MASTER DEVELOPMENT DRAINAGE PLAN FOR NORTH POINTE CENTRE
and
PRELIMINARY AND FINAL DRAINAGE PLAN AND REPORT
for
NORTH POINTE CENTRE FILING NO. 4

June, 1998

Prepared for:

Development Management Inc.

Prepared by:

Rockwell-Minchow Consultants, Inc.
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(719) 475-2575

Project# 97-074

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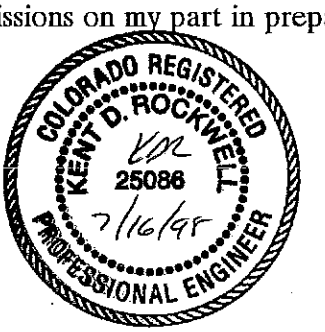
ENGINEER'S STATEMENT

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 of Colorado Springs for drainage reports, and said drainage 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.

Kent D. Rockwell, P.E.



DEVELOPER'S STATEMENT

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

BY: _____ DATE 7/16/98
LandPlan Inc

TITLE: Agent/DM

ADDRESS: 4065 Sinton Rd
C.S. Colo 80907

CITY OF COLORADO SPRINGS

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

_____ _____
CITY ENGINEER DATE 7/17/98

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PURPOSE

The purpose of this Drainage Report is to identify the existing and developed runoff patterns and runoff quantities affecting the proposed North Pointe Centre including the North Pointe Centre Development Filing No. 4 site (2.960 acres). In addition, existing and proposed drainage facilities will be identified.

SUMMARY of DATA

The sources of information used in the development of this study are listed below:

1. City of Colorado Springs and El Paso County "Drainage Criteria Manual", October 1987, revised November 1991.

2. Soil Survey for El Paso County, Colorado. U.S. Department of Agriculture, Soil Conservation Service, June 1980.

3. "Flood Insurance Studies for Colorado Springs and El Paso County, Colorado", prepared by the Federal Emergency Management Agency (FEMA), 1985.

4. "North Pointe Centre Drainage Report and Plan," prepared by United Planning & Engineering, July 27, 1984, amended August 3, 1984.

5. "Amended Final Drainage Study for North Pointe Centre Located at the Northeast Corner of Rockrimmon Road and Delmonico Drive," prepared by VTN Colorado, Inc., March, 1985, June, 1985, and July, 1985.

The "North Pointe Centre Drainage Report and Plan," prepared by United Planning & Engineering and the "Amended Final Drainage Study for North Pointe Centre Located at the Northeast Corner of Rockrimmon Road and Delmonico Drive," prepared by VTN Colorado, Inc. describe the proposed drainage patterns and facilities required to serve the entire North Pointe Development. This report will provide additional information regarding the overall development of North Pointe Centre Development and more specific information for North Pointe Centre Filing No. 4 located at the extreme south end of the overall North Pointe Centre Development. This report also updates the drainage calculations based on updated criteria.

GENERAL LOCATION AND DESCRIPTION

The overall North Pointe Centre Development is located within the City of Colorado Springs, El Paso County, Colorado, encompassing approximately 26 acres north of Rockrimmon Boulevard and east of Delmonico Drive. The site is situated within the south half of Section 18, Township 13 South, Range 66 West of the 6th P.M. (see Vicinity Map - Figure 1).

The overall North Pointe Centre Development is bound on the south by Rockrimmon Boulevard, on the west by Delmonico Boulevard, on the east by the Denver and Rio Grande Railroad and on the north by existing townhomes and a future park. Portions of the overall North Pointe Centre Development have previously been platted as North Pointe Centre Filing No. 1 and North Pointe Centre Filing No. 2. North Pointe Centre Filing No. 3, located at the extreme northern side of the development has recently been platted and is currently under development. Buildings and parking lots currently exists or are under construction within these platted parcels. Drainage facilities have previously been installed to service the existing development within North Pointe Centre Filings 1, 2 and 3. The existing drainage facilities within the North Pointe Centre Development are shown on Exhibit 1.

The existing terrain of the entire development slopes from north to south toward Rockrimmon Boulevard. Existing slopes range from 2% to 3% through the majority of the site, with a steep slope extending approximately 20' vertically from the north side of Rockrimmon Boulevard. Another 20' slope exists approximately 250 to 300 feet south of the north line. A third slope, approximately 10' high, exists along the north property line of the overall North Pointe Centre Development.

The southernmost 2.960 acres of the North Pointe Centre Development will be platted as North Pointe Centre Filing No. 4. Filing No. 4 will be developed as a hotel with associated parking.

