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Colorado Springs
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Engineering
Planning
Surveying

MASTER DEVELOPMENT DRAINAGE PLAN

FOR

CHARTER GREENS

November, 1992
Revised January, 1993

Job No. 8418.80

Prepared For:

VINTAGE COMMUNITIES, INC.
7710 North Union Boulevard
Colorado Springs, CO 80920
(719) 528-5000

Prepared By:

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RETURN WITHIN 2 WEEKS TO:
CITY OF COLORADO SPRINGS
STORM WATER & SUBDIVISION
101 W. COSTILLA, SUITE 113
COLORADO SPRINGS, CO 80903
(719) 385-5979



Recycled

**MASTER DEVELOPMENT DRAINAGE PLAN
FOR
CHARTER GREENS**

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DRAINAGE PLAN	(Back Pocket)

**CONDITIONS OF ACCEPTANCE
MASTER DEVELOPMENT DRAINAGE PLAN
FOR
CHARTER GREENS**

MARCH 1, 1993

The following two reports will establish the outfall adequacy for the Charter Greens Development:

Design Report for Pine Creek Detention Facility #1, December 1992, and
Final Drainage Report for Pine Creek Corridor from Detention Facility #1 to Chapel Hills Drive, January 1993,
Both studies by Obering Wurth & Assoc.

As of this date, these two studies are under consideration but have not been accepted by the City Engineer. Therefore, the following conditions of acceptance will apply to the Charter Greens Development:

- 1) The limit of allowable development prior to construction of Detention Facility 1A will be per the above referenced design report for Detention Facility #1.
- 2) No platting beyond Charter Greens Filing 1 will be allowed until the above referenced studies are signed by the City Engineer.
- 3) The Developer, Vintage Communities, will be responsible to control storm runoff from Filing #1 such that no erosion will leave the site and enter the Pine Creek Channel.

There are offsite areas shown on the M.D.D.P. which propose storm runoff from public streets entering unlined channels through the Golf Course. When those areas develop, private maintenance agreements may be needed.

DRAINAGE REVIEW:

FILED IN ACCORDANCE WITH SECTION 15-3-906
OF THE CODE OF THE CITY OF COLORADO
SPRINGS, 1980, AS AMENDED.


CITY ENGINEER

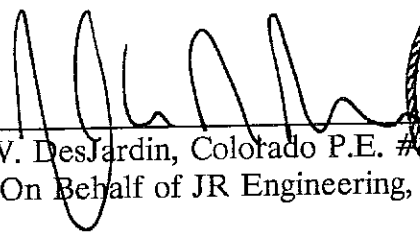
for: 3.1.93
DATE

**MASTER DEVELOPMENT DRAINAGE PLAN
CHARTER GREENS**

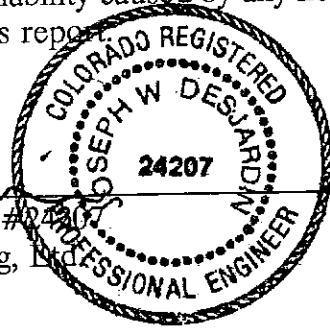
DRAINAGE REPORT STATEMENT

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



Joseph W. DesJardin, Colorado P.E. #24207
For and On Behalf of JR Engineering, Inc.

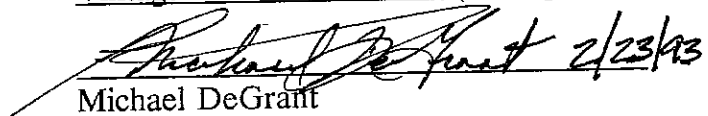


1-18-93
Date

DEVELOPER'S STATEMENT:

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

Business Name: Briargate Joint Venture By:
Vintage Communities, Inc. (Managing Agent)

By: 
Michael DeGraff

Title: Development Manager

Address: 7710 North Union Boulevard
Colorado Springs, CO 80920

CITY OF COLORADO SPRINGS ONLY:
Filed in accordance with Section 15-3-906 of the Code of the City of Colorado Springs, 1980, as amended.

SEE Condition Page
City Engineer _____ Date _____

Conditions:

MASTER DEVELOPMENT DRAINAGE PLAN
FOR
CHARTER GREENS
JANUARY, 1993

PURPOSE:

The purpose of the Master Development Drainage Plan is to identify relevant site drainage issues such as major drainage-ways, existing drainage facilities to include ponding/ detention areas, and drainage areas tributary to the proposed development. Analysis of these drainage issues is necessary to demonstrate the ability of downstream facilities to convey developed runoff from the proposed development.

Incorporated in this study for Charter Greens is information from the Pine Creek Drainage Basin Planning Study. No drainage problems are identified in the planning study for the proposed development, and the analysis is generally in accordance with the planning study, as amended to include additional detention facilities in the Pine Creek Golf Course.

GENERAL DESCRIPTION:

Charter Greens is a proposed 54.7 acre, low density development in the Briargate Development located in the northeast part of Colorado Springs, Colorado. The site is located south of Old Ranch Road, west of Lexington Drive, and north of the proposed alignment of Chapel Hills Drive and the Pine Creek Golf Course (Vicinity Map).

The site lies entirely within the Pine Creek Drainage Basin for which the City adopted a Drainage Basin Planning Study, dated October, 1988, as amended. The proposed development conforms with the designated land use map for the site.

The overall basin drainage slopes naturally east to west at approximately a 3% slope and outfalls to Pine Creek west of the Pine Creek Golf Course. Existing developments in the basin include a residential area and the Challenger Middle School along Lexington Drive, and the Pine Creek Golf Course.

