

To: Lisa Gish
Engineering Inspector I
El Paso County Department of Public Works

From: Eric Gunderson, P.E.,
Kimley-Horn and Associates, Inc.

Date: April 6, 2023

Subject: Widefield Parks and Recreation – Recreation Center – Pond Outlet Structure

Based upon an email received by Kimley-Horn from Lisa Gish dated April 4, 2023 4:09PM, it is understood the proposed outlet structure in the extended detention basin at the subject site has been constructed differently than the approved plans dated 2/28/23. The approved plans call for a 5'x5' Type C CDOT structure with 4:1 sideslope/grate. Based upon the referenced email from the County, it is understood the structure was installed at 4'x4' and was installed with a flat top instead of the 4:1 sloping grate.

Attached is a markup of the approved pond plans showing the as constructed condition based upon the information above. Kimley-Horn redesigned the outlet structure using this information and the MHFD analysis has been included in this memo, following the plan markup.

Kimley-Horn proposes lowering the restrictor plate on the outlet pipe 6" for a total of 12" of clearance as noted. This will maintain the appropriate pre-development vs. post development flow ratios and drain times to be in compliance with the approved final drainage report for the project.

Final as-built drawings will be required to be provided to Kimley-Horn to perform the final pond certification following construction. The pond certification will then be submitted to El Paso County for their records.

Based upon the information above and analysis performed herein and the adjustment to the restrictor plate, the change in size and slope of the outlet structure is acceptable to the engineer of record.

Thank You,

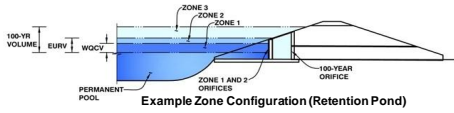
Eric Gunderson, PE



DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Widfield Rec Center
 Basin ID: South Pond - As Built Condition



UNCHANGED FROM APPROVED FDR
 AMENDMENT NO. 1 DATED 3/1/23

Watershed Information

Selected BMP Type =	EDB
Watershed Area =	22.04 acres
Watershed Length =	1,400 ft
Watershed Length to Centroid =	600 ft
Watershed Slope =	0.040 ft/ft
Watershed Imperviousness =	20.00% 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
Target WQC Drain Time =	40.0 hours
Location for 1-hr Rainfall Depths =	User Input

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

Water Quality Capture Volume (WOCV) =	0.212 acre-feet
Excess Urban Runoff Volume (EURV) =	0.393 acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.248 acre-feet
5-yr Runoff Volume (P1 = 1.5 in.) =	0.358 acre-feet
10-yr Runoff Volume (P1 = 1.75 in.) =	0.460 acre-feet
25-yr Runoff Volume (P1 = 2 in.) =	0.797 acre-feet
50-yr Runoff Volume (P1 = 2.25 in.) =	1.118 acre-feet
100-yr Runoff Volume (P1 = 2.55 in.) =	1.599 acre-feet
500-yr Runoff Volume (P1 = 3.14 in.) =	2.515 acre-feet
Approximate 2-yr Detention Volume =	0.243 acre-feet
Approximate 5-yr Detention Volume =	0.327 acre-feet
Approximate 10-yr Detention Volume =	0.417 acre-feet
Approximate 25-yr Detention Volume =	0.541 acre-feet
Approximate 50-yr Detention Volume =	0.651 acre-feet
Approximate 100-yr Detention Volume =	0.876 acre-feet

Optional User Overrides

		acre-feet
		acre-feet
	1.19	inches
	1.50	inches
	1.75	inches
	2.00	inches
	2.25	inches
	2.55	inches
		inches

Depth Increment = 1.00 ft		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	--	--	--	--	16	0.000	--	--
5759	--	0.68	--	--	--	604	0.014	211	0.005	--
5760	--	1.68	--	--	--	3,953	0.091	2,489	0.057	--
5761	--	2.68	--	--	--	9,115	0.209	9,023	0.207	--
5762	--	3.68	--	--	--	12,037	0.276	19,599	0.450	--
5763	--	4.68	--	--	--	14,094	0.324	32,665	0.750	--
5764	--	5.68	--	--	--	16,345	0.375	47,884	1.099	--
5765	--	6.68	--	--	--	18,851	0.433	65,482	1.503	--

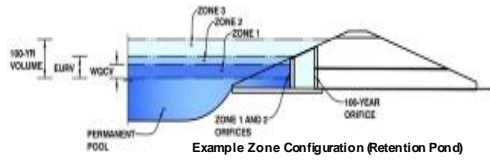
Define Zones and Basin Geometry

Zone 1 Volume (WOCV) =	0.212	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.181	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.483	acre-feet
Total Detention Basin Volume =	0.876	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

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD- Detention, Version 4.06 (July 2022)

Project: Widefield Rec Center
Basin ID: South Pond - As Built Condition



	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WOCV)	2.71	0.212	Orifice Plate
Zone 2 (EURV)	3.47	0.181	Circular Orifice
Zone 3 (100-year)	5.06	0.483	Weir&Pipe (Restrict)
Total (all zones)		0.876	

CHANGES FROM APPROVED FDR AMENDMENT NO. 1 DATED 3/1/23 NOTED IN RED

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

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

Calculated Parameters for Underdrain

Underdrain Orifice Area = ft²
Underdrain Orifice Centroid = feet

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

Centroid of Lowest Orifice = ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate = ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing = inches
Orifice Plate: Orifice Area per Row = sq. inches (diameter = 15/16 inch)

