PRELIMINARY/FINAL DRAINAGE REPORT

FOR

APPALOOSA HWY 24 SUBDIVISION
FILING NO. 2, LOTS 1, 2 & 3

Prepared For:
Platte Valley, LLC
1378 Promontory Bluff View
Colorado Springs, CO 80921

Prepared By:
Associated Design Professionals, Inc.
3520 Austin Bluffs Parkway Suite 102
Colorado Springs, CO 80918
719.266-5212

ADP Project No. 160504
May 16, 2018

This drainage report is for project VR1813, which has not yet been approved. Your site specific drainage report cannot be approved until this report has been approved.

The drainage letter submitted with the special use has been reviewed and comments will be provided with this PPR.

ADP CIVIL
ENGINEERING FOR THE FUTURE

ADPCIVIL
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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 of the drainage basin. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparing this report.

_____
Michael A. Bartusek, P.E. #23329

DEVELOPER'S STATEMENT:
I, the Developer, have read and will comply with all of the requirements specified in this drainage report and plan.

By: _____
Ron Waldthausen

Title: President

Address: Platte Valley, LLC
1378 Promontory Bluff View
Colorado Springs, CO 80921

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

_____ _____
Jennifer Irvine, County Engineer/ECM Administrator Date

Conditions:

PRELIMINARY/FINAL DRAINAGE REPORT
APPALOOSA SUBDIVISION
FILING NO. 2, LOTS 1, 2 & 3

PROJECT DESCRIPTION

This drainage report is for the development of the Appaloosa Subdivision, Filing No. 2, Lots 1, 2 & 3. The currently vacant 4.67 acre site is located north of U.S. Hwy 24 and east of Amelia Street. It is further described as the southern portion of Section 7, Township 14 South, Range 65 West of the 6th Principal Meridian in El Paso County, Colorado.

All of this lot is located in Sand Creek drainage basin and drains into the central tributary of Sand Creek. An existing 4'x4' box culvert is located at the southeast corner of U.S. Hwy 24 and Amelia St. Also an existing concrete channel is located on the east side of proposed Lot 3.

SOILS

The soil on the site can be described as having a rapid permeability, medium-surface runoff, and moderate to high hazard of erosion. The soils within the site are Truckton sandy loams. These soils are classified as Hydrologic Group 'B'.

FLOODPLAIN STATEMENT

A small portion of the developed site is located within a designated FEMA 100-year floodplain according to the information published in the Federal Emergency Management Agency Flood Plain Map No. 080059C0754F, dated March 17, 1997, and LOMR 05-08-0368P dated May 23, 2007. This area falls within the existing concrete channel.

METHOD OF COMPUTATION

The methodology utilized for this report is in accordance with the *City Drainage Criteria Manual, Volumes 1*, dated May 2014. The Rational Method for computation of runoff was used for determining Sub-Basin flows.

$Q = cia$

Where
- Q = maximum rate of runoff in cubic feet per second
- c = runoff coefficient representing drainage area characteristics
- i = average rainfall intensity, in inches per hour, for the duration required for the runoff to become established
- a = drainage basin size in acres

EXISTING DRAINAGE CONDITIONS

The existing site has been overlot graded and is covered with rangeland grasses. The western portion of the site drains in a southerly direction toward the existing 4' x 4' box culvert under U.S. Hwy 24. The eastern portion of the site drains westerly toward the 4' x 4' box culvert. An existing concrete channel is located on the east side of the lot, but no flows from this parcel drain to the concrete channel. A portion of the concrete channel has failed with other portions showing signs of joint failure.

The existing sub-basin AEX produces flows of 0.8 cfs for the 5-year storm and 6.3 cfs for the 100-year storm.

DEVELOPED DRAINAGE CONDITIONS

The developed site will be divided into three (3) lots. Lots 1 and 2 will encompass 0.98 acres each and Lot 3 will encompass 2.7 acres. The proposed land is zoned I-2 (Limited Industrial). Drainage from each lot will be self-contained with all flows directed to an extended detention basin (EDB) facility in the southwest corner of Lot 3.

Lot 1, Sub-basin A, is located in the northern portion of the site. Sub-basin A will produce flows of 1.6 cfs for the 5-year storm and 3.5 cfs for the 100-year storm. These flows will continue south and be intercepted by a proposed swale located along the property line. The flows will then travel west to a proposed type 'C' inlet at the southwest corner of the site. An 18" HDPE storm sewer will transport these flows into Lot 2.

Lot 2, Sub-basin B, is located in the center of the site. Sub-basin B will produce flows of 1.6 cfs for the 5-year storm and 3.5 cfs for the 100-year storm. As with Lot 1 the site flows will be intercepted by a swale located along the property line. These flows will be intercepted by a type 'C' inlet at the southwest corner of the lot. These flows will combine with the flows from Sub-basin A at DP1 to produce flows of 3.2 cfs for the 5-year storm and 7.0 cfs for the 100-year storm. An 18" HDPE storm sewer will transport these flows into the proposed EDB in Lot 3.

Lot 3, Sub-basin C, is located in the southern portion of the site. Sub-basin C will produce flows of 3.7 cfs and 8.3 cfs respectively. These flows will be intercepted by a proposed swale located along the south property line and into the proposed EDB. The combined flows into the basin at DP2 will be 6.5 cfs for the 5-year storm and 14.3 cfs for the 100-year storm.

The proposed 0.656 ac.ft. EDB will reduce the site flows into the existing 4' x 4' box culvert to 3.9 cfs for the 5-year storm and 5.3 cfs for the 100-year storm.

CONCRETE CHANNEL REPAIR

Approximately 120 lf of the existing concrete channel will need to be removed and replaced. The channel section is 6 feet wide and 7 feet deep. The new concrete channel section will be doweled into the concrete channel sections which remain.

WATER QUALITY AND DETENTION

Water quality for the site will be achieved within by 0.118 acre-feet of storage, 1.85 ft deep within the 0.656 ac. ft. extended detention basin (EDB). The remainder of the basin will provide the storage volume required for detention. The facility will have an 18" HDPE outlet pipe with a 12" restrictor plate located 6.5"above the pipe invert.

PRIVATE DRAINAGE FACILITIES

Item	Unit	Quantity	Unit Cost	Total Cost
18" HDPE FES	EA	1	$450	$ 450.00
18" HDPE	LF	400	$45	$ 18,000.00
Outlet Structure	EA	1	$5,000	$ 5,000.00
Emergency Spillway	EA	1	$1,500	$ 1,500.00
Type 'C' Inlet	EA	2	$3,270	$ 6,540.00
Concrete Channel	LF	120	$150	$18,000.00
			Sub-Total	$49,490.00
			15% Contingency & Engineering	$ 7,423.50
			TOTAL	**$56,913.50**

DRAINAGE BASIN FEES

Based on a resolution, No. 16-336, passed by the Board of County Commissioners on September 29, 2016, drainage and bridge fees will only be assessed on the two (2) smaller lots in the replat. The area of the two (2) smaller lots is 1.96 acres.

The proposed development is located within the Sand Creek drainage basin. The 2018 drainage basin fee calculation is as follows:

Impervious Coverage	=	73.6%
Area Subject to Fee	=	0.736 x 1.96 acres = 1.443 acre
Sand Creek Basin Fee	=	$17,197/acre
Drainage Basin Fee	=	$17,197 x 1.443 = $24,815
Sand Creek Bridge Fee	=	$5,210
Bridge Fee	=	$5,210 x 1.443 = $7,518

CONCLUSION

The proposed development and subsequent lot developments follow the "Four Step Process" as mandated by the EPA as follows:

Step 1: Runoff has been reduced by disconnecting impervious areas where possible, eliminating "unnecessary" impervious areas and encouraging infiltration into suitable soils.

Step 2: All drainageways, ditches and channels have been stabilized by the following methods:

- Tributaries have been left in their relatively natural state where possible.
- New drainageways and swales have been stabilized with either riprap or erosion control fabric depending on the erosion potential.
- No new roadside ditches are proposed for the development.

