

## FINAL DRAINAGE REPORT

# FORT COLLINS MONTESSORI SCHOOL

LOT 1, MONTESSORI SUBDIVISION  
FORT COLLINS, CO 80526

Prepared For:

Hauser Architects, P.C.  
3780 East 15<sup>th</sup> Street, Suite 201  
Loveland, CO 80538  
970-669-8220

Prepared By:

Coffey Engineering & Surveying, LLC  
4045 St. Cloud Drive, Suite 180  
Loveland, CO 80538  
970-622-2095



Project No. 2259.03

December 17, 2019

## STAGE-DISCHARGE SIZING OF THE SPILLWAY

**Project:** Fort Collins Montessori School

**Basin ID:** Detention Pond System

**Design Information (input):**

Bottom Length of Weir	L =	20.00	feet
Angle of Side Slope Weir	Angle =	45.00	degrees
Elev. for Weir Crest	EL. Crest =	5,088.60	feet
Coef. for Rectangular Weir	C <sub>w</sub> =	2.60	
Coef. for Trapezoidal Weir	C <sub>t</sub> =	2.20	

**Calculation of Spillway Capacity (output):**

Water Surface Elevation ft. <i>(linked)</i>	Rect. Weir Flowrate cfs <i>(output)</i>	Triangle Weir Flowrate cfs <i>(output)</i>	Total Spillway Release cfs <i>(output)</i>	Total Pond Release cfs <i>(output)</i>
5083.60	0.00	0.00	0.00	0.00
5084.00	0.00	0.00	0.00	0.00
5084.50	0.00	0.00	0.00	0.00
5085.00	0.00	0.00	0.00	0.00
5085.50	0.00	0.00	0.00	0.00
5086.00	0.00	0.00	0.00	0.00
5086.50	0.00	0.00	0.00	0.00
5087.00	0.00	0.00	0.00	0.00
5087.50	0.00	0.00	0.00	0.00
5088.00	0.00	0.00	0.00	0.00
5088.60	0.00	0.00	0.00	0.00
5089.10	18.38	0.39	18.77	18.77
5089.60	52.00	2.20	54.20	54.20

This calc shows the spillway was sized for 18.77 cfs at 6-inch flow depth.

Is this the correct flow rate? Should the Phase II flow rate (25 cfs) be used?

The spillway has been expanded to 27' to pass 25 cfs of flow.

LID REQUIREMENTS	
TOTAL IMPERVIOUS AREA ON SITE	93,654 SQ FT
REQUIRED TREATMENT AREA (75%)	70,240 SQ FT
TOTAL IMPERVIOUS AREA TREATED BY LID	75,358 SQ FT (80%)

Page Updated.

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BASIN SUMMARY				
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BASIN SUMMARY				
	BASIN 1	BASIN 2	BASIN 3	BASIN 4
AREA (ACRES)	0.72	1.95	0.59	0.64
IMPERVIOUS AREA (ACRES)	0.54	0.78	0.42	0.41
PERCENT IMPERVIOUS (%)	74	41	71	62
PERCENT OF IMPERVIOUS AREA (%)	25.1	36.3	19.5	19.1
REQUIRED WQCV (INCHES)	0.235	0.146	-	0.194
LID VOLUME REQUIRED (CU. FT.)	738	1240	697	542
LID VOLUME PROVIDED (CU. FT.)	774	1332	892	576
REQUIRED FLAT AREA (SQ. FT)	464	697	-	346
PROVIDED FLAT AREA (SQ. FT)	508	1190	-	378

$$WQCV = a(0.91I^2 - 1.19I + 0.78I) \quad \text{Equation 7-1}$$

Where: WQCV = Water Quality Capture Volume, watershed inches  
 a = Coefficient corresponding to WQCV drain time (Table 5.4-1)  
 I = Imperviousness (%/100)

$$V = \left(\frac{WQCV}{12}\right) A \times 1.2 \quad \text{Equation 7-2}$$

Where: V = required volume, acre-ft  
 A = tributary catchment area upstream, acres  
 WQCV = Water Quality Capture Volume, watershed inches  
 1.2 = to account for the additional 20% of required storage for sedimentation accumulation

$$A_f = 0.02AI \quad \text{Equation B-2}$$

Where:

