0.03	0.04	0.04	0.06
	2:55:00	0.00	0.00	0.01	0.01	0.02	0.02	0.02	0.02	0.03
	3:00:00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	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
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	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Summary Stage-Area-Volume-Discharge Relationships

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

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

Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]
	0.00	100	0.002	0	0.000	0.00
	0.50	1,784	0.041	471	0.011	0.02
	1.00	6,753	0.155	2,605	0.060	0.04
	1.50	9,678	0.222	6,713	0.154	0.05
	2.00	13,269	0.305	12,450	0.286	0.08
	2.50	14,630	0.336	19,424	0.446	0.52
	3.00	16,263	0.373	27,148	0.623	3.86
	3.50	16,263	0.373	35,279	0.810	9.97
	4.00	16,263	0.373	43,411	0.997	10.78
	4.50	16,263	0.373	51,542	1.183	11.53
	5.00	16,263	0.373	59,674	1.370	12.24

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).

Stormwater Detention and Infiltration Design Data Sheet

SDI-Design Data v2.00, Released January 2020

Stormwater Facility Name: **POND A - POND CERTIFICATION**

Facility Location & Jurisdiction: **CANDELAS INDIANA NORTH**

User Input: Watershed Characteristics

Extended Detention Basin (EDB)	EDB	
Watershed Area =	7.61	acres
Watershed Length =	832	ft
Watershed Length to Centroid =	415	ft
Watershed Slope =	0.025	ft/ft
Watershed Imperviousness =	42.7%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	100.0%	percent
Target WQCV Drain Time =	40.0	hours

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

Arvada - City Hall

User Defined Stage [ft]	User Defined Area [ft^2]	User Defined Stage [ft]	User Defined Discharge [cfs]
0.00	0	0.00	0.00
0.50	1,784	0.50	0.02
1.00	6,753	1.00	0.04
1.50	9,678	1.50	0.05
2.00	13,269	2.00	0.08
2.50	14,630	2.50	0.52
3.00	16,263	3.00	3.85
3.50	16,263	3.50	9.97
4.00	16,263	4.00	10.78
4.50	16,263	4.50	11.53
5.00	16,263	5.00	12.24

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

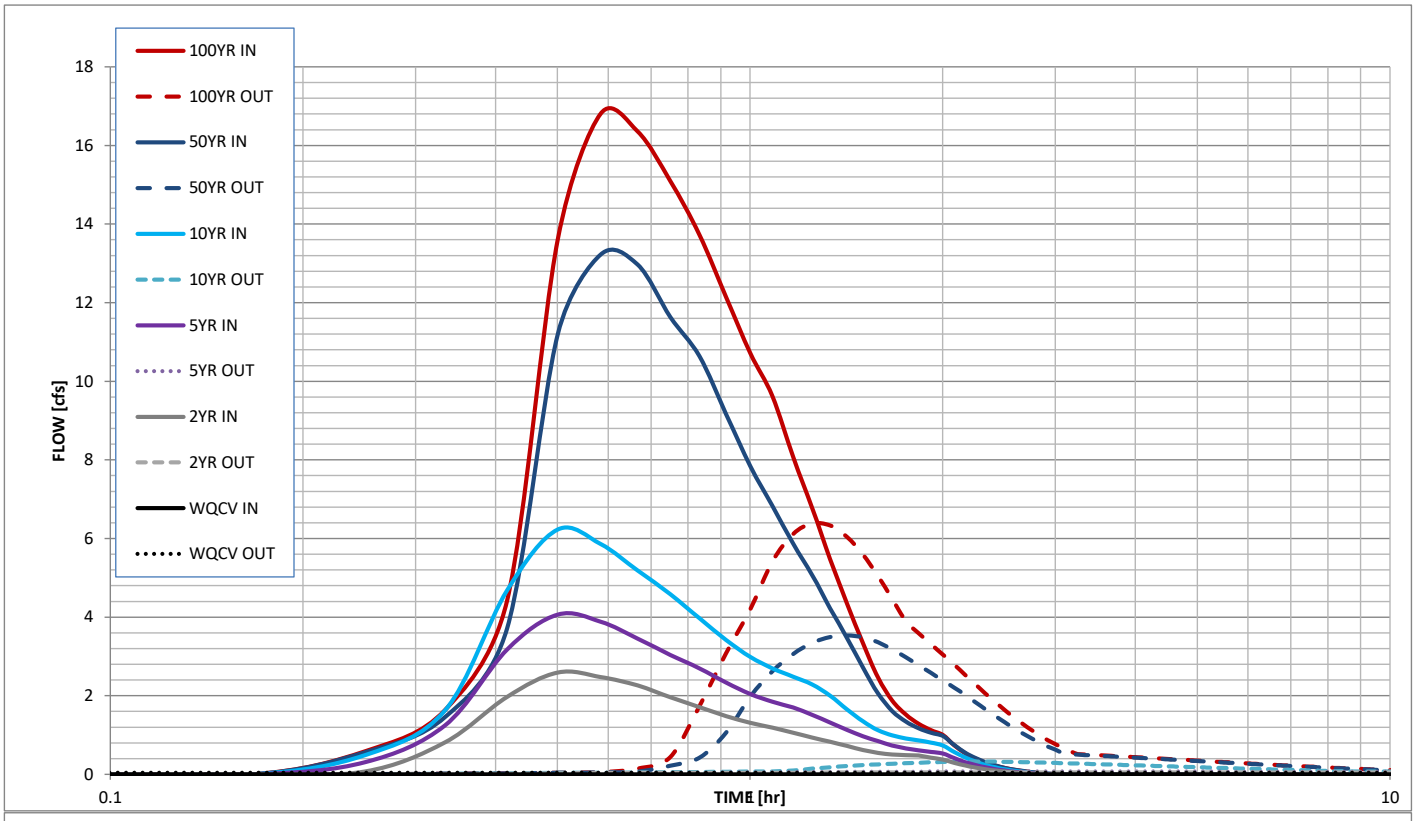
Once CUHP has been run and the Stage-Area-Discharge information has been provided, click 'Process Data' to interpolate the Stage-Area-Volume-Discharge data and generate summary results in the table below. Once this is complete, click 'Print to PDF'.

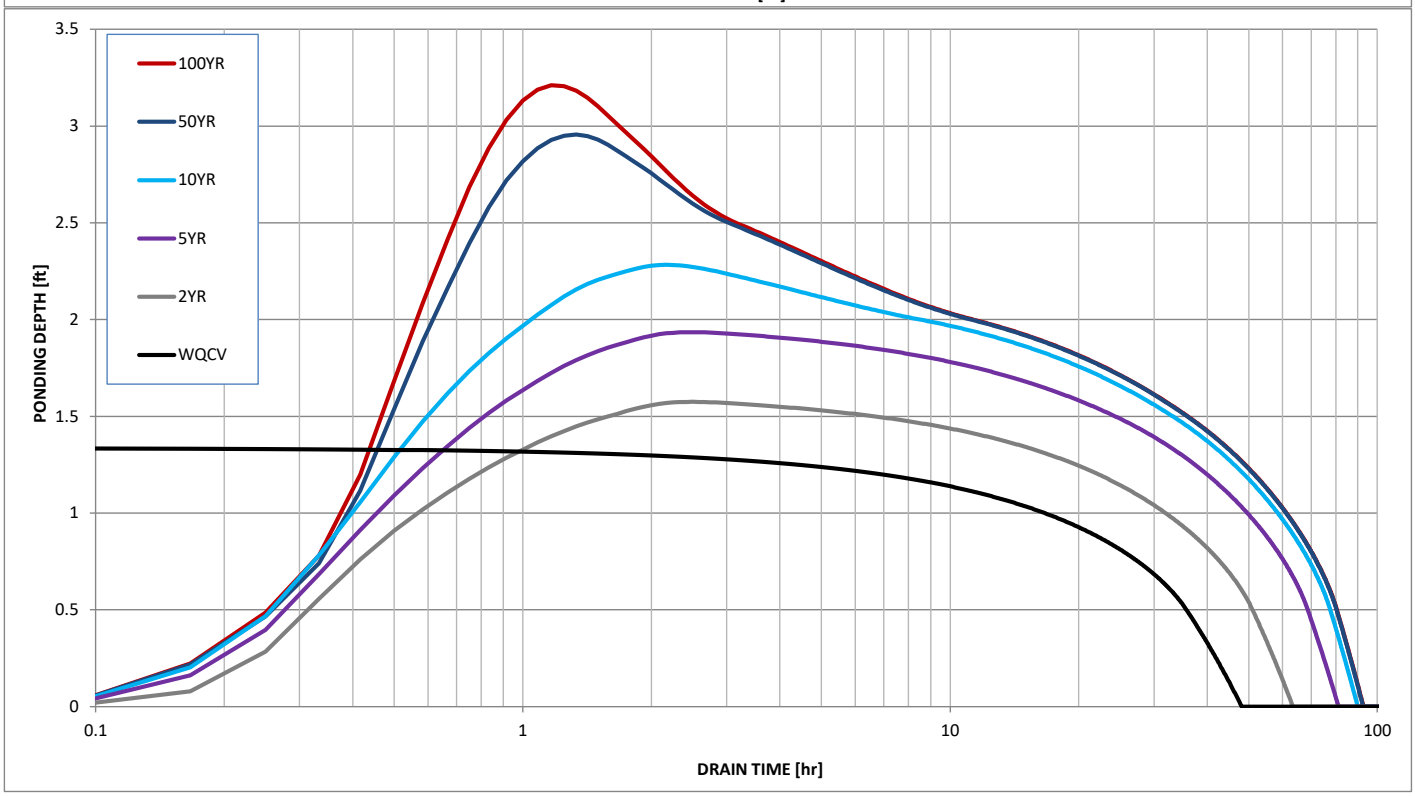
After completing and printing this worksheet to a pdf, go to:
https://maperture.digitaldataservices.com/gvh/?viewer=cswdif
Create a new stormwater facility, and attach the PDF of this worksheet to that record.

Routed Hydrograph Results

Design Storm Return Period =	WQCV	2 Year	5 Year	10 Year	50 Year	100 Year	
One-Hour Rainfall Depth =	N/A	0.78	1.05	1.30	1.95	2.27	in
CUHP Runoff Volume =	0.119	0.180	0.278	0.408	0.838	1.066	acre-ft
Inflow Hydrograph Volume =	N/A	0.180	0.278	0.408	0.838	1.066	acre-ft
Time to Drain 97% of Inflow Volume =	40.8	54.4	**69.9**	76.4	72.9	70.3	hours
Time to Drain 99% of Inflow Volume =	43.9	58.3	74.7	82.2	81.4	**80.1**	hours
Maximum Ponding Depth =	1.34	1.57	1.93	2.28	2.96	3.21	ft
Maximum Ponded Area =	0.20	0.23	0.29	0.32	0.37	**0.37**	acres
Maximum Volume Stored =	0.119	0.170	0.264	0.373	0.606	0.700	acre-ft

Stormwater Detention and Infiltration Design Data Sheet





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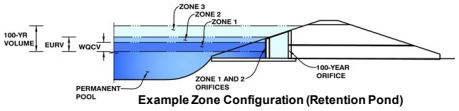
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: CANDELAS INDIANA NORTH

Basin ID: MAJOR BASIN B - POND CERTIFICATION



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	32.20	acres
Watershed Length =	1,600	ft
Watershed Length to Centroid =	960	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	43.90%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	100.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	Arvada - City Hall	