Step 3: The proposed development will disturb approximately 4.5 acres, although the initial disturbance will only be 0.7 acres.

Step 4: The development of this project will not affect sensitive waters.

The development of this site will have little impact on downstream properties once the EDB is constructed.

REFERENCES

1. City of Colorado Springs and El Paso County (1994). ***Drainage Criteria Manual Volume 1*** (DCM).

2. City of Colorado Springs and El Paso County (1994). ***Drainage Criteria Manual Volume II*** (DCM).

3. Soil Survey of El Paso County Area, Colorado by USDA, NRCS.

4. ***El Paso County (January 2006) Engineering Criteria Manual.***

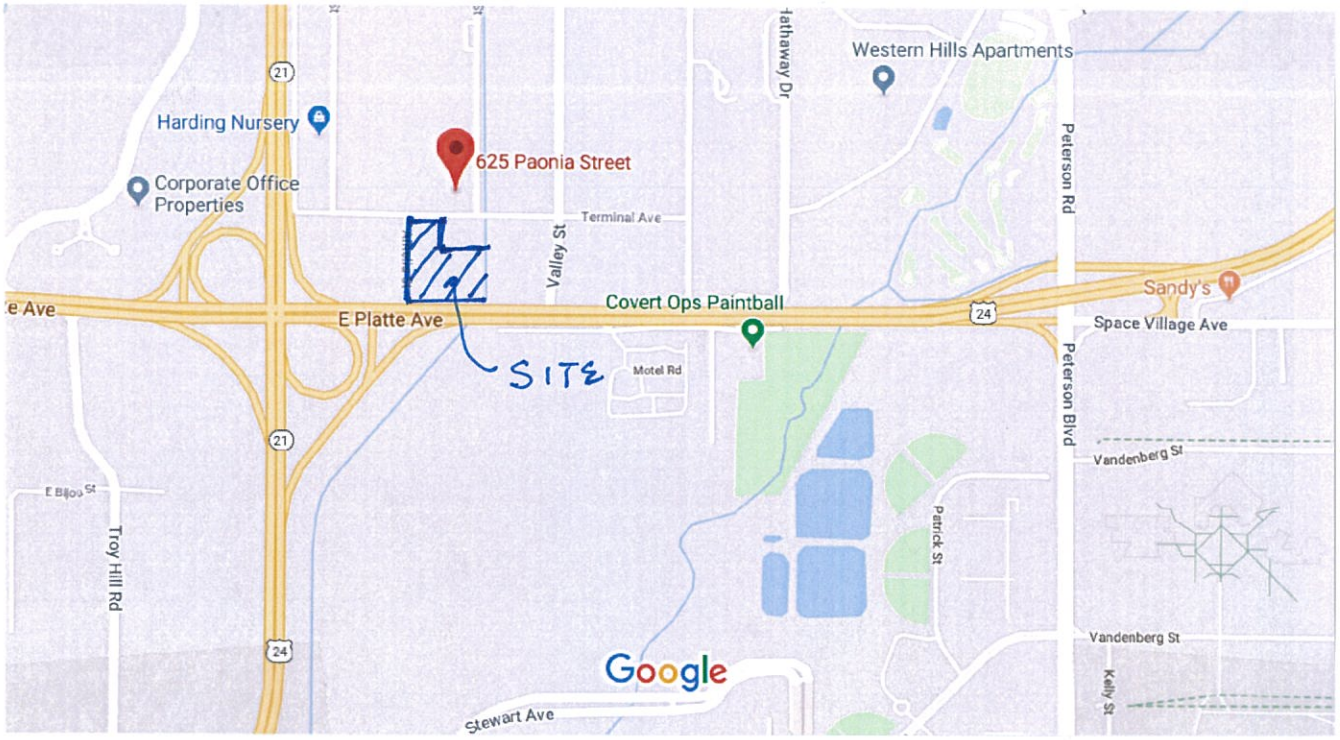
5. Urban Drainage and Flood Control District (June 2011). ***Urban Storm Drainage Criteria Manual, Volume 1-3.***

6. Sand Creek Drainage Basin Planning Study (DBPS).

7. Preliminary/Final Drainage Plan and Report for the Appaloosa Hwy 24 Subdivision by Oliver E. Watts, Consulting Engineer, dated November, 2000.

APPENDIX A

MAPS

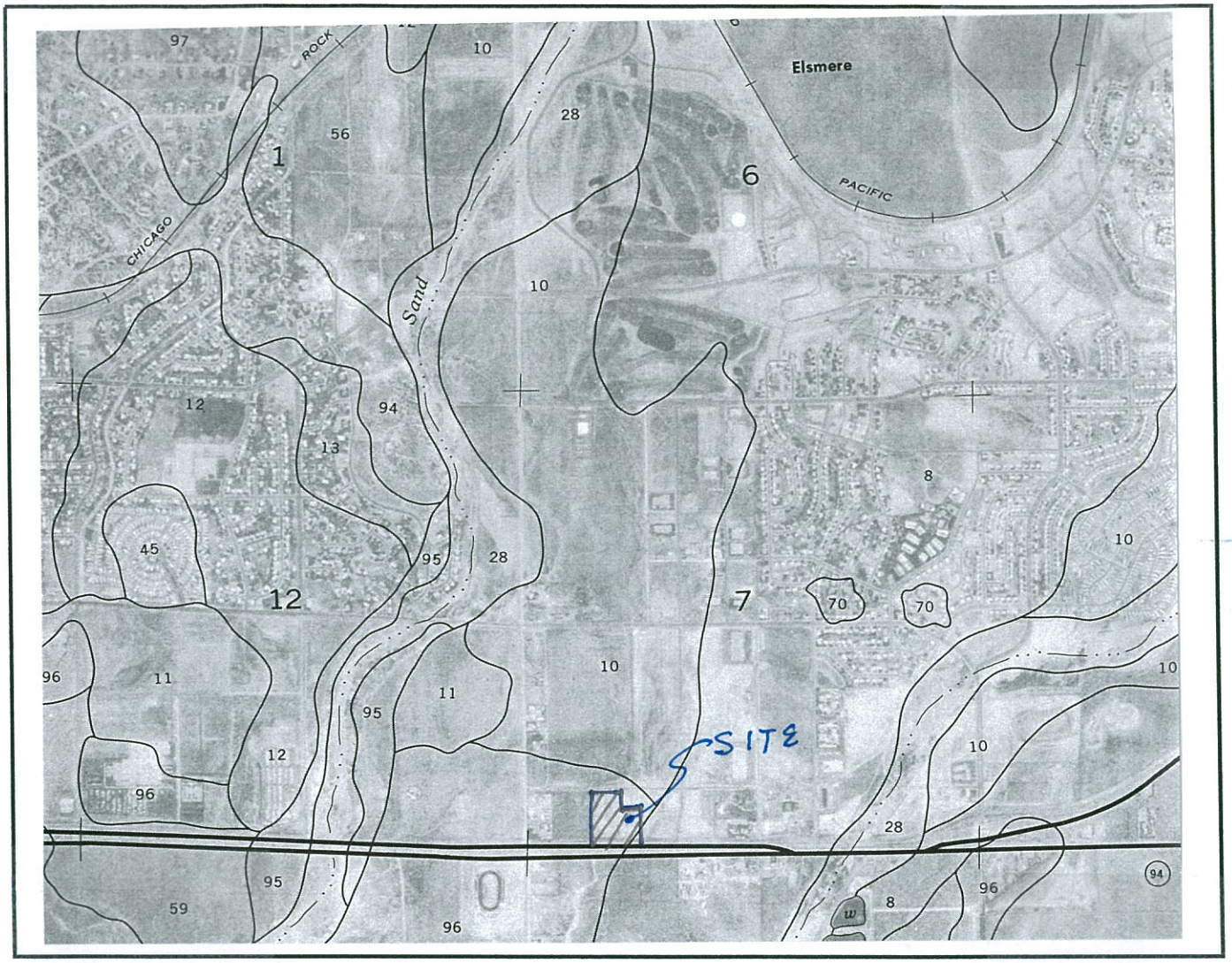


VICINITY MAP

N.T.S.

