FINAL
DRAINAGE PLAN AND REPORT

MURR SUBDIVISION

A PROPOSED 4-LOT SUBDIVISION AT 10090 DAVIS ROAD

Southeast quarter of the Southwest quarter of Section 33,Township 13 South, Range 64 Wet, of the 6th P.M., County of El Paso, State of Colorado, Except the West 66 feet and Except the East 68.4 feet of the Southerly 373.8 feet, thereof

PCD File: MS231

December 29, 2022

Revised
April 14, 2023

Prepared for
Erik and Sharon Murr
14090 Davis Road
Peyton, CO 80831-7502

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

OLIVER E. WATTS, PE-LS
OLIVER E. WATTS, CONSULTING ENGINEER, INC.
CIVIL ENGINEERING AND SURVEYING
614 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907
(719) 593-0173
fax (719) 265-9660
olliewatts@aol.com
Celebrating over 43 years in business

April 19, 2023

El Paso County Planning and Community Development
2880 International Circle
Colorado Springs, CO 80910

ATTN: *Joshua Palmer, P.E.*

SUBJECT: Final Drainage Plan and Report
Murr Subdivision

Transmitted herewith for your review and approval is the drainage plan and report for the proposed Murr Subdivision at 10090 Davis Road in El Paso County. This report will accompany the minor subdivision submittal.

Please contact me if I may provide any further information.

Oliver E. Watts, Consulting Engineer, Inc.

BY: ______________________________
Oliver E. Watts, President

Table of Contents

1. ENGINEER'S STATEMENT:

The attached drainage plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the County for drainage reports and said report is in conformity with the applicable 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.

Oliver E. Watts, Consulting Engineer, Inc.

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

2. OWNERS / DEVELOPER'S STATEMENT:

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

Erik and Sharon Murr

By: ____
14090 Davis Road
Peyton, CO 80831-7502

EL PASO COUNTY:

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

____ __________________
Joshua Palmer, P.E., date
County Engineer / ECM Administrator

Conditions:

4. LOCATION AND DESCRIPTION:
The proposed Murr Subdivision is located at 10090 Davis Road, being the Southeast quarter of the Southwest quarter of Section 33, Township 13 South, Range 64 Wet, of the 6th P.M., County of El Paso, State of Colorado, Except the West 66 feet and Except the East 68.4 feet of the Southerly 373.8 feet, thereof. The site is 37.134 acres and zoned RR-5. The site current has a single family home and out buildings in the southwest corner. We propose to subdivide the property into four, single family, residential lots. There will be three, 5-acre lots along the north boundary and one lot on the south, which contains said existing house and outbuildings. This proposed Lot 4 is 21.32 acres.

The site, other than the home is used for livestock. The majority of the lot is native grasses. The terrain slopes from the northwest to the south, east and southeast. Access for the site is a private drive, off of Davis Road.

The property is in the Livestock Company drainage basin.

5. FLOOD PLAIN STATEMENT:
This subdivision is not within the limits of a flood plain or flood hazard area, according to FEMA map panel number 08041C0780 G, dated December 7, 2018, a copy of which is enclosed for reference.

6. METHOD AND CRITERIA:
The method used for all computations is that specified in the City-County Drainage Criteria Manual, using the rational method for areas of the size of the development. All computations are enclosed for reference and review.

The soils in the subdivision have been mapped by the local USDA/SCS office, and a soils map and interpretation sheet are enclosed for reference. All soils in this area are of the Blakeland complex, being in hydrologic group "A".

7. DESCRIPTION OF RUNOFF:
<u>EXISTING DRAINAGE CONDITIONS</u>

As shown on the existing conditions drainage map, the site is adjacent to and north of Davis Road. Access to the subdivision will be along the westerly boundary, where an existing access exists. The subdivision area consists of drainage basins A, B and C. and an offsite basin (O-1) will drain into the access road, developing 1.0 cfs \ 7.4 cfs (5-year / 100-year runoffs. The access road will divert the runoff onto Davis Road, which will drain easterly. Basin A lies north of Davis Road and will drain easterly with 2.3 cfs / 17.1 cfs into an existing "buffalo wallow" near the southeast corner and thence across Davis Road. Basis B will drain 1.4 cfs / 10.5 cfs southerly into the same outfall point. Basin C consists of the northerly portion of the subdivision, draining easterly with 2.3 cfs / 16.7 cfs onto adjacent range lands.