$A_f$  = minimum (flat) filter area (ft<sup>2</sup>)

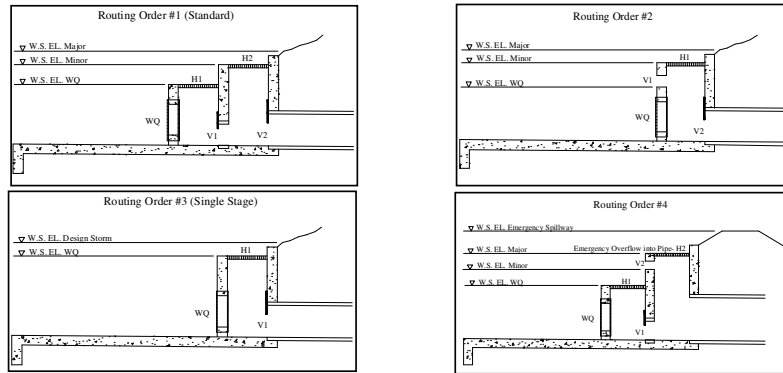
A = area tributary to the rain garden (ft<sup>2</sup>)

I = imperviousness of area tributary to the rain garden (percent expressed as a decimal)

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

Project: Fort Collins Montessori School  
 Basin ID: Rain Garden 1



**Current Routing Order is #3**

**Design Information (Input):**

Circular Opening: Diameter in Inches

OR

Rectangular Opening: Width in Feet  
 Length (Height for Vertical)

Percentage of Open Area After Trash Rack Reduction  
 Orifice Coefficient  
 Weir Coefficient  
 Orifice Elevation (Bottom for Vertical)

	#1 Horiz.	#2 Horiz.	#1 Vert.	#2 Vert.	
Dia. =					inches
W =	3.00		1.23		ft.
L or H =	3.00		1.40		ft.
% open =	50		100		%
C <sub>o</sub> =	0.67		0.60		
C <sub>w</sub> =	3.00				
E <sub>o</sub> =	5089.30		5,087.04		ft.

**Calculation of Collection Capacity:**

Net Opening Area (after Trash Rack Reduction)  
 OPTIONAL: User-Override Net Opening Area  
 Perimeter as Weir Length  
 OPTIONAL: User-Override Weir Length

A <sub>o</sub> =	4.50	1.72			sq. ft.
A <sub>b</sub> =					sq. ft.
L <sub>w</sub> =	9.00				ft.
L <sub>w</sub> =					ft.
Top Elevation of Vertical Orifice Opening, Top =	5088.44				ft.
Center Elevation of Vertical Orifice Opening, Cen =	5087.74				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).**