ADP CIVIL
ENGINEERING FOR THE FUTURE

3520 Austin Bluffs Pkwy, Suite 102
Colorado Springs, CO 80918
(719) 266-5212
fax: (719) 266-5341



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SOILS MAP

N.T.S.

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ENGINEERING FOR THE FUTURE

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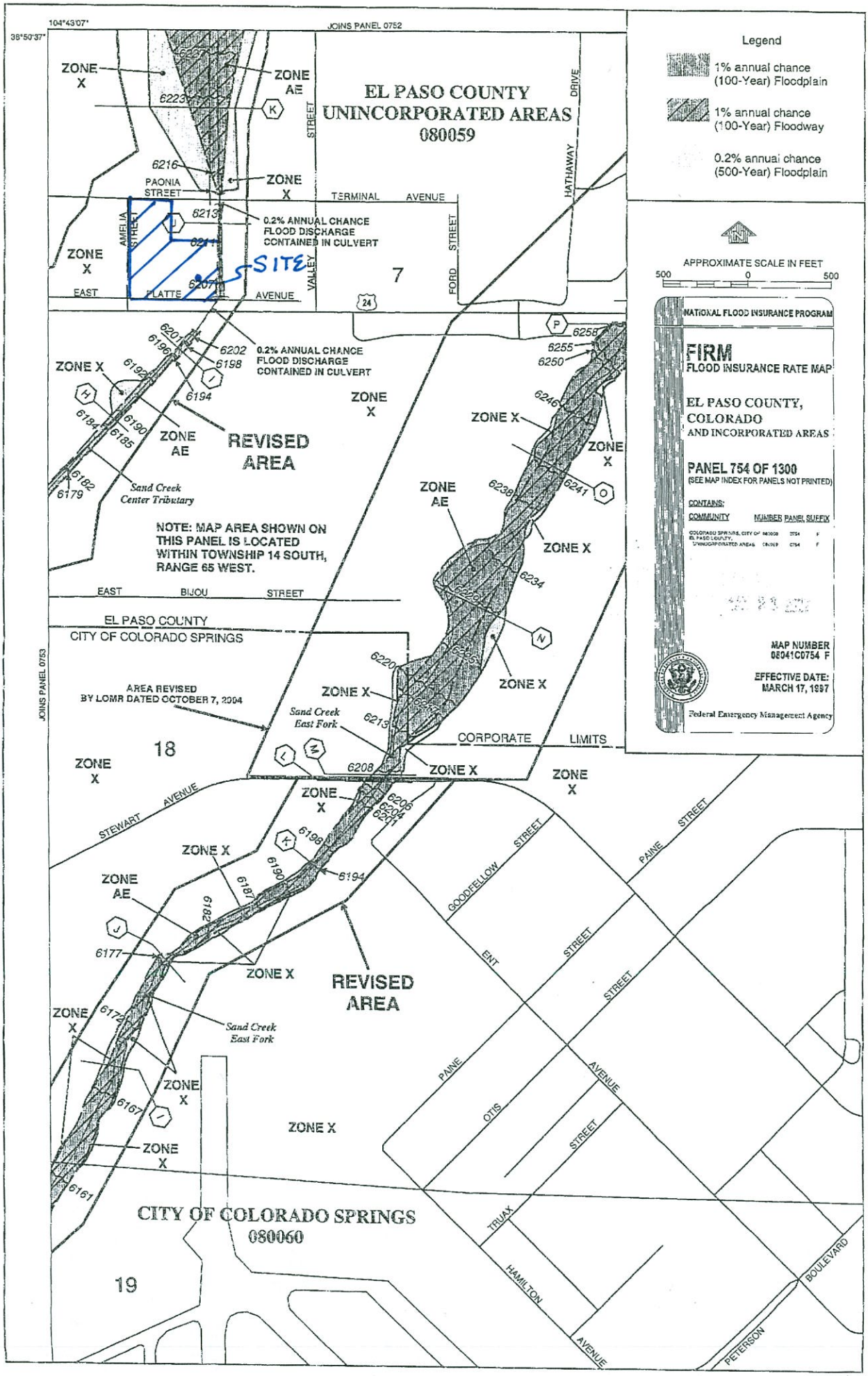

104°43'07"
38°50'37"
JOINS PANEL 0752
EL PASO COUNTY
UNINCORPORATED AREAS
080059
ZONE X
ZONE AE
ZONE A
PAONIA STREET
TERMINAL AVENUE
AMELIA STREET
0.2% ANNUAL CHANCE FLOOD DISCHARGE CONTAINED IN CULVERT
SITE
EAST PLATTE AVENUE
VALLEY STREET
FORD STREET
HATHAWAY DRIVE
REVISED AREA
Sand Creek Center Tributary
NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 14 SOUTH, RANGE 65 WEST.
EAST BIJOU STREET
EL PASO COUNTY
CITY OF COLORADO SPRINGS
JOINS PANEL 0753
AREA REVISED BY LOMR DATED OCTOBER 7, 2004
Sand Creek East Fork
CORPORATE LIMITS
STEWART AVENUE
GOODFELLOW STREET
PAINE STREET
OTIS STREET
TRUAX
HAMILTON
AVENUE
BOULEVARD
PETERSON
CITY OF COLORADO SPRINGS
080060
Legend
1% annual chance (100-Year) Floodplain
1% annual chance (100-Year) Floodway
0.2% annual chance (500-Year) Floodplain
APPROXIMATE SCALE IN FEET
500 0 500
NATIONAL FLOOD INSURANCE PROGRAM
FIRM
FLOOD INSURANCE RATE MAP
EL PASO COUNTY, COLORADO AND INCORPORATED AREAS
PANEL 754 OF 1300
(SEE MAP INDEX FOR PANELS NOT PRINTED)
CONTAINS:
COMMUNITY NUMBER PANEL SUFFIX
COLORADO SPRINGS, CITY OF 080060 0754 F
EL PASO COUNTY, UNINCORPORATED AREAS 080059 0754 F
MAP NUMBER 08041C0754 F
EFFECTIVE DATE: MARCH 17, 1997
Federal Emergency Management Agency

APPENDIX B

DESIGN CALCULATIONS

APPALOOSA SUBDIVISION

PROJ. #160504

DRAINAGE CALCULATION SHEET

file:appaloosa dr

04/24/18

AREA DESIG.	AREA (acre)	C5 (5 yr)	C100 (100 yr)	C5 X A	C100 X A	L (ft)	Initial Tci Slope (%)	ti (min)	L (ft)	Travel Time Slope (%)	V (fps)	Tt (min)	TC (min)	I5 (in/hr)	I100 (in/hr)	Q5 (cfs)	Q100 (cfs)	length L (feet)	vel. V (fps)	^t (min)	AREA DESIG.
EXISTING CONDITIONS																					
Aex	4.58	0.08	0.35	0.37	1.60	250	1.20	28.40	300	1.30	1.20	4.17	32.56	2.21	3.86	0.81	6.18				Aex
DEVELOPED CONDITIONS																					
A1	1.00	0.49	0.62	0.49	0.62	175	2.20	11.63	170	0.50	0.70	4.05	15.68	3.30	5.77	1.62	3.57	150	10.00	0.25	A1
A2	0.98	0.49	0.62	0.48	0.61	175	2.20	11.63	170	0.50	0.70	4.05	15.68	3.30	5.77	1.59	3.50				A2
DP1	1.98			0.97	1.23								15.93	3.28	5.72	3.18	7.02	175	10.00	0.29	DP1
A3	2.60	0.49	0.62	1.27	1.61	250	1.20	16.98	300	1.30	1.20	4.17	21.15	2.83	4.94	3.60	7.96				A3
DP2	4.58			2.24	2.84								21.15	2.83	4.94	6.35	14.02				DP2

IMPERVIOUS AREA CALC

Description	Imperv %
UNDEV	0
LOOSE GRAVEL	80
PAVED PARKING	100
BUILDINGS	100

Subasin	Area	Landscape	Building	Imperious Area Description: Paved Parking	Loose Gravel	Total Imperv
A1	1.00	0.16	0.04	0.20	0.60	72.0
A2	0.98	0.14	0.04	0.20	0.60	73.5
A3	2.60	0.35	0.25	0.40	1.60	74.2
Total	4.58					73.6