The affected drainage basins for the proposed development in the Drainage Basin Planning Study are 19, 17, and 14.

The soil within the study area is classified in Hydrologic Soil Group A and B by the Soil Conservation Survey, "Soil Survey of El Paso County Area, Colorado", (Soils Investigation) and is summarized as follows:

Identity Number	Soil Type	Hydrologic Group
8	Blakeland	A
68	Peyton Park	B
97	Truckton	B

Soils Type A and B have a low natural runoff.

The Pine Creek Drainage Basin is a closed no-fee basin.

Runoff is determined using the Rational Method.

OFF-SITE DRAINAGE:

The proposed development is affected by off-site drainage from the east, as shown on the enclosed Charter Greens Drainage Plan. The runoff from the overall drainage area outfalls either to a proposed detention pond in the Pine Creek Golf Course (Pond Outfall) or to Pine Creek at Chapel Hills Drive (Creek Outfall).

Drainage Area A (Pond Outfall):

The drainage area tributary to the Pond Outfall is 90.5 acres (Basin 19A-1, 17.2 acres; 19A-2, 27.8 acres; 19A-3, 15.9 acres and 19A-4, 29.6 acres). The school site (Basin 19A-4, 29.6 acres) will provide required detention facilities in accordance with the 35% (developed minus historic) Pine Creek criteria. As a result, the runoff at the Pond Outfall (Design Point DP-2A) for $Q_{10} = 145$ cfs and $Q_{100} = 225$ cfs, of which 200 cfs is conveyed in a 42 inch RCP pipe. Pipe flow is maximized to divert basin runoff to the detention pond.

For information purposes, off-site basins within the planning study Basin 14 affecting drainage conveyance facilities to the detention pond in the golf course are shown as Basin 14A-1, 58.8 acres and 14A-2, 33.1 acres. The runoff at the Pond Outfall in the grass channel for $Q_{10} = 147$ cfs, and $Q_{100} = 257$ cfs.

Drainage Area B (Creek Outfall):

The drainage area tributary to the Creek Outfall is 86.0 acres (Basin 19B-1, 13.0 acres; 19B-2, 6.3 acres; 19B-3, 29.9 acres; 19B-4, 1.7 acres; 19B-5, 7.5 acres; 19B-6, 2.2 acres; 19B-7, 9.5 acres; 19B-8, 2.4 acres; 19B-9, 1.9 acres; and 19B-10, 11.6 acres). The proposed Charter Greens development drainage area contributing to the Creek Outfall is approximately 52 acres. At the Creek Outfall (Design Point DP-6) the runoff for $Q_{10} = 119$ cfs and $Q_{100} = 212$ cfs, of which 120 cfs is conveyed in a 36 inch RCP pipe. At Pine Creek, Chapel Hills Drive will be sagged allowing street runoff to discharge directly to the Creek.

Required storm sewer improvements and design criteria are shown on the Drainage Plan.

A summary of all calculations is included in the Appendix.

ON-SITE DRAINAGE:

Based upon proposed grading and development configurations, Charter Greens has been divided into 6 basins, (Basin 19B-3, 29.9 acres; 19B-4, 1.7 acres; 19B-6, 2.2 acres; 19B-7, 9.5 acres; and 19B-9, 1.9 acres) as shown on the Drainage Plan. Also, approximately 4.9 acres is included in Basin 19B-1, 13.0 acres. The site total drainage area is approximately 52.0 acres.

Runoff from Basin 19B-1, (4.9 acres Charter Greens and 8.1 acres off-site), will surface flow south in Lexington Drive and then west in Chapel Hills Drive with Basin 19B-4, 1.7 acres, to Treelake Drive. At Treelake Drive a 36" RCP storm sewer will collect runoff from Basin 19B-1, 19B-4 and 19B-3. The storm sewer in Treelake Drive will be extended in to the development to intercept Q_{100} runoff.

Runoff from Basin 19B-6, 2.2 acres; 19B-7, 9.5 acres; and 19B-9, 1.9 acres, will surface flow to Chapel Hills Drive. In Chapel Hills Drive, surface and storm sewer facilities will convey the runoff westerly to the Pine Creek Outfall.

A summary of all calculations is included in the Appendix.

OUTFALL DRAINAGE FACILITIES:

Drainage facilities required to accommodate runoff from Charter Greens consist of surface flow in streets and necessary storm sewer improvements as shown on the Drainage Plan. Affected drainage is conveyed to either a proposed detention pond in the Pine Creek Golf Course or to Pine Creek crossing Chapel Hills Drive, as required by the planning study. No drainage problems exist, however, all proposed drainage facilities are subject to final design.

Reference is made to the Design Report for Pine Creek Detention Facility No. 1, dated December 1992, and the Final Drainage Report for Pine Creek Corridor from Detention Facility No. 1 through Chapel Hills Drive, dated January 1993 prepared by Obering, Wurth & Associates. Together, these reports allow for the development of Charter Greens and provide for the conveyance of developed flows through the Pine Creek Corridor to Detention Facility No. 1.

The design parameters for Detention Facility No. 1A is beyond the scope of this study. Preliminary data is included in the Addendum Plan for Pine Creek Drainage Basin Master Plan.

SUMMARY:

Charter Greens is a proposed 54.7 acre, low density residential development in the northeast part of Colorado Springs, Colorado. The proposed development land use and drainage concept is consistent with the Pine Creek Drainage Basin Planning Study. No drainage problems exist.

