

**FINAL DRAINAGE REPORT – ADDENDUM NO. 1**

**for**

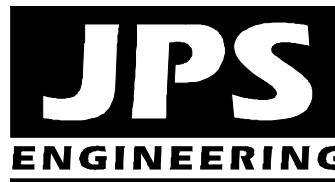
**ARACO ENTERPRISES LLC - BUILDING ADDITION  
7470 SOUTHMOOR DRIVE, FOUNTAIN, CO**

**Prepared for:**

**Araco Enterprises LLC**  
7470 Southmoor Drive  
Fountain, CO 80817

June 17, 2024

**Prepared by:**



**19 E. Willamette Ave.  
Colorado Springs, CO 80903  
(719)-477-9429  
[www.jpsengr.com](http://www.jpsengr.com)**

**JPS Project No. 111705  
PPR-1950**

**ARACO ENTERPRISES LLC - BUILDING ADDITION  
7470 SOUTHMOOR DRIVE, FOUNTAIN, CO  
DRAINAGE REPORT STATEMENTS**



**1. Engineer's Statement:**

The attached drainage plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the County for drainage reports and said report is in conformity with the master plan for the drainage basin. I accept responsibility for liability caused by negligent acts, errors or omissions on my part in preparing this report:

*John P. Schwab*

John P. Schwab      Colorado P.E. No. 29891

**2. Developer's Statement:**

I, the developer, have read and will comply with all the requirements specified in this drainage report and plan.

By: \_\_\_\_\_

6/21/24

Printed Name: Arturo Acosta

\_\_\_\_\_  
Date

Title: Manager

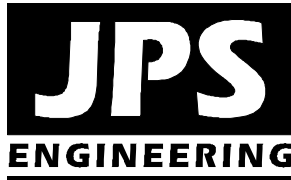
**3. El Paso County Statement:**

Filed in accordance with the requirements of the El Paso County Land Development Code, Drainage Criteria Manual, Volumes 1 and 2, and Engineering Criteria Manual as amended.

\_\_\_\_\_  
Joshua Palmer, P.E.  
County Engineer / ECM Administrator

\_\_\_\_\_  
Date

Conditions:



19 E. Willamette Avenue  
Colorado Springs, CO 80903  
(719)-477-9429  
www.jpsegr.com

## **ARACO ENTERPRISES LLC – FINAL DRAINAGE REPORT ADDENDUM NO. 1**

### **I. GENERAL**

#### **A. Background**

Araco Enterprises LLC is constructing a building addition along with parking and related site improvements on the developed property at 7470 Southmoor Drive in Fountain, Colorado. The project site (El Paso County Assessor's No. 65244-00-085) is an unplatted 4.2-acre developed parcel described as a tract in the Southeast Quarter of Section 24, Township 15 South, Range 66 West of the 6<sup>th</sup> P.M. The property is located along the southwest side of Southmoor Drive. The property is zoned M (Industrial).

#### **B. Scope**

JPS Engineering prepared the "Final Drainage Report (FDR) for Araco Enterprises LLC – Building Addition" dated June 10, 2022 (approved by El Paso County on 1/5/23; PPR-1950). This report serves as an Addendum to the previously approved FDR. The purpose of this Addendum is to provide updated drainage calculations in support of consolidating the on-site stormwater detention facilities into a single basin at the northwest corner of the property.

### **II. DEVELOPED DRAINAGE CONDITIONS**

The developed drainage basins and projected flows are shown on the attached Figure D1 (Appendix C). The previously depicted Detention Basin A2 (near the southeast corner of the site) has been eliminated, and the proposed Detention Basin A1 at the northwest corner of the site has been enlarged to meet all of the required on-site stormwater detention and water quality requirements.

Appendix A of this Addendum includes updated hydrologic calculations along with updated hydraulic calculations for the proposed Storm Sewer System A2-A1 (24" HDPE and 18" HDPE) conveying the developed drainage from the southerly Basin A2 into Detention Basin A1.

Appendix B includes updated detention pond design calculations, and the revised outlet structure design details are provided on Sh. C3.1.

### **III. SUMMARY**

This Addendum No. 1 to the “Final Drainage Report for Araco Enterprises LLC – Building Addition” provides revised drainage calculations for the consolidation of on-site stormwater detention facilities in Detention Basin A1 at the northwest corner of the property. The proposed detention pond has been designed to provide stormwater detention and water quality to mitigate developed drainage impacts for this site. Proper construction and maintenance of the proposed drainage and erosion control facilities will ensure that this development has no significant adverse drainage impact on downstream or surrounding areas.

**APPENDIX A**  
**DRAINAGE CALCULATIONS**

ARACO CONCRETE  
COMPOSITE RUNOFF COEFFICIENTS

DEVELOPED CONDITIONS											
5-YEAR C VALUES											
BASIN	TOTAL AREA (AC)	(AC)	SUB-AREA 1 DEVELOPMENT/ COVER	C	AREA (AC)	SUB-AREA 2 DEVELOPMENT/ COVER	C	(AC)	SUB-AREA 3 DEVELOPMENT/ COVER	C	WEIGHTED C VALUE
A1	1.46	1.293	ASPHALT	0.9	0.167	LANDSCAPED	0.08				0.806
A2	2.30	1.340	BUILDING / ASPHALT	0.9	0.550	GRAVEL	0.59	0.41	LANDSCAPED	0.08	0.665
A1,A2	3.76										0.720
100-YEAR C VALUES											
BASIN	TOTAL AREA (AC)	(AC)	SUB-AREA 1 DEVELOPMENT/ COVER	C	AREA (AC)	SUB-AREA 2 DEVELOPMENT/ COVER	C	(AC)	SUB-AREA 3 DEVELOPMENT/ COVER	C	WEIGHTED C VALUE
A1	1.46	1.293	ASPHALT	0.96	0.167	LANDSCAPED	0.35				0.890
A2	2.30	1.340	BUILDING / ASPHALT	0.96	0.550	GRAVEL	0.7	0.41	LANDSCAPED	0.35	0.727
A1,A2	3.76										0.790

ARACO CONCRETE  
RATIONAL METHOD

## HISTORIC FLOWS

BASIN	DESIGN POINT	AREA (AC)	C		Overland Flow			Channel flow					TOTAL T <sub>c</sub> <sup>(4)</sup> (MIN)	TOTAL T <sub>c</sub> <sup>(4)</sup> (MIN)	INTENSITY <sup>(5)</sup>		PEAK FLOW	
			5-YEAR	100-YEAR	LENGTH (FT)	SLOPE (FT/FT)	T <sub>co</sub> <sup>(1)</sup> (MIN)	CHANNEL LENGTH (FT)	CONVEYANCE COEFFICIENT C	SLOPE (FT/FT)	SCS <sup>(2)</sup> VELOCITY (FT/S)	T <sub>t</sub> <sup>(3)</sup> (MIN)			5-YR (IN/HR)	100-YR (IN/HR)	Q5 <sup>(6)</sup> (CFS)	Q100 <sup>(6)</sup> (CFS)
A	1	3.76	0.113	0.374	300	0.01	31.3	70	15	0.014	1.77	0.7	32.0	32.0	2.39	4.01	1.01	5.63
B	2	0.44	0.080	0.350	60	0.17	5.7	130	15	0.015	1.84	1.2	6.8	6.8	4.70	7.89	0.17	1.21

