MASTER DEVELOPMENT DRAINAGE PLAN AND REPORT

CYGNET BUSINESS PARK

AND

PRELIMINARY/FINAL DRAINAGE REPORT

Airport OZ Subdivision

A TRACT OF LAND IN THE SOUTHEAST QUARTER OF SECTION 25, TOWNSHIP 14 SOUTH, RANGE 66 WEST OF THE 6TH P.M., IN THE CITY OF COLORADO SPRINGS, EL PASO COUNTY, COLORADO

August 15, 2019

Revised
November 21, 2019
January 7, 2020
January 28, 2020
March 3, 2020
March 17, 2020
March 23, 2020
March 26, 2020
April 14, 2020

prepared for
Nomind 6, LLC, a Colorado Limited Liability Company
2 N. Cascade Ave., Suite 300
Colorado Springs, CO 80903

Oliver E. Watts, Consulting Engineer, Inc.
Colorado Springs, Colorado

OLIVER E. WATTS, PE-LS
OLIVER E. WATTS, CONSULTING ENGINEER, INC.
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Celebrating over 41 years in business

April 14, 2020

City Engineering
Development Review Division
30 South Nevada Ave
Suite 402
Colorado Springs, CO 80903

ATTN: *Jonathan Scherer*

SUBJECT: Preliminary/Final Drainage Plan and Report
Airport OZ Subdivision

Gentlemen

Transmitted herewith for your review and approval is the Preliminary/Final Drainage Plan and Report for the Airport OZ Subdivision, also serving as a Master drainage report for the Cygnet Business Park. This report has been revised in accordance with our meeting of January 6, 2020, and your review comments of January 24, 2020 and February 12, 2020, along with our telephone conferences of the past week, your additional comments of March 25, 2000 and the revising of the subdivision plat of April 14, 2020.

The purpose of the report is to "identify on-site and offsite drainage patterns, storm sewer, culvert and inlet locations, areas tributary to the site, and to safely route developed storm water to adequate outfalls"

Please contact me if I may provide any further information.

Oliver E. Watts, Consulting Engineer, Inc.

BY: _____
Oliver E. Watts, President

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1. ENGINEER'S STATEMENT:

This report and plan for the drainage design of Airport OZ Subdivision was prepared by me (or under my direct supervision) and is correct to the best of my knowledge and belief. Said drainage report and plan has been prepared in accordance with the City of Colorado Springs Drainage Criteria Manual and is in conformity with the master plan of the drainage basin. I understand that the City of Colorado Springs does not and will not assume liability for drainage facilities designed by others. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparing this report.

Oliver E. Watts, Consulting Engineer, Inc.

OLIVER L. WATTS REGISTERED 9853 P. E. & L. S. STATE OF COLORADO

3/26/20

Oliver E. Watts Colo. PE-LS No. 9853 date

2. DEVELOPER'S STATEMENT:

Nomind 6, LLC hereby certifies that the drainage facilities for Airport OZ Subdivision shall be constructed according to the design presented in this report. I understand that the City of Colorado Springs does not and will not assume liability for the drainage facilities designed and / or certified by my engineer and that are submitted to the City of Colorado Springs pursuant to section 7.7.906 of the City Code; and cannot, on behalf of Airport OZ Subdivision, guarantee that final drainage design review will absolve Nomind 6, LLC and/or their successors and/or assigns of future liability for improper design. I further understand that approval of the final plat does not imply approval of my engineer's drainage design

By: March 26, 2020
Robert Garner, manager date
Nomind 6, LLC, a Colorado Limited Liability Company
2 N. Cascade Ave., Suite 300
Colorado Springs, CO 80903
(719) 577-0044

3. CITY OF COLORADO SPRINGS STATEMENT:

Filed in accordance with Section 7.7.906 of the Code of the City of Colorado Springs, 2001, as amended.

Jonathan B. Ahrens 04/15/2020
for City Engineer date

Conditions:

4. LOCATION AND DESCRIPTION:

The Airport OZ Subdivision is a 2-lot, 1-tract, commercial subdivision plat of a tract of land in the Southeast Quarter of Section 25, Township 14 South, Range 66 West of the 6th P.M., in the City of Colorado Springs, El Paso County, Colorado. The 25.8 acre site is zoned PBC and PIP 2. It will be rezoned to (only) PIP 2. There are no structures on the site at this time, save the private road, Cygnet Heights. It is located on the southeast corner of Powers and Fountain. The Assessor's Parcel Number is 6425000066.

The purpose of this report is to support the Concept Plan and Subdivision Plat approval process for the Airport Oz Subdivision. Each lot of the subdivision will have a Final Drainage Report to accompany the future submittal of the required land use development plan. The subdivision of Tract B requires this report to serve as a master plan for the entire Cygnet area. This was required as part of the approval of the revised drainage report for Cygnet Filing no. 2. Because of that the existing two Cygnet lots are addressed. The entire development is shown on the enclosed drainage plan.

The site is bounded on the north by Fountain Boulevard; the west by Powers Boulevard; the east by Aviation Way and the south by Cygnet Business Park Filing No. 1 (southwest) and Filing No. 2 (southeast). The parcel is in the Peterson Field Drainage Basin. URS did the Peterson Drainage Basin Study in 2004. URS did the Cygnet Business Park MDDP in February 2005, which we understand has not been approved. The drainage report for Cygnet Business Park Filing No. 1 was also done by URS and approved by the City 1-21-05. A portion of our proposed Lot 4 was shown as Basin OS-3 in said report. Springs Engineering amended the Filing 1 report, and the City approved it 2-5-08. Cygnet Business Park Filing No. 2 drainage report was also done by Springs Engineering and approved by the City 7-25-06. An amendment was also done for Filing 2 by Stantec and approved by the City 8-16-17.

We propose to plat the proposed filing no. 1 site into a 2-lot, 1-tract, commercial subdivision as shown on the enclosed drainage plan. The private road, Cygnet Heights will divide the lots. The common water quality pond site will occupy the 1.2 acre southwest portion of the subdivision as Tract "B". For the purpose of this master plan, schematic development configurations are shown on each lot, which is shown in as typical only. As stated above, a detailed final drainage plan and report will accompany the development plan submittal for each lot.

The two Cygnet Subdivision lots are complete as shown on the drainage plan, except for the final construction of the adjacent detention pond, for which a design was approved in the referenced URS report.

All public improvements and utilities are in place on Fountain Boulevard, and in Aviation Way. Public utilities and some curb in gutter are in place in Cygnet Heights. Service lines and this curb and gutter will need to be run into serve the proposed lots; however construction is complete for the two Cygnet Subdivision lots.

5. DRAINAGE CRITERIA AND SOILS CONDITIONS:

The method used for all computations is that specified in the City of Colorado Springs Drainage Criteria Manual, using the rational method for areas of the size of the subdivision and the SCS method for the review of the major basin involved. All computations are enclosed for reference and review.

The local USDA/SCS office has mapped the soils in the subdivision. A soils map and interpretation sheet are enclosed for reference. All soils in this area are of hydrologic groups "A" and "B" within the major basin.

6. DESCRIPTION OF RUNOFF:

EXISTING DRAINAGE CONDITIONS

The South half of Fountain Boulevard East of Cygnet Drive, (Basin 0-1) drains into Signet Drive at the North end, creating 1.47 cfs / 4.2 cfs (5-year / 100-year runoffs). All of the remaining subdivision except Cygnet Drive consists of range land. The east portion (Basins A-C) will drain into Signet Drive and thence into The Cygnet Business Park, where a drainage outfall and temporary detention pond exists as shown on the drainage plan. The outfall point of this routing crosses Tract B and discharges into the Peterson Field drainage channel. The westerly portion of this subdivision will be Lot 2, (Basin E) and drains to the Southwest into Tract B, which is a potential water quality treatment site for this subdivision. The subdivision runoff combines with the runoff from the Cygnet Business Park detention pond, and outfalls into the existing Peterson Field Channel.

PROPOSED DRAINAGE CONDITIONS

IMPERVIOUS COMPUTATIONS:

Drainage computations are based on the computed impervious ratio shown on the drainage plan. This is an anticipated value for the unplatted portion and reflects the existing value for the Cygnet filings. These values are shown in the enclosed computations, and may be summarized as follows:

Identifier	Percent Impervious
Basin O-1	40%
Basins A & B	73%
Lot 1, (Basin C)	71%
Lot 2 (Basin E)	61%
Tract B(Basin H)	61%
Cygnet Filing No. 1 (Basin G)	66%
Cygnet Filing No. 2 (Basin F)	74%
Combined Cygnet (Basins F + G)	70%

DETENTION CRITERIA:

In accordance with the City's policy clarification ("On-Site Detention Requirements – When Regional Detention is Provided") only water quality treatment is required in the case where a regional detention facility is provided that provides detention for both the minor and major storms. A copy of this Policy Clarification is enclosed. Included in the back of this report is the drainage basin boundary map for the existing Powers Boulevard Detention Facility, which provides minor and major storm event detention for its design tributary area. The location of this subdivision and the adjacent Cygnet Subdivision, are shown on the map. Also included are the design criteria from the report, indicating that both the 10 and 100-year runoffs are considered.

WATER QUALITY:

Each lot, being over one acre is size, would be required to provide water quality treatment. It is proposed that a single water quality pond be provided in Tract A to be owned and maintained by a common association for that purpose. For planning purposes a water quality only extended detention basin is computed (see Appendix for preliminary water quality calculations). The enclosed computations indicate maximizing the space available in Tract B. A routing computation is enclosed, and shows that more than adequate area exists as the maximum ponding depth is 4.21' for the 100-year storm and the depth available is over 8 feet. The final design for this water quality pond would be based on the expected development proposals for the subdivision lots, represented by the master plan layout on the drainage plan. It is therefore reasonable to expect a smaller footprint for the final design than shown on the drainage plan.

CYGNET WATER QUALITY:

Water quality treatment for Cygnet Business Park Filing No. 1 and Cygnet Business Park Filing No.2 is proposed as provided per the approved drainage plan for Filing 1. A temporary pond now exists with the grading approximating the proposed configuration. The design for this pond was later modified slightly in the Filing No. 2 report. The impervious percentage was overestimated to be 80% in this latter report and the design for the URS pond is rerouted herein using the above computed existing impervious percentage of 70% and found to be adequate as proposed. The completion of this pond would satisfy the conditions placed on The Filing No. 2 report, although a storm sewer and related easements would be needed to extend the outfall of the pond to the discharge point into the Peterson Field channel. This would correct the existing conflict with Tract B. Details are described herein and shown on the drainage plan.

SUBDIVISION DRAINAGE ROUTING:

Preliminary storm sewer computations are in the appendix. Runoff from the offsite basin (O-1) will continue as is and will be contained in the shown 16' D-10 R inlets at the south boundary. The runoff at the North boundary is 1.4 cfs / 4.2 cfs (5-year / 100-year runoffs. Basins A and B will amount to an inflow of 9.7 cfs / 22.5 cfs (5-year / 100- year runoffs) into Cygnet Drive. This will combine with the offsite basin O-1 and a portion of Cygnet Drive (Part of Basin D) to total 11.2 cfs / 26.7 cfs in the street at the south line of these lots. This is well within the capacity of the 48' private street of 23 cfs/67 cfs. Since the City criteria does not provide for that type of street, private computation sheets are enclosed, and the 100-year capacity is compared to the top of curb capacity for a forty foot street. This runoff will combine with the 13.5 cfs / 26.8 cfs runoff from Lot 1 (Basin C) to become 28.5 cfs / 62.6 cfs at the subdivision boundary, where two, private 16-foot D-10 R catch basins in a sump condition will intercept the total 100-year runoff. The capacity of the street at that location is 36 cfs / 107 cfs. A proposed private 24" and 36" storm sewer will route this total to the southwest corner of lot 2 and combine with Basin E, where a private 8' D-10R is provide with a private 24" storm sewer. A private 36" storm sewer will then run to Tract B, totaling 34.9 cfs / 76.8 cfs. This is the upper end of the proposed water quality pond in Tract B and is outfall point for the storm sewer. The outlet of the pond is located at the southwest corner and will be a second inlet into the existing Peterson Field channel, where an 8' outlet box and a 24" RCP at a minimum slope of 2.13% are provided. The water quality pond will be required for the development of the first lot.