SPILLWAY CALCULATIONS

b = 10'

d = 0.5'

C = 3.2

Q = d^1.5xbxC

Q = 11.3 cfs

PIPE CAPACITY

D = 18"

S = 1.0%

n = 0.012

Q max = 11.4 cfs

FOREBAY CALCULATIONS

2% OF WQV

0.02 X 0.118 = 0.002 AF = 102 CF

FOREBAY NOTCH CALCULATIONS

25 OF 100YR FLOW

0.02 X 14.0 = 0.28 CFS

W =Q/(D61.5XC

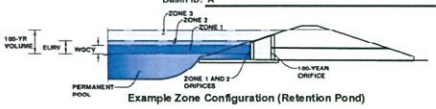
W=0.28/(1X3.0)=0.09 FT

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: Appaloosa Subdivision

Basin ID: A



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	EDB	
Watershed Area =	4.58	acres
Watershed Length =	550	ft
Watershed Slope =	0.012	ft/ft
Watershed Imperviousness =	76.70%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	100.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Desired WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	Denver - Capitol Building	
Water Quality Capture Volume (WQCV) =	0.118	acre-feet
Excess Urban Runoff Volume (EURV) =	0.389	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.327	acre-feet
5-yr Runoff Volume (P1 = 1.5 in.) =	0.431	acre-feet
10-yr Runoff Volume (P1 = 1.75 in.) =	0.538	acre-feet
25-yr Runoff Volume (P1 = 2 in.) =	0.662	acre-feet
50-yr Runoff Volume (P1 = 2.25 in.) =	0.757	acre-feet
100-yr Runoff Volume (P1 = 2.52 in.) =	0.880	acre-feet
500-yr Runoff Volume (P1 = 3.01 in.) =	1.098	acre-feet
Approximate 2-yr Detention Volume =	0.307	acre-feet
Approximate 5-yr Detention Volume =	0.405	acre-feet
Approximate 10-yr Detention Volume =	0.506	acre-feet
Approximate 25-yr Detention Volume =	0.542	acre-feet
Approximate 50-yr Detention Volume =	0.564	acre-feet
Approximate 100-yr Detention Volume =	0.597	acre-feet

Optional User Override 1-hr Precipitation	
1.19	inches
1.50	inches
1.75	inches
2.00	inches
2.25	inches
2.52	inches
3.01	inches

Stage-Storage Calculation

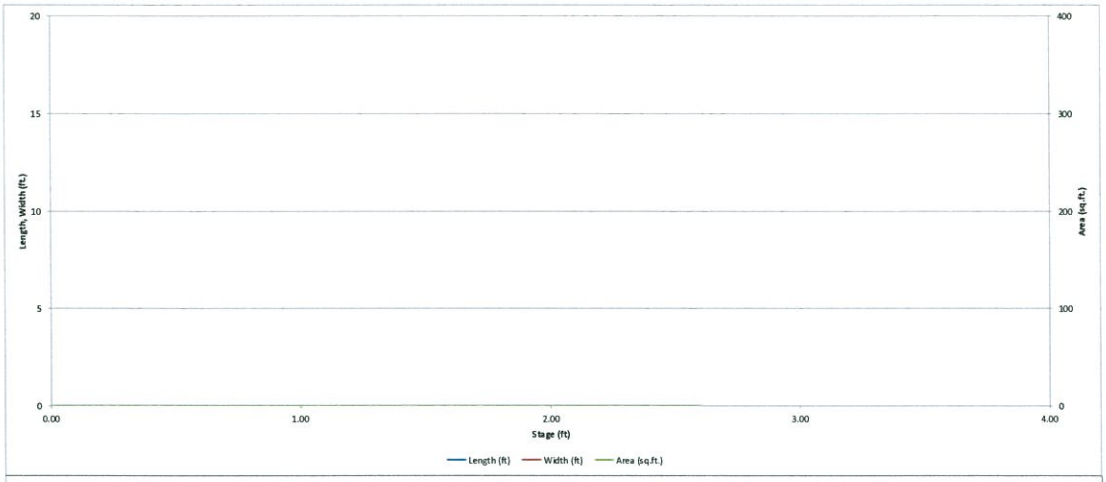
Zone 1 Volume (WQCV) =	0.118	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.271	acre-feet
Zone 3 (100yr + 1 / 2 WQCV - Zones 1 & 2) =	0.267	acre-feet
Total Detention Basin Volume =	0.656	acre-feet
Initial Surcharge Volume (ISV) =	0	ft^3
Initial Surcharge Depth (ISD) =	0.33	ft
Total Available Detention Depth (H_{total}) =	5.00	ft
Depth of Trickle Channel (H_{TC}) =	0.50	ft
Slope of Trickle Channel (S_{TC}) =	0.001	ft/ft
Slopes of Main Basin Sides (S_{main}) =	3	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	2	
Initial Surcharge Area (A_{SV}) =	0	ft^2
Surcharge Volume Length (L_{SV}) =	0.3	ft
Surcharge Volume Width (W_{SV}) =	0.3	ft
Depth of Basin Floor (H_{FLOOR}) =	0.10	ft
Length of Basin Floor (L_{FLOOR}) =	99.9	ft
Width of Basin Floor (W_{FLOOR}) =	50.0	ft
Area of Basin Floor (A_{FLOOR}) =	4,997	ft^2
Volume of Basin Floor (V_{FLOOR}) =	166	ft^3
Depth of Main Basin (H_{MAIN}) =	4.07	ft
Length of Main Basin (L_{MAIN}) =	124.4	ft
Width of Main Basin (W_{MAIN}) =	74.4	ft
Area of Main Basin (A_{MAIN}) =	9,256	ft^2
Volume of Main Basin (V_{MAIN}) =	28,568	ft^3
Calculated Total Basin Volume (V_{total}) =	0.660	acre-feet