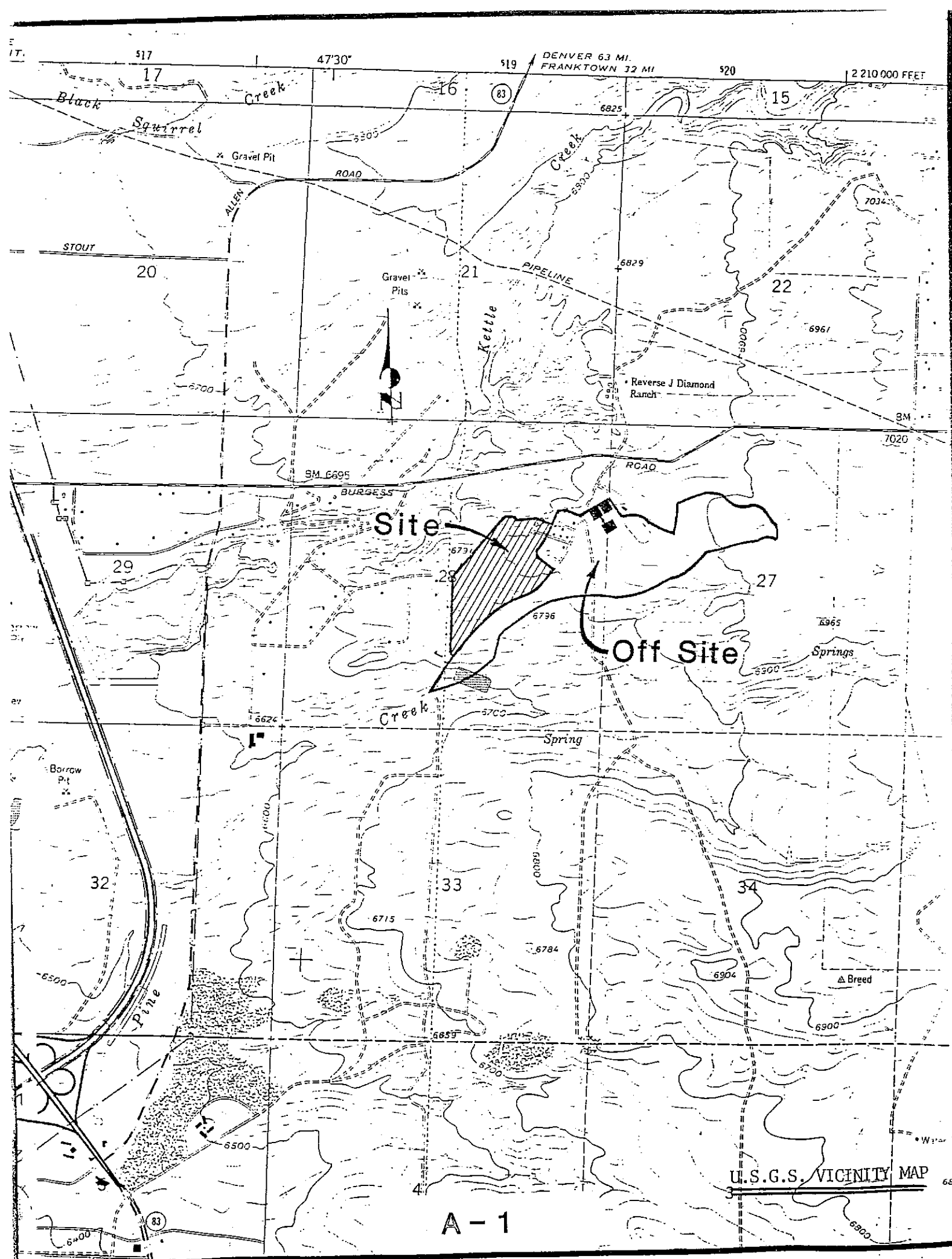
Affected on-site and off-site drainage is conveyed to either a detention pond in the golf course or to Pine Creek. On-site drainage facilities include a 36" RCP storm sewer and inlets. Off-site drainage facilities include detention pond, storm sewer, and appurtenances.

Pine Creek is designated as a closed basin and the developer is responsible for all drainage costs.

No portion of Charter Greens studied herein is within a FEMA designated floodplain per Flood Insurance Rate Map Community Panel Number 080060 0152B, effective December 18, 1986.