## DEVELOPED FLOWS

					Overland Flow			Channel flow												
BASIN	DESIGN POINT	AREA (AC)	C		LENGTH (FT)	SLOPE (FT/FT)	Tco <sup>(1)</sup> (MIN)	CHANNEL LENGTH (FT)	CONVEYANCE COEFFICIENT C	SLOPE (FT/FT)	SCS <sup>(2)</sup> VELOCITY (FT/S)	Tt <sup>(3)</sup> (MIN)	TOTAL Tc <sup>(4)</sup> (MIN)	TOTAL Tc <sup>(4)</sup> (MIN)	INTENSITY <sup>(5)</sup>		PEAK FLOW			
			5-YEAR	100-YEAR											5-YR (IN/HR)	100-YR (IN/HR)	Q5 <sup>(6)</sup> (CFS)	Q100 <sup>(6)</sup> (CFS)		
DEVELOPED FLOW:																				
A1	A1	1.46	0.806	0.890	100	0.01	5.4	200	20	0.015	2.45	1.4	6.7	6.7	4.72	7.93	5.55	10.30		
A2	A2	2.30	0.665	0.727	100	0.03	5.5	500	20	0.01	2.00	4.2	9.7	9.7	4.18	7.01	6.39	11.72		
Tt A2 to DP1								485	20	0.008	1.79	4.5								
A1,A2			1	3.76	0.720	0.790							14.2	14.2	3.60	6.05	9.75	17.96		
DETAINED FLOW:																				
POND A1 DISCHARGE			1	3.76													0.10	1.00		
B			2	0.44	0.080	0.350	60	0.17	5.7	130	15	0.015	1.84	1.2	6.8	6.8	4.70	7.89	0.17	1.21

1) OVERLAND FLOW T<sub>co</sub> = (0.395\*(1.1-RUNOFF COEFFICIENT)\*(OVERLAND FLOW LENGTH<sup>(0.5)</sup>/(SLOPE<sup>(0.333)</sup>))2) SCS VELOCITY = C \* ((SLOPE(FT/FT)<sup>0.5</sup>))

C = 2.5 FOR HEAVY MEADOW

C = 5 FOR TILLAGE/FIELD

C = 7 FOR SHORT PASTURE AND LAWNS

C = 10 FOR NEARLY BARE GROUND

C = 15 FOR GRASSED WATERWAY

C = 20 FOR PAVED AREAS AND SHALLOW PAVED SWALES

3) MANNING'S CHANNEL TRAVEL TIME = L/V (WHEN CHANNEL VELOCITY IS KNOWN)

4) T<sub>c</sub> = T<sub>co</sub> + T<sub>t</sub>

\*\*\* IF TOTAL TIME OF CONCENTRATION IS LESS THAN 5 MINUTES, THEN 5 MINUTES IS USED

5) INTENSITY BASED ON I-D-F EQUATIONS IN CITY OF COLORADO SPRINGS DRAINAGE CRITERIA MANUAL

$$I_5 = -1.5 * \ln(T_c) + 7.583$$

$$I_{100} = -2.52 * \ln(T_c) + 12.735$$

6) Q = CIA

ARACO CONCRETE - 7470 SOUTHMOOR DRIVE  
STORM INLET SIZING SUMMARY

		BASIN FLOW		INLET FLOW					
INLET	DP	Q5 FLOW (CFS)	Q100 FLOW (CFS)	INLET FLOW % OF BASIN	Q5 FLOW (CFS)	Q100 FLOW (CFS)	INLET CONDITION / TYPE	INLET SIZE	INLET CAPACITY (CFS)
A2	A2	6.4	11.7	100	6.4	11.7	SUMP TYPE 16	DOUBLE	20.1
A1	A1	5.6	10.3	100	5.6	10.3	SUMP TYPE 16	DOUBLE	16.5



**INLET MANAGEMENT**

Worksheet Protected

<b>INLET NAME</b>	<a href="#">Inlet A2</a>	<a href="#">Inlet A1</a>
Site Type (Urban or Rural)	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET
Hydraulic Condition	In Sump	In Sump
Inlet Type	Denver No. 16 Combination	Denver No. 16 Combination

**USER-DEFINED INPUT****User-Defined Design Flows**

Minor $Q_{Known}$ (cfs)	6.4	5.6
Major $Q_{Known}$ (cfs)	11.7	10.3

**Bypass (Carry-Over) Flow from Upstream**

Receive Bypass Flow from:	No Bypass Flow Received	No Bypass Flow Received
Minor Bypass Flow Received, $Q_b$ (cfs)	0.0	0.0
Major Bypass Flow Received, $Q_b$ (cfs)	0.0	0.0

**Watershed Characteristics**

Subcatchment Area (acres)		
Percent Impervious		
NRCS Soil Type		

**Watershed Profile**

Overland Slope (ft/ft)		
Overland Length (ft)		
Channel Slope (ft/ft)		
Channel Length (ft)		

**Minor Storm Rainfall Input**

Design Storm Return Period, $T_r$ (years)		
One-Hour Precipitation, $P_1$ (inches)		

**Major Storm Rainfall Input**

Design Storm Return Period, $T_r$ (years)		
One-Hour Precipitation, $P_1$ (inches)		

**CALCULATED OUTPUT**

<b>Minor Total Design Peak Flow, <math>Q</math> (cfs)</b>	<b>6.4</b>	<b>5.6</b>
<b>Major Total Design Peak Flow, <math>Q</math> (cfs)</b>	<b>11.7</b>	<b>10.3</b>
Minor Flow Bypassed Downstream, $Q_b$ (cfs)	N/A	N/A
Major Flow Bypassed Downstream, $Q_b$ (cfs)	N/A	N/A

**Minor Storm (Calculated) Analysis of Flow Time**

C	N/A	N/A
$C_s$	N/A	N/A
Overland Flow Velocity, $V_i$	N/A	N/A
Channel Flow Velocity, $V_t$	N/A	N/A
Overland Flow Time, $T_i$	N/A	N/A
Channel Travel Time, $T_t$	N/A	N/A
Calculated Time of Concentration, $T_c$	N/A	N/A
Regional $T_c$	N/A	N/A
Recommended $T_c$	N/A	N/A
$T_c$ selected by User	N/A	N/A
Design Rainfall Intensity, $I$	N/A	N/A
Calculated Local Peak Flow, $Q_p$	N/A	N/A

**Major Storm (Calculated) Analysis of Flow Time**

C	N/A	N/A
$C_s$	N/A	N/A
Overland Flow Velocity, $V_i$	N/A	N/A
Channel Flow Velocity, $V_t$	N/A	N/A
Overland Flow Time, $T_i$	N/A	N/A
Channel Travel Time, $T_t$	N/A	N/A
Calculated Time of Concentration, $T_c$	N/A	N/A
Regional $T_c$	N/A	N/A
Recommended $T_c$	N/A	N/A
$T_c$ selected by User	N/A	N/A
Design Rainfall Intensity, $I$	N/A	N/A
Calculated Local Peak Flow, $Q_p$	N/A	N/A

**ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)**

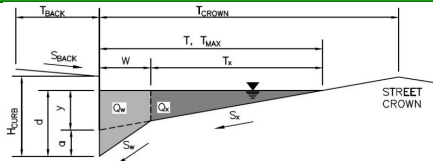
(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:

Araco Enterprises - Inlet A2 (Sump Condition)

Inlet ID:

Inlet A1

**Gutter Geometry (Enter data in the blue cells)**

Maximum Allowable Width for Spread Behind Curb

Side Slope Behind Curb (leave blank for no conveyance credit behind curb)

Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

Height of Curb at Gutter Flow Line

Distance from Curb Face to Street Crown

Gutter Width

Street Transverse Slope

Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)

Street Longitudinal Slope - Enter 0 for sump condition

Manning's Roughness for Street Section (typically between 0.012 and 0.020)

Max. Allowable Spread for Minor &amp; Major Storm

Max. Allowable Depth at Gutter Flowline for Minor &amp; Major Storm

Check boxes are not applicable in SUMP conditions

**MINOR STORM** Allowable Capacity is based on Depth Criterion**MAJOR STORM** Allowable Capacity is based on Depth Criterion

$T_{BACK} = 4.0$  ft  
 $S_{BACK} = 0.020$  ft/ft  
 $n_{BACK} = 0.020$

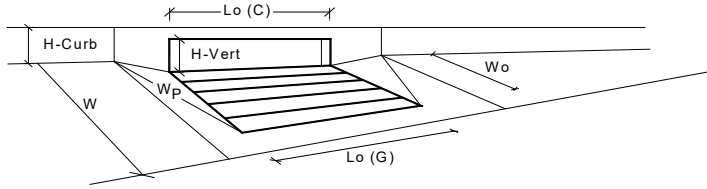
$H_{CURB} = 6.00$  inches  
 $T_{CROWN} = 50.0$  ft  
 $W = 2.00$  ft  
 $S_x = 0.013$  ft/ft  
 $S_w = 0.083$  ft/ft  
 $S_o = 0.000$  ft/ft  
 $n_{STREET} = 0.016$

	Minor Storm	Major Storm	
$T_{MAX} =$	50.0	50.0	ft
$d_{MAX} =$	6.0	12.0	inches
	<input type="checkbox"/>	<input type="checkbox"/>	

	Minor Storm	Major Storm	
$Q_{allow} =$	SUMP	SUMP	cfs

# INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



## Design Information (Input)

Type of Inlet Denver No. 16 Combination  
 Local Depression (additional to continuous gutter depression 'a' from above)  
 Number of Unit Inlets (Grate or Curb Opening)  
 Water Depth at Flowline (outside of local depression)

### Grate Information

Length of a Unit Grate  
 Width of a Unit Grate  
 Area Opening Ratio for a Grate (typical values 0.15-0.90)  
 Clogging Factor for a Single Grate (typical value 0.50 - 0.70)  
 Grate Weir Coefficient (typical value 2.15 - 3.60)  
 Grate Orifice Coefficient (typical value 0.60 - 0.80)

### Curb Opening Information

Length of a Unit Curb Opening  
 Height of Vertical Curb Opening in Inches  
 Height of Curb Orifice Throat in Inches  
 Angle of Throat (see USDCM Figure ST-5)  
 Side Width for Depression Pan (typically the gutter width of 2 feet)  
 Clogging Factor for a Single Curb Opening (typical value 0.10)  
 Curb Opening Weir Coefficient (typical value 2.3-3.7)  
 Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)

### Low Head Performance Reduction (Calculated)

Depth for Grate Midwidth  
 Depth for Curb Opening Weir Equation  
 Combination Inlet Performance Reduction Factor for Long Inlets  
 Curb Opening Performance Reduction Factor for Long Inlets  
 Grated Inlet Performance Reduction Factor for Long Inlets

### Total Inlet Interception Capacity (assumes clogged condition)

**Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)**

	MINOR	MAJOR	
Type =	Denver No. 16 Combination		
$a_{local}$ =	2.00	2.00	inches
No =	2	2	
Ponding Depth =	6.0	9.5	inches
	MINOR	MAJOR	<input checked="" type="checkbox"/> Override Depths
$L_o$ (G) =	3.00	3.00	feet
$W_o$ =	1.73	1.73	feet
$A_{ratio}$ =	0.31	0.31	
$C_r$ (G) =	0.50	0.50	
$C_w$ (G) =	3.60	3.60	
$C_o$ (G) =	0.60	0.60	
	MINOR	MAJOR	
$L_o$ (C) =	3.00	3.00	feet
$H_{vert}$ =	6.50	6.50	inches
$H_{throat}$ =	5.25	5.25	inches
Theta =	0.00	0.00	degrees
$W_p$ =	2.00	2.00	feet
$C_r$ (C) =	0.10	0.10	
$C_w$ (C) =	3.70	3.70	
$C_o$ (C) =	0.66	0.66	
	MINOR	MAJOR	
$d_{Grate}$ =	0.523	0.813	ft
$d_{Curb}$ =	0.33	0.62	ft
$RF_{Combination}$ =	0.71	1.00	
$RF_{Curb}$ =	1.00	1.00	
$RF_{Grate}$ =	0.71	1.00	
	MINOR	MAJOR	
$Q_a$ =	6.2	16.5	cfs
$Q_{PEAK REQUIRED}$ =	5.6	10.3	cfs

# ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

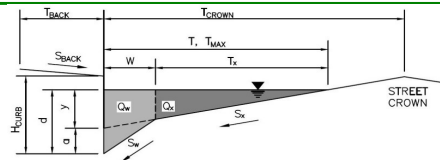
(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:

Araco Enterprises - Inlet A2 (Sump Condition)

Inlet ID:

Inlet A2

**Gutter Geometry (Enter data in the blue cells)**

Maximum Allowable Width for Spread Behind Curb

Side Slope Behind Curb (leave blank for no conveyance credit behind curb)

Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

Height of Curb at Gutter Flow Line

Distance from Curb Face to Street Crown

Gutter Width

Street Transverse Slope

Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)

Street Longitudinal Slope - Enter 0 for sump condition

Manning's Roughness for Street Section (typically between 0.012 and 0.020)

Max. Allowable Spread for Minor &amp; Major Storm

Max. Allowable Depth at Gutter Flowline for Minor &amp; Major Storm

Check boxes are not applicable in SUMP conditions

MINOR STORM Allowable Capacity is based on Depth Criterion

MAJOR STORM Allowable Capacity is based on Depth Criterion

$T_{BACK} = 4.0$  ft  
 $S_{BACK} = 0.020$  ft/ft  
 $n_{BACK} = 0.020$

$H_{CURB} = 6.00$  inches  
 $T_{CROWN} = 50.0$  ft  
 $W = 2.00$  ft  
 $S_x = 0.037$  ft/ft  
 $S_w = 0.083$  ft/ft  
 $S_o = 0.000$  ft/ft  
 $n_{STREET} = 0.016$