<u>PROPOSED DRAINAGE CONDITIONS</u>

The area will be graded to conform to the existing topography shown on the drainage plans and existing routing will remain. All runoff will be routed to and contained within the private site,

Unresolved from review 1. Indicate if there is an existing roadside ditch on Davis Road and determine if the ditch can handle increased flows.

Unresolved from review 1. Indicate if any roadside ditches/swales will be needed to convey flows along the private driveway. If it will, provide calculations for the size of the swales.

terminating at the historic outfall points. The offsite Basins O=1 will continue to be routed southerly along the access roadway and will increase to 1.8 cfs / 8.8 cfs. Basin A will remain unchanged and continue to discharge into the Buffalo Wallow with 2.3 cfs / 17.1 cfs runoff. Basin B will continue to share the same outfall point, with 1.4 cfs / 10.5 cfs. The Buffalo wallow will continue to provide detention benefits and should not be re-graded, having a total discharge of 3.6 cfs / 26.9 cfs into it. The total runoff at this point is essentially equal to the historic value and no improvements will be necessary. Basin C will continue to drain easterly to adjacent range land and will increase to 5.3 cfs / 24.6 cfs. This area is stable and should not require improvemtnt, Basins A, B, and C runoffs are not concentrated into stream configurations short of the outfall points.
The existing private roadway along the westerly boundary will required continued maintenance for borrow ditch erosion, and this subdivision will have negligable affect on that. It would appear that a roadway will be constructed along the south boundary of lots 1-3 for common access, and that will require similary maintanance for roadside ditches. Individual driveways will require culverts where they meet the common access roadway and 18" cmp's are normally sufficient. The existng culvert at the outfall point of basins A and B is County maintained and appears to be sufficient with a history of use.
FOUR STEP PROCESS : The proposed development will disturb less than 1 acre total.

- Step 1: **Employ Runoff Reduction Practices** – Runoff is not anticipated to increase appreciably across all 4 lots. A combined flow from the lots is anticipated to only increase by 4 cfs. The existing prairie grass will act as a natural runoff reducer.

- Step 2: **Stabilize Drainageways** – The development of this project does not anticipate having any negative effects on downstream drainageways. The existing prairie grass will act as a natural stabilizer, no additional installation is needed.

- Step 3: **Provide Water Quality Capture Volume –** The existing prairie grass is a natural water quality capture and control device. There is no need to install any additional devices.

- Step 4: **Consider Need for Industrial and Commercial BMP's –** The site is a 4 lot residential subdivision across 37 acres. The site is covered with prairie grass and said grass acts as a natural BMP for stormwater runoff. It absorbs the flows and reduces/eliminates potential erosion.

8. COST ESTIMATE:
No storm sewers appear to be required at this time. The construction of the private accesses may create areas that could require private culverts.

9. FEES:
This site is within the Livestock Company Drainage Basin. Fees are due. The large lots are estimated to result in approximately 2% impervious density.
Basin Fee: $21,351.00 per impervious acre
Bridge: $254.00
Total Fees Estimated: ($ 21,351.00 at 37.134 acres x 2%) – 25% (Large Lot Drainage Basin Fee Reduction) = $11.892.72

Revise to include a calculation of how 2% impervious for the development was determined for drainage fees.

Bridge Fee: $ 254.00 xs37.134 x 0.02 x 0.75 = $ 141.48

The 25% reduction of fees does not apply to the bridge fee. Revise to calculate full fee for the development.

10. SUMMARY

The proposed Murr Subdivision is a 4-lot, minor subdivision in the RR-5 zone. There will be no change in the historic runoff amounts for this development: The existing grasses in the sandy soil will hold runoff to said historic levels. There will be no adverse effects on downstream or surrounding properties.

The drainage analysis has been prepared in accordance with the current El Paso County Drainage Criteria Manuel. Supporting information and calculations are included in this report.