An outfall from the Cygnet Business Park Filing No. 1 pond is proposed to be a private 48" RCP at a 0.12% slope to the existing inlet into the Peterson Field Channel. This would replace the existing open channel across Tract B, and would require a private easement (none now exists).

The ownership and maintenance responsibilities of all of the private facilities, including the street, storm sewers and water quality pond, will be that of the "Cygnet Airport Business Center Association".

FOUR STEP PROCESS

The following process has been followed to minimize adverse impacts of urbanization.

Runoff Reduction: The scope of the development has been minimized consistent with zoning requirements to present the minimum footprint in providing a commercial / industrial development. The undisturbed portions are to be landscaped to reduce the impervious percent.

Treat and Slowly Release: The above described water quality pond will provide water quality treatment and a reduced rate of discharge from the development.

Channel Stabilizing: The site will be graded to route the runoff channel over improved street and curb installations to provide channel stabilizing in the natural erosive material over the site. Discharge from the site will be into the existing Peterson Field drainage channel in accordance with the

master drainage plan and previous subdivision drainage reports. There will be no adverse affect on downstream developments as a result of this subdivision

Source Controls: This is a commercial/industrial site. During construction, standard site specific BMP's will be employed to minimize and mitigate erosive problems. Source controls should not be required but the need will be addressed with the site specific reports.

7. FLOOD PLAIN STATEMENT:

This subdivision is not within the limits of a flood plain or flood hazard area, according to FEMA map panel number 08041C0761 G, dated December 7, 2018, a copy of which are enclosed for reference.

8. FEES:

	Airport Oz	Lot 1	Lot 2	Tract A	Tract B
	20.201	11.665	6.182	1.163	1.191
Total Due		57.74%	30.60%	5.76%	5.90%
$271,541.84	Peterson Field Drainage Fees (20.201 acres @ $ 13,442.00/acre)	$156,800.93	$83,098.44	$15,633.05	$16,009.42
$12,504.42	Peterson Field Bridge (20.201 acres @ $ 619.00/ acre)	$7,220.64	$3,826.66	$719.90	$737.23
$284,046.26	**Total (Check to City of Colorado Springs)**	$164,021.57	$86,925.10	$16,352.94	$16,746.65

9. COST ESTIMATE:

All improvements listed below are private and non-reimbursable
A: AIRPORT OZ FINAL DRAINAGE PLAN

Item No.	Description	Quantity	Unit Cost	Cost
1	8' D-10R catch basin	1 ea	4500.00	4.500.00
2	16' D-10R catch basin	2 ea	7,000.00	14,000.00
5	24" RCP storm sewer	163 lf	60.00	9,780.00
6	36" RCP storm sewer	808 lf	100.00	80,800.00
7	Riprap	15 CY	70.00	1,050.00
8	Pond Grading	7,500 cy	3.50	26,250.00
9	8' Pond Outlet Box	1 ea	12,000.00	12,000.00
	Subtotal Construction Cost			$ 148,380.00
	Engineering and contingency		15%	22,257.00
	Total Estimated Cost			$ 170,637.00

B. ADDITIONAL MASTER PLAN, CYGNET POND IMPROVEMENTS:

Item No.	Description	Quantity	Unit Cost	Cost
1	Outlet Box	1 ea	$15,000.00	$ 15,000.00
2	48" RCP storm sewer	175 lf	130.00	22,750.00
6	Pond Grading	3,000 cy	3.50	10,500.00
	Subtotal Construction Cost			$ 48,250.00
	Engineering and contingency		15%	7,237.50
	Total Estimated Cost			$ 55,487.500

10. SUMMARY

The Airport OZ Subdivision is a proposed 2-lot, 1-tract, commercial subdivision containing 20.2 acres. The proposed drainage facilities will combine with the runoff from the Cygnet Subdivision, Filings No. 1 and No. 2, according to the approved drainage reports of file with the City. This will adequately convey, treat and discharge runoff from the site to existing sufficient downstream facilities. Site runoff and storm drain and appurtenances will not adversely affect the downstream and surrounding developments.

The drainage analysis has been prepared in accordance with the current City of Colorado Springs Drainage Criteria Manual. Supporting information and preliminary calculations are included in this report. This Preliminary/Final Drainage Report has been prepared to show preliminary design level stormwater management measures. Final Drainage Report(s) will be prepared during the development planning approval process. The Final Drainage Report(s) will comply with the most current version of the City of Colorado Springs Drainage Criteria Manual.

This report and findings is in general conformance with the Master Drainage reports and subdivision drainage reports on file with the City.

References

1. City of Colorado Springs Drainage Criteria Manuel, Volumes 1 and 2, May, 2014

2. Cygnet Business Park Filing No. 1, prepared by URS, City approved 1-21-05.

3. Cygnet Business Park Filing No. 1 amended, prepared by Springs Engineering, City approved 2-5-08.

4. Cygnet Business Park Filing No. 2, prepared by Springs Engineering, City approved 7-25-06.

5. Cygnet Business Park Filing No. 2 amended, prepared by Stantec, City approved 8-16-17.

6. Peterson Drainage Basin Planning Study, prepared by URS

7. Powers Boulevard Detention Facility Drainage Report, prepared by Kiowa Engineering, Sept., 1989.

MAJOR BASIN	SUB BASIN	AREA		BASIN		Tc MIN	I -in/hr-		SOIL GRP	DEV. TYPE	C		FLOW		RETURN PERIOD -yr.-	
		PLANIM READ	ACRES	LENGTH -ft-	HEIGHT -ft								qp -cfs-	qp -cfs-		
Pete Field	01	COGO	0.568	100	3	10.3			A/B	STREET					5	100
Historic		V=2.53	0.852	+750	12	+4.9				L/S						
			1.42			15.2	3.4	5.9		40%	0.28	0.50	1.4	4.2		
	A	COGO	3.13	100	2	14.7				R/L	0.08	0.35				
			V=0.65	+350	6	+8.9										
						23.6	2.8	4.8					0.71	5.2		
	B	COGO	2.40	100	2	14.7				R/L	0.08	0.35				
			V=0.60	+350	5	+9.8										
						24.5	2.6	4.5					0.50	3.8		
	C	COGO	11.23	100	2	14.7				R/L	0.08	0.35				
			V=0.67	+880	16	+218										
						36.5	2.2	3.6					2.0	14.1		
	D1	COGO	0.37													
	D2	COGO	0.79													
	D		1.16							STREET	0.90	0.96				
	E	COGO	6.18	100	2	14.7				R/L	0.08	0.35				
			V=0.56	+1200	15	35.7										
						50.5	1.8	3.0					0.7	6.4		
	F	COGO	9.78	100	2	14.6				R/L	0.08	0.35				
			V=0.59	+800	11	+23										
						37.3	2.1	3.6					1.6	12.3		
	G	COGO	7.28	100	2	14.6				R/L	0.08	0.35				
			V=0.65	+700	12	+0.8										
						32.4	2.3	3.9					1.3	9.9		
	H	COGO	1.191	100	2	8.8				R/L	0.08	0.35				
			V=2.30	+300	2	+8.7										
						23.3	2.7	4.6					0.36	1.9		

HYDROLOGICAL COMPUTATION – BASIC DATA

PROJ: Airport OZ sub. BY: O.E. Watts

RATIONAL METHOD DATE: November 15, 2019, 1-7-20, 2-24-20

OLIVER E. WATTS, CONSULTING ENGINEER, INC.

614 ELKTON DRIVE COLORADO SPRINGS, CO 80907

MAJOR BASIN	SUB BASIN	AREA		BASIN		Tc MIN	I -in/hr-		SOIL GRP	DEV. TYPE	C		FLOW		RETURN PERIOD -yr-	
		PLANIM READ	ACRES	LENGTH -ft-	HEIGHT -ft-								qp -cfs-	qp -cfs-		
PETE FIELD	01	COGO	1.42	SEE P	1	15.2	3.4	5.9	A/B	40%	0.28	0.50	1.4	4.2	5	100
DEVELOPED	A+B	COGO	1.83	100	1	5.2				BLDG						
			2.25							A.C.						
			5.53							73%	0.59	0.70				
	A	COGO	3.13	100	1	9.2										
			V=2.44	+470	7	+3.2										
						12.4	3.8	6.5		73%	0.59	0.70	5.5	14.2		
	B	COGO	2.40	100	1	9.2										
			V=2.19	+500	6	+3.8										
						13.0	3.8	6.4		73%	0.59	0.70	4.9	10.8		
	C	COGO	4.30	100	1.2	10.2				BLDG						
		V=2.3	8.30	+1210	16	+8.8				AC						
			11.23			19.0	2.4	5.2		71%	0.50	0.63	13.5	26.8		
	D	COGO	1.16							STREET	0.90	0.96				
	E	COGO	1.85	100	1	12.2				BLDG						
		V=2.16	2.19	+1450	17	+11				A.C.						
			6.18			23.3	2.8	4.6		61%	0.43	0.58	7.4	16.5		
	F	COGO	0.30	100	2	5.2				BLDG						
			1.35	+950	V=2.47	+6.4				A.C.						
			9.78			11.6	3.8	6.4		74%	0.54	0.66	20.1	41.3		
	G	COGO	3.26	100	2	9.2				A.C.						
			030	+900	V=2.11	+7.1				BLDG						
			7.28			16.3	3.3	5.6		66%	0.46	.0.60	11.0	24.5		
	F+G			+730	V=152	+8.0										
			17.06			19.6	3.0	5.1		70%	0.49	0.62	25.0	53.9		
	+H	S=0.18	+1.19	+164	V=1.5	+0.2				R/L	0.08	0.35				
	F=H					19.8	2.8	5.0		MIX	0.463	0.605	23.7	53.0		

HYDROLOGICAL COMPUTATION – BASIC DATA
PROJ: AIRPORT OZ SUB BY: O.E. WATTS
RATIONAL METHOD DATE: NOVEMBER 16, 2019 , 1-7-20, 2-24-20

