MASTER DEVELOPMENT DRAINAGE PLAN

FOR

POWERWOOD ADDITION NO. 2

Prepared For:
Mr. Marty Chase
3225 Templeton Gap Road
Colorado Springs, CO 80907

Prepared By:
Associated Design Professionals, Inc.
1861 Austin Bluffs Parkway, Suite 101
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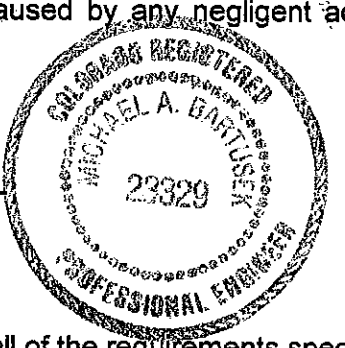
(719) 266-5212

August 1, 2003
020202

ADP
Associated Design Professionals, Inc.

ENGINEERS 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 negligent acts, errors or omissions on my part in preparing this report.



Michael A. Bartusek, P.E. #23329

DEVELOPER'S STATEMENT:

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

Infinity
BUSINESS NAME

By: _____

Title: President

Address: 1465 N Union Blvd
Colo Springs, CO
80909

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

Tim Mitchell
City Engineer

Oct 3, 2003
Date

Conditions:

POWERWOOD ADDITION NO. 2
MASTER DEVELOPMENT DRAINAGE PLAN

GENERAL

This is a drainage study for the platting and annexation of an 87.57-acre site described as PowerWood Addition No. 2. The site is located within the Cottonwood Creek Drainage Basin in Colorado Springs, Colorado. The future development of this property consists of 30.56-acres of community commercial, 37.89-acres of office and light industrial parcels and 19.12-acres of multi-family residential areas. This study will consider the impact, if any, on the existing development and neighboring properties.

This site is located north of Woodman Road and east of Powers Boulevard. A portion of the site along the northwest corner is located within a designated FEMA 100-year floodplain as designated on Map No. 08041C0529F, dated March 17, 1997. According to the El Paso County Area Soil Survey, the soil on the site is classified as a Blakeland Sandy Loam. This soil can be described as having a rapid permeability, slow surface runoff and a moderate hazard of erosion. The soil classification is A. Once grading has taken place, a soil classification of B will be used.

The site has been previously analyzed as part of the following Master Drainage Studies:

Cottonwood Creek Drainage Basin Planning Study, by Ayers Associates, revised February, 1999.

Powers Boulevard – Woodman Road Interchange Preliminary Drainage Report, prepared by URS, February, 2002.

Cottonwood Creek Stability Evaluation, by Ayers Associates, revised May, 1996.

METHOD OF COMPUTATIONS:

The Methodology utilized for this report is in accordance with the *City/County Drainage Criteria Manual*. The Rational Method for computation of runoff was used.

$$Q = cia$$

Where Q = maximum rate of runoff in cubic feet per second
c = runoff coefficient representing drainage area characteristics
i = average rainfall intensity, in inches per hour, for the duration required for the runoff to become established
a = drainage basin size in acres

EXISTING DRAINAGE CHARACTERISTICS

The site is sparsely vegetated with a one single-family dwelling. The slope across the site is predominately 6-8 percent in a northwesterly direction to Cottonwood Creek. Off-site basins C-I, and OS2 –OS6 contribute flows directly to the Cottonwood Creek. The remainder of the parcel drains to the West, South and Southwest to existing drainage facilities located along Powers and Woodman Road.

Based on the existing conditions of the site, the following storm flows will result:

Sub-Basin	5-Year Flow (CFS)	100-Year Flow (CFS)
A	18.3	47.9
B	4.3	11.2
C	31.1	81.5
D	4.9	13.0
E	6.2	16.3
F	3.5	9.2
G	3.4	8.9
H	1.7	4.4
I	0.5	1.3
OS-1	2.5	6.5
OS-2	4.9	12.9
OS-3	4.9	12.8
OS-4	2.1	5.6
OS-5	44.9	117.6
OS-6	4.4	11.6

The existing combined flow entering Cottonwood Creek as shown on the Historic Conditions Drainage Plan is 360.8 cfs. The Cottonwood Creek DBPS, June 1994, lists the Q(100) for this area to be approximately 421 cfs at fully developed conditions for the existing zoning or existing conditions.

PROPOSED DRAINAGE CHARACTERISTICS

The proposed development will consist of several different uses: office and industrial, community commercial, and multi-family residential. The existing topography reveals two existing eroded tributaries of Cottonwood Creek. One along the northwest corner of the site and the other located alone the northeast corner of the property. The proposed grading allows the tributaries to be filled as designated by the prudent line shown in the Cottonwood Creek Stabilization Evaluation, May 1996. Channel bottom stabilization of placed riprap shall be constructed along a 50' section of channel as delineated on the Developed Site Conditions Plan.

The challenges that arise with the tributary to the northeast include additional site drainage from OS-2-OS-5 sub-basins. The proposed grading to occur at the site requires the installation of drainage facilities to accommodate the off-site flows from the properties to the east. Should future development occur on the adjacent properties, grading shall include the installation of permanent detention facilities and the abandonment of the storm water facilities collecting the historic flows. All future adjacent developments must contain all developed flows above the historic levels due to downstream creek degradation that has occurred in Cottonwood Creek.

Based on the proposed developments to occur at the site, the following storm flows will result:

Sub-Basin	5-Year Flow (CFS)	100-Year Flow (CFS)
A(1)	5.2	10.3
A(2)	2.9	5.8
B	2.9	5.5
C	66.6	133.0
D	3.2	6.3
E	32.5	64.9

F	2.9	5.8
G	14.0	27.9
H	13.3	26.5
I	3.5	7.0
J	10.3	20.5
K	4.4	11.6
L	2.1	4.1
M	29.0	58.0
N	6.0	12.0
O	3.4	6.8
P	2.4	4.8
Q	2.2	4.4
R	2.7	6.9
S	9.3	24.4
T	9.1	18.2
U	31.5	62.8
V	0.7	1.9
W	2.6	5.2
X	11.5	23.0
Y	1.6	3.3
Z	3.5	7.0

PowerWood Community Commercial Retail Center is planned on lots 1, 2, 4, 5, 7 & 8 located along the southern portion of the property. The proposed community commercial area drains towards the west to the proposed drainage facilities by CDOT located along Woodmen Road and Powers Boulevard. The sub-basins located along the proposed development draining to Cottonwood Creek are anticipated to generate 141.5 cfs at fully developed conditions. The proposed drainage facilities by CDOT include a series of inlets and vegetated ditches located along the interchange ramp, Woodmen Road and Powers Boulevard.

PowerWood Office-Industrial Park is planned on lots 9, 10, 11, 12 and the majority of the remaining unplatted lot. Lots 10, 11, 12 and portions of the unplatted parcel drain to the proposed detention area via traditional storm water facilities located along the roadway. The contributing flows from Sub-basins E-H, L-M, O-Q, T, U and Z to detention facility are 183.3 cfs. The detention basin will hold the developed flows and pass the difference between the historic Q(100) flow rates and the developed Q(100) flow rate which is 34.7 cfs.

Sub-basins K and N will sheet flow into the proposed CDOT drainage facilities located along Powers Boulevard. The contributing flows are 23.6 cfs.