Calculated Parameters for Plate

WQ Orifice Area per Row = ft²
Elliptical Half-Width = feet
Elliptical Slot Centroid = feet
Elliptical Slot Area = ft²

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.00	2.00					
Orifice Area (sq. inches)	0.67	0.67	0.67					

	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)

	Zone 2 Circular	Not Selected	
Invert of Vertical Orifice =	<input type="text" value="2.71"/>	<input type="text" value="N/A"/>	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	<input type="text" value="3.47"/>	<input type="text" value="N/A"/>	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	<input type="text" value="1.87"/>	<input type="text" value="N/A"/>	inches

Calculated Parameters for Vertical Orifice

	Zone 2 Circular	Not Selected	
Vertical Orifice Area =	<input type="text" value="0.02"/>	<input type="text" value="N/A"/>	ft ²
Vertical Orifice Centroid =	<input type="text" value="0.08"/>	<input type="text" value="N/A"/>	feet

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

5' PER FDR
4 PER FDR
5' PER FDR

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, H _o =	<input type="text" value="3.47"/>	<input type="text" value="N/A"/>	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	<input type="text" value="4.00"/>	<input type="text" value="N/A"/>	feet
Overflow Weir Gate Slope =	<input type="text" value="0.00"/>	<input type="text" value="N/A"/>	H:V
Horiz. Length of Weir Sides =	<input type="text" value="4.00"/>	<input type="text" value="N/A"/>	feet
Overflow Gate Type =	Type C Gate	<input type="text" value="N/A"/>	
Debris Clogging % =	50%	<input type="text" value="N/A"/>	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Gate Upper Edge, H ₁ =	<input type="text" value="3.47"/>	<input type="text" value="N/A"/>	feet
Overflow Weir Slope Length =	<input type="text" value="4.00"/>	<input type="text" value="N/A"/>	feet
Gate Open Area / 100-yr Orifice Area =	<input type="text" value="7.09"/>	<input type="text" value="N/A"/>	
Overflow Gate Open Area w/o Debris =	<input type="text" value="11.14"/>	<input type="text" value="N/A"/>	ft ²
Overflow Gate Open Area w/ Debris =	<input type="text" value="5.57"/>	<input type="text" value="N/A"/>	ft ²

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

18 PER FDR

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	<input type="text" value="0.08"/>	<input type="text" value="N/A"/>	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	<input type="text" value="24.00"/>	<input type="text" value="N/A"/>	inches
Restrictor Plate Height Above Pipe Invert =	<input type="text" value="12.00"/>	<input type="text" value="N/A"/>	inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	<input type="text" value="1.57"/>	<input type="text" value="N/A"/>	ft ²
Outlet Orifice Centroid =	<input type="text" value="0.58"/>	<input type="text" value="N/A"/>	feet
Half-Central Angle of Restrictor Plate on Pipe =	<input type="text" value="1.57"/>	<input type="text" value="N/A"/>	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage =	<input type="text" value="5.18"/>	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	<input type="text" value="21.00"/>	feet
Spillway End Slopes =	<input type="text" value="4.00"/>	H:V
Freeboard above Max Water Surface =	<input type="text" value="1.00"/>	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth =	<input type="text" value="0.50"/>	feet
Stage at Top of Freeboard =	<input type="text" value="6.68"/>	feet
Basin Area at Top of Freeboard =	<input type="text" value="0.43"/>	acres
Basin Volume at Top of Freeboard =	<input type="text" value="1.50"/>	acre-ft

Routed Hydrograph Results

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

	WOCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period =									
One-Hour Rainfall Depth (in)	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.55	3.14
CUHP Runoff Volume (acre-ft)	0.212	0.393	0.248	0.358	0.460	0.797	1.118	1.599	2.515
Inflow Hydrograph Volume (acre-ft)	N/A	N/A	0.248	0.358	0.460	0.797	1.118	1.599	2.515
CUHP Predevelopment Peak Q (cfs)	N/A	N/A	0.2	0.4	0.5	4.9	9.8	16.6	28.6
OPTIONAL Override Predevelopment Peak Q (cfs)	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre)	N/A	N/A	0.01	0.02	0.02	0.22	0.44	0.76	1.30
Peak Inflow Q (cfs)	N/A	N/A	3.4	5.0	6.3	11.7	16.9	24.1	36.8
Peak Outflow Q (cfs)	0.1	0.2	0.1	0.2	0.6	5.3	9.9	14.8	23.1
Ratio Peak Outflow to Predevelopment Q	N/A	N/A	N/A	0.4	1.2	1.1	1.0	0.9	0.8
Structure Controlling Flow	Vertical Orifice 1	Overflow Weir 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Spillway
Max Velocity through Gate 1 (fps)	N/A	N/A	N/A	N/A	0.0	0.5	0.9	1.3	1.5
Max Velocity through Gate 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)	46	59	51	58	61	57	54	50	43
Time to Drain 99% of Inflow Volume (hours)	49	64	54	62	67	64	63	60	57
Maximum Ponding Depth (ft)	2.71	3.47	2.79	3.23	3.54	3.81	3.99	4.31	5.39
Area at Maximum Ponding Depth (acres)	0.21	0.26	0.22	0.25	0.27	0.28	0.29	0.31	0.36
Maximum Volume Stored (acre-ft)	0.213	0.393	0.231	0.330	0.409	0.483	0.535	0.633	0.993