OLIVER E. WATTS, CONSULTING ENGINEER, INC.
614 ELKTON DRIVE COLORADO SPRINGS, CO 80907

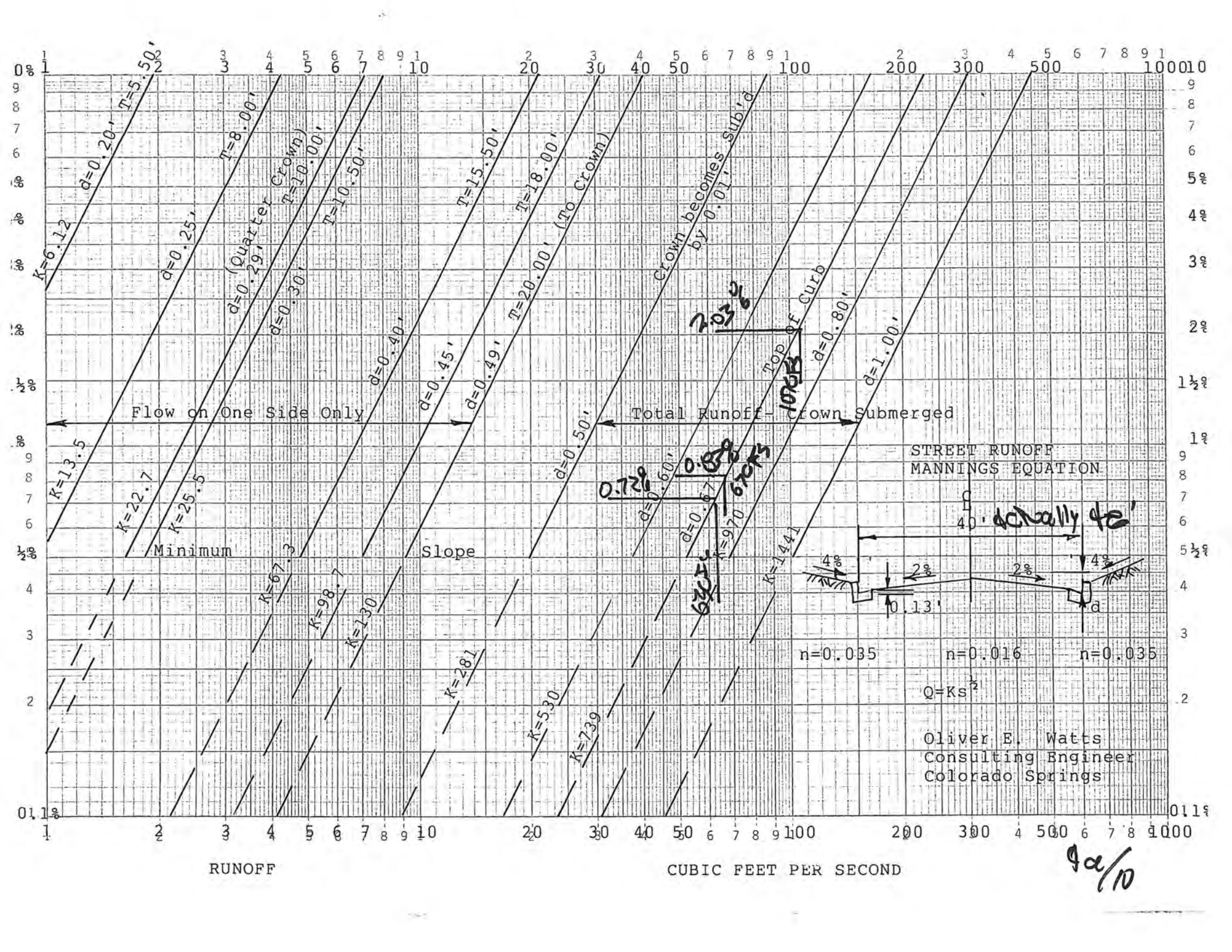
MAJOR BASIN	SUB BASIN	AREA		BASIN		Tc MIN	I -IN/HR-		SOIL GRP	DEV. TYPE	C		FLOW		RETURN PERIOD -YR-	
		PLANIM READ	ACRES	LENTH -FT.=	HEIGHT -FT.-								qp -CFS-	qp -CFS-		
PETE FIELD	A	COGO	3.13			12.4									5	100
DEVELOPED	+B	COGO	2.40	+324	6	+2.0										
	TOTAL		V=2.72			14.4	3.9	6.7		73%	0.50	0.70	9.7	22.5		
ROUTING	+O1		1.42							40%	0.28	0.50				
	+D1	COGO	0.37	+322	V=1.73	+3.1				STREET	0.90	0.96				
	TOTAL		7.32		USE	17.5	3.2	5.4		MIX	0.478	0.674	11.2	26.7		
	+C	COGO	11.23							71%	0.50	0.63				
	+D2	COGO	0.79	+628	V-2.71	+2.8				STREET	0.90	0.96				
	TOTAL		19.34			20.3	2.9	4.9		MIX	0.508	0660	28.5	62.6		
	+E	COGO	6.18	+515	V=4.61	+1.9				61%	043	0.58				
	TOTAL		25.52			22.2	2.8	4.7		MIX	0.489	0.641	34.9	76.8		
	+H	COGO	1.19	+410	V=6.11	+1.1				70%	0.49	0.52				
	TOTAL		26.71			23.3	2.7	4.6		MIX	0.476	0.636	34.3	70.1		
	O1	COGO	1.42							40%	0.28	0.50				
	+D	COGO	1.16							STREET	0.90	0.96				
	TOTAL		2.58	SEE	P2	19.6	2.4			MIX	0.558		3.4		2	

HYDROLOGICAL COMPUTATION – BASIC DATA
PROJ: AIRPORT OZ SUB BY: O.E. WATTS
RATIONAL METHOD DATE: November 18, 2019, 1-7-20, 2-24-20, 3-17-20

OLIVER E. WATTS, CONSULTING ENGINEER, INC.
614 ELKTON DRIVE COLORADO SPRINGS, CO 80907

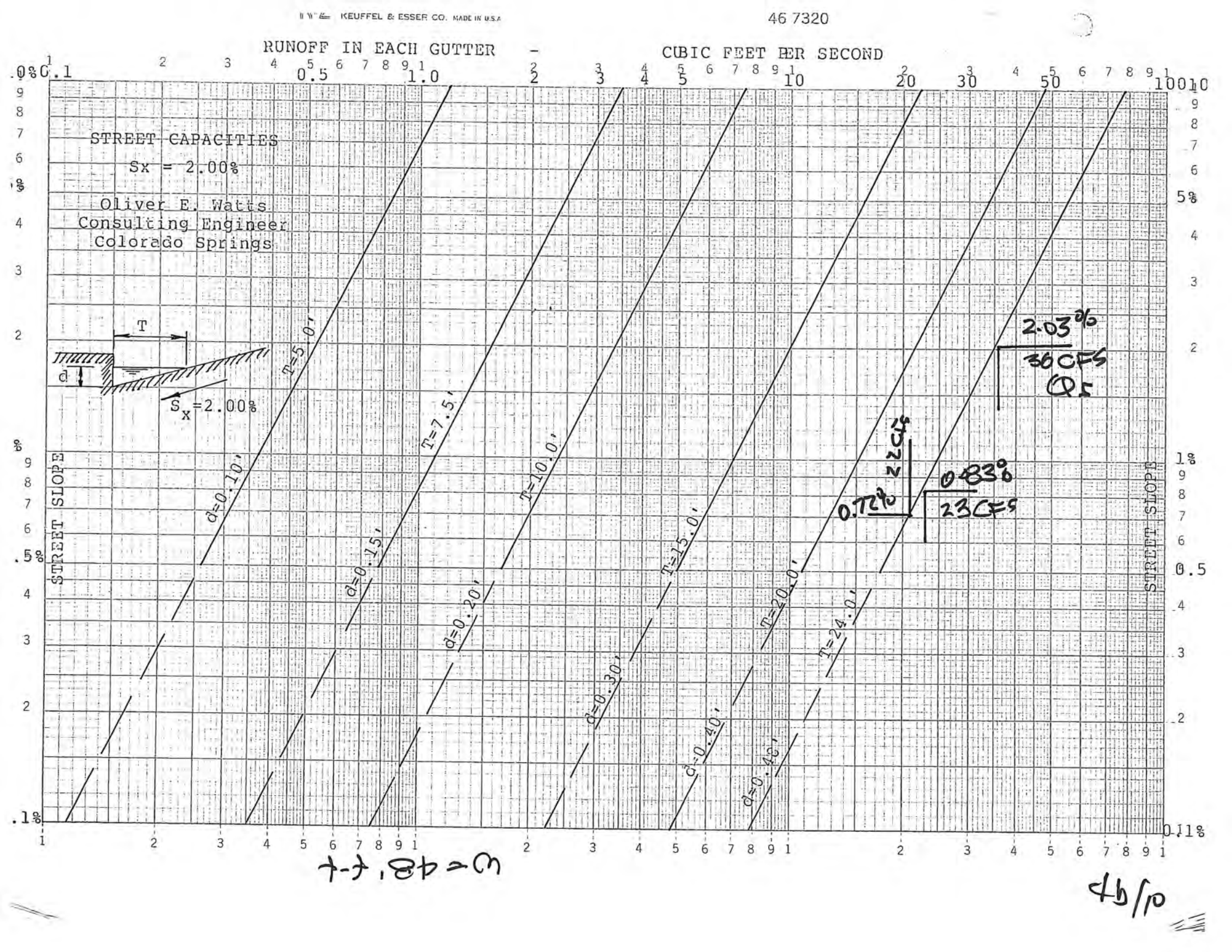
STREET AND STORM SEWER CALCULATIONS

STREET	LOCATION	DISTANCE -FT-	ELEVATION & SLOPE	TOTAL RUNOFF -CFS-	STREET FLOW / CAPACITY -CFS- 5-YR 100-YR	PIPE FLOW -CFS-	TYPE PIPE, CATCH BASIN & SLOPE %
CYGNET HISTORIC	01		56.02				
		322.32	0.72%	1.4/4.2	1.4/22 4.2/63		d=0.18' T=9.0' A=0.81 SF V=1.73 FPS
DEVELOPED	B		53.69				
		627.65	0.83%	11.2/26.7	11.2/23 26.7/67		d=0.37' T=18.7 A=3.49 V=3.21
	D		48.47	28.5/62.6		62.6	2-16"D-10R, 24" RCP @ 1.92% min.
		515	2.03%	28.5/62.6	28.5/36 62.6/107	62.6	36"RCP @0.80% min V=4.61 FPS
	E		38	7.4/16.5		16.5	8' D-10R, 24" RCP
		279	3.58%	34.9/76.8		76.8	36" RCP + RIPRAP ED
	POND		44			76.8	
		488.38	2.29%	76.8		76.8 33	OUTLET BOX, 8'X8' GRATE 24" RCP @ 2.13% min
			26.83				
			27.4				
	CYGNET OUTFALL	174.81	0.33%	50.2		50.2	48" RCP, 0.12% MIN.
			26.83				


STREET RUNOFF
MANNINGS EQUATION
Flow on One Side Only
Total Runoff - Crown Submerged
Minimum Slope
Crown becomes Sub'd by 0.01' (To Crown)
Top of Curb
(Quarter Crown)
T=5.50'
T=8.00'
T=10.00'
T=10.50'
T=15.50'
T=18.00'
T=20.00'
d=0.20'
d=0.25'
d=0.29'
d=0.30'
d=0.40'
d=0.45'
d=0.49'
d=0.50'
d=0.60'
d=0.67'
d=0.80'
d=1.00'
K=6.12
K=13.5
K=22.7
K=25.5
K=67.3
K=98.7
K=130
K=281
K=530
K=739
K=970
K=1441
0.728
0.839
7.03
40' actually 46'
4%
2%
0.13'
d
n=0.035
n=0.016
n=0.035
Q=Ks^½
Oliver E. Watts
Consulting Engineer
Colorado Springs
RUNOFF
CUBIC FEET PER SECOND
9a/10

KEUFFEL & ESSER CO. MADE IN U.S.A.

46 7320



Stormwater Detention and Infiltration Design Data Sheet

Workbook Protected Worksheet Protected

5/10

Stormwater Facility Name: Cygnet Inldustrial Park, - Existing Basin

Facility Location & Jurisdiction: Powers Blvd South of Aviation Way - Colorado Springs

User Input: Watershed Characteristics

Watershed Slope =	0.015	ft/ft
Watershed Length =	1800	ft
Watershed Area =	17.06	acres
Watershed Imperviousness =	70.0%	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

Location for 1-hr Rainfall Depths (use dropdown):

Denver - Capitol Building

WQCV Treatment Method = Extended Detention

User Defined Stage [ft]	User Defined Area [ft^2]	User Defined Stage [ft]	User Defined Discharge [cfs]
0.00	1,072	0.00	
0.50	1,777	0.50	0.01
1.00	2,417	1.00	0.04
1.50	3,167	1.50	0.07
2.00	4,037	2.00	0.11
2.50	5,019	2.50	0.13
3.00	7,105	3.00	0.15
3.50	8,785	3.50	0.17
4.00	10,235	4.00	18.48
4.50	11,853	4.50	51.95
4.60	17,091	4.60	59.91
4.70	12,329	4.70	65.94
4.80	12,568	4.80	71.06
4.90	12,808	4.90	76.41
5.00	13,003	5.00	81.97

After completing and printing this worksheet to a pdf, go to:
https://maperture.digitaldataservices.com/gvh/?viewer=cswdif
create a new stormwater facility, and
attach the pdf of this worksheet to that record.

