PART 2

FINAL DRAINAGE REPORT
for
FALCON MARKETPLACE

El Paso County, Colorado

September 12, 2019

SF-19-001

Prepared for:

LG HI Falcon, LLC.
3953 Maple Ave, #290
Dallas, TX 75219
Contact: Ben Hummel
(214) 416-9820

Prepared by:

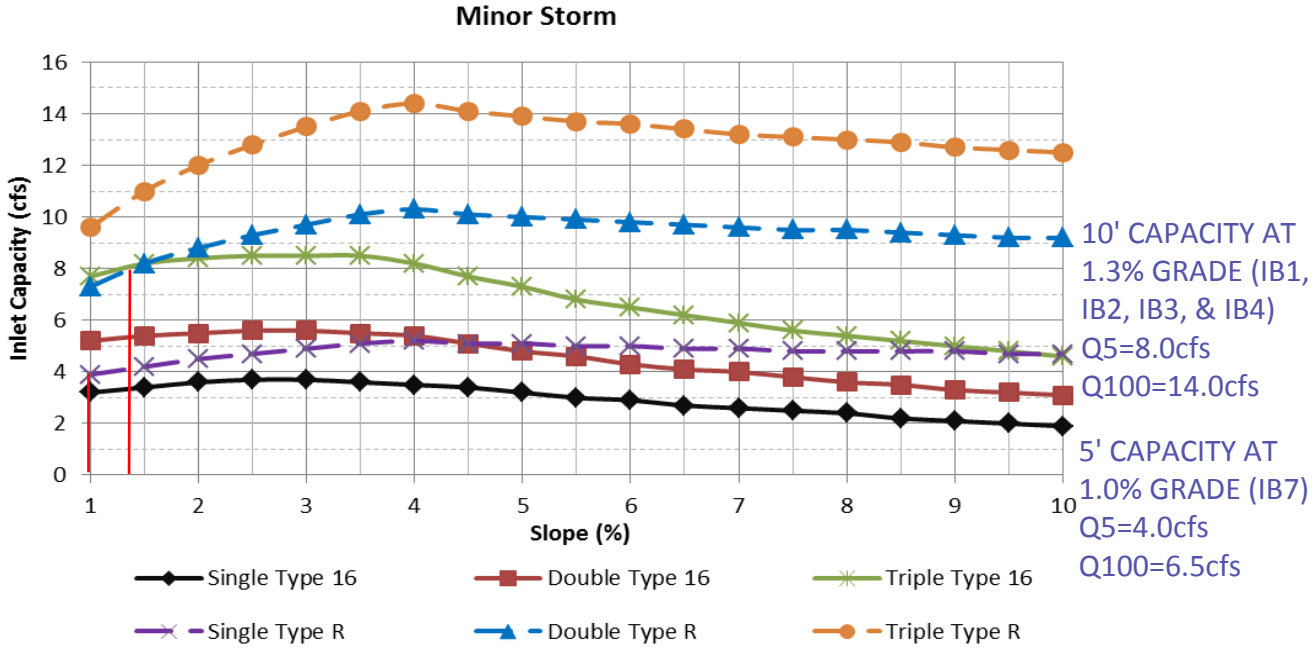
Drexel, Barrell & Co.
3 South 7th Street
Colorado Springs, CO 80905
Contact: Tim McConnell, P.E.
(719) 260-0887

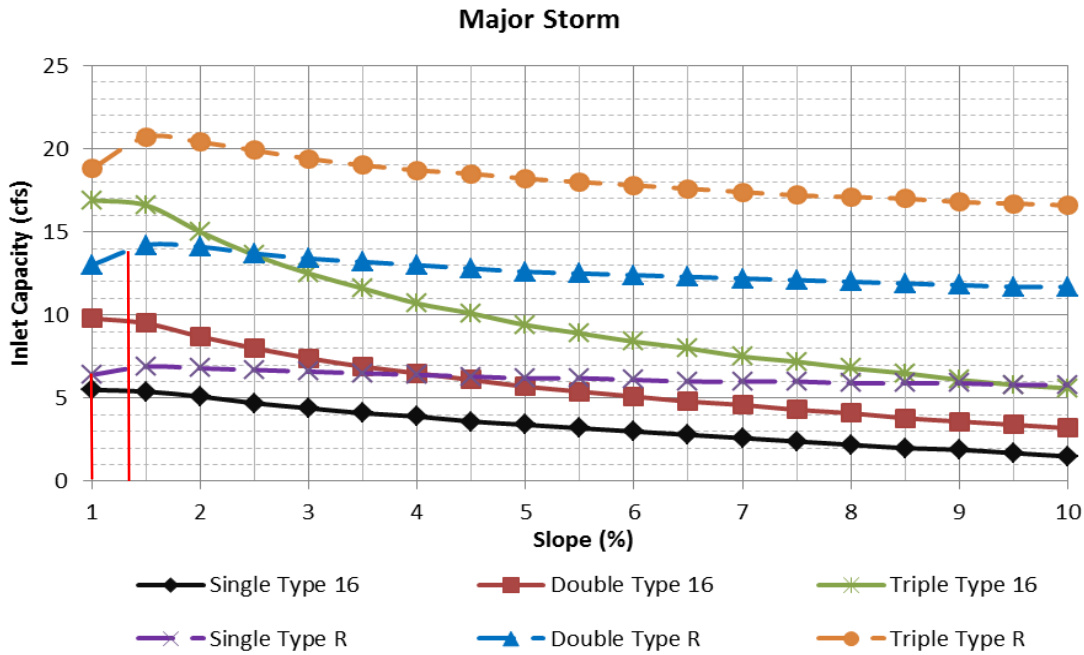
Inlet Summary (see figures 8-7, 8-10 & 8-11)

			Flow		Capacity	
Inlet	**Type**		**Q5 (cfs)**	**Q100 (cfs)**	**Q5 (cfs)**	**Q100 (cfs)**
IA1	10' Type R	sump	3.4	7.7		
IB1	10' Type R	at-grade	2.8	5.1	8.0	14.0
IB2	10' Type R	at-grade	2.0	3.7	8.0	14.0
IB3	10' Type R	at-grade	1.4	2.5	8.0	14.0
IB4	10' Type R	at-grade	0.8	1.4	8.0	14.0
IB5	10' Type R	sump	0.8	1.5	10.5	10.5
IB6	10' Type R	sump	0.9	1.6	10.5	10.5
IB7	5' Type R	at-grade	1.6	2.9	4.0	6.5
IB8	10' Type R	sump	1.6	2.9	10.5	10.5
IB9	10' Type R	sump	1.5	2.7	10.5	10.5
IC1	5' Type R	sump	1.3	2.6	6.5	6.5
IC3	5' Type R	sump	0.8	1.5	6.5	6.5

Figure 8-7. Inlet Capacity Chart Continuous Grade Conditions, Residential (Local)
(Attached and Detached Sidewalk)

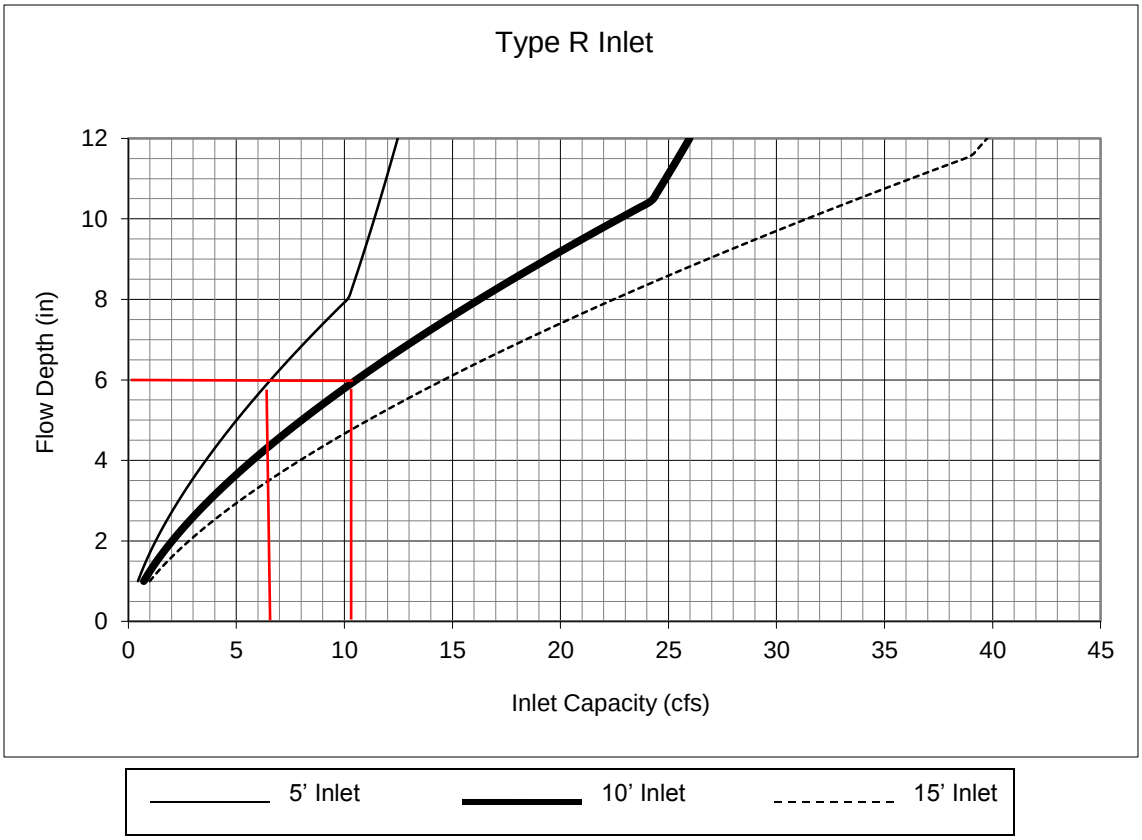
Street Section Data: Street Width Flowline to Flowline = 34'
Type of Curb and Gutter: D-10-R = 8" vertical
Type 16 = 6" vertical





The standard street section parameters as defined in Chapter 7 must apply to use these charts. For non-standard sections, the inlet capacity shall be calculated using the UDFCD spreadsheets. The maximum spread width is limited by the curb height based on no curb overtopping during a minor storm and flow being contained within the public right-of-way during the major storm. Calculations were done using UD-Inlet 3.00.xls, Mar., 2011 with the default clogging factors.

Figure 8-11. Inlet Capacity Chart Sump Conditions , Curb Opening (Type R) Inlet



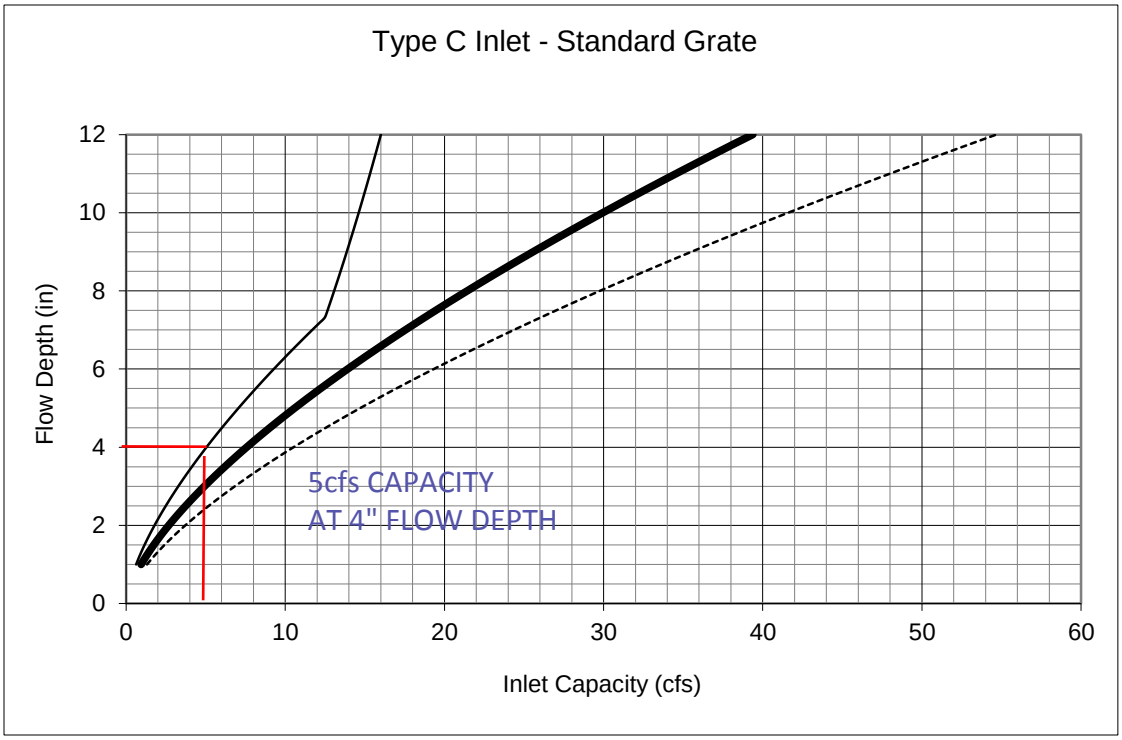
10' INLET CAPACITY AT
6" FLOW DEPTH
(IB5, IB6, IB8 & IB9)
Q=10.5cfs

5' INLET CAPACITY AT
6" FLOW DEPTH
(IC1 & IC3)
Q=6.5cfs

Notes:

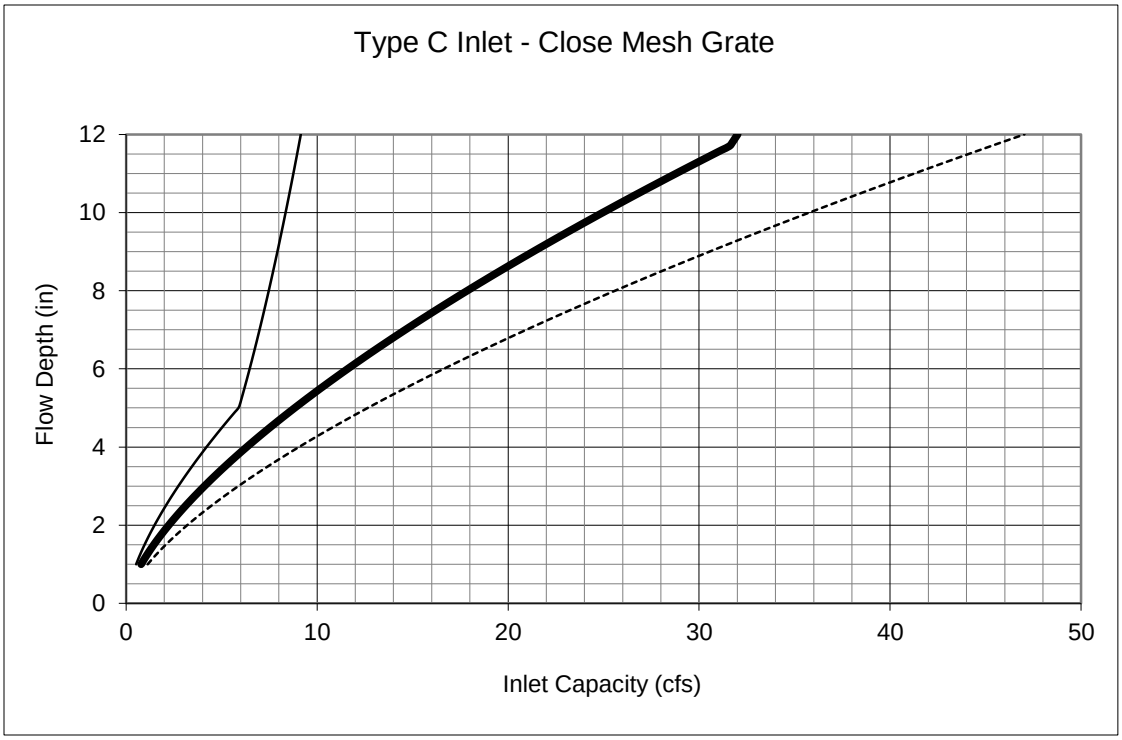
1. The standard inlet parameters must apply to use this chart.

Figure 8-10. Inlet Capacity Chart Sump Conditions, Area (Type C) Inlet



INLET IA2
Q5=0.0cfs
Q100= 0.2cfs

INLET IC2
Q5=0.0cfs
Q100=0.3cfs

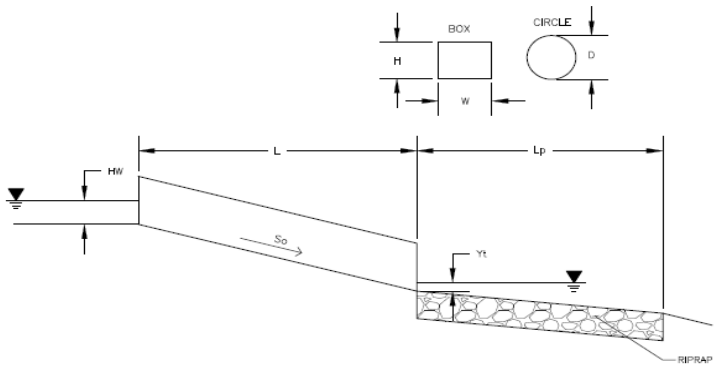


One Grate — Two Grates - - - - - Three Grates

Notes:
1. The standard inlet parameters must apply to use these charts.

Determination of Culvert Headwater and Outlet Protection

Project: Falcon Marketplace
Basin ID: DP27



Soil Type:
Choose One:
- (●) Sandy
- ( ) Non-Sandy

Supercritical Flow! Using Da to calculate protection type

Design Information (Input):

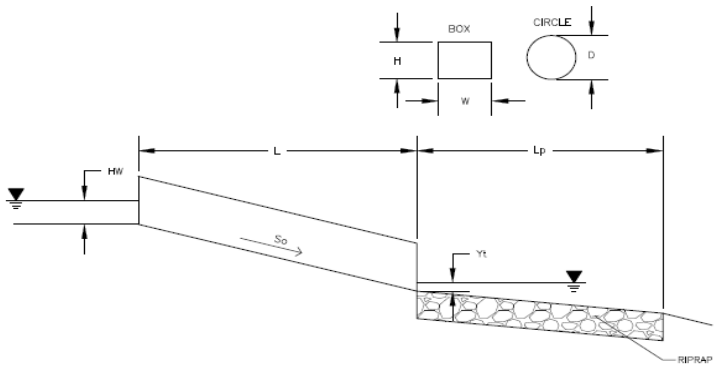
Design Discharge	Q =	1.9	cfs
Circular Culvert:			
Barrel Diameter in Inches	D =	18	inches
Inlet Edge Type (Choose from pull-down list)		Square End with Headwall	
Box Culvert:		**OR**	
Barrel Height (Rise) in Feet	Height (Rise) =		ft
Barrel Width (Span) in Feet	Width (Span) =		ft
Inlet Edge Type (Choose from pull-down list)			
Number of Barrels	No =	1	
Inlet Elevation	Elev IN =	6885.5	ft
Outlet Elevation **OR** Slope	Elev OUT =	6885	ft
Culvert Length	L =	24	ft
Manning's Roughness	n =	0.012	
Bend Loss Coefficient	k_b =	0	
Exit Loss Coefficient	k_x =	1	
Tailwater Surface Elevation	Elev Y_t =		ft
Max Allowable Channel Velocity	V =	5	ft/s

Required Protection (Output):

Tailwater Surface Height	Y_t =	0.60	ft
Flow Area at Max Channel Velocity	A_t =	0.38	ft^2
Culvert Cross Sectional Area Available	A =	1.77	ft^2
Entrance Loss Coefficient	k_e =	0.50	
Friction Loss Coefficient	k_f =	0.37	
Sum of All Losses Coefficients	k_s =	1.87	ft
Culvert Normal Depth	Y_n =	0.34	ft
Culvert Critical Depth	Y_c =	0.52	ft
Tailwater Depth for Design	d =	1.01	ft
Adjusted Diameter **OR** Adjusted Rise	D_a =	0.92	ft
Expansion Factor	1/(2*tan(Θ)) =	6.70	
Flow/Diameter$^{2.5}$ **OR** Flow/(Span * Rise$^{1.5}$)	Q/D^2.5 =	0.69	$ft^{0.5}/s$
Froude Number	Fr =	2.22	**Supercritical!**
Tailwater/Adjusted Diameter **OR** Tailwater/Adjusted Rise	Yt/D =	0.65	
Inlet Control Headwater	HW_I =	0.71	ft
Outlet Control Headwater	HW_O =	0.54	
Design Headwater Elevation	**HW =**	**6,886.21**	**ft**
Headwater/Diameter OR Headwater/Rise Ratio	**HW/D =**	**0.47**	
Minimum Theoretical Riprap Size	d_{50} =	1	in
Nominal Riprap Size	d_{50} =	6	in
UDFCD Riprap Type	**Type =**	**VL**	
Length of Protection	**L_p =**	**5**	**ft**
Width of Protection	**T =**	**3**	**ft**

Determination of Culvert Headwater and Outlet Protection

Project: Falcon Marketplace
Basin ID: DP30



Soil Type:
Choose One:
- (●) Sandy
- ( ) Non-Sandy

Supercritical Flow! Using Da to calculate protection type

Design Information (Input):

Design Discharge	Q =	6.6	cfs
Circular Culvert:			
Barrel Diameter in Inches	D =	18	inches
Inlet Edge Type (Choose from pull-down list)		Square End with Headwall	
Box Culvert:		**OR**	
Barrel Height (Rise) in Feet	Height (Rise) =		ft
Barrel Width (Span) in Feet	Width (Span) =		ft
Inlet Edge Type (Choose from pull-down list)			
Number of Barrels	No =	1	
Inlet Elevation	Elev IN =	6879.49	ft
Outlet Elevation **OR** Slope	Elev OUT =	6875	ft
Culvert Length	L =	90.1	ft
Manning's Roughness	n =	0.012	
Bend Loss Coefficient	k_b =	0	
Exit Loss Coefficient	k_x =	1	
Tailwater Surface Elevation	Elev Y_t =		ft
Max Allowable Channel Velocity	V =	5	ft/s

Required Protection (Output):

Tailwater Surface Height	Y_t =	0.60	ft
Flow Area at Max Channel Velocity	A_t =	1.32	ft^2
Culvert Cross Sectional Area Available	A =	1.77	ft^2
Entrance Loss Coefficient	k_e =	0.50	
Friction Loss Coefficient	k_f =	1.39	
Sum of All Losses Coefficients	k_s =	2.89	ft
Culvert Normal Depth	Y_n =	0.52	ft
Culvert Critical Depth	Y_c =	0.99	ft
Tailwater Depth for Design	d =	1.25	ft
Adjusted Diameter **OR** Adjusted Rise	D_a =	1.01	ft
Expansion Factor	1/(2*tan(Θ)) =	6.66	
Flow/Diameter$^{2.5}$ **OR** Flow/(Span * Rise$^{1.5}$)	Q/D^2.5 =	2.40	$ft^{0.5}/s$
Froude Number	Fr =	3.45	**Supercritical!**
Tailwater/Adjusted Diameter **OR** Tailwater/Adjusted Rise	Yt/D =	0.59	
Inlet Control Headwater	HW_I =	1.53	ft
Outlet Control Headwater	HW_O =	-2.62	
Design Headwater Elevation	**HW =**	**6,881.02**	**ft**
Headwater/Diameter OR Headwater/Rise Ratio	**HW/D =**	**1.02**	
Minimum Theoretical Riprap Size	d_{50} =	3	in
Nominal Riprap Size	d_{50} =	6	in
UDFCD Riprap Type	**Type =**	**VL**	
Length of Protection	**L_p =**	**5**	**ft**
Width of Protection	**T =**	**3**	**ft**

DETENTION VOLUME BY THE FULL SPECTRUM METHOD

Project:
Basin ID:

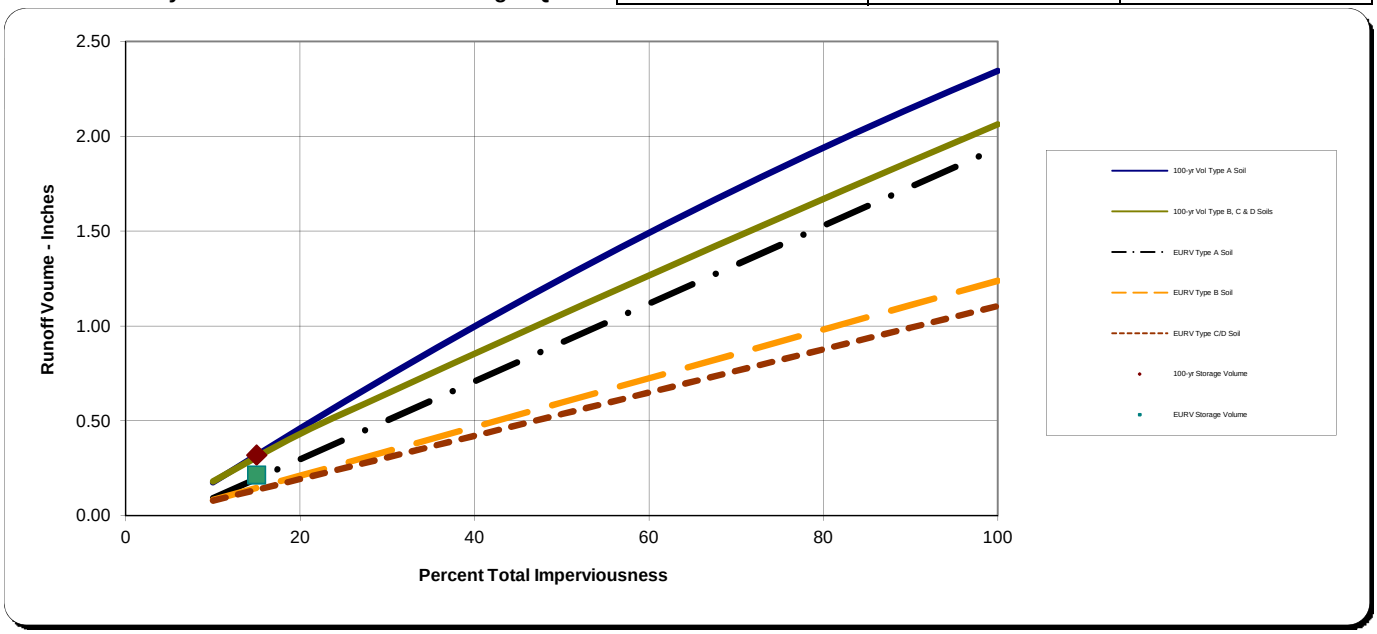
* User input data shown in blue.

Area of Watershed (acres)	740.00	
Subwatershed Imperviousness	15.0%	
Level of Minimizing Directly Connected Impervious Area (MDCIA)	0	0
Effective Imperviousness[1]	15.0%	

Hydrologic Soil Type	**Percentage of Area**	**Area (acres)**
Type A	100.0%	740.0
Type B		0.0
Type C or D		0.0

Recommended Horton's Equation Parameters for CUHP		
Infiltration (inches per hour)		**Decay Coefficient--α**
Initial--f_i	**Final--f_o**	
5	1.0	0.0007

	Detention Volumes [2,5]		**Maximum Allowable Release Rate, cfs[3]**
	(watershed inches)	**(acre-feet)**	
Excess Urban Runoff Volume[4]	0.22	13.30	Design Oulet to Empty EURV in 72 Hours
100-year Detention Volume Including WQCV [5]	0.32	19.72	370.00



Notes:

1) Effective imperviousness is based on Figure ND-1 of the Urban Storm Drainage Criteria Manual (USDCM).

2) Results shown reflect runoff reduction from Level 1 or 2 MDCIA and are plotted at the watershed's total imperviousness value; the impact of MDCIA is reflected by the results being below the curves.

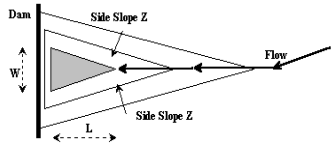
3) Maximum allowable release rates for 100-year event are based on Table SO-1. Outlet for the Excess Urban Runoff Volume (EURV) to be designed to empty out the EURV in 72 hours. Outlet design is similar to one for the WQCV outlet of an extended detention basin (i.e., perforated plate with a micro-pool) and extends to top of EURV water surface elevation.

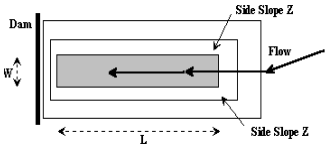
4) EURV approximates the difference between developed and pre-developed runoff volume.

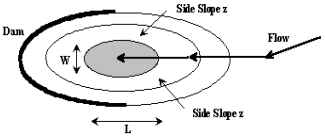
5) 100-yr detention volume includes EURV. No need to add more volume for WQCV or EURV

STAGE-STORAGE SIZING FOR DETENTION BASINS

Project: FALCON MARKETPLACE
Basin ID: NORTH POND #1







Design Information (Input):

Width of Basin Bottom, W = ft
Length of Basin Bottom, L = ft
Dam Side-slope (H:V), Z_d = ft/ft

Check Basin Shape

Right Triangle OR…
Isosceles Triangle OR…
Rectangle OR…
Circle / Ellipse OR…
Irregular (Use Overide values in cells G32:G52)

Stage-Storage Relationship:

	MINOR	MAJOR	
Storage Requirement from Sheet 'Modified FAA':			acre-ft.
Storage Requirement from Sheet 'Hydrograph':			acre-ft.
Storage Requirement from Sheet 'Full-Spectrum':	13.30	19.72	acre-ft.

