MASTER DEVELOPMENT DRAINAGE PLAN
VISTA MESA
COLORADO SPRINGS, COLORADO

WRC ENGINEERING, INC.

MASTER DEVELOPMENT DRAINAGE PLAN
VISTA MESA
COLORADO SPRINGS, COLORADO

Prepared For:

CLASSIC HOMES
5585 ERINDALE DRIVE, SUITE 207
COLORADO SPRINGS, COLORADO 80918

Prepared By:

WRC ENGINEERING, INC.
1660 SOUTH ALBION STREET, SUITE 500
DENVER, COLORADO 80222
(303) 757-8513

WRC FILE: 1830/1

JUNE 8, 1994

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 City/County for drainage reports and said report is in conformity with the master plan of the drainage basin. I accept responsibility for any liability caused by any neglect acts, errors or omissions on my part in preparing this report.

COLORADO REGISTERED BRUCE J. BUTTRAM PROFESSIONAL ENGINEER 6/9/94

Bruce J. Buttram

Name

Developer's Statement:

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

JBS Corp.

Business Name

By:

Title: Development Manager

Address: 5585 Erindale Dr STE 207

Colo. Springs. Co. 80918

CITY OF COLORADO SPRINGS:

Filed in accordance with Section 15-3-906 of the Code of the City of Colorado Springs, 1980, as amended.

Tim Mitchell for

City Engineer

June 10, 1994

Date

Conditions:

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INTRODUCTION

The purpose of this Master Development Drainage Plan (MDDP) is to: evaluate the existing and proposed drainage patterns from Vista Mesa and tributary sites; identify the major drainageways and drainage facilities adjacent to the project site; and evaluate the ability of the downstream drainage facilities to convey the developed runoff. The criteria contained in the City of Colorado Springs and El Paso County Drainage Criteria Manual (Manual) was used to determine runoff rates from the site and evaluate drainage facilities.

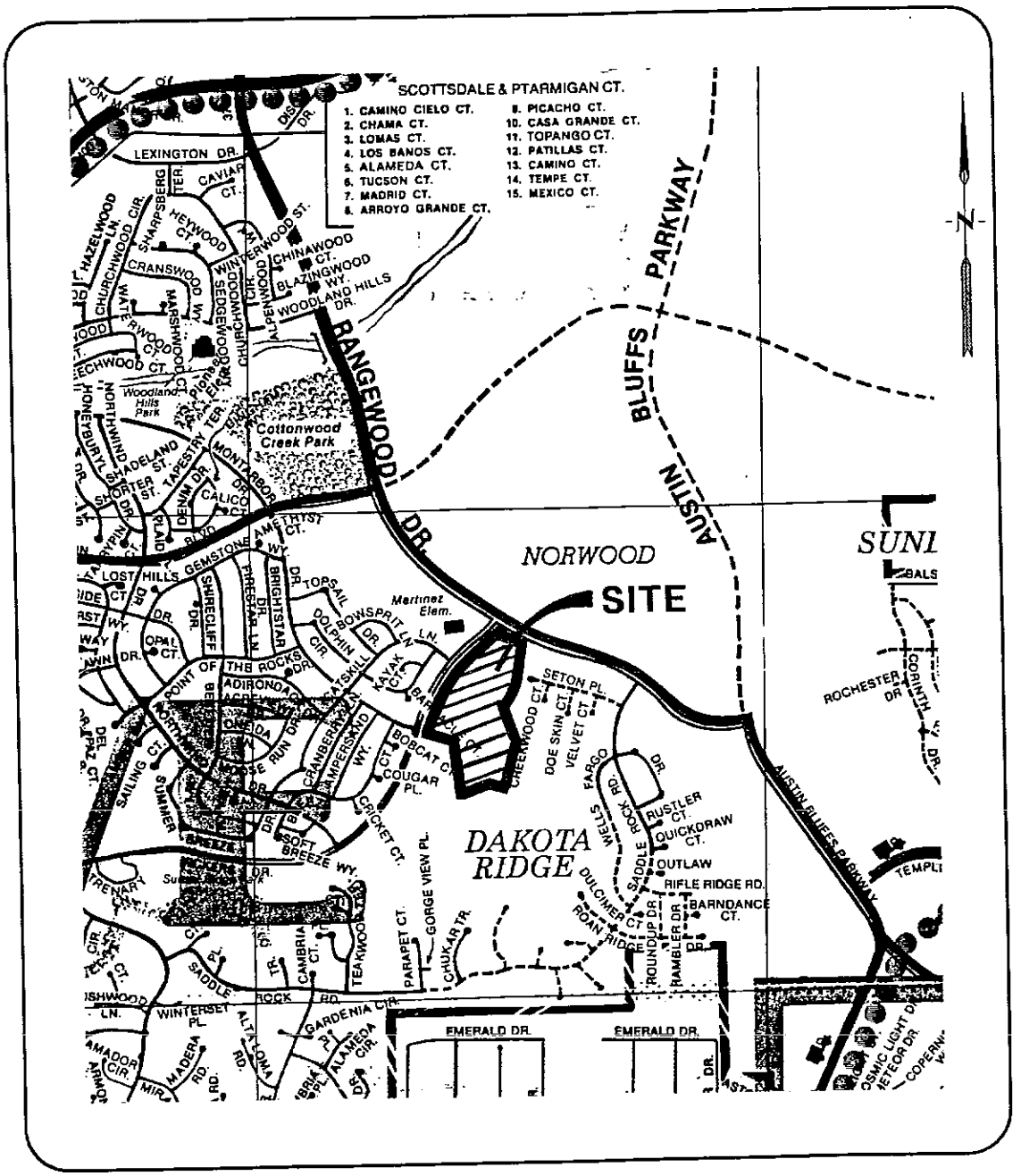
GENERAL LOCATION AND DESCRIPTION

Vista Mesa is located in Section 14, Township 13 South, Range 66 West of the 6th Principal Meridian, Colorado Springs, Colorado. The location of the site is shown in Figure-1. The area of the site is approximately 83 acres. The site slopes to the north at grades that vary from 3% to 20%. Existing vegetation primarily consists of native grasses. Review of the Soil Conservation Service Soil Survey for El Paso County indicate that the on-site soil consists of Bresser Sandy Loam which is classified as a hydrological group B (see Figure-2). The site is surrounded by the Norwood Trail Drainageway on the east; Vickers Drive and Rangewood Drive on the north; unplatted ground on the west; and Sunset Mesa on the south. The site is not located in the 100-year floodplain as depicted in FIRM Panel 080060 0158B.

DRAINAGE PATTERNS

Vista Mesa is located in the Cottonwood Creek drainage basin. A Drainage Basin Planning Study (DBPS) for Cottonwood Creek drainage basin has been prepared by URS Consultants. The site is located in Sub-basin K1 of the DBPS. The DBPS shows that the Norwood Trail Drainageway is to remain in a natural state without channel improvements. Historically the site has drained overland into the Norwood Trail Drainageway and into Vickers Drive. There are no off-site sub-basins tributary to the site.

Developed storm runoff from Vista Mesa was analyzed for the 10-year and 100-year event, in accordance with the criteria contained in the manual. The Rational Method was used to calculate runoff rates. A runoff coefficient of 0.55 and 0.65 was used for the 10-year and 100-year storms, respectively, which corresponds to residential lots less than 1/8 acre and soils in the hydrological group B. Vista Mesa is divided into 12 sub-basins. Sub-basins K and L flow overland directly into the undeveloped land west of the site and the Norwood Trail Drainageway. Sub-basins A thru J are routed overland and through the streets towards Vickers Drive. Drawings-1 and -2 depict the developed sub-basins within Vista Mesa.