Routed Hydrograph Results

Design Storm Return Period =	WQCV	2 Year	5 Year	10 Year	50 Year	100 Year	
One-Hour Rainfall Depth =	0.53	0.83	1.09	1.33	1.99	2.31	in
Calculated Runoff Volume =	0.391	0.758	1.056	1.400	2.370	2.885	acre-ft
OPTIONAL Override Runoff Volume =							acre-ft
Inflow Hydrograph Volume =	0.391	0.758	1.055	1.399	2.369	2.885	acre-ft
Time to Drain 97% of Inflow Volume =	53.6	41.8	37.4	33.9	27.7	25.2	hours
Time to Drain 99% of Inflow Volume =	72.5	61.6	55.8	50.6	41.5	38.8	hours
Maximum Ponding Depth =	3.53	3.68	3.79	3.91	4.15	4.26	ft
Maximum Ponded Area =	0.20	0.21	0.22	0.23	0.25	0.25	acres
Maximum Volume Stored =	0.331	0.363	0.387	0.414	0.472	0.497	acre-ft

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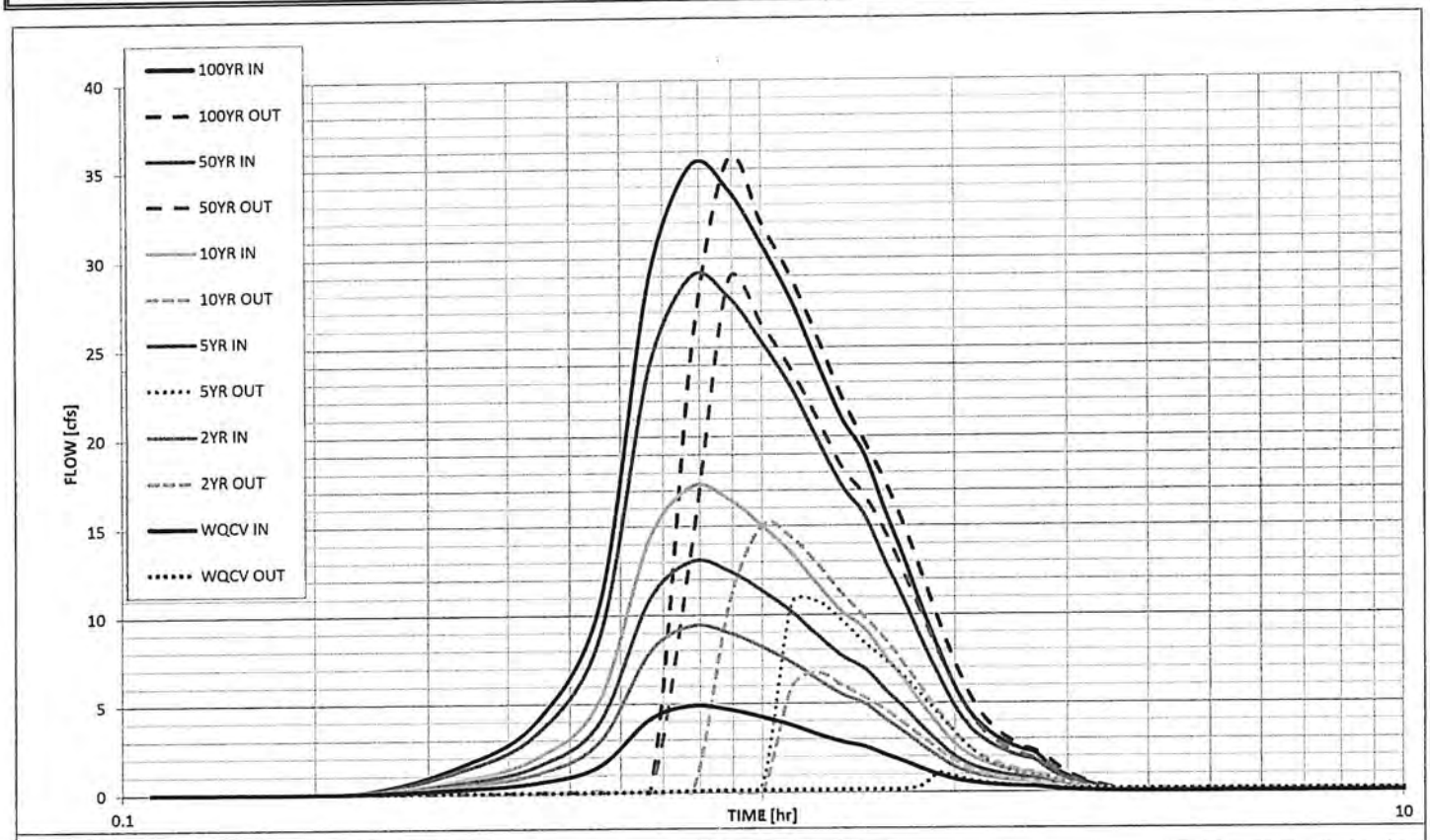
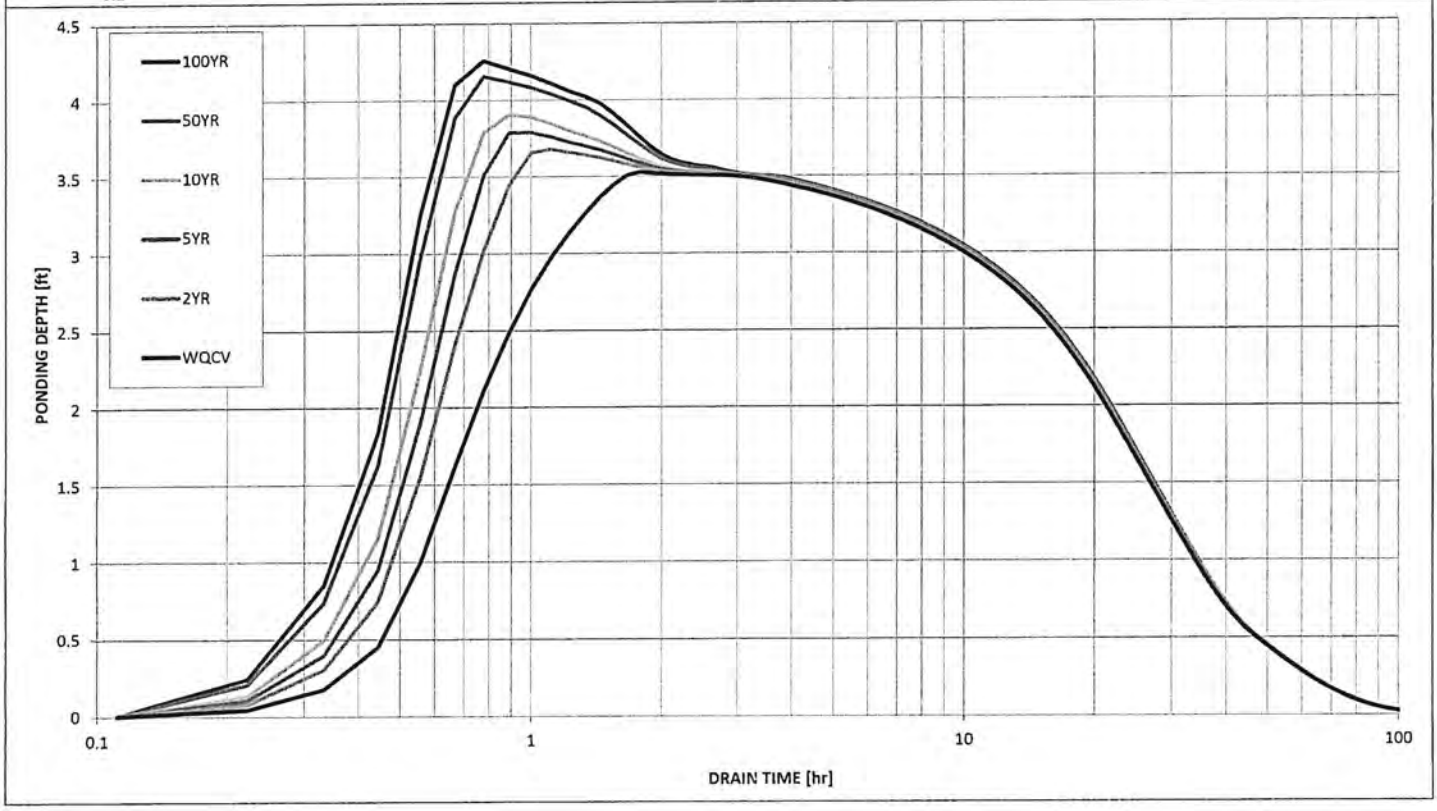
Stormwater Detention and Infiltration Design Data Sheet





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Stormwater Detention and Infiltration Design Data Sheet

Workbook Protected Worksheet Protected

Stormwater Facility Name: Airport OZ Sub, Tract B EDB

Facility Location & Jurisdiction: Powers Blvd South of Aviation Way - Colorado Springs

User Input: Watershed Characteristics

Watershed Slope =	0.018	ft/ft
Watershed Length =	2343	ft
Watershed Area =	26.71	acres
Watershed Imperviousness =	68.0%	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

Location for 1-hr Rainfall Depths (use dropdown): Denver - Capitol Building

WQCV Treatment Method = Extended Detention

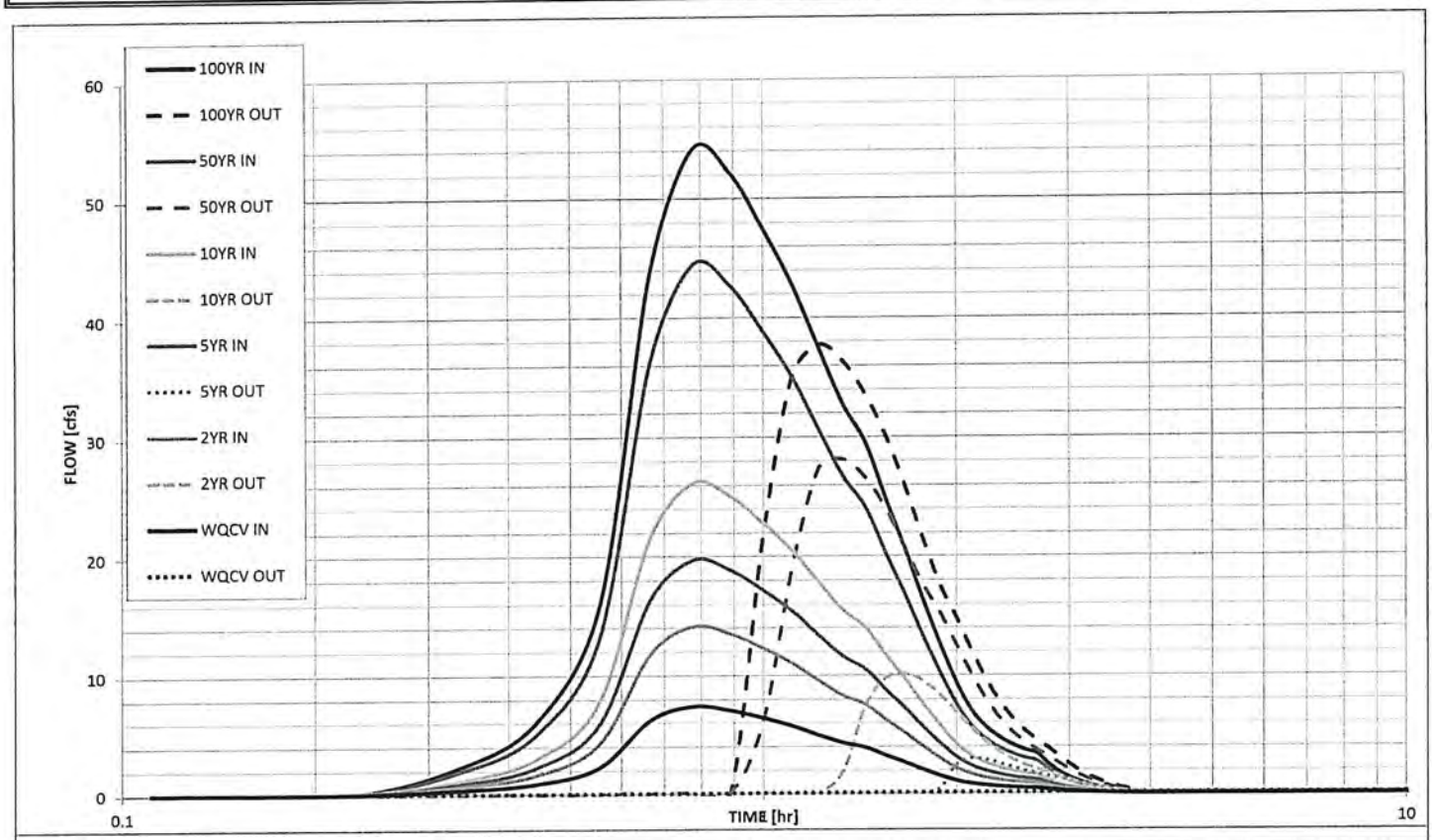
User Defined Stage [ft]	User Defined Area [ft^2]	User Defined Stage [ft]	User Defined Discharge [cfs]
0.00	8,628	0.00	
0.50	10,956	0.50	0.01
1.00	13,283	1.00	0.04
1.50	15,610	1.50	0.07
2.00	17,938	2.00	0.11
2.50	20,661	2.50	0.13
3.00	23,384	3.00	0.15
3.50	26,107	3.50	0.17
4.00	28,830	4.00	18.48
4.50	45,280	4.50	51.95
4.60	48,570	4.60	59.91
4.70	51,860	4.70	65.94
4.80	55,150	4.80	71.06
4.90	58,440	4.90	76.41
5.00	61,730	5.00	81.97

