Costin Engineering
CIVIL ENGINEERING AND LAND SURVEYING
1590 SOUTH ACOMA ST. DENVER, COLORADO 80223
TELEPHONE: 744-7084

REVISED
~~FINAL~~

DRAINAGE STUDY
TAMARRON AT ROCKRIMMON

Prepared for:

AMERICAN CONTINENTAL CORPORATION

Prepared by:

COSTIN ENGINEERING CO.
2132 E. Bijou
635-2217

MARCH 1979

Revised August 31, 1979

Project No. 435

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<u>CERTIFICATIONS</u>

Registered Engineer

I, William E. Miller, a registered engineer in the State of Colorado, hereby certify that the attached drainage plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. I further certify that said drainage report is in accordance with all City of Colorado Springs Ordinances and specifications and criteria.

William E. Miller
Colorado P.E. No. 13889

WILLIAM E. MILLER REGISTERED 13889 PROFESSIONAL ENGINEER STATE OF COLORADO

Owner and Developer of the Site

The developer has read and will comply with all of the requirements specified in this drainage report as approved by the City Engineer.

By ______________________

Title Const Supt

Approved:

City of Colorado Springs, Department of Public Works

______________________ City Engineer

______________ Date

TABLE OF CONTENTS

SCOPE

This revised report presents the more detailed analysis of the projects' storm drainage system as referenced in the scope section of the report presented in March, 1979 and revised on May 3, 1979.

PROJECT DESCRIPTION

Tamarron at Rockrimmon is low density detached single family development about 410 units on approximately 150 acres.

The project is located in the northwest portion of Colorado Springs, El Paso County, Colorado, in Sections 12, 13, and 18, Township 13 South, Range 66 West of the 6th P.M. The site lies entirely within the Rockrimmon North Drainage Basin. A master plan for the area shows low and higher density residential development along with some neighborhood commercial uses adjacent to the site. Residential construction is presently underway along the north boundary of the site.

SOILS CLASSIFICATION

The different soil types found in the basin are indicated on pages 7 - 9. These areas are also shown on Map 1. The mapping and interpretations are courtesy of the Soil Conservation Service. The site itself is located primarily within an area designated by mapping unit C - 3 - CD, hydrologic soil group C. Offsite Basin A soils are designated primarily RB-1, hydrologic soil group D. Offsite Basin B soils are designated C3 - CD, hydrologic soil group C.

HYDROLOGY

This study is based on the current City of Colorado Springs requirements as detailed in Determination of Storm Runoff Criteria, March 1977, and HUD - FHA requirements detailed in Minimum Property Standards, 1873 as revised.

In summary, this implies that allowable street flows are based on a 5 year storm and the rational method for small basins, and the SCS method for larger basins. 100 year storm flows based on the reational and SES methods as indicated above are also calculated. Minimum house elevations in relation to street flow depths, ponding depths at culverts, and emergency overflow swale flow depths are considered.

The total precipitation for the 5 year - 6 hour storm is 2.1 inches, and 3.5 for the 100 - 6 hour storm.

In those calculations using the rational method, a minimum time of concentration of 10 minutes is used. A "C" value of 0.5 is used for residential, 0.7 for commercial or multifamily areas for the 5 year storm. For the 100 year storm these values are multiplied by 1.25 to account for the effect of anticedent precipitation.

The 100 year intensity-duration relationship is derived in accordance with the method of the NOAA Atlas 2. These calculations are detailed on page 13. The resulting data is shown on the graph on page 14.

Allowable street flow capacity is based on Tables 4 and 5 of the above mentioned criteria. These tables are reproduced on pages 16 and 17. Street flow velocities are based on a chart prepared by the City of Arvada, Colorado, attached as page 15.

Offsite Basins

Two relatively large offsite basins are tributary to this project. These basins are shown on Map 2. Peak runoff rates are calculated on pages 10 and 11. Since the 100-year storm flows for both offsite basins exceed 500 cfs, these 100-year storm flows are used for channel and culvert design.

For offsite Basin B, the design flow is 755 cfs at Rockrimmon Blvd. Calculations on pages 34-37 show a 96 inch CMP will be required to pass this flow without overtopping the street.

Additionally, the flows from the existing systems installed in Rockrimmon Blvd. (which orignates in a replat of Comstock Village Filing No. 2, Second Filing) shall be intercepted and routed to the major channel by means of a 42" diameter R.C.P. This conforms with the original drainage plans for the area.

The flows from this area were included in the original computation for Basin B, therefore no adjustment of the channel computation is necessary.

Downstream from this crossing, the present channel is relatively deep with steep side walls. In order to provide a stable channel, the side walls will be graded so as to not exceed 3:1 slope. The proposed channel cross section is shown on page 38. Average velocities for the design storm range from 7 to 18 ft/sec. Channel improvements extend from Rockrimmon Boulevard downstream 2100 feet.

Farther downstream, at bends at stations 20 + 00 and 27 + 00, as shown on the attached map, riprap slope protection shall be provided on the north side of the channel.

For offsite Basin A, the design flow is 1115 cfs. Calculations on pages 34-35 indicates a 8 ft of 8 ft concrete box culvert will be required to pass this flow without overtopping the street.

At the discharge of this culvert, a riprap performed scour hole energy dissapator designed in accordance with the Corps of Engineers Hydraulic Design Chart 722-6 and 722-7 will be provided.

A small reservoir is presently located downstream from this energy dissapator. The earthfill enbankment shall be breached so that water will not be retained. This operation shall be accomplished in such a manner that control over the discharge is maintained at all times.

Onsite Basins

No unusual problems were encountered in the onsite basin analysis. These calculations are found on pages 18 through 33. The results are indicated on Map 2.

10/18/79 REVISED

COST ESTIMATE

Basin	Item	Quant.	Unit	Unit Price	Amount
A	11'5"x7'1" Pipe Arch (Alum.)	190	LF	$ 110	$ 20,900 – ?
A	6' Inlet	1	LS	900	900
A	4' Inlet	1	LS	600	600
A	Riprap, dissapator	1200	ton	20	24,000 – ?
B	7'x15' Pure Arch w/Paved Invert (Alum.)	200	LF	200	40,000 – ?
B	8' Inlet	2	LS	1,200	2,400
B	42 inch RCP	810	LF	60 (40.00)?	48,600 – ?
B	5' diameter MH	1	LS	1000	1,000
B	4' diameter access MH	1	LS	500	500
B	6x6 Junction Box	1	LS	3,000	3,000
B	24 inch RCP	374	LF	35 (23.00)	13,090 – ?
B	4' Dia Std MH	1	LS	800	800
C	(See Items in Basin G)				
D	(Included in Basin A)				
F	4' Inlet	1	LS	600	600
F	18" Dia RCP	180	LF	30 (18.00)	5,400 – ?
G	22' Inlet ?	1	LS	3,200	3,200 – ?
G	4' Inlet ?	1	LS	600	600
G	6' Inlet ?	1	LS	900	900
G	18" Dia RCP	36	LF	30 (18.00)	1,080 – ?
G	4' Dia Std MH	6	LS	800	4,800
G	36" Dia RCP	570	LF	50 (36.00)	28,500 – ?
H	(Included in Basin B)				
I	(Included in Basin B)				

COST ESTIMATE

Basin	Item	Quant.	Unit	Unit Price	Amount
J	4' Inlet	3	LS	$ 600	$ 1,800
J	6' Inlet	1	LS	900	900
J	18" Dia RCP	105	LF	30 ± 18.00	3,150
J	24" Dia RCP	85	LF	35 ± 24.00	2,975
K	14' Inlet	1	LS	2,000	2,000
K	6' Inlet	1	LS	900	900
K	36" RCP	170	LF	50 ± 36.00	8,500
L	4' Inlet	1	LS	600	600
L	18" Dia RCP	115	LF	30 ± 18.00	3,450
M	4' Inlet	4	LS	600	2,400
M	6' Inlet	1	LS	900	900
M	18" Dia RCP	130	LF	30 ± 18.00	3,900
M	24" Dia RCP	550	LF	35 ± 24.00	19,250
V	4' Inlet	3	LS	600	1,800
V	8' Inlet	1	LS	1,200	1,200
V	18" Dia RCP	35	LF	30 ± 18.00	1,050
V	21" Dia RCP	25	LF	33 ± 21.00	825
V	24" Dia RCP	200	LF	35 ± 24.00	7,000
U	4' Inlet	2	LS	600	1,200
U	8' Inlet	1	LS	1,200	1,200
U	21" Dia RCP	30	LF	33 ± 21.00	990
U	24" Dia RCP	150	LF	35 ± 24.00	5,250
T	Future Development of Tract "A"				
S	Future Development of Tract "A"				

COST ESTIMATE

Basin	Item	Quant.	Unit	Unit Price	Amount
N	8' Inlet	1	LS	$ 1,200	$ 1,200
N	4' Inlet	1	LS	600	600
N	21" Dia RCP	176	LF	33	5,808
O	(Included in Basin A)				
Q	(Included in Basin A)				
D	(Included in Basin A)				
P	8' Inlet	1	LS	1,200	1,200
P	4' Inlet	1	LS	600	600
P	21" Dia RCP	250	LF	33	8,250
R	N/A				
-	Riprap Channel	1200	TON	20	24,000
-	Riprap @ Outfalls	75	TON	20	1,500
-	Paved Channel (Concrete Lined)	1338	LF	150	200,700
			TOTAL		$515,968

SEE 10/18/79 REVISED ESTIMATE

COST ESTIMATE

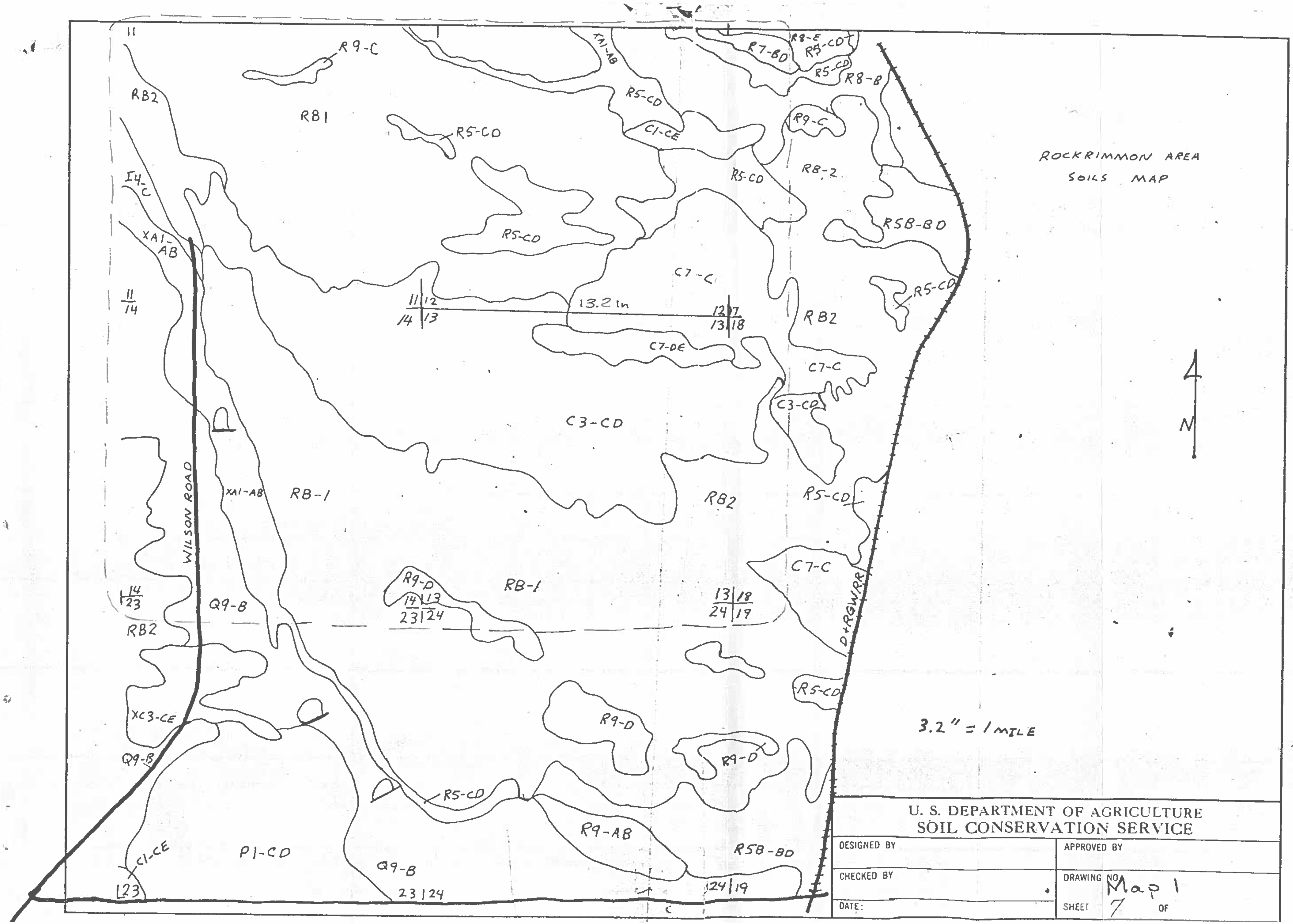
Basin	Item	Quant.	Unit	Unit Price	Amount
A	8x8 box culv/CMP	190	LF	$ 290	$ 55,100
A	6' Inlet	1	LS	900	900
A	4' Inlet	1	LS	600	600
A	Riprap, dissapator	1200	ton	20	24,000
B	96 inch CMP	200	LF	245	49,000
B	8' Inlet	2	LS	1,200	2,400
B	42 inch RCP	810	LF	60	48,600
B	5' diameter MH	1	LS	1000	1,000
B	4' diameter access MH	1	LS	500	500
B	6x6 Junction Box	1	LS	3,000	3,000
B	24 inch RCP	374	LF	35	13,090
B	4' Dia Std MH	1	LS	800	800
C	(See Items in Basin G)				
D	(Included in Basin A)				
F	4' Inlet	1	LS	600	600
F	18" Dia RCP	180	LF	30	5,400
G	22' Inlet	1	LS	3,200	3,200
G	4' Inlet	1	LS	600	600
G	6' Inlet	1	LS	900	900
G	18" Dia RCP	36	LF	30	1,080
G	4' Dia Std MH	6	LS	800	4,800
G	36" Dia RCP	570	LF	50	28,500
H	(Included in Basin B)				
I	(Included in Basin B)				