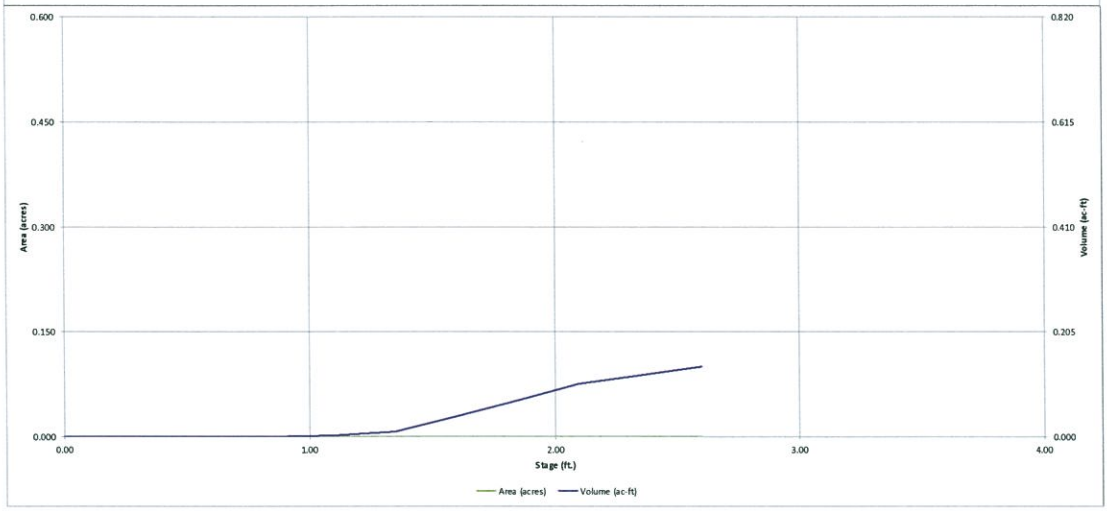
Depth Increment = 0.25 ft

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								
ISV	0.33							0	0.000
	0.50							0	0.000
	0.75							0	0.000
Floor	0.93							124	0.003
	1.00							471	0.011
	1.25							1,762	0.040
	1.50							3,111	0.071
	1.75							4,519	0.104
Zone 1 (WQCV)	1.86							5,216	0.120
	2.00							5,967	0.137
	2.25							7,578	0.174
	2.50							9,171	0.211
	2.75		110.9	60.9	6,754		0.155	10,828	0.249
	3.00		112.4	62.4	7,014		0.161	12,549	0.288
	3.25		113.9	63.9	7,279		0.167	14,335	0.329
	3.50		115.4	65.4	7,548		0.173	16,189	0.372
Zone 2 (EURV)	3.61		116.0	66.1	7,668		0.176	17,026	0.391
	3.75		116.9	66.9	7,821		0.180	18,110	0.416
	4.00		118.4	68.4	8,099		0.186	20,100	0.461
	4.25		119.9	69.9	8,382		0.192	22,160	0.509
	4.50		121.4	71.4	8,669		0.199	24,291	0.558
	4.75		122.9	72.9	8,960		0.206	26,494	0.608
Z3 (100+1/2WQCV)	5.00		124.4	74.4	9,256		0.212	28,771	0.660
	5.25		125.9	75.9	9,556		0.219	31,123	0.714
	5.50		127.4	77.4	9,861		0.226	33,550	0.770
	5.75		128.9	78.9	10,171		0.233	36,054	0.828
	6.00		130.4	80.4	10,485		0.241	38,636	0.887
	6.25		131.9	81.9	10,803		0.248	41,296	0.948
	6.50		133.4	83.4	11,126		0.255	44,038	1.011
	6.75		134.9	84.9	11,453		0.263	46,860	1.076
	7.00		136.4	86.4	11,785		0.271	49,765	1.142
	7.25		137.9	87.9	12,122		0.278	52,753	1.211
	7.50		139.4	89.4	12,463		0.286	55,826	1.282
	7.75		140.9	90.9	12,808		0.294	58,985	1.354
	8.00		142.4	92.4	13,158		0.302	62,230	1.429
	8.25		143.9	93.9	13,513		0.310	65,564	1.505
	8.50		145.4	95.4	13,872		0.318	68,987	1.584
	8.75		146.9	96.9	14,235		0.327	72,500	1.664
	9.00		148.4	98.4	14,603		0.335	76,105	1.747
	9.25		149.9	99.9	14,975		0.344	79,802	1.832
	9.50		151.4	101.4	15,352		0.352	83,593	1.919
	9.75		152.9	102.9	15,734		0.361	87,479	2.008
	10.00		154.4	104.4	16,120		0.370	91,460	2.100
	10.25		155.9	105.9	16,510		0.379	95,539	2.193
	10.50		157.4	107.4	16,905		0.388	99,716	2.289
	10.75		158.9	108.9	17,305		0.397	103,992	2.387
	11.00		160.4	110.4	17,708		0.407	108,368	2.488
	11.25		161.9	111.9	18,117		0.416	112,847	2.591
	11.50		163.4	113.4	18,530		0.425	117,427	2.696
	11.75		164.9	114.9	18,947		0.435	122,112	2.803
	12.00		166.4	116.4	19,369		0.445	126,901	2.913
	12.25		167.9	117.9	19,796		0.454	131,797	3.026
	12.50		169.4	119.4	20,227		0.464	136,799	3.140
	12.75		170.9	120.9	20,662		0.474	141,910	3.258
	13.00		172.4	122.4	21,102		0.484	147,131	3.378
	13.25		173.9	123.9	21,546		0.495	152,462	3.500
	13.50		175.4	125.4	21,995		0.505	157,904	3.625
	13.75		176.9	126.9	22,449		0.515	163,460	3.753
	14.00		178.4	128.4	22,907		0.526	169,129	3.883
	14.25		179.9	129.9	23,369		0.536	174,914	4.015
	14.50		181.4	131.4	23,836		0.547	180,814	4.151
	14.75		182.9	132.9	24,308		0.558	186,832	4.289
	15.00		184.4	134.4	24,783		0.569	192,968	4.430

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)



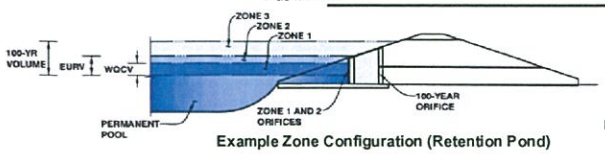


Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: s Academy Business Ctr

Basin ID: A



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.85	0.118	Orifice Plate
Zone 2 (EURV)	3.60	0.271	Orifice Plate
(100+1/2WQCV)	4.98	0.267	Weir&Pipe (Restrict)
		0.656	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 =	1.50	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	6.00	inches
Orifice Plate: Orifice Area per Row =	0.31	sq. inches (diameter = 5/8 inch)

Calculated Parameters for Plate

WQ Orifice Area per Row =	2.153E-03	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	0.50	1.00					
Orifice Area (sq. inches)	0.31	0.31	0.31					

	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

Calculated Parameters for Vertical Orifice

	Not Selected	Not Selected	
Vertical Orifice Area =	N/A	N/A	ft^2
Vertical Orifice Centroid =	N/A	N/A	feet

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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	1.50	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	2.00	N/A	feet
Overflow Weir Slope =	0.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	2.00	N/A	feet
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	1.50	N/A	feet
Over Flow Weir Slope Length =	2.00	N/A	feet
Grate Open Area / 100-yr Orifice Area =	4.87	N/A	should be ≥ 4
Overflow Grate Open Area w/o Debris =	2.80	N/A	ft^2
Overflow Grate Open Area w/ Debris =	1.40	N/A	ft^2

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 =	0.00	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 =	6.50		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	0.58	N/A	ft^2
Outlet Orifice Centroid =	0.32	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	1.29	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	5.00	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	5.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

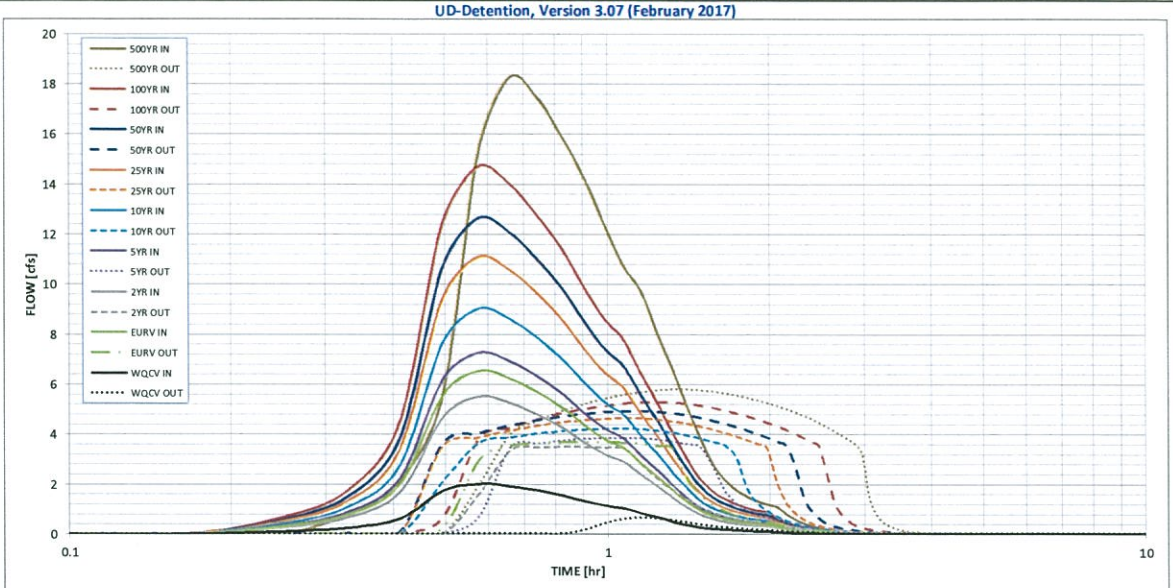
Spillway Design Flow Depth=	0.76	feet
Stage at Top of Freeboard =	6.76	feet
Basin Area at Top of Freeboard =	0.26	acres