Labels for WQCV, Minor, & Major Storage Stages (input)	Water Surface Elevation ft (input)	Side Slope (H:V) ft/ft Below El. (input)	Basin Width at Stage ft (output)	Basin Length at Stage ft (output)	Surface Area at Stage ft^2 (output)	Surface Area at Stage ft^2 User Overide	Volume Below Stage ft^3 (output)	Surface Area at Stage acres (output)	Volume Below Stage acre-ft (output)	Target Volumes for WQCV, Minor, & Major Storage Volumes (for goal seek)
	6882.00					531		0.012	0.000	
	6883.00		0.00	0.00		531	531	0.012	0.012	
	6884.00		0.00	0.00		531	1,062	0.012	0.024	
	6885.00		0.00	0.00		886	1,771	0.020	0.041	
	6886.00		0.00	0.00		9,189	6,808	0.211	0.156	
	6887.00		0.00	0.00		27,880	25,343	0.640	0.582	
	6888.00		0.00	0.00		60,263	69,414	1.383	1.594	
	6889.00		0.00	0.00		85,329	142,210	1.959	3.265	
	6890.00		0.00	0.00		103,874	236,812	2.385	5.436	
	6891.00		0.00	0.00		111,922	344,710	2.569	7.913	
	6892.00		0.00	0.00		116,616	458,979	2.677	10.537	
WQCV	6893.00		0.00	0.00		128,472	581,523	2.949	13.350	
	6894.00		0.00	0.00		136,926	714,222	3.143	16.396	
	6895.00		0.00	0.00		145,498	855,434	3.340	19.638	
	6896.00		0.00	0.00		154,188	1,005,277	3.540	23.078	
	6896.50		0.00	0.00		158,590	1,083,471	3.641	24.873	
100-YR	6897.00		0.00	0.00		162,992	1,163,867	3.742	26.719	
	6897.50		0.00	0.00		167,639	1,246,524	3.848	28.616	
	6898.00		0.00	0.00		172,286	1,331,506	3.955	30.567	
	6899.00		0.00	0.00		181,155	1,508,226	4.159	34.624	
	6900.00		0.00	0.00		190,124	1,693,866	4.365	38.886	
	6901.00		0.00	0.00		199,194	1,888,525	4.573	43.355	
							#N/A		#N/A	
							#N/A		#N/A	
							#N/A		#N/A	
							#N/A		#N/A	
							#N/A		#N/A	
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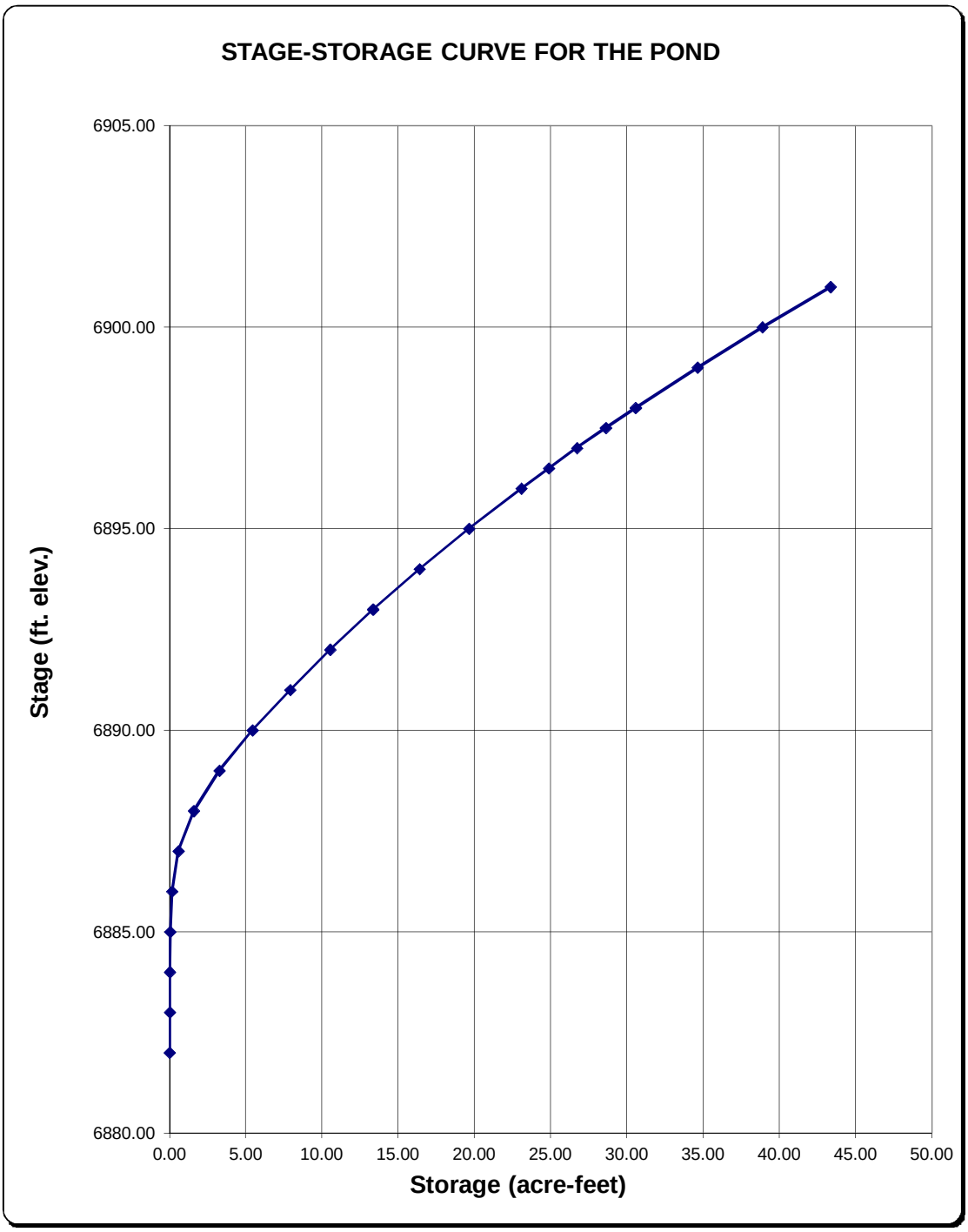
							#N/A		#N/A	

STAGE-STORAGE SIZING FOR DETENTION BASINS

Project:
Basin ID:



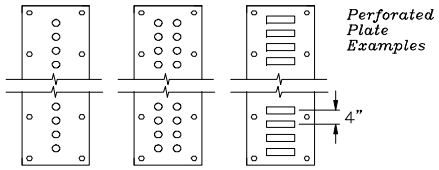
STAGE-DISCHARGE SIZING OF THE WATER QUALITY CAPTURE VOLUME (WQCV) OUTLET

Project: FALCON MARKETPLACE
Basin ID: NORTH POND #1

WQCV Design Volume (Input):

Catchment Imperviousness, I_a = 15.0 percent
Catchment Area, A = 740.00 acres
Depth at WQCV outlet above lowest perforation, H = 8 feet
Vertical distance between rows, h = 30.00 inches
Number of rows, NL = 3.00
Orifice discharge coefficient, C_o = 0.50
Slope of Basin Trickle Channel, S = 0.005 ft / ft
Time to Drain the Pond = 40 hours

Diameter of holes, D = 5.000 inches
Number of holes per row, N = 1
OR
Height of slot, H = inches
Width of slot, W = inches



Watershed Design Information (Input):

Percent Soil Type A = 100 %
Percent Soil Type B = %
Percent Soil Type C/D = %

Outlet Design Information (Output):

Excess Urban Runoff Volume (From 'Full-Spectrum Sheet') 0.216 watershed inches
N/A
Excess Urban Runoff Volume (From 'Full-Spectrum Sheet') 13.300 acre-feet
Outlet area per row, Ao = 69.21 square inches
Total opening area at each row based on user-input above, Ao = 19.63 square inches
Total opening area at each row based on user-input above, Ao = 0.136 square feet

3

	Central Elevations of Rows of Holes in feet																								
	Row 1	Row 2	Row 3	Row 4	Row 5	Row 6	Row 7	Row 8	Row 9	Row 10	Row 11	Row 12	Row 13	Row 14	Row 15	Row 16	Row 17	Row 18	Row 19	Row 20	Row 21	Row 22	Row 23	Row 23	Σ Flow
	6885.00	6887.50	6890.00																						
	Collection Capacity for Each Row of Holes in cfs																								
6882.00	0.0000	0.0000	0.0000																						**0.00**
6883.00	0.0000	0.0000	0.0000																						**0.00**
6884.00	0.0000	0.0000	0.0000																						**0.00**
6885.00	0.0000	0.0000	0.0000																						**0.00**
6886.00	0.5457	0.0000	0.0000																						**0.55**
6887.00	0.7717	0.0000	0.0000																						**0.77**
6888.00	0.9452	0.3859	0.0000																						**1.33**
6889.00	1.0914	0.6683	0.0000																						**1.76**
6890.00	1.2202	0.8628	0.0000																						**2.08**
6891.00	1.3367	1.0209	0.5457																						**2.90**
6892.00	1.4438	1.1576	0.7717																						**3.37**
6893.00	1.5435	1.2798	0.9452																						**3.77**
6894.00	1.6371	1.3913	1.0914																						**4.12**
6895.00	1.7256	1.4945	1.2202																						**4.44**
6896.00	1.8099	1.5910	1.3367																						**4.74**
6896.50	1.8505	1.6371	1.3913																						**4.88**
6897.00	1.8904	1.6820	1.4438																						**5.02**
6897.50	1.9293	1.7256	1.4945																						**5.15**
6898.00	1.9675	1.7683	1.5435																						**5.28**
6899.00	2.0418	1.8505	1.6371																						**5.53**
6900.00	2.1135	1.9293	1.7256																						**5.77**
6901.00	2.1828	2.0050	1.8099																						**6.00**
	#N/A	#N/A	#N/A																						**#N/A**
	#N/A	#N/A	#N/A																						**#N/A**
	#N/A	#N/A	#N/A																						**#N/A**
	#N/A	#N/A	#N/A																						**#N/A**
	#N/A	#N/A	#N/A																						**#N/A**
	#N/A	#N/A	#N/A																						**#N/A**
	#N/A	#N/A	#N/A																						**#N/A**
	#N/A	#N/A	#N/A																						**#N/A**
	#N/A	#N/A	#N/A																						**#N/A**
	#N/A	#N/A	#N/A																						**#N/A**
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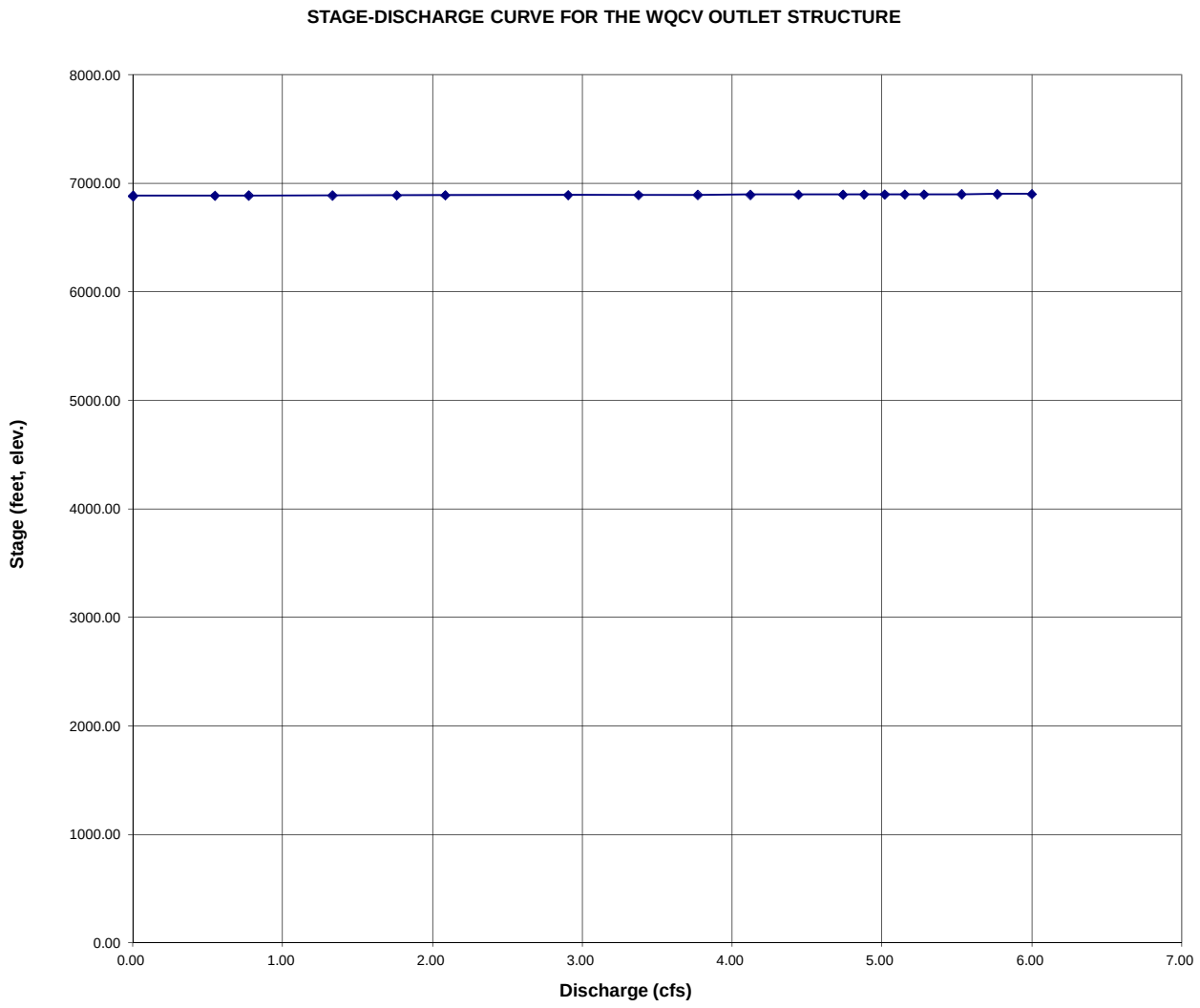
	#N/A	#N/A	#N/A																						**#N/A**
	#N/A	#N/A	#N/A																						**#N/A**
	#N/A	#N/A	#N/A																						**#N/A**
	#N/A	#N/A	#N/A																						**#N/A**
	#N/A	#N/A	#N/A																						**#N/A**
	#N/A	#N/A	#N/A																						**#N/A**
	#N/A	#N/A	#N/A																						**#N/A**
	#N/A	#N/A	#N/A																						**#N/A**
	#N/A	#N/A	#N/A																						**#N/A**
	#N/A	#N/A	#N/A																						**#N/A**
	Override Area Row 1	Override Area Row 2	Override Area Row 3	Override Area Row 4	Override Area Row 5	Override Area Row 6	Override Area Row 7	Override Area Row 8	Override Area Row 9	Override Area Row 10	Override Area Row 11	Override Area Row 12	Override Area Row 13	Override Area Row 14	Override Area Row 15	Override Area Row 16	Override Area Row 17	Override Area Row 18	Override Area Row 19	Override Area Row 20	Override Area Row 21	Override Area Row 22	Override Area Row 23	Override Area Row 24	
	0.14	0.14	0.14																						

STAGE-DISCHARGE SIZING OF THE WATER QUALITY CAPTURE VOLUME (WQCV) OUTLET

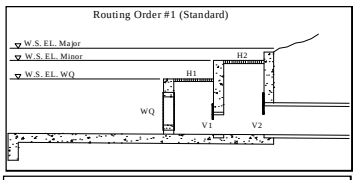
Worksheet Protected

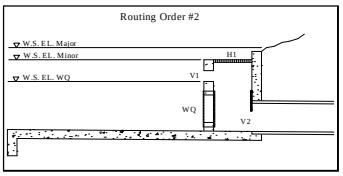
Project: FALCON MARKETPLACE
Basin ID: NORTH POND #1

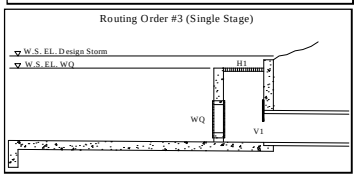


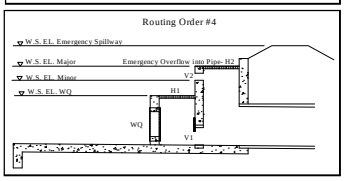
STAGE-DISCHARGE SIZING OF THE WEIRS AND ORIFICES (INLET CONTROL)

Project: Falcon Marketplace #1
Basin ID: NORTH POND #1









Current Routing Order is #3

Design Information (Input):

			#1 Horiz.	#2 Horiz.	#1 Vert.	#2 Vert.	
Circular Opening:	Diameter in Inches	Dia. =			96.00		inches
OR							
Rectangular Opening:	Width in Feet	W =	8.00				ft.
	Length (Height for Vertical)	L or H =	12.00				ft.
	Percentage of Open Area After Trash Rack Reduction	% open =	80		100		%
	Orifice Coefficient	C_o =	0.75		0.75		
	Weir Coefficient	C_w =	3.00				
	Orifice Elevation (Bottom for Vertical)	E_o =	6893.80		6,881.97		ft.

Calculation of Collection Capacity:

		#1 Horiz.	#2 Horiz.	#1 Vert.	#2 Vert.	
Net Opening Area (after Trash Rack Reduction)	A_o =	76.80		50.27		sq. ft.
OPTIONAL: User-Overide Net Opening Area	A_o =					sq. ft.
Perimeter as Weir Length	L_w =	36.80	ft.			
OPTIONAL: User-Overide Weir Length	L_w =		ft.			

Top Elevation of Vertical Orifice Opening, Top = 6889.97 ft.
Center Elevation of Vertical Orifice Opening, Cen = 6885.97 ft.

Routing 3: Single Stage - Water flows through WQCV plate and #1 horizontal opening into #1 vertical opening. This flow will be applied to culvert sheet (#2 vertical & horizontal openings is not used).

			Horizontal Orifices				Vertical Orifices			
Labels for WQCV, Minor, & Major Storage W.S. Elevations (input)	Water Surface Elevation ft (linked)	WQCV Plate/Riser Flow cfs (User-linked)	#1 Horiz. Weir Flow cfs (output)	#1 Horiz. Orifice Flow cfs (output)	#2 Horiz. Weir Flow cfs (output)	#2 Horiz. Orifice Flow cfs (output)	#1 Vert. Collection Capacity cfs (output)	#2 Vert. Collection Capacity cfs (output)	**Total Collection Capacity cfs (output)**	Target Volumes for WQCV, Minor, & Major Storage Volumes (link for goal seek)
	6882.00	0.00	0.00	0.00	0.00	0.00	0.14	0.00	**0.00**	
	6883.00	0.00	0.00	0.00	0.00	0.00	27.95	0.00	**0.00**	
	6884.00	0.00	0.00	0.00	0.00	0.00	77.34	0.00	**0.00**	
	6885.00	0.00	0.00	0.00	0.00	0.00	141.04	0.00	**0.00**	
	6886.00	0.55	0.00	0.00	0.00	0.00	216.33	0.00	**0.55**	
	6887.00	0.77	0.00	0.00	0.00	0.00	301.66	0.00	**0.77**	
	6888.00	1.33	0.00	0.00	0.00	0.00	395.95	0.00	**1.33**	
	6889.00	1.76	0.00	0.00	0.00	0.00	498.43	0.00	**1.76**	
	6890.00	2.08	0.00	0.00	0.00	0.00	607.33	0.00	**2.08**	
	6891.00	2.90	0.00	0.00	0.00	0.00	678.51	0.00	**2.90**	
	6892.00	3.37	0.00	0.00	0.00	0.00	742.90	0.00	**3.37**	
WQCV	6893.00	3.77	0.00	0.00	0.00	0.00	802.14	0.00	**3.77**	
	6894.00	4.12	9.87	206.72	0.00	0.00	857.30	0.00	**13.99**	
	6895.00	4.44	145.12	506.36	0.00	0.00	909.11	0.00	**149.56**	
	6896.00	4.74	360.25	685.61	0.00	0.00	958.13	0.00	**364.99**	
	6896.50	4.88	489.80	759.53	0.00	0.00	981.72	0.00	**494.67**	
100-YR	6897.00	5.02	631.97	826.88	0.00	0.00	1004.76	0.00	**636.98**	
	6897.50	5.15	785.73	889.13	0.00	0.00	1027.28	0.00	**790.88**	
	6898.00	5.28	950.26	947.31	0.00	0.00	1049.32	0.00	**952.58**	
	6899.00	5.53	1309.10	1054.06	0.00	0.00	1092.06	0.00	**1059.59**	
	6900.00	5.77	1704.34	1150.96	0.00	0.00	1133.19	0.00	**1133.19**	
	6901.00	6.00	2132.89	1240.31	0.00	0.00	1172.88	0.00	**1172.88**	
		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	
		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	
		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	
		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	
		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	
		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	
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		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	
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		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	
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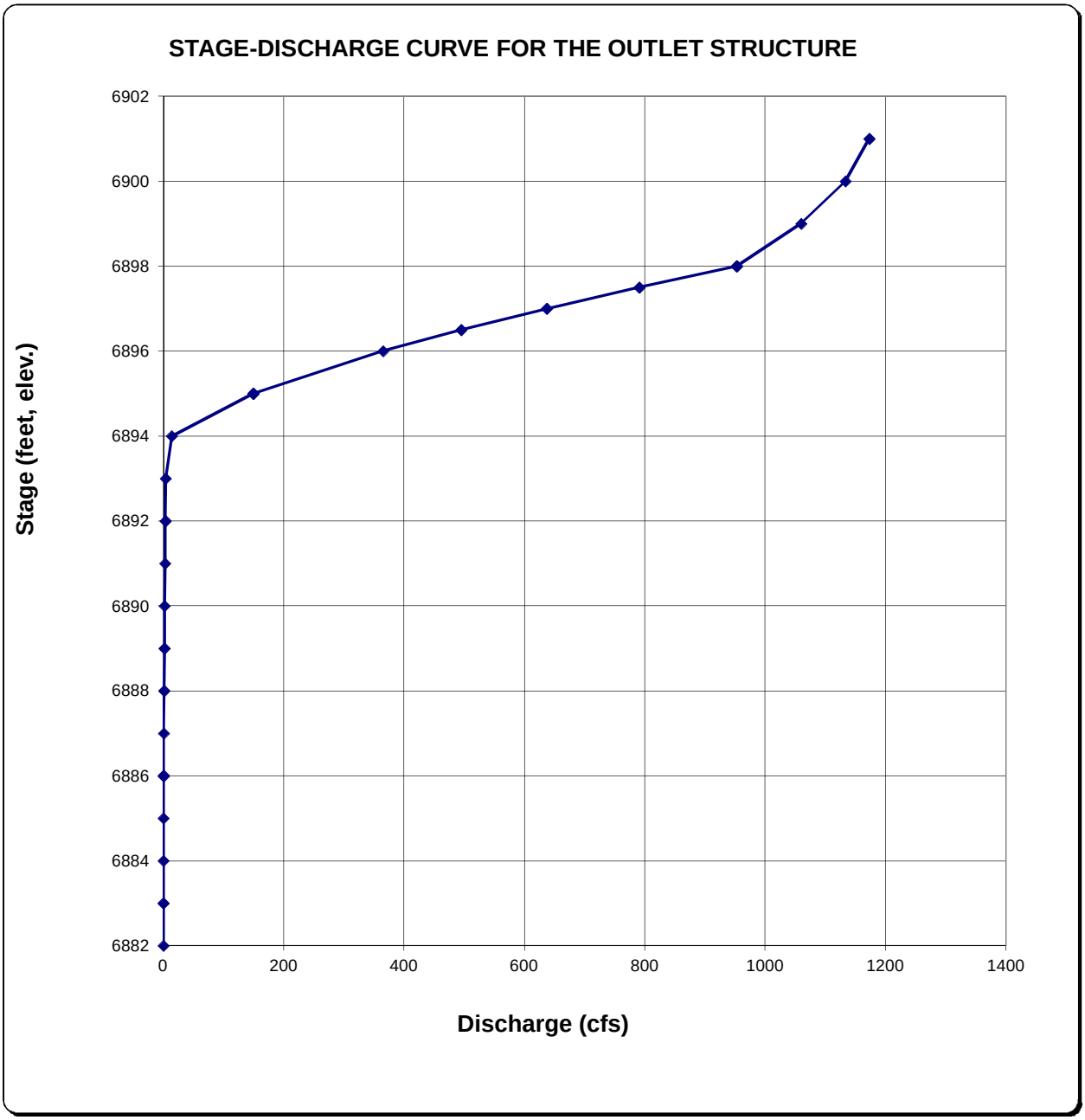
		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	
		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	
		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	
		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	
		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	
		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	
		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.00	**#N/A**	

STAGE-DISCHARGE SIZING OF THE WEIRS AND ORIFICES (INLET CONTROL)

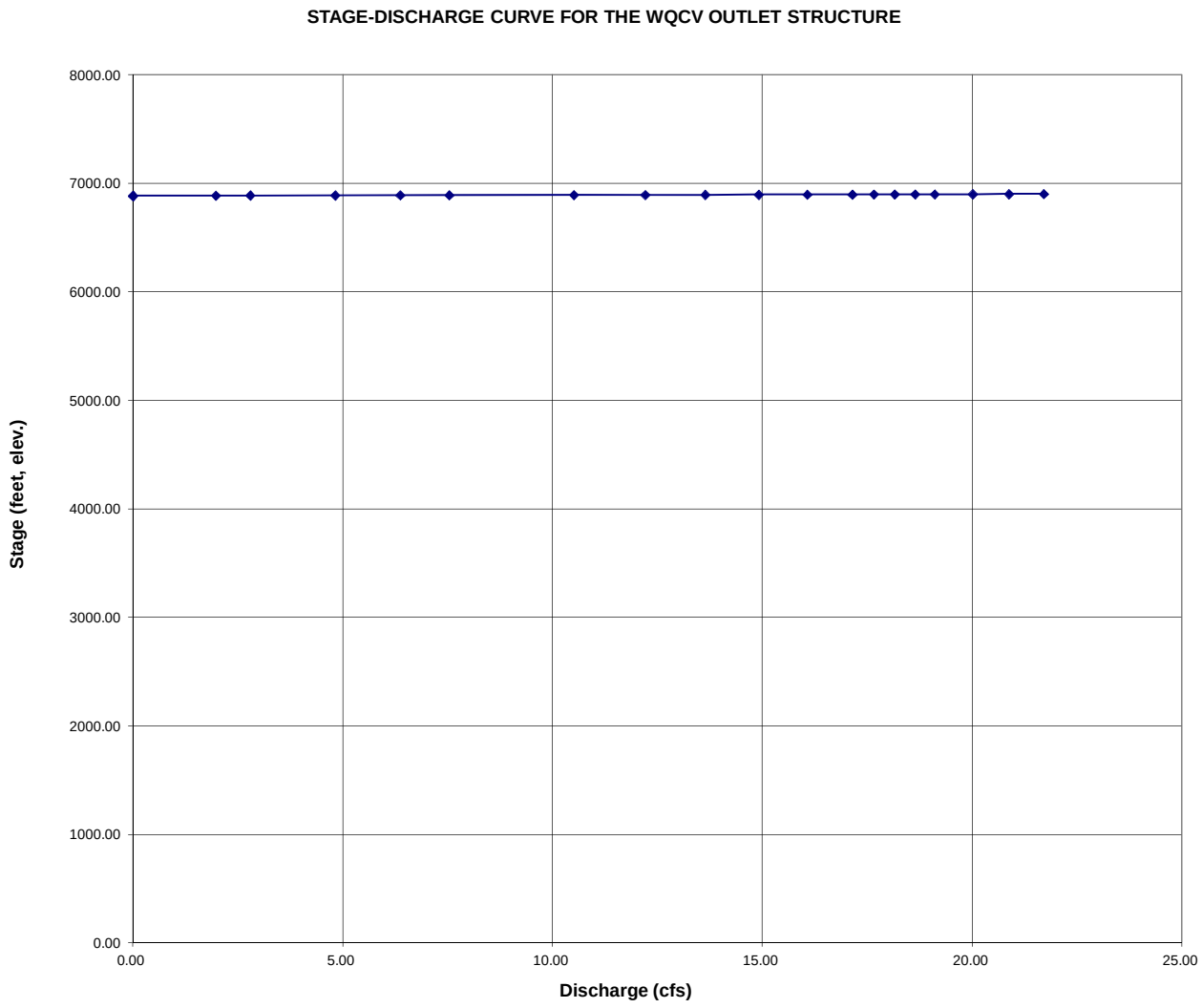
Project: Falcon Marketplace #1
Basin ID: NORTH POND #1



STAGE-DISCHARGE SIZING OF THE WATER QUALITY CAPTURE VOLUME (WQCV) OUTLET

Worksheet Protected

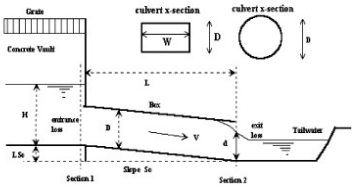
Project: FALCON MARKETPLACE
Basin ID: NORTH POND #1



STAGE-DISCHARGE SIZING OF THE OUTLET CULVERT (INLET vs. OUTLET CONTROL WITH TAILWATER EFFECTS)

Project: **FALCON MARKETPLACE**
Basin ID: **NORTH POND #1**

Status: Culvert Data is valid!