COST ESTIMATE

Basin	Item	Quant.	Unit	Unit Price	Amount
J	4' Inlet	3	LS	$ 600	$ 1,800
J	6' Inlet	1	LS	900	900
J	18" Dia RCP	105	LF	30	3,150
J	24" Dia RCP	85	LF	35	2,975
K	14' Inlet	1	LS	2,000	2,000
K	6' Inlet	1	LS	900	900
K	36" RCP	170	LF	50	8,500
L	4' Inlet	1	LS	600	600
L	18" Dia RCP	115	LF	30	3,450
M	4' Inlet	4	LS	600	2,400
M	6' Inlet	1	LS	900	900
M	18" Dia RCP	130	LF	30	3,900
M	24" Dia RCP	550	LF	35	19,250
V	4' Inlet	3	LS	600	1,800
V	8' Inlet	1	LS	1,200	1,200
V	18" Dia RCP	35	LF	30	1,050
V	21" Dia RCP	25	LF	33	825
V	24" Dia RCP	200	LF	35	7,000
U	4' Inlet	2	LS	600	1,200
U	8' Inlet	1	LS	1,200	1,200
U	21" Dia RCP	30	LF	33	990
U	24" Dia RCP	150	LF	35	5,250
T	Future Development of Tract "A"				
S	Future Development of Tract "A"				

COST ESTIMATE

Basin	Item	Quant.	Unit	Unit Price	Amount
N	8' Inlet	1	LS	$ 1,200	$ 1,200
N	4' Inlet	1	LS	600	600
N	21" Dia RCP	176	LF	33	5,808
O	(Included in Basin A)				
Q	(Included in Basin A)				
D	(Included in Basin A)				
P	8' Inlet	1	LS	1,200	1,200
P	4' Inlet	1	LS	600	600
P	21" Dia RCP	250	LF	33	8,250
R	N/A				
-	Riprap Channel	16100	TON	20	322,000
-	Riprap @ Outfalls	75	TON	20	1,500
			TOTAL		$ 656,468



U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

DESIGNED BY	APPROVED BY
CHECKED BY	DRAWING NO. Map 1
DATE:	SHEET 7 OF

SCS-CONS-5
10-75
FILE CODE CONS-14-5

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

FEB. 27 1979

INVENTORY & EVALUATION
OF LAND, WATER, AND RELATED RESOURCES

REQUESTED BY Harold L. Catlin
Castin Engineering Co.

LOCATION 1590 S. Acoma
Denver, CO 80222

ASSISTED BY Jim Currier

DATE 2/23/79

* [X] INDIVIDUAL ☐ GROUP ☐ UNIT OF GOVERNMENT

SITUATION: Harold Catlin requested information on soils in the Rockrimmon area for hydrologic study.

SUGGESTED SOLUTION(S) Information provided as requested. Soils in the area are the following:

RB-1	Q9-B
R5-CD	XA1-AB
RB-2	XC3-CE
C7-C	R9-D
I4-C	P1-CD
R9-AB	

* *Check appropriate category*

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"Soil Characteristics"

"CONTINUES ON OTHER SIDE"

MAP SYMBOL	SOIL NAME	HYDRO. SOIL GROUP	SHRINK-SWELL	POTENTIAL FROST-ACTION	DEPTH TO BEDROCK
RB-1	Travessilla-Rock outcrop complex, 8 to 9%	D	low	low	6-20" (hard)
RB-2	Chaseville-Midway complex	A (D)	low (high)	low (low)	760" (10-20"-rip)
R9-AB	Bresser sandy loam, 0 to 3%	B	low	low	760"
R5-CD	Truckton sandy loam, 3 to 9%	B	low	moderate	760"
Q9-B	Chaseville gravelly sandy loam, 1 to 8%	A	low	low	760"
P1-CD	Ascalon sandy loam, 3 to 9%	B	low	moderate	760"
I4-C	Bresser sandy loam, 3 to 5%	B	low	low	760"
C7-C	Cushman loam, 1 to 5%	C	low	low	20-40"-rip
XA1-AB	Ustic Torrifluvents, loamy	B	---	moderate	760"
XC3-CE	Razor-Midway complex	C (D)	moderate high	low	20-40"-rip (10-20"-rip)
C3-CD	Razor clay loam, 3 to 9%	C	moderate	low	20-40"-rip
C7-DE	Cushman loam, 5 to 15%	C	low	low	20-40"-rip
R7-BD	Blakeland loamy sand, 1 to 9%	A	low	low	760"
R8-B	Kettle gravelly loamy sand, 3 to 8%	B	low	moderate	760"
C1-CE	Midway clay loam, 3 to 25%	D	high	low	10-20"-rip
R9-D	Bresser sandy loam, 5 to 9%	B	low	low	760"

Rockrimmon offsite basin A

SCS method as modified by Colorado Springs Drawing Criteria (CSDC)

Area: 446 acres

Hydrologic soil group: D

Determine weighted runoff curve number:

Land Use	Percent	Curve No.	Product
Detached housing, 1/8 acre	30	92	2760
Detached housing, 1/4 acre	35	87	3045
Multi-family - Commercial	10	95	950
Streets	10	98	980
Open space	15	84	1260
	100		8995

Therefore 8995/100 = 89.95, use CN = 90.

For 5 year - 6 hr precipitation = 2.1, CN = 90: Runoff = 1.18 in.

For 100 year - 6 hr precipitation = 3.5, CN = 90: Runoff = 2.45 in.

Estimate Tc:

Upper elevation = 6940
Lower elevation = 6320
Therefore fall = 620 ft.

Flow path = 13,200 ft = 2.5 miles

Tc = 0.63 hrs (Figure II, CSDC)

Determine peak runoff rate:

q = 650 CSM (Figure I, CSDC)

Q_5 = (650)(0.70)(1.18) = 537 cfs

Q_{100} = (650) (0.70) (2.45) = 1115 cfs

Rockrimmon offsite basin B

SCS method as modified by Colorado Springs Drainage

Criteria (CSDC)

Area: 212 acres

Hydrologic soid group: C

Determine weighted runoff curve number:

Land Use	Percent	Curve No.	Product
Detached housing, 1/3 acre	55	81	4455
Multi-family, Comm.	10	94	940
Streets	15	98	1470
Open space	20	79	1580
	100		8445

Therefore 8445/100 = 84.45, use CN = 84

For 5 year - 6 hr precipitation = 2.1, CN = 84 : Runoff = 0.82

For 100 year - 6 hr precipitation = 3.5, CN = 84 : Runoff = 1.94

Estimate Tc:

Upper elevation = 6750
Lower elevation = 5990
Therefore fall = 760 ft.
Flow path = 4000 ft = 0.76 miles
Tc = 0.14 hrs (Figure II, CSDC)

Determine peak runoff rate:

q = 1180 CSM (Figure I, CSDC)

Q_5 = (1180) (0.33) (0.82) = 319 cfs

Q_{100} = (1180) (0.33) (1.94) = 755 cfs

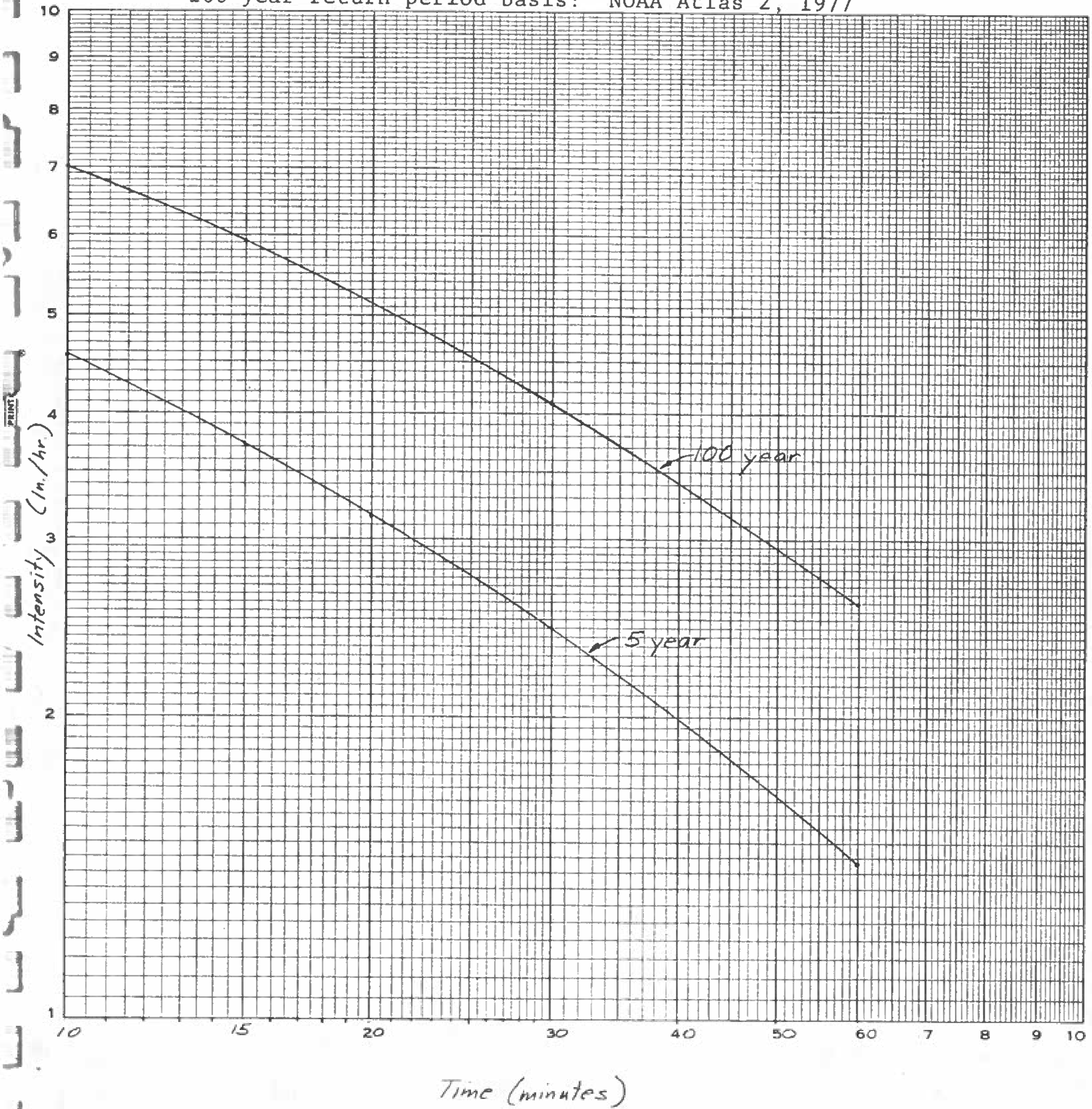
4/13/79

Intensity - Duration - Frequency Curves

Colorado Springs, Colorado

5 year return period basis: Colorado Springs Drainage Criteria Manuel, Figure 3, March 1977

100 year return period basis: NOAA Atlas 2, 1977



The following is a discussion of the method used to develop the intensity duration relationship curve for the Rockrimmon area for the 100 year return period.