PowerWood residential development is planned on the remainder of the unplatted parcel to north. All flows from this parcel will either sheet flow to Cottonwood Creek or enter Cottonwood Creek via the storm water facilities shown on the Developed Conditions Drainage Plan. The contributing flows from the planned multi-family development to Cottonwood Creek are 142.8 cfs.

The storm sewer facilities along the proposed roadway include a series of D10R inlets and to outfalls along Cottonwood Creek or the proposed detention facility. The inlets located along the line to the south will connect to the proposed CDOT storm water facilities along Powers Boulevard. The inlets located along the roadways to the east and west will outfall to along Cottonwood Creek.

DRAINAGE FEES

The 2003 Drainage fees for the Cottonwood Creek Drainage Basin are as follows:

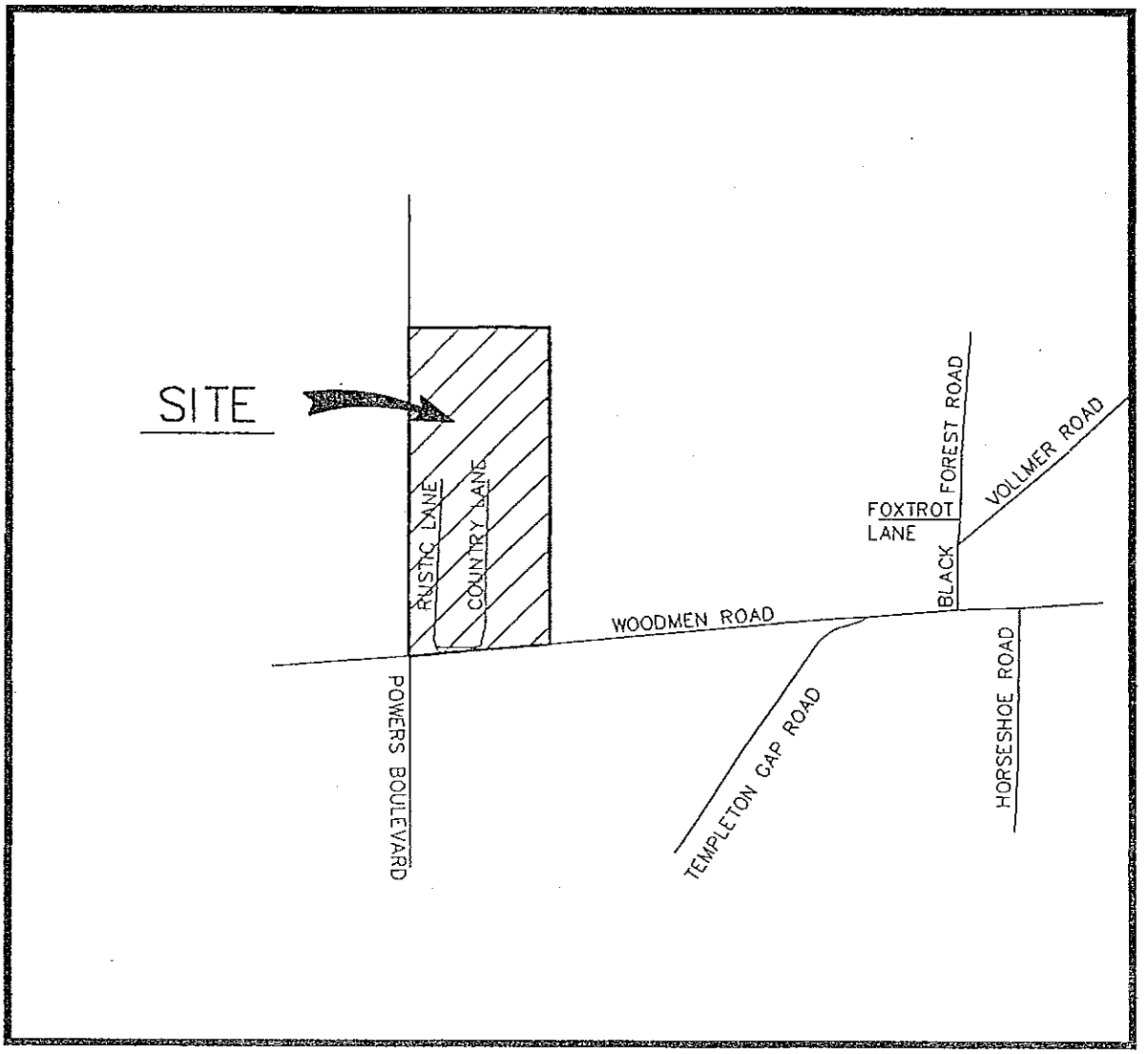
Drainage Fees:	$7,653/Acre x 87.57=	$670,173.21
Bridge Fees:	$656/Acre x 87.57 =	$57445.92
		$727,619.13

SUMMARY

Development of this site will cause no damage to adjacent property owners and improve existing eroding tributaries with proposed drainage facilities. The only flows that will be contributing to Cottonwood Creek are anticipated to be historic levels. All off-site historic flows will be collected and passed to Cottonwood Creek. The difference between the developed flows and historic flows will be collected and detained onsite. The difference between the developed flows from the adjacent parcels is to be detained on the corresponding parcel for which the flows are created. Fees amounting to $727,619.13 for the Cottonwood Creek basin are required before platting. All areas disturbed by construction will be reseeded and erosion control measures will be installed during construction of the proposed site.

Appendix A

Maps



-N- **VICINITY MAP**

N.T.S.

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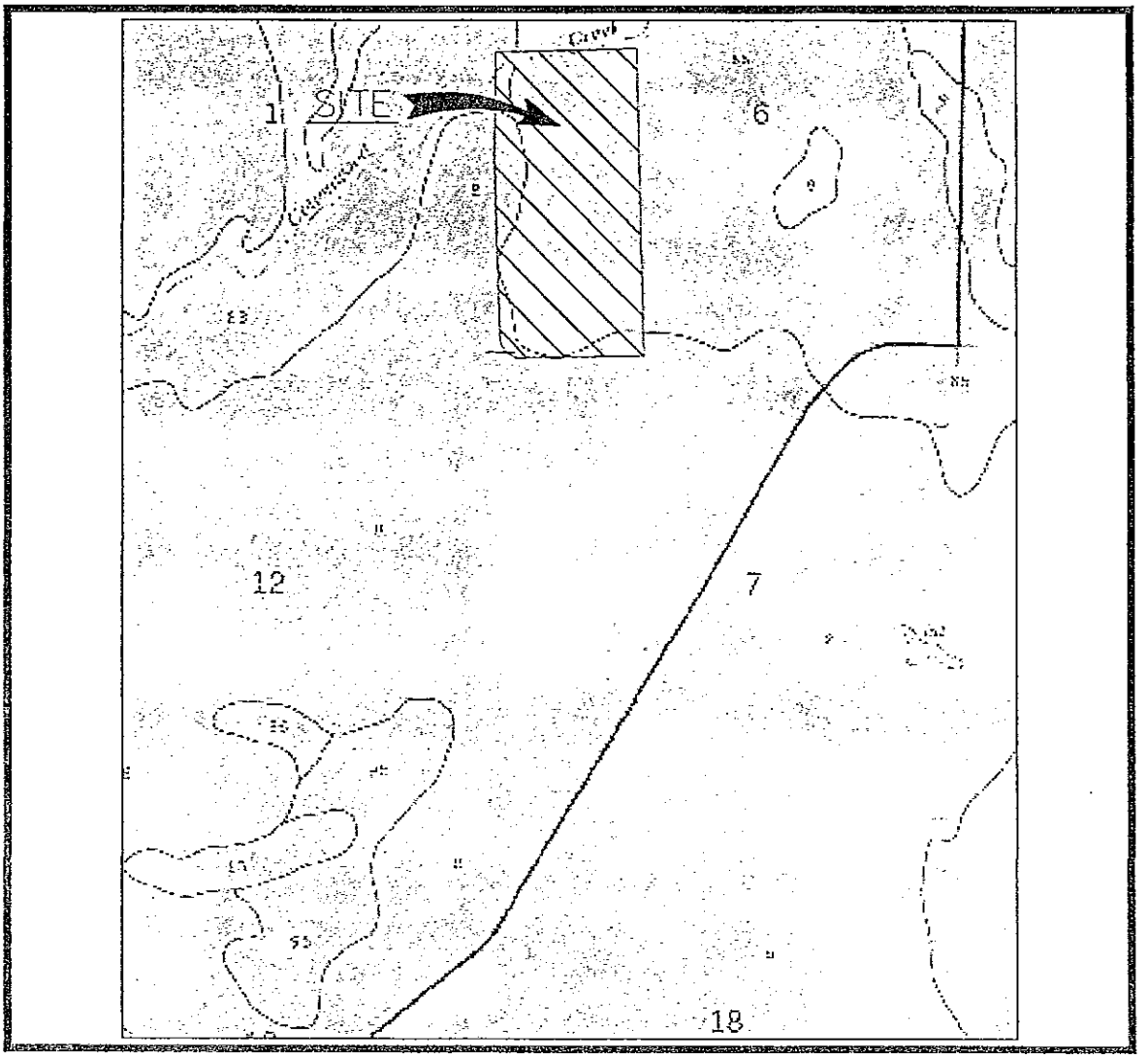