The existing ground cover on the undeveloped portions of the North Pointe Centre Development consists of sparse native grasses. The ground cover on the proposed Filing No. 4 area consists of well-established native grasses. A steep slope extending up from Rockrimmon Boulevard and Delmonico Drive approximately 15 to 25 feet exists along the south and west sides of the Filing No. 4 site.

SOILS

According to the Soil Survey of El Paso County Area, Colorado, prepared by the U.S. Department of Agriculture Soil Conservation Service, the soils underlying the site are of the Chaseville/Midway combination series (Soil 18) and Truckton (Soil 97), as depicted on Figure 2. The Chaseville series is classified as Hydrological Group "A" and the Midway series is classified as Hydrologic Group "D". The Tructon series is classified as Hydrological Group "B" soils. Hydrological Group "B" soils were utilized to select runoff coefficients.

FLOODPLAIN STATEMENT

According to the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) Panel #0841C0512 F, the southern portion of the site is located within a designated 100 year floodplain. This area of the site will remain undisturbed. The proposed buildings will set well above the established 100 year flood plain elevation.

DRAINAGE CRITERIA

The current City of Colorado Springs/El Paso County Drainage Criteria was utilized in the preparation of this study. Calculations were performed to determine the historic and developed runoff quantities generated during the 5 year and 100 year frequency storms. The Rational Method was used according to criteria for basins less than 100 acres.

The site lies within the North Rockrimmon Drainage Basin.

HISTORIC DRAINAGE BASIN DESCRIPTION

The entire site was altered from its original terrain in the mid-1980's to create pad sites for the overall development. The "historic" runoff calculations presented in this report are based on the existing grades and existing development as of the date of this report. The overall development is described by 5 historic basins (see Exhibit 1).

Basin A is located toward the north side of the site and consists of 2.96 acres. Approximately one-third of Basin A has previously been developed. The other two-thirds of the development is currently being developed. Historic flows rates of 4.2 cubic feet per second (cfs) during the 5 year storm and 8.6 cfs during the 100 year storm generated from this basin flow southerly into two existing area inlets located toward the south-central portion of Basin A. These flows are conveyed southerly within an existing storm sewer system as shown on Exhibit 1. The existing system consists of 15", 18" and 27" reinforced concrete pipes (RCP) extending from the northwest corner of the site to the southeast corner of the site.

Basin B consists of 17.75 acres and extends from the northern property line to the southern property line. Approximately 20% of this basin is currently developed as a commercial site with associated asphalt parking. This basin currently generates flows of Q_5 = 16.9 cfs and Q_{100} = 34.4 cfs. These flows are collected within a series of area inlets located throughout the western side of Basin B.

Previous development plans for Basin B called for another drainage system to be extended along the eastern side of Basin B. The eastern system was not built. Both of these systems appear to have been designed to accommodate the 5 year storm flows which is consistent with the drainage criteria utilized at that time.

The total flows reaching Historic Design Point #1 from Basins A and B are 19.3 cfs during the 5 year storm and 39.5 cfs during the 100 year storm. The existing 27" RCP ties into an existing junction box located approximately 50' north of Rockrimmon Boulevard. Two 36" RCP's extend southerly out of the junction box to the south side of Rockrimmon Boulevard. The two existing 36" RCP's have a combined normal flow capacity of approximately 150 cfs assuming a slope of 1% (see VTN Report).

Basin C consist of 1.23 acres of existing commercial development. This basin discharges 6.3 cfs and 11.8 cfs to the southwest corner of the basin where a 6" pipe is located. It appears this pipe is connected to a 5' inlet located along Delmonico Boulevard.

The area just east of Delmonico Drive and just north of Rockrimmon Drive comprise Basin D. Runoff rates of 2.9 cfs during the 5 year storm and 7.0 cfs during the 100 year storm are generated from this 2.23 acre basin. These flows sheet flow onto Delmonico Drive, eventually flowing easterly within Rockrimmon Boulevard to a low point located at the southeast corner of this development.

Basin E is located along the eastern side of the site and consists of 3.66 acres. Runoff rates of Q_5 = 2.8 cfs and Q_{100} = 6.7 cfs discharge as sheet flow onto the railroad property located just east of the North Pointe Centre Development.

The combined flows from Basins A, B, C, D and E are 24.8 cfs during the 5 year storm and 52.3 cfs during the 100 year storm (Design Point #2). These flows along with the flows generated from the adjacent streets reach the existing inlet on the north side of Rockrimmon Boulevard. These flows are conveyed southerly to an existing channel on the south side of Rockrimmon Boulevard via the 2 - 36" RCP's mentioned above.