Design Information (Input):

Circular Culvert:	Barrel Diameter in Inches	D =	96	in.
Circular Culvert:	Inlet Edge Type (choose from pull-down list)		Grooved End with Headwall	
OR:				
Box Culvert:	Barrel Height (Rise) in Feet	Height (Rise) =		ft.
Box Culvert:	Barrel Width (Span) in Feet	Width (Span) =		ft.
Box Culvert:	Inlet Edge Type (choose from pull-down list)		Square Edge w/ 90-15 deg. Flared Wingwall	
	Number of Barrels	No =	1	
	Inlet Elevation at Culvert Invert	I_{elev} =	6881.97	ft. elev.
	Outlet Elevation at Culvert Invert	O_{elev} =	6880.85	ft. elev.
	Culvert Length in Feet	L =	78.0	ft.
	Manning's Roughness	n =	0.0120	
	Bend Loss Coefficient	K_b =	0.00	
	Exit Loss Coefficient	K_x =	1.00	

Design Information (calculated):

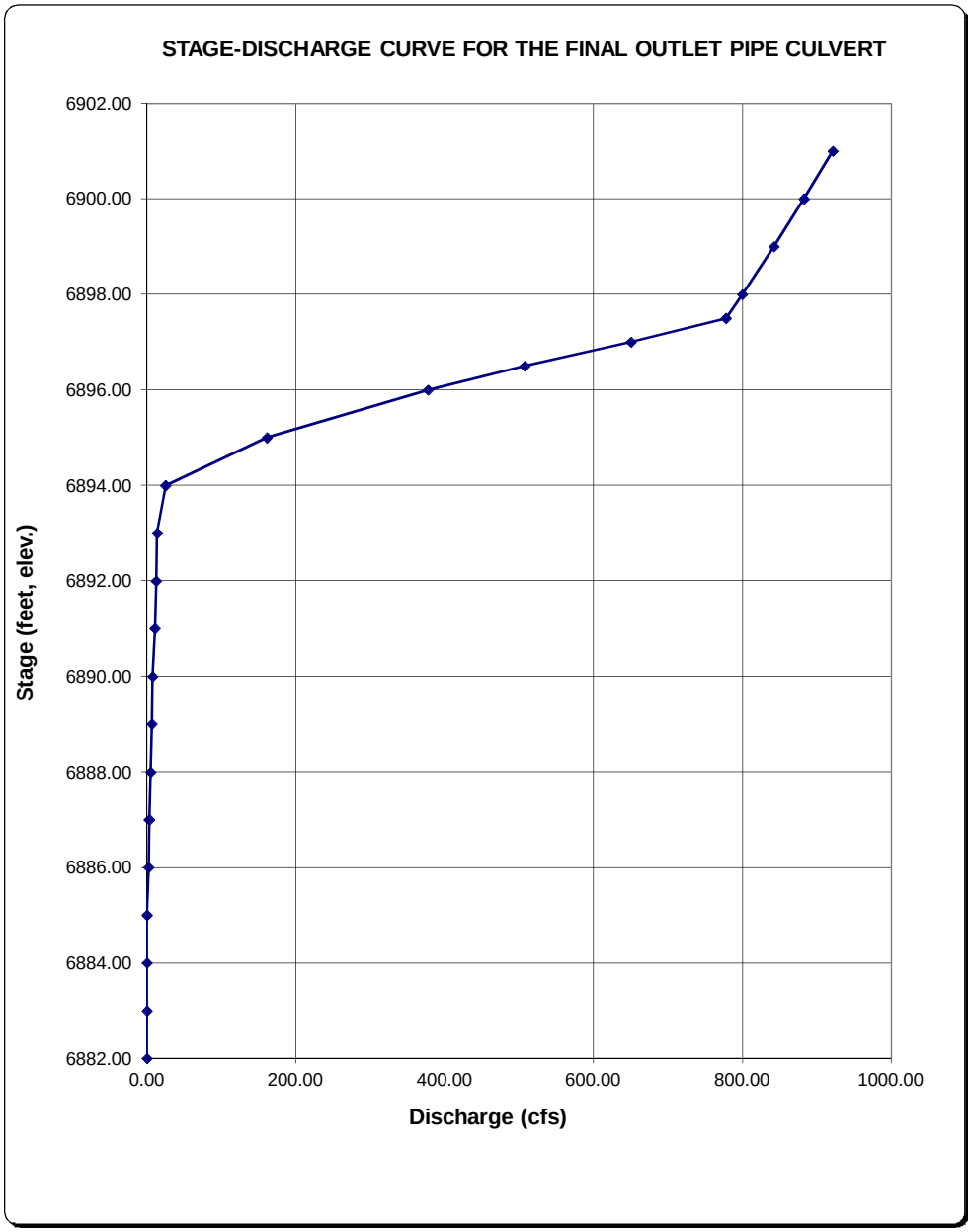
Entrance Loss Coefficient	K_e =	0.20
Friction Loss Coefficient	K_f =	0.13
Sum of All Loss Coefficients	K_s =	1.33
Orifice Inlet Condition Coefficient	C_d =	0.99
Minimum Energy Condition Coefficient	KE_{low} =	-0.04

Calculations of Culvert Capacity (output):

Water Surface Elevation From Sheet "Basin" (ft., linked)	Tailwater Surface Elevation ft (input if known)	Culvert Inlet-Control Flowrate cfs (output)	Culvert Outlet-Control Flowrate cfs (output)	Flowrate Into Culvert From Sheet "Outlet" (cfs, linked)	Controlling Culvert Flowrate cfs (output)	Inlet Equation Used (output)
6882.00	0.00	0.10	73.88	**0.00**	**0.00**	Min. Energy. Eqn.
6883.00	0.00	8.20	127.58	**0.00**	**0.00**	Min. Energy. Eqn.
6884.00	0.00	38.80	179.44	**0.00**	**0.00**	Min. Energy. Eqn.
6885.00	0.00	83.70	227.39	**0.00**	**0.00**	Min. Energy. Eqn.
6886.00	0.00	142.70	253.50	**1.98**	**1.98**	Regression Eqn.
6887.00	0.00	207.40	260.30	**2.79**	**2.79**	Regression Eqn.
6888.00	0.00	284.50	274.34	**4.82**	**4.82**	Regression Eqn.
6889.00	0.00	370.40	296.59	**6.37**	**6.37**	Regression Eqn.
6890.00	0.00	456.70	327.85	**7.54**	**7.54**	Regression Eqn.
6891.00	0.00	537.00	401.74	**10.51**	**10.51**	Regression Eqn.
6892.00	0.00	609.70	475.03	**12.21**	**12.21**	Regression Eqn.
6893.00	0.00	675.30	541.57	**13.64**	**13.64**	Regression Eqn.
6894.00	0.00	735.40	601.48	**24.79**	**24.79**	Regression Eqn.
6895.00	0.00	790.90	656.53	**161.20**	**161.20**	Regression Eqn.
6896.00	0.00	843.00	707.57	**377.40**	**377.40**	Regression Eqn.
6896.50	0.00	867.90	731.66	**507.45**	**507.45**	Regression Eqn.
6897.00	0.00	892.20	755.10	**650.12**	**650.12**	Regression Eqn.
6897.50	0.00	915.90	777.72	**804.36**	**777.72**	Regression Eqn.
6898.00	0.00	939.10	799.86	**966.41**	**799.86**	Regression Eqn.
6899.00	0.00	984.10	842.42	**1074.08**	**842.42**	Regression Eqn.
6900.00	0.00	1027.50	882.74	**1133.19**	**882.74**	Regression Eqn.
6901.00	0.00	1069.50	921.46	**1172.88**	**921.46**	Regression Eqn.
0.00	0.00	0.00	0.00	**#N/A**	**#N/A**	No Flow (WS < inlet)
0.00	0.00	0.00	0.00	**#N/A**	**#N/A**	No Flow (WS < inlet)
0.00	0.00	0.00	0.00	**#N/A**	**#N/A**	No Flow (WS < inlet)
0.00	0.00	0.00	0.00	**#N/A**	**#N/A**	No Flow (WS < inlet)
0.00	0.00	0.00	0.00	**#N/A**	**#N/A**	No Flow (WS < inlet)
0.00	0.00	0.00	0.00	**#N/A**	**#N/A**	No Flow (WS < inlet)
0.00	0.00	0.00	0.00	**#N/A**	**#N/A**	No Flow (WS < inlet)
0.00	0.00	0.00	0.00	**#N/A**	**#N/A**	No Flow (WS < inlet)
0.00	0.00	0.00	0.00	**#N/A**	**#N/A**	No Flow (WS < inlet)
0.00	0.00	0.00	0.00	**#N/A**	**#N/A**	No Flow (WS < inlet)
0.00	0.00	0.00	0.00	**#N/A**	**#N/A**	No Flow (WS < inlet)
0.00	0.00	0.00	0.00	**#N/A**	**#N/A**	No Flow (WS < inlet)
0.00	0.00	0.00	0.00	**#N/A**	**#N/A**	No Flow (WS < inlet)
0.00	0.00	0.00	0.00	**#N/A**	**#N/A**	No Flow (WS < inlet)
0.00	0.00	0.00	0.00	**#N/A**	**#N/A**	No Flow (WS < inlet)
0.00	0.00	0.00	0.00	**#N/A**	**#N/A**	No Flow (WS < inlet)
0.00	0.00	0.00	0.00	**#N/A**	**#N/A**	No Flow (WS < inlet)
0.00	0.00	0.00	0.00	**#N/A**	**#N/A**	No Flow (WS < inlet)
0.00	0.00	0.00	0.00	**#N/A**	**#N/A**	No Flow (WS < inlet)
0.00	0.00	0.00	0.00	**#N/A**	**#N/A**	No Flow (WS < inlet)
0.00	0.00	0.00	0.00	**#N/A**	**#N/A**	No Flow (WS < inlet)
0.00	0.00	0.00	0.00	**#N/A**	**#N/A**	No Flow (WS < inlet)

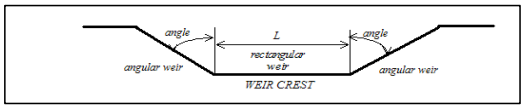
STAGE-DISCHARGE SIZING OF THE OUTLET CULVERT (INLET vs. OUTLET CONTROL WITH TAILWATER EFFECTS)

Project: FALCON MARKETPLACE
Basin ID: NORTH POND #1



STAGE-DISCHARGE SIZING OF THE SPILLWAY

Project: FALCON MARKETPLACE
Basin ID: NORTH POND #1



Design Information (input):

Bottom Length of Weir	L =	160.00	feet
Angle of Side Slope Weir	Angle =	75.96	degrees
Elev. for Weir Crest	EL. Crest =	6,898.00	feet
Coef. for Rectangular Weir	C_w =		
Coef. for Trapezoidal Weir	C_t =	3.50	

Calculation of Spillway Capacity (output):

Water Surface Elevation ft. (linked)	Rect. Weir Flowrate cfs (output)	Triangle Weir Flowrate cfs (output)	Total Spillway Release cfs (output)	Total Pond Release cfs (output)
6882.00	0.00	0.00	0.00	0.00
6883.00	0.00	0.00	0.00	0.00
6884.00	0.00	0.00	0.00	0.00
6885.00	0.00	0.00	0.00	0.00
6886.00	0.00	0.00	0.00	1.98
6887.00	0.00	0.00	0.00	2.79
6888.00	0.00	0.00	0.00	4.82
6889.00	0.00	0.00	0.00	6.37
6890.00	0.00	0.00	0.00	7.54
6891.00	0.00	0.00	0.00	10.51
6892.00	0.00	0.00	0.00	12.21
6893.00	0.00	0.00	0.00	13.64
6894.00	0.00	0.00	0.00	24.79
6895.00	0.00	0.00	0.00	161.20
6896.00	0.00	0.00	0.00	377.40
6896.50	0.00	0.00	0.00	507.45
6897.00	0.00	0.00	0.00	650.12
6897.50	0.00	0.00	0.00	777.72
6898.00	0.00	0.00	0.00	799.86
6899.00	0.00	14.00	14.00	856.42
6900.00	0.00	79.17	79.17	961.91
6901.00	0.00	218.18	218.18	1,139.63
#N/A	#N/A	#N/A	#N/A	#N/A
#N/A	#N/A	#N/A	#N/A	#N/A
#N/A	#N/A	#N/A	#N/A	#N/A
#N/A	#N/A	#N/A	#N/A	#N/A
#N/A	#N/A	#N/A	#N/A	#N/A
#N/A	#N/A	#N/A	#N/A	#N/A
#N/A	#N/A	#N/A	#N/A	#N/A
#N/A	#N/A	#N/A	#N/A	#N/A
#N/A	#N/A	#N/A	#N/A	#N/A
#N/A	#N/A	#N/A	#N/A	#N/A
#N/A	#N/A	#N/A	#N/A	#N/A
#N/A	#N/A	#N/A	#N/A	#N/A
#N/A	#N/A	#N/A	#N/A	#N/A
#N/A	#N/A	#N/A	#N/A	#N/A
#N/A	#N/A	#N/A	#N/A	#N/A
#N/A	#N/A	#N/A	#N/A	#N/A
#N/A	#N/A	#N/A	#N/A	#N/A
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PROJECT INFORMATION

PROJECT:	Falcon Marketplace
PROJECT NO:	20988-00CSCV
DESIGN BY:	KGV
REV. BY:	TDM
AGENCY:	El Paso County
REPORT TYPE:	Preliminary
DATE:	6/19/2017

Drexel, Barrell & Co.

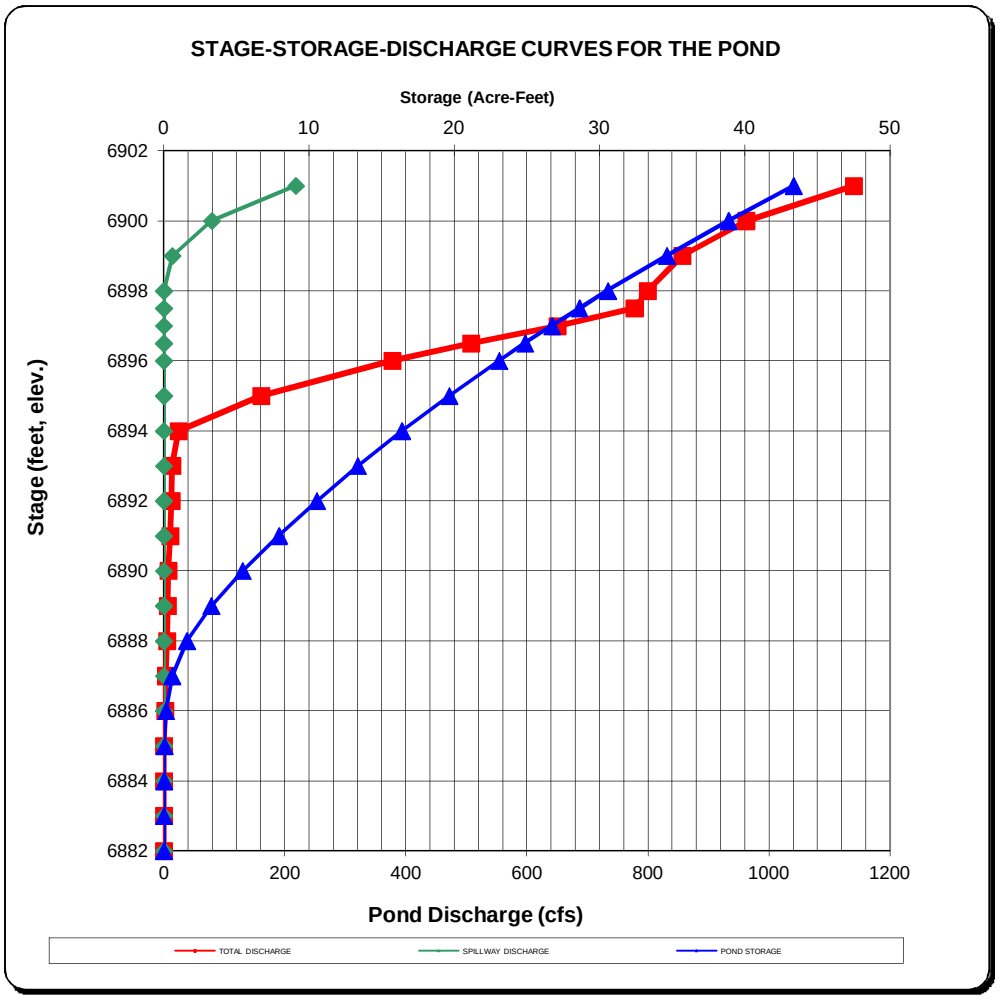
SPILLWAY CALCULATIONS

Q=CL(H^(2/3))

Weir coefficient C:	3.5
Depth H, ft:	1.5
Flowrate Q. cfs:	1016
Required L, ft:	**158.01**

STAGE-DISCHARGE SIZING OF THE SPILLWAY

Project: FALCON MARKETPLACE
Basin ID: NORTH POND #1



Aluminum Bar Grating

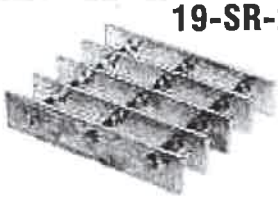
TRASH RACK GRATE
AT FRONT OF BOX

RECTANGULAR BAR SWAGE-LOCKED 1-3/16" C/C Bearing Bars

19-SR-4

Cross Rods 4" C/C

19-SR-2



Cross Rods 2" C/C

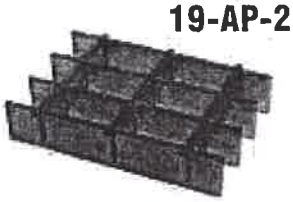
NON-SERRATED & SERRATED

PRESS-LOCKED 1-3/16" C/C Bearing Bars

19-AP-4

Cross Bars 4" C/C

19-AP-2



Cross Bars 2" C/C

LOAD & DEFLECTION TABLE

SPAN (Direction of Bearing Bar)

Bar Size	Symbol	Approx. Weight psf	Sec. Mod Per Ft. Of Width		24"	30"	36"	42"	48"	54"	60"	66"	72"	78"	84"	96"	108"
3/4" x 1/8"	19-SR-4	1.4	0.118	U	237	152	105	77									
	19-SR-2	1.6		D	0.192	0.300	0.432	0.588									
	19-AP-4	1.5		C	237	189	158	135									
	19-AP-2	1.8		D	0.154	0.240	0.346	0.470									
3/4" x 3/16"	19-SR-4	1.9	0.178	U	355	227	158	116									
	19-SR-2	2.1		D	0.192	0.300	0.432	0.588									
	19-AP-4	2.2		C	355	284	237	203									
	19-AP-2	2.7		D	0.154	0.240	0.346	0.470									
1" x 1/8"	19-SR-4	1.7	0.211	U	421	269	187	137	105								
	19-SR-2	1.9		D	0.144	0.225	0.324	0.441	0.576								
	19-AP-4	1.8		C	421	337	281	241	211								
	19-AP-2	2.2		D	0.115	0.180	0.259	0.353	0.461								
1" x 3/16"	19-SR-4	2.5	0.316	U	632	404	281	206	158	125							
	19-SR-2	2.7		D	0.144	0.225	0.324	0.441	0.576	0.729							
	19-AP-4	2.8		C	632	505	421	361	316	281							
	19-AP-2	3.3		D	0.115	0.180	0.259	0.353	0.461	0.583							
1-1/4" x 1/8"	19-SR-4	2.1	0.329	U	658	421	292	215	164	130							
	19-SR-2	2.3		D	0.115	0.180	0.259	0.353	0.461	0.583							
	19-AP-4	2.4		C	658	526	439	376	329	292							
	19-AP-2	2.8		D	0.092	0.144	0.207	0.282	0.369	0.467							
1-1/4" x 3/16"	19-SR-4	3.1	0.493	U	987	632	439	322	247	195	158						
	19-SR-2	3.3		D	0.115	0.180	0.259	0.353	0.461	0.583	0.720						
	19-AP-4	3.5		C	987	789	658	564	493	439	395						
	19-AP-2	4.2		D	0.092	0.144	0.207	0.282	0.369	0.467	0.576						
1-1/2" x 1/8"	19-SR-4	2.5	0.474	U	947	606	421	309	237	187	152						
	19-SR-2	2.7		D	0.096	0.150	0.216	0.294	0.384	0.486	0.600						
	19-AP-4	2.8		C	947	758	632	541	474	421	379						
	19-AP-2	3.2		D	0.077	0.120	0.173	0.235	0.307	0.389	0.480						
1-1/2" x 3/16"	19-SR-4	3.7	0.711	U	1421	909	632	464	355	281	227	188					
	19-SR-2	3.9		D	0.096	0.150	0.216	0.294	0.384	0.486	0.600	0.726					
	19-AP-4	4.1		C	1421	1137	947	812	711	632	568	517					
	19-AP-2	4.8		D	0.077	0.120	0.173	0.235	0.307	0.389	0.480	0.581					
1-3/4" x 3/16"	19-SR-4	4.2	0.967	U	1934	1238	860	632	484	382	309	256	215	183			
	19-SR-2	4.4		D	0.082	0.129	0.185	0.252	0.329	0.417	0.514	0.622	0.741	0.869			
	19-AP-4	4.7		C	1934	1547	1289	1105	967	860	774	703	645	595			
	19-AP-2	5.3		D	0.066	0.103	0.148	0.202	0.263	0.333	0.411	0.498	0.592	0.695			
2" x 3/16"	19-SR-4	4.8	1.263	U	2526	1617	1123	825	632	499	404	334	281	239	206		
	19-SR-2	5.0		D	0.072	0.113	0.162	0.221	0.288	0.365	0.450	0.545	0.648	0.761	0.882		
	19-AP-4	5.3		C	2526	2021	1684	1444	1263	1123	1011	919	842	777	722		
	19-AP-2	5.9		D	0.058	0.090	0.130	0.176	0.230	0.292	0.360	0.436	0.518	0.608	0.706		
2-1/4" x 3/16"	19-SR-4	5.4	1.599	U	3197	2046	1421	1044	799	632	512	423	355	303	261	200	
	19-SR-2	5.6		D	0.064	0.100	0.144	0.196	0.256	0.324	0.400	0.484	0.576	0.676	0.784	1.024	
	19-AP-4	5.8		C	3197	2558	2132	1827	1599	1421	1279	1163	1066	984	914	799	
	19-AP-2	6.5		D	0.051	0.080	0.115	0.157	0.205	0.259	0.320	0.387	0.461	0.541	0.627	0.819	
2-1/2" x 3/16"	19-SR-4	5.9	1.974	U	3947	2526	1754	1289	987	780	632	522	439	374	322	247	195
	19-SR-2	6.1		D	0.058	0.090	0.130	0.176	0.230	0.292	0.360	0.436	0.518	0.608	0.706	0.922	1.166
	19-AP-4	6.4		C	3947	3158	2632	2256	1974	1754	1579	1435	1316	1215	1128	987	877
	19-AP-2	7.1		D	0.046	0.072	0.104	0.141	0.184	0.233	0.288	0.348	0.415	0.487	0.564	0.737	0.933

U = safe uniform load, psf (page 93)
C = safe concentrated load, psf (page 93)
D = deflection, inches
E = modulus of elasticity, 10,000,000 psi
F = fiber stress, 12,000 psi

Material: ASTM B-221, 6063 or 6061

Deflection: Spans and loads to the right of the bold line exceed 1/4" deflection for uniform load of 100 psf which provides safe pedestrian comfort. These can be exceeded for other types of loads with engineer's approval.

Serrated Bars: For serrated grating, the depth of grating required for a specified load is 1/4" deeper than that shown in the table.

General: Loads and deflections are theoretical and based on static loading.

Finish: Mill finish unless otherwise specified.

FALCON MARKETPLACE
15-FT Head x 62.4 = 936 psf

SR/AP-19 PANEL WIDTH (inches)

Note: Includes 1/4" (1/8" each side) for extended cross rods on swage-locked (SR) and extended cross bars on press-locked (AP).

No. of Bars	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1/8" Bar	1 9/16	2 3/4	3 15/16	5 1/8	6 5/16	7 1/2	8 11/16	9 7/8	11 1/16	12 1/4	13 7/16	14 5/8	15 13/16	17	18 3/16
3/16" Bar	1 5/8	2 13/16	4	5 3/16	6 3/8	7 9/16	8 3/4	9 15/16	11 1/8	12 5/16	13 1/2	14 11/16	15 7/8	17 1/16	18 1/4
No. of Bars	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**
1/8" Bar	19 3/8	20 9/16	21 3/4	22 15/16	24 1/8	25 5/16	26 1/2	27 11/16	28 7/8	30 1/16	31 1/4	32 7/16	33 5/8	34 13/16	36
3/16" Bar	19 7/16	20 5/8	21 13/16	23	24 3/16	25 3/8	26 9/16	27 3/4	28 15/16	30 1/8	31 5/16	32 1/2	33 11/16	34 7/8	36 1/16

Flow depths entering Pond SR4

CLOMR

Min Ch El	6895.98	
WS Elev	6898.75	
Max flow depth (north)	***2.8***	ft

NORTHWEST SWALE

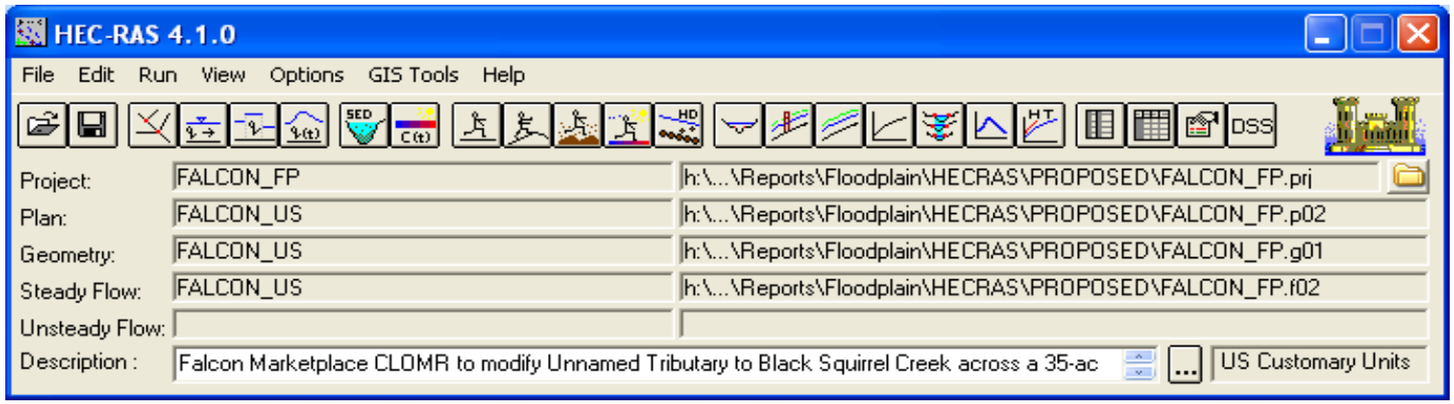
Assuming trapezoidal channelized flow at riprap entry

Q100	30.2	cfs
Width	8	ft
Side Slopes	5	:1
Slope	1.6	%
n	0.020	

Calculated flow depth	***0.5***	ft

Project: Falcon Marketplace
Project No.: 20988-00

HEC-RAS Data Output
Proposed Conditions Model, North (Drexel Barrell Model)
File: H:\20988-00CSCV\Reports\Floodplain\HECRAS\PROPOSED\FALCON_FP.prj
Plan: FALCON_US



Date: 10/17/16
100-year Output, Standard Tabel 1
Cross Sections: 2926-2842

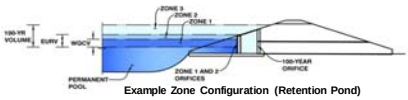
Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
FALCON_US	2926	100-YR	1016	6895.98	6898.75	6898.75	6899.12	0.025538	6.71	306.22	403.31	0.91
FALCON_US	2842	100-YR	1016	6888.58	6897	6889.37	6897	0.000001	0.15	6775.42	897.89	0.01

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: FALCON MARKETPLACE

Basin ID: POND 2



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	**EDB**			
Watershed Area =	27.80	acres		
Watershed Length =	1,500	ft		
Watershed Slope =	0.020	ft/ft		
Watershed Imperviousness =	86.80%	percent		
Percentage Hydrologic Soil Group A =	100.0%	percent		
Percentage Hydrologic Soil Group B =	0.0%	percent		
Percentage Hydrologic Soil Groups C/D =	0.0%	percent		
Desired WQCV Drain Time =	40.0	hours		
Location for 1-hr Rainfall Depths =	User Input			
Water Quality Capture Volume (WQCV) =	0.870	acre-feet	Optional User Override 1-hr Precipitation	
Excess Urban Runoff Volume (EURV) =	3.247	acre-feet		
2-yr Runoff Volume (P1 = 0.95 in.) =	1.799	acre-feet	0.95	inches
5-yr Runoff Volume (P1 = 1.22 in.) =	2.375	acre-feet	1.22	inches
10-yr Runoff Volume (P1 = 1.48 in.) =	2.968	acre-feet	1.48	inches
25-yr Runoff Volume (P1 = 1.86 in.) =	3.832	acre-feet	1.86	inches
50-yr Runoff Volume (P1 = 2.19 in.) =	4.561	acre-feet	2.19	inches
100-yr Runoff Volume (P1 = 2.54 in.) =	5.426	acre-feet	2.54	inches
500-yr Runoff Volume (P1 = 3.46 in.) =	7.652	acre-feet	3.46	inches
Approximate 2-yr Detention Volume =	1.708	acre-feet		
Approximate 5-yr Detention Volume =	2.258	acre-feet		
Approximate 10-yr Detention Volume =	2.792	acre-feet		
Approximate 25-yr Detention Volume =	3.627	acre-feet		
Approximate 50-yr Detention Volume =	4.136	acre-feet		
Approximate 100-yr Detention Volume =	4.593	acre-feet		

Stage-Storage Calculation

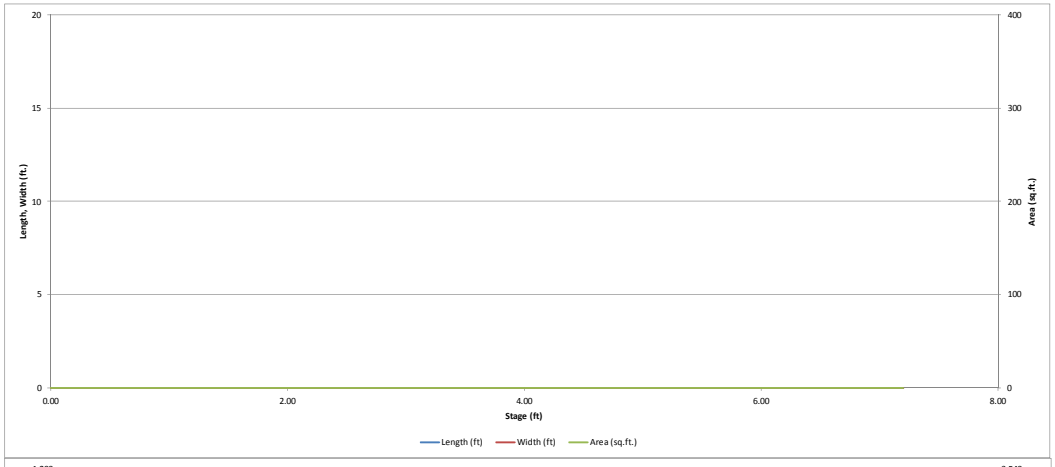
Zone 1 Volume (WQCV) =	0.870	acre-feet	
Zone 2 Volume (User Defined - Zone 1) =	0.400	acre-feet	**Total detention volume is less than 100-year volume.**
Select Zone 3 Storage Volume (Optional) =		acre-feet	
Total Detention Basin Volume =	1.270	acre-feet	
Initial Surcharge Volume (ISV) =	user	ft^3	
Initial Surcharge Depth (ISD) =	user	ft	
Total Available Detention Depth (H_{total}) =	user	ft	
Depth of Trickle Channel (H_{TC}) =	user	ft	
Slope of Trickle Channel (S_{TC}) =	user	ft/ft	
Slopes of Main Basin Sides (S_{main}) =	user	H:V	
Basin Length-to-Width Ratio ($R_{L/W}$) =	user		
Initial Surcharge Area (A_{ISV}) =	user	ft^2	
Surcharge Volume Length (L_{ISV}) =	user	ft	
Surcharge Volume Width (W_{ISV}) =	user	ft	
Depth of Basin Floor (H_{FLOOR}) =	user	ft	
Length of Basin Floor (L_{FLOOR}) =	user	ft	
Width of Basin Floor (W_{FLOOR}) =	user	ft	
Area of Basin Floor (A_{FLOOR}) =	user	ft^2	
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3	
Depth of Main Basin (H_{MAIN}) =	user	ft	
Length of Main Basin (L_{MAIN}) =	user	ft	
Width of Main Basin (W_{MAIN}) =	user	ft	
Area of Main Basin (A_{MAIN}) =	user	ft^2	
Volume of Main Basin (V_{MAIN}) =	user	ft^3	
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet	

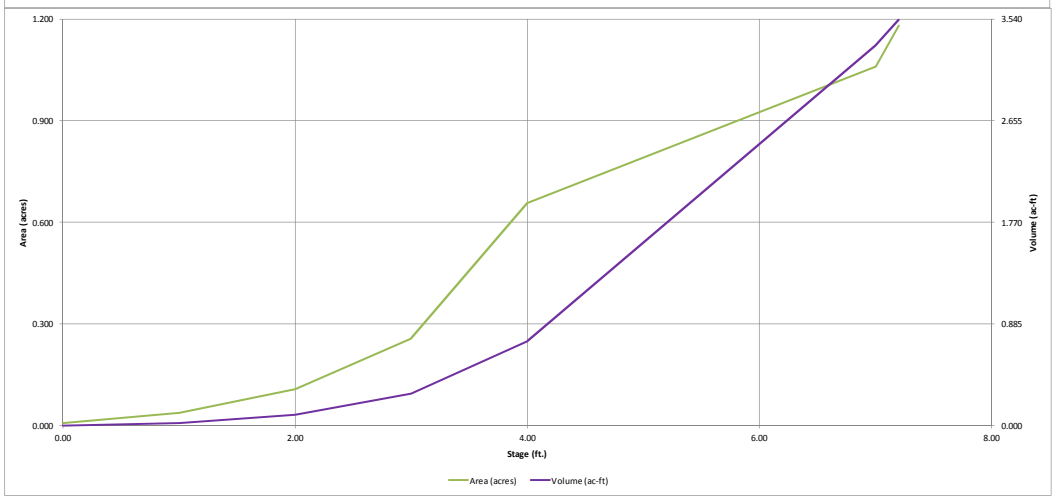
Depth Increment = ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	300	0.007		
6873	--	1.00	--	--	--	1,659	0.038	963	0.022
6874	--	2.00	--	--	--	4,721	0.108	4,122	0.095
6875	--	3.00	--	--	--	11,225	0.258	12,142	0.279
6876	--	4.00	--	--	--	28,592	0.656	32,051	0.736
6879	--	7.00	--	--	--	46,125	1.059	144,126	3.309
6879.2	--	7.20	--	--	--	51,425	1.181	153,881	3.533

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)



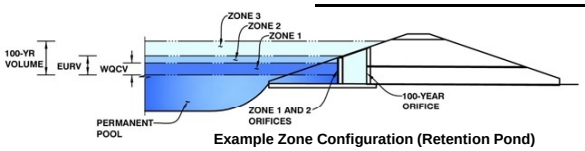


Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: FALCON MARKETPLACE

Basin ID: POND 2



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	4.21	0.870	Orifice Plate
Zone 2 (User)	4.76	0.400	Weir&Pipe (Circular)
Zone 3			
		1.270	Total

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

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

Calculated Parameters for Underdrain

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

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	4.21	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	14.70	inches
Orifice Plate: Orifice Area per Row =	N/A	inches

Calculated Parameters for Plate

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

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.40	2.81					
Orifice Area (sq. inches)	2.46	2.46	2.00					

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

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice

	Not Selected	Not Selected	
Vertical Orifice Area =			ft^2
Vertical Orifice Centroid =			feet