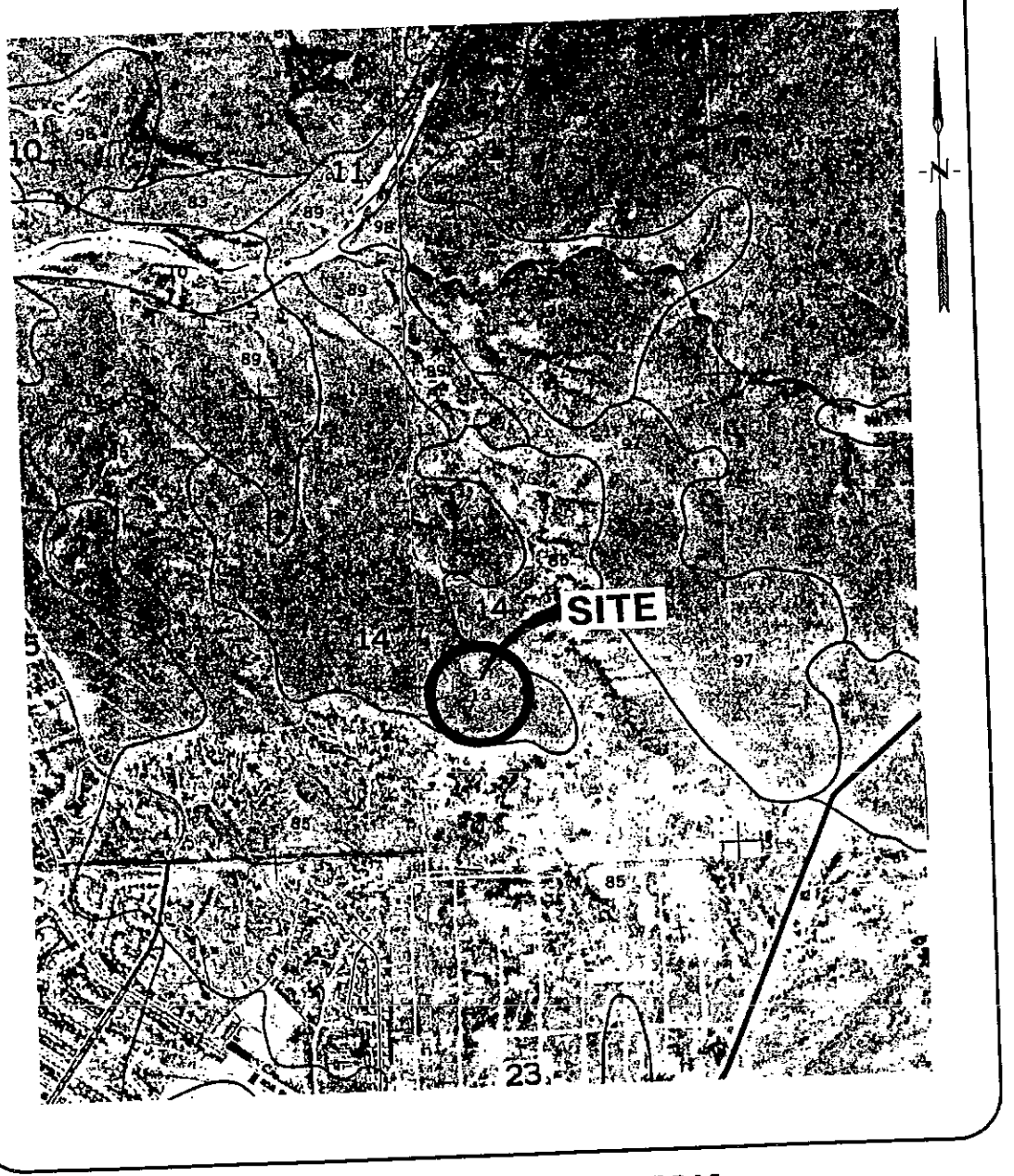
VICINITY MAP

N.T.S.

WRC

CLASSIC HOMES - VISTA MESA

FIGURE 1



SOIL CLASSIFICATION

N.T.S.

WRC

CLASSIC HOMES - VISTA MESA

FIGURE 2

DRAINAGE FACILITIES

Existing drainage facilities adjacent to the site consist of a 48-inch storm sewer in Vickers Drive and a 72-inch diameter culvert that conveys the flows in the Norwood Trail Drainageway under Rangewood Drive. The storm sewer in Vickers Drive was designed in conjunction with the Promontory 1 development. It was designed, in accordance with the criteria applicable at the time, to convey the 5-year runoff as calculated using the SCS method. The current criteria requires that storm sewers be designed for the 10-year event using the Rational Method for sub-basins 100 acres or less. Due to the different methodologies for computing storm runoff and a different recurrence interval, the existing storm sewer appears to be undersized to convey the 10-year runoff from Vista Mesa and tributary sub-basins. To minimize the impacts that the developed runoff from Vista Mesa will have on Vickers Drive, storm sewers are proposed within the subdivision that will convey storm runoff directly to the Norwood Trial Drainageway. The storm sewers were located by comparing the allowable street capacity with the calculated storm runoff. Final storm sewer and inlet location and size will be determined during final design of the drainage improvements. Approximately 60 cubic feet per second (cfs) will be intercepted by the storm sewers located in Rockledge Drive and Piñon Mesa Drive and conveyed to the drainageway. Approximately 25 cfs will be intercepted by storm sewer in Stonefield Drive and High Mesa Drive or routed in the street into Vickers Drive. Historically the runoff that is being discharged directly into the Norwood Trail Drainageway flows down to Vickers Drive. It is intercepted by the existing storm sewer in Vickers Drive and discharged at the downstream end of the 72-inch culvert. Diverting runoff into the Norwood Trail Drainageway is not considered a transbasin diversion due to the fact that historically the runoff is discharged at the downstream end of the culvert.

The capacity of the 72-inch culvert under Rangewood Drive was analyzed to evaluate the impacts from the proposed Vista Mesa drainage plan. In order to determine the flow reaching the upstream end of the culvert, the drainage studies and drainage plans for Deer Run, Dakota Ridge and Sierra Ridge were reviewed to determine the area that is drained directly into the Norwood Trail Drainageway. The tributary area is depicted as sub-basin OS-1 in Drawing-3. The runoff from sub-basin OS-1 was combined with that from sub-basin L and the proposed discharges from Vista Mesa storm sewers to obtain flow rates of 137.9 cfs and 218 cfs for the 10-year and 100-year storm, respectively, at the upstream end of the culvert. Using a headwater to diameter ratio of 1.0 and inlet control, the culvert has a capacity of 195 cfs, which is adequate to convey the 10-year flow. The 100-year flow is conveyed through the culvert with a 1.08 headwater to diameter ratio. The available existing headwater to diameter ratio is approximately 2.5.

Runoff rates from Prominence (sub-basin OS-3) and the undeveloped site west of Vista Mesa (sub-basin OS-2) were estimated to evaluate the impacts to Vickers Drive from Vista Mesa. The undeveloped parcel was assumed to be single family residential with runoff coefficients of 0.55 and 0.65 for the 10- and 100-year storms, respectively.

Sub-basins OS-2 and OS-3 are depicted on Drawing-3. Taking into account the contributing flows from Vista Mesa, the 10-year flow at the intersection of Vickers Drive and Rangewood is 186 cfs and the 100-year flow is 324. The 48-inch storm sewer in Vickers has a flow capacity of 160 cfs. There may be a lack of storm sewer and street capacity in Vickers to convey to 10-year and 100-year runoff as required by the current criteria. Therefore, some ponding in the street can be expected to occur since the storm sewer was designed for the 5-year storm event. The potential drainage problems resulting from the development of Vista Mesa and possible solutions will be addressed in the preliminary drainage report for Vista Mesa.