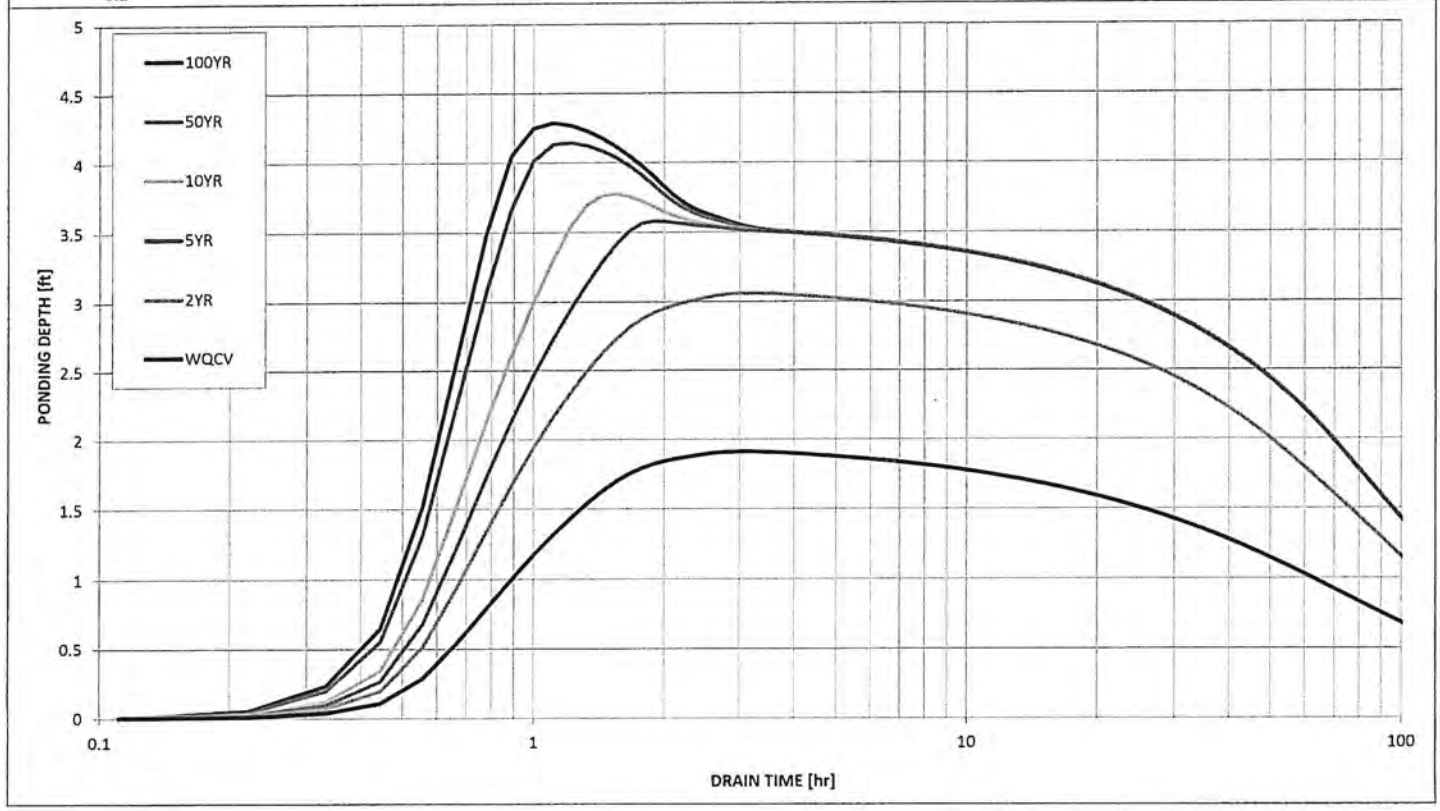
After completing and printing this worksheet to a pdf, go to:
https://maperture.digitaldataservices.com/gvh/?viewer=cswdif
create a new stormwater facility, and
attach the pdf of this worksheet to that record.

Routed Hydrograph Results

Design Storm Return Period =	WQCV	2 Year	5 Year	10 Year	50 Year	100 Year	
One-Hour Rainfall Depth =	0.53	0.83	1.09	1.33	1.99	2.31	in
Calculated Runoff Volume =	0.593	1.147	1.601	2.134	3.653	4.460	acre-ft
OPTIONAL Override Runoff Volume =							acre-ft
Inflow Hydrograph Volume =	0.592	1.146	1.601	2.134	3.652	4.460	acre-ft
Time to Drain 97% of Inflow Volume =	>160	>160	>160	>160	>160	>160	hours
Time to Drain 99% of Inflow Volume =	>160	>160	>160	>160	>160	>160	hours
Maximum Ponding Depth =	1.91	3.06	3.58	3.78	4.15	4.29	ft
Maximum Ponded Area =	0.40	0.54	0.61	0.63	0.77	0.88	acres
Maximum Volume Stored =	0.572	1.113	1.416	1.535	1.785	1.904	acre-ft

Stormwater Detention and Infiltration Design Data Sheet





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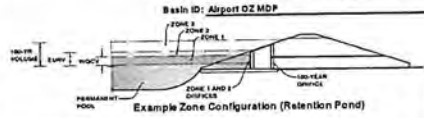
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: Cygnet Business Park, Existing Detention Basin

Basin ID: Airport OZ MDP



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	EDB			
Watershed Area =	17.00	acres		
Watershed Length =	1,800	ft		
Watershed Slope =	0.015	ft/ft		
Watershed Imperviousness =	70.00%	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) =	0.391	acre-feet	Optional User Override 1-hr Precipitation	
Excess Urban Runoff Volume (EURV) =	1.311	acre-feet		
2-yr Runoff Volume (P1 = 1.19 in.) =	1.093	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	1.453	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	1.842	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	2.324	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	2.679	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	3.147	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	4.135	acre-feet		inches
Approximate 2-yr Detention Volume =	1.025	acre-feet		
Approximate 5-yr Detention Volume =	1.366	acre-feet		
Approximate 10-yr Detention Volume =	1.724	acre-feet		
Approximate 25-yr Detention Volume =	1.852	acre-feet		
Approximate 50-yr Detention Volume =	1.927	acre-feet		
Approximate 100-yr Detention Volume =	2.064	acre-feet		

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.391	acre-feet	
Select Zone 2 Storage Volume (Optional) =		acre-feet	**Total detention volume is less than 100-year volume.**
Select Zone 3 Storage Volume (Optional) =		acre-feet	
Total Detention Basin Volume =	0.391	acre-feet	
Initial Surcharge Volume (ISV) =	user	ft^3	
Initial Surcharge Depth (ISD) =	user	ft	
Total Available Detention Depth (H_{total}) =	user	ft	
Depth of Trickle Channel (H_{TC}) =	user	ft	
Slope of Trickle Channel (S_{TC}) =	user	ft/ft	
Slopes of Main Basin Sides (S_{main}) =	user	H:V	
Basin Length-to-Width Ratio ($R_{L/W}$) =	user		
Initial Surcharge Area (A_{ISV}) =	user	ft^2	
Surcharge Volume Length (L_{ISV}) =	user	ft	
Surcharge Volume Width (W_{ISV}) =	user	ft	
Depth of Basin Floor (H_{FLOOR}) =	user	ft	
Length of Basin Floor (L_{FLOOR}) =	user	ft	
Width of Basin Floor (W_{FLOOR}) =	user	ft	
Area of Basin Floor (A_{FLOOR}) =	user	ft^2	
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3	
Depth of Main Basin (H_{MAIN}) =	user	ft	
Length of Main Basin (L_{MAIN}) =	user	ft	
Width of Main Basin (W_{MAIN}) =	user	ft	
Area of Main Basin (A_{MAIN}) =	user	ft^2	
Volume of Main Basin (V_{MAIN}) =	user	ft^3	
Calculated Total Basin Volume (V_{total}) =	user	acre-feet	