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

	Zone 2 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	4.21		ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	6.00		feet
Overflow Weir Slope =	0.00		H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	6.00		feet
Overflow Grate Open Area % =	70%		%, grate open area/total area
Debris Clogging % =	50%		%

Calculated Parameters for Overflow Weir

	Zone 2 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	4.21		feet
Over Flow Weir Slope Length =	6.00		feet
Grate Open Area / 100-yr Orifice Area =	5.13		should be $\geq$ 4
Overflow Grate Open Area w/o Debris =	25.20		ft^2
Overflow Grate Open Area w/ Debris =	12.60		ft^2

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

	Zone 2 Circular	Not Selected	
Depth to Invert of Outlet Pipe =	0.00		ft (distance below basin bottom at Stage = 0 ft)
Circular Orifice Diameter =	30.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 2 Circular	Not Selected	
Outlet Orifice Area =	4.91		ft^2
Outlet Orifice Centroid =	1.25		feet
Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	5.80	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	120.00	feet
Spillway End Slopes =	5.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

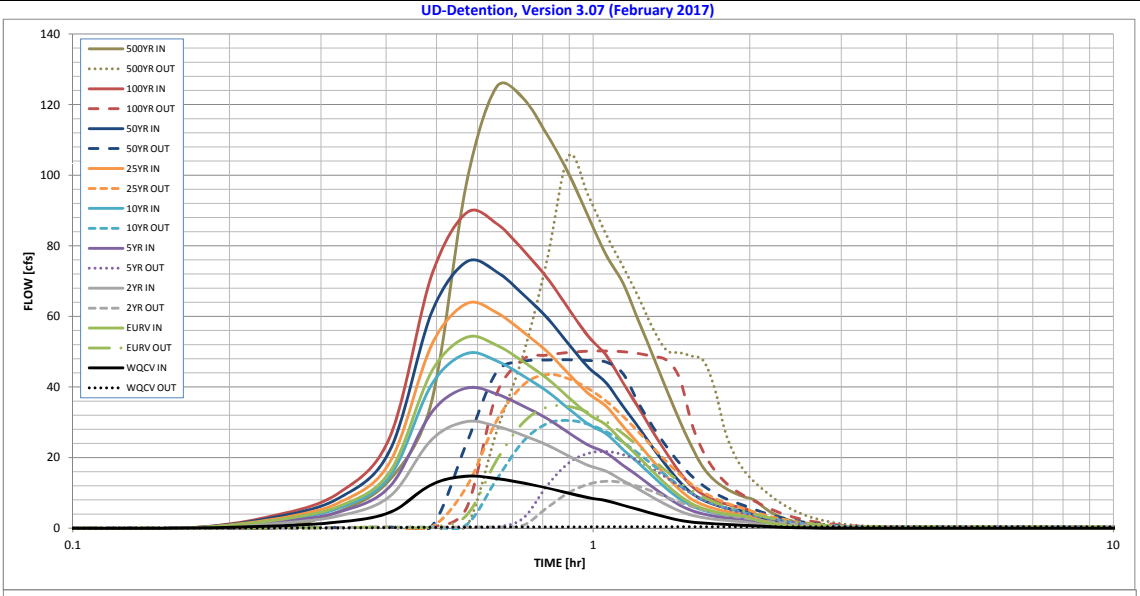
Spillway Design Flow Depth=	0.39	feet
Stage at Top of Freeboard =	7.19	feet
Basin Area at Top of Freeboard =	1.17	acres

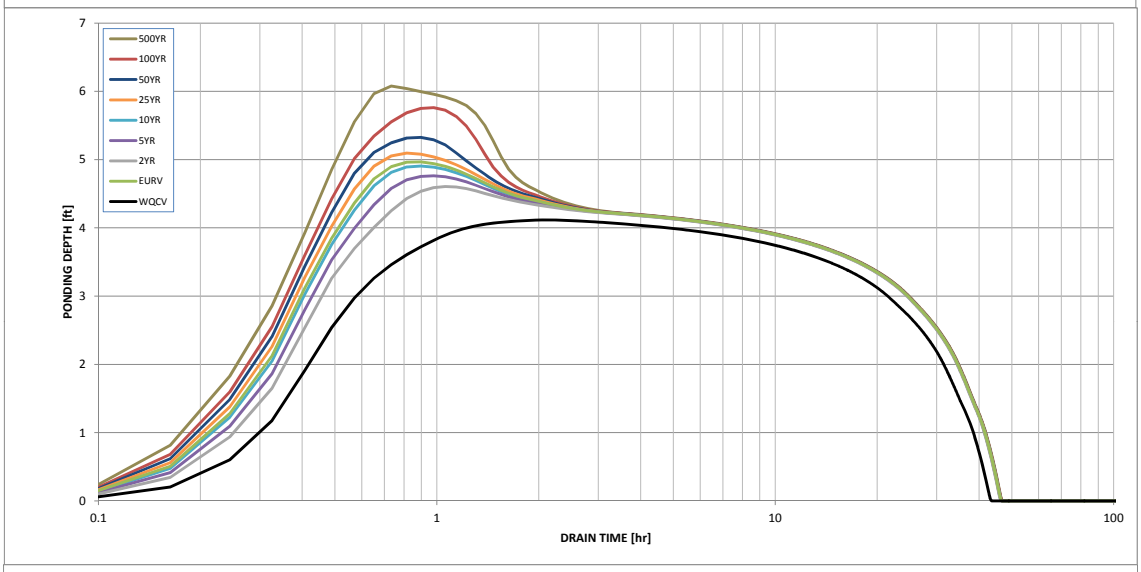
Routed Hydrograph Results

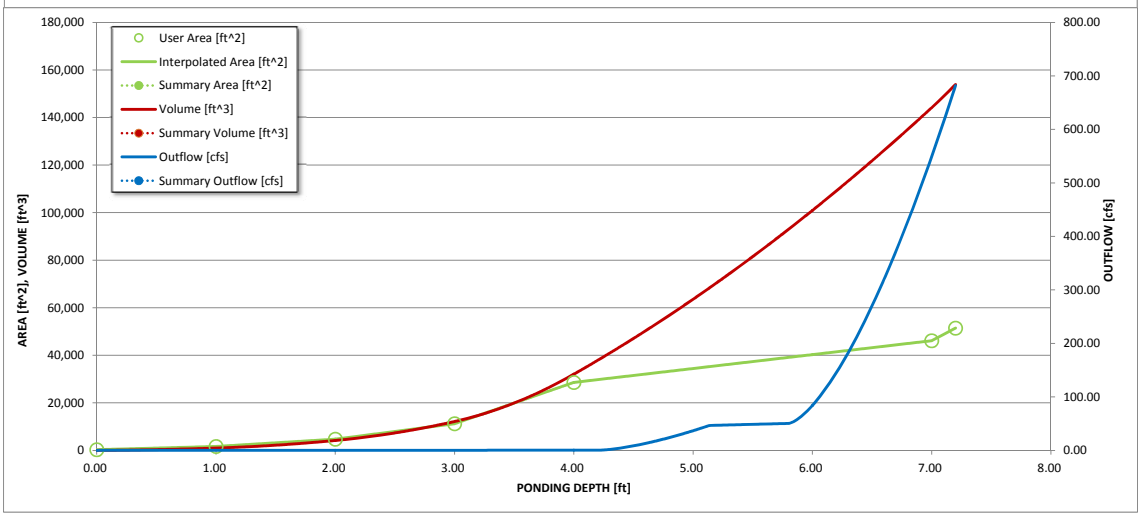
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	0.95	1.22	1.48	1.86	2.19	2.54	3.46
Calculated Runoff Volume (acre-ft) =	0.870	3.247	1.799	2.375	2.968	3.832	4.561	5.426	7.652
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.870	3.247	1.799	2.375	2.969	3.832	4.561	5.422	7.651
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.00	0.00	0.01	0.03	0.20	0.50	1.22
Predevelopment Peak Q (cfs) =	0.0	0.0	0.0	0.1	0.3	0.7	5.5	13.8	34.0
Peak Inflow Q (cfs) =	14.7	54.0	30.2	39.7	49.5	63.6	75.4	89.3	124.9
Peak Outflow Q (cfs) =	0.4	34.4	13.3	21.7	30.5	43.5	47.7	50.2	105.3
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	181.6	105.6	61.3	8.7	3.6	3.1
Structure Controlling Flow =	Plate	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Outlet Plate 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	1.36	0.52	0.8	1.2	1.7	1.9	2.0	2.0
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	35	38	36	35	33	32	31	27
Time to Drain 99% of Inflow Volume (hours) =	**41**	40	42	41	41	40	39	38	36
Maximum Ponding Depth (ft) =	4.12	4.97	4.61	4.76	4.91	5.09	5.33	5.76	6.08
Area at Maximum Ponding Depth (acres) =	0.67	0.79	0.74	0.76	0.78	0.80	0.83	0.89	0.93
Maximum Volume Stored (acre-ft) =	0.809	1.428	1.154	1.273	1.381	1.531	1.719	2.099	2.382

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.

	SOURCE	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK
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]
4.89 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:04:53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hydrograph	0:09:47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Constant	0:14:40	0.65	2.28	1.30	1.70	2.10	2.66	3.10	3.61	4.82
1.023	0:19:34	1.75	6.28	3.55	4.65	5.77	7.36	8.66	10.16	13.86
	0:24:27	4.50	16.14	9.12	11.93	14.80	18.89	22.23	26.08	35.61
	0:29:20	12.35	44.26	25.03	32.75	40.62	51.80	60.94	71.47	97.44
	0:34:14	14.72	54.02	30.18	39.70	49.45	63.59	75.41	89.32	124.94
	0:39:07	14.06	51.84	28.89	38.04	47.43	61.11	72.66	86.34	121.79
	0:44:01	12.80	47.18	26.29	34.62	43.17	55.63	66.23	78.80	111.52
	0:48:54	11.45	42.46	23.60	31.11	38.83	50.11	59.67	71.02	100.59
	0:53:47	9.91	37.07	20.50	27.09	33.88	43.81	52.23	62.25	88.39
	0:58:41	8.62	32.32	17.80	23.57	29.52	38.23	45.62	54.41	77.35
	1:03:34	7.82	29.22	16.15	21.35	26.70	34.53	41.15	49.01	69.48
	1:08:28	6.47	24.44	13.45	17.82	22.32	28.92	34.53	41.21	58.70
	1:13:21	5.30	20.22	11.09	14.71	18.46	23.95	28.62	34.19	48.79
	1:18:14	4.10	15.96	8.68	11.56	14.55	18.95	22.71	27.20	39.03
	1:23:08	3.07	12.28	6.60	8.84	11.18	14.62	17.57	21.09	30.39
	1:28:01	2.21	9.13	4.84	6.53	8.29	10.90	13.14	15.83	22.93
	1:32:55	1.71	6.87	3.68	4.94	6.25	8.19	9.84	11.82	17.02
	1:37:48	1.41	5.55	3.00	4.01	5.05	6.59	7.90	9.46	13.56
	1:42:41	1.19	4.67	2.54	3.38	4.26	5.55	6.65	7.95	11.37
	1:47:35	1.05	4.07	2.22	2.95	3.71	4.83	5.78	6.91	9.85
	1:52:28	0.94	3.65	1.99	2.65	3.33	4.32	5.17	6.17	8.79
	1:57:22	0.87	3.34	1.83	2.43	3.05	3.96	4.73	5.65	8.03
	2:02:15	0.64	2.48	1.35	1.80	2.26	2.95	3.53	4.24	6.10
	2:07:08	0.47	1.80	0.98	1.31	1.64	2.13	2.56	3.06	4.40
	2:12:02	0.34	1.33	0.72	0.96	1.21	1.58	1.89	2.27	3.26
	2:16:55	0.25	0.99	0.54	0.71	0.90	1.17	1.41	1.69	2.43
	2:21:49	0.18	0.72	0.39	0.52	0.66	0.86	1.03	1.24	1.79
	2:26:42	0.13	0.52	0.28	0.37	0.47	0.62	0.74	0.89	1.29
	2:31:35	0.09	0.37	0.20	0.27	0.34	0.45	0.54	0.65	0.94
	2:36:29	0.06	0.26	0.14	0.19	0.24	0.31	0.38	0.45	0.66
	2:41:22	0.04	0.17	0.09	0.12	0.15	0.20	0.24	0.30	0.44
	2:46:16	0.02	0.09	0.05	0.06	0.08	0.11	0.14	0.17	0.26
	2:51:09	0.01	0.04	0.02	0.03	0.04	0.05	0.06	0.08	0.12
	2:56:02	0.00	0.01	0.00	0.01	0.01	0.01	0.02	0.02	0.04
	3:00:56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:44:56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:49:50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:54:43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:59:37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:04:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:09:23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:14:17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:19:10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:24:04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:28:57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:33:50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:38:44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:43:37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:48:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:53:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:58:17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:03:11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:08:04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:12:58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:17:51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:22:44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:27:38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:32:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:37:25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:42:18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:47:11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:52:05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

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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]

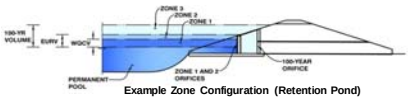
For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

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

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

Project: FALCON MARKETPLACE

Basin ID: POND #3



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	**EDB**			
Watershed Area =	5.31	acres		
Watershed Length =	1,000	ft		
Watershed Slope =	0.020	ft/ft		
Watershed Imperviousness =	48.20%	percent		
Percentage Hydrologic Soil Group A =	100.0%	percent		
Percentage Hydrologic Soil Group B =	0.0%	percent		
Percentage Hydrologic Soil Groups C/D =	0.0%	percent		
Desired WQCV Drain Time =	40.0	hours		
Location for 1-hr Rainfall Depths =	UDFCD Default			
Water Quality Capture Volume (WQCV) =	0.089	acre-feet	Optional User Override 1-hr Precipitation	
Excess Urban Runoff Volume (EURV) =	0.292	acre-feet		
2-yr Runoff Volume (P1 = 0.95 in.) =	0.148	acre-feet	0.95	inches
5-yr Runoff Volume (P1 = 1.22 in.) =	0.203	acre-feet	1.22	inches
10-yr Runoff Volume (P1 = 1.48 in.) =	0.274	acre-feet	1.48	inches
25-yr Runoff Volume (P1 = 1.86 in.) =	0.430	acre-feet	1.86	inches
50-yr Runoff Volume (P1 = 2.19 in.) =	0.542	acre-feet	2.19	inches
100-yr Runoff Volume (P1 = 2.54 in.) =	0.677	acre-feet	2.54	inches
500-yr Runoff Volume (P1 = 3.46 in.) =	1.026	acre-feet	3.46	inches
Approximate 2-yr Detention Volume =	0.141	acre-feet		
Approximate 5-yr Detention Volume =	0.193	acre-feet		
Approximate 10-yr Detention Volume =	0.261	acre-feet		
Approximate 25-yr Detention Volume =	0.331	acre-feet		
Approximate 50-yr Detention Volume =	0.379	acre-feet		
Approximate 100-yr Detention Volume =	0.463	acre-feet		

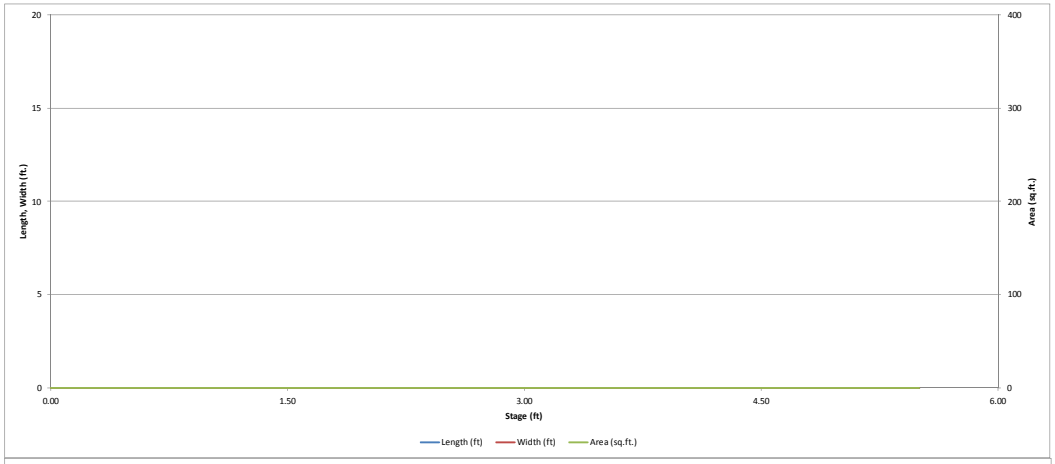
Stage-Storage Calculation

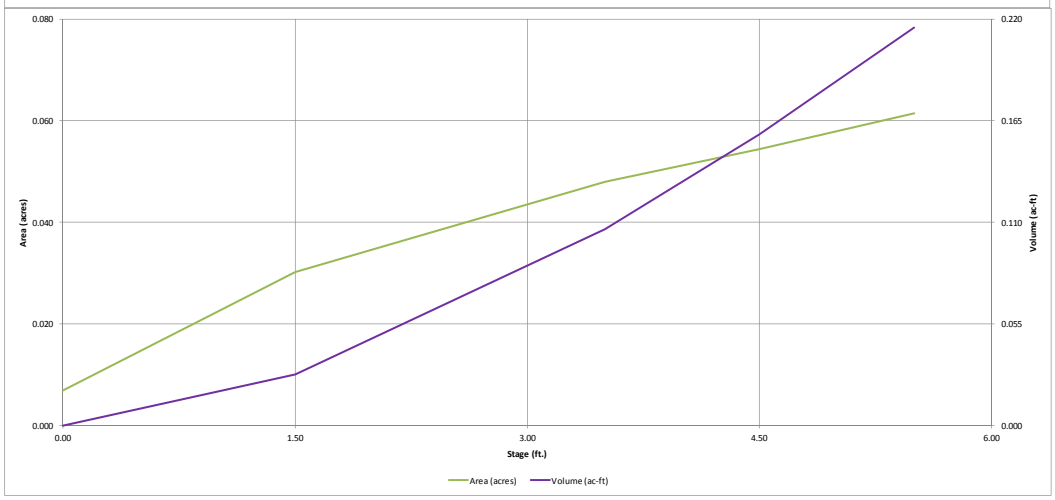
Zone 1 Volume (WQCV) =	0.089	acre-feet	
Zone 2 Volume (User Defined - Zone 1) =	0.126	acre-feet	**Total detention volume is less than 100-year volume.**
Select Zone 3 Storage Volume (Optional) =		acre-feet	
Total Detention Basin Volume =	0.215	acre-feet	
Initial Surcharge Volume (ISV) =	user	ft^3	
Initial 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)
Micropool	--	0.00	--	--	--	303	0.007		
6881	--	1.50	--	--	--	1,319	0.030	1,203	0.028
6883	--	3.50	--	--	--	2,092	0.048	4,627	0.106
6884	--	4.50	--	--	--	2,370	0.054	6,858	0.157
6885	--	5.50	--	--	--	2,675	0.061	9,381	0.215

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

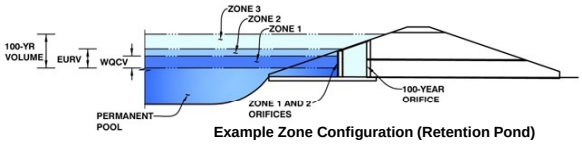




Detention Basin Outlet Structure Design

Project: FALCON MARKETPLACE

Basin ID: POND #3



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.14	0.089	Orifice Plate
Zone 2 (User)	5.50	0.126	Weir&Pipe (Restrict)
Zone 3			
		0.215	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 =	3.14	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	13.50	inches
Orifice Plate: Orifice Area per Row =	N/A	inches

Calculated Parameters for Plate

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

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.05	2.09					
Orifice Area (sq. inches)	0.45	0.40	0.30					

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

Calculated Parameters for Vertical Orifice

	Not Selected	Not Selected	
Vertical Orifice Area =			ft^2
Vertical Orifice Centroid =			feet

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

	Zone 2 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	3.38		ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	4.00		feet
Overflow Weir Slope =	0.00		H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	3.00		feet
Overflow Grate Open Area % =	70%		%, grate open area/total area
Debris Clogging % =	50%		%

Calculated Parameters for Overflow Weir

	Zone 2 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	3.38		feet
Over Flow Weir Slope Length =	3.00		feet
Grate Open Area / 100-yr Orifice Area =	5.35		should be $\geq$ 4
Overflow Grate Open Area w/o Debris =	8.40		ft^2
Overflow Grate Open Area w/ Debris =	4.20		ft^2

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

	Zone 2 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.00		ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	24.00		inches
Restrictor Plate Height Above Pipe Invert =	12.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 2 Restrictor	Not Selected	
Outlet Orifice Area =	1.57		ft^2
Outlet Orifice Centroid =	0.58		feet
Half-Central Angle of Restrictor Plate on Pipe =	1.57	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

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

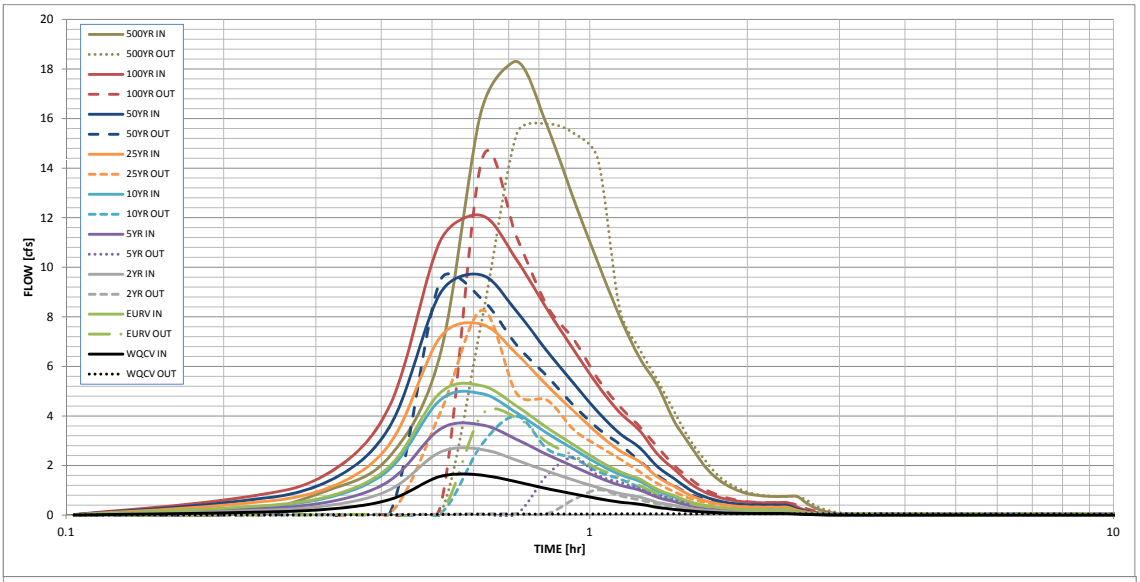
Calculated Parameters for Spillway

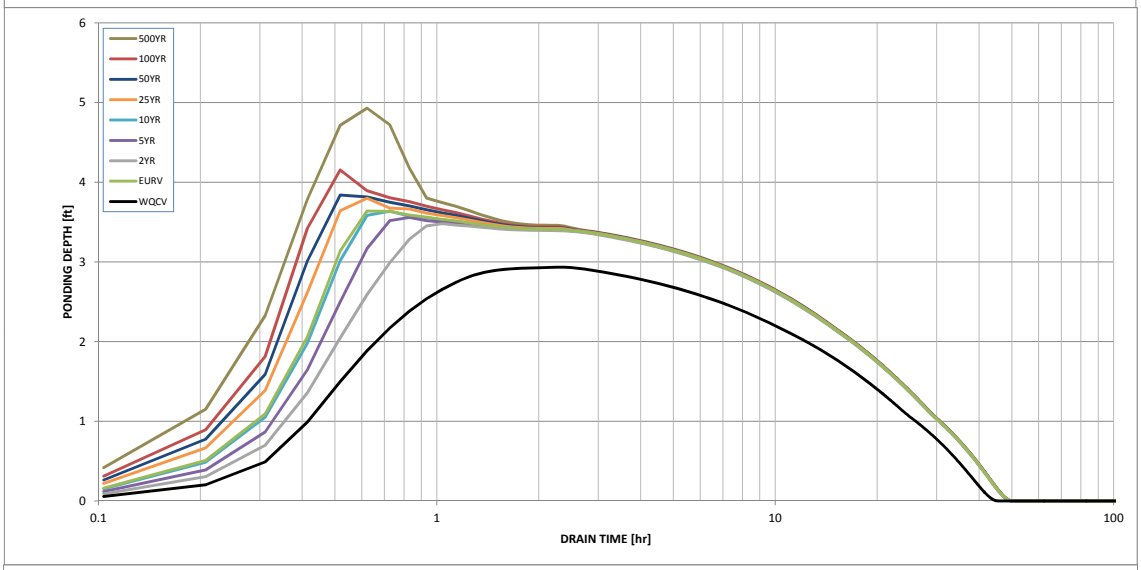
Spillway Design Flow Depth=		feet
Stage at Top of Freeboard =		feet
Basin Area at Top of Freeboard =		acres

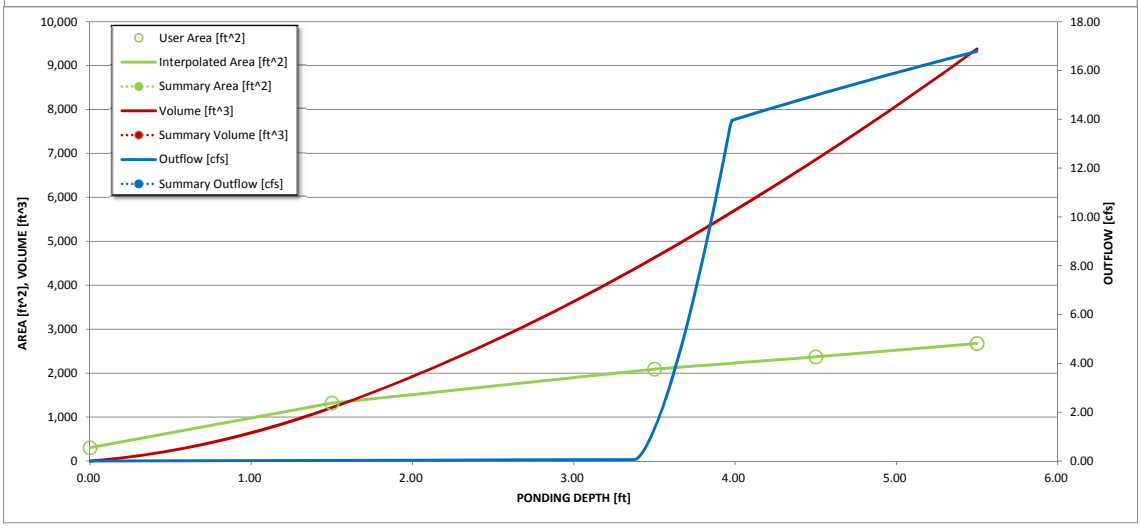
Routed Hydrograph Results

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	0.95	1.22	1.48	1.86	2.19	2.54	3.46
Calculated Runoff Volume (acre-ft) =	0.089	0.292	0.148	0.203	0.274	0.430	0.542	0.677	1.026
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.089	0.291	0.147	0.202	0.273	0.429	0.541	0.676	1.025
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.00	0.01	0.01	0.16	0.33	0.54	0.99
Predevelopment Peak Q (cfs) =	0.0	0.0	0.0	0.0	0.1	0.8	1.7	2.8	5.3
Peak Inflow Q (cfs) =	1.6	5.2	2.6	3.6	4.9	7.7	9.7	12.1	18.3
Peak Outflow Q (cfs) =	0.1	4.0	1.0	2.3	4.0	8.3	9.5	14.3	15.8
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	54.9	56.7	9.9	5.5	5.0	3.0
Structure Controlling Flow =	Plate	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Outlet Plate 1	Outlet Plate 1
Max Velocity through Grate 1 (fps) =	N/A	0.48	0.11	0.3	0.5	1.0	1.1	1.7	1.9
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	36	40	39	36	32	30	27	22
Time to Drain 99% of Inflow Volume (hours) =	**42**	43	45	44	43	41	39	38	35
Maximum Ponding Depth (ft) =	2.93	3.64	3.48	3.56	3.64	3.80	3.84	4.15	4.93
Area at Maximum Ponding Depth (acres) =	0.04	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.06
Maximum Volume Stored (acre-ft) =	0.080	0.113	0.105	0.109	0.113	0.120	0.122	0.139	0.181

Detention Basin Outlet Structure Design







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

Detention Basin Outlet Structure Design

Outflow Hydrograph Workbook Filename: _____

Storm Inflow Hydrographs

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

	SOURCE	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK
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]
6.22 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:06:13	0.00	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.03
Hydrograph	0:12:26	0.10	0.30	0.15	0.21	0.28	0.43	0.53	0.65	0.95
Constant	0:18:40	0.22	0.71	0.37	0.50	0.67	1.03	1.29	1.59	2.36
0.803	0:24:53	0.62	1.97	1.02	1.38	1.85	2.86	3.56	4.39	6.49
	0:31:06	1.56	4.94	2.55	3.47	4.65	7.18	8.95	11.06	16.38
	0:37:19	1.61	5.22	2.65	3.64	4.90	7.70	9.69	12.09	18.30
	0:43:32	1.34	4.39	2.21	3.05	4.12	6.50	8.21	10.29	15.70
	0:49:46	1.06	3.52	1.77	2.44	3.30	5.22	6.61	8.30	12.72
	0:55:59	0.85	2.83	1.42	1.96	2.65	4.19	5.30	6.66	10.19
	1:02:12	0.66	2.21	1.11	1.53	2.08	3.29	4.16	5.23	8.02
	1:08:25	0.52	1.75	0.87	1.21	1.64	2.60	3.30	4.15	6.36
	1:14:38	0.44	1.46	0.73	1.01	1.37	2.16	2.73	3.42	5.22
	1:20:52	0.31	1.03	0.52	0.71	0.97	1.54	1.95	2.45	3.77
	1:27:05	0.23	0.78	0.39	0.54	0.73	1.16	1.47	1.84	2.83
	1:33:18	0.16	0.53	0.27	0.37	0.50	0.80	1.01	1.28	1.97
	1:39:31	0.12	0.39	0.20	0.27	0.37	0.58	0.74	0.93	1.43
	1:45:44	0.09	0.30	0.15	0.21	0.29	0.45	0.57	0.72	1.11
	1:51:58	0.08	0.25	0.13	0.17	0.24	0.37	0.47	0.59	0.91
	1:58:11	0.07	0.23	0.11	0.16	0.21	0.33	0.42	0.53	0.80
	2:04:24	0.07	0.22	0.11	0.15	0.20	0.32	0.40	0.51	0.77
	2:10:37	0.07	0.21	0.11	0.15	0.20	0.31	0.40	0.50	0.75
	2:16:50	0.07	0.21	0.11	0.15	0.20	0.31	0.40	0.50	0.75
	2:23:04	0.07	0.21	0.11	0.15	0.20	0.31	0.40	0.50	0.75
	2:29:17	0.04	0.13	0.07	0.09	0.12	0.20	0.25	0.32	0.49
	2:35:30	0.02	0.08	0.04	0.05	0.07	0.12	0.15	0.19	0.29
	2:41:43	0.01	0.04	0.02	0.03	0.04	0.06	0.08	0.10	0.16
	2:47:56	0.01	0.02	0.01	0.02	0.02	0.04	0.05	0.06	0.09
	2:54:10	0.00	0.01	0.01	0.01	0.01	0.02	0.02	0.03	0.04
	3:00:23	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01
	3:06:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:12:49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:19:02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:31:29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:37:42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:43:55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:56:22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:02:35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:08:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:21:14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:27:28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:33:41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:39:54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:46:07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:52:20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:58:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:04:47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:11:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:17:13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:23:26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:29:40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:42:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:48:19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:54:32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:06:59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:13:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:19:25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:25:38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:31:52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:38:05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:44:18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:50:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:56:44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	7:02:58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	7:09:11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	7:15:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	7:21:37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	7:27:50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Detention Basin Outlet Structure Design

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.