APPENDIX

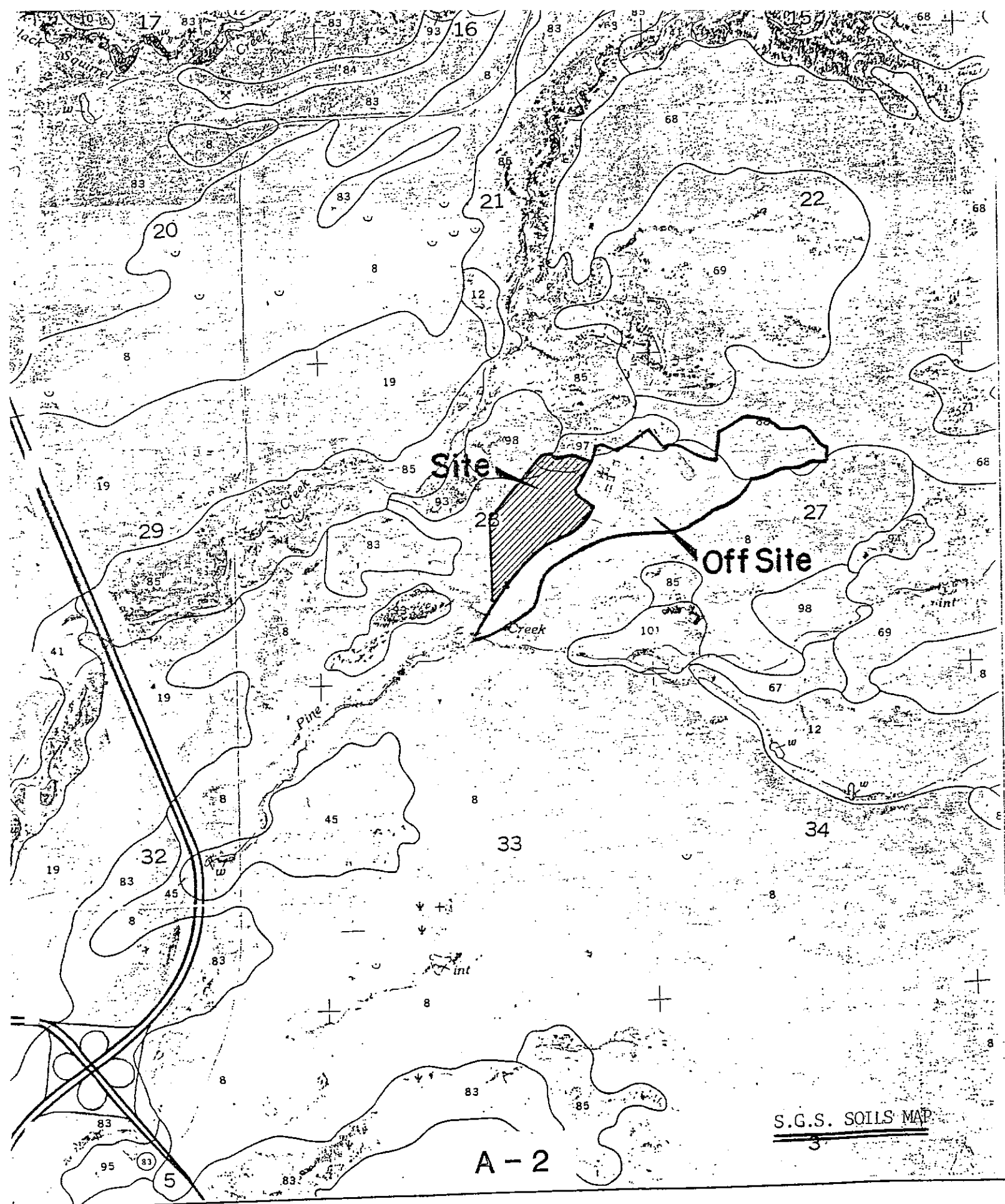
U.S.G.S. VICINITY MAP



U.S.G.S. VICINITY MAP

A-1

S.C.S. SOILS MAP



Site

Off Site

S.G.S. SOILS MAP

A-2

SUMMARY OF HYDROLOGIC COMPUTATIONS

BASIN	AREA in ACRES	BASIN		Tc (min.)	I ₁₀	I ₁₀₀	SOIL GROUP	LAND USE	C ₁₀	C ₁₀₀	FLOW	
		LENGTH	HEIGHT								Q ₁₀	Q ₁₀₀
BASIN 19 (Pine Creek Drainage Basin Planning Study)												
19A-1	17.2	1800	S=2.8% 50'	19	3.5	5.3	A&B	Golf Cvs. L, LM	C _w =0.45 6.4@0.30 10.8@0.55	C _w =0.61 6.4@0.55 10.8@0.65	27	56
			Tc=0v.120 @ 2% = 14 St. 1680 / 5.4 ft/s = 5									
19A-2	27.8	2000	S=3.5% 70'	19	3.5	5.3	A&B	Golf Cvs. L, LM, M	C _w =0.50 5.0@0.30 22.8@0.55	C _w =0.63 5.0@0.55 22.8@0.65	49	93
			Tc=0v.120 @ 2% = 14 St. 1880 / 6.4 ft/s = 5									
DP-1 (Basin 19A-1 & 19A-2) Chapel Hills Dr & Unnamed Rd. South												
-	45.0	3000	S=2.3% 70'	24	3.1	4.6	A&B	-	C _w =0.49 11.4@0.30 33.6@0.55	C _w =0.62 11.4@0.55 33.6@0.65	68	128
			Tc=0v.120 @ 2% = 14 St. 2380 / 4.9 ft/s = 10									
19A-3	15.9	2000	S=3.5% 70'	19	3.5	5.3	A&B	LM	0.55	0.65	31	55
			Tc=0v.120 @ 2% = 14 St. 1880 / 6.4 ft/s = 5									
DP-2(EAST) (Basin 19A-3 & DP-1) Chapel Hills Dr & Golf Clubhouse Rd. (Runoff from East)												
-	60.9	4200	S=2.9% 120'	26	3.0	4.4	A&B	-	C _w =0.50 15.9@0.55 45.0@0.49	C _w =0.63 15.9@0.65 45.0@0.62	91	169
			Tc=0v.120 @ 2% = 14 St. 4080 / 5.5 ft/s = 12									



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SUMMARY OF HYDROLOGIC COMPUTATIONS