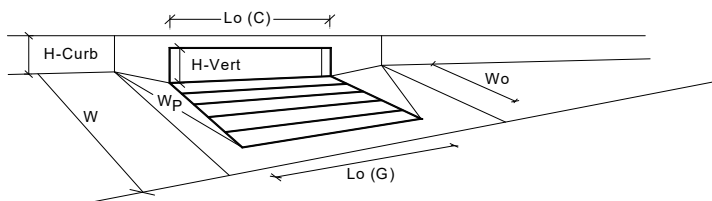
	Minor Storm	Major Storm	
$I_{MAX} =$	50.0	50.0	ft
$d_{MAX} =$	6.0	12.0	inches

$Q_{allow} =$ 

Minor Storm	Major Storm	
SUMP	SUMP	cfs

# INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



## Design Information (Input)

Type of Inlet Denver No. 16 Combination  
 Local Depression (additional to continuous gutter depression 'a' from above)  
 Number of Unit Inlets (Grate or Curb Opening)  
 Water Depth at Flowline (outside of local depression)

## Grate Information

Length of a Unit Grate  
 Width of a Unit Grate  
 Area Opening Ratio for a Grate (typical values 0.15-0.90)  
 Clogging Factor for a Single Grate (typical value 0.50 - 0.70)  
 Grate Weir Coefficient (typical value 2.15 - 3.60)  
 Grate Orifice Coefficient (typical value 0.60 - 0.80)

## Curb Opening Information

Length of a Unit Curb Opening  
 Height of Vertical Curb Opening in Inches  
 Height of Curb Orifice Throat in Inches  
 Angle of Throat (see USDCM Figure ST-5)  
 Side Width for Depression Pan (typically the gutter width of 2 feet)  
 Clogging Factor for a Single Curb Opening (typical value 0.10)  
 Curb Opening Weir Coefficient (typical value 2.3-3.7)  
 Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)

## Low Head Performance Reduction (Calculated)

Depth for Grate Midwidth  
 Depth for Curb Opening Weir Equation  
 Combination Inlet Performance Reduction Factor for Long Inlets  
 Curb Opening Performance Reduction Factor for Long Inlets  
 Grated Inlet Performance Reduction Factor for Long Inlets

## Total Inlet Interception Capacity (assumes clogged condition)

**WARNING: Inlet Capacity less than Q Peak for Minor Storm**

	MINOR	MAJOR	
Type =	Denver No. 16 Combination		
$a_{local}$ =	2.00	2.00	inches
No =	2	2	
Ponding Depth =	6.0	12.0	inches
	MINOR	MAJOR	<input type="checkbox"/> Override Depths
$L_o (G)$ =	3.00	3.00	feet
$W_o$ =	1.73	1.73	feet
$A_{ratio}$ =	0.31	0.31	
$C_r (G)$ =	0.50	0.50	
$C_w (G)$ =	3.60	3.60	
$C_o (G)$ =	0.60	0.60	
	MINOR	MAJOR	
$L_o (C)$ =	3.00	3.00	feet
$H_{vert}$ =	6.50	6.50	inches
$H_{throat}$ =	5.25	5.25	inches
Theta =	0.00	0.00	degrees
$W_p$ =	2.00	2.00	feet
$C_r (C)$ =	0.10	0.10	
$C_w (C)$ =	3.70	3.70	
$C_o (C)$ =	0.66	0.66	
	MINOR	MAJOR	
$d_{Grate}$ =	0.523	1.023	ft
$d_{Curb}$ =	0.33	0.83	ft
$RF_{Combination}$ =	0.71	1.00	
$RF_{Curb}$ =	1.00	1.00	
$RF_{Grate}$ =	0.71	1.00	
	MINOR	MAJOR	
$Q_a$ =	6.2	20.1	cfs
$Q_{PEAK REQUIRED}$ =	6.4	11.7	cfs

ARACO CONCRETE - 7470 SOUTHMOOR DRIVE  
STORM SEWER SIZING SUMMARY

PIPE FLOW				PIPE CAPACITY		
PIPE	BASINS	Q5 FLOW (CFS)	Q100 FLOW (CFS)	PIPE SIZE (IN)	MIN. PIPE SLOPE	FULL PIPE CAPACITY (CFS)
A2	A2	6.4	11.7	24	0.5%	16.0
A1	A1	5.6	10.3	18	1.0%	10.5

**ASSUMPTIONS:**  
1. STORM DRAIN PIPE ASSUMED TO BE RCP OR HDPE

# Hydraulic Analysis Report

## Project Data

Project Title: Project - Araco  
Designer: JPS  
Project Date: Wednesday, October 23, 2019  
Project Units: U.S. Customary Units  
Notes:

## Channel Analysis: SD-A2

Notes:

## Input Parameters

Channel Type: Circular  
Pipe Diameter: 2.0000 ft  
Longitudinal Slope: 0.0050 ft/ft  
Manning's n: 0.0130  
Depth: 2.0000 ft

## Result Parameters

Flow: 15.9965 cfs  
Area of Flow: 3.1416 ft<sup>2</sup>  
Wetted Perimeter: 6.2832 ft  
Hydraulic Radius: 0.5000 ft  
Average Velocity: 5.0918 ft/s  
Top Width: 0.0000 ft  
Froude Number: 0.0000  
Critical Depth: 1.4414 ft  
Critical Velocity: 6.5991 ft/s  
Critical Slope: 0.0066 ft/ft  
Critical Top Width: 1.79 ft  
Calculated Max Shear Stress: 0.6240 lb/ft<sup>2</sup>  
Calculated Avg Shear Stress: 0.1560 lb/ft<sup>2</sup>

## Channel Analysis: SD-A1

Notes:

### Input Parameters

Channel Type: Circular

Pipe Diameter: 1.5000 ft

Longitudinal Slope: 0.0100 ft/ft

Manning's n: 0.0130

Depth: 1.5000 ft

### Result Parameters

Flow: 10.5043 cfs

Area of Flow: 1.7671 ft<sup>2</sup>

Wetted Perimeter: 4.7124 ft

Hydraulic Radius: 0.3750 ft

Average Velocity: 5.9442 ft/s

Top Width: 0.0000 ft

Froude Number: 0.0000

Critical Depth: 1.2451 ft

Critical Velocity: 6.6989 ft/s

Critical Slope: 0.0098 ft/ft

Critical Top Width: 1.13 ft

Calculated Max Shear Stress: 0.9360 lb/ft<sup>2</sup>

Calculated Avg Shear Stress: 0.2340 lb/ft<sup>2</sup>



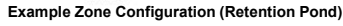
## **APPENDIX B**

### **STORMWATER DETENTION CALCULATIONS**

ARACO CONCRETE  
COMPOSITE RUNOFF COEFFICIENTS

IMPERVIOUS AREAS - EXISTING CONDITIONS											
BASIN	TOTAL AREA (AC)	(AC)	SUB-AREA 1 DEVELOPMENT/ COVER	PERCENT IMPERVIOUS	AREA (AC)	SUB-AREA 2 DEVELOPMENT/ COVER	PERCENT IMPERVIOUS	(AC)	SUB-AREA 3 DEVELOPMENT/ COVER	PERCENT IMPERVIOUS	WEIGHTED % IMP
A	3.76	0.15	BUILDING / PAVEMENT	100	3.61	MEADOW	0				3.989
IMPERVIOUS AREAS - DEVELOPED CONDITIONS											
BASIN	TOTAL AREA (AC)	(AC)	SUB-AREA 1 DEVELOPMENT/ COVER	PERCENT IMPERVIOUS	AREA (AC)	SUB-AREA 2 DEVELOPMENT/ COVER	PERCENT IMPERVIOUS	(AC)	SUB-AREA 3 DEVELOPMENT/ COVER	PERCENT IMPERVIOUS	WEIGHTED % IMP
A1	1.46	1.293	ASPHALT	100	0.167	LANDSCAPED	0				88.562
A2	2.30	1.340	BUILDING / ASPHALT	100	0.550	NATIVE GRAVEL	40	0.41	LANDSCAPE	0	67.826
A1,A2	3.76										75.878

