EPC STORMWATER REVIEW COMMENTS
IN ORANGE BOXES WITH BLACK TEXT

Falcon Highlands South

Preliminary Drainage Report

Owner/Developer
Challenger Homes
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Atwell, LLC
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303-462-1100
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Atwell Project Number
21005234

Submitted by: Atwell, LLC

October 30, 2023

PUDSP-22-005

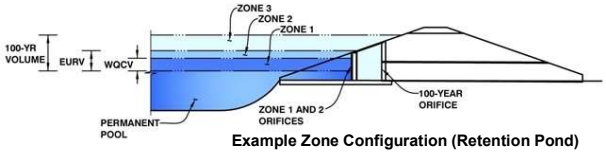
Provide the missing pages of the MHFD spreadsheet.

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Project: FALCON HIGHLANDS FILING NO. 3

Basin ID: DETENTION POND 1 (BASINS B, OS-1, OS-2, OS-4, OS-5)



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	4.15	1.805	Orifice Plate
Zone 2 (EURV)	6.18	3.538	Orifice Plate
Zone 3 (100-year)	7.50	3.615	Weir&Pipe (Restrict)
Total (all zones)		8.958	

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

			Calculated Parameters for Underdrain		
Underdrain Orifice Invert Depth =		ft (distance below the filtration media surface)	Underdrain Orifice Area =		ft²
Underdrain Orifice Diameter =		inches	Underdrain Orifice Centroid =		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)

			Calculated Parameters for Plate		
Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	5.056E-02	ft²
Depth at top of Zone using Orifice Plate =	6.18	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	24.00	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	7.28	sq. inches (use rectangular openings)	Elliptical Slot Area =	N/A	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	2.00	4.00	6.00				
Orifice Area (sq. inches)	7.28	7.28	7.28	7.28				

	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		Calculated Parameters for Vertical Orifice	Not Selected	Not Selected	
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	N/A	N/A	ft²
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	N/A	N/A	feet
Vertical Orifice Diameter =	N/A	N/A	inches				

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

	Zone 3 Weir	Not Selected		Calculated Parameters for Overflow Weir	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	6.00	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	6.00	N/A	feet
Overflow Weir Front Edge Length =	4.67	N/A	feet	Overflow Weir Slope Length =	3.50	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	29.71	N/A	
Horiz. Length of Weir Sides =	3.50	N/A	feet	Overflow Grate Open Area w/o Debris =	11.38	N/A	ft²
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	5.69	N/A	ft²
Debris Clogging % =	50%	N/A	%				

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

	Zone 3 Restrictor	Not Selected		Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	1.00	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	0.38	N/A	ft²
Outlet Pipe Diameter =	42.00	N/A	inches	Outlet Orifice Centroid =	0.17	N/A	feet
Restrictor Plate Height Above Pipe Invert =	3.50		inches	Half-Central Angle of Restrictor Plate on Pipe =	0.59	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

			Calculated Parameters for Spillway		
Spillway Invert Stage=	9.00	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	1.38	feet
Spillway Crest Length =	60.00	feet	Stage at Top of Freeboard =	10.38	feet
Spillway End Slopes =	5.00	H:V	Basin Area at Top of Freeboard =	4.07	acres
Freeboard above Max Water Surface =	0.00	feet	Basin Volume at Top of Freeboard =	16.07	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).*