Depth Increment = 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	--	--	--	1,072	0.025		
	--	0.50	--	--	--	1,777	0.041	695	0.016
	--	1.00	--	--	--	2,417	0.056	1,737	0.040
	--	1.50	--	--	--	3,167	0.073	3,125	0.072
	--	2.00	--	--	--	4,037	0.093	4,917	0.113
	--	2.50	--	--	--	5,019	0.115	7,222	0.166
	--	3.00	--	--	--	7,105	0.163	10,253	0.235
	--	3.50	--	--	--	8,765	0.202	14,225	0.327
	--	4.00	--	--	--	10,235	0.235	18,980	0.436
	--	4.50	--	--	--	11,853	0.272	24,502	0.562
	--	4.60	--	--	--	12,091	0.278	25,699	0.590
	--	4.70	--	--	--	12,329	0.283	26,920	0.618
	--	4.80	--	--	--	12,568	0.289	28,165	0.647
	--	4.90	--	--	--	12,808	0.294	29,434	0.676
	--	5.00	--	--	--	13,003	0.299	30,725	0.705
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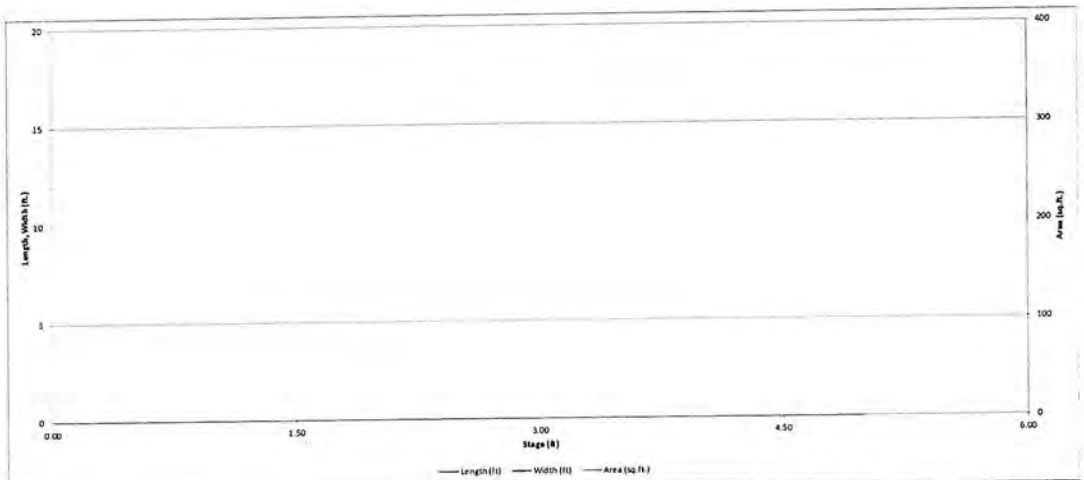
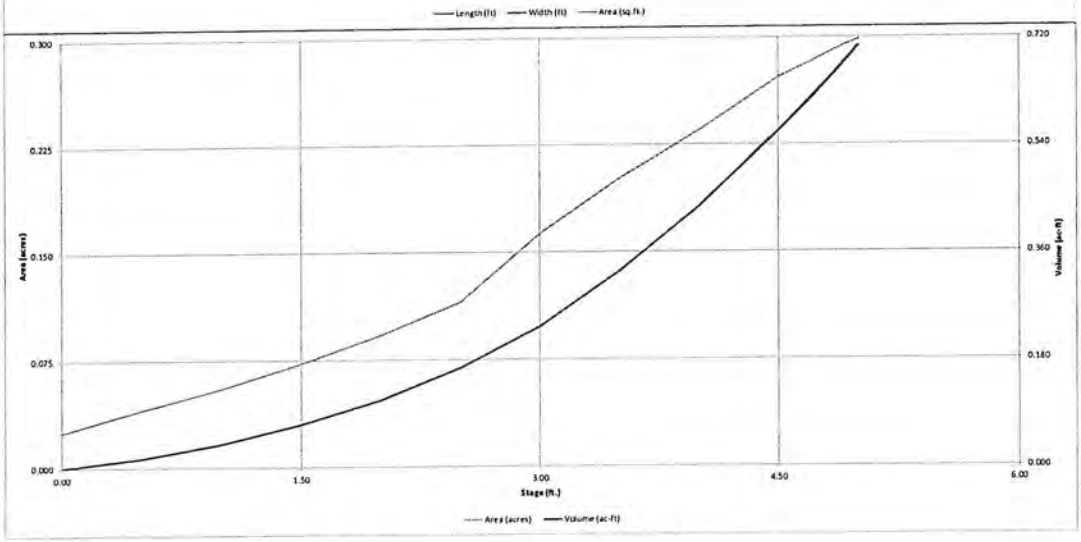
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)





National Flood Hazard Layer FIRMette

FEMA

38°48'23.16"N

104°43'18.06"W

38°47'55.12"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN — Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 / 17.5 — Cross Sections with 1% Annual Chance / Water Surface Elevation
- Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represen an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 8/15/2019 at 4:08:33 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

Airport OZ Subdivisi
SCS SOILS MAP
1"=2000'

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			Bedrock		Potential frost action
		Frequency	Duration	Months	Depth	Hardness	
					In		
Tomah: [1]92, [1]93:							
Tomah part	B	None	---	---	>60	---	Moderate.
Crowfoot part	B	None	---	---	>60	---	Moderate.
Travessilla: [1]94:							
Travessilla part	D	None	---	---	6-20	Hard	Low.
Rock outcrop part	D	---	---	---	---	---	---
Truckton: 95, 96, 97	B	None	---	---	>60	---	Moderate.
[1]98:							
Truckton part	B	None	---	---	>60	---	Moderate.
Blakeland part	A	None	---	---	>60	---	Low.
[1]99, [1]100:							
Truckton part	B	None	---	---	>60	---	Moderate.
Bresser part	B	None	---	---	>60	---	Low.
Ustic Torrifluvents: 101	B	Occasional	Very brief	Mar-Aug	>60	---	Moderate.
Valent: 102, 103	A	None	---	---	>60	---	Low.
Vona: 104, 105	B	None	---	---	>60	---	Moderate.
Wigton: 106	A	None	---	---	>60	---	Low.
Wiley: 107, 108	B	None	---	---	>60	---	Low.
Yoder: 109, 110	B	None	---	---	>60	---	Low.

[1]This map unit is made up of two or more dominant kinds of soil. See map unit description for the composition and behavior characteristics of the map unit.

TABLE 16.--SOIL AND WATER FEATURES

[Absence of an entry indicates the feature is not a concern. See "flooding" in Glossary for definition of terms as "rare," "brief," and "very brief." The symbol > means greater than]

Soil name and map symbol	Hydrologic group	Flooding			Bedrock		Potential frost action
		Frequency	Duration	Months	Depth	Hardness	
					In		
Alamosa: 1	C	Frequent	Brief	May-Jun	>60	---	High.
Ascalon: 2, 3	B	None	---	---	>60	---	Moderate.
Badland: 4	D	---	---	---	---	---	---
Bijou: 5, 6, 7	B	None	---	---	>60	---	Low.
Blakeland: 8	A	None	---	---	>60	---	Low.
[1]9: Blakeland part	A	None	---	---	>60	---	Low.
Fluvaquentic Haplaquolls part	D	Common	Very brief	Mar-Aug	>60	---	High.
Blendon: 10	B	None	---	---	>60	---	Moderate.
Bresser: 11, 12, 13	B	None	---	---	>60	---	Low.
Brussett: 14, 15	B	None	---	---	>60	---	Moderate.
Chaseville: 16, 17	A	None	---	---	>60	---	Low.
[1]18: Chaseville part	A	None	---	---	>60	---	Low.
Midway part	D	None	---	---	10-20	Rippable	Moderate.
Columbine: 19	A	None to rare	---	---	>60	---	Low.
Connerton: [1]20: Connerton part	B	None	---	---	>60	---	High.
Rock outcrop part	D	---	---	---	---	---	---
Cruckton: 21	B	None	---	---	>60	---	Moderate.
Cushman: 22, 23	C	None	---	---	20-40	Rippable	Moderate.
[1]24: Cushman part	C	None	---	---	20-40	Rippable	Moderate.
Kutch part	C	None	---	---	20-40	Rippable	Moderate.
Elbeth: 25, 26	B	None	---	---	>60	---	Moderate.
[1]27: Elbeth part	B	None	---	---	>60	---	Moderate.

See footnote at end of table.

WATER RESOURCES
ENGINEERING DIVISION

POLICY STATEMENT AND CLARIFICATION

SUBJECT: ON-SITE DETENTION REQUIREMENTS WHEN REGIONAL DETENTION IS PROVIDED

DATE: AUGUST 10, 2017; REVISED SEPTEMBER 15, 2017

OVERVIEW:
The planning and conceptual design of regional detention is frequently provided as part of a master planning process. This document is intended to clarify criteria regarding on-site detention requirements when regional detention is constructed downstream of a development or redevelopment project.

REFERENCE MATERIALS:
The 2014 City of Colorado Springs Drainage Criteria Manual Provides the following guidance:

Volume 1, Chapter 6, Section 4 states, "Detention facilities shall be provided for all new development sites larger than 1 acre unless an approved basin plan includes the site being developed. In cases where project-specific conditions cause detention to be infeasible or ineffective, a variance may be requested."

Volume 1, Chapter 6, Section 5 states, "Full spectrum detention is a relatively new approach to detention that is expected to effectively limit peak flow rates to near predevelopment levels. In addition to reducing runoff rates, full spectrum detention can also provide some mitigation of increased runoff volume and water quality benefits. Unless an alternative detention concept is approved through a master planning process, the full spectrum detention approach, as defined in Chapter 13 of this Manual, shall be implemented as the standard detention approach. Alternative detention approaches will be evaluated based on their ability of achieve results similar to full spectrum detention and not only based on potential cost reduction."

POLICY STATEMENT AND CLARIFICATION:
When a separate existing regional detention facility is provided downstream of the site as part of a master planning process and detention requirements have been triggered per the DCM, detention requirements will be satisfied according to the following:

- If the existing downstream regional detention facility provides detention for the minor storm event (5 or 10 year) in addition to providing detention for the major storm event (100 year) and the facility was part of a previously approved master study, then only water quality capture volume (WQCV) treatment is required on-site.

- If the existing downstream regional detention facility does not provide detention for the minor storm event, but does provide detention for the major storm event, then excess urban runoff volume (EURV) treatment is required on-site.

- If the existing downstream regional detention facility does not provide detention for the major storm event, then full spectrum detention is required on-site.

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

3.2 Time of Concentration

One of the basic assumptions underlying the Rational Method is that runoff is a function of the average rainfall rate during the time required for water to flow from the hydraulically most remote part of the drainage area under consideration to the design point. However, in practice, the time of concentration can be an empirical value that results in reasonable and acceptable peak flow calculations.

For urban areas, the time of concentration (t_c) consists of an initial time or overland flow time (t_i) plus the travel time (t_t) in the storm sewer, paved gutter, roadside drainage ditch, or drainage channel. For non-urban areas, the time of concentration consists of an overland flow time (t_i) plus the time of travel in a concentrated form, such as a swale or drainageway. The travel portion (t_t) of the time of concentration can be estimated from the hydraulic properties of the storm sewer, gutter, swale, ditch, or drainageway. Initial time, on the other hand, will vary with surface slope, depression storage, surface cover, antecedent rainfall, and infiltration capacity of the soil, as well as distance of surface flow. The time of concentration is represented by Equation 6-7 for both urban and non-urban areas.

$$t_c = t_i + t_t \quad \text{(Eq. 6-7)}$$

Where:

t_c = time of concentration (min)

t_i = overland (initial) flow time (min)

t_t = travel time in the ditch, channel, gutter, storm sewer, etc. (min)

3.2.1 Overland (Initial) Flow Time

The overland flow time, t_i, may be calculated using Equation 6-8.

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L}}{S^{0.33}} \quad \text{(Eq. 6-8)}$$

Where:

t_i = overland (initial) flow time (min)
C_5 = runoff coefficient for 5-year frequency (see Table 6-6)
L = length of overland flow (300 ft maximum for non-urban land uses, 100 ft maximum for urban land uses)
S = average basin slope (ft/ft)

Note that in some urban watersheds, the overland flow time may be very small because flows quickly concentrate and channelize.

3.2.2 Travel Time

For catchments with overland and channelized flow, the time of concentration needs to be considered in combination with the travel time, t_t, which is calculated using the hydraulic properties of the swale, ditch, or channel. For preliminary work, the overland travel time, t_t, can be estimated with the help of Figure 6-25 or Equation 6-9 (Guo 1999).

$$V = C_v S_w^{0.5} \quad \text{(Eq. 6-9)}$$

Where:

V = velocity (ft/s)

C_v = conveyance coefficient (from Table 6-7)

S_w = watercourse slope (ft/ft)

Table 6-7. Conveyance Coefficient, C_v

Type of Land Surface	C_v
Heavy meadow	2.5
Tillage/field	5
Riprap (not buried)*	6.5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

Native

Paved

* For buried riprap, select C_v value based on type of vegetative cover.

The travel time is calculated by dividing the flow distance (in feet) by the velocity calculated using Equation 6-9 and converting units to minutes.

The time of concentration (t_c) is then the sum of the overland flow time (t_i) and the travel time (t_t) per Equation 6-7.