CONCLUSIONS

The 10-year and 100-year developed runoff rates have been calculated for Vista Mesa to evaluate the impacts on downstream drainage facilities. To minimize the impacts in Vickers Drive, it is proposed that approximately 60 cfs be routed from Vista Mesa directly into the Norwood Trail Drainageway. Taking into account the runoff from the area tributary to the 72-inch culvert and the proposed flow from Vista Mesa the 10- and 100-year flow at the upstream end of the culvert is 137.9 cfs and 218 cfs, respectively. The existing culvert has adequate capacity to convey these flows. The actual amount of runoff that is routed from Vista Mesa directly into the Norwood Trail Drainageway will be determined during final design of the Vista Mesa drainage improvements.

REFERENCES

1. City of Colorado Springs and El Paso County Drainage Criteria Manual, October, 1987.

2. Soil Survey of El Paso County Area, Colorado, United States Department of Agriculture.

3. Drainage Study, Dakota Ridge Filing No. 1, JR Engineering, Ltd., May, 1987.

4. Preliminary and Final Drainage Study for Deer Run Filings 2 and 3, KLH Engineering, Inc., June, 1993.

5. Drainage Letter, Dakota Ridge Filing No. 2, JR Engineering, Ltd., November, 1987.

6. Preliminary and Final Drainage Study for Deer Run Subdivision Filing No 1, KLH Engineering, Inc., April, 1993.

7. Preliminary and Final Drainage Study for Dakota Ridge Filing No. 3, Rockwell-Minchow Consultants, Inc., January, 1994.

8. Preliminary Drainage Report for Sierra Ridge, Rockwell-Minchow Consultants, Inc.

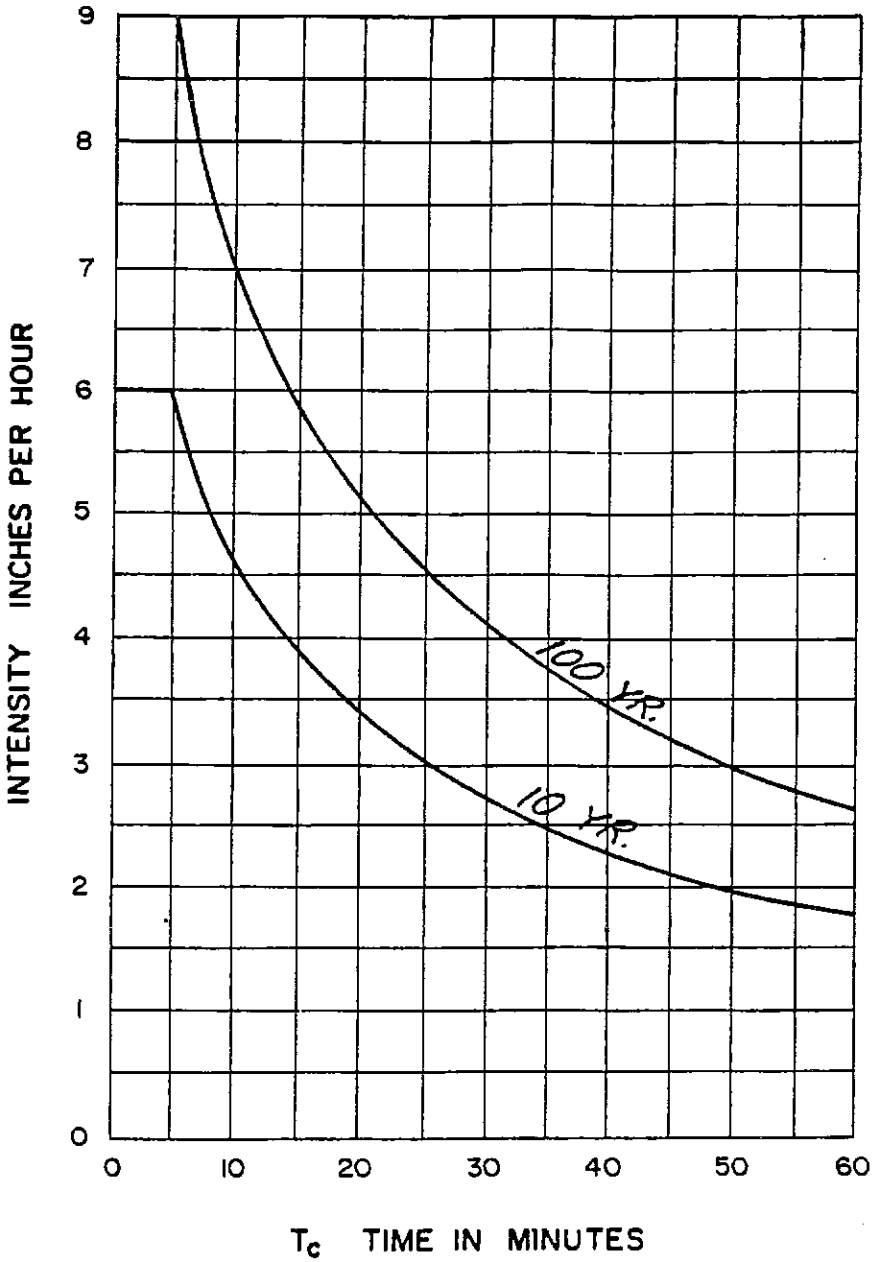
9. Master Drainage Study for Promontory I Development, KLH Engineering, Consultants, Inc., January, 1984.

10. Drainage Report for Prominence Subdivision Filing No. 1, KLH Engineering, Consultants, Inc., March, 1984.

11. Drainage Report for Vickers Extension, KLH Engineering, Consultants, Inc.

12. Cottonwood Creek Drainage Basin Planning Study Drainage Plan, Sheets 5, 7 and 9, URS Consultants, November 24, 1993.

APPENDIX



RE: Based upon Pikes Peak area council of governments/ areawide urban runoff control manual.