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SOILS MAP

N.T.S.

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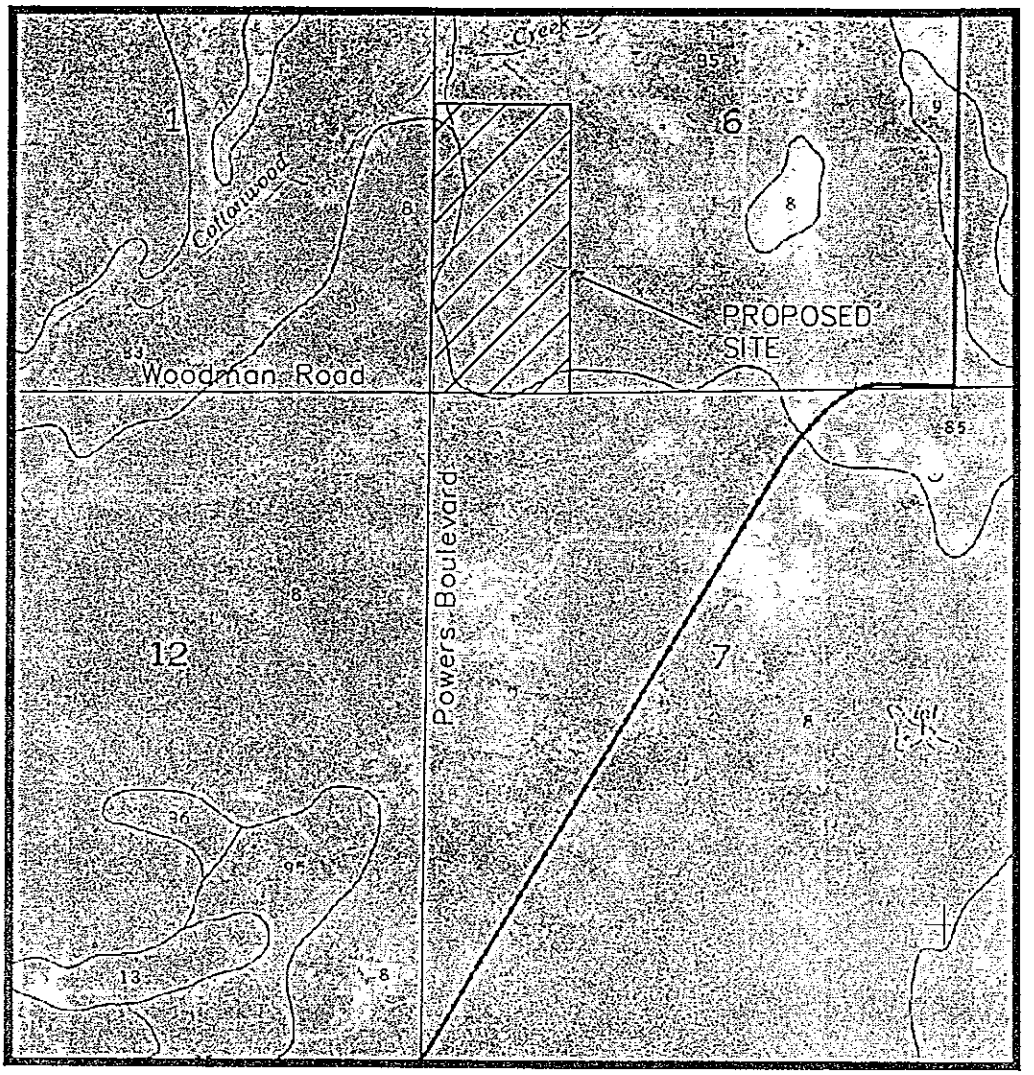
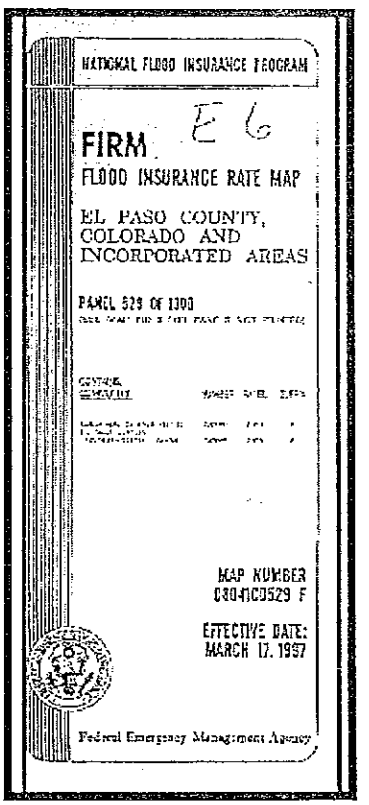


FLOODPLAIN MAP

N.T.S.