3.2.3 First Design Point Time of Concentration in Urban Catchments

Using this procedure, the time of concentration at the first design point (typically the first inlet in the system) in an urbanized catchment should not exceed the time of concentration calculated using Equation 6-10. The first design point is defined as the point where runoff first enters the storm sewer system.

$$t_c = \frac{L}{180} + 10 \qquad \text{(Eq. 6-10)}$$

Where:

t_c = maximum time of concentration at the first design point in an urban watershed (min)

L = waterway length (ft)

Equation 6-10 was developed using the rainfall-runoff data collected in the Denver region and, in essence, represents regional "calibration" of the Rational Method. Normally, Equation 6-10 will result in a lesser time of concentration at the first design point and will govern in an urbanized watershed. For subsequent design points, the time of concentration is calculated by accumulating the travel times in downstream drainageway reaches.

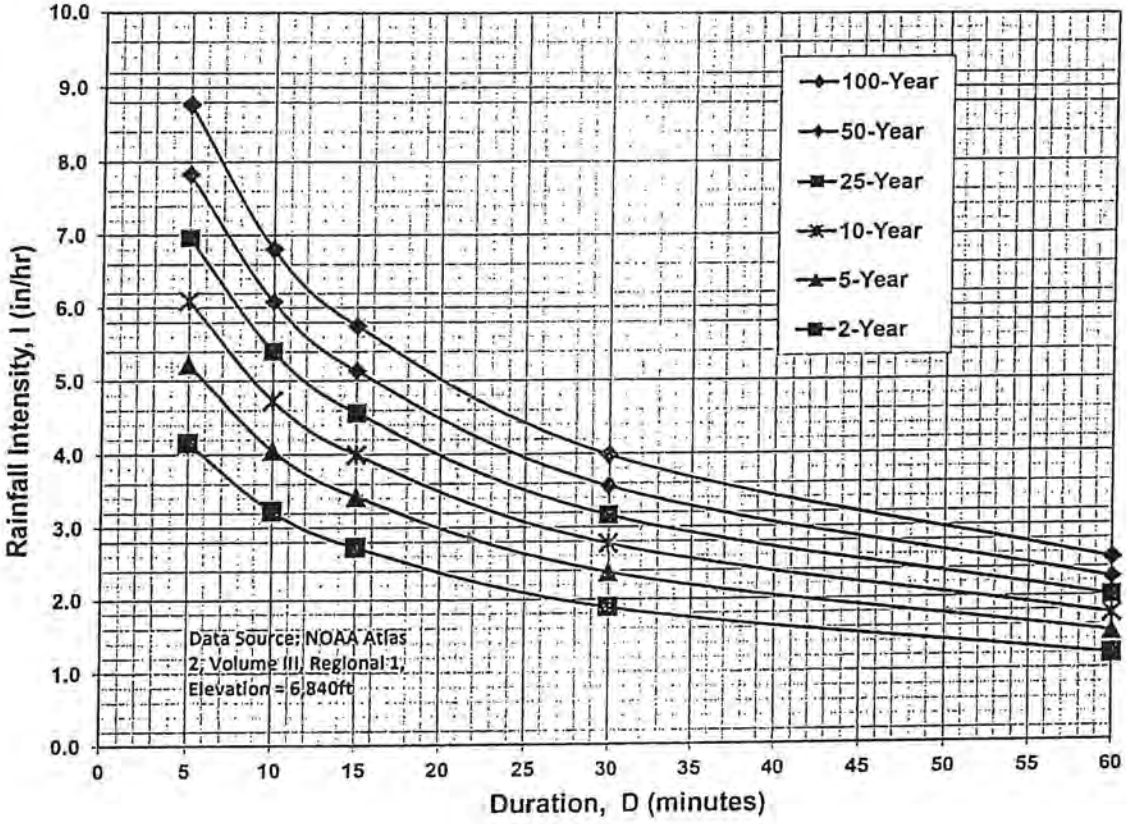
3.2.4 Minimum Time of Concentration

If the calculations result in a t_c of less than 10 minutes for undeveloped conditions, it is recommended that a minimum value of 10 minutes be used. The minimum t_c for urbanized areas is 5 minutes.

3.2.5 Post-Development Time of Concentration

As Equation 6-8 indicates, the time of concentration is a function of the 5-year runoff coefficient for a drainage basin. Typically, higher levels of imperviousness (higher 5-year runoff coefficients) correspond to shorter times of concentration, and lower levels of imperviousness correspond to longer times of

Figure 6-5. Colorado Springs Rainfall Intensity Duration Frequency



IDF Equations

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

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

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

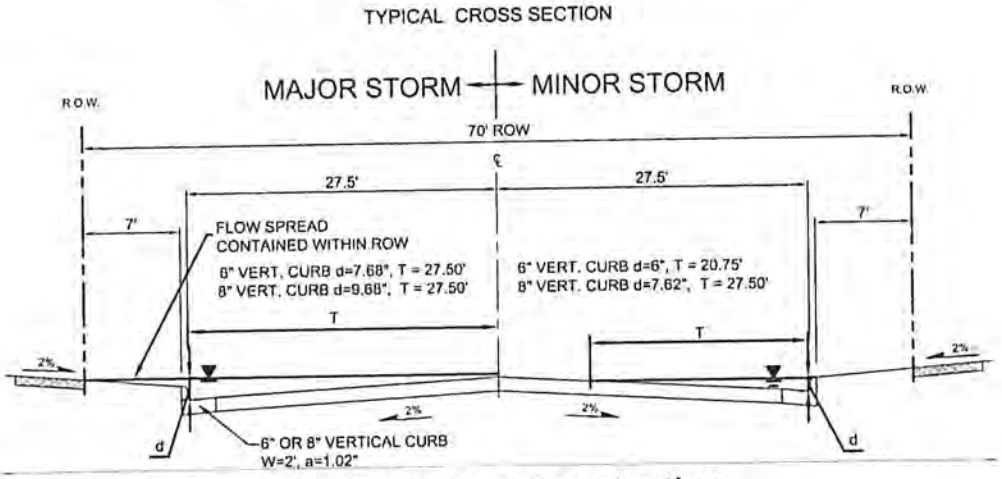
$I_{10} = -1.75 \ln(D) + 8.847$

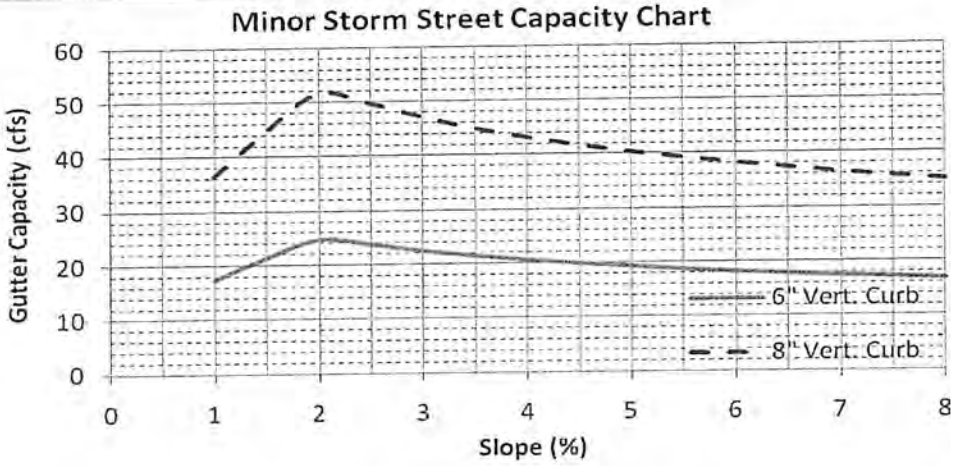
$I_5 = -1.50 \ln(D) + 7.583$

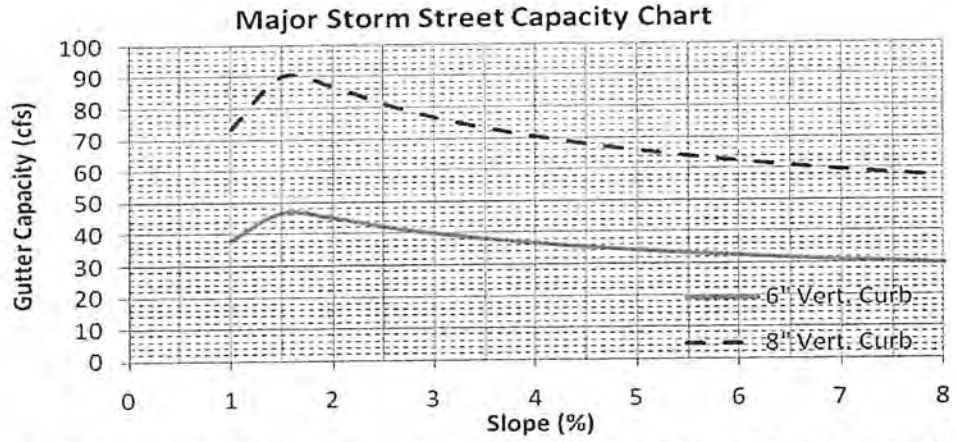
$I_2 = -1.19 \ln(D) + 6.035$

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

Figure 7-4. Street Capacity Charts Industrial

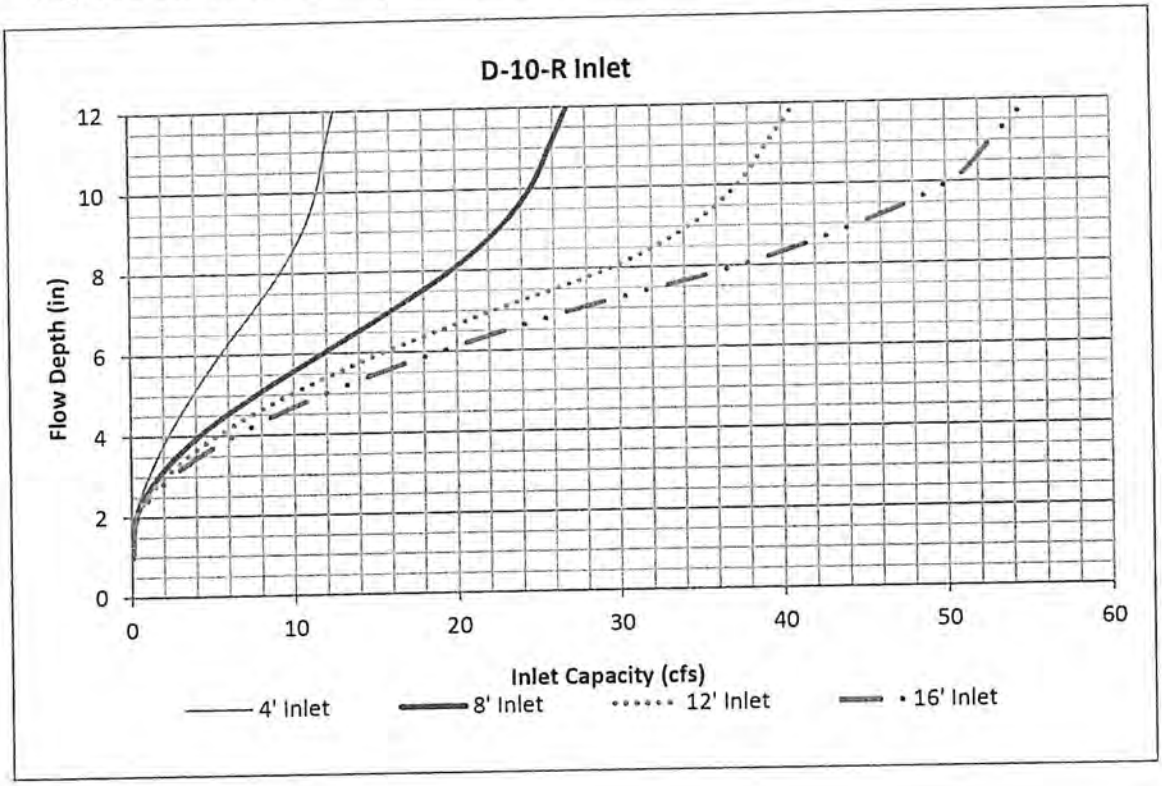






These charts shall only be used for the standard street sections as shown. The capacity shown is based on ½ the street section as calculated by the UD-Inlet spreadsheets. Minor storm capacities are based on no crown overtopping, curb height or maximum allowable spread widths. Major storm capacities are based on flow being containing within the public right-of-way, including conveyance capacity behind the curb. The UDFCD Safety Reduction Factor was applied. An 'n_{STREET}' of 0.016 and 'n_{BACK}' of 0.020 was used. Calculations were done using UD-Inlet 3.00.xls, March, 2011.