HDR Infrastructure, Inc.
A Centerra Company

The City of Colorado Springs / El Paso County
Drainage Criteria Manual

Storm Rainfall
Time Intensity-Frequency Curves

Date
OCT. 1987

Figure
5 - 1

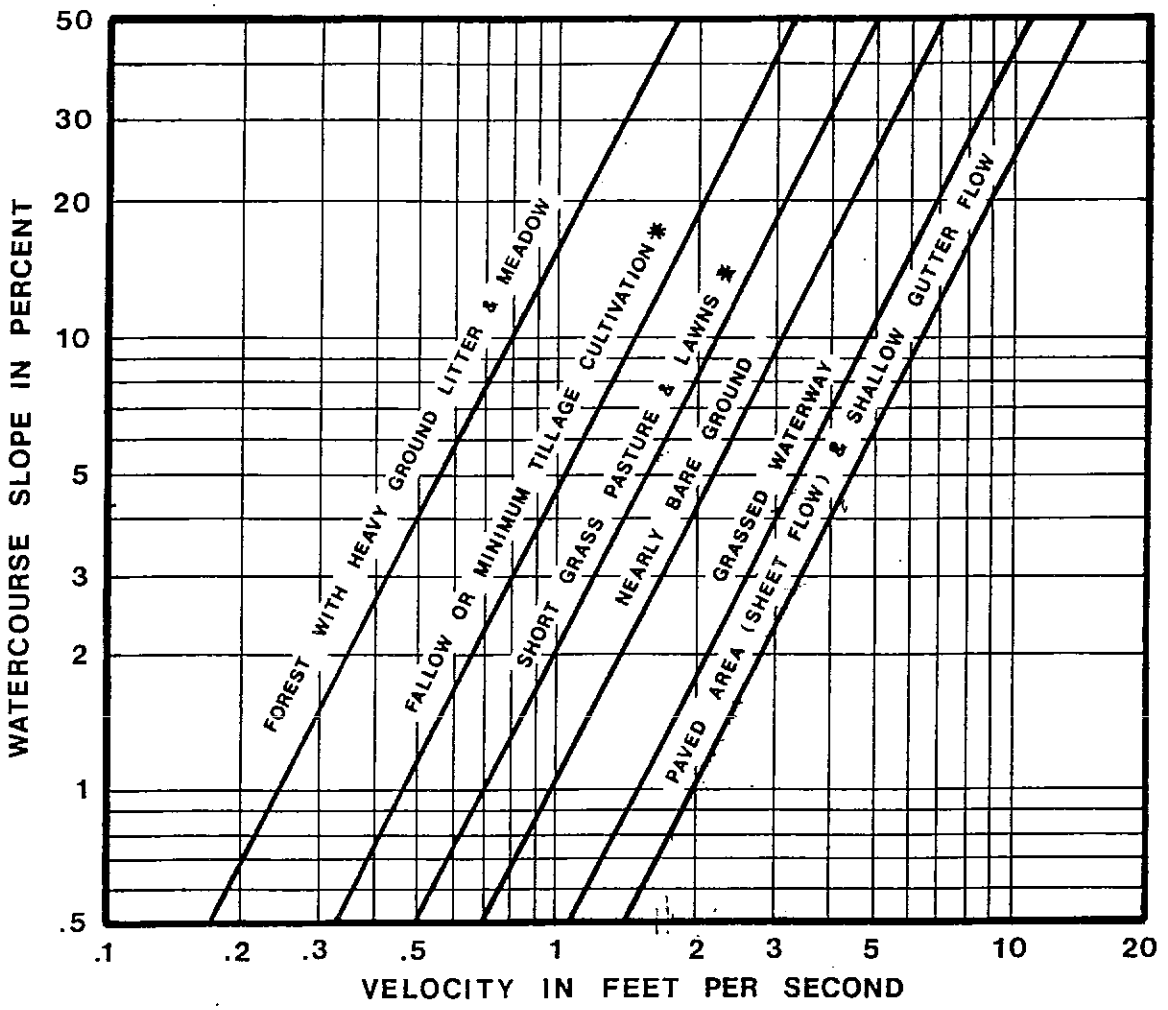


FIGURE 3-2. ESTIMATE OF AVERAGE FLOW VELOCITY FOR USE WITH THE RATIONAL FORMULA.

* MOST FREQUENTLY OCCURRING "UNDEVELOPED" LAND SURFACES IN THE DENVER REGION.

REFERENCE: "Urban Hydrology For Small Watersheds" Technical Release No. 55, USDA, SCS Jan. 1975.

TABLE 5-1

RECOMMENDED AVERAGE RUNOFF COEFFICIENTS AND PERCENT IMPERVIOUS

LAND USE OR SURFACE CHARACTERISTICS	PERCENT IMPERVIOUS	"C" FREQUENCY 10 A&B*	10 C&D*	100 A&B*	100 C&D*
Business					
Commercial Areas	95	0.90	0.90	0.90	0.90
Neighborhood Areas	70	0.75	0.75	0.80	0.80
Residential					
1/8 Acre or less	65	0.55	0.65	0.65	0.75
1/4 Acre	40	0.50	0.60	0.60	0.70
1/3 Acre	30	0.40	0.50	0.55	0.60
1/2 Acre	25	0.35	0.45	0.45	0.55
1 Acre	20	0.30	0.40	0.40	0.50
Industrial					
Light Areas	80	0.70	0.70	0.80	0.80
Heavy Areas	90	0.80	0.80	0.90	0.90
Parks and Cemeteries	7	0.30	0.35	0.55	0.60
Playgrounds	13	0.30	0.35	0.60	0.65
Railroad Yard Areas	40	0.50	0.55	0.60	0.65
Undeveloped Areas					
Historic Flow Analysis- Greenbelts, Agricultural	2	0.15	0.25	0.20	0.30
Pasture/Meadow	0	0.25	0.30	0.35	0.45
Forest	0	0.10	0.15	0.15	0.20
Exposed Rock	100	0.90	0.90	0.95	0.95
Offsite Flow Analysis (when land use not defined)	45	0.55	0.60	0.65	0.70
Streets					
Paved	100	0.90	0.90	0.95	0.95
Gravel	80	0.80	0.80	0.85	0.85
Drive and Walks	100	0.90	0.90	0.95	0.95
Roofs	90	0.90	0.90	0.95	0.95
Lawns	0	0.25	0.30	0.35	0.45

* Hydrologic Soil Group

STANDARD FORM SF-2

TIME OF CONCENTRATION

SUBDIVISION VISTA MESA

CALCULATED BY [illegible] DATE 4/18/94

$t_c = t_i + t_t$

SUB-BASIN DATA			INITIAL/OVERLAND TIME (t_i)			TRAVEL TIME (t_t)				t_c CHECK (URBANIZED BASINS)			FINAL t_c	REMARKS
DESIG: (1)	AREA Ac (2)	C_{10} (3)	LENGTH Ft (4)	SLOPE % (5)	t_i Min (6)	LENGTH Ft (7)	SLOPE % (8)	VEL. FPS (9)	t_t Min (10)	COMP. t_c (11)	TOTAL LENGTH Ft (12)	$t_c = (L/180)+10$ Min (13)	Min (14)	
1	A	0.55	100	15.0	4.0	150	13.0	2.6	1.0					LAWN
						1250	4.5	4.4	4.7	9.7			9.7	GUTTER
2	B	0.55	100	10.0	4.6	320	5.3	1.7	3.1					LAWN
						240	7.0	5.2	0.8	8.5			8.5	GUTTER
3	C	0.55	100	2.0	7.9	140	3.0	1.3	1.8					LAWN
						700	4.9	4.4	2.7	12.4			12.4	GUTTER
4	D	0.55	100	15.0	4.0	120	8.3	2.0	1.0					LAWN
						850	2.1	2.8	5.1	10.1			10.1	GUTTER
5	E	0.55	100	12.0	4.3	310	9.5	2.2	2.4					LAWN
						1070	5.2	4.6	3.9	10.6			10.6	GUTTER

STANDARD FORM SF-2

TIME OF CONCENTRATION

SUBDIVISION VISTA MESA

CALCULATED BY Jck DATE 4/18/94

$t_c = t_i + t_t$

SUB-BASIN DATA			INITIAL/OVERLAND TIME (t_i)			TRAVEL TIME (t_t)				t_c CHECK (URBANIZED BASINS)			FINAL t_c	REMARKS
DESIG: (1)	AREA Ac (2)	C (3)	LENGTH Ft (4)	SLOPE % (5)	t_i Min (6)	LENGTH Ft (7)	SLOPE % (8)	VEL. FPS (9)	t_t Min (10)	COMP. t_c (11)	TOTAL LENGTH Ft (12)	t_c =(L/180)+10 Min (13)	Min (14)	
6	F	0.55	150	2.0	9.6	850	4.7	4.4	3.2	12.8			12.8	LAWN + GUTTER
7	G	0.55	100	3.0	6.9	40	5.0	1.6	0.4					LAWN
						450	2.7	3.3	2.3	9.6			9.6	GUTTER
8	H	0.55	100	2.0	7.9	550	6.2	1.8	5.1					LAWN
						170	7.1	5.2	0.5	13.5			13.5	GUTTER
8A	I	0.55	100	1.0	9.9	130	2.3	1.1	2.0					LAWN
						750	3.9	4.0	3.1	15.0			15.0	GUTTER
9 10	J	0.55				2550	2.4	3.0	14.2				14.2	GUTTER
10 H	K	0.55				1750	5.1	3.5	8.3				8.3	GRASSED CHANNEL
11 12	L	0.55				2900	6.6	3.9	12.4				12.4	GRASSED CHANNEL