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

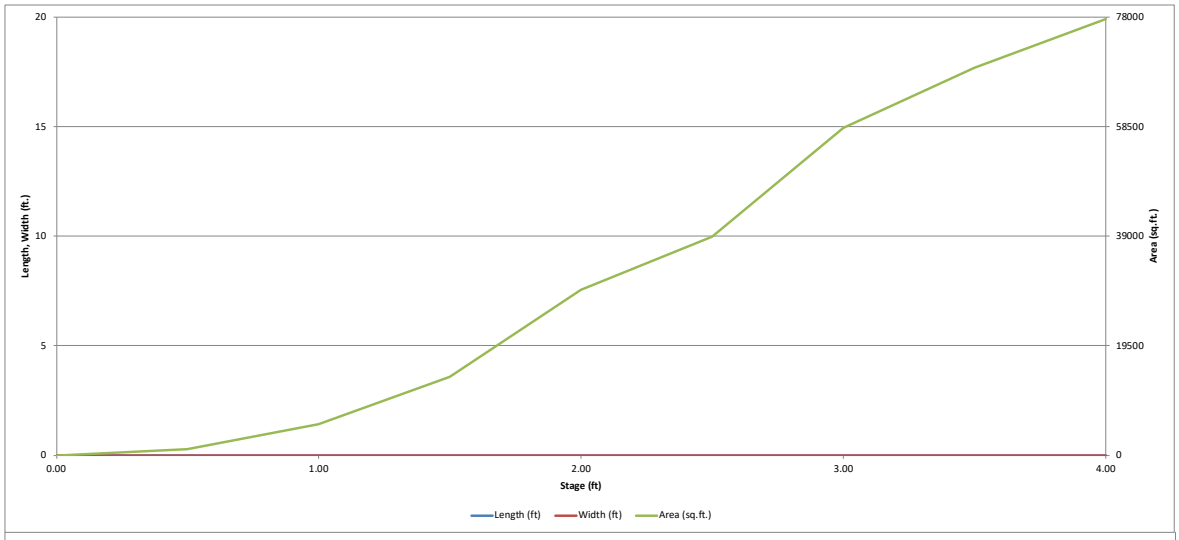
			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.510	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	1.323	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 0.78 in.) =	0.801	acre-feet	0.78	inches
5-yr Runoff Volume (P1 = 1.06 in.) =	1.257	acre-feet	1.06	inches
10-yr Runoff Volume (P1 = 1.31 in.) =	1.823	acre-feet	1.31	inches
25-yr Runoff Volume (P1 = 1.68 in.) =	2.938	acre-feet	1.68	inches
50-yr Runoff Volume (P1 = 2 in.) =	3.802	acre-feet	2.00	inches
100-yr Runoff Volume (P1 = 2.34 in.) =	4.849	acre-feet	2.34	inches
500-yr Runoff Volume (P1 = 3.24 in.) =	7.387	acre-feet	3.24	inches
Approximate 2-yr Detention Volume =	0.762	acre-feet		
Approximate 5-yr Detention Volume =	1.255	acre-feet		
Approximate 10-yr Detention Volume =	1.518	acre-feet		
Approximate 25-yr Detention Volume =	1.859	acre-feet		
Approximate 50-yr Detention Volume =	2.044	acre-feet		
Approximate 100-yr Detention Volume =	2.477	acre-feet		

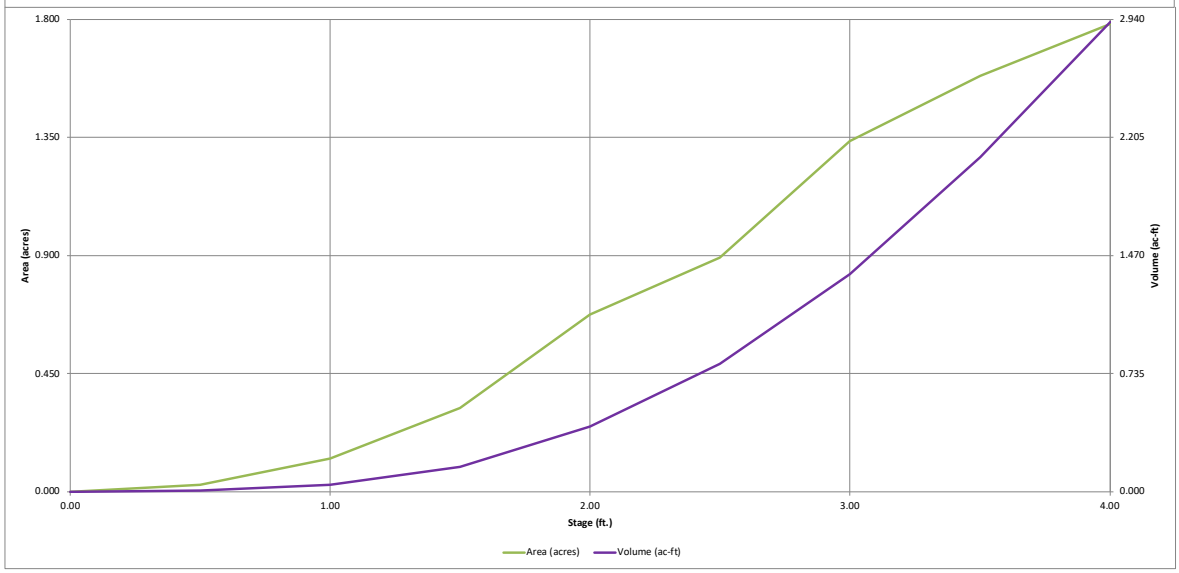
Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.510	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.813	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.154	acre-feet
Total Detention Basin Volume =	2.477	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 = 0.50 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	0	0.000		
5611.5	--	0.50	--	--	--	1,105	0.025	276	0.006
5612	--	1.00	--	--	--	5,519	0.127	1,932	0.044
5612.5	--	1.50	--	--	--	13,905	0.319	6,788	0.156
5613	--	2.00	--	--	--	29,410	0.675	17,617	0.404
5613.5	--	2.50	--	--	--	38,855	0.892	34,683	0.796
5614	--	3.00	--	--	--	58,222	1.337	58,952	1.353
5614.5	--	3.50	--	--	--	69,036	1.585	90,767	2.084
5615	--	4.00	--	--	--	77,713	1.784	127,454	2.926


20
15
10
5
0
Length, Width (ft.)
78000
58500
39000
19500
0
Area (sq.ft.)
0.00
1.00
2.00
3.00
4.00
Stage (ft)
Length (ft)
Width (ft)
Area (sq.ft.)

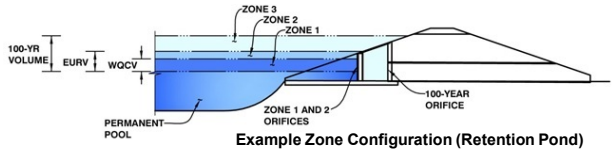

1.800
1.350
0.900
0.450
0.000
Area (acres)
2.940
2.205
1.470
0.735
0.000
Volume (ac-ft)
0.00
1.00
2.00
3.00
4.00
Stage (ft.)
Area (acres)
Volume (ac-ft)

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: CANDELAS INDIANA NORTH

Basin ID: MAJOR BASIN B - POND CERTIFICATION



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.15	0.510	Orifice Plate
Zone 2 (EURV)	2.98	0.813	Orifice Plate
Zone 3 (100-year)	3.75	1.154	Weir&Pipe (Restrict)
Total (all zones)		2.477	

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

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

Calculated Parameters for Underdrain

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

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	1.667E-02	ft^2
Depth at top of Zone using Orifice Plate =	2.99	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	12.00	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	2.40	sq. inches (diameter = 1-3/4 inches)	Elliptical Slot Area =	N/A	ft^2

Calculated Parameters for Plate

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.00	2.00					
Orifice Area (sq. inches)	2.40	2.40	2.40					

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

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orif

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

	Zone 3 Weir	Not Selected			Zone 3 Weir	Not Selected
Overflow Weir Front Edge Height, Ho =	3.00	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	3.73	N/A
Overflow Weir Front Edge Length =	19.00	N/A	feet	Overflow Weir Slope Length =	3.01	N/A
Overflow Weir Grate Slope =	4.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	10.75	N/A
Horiz. Length of Weir Sides =	2.92	N/A	feet	Overflow Grate Open Area w/o Debris =	45.24	N/A
Overflow Grate Type =	Close Mesh Grate	N/A		Overflow Grate Open Area w/ Debris =	22.62	N/A
Debris Clogging % =	50%	N/A	%			

Calculated Parameters for Overflow W

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

	Zone 3 Restrictor	Not Selected			Zone 3 Restrictor	Not Selected
Depth to Invert of Outlet Pipe =	0.00	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	4.21	N/A
Outlet Pipe Diameter =	30.00	N/A	inches	Outlet Orifice Centroid =	1.09	N/A
Restrictor Plate Height Above Pipe Invert =	24.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	2.21	N/A

Calculated Parameters for Outlet Pipe w/ Flow Restriction Pla

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	4.00	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.80	feet
Spillway Crest Length =	25.00	feet	Stage at Top of Freeboard =	5.80	feet
Spillway End Slopes =	10.00	H:V	Basin Area at Top of Freeboard =	1.78	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	2.93	acre-ft

Calculated Parameters for Spillway

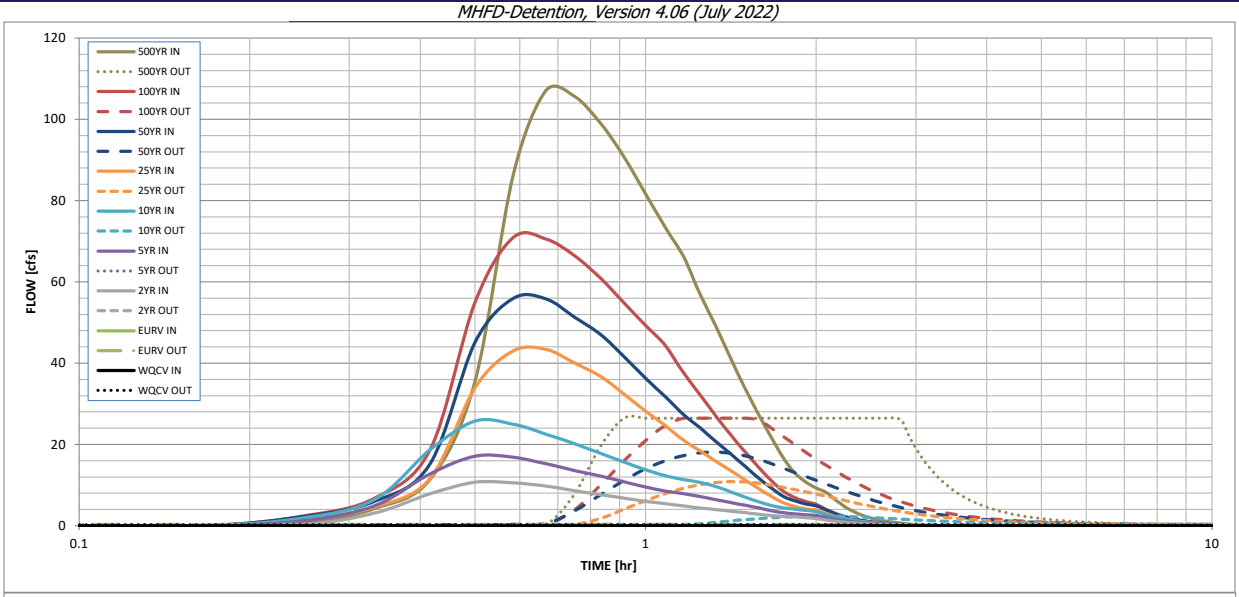
Routed Hydrograph Results

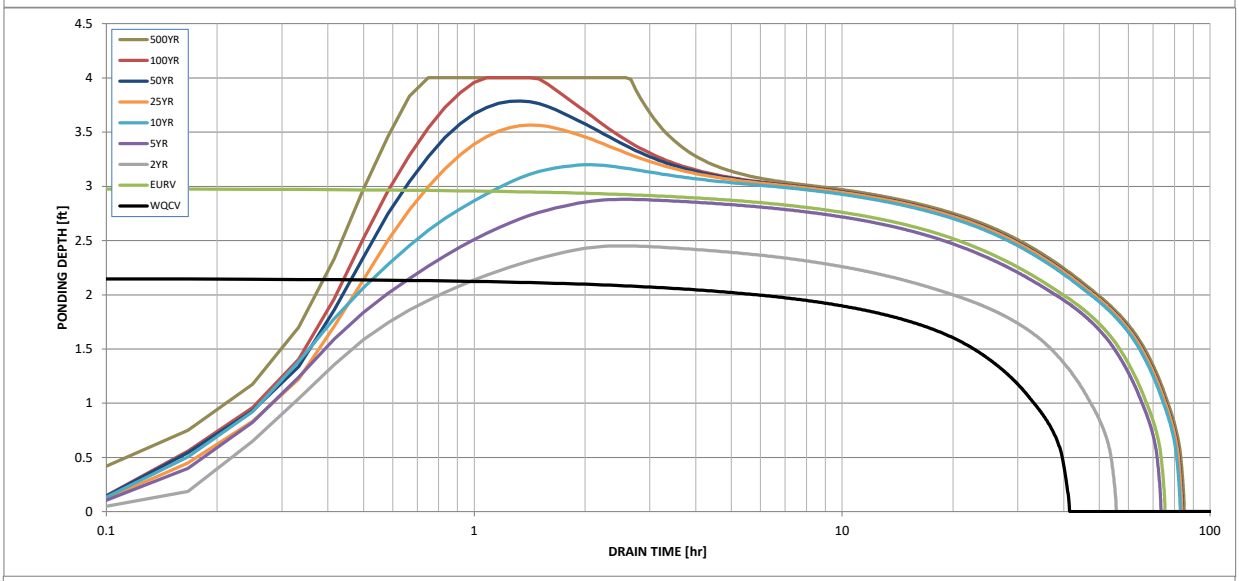
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through A