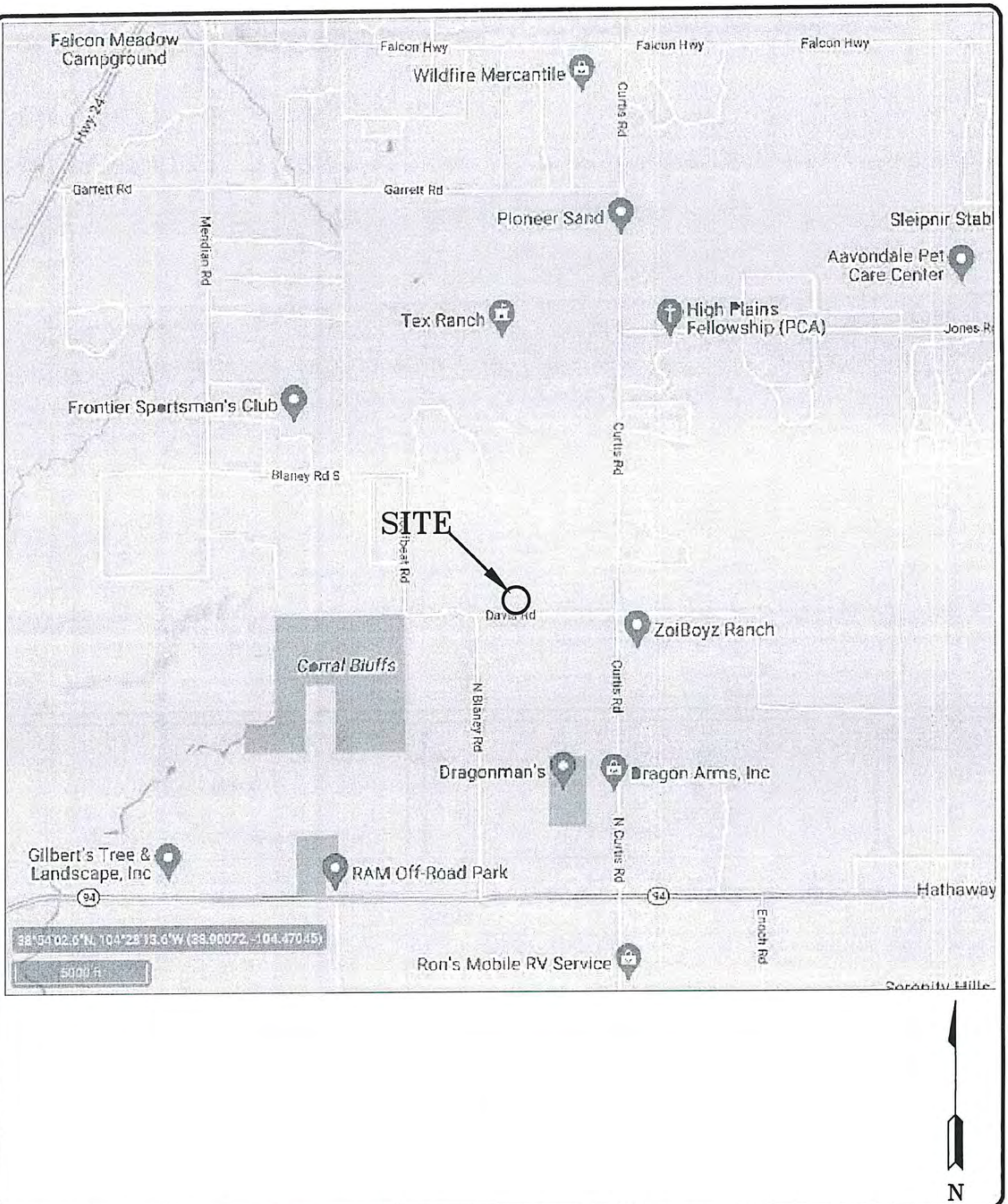
Unresolved from review 1. Address the need for detention. Basin C developed flows are significantly higher compared to historic flows. Developed flows should match historic flows per criteria.

Unresolved from review 1. Update summary to discuss the condition of the outfall. Per ECM 3.2.4 a suitable outfall is required. Determine if outfall/culvert is stable and in good condition and can withstand increase in flows.

References

1. El Paso County Engineering Criteria Manuel, December 13, 2016

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



Murr Subdivision

VICINITY MAP
4-LOT MINOR SUBDIVISION
14090 DAVIS ROAD
EL PASO COUNTY, CO.