CALCULATED BY JK
DATE 4/19/94
CHECKED BY

STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN (RATIONAL METHOD PROCEDURE)

JOB NO 1830
PROJECT VISTA MESA
DESIGN STORM 10

STREET		DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
			AREA DESIGN	AREA (AC)	RUNOFF COEFF	t_c (MIN)	C·A (AC)	I IN/HR	Q (CFS)	t_c (MIN)	Σ(C·A) (AC)	I (IN/HR)	Q (CFS)	SLOPE (%)	STREET FLOW(CFS)	DESIGN FLOW(CFS)	SLOPE (%)	PIPE SIZE	LENGTH (FT)	VELOCITY (FPS)	t_t (MIN)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
1		1	A	14.3	0.55	9.7	7.87	4.6	36.7				36.7									
2		2	B	4.1	0.55	8.5	2.26	5.0	11.3	12.7	10.1	4.2	42.4	1.7					450	2.5	3.0	
3		3	C	4.3	0.55	12.4	2.37	4.3	10.2	15.8	12.5	3.8	47.5	4.9					800	4.3	3.1	
4																						
5		5	E	7.4	0.55	10.6	4.07	4.6	18.7				18.7									
6		6	F	6.5	0.55	12.8	3.58	4.2	15.0	13.0	7.65	4.15	31.7	6.0					700	4.8	2.4	
7		4	D	7.1	0.55	10.1	3.91	4.6	18.0	14.3				4.9					350	4.5	1.3	
8																						
9		3	C	4.3	0.55	12.4	2.37	4.3	10.2	15.8	12.5	3.8	47.5									
10		4	D	7.1	0.55	10.1	3.91	4.6	18.0	20.9	24.06	3.35	80.6	2.1					850	2.8	5.1	
11																						

CALCULATED BY JK
DATE 4/20/94
CHECKED BY

STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN (RATIONAL METHOD PROCEDURE)

JOB NO 830
PROJECT VISTA MESA
DESIGN STORM 10

STREET		DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
			AREA DESIGN	AREA (AC)	RUNOFF COEFF	t_c (MIN)	C·A (AC)	I IN/HR	Q (CFS)	t_c (MIN)	Σ(C·A) (AC)	I (IN/HR)	Q (CFS)	SLOPE (%)	STREET FLOW (CFS)	DESIGN FLOW (CFS)	SLOPE (%)	PIPE SIZE	LENGTH (FT)	VELOCITY (FPS)	t_t (MIN)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
1		8	H	6.9	0.55	13.5	3.80	4.1	15.6				15.6	—					—	—	—	
2		8	I	5.1	0.55	15.0	2.81	3.9	10.9	15.0	6.61	3.9	25.8									
3		7	G	6.4	0.55	9.6	3.52	4.6	16.2	18.1				2.7					600	3.2	3.1	
4																						
5		4	D	7.1	0.55	10.1	3.91	4.6	18.0	20.9	24.06	3.35	80.6									
6		7	G	6.4	0.55	9.6	3.52	4.6	16.2	24.0	27.58	3.10	85.5	4.3					830	4.4	3.1	
7		9	J	4.2	0.55	14.2	2.31	3.95	9.12	27.3	29.89	2.85	85.2	1.3					450	2.3	3.3	
8																						
9																						
10																						
11																						

CALCULATED BY JK
DATE 4/20/84
CHECKED BY

STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN (RATIONAL METHOD PROCEDURE)

JOB NO 1830
PROJECT VISTA MESA
DESIGN STORM 100

STREET		DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
			AREA DESIGN	AREA (AC)	RUNOFF COEFF	t_c (MIN)	C·A (AC)	I IN/HR	Q (CFS)	t_c (MIN)	Σ(C·A) (AC)	I (IN/HR)	Q (CFS)	SLOPE (%)	STREET FLOW (CFS)	DESIGN FLOW (CFS)	SLOPE (%)	PIPE SIZE	LENGTH (FT)	VELOCITY (FPS)	t_t (MIN)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
1		1	A	14.3	0.65	9.7	9.30	7.15	66.5				66.5									
2		2	B	4.1	0.65	8.5	2.67	7.45	19.9	12.7	11.97	6.40	76.6	1.7					450	2.5	3.0	
3		3	C	4.3	0.65	12.4	2.80	6.40	17.9	15.8	14.77	5.75	84.9	4.9					800	4.3	3.1	
4		4	D	7.1	0.65	10.1	4.62	6.90	31.9	20.9	18.43 (Σ1-6)	3.33	94.7	2.1					850	2.8	5.1	
5																						
6		5	E	7.4	0.65	10.6	4.81	6.87	33.0				33.0									
7		6	F	6.5	0.65	12.8	4.23	6.20	26.2	13.0	9.04	6.30	57.0	6.0					700	4.8	2.4	
8		4	D	7.1	0.65	10.1	4.62	6.90	31.9	14.3				4.9					350	4.5	1.3	
9																						
10																						
11																						

CALCULATED BY JK
DATE 4/20/94
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STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN (RATIONAL METHOD PROCEDURE)

JOB NO 1830
PROJECT VISTA MESA
DESIGN STORM 100

STREET		DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
			AREA DESIGN	AREA (AC)	RUNOFF COEFF	t_c (MIN)	C·A (AC)	I IN/HR	Q (CFS)	t_c (MIN)	Σ(C·A) (AC)	I (IN/HR)	Q (CFS)	SLOPE (%)	STREET FLOW (CFS)	DESIGN FLOW (CFS)	SLOPE (%)	PIPE SIZE	LENGTH (FT)	VELOCITY (FPS)	t_t (MIN)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
1		8	H	6.9	0.65	13.5	4.49	6.10	27.4					—					—	—	—	
2		8	I	5.1	0.65	15.0	3.32	5.90	19.6	15.0	7.81	5.90	46.1									
3		7	G	6.4	0.65	9.6	4.16	7.12	29.6	18.1				2.7					600	3.2	3.1	
4																						
5		4	D	7.1	0.65	10.1	4.62	6.90	31.9	20.9	28.43	3.33	94.7									
6		7	G	6.4	0.65	9.6	4.16	7.12	29.6	24.0	40.4	4.67	188.7	4.3					830	4.4	3.1	
7		9	J	4.2	0.65	14.2	2.73	6.20	16.9	27.3	43.1	4.30	185.6	1.3					450	2.3	3.3	
8																						
9																						
10																						
11																						

WRC ENGINEERING, INC.
1660 SOUTH ALBION STREET–SUITE 500
DENVER, COLORADO 80222
PHONE NO. (303) 757–8513
FAX NO. (303) 758–3208

JOB NUMBER: 1830 SHEET 1 OF ___
JOB NAME: NORWOOD
CALC. BY: JK DATE 4/21/97
CHKD. BY: ___ DATE ___/___/___
REV. BY: ___ DATE ___/___/___

SUBJECT: OFFSITE FLOW, COMPOSITE C

$C_{10} = .59$ $C_{10} = .60$ $C_{10} = .25$
$C_{100} = .71$ $C_{100} = .70$ $C_{100} = .30$

DAKOTA RIDGE		DEER RUN		NORWOOD TRAIL DRAINAGE WAY	
BASIN	ACRES	BASIN	ACRES	BASIN	ACRES
B.2	9.0	I	1.89		30
C.1	8.0	II	2.93		
C.2	9.7	III	1.75		
D	5.3	IV	2.92		
E	3.1	V	1.39		
F	3.2		10.88		
	38.3				