Reference: N O A A Atlas 2, Volume III - Colorado, 1973

Region 1

For the one hour value:

$$Y_{100} = 1.897 + 0.439 \left[(X_3)(X_3/X_4)\right] - 0.008Z$$

Where X_3 = 100 yr 6 - hr value = 3.5

X_4 = 100 yr 24 - hr value = 4.4

Z = Point elevation in hundres of feet = 65

Therefore

$$Y_{100} = 1.897 + 0.439 \left[(3.5)(3.5/4.4)\right] - 0.008\ (65)$$

$$= 2.60 \text{ in.}$$

For shorter times:

Duration (min.)	Ratio to 1-hr	Precip	Intensity (in./hr.)
5	0.29	0.75	9.00
10	0.45	1.17	7.02
15	0.57	1.48	5.92
30	0.79	2.05	4.10

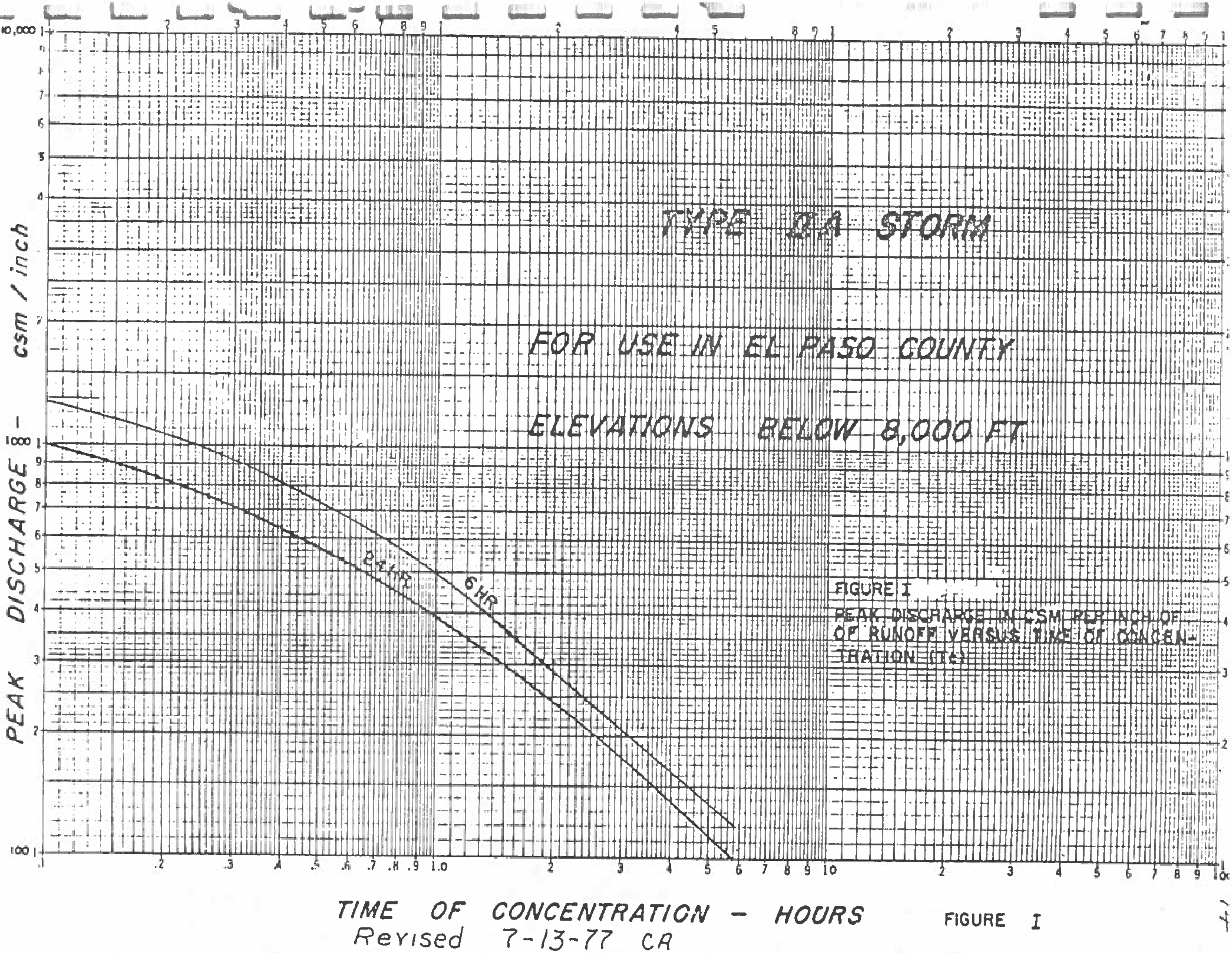
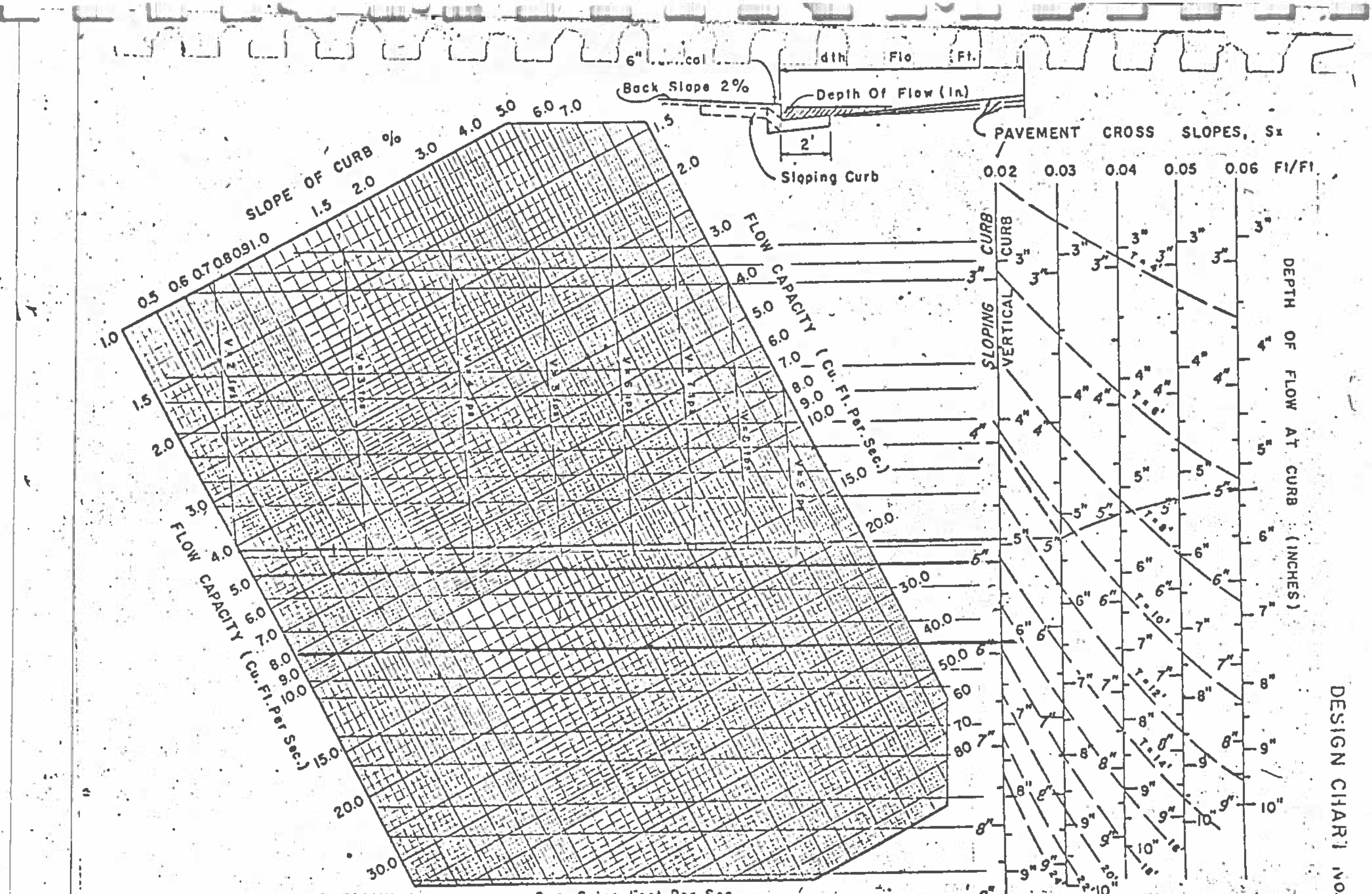

TYPE IIA STORM
FOR USE IN EL PASO COUNTY
ELEVATIONS BELOW 8,000 FT
6HR
24HR
FIGURE I
PEAK DISCHARGE IN CSM PER INCH OF OF RUNOFF VERSUS TIME OF CONCEN-TRATION (Tc)
PEAK DISCHARGE - csm / inch
TIME OF CONCENTRATION - HOURS
Revised 7-13-77 CR

FIGURE I



MODIFIED MANNINGS FORMULA
Q = 0.56 (z/n) (S ½) (D ⁸⁄₃)
V = Q/A, Velocity In Feet/Sec.
Velocity Shown For Gutter With Pavement Slope 0.03-0.04 Ft/Ft

Q = Cubic Feet Per Sec.
Sx = Pavement Cross Slope Ft/Ft
z = Is Reciprical Of Cross Slope Sx
n = Friction Factor 0.017
S = % Slope Of Curb & Guttor
D = Depth Of Flow At Curbline (Feet)
T = Width Of Flow From Curbline (Ft. Avg.)

CAPACITY CHART
CURB & GUTTER FLOWS
VS DEPTH & PAVEMENT SLOPE
DRAINAGE STUDY-ARVADA
THE KEN R. WHITE COMPANY

Table 4 - Permissible Drainage Street Capacities with level ramp curbs*

S	34' Residential		36' Residential		40' Residential	
%	FPS	CFS	FPS	CFS	FPS	CFS
0.5	2.85	11.7	2.77	11.6	2.62	11.2
1.0	4.03	16.6	3.92	16.4	3.70	15.8
1.5	4.93	20.3	4.80	20.1	4.54	19.3
2.0	5.69	23.5	5.54	23.2	5.24	22.3
2.5	6.37	26.2	6.20	25.9	5.86	24.9
3.0	6.97	28.7	6.79	28.4	6.42	27.3
3.5	7.53	31.0	7.33	30.7	6.93	29.5
4.0	8.05	33.2	7.84	32.8	7.41	31.5
4.5	8.54	35.2	8.31	34.8	7.86	33.4
5.0	9.00	37.1	8.76	36.7	8.28	35.2
5.5	9.44	38.9	9.19	38.5	8.69	37.0
6.0	9.86	40.6	9.60	40.2	9.07	38.6

*Intermediate values may be obtained by arithmetic interpolation.