*MHFD-Detention, Version 4.04 (February 2021)*

Basin ID: A1

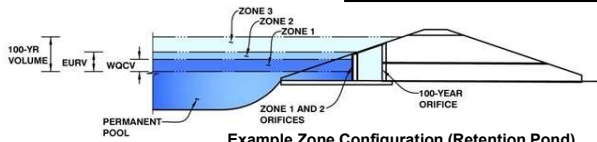
4/17/2024, 2:51 PM

# DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Project: **ARACO CONCRETE**

Basin ID: **A1**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.14	0.096	Orifice Plate
Zone 2 (EURV)	5.57	0.275	Orifice Plate
Zone 3 (100-year)	7.31	0.163	Weir&Pipe (Restrict)
Total (all zones)		0.534	

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

Underdrain Orifice Area =	N/A	ft <sup>2</sup>
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 =	5.57	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	14.60	inches
Orifice Plate: Orifice Area per Row =	N/A	inches

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

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	1.86	3.71					
Orifice Area (sq. inches)	0.75	0.75	0.75					

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

	Not Selected	Not Selected	
Vertical Orifice Area =	N/A	N/A	ft <sup>2</sup>
Vertical Orifice Centroid =	N/A	N/A	feet

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	
Overflow Weir Front Edge Height, H <sub>o</sub> =	6.40	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	4.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V
Horiz. Length of Weir Sides =	2.50	N/A	feet
Overflow Grate Type =	Type C Grate	N/A	
Debris Clogging % =	50%	N/A	%

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H <sub>u</sub> =	6.40	N/A	feet
Overflow Weir Slope Length =	2.50	N/A	feet
Grate Open Area / 100-yr Orifice Area =	89.98	N/A	
Overflow Grate Open Area w/o Debris =	6.96	N/A	ft <sup>2</sup>
Overflow Grate Open Area w/ Debris =	3.48	N/A	ft <sup>2</sup>

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.10	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	18.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	1.60		inches

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	0.08	N/A	ft <sup>2</sup>
Outlet Orifice Centroid =	0.08	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	0.61	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	7.50	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	3.00	feet
Spillway End Slopes =	0.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Spillway Design Flow Depth=	1.00	feet
Stage at Top of Freeboard =	9.50	feet
Basin Area at Top of Freeboard =	0.11	acres
Basin Volume at Top of Freeboard =	0.76	acre-ft

## Routed Hydrograph Results

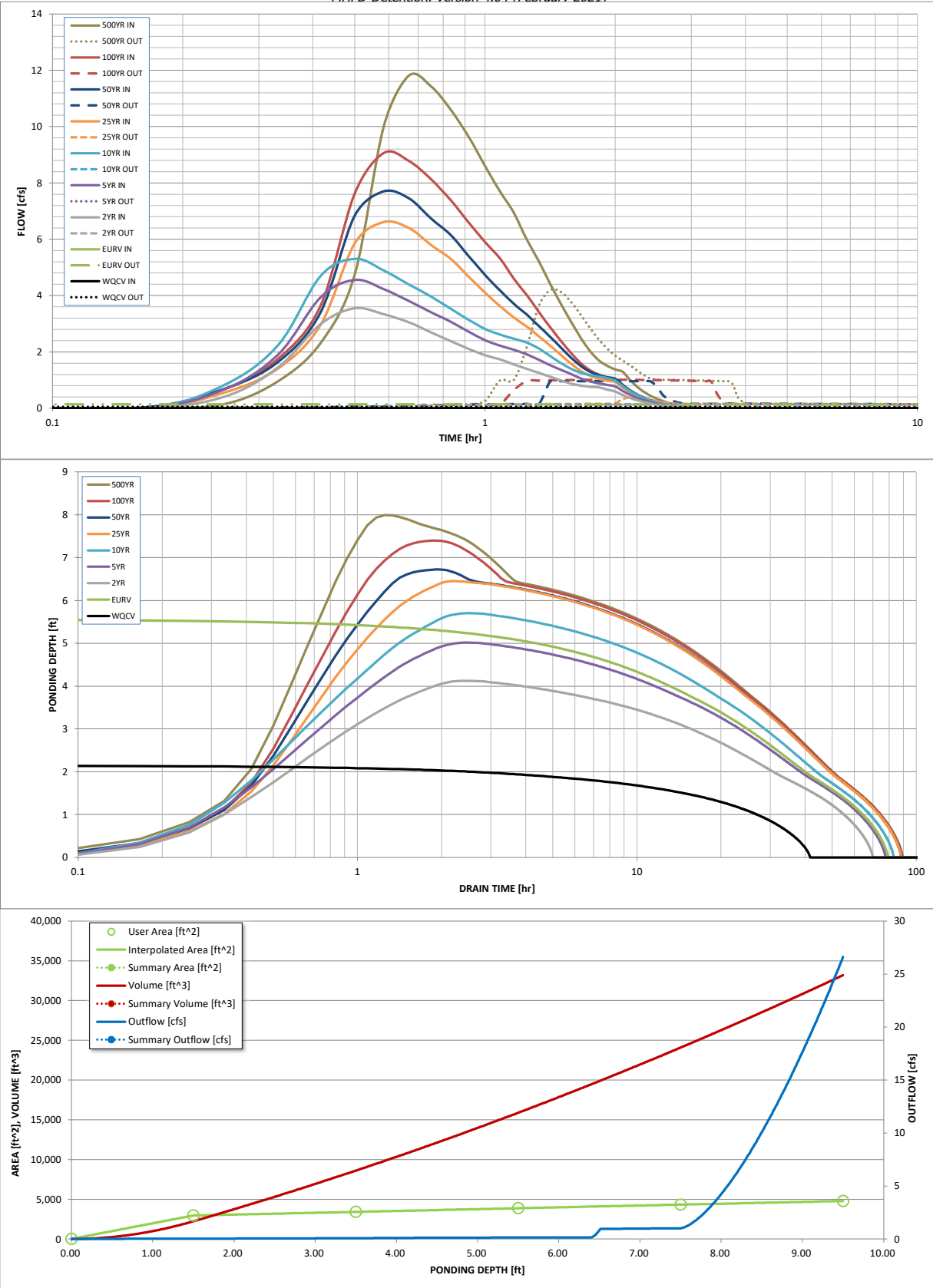
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