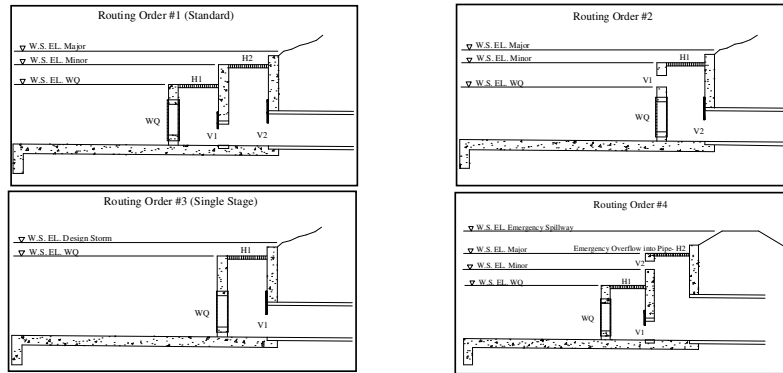
Labels for WQCV, Minor, & Major Storage W.S. Elevations	Water Surface Elevation ft	WQCV Plate/Riser Flow cfs	Horizontal Orifices				Vertical Orifices		Total Collection Capacity cfs	Target Volumes for WQCV, Minor, & Major Storage Volumes
			#1 Horiz. Weir Flow cfs	#1 Horiz. Orifice Flow cfs	#2 Horiz. Weir Flow cfs	#2 Horiz. Orifice Flow cfs	#1 Vert. Collection Capacity cfs	#2 Vert. Collection Capacity cfs		
(input)	(linked)	(User-linked)	(output)	(output)	(output)	(output)	(output)	(output)	(output)	(link for goal seek)
	5088.30	0.00	0.00	0.00	0.00	0.00	5.92	0.00	0.00	
	5088.50	0.00	0.00	0.00	0.00	0.00	7.22	0.00	0.00	
	5088.75	0.00	0.00	0.00	0.00	0.00	8.32	0.00	0.00	
	5089.00	0.00	0.00	0.00	0.00	0.00	9.30	0.00	0.00	
	5089.30	0.00	0.00	0.00	0.00	0.00	10.34	0.00	0.00	WQCV
	5089.50	0.00	2.41	10.82	0.00	0.00	10.99	0.00	2.41	
	5089.75	0.00	8.15	16.23	0.00	0.00	11.74	0.00	8.15	
	5090.00	0.00	15.81	20.24	0.00	0.00	12.45	0.00	12.45	
	5090.30	0.00	27.00	24.20	0.00	0.00	13.25	0.00	13.25	Top of RG

Please note the 100-yr flow rate for this inlet on this page

Flow added to sheet.

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

Project: Fort Collins Montessori School  
 Basin ID: Rain Garden 3



**Current Routing Order is #3**

**Design Information (Input):**

Circular Opening:	Diameter in Inches	Dia. =	#1 Horiz.	#2 Horiz.	#1 Vert.	#2 Vert.	inches
<b>OR</b>							
Rectangular Opening:	Width in Feet	W =	3.00		1.19		ft.
	Length (Height for Vertical)	L or H =	3.00		1.48		ft.
Percentage of Open Area After Trash Rack Reduction		% open =	50		100		%
Orifice Coefficient		C <sub>o</sub> =	0.67		0.60		
Weir Coefficient		C <sub>w</sub> =	3.00				
Orifice Elevation (Bottom for Vertical)		E <sub>o</sub> =	5089.25		5,085.91		ft.

**Calculation of Collection Capacity:**

Net Opening Area (after Trash Rack Reduction)	A <sub>o</sub> =	4.50	1.76	sq. ft.
OPTIONAL: User-Override Net Opening Area	A <sub>o</sub> =			sq. ft.
Perimeter as Weir Length	L <sub>w</sub> =	9.00		ft.
OPTIONAL: User-Override Weir Length	L <sub>w</sub> =			ft.
Top Elevation of Vertical Orifice Opening, Top =		5087.39		ft.
Center Elevation of Vertical Orifice Opening, Cen =		5086.65		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).**

Labels for WQCV, Minor, & Major Storage W.S. Elevations	Water Surface Elevation ft	WQCV Plate/Riser Flow cfs	Horizontal Orifices				Vertical Orifices		Total Collection Capacity cfs	Target Volumes for WQCV, Minor, & Major Storage Volumes
			#1 Horiz. Weir Flow cfs	#1 Horiz. Orifice Flow cfs	#2 Horiz. Weir Flow cfs	#2 Horiz. Orifice Flow cfs	#1 Vert. Collection Capacity cfs	#2 Vert. Collection Capacity cfs		
(input)	(linked)	(User-linked)	(output)	(output)	(output)	(output)	(output)	(output)	(output)	(link for goal seek)
	5088.25	0.00	0.00	0.00	0.00	0.00	10.72	0.00	0.00	
	5088.50	0.00	0.00	0.00	0.00	0.00	11.53	0.00	0.00	
	5088.75	0.00	0.00	0.00	0.00	0.00	12.28	0.00	0.00	
	5089.00	0.00	0.00	0.00	0.00	0.00	12.99	0.00	0.00	
	5089.25	0.00	0.00	0.00	0.00	0.00	13.66	0.00	0.00	Grate
	5089.50	0.00	3.38	12.10	0.00	0.00	14.31	0.00	3.38	
	5089.75	0.00	9.55	17.11	0.00	0.00	14.92	0.00	9.55	
	5090.00	0.00	17.54	20.95	0.00	0.00	15.51	0.00	15.51	
	5090.25	0.00	27.00	24.20	0.00	0.00	16.08	0.00	16.08	Top of RG

Please note the 100-yr flow rate for this inlet on this page

Flow added to sheet.