BASIN	AREA in ACRES	BASIN		Tc (min.)	I ₁₀	I ₁₀₀	SOIL GROUP	LAND USE	C ₁₀	C ₁₀₀	FLOW	
		LENGTH	HEIGHT								Q ₁₀	Q ₁₀₀
19A-4 School Area	29.6	1500	S=4.7% 70	21	3.3	5.0	A&B	School Playgrounds	C _w =0.60 15.0@0.90 14.6@0.30	C _w =0.78 15.0@0.95 14.6@0.60	59	115
(Historic) 19A-4	29.6	1500	S=4.7% 70	33	2.5	3.8	A&B	Historic	0.15	0.20	11	22
- School Detention Release Rate = 115 (Dev.) - 22 (Hist.) = 93 cfs × 0.65 = 60 cfs												
DP-2A* Pond Outfall	(Basin 19A-3, DP-1) (90.5) 60.9	5600	S=3.4% 190	28	2.8	4.3	A&B	-	C _w =0.50 15.9@0.55 45.0@0.49	C _w =0.63 15.9@0.65 45.0@0.62	(35+60) 145	(165+60) 225
* School Detention			T _c = Ov. 120' @ 2% = 14 St. 4080' / 5.5% / 5 = 12 Pipe. 1400' / 16% / 5 = 2									
DP-2A** Pond Outfall	(Basin 19A-3, DP-1) (90.5) 90.5	5600	S=3.4% 190	28	2.8	4.3	A&B	-	C _w =0.54 15.9@0.55 45.0@0.49 29.6@0.60	C _w =0.68 15.9@0.65 45.0@0.62 29.6@0.78	137	264
** No School Detention			T _c = Ov. 120' @ 2% = 14 St. 4080' / 5.5% / 5 = 12 Pipe. 1400' / 16% / 5 = 2									



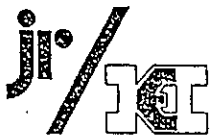
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CHARTER GREENS

SUMMARY OF HYDROLOGIC COMPUTATIONS

BASIN	AREA in ACRES	BASIN		T _c (min.)	I ₁₀	I ₁₀₀	SOIL GROUP	LAND USE	C ₁₀	C ₁₀₀	FLOW	
		LENGTH	HEIGHT								Q ₁₀	Q ₁₀₀
19B-1	13.0	1700	S=2.9% 50	22	3.2	4.9	A&B	LM, L	0.50	0.60	21	38
			T _c = Ov. 150' @ 2% = 17 St. 1520 / 5.5 ft/s = 5									
19B-2	6.3	1100	S=2.7% 30	22	3.2	4.9	A&B	Park	0.30	0.55	6	17
			T _c = Ov. 300' @ 2.7% = 19 St. 800 / 5 ft/s = 3									
DP-3	(Basin 19B-1 & 19B-2)	Chapel Hills Dr. & Lexington Dr.										
-	19.3	1700	S=2.9% 50	22	3.2	4.9	A&B	-	C _w = 0.44 13.0 @ 0.50 6.3 @ 0.30	C _w = 0.59 13.0 @ 0.60 6.3 @ 0.55	27	56
			T _c = Ov. 150' @ 2% = 17 St. 1550 / 5.5 ft/s = 5									
19B-4	1.7	900	24	13	4.1	6.1	A&B	L	0.50	0.60	3	6
			T _c = Ov. 50' @ 2% = 10 St. 850 / 5.3 ft/s = 3									
DP-4 (EAST)	(Basin 19B-4, DP-3)	Chapel Hills Dr. & Treelake Dr. (Runoff from East)										
-	21.0	2600	S=2.8% 74	20	3.4	5.2	A&B	-	C _w = 0.44 6.3 @ 0.30 14.7 @ 0.50	C _w = 0.58 6.3 @ 0.55 14.7 @ 0.60	31	63
			T _c = Ov. 120' @ 2% = 14 St. 2480 / 6.8 ft/s = 6									



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CHARTER GREENS

SUMMARY OF HYDROLOGIC COMPUTATIONS

BASIN	AREA in ACRES	BASIN		T _c (min.)	I ₁₀	I ₁₀₀	SOIL GROUP	LAND USE	C ₁₀	C ₁₀₀	FLOW	
		LENGTH	HEIGHT								Q ₁₀	Q ₁₀₀
19B-5	7.5	1600	S=2.8% 44	19	3.5	5.3	A&B	MH	0.55	0.65	14	26
		T _c = Ov. 120' @ 2% = 14 St. 1480 / 5.4 ft/s = 5										
19B-3	29.9	2900	S=2.2% 64	24	3.1	4.6	A&B	L	0.50	0.60	46	83
		T _c = Ov. 120' @ 2% = 14 St. 2780 / 4.8 ft/s = 10										
DP-4	(Basin	19B-3, 19B-4, 19B-5 & DP-3)	Chapel Hills Dr. & Tree Lake Dr.									
-	58.4	2600	S=2.8% 74	24	3.1	4.6	A&B	-	C _w =0.42	C _w =0.52	76	140
		T _c = Ov. 150' @ 2% = 17 St. 2450 / 3.4 ft/s = 7							29.9 @ 0.50	29.9 @ 0.60		
									1.7 @ 0.50	1.7 @ 0.60		
									7.5 @ 0.55	7.5 @ 0.65		
									19.3 @ 0.44	19.3 @ 0.59		
19B-6	2.2	800	S=3.8% 30	12	4.3	6.5	A&B	L	0.50	0.60	5	9
		T _c = Ov. 50' @ 2% = 10 St. 750 / 6.3 ft/s = 2										
19B-7	9.5	1150	S=3.8% 44	13	4.1	6.1	A&B	L	0.50	0.60	19	35
		T _c = Ov. 50' @ 2% = 10 St. 1100 / 6.3 ft/s = 3										