DRAWN:	DATE:	CHECKED:	DATE:
	10/27/22		

MAJOR BASIN	SUB BASIN	AREA		BASIN		Tc MIN	I in./hr.		SOIL GRP	DEV. TYPE	C		FLOW 5-yr	FLOW 100-yr	RETURN PERIOD -years-	
		PLANIM READ	ACRES	LENGTH -FT.-	HEIGHT -FT.-		5	100			5	100	qp -CFS-	qp -CFS-		
Livestock	O-1		6.44	300	5	27			A	PASTURE					5	100
Company		K=10	F=1.13	+1090		+16										
						43	2.0	3.3					1.0	7.4	5	100
HISTORIC																
CONDITIONS	A		12.55	300	14	19										
		K=7	V=1.38	+1080	42	+13										
						32	2.3	3.9					2.3	17.1	5	100
	B		7.17	300	22	17										
		K=7	V=1.17	+710	20	+10										
						27	2.5	4.2					1.4	10.5	5	100
	A+B		19.72			32	2.3	3.9					3.6	26.9	5	100
	C		17.09	300	18	46										
		K=7	V=1.59	+770	40	+8										
						54	17	2.8					2.3	16.7	5	100

HYDROLOGICAL COMPUTATION – BASIC DATA

PROJ: MURR SUBDIVISION BY: O.E. WATTS

RATIONAL METHOD DATE: 12/30/22

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 5-yr	FLOW 100-yr	RETURN PERIOD -years-	
		PLANIM READ	ACRES	LENGTH -FT.-	HEIGHT -FT.-		5	100			5	100	qp -CFS-	qp -CFS-		
Livestock	O-1	2.43	6.44	300	5	25			A	5 ACRE	0.14	0.40			5	100
Company		K=10	V1.13	+1090	+6	+16										
						41	2.0	3.4					1.8	8.8	5	100
DEVELOPED																
CONDITIONS	A	4.73	12.55	300	14	18			A	PASTURE	0.08	0.35				
		K=7	V=1.38	+1080	42	+13										
						31	2.3	3.9					2.3	17.1	5	100
	B	2.70	7.17	300	22	16			A	PASTURE	0.08	0.35				
		K=7	V=1.17	+710	20	+10										
						26	2.8	4.6					1.4\	10.5	5	100
	A+B		19.72			31	2.3	3.9	A	PASTURE	0.08	0.35	3.6	26.9	5	100
	C		17.09	300	18	28			A	5 ACRE	0.14	0.40				
		K=7	V=1.59	+770	40	+8										
						36	2.2	2.8	A	5 ACRE	0.14	0.40	5.3	24.6	5	100

HYDROLOGICAL COMPUTATION – BASIC DATA
PROJ: MURR SUBDIVISION BY: O.E. WATTS
RATIONAL METHOD DATE: 12/30/22, 4-14-23

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

Land use for basin A cannot be pasture. Pasture assumes a 0% impervious value for the land use and that is not an appropriate use for the developed conditions since it contains residential development. Update to use an appropriate land use with some impervious value.

National Flood Hazard Layer FIRMette

FEMA

104°34'20"W 38°52'21"N

104°33'42"W 38°51'53"N

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

1:6,000

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

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
- B 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 represent 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 12/20/2022 at 10:36 AM 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.

)F AGRICULTURE
TION SERVICE

N
1"=2000'