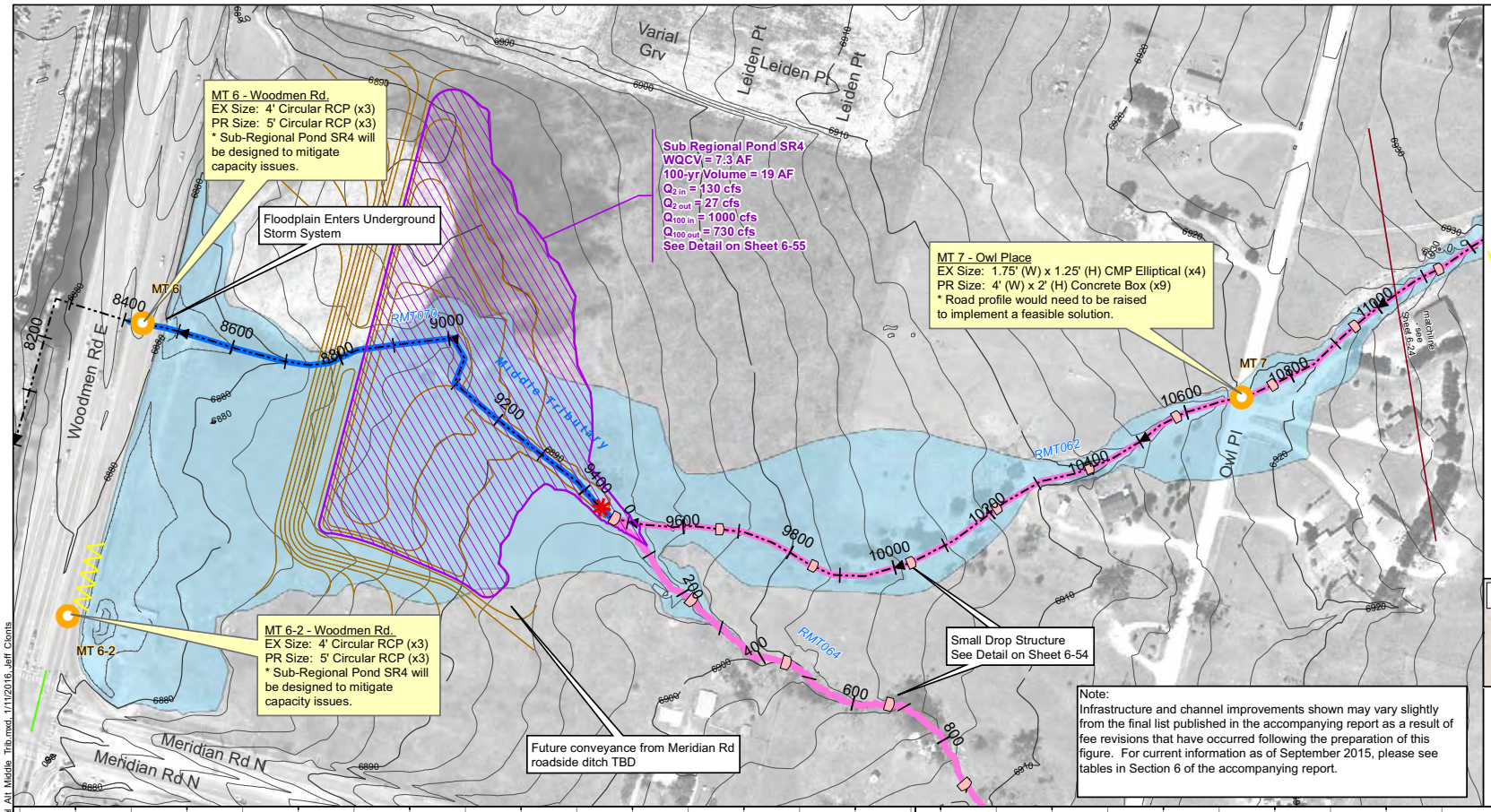
Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]

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).

Falcon DBPS Excerpts

Sheet 6-23
Falcon DBPS
Conceptual Plan
Middle Tributary
El Paso County, CO



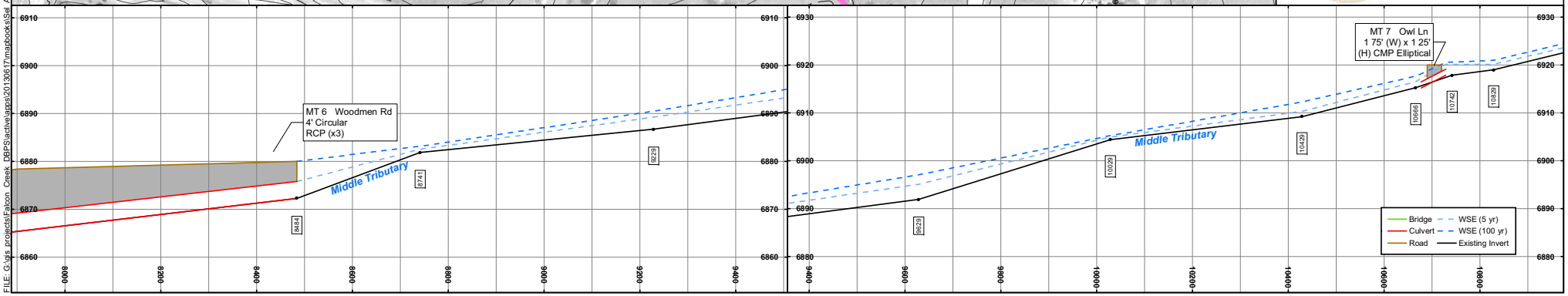
Drainageway Crossing
Stream Centerline
Existing Approximate 100-yr Floodplain*
Floodplain Study Limit

Storm Sewer
Inlet
Manhole
Pipe

Reach Improvements
Natural Channel Design
Protect In Place
Roadside Ditch Improvement
Small Drop Structures w/ Toe Protection
Existing Detention
Proposed Detention
Proposed Detention Grading
Small Drop Structure
Cross Vane
Immediate Action Required to Preserve Existing Condition

0 100 200 Feet

* These approximate 100 yr floodplain boundaries are for planning purposes only This information is not intended to replace the information provided on the FEMA Flood Insurance Rate Maps for this area
** These are conceptual design drawings and are subject to change These drawings are not intended for construction purposes



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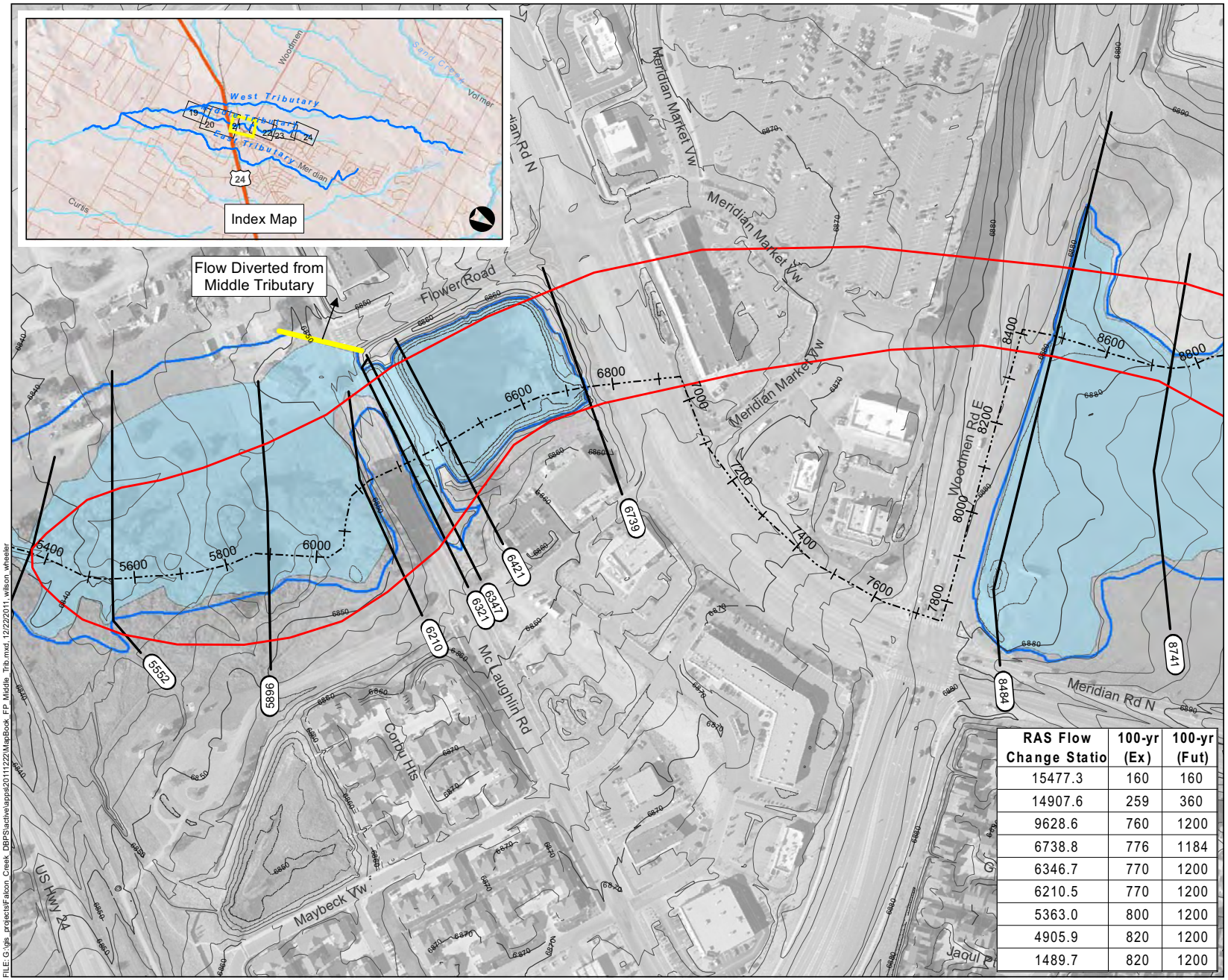


RAS Flow Change Statio	100-yr (Ex)	100-yr (Fut)
15477.3	160	160
14907.6	259	360
9628.6	760	1200
6738.8	776	1184
6346.7	770	1200
6210.5	770	1200
5363.0	800	1200
4905.9	820	1200
1489.7	820	1200

Sheet 4-21

Middle Tributary Floodplain
Falcon DBPS
El Paso County, CO

Legend

- Approximate 100-yr Floodplain Existing
- Approximate 100-yr Floodplain Existing (Based on Assumed Split Flow Condition)
- Approximate 100-yr Floodplain Future
- Approximate 100-yr Floodplain Future (Based on Assumed Split Flow Condition)
- Shallow Flooding
- HEC-RAS Centerline
- XSCutLines (Middle Trib)
- FEMA Regulatory Floodplain (Effective as of of 1999)*
- Study Limit

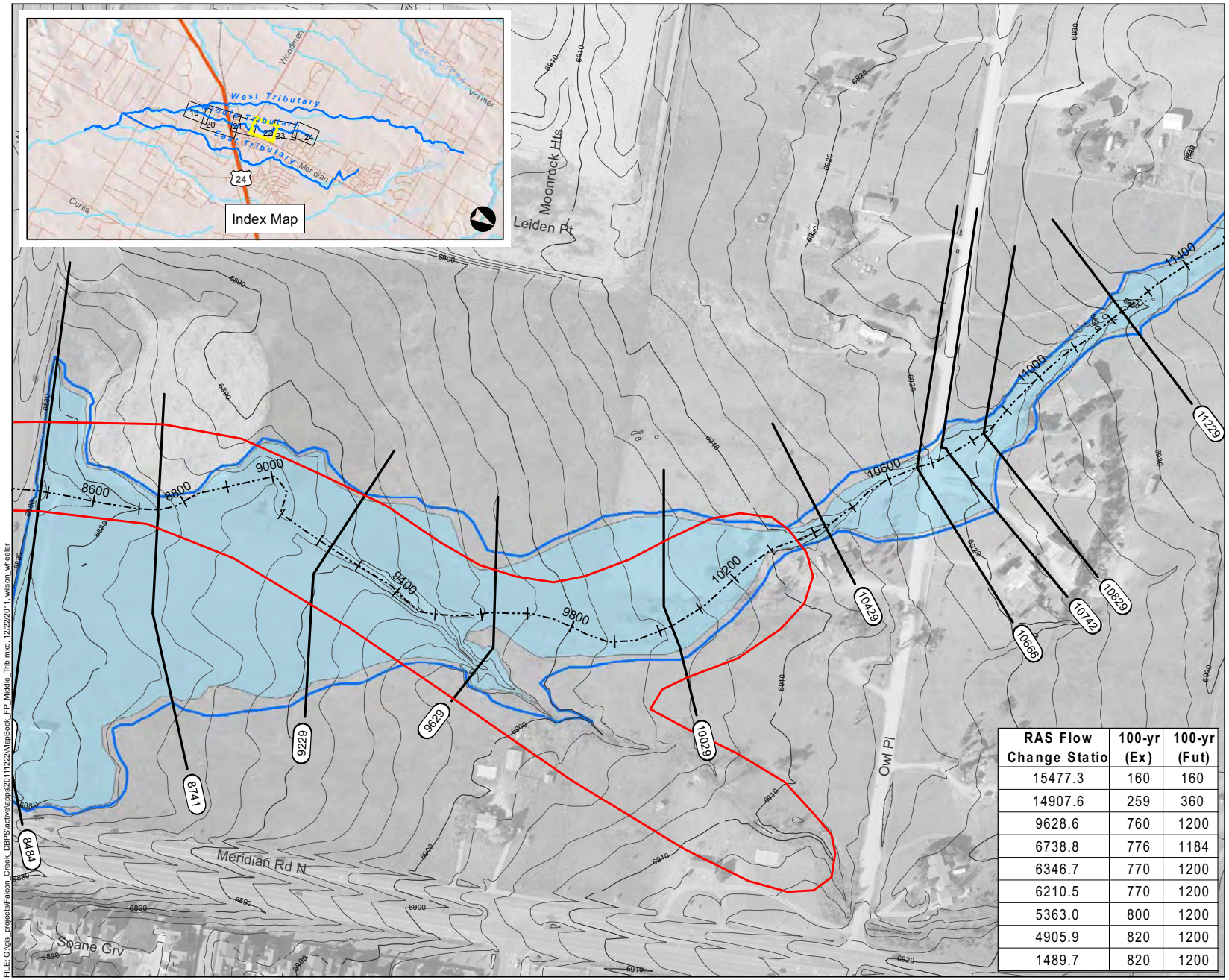
*Letters of Map Change completed after 1999 are not shown

N

0 100 200 400
Feet

Matrix DESIGN GROUP

FILE: G:\gis_projects\Falcon_Creek_DBPS\active\apps\20111222\MapBook_FP_Middle_Trib.mxd, 12/22/2011, wilson_wheeler



RAS Flow Change Statio	100-yr (Ex)	100-yr (Fut)
15477.3	160	160
14907.6	259	360
9628.6	760	1200
6738.8	776	1184
6346.7	770	1200
6210.5	770	1200
5363.0	800	1200
4905.9	820	1200
1489.7	820	1200

Sheet 4-22

Middle Tributary Floodplain
Falcon DBPS
El Paso County, CO

Legend

- Approximate 100-yr Floodplain Existing
- Approximate 100-yr Floodplain Existing (Based on Assumed Split Flow Condition)
- Approximate 100-yr Floodplain Future
- Approximate 100-yr Floodplain Future (Based on Assumed Split Flow Condition)
- Shallow Flooding
- HEC-RAS Centerline
- XSCutLines (Middle Trib)
- FEMA Regulatory Floodplain (Effective as of 1999)*
- Study Limit

*Letters of Map Change completed after 1999 are not shown

N

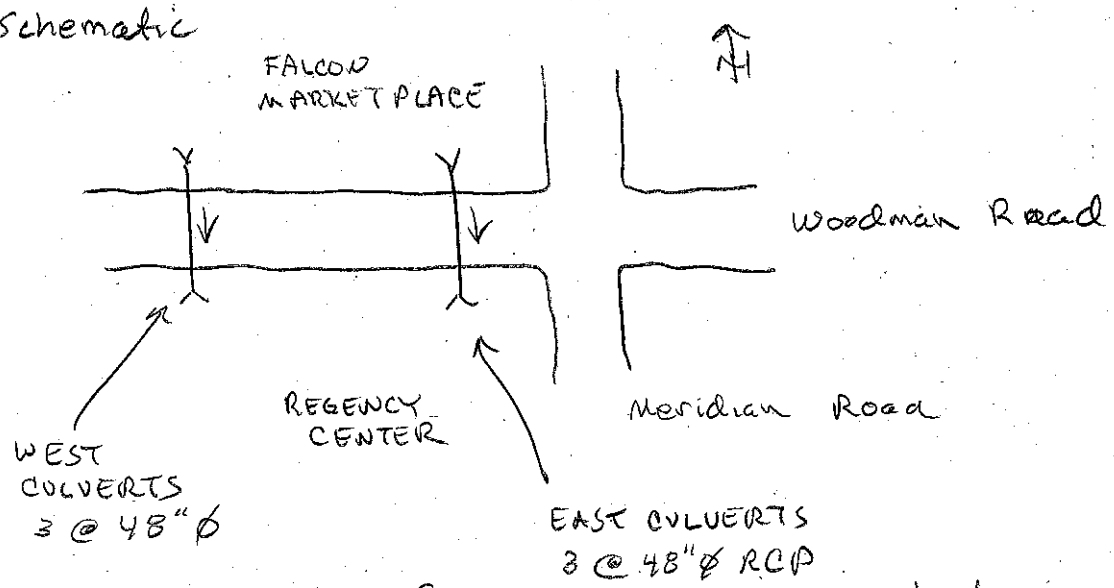
0 100 200 400
Feet

Matrix DESIGN GROUP

FILE: G:\gis_projects\Falcon_Creek_DBPS\active\apps\20111222\MapBook_FP_Middle_Trib.mxd, 12/22/2011, wilson_wheeler

CLOMR Excerpts

① Schematic



② Use FHWA HY-8 software to check culvert capacity

③ Model input based on 3 sources of information

a) project surveys by DBC for Falcon Marketplace
email 9/26/16

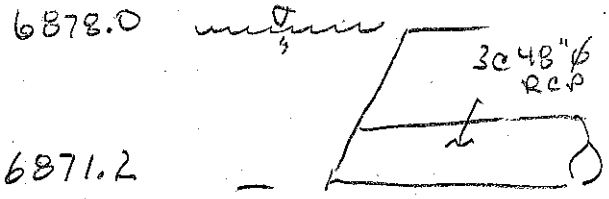
b) Design drawing from Regency Center
URS 8/24/04

c) Design drawing for culvert extension on north side of woodman
DMJM Harris/AECOM 9/11/2007

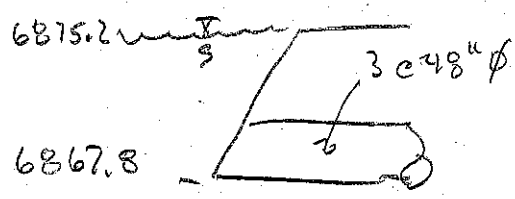
d) See HY8 model output files
file: HY-8-Woodman Culverts.hy8

e) Design flow rate varied until allowable headwater elevation reached. Allowable headwater elevation = to north edge of Woodman Road Asphalt.

f) west culvert:



EAST CULVERT:



g) The woodman Road culverts discharge to large 84" culvert & 8'x8' culvert on the Regency center property that are @ a significantly lower elevation.

than the invert of the 48"Ø pipes; therefore inlet control conditions are anticipate w/ no backwater from downstream

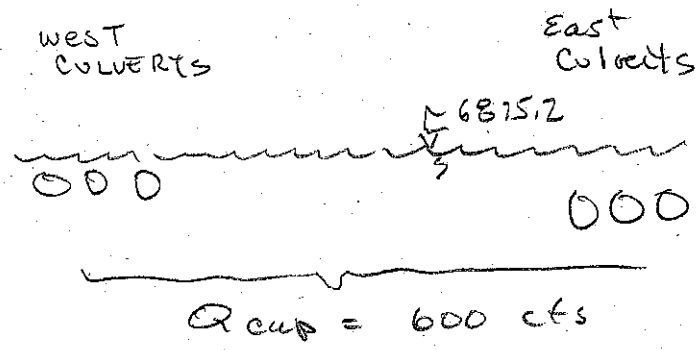
(4) See HY-8 output

a) West Culvert: Q_{cap} = 355 cfs w/ HW @ 6877.99 ≈ 6878

b) East Culvert: Q_{cap} = 405 cfs w/ HW @ 6875.12 ≈ 6875.2

c) Total Capacity 760 cfs

d) Also looked @ capacity of both culverts with the lower allowable headwater elevation



HY-8 Culvert Analysis Report

Project Notes

Project Title:

Designer:

Project Date: Wednesday, September 28, 2016

Notes:

Project Units: U.S. Customary Units

Outlet Control Option: Profiles

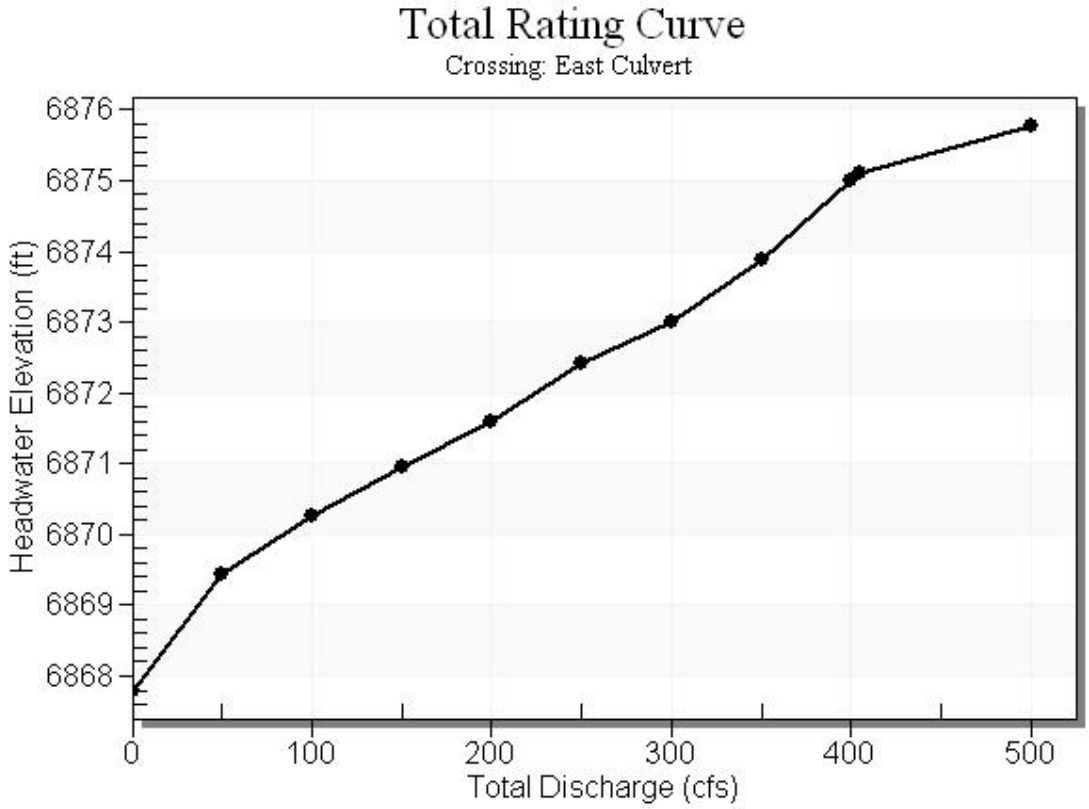
Exit Loss Option: Standard Method

Crossing Notes: East Culvert

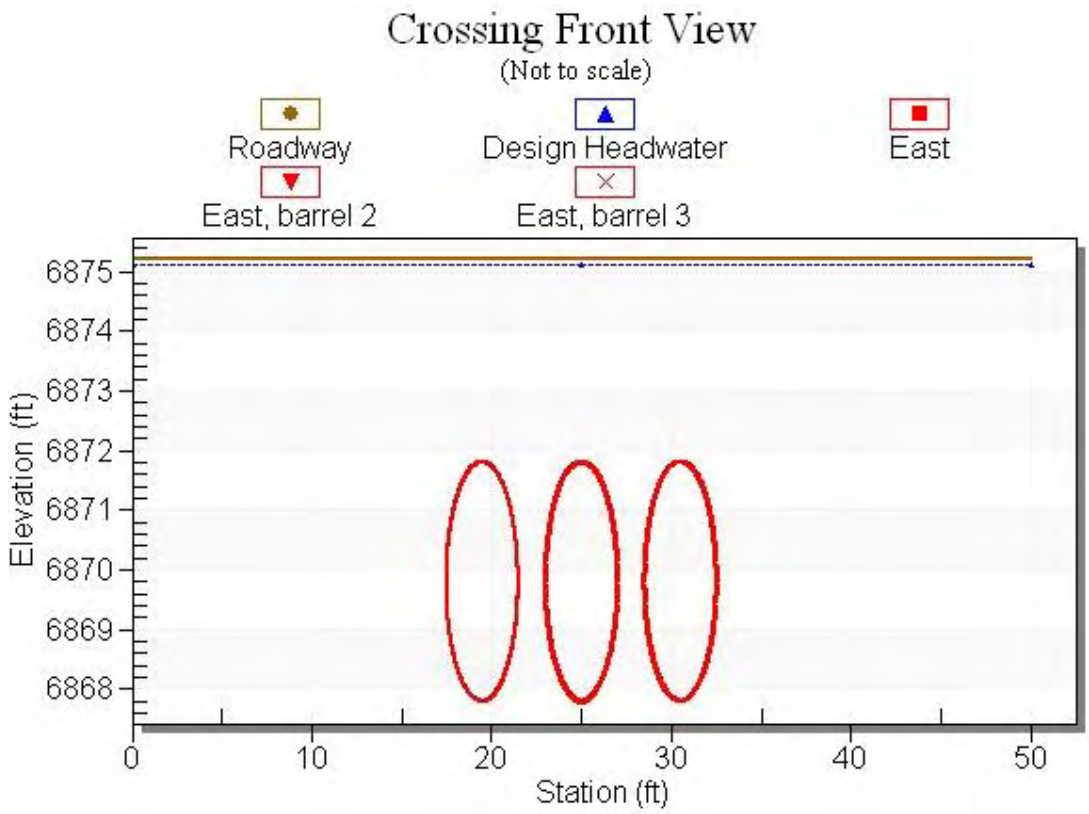
Table 1 - Summary of Culvert Flows at Crossing: East Culvert

Headwater Elevation (ft)	Total Discharge (cfs)	East Discharge (cfs)	Roadway Discharge (cfs)	Iterations
6867.80	0.00	0.00	0.00	1
6869.44	50.00	50.00	0.00	1
6870.26	100.00	100.00	0.00	1
6870.95	150.00	150.00	0.00	1
6871.58	200.00	200.00	0.00	1
6872.41	250.00	250.00	0.00	1
6873.01	300.00	300.00	0.00	1
6873.88	350.00	350.00	0.00	1
6875.00	400.00	400.00	0.00	1
6875.12	405.00	405.00	0.00	1
6875.78	500.00	432.38	67.60	5
6875.20	408.39	408.39	0.00	Overtopping

Rating Curve Plot for Crossing: East Culvert



Crossing Front View (Roadway Profile): East Culvert



Culvert Notes: East

Table 2 - Culvert Summary Table: East

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	6867.80	0.000	0.0*	0-NF	0.000	0.000	0.000	0.000	0.000	0.000
50.00	50.00	6869.44	1.645	0.0*	1-S2n	1.114	1.197	1.117	0.745	5.778	8.385
100.00	100.00	6870.26	2.457	0.0*	1-S2n	1.620	1.708	1.622	1.169	6.978	10.692
150.00	150.00	6870.95	3.153	0.0*	1-S2n	2.042	2.114	2.043	1.532	7.747	12.238
200.00	200.00	6871.58	3.785	0.0*	1-S2n	2.445	2.461	2.445	1.864	8.280	13.414
250.00	250.00	6872.41	4.445	4.610	2-M2c	2.874	2.763	2.766	2.175	8.989	14.366
300.00	300.00	6873.01	5.196	5.208	2-M2c	3.464	3.018	3.030	2.473	9.792	15.165
350.00	350.00	6873.88	6.077	6.001	2-M2c	4.000	3.246	3.258	2.760	10.663	15.852
400.00	400.00	6875.00	7.109	7.200	7-M2c	4.000	3.420	3.447	3.039	11.579	16.454
405.00	405.00	6875.12	7.221	7.318	7-M2c	4.000	3.437	3.464	3.066	11.676	16.509
500.00	432.38	6875.78	7.861	7.984	7-M2c	4.000	3.533	3.544	3.578	12.241	17.466

* theoretical depth is impractical. Depth reported is corrected.