Table 5 Permissible Drainage Street Capacities with 8" Vertical Curbs *
8" Curb - Full Storm Water Capacity (with level curbs)

S	34' Residential		36' Residential		40' Residential		34' One-Way Art.		60' & 76' Arterial		S
%	FPS	CFS	FPS	CFS	FPS	CFS	FPS	CFS	FPS	CFS	%
0.5	4.08	28.9	4.02	29.5	3.90	30.1		20.0		20.0	0.5
1.0	5.76	40.9	5.70	41.7	5.51	42.6		30.0		30.0	1.0
1.5	7.06	50.1	6.97	51.1	6.75	52.2	6.97	30.0	6.97	30.0	1.5
2.0	8.15	57.8	8.05	59.0	7.79	60.2	8.05	34.0	8.05	34.0	2.0
2.5	9.11	64.7	9.00	65.9	8.71	67.4	9.00	36.0	9.00	36.0	2.5
3.0	9.98	70.9	9.86	72.2	9.54	73.8	9.86	38.0	9.86	38.0	3.0
3.5	10.78	76.5	10.65	78.0	10.31	79.7	10.65	40.0	10.65	40.0	3.5
4.0	11.52	81.8	11.38	83.4	11.02	85.2	11.38	42.0	11.38	42.0	4.0
4.5	12.22	86.8	12.07	88.5	11.69	90.4	12.07	43.0	12.07	43.0	4.5
5.0	12.89	91.5	12.73	93.3	12.32	95.3	12.73	45.0	12.73	45.0	5.0
5.5	13.52	95.9	13.35	97.8	12.92	99.9	13.35	47.0	13.35	47.0	5.5
6.0	14.12	100.0	13.94	102.2	13.49	104.3	13.94	49.0	13.94	49.0	6.0

[illegible] Obtained by Arithmetic Interpolation

INCREMENTAL AREA				TIME OF CONCENTRAT		FOR TOTAL CONTRIBUTING AREA			STREET COMPUTATIONS						FOR DESIGN FLOW		COMMENTS
NAME	A	C	C-A	THRU AREA	TOTAL	I	ΣC-A	Q	S (%)	L (ft.)	V (f.p.s.)	Δt (min.)	DESIGN (c.f.s.)	ALLOW (c.f.s.)	V	DEPTH (in.)	
A	Offsite Basins			—	—	—	—	*	—	—	—	—	—	—	—	—	See SCS Calculations on Pg 2
B	Offsite Basins			—	—	—	—	*	—	—	—	—	—	—	—	—	See SCS. Calculations on Pg 3
C	15.5	0.7	10.9	10	10	4.6	10.9	50.1	0.7	800				24			Inlet provided for undeveloped flow and storm sewer sized For developed flow.
F.	1.5	0.5	0.75	10	10	4.6	0.75	3.5	6.0%	350'				40			Provide curb inlet, w/outfall to channel
G.1	1.8	0.5	0.9	10.9	—	4.5	—	—	1%	700'	3	3.9		30			OVERLAND FLOW @ 2% => t_{OH}=7min.
G.2	0.6	0.5	0.3	1.0	11.9	4.2	1.2	5.0	5%	350'	6	1.0		37			
G.3	1.3	0.5	0.7	10	—	4.6	0.7	3.2									Sub-Area Alone
G.4	1.0	0.5	0.5	10	—	4.6	0.5	2.3									" " "
																	*Provide Inlet w/outfall to channel (Basin "C" plus "G")
	Summation of Area = $G_1+G_2+G_3+G_4$ ∴																
					11.9	4.2	2.4	10.1	— for inlet sizing								∴ G_{TOTAL} + C = 50+10.1 = 60.1 cfs for pipe sizing

BASED ON RATIONAL METHOD: Q=CIA

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S = MIN. DRAINAGE GRADE IN %
L = LENGTH OF FLOW-PATH THRU AREA IN FEET
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Date: 8/27/79
By: MBM.
Checked:

Costin Engineering
CIVIL ENGINEERING & LAND SURVEYING
1590 SOUTH ACOMA STREET
DENVER, COLORADO 80233
TELEPHONE: 744-7084

INCREMENTAL AREA				TIME OF CONCENTRAT		FOR TOTAL CONTRIBUTING AREA			STREET COMPUTATIONS						FOR DESIGN FLOW		COMMENTS
NAME	A	C	C-A	THRU AREA	TOTAL	I	ΣC-A	Q	S (%)	L (ft.)	V (f.p.s.)	Δt (min.)	DESIGN (c.f.s.)	ALLOW (c.f.s.)	V	DEPTH (in.)	
H	0.9	0.5	0.45	10	—	4.6	0.45	2.07									provide INLET. (SEE below)
I.1	2.7	0.7	1.9	10		4.6	1.9	8.7	2.0	1800	4						Street Flows only; IGNORES Offsite pipe.
I.2	0.4	0.7	0.3	10		4.6	2.2	10.1	2.5	50	3						INCLUDES I.1
I.3	0.4	0.7	0.3	10		4.6	2.5	11.50	6.5	100	8						INCLUDES I.1 + I.2
Summation @ Inlet =																	Σ = I.1+I.2+I.3+H
					10	4.6	3	13.80									Provide Inlet — 8' (AVE. st. slope 4%)
J.7	0.8	0.5	0.4	10		4.6	0.4	1.84									
J.1	1.0	0.5	0.5		10	4.6	0.9	4.14									
J.2	0.6	0.5	0.3		10	4.6	1.2	5.52									
J.3	0.8	0.5	0.4	1.3	11.3	4.4	1.6	7.04	3	300	4	1.3					
J.4	0.8	0.5	0.4		11.3	4.4	2.0	8.80									
J.5	0.7	0.5	0.35	0.7	12.0	4.1	2.4	9.84	3	150	4	0.7					Provide Inlet-6' ~ sub-area alone.
J.6	1.9	0.5	0.95	—	10	4.6	0.95	4.37									Provide Inlets - 4' ~ sub area alone
J.8	0.5	0.5	0.25	—	10	4.6	0.25	1.15									Provide Inlet - 4' ~ subarea alone
																	Provide Pipe Outfall to Drainage Tract - open Channel - Q=15.4 cfs.

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TELEPHONE: 744-7084

INCREMENTAL AREA				TIME OF CONCENTRAT		FOR TOTAL CONTRIBUTING AREA			STREET COMPUTATIONS						FOR DESIGN FLOW		COMMENTS
NAME	A	C	C-A	THRU AREA	TOTAL	I	ΣC-A	Q	S (%)	L (ft.)	V (f.p.s.)	Δt (min.)	DESIGN (c.f.s.)	ALLOW (c.f.s.)	V	DEPTH (in.)	
K.14	1.7	0.5	0.9	10		4.6	0.9	4.14									
K.1	1.5	0.5	0.8	0.6	10.6	4.5	1.7	7.65	4.0	200	6	0.6					
K.2	0.9	0.5	0.5	-	10.6	4.5	2.2	9.90									Sub-area alone, provide
K.3	1.4	0.5	0.7	0.8	11.4	4.3	2.9	12.47	3.5	250	5	0.8					drainage pans
K.4	0.4	0.5	0.2	0.5	11.9	4.2	3.1	13.02	5	200	7	0.5					
K.5	1.3	0.5	0.7	3.3	15.2	3.7	3.8	14.06	1.5	800	4	3.3					Σ K.1-K.5 + K.14.
K.6	2.3	0.5	1.2	10		4.6	1.2	5.5									Sub-area alone, provide pans.
K.7	1.0	0.5	0.5	10		4.6	0.5	2.3									
K.8	0.8	0.5	0.4	0.8	10.8	4.5	2.5	11.3	4.0	300	6	0.8					Σ K.6-8.
K.9.	1.5	0.5	0.8	10		4.6	0.8	3.7									Sub-area alone,
K.10.	0.5	0.5	0.3	10		4.6	0.3	1.4									provide pans.
K.11.	1.5	0.5	0.8	3.3	13.3	4.0	1.9	7.6	2.5	800	4	3.3					Σ K.9-11
K.12	2.0	0.5	1.0	10		4.6	1.0	4.6									Sub-area - provide 6' inlet
K.13	1.5	0.5	0.8	3.3	13.3	4.0	1.8	7.2	2.5	800	4	3.3					@ culvert outfall
			Summation of Area														Σ K1-11 + K14, provide 14'
																	inlet @ culvert outfall.
					15.2	3.7	8.2	30.2									

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Date: 8 28 79
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1590 SOUTH ACOMA STREET
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TELEPHONE: 744-7084

INCREMENTAL AREA				TIME OF CONCENTRAT		FOR TOTAL CONTRIBUTING AREA			STREET COMPUTATIONS						FOR DESIGN FLOW		COMMENTS
NAME	A	C	C-A	THRU AREA	TOTAL	I	ΣC-A	Q	S (%)	L (ft.)	V (f.p.s.)	Δt (min.)	DESIGN (c.f.s.)	ALLOW (c.f.s.)	V	DEPTH (in.)	
Z.1	4.2	0.2	0.8		15	3.7	0.8	3.0									Overland Flow ~850'~5%, Tc=15min
																	for sub-area alone.
L.1	2.1	0.5	1.1	21.9	—	3.0	1.1	3.3	2.5	450	4	1.9					Overland Flows 180'~2.5% = 20min
L.2	0.8	0.5	0.4	—	21.9	3.0	1.5	4.5									INCLUDES L.1, provide inlet ~4'
																	No pan at Intersection.
M.5	0.8	0.5	.4	10		4.6	.4	1.8									
M.6	1.2	0.5	.6	.7	10.7	4.5	1.0	4.5	8	400	9	0.7					Sub-basin, provide inlet
M.7	1.2	0.5	.6	1.0	11.7	4.2	1.6	6.7	3	300	5	1.0					~6' No pan.
M.8	0.4	0.5	.2	1.0	12.7	4.1	1.8	7.4	3	300	5	1.0					
M.9	1.6	0.5	.8	1.5	14.2	3.9	2.6	10.1	5	550	6	1.5					
M.2	0.4	0.5	.2	10	10	4.6	.2	0.9									
M.3	1.9	0.5	1.0	5	15	3.7	1.2	4.4									Overland Flow 100'~4% = tc = 5min
M.4	0.5	0.5	.3	.6	15.6	3.6	1.5	5.4	4	200	5.5	0.6					provide inlet ~4', with pan
																	@ cul-de-sac.
M.1	0.6	0.5	.3	10	—	4.6	0.3	1.4									Sub-basin only, provide
M.10	0.6	0.5	.3	—	10	4.6	0.6	2.8									inlet @ Low point ~4'

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INCREMENTAL AREA				TIME OF CONCENTRAT		FOR TOTAL CONTRIBUTING AREA			STREET COMPUTATIONS						FOR DESIGN FLOW		COMMENTS
NAME	A	C	C-A	THRU AREA	TOTAL	I	ΣC-A	Q	S (%)	L (ft.)	V (f.p.s.)	Δt (min.)	DESIGN (c.f.s.)	ALLOW (c.f.s.)	V	DEPTH (in.)	
V.8	1.6	0.5	0.8	—	12.2	4.2	0.8	3.4	3.3	800	6	2.2					Overland Flow ~ 120' @ 2% ~ 12 min
V.6	1.7	0.5	0.9	.6	12.8	4.0	1.7	6.8	3.0	200	6	0.6					
V.7	1.0	0.5	0.5	—	12.8	4.0	2.2	8.8	3.0	200	6	0.6					Provide Cross-Pan as needed;
V.3	1.7	0.5	0.9	1.0	13.8	3.9	3.1	12.1	6.0	550	9	1.0					provide inlet ~ 8'
V.2	1.5	0.5	0.8	10	—	4.6	0.8	3.7	4	800	7	1.9					Provide Inlet ~ 4'
V.5	2.5	0.5	1.3		12.7	4.0	1.3	5.2	6	350	9	0.7					Overland Flow ~ 120' ~ 2% ~ 12 min
																	Provide Inlet ~ 4'
V.4	2.0	0.5	1.00	—	10	4.6	1.00	4.6	0.6	200	2	1.7					
V.1	0.8	0.5	0.4	—	10	4.6	1.4	6.4	0.6	200	2	1.7					Provide Inlet in sump
																	@ low point ~ 4'
U.1	0.8	0.5	0.4	—	10	4.6	0.4	1.8	0.6	200	2	1.7					
U.4	1.2	0.5	0.6	—	10	4.6	1.0	4.6	0.6	350	2	2.9					Provide Inlet ~ 4' (sump)
U.3	3.6	0.5	1.8	16.7	—	3.5	1.8	6.3	5	800	8	1.7					OVERLAND FLOW - 180' @ 2% ~ 15 min
U.2	2.7	0.5	1.4	16.0	16.7	3.5	3.2	11.2	5	500	8	1.0					" , provide INlet.
U.5	1.0	0.5	0.5		12.9	4.0	0.5	2.0	5	450	8	0.9					OVERLAND FLOW, 180' @ 2% ~ 12 min.
					Summation of Area												INLET SIZING ~ 8' (sump)
					16.7	3.5	3.7	13.0									Σ U3+U2+U5

Also place inlet at future P.C.R. in "Tract A" R.O.W. to help prevent ponding.