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Appendix B

Drainage Calculations

POWERWOOD NO. 2 ADDITION

HISTORIC RUNOFF RATES

RATIONAL METHOD (Q=CiA)

BASIN	TOTAL AREA (acres)	WEIGHTED C(5)	WEIGHTED C(100)	OVERLAND FLOW C(5)	OVERLAND FLOW Length (feet)	OVERLAND FLOW Slope (%)	OVERLAND FLOW Ti (min.)	OVERLAND FLOW C(5)	CHANNEL FLOW Length (feet)	CHANNEL FLOW Slope (%)	CHANNEL FLOW Ti (min.)	CHANNEL FLOW Slope (%)	CHANNEL FLOW Length (feet)	CHANNEL FLOW Velocity (f.p.s.)	CHANNEL FLOW Tt (min.)	STREET FLOW Slope (%)	STREET FLOW Length (feet)	STREET FLOW Velocity (f.p.s.)	STREET FLOW Tt (min.)	Tc TOTAL (min.)	INTENSITY I(5) (in./hr.)	INTENSITY I(100) (in./hr.)	PEAK FLOWS Q(5) (c.f.s.)	PEAK FLOWS Q(100) (c.f.s.)
A	21.13	0.30	0.45	0.30	261	4.5%	14.1	0.30	0	0.0%	0.0	7%	984	2.60	6.3	0%	0	0.00	0.0	20.4	2.9	5.0 CA(equiv)	18.3 6.34	47.9 9.53
B	4.91	0.30	0.45	0.30	743	7.4%	20.1	0.30	0	0.0%	0.0	0%	0	0.00	0.0	0%	0	0.00	0.0	20.1	2.9	5.1 CA(equiv)	4.3 1.47	11.2 2.21
C	48.38	0.30	0.45	0.30	1033	5.8%	25.8	0.30	0	0.0%	0.0	6%	1899	3.75	8.4	0%	0	0.00	0.0	34.2	2.1	3.7 CA(equiv)	31.1 14.51	81.5 21.77
D	6.65	0.30	0.45	0.30	1301	7.3%	26.8	0.30	0	0.0%	0.0	0%	0	0.00	0.0	0%	0	0.00	0.0	26.8	2.5	4.3 CA(equiv)	4.9 2.00	13.0 2.99
E	6.62	0.30	0.45	0.30	683	10.2%	17.4	0.30	0	0.0%	0.0	0%	0	0.00	0.0	0%	0	0.00	0.0	17.4	3.1	5.5 CA(equiv)	6.2 1.99	16.3 2.98
F	3.29	0.30	0.45	0.30	313	7.4%	13.1	0.30	0	0.0%	0.0	18%	169	6.50	0.4	0%	0	0.00	0.0	13.5	3.5	6.2 CA(equiv)	3.5 0.99	9.2 1.48
G	3.29	0.30	0.45	0.30	378	7.9%	14.1	0.30	0	0.0%	0.0	15%	108	6.00	0.3	0%	0	0.00	0.0	14.4	3.4	6.0 CA(equiv)	3.4 0.99	8.9 1.48
H	1.34	0.30	0.45	0.30	223	13.4%	9.1	0.00	0	0.0%	0.0	0%	0	0.00	0.0	0%	0	0.00	0.0	9.1	4.2	7.4 CA(equiv)	1.7 0.40	4.4 0.60
I	0.33	0.30	0.45	0.30	60	43.0%	3.2	0.30	0	0.0%	0.0	0%	0	0.00	0.0	0%	0	0.00	0.0	5.0	5.2	9.1 CA(equiv)	0.5 0.10	1.3 0.15
OS-1	2.82	0.30	0.45	0.30	655	6.6%	19.6	0.30	0	6.6%	0.0	0%	0	5.09	0.0	0%	0	5.09	0.0	19.6	2.9	5.1 CA(equiv)	2.5 0.85	6.5 1.27
OS-2	7.33	0.30	0.45	0.30	465	6.5%	16.6	0.30	420	7.6%	15.0	0%	0	2.65	0.0	0%	0	2.65	0.0	31.7	2.2	3.9 CA(equiv)	4.9 2.20	12.9 3.30
OS-3	6.56	0.30	0.45	0.30	756	14.7%	16.2	0.30	172	5.8%	10.5	0%	0	3.25	0.0	0%	0	3.25	0.0	26.7	2.5	4.3 CA(equiv)	4.9 1.97	12.8 2.95
OS-4	1.94	0.30	0.45	0.30	374	11.0%	12.5	0.30	0	0.0%	0.0	0%	0	3.50	0.0	0%	0	3.50	0.0	12.5	3.7	6.4 CA(equiv)	2.1 0.58	5.6 0.87
OS-5	70.58	0.30	0.45	0.30	502	5.9%	17.9	0.30	0	0.0%	0.0	0%	2338	2.30	16.9	0%	0	0.00	0.0	34.8	2.1	3.7 CA(equiv)	44.9 21.17	117.6 31.76
OS-6	4.99	0.30	0.45	0.30	544	8.1%	16.7	0.30	0	0.0%	0.0	0%	492	3.10	2.6	0%	0	0.00	0.0	19.4	3.0	5.2 CA(equiv)	4.4 1.50	11.6 2.25

POWERWOOD NO. 2 ADDITION

DEVELOPED RUNOFF RATES

RATIONAL METHOD (Q=CiA)

BASIN	TOTAL AREA (acres)	WEIGHTED C(5)	WEIGHTED C(100)	OVERLAND FLOW C(5)	OVERLAND FLOW Length (feet)	OVERLAND FLOW Slope (%)	OVERLAND FLOW Ti (min.)	STREET/CHANNEL FLOW Slope (%)	STREET/CHANNEL FLOW Length (feet)	STREET/CHANNEL FLOW Velocity (f.p.s.)	STREET/CHANNEL FLOW Tt (min.)	Tc TOTAL (min.)	INTENSITY I(5) (in./hr.)	INTENSITY I(100) (in./hr.)	PEAK FLOWS Q(5) (c.f.s.)	PEAK FLOWS Q(100) (c.f.s.)
A(1)	1.42	0.70	0.80	0.70	0	0.0%	0.0	4%	1000	3.75	4.4	5.0	5.2	9.1	**5.2**	**10.3**
														CA(equiv)	0.99	1.14
A(2)	0.80	0.70	0.80	0.70	0	0.0%	0.0	4%	451	3.00	1.9	5.0	5.2	9.1	**2.9**	**5.8**
														CA(equiv)	0.56	0.64
B	0.91	0.70	0.80	0.70	275	4.7%	7.1	0%	0	0.00	0.0	7.1	4.6	8.1	**2.9**	**5.9**
														CA(equiv)	0.64	0.73
C	22.49	0.70	0.80	0.70	325	3.0%	9.0	0%	0	0.00	0.0	9.0	4.2	7.4	**66.6**	**133.0**
														CA(equiv)	15.74	17.99
D	0.87	0.70	0.80	0.70	0	0.0%	0.0	4%	599	4.20	2.4	5.0	5.2	9.1	**3.2**	**6.3**
														CA(equiv)	0.61	0.70
E	9.90	0.70	0.80	0.70	283	5.6%	6.8	0%	0	0.00	0.0	6.8	4.7	8.2	**32.5**	**64.9**
														CA(equiv)	6.93	7.92
F	0.80	0.70	0.80	0.40	0	0.0%	0.0	5%	497	4.60	1.8	5.0	5.2	9.1	**2.9**	**5.8**
														CA(equiv)	0.56	0.64
G	5.02	0.70	0.80	0.70	275	3.3%	8.0	4%	588	4.10	2.4	10.4	4.0	7.0	**14.0**	**27.9**
														CA(equiv)	3.51	4.02
H	4.48	0.70	0.80	0.70	286	3.3%	8.2	4%	207	4.20	0.8	9.0	4.2	7.4	**13.3**	**26.5**
														CA(equiv)	3.14	3.58
I	1.17	0.70	0.80	0.70	324	3.3%	8.7	0%	0	0.00	0.0	8.7	4.3	7.5	**3.5**	**7.0**
														CA(equiv)	0.82	0.94
J	3.28	0.70	0.80	0.70	185	2.0%	7.8	0%	0	0.00	0.0	7.8	4.5	7.8	**10.3**	**20.5**
														CA(equiv)	2.30	2.62
K	2.85	0.30	0.45	0.30	100	33.3%	4.5	0%	0	0.00	0.0	5.0	5.2	9.1	**4.4**	**11.6**
														CA(equiv)	0.86	1.28
L	0.57	0.70	0.80	0.70	0	0.0%	0.0	2%	432	2.75	2.6	5.0	5.2	9.1	**2.1**	**4.1**
														CA(equiv)	0.40	0.46
M	9.44	0.70	0.80	0.70	290	3.4%	8.2	0%	0	0.00	0.0	8.2	4.4	7.7	**29.0**	**58.0**
														CA(equiv)	6.61	7.55