	WQCV	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	2.52	3.14
CUHP Runoff Volume (acre-ft) =	0.096	0.370	0.264	0.343	0.406	0.483	0.557	0.645	0.838
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.264	0.343	0.406	0.483	0.557	0.645	0.838
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.0	0.0	0.1	0.5	0.9	1.5	2.8
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.00	0.01	0.01	0.12	0.25	0.41	0.76
Peak Inflow Q (cfs) =	N/A	N/A	3.5	4.6	5.3	6.6	7.7	9.1	11.8
Peak Outflow Q (cfs) =	0.0	0.1	0.1	0.1	0.1	0.4	1.0	1.0	4.2
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	3.6	2.9	0.8	1.0	0.7	1.5
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Plate	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	0.0	0.1	0.1	0.1
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) =	39	71	63	70	74	78	77	76	74
Time to Drain 99% of Inflow Volume (hours) =	40	75	67	74	79	84	83	83	82
Maximum Ponding Depth (ft) =	2.15	5.56	4.12	5.02	5.70	6.45	6.72	7.40	8.00
Area at Maximum Ponding Depth (acres) =	0.07	0.09	0.08	0.09	0.09	0.09	0.10	0.10	0.10
Maximum Volume Stored (acre-ft) =	0.096	0.370	0.247	0.322	0.383	0.452	0.477	0.542	0.602

Note that while the indicated ratios of Peak Outflow to Predevelopment Q appear higher than the recommended range for the 5-year and 10-year storms, the actual Peak Outflows are negligible (0.1 cfs) for these design storms.

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)



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

# DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename: \_\_\_\_\_

## Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.15
	0:15:00	0.00	0.00	0.41	0.67	0.83	0.56	0.69	0.68	0.97
	0:20:00	0.00	0.00	1.47	1.92	2.26	1.42	1.66	1.78	2.31
	0:25:00	0.00	0.00	2.99	3.94	4.69	2.95	3.40	3.63	4.74
	0:30:00	0.00	0.00	3.55	4.55	5.30	5.85	6.84	7.62	10.00
	0:35:00	0.00	0.00	3.34	4.23	4.89	6.61	7.70	9.06	11.81
	0:40:00	0.00	0.00	3.05	3.81	4.40	6.40	7.45	8.78	11.43
	0:45:00	0.00	0.00	2.70	3.41	3.96	5.80	6.74	8.13	10.60
	0:50:00	0.00	0.00	2.38	3.07	3.53	5.30	6.15	7.39	9.64
	0:55:00	0.00	0.00	2.11	2.72	3.14	4.67	5.41	6.60	8.61
	1:00:00	0.00	0.00	1.88	2.42	2.82	4.11	4.74	5.91	7.70
	1:05:00	0.00	0.00	1.73	2.22	2.62	3.63	4.18	5.32	6.94
	1:10:00	0.00	0.00	1.56	2.08	2.47	3.22	3.70	4.60	5.98
	1:15:00	0.00	0.00	1.40	1.91	2.33	2.89	3.32	4.02	5.21
	1:20:00	0.00	0.00	1.26	1.72	2.12	2.54	2.91	3.41	4.40
	1:25:00	0.00	0.00	1.12	1.53	1.85	2.22	2.53	2.87	3.69
	1:30:00	0.00	0.00	0.99	1.36	1.60	1.88	2.14	2.39	3.06
	1:35:00	0.00	0.00	0.88	1.22	1.40	1.58	1.79	1.96	2.50
	1:40:00	0.00	0.00	0.80	1.06	1.26	1.32	1.50	1.59	2.03
	1:45:00	0.00	0.00	0.76	0.95	1.18	1.15	1.30	1.35	1.70
	1:50:00	0.00	0.00	0.74	0.89	1.13	1.04	1.18	1.20	1.51
	1:55:00	0.00	0.00	0.66	0.83	1.07	0.98	1.10	1.10	1.38
	2:00:00	0.00	0.00	0.59	0.78	0.99	0.93	1.05	1.03	1.29
	2:05:00	0.00	0.00	0.47	0.61	0.78	0.74	0.83	0.80	1.00
	2:10:00	0.00	0.00	0.37	0.48	0.61	0.57	0.64	0.61	0.76
	2:15:00	0.00	0.00	0.28	0.37	0.47	0.44	0.49	0.46	0.58
	2:20:00	0.00	0.00	0.22	0.28	0.36	0.34	0.38	0.35	0.44
	2:25:00	0.00	0.00	0.17	0.22	0.27	0.26	0.29	0.27	0.33
	2:30:00	0.00	0.00	0.13	0.16	0.20	0.19	0.21	0.20	0.25
	2:35:00	0.00	0.00	0.09	0.12	0.15	0.14	0.16	0.15	0.19
	2:40:00	0.00	0.00	0.07	0.09	0.11	0.11	0.12	0.12	0.14
	2:45:00	0.00	0.00	0.05	0.06	0.08	0.08	0.09	0.08	0.11
	2:50:00	0.00	0.00	0.03	0.04	0.06	0.05	0.06	0.06	0.07
	2:55:00	0.00	0.00	0.02	0.03	0.04	0.04	0.04	0.04	0.05
	3:00:00	0.00	0.00	0.01	0.02	0.02	0.02	0.02	0.02	0.03
	3:05:00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

# Design Procedure Form: Extended Detention Basin (EDB)

UD-BMP (Version 3.06, November 2016)

Sheet 1 of 4

Designer: JPS  
 Company: JPS  
 Date: June 4, 2024  
 Project: ARACO CONCRETE  
 Location: BASIN EDB-A1

## 1. Basin Storage Volume

- A) Effective Imperviousness of Tributary Area,  $I_a$
- B) Tributary Area's Imperviousness Ratio ( $i = I_a / 100$ )
- C) Contributing Watershed Area
- D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm
- E) Design Concept  
(Select EURV when also designing for flood control)
- F) Design Volume (WQCV) Based on 40-hour Drain Time  
 $(V_{DESIGN} = (1.0 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12 * Area))$
- G) For Watersheds Outside of the Denver Region,  
 Water Quality Capture Volume (WQCV) Design Volume  
 $(V_{WQCV\ OTHER} = (d_b * (V_{DESIGN} / 0.43)))$
- H) User Input of Water Quality Capture Volume (WQCV) Design Volume  
 (Only if a different WQCV Design Volume is desired)
- I) Predominant Watershed NRCS Soil Group
- J) Excess Urban Runoff Volume (EURV) Design Volume  
 For HSG A:  $EURV_A = 1.68 * i^{1.28}$   
 For HSG B:  $EURV_B = 1.36 * i^{1.08}$   
 For HSG C/D:  $EURV_{C/D} = 1.20 * i^{1.08}$

$I_a = 76.0$  %

$i = 0.760$

Area = 3.760 ac

$d_b =$  in

Choose One

☐ Water Quality Capture Volume (WQCV)

☒ Excess Urban Runoff Volume (EURV)

$V_{DESIGN} = 0.096$  ac-ft

$V_{DESIGN\ OTHER} =$  ac-ft

$V_{DESIGN\ USER} =$  ac-ft

Choose One

☒ A

☐ B

☐ C / D

EURV = 0.370 ac-ft

## 2. Basin Shape: Length to Width Ratio

(A basin length to width ratio of at least 2:1 will improve TSS reduction.)