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Date: 8 28 79
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INCREMENTAL AREA				TIME OF CONCENTRAT		FOR TOTAL CONTRIBUTING AREA			STREET COMPUTATIONS						FOR DESIGN FLOW		COMMENTS
AME	A	C	C-A	THRU AREA	TOTAL	I	ΣC-A	Q	S (%)	L (ft.)	V (f.p.s.)	Δt (min.)	DESIGN (c.f.s.)	ALLOW (c.f.s.)	V	DEPTH (in.)	
T.1	1.0	0.5	0.5	10.1	—	4.6	0.5	2.30	0.6	250	2	2.1					Overland Flow 100'~2% → 8min
T.2	1.0	0.5	0.5	—	10.1	4.6	1.0	4.6									FUTURE DEVELOPEMENT
																	*PROVIDE FUTURE INLET~4'
																	*OUTFALL PIPE → 24" min ~1.5%
S.1	0.8	0.5	0.4	10.9	—	4.4	0.4	1.8	0.6	350	2	2.9					OVERLAND FLOW 100'~2% → 8min
S.2	1.0	0.5	0.5	—	10.9	4.4	0.9	4.0									FUTURE DEVELOPEMENT*
																	*Provide Inlet/OUTFALL → L= 4', Dia= 18", S=1.0%
N.1	0.8	0.5	.4	—	10	4.6	0.4	1.84	4.1	450	8	0.9					OVERLAND FLOW — 100'~2% → 8min,
																	provide inlet ~ 4', and outfall.
N.2	1.9	0.5	1.0	11.8	11.8	4.2	1.0	4.2	2.6	1150	5	3.8					OVERLAND FLOW - 100'~2% → 8 min
N.3	1.8	0.5	0.9	0.9	12.7	4.1	1.9	7.8	4.6	450	8	0.9					N.2 + N3
N.4	3.6	0.5	1.8		10	4.6	1.8	8.3									sub-basin alone.
					Summation @ Inlet												Σ' N2 → 4
					12.7	4.1	3.7	15.2									provide inlet ~ 8' in sump
																	with cross pan at intersection.
2.1	2.3	0.5	1.15	12.0	—	4.2	1.15	4.8	3.3	1200	5	4					OVERLAND FLOW 100'~2% → 8 min.
2.2	2.4	0.5	1.20	4.0	16	3.6	2.35	8.5	2.6	1150	4.8	4					Provide pans @ intersections and
																	inlet @ culvert ~ 6' in sump

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Date: 8.28.79
By: MBM.
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INCREMENTAL AREA				TIME OF CONCENTRAT		FOR TOTAL CONTRIBUTING AREA			STREET COMPUTATIONS						FOR DESIGN FLOW		COMMENTS
NAME	A	C	C·A	THRU AREA	TOTAL	I	ΣC·A	Q	S (%)	L (ft.)	V (f.p.s.)	Δt (min.)	DESIGN (c.f.s.)	ALLOW (c.f.s.)	V	DEPTH (in.)	
P.1	0.9	0.5	0.5	10	10	4.6	0.5	2.3									Sub-basin alone.
					Summation @ Low Point												
					16	3.6	2.9	10.4									Σ 0.1 + 0.2 + Q.1
Q.1	0.9	0.5	0.5	–	10	4.6	0.5	2.3									Provide inlet in sump ~ 4'
P.1	0.5	0.5	0.3		10	4.6	0.3	1.4	1	180	3	1.0					OVERLAND FLOW ~ 60' @ 2% ~ 6 min
P.2	1.0	0.5	0.5		10	4.6	0.8	3.7									
P.3	0.4	0.5	0.2		10	4.6	1.0	4.6	1	280	3	1.6					
P.4	0.8	0.5	0.4		10	4.6	0.4	1.8	1	200	3	1.1					OVERLAND FLOW ~ 80' @ 2% ~ 8 min
P.5	0.4	0.5	0.2		10	4.6	0.6	2.8									
P.6	0.6	0.5	0.3		10.5	4.4	0.9	4.0	2	340	4	1.4					Tc = 8.0 + 1.1 + 1.4 = 10.5 min
P.7	1.1	0.5	0.6		10	4.6	0.6	2.8									Subarea alone
P.8	0.6	0.5	0.3		10	4.6	0.9	4.1									
					Summation P.4 → P.8												Σ P.4 – P.8
					10.5	4.4	1.8	7.9									
					Summation P.1 → P.8												Σ P.1 – P.8
					10.5	4.4	2.8	12.3									Provide inlet @ North side in Sump ~ 8'

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	INCREMENTAL AREA			TIME OF CONCENTRAT		FOR TOTAL CONTRIBUTING AREA			STREET COMPUTATIONS						FOR DESIGN FLOW		COMMENTS
..ME	A	C	C·A	THRU AREA	TOTAL	I	ΣC·A	Q	S (%)	L (ft.)	V (f.p.s.)	Δt (min.)	DESIGN (c.f.s.)	ALLOW (c.f.s.)	V	DEPTH (in.)	
9	0.9	0.5	0.5		10	4.6	0.5	2.3									
10	0.6	0.5	0.3		10	4.6	0.8	3.7									Provide inlet @ South Side in sump ~ 4'
1	0.7	0.5	0.4		10	4.6	0.4	1.8	4	250	7	.6					Flow to St. @ Del Monico
2	0.8	0.5	0.4		10	4.6	0.4	1.8	4	250	7	.6					Flow to St. @ Del Monico.

BASED ON RATIONAL METHOD: Q=CIA

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...WATERSHED AREA IN ACRES

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STORM DRAINAGE COMPUTATIONS

SUBDIVISION: lamarron @ Kaltimmon

…ME	INCREMENTAL AREA A	C	C·A	TIME OF CONCENTRAT THRU AREA	TOTAL	FOR TOTAL CONTRIBUTING AREA I	∑C·A	Q	STREET COMPUTATIONS S (%)	L (ft.)	V (f.p.s.)	Δt (min.)	DESIGN (c.f.s.)	ALLOW (c.f.s.)	FOR DESIGN FLOW V	DEPTH (in.)	COMMENTS
7	—	—	—	—	—	—	—	*	—	—	—	—	—	—	—		SEE S.C.S. Calculations Pg —
3	—	—	—	—	—	—	—	*	—	—	—	—	—	—	—		" " " "
																	Offsite Basin, Developed
7.	15.5	0.88	13.6		10	7	13.6	95									routing not known.
E.	1.5	0.63	1.0		10	7	1.0	7.0									Providing 4' sump inlet.
.1	1.8	0.63	1.1	10.9	10.9	6.5	1.1	7.2									Sub-Area Alone
.2	0.6	0.63	0.4	1.0	11.9	6.5	1.5	9.8									
.3	1.3	0.63	0.8		10	7	1.3	9.1									Sub-Area Alone
.4	1.0	0.63	0.6		10	7	1.0	7.0									Sub-Area Alone
					Summation Not Including Offsite												∑ G.1 → G.4
					11.9	6.5	2.9	18.9									
					Summation Including Offsite												∑ G.1 → G.4 + C, Tc = 10 min
					11.9	6.5	18.4	120	4	800	7	1.9					Provide overflow swale
																	* assumption that
																	all future offsite will be
																	routed to this point
																	is extremely conservative.

STORM DRAINAGE COMPUTATIONS

SUBDIVISION: lamarron @ KcCrimmon

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I = RAINFALL INTENSITY IN IN./HR. FOR 100 YR. STORM
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ME	A	C	C·A	THRU AREA	TOTAL	I	ΣC·A	Q	S (%)	L (ft.)	V (f.p.s.)	ΔT (min.)	DESIGN (c.f.s.)	ALLOW (c.f.s.)	V	DEPTH (in.)	COMMENTS
NCREMENTAL AREA				T ME OF CONCENTRAT		FOR TOTAL CONTRIBUTING AREA			STREET COMPUTATIONS						FOR DESIGN FLOW		
1	0.9	0.63	0.6		10	7	0.6	4.2									Overflow to Ditch @ 8' sump
																	inlet.
.1	2.7	0.7	1.9		10	7	1.9	13.3									Sub-Area
.2	0.4	0.7	0.3		10	7	2.2	15.4									
.3	0.4	0.7	0.3		10	7	2.5	17.5									
						Summation @ Low Pt.											
					10	7	3.1	21.7									Minor overflow @ Ditch
.7	0.8	0.63	0.5		10	7	0.5	3.5									Flow will be
1	1.0	0.63	0.6		10	7	1.1	7.7									collected to inlet
.2	0.6	0.63	0.4		10	7	1.5	10.5									capacity, ±6.2 cfs
.3	0.8	0.63	0.5		11.3	6.7	2.0	13.4									will pass to Basin K.
.4	0.8	0.63	0.5		11.3	6.7	2.5	16.8									
.5	0.7	0.63	0.4		12.0	6.5	2.9	18.9									
.6	1.9	0.63	1.2		10	7	1.2	8.4									Inlets provided will
																	collect all Flow.
.8	0.5	0.63	0.3		10	7	0.3	2.1									Inlet provided will collect
																	all flow.
																	OUTFALL PIPE WILL CARRY
																	INLET CAPACITY.: Net 6.2 cfs passes

BASED ON RATIONAL METHOD: Q=CIA

DESIGN PEAK RUNOFF RATE IN C.F.S.
RUNOFF COEFFICIENT
WATERSHED AREA IN ACRES

I = RAINFALL INTENSITY IN IN./HR. FOR 100 YR. STORM
S = MIN. DRAINAGE GRADE IN %
L = LENGTH OF FLOW-PATH THRU AREA IN FEET
V = RUN-OFF VELOCITY IN F.P.S.

Date: 8.29.79
By: MBM
Checked:

Costin Engineering
CIVIL ENGINEERING & LAND SURVEYING
1590 SOUTH ACOMA STREET
DENVER, COLORADO 80233
TELEPHONE: 744-7084

INCREMENTAL AREA				TIME OF CONCENTRATION		FOR TOTAL CONTRIBUTING AREA			STREET COMPUTATIONS						FOR DESIGN FLOW		COMMENTS
NAME	A	C	C-A	INLET AREA	TOTAL	I	ΣC-A	Q	S (%)	L (ft.)	V (f.p.s.)	ΔT (min.)	DESIGN (c.f.s.)	ALLOW (c.f.s.)	V	DEPTH (in.)	
14	1.7	0.63	1.1		10	7	1.1	7.7									
1	1.5	0.63	1.0		10.6	6.9	2.1	14.5									
2	0.9	0.63	0.6		10.6	6.9	2.7	18.6					18.6	20.3			Street capacities - OK.
3	1.4	0.63	0.9		11.4	6.6	3.6	23.8									
4	0.4	0.63	0.3		11.9	6.5	3.9	25.4									
5	1.3	0.63	0.8		15.2	5.9	4.7	27.7					27.7	36.7			
6	2.3	0.63	1.5		10	7	1.5	10.5									
7	1.0	0.63	0.6		10	7	2.1	14.7									
8	0.8	0.63	0.5		10.8	6.9	2.6	17.9									
						Summation with Area J overburden											J-Contributing C-A = 0.9
					15.2	5.9	8.2	48.4									
9	1.5	0.63	1.0		10	7	1.0	7									
10	0.5	0.63	0.3		10	7	1.3	9.1									
11	1.5	0.63	1.0		13.3	6.3	2.3	14.5									
						Summation with Area J + Prior K.											
					15.2	5.9	10.5	62.0							9.9	8	
12	2.0	0.63	1.3	10		7	1.3	9.1									
13	1.5	0.63	1.0		13.3	6.3	2.3	14.5									
						Summation with Area J + Prior K											At inlets, overflow
					15.2	5.9	12.8	75.5									to swale at low pt.

BASED ON RATIONAL METHOD: Q = CIA

DESIGN PEAK RUNOFF RATE IN C.F.S.
RUNOFF COEFFICENT
WATERSHED AREA IN ACRES

I = RAINFALL INTENSITY IN IN./HR. FOR 100 YR. STORM
S = MIN. DRAINAGE GRADE IN %
L = LENGTH OF FLOW-PATH THRU AREA IN FEET
V = RUN-OFF VELOCITY IN F.P.S.

Date: 8.29.79
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TELEPHONE: 744-7084

STORM DRAINAGE COMPUTATIONS

SUBDIVISION –

NE	INCREMENTAL AREA A	C	C·A	TIME OF CONCENTRAT THRU AREA	TOTAL	FOR TOTAL CONTRIBUTING AREA I	ΣC·A	Q	STREET COMPUTATIONS S (%)	L (ft.)	V (f.p.s.)	ΔI (min.)	DESIGN (c.f.s.)	ALLOW (c.f.s.)	FOR DESIGN FLOW V	DEPTH (in.)	COMMENTS
1	4.2	0.5	2.1		15	5.9	2.1	12.4							6	0.83	Sub-area alone.
																	Ditch Flow in tract, not
.1	2.1	0.63	1.3	21.9		4.9	1.3	6.4									including L Basin.
2	0.8	0.63	0.5		21.9	4.9	1.8	8.8									Provide overflow
																	swale, minimal flow
.5	0.8	0.63	0.5		10	7	0.5	3.5									will pass inlet.
.6	1.2	0.63	0.8	.7	10.7	6.8	1.3	8.8									
.7	1.2	0.63	0.8	1.0	11.7	6.6	2.1	13.9									OVERFLOW WILL CROSS
.8	0.4	0.63	0.25	1.0	12.7	6.4	2.4	15.4									STREET and Flow to
.9	1.6	0.63	1.0	1.5	14.2	6.1	3.4	20.7									to channel.
.2	0.4	0.63	0.3		10	.7	0.3	2.1									OVERFLOW WILL CROSS
.3	1.9	0.63	1.2	5	15	5.9	1.5	8.9									STREET and Flow to
.4	0.5	0.63	0.3	0.6	15.6	5.8	1.8	10.4									channel.
.1	0.6	0.63	0.4	10		7	0.4	2.8									4' INLET IN SUMP should
.10	0.6	0.63	0.4		10	7	0.8	5.6									handle this Flow, however
																	overtopping the curb will
																	occur due to flow
																	from Anaconda St. –
																	Flow directly to
																	channel.