N	1.66	0.70	0.80	0.70	127	33.3%	2.5	0%	0	0.00	0.0	5.0	5.2	9.1 CA(equiv)	**6.0** 1.16	**12.0** 1.33
O	0.94	0.70	0.80	0.70	0	0.0%	0.0	3%	521	3.70	2.3	5.0	5.2	9.1 CA(equiv)	**3.4** 0.66	**6.8** 0.75
P	0.66	0.70	0.80	0.70	0	0.0%	0.0	4%	496	6.12	4.0	5.0	5.2	9.1 CA(equiv)	**2.4** 0.46	**4.8** 0.53
Q	0.60	0.70	0.80	0.70	0	0.0%	0.0	2%	315	2.75	1.9	5.0	5.2	9.1 CA(equiv)	**2.2** 0.42	**4.4** 0.48
R	1.98	0.30	0.45	0.30	229	21.7%	7.8	0%	0	0.00	0.0	7.8	4.5	7.8 CA(equiv)	**2.7** 0.59	**6.9** 0.89
S	7.40	0.30	0.45	0.30	180	33.3%	6.0	0%	1532	3.80	3.2	9.2	4.2	7.3 CA(equiv)	**9.3** 2.22	**24.4** 3.33
T	2.91	0.70	0.80	0.70	265	3.5%	7.7	0%	0	0.00	0.0	7.7	4.5	7.8 CA(equiv)	**9.1** 2.04	**18.2** 2.33
U	9.35	0.70	0.80	0.70	240	5.4%	6.4	0%	0	0.00	0.0	6.4	4.8	8.4 CA(equiv)	**31.5** 6.55	**62.8** 7.48
V	0.61	0.30	0.45	0.30	236	11.8%	9.7	6%	140	4.80	0.5	10.2	4.0	7.0 CA(equiv)	**0.7** 0.18	**1.9** 0.27
W	0.72	0.70	0.80	0.70	0	0.0%	0.0	2%	372	6.72	0.9	5.0	5.2	9.1 CA(equiv)	**2.6** 0.50	**5.2** 0.58
X	3.70	0.70	0.80	0.70	250	3.0%	7.9	0%	0	4.17	0.0	7.9	4.4	7.8 CA(equiv)	**11.5** 2.59	**23.0** 2.96
Y	0.45	0.70	0.80	0.70	0	3.0%	0.0	3%	150	3.25	0.8	5.0	5.2	9.1 CA(equiv)	**1.6** 0.32	**3.3** 0.36
Z	0.96	0.70	0.80	0.70	0	3.0%	0.0	3%	518	3.25	2.7	5.0	5.2	9.1 CA(equiv)	**3.5** 0.67	**7.0** 0.77

Stetson Hills Self Storage

DEVELOPED RUNOFF SURFACE ROUTING

DESIGN POINT	CONTRIBUTING BASINS	CA(equivalent)		Tc	INTENSITY		TOTAL FLOWS	
		CA(5)	CA(100)	(min.)	I(5) (in./hr.)	I(100) (in./hr.)	Q(5) (c.f.s)	Q(100) (c.f.s.)
DP-1	OS-1 A(1)	0.85 0.99 1.84	1.27 1.14 2.41	19.6 Travel Street	2.9 Length 100	5.1 Velocity 5.09	**5.4** Tt 0.3	**12.3** Routed Tc 19.9
DP-2	B DP-1	0.64 1.84 2.48	0.73 2.41 3.13	19.9 Travel Overland	2.8 Length 400	4.9 Velocity 5.42	**7.0** Tt 1.2	**15.5** Routed Tc 21.1
DP-3	C	15.74 0.00 15.74	17.99 0.00 17.99	15.0 Travel Overland	3.1 Length 650	5.4 Velocity 3.7	**48.6** Tt 2.9	**97.0** Routed Tc 17.9
DP-4	OS-2 A(2)	2.20 0.56 2.76	3.30 0.64 3.94	31.7 Travel Street	2.2 Length 450	3.8 Velocity 3.5	**6.0** Tt 2.1	**14.8** Routed Tc 33.8
DP-5	D I DP-4	0.61 0.82 2.76 4.19	0.70 0.94 3.94 5.57	33.8 Travel Street/Pipe	2.1 Length 672	3.6 Velocity 4	**8.6** Tt 2.8	**20.0** Routed Tc 36.6
DP-6	DP-5 J	4.19 2.30 6.48	5.57 2.62 8.19	36.6 Travel Pipe/Over	2.0 Length 300	3.5 Velocity 5.6	**13.1** Tt 0.9	**29.0** Routed Tc 37.5
DP-7	OS-3	1.97 0.00 1.97	2.95 0.00 2.95	26.7 Travel Overland	2.3 Length 756	4.1 Velocity 4.2	**4.6** Tt 3.0	**12.0** Routed Tc 29.7
DP-8	DP-7 F	1.97 0.56 2.53	2.95 0.64 3.59	29.7 Travel Pipe	2.2 Length 540	3.9 Velocity 3.7	**5.6** Tt 2.4	**14.0** Routed Tc 32.1
DP-9	DP-8 L	2.53 0.40 2.93	3.59 0.46 4.05	32.1 Travel Pipe	2.1 Length 460	3.7 Velocity 3.8	**6.3** Tt 2.0	**15.2** Routed Tc 34.1
DP-10	E G	6.93 3.51 10.44	7.92 4.02 11.94	13.1 Travel Over/Street	3.2 Length 815	5.6 Velocity 3.8	**33.4** Tt 3.6	**66.7** Routed Tc 16.7

DP-11	DP-10 H	10.44 3.14 13.58	11.94 3.58 15.52	16.7 Travel Over/Street	3.0 Length 515	5.3 Velocity 4.2	**40.9** Tt 2.0	**81.7** Routed Tc 18.7
DP-12	0 DP-9 DP-11	0.66 2.93 13.58 17.17	0.75 4.05 15.52 20.32	18.7 Travel Pipe/Street	2.8 Length 510	5.0 Velocity 3.7	**48.7** Tt 2.3	**100.8** Routed Tc 21.0
DP-13	OS-4 Z U	0.58 0.67 6.55 7.80	0.87 0.77 7.48 9.12	12.5 Travel Overland	3.3 Length 875	5.8 Velocity 5.2	**26.1** Tt 2.8	**53.2** Routed Tc 15.3
DP-14	P Q T DP-12 DP-13	0.46 0.42 2.04 17.17 7.80 27.88	0.53 0.48 2.33 20.32 9.12 32.78	21.0 Travel St/Ov/Pipe	2.7 Length 575	4.7 Velocity 4.2	**74.8** Tt 2.3	**153.6** Routed Tc 23.3
DP-15	DP-14 M	27.88 6.61 34.49	32.78 7.55 40.33	23.3 Travel Over/Pipe	2.6 Length 300	4.5 Velocity 3.9	**89.7** Tt 1.3	**183.3** Routed Tc 24.6
DP-16	OS-5 V	21.17 0.18 21.36	31.76 0.27 32.04	34.8 Travel Over/Pipe	2.1 Length 420	3.6 Velocity 4.6	**44.1** Tt 1.5	**115.5** Routed Tc 36.3
DP-17	W X Y	0.50 2.59 0.32 3.41	0.58 2.96 0.36 3.90	7.9 Travel Over/Pipe	4.0 Length 650	7.0 Velocity 4.6	**13.7** Tt 2.4	**27.3** Routed Tc 10.3