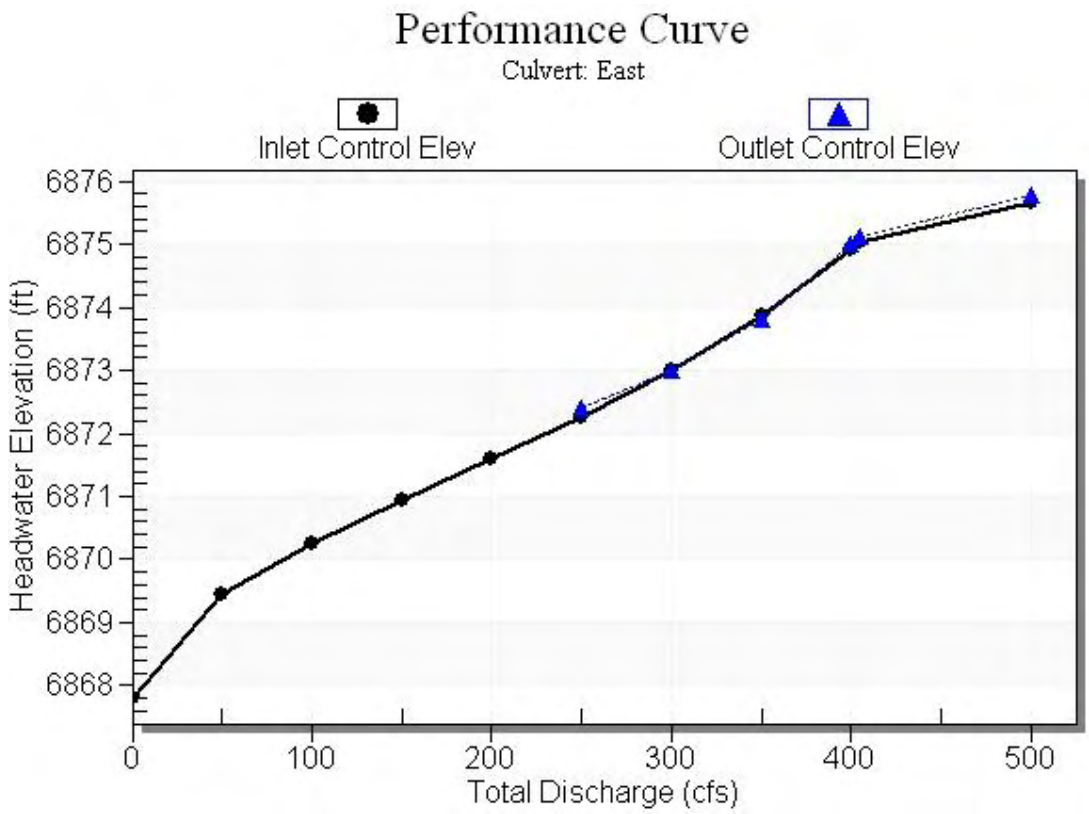
****

Inlet Elevation (invert): 6867.80 ft, Outlet Elevation (invert): 6866.90 ft

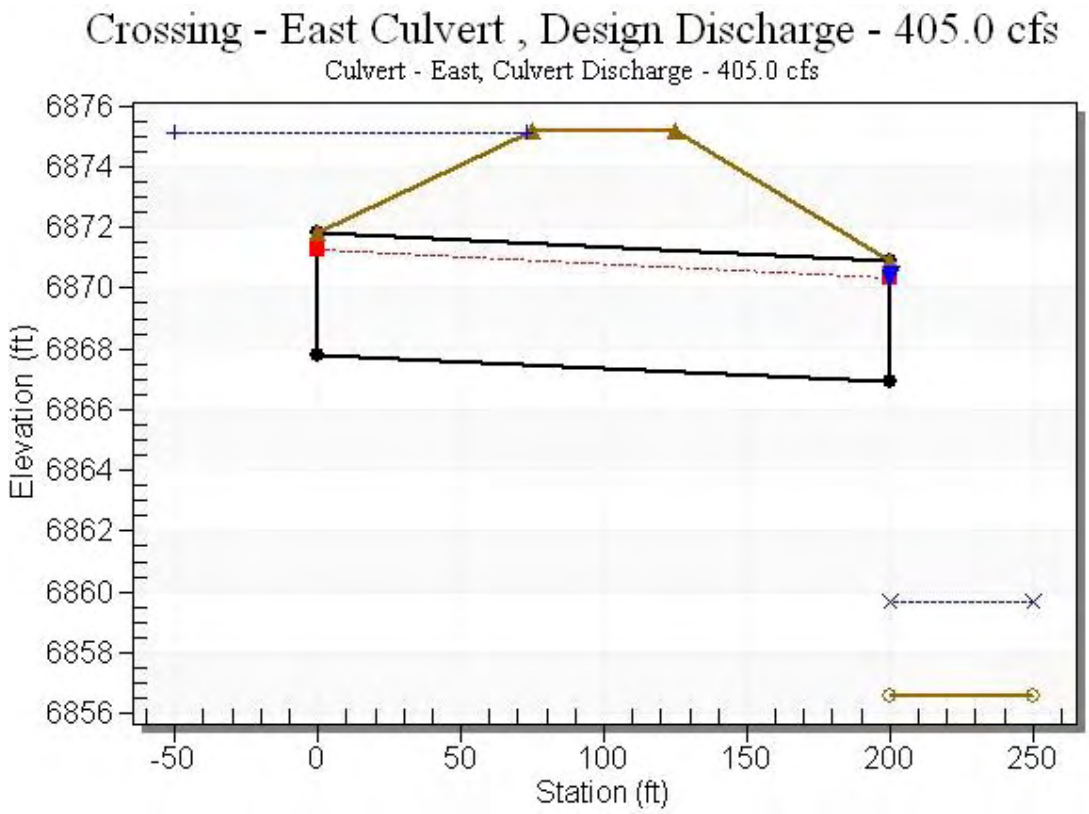
Culvert Length: 200.00 ft, Culvert Slope: 0.0045

****

Culvert Performance Curve Plot: East



Water Surface Profile Plot for Culvert: East



Site Data - East

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 6867.80 ft

Outlet Station: 200.00 ft

Outlet Elevation: 6866.90 ft

Number of Barrels: 3

Culvert Data Summary - East

Barrel Shape: Circular

Barrel Diameter: 4.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0130

Inlet Type: Conventional

Inlet Edge Condition: Square Edge with Headwall

Inlet Depression: NONE

Table 3 - Downstream Channel Rating Curve (Crossing: East Culvert)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
0.00	6856.60	0.00	0.00	0.00	0.00
50.00	6857.35	0.75	8.39	0.47	1.71
100.00	6857.77	1.17	10.69	0.73	1.74
150.00	6858.13	1.53	12.24	0.96	1.74
200.00	6858.46	1.86	13.41	1.16	1.73
250.00	6858.78	2.18	14.37	1.36	1.72
300.00	6859.07	2.47	15.17	1.54	1.70
350.00	6859.36	2.76	15.85	1.72	1.68
400.00	6859.64	3.04	16.45	1.90	1.66
405.00	6859.67	3.07	16.51	1.91	1.66
500.00	6860.18	3.58	17.47	2.23	1.63

Tailwater Channel Data - East Culvert

Tailwater Channel Option: Rectangular Channel

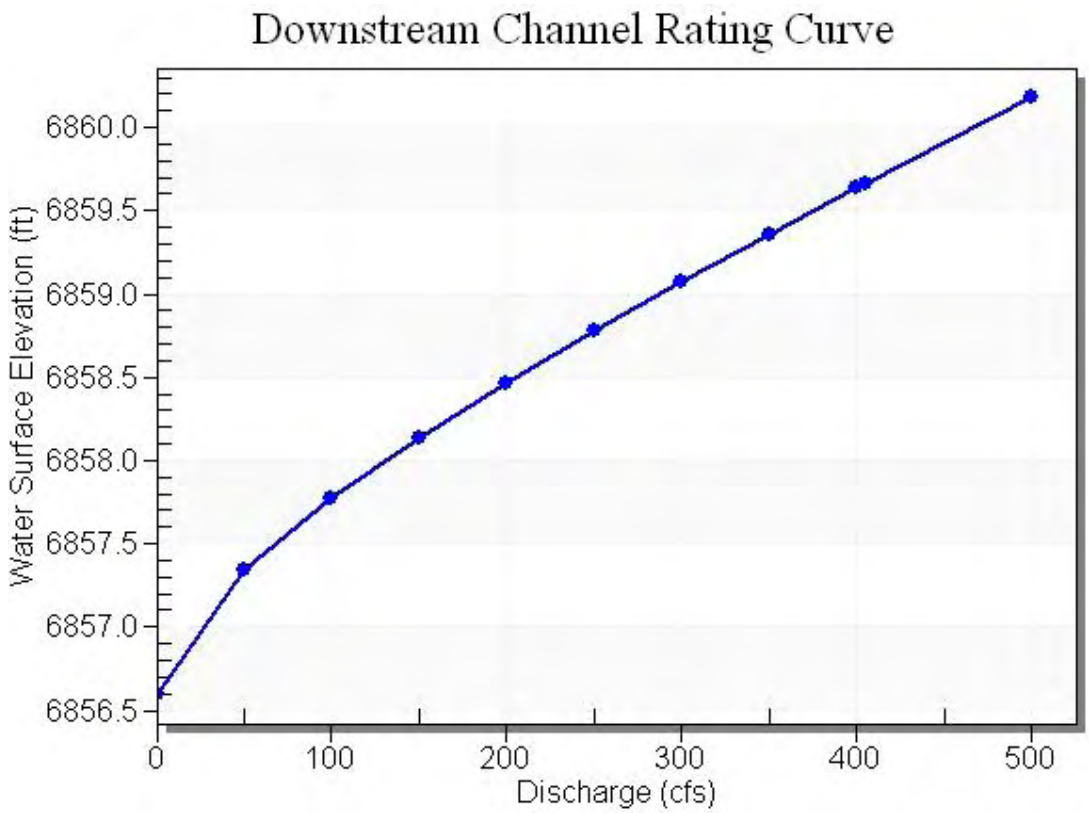
Bottom Width: 8.00 ft

Channel Slope: 0.0100

Channel Manning's n: 0.0130

Channel Invert Elevation: 6856.60 ft

Tailwater Rating Curve Plot for Crossing: East Culvert



Roadway Data for Crossing: East Culvert

Roadway Profile Shape: Irregular Roadway Shape (coordinates)

Irregular Roadway Cross-Section:

Coord No.	Station (ft)	Elevation (ft)
0	0.00	6875.20
1	25.00	6875.20
2	50.00	6875.20

Roadway Surface: Paved

Roadway Top Width: 50.00 ft

HY-8 Culvert Analysis Report

Project Notes

Project Title:

Designer:

Project Date: Wednesday, September 28, 2016

Notes:

Project Units: U.S. Customary Units

Outlet Control Option: Profiles

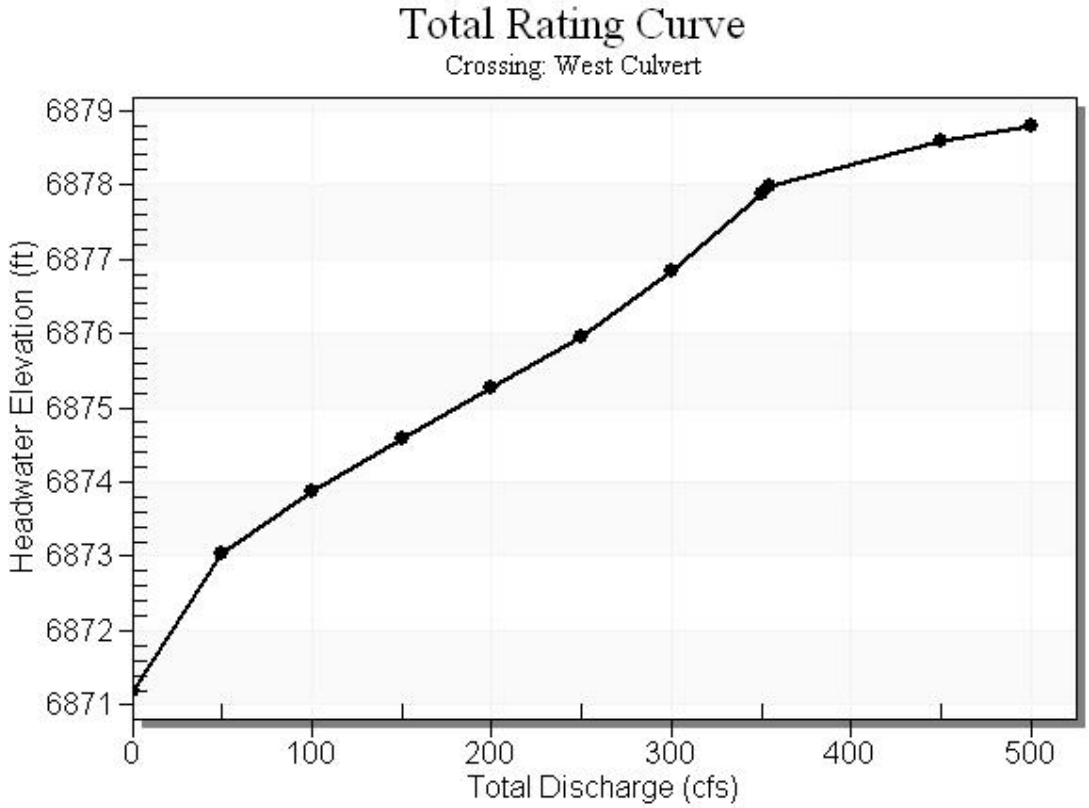
Exit Loss Option: Standard Method

Crossing Notes: West Culvert

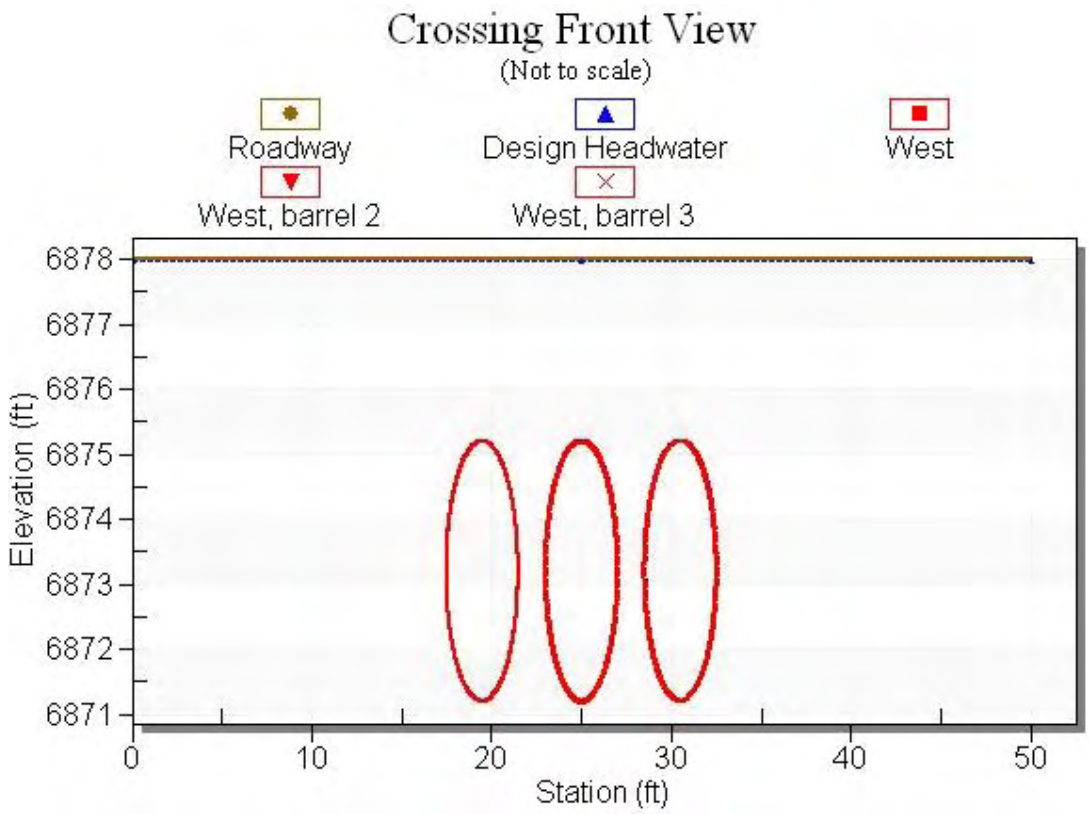
Table 1 - Summary of Culvert Flows at Crossing: West Culvert

Headwater Elevation (ft)	Total Discharge (cfs)	West Discharge (cfs)	Roadway Discharge (cfs)	Iterations
6871.20	0.00	0.00	0.00	1
6873.04	50.00	50.00	0.00	1
6873.88	100.00	100.00	0.00	1
6874.60	150.00	150.00	0.00	1
6875.27	200.00	200.00	0.00	1
6875.96	250.00	250.00	0.00	1
6876.84	300.00	300.00	0.00	1
6877.87	350.00	350.00	0.00	1
6877.99	355.00	355.00	0.00	1
6878.59	450.00	381.65	68.32	5
6878.80	500.00	390.91	108.90	4
6878.00	355.54	355.54	0.00	Overtopping

Rating Curve Plot for Crossing: West Culvert



Crossing Front View (Roadway Profile): West Culvert



Culvert Notes: West

Table 2 - Culvert Summary Table: West

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	6871.20	0.000	0.0*	0-NF	0.000	0.000	0.000	0.000	0.000	0.000
50.00	50.00	6873.04	1.649	1.836	2-M2c	1.492	1.197	1.197	0.821	5.273	8.705
100.00	100.00	6873.88	2.463	2.685	2-M2c	2.228	1.708	1.716	1.297	6.473	11.017
150.00	150.00	6874.60	3.159	3.396	2-M2c	2.970	2.114	2.121	1.709	7.390	12.536
200.00	200.00	6875.27	3.791	4.071	2-M2c	4.000	2.461	2.465	2.090	8.203	13.674
250.00	250.00	6875.96	4.451	4.755	2-M2c	4.000	2.763	2.766	2.449	8.989	14.582
300.00	300.00	6876.84	5.202	5.642	7-M2c	4.000	3.018	3.030	2.795	9.792	15.335
350.00	350.00	6877.87	6.083	6.665	7-M2c	4.000	3.246	3.258	3.130	10.646	15.976
355.00	355.00	6877.99	6.179	6.787	7-M2c	4.000	3.264	3.278	3.163	10.735	16.035
450.00	381.65	6878.59	6.718	7.388	7-M2c	4.000	3.356	3.380	3.777	11.230	17.019
500.00	390.91	6878.80	6.916	7.602	7-M2c	4.000	3.388	3.413	4.093	11.410	17.453

* theoretical depth is impractical. Depth reported is corrected.

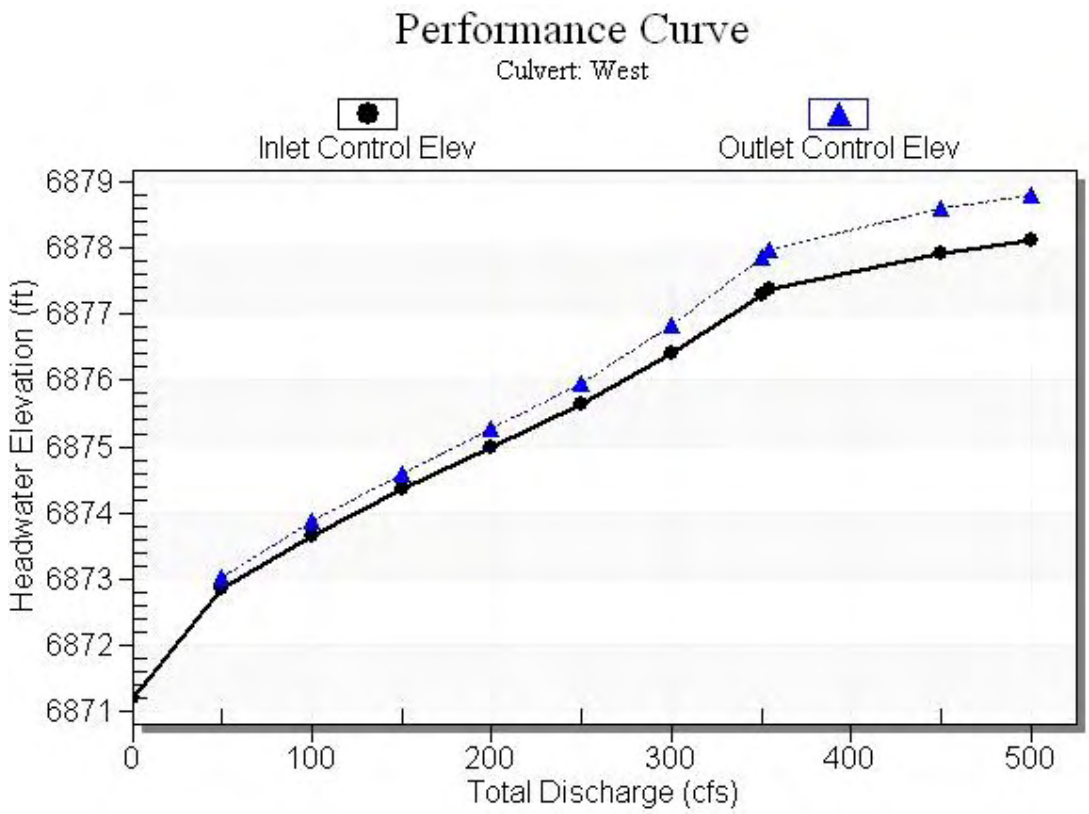
****

Inlet Elevation (invert): 6871.20 ft, Outlet Elevation (invert): 6870.90 ft

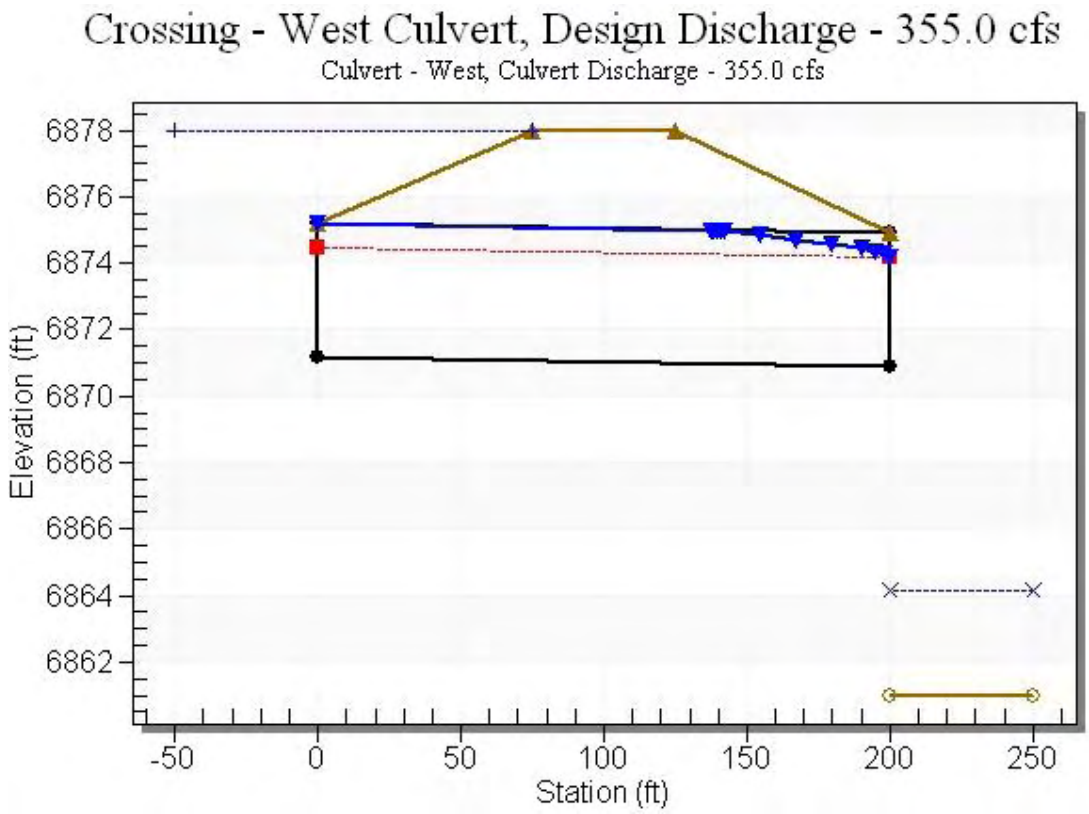
Culvert Length: 200.00 ft, Culvert Slope: 0.0015

****

Culvert Performance Curve Plot: West



Water Surface Profile Plot for Culvert: West



Site Data - West

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 6871.20 ft

Outlet Station: 200.00 ft

Outlet Elevation: 6870.90 ft

Number of Barrels: 3

Culvert Data Summary - West

Barrel Shape: Circular

Barrel Diameter: 4.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0130

Inlet Type: Conventional

Inlet Edge Condition: Square Edge with Headwall

Inlet Depression: NONE

Table 3 - Downstream Channel Rating Curve (Crossing: West Culvert)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
0.00	6861.00	0.00	0.00	0.00	0.00
50.00	6861.82	0.82	8.71	0.51	1.69
100.00	6862.30	1.30	11.02	0.81	1.71
150.00	6862.71	1.71	12.54	1.07	1.69
200.00	6863.09	2.09	13.67	1.30	1.67
250.00	6863.45	2.45	14.58	1.53	1.64
300.00	6863.79	2.79	15.34	1.74	1.62
350.00	6864.13	3.13	15.98	1.95	1.59
355.00	6864.16	3.16	16.03	1.97	1.59
450.00	6864.78	3.78	17.02	2.36	1.54
500.00	6865.09	4.09	17.45	2.55	1.52

Tailwater Channel Data - West Culvert

Tailwater Channel Option: Rectangular Channel

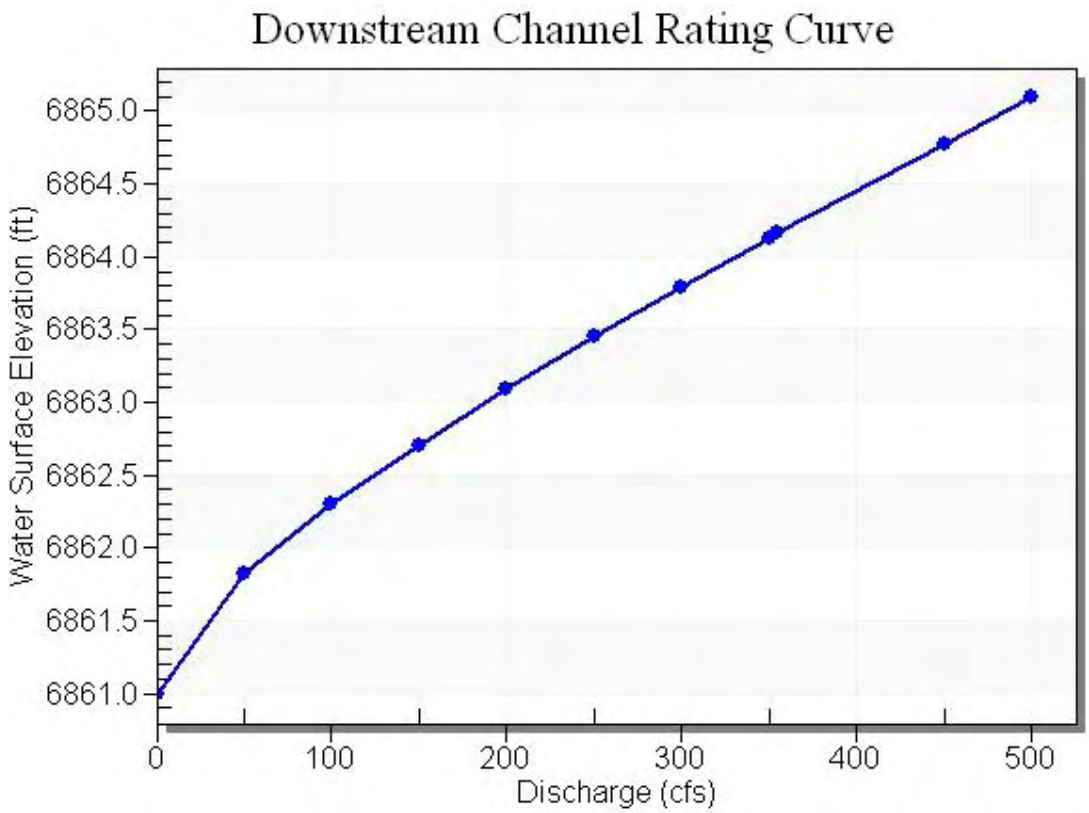
Bottom Width: 7.00 ft

Channel Slope: 0.0100

Channel Manning's n: 0.0130

Channel Invert Elevation: 6861.00 ft

Tailwater Rating Curve Plot for Crossing: West Culvert



Roadway Data for Crossing: West Culvert

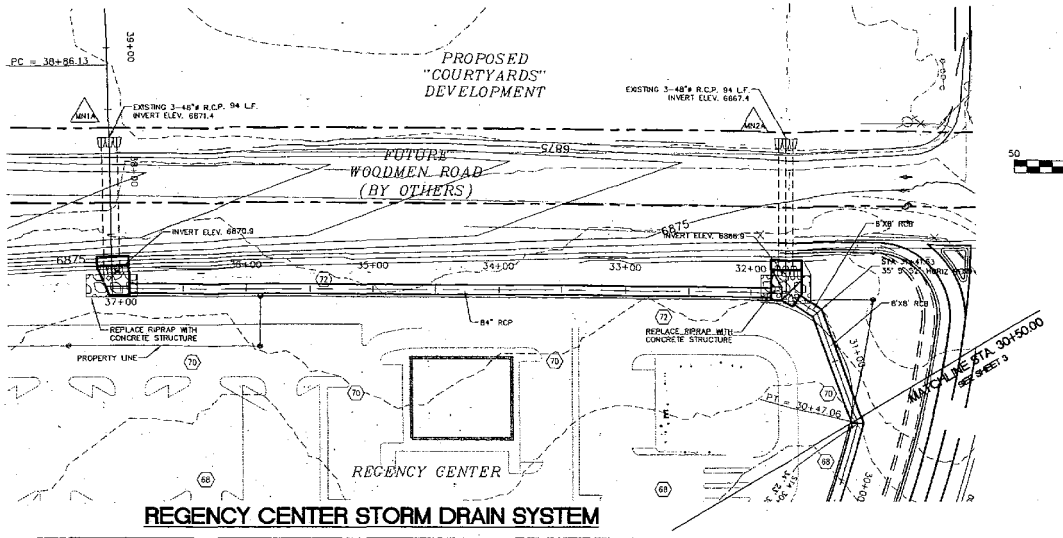
Roadway Profile Shape: Irregular Roadway Shape (coordinates)

Irregular Roadway Cross-Section:

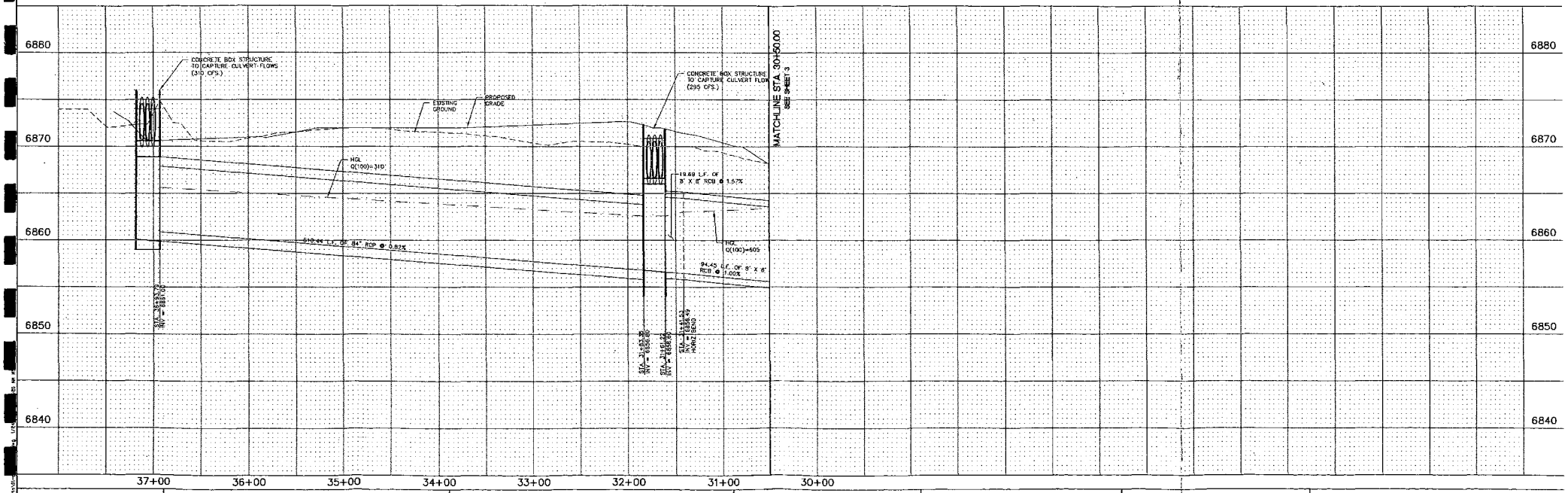
Coord No.	Station (ft)	Elevation (ft)
0	0.00	6878.00
1	25.00	6878.00
2	50.00	6878.00

Roadway Surface: Paved

Roadway Top Width: 50.00 ft



REGENCY CENTER STORM DRAIN SYSTEM



STATEMENT:
EL PASO COUNTY RECOGNIZES THE DESIGN ENGINEER AS HAVING RESPONSIBILITY FOR THE DESIGN; THE COUNTY HAS LIMITED ITS SCOPE OF REVIEW ACCORDINGLY. RESUBMITTAL REQUIRED IF CONSTRUCTION HAS NOT COMMENCED WITHIN 180 DAYS AFTER REVIEW DATE.