Figure 8-12. Inlet Capacity Chart Sump Conditions, Curb Opening (D-10-R) Inlet



$$Q=\frac{0.463}{n} D^{8/3} S^{\frac{1}{2}}$$

$$Q=KS^{\frac{1}{2}}$$

DIAMETER -IN.-	AREA -FT2-	D 8/3 -FT-	K			
			N=0.010	N=0.013	N=0.024	N=0.0
2	0.02182	0.008413	0.3895	---	---	---
4	0.08727	0.053420	2.4733	---	---	---
6	0.19630	0.157500	7.2922	5.609	---	---
8	0.34910	0.339200	15.7050	12.081	---	---
10	0.54540	0.615000	28.4745	21.903	---	---
12	0.78540	1.000000	46.3000	35.615	---	---
15	1.22720	1.813100	83.9465	64.574	---	---
18	1.76710	2.948300	136.5100	105.000	56.88	52.
21	2.40530	4.447400	205.9100	158.400	85.80	79.
24	3.14160	6.349600	293.9900	226.140	122.49	113.
27	3.97610	8.692700	402.4700	309.590	167.70	154.
30	4.90870	11.512600	533.0300	410.030	222.10	205.
33	5.93960	14.844100	---	528.680	---	---
36	7.06860	18.720800	866.7700	666.700	361.20	333.
39	8.29580	23.175100	---	825.400	---	---
42	9.62110	28.238900	---	1005.000	544.80	502.
48	12.56640	40.317500	---	1436.000	777.80	718.
54	15.90430	55.195000	---	1966.000	1065.00	983.
60	19.63500	73.100400	---	2604.000	1410.00	1302.
66	23.75830	94.254200	---	3357.000	1818.00	1678.
72	28.27430	118.869400	---	4234.000	2293.00	2117.
78	33.18310	147.152900	---	5241.000	2839.00	2620.
84	38.48450	179.306000	---	6386.000	3459.00	3193.
90	44.17860	215.524500	---	7676.000	4158.00	3838.
96	50.26550	256.000000	---	9118.000	4939.00	4559.
108	63.61730	350.466600	---	12480.000	6761.00	6140.
120	78.53980	464.158900	---	16530.000	8954.00	8265.

Oliver E. Watts
Consulting Engi
Colorado Spring

LEGEND

DESIGN POINT

MAJOR BASIN BOUNDARY

SUB-BASIN BOUNDARY

SCALE : 1"=2000'

SAND CREEK BASIN

POWERS BLVD. DRAINAGE AREA

AIRPORT OZ SUB

CYGNET SUBS

PROPOSED POWERS BLVD.

PROPOSED DETENTION SITE

PROPOSED HANCOCK RD.

ZEPHELIN RD.

PETERSON FIELD

COLORADO SPRINGS MUNICIPAL AIRPORT OUTFALL POINT

AP

PETERSON FIELD DRAINAGE BASIN BOUNDARY

DRENNAN RD.

WINDMILL GULCH BASIN

Little Johnson Res

OLIVER E. WATTS
CONSULTING ENGINEER, INC.
COLORADO SPRINGS

Airport OZ Subdivision
Powers Blvd Detention Basin
1"=2000'

Kiowa Engineering Corporation
419 W. Bijou Street
Colorado Springs, Colorado
80905-1308

POWERS BLVD. DETENTION FACILITY

DRAINAGE BASIN BOUNDARIES

Project No.	89-08-16
Date:	9/89
Design:	RNW
Drawn:	EAK
Check:	
Revisions:	

FIGURE 4

IV. PRELIMINARY DESIGN DEVELOPMENT

The selected design for the detention facility is presented in this section. The design is based upon a combination of concepts developed in the alternative evaluation phase. Presented on Figure 8, is the preliminary layout of the Powers Boulevard Detention facility, and associated technical data. The facility has been sized to store the 100-year volume for future conditions from the Powers Boulevard basins, including the allowance for one-foot of freeboard. The freeboard elevation was controlled to elevation 5988.5, which corresponds to the minimum edge of shoulder elevation along Powers Boulevard.

The following criteria was applied to the preliminary layout of the detention facility, in addition to criteria summarized within the City/County Drainage Criteria Manual.

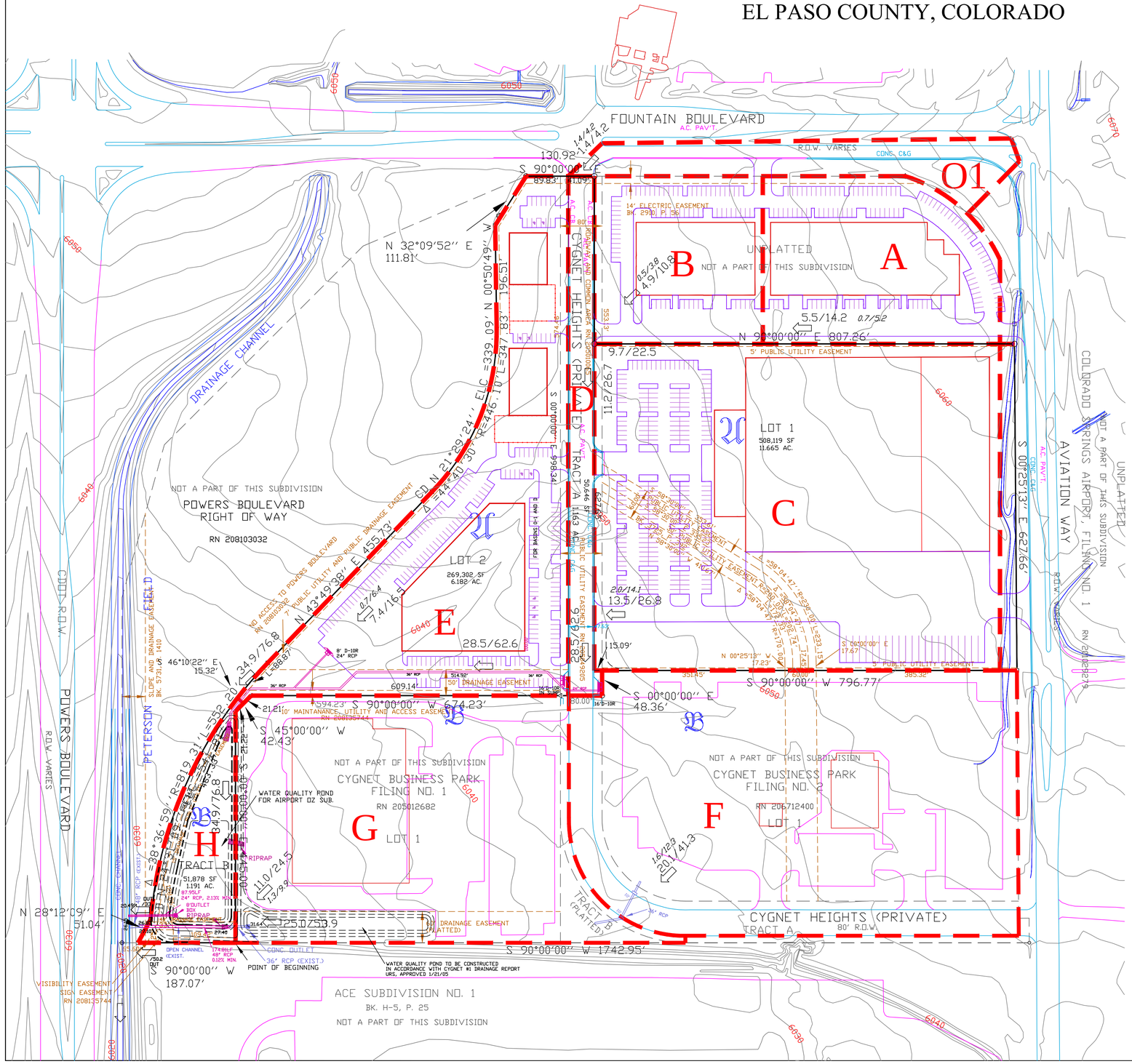
1. Maximum embankment height, ten-feet.
2. Minimum embankment crest, 15-feet.
3. Maximum embankment slope, three horizontal to one vertical.
4. Typical finished slope within storage area, four horzontal to one vertical.
5. Outlet sized to control trickle, 10-year and 100-year runoff.
6. 100-year drain time, 30 to 36 hours.
7. Emergency spillway capacity, 100-year, with principal outlet plugged.
8. Minimum bottom cross slope, two percent.
9. Maintenance access road width, 12-feet.

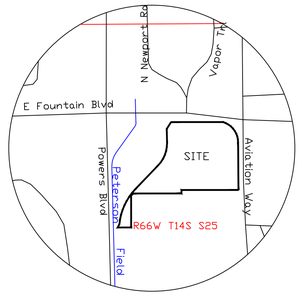
Water Quality

The primary water quality feature is a storage area capable of controlling approximately 0.3 inches of runoff from the Powers Boulevard basins, assuming that the basins are fully developed. The volume of runoff chosen for the design of the water quality basin within the detention facility has been developed in an ongoing study being conducted by the Urban Draiange and Flood

MASTER DRAINAGE PLAN
AIRPORT OZ SUBDIVISION

PART OF THE SE1/4, SECTION 25, T.14S., R.66W. OF THE 6TH P.M.
IN THE CITY OF COLORADO SPRINGS
EL PASO COUNTY, COLORADO





VICINITY MAP
1"=1000'

N

100 0 100 200 300

Scale 1" = 100'

LEGEND:

- ○ SET 2" AL. CAP, #9853 ON #5 REBAR
- ◁ FOUND YELLOW #34964 CAP ON #4 REBAR
- □ FOUND 2" AL. CAP, #23515 ON #5 REBAR+
- ◎ FOUND CDOT 3-1/4" AL. CAP ON #5 REBAR
- ◉ FOUND CDOT 3-1/4" AL. CAP MILE MARKER
- ⊕ FOUND ILLEG. ZAPPIT ON CONC. NAIL

CONTOUR LEGEND:

ORIGINAL CONTOURS:
2'
10'
FINISH CONTOURS:
2'
10'

LEGEND:

- 8.3/14.9 / 10.5/20.4 — RUNOFF IN CFS 5-YEAR/100-YEAR — *HISTORIC CONDITION* / DEVELOPED CONDITION
- A — LIMIT OF DRAINAGE BASIN AND DESIGNATION
- EXISTING STORM SEWER AS LABELED
- PROPOSED STORM SEWER AS LABELED
- B — LIMIT OF SOILS TYPE AND GROUP

BASIN	AREA	RUNOFF - CFS	
	AC.	HISTORIC	DEVELOPED
01	1.42	1.4/4.2	1.4/4.2
A	3.13	0.71/5.2	5.5/14.2
B	2.40	0.50/3.8	4.9/10.8
C	11.23	2.0/14.1	13.5/26.8
D	1.16	N/A	N/A
E	6.18	0.7/6.4	7.4/16.5
H	1.19	0.3/1.9	2.2/4.5
ROUTING			
A+B	5.51	5/100 YR.	9.7/22.5
01-B	7.32		11.2/26.7
01-D	19.34		28.5/62.6
01-E	25.52		34.9/76.8
01-H	26.71		34.3/70.1
F	9.78	1.6/12.3	20.1/41.3
G	7.28	1.3/9.9	11.0/24.5
F+G	17.06		25.0/53.9
F-H	18.25		20.6/54.3

Prepared by the Office of:
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Celebrating over 41 years in business

City File No.: AR FP 19-00506