CIRCULAR CHANNEL ANALYSIS AND DESIGN
SOLVED WITH MANNING'S EQUATION

POWERWOOD NO. 2 MDDP
DEPTH OF FLOW BETWEEN DP-4 AND DP-5

Manning Pipe Calculator

Given Input Data:

Shape	Circular
Solving for	Depth of Flow
Diameter	18.0000 in
Flowrate	20.0000 cfs
Slope	0.0200 ft/ft
Manning's n	0.0090

Computed Results:

Depth	13.7622 in
Area	1.7671 ft2
Wetted Area	1.4498 ft2
Wetted Perimeter	38.3108 in
Perimeter	56.5487 in
Velocity	13.7953 fps
Hydraulic Radius	5.4493 in
Percent Full	76.4568 %
Full flow Flowrate	21.4578 cfs
Full flow velocity	12.1426 fps

CIRCULAR CHANNEL ANALYSIS AND DESIGN
SOLVED WITH MANNING'S EQUATION

POWERWOOD NO. 2 MDDP
DEPTH OF FLOW BETWEEN DP-5 AND DP-6

Manning Pipe Calculator

Given Input Data:

Shape	Circular
Solving for	Depth of Flow
Diameter	18.0000 in
Flowrate	29.0000 cfs
Slope	0.0500 ft/ft
Manning's n	0.0090

Computed Results:

Depth	12.8036 in
Area	1.7671 ft2
Wetted Area	1.3445 ft2
Wetted Perimeter	36.1284 in
Perimeter	56.5487 in
Velocity	21.5699 fps
Hydraulic Radius	5.3587 in
Percent Full	71.1311 %
Full flow Flowrate	33.9277 cfs
Full flow velocity	19.1992 fps

CIRCULAR CHANNEL ANALYSIS AND DESIGN
SOLVED WITH MANNING'S EQUATION

POWERWOOD NO. 2 MDDP
DEPTH OF FLOW BETWEEN DP-7 AND DP-8

Manning Pipe Calculator

Given Input Data:

Shape	Circular
Solving for	Depth of Flow
Diameter	18.0000 in
Flowrate	14.0000 cfs
Slope	0.0200 ft/ft
Manning's n	0.0090

Computed Results:

Depth	10.5967 in
Area	1.7671 ft2
Wetted Area	1.0821 ft2
Wetted Perimeter	31.4847 in
Perimeter	56.5487 in
Velocity	12.9378 fps
Hydraulic Radius	4.9492 in
Percent Full	58.8704 %
Full flow Flowrate	21.4578 cfs
Full flow velocity	12.1426 fps

CIRCULAR CHANNEL ANALYSIS AND DESIGN
SOLVED WITH MANNING'S EQUATION

POWERWOOD NO. 2 MDDP
DEPTH OF FLOW BETWEEN DP-8 AND DP-9

Manning Pipe Calculator

Given Input Data:

Shape	Circular
Solving for	Depth of Flow
Diameter	18.0000 in
Flowrate	15.2000 cfs
Slope	0.0200 ft/ft
Manning's n	0.0090

Computed Results:

Depth	11.1854 in
Area	1.7671 ft2
Wetted Area	1.1540 ft2
Wetted Perimeter	32.6893 in
Perimeter	56.5487 in
Velocity	13.1711 fps
Hydraulic Radius	5.0837 in
Percent Full	62.1412 %
Full flow Flowrate	21.4578 cfs
Full flow velocity	12.1426 fps

CIRCULAR CHANNEL ANALYSIS AND DESIGN
SOLVED WITH MANNING'S EQUATION

POWERWOOD NO. 2 MDDP
DEPTH OF FLOW BETWEEN DP-10 AND DP-11

Manning Pipe Calculator

Given Input Data:

Shape	Circular
Solving for	Depth of Flow
Diameter	30.0000 in
Flowrate	88.5000 cfs
Slope	0.0300 ft/ft
Manning's n	0.0090

Computed Results:

Depth	21.4897 in
Area	4.9087 ft2
Wetted Area	3.7629 ft2
Wetted Perimeter	60.5467 in
Perimeter	94.2478 in
Velocity	23.5188 fps
Hydraulic Radius	8.9495 in
Percent Full	71.6324 %
Full flow Flowrate	102.6188 cfs
Full flow velocity	20.9053 fps

CIRCULAR CHANNEL ANALYSIS AND DESIGN
SOLVED WITH MANNING'S EQUATION

POWERWOOD NO. 2 MDDP
DEPTH OF FLOW BETWEEN DP-9/DP-10 AND DP-12

Manning Pipe Calculator

Given Input Data:

Shape	Circular
Solving for	Depth of Flow
Diameter	30.0000 in
Flowrate	100.8000 cfs
Slope	0.0300 ft/ft
Manning's n	0.0090

Computed Results:

Depth	24.1214 in
Area	4.9087 ft2
Wetted Area	4.2300 ft2
Wetted Perimeter	66.7335 in
Perimeter	94.2478 in
Velocity	23.8299 fps
Hydraulic Radius	9.1276 in
Percent Full	80.4045 %
Full flow Flowrate	102.6188 cfs
Full flow velocity	20.9053 fps

CIRCULAR CHANNEL ANALYSIS AND DESIGN
SOLVED WITH MANNING'S EQUATION

POWERWOOD NO. 2 MDDP
DEPTH OF FLOW BETWEEN DP-13 AND DP-14

Manning Pipe Calculator

Given Input Data:

Shape	Circular
Solving for	Depth of Flow
Diameter	24.0000 in
Flowrate	53.2000 cfs
Slope	0.0300 ft/ft
Manning's n	0.0090

Computed Results:

Depth	18.4905 in
Area	3.1416 ft2
Wetted Area	2.5972 ft2
Wetted Perimeter	51.4146 in
Perimeter	75.3982 in
Velocity	20.4835 fps
Hydraulic Radius	7.2742 in
Percent Full	77.0439 %
Full flow Flowrate	56.5979 cfs
Full flow velocity	18.0157 fps

CIRCULAR CHANNEL ANALYSIS AND DESIGN
SOLVED WITH MANNING'S EQUATION

POWERWOOD NO. 2 MDDP
DEPTH OF FLOW BETWEEN DP-14 AND DP-15

Manning Pipe Calculator

Given Input Data:

Shape	Circular
Solving for	Depth of Flow
Diameter	36.0000 in
Flowrate	183.3000 cfs
Slope	0.0500 ft/ft
Manning's n	0.0090

Computed Results:

Depth	25.5161 in
Area	7.0686 ft2
Wetted Area	5.3572 ft2
Wetted Perimeter	72.0559 in
Perimeter	113.0973 in
Velocity	34.2158 fps
Hydraulic Radius	10.7060 in
Percent Full	70.8779 %
Full flow Flowrate	215.4275 cfs
Full flow velocity	30.4768 fps