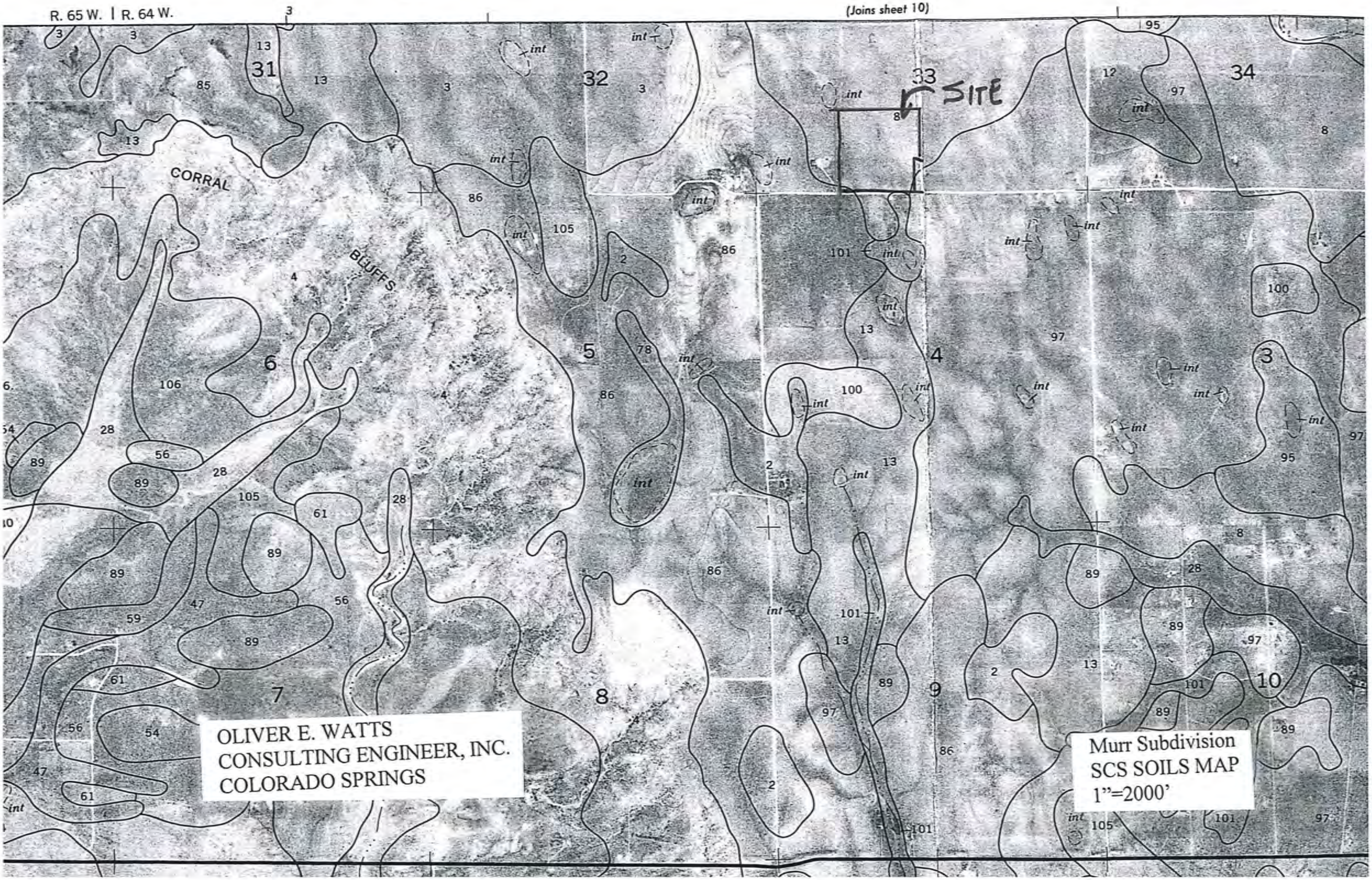


TABLE 16.--SOIL AND WATER FEATURES

[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	Hydro-logic 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.

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

Soil name and map symbol	Hydro-logic 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 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

* 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.