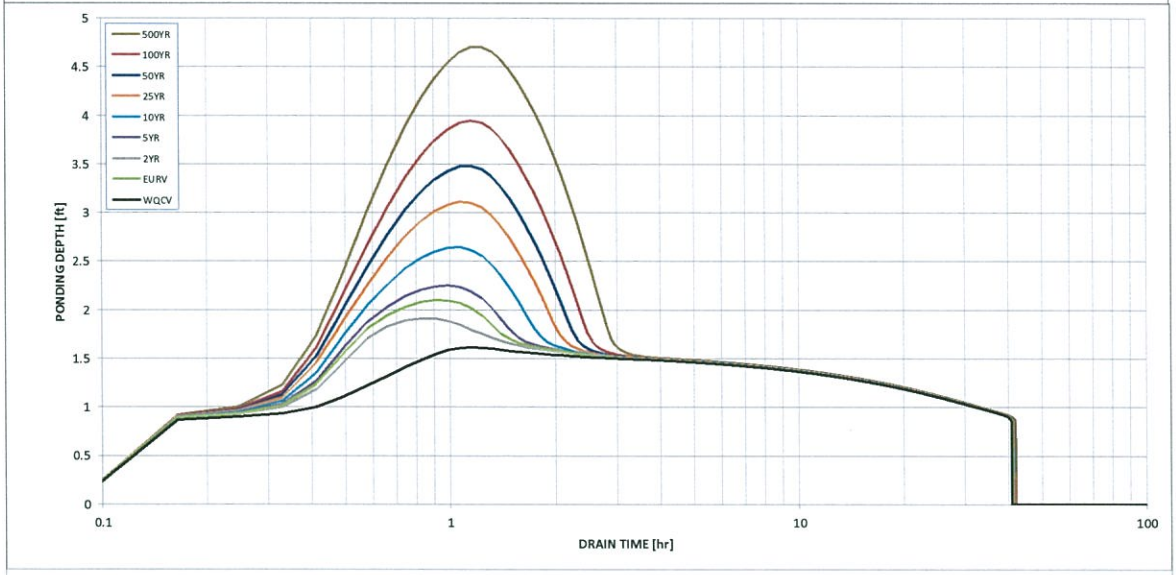
Routed Hydrograph Results

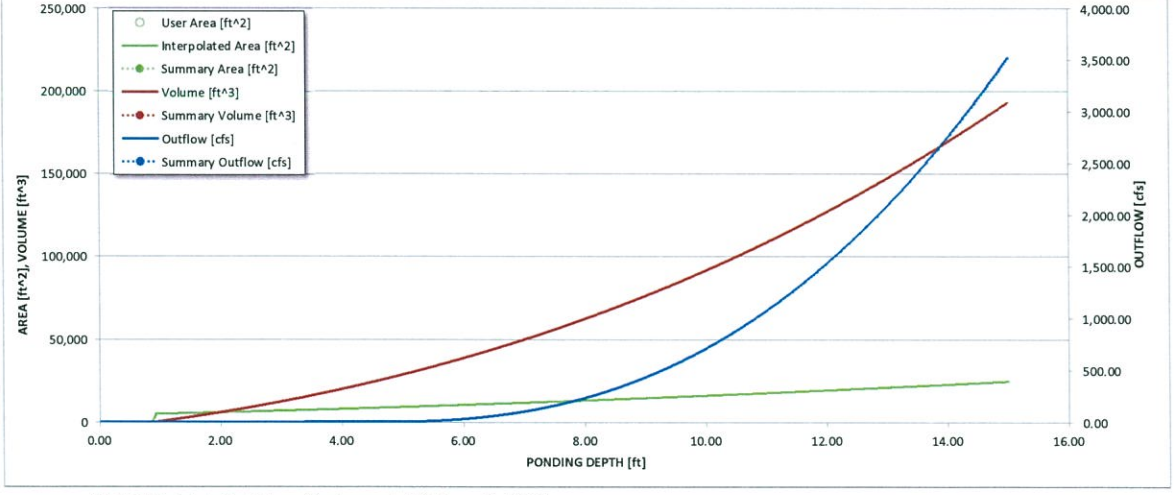
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	3.01
Calculated Runoff Volume (acre-ft) =	0.118	0.389	0.327	0.431	0.538	0.662	0.757	0.880	1.098
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.118	0.388	0.326	0.431	0.537	0.662	0.756	0.879	1.097
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.02	0.20	0.67	0.93	1.25	1.77
Predevelopment Peak Q (cfs) =	0.0	0.0	0.1	0.1	0.9	3.1	4.3	5.7	8.1
Peak Inflow Q (cfs) =	2.0	6.5	5.5	7.3	9.0	11.1	12.6	14.7	18.2
Peak Outflow Q (cfs) =	0.7	3.7	3.5	3.8	4.2	4.6	4.9	5.3	5.8
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	39.8	4.5	1.5	1.2	0.9	0.7
Structure Controlling Flow =	Overflow Grate 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1
Max Velocity through Grate 1 (fps) =	0.19	1.31	1.23	1.4	1.5	1.6	1.7	1.9	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	33	34	32	30	28	27	25	22
Time to Drain 99% of Inflow Volume (hours) =	40	38	39	38	38	37	36	36	34
Maximum Ponding Depth (ft) =	1.61	2.10	1.91	2.25	2.64	3.11	3.48	3.94	4.70
Area at Maximum Ponding Depth (acres) =	0.13	0.14	0.14	0.14	0.15	0.16	0.17	0.18	0.20
Maximum Volume Stored (acre-ft) =	0.087	0.151	0.127	0.173	0.232	0.304	0.366	0.450	0.598

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.

Time Interval	SOURCE	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK
	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]
4.96 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:04:58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hydrograph	0:09:55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Constant	0:14:53	0.09	0.29	0.25	0.32	0.40	0.49	0.56	0.65	0.80
1.008	0:19:50	0.24	0.78	0.66	0.87	1.08	1.32	1.50	1.74	2.16
	0:24:48	0.63	2.01	1.70	2.23	2.77	3.39	3.86	4.48	5.55
	0:29:46	1.73	5.54	4.68	6.14	7.61	9.32	10.62	12.31	15.26
	0:34:43	2.01	6.53	5.50	7.25	9.02	11.07	12.63	14.67	18.25
	0:39:41	1.91	6.22	5.24	6.91	8.60	10.57	12.06	14.01	17.44
	0:44:38	1.74	5.66	4.77	6.29	7.83	9.62	10.98	12.76	15.88
	0:49:36	1.54	5.04	4.24	5.61	6.98	8.59	9.81	11.41	14.22
	0:54:34	1.31	4.34	3.65	4.83	6.02	7.42	8.48	9.87	12.32
	0:59:31	1.15	3.79	3.19	4.21	5.25	6.46	7.39	8.59	10.71
	1:04:29	1.04	3.43	2.88	3.81	4.76	5.86	6.69	7.79	9.71
	1:09:26	0.84	2.81	2.36	3.13	3.92	4.83	5.53	6.45	8.06
	1:14:24	0.67	2.29	1.92	2.55	3.19	3.95	4.52	5.28	6.61
	1:19:22	0.50	1.75	1.46	1.95	2.45	3.04	3.49	4.09	5.13
	1:24:19	0.36	1.29	1.07	1.44	1.82	2.27	2.61	3.06	3.86
	1:29:17	0.27	0.94	0.78	1.05	1.32	1.64	1.89	2.21	2.80
	1:34:14	0.21	0.73	0.61	0.82	1.03	1.27	1.46	1.70	2.15
	1:39:12	0.17	0.60	0.50	0.67	0.84	1.05	1.20	1.40	1.77
	1:44:10	0.15	0.51	0.43	0.57	0.72	0.89	1.02	1.19	1.50
	1:49:07	0.13	0.45	0.38	0.50	0.63	0.78	0.89	1.04	1.31
	1:54:05	0.12	0.41	0.34	0.45	0.57	0.70	0.80	0.94	1.18
	1:59:02	0.11	0.38	0.32	0.42	0.52	0.65	0.74	0.86	1.08
	2:04:00	0.08	0.28	0.23	0.31	0.38	0.47	0.54	0.63	0.80
	2:08:58	0.06	0.20	0.17	0.23	0.28	0.35	0.40	0.47	0.58
	2:13:55	0.04	0.15	0.12	0.16	0.21	0.26	0.29	0.34	0.43
	2:18:53	0.03	0.11	0.09	0.12	0.15	0.19	0.22	0.25	0.32
	2:23:50	0.02	0.08	0.06	0.09	0.11	0.13	0.15	0.18	0.23
	2:28:48	0.02	0.05	0.05	0.06	0.08	0.10	0.11	0.13	0.16
	2:33:46	0.01	0.04	0.03	0.04	0.05	0.07	0.08	0.09	0.12
	2:38:43	0.01	0.02	0.02	0.03	0.04	0.04	0.05	0.06	0.08
	2:43:41	0.00	0.01	0.01	0.02	0.02	0.03	0.03	0.04	0.05
	2:48:38	0.00	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02
	2:53:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
	2:58:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:03:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:08:29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:13:26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:18:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:23:22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:28:19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:33:17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:38:14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:43:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:48:10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:53:07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:58:05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:03:02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:08:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:12:58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:17:55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:22:53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:27:50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:32:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:37:46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:42:43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:47:41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:52:38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:57:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:02:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:07:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:12:29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:17:26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:22:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:27:22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:32:19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:37:17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:42:14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:47:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:52:10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:57:07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