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CHARTER GREENS

SUMMARY OF HYDROLOGIC COMPUTATIONS

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BASIN	AREA in ACRES	BASIN		Tc (min.)	I ₁₀	I ₁₀₀	SOIL GROUP	LAND USE	C ₁₀	C ₁₀₀	FLOW	
		LENGTH	HEIGHT								Q ₁₀	Q ₁₀₀
19B-8	2.4	800	S=3.87% 30	12	4.3	6.5	A&B	MH	0.55	0.65	6	10
		Tc=0v. 50' @ 27% = 10 5t. 750' / 6.3 ft/s = 2										
DP-5	(Basin 19B-6, 19B-7, 19B-8, DP-4)	Chapel Hills Dr & Croycroft Dr.										
-	72.5	3400	S=3.87% 104	24	3.1	4.6	A&B	-	Cw=0.44	Cw=0.54	99	180
		Tc=0v. 120' @ 27% = 14 5t. 3280' / 5.6 ft/s = 10							2.2 @ 0.50	2.2 @ 0.60		
									9.5 @ 0.50	9.5 @ 0.60		
									2.4 @ 0.55	2.4 @ 0.65		
									58.4 @ 0.42	58.4 @ 0.52		
19B-9	1.9	600	S=3.37% 20	15	3.9	5.9	A&B	L	0.50	0.60	4	7
		Tc=0v. 120' @ 27% = 14 5t. 480' / 5.8 ft/s = 1										
19B-10	11.6	1800	S=5.67% 100	18	3.6	5.4	A&B	M	0.55	0.65	23	41
		Tc=0v. 120' @ 27% = 14 5t. 1680' / 7.6 ft/s = 4										
DP-6	(Basin 19B-9, 19B-10 & DP-5)	Chapel Hills Dr & Pine Creek Creek Outfall.										
Creek Outfall	86.0	4600	S=3.7% 168	26	3.0	4.4	A&B	-	Cw=0.46	Cw=0.56	119	212
		Tc=0v. 120' @ 27% = 14 5t. 4480' / 6.2 ft/s = 12							1.9 @ 0.50	1.9 @ 0.6		
									11.6 @ 0.55	11.6 @ 0.65		
									72.5 @ 0.44	72.5 @ 0.54		



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SUMMARY OF HYDROLOGIC COMPUTATIONS

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BASIN	AREA in ACRES	BASIN		T _c (min.)	I ₁₀	I ₁₀₀	SOIL GROUP	LAND USE	C ₁₀	C ₁₀₀	FLOW	
		LENGTH	HEIGHT								Q ₁₀	Q ₁₀₀
<u>SUPPLEMENTAL DATA:</u>												
BASIN 14 (Pine Creek Drainage Basin Planning Study)												
14A-1	58.8	3100	140	21	3.3	5.0	A&B	L, LM	0.55	0.65	107	191
		S = 4.5%										
		T _c = Ov. 120' @ 2% = 14										
		St. 2980 / 6.8 ft = 7										
14A-2	33.1	2200	100	19	3.5	5.3	A&B	M	0.55	0.65	64	114
		S = 4.5%										
		T _c = Ov. 120' @ 2% = 14										
		St. 2080 / 6.8 ft = 5										
ODD-1	(Basin 14A-1 & 14A-2) Golf Course Channel Outfall to Detention Pond.											
Channel Outfall to Pond.	91.9	5300	240	27	2.9	4.3	A&B	-	0.55	0.65	147	257
		S = 4.5%										
		T _c = Ov. 120' @ 2% = 14										
		St. 5180 / 6.8 ft = 13										



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CHARTER GREENS

SUMMARY OF HYDROLOGIC COMPUTATIONS

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REFERENCES

PUBLICATIONS

- Pine Creek Drainage Basin, Drainage Basin Planning Study Revised October, 1988, by Obering, Wurth & Associates, approved by the City of Colorado Springs on June 20, 1989.
- Soil Survey of El Paso County Area, Colorado, United States Department of Agriculture Soil Conservation Service in Cooperation with the Colorado Agricultural Experiment Station.
- City of Colorado Springs/El Paso County Drainage Criteria Manual, revised November, 1991.
- Flood Insurance Rate Map (FIRM), City of Colorado Springs, Colorado, El Paso County, Community-Panel Number 080060 0152B, Federal Emergency Management Agency (FEMA).