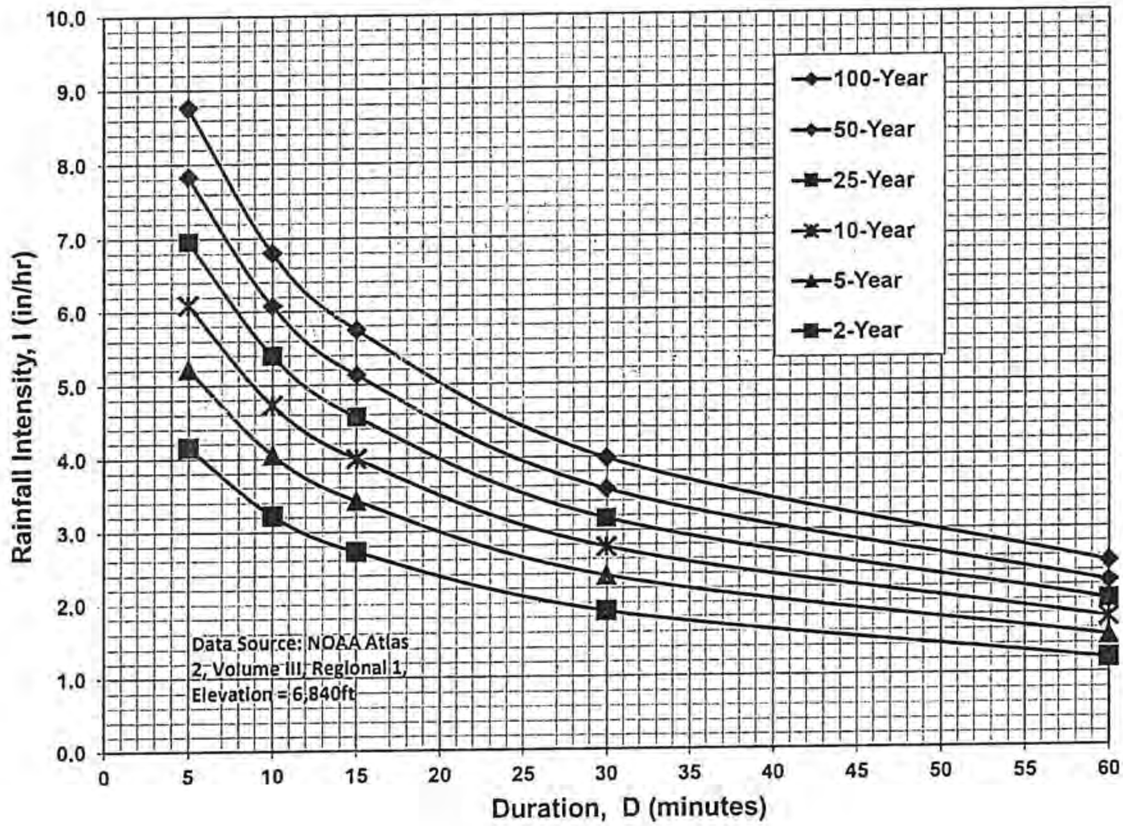
3.2.4 Minimum Time of Concentration

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

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

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

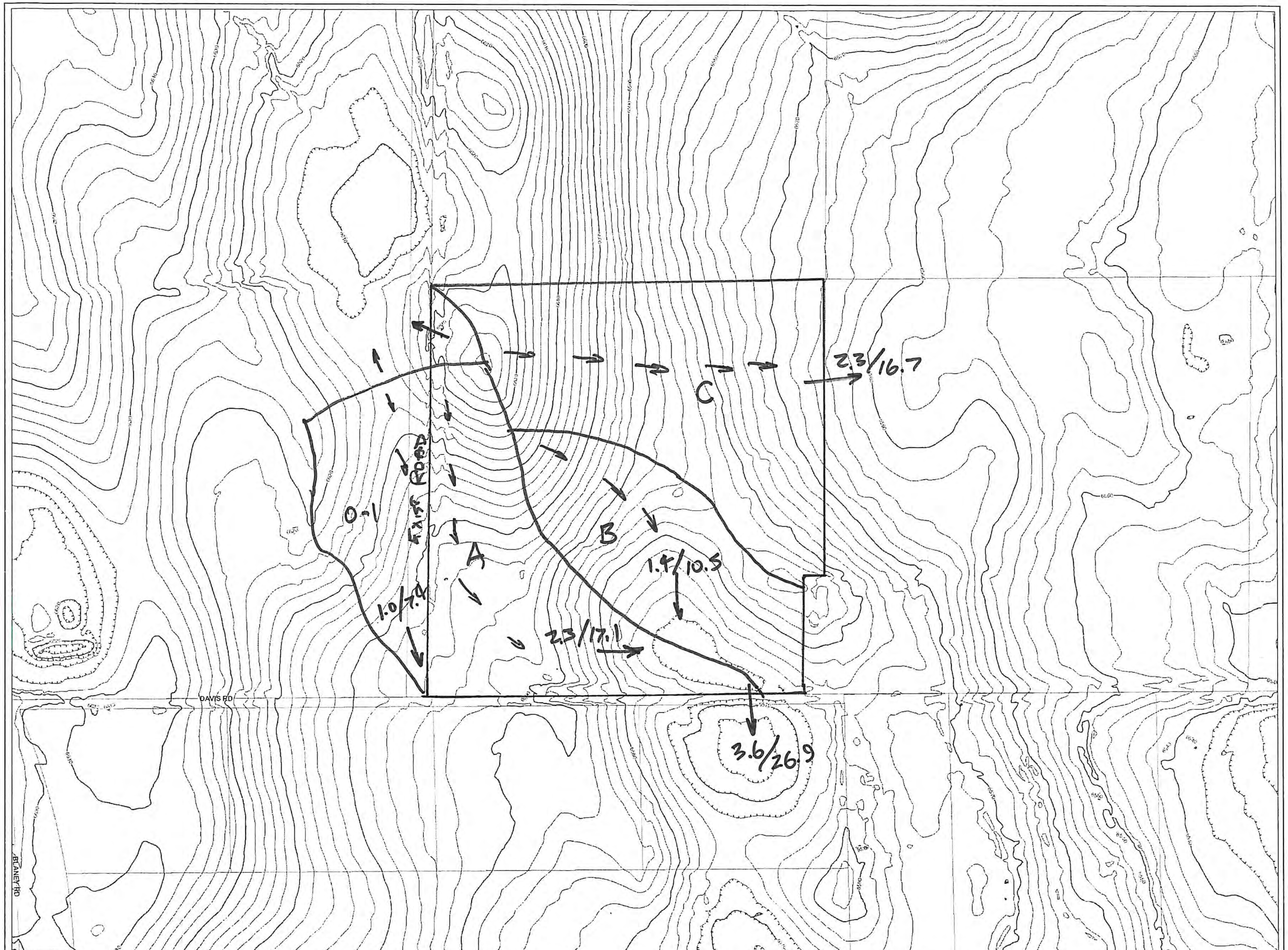
$$I_{25} = -2.00 \ln(D) + 10.111$$

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

$$I_{5} = -1.50 \ln(D) + 7.583$$

$$I_{2} = -1.19 \ln(D) + 6.035$$

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



Colorado Springs Utilities
It's how we're all connected

1" = 340'
Scale ~~1" = 200'*~~
0 50 100 200 300 400
Feet
N

* Scale is accurate if PDF is printed on standard 22 x 34 D Size paper with page size property set to 'Actual Size'. Settings other than these may result in an inaccurate verbal map scale but scale bar will be correct.

Map Created: 12/28/2022

Reference Map

Y-28	Z-28	AE-28
Y-29	Z-29	AE-29
Y-30	Z-30	AE-30
Y-31	Z-31	AE-31

Bridge, Alley, Paved Parking, Unpaved Road, Paved Road, Fence, Hedge, Wall, Railroad Track, Building, Parcel, Lake, Stream, Intermediate Contour, Intermediate Depression Contour, Intermediate Indefinite Contour, Intermediate Dep. Indef. Contour, Index Contour, Index Depression Contour, Index Indefinite Contour, Index Dep. Indef. Contour

Horizontal Datum: State Plane Central CO Zone - NAD83
Vertical Datum: State Plane NGVD29 - US Survey Feet (Utility Data)
Vertical Datum: State Plane NGVD88 - US Survey Feet (Contour & Control Data)