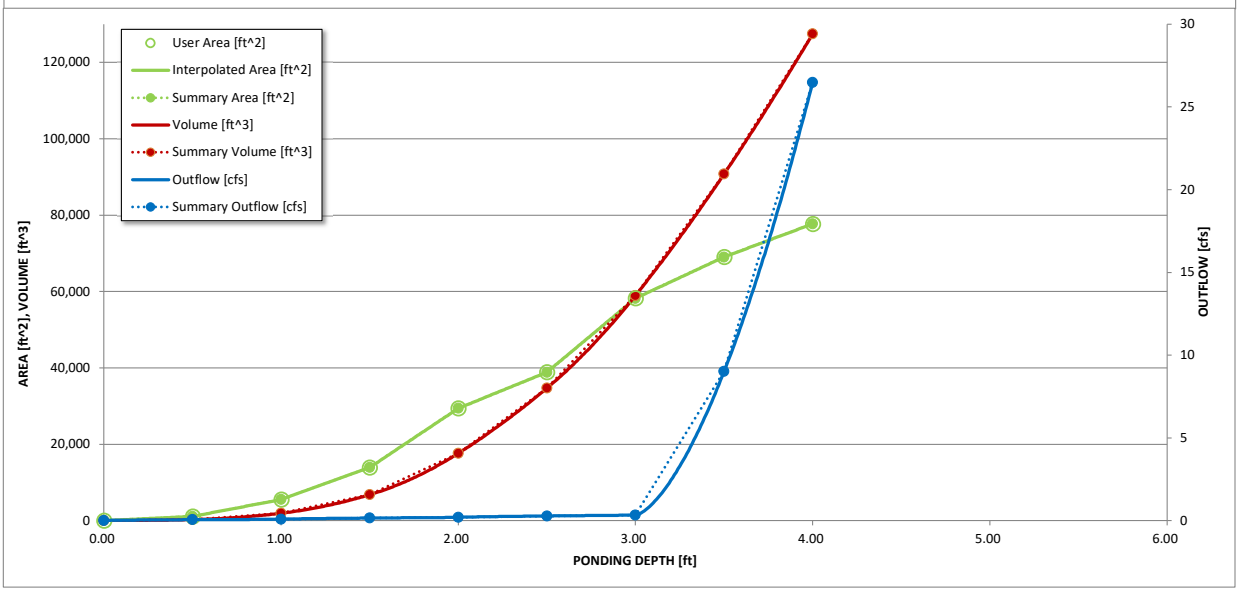
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	0.78	1.06	1.31	1.68	2.00	2.34
CUHP Runoff Volume (acre-ft) =	0.510	1.323	0.801	1.257	1.823	2.938	3.802	4.849
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.801	1.257	1.823	2.938	3.802	4.849
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.3	2.0	7.4	20.2	28.6	39.2
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A						
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.06	0.23	0.63	0.89	1.22
Peak Inflow Q (cfs) =	N/A	N/A	10.7	17.1	25.7	43.4	55.9	70.9
Peak Outflow Q (cfs) =	0.2	0.3	0.3	0.3	2.4	10.8	18.1	26.5
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.2	0.3	0.5	0.6	0.7
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	N/A
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.0	0.2	0.4	0.6
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	68	51	66	74	71	69	66
Time to Drain 99% of Inflow Volume (hours) =	**40**	72	54	71	79	78	77	76
Maximum Ponding Depth (ft) =	2.15	2.98	2.45	2.88	3.20	3.56	3.79	4.00
Area at Maximum Ponding Depth (acres) =	0.74	1.32	0.87	1.22	1.43	1.61	1.70	1.78
Maximum Volume Stored (acre-ft) =	0.511	1.327	0.743	1.187	1.616	2.180	2.543	2.926

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename: _____

Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.71
	0:15:00	0.00	0.00	0.29	1.23	1.93	1.53	2.28	2.41	4.26
	0:20:00	0.00	0.00	3.16	4.99	6.50	4.67	6.03	6.81	11.43
	0:25:00	0.00	0.00	7.87	12.79	18.70	11.66	15.29	18.77	35.52
	0:30:00	0.00	0.00	10.68	17.10	25.73	33.94	45.12	54.95	86.11
	0:35:00	0.00	0.00	10.55	16.82	24.99	43.00	55.93	70.90	106.99
	0:40:00	0.00	0.00	9.76	15.24	22.55	43.41	55.81	70.56	105.59
	0:45:00	0.00	0.00	8.61	13.56	20.14	40.00	51.30	66.39	98.96
	0:50:00	0.00	0.00	7.62	12.20	17.76	36.72	47.03	60.83	90.68
	0:55:00	0.00	0.00	6.79	10.80	15.65	32.34	41.53	54.79	81.67
	1:00:00	0.00	0.00	6.02	9.51	13.76	28.19	36.31	49.27	73.40
	1:05:00	0.00	0.00	5.42	8.52	12.31	24.60	31.77	44.34	66.22
	1:10:00	0.00	0.00	4.84	7.85	11.36	21.04	27.34	37.60	56.72
	1:15:00	0.00	0.00	4.36	7.15	10.63	18.32	23.98	32.08	48.87
	1:20:00	0.00	0.00	3.95	6.39	9.59	15.77	20.61	26.83	40.85
	1:25:00	0.00	0.00	3.57	5.68	8.28	13.48	17.55	22.17	33.66
	1:30:00	0.00	0.00	3.19	5.00	7.02	11.21	14.53	18.09	27.39
	1:35:00	0.00	0.00	2.82	4.38	5.90	9.11	11.76	14.39	21.71
	1:40:00	0.00	0.00	2.50	3.68	4.95	7.22	9.27	11.09	16.75
	1:45:00	0.00	0.00	2.30	3.19	4.38	5.66	7.25	8.49	13.03
	1:50:00	0.00	0.00	2.21	2.90	4.06	4.76	6.10	6.94	10.76
	1:55:00	0.00	0.00	1.97	2.70	3.79	4.19	5.37	5.94	9.28
	2:00:00	0.00	0.00	1.77	2.50	3.46	3.82	4.88	5.23	8.21
	2:05:00	0.00	0.00	1.43	2.01	2.78	3.01	3.83	4.02	6.32
	2:10:00	0.00	0.00	1.12	1.57	2.16	2.30	2.92	2.97	4.67
	2:15:00	0.00	0.00	0.88	1.22	1.67	1.76	2.22	2.18	3.44
	2:20:00	0.00	0.00	0.68	0.94	1.28	1.33	1.67	1.61	2.54
	2:25:00	0.00	0.00	0.53	0.72	0.97	1.01	1.27	1.22	1.92
	2:30:00	0.00	0.00	0.41	0.54	0.72	0.76	0.94	0.92	1.43
	2:35:00	0.00	0.00	0.31	0.41	0.54	0.56	0.70	0.69	1.08
	2:40:00	0.00	0.00	0.23	0.30	0.41	0.42	0.52	0.52	0.82
	2:45:00	0.00	0.00	0.17	0.22	0.30	0.32	0.39	0.39	0.60
	2:50:00	0.00	0.00	0.12	0.15	0.21	0.22	0.28	0.28	0.43
	2:55:00	0.00	0.00	0.08	0.10	0.14	0.15	0.18	0.18	0.28
	3:00:00	0.00	0.00	0.04	0.06	0.08	0.09	0.11	0.11	0.16
	3:05:00	0.00	0.00	0.02	0.03	0.04	0.04	0.05	0.05	0.08
	3:10:00	0.00	0.00	0.01	0.01	0.01	0.01	0.02	0.02	0.02
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	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
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	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Summary Stage-Area-Volume-Discharge Relationships

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

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

Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]
	0.00	0	0.000	0	0.000	0.00
	0.50	1,105	0.025	276	0.006	0.06
	1.00	5,519	0.127	1,932	0.044	0.08
	1.50	13,905	0.319	6,788	0.156	0.16
	2.00	29,410	0.675	17,617	0.404	0.19
	2.50	38,855	0.892	34,683	0.796	0.28
	3.00	58,222	1.337	58,952	1.353	0.33
	3.50	69,036	1.585	90,767	2.084	9.01
	4.00	77,713	1.784	127,454	2.926	26.48

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).

Stormwater Detention and Infiltration Design Data Sheet

SDI-Design Data v2.00, Released January 2020

Stormwater Facility Name: **CANDELAS INDIANA NORTH**

Facility Location & Jurisdiction: **POND B CERTIFICATION**

User Input: Watershed Characteristics

Extended Detention Basin (EDB)	EDB	
Watershed Area =	32.20	acres
Watershed Length =	1,600	ft
Watershed Length to Centroid =	960	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	43.9%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	100.0%	percent
Target WQCV Drain Time =	40.0	hours

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

Arvada - City Hall

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

Once CUHP has been run and the Stage-Area-Discharge information has been provided, click 'Process Data' to interpolate the Stage-Area-Volume-Discharge data and generate summary results in the table below. Once this is complete, click 'Print to PDF'.