TOTAL AREA = 79.2

$$C_{10_{comp}} = \frac{A_1}{A_T} C_{10_1} + \frac{A_2}{A_T} C_{10_2} + \frac{A_3}{A_T} C_{10_3}$$

$$C_{10_{comp}} = \frac{38.3}{79.2}(.59) + \frac{10.88}{79.2}(.60) + \frac{30}{79.2}(.25)$$

$$C_{10_{comp}} = .29 + .08 + .09 = .46$$

$$C_{100_{comp}} = \frac{38.3}{79.2}(.71) + \frac{10.88}{79.2}(.70) + \frac{30}{79.2}(.30)$$

$$C_{100_{comp}} = .34 + .10 + .11 = .55$$

STANDARD FORM SF-2

TIME OF CONCENTRATION

SUBDIVISION VISTA MESA

CALCULATED BY JK DATE 4/21/94 $t_c = t_i + t_t$

SUB-BASIN DATA			INITIAL/OVERLAND TIME (t_i)			TRAVEL TIME (t_t)				t_c CHECK (URBANIZED BASINS)			FINAL t_c	REMARKS
DESIG: (1)	AREA Ac (2)	$C_{\#10}$ (3)	LENGTH Ft (4)	SLOPE % (5)	t_i Min (6)	LENGTH Ft (7)	SLOPE % (8)	VEL. FPS (9)	t_t Min (10)	COMP. t_c (11)	TOTAL LENGTH Ft (12)	$t_c = (L/180)+10$ Min (13)	Min (14)	
A	79.4	.46	250	2.4	13.6	1500	2.7	3.2	7.8					GUTTER
						3200	4.5	3.1	17.2	38.6				NATURAL
11	14.2	.55	100	11.0	4.45	3100	6.0	1.8	28.7	33.2				LAWN
10	4.9	.55	100	8.0	4.95	1500	5.3	1.7	14.7	19.7				LAWN

CALCULATED BY JK
DATE 4/21/94
CHECKED BY

STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN (RATIONAL METHOD PROCEDURE)

JOB NO 1830
PROJECT VISTA MESA / OFFSITE
DESIGN STORM 10 & 100

STREET		DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
			AREA DESIGN	AREA (AC)	RUNOFF COEFF	t_c (MIN)	C·A (AC)	I IN/HR	Q (CFS)	t_c (MIN)	Σ(C·A) (AC)	I (IN/HR)	Q (CFS)	SLOPE (%)	STREET FLOW (CFS)	DESIGN FLOW (CFS)	SLOPE (%)	PIPE SIZE	LENGTH (FT)	VELOCITY (FPS)	t_t (MIN)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
1	10YR	A		79.2	.46	38.6	36.4	2.35	85.6				85.6	—						—	—	
2		11	L	14.2	.55	33.2	7.81	2.6	20.3	38.6	44.2	2.35	103.9									
3					EQUIVALENT		44.6	CA @	6	38.6	58.66	2.35	137.9									
4		10	K	4.9	0.55	19.7	2.70	3.45	9.3													
5																						
6	100YR	A		79.2	.55	38.6	43.6	3.5	152.6				152.6	—						—	—	
7		11	L	14.2	.65	33.2	9.23	3.9	36.0	38.6	52.8	3.5	184.8									
8					EQUIVALENT		9.52	CA @	6	38.6	62.32	3.5	218.1									
9		10	K	4.9	0.65	19.7	3.19	5.2	16.6													
10																						
11																						

WRC ENGINEERING, INC.
1660 SOUTH ALBION STREET–SUITE 500
DENVER, COLORADO 80222
PHONE NO. (303) 757–8513
FAX NO. (303) 758–3208

JOB NUMBER: 1830 SHEET 1 OF ____
JOB NAME: VISTA MESA
CALC. BY: GPB DATE 4/21/95
CHKD. BY: ____ DATE __/__/__
REV. BY: ____ DATE __/__/__

SUBJECT: OFFSITE DRAINAGE

BASIN	AREA
OS-2	40.9
OS-3 + NORTHWIND FILING 7 & PROMINENCE SUBDIVISION	

BASIN PER DR. STUDY	AREA	C_{10}	C_{100}
A3 (NORTHWIND) (PARTIAL)	1.8	.55	.65
B4 (PROM.)	4.3	.55	.65
B5	6.1	.55	.65
B6	4.8	.55	.65
B7	4.9	.55	.65
B8	3.1	.65	.72
B12	1.2	.90	.95
B9	8.1	.75	.80
B11 (PARTIAL)	0.2	.90	.95
	Σ 34.5 Ac.		

COMPOSITE C_{10}:

$$\frac{21.9}{34.5}(.55) + \frac{3.1}{34.5}(.65) + \frac{8.1}{34.5}(.75) + \frac{1.4}{34.5}(.90) = \underline{0.62}$$

C_{100}:

$$\frac{21.9}{34.5}(.65) + \frac{3.1}{34.5}(.72) + \frac{8.1}{34.5}(.80) + \frac{1.4}{34.5}(.95) = \underline{0.70}$$

STANDARD FORM SF-2

TIME OF CONCENTRATION

SUBDIVISION VISTA MESA

CALCULATED BY GPB DATE 1/21/94

$t_c = t_i + t_t$

SUB-BASIN DATA			INITIAL/OVERLAND TIME (t_i)			TRAVEL TIME (t_t)				t_c CHECK (URBANIZED BASINS)			FINAL t_c	REMARKS
DESIG: (1)	AREA Ac (2)	$C_{5/10}$ (3)	LENGTH Ft (4)	SLOPE % (5)	t_i Min (6)	LENGTH Ft (7)	SLOPE % (8)	VEL. FPS (9)	t_t Min (10)	COMP. t_c (11)	TOTAL LENGTH Ft (12)	$t_c = (L/180)+10$ Min (13)	Min (14)	
OS-2	40.9	.55	100	6.0	5.5	2745	5.9	4.8	9.5				16.0	GUTTER
	L=1830,		ASSUME 50% IMPR. IN LENG					✓ FOR	DEVELOPED	CONDITIONS				
OS-3	34.5	.62	100	4.0	5.3	850	4.0	4.0	3.5					GUTTER
						2286	1.22	12.7	3.0				11.8	PIPE
OS-4	1.8	.90	100	2.7	2.6	1865	2.7	3.3	9.4				12.0	GUTTER
		C_{100}												
OS-2	40.9	.65	100	6.0	4.5	2745	5.9	4.8	9.5				15.0	GUTTER
OS-3	34.5	.70	100	4.0	4.5	850	4.0	4.0	3.5					GUTTER
						2286	1.22	12.7	3.0				10.5	PIPE
OS-4	1.8	.95	100	2.7	1.9	1865	2.7	3.3	9.4				11.3	GUTTER

CALCULATED BY GPB
DATE 4/21/94
CHECKED BY _____

STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN (RATIONAL METHOD PROCEDURE)

JOB NO 1830
PROJECT VISTA MESA OFFSITE
DESIGN STORM 10 YR

STREET		DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
			AREA DESIGN	AREA (AC)	RUNOFF COEFF	t_c (MIN)	C·A (AC)	I IN/HR	Q (CFS)	t_c (MIN)	Σ(C·A) (AC)	I (IN/HR)	Q (CFS)	SLOPE (%)	STREET FLOW(CFS)	DESIGN FLOW (CFS)	SLOPE (%)	PIPE SIZE	LENGTH (FT)	VELOCITY (FPS)	t_t (MIN)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
1	VICKERS	B	OS-2	40.9	.55	16.0	22.5	3.8	85.5													
2		C	OS-4	1.8	.90	12.0	1.6	4.4	7.1	18.6	24.1	3.4	81.9				1.22	48"	1965	12.7	2.6	
3																						
4		C	OS-3	34.5	.62	11.8	21.4	4.3	91.9													
5																						
6		EQUIVALENT C FROM VISTA MESA STORM SEWER					6.4	3.9	25.0													
7																						
8		OS-2 3, 4 V.M.								18.6	51.9	3.5	181.7									
9																						
10																						
11																						