BASED ON RATIONAL METHOD: Q=CIA

DESIGN PEAK RUNOFF RATE IN C.F.S.
RUNOFF COEFFICENT
WATERSHED AREA IN ACRES

I = RAINFALL INTENSITY IN IN./HR. FOR 100 YR. STORM
S = MIN. DRAINAGE GRADE IN %
L = LENGTH OF FLOW-PATH THRU AREA IN FEET
V = RUN-OFF VELOCITY IN F.P.S.

Date: 8 29 79
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Checked:

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INCREMENTAL AREA				TIME OF CONCENTRAT		FOR TOTAL CONTRIBUTING AREA			STREET COMPUTATIONS						FOR DESIGN FLOW		COMMENTS
ME	A	C	C·A	THRU AREA	TOTAL	I	ΣC·A	Q	S (%)	L (ft.)	V (f.p.s.)	Δt (min.)	DESIGN (c.f.s.)	ALLOW (c.f.s.)	V	DEPTH (In.)	
8	1.6	0.63	1.0		12.2	6.5	1.0	6.5									
6	1.7	0.63	1.1	.6	12.8	6.3	2.1	13.2									
.7	1.0	0.63	0.63		12.8	6.3	2.7	17.0									
3	1.7	0.63	1.1	1.0	13.8	6.1	3.8	23.2	3.9								5 cfs. over-flow, passes inlet
2	1.5	0.63	1.0	–	10	7	1	7.0	3.9		7		30.2	33.2			2.3 cfs over-flow, passes inlet
5	2.5	0.63	1.6		12.7	6.3	1.6	10.1									Inlet provided - 4' in sump.
																	∴ 2.1 cfs, passes.
.4	2.0	0.63	1.3		10	7	1.3	9.1									
1	0.8	0.63	0.5		10	7	1.8	12.6									@ Low point, 4' inlet in sump.
																	∴ 4.7 passes inlet.
																	*provide swale for overflow
																	on side lot line, min.
																	10' wide, with max 1' depth.
																	Velocity - ± 2 f.p.s. @ 2%
7.1	0.8	0.63	0.5		10	7	0.5	3.5									
7.4	1.2	0.63	0.8		10	7	1.3	9.1									Sub-Area, inlet in sump
																	provided.

Iamarron @ McCrimmon

BASED ON RATIONAL METHOD: Q=CIA

DESIGN PEAK RUNOFF RATE IN C.F.S.
RUNOFF COEFFICENT
WATERSHED AREA IN ACRES

I = RAINFALL INTENSITY IN IN./HR. FOR 100 YR. STORM
S = MIN. DRAINAGE GRADE IN %
L = LENGTH OF FLOW-PATH THRU AREA IN FEET

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INCREMENTAL AREA				TIME OF CONCENTRAT		FOR TOTAL CONTRIBUTING AREA			STREET COMPUTATIONS						FOR DESIGN FLOW		COMMENTS
E	A	C	C-A	THRU AREA	TOTAL	I	ΣC-A	Q	S (%)	L (ft.)	V (f.p.s.)	ΔI (min.)	DESIGN (c.f.s.)	ALLOW (c.f.s.)	V	DEPTH (in.)	
3	3.6	0.63	2.3	16.7	16.7	5.7	2.3	13.1									
2	2.7	0.63	1.7	16.0	16.7	5.7	4.0	22.8									Inlet ~8' in sump is provided.
5	1.0	0.63	0.63		12.9	6.3	0.63	4.0									Overflow crosses St. to
																	low pt. @ future st. –
																	flows to inlet and/or
																	to channel.
1	1.0	0.63	0.6	–	10.1	7	0.6	4.2									FUTURE DEVELOPEMENT
2	1.0	0.63	0.6	–	10.1	7	1.2	8.4									of TRACT A, provided
																	4' inlet in sump, with minor
																	overflow swale.
1	0.8	0.63	0.5		10.9	6.8	0.5	3.4									Inlet in sump (4')
2	1.0	0.63	0.6		10.9	6.8	1.1	7.5									should handle total
																	Flow, but provide swale.
1	0.8	0.63	0.5		10	7	0.5	3.5									INLET ~4' in sump,
																	overflow swale @
																	utility tract to
																	Flow directly to
																	channel.

STORM DRAINAGE COMPUTATIONS

SUBDIVISION: lamarron @ Kalimmon

BASED ON RATIONAL METHOD: Q=CIA

DESIGN PEAK RUNOFF RATE IN C.F.S.
RUNOFF COEFFICIENT
WATERSHED AREA IN ACRES

I = RAINFALL INTENSITY IN IN./HR. FOR 100 YR. STORM
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INCREMENTAL AREA				TIME OF CONCENTRAT		FOR TOTAL CONTRIBUTING AREA			STREET COMPUTATIONS						FOR DESIGN FLOW		COMMENTS
AME	A	C	C-A	THRU AREA	TOTAL	I	ΣC-A	Q	S (%)	L (ft.)	V (f.p.s.)	Δt (min.)	DESIGN (c.f.s.)	ALLOW (c.f.s.)	V	DEPTH (in.)	
.2	1.9	0.63	1.2		11.8	6.5	1.2	7.8									
.3	1.8	0.63	1.1		12.7	6.4	3.3	21.1									N.2+N.3
.4	3.6	0.63	2.3		10	7	2.3	16.1									Sub-basin alone.
						Summation @ Inlet											Σ N.2+N.3+N.4
					12.7	6.4	5.6	35.8									
																	Overflow to cross st. and
.1	2.3	0.63	1.4		12	6.5	1.4	9.1									go to channel via swale.
.2	2.4	0.63	1.5		16	5.8	2.9	16.8									
.1	0.9	0.63	0.6		10	7	0.6	4.2									
						Summation @ INLET											Σ O.1+O.2+Q.1
					16	5.8	3.5	20.3									INLET ~6' in sump provided,
																	overflow @ low pt. directly
																	to channel.
D.1	0.9	0.63	0.6		10	7	0.6	4.2									INLET ~4' in sump will
																	handle total flow. +
																	some overflow from
																	basin on other side of st.
P.1	0.5	0.63	0.3		10	7	0.3	2.1									
P.2	1.0	0.63	0.6		10	7	0.9	6.3									Sub-basin
P.3	0.4	0.63	0.3		10	7	1.2	8.4									

BASED ON RATIONAL METHOD: Q=CIA

Q = DESIGN PEAK RUNOFF RATE IN C.F.S.
C = RUNOFF COEFFICIENT
A = WATERSHED AREA IN ACRES
I = RAINFALL INTENSITY IN IN./HR. FOR 100 YR. STORM
S = MIN. DRAINAGE GRADE IN %
L = LENGTH OF FLOW-PATH THRU AREA IN FEET
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INCREMENTAL AREA				TIME OF CONCENTRAT		FOR TOTAL CONTRIBUTING AREA			STREET COMPUTATIONS						FOR DESIGN FLOW		COMMENTS
NAME	A	C	C·A	THRU AREA	TOTAL	I	ΣC·A	Q	S (%)	L (ft.)	V (f.p.s.)	Δt (min.)	DESIGN (c.f.s.)	ALLOW (c.f.s.)	V	DEPTH (in.)	
P.4	0.8	0.63	0.5		10	7	0.5	3.5									
P.5	0.4	0.63	0.3		10	7	0.8	5.6									Sub-basin
P.6	0.6	0.63	0.4	0.5	10.5	6.9	1.2	8.3									
P.7	1.1	0.63	0.7		10	7	0.7	4.9									
P.8	0.6	0.63	0.4		10	7	1.1	7.7									
						Summation P.1 → P.8											Σ P.1 – P.8
					10.5	6.9	3.5	24.2									@ inlet ~8' in sump.
P.9	0.9	0.63	0.6		10	7	0.6	4.2									
P.10	0.6	0.63	0.4		10	7	1.0	7.0									@ Low point ~ inlet (4') in sump, provide swale for overflow of other basin, minimal.
3.1	0.7	0.63	0.4		10	7	0.4	2.8									Flow to Del Monico
3.2	0.8	0.63	0.5		10	7	0.5	3.5									Flow to Del Monico.

BASED ON RATIONAL METHOD: Q=CIA

Q = DESIGN PEAK RUNOFF RATE IN C.F.S.
C = RUNOFF COEFFICIENT
A = WATERSHED AREA IN ACRES

I = RAINFALL INTENSITY IN IN./HR. FOR 100 YR. STORM
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TELEPHONE: 744-7084

PROJECT: Rockrimmon Basin A

STATION: E. Saddlemountain Rd.

OUTLET CONTROL DESIGN CALCULATIONS

DESIGNER: JTL

DATE: 3/28/79

INITIAL DATA:

Q_{100} = 1115 cfs

AHW El. = 6337 ft.

So = ______

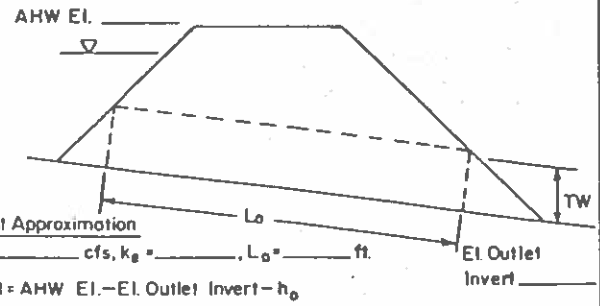
Lo = 120 ft.

El. Outlet Invert 6305 ft.

Stream Data:

Barrel Shape and Material ______ Barrel n = ______

SKETCH



First Approximation

Q = ______ cfs, k_e = ______, L_o = ______ ft.

H = AHW El. − El. Outlet Invert − h_o

= ______ − ______ − ______ = ______

∴ A = ______ ft^2 or D = ______ ft.; Try ______

	Q	Q/N	* H	Q/NB	(1) d_c	$\frac{d_c+D}{2}$	Qn	(2) TW	(3) h_o	(4) HW_o	(5) V_o	COMMENTS
	Trial No. 1 (Chart 4), N = 1, B = —, D = 8, k_e = 0.5											CMP (single)
1		1115	23						8	6336		OK
	Trial No. ______ (Chart 4), N = 2, B = ______, D = 6, k_e = 0.5											CMP (double)
2	1115	560	24						6	6335		OK
	Trial No. ______ (Chart 1), N = 1, B = ______, D = ______, k_e = 0.5											Box culvert
3	1115	1115	14	160					7	6326		7'×7' → OK
4		1115	27*						6	6338		6'×6' R=1.5, V=30.97 → OK

Notes and Equations:

(1) d_c cannot exceed D

(2) TW based on d_n in natural channel, or other downstream control.

(3) $h_o = \frac{d_c+D}{2}$ or TW, whichever is larger.

(4) HW_o = H + h_o + El. Outlet Invert.

(5) Outlet Velocity (V_o) = Q/Area defined by d_c or TW, not greater than D. Do not compute until control section is known.

SELECTED DESIGN

N = ______

B = ______ ft.

D = ______ ft.

k_e = ______

At Design Q:

HW_o = ______ ft.

V_o = ______ f/s

$$* \quad H = \left[1 + k_e + \frac{29n^2 \cdot L}{R^{1.33}}\right] \frac{V^2}{2g}$$

PROJECT: *Rockrimmon* — *Basin A*

STATION: *E. Saddlemountain Rd.*

CULVERT INLET CONTROL SECTION DESIGN CALCULATIONS

DESIGNER: *JTL*

DATE: *3/28/79*

INITIAL DATA:

Q *100* = *1115* cfs

AHW El. = *6337* ft.

S_o = ______

L_a = *120* ft.

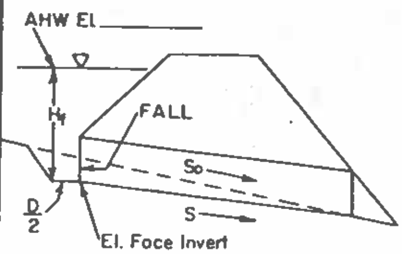
El. Stream Bed at Face *6317* ft.