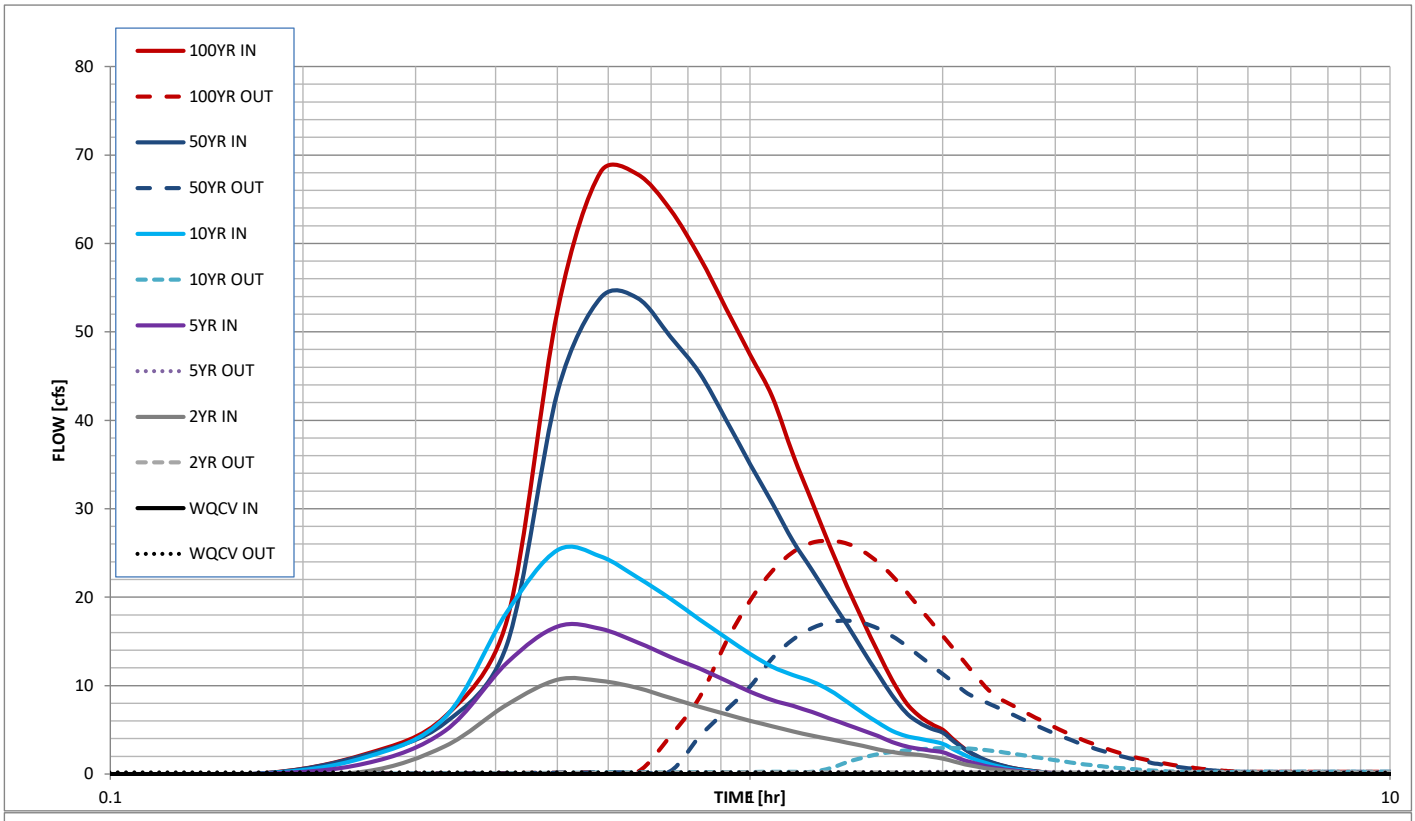
User Defined Stage [ft]	User Defined Area [ft^2]	User Defined Stage [ft]	User Defined Discharge [cfs]
0.00	0	0.00	0.00
0.50	1,105	0.50	0.06
1.00	5,519	1.00	0.08
1.50	13,905	1.50	0.12
2.00	29,410	2.00	0.18
2.50	38,855	2.50	0.21
3.00	58,222	3.00	0.28
3.50	69,036	3.50	8.97
4.00	77,714	4.00	26.44

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

Routed Hydrograph Results

Design Storm Return Period =	WQCV	2 Year	5 Year	10 Year	50 Year	100 Year	
One-Hour Rainfall Depth =	N/A	0.78	1.05	1.30	1.95	2.27	in
CUHP Runoff Volume =	0.510	0.801	1.234	1.799	3.663	4.651	acre-ft
Inflow Hydrograph Volume =	N/A	0.801	1.234	1.799	3.663	4.651	acre-ft
Time to Drain 97% of Inflow Volume =	44.8	61.4	**81.3**	88.1	82.1	79.0	hours
Time to Drain 99% of Inflow Volume =	46.8	64.3	85.4	93.8	91.7	**90.3**	hours
Maximum Ponding Depth =	2.15	2.46	2.87	3.16	3.74	4.00	ft
Maximum Ponded Area =	0.74	0.87	1.22	1.41	1.68	**1.78**	acres
Maximum Volume Stored =	0.511	0.759	1.184	1.566	2.467	2.910	acre-ft

Stormwater Detention and Infiltration Design Data Sheet



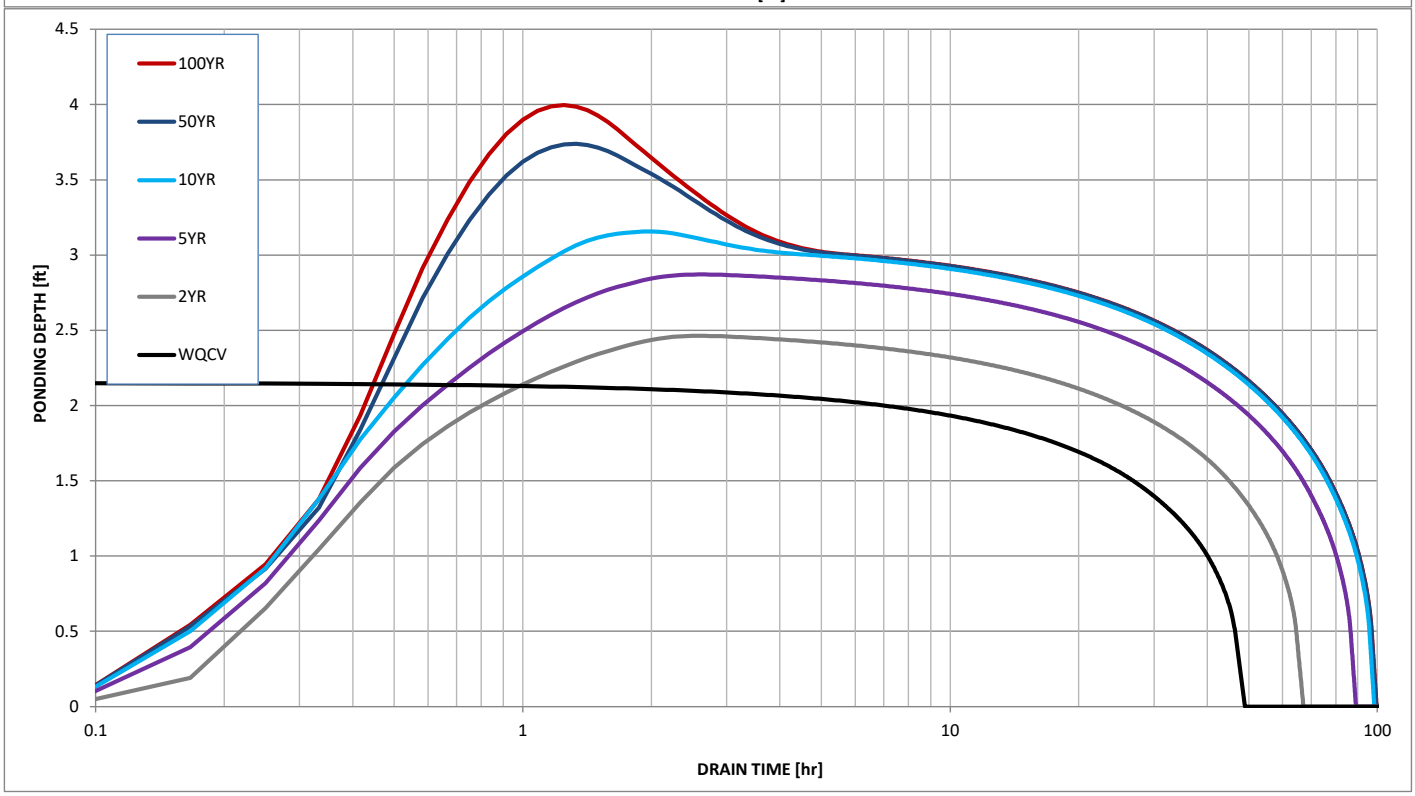
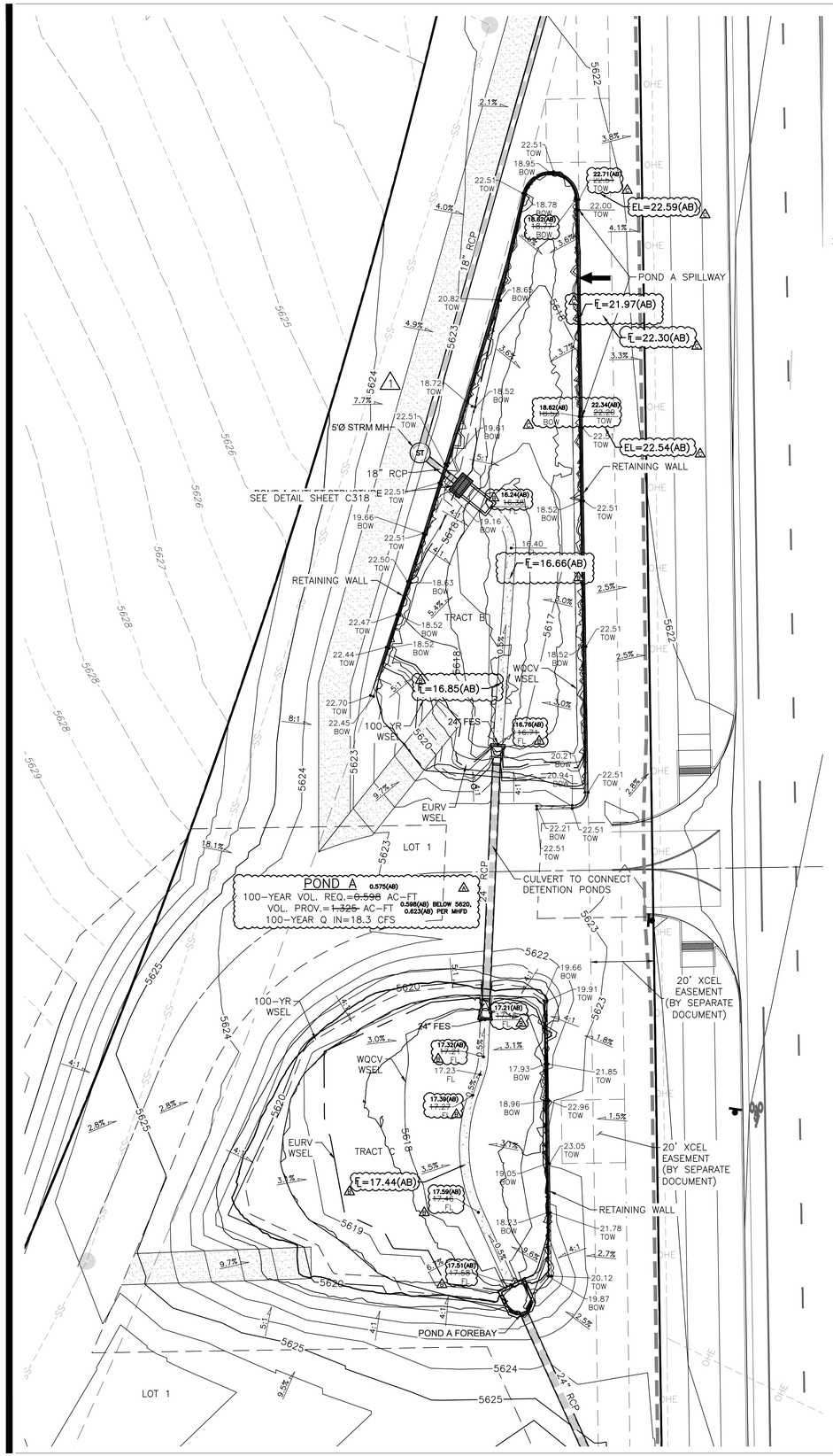


EXHIBIT C

AS-BUILT DETENTION POND CONSTRUCTION DOCUMENTS



N

20 10 0 20 40

SCALE: 1"=20'

ALL LINEAL DIMENSIONS ARE IN U.S. SURVEY FEET

RECORD DRAWING

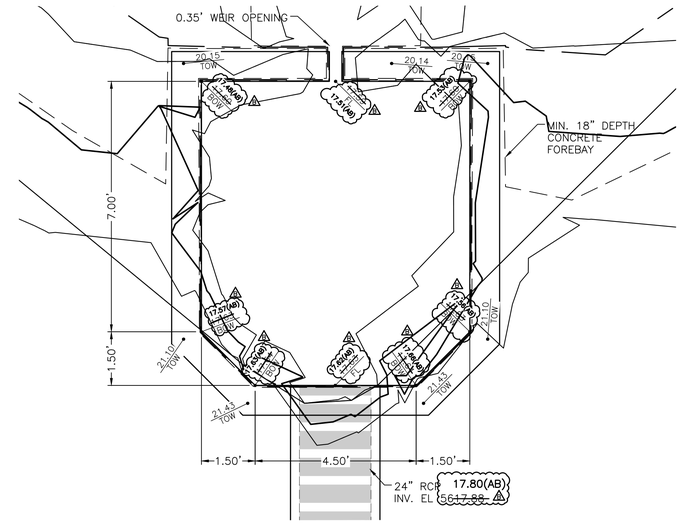
MARTIN/MARTIN BY: DAL DATE: 08/23/22

This "drawing" is a record of final construction plans, notes and details, as well as approved supplemental instructions or modifications added during construction. If provided to MARTIN/MARTIN, as-constructed information has been noted with a bold font and the symbol **(AB)** beside stricken design information. All other information has not been field verified. The source of all as-constructed information is identified with clouds and/or delta symbols indicated below. Neither MARTIN/MARTIN nor the Engineer of Record has verified the accuracy of the as-constructed information provided by others and shall not be responsible for any errors or omissions which may be incorporated herein as a result.