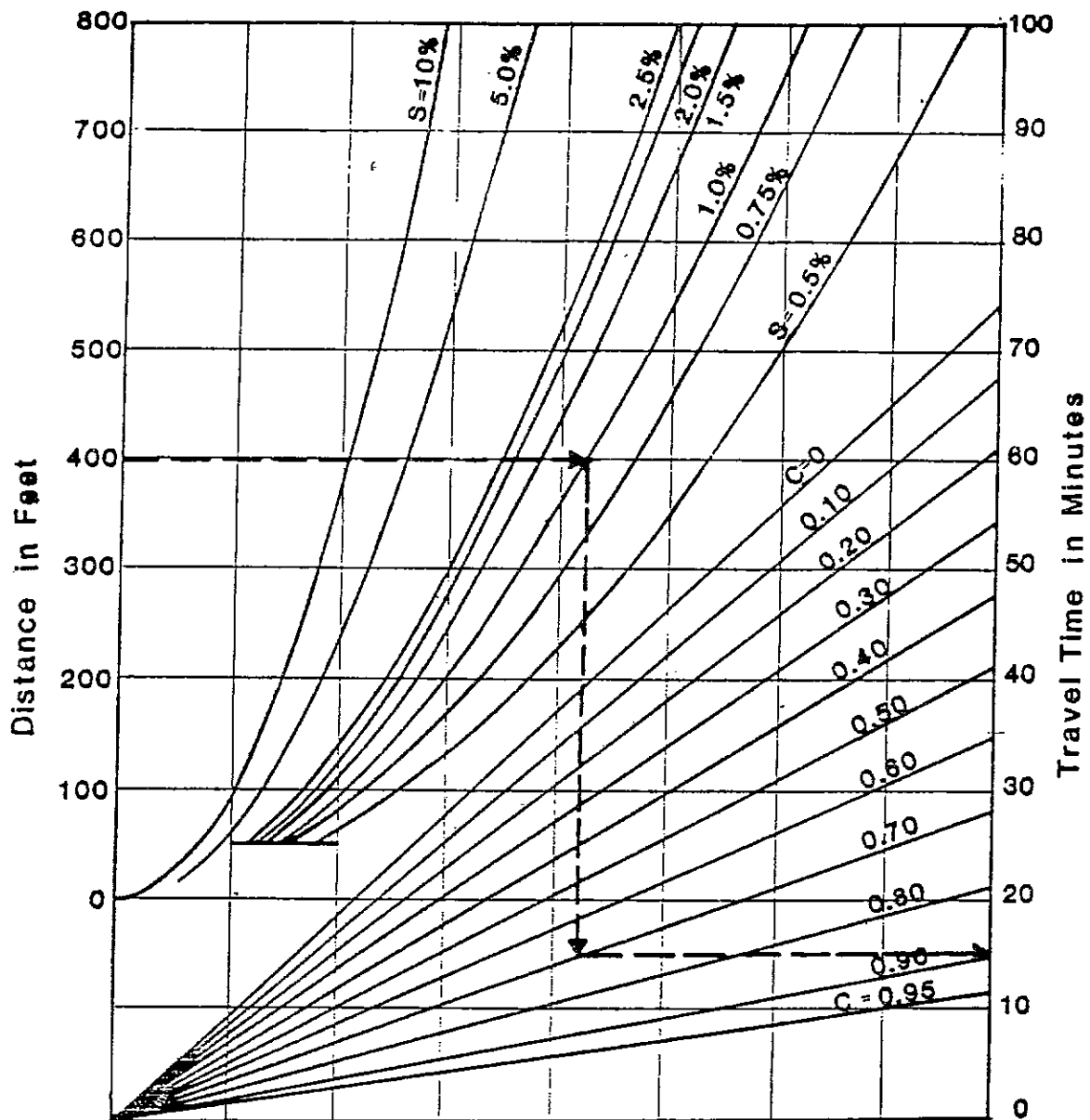
TABLE 5-1

RECOMMENDED AVERAGE RUNOFF COEFFICIENTS AND PERCENT IMPERVIOUS

LAND USE OR SURFACE CHARACTERISTICS	PERCENT IMPERVIOUS	"C" FREQUENCY			
		10		100	
		A&B*	C&D*	A&B*	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	0.60	0.70	0.70	0.80
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

9/30/90



REFERENCE : Wright - McLaughlin Engineers, Urban Storm Drainage Criteria Manual, Vol. 1,
 Denver Regional Council of Governments, Denver, Co. 1977