Barrel Shape and Material ______ Barrel n= ______

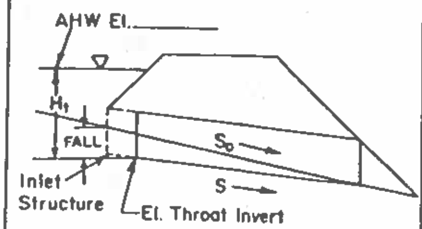
N= ______, B= ______

D= ______, $NBD^{3/2}$ = ______

(Pipe) $ND^{5/2}$ = ______



CONVENTIONAL or BEVELED INLET: FACE CONTROL SECTION (Upper Headings)



TAPERED INLET THROAT CONTROL SECTION (Lower Headings)

DEFINITIONS OF INLET CONTROL SECTION

	Q	$\frac{Q}{ND}$ / $\frac{Q}{NBD^{3/2}}$	$\frac{H_f}{D}$ / $\frac{H_t}{D}$	H_f / H_t	(1) El. Face Invert / El. Throat Invert	El. Stream Bed At Face	(2) FALL	(3) HW_f / HW_t	(4) S	(5) V_o	Note: Use Upper Headings for Conventional or Beveled Face; Lower Headings for Tapered Inlet Throat. COMMENTS
	Trial No. *1* Inlet and Edge Description *Chart 12*										
1		*1115*	*3.1*	*25*		*6317*		*6342*			*(1) 8' φ CMP, Exceeds AHW elev.*
2	*1115*	*560*	*3.3*	*20*		*6317*		*6337*			*(2) 6' φ CMP, OK*
	Trial No. ______ Inlet and Edge Description *Chart 7*										
3	*1115*	*160*	*3.5*	*24.5*		*6317*		*6342*			*7'×7' box — No good*
4	*1115*	*186*	*6.8*	*40.8*				*6358*			*6'×6' box culvert - No good*
5	*1115*	*140*	*2.2*	*17.6*				*6335*			*8'×8' box - OK - Use*
	Trial No. ______ Inlet and Edge Description ______										

Notes and Equations:

(1) El. Face (or throat) invert = AHW El. − H_f (or H_t)

(2) FALL = El. Stream Bed at Face − El. face (or throat) invert

(3) HW_f (or HW_t) = H_f (or H_t) + El. face (or throat) invert, where El face (or throat) invert should not exceed El. stream bed.

(4) $S \approx S_o - FALL/L_a$

(5) Outlet Velocity = Q/Area defined by d_n at S

SELECTED DESIGN

Inlet Description:

FALL = ______ ft.

Invert El = ______ ft.

Bevels:

Angle = ______

b= ______ in., d= ______ in.

PROJECT: Rockrimmon Basin B

OUTLET CONTROL DESIGN CALCULATIONS

DESIGNER: JTL

STATION: Rockrimmon Blvd.

DATE: 4/13/79

INITIAL DATA:

Q 100 = 755 cfs

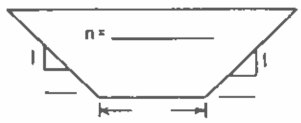
AHW El. = 6290 ft.

So = 1%

Lo = 200 ft.

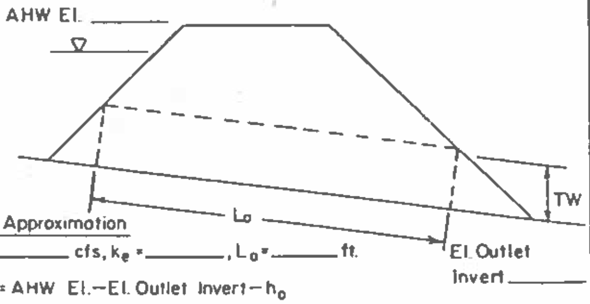
El. Outlet Invert 6268 ft.

Stream Data:



Barrel Shape and Material ____________ Barrel n = ________

SKETCH



First Approximation

Q = ____ cfs, k_e = ____, L_o = ____ ft.

H = AHW El. − El. Outlet Invert − h_o

= ____ − ____ − ____ = ____

∴ A = ____ ft^2 or D = ____ ft.; Try ____

Q	Q/N	* H	Q/NB	(1) d_c	$\frac{d_c+D}{2}$	Qn	(2) TW	(3) h_o	(4) HW_o	(5) V_o	COMMENTS
Trial No. 1, N = ____, B = ____, D = ____, k_e = 0.5 (Chart 4, HEC 13)											
① 755	755										No — 6' ϕ CMP
②	755	28						7	6303		NO — 7' ϕ CMP
③	755	14		6.8	7.4		~3	7.4	6289		OK! — 8' ϕ CMP
Trial No. ____, N = ____, B = ____, D = ____, k_e = ____											
Trial No. ____, N = ____, B = ____, D = ____, k_e = ____											

Notes and Equations:

(1) d_c cannot exceed D

(2) TW based on d_n in natural channel, or other downstream control.

(3) $h_o = \frac{d_c+D}{2}$ or TW, whichever is larger.

(4) HW_o = H + h_o + El. Outlet Invert.

(5) Outlet Velocity (V_o=Q/Area defined by d_c or TW, not greater than D. Do not compute until control section is known.

SELECTED DESIGN

N = ________ At Design Q:

B = ________ ft.

D = ________ ft. HW_o = ________ ft.

k_e = ________ V_o = ________ f/s

$$* \quad H = \left[1 + k_e + \frac{29n^2 \cdot L}{R^{1.33}}\right] \frac{V^2}{2g}$$

PROJECT: *Rockrimmon* *Basin B*

STATION: *Rockrimmon Blvd.*

CULVERT INLET CONTROL SECTION DESIGN CALCULATIONS

DESIGNER: *VTL*

DATE: *4/13/79*

INITIAL DATA:

Q *100* = *755* cfs

AHW El. = *6290* ft.

S_o = *1%*

L_a = *200* ft.

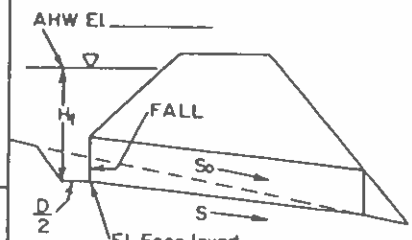
El. Stream Bed at Face *6270* ft.

Barrel Shape and Material ________ Barrel n= ________

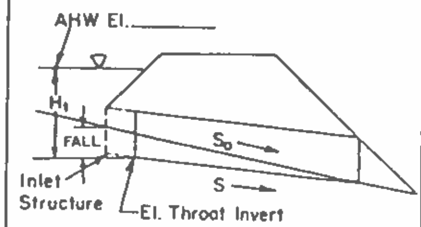
N = ________, B = ________

D = ________, $NBD^{3/2}$ = ________

(Pipe) $ND^{5/2}$ = ________



CONVENTIONAL or BEVELED INLET: FACE CONTROL SECTION (Upper Headings)



TAPERED INLET THROAT CONTROL SECTION (Lower Headings)

DEFINITIONS OF INLET CONTROL SECTION

	Q	Q/NB ($Q/NBD^{3/2}$)	H_f/D (H_t/D)	H_f (H_t)	(1) El. Face Invert (El. Throat Invert)	El. Stream Bed At Face	(2) FALL	(3) HW_f (HW_t)	(4) S	(5) V_o	Note: Use Upper Headings for Coventional or Beveled Face; Lower Headings for Tapered Inlet Throat. COMMENTS
	Trial No. ____ Inlet and Edge Description *Headwall* *Chart 12, HEC 13*										
③		*755*	*1.75*	*14*		*6270*		*6284*			*8' ⌀ OK*
	Trial No. ____ Inlet and Edge Description ________										
	Trial No. ____ Inlet and Edge Description ________										

Notes and Equations:

(1) El. Face (or throat) invert = AHW El. − H_f (or H_t)

(2) FALL = El. Stream Bed at Face − El. face (or throat) invert

(3) HW_f (or HW_t) = H_f (or H_t) + El. face (or throat) invert, where El. face (or throat) invert should not exceed El. stream bed.

(4) $S \approx S_o - FALL/L_a$

(5) Outlet Velocity = Q/Area defined by d_n at S

SELECTED DESIGN

Inlet Description:

FALL = ________ ft.

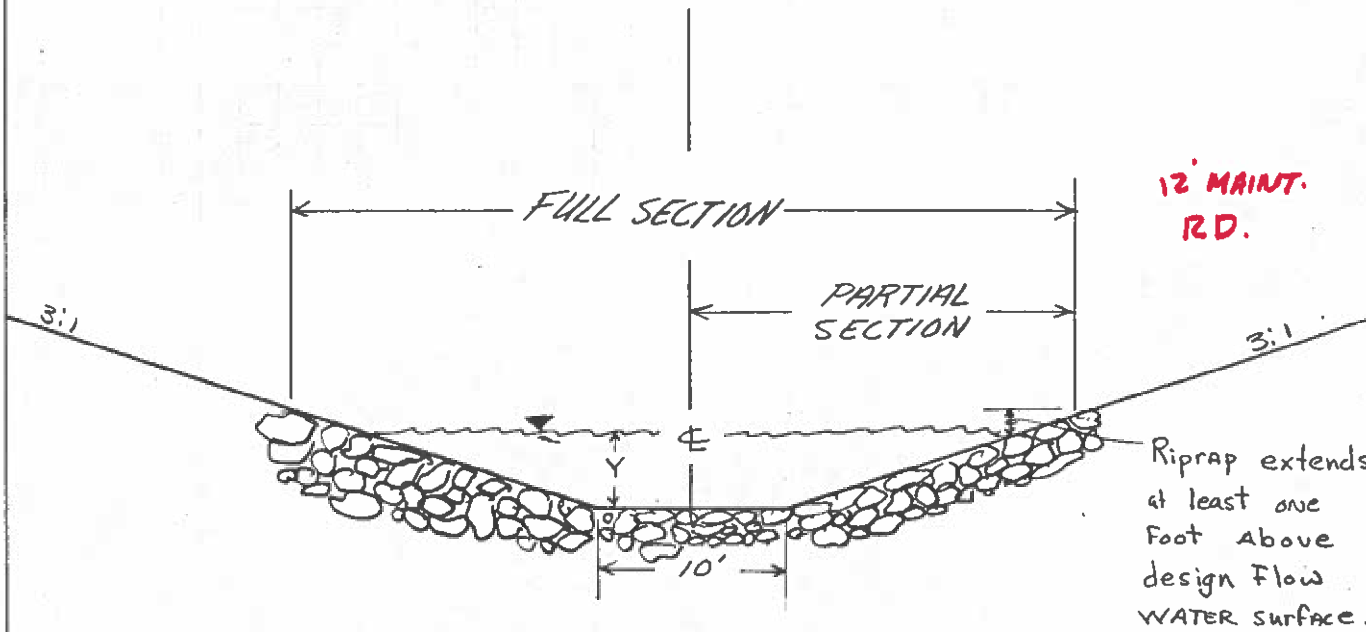
Invert El. = ________ ft.

Bevels:

Angle = ________

b = ________ in., d = ________ in.

MAJOR CHANNEL DETAIL



Y — Flow depth varies from 2.5' to 5.2' for the 100 year storm. Q_{100} = 755 cfs at Rockrimmon Blvd.

Riprap Sizing:

A. MAJOR CHANNEL:

$$\frac{D_{50}}{D_o} = C\,\frac{D_o}{TW}\left(\frac{Q}{D_o^{5/2}}\right)^{4/3}$$

WHERE
$C = 0.0125$
$Q = 755$ cfs
$D_o = 8$ ft.
$TW = 4$ ft.

$\therefore \dfrac{D_{50}}{D_o} = 0.1679$

$\therefore D_{50} = 1.34'$; use 1.5' dia.

B. AT ENERGY DISSAPATOR: SAME EQUATION AS ABOVE.

WHERE
$C = 0.0082$
$Q = 1115$ cfs.
$D_o = 8$ ft.
$TW = 4$ ft.

$\therefore \dfrac{D_{50}}{D_o} = 0.1101$

$\therefore D_{50} = 0.88'$; use 1.0' dia. min.

Energy Dissapator Weir Calculation:

$$Q = (3.57)(L)(H^{1.5})$$

WHERE
$C = 3.57$ For 3:1 weir.
L = AVE. VALUE For trapezoidal channel section.

* Assume $H = 5$ ft. $\therefore L_{AVE.} = 31'$

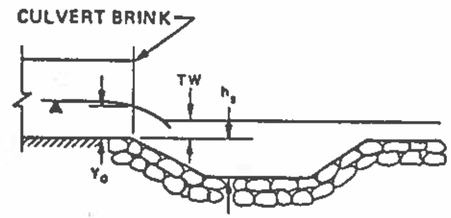
$\therefore Q = 1237$ cfs $\gg 1115$ cfs

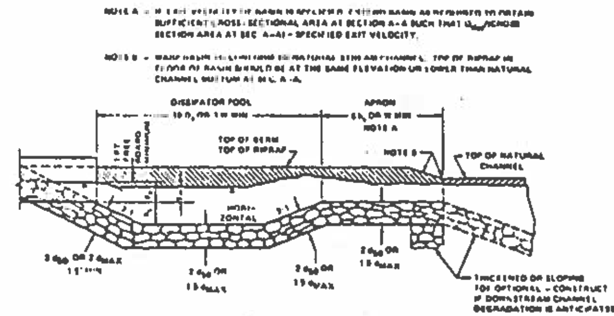
$\therefore$ use $H = 5$ ⟶ INV. WEIR 6204.00

MAJOR CHANNEL

STA. 42+95.40

RIPRAP BASINS





W= 10'

	TW	y_e	(1) TW/y_e	d_{50}/y_e	d_{50}	h_s/y_e	h_s	(2) h_s/d_{50}	
LOW TW $TW/y_e \le 0.75$	2'	4'	0.5	0.38	1.5	1.5	6'	4.0	
	V ALLOWABLE	L/D_e (3)	L	V_{ave}/V_L	V_L				
HIGH TW $TW/y_e > 0.75$									

8.2.79
mBM

	Larger of		
Length of Pool	$= 10\ h_s$ or $3W_o$	= 60	ft.
Length of Apron	$= 5\ h_s$ or W_o	= 30	ft.
Thickness of Approach	$= 3d_{50}$ or $2d_{max}$	= 4.5	ft.
Thickness of Remainder of Basin	$= 2d_{50}$ or $1.5d_{max}$	= 3.0	ft.