A AS-CONSTRUCTED INFORMATION PROVIDED BY WAGNER CONSTRUCTION ON 06/14/2023.

B AS-CONSTRUCTED INFORMATION PROVIDED BY MARTIN/MARTIN CONSULTING ENGINEERS ON 07/31/2023.

C AS-CONSTRUCTED INFORMATION PROVIDED BY MARTIN/MARTIN CONSULTING ENGINEERS ON 08/17/2023.



FOREBAY A DETAIL

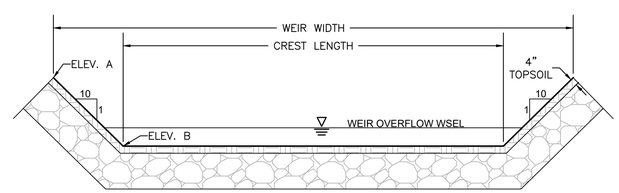
SCALE: 1"=2'

KEY MAP

SCALE: 1"=500'

LEGEND

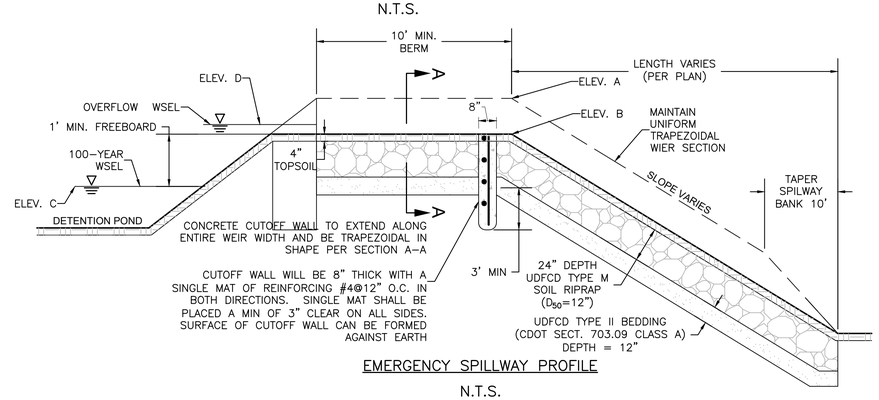
EXISTING		PROPOSED
	PROPERTY LINE	
	RIGHT-OF-WAY LINE	
	SECTION LINE	
	EASEMENT	
	RETAINING WALL	
	CURB & GUTTER	
5750	CONTOURS	5750
	STORM SEWER	
ST	STORM MANHOLE	
RD	ROOF DRAIN	RD
	WATERS OF THE U.S.	
	INLET	
	FLARED END SECTION	
	SIGN	
	GRADING ARROW	
	DECIDUOUS TREE	
	EVERGREEN TREE	
	BUSH/SHRUB	
DRIVE	DESCRIPTIONS	DRIVE
ELEV.	SPOT ELEVATIONS	ELEV.



OVERFLOW WEIR

SECTION A–A

N.T.S.



EMERGENCY SPILLWAY PROFILE

N.T.S.

POND	ELEV A	ELEV B	ELEV C	ELEV D	WIDTH	CREST LENGTH	DESIGN FLOW	UNIT DISCHARGE	RIPRAP TYPE	RIPRAP D50
	FT	FT	FT	FT	FT	FT	CFS	CFS/FT	–	IN
POND A	56~~22.51~~ 22.59(AB)	56~~22.20~~ 22.30(AB)	5619.67	5622.40	72'	65'	18.3	0.28	M	12

COLORADO 811 KNOW WHAT'S BELOW. CALL BEFORE YOU DIG.

CALL 811 2-BUSINESS DAYS IN ADVANCE BEFORE YOU DIG, GRADE OR EXCAVATE FOR MARKING OF UNDERGROUND MEMBER UTILITIES

MARTIN/MARTIN ASSUMES NO RESPONSIBILITY FOR UTILITY LOCATIONS. UNLESS OTHERWISE NOTED, THE UTILITIES SHOWN ON THIS DRAWING ARE BASED ON INFORMATION PROVIDED BY OTHERS AND DEPICTED AS ASCE (38) QUALITY LEVEL D. IN ACCORDANCE WITH THE PROVISIONS OF COLORADO REVISED STATUTE, TITLE 9, IT IS THE CONTRACTORS RESPONSIBILITY TO CALL COLORADO 811 UTILITY LOCATE SERVICE FOR UTILITY LOCATES BEFORE DIGGING, AND FIELD VERIFY THE SIZE, MATERIAL, HORIZONTAL AND VERTICAL LOCATION OF ALL EXISTING UTILITIES (DEPICTED OR NOT DEPICTED) PRIOR TO THE COMMENCEMENT OF ANY CONSTRUCTION.

MARTIN/MARTIN CONSULTING ENGINEERS
12499 WEST COLFAX AVENUE, LAKEWOOD, COLORADO 80215
MAIN 303.431.6100 MARTINMARTIN.COM

COLORADO LICENSED PROFESSIONAL ENGINEER

11-10-21

CANDELAS INDIANA NORTH

POND A PLAN

No.	Issue / Revision	Date	Name
1	1ST SUBMITTAL	10/02/20	DK
2	2ND SUBMITTAL	01/22/21	DK
3	3RD SUBMITTAL	04/09/21	DK
4	4TH SUBMITTAL	07/02/21	DK
5	5TH SUBMITTAL	09/10/21	DK
6	CONSTRUCTION ISSUE	11/10/21	DK
7	RECORD DRAWING SUBMITTAL	08/23/23	DK

Job Number 20.0287

Project Manager R. SOLTIS/D. KUNTZ

Design By B. KAISER

Drawn By E. BERNAL/M. WOOD

Principal In Charge D. LOVATO

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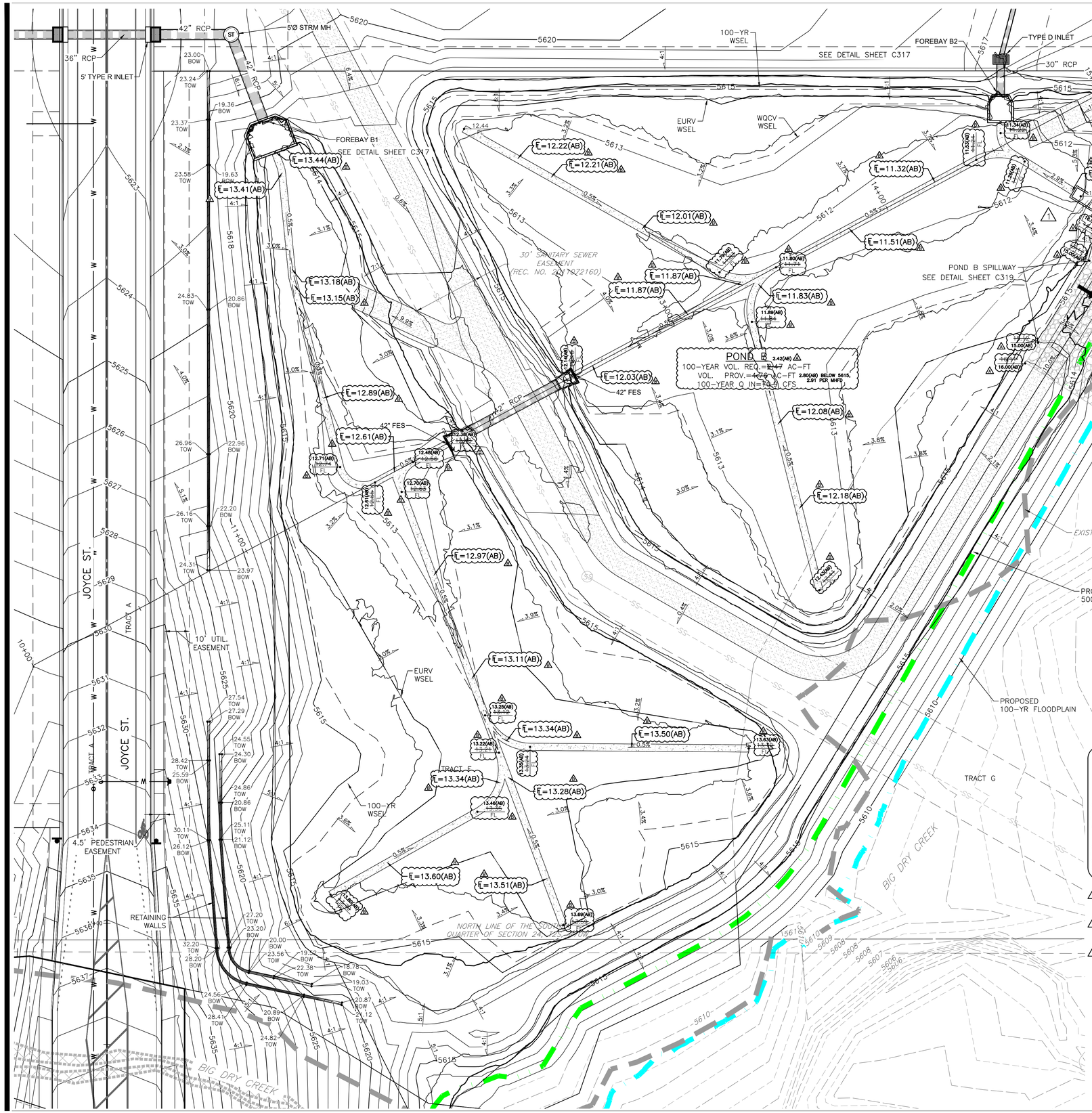
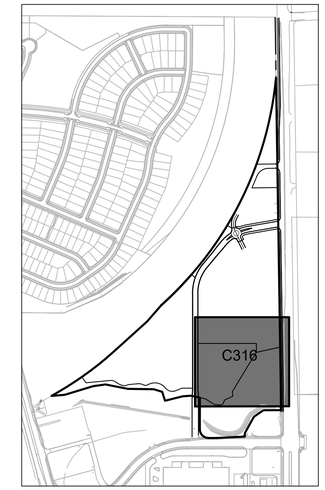
Sheet Number:

C315





KEY MAP
SCALE: 1"=500'

LEGEND

EXISTING		PROPOSED
	PROPERTY LINE	
	RIGHT-OF-WAY LINE	
	SECTION LINE	
	EASEMENT	
	RETAINING WALL	
	CURB & GUTTER	
5750	CONTOURS	5750
	STORM SEWER	
ST	STORM MANHOLE	
RD	ROOF DRAIN	RD
	WATERS OF THE U.S.	
	INLET	
	FLARED END SECTION	
	SIGN	
	GRADING ARROW	
	DECIDUOUS TREE	
	EVERGREEN TREE	
	BUSH/SHRUB	
DRIVE	DESCRIPTIONS	DRIVE
ELEV.	SPOT ELEVATIONS	ELEV.