REVIEW:
STREET DESIGN:
CURB & GUTTER REVIEW _____ DATE: _____
FINAL REVIEW _____ DATE: _____
DRAINAGE DESIGN: DRAINAGE BASIN _____

DESIGN DATA:
SIDEWALKS: WIDTH 4'
LOCATION: ATTACHED O
DETACHED, 6" FROM P/L ø
CURB TYPE 10 20 30 40 50
CRCD SRCD
R/W WIDTH 80' F/C-F/C 44'
STREET TYPE COLLECTOR
HVEEM _____
ASPHALT THICKNESS:
AC SURFACE _____
AC BASE _____
AGGREGATE BASE THICKNESS:
CLASS 6 _____
CLASS 5 _____
CLASS 2 _____

SCALE: HORIZONTAL: 1" = 50' VERTICAL: 1" = 5'
BENCH MARK:
(SEE COVER SHEET)

REVISIONS:

NO.	DESCRIPTION	DATE

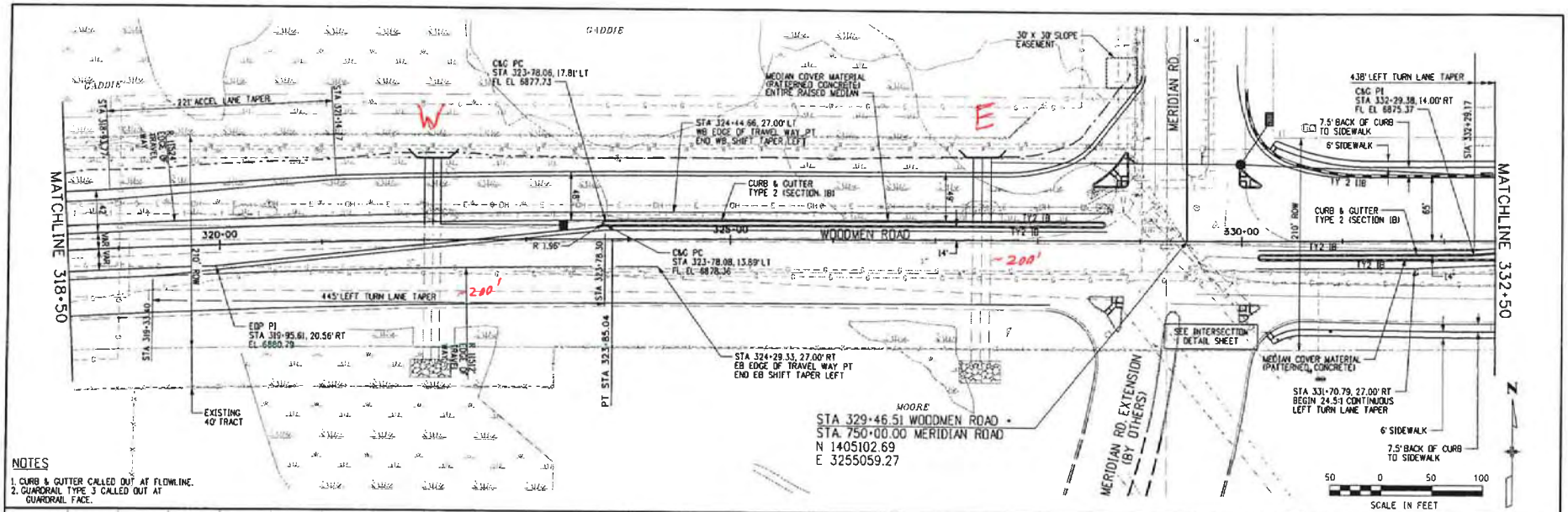
ENGINEER:
DESIGNED BY: JOR DATE: 8/24/04
DRAWN BY: JOR DATE: 8/24/04
CHECKED BY: _____ DATE: _____

48 HOURS BEFORE YOU DIG, CALL UTILITY LOCATORS
1-800-922-1987
(SEE COVER FOR LIST OF UTILITY CONTACTS)

URS
8960 FEDERAL DRIVE #300
COLORADO SPRINGS, COLORADO 80921
PHONE: (719) 531-0001
FAX: (719) 531-0007

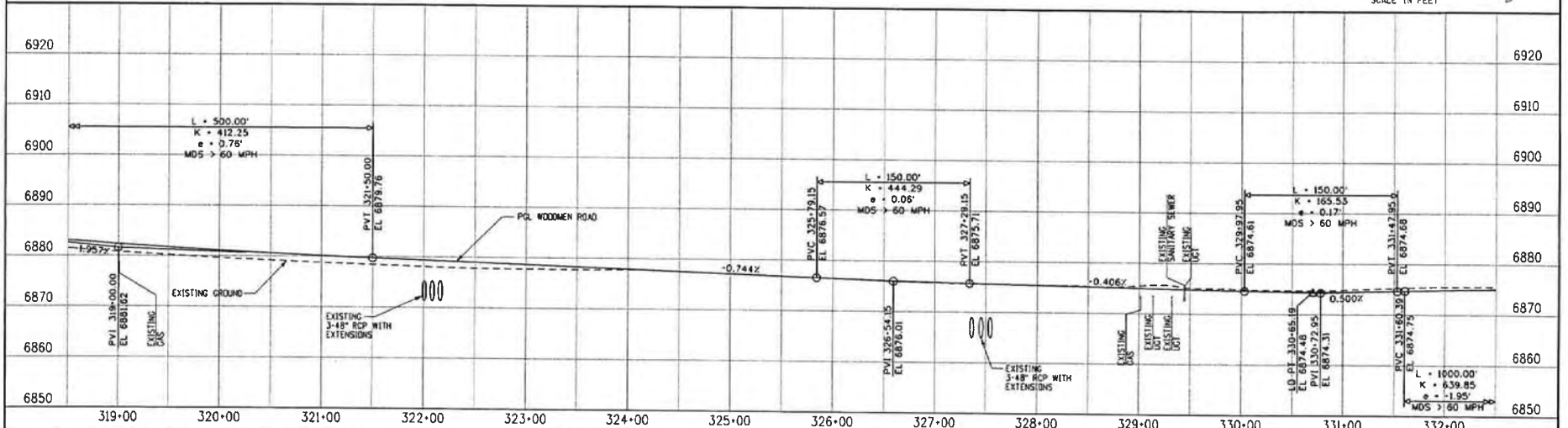
PROJECT REGENCY CENTER
SHEET TITLE PLAN & PROFILE CHANNEL
FROM STA. 30+50 TO STA. 37+00
JOB NO. 21710844 SHEET 2 OF 4

10/10/2007 7:27:19 AM



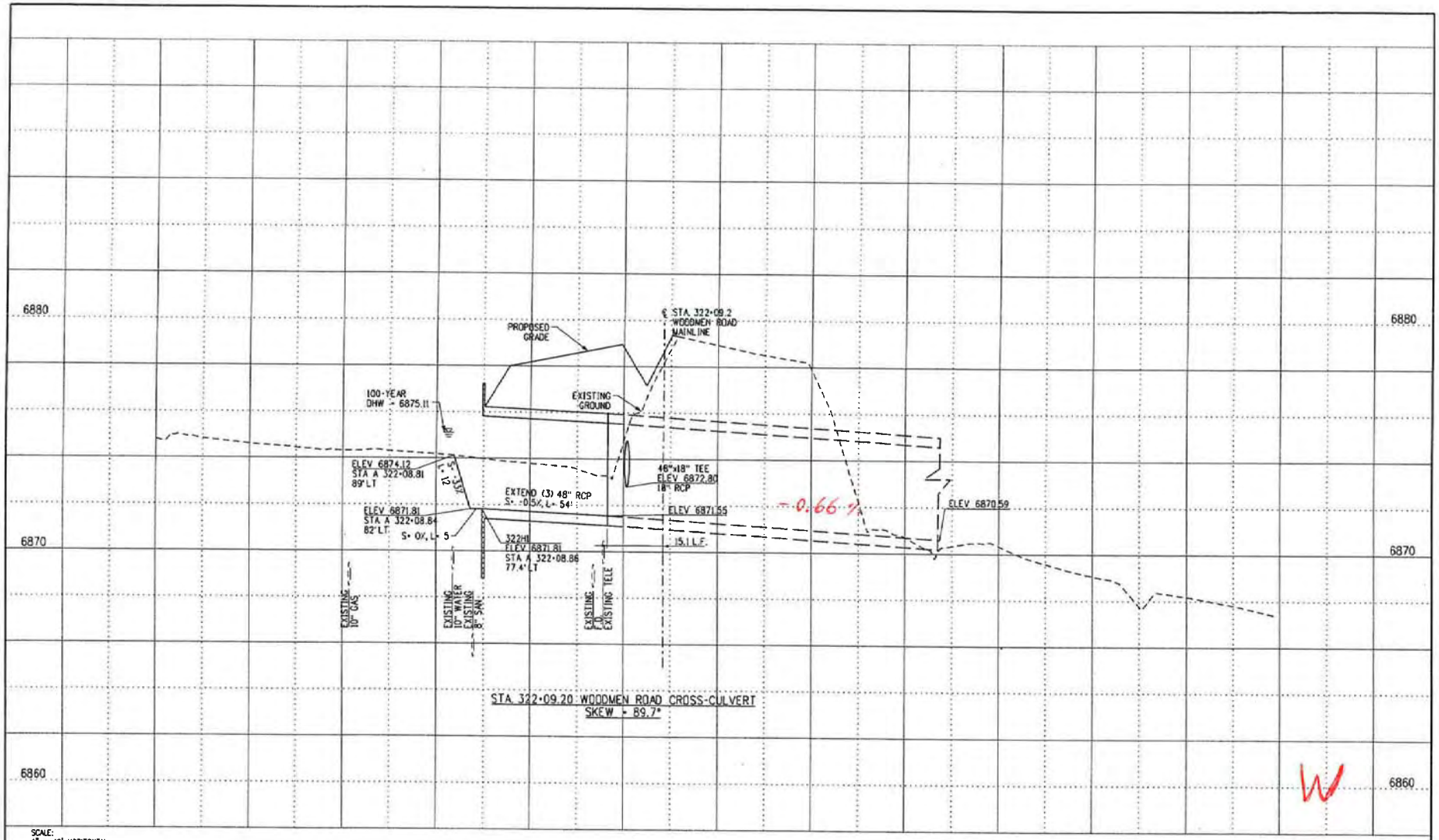
NOTES

1. CURB & GUTTER CALLED OUT AT FLOWLINE.
2. GUARDRAIL TYPE 3 CALLED OUT AT GUARDRAIL FACE.



Computer File Information			Sheet Revisions			DMJM HARRIS | AECOM	As Constructed	WOODMEN ROAD	Project No./Code
Creation Date: 02/07/06	Initials: LPS					2950 Professional Place Colorado Springs, Colorado 80904 Phone: (719) 386-8300 Fax: (719) 386-8336	No Revisions: –	PLAN & PROFILE-WOODMEN ROAD	STU M240-062
Last Modification Date: 9/11/2007	Initials: LPS						Revised: –	Designer: MES / Detailer: LPS	13263
Full Path: I:\4954\4954_0604\cadd\roadway\54RDPP24.dgn							Void: –	Structure Numbers	
Drawing Scale: 1"=50'								Sheet Subset: ROADWAY / Subset Sheets: ROPP23 of 38	Sheet Number 91
V8 Ver. 08.00.01.19	Units: ENGLISH								

10/10/2007 8:00:43 AM



SCALE:
1" = 40' HORIZONTAL
1" = 4' VERTICAL

Computer File Information			
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Last Modification Date:	9/17/2007	Initials:	LPS
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Drawing Scale:	1=20		
V8 Ver.	08.00.01.19	Units:	ENGLISH

Sheet Revisions		

DMJM HARRIS | AECOM
2950 Professional Place
Colorado Springs, Colorado 80904
Phone: (719) 388-8300 Fax: (719) 388-8338

EL PASO COUNTY DEPARTMENT OF TRANSPORTATION

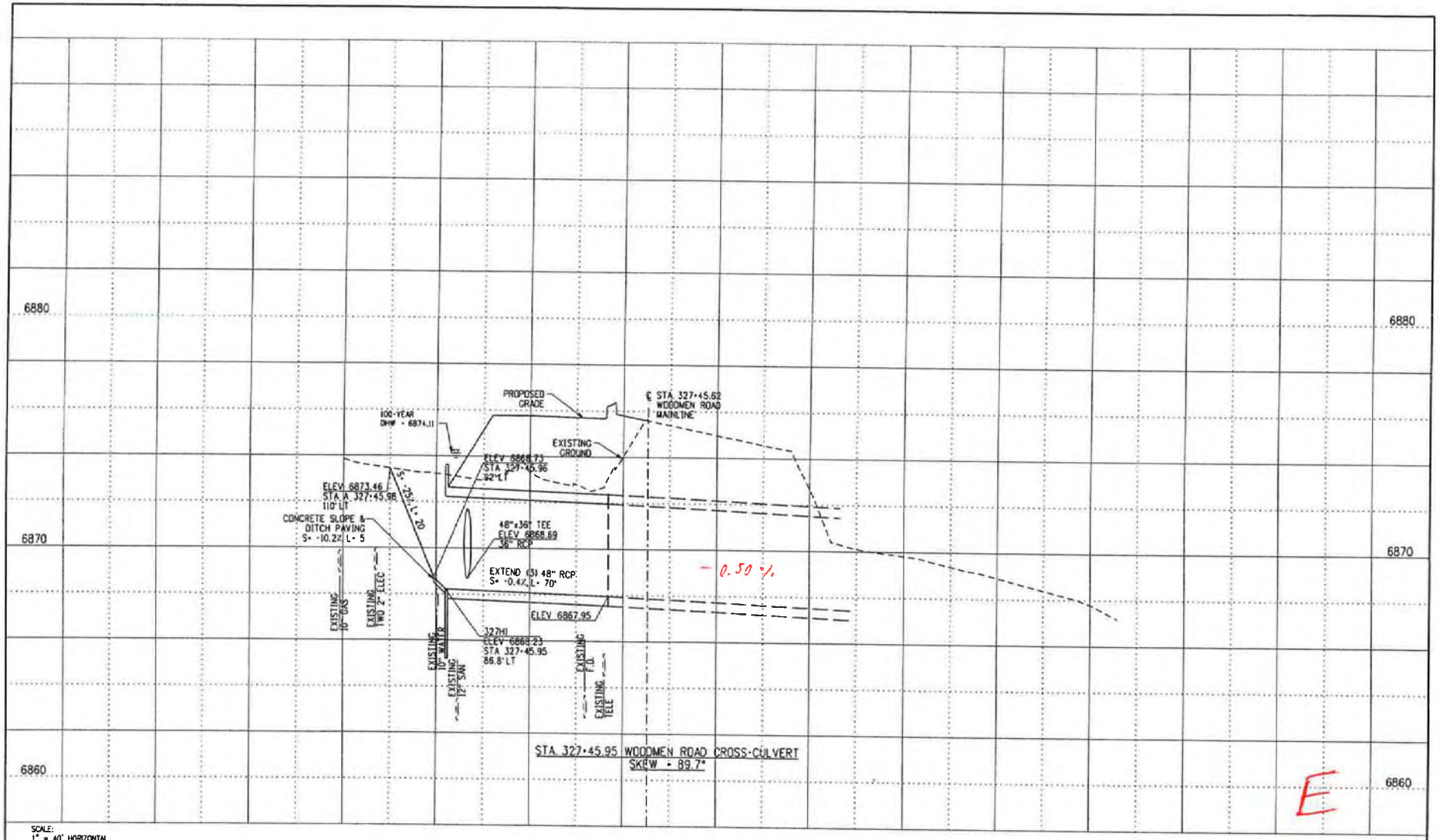
As Constructed	
No Revisions:	-
Revised:	-
Void:	-

WOODMEN ROAD
STORM SEWER PROFILE -
WOODMEN RD. STA. 322+09.20

Designer:	CLK	Structure Numbers	
Detailer:	LPS		
Sheet Subset:	DRAINAGE	Subset Sheets:	DR45 of 50

Project No./Code
STU M240-062
13263
Sheet Number 193

10/10/2007 8:00:56 AM



SCALE:
1" = 40' HORIZONTAL
1" = 4' VERTICAL

Computer File Information		
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Last Modification Date: 10/1/2007	Initials: LPS	
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Drawing Scale: 1=20		
V8 Ver. 08.00.01.19	Units: ENGLISH	

Sheet Revisions

DMJM HARRIS | AECOM
2950 Professional Place
Colorado Springs, Colorado 80904
Phone: (719) 366-8300 Fax: (719) 366-8338

EL PASO COUNTY DEPARTMENT OF TRANSPORTATION

As Constructed
No Revisions: -
Revised: -
Void: -

WOODMEN ROAD
STORM SEWER PROFILE - WOODMEN RD. STA. 327+45.95

Designer: CLK
Detailer: LPS
Structure Numbers
Sheet Subset: DRAINAGE
Subset Sheets: DR47 of 50

Project No./Code
STU M240-062
13263
Sheet Number 195

CLOMR Approval

Federal Emergency Management Agency

Washington, D.C. 20472

May 26, 2017

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

IN REPLY REFER TO:
Case No.: 17-08-0074R
Community Name: El Paso County, CO
Community No.: 080059

The Honorable Darryl Glenn
Chairman, El Paso County
Board of Commissioners
200 South Cascade Avenue, Suite 100
Colorado Springs, CO 80903

Dear Mr. Glenn:

The Flood Insurance Study Report and Flood Insurance Rate Map for your community have been revised by this Letter of Map Revision (LOMR). Please use the enclosed annotated map panel(s) revised by this LOMR for floodplain management purposes and for all flood insurance policies and renewals issued in your community.

Additional documents are enclosed that provide information regarding this LOMR. Please see the List of Enclosures below to determine which documents are included. Other attachments specific to this request may be included as referenced in the Determination Document. If you have any questions regarding floodplain management regulations for your community or the National Flood Insurance Program (NFIP) in general, please contact the Consultation Coordination Officer for your community. If you have any technical questions regarding this LOMR, please contact the Director, Mitigation Division of the Department of Homeland Security's Federal Emergency Management Agency (FEMA) in Denver, Colorado, at (303) 235-4830, or the FEMA Map Information eXchange (FMIX) toll free at 1-877-336-2627 (1-877-FEMA MAP). Additional information about the NFIP is available on our website at http://www.fema.gov/national-flood-insurance-program.

Sincerely,

Patrick "Rick" F. Sacbibit, P.E., Branch Chief
Engineering Services Branch
Federal Insurance and Mitigation Administration

List of Enclosures:

Letter of Map Revision Determination Document
Annotated Flood Insurance Rate Map
Annotated Flood Insurance Study Report

cc: Mr. Keith Curtis, P.E., CFM
Floodplain Administrator
El Paso County

Mr. Steven Leslie, P.E., CFM
Project Engineer
Drexell, Barrell & CO

Federal Emergency Management Agency

Washington, D.C. 20472

CONDITIONAL LETTER OF MAP REVISION COMMENT DOCUMENT

COMMUNITY INFORMATION		PROPOSED PROJECT DESCRIPTION	BASIS OF CONDITIONAL REQUEST
COMMUNITY	El Paso County Colorado (Unincorporated Areas)	CHANNELIZATION BRIDGE	HYDRAULIC ANALYSIS UPDATED TOPOGRAPHIC DATA HYDROLOGIC ANALYSIS
	COMMUNITY NO.: 080059		
IDENTIFIER	Falcon Marketplace	APPROXIMATE LATITUDE & LONGITUDE: 38.9426, -104.610 SOURCE: USGS QUADRANGLE DATUM: NAD 83	

AFFECTED MAP PANELS

TYPE: FIRM* NO.: 08041C0575F DATE: March 17, 1997

* FIRM - Flood Insurance Rate Map

FLOODING SOURCE(S) AND REACH DESCRIPTION

Unnamed Tributary to Black Squirrel Creek- from Woodmen Road to approximately 2,280 feet upstream of Woodmen Road

PROPOSED PROJECT DESCRIPTION

Flooding Source	Proposed Project	Location of Proposed Project
Unnamed Tributary to Black Squirrel Creek	Channelization	From Woodmen Road to approximately 2,820 feet upstream of Woodmen Road
	Bridge Modification	At Woodmen Road

SUMMARY OF IMPACTS TO FLOOD HAZARD DATA

Flooding Source	Effective Flooding	Proposed Flooding	Increases	Decreases
Unnamed Tributary to Black Squirrel Creek	Zone A	Zone AE	Yes	Yes
	No BFEs	BFEs	Yes	None

* BFEs - Base (1-percent-annual-chance) Flood Elevations

COMMENT

This document provides the Federal Emergency Management Agency's (FEMA's) comment regarding a request for a CLOMR for the project described above. This document is not a final determination; it only provides our comment on the proposed project in relation to the flood hazard information shown on the effective National Flood Insurance Program (NFIP) map. We reviewed the submitted data and the data used to prepare the effective flood hazard information for your community and determined that the proposed project meets the minimum floodplain management criteria of the NFIP. Your community is responsible for approving all floodplain development and for ensuring that all permits required by Federal or State/Commonwealth law have been received. State/Commonwealth, county, and community officials, based on their knowledge of local conditions and in the interest of safety, may set higher standards for construction in the Special Flood Hazard Area (SFHA), the area subject to inundation by the base flood). If the State/Commonwealth, county, or community has adopted more restrictive or comprehensive floodplain management criteria, these criteria take precedence over the minimum NFIP criteria.

This comment is based on the flood data presently available. If you have any questions about this document, please contact the FEMA Map Information eXchange (FMIX) toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMC Clearinghouse, 3601 Eisenhower Avenue, Suite 500, Alexandria, VA 22304-6426. Additional Information about the NFIP is available on the FEMA website at http://www.fema.gov/national-flood-insurance-program.

Patrick "Rick" F. Sacbibit, P.E., Branch Chief
Engineering Services Branch
Federal Insurance and Mitigation Administration

Federal Emergency Management Agency

Washington, D.C. 20472

CONDITIONAL LETTER OF MAP REVISION COMMENT DOCUMENT (CONTINUED)

COMMUNITY INFORMATION

USE PARAGRAPH BELOW WHEN REQUEST IS FOR ZONE A ONLY

To determine the changes in flood hazards that will be caused by the proposed project, we compared the hydraulic modeling reflecting the proposed project (referred to as the proposed conditions model) to the hydraulic modeling reflecting the existing conditions.

The table below shows the changes in the base flood water-surface elevations (WSELs).

Base Flood WSEL Comparison Table

Flooding Source: Unnamed Tributary to Black Squirrel Creek		Base Flood WSEL Change (feet)	Location of maximum change
Proposed vs. Existing	Maximum increase	None	N/A
	Maximum decrease	7.3	Approximately 880 feet upstream of Woodmen Road

NFIP regulations Subparagraph 60.3(b)(7) requires communities to ensure that the flood-carrying capacity within the altered or relocated portion of any watercourse is maintained. This provision is incorporated into your community's existing floodplain management ordinacnes; therefore, responsibility for maintenance of the altered or relocated watercourse, including any related appurtenances such as bridges, culverts, and other drainage structures, rests with your community. We may request that your community submit a description and schedule of maintenance activites necessary to ensure this requirement.

This comment is based on the flood data presently available. If you have any questions about this document, please contact the FEMA Map Information eXchange (FMIX) toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMC Clearinghouse, 3601 Eisenhower Avenue, Suite 500, Alexandria, VA 22304-6426. Additional information about the NFIP is available on the FEMA website at http://www.fema.gov/national-flood-insurance-program.

Patrick "Rick" F. Sacbibit, P.E., Branch Chief
Engineering Services Branch
Federal Insurance and Mitigation Administration

Federal Emergency Management Agency
Washington, D.C. 20472

CONDITIONAL LETTER OF MAP REVISION COMMENT DOCUMENT (CONTINUED)

COMMUNITY INFORMATION (CONTINUED)

DATA REQUIRED FOR FOLLOW-UP LOMR

Upon completion of the project, your community must submit the data listed below and request that we make a final determination on revising the effective FIRM. If the project is built as proposed and the data below are received, a revision to the FIRM would be warranted.

• Detailed application and certification forms must be used for requesting final revisions to the maps. Therefore, when the map revision request for the area covered by this letter is submitted, Form 1, entitled "Overview and Concurrence Form," must be included. A copy of this form may be accessed at http://www.fema.gov/plan/prevent/fhm/dl_mt-2.shtm.

• The detailed application and certification forms listed below may be required if as-built conditions differ from the proposed plans. If required, please submit new forms, which may be accessed at http://www.fema.gov/plan/prevent/fhm/dl_mt-2.shtm, or annotated copies of the previously submitted forms showing the revised information.

Form 2, entitled "Riverine Hydrology and Hydraulics Form." Hydraulic analyses for as-built conditions of the base flood must be submitted with Form 2.

Form 3, entitled "Riverine Structures Form."

• A certified topographic work map showing the revised and effective base floodplain boundaries. Please ensure that the revised information ties-in with the current effective information at the downstream and upstream ends of the revised reach.

• An annotated copy of the FIRM, at the scale of the effective FIRM, that shows the revised base floodplain boundary delineations shown on the submitted work map and how they tie-in to the base floodplain boundary delineations shown on the current effective FIRM at the downstream and upstream ends of the revised reach.

• As-built plans, certified by a registered Professional Engineer, of all proposed project elements.

• Documentation of the individual legal notices sent to property owners who will be affected by any widening or shifting of the base floodplain and/or any BFE increases along the Unnamed Tributary to Black Squirrel Creek.

This comment is based on the flood data presently available. If you have any questions about this document, please contact the FEMA Map Information eXchange (FMIX) toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMC Clearinghouse, 3601 Eisenhower Avenue, Suite 500, Alexandria, VA 22304-6426. Additional Information about the NFIP is available on the FEMA website at http://www.fema.gov/national-flood-insurance-program.

Patrick "Rick" F. Sacbibit, P.E., Branch Chief
Engineering Services Branch
Federal Insurance and Mitigation Administration

Federal Emergency Management Agency
Washington, D.C. 20472

CONDITIONAL LETTER OF MAP REVISION COMMENT DOCUMENT (CONTINUED)

COMMUNITY INFORMATION (CONTINUED)

COMMUNITY REMINDERS

We have designated a Consultation Coordination Officer (CCO) to assist your community. The CCO will be the primary liaison between your community and FEMA. For information regarding your CCO, please contact:

Ms. Jeanine P. Petterson
Director, Mitigation Division
Federal Emergency Management Agency, Region VIII
Denver Federal Center, Building 710
P.O. Box 25267
Denver, CO 80225-0267
(303) 235-4830

WHEN PRELIMINARY STUDY HAS BEEN SUBMITTED TO COMMUNITY FOR REVIEW

A preliminary study is being conducted for El Paso County. Preliminary copies of the revised FIRM and FIS report were submitted to your community for review on July 29, 2015, and may become effective before the revision request following this CLOMR is submitted. Please ensure that the data submitted for the revision ties into the data effective at the time of the submittal.

This comment is based on the flood data presently available. If you have any questions about this document, please contact the FEMA Map Information eXchange (FMIX) toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMC Clearinghouse, 3601 Eisenhower Avenue, Suite 500, Alexandria, VA 22304-6426. Additional Information about the NFIP is available on the FEMA website at http://www.fema.gov/national-flood-insurance-program.

Patrick "Rick" F. Sacbibit, P.E., Branch Chief
Engineering Services Branch
Federal Insurance and Mitigation Administration

Drainage Map

LEGEND

PROPERTY LINE
EX. MINOR CONTOUR
EX. MAJOR CONTOUR 6800
BASIN BOUNDARY
FLOW DIRECTION
DESIGN POINT
BASIN DESCRIPTION ..... BASIN / IMPERVIOUS COVERAGE PERCENTAGE / BASIN AREA (ACRES)

N

100 0 100 200
SCALE: 1"=100'

RUNOFF SUMMARY

BASIN	DP	Area (Ac.)	Q_5 (CFS)	Q_{100} (CFS)
JMT060			160	670
O1	DP1	30.50	9.6	28.3
O2	DP2	2.06	0.7	4.9
O3	DP3	2.24	5.1	9.8
O4	DP4	4.46	7.2	15.8
E1		35.70	7.7	46.7
	DP5	74.96	20.0	70.8
O5	DP6	2.17	2.9	6.6
JMT070			180.0	740.8

PREPARED BY:

DREXEL, BARRELL & CO.
Engineers • Surveyors
3 SOUTH 7TH STREET
COLORADO SPGS, COLORADO 80905
CONTACT: TIM D. McCONNELL, P.E.
(719)260-0887
BOULDER • COLORADO SPRINGS

CLIENT:

HUMMEL INVESTMENTS, LLC
8117 PRESTON ROAD, SUITE 120
DALLAS, TEXAS 75225
(214) 416-9820

DRAINAGE PLAN FOR
FALCON MARKETPLACE
FALCON, COLORADO

ISSUE	DATE
INITIAL ISSUE	3-23-17
REVISION	7-19-19

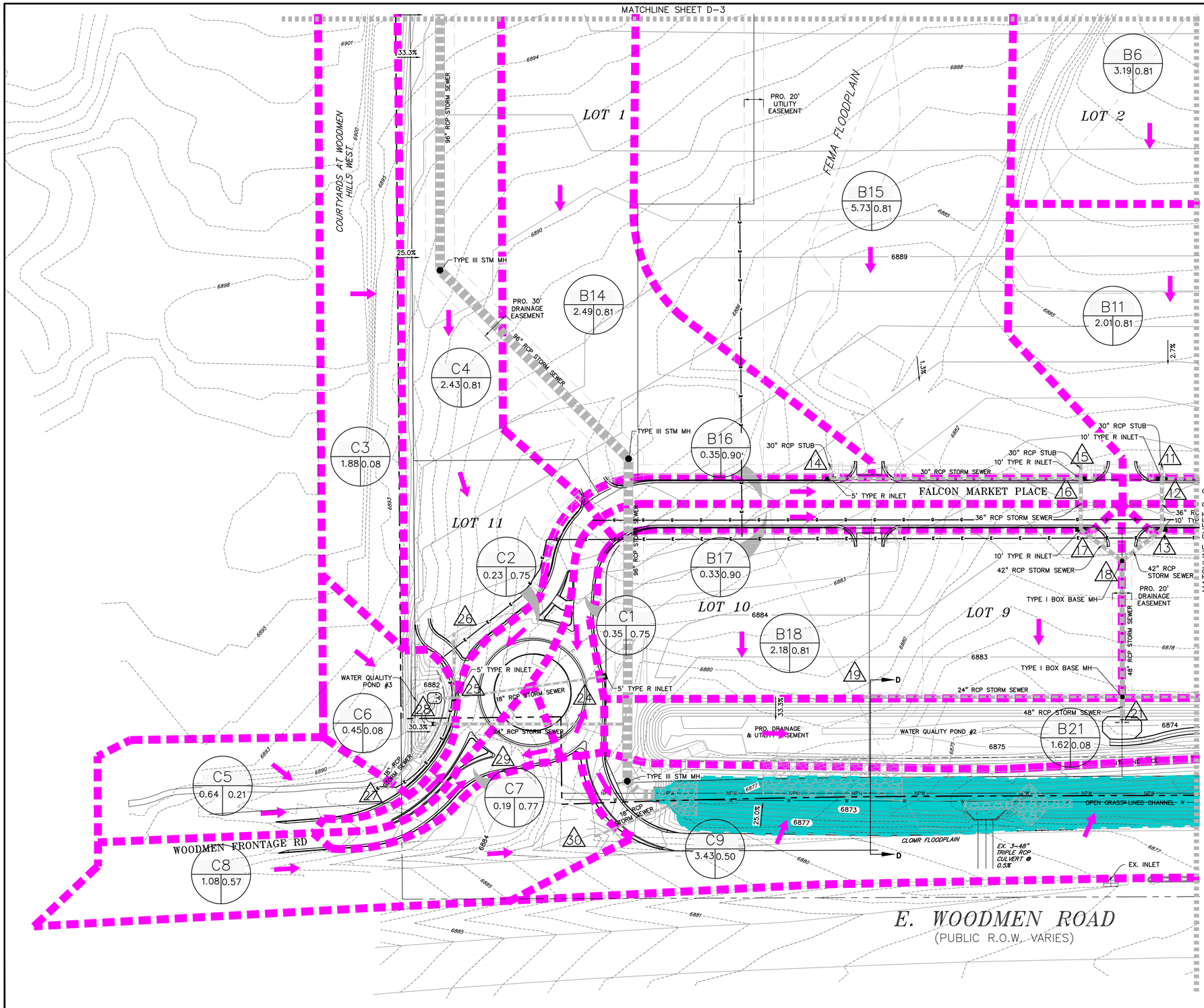
DESIGNED BY:	TDM
DRAWN BY:	KGV
CHECKED BY:	TDM
FILE NAME:	

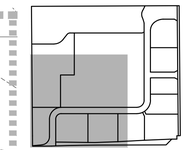
PREPARED UNDER MY DIRECT SUPERVISION FOR AND ON BEHALF OF DREXEL, BARRELL & CO.