$L : W = 4.0 : 1$

## 3. Basin Side Slopes

- A) Basin Maximum Side Slopes  
(Horizontal distance per unit vertical, 4:1 or flatter preferred)

$Z = 0.00$  ft / ft

DIFFICULT TO MAINTAIN, INCREASE WHERE POSSIBLE

## 4. Inlet

- A) Describe means of providing energy dissipation at concentrated inflow locations:

Concrete Forebay

# Design Procedure Form: Extended Detention Basin (EDB)

Sheet 2 of 4

Designer: JPS  
 Company: JPS  
 Date: June 4, 2024  
 Project: ARACO CONCRETE  
 Location: BASIN EDB-A1

## 5. Forebay

- A) Minimum Forebay Volume  
 ( $V_{FMIN} = 2\%$  of the WQCV)
- B) Actual Forebay Volume
- C) Forebay Depth  
 ( $D_F = 18$  inch maximum)
- D) Forebay Discharge
- i) Undetained 100-year Peak Discharge
- ii) Forebay Discharge Design Flow  
 ( $Q_F = 0.02 * Q_{100}$ )
- E) Forebay Discharge Design

$V_{FMIN} = 0.002$  ac-ft

$V_F = 0.002$  ac-ft

$D_F = 15.0$  in

$Q_{100} = 17.96$  cfs

$Q_F = 0.36$  cfs

- Choose One
- ☐ Berm With Pipe
- ☒ Wall with Rect. Notch
- ☐ Wall with V-Notch Weir

(flow too small for berm w/ pipe)

F) Discharge Pipe Size (minimum 8-inches)

Calculated  $D_p =$  in

G) Rectangular Notch Width

Calculated  $W_N = 3.9$  in

## 6. Trickle Channel

- A) Type of Trickle Channel
- F) Slope of Trickle Channel

- Choose One
- ☒ Concrete
- ☐ Soft Bottom

$S = 0.0050$  ft / ft

## 7. Micropool and Outlet Structure

- A) Depth of Micropool (2.5-feet minimum)
- B) Surface Area of Micropool (10 ft<sup>2</sup> minimum)
- C) Outlet Type

$D_M = 2.5$  ft

$A_M = 10$  sq ft

- Choose One
- ☒ Orifice Plate
- ☐ Other (Describe):

D) Smallest Dimension of Orifice Opening Based on Hydrograph Routing  
 (Use UD-Detention)

$D_{orifice} = 0.75$  inches

E) Total Outlet Area

$A_{ot} = 2.25$  square inches



# Design Procedure Form: Extended Detention Basin (EDB)

Sheet 3 of 4

Designer: JPS  
 Company: JPS  
 Date: June 4, 2024  
 Project: ARACO CONCRETE  
 Location: BASIN EDB-A1

## 8. Initial Surge Volume

- A) Depth of Initial Surge Volume  
(Minimum recommended depth is 4 inches)
- B) Minimum Initial Surge Volume  
(Minimum volume of 0.3% of the WQCV)
- C) Initial Surge Provided Above Micropool

$D_{IS} = 6$  in

$V_{IS} =$  cu ft

$V_s = 5.0$  cu ft

## 9. Trash Rack

- A) Water Quality Screen Open Area:  $A_t = A_{ot} * 38.5 * (e^{-0.095D})$
- B) Type of Screen (If specifying an alternative to the materials recommended in the USDCM, indicate "other" and enter the ratio of the total open area to the total screen area for the material specified.)

Other (Y/N): N

C) Ratio of Total Open Area to Total Area (only for type 'Other')

D) Total Water Quality Screen Area (based on screen type)

E) Depth of Design Volume (EURV or WQCV)  
(Based on design concept chosen under 1E)

F) Height of Water Quality Screen ( $H_{TR}$ )

G) Width of Water Quality Screen Opening ( $W_{opening}$ )  
(Minimum of 12 inches is recommended)

$A_t = 81$  square inches

S.S. Well Screen with 60% Open Area

User Ratio =

$A_{total} = 134$  sq. in.

$H = 5.57$  feet

$H_{TR} = 94.84$  inches

$W_{opening} = 12.0$  inches

Design Procedure Form: Extended Detention Basin (EDB)

Sheet 4 of 4

Designer: JPS  
Company: JPS  
Date: June 4, 2024  
Project: ARACO CONCRETE  
Location: BASIN EDB-A1

10. Overflow Embankment

A) Describe embankment protection for 100-year and greater overtopping:

Buried Riprap Spillway

B) Slope of Overflow Embankment  
(Horizontal distance per unit vertical, 4:1 or flatter preferred)

11. Vegetation

Choose One

☐ Irrigated

☒ Not Irrigated

12. Access

A) Describe Sediment Removal Procedures

Periodic inspection and maintenance by property owner as required  
Ramp provided for skid-loader access to pond bottom

Notes:

# Hydraulic Analysis Report

## Project Data

Project Title: Project - Araco – Detention Pond Trickle Channel

Designer: JPS

Project Date: Wednesday, June 5, 2024

Project Units: U.S. Customary Units

Notes:

## Channel Analysis: Channel Analysis - Trickle Channel

Notes:

## Input Parameters

Channel Type: Triangular

Side Slope 1 (Z1): 12.0000 ft/ft

Side Slope 2 (Z2): 12.0000 ft/ft

Longitudinal Slope: 0.0050 ft/ft

Manning's n: 0.0130

Flow: 0.1800 cfs = **1% of 100-Yr Peak Inflow (DP1)**

## Result Parameters

**Depth: 0.1125 ft OK**

Area of Flow: 0.1520 ft<sup>2</sup>

Wetted Perimeter: 2.7105 ft

Hydraulic Radius: 0.0561 ft

Average Velocity: 1.1842 ft/s

**Top Width: 2.7011 ft OK**

Froude Number: 0.8797

Critical Depth: 0.1069 ft

Critical Velocity: 1.3120 ft/s

Critical Slope: 0.0066 ft/ft

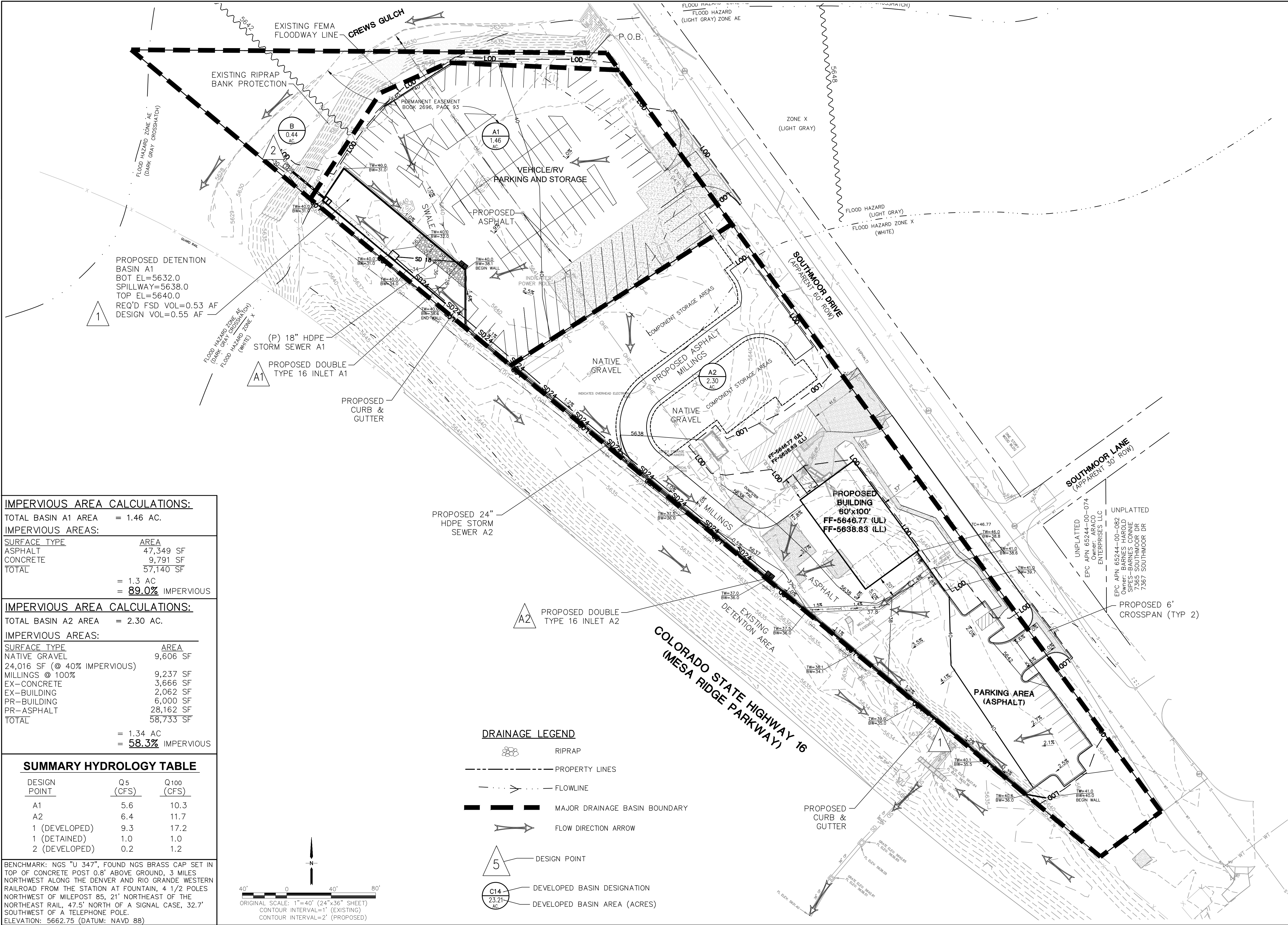
Critical Top Width: 2.57 ft

Calculated Max Shear Stress: 0.0351 lb/ft<sup>2</sup>

Calculated Avg Shear Stress: 0.0175 lb/ft<sup>2</sup>

## **APPENDIX C**

### **FIGURES**



**IMPERVIOUS AREA CALCULATIONS:**

TOTAL BASIN A1 AREA = 1.46 AC.

IMPERVIOUS AREAS:

SURFACE TYPE	AREA
ASPHALT	47,349 SF
CONCRETE	9,791 SF
TOTAL	57,140 SF

= 1.3 AC  
= **89.0%** IMPERVIOUS

**IMPERVIOUS AREA CALCULATIONS:**

TOTAL BASIN A2 AREA = 2.30 AC.

IMPERVIOUS AREAS:

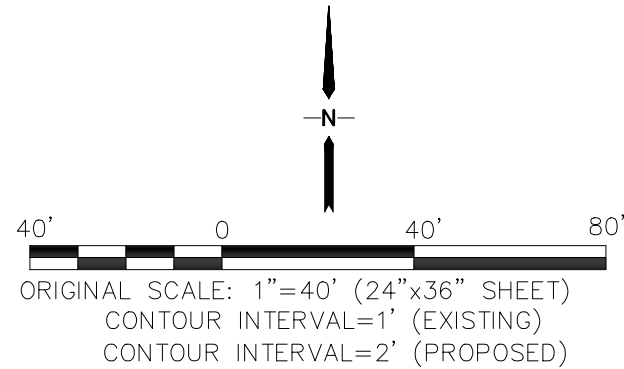
SURFACE TYPE	AREA
NATIVE GRAVEL	9,606 SF
24,016 SF (@ 40% IMPERVIOUS)	
MILLINGS @ 100%	9,237 SF
EX-CONCRETE	3,666 SF
EX-BUILDING	2,062 SF
PR-BUILDING	6,000 SF
PR-ASPHALT	28,162 SF
TOTAL	58,733 SF

= 1.34 AC  
= **58.3%** IMPERVIOUS

**SUMMARY HYDROLOGY TABLE**

DESIGN POINT	Q5 (CFS)	Q100 (CFS)
A1	5.6	10.3
A2	6.4	11.7
1 (DEVELOPED)	9.3	17.2
1 (DETAINED)	1.0	1.0
2 (DEVELOPED)	0.2	1.2

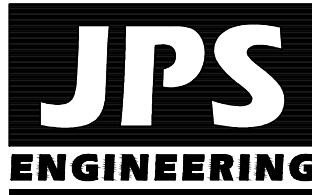
BENCHMARK: NGS "U 347", FOUND NGS BRASS CAP SET IN TOP OF CONCRETE POST 0.8' ABOVE GROUND, 3 MILES NORTHWEST ALONG THE DENVER AND RIO GRANDE WESTERN RAILROAD FROM THE STATION AT FOUNTAIN, 4 1/2 POLES NORTHEAST OF MILEPOST 85, 21' NORTHEAST OF THE NORTHEAST RAIL, 47.5' NORTH OF A SIGNAL CASE, 32.7' SOUTHWEST OF A TELEPHONE POLE.  
ELEVATION: 5662.75 (DATUM: NAVD 88)



- DRAINAGE LEGEND**
- RIPRAP
  - PROPERTY LINES
  - FLOWLINE
  - MAJOR DRAINAGE BASIN BOUNDARY
  - FLOW DIRECTION ARROW
  - 5 --- DESIGN POINT
  - C14 --- DEVELOPED BASIN DESIGNATION
  - 23.21 --- DEVELOPED BASIN AREA (ACRES)

**ARACO CONCRETE**  
**7470 SOUTHMOOR DR., COLORADO SPRINGS, COLORADO 80915**

**DEVELOPED DRAINAGE PLAN**



19 E. Willamette Ave.  
Colorado Springs, CO  
80903  
PH: 719-477-9429  
FAX: 719-471-0766  
www.jpsengr.com



CALL UTILITY NOTIFICATION  
CENTER OF COLORADO  
1-800-922-1987  
CALL 2-BUSINESS DAYS IN ADVANCE  
BEFORE YOU DIG GRADE, OR EXCAVATE  
FOR THE MEMBER UTILITIES.

NO.	REVISION	BY	DATE

HORZ. SCALE: 1"=40'	DRAWN: BJJ
VERT. SCALE: N/A	DESIGNED: JPS
SURVEYED: LDC	CHECKED: JPS
CREATED: 6/21/19	LAST MODIFIED: 06/13/24
PROJECT NO: 111705	MODIFIED BY: PV

SHEET: **D1**