CIRCULAR CHANNEL ANALYSIS AND DESIGN
SOLVED WITH MANNING'S EQUATION

POWERWOOD NO. 2 MDDP
DEPTH OF FLOW FOR PIPE AT DP-16

Manning Pipe Calculator

Given Input Data:

Shape	Circular
Solving for	Depth of Flow
Diameter	30.0000 in
Flowrate	115.5000 cfs
Slope	0.0500 ft/ft
Manning's n	0.0090

Computed Results:

Depth	21.6765 in
Area	4.9087 ft2
Wetted Area	3.7979 ft2
Wetted Perimeter	60.9625 in
Perimeter	94.2478 in
Velocity	30.4114 fps
Hydraulic Radius	8.9711 in
Percent Full	72.2551 %
Full flow Flowrate	132.4803 cfs
Full flow velocity	26.9887 fps

CIRCULAR CHANNEL ANALYSIS AND DESIGN
SOLVED WITH MANNING'S EQUATION

POWERWOOD NO. 2 MDDP
DEPTH OF FLOW AT DP-17

Manning Pipe Calculator

Given Input Data:

Shape	Circular
Solving for	Depth of Flow
Diameter	18.0000 in
Flowrate	27.3000 cfs
Slope	0.0500 ft/ft
Manning's n	0.0090

Computed Results:

Depth	12.2305 in
Area	1.7671 ft2
Wetted Area	1.2785 ft2
Wetted Perimeter	34.8827 in
Perimeter	56.5487 in
Velocity	21.3526 fps
Hydraulic Radius	5.2779 in
Percent Full	67.9470 %
Full flow Flowrate	33.9277 cfs
Full flow velocity	19.1992 fps

STORAGE VOLUME FOR DETENTION BASINS Version 2.10

Project : POWERWOOD NO. 2 User: ADP Date: 04-29-2002

ounty : EL PASO State: CO Checked: ____ Date: _____
ubtitle: NORTH POND CALCULATIONS - DP-15

Drainage Area: 60 Acres Rainfall Frequency: 100 years
Rainfall-Type: II
24-Hour Rainfall: 2.64 inches Runoff Curve Number: 67
Peak Inflow: 183.30 cfs
Peak Outflow: 34.70 cfs
Runoff Volume: 0.4 inches
Detention Basin Storage Volume: 0.19 inches or 1.0 acre feet

Appendix C

Design Charts

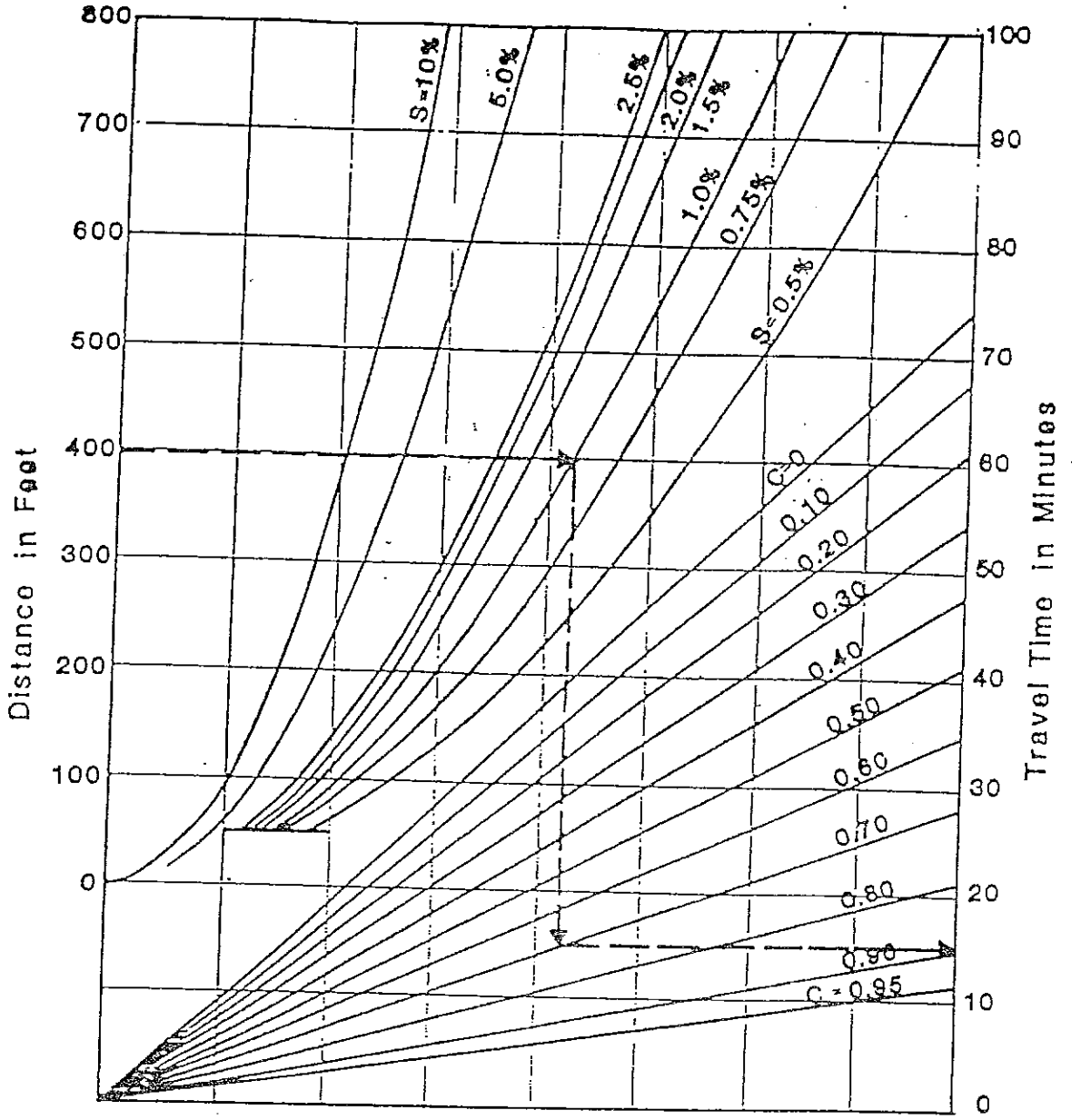
TABLE 5-1

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	0.60	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