RECORD DRAWING

MARTIN/MARTIN BY: DAL DATE: 08/23/22

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C AS-CONSTRUCTED INFORMATION PROVIDED BY MARTIN/MARTIN CONSULTING ENGINEERS ON 08/17/2023.

N

SCALE: 1"=20'
ALL LINEAL DIMENSIONS ARE IN U.S. SURVEY FEET

COLORADO 811
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CALL 811 2-BUSINESS DAYS IN ADVANCE BEFORE YOU DIG, GRADE OR EXCAVATE FOR MARKING OF UNDERGROUND MEMBER UTILITIES

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MAIN 303.431.6100 MARTINMARTIN.COM

COLORADO LICENSED PROFESSIONAL ENGINEER
11-10-21

CANDELAS INDIANA NORTH

POND B PLAN

No.	Issue / Revision	Date	Name
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5	5TH SUBMITTAL	09/10/21	DK
6	CONSTRUCTION ISSUE	11/10/21	DK
7	RECORD DRAWING SUBMITTAL	08/23/23	DK

Job Number 20.0287
Project Manager R. SOLTIS/D. KUNTZ
Design By B. KAISER
Drawn By E. BERNAL/M. WOOD
Principal In Charge D. LOVATO

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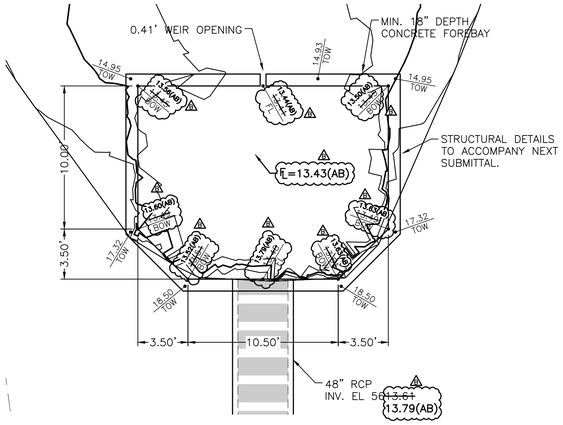
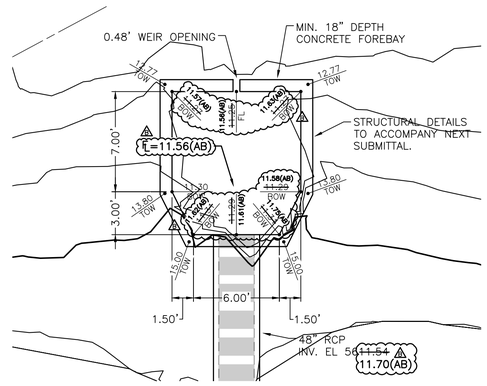
Sheet Number:

C316



FOREBAY B1 DETAIL
SCALE: 1"=5'



FOREBAY B2 DETAIL
SCALE: 1"=5'

RECORD DRAWING

MARTIN/MARTIN BY: DAL DATE: 08/23/22

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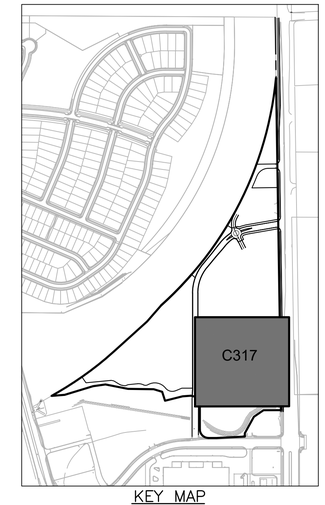
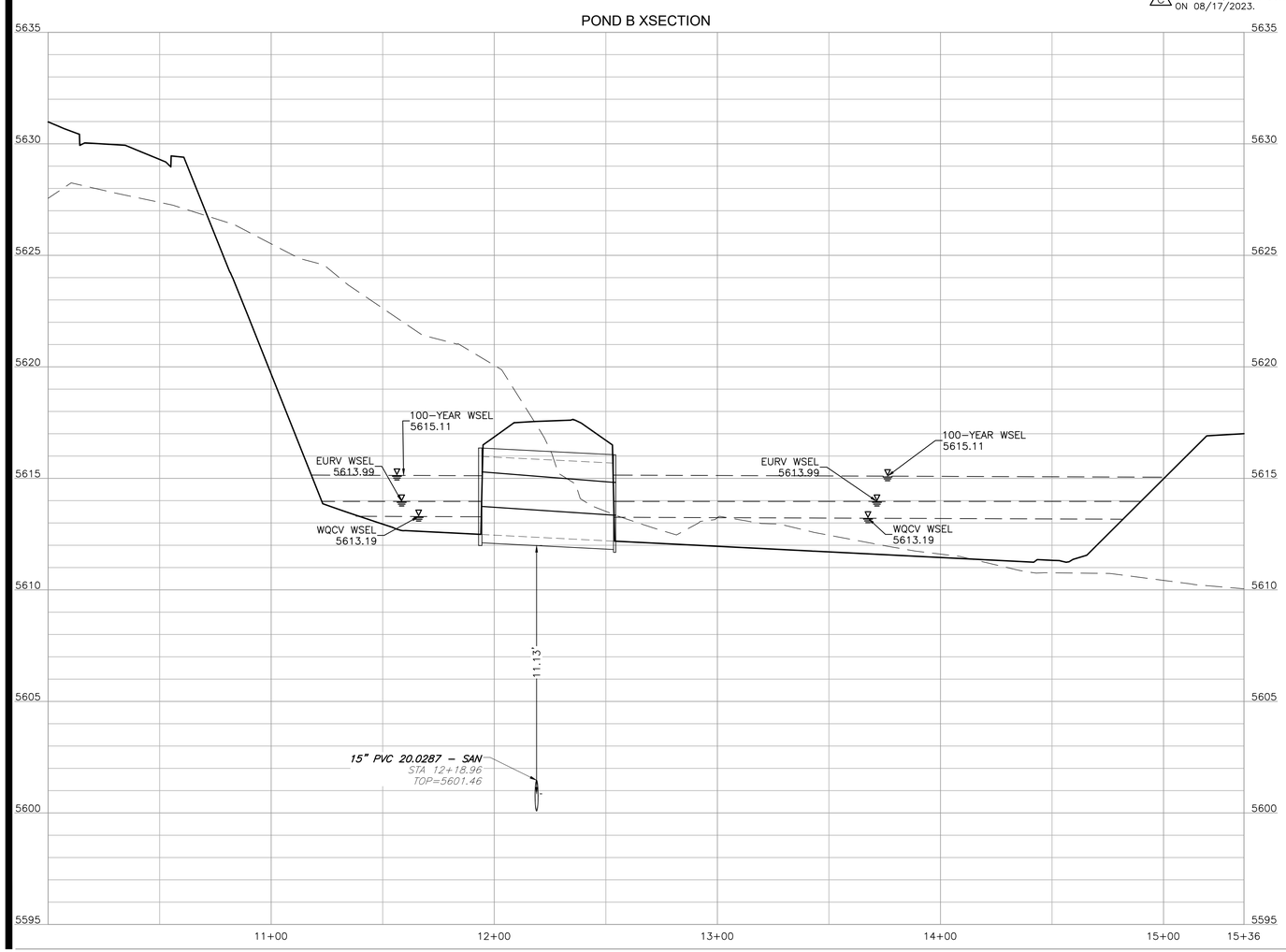
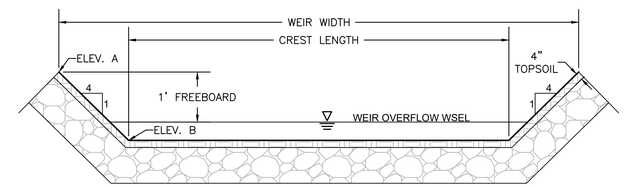
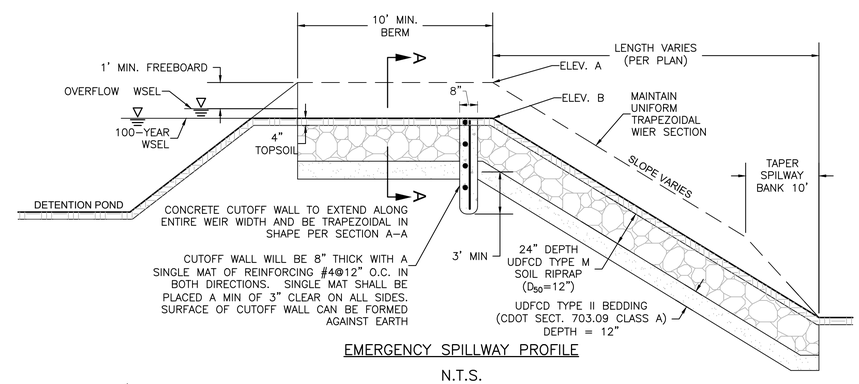


KEY MAP
SCALE: 1"=500'





OVERFLOW WEIR
SECTION A–A
N.T.S.



EMERGENCY SPILLWAY PROFILE
N.T.S.

1

POND	ELEV A	ELEV B	WIDTH	CREST LENGTH	DESIGN FLOW	UNIT DISCHARGE	RIPRAP TYPE	RIPRAP D50
	FT	FT	FT	FT	CFS	CFS/FT	–	IN
POND B	A ~~5616.75~~ **(15.00(AB))**	A ~~5615.12~~ **(15.00(AB))**	10'	40'	70.9	1.77	M	12

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COLORADO LICENSED PROFESSIONAL ENGINEER
11-10-21

CANDELAS INDIANA NORTH

POND B DETAILS

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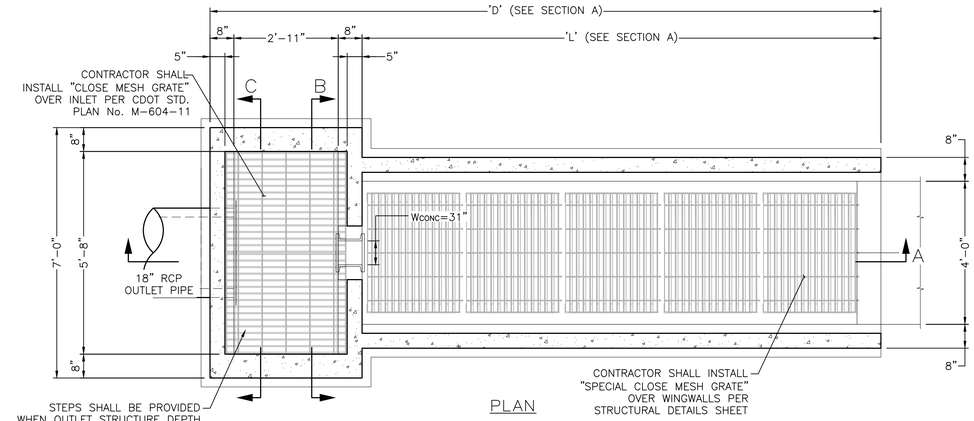
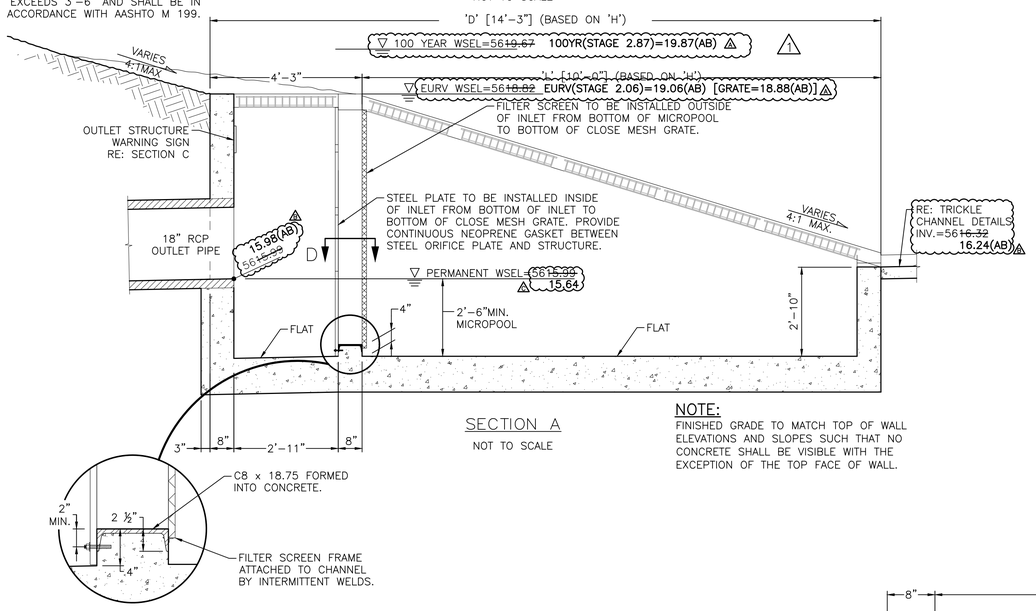