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).

APPENDIX C

DESIGN CHARTS

Table 6-6. Runoff Coefficients for Rational Method
(Source: UDFCD 2001)

Land Use or Surface Characteristics	Percent Impervious	Runoff Coefficients											
		2-year		5-year		10-year		25-year		50-year		100-year	
		HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D
Business													
Commercial Areas	95	0.79	0.80	0.81	0.82	0.83	0.84	0.85	0.87	0.87	0.88	0.88	0.89
Neighborhood Areas	70	0.45	0.49	0.49	0.53	0.53	0.57	0.58	0.62	0.60	0.65	0.62	0.68
Residential													
1/8 Acre or less	65	0.41	0.45	0.45	0.49	0.49	0.54	0.54	0.59	0.57	0.62	0.59	0.65
1/4 Acre	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
1/3 Acre	30	0.18	0.22	0.25	0.30	0.32	0.38	0.39	0.47	0.43	0.52	0.47	0.57
1/2 Acre	25	0.15	0.20	0.22	0.28	0.30	0.36	0.37	0.46	0.41	0.51	0.46	0.56
1 Acre	20	0.12	0.17	0.20	0.26	0.27	0.34	0.35	0.44	0.40	0.50	0.44	0.55
Industrial													
Light Areas	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Heavy Areas	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Parks and Cemeteries	7	0.05	0.09	0.12	0.19	0.20	0.29	0.30	0.40	0.34	0.46	0.39	0.52
Playgrounds	13	0.07	0.13	0.16	0.23	0.24	0.31	0.32	0.42	0.37	0.48	0.41	0.54
Railroad Yard Areas	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
Undeveloped Areas													
Historic Flow Analysis—Greenbelts, Agriculture	2	0.03	0.05	0.09	0.16	0.17	0.26	0.26	0.38	0.31	0.45	0.36	0.51
Pasture/Meadow	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Forest	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Exposed Rock	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Offsite Flow Analysis (when landuse is undefined)	45	0.26	0.31	0.32	0.37	0.38	0.44	0.44	0.51	0.48	0.55	0.51	0.59
Streets													
Paved	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Gravel	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Drive and Walks	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Roofs	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Lawns	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50

Figure 6-25. Estimate of Average Concentrated Shallow Flow

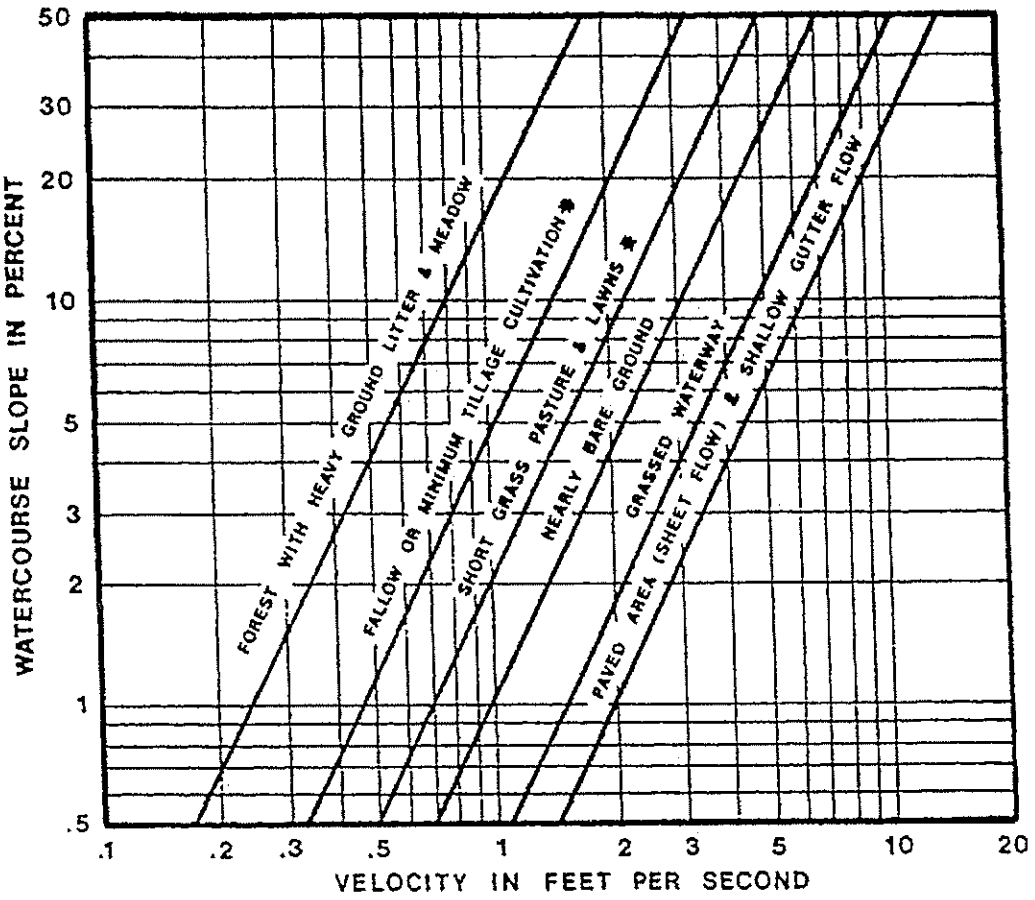
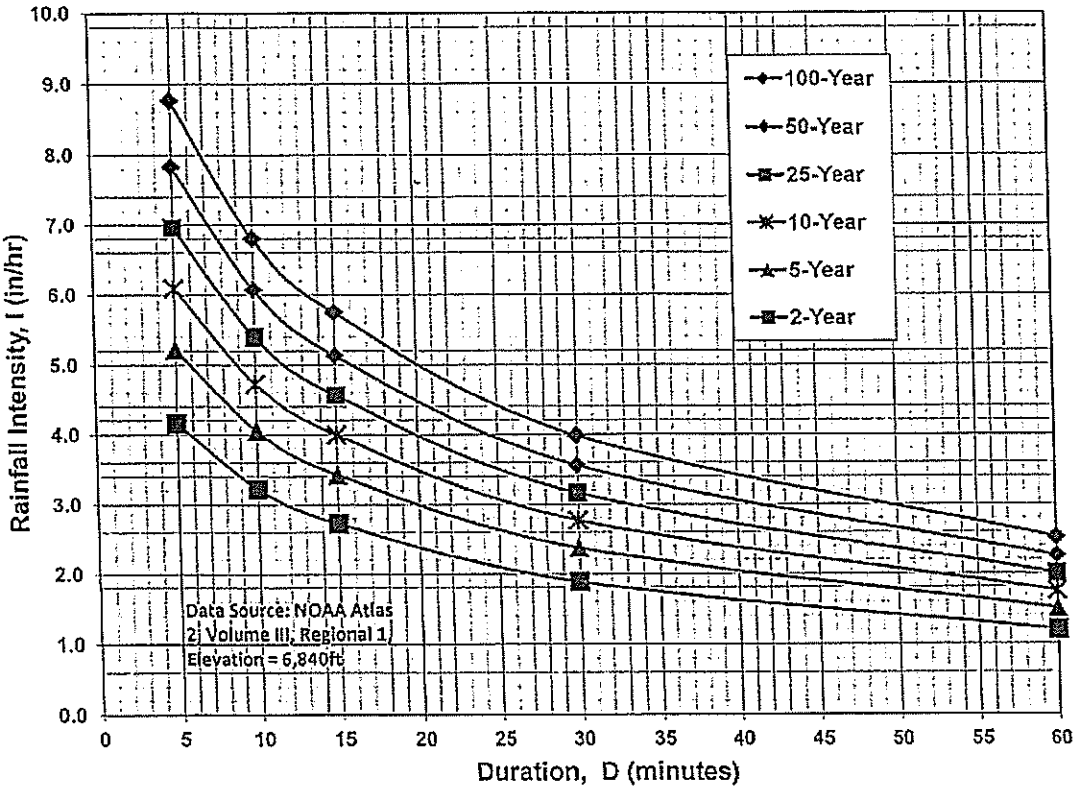