(1) $TW/y_e \le 0.75$ for Low TW Design

(2) $2 < hs/d_{50} < 4$

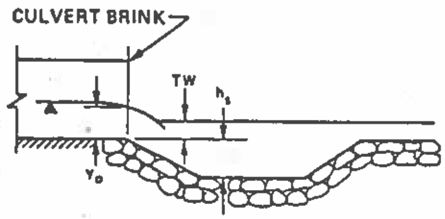
(3) $D_e = [4A/\pi]^{1/2}$

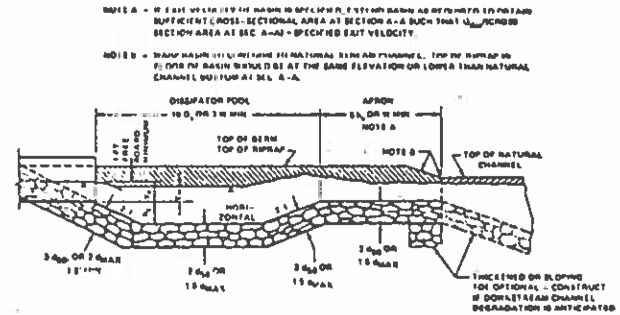
* No downstream degradation anticipated.

MAJOR CHANNEL

STA. 35+49.67

RIPRAP BASINS





W= 10'

	TW	y_e	(1) TW/y_e	d_{50}/y_e	d_{50}	h_s/y_e	h_s	(2) h_s/d_{50}	
LOW TW $TW/y_e \le 0.75$	2'	4'	0.5	0.38	1.5'	1.5	6'	4'	
	V ALLOWABLE	L/D_e (3)	L	V_{ave}/V_L	V_L				
HIGH TW $TW/y_e > 0.75$									

8-2-79
MBM

	Larger of		
Length of Pool	= 10 h_s or $3W_o$	= 60	ft.
Length of Apron	= 5 h_s or W_o	= 30	ft.
Thickness of Approach	= $3d_{50}$ or $2d_{max}$	= 4.5	ft.
Thickness of Remainder of Basin	= $2d_{50}$ or $1.5d_{max}$	= 3.0	ft.

(1) $TW/y_e \le 0.75$ for Low TW Design

(2) $2 < hs/d_{50} < 4$

(3) $D_e = [4A/\pi]^{1/2}$

* Downstream degradation probable, add "toe section".

NTER SURFACE PROFILE, STANDARD STEP METHOD 4 28 1979

OJECT:...Tamarron at Rockrimmon.................100yr storm...

EACH:....Major channel; D50 = 1.5 ft riprap; Anomalies...... caused by wide spacing of cross sections.

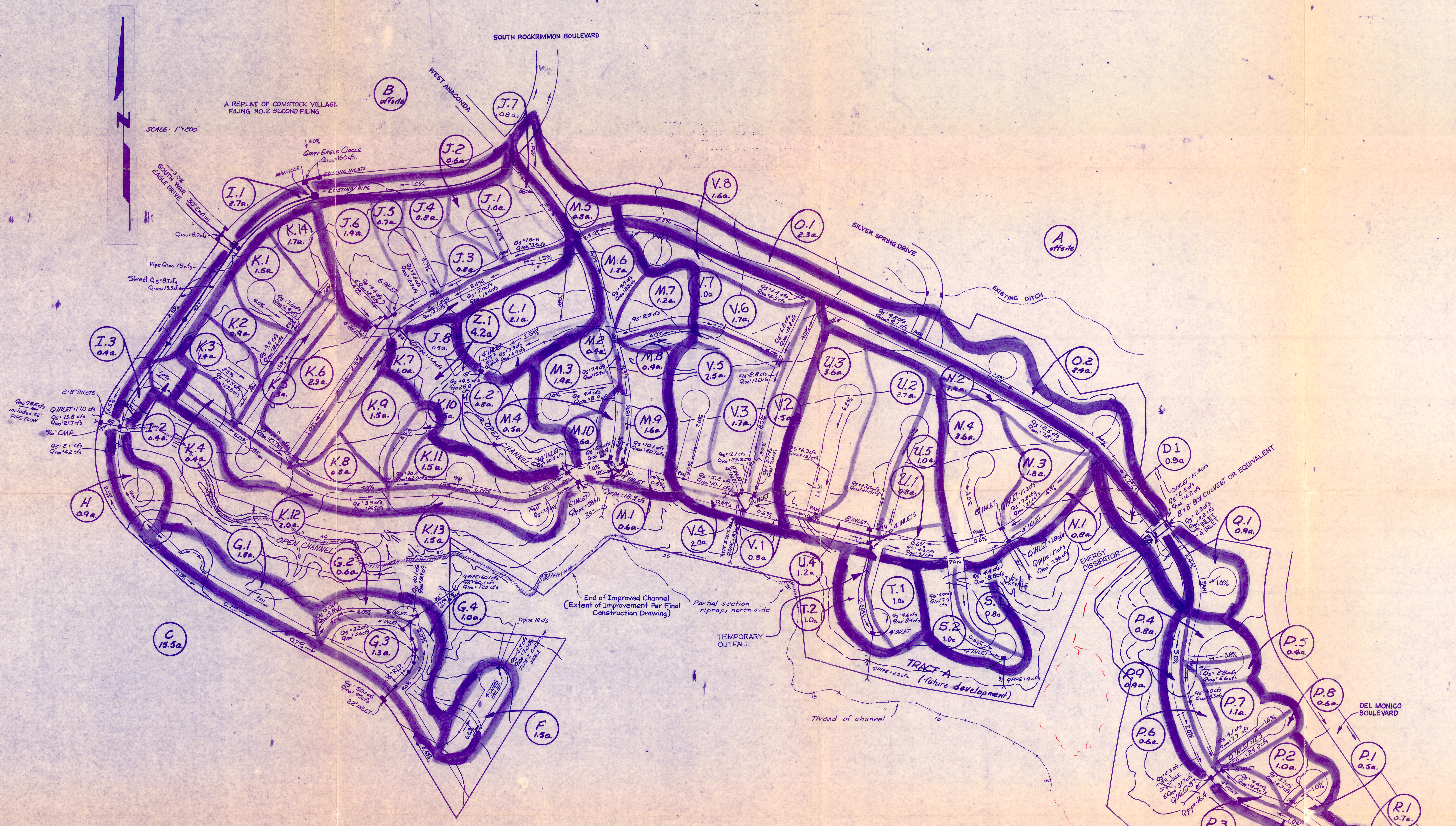
= 755.000 CFS N= 0.042 B= 10.000

PERCRITICAL FLOW

D	STA	INV ELEV	Z	FLOW DEPTH	VEL	VEL HEAD	WSE	EGL	S	
1	4890.00	6368.00	3.0	3.875	9.01	1.26	6371.88	6373.14	0.0199	
2	4750.00	6366.00	3.0	3.875	9.01	1.26	6369.88	6371.14	0.0199	*
3	4710.00	6364.00	3.0	3.040	12.99	2.62	6367.04	6369.66	0.0539	
4	4680.00	6362.00	3.0	2.911	13.85	2.98	6364.91	6367.89	0.0642	
5	4670.00	6360.00	3.0	2.529	16.98	4.48	6362.53	6367.00	0.1125	
6	4655.00	6358.00	3.0	2.474	17.52	4.77	6360.47	6365.24	0.1227	
7	4640.00	6356.00	3.0	2.448	17.79	4.91	6358.45	6363.36	0.1280	
8	4620.00	6354.00	3.0	2.537	16.90	4.43	6356.54	6360.97	0.1110	
9	4500.00	6347.74	3.0	3.717	9.60	1.43	6351.46	6352.89	0.0236	
10	4408.28	6342.52	3.0	2.897	13.94	3.02	6345.42	6348.44	0.0654	
11	4390.00	6342.00	3.0	2.954	13.55	2.85	6344.95	6347.81	0.0605	
12	4300.00	6341.50	3.0	3.875	9.01	1.26	6345.38	6346.64	0.0199	*
13	4200.00	6340.90	3.0	3.875	9.01	1.26	6344.78	6346.04	0.0199	*
14	4100.00	6340.30	3.0	3.875	9.01	1.26	6344.18	6345.44	0.0199	*
15	4050.00	6340.00	3.0	3.875	9.01	1.26	6343.88	6345.14	0.0199	*
16	4000.00	6338.57	3.0	3.438	10.81	1.82	6342.01	6343.82	0.0226	
17	3900.00	6335.71	3.0	3.626	9.97	1.54	6339.34	6340.88	0.0262	
18	3800.00	6332.86	3.0	3.511	10.47	1.70	6336.37	6338.07	0.0299	
19	3700.00	6330.00	3.0	3.574	10.20	1.61	6333.57	6335.19	0.0273	
20	3633.00	6328.00	3.0	3.540	10.34	1.66	6331.54	6333.20	0.0282	
21	3510.00	6326.00	3.0	3.875	9.01	1.26	6329.88	6331.14	0.0199	*
22	3390.00	6324.00	3.0	4.414	7.36	0.84	6328.41	6329.25	0.0117	
23	3300.00	6322.00	3.0	3.430	10.85	1.83	6325.43	6327.26	0.0329	
24	3210.00	6320.00	3.0	4.376	7.46	0.86	6324.38	6325.24	0.0119	
25	2800.00	6310.00	3.0	3.345	11.26	1.97	6313.35	6315.32	0.0365	
26	2720.00	6308.00	3.0	3.974	8.67	1.17	6311.97	6313.14	0.0174	
27	2580.00	6306.00	3.0	3.875	9.01	1.26	6309.88	6311.14	0.0199	*
28	2490.00	6304.00	3.0	3.696	9.69	1.46	6307.70	6309.15	0.0242	
29	2340.00	6302.00	3.0	3.875	9.01	1.26	6305.88	6307.14	0.0199	*
30	2170.00	6300.00	3.0	3.875	9.01	1.26	6303.88	6305.14	0.0199	*
31	2070.00	6298.00	3.0	3.862	9.06	1.27	6301.86	6303.14	0.0201	
32	1930.00	6296.00	3.0	3.705	9.65	1.45	6299.70	6301.15	0.0240	
33	1880.00	6294.00	3.0	4.084	8.31	1.07	6298.08	6299.16	0.0159	
34	1820.00	6292.00	3.0	3.232	11.86	2.18	6295.23	6297.42	0.0420	
35	1680.00	6290.00	3.0	3.875	9.01	1.26	6293.88	6295.14	0.0199	*

* INDICATES CRITICAL DEPTH WAS ASSUMED

TAMARRON at ROCKRIMMON



1. ALL OUTFALL POINTS TO HAVE ADEQUATE RIP RAP PROTECTION
2. MAJOR CONC. CHANNEL REQUIRES MIN. 12' MAINT. ROAD.

REVIEWED C. [signature] 9/7/79

Denotes Improved Channel, See Report and Final Construction Drawing for Extent of Improvement.

NO	DESCRIPTION	DATE	BY
5	Revised per new Calculations	8-31-79	R.R.C.
4	Street Grades	8-27-79	R.R.C.
3	Sub-Basin Adjustments	8-21-79	R.R.C.
2	Channel,	5/3/79	JTL
1	Flow, culvert	4/13/79	JTL

REVISIONS

Costin Engineering
CIVIL ENGINEERING AND LAND SURVEYING
1590 SOUTH ACOMA ST DENVER, COLORADO 80223
TELEPHONE (303) 744-7084

TAMARRON AT ROCKRIMMON
ON SITE DRAINAGE PLAN
MAP 2

American Continental Corporation

SCANNED

DRAWN BY: SL
CHECKED BY: JTL
DESIGN BY:
APPROVED BY:
DATE: 3-28-79
PROJECT NO.: 432
SHEET NO.:

SEP 3 1979

2