PLAN

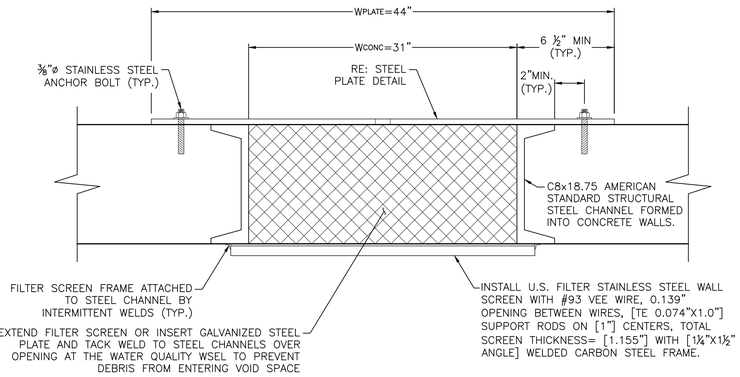
NOT TO SCALE



SECTION A

NOT TO SCALE

NOTE:
FINISHED GRADE TO MATCH TOP OF WALL ELEVATIONS AND SLOPES SUCH THAT NO CONCRETE SHALL BE VISIBLE WITH THE EXCEPTION OF THE TOP FACE OF WALL.



SECTION D

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RECORD DRAWING

MARTIN/MARTIN BY: DAL DATE: 08/23/22

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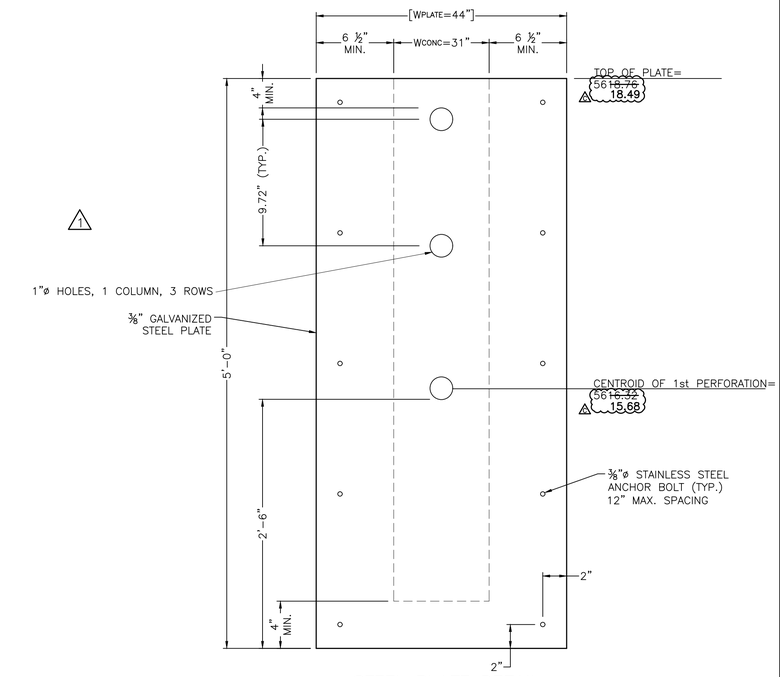
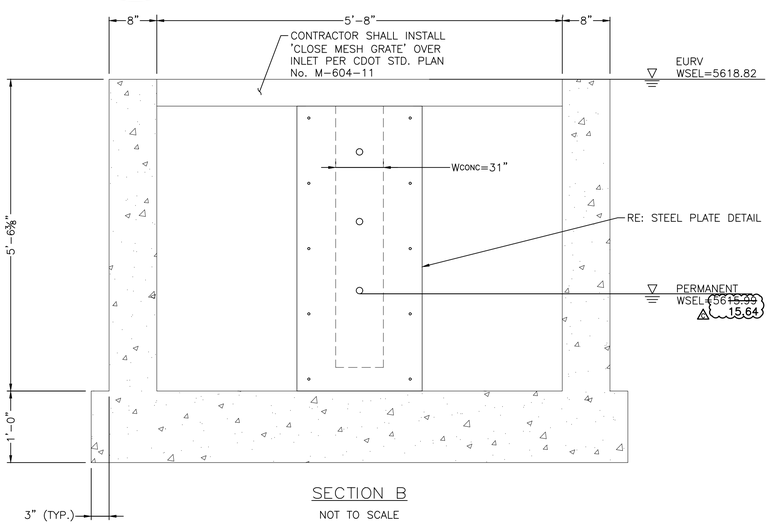


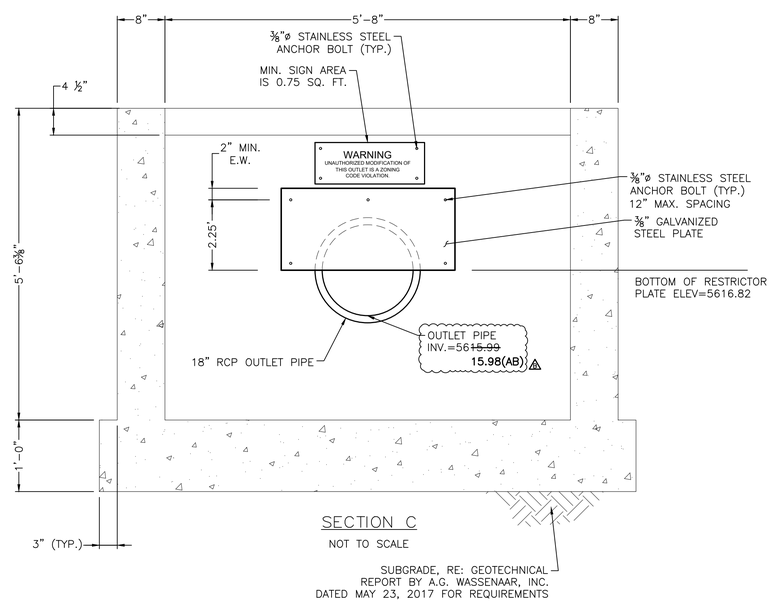
STEEL PLATE DETAIL

NOT TO SCALE



SECTION B

NOT TO SCALE



SECTION C

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COLORADO LICENSED PROFESSIONAL ENGINEER DAVID ANTHONY LOVATO

11-10-21

CANDELAS INDIANA NORTH

POND A OUTLET STRUCTURE

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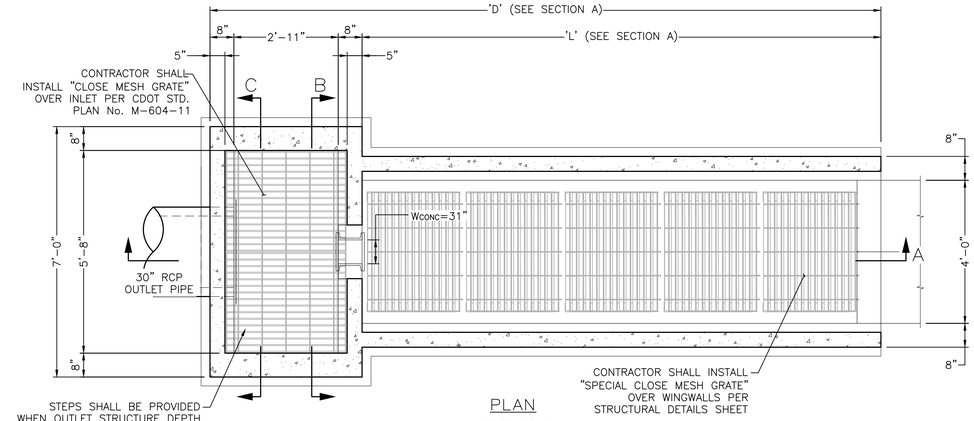
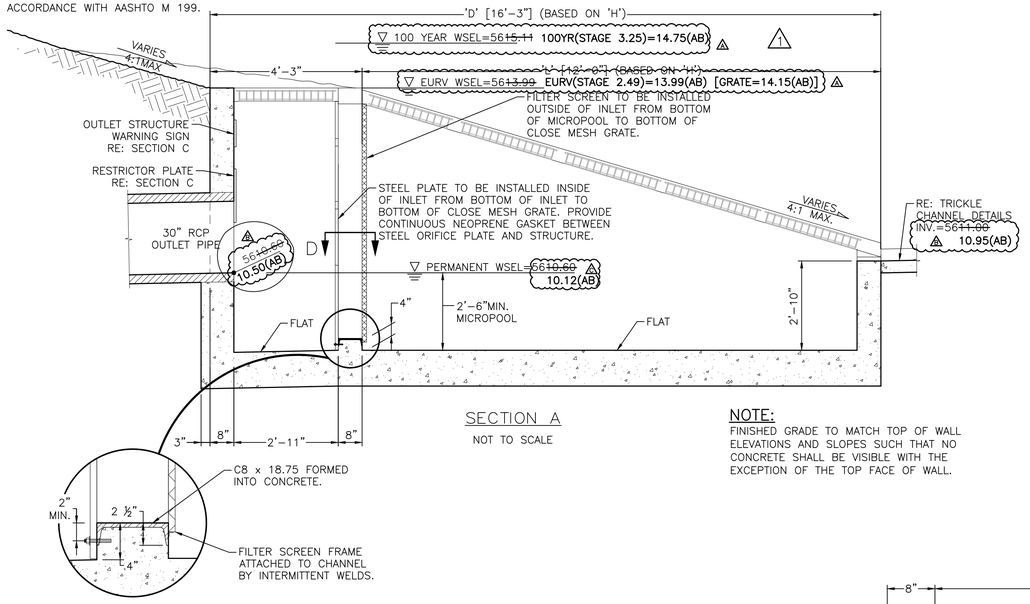


PLAN

NOT TO SCALE



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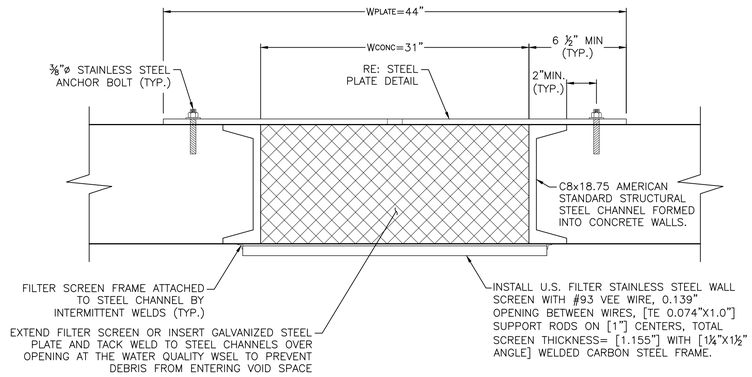