Date: OCT. 1987

Figure: 5-2

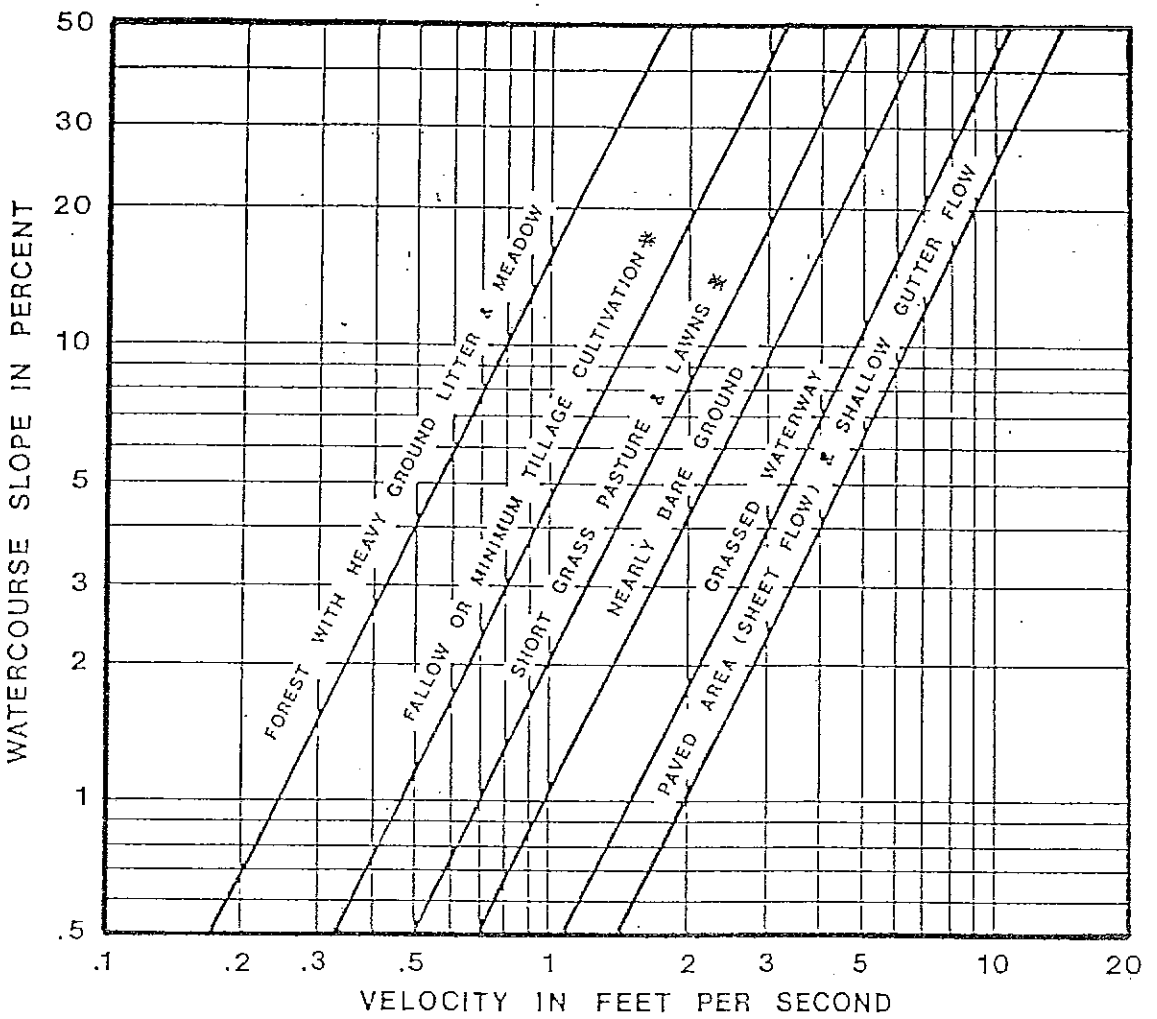
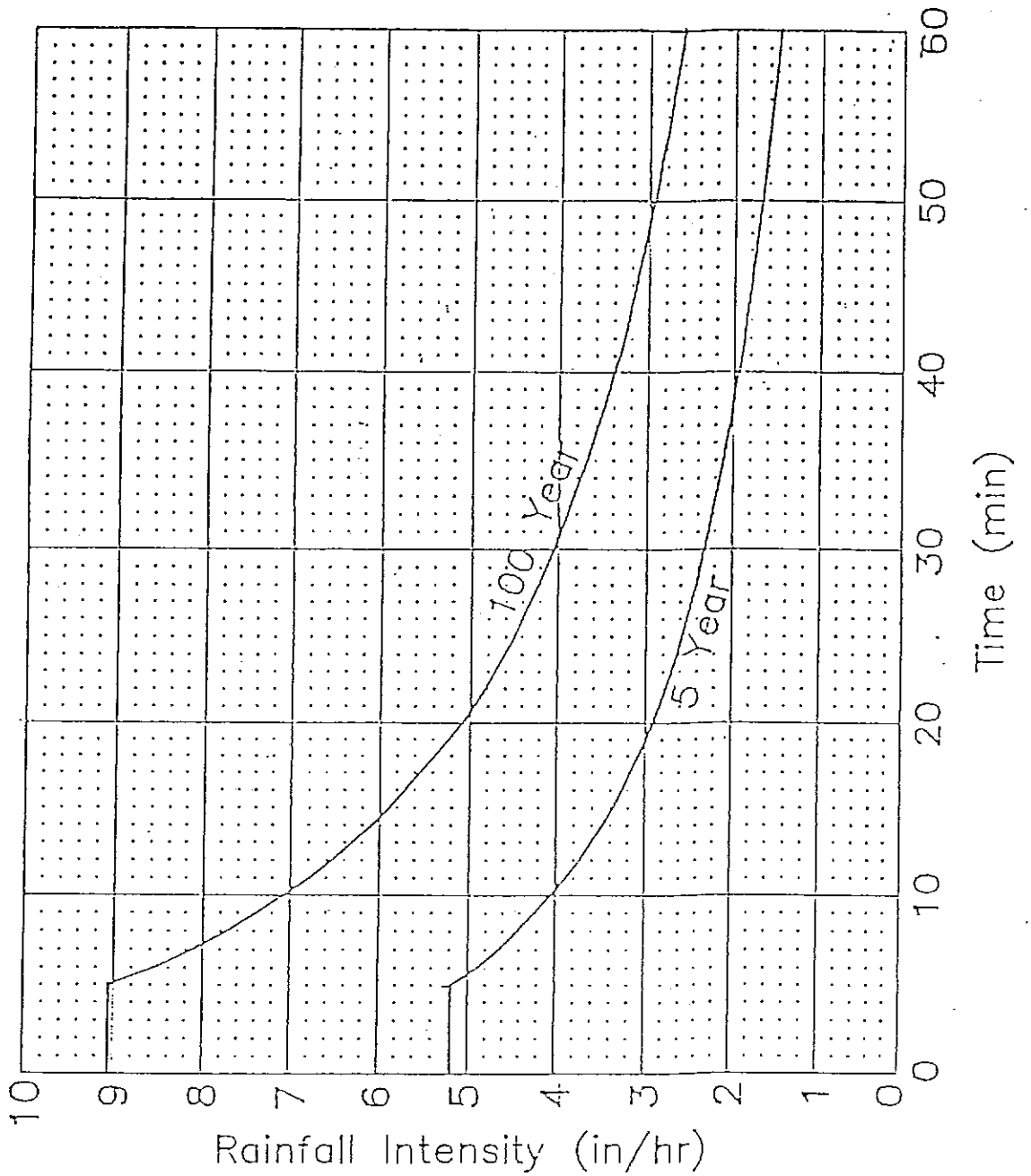


FIGURE 3-2. ESTIMATE OF AVERAGE FLOW VELOCITY FOR USE WITH THE RATIONAL FORMULA.

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

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



$$I_t = \frac{36.4 * I_{60}}{t^{0.80} + 6.72}$$

5 Year: I_{60}= 1.50
100 Year: I_{60}= 2.62

RE: Based upon Pikes Peak Area Council of Governments Areawide Urban Runoff Control Manual.

The City of Colorado Springs / El Paso County Drainage Criteria Manual	Date: MAR. 1995
Storm Rainfall Time Intensity – Frequency Curves	Figure: 5 – 1