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) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.14
CUHP Runoff Volume (acre-ft) =	1.805	5.343	3.998	5.371	6.465	8.455	10.397	12.929	18.387
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	3.998	5.371	6.465	8.455	10.397	12.929	18.387
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	1.7	3.4	4.7	40.0	79.1	127.8	228.6
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.03	0.04	0.34	0.67	1.08	1.94
Peak Inflow Q (cfs) =	N/A	N/A	82.6	111.9	136.5	192.3	244.1	318.7	451.4
Peak Outflow Q (cfs) =	0.9	3.5	1.3	2.2	5.0	5.2	5.4	5.6	51.9
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.6	1.1	0.1	0.1	0.0	0.2
Structure Controlling Flow =	Plate	Overflow Weir 1	Plate	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	0.18	N/A	0.1	0.3	0.3	0.3	0.3	0.3
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	67	58	68	69	71	73	76	77
Time to Drain 99% of Inflow Volume (hours) =	**40**	72	62	73	75	78	82	86	89
Maximum Ponding Depth (ft) =	4.15	6.18	5.43	6.09	6.43	7.10	7.72	8.46	9.40
Area at Maximum Ponding Depth (acres) =	1.28	2.36	1.80	2.29	2.56	2.86	3.17	3.49	4.01
Maximum Volume Stored (acre-ft) =	1.809	5.348	3.798	5.115	5.964	7.764	9.641	12.141	15.628

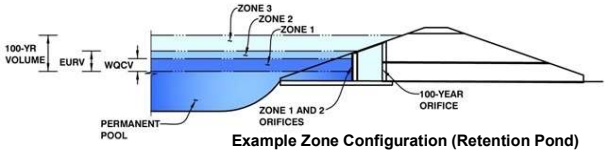
Provide the missing pages of the MHFD spreadsheet.

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: FALCON HIGHLANDS SOUTH

Basin ID: DETENTION POND 2 - (BASINS C, OS-3, 0S-6, OS-7)



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	4.97	1.461	Orifice Plate
Zone 2 (EURV)	6.93	2.497	Orifice Plate
Zone 3 (100-year)	8.50	2.950	Weir&Pipe (Restrict)
Total (all zones)		6.908	

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

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)	Underdrain Orifice Area =	N/A	ft²
Underdrain Orifice Diameter =	N/A	inches	Underdrain Orifice Centroid =	N/A	feet

Calculated Parameters for Underdrain

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

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	3.458E-02	ft²
Depth at top of Zone using Orifice Plate =	4.50	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	27.00	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	4.98	sq. inches (use rectangular openings)	Elliptical Slot Area =	N/A	ft²

Calculated Parameters for Plate

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	2.20	4.40					
Orifice Area (sq. inches)	4.98	4.98	4.98					

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

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected			Not Selected	Not Selected	
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	N/A	N/A	ft²
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	N/A	N/A	feet
Vertical Orifice Diameter =	N/A	N/A	inches				

Calculated Parameters for Vertical Orifice

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

	Zone 3 Weir	Not Selected			Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	5.50	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	5.50	N/A	feet
Overflow Weir Front Edge Length =	4.67	N/A	feet	Overflow Weir Slope Length =	3.50	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	33.90	N/A	
Horiz. Length of Weir Sides =	3.50	N/A	feet	Overflow Grate Open Area w/o Debris =	11.38	N/A	ft²
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	5.69	N/A	ft²
Debris Clogging % =	50%	N/A	%				

Calculated Parameters for Overflow Weir

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

	Zone 3 Restrictor	Not Selected			Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	1.00	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	0.34	N/A	ft²
Outlet Pipe Diameter =	42.00	N/A	inches	Outlet Orifice Centroid =	0.16	N/A	feet
Restrictor Plate Height Above Pipe Invert =	3.20		inches	Half-Central Angle of Restrictor Plate on Pipe =	0.56	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	9.50	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	1.36	feet
Spillway Crest Length =	60.00	feet	Stage at Top of Freeboard =	10.86	feet
Spillway End Slopes =	5.00	H:V	Basin Area at Top of Freeboard =	2.68	acres
Freeboard above Max Water Surface =	0.00	feet	Basin Volume at Top of Freeboard =	10.51	acre-ft