SECTION D

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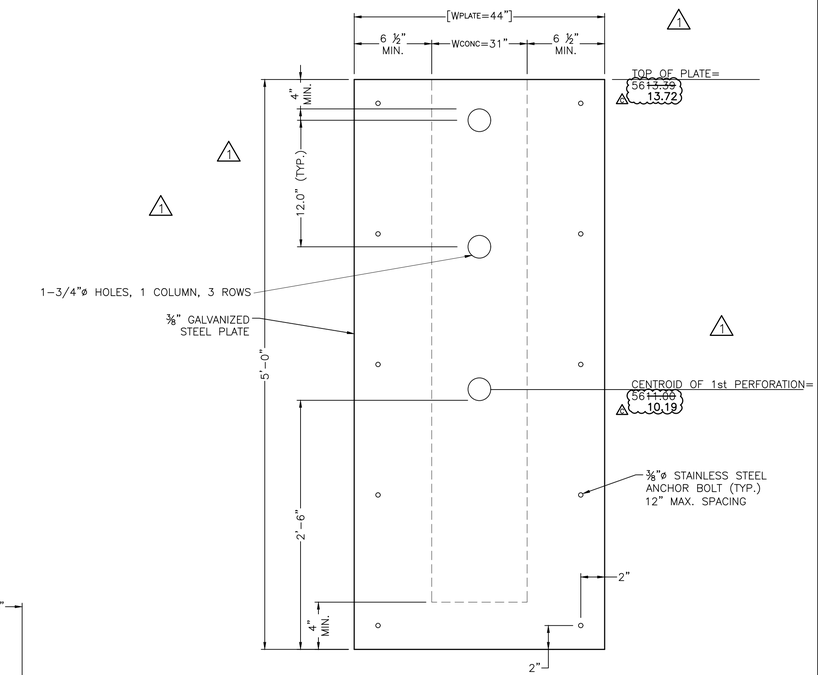

STEEL PLATE DETAIL

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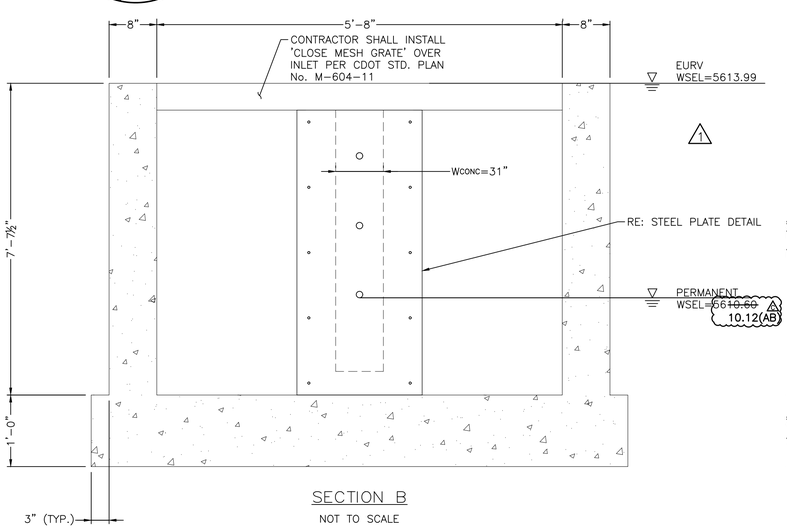

SECTION B

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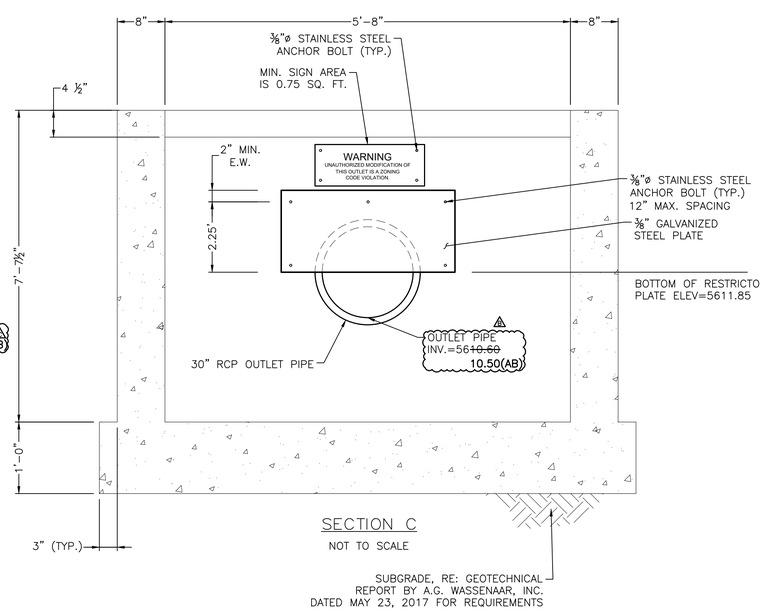

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RECORD DRAWING

MARTIN/MARTIN BY: DAL DATE: 08/23/22

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11-10-21

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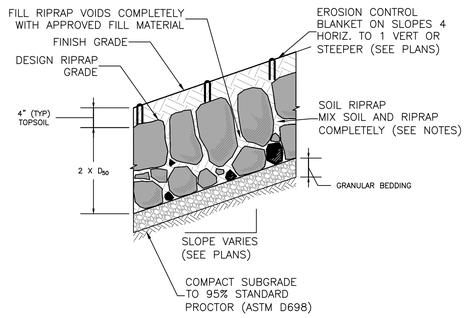
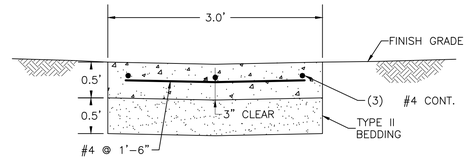
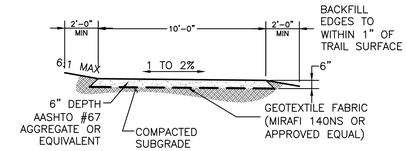


TYPICAL SECTION –
SOIL RIPRAP WITH EROSION CONTROL FABRIC

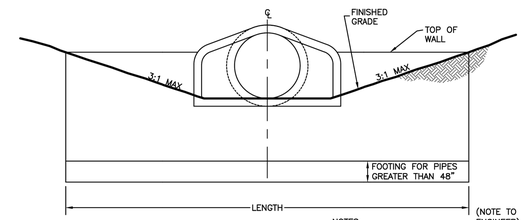
1. ALL RIPRAP SHALL BE INSTALLED PER URBAN DRAINAGE AND FLOOD CONTROL DISTRICT SPECIFICATIONS.
2. ELEVATION TOLERANCES FOR THE SOIL RIPRAP SHALL BE 0.10 FEET. THICKNESS OF SOIL RIPRAP SHALL BE NO LESS THAN THICKNESS SHOWN AND NO MORE THAN 2–INCHES GREATER THAN THE THICKNESS SHOWN.
3. WHERE "SOIL RIPRAP" IS DESIGNATED ON THE CONTRACT DRAWINGS, RIPRAP VOIDS ARE TO BE FILLED WITH NATIVE SOIL. THE RIPRAP SHALL BE PRE–MIXED WITH THE NATIVE SOIL AT THE FOLLOWING PROPORTIONS BY VOLUME: 65 PERCENT RIPRAP AND 35 PERCENT SOIL. THE SOIL USED FOR MIXING SHALL BE NATIVE TOPSOIL AND SHALL HAVE A MINIMUM FINES CONTENT OF 15 PERCENT. THE SOIL RIPRAP SHALL BE INSTALLED IN A MANNER THAT RESULTS IN A DENSE, INTERLOCKED LAYER OF RIPRAP WITH RIPRAP VOIDS FILLED COMPLETELY WITH SOIL. SEGREGATION OF MATERIALS SHALL BE AVOIDED AND IN NO CASE SHALL THE COMBINED MATERIAL CONSIST PRIMARILY OF SOIL; THE DENSITY AND INTERLOCKING NATURE OF RIPRAP IN THE MIXED MATERIAL SHALL ESSENTIALLY BE THE SAME AS IF THE RIPRAP WAS PLACED WITHOUT SOIL.
4. WHERE SPECIFIED (TYPICALLY AS "BURIED SOIL RIPRAP"), A SURFACE LAYER OF TOPSOIL SHALL BE PLACED OVER THE SOIL RIPRAP ACCORDING TO THE THICKNESS SPECIFIED ON THE CONTRACT DRAWINGS. THE TOPSOIL SURFACE LAYER SHALL BE COMPACTED TO APPROXIMATELY 85% OF MAXIMUM DENSITY AND WITHIN TWO PERCENTAGE POINTS OF OPTIMUM MOISTURE IN ACCORDANCE WITH ASTM D698. TOPSOIL SHALL BE ADDED TO ANY AREAS THAT SETTLE.
5. ALL SOIL RIPRAP THAT IS BURIED WITH TOPSOIL SHALL BE REVIEWED AND APPROVED BY THE ENGINEER PRIOR TO ANY TOPSOIL PLACEMENT.
6. COMPACT AND LEVEL ALL SOIL TO ELIMINATE VOIDS AND PREVENT ROCKS FROM PROJECTING ABOVE DESIGN RIPRAP TOP GRADE.
7. CRIMP OR TACKIFY MULCH OR USE APPROVED HYDROMULCH AS CALLED FOR IN THE PLANS AND SPECIFICATIONS.
8. RIPRAP IS NOT TO BE DUMPED DIRECTLY ON FILTER FABRIC OR BEDDING MATERIAL.
9. ALWAYS PLACE FILTER FABRIC STARTING DOWNSTREAM AND WORK UPSTREAM.



TYPICAL TRICKLE CHANNEL
CROSS–SECTION

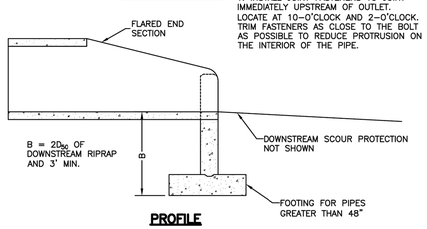


ACCESS ROAD SECTION



ELEVATION VIEW

NOTES:
1. INSTALL JOINT FASTENERS TO JOINT IMMEDIATELY UPSTREAM OF OUTLET. LOCATE AT 10–O'CLOCK AND 2–O'CLOCK. TRIM FASTENERS AS CLOSE TO THE BOLT AS POSSIBLE TO REDUCE PROTRUSION ON THE INTERIOR OF THE PIPE.



PROFILE

HEADWALL DESIGN TABLE

PIPE SIZE	LENGTH, MIN
18"	7'–0"
24"	8'–0"
30"	10'–0"
36"	12'–6"
42"	15'–9"
48"	17'–6"
54"	19'–6"
60"	21'–6"
66"	22'–6"
72"	24'–0"

FLARED END SECTION (FES) HEADWALL DETAIL

RECORD DRAWING

MARTIN/MARTIN BY: DAL DATE: 08/23/22

This "drawing" is a record of final construction plans, notes and details, as well as approved supplemental instructions or modifications added during construction. If provided to MARTIN/MARTIN, as–constructed information has been noted with a bold font and the symbol **(AB)** beside stricken design information. All other information has not been field verified. The source of all as–constructed information is identified with clouds and/or delta symbols indicated below. Neither MARTIN/MARTIN nor the Engineer of Record has verified the accuracy of the as–constructed information provided by others and shall not be responsible for any errors or omissions which may be incorporated herein as a result.

A AS–CONSTRUCTED INFORMATION PROVIDED BY WAGNER CONSTRUCTION ON 06/14/2023.

B AS–CONSTRUCTED INFORMATION PROVIDED BY MARTIN/MARTIN CONSULTING ENGINEERS ON 07/31/2023.

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11–10–21

CANDELAS INDIANA NORTH

POND DETAILS

No.	Issue / Revision	Date	Name
1	1ST SUBMITTAL	10/02/20	DK
2	2ND SUBMITTAL	01/22/21	DK
3	3RD SUBMITTAL	04/09/21	DK
4	4TH SUBMITTAL	07/02/21	DK
5	5TH SUBMITTAL	09/10/21	DK
6	CONSTRUCTION ISSUE	11/10/21	DK
7	RECORD DRAWING SUBMITTAL	08/23/23	DK

Job Number 20.0287
Project Manager R. SOLTIS/D. KUNTZ
Design By B. KAISER
Drawn By E. BERNAL/M. WOOD
Principal In Charge D. LOVATO

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Sheet Number:

C320