DEVELOPED DRAINAGE BASIN DESCRIPTION

A brief description of each developed drainage basin is provided in this section of the report. A summary of peak developed runoff for the basins is depicted on the developed drainage plan (Exhibit 2). The site has been divided into 12 developed on-site drainage basins. No runoff enters this site from surrounding developments.

Basin I consists of 1.75 acres at the northwest corner of the site and is currently under construction as a commercial/office parking lot. Runoff rates of 6.9 cfs and 12.9 cfs are generated from this basin during the 5 year and 100 year storms, respectively. These flows discharge to a 4' inlet which connects to the existing 15" RCP extending southerly from Basin II.

Runoff rates of Q_5 = 2.2 cfs and Q_{100} = 4.2 cfs are generated from the 0.90 acre Basin II. The combined flows from Basins I and II (Q_5 = 7.2 cfs and Q_{100} = 13.4 cfs) are conveyed southerly within the existing 15" RCP as shown on Exhibit 2. The existing 15" RCP at a slope of 2.7% has a normal flow capacity of 11.5 cfs. Therefore, the system will operate under pressure during the 100 year storm or the runoff will continue southerly within the parking lots as surface flow. This is consistent with the statement made in the VTN Report stating "The expected 5-year developed runoff generated on site will be conveyed in an underground system. Flows exceeding 5 year runoff quantities and up to 100 year runoff, will be carried in surface swale over the pipe to the southeast corner."

Basin III is located just east of Basin I and generates developed flow rates of 2.5 cfs and 4.8 cfs during the 5 year and 100 year storms, respectively. Runoff generated from this basin discharges into Basin V as street flow.

The 1.87 acres just east of Basin III generates flows of 6.2 cfs during the 5 year storm and 11.8 cfs during the 100 year storm. Proposed plans for North Pointe Centre Filing No. 3 call for a 4' inlet to collect these flows and discharge directly to the south via a 24" RCP. As future development occurs within Basin VI, the 24" RCP will be extended through Basin VI.

Basin V consists of 8.07 acres of future parking and a future health club. This basin generates flows of 27.1 cfs during the 5 year storm and 50.1 cfs during the 100 year storm. The flows generated from this basin will be collected within future inlets installed at various points within Basin V. The combined 5 year storm flows of 36.6 cfs from Basins I, II, III and V reaching Developed Design Point #2 will be piped southerly toward Rockrimmon Boulevard. The 100 year storm flows of 68.6 cfs will surface flow to the south and east toward Design Point #5.

Basin VI, located just east of Basin V, generates flows of 9.8 cfs during the 5 year storm and 17.8 cfs during the 100 year storm. These 5 year storm flows will also be collected within a series of inlets to be constructed on the east side of the future health club. The exact location and size of these inlets will be determined at a future date.

The combined flows of 15.1 cfs during the 5 year storm and 27.8 cfs during the 100 year storm generated from Basins IV and VI will be directed to Developed Design Point #3. 24" RCP and 27" RCP will be extended from Basin IV to Design Point #4. At Design Point #4, flows from Basins I, II, III, IV, V, and VI will converge. The total developed flows at this point are Q_5 = 44.8 cfs and Q_{100} = 83.7 cfs. The existing 27" RCP from this point south has a slope of 2% and a corresponding normal flow capacity of 47 cfs. As previously designed, the 5 year storm flows will be conveyed southerly within the piping system and the 100 year storm flows will flow southerly as surface flow.

The 3.77 acres just south of Basins V and VI comprises Basin VII. Runoff rates of Q_5 = 12.1 cfs and Q_{100} = 22.0 cfs are generated from this basin. At Design Point #5, the total flows generated from the upstream basins are 54.4 cfs during the 5 year storm and 98.0 cfs during the 100 year storm.

The existing 27" RCP just downstream of Design Point #5 has a normal flow capacity of 59 cfs at 3.12%. The 27" inch will carry the 5 year storm flows but not the 100 year flows from this point. Therefore, a 20' sump inlet will be installed just north of Basin X to collect the 100 year flows reaching Design Point #5 before they enter North Pointe Centre Filing No. 4. A parallel 27" pipe will be installed from this point to the existing 36" RCP extending under Rockrimmon Boulevard.

Developed Basin VIII is the same as historic Basin C and developed Basin IX is the same as historic Basin D. Basin VIII is currently fully developed and will continue to discharge flows toward the existing 6" diameter pipe. This pipe should be upsized with the development of the adjacent area. Basin IX will continue to discharge flows to Delmonico Drive and Rockrimmon Boulevard in the same manner they currently do.

The east half of North Pointe Centre Filing No. 4 comprises Basin X. The runoff generated from this basin flows southeasterly within the proposed parking lot to a proposed 4' inlet. The developed flows