Calculated Parameters for Spillway

Routed Hydrograph Results

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

Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.14
CUHP Runoff Volume (acre-ft) =	1.461	3.958	2.782	3.770	4.562	6.235	7.830	9.935	14.450
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	2.782	3.770	4.562	6.235	7.830	9.935	14.450
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	2.4	4.4	6.3	60.6	107.6	179.2	303.0
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.02	0.04	0.06	0.59	1.04	1.74	2.94
Peak Inflow Q (cfs) =	N/A	N/A	76.1	112.7	143.2	201.4	269.1	329.3	498.0
Peak Outflow Q (cfs) =	0.8	4.5	4.2	4.4	4.5	4.8	5.0	5.2	71.1
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.0	0.7	0.1	0.0	0.0	0.2
Structure Controlling Flow =	Plate	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1	Spillway	N/A
Max Velocity through Grate 1 (fps) =	N/A	0.30	0.29	0.3	0.3	0.3	0.3	0.3	0.3
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) =	37	47	47	47	48	50	52	55	51
Time to Drain 99% of Inflow Volume (hours) =	**40**	52	51	52	54	57	60	63	61
Maximum Ponding Depth (ft) =	4.97	6.93	5.84	6.44	6.93	7.87	8.62	9.50	10.00
Area at Maximum Ponding Depth (acres) =	0.87	1.62	1.25	1.45	1.62	1.88	2.23	2.48	2.68
Maximum Volume Stored (acre-ft) =	1.469	3.965	2.396	3.199	3.965	5.594	7.157	9.222	10.512

see additional comments on DR-06

Design Procedure Form: Runoff Reduction

UD-BMP (Version 3.07, March 2018)

Designer: SNB
Company: Atwell, LLC
Date: September 20, 2023
Project: Falcon Highlands
Location: El Paso County

SITE INFORMATION (User Input in Blue Cells)

confirm slope

WQCV Rainfall Depth = 0.60 inches
Depth of Average Runoff Producing Storm, d_6 = 0.43 inches (for Watersheds Outside of the Denver Region, Figure 3-1 in USDCM Vol. 3)

Area Type	UIA:RPA											
Area ID	A											
Downstream Design Point ID	E											
Downstream BMP Type	None											
DCIA (ft^2)	--											
UIA (ft^2)	34,529											
RPA (ft^2)	17,265											
SPA (ft^2)	--											
HSG A (%)	100%											
HSG B (%)	0%											
HSG C/D (%)	0%											
Average Slope of RPA (ft/ft)	0.009											
UIA:RPA Interface Width (ft)	350.00											

interface looks to be approximately 815'

CALCULATED RUNOFF RESULTS

Area ID	A											
UIA:RPA Area (ft^2)	51,794											
L / W Ratio	0.42											
UIA / Area	0.6667											
Runoff (in)	0.00											
Runoff (ft^3)	0											
Runoff Reduction (ft^3)	1439											

CALCULATED WQCV RESULTS

Area ID	A											
WQCV (ft^3)	1439											
WQCV Reduction (ft^3)	1439											
WQCV Reduction (%)	100%											
Untreated WQCV (ft^3)	0											

CALCULATED DESIGN POINT RESULTS (sums results from all columns with the same Downstream Design Point ID)

Downstream Design Point ID	E											
DCIA (ft^2)	0											
UIA (ft^2)	34,529											
RPA (ft^2)	17,265											
SPA (ft^2)	0											
Total Area (ft^2)	51,794											
Total Impervious Area (ft^2)	34,529											
WQCV (ft^3)	1,439											
WQCV Reduction (ft^3)	1,439											
WQCV Reduction (%)	100%											
Untreated WQCV (ft^3)	0											

CALCULATED SITE RESULTS (sums results from all columns in worksheet)

Total Area (ft^2)	51,794
Total Impervious Area (ft^2)	34,529
WQCV (ft^3)	1,439
WQCV Reduction (ft^3)	1,439
WQCV Reduction (%)	100%
Untreated WQCV (ft^3)	0

if you combine the information onto one sheet, the spreadsheet will then average the WQCV Reduction %. You need an average of 80% WQCV Reduction for Runoff Reduction.