HDR Infrastructure, Inc.
 A Centerra Company

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

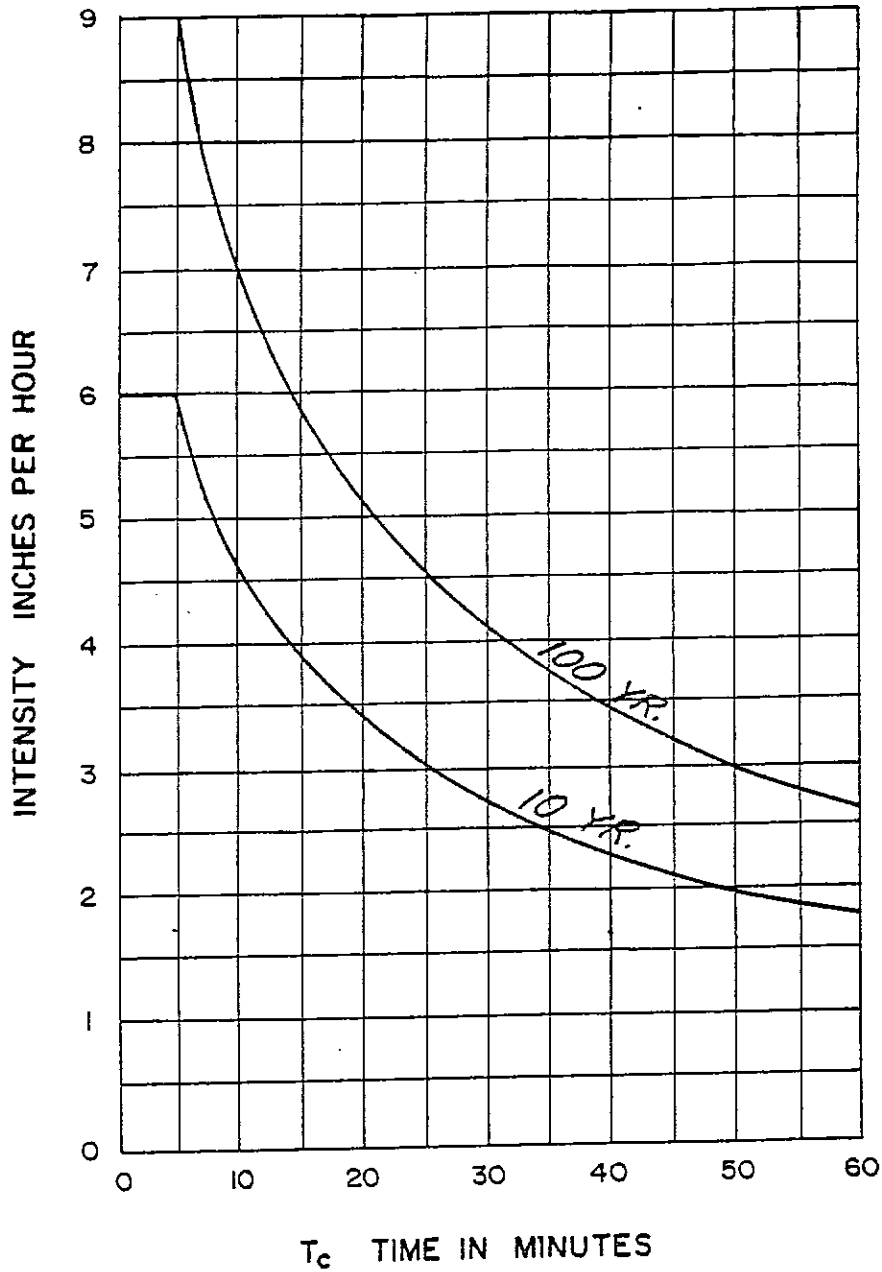
Overland Flow Curves

5-10

Date
 OCT. 1987

Figure

5-2



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



HDR Infrastructure, Inc.
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Drainage Criteria Manual

Storm Rainfall
Time Intensity-Frequency Curves

Date

OCT. 1987

Figure

5 - 1



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PROJECT CHARTER GREENS

BY ABE

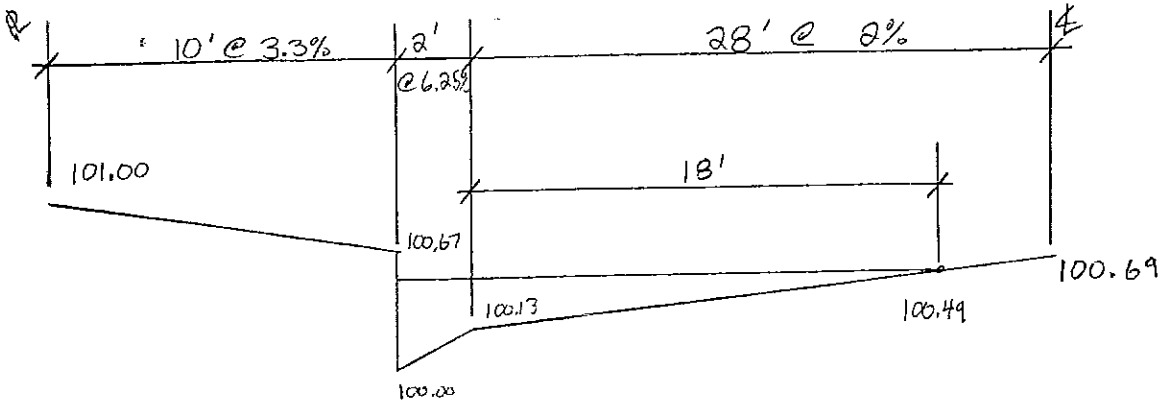
CHK.

DATE 10/22/92

SUBJECT STREET FLOW VELOCITY FOR T₂

REV. 1/11/92

SHEET NO. 1 OF 2



$$d = 8''$$

$$A = .13 + .72 + 3.24 = 4.09$$

$$P = .49 + 2.0 + 18 = 20.49$$

$$Q = \frac{1.486}{N} A R^{.66} S^{.5}$$

$$Q = \frac{1.486}{.016} (4.09) (.20)^{.66} (.5)^{.5}$$

$$Q = 131.3 \sqrt{S}$$

$$\therefore V = 32.1 \sqrt{S}$$

SLOPE	CAPACITY	VELOCITY
1%	13 cfs	3.2 fps
2%	19 cfs	4.5 fps
4%	26 cfs	6.4 fps
6%	32 cfs	7.9 fps
8%	37 cfs	9.1 fps
10%	42 cfs	10.2 fps

Q₁₀ Street Runoff Data.



$d = 12''$

$Q = \frac{1.486}{N} A R^{.66} S^{.5}$

$A = 1.74 + .13 + 7.84 + 8.68 + 1.65 = 20.04$

$P = 28.01 + 2 + .67 + 10 = 40.68$

$Q = \frac{1.486}{.016} (20.04) (.49)^{.66} (S)^{.5}$

$Q = 1162.3 \sqrt{S}$

$\therefore V = 58 \sqrt{S}$

SLOPE	CAPACITY	VELOCITY
1%	116 cfs	5.8 fps
2%	164 cfs	8.2 fps
4%	233 cfs	11.6 fps
6%	285 cfs	14.2 fps
8%	329 cfs	16.4 fps
10%	368 cfs	18.3 fps

Q100 Street Runoff Data.

DRAINAGE PLAN