Lower Left: 3264074,1377203
Upper Right: 3268074,1380203

Contours & Parcels Public Access Map

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

21-5660

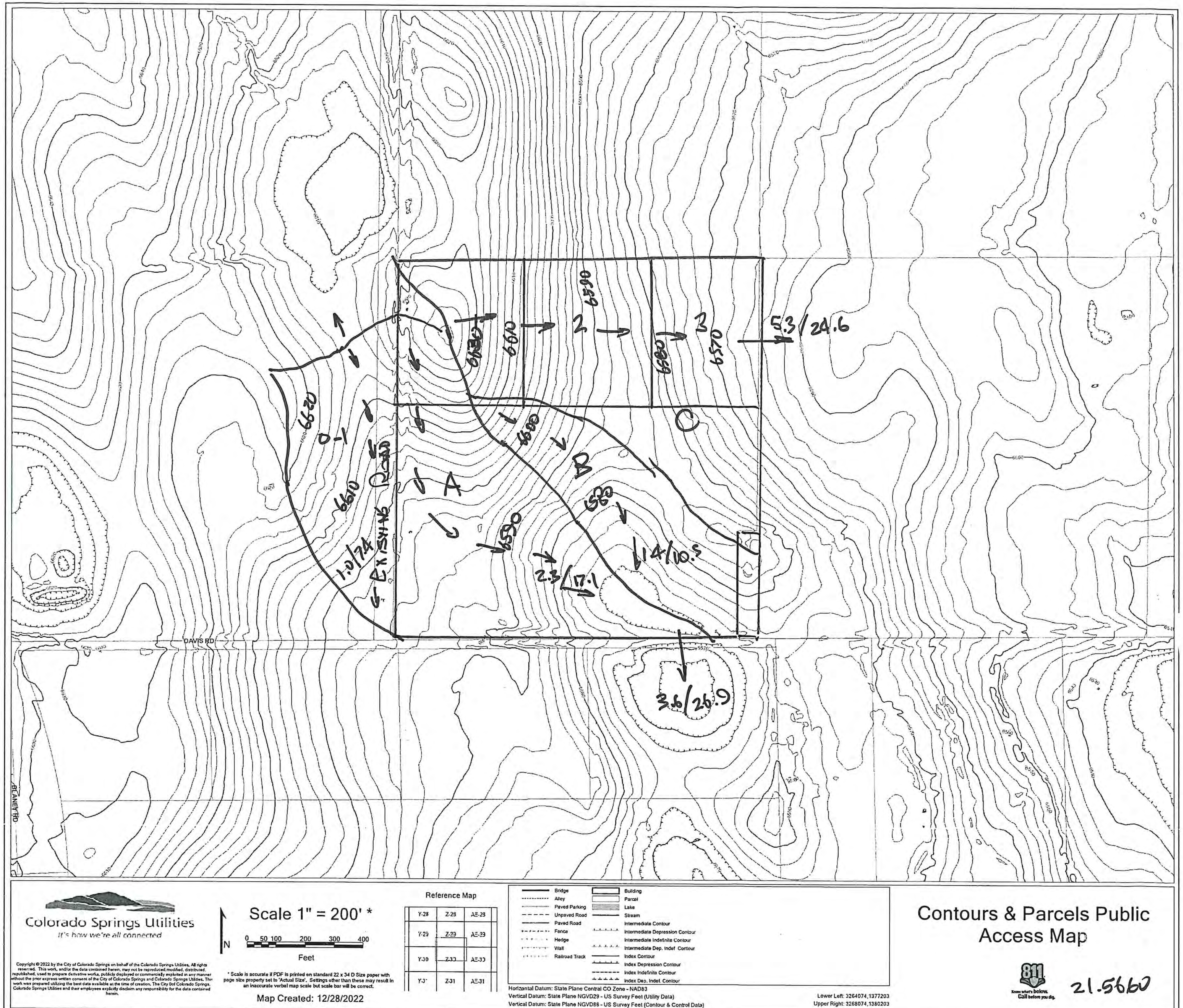
Murr Subdivision
Drainage Plan
Existing Conditions

HISTORIC CONDITIONS

DRAINAGE BASIN SUMMARY

BASIN	AREA -AC.-	RUNOFF IN CFS 5-YEAR	RUNOFF IN CFS 100-YEAR
OS-1	6.44	1.0	7.4
A	12.55	2.3	17.1
B	7.17	1.4	10.5
A+B	19.72	3.6	26.9
C	17.09	2.3	16.7

OLIVER E. WATTS
CONSULTING ENGINEER, INC.
COLORADO SPRINGS



OLIVER E. WATTS
CONSULTING ENGINEER, INC.
COLORADO SPRINGS

DEVELOPED CONDITIONS

DRAINAGE BASIN SUMMARY

BASIN	AREA -AC.-	RUNOFF IN CFS 5-YEAR	RUNOFF IN CFS 100-YEAR
OS-1	6.44	1.8	8.8
A	12.55	2.3	17.1
B	7.17	1.4	10.5
A+B	19.72	3.6	26.9
C	17.09	5.3	24.6

Flows significantly increase after development. Per unresolved comment on page 6, address whether detention is required because of runoff increase.

ndition