Figure 6-5. Colorado Springs Rainfall Intensity Duration Frequency



IDF Equations

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

$I_{50} = -2.25 \ln(D) + 11.375$

$I_{25} = -2.00 \ln(D) + 10.111$

$I_{10} = -1.75 \ln(D) + 8.847$

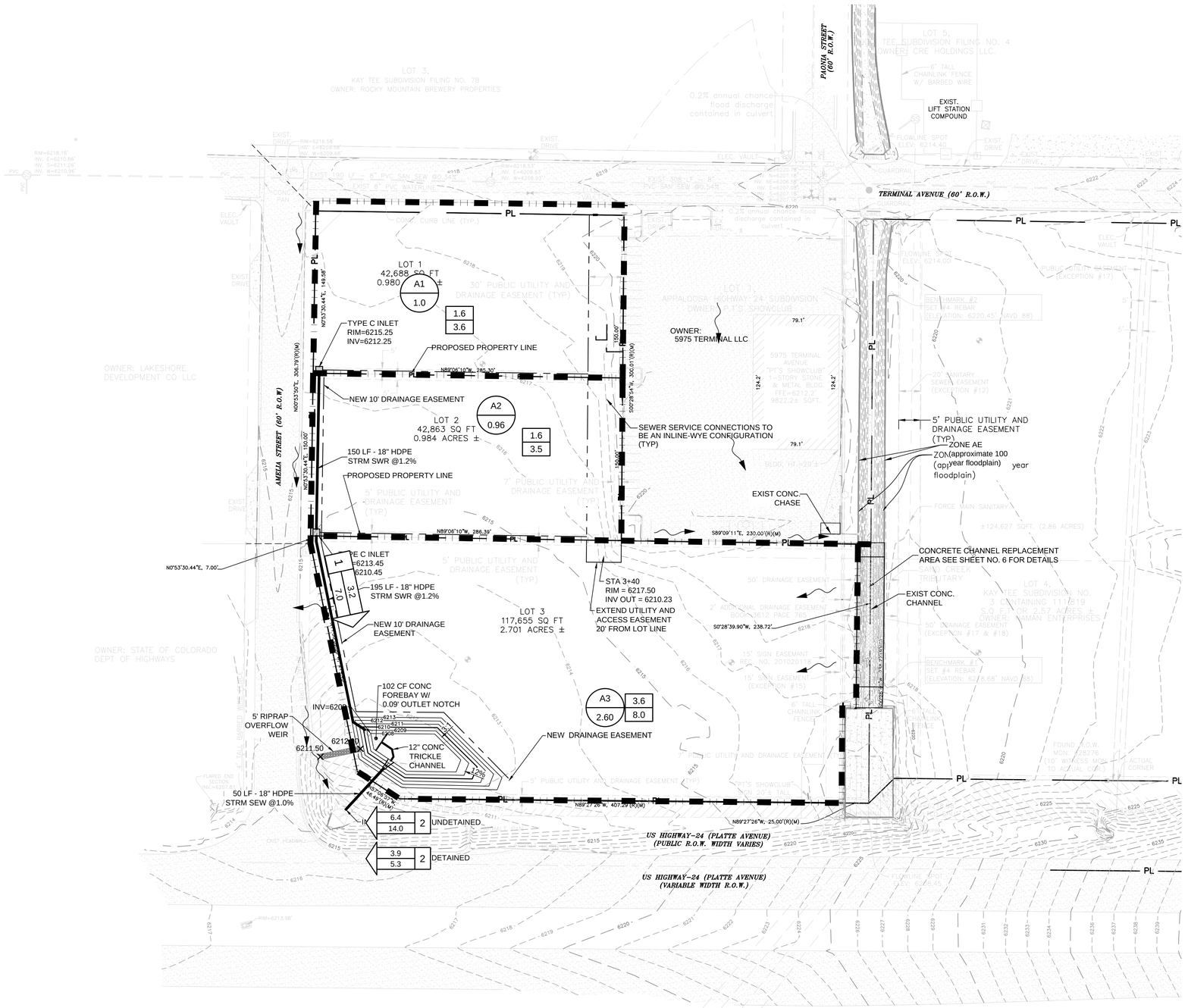
$I_5 = -1.50 \ln(D) + 7.583$

$I_2 = -1.19 \ln(D) + 6.035$

Note: Values calculated by equations may not precisely duplicate values read from figure.

LEGEND

- A1A / 1.0 — BASIN DESIGNATION; BASIN AREA, ACRES
- XX / XX — 5 YEAR STORM, CFS; 100 YEAR STORM, CFS
- DESIGN POINT — XX / XX.X / XX.X — 5 YEAR ACCUMULATED FLOW, CFS; 100 YEAR ACCUMULATED FLOW, CFS
- SUB-BASIN BOUNDARY
- DIRECTION OF DRAINAGE FLOW



GRAPHIC SCALE

50 0 25 50 100 200

(IN FEET)
1 inch = 50 ft.

DESIGNED BY	MAB
DRAWN BY	HJG
CHECKED BY	MAB
DATE	04/16/18
JOB NO.	160504
CAD FILE NO.	160504-Const
SCALE: HORZ.	1" = 50'
VERT.	N/A

PREPARED BY:

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(719) 266-5212
fax: (719) 266-5341

NO.	DATE	REVISION	BY

APPALOOSA HIGHWAY 24 SUBDIVISION
FILING NO. 2
COLORADO SPRINGS, COLORADO

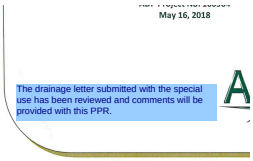
DRAINAGE PLAN

SHEET
1 of 1

M:\LAND PROJECTS\2016\160504-Appaloosa Sub\DWG\160504-Const.dwg Mike Wed, 06/06/18 10:39 AM

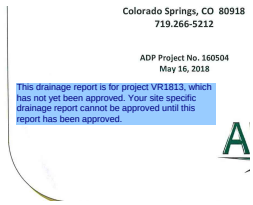
Markup Summary

dsdgrimm (2)



Subject: Engineer
Page Label: 1
Author: dsdgrimm
Date: 9/4/2018 3:25:33 PM
Color:

The drainage letter submitted with the special use has been reviewed and comments will be provided with this PPR.



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Page Label: 1
Author: dsdgrimm
Date: 9/4/2018 3:25:58 PM
Color:

This drainage report is for project VR1813, which has not yet been approved. Your site specific drainage report cannot be approved until this report has been approved.