Design Procedure Form: Runoff Reduction

UD-BMP (Version 3.07, March 2018) — Sheet 1 of 1

Designer:
Company: SNB
Date: September 20, 2023
Project: Falcon Highlands
Location: El Paso County

SITE INFORMATION (User Input in Blue Cells)

WQCV Rainfall Depth = 0.60 inches
Depth of Average Runoff Producing Storm, d_6 = 0.43 inches (for Watersheds Outside of the Denver Region, Figure 3-1 in USDCM Vol. 3)

Area Type	UIA:RPA											
Area ID	B & C											
Downstream Design Point ID	F											
Downstream BMP Type	None											
DCIA (ft^2)	--											
UIA (ft^2)	36,334											
RPA (ft^2)	18,167											
SPA (ft^2)	--											
HSG A (%)	100%											
HSG B (%)	0%											
HSG C/D (%)	0%											
Average Slope of RPA (ft/ft)	0.009											
UIA:RPA Interface Width (ft)	350.00											

local stormwater arrow shows slope at 0.076

interface looks to be approximately 515'

CALCULATED RUNOFF RESULTS

Area ID	B & C											
UIA:RPA Area (ft^2)	54,501											
L / W Ratio	0.44											
UIA / Area	0.6667											
Runoff (in)	0.00											
Runoff (ft^3)	0											
Runoff Reduction (ft^3)	1514											

CALCULATED WQCV RESULTS

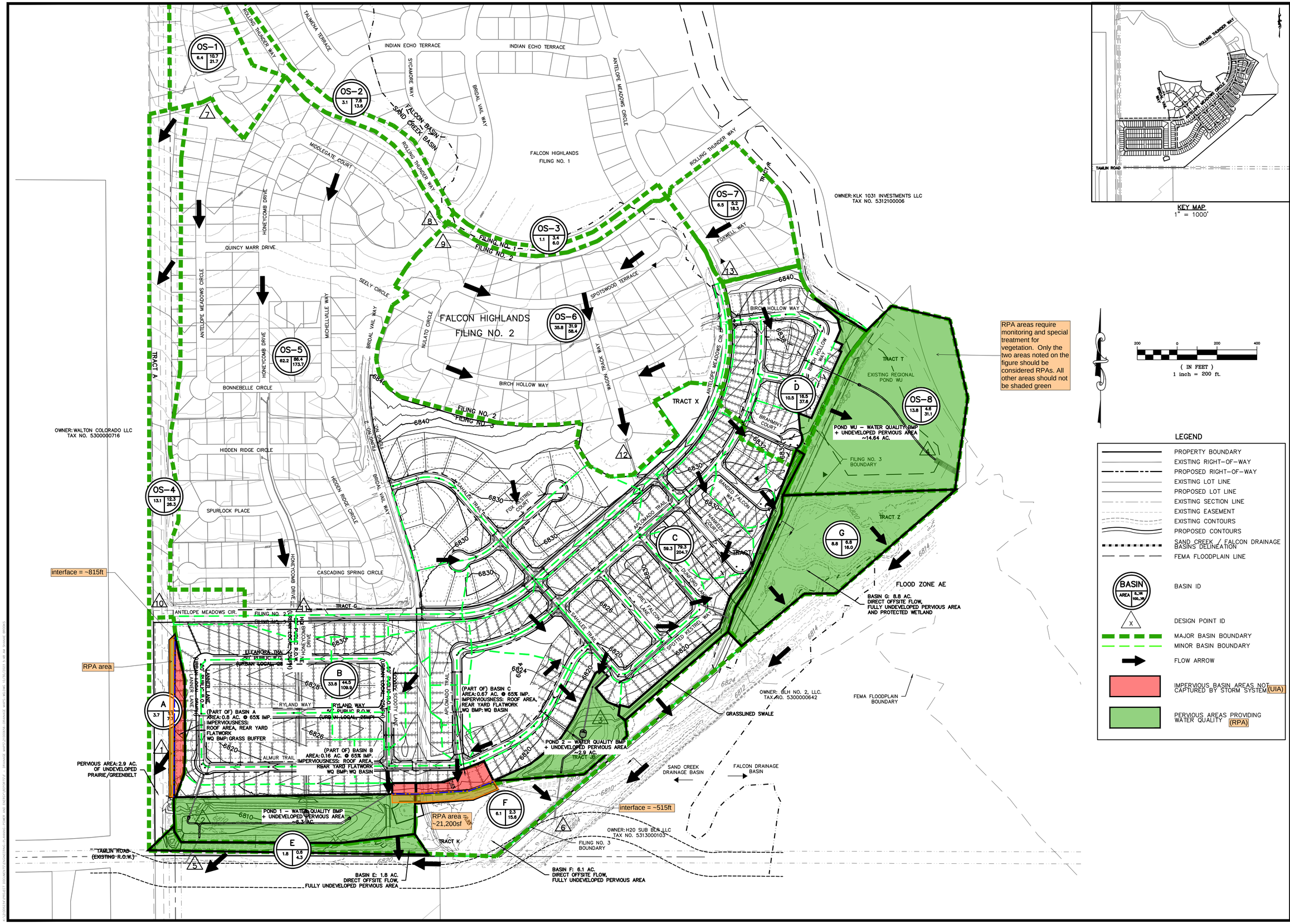
Area ID	B & C											
WQCV (ft^3)	1514											
WQCV Reduction (ft^3)	1514											
WQCV Reduction (%)	100%											
Untreated WQCV (ft^3)	0											