CALCULATED BY GPB
DATE 4/21/94
CHECKED BY

STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN (RATIONAL METHOD PROCEDURE)

JOB NO 1830
PROJECT VISTA MESA/OFFSITE
DESIGN STORM 100 YR

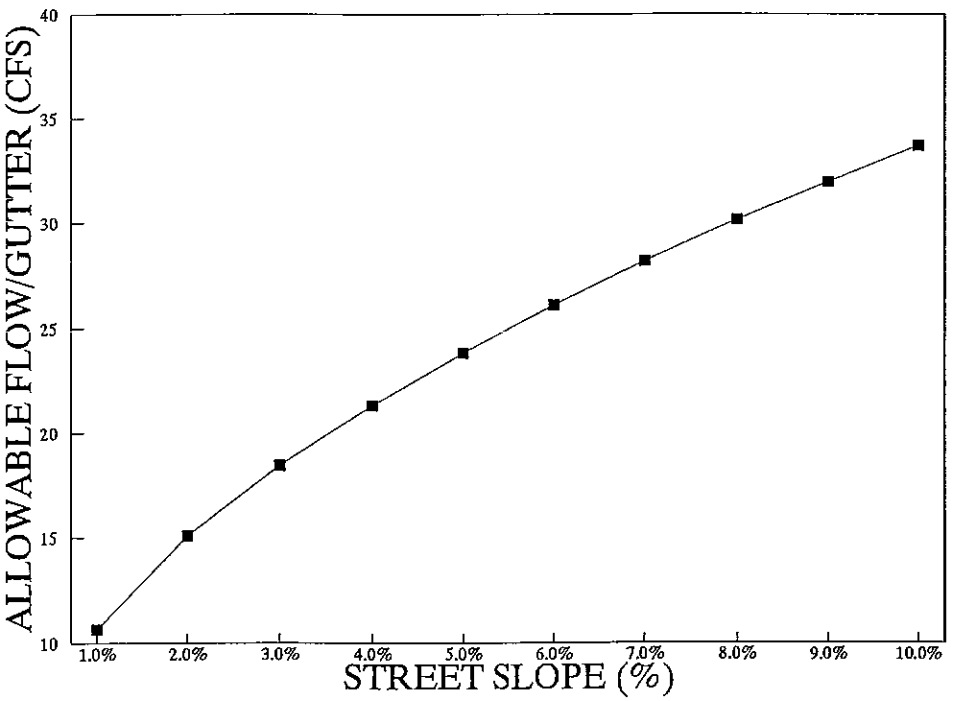
	STREET	DESIGN POINT	DIRECT RUNOFF: AREA DESIGN	AREA (AC)	RUNOFF COEFF	t_c (MIN)	C·A (AC)	I IN/HR	Q (CFS)	TOTAL RUNOFF: t_c (MIN)	Σ(C·A) (AC)	I (IN/HR)	Q (CFS)	STREET: SLOPE (%)	STREET FLOW (CFS)	PIPE: DESIGN FLOW (CFS)	SLOPE (%)	PIPE SIZE	TRAVEL TIME: LENGTH (FT)	VELOCITY (FPS)	t_t (MIN)	REMARKS
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
1	VICKERS	B	OS-2	40.9	.65	15.0	26.6	5.8	154.0													
2		C	OS-4	1.8	.95	11.3	1.7	6.8	11.6	17.6	28.3	5.5	155.7				1.22	48"	1965	12.7	2.6	
3																						
4		C	OS-3	34.5	.70	10.5	24.2	6.9	166.6													
5																						
6		Equiv. CA From Vista Storm Sewer			VARIES		6.4	3.9	25.0													
7																						
8																						
9			OS-2 3, 4 V.M.							17.6	58.9	5.5	324.0									
10																						
11																						

RESIDENTIAL STREET CAPACITY

36' WIDTH FLOW LINE TO FLOW LINE
TYPE 1 – VERTICAL CURB & GUTTER

Sx=	0.02
Ts=	15
n=	0.016
Eo	0.34

S	Qs	Qt
1.0%	7	10.7
2.0%	10	15.1
3.0%	12	18.4
4.0%	14	21.3
5.0%	16	23.8
6.0%	17	26.1
7.0%	19	28.2
8.0%	20	30.1
9.0%	21	32.0
10.0%	22	33.7