DRAWING SCALE:
HORIZONTAL: 1"=100'
VERTICAL: N/A

EXISTING DRAINAGE CONDITIONS

PROJECT NO. 20988-00CSCV
DRAWING NO.
ED-1
SHEET: 1 OF 1





-N-

50 0 50 100

SCALE: 1"=50'

RUNOFF SUMMARY

BASIN	DP	Area (Ac.)	Q_5 (CFS)	Q_{100} (CFS)
A1	DP1	1.81	3.4	7.7
	DP2	1.81	3.4	7.7
A2		4.82	1.4	10.2
	DP3	6.63	4.6	17.3
B4	DP4	2.35	7.5	14.6
B5		0.63	2.8	5.1
	DP5	2.99	10.0	19.3
B6	DP6	3.19	12.8	23.6
B7		0.46	2.0	3.7
	DP7	6.63	23.8	28.0
B8	DP8	1.04	3.5	6.9
B9		0.30	1.4	2.5
	DP9	1.35	4.9	9.3
B10		0.18	0.8	1.4
	DP10	8.16	29.2	38.1
B11	DP11	2.01	7.8	14.6
B12		0.18	0.8	1.5
	DP12	10.35	36.4	51.9
B13		0.20	0.9	1.6
	DP13	10.55	37.1	53.2
B14	DP14	2.49	9.1	17.0
B15	DP15	5.73	20.3	38.0
B16		0.35	1.6	2.9
	DP16	8.56	30.6	57.1
B17		0.33	1.5	2.7

BASIN	DP	Area (Ac.)	Q_5 (CFS)	Q_{100} (CFS)
	DP17	8.89	31.9	59.3
	DP18	19.44	52.1	88.2
B18	DP19	2.18	7.8	15.0
B19	DP20	2.57	10.1	18.8
	DP21	24.19	67.6	117.5
B20	DP22	2.03	5.6	11.4
B21		1.62	0.5	4.0
	DP23	27.85	67.4	121.8
C1	DP24	0.35	1.3	2.6
C2		0.23	0.8	1.5
	DP25	0.59	2.0	3.8
C3		1.88	0.6	4.2
C4		2.19	6.9	13.8
	DP26	4.08	5.4	13.7
C5	DP27	0.64	0.5	1.9
C6		0.45	0.2	1.2
	DP28	5.31	7.4	18.3
C7	DP29	0.19	0.7	1.3
C8		1.14	2.5	5.5
	DP30	1.33	3.1	6.6
C9		3.43	7.3	16.2
D1		2.62	4.1	8.8
D2		0.07	0.3	0.6
D3		0.07	0.3	0.6
	DPO1	32.50	10.3	30.2

PREPARED BY:

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COLORADO SPGS, COLORADO 80905
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BOULDER • COLORADO SPRINGS

CLIENT:

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DALLAS, TEXAS 75225
(214) 416-9820

DRAINAGE PLAN FOR FALCON MARKETPLACE

FALCON, COLORADO

ISSUE	DATE
INITIAL ISSUE	6-28-19
REVISED	7-19-19

DESIGNED BY:	TDM
DRAWN BY:	KGV
CHECKED BY:	TDM
FILE NAME:	

PREPARED UNDER MY DIRECT SUPERVISION FOR AND ON BEHALF OF DREXEL, BARRELL & CO.

DRAWING SCALE:
HORIZONTAL: 1"=50'
VERTICAL: N/A

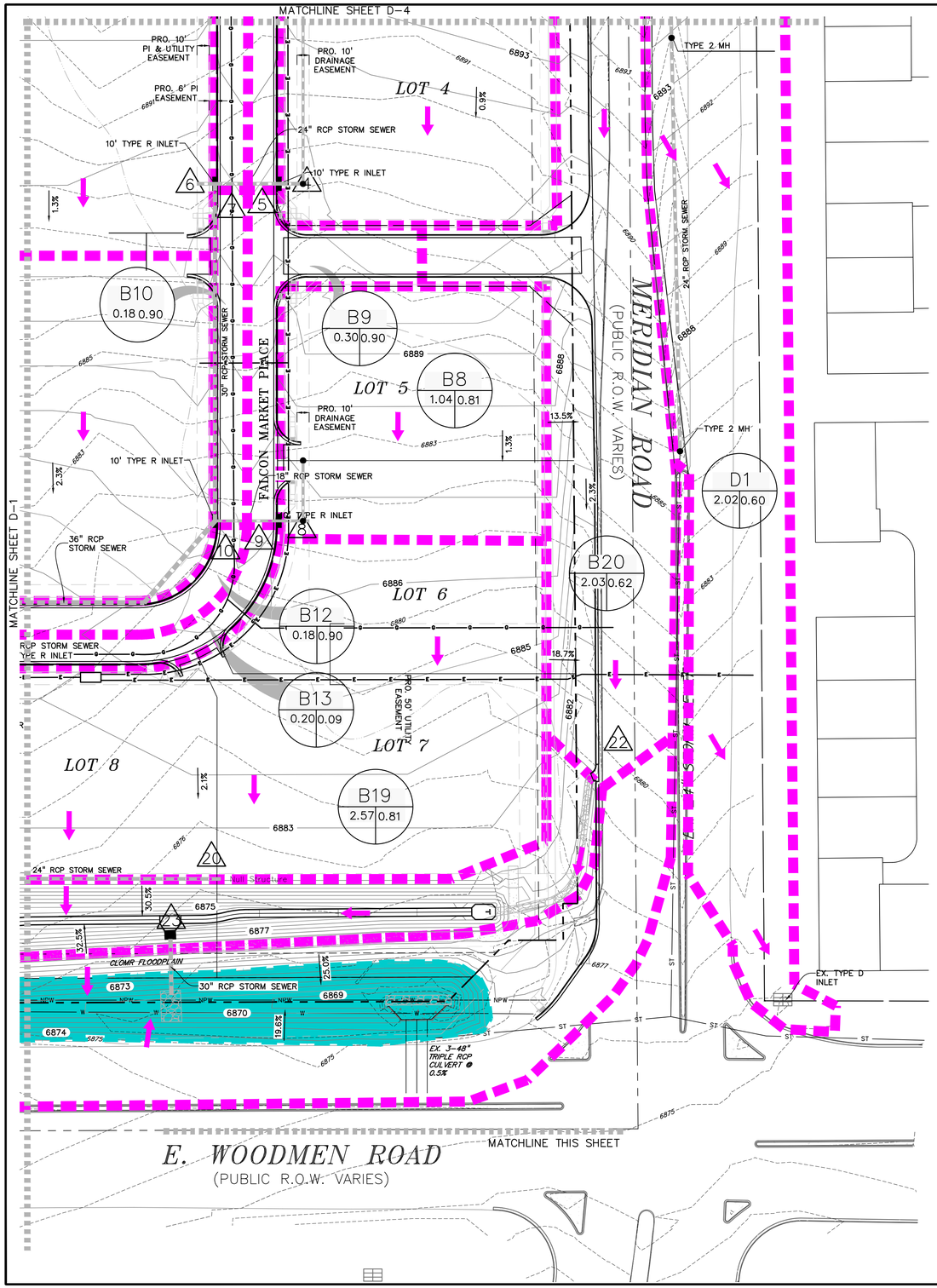
PROPOSED DRAINAGE CONDITIONS

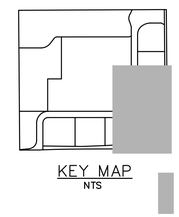
PROJECT NO. 20988-00CSCV

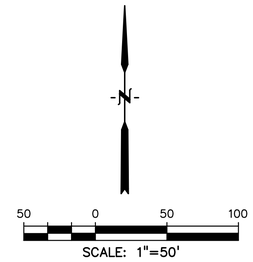
DRAWING NO.

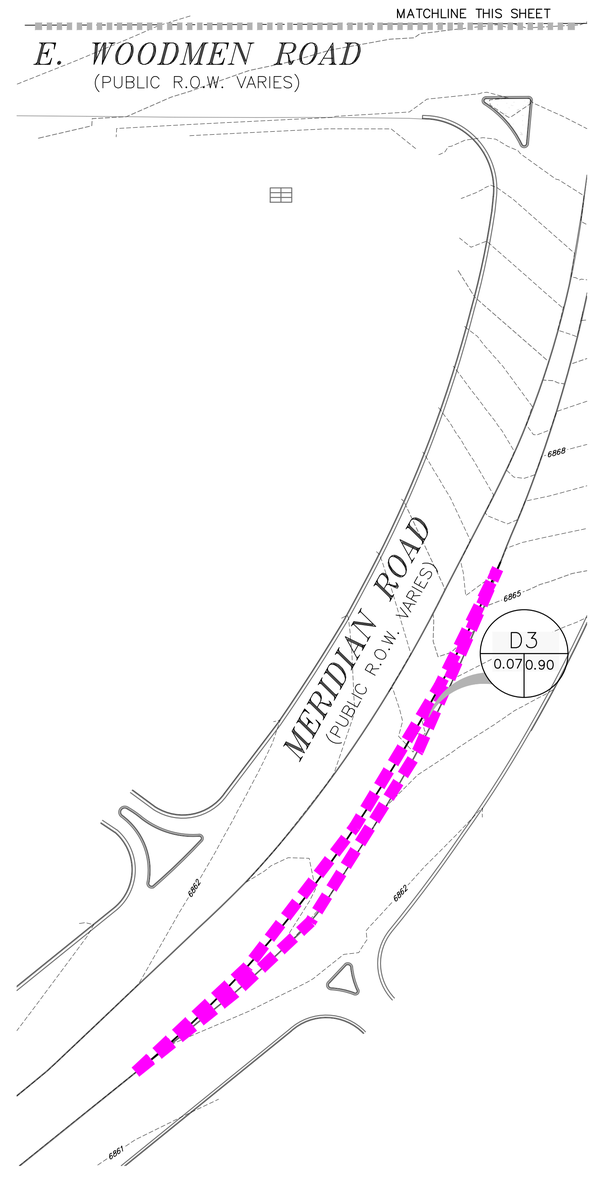
D-1

SHEET: 1 OF 5









RUNOFF SUMMARY

BASIN	DP	Area (Ac.)	Q_5 (CFS)	Q_{100} (CFS)
A1	DP1	1.81	3.4	7.7
	DP2	1.81	3.4	7.7
A2		4.82	1.4	10.2
	DP3	6.63	4.6	17.3
B4	DP4	2.35	7.5	14.6
B5		0.63	2.8	5.1
	DP5	2.99	10.0	19.3
B6	DP6	3.19	12.8	23.6
B7		0.46	2.0	3.7
	DP7	6.63	23.8	28.0
B8	DP8	1.04	3.5	6.9
B9		0.30	1.4	2.5
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	DP25	0.59	2.0	3.8
C3		1.88	0.6	4.2
C4		2.19	6.9	13.8
	DP26	4.08	5.4	13.7
C5	DP27	0.64	0.5	1.9
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	DP28	5.31	7.4	18.3
C7	DP29	0.19	0.7	1.3
C8		1.14	2.5	5.5
	DP30	1.33	3.1	6.6
C9		3.43	7.3	16.2
D1		2.62	4.1	8.8
D2		0.07	0.3	0.6
D3		0.07	0.3	0.6
	DPO1	32.50	10.3	30.2

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(214) 416-9820

DRAINAGE PLAN FOR
FALCON MARKETPLACE
FALCON, COLORADO

ISSUE	DATE
INITIAL ISSUE	6-28-19
REVISED	7-19-19

DESIGNED BY:	TDM
DRAWN BY:	KGV
CHECKED BY:	TDM
FILE NAME:	

PREPARED UNDER MY DIRECT SUPERVISION FOR AND ON BEHALF OF DREXEL, BARRELL & CO.

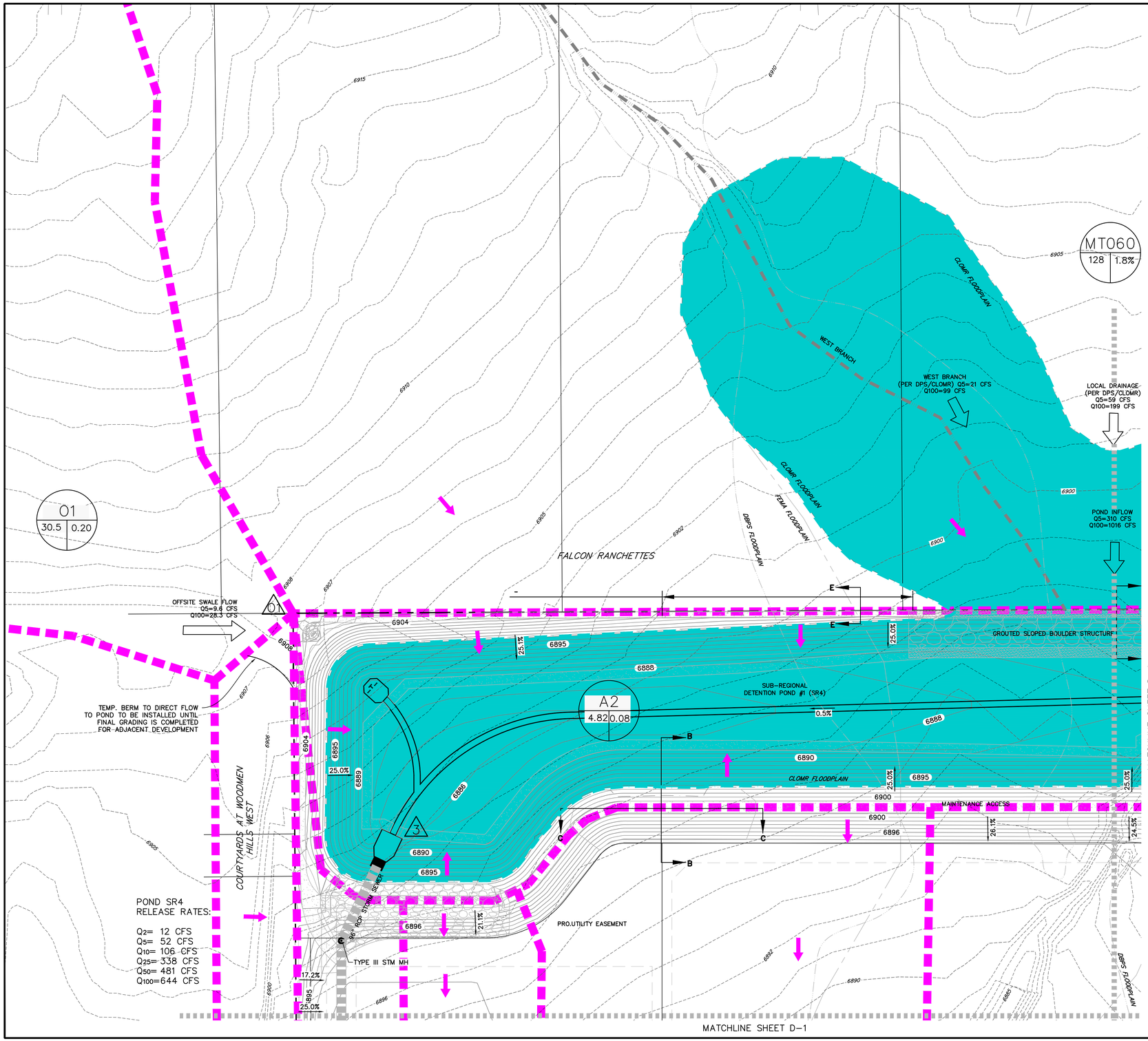
DRAWING SCALE:
HORIZONTAL: 1"=50'
VERTICAL: N/A

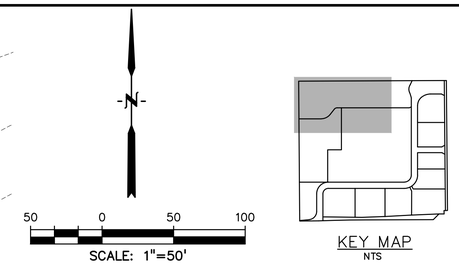
PROPOSED DRAINAGE CONDITIONS

PROJECT NO. 20988-00CSCV
DRAWING NO.

D-2

SHEET: 2 OF 5





RUNOFF SUMMARY

BASIN	DP	Area (Ac.)	Q_5 (CFS)	Q_{100} (CFS)
A1	DP1	1.81	3.4	7.7
	DP2	1.81	3.4	7.7
A2		4.82	1.4	10.2
	DP3	6.63	4.6	17.3
B4	DP4	2.35	7.5	14.6
B5		0.63	2.8	5.1
	DP5	2.99	10.0	19.3
B6	DP6	3.19	12.8	23.6
B7		0.46	2.0	3.7
	DP7	6.63	23.8	28.0
B8	DP8	1.04	3.5	6.9
B9		0.30	1.4	2.5
	DP9	1.35	4.9	9.3
B10		0.18	0.8	1.4
	DP10	8.16	29.2	38.1
B11	DP11	2.01	7.8	14.6
B12		0.18	0.8	1.5
	DP12	10.35	36.4	51.9
B13		0.20	0.9	1.6
	DP13	10.55	37.1	53.2
B14	DP14	2.49	9.1	17.0
B15	DP15	5.73	20.3	38.0
B16		0.35	1.6	2.9
	DP16	8.56	30.6	57.1
B17		0.33	1.5	2.7

BASIN	DP	Area (Ac.)	Q_5 (CFS)	Q_{100} (CFS)
	DP17	8.89	31.9	59.3
	DP18	19.44	52.1	86.2
B18	DP19	2.18	7.8	15.0
B19	DP20	2.57	10.1	18.8
	DP21	24.19	67.6	117.5
B20	DP22	2.03	5.6	11.4
B21		1.62	0.5	4.0
	DP23	27.85	67.4	121.8
C1	DP24	0.35	1.3	2.6
C2		0.23	0.8	1.5
	DP25	0.59	2.0	3.8
C3		1.88	0.6	4.2
C4		2.19	6.9	13.8
	DP26	4.08	5.4	13.7
C5	DP27	0.64	0.5	1.9
C6		0.45	0.2	1.2
	DP28	5.31	7.4	18.3
C7	DP29	0.19	0.7	1.3
C8		1.14	2.5	5.5
	DP30	1.33	3.1	6.6
C9		3.43	7.3	16.2
D1		2.62	4.1	8.8
D2		0.07	0.3	0.6
D3		0.07	0.3	0.6
	DPO1	32.50	10.3	30.2

PREPARED BY:

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COLORADO SPGS, COLORADO 80905
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DRAINAGE PLAN FOR
FALCON MARKETPLACE
FALCON, COLORADO

ISSUE	DATE
INITIAL ISSUE	6-28-19
REVISED	7-19-19

DESIGNED BY:	TDM
DRAWN BY:	KGV
CHECKED BY:	TDM
FILE NAME:	

PREPARED UNDER MY DIRECT SUPERVISION FOR AND ON BEHALF OF DREXEL, BARRELL & CO.

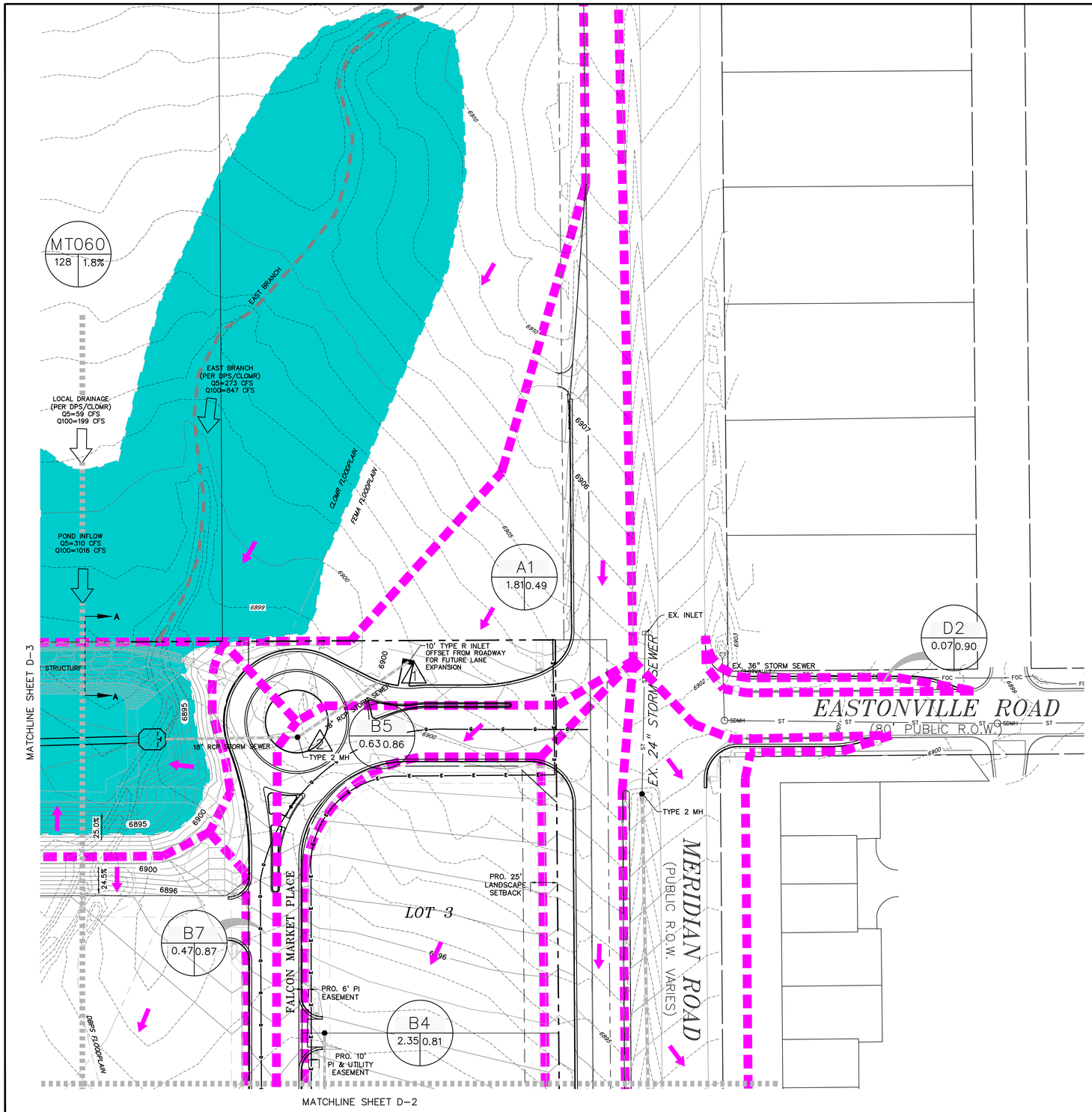
DRAWING SCALE:
HORIZONTAL: 1"=50'
VERTICAL: N/A

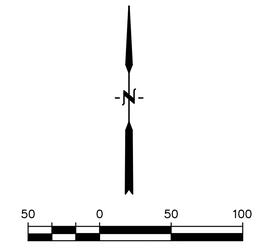
PROPOSED DRAINAGE CONDITIONS

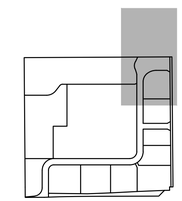
PROJECT NO. 20988-00CSCV
DRAWING NO.

D-3

SHEET: 3 OF 5







KEY MAP
NTS

LEGEND

PROPERTY LINE
LOT LINE
PROPOSED STORM SEWER
EX. MINOR CONTOUR
EX. MAJOR CONTOUR — 6800 —
PR. MINOR CONTOUR
PR. MAJOR CONTOUR — 6800 —
BASIN BOUNDARY
FLOW DIRECTION
PROPOSED (CLOMR/LOMR) FLOODPLAIN
DESIGN POINT
BASIN DESCRIPTION — BASIN / IMPERVIOUS COVERAGE / BASIN AREA (ACRES)

RUNOFF SUMMARY

BASIN	DP	Area (Ac.)	Q_5 (CFS)	Q_{100} (CFS)
A1	DP1	1.81	3.4	7.7
	DP2	1.81	3.4	7.7
A2		4.82	1.4	10.2
	DP3	6.63	4.6	17.3
B4	DP4	2.35	7.5	14.6
B5		0.63	2.8	5.1
	DP5	2.99	10.0	19.3
B6	DP6	3.19	12.8	23.6
B7		0.46	2.0	3.7
	DP7	6.63	23.8	28.0
B8	DP8	1.04	3.5	6.9
B9		0.30	1.4	2.5
	DP9	1.35	4.9	9.3
B10		0.18	0.8	1.4
	DP10	8.16	29.2	38.1
B11	DP11	2.01	7.8	14.6
B12		0.18	0.8	1.5
	DP12	10.35	36.4	51.9
B13		0.20	0.9	1.6
	DP13	10.55	37.1	53.2
B14	DP14	2.49	9.1	17.0
B15	DP15	5.73	20.3	38.0
B16		0.35	1.6	2.9
	DP16	8.56	30.6	57.1
B17		0.33	1.5	2.7

BASIN	DP	Area (Ac.)	Q_5 (CFS)	Q_{100} (CFS)
	DP17	8.89	31.9	59.3
	DP18	19.44	52.1	88.2
B18	DP19	2.18	7.8	15.0
B19	DP20	2.57	10.1	18.8
	DP21	24.19	67.6	117.5
B20	DP22	2.03	5.6	11.4
B21		1.62	0.5	4.0
	DP23	27.85	67.4	121.8
C1	DP24	0.35	1.3	2.6
C2		0.23	0.8	1.5
	DP25	0.59	2.0	3.8
C3		1.88	0.6	4.2
C4		2.19	6.9	13.8
	DP26	4.08	5.4	13.7
C5	DP27	0.64	0.5	1.9
C6		0.45	0.2	1.2
	DP28	5.31	7.4	18.3
C7	DP29	0.19	0.7	1.3
C8		1.14	2.5	5.5
	DP30	1.33	3.1	6.6
C9		3.43	7.3	16.2
D1		2.62	4.1	8.8
D2		0.07	0.3	0.6
D3		0.07	0.3	0.6
	DPO1	32.50	10.3	30.2

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DRAINAGE PLAN FOR FALCON MARKETPLACE
FALCON, COLORADO

ISSUE	DATE
INITIAL ISSUE	6-28-19
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DESIGNED BY:	TDM
DRAWN BY:	KGV
CHECKED BY:	TDM
FILE NAME:	

PREPARED UNDER MY DIRECT SUPERVISION FOR AND ON BEHALF OF DREXEL, BARRELL & CO.

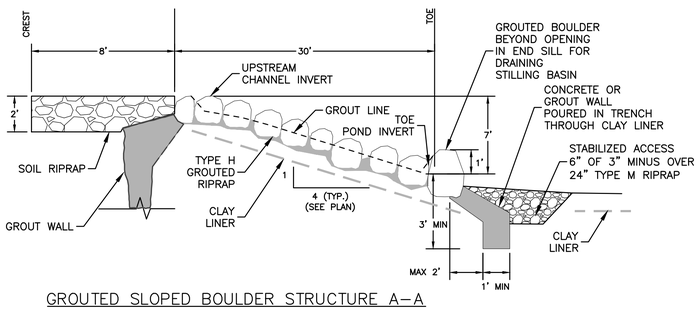
DRAWING SCALE:
HORIZONTAL: 1"=50'
VERTICAL: N/A

PROPOSED DRAINAGE CONDITIONS

PROJECT NO. 20988-00CSCV
DRAWING NO.

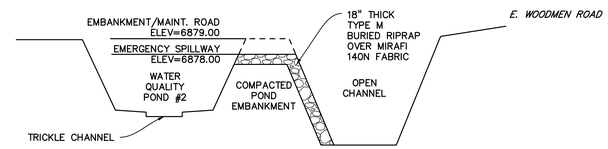
D-4

SHEET: 4 OF 5



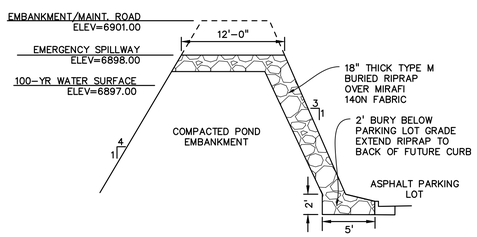
GROUTED SLOPED BOULDER STRUCTURE A–A

NO SCALE



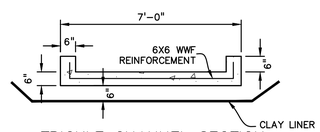
POND #2 & OPEN CHANNEL SECTION D–D

NO SCALE



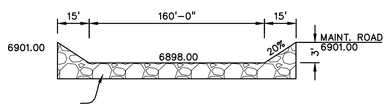
SPILLWAY SECTION B–B

NO SCALE



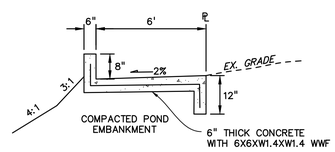
TRICKLE CHANNEL SECTION

NO SCALE



SPILLWAY SECTION C–C

NO SCALE



THIS SECTION REFERS TO A PORTION OF MAINTENANCE ROAD BEGINNING AT THE EAST EDGE OF THE GROUTED RIPRAP FOR A LENGTH OF 250–LF EAST ALONG THE NORTH PROPERTY LINE

MAINTENANCE ROAD SECTION E–E

NO SCALE

PREPARED BY:

DREXEL, BARRELL & CO.
Engineers • Surveyors
3 SOUTH 7TH STREET
COLORADO SPGS, COLORADO 80905
CONTACT: TIM D. McCONNELL, P.E.
(719)260-0887
BOULDER • COLORADO SPRINGS

CLIENT:

HUMMEL INVESTMENTS, LLC
8117 PRESTON ROAD, SUITE 120
DALLAS, TEXAS 75225
(214) 416–9820

DRAINAGE PLAN FOR
FALCON MARKETPLACE
FALCON, COLORADO

ISSUE	DATE
INITIAL ISSUE	6–28–19
REVISED	7–19–19

DESIGNED BY:	TDM
DRAWN BY:	KGV
CHECKED BY:	TDM
FILE NAME:	

PREPARED UNDER MY DIRECT SUPERVISION FOR AND ON BEHALF OF DREXEL, BARRELL & CO.

DRAWING SCALE:
HORIZONTAL: N/A
VERTICAL: N/A

PROPOSED DRAINAGE DETAILS

PROJECT NO. 20988–00CSCV

DRAWING NO.

D-5

SHEET: 5 OF 5