CALCULATED DESIGN POINT RESULTS (sums results from all columns with the same Downstream Design Point ID)

Downstream Design Point ID	F											
DCIA (ft^2)	0											
UIA (ft^2)	36,334											
RPA (ft^2)	18,167											
SPA (ft^2)	0											
Total Area (ft^2)	54,501											
Total Impervious Area (ft^2)	36,334											
WQCV (ft^3)	1,514											
WQCV Reduction (ft^3)	1,514											
WQCV Reduction (%)	100%											
Untreated WQCV (ft^3)	0											

CALCULATED SITE RESULTS (sums results from all columns in worksheet)

Total Area (ft^2)	54,501
Total Impervious Area (ft^2)	36,334
WQCV (ft^3)	1,514
WQCV Reduction (ft^3)	1,514
WQCV Reduction (%)	100%
Untreated WQCV (ft^3)	0



811 Know what's below. Call before you dig.

THE LOCATIONS OF EXISTING UNDERGROUND UTILITIES ARE SHOWN IN AN APPROXIMATE WAY ONLY AND HAVE NOT BEEN INDEPENDENTLY VERIFIED BY THE OWNER OR ITS REPRESENTATIVE. THE CONTRACTOR SHALL DETERMINE THE EXACT LOCATION OF ALL EXISTING UTILITIES BEFORE COMMENCING WORK, AND AGREES TO BE FULLY RESPONSIBLE FOR ANY AND ALL DAMAGES WHICH MIGHT BE OCCASIONED BY THE CONTRACTOR'S FAILURE TO EXACTLY LOCATE AND PRESERVE ANY AND ALL UNDERGROUND UTILITIES.

NOTICE:
CONSTRUCTION SITE SAFETY IS THE SOLE RESPONSIBILITY OF THE CONTRACTOR; NEITHER THE OWNER NOR THE ENGINEER SHALL BE EXPECTED TO ASSUME ANY RESPONSIBILITY FOR SAFETY OF THE WORK, OF PERSONS ENGAGED IN THE WORK, OF ANY NEARBY STRUCTURES, OR OF ANY OTHER PERSONS.

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JIM BYERS

PROJECT
FALCON HIGHLANDS FILING NO. 3
EL PASO COUNTY, COLORADO
DRAINAGE MAP
WATER QUALITY MAP

DATE 08/26/2022

A	1st SUBMITTAL TO EPC 02/21/2022 – RDL
B	2nd SUBMITTAL TO EPC 08/26/2022 – RDL
C	3rd SUBMITTAL TO EPC 04/26/2023 – RDL
D	4TH SUBMITTAL TO EPC 07/21/2023 – DJM

REVISIONS

DR. SLP CH. DJM
P.M. DJM
JOB 21002568
SHEET NO. 1
DR-06

CAD FILE: 21000866-DRAINAGE MAPS-WQ.DWG