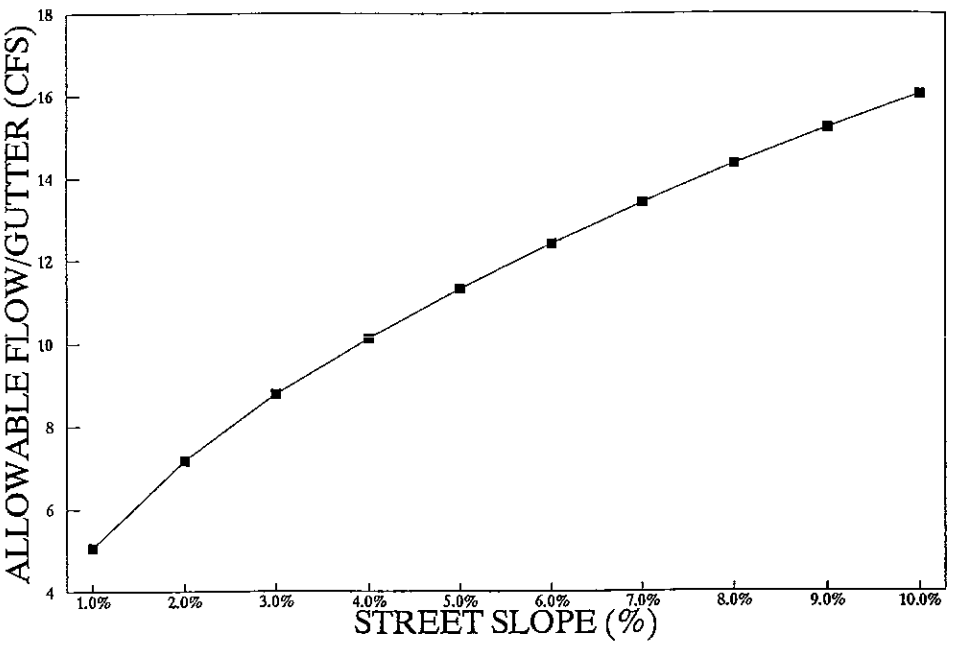


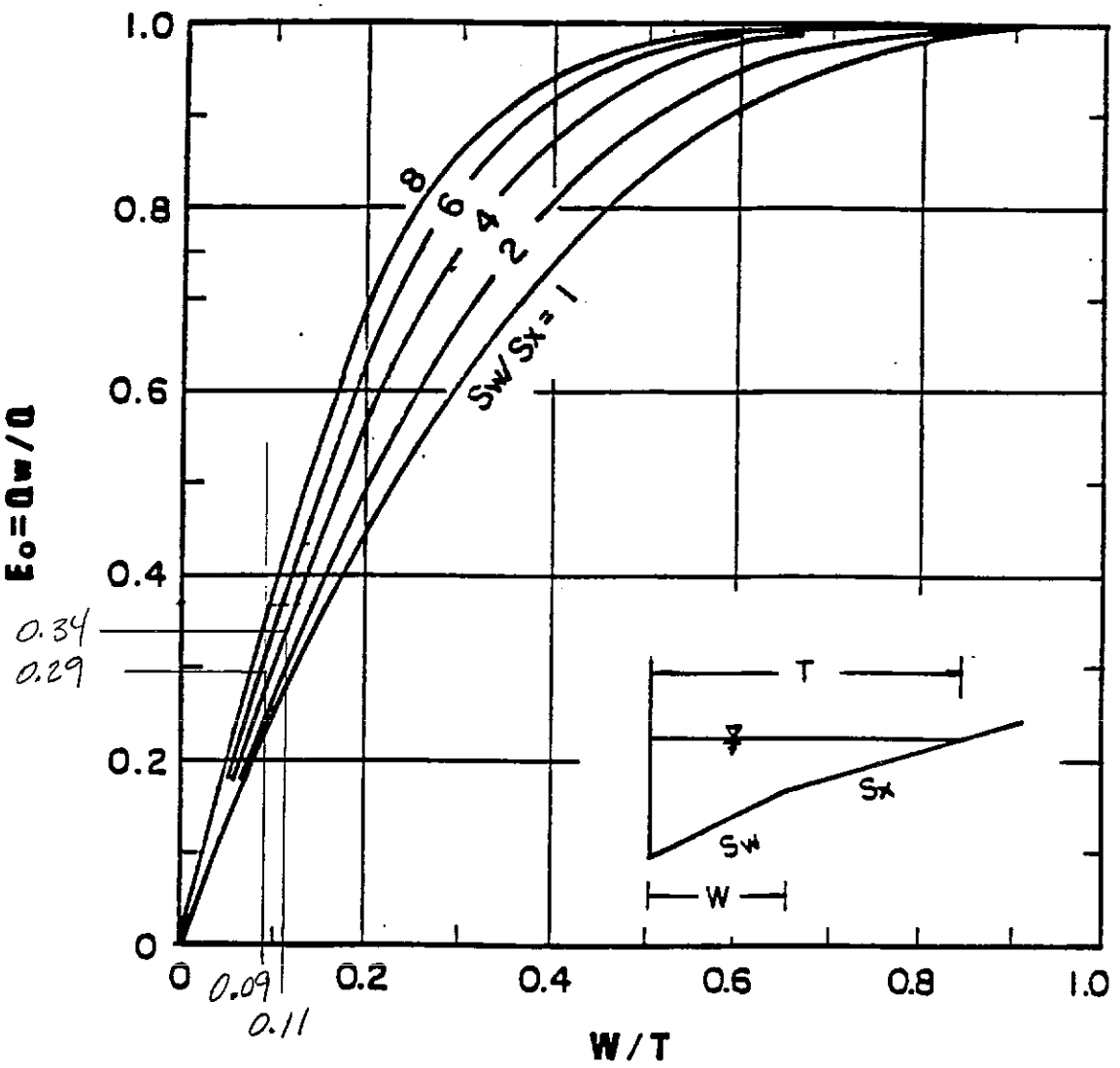
RESIDENTIAL STREET CAPACITY

36' WIDTH FLOW LINE TO FLOW LINE
TYPE 2 – RAMP CURB & GUTTER

Sx=	0.02
Ts=	11.67
n=	0.016
Eo	0.29

S	Qs	Qt
1.0%	4	5.1
2.0%	5	7.2
3.0%	6	8.8
4.0%	7	10.1
5.0%	8	11.3
6.0%	9	12.4
7.0%	10	13.4
8.0%	10	14.3
9.0%	11	15.2
10.0%	11	16.0





REFERENCE : FHWA Hydraulic Engineering Circular No. 12

HDR Infrastructure, Inc.
A Centerra Company

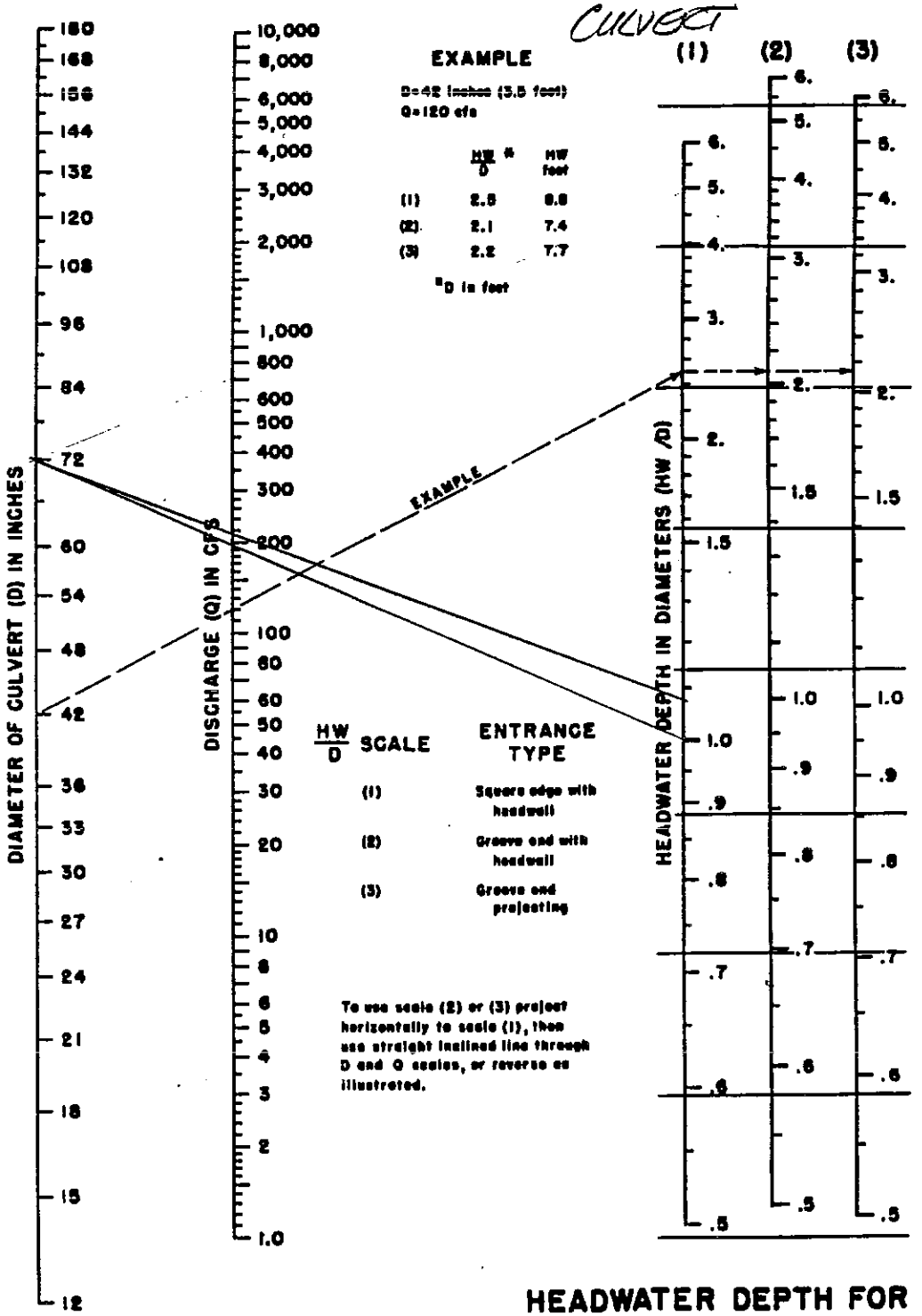
The City of Colorado Springs / El Paso County
Drainage Criteria Manual

Ratio of Frontal Flow to Gutter Flow

Date
OCT. 1987

Figure
7 - 3

RANGEWOOD BLVD. 72" RCP CULVERT



HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

HEADWATER SCALES 2 & 3
REVISED MAY 1964

BUREAU OF PUBLIC ROADS JAN. 1963