## Equalizer Pipe-Dentention Pond 1 to Spillway (Phase II total - P1)

Invert Elev Dn (ft)	=	5086.20
Pipe Length (ft)	=	66.00
Slope (%)	=	-3.91
Invert Elev Up (ft)	=	5083.62
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Circular Culvert
Culvert Entrance	=	Smooth tapered inlet throat
Coeff. K,M,c,Y,k	=	0.534, 0.555, 0.0196, 0.9, 0.2

### Calculations

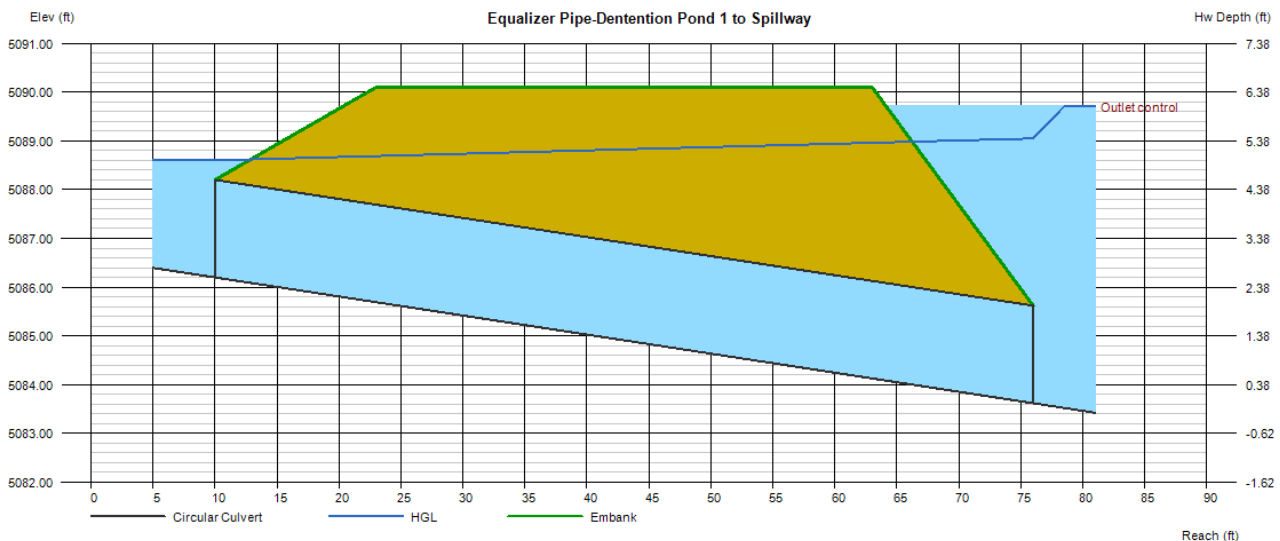
Qmin (cfs)	=	18.65
Qmax (cfs)	=	18.65
Tailwater Elev (ft)	=	5088.6

### Highlighted

Qtotal (cfs)	=	18.65
Qpipe (cfs)	=	18.65
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	5.94
Veloc Up (ft/s)	=	5.94
HGL Dn (ft)	=	5088.60
HGL Up (ft)	=	5089.05
Hw Elev (ft)	=	5089.71
Hw/D (ft)	=	3.04
Flow Regime	=	Outlet Control

### Embankment

Top Elevation (ft)	=	5090.10
Top Width (ft)	=	40.00
Crest Width (ft)	=	20.00



Note added.

Please add this note from your response to this page. Thank you!

The flowrate has been updated to be the total flow of Phase II (25.07) - The Phase II flow from Basin P1 (6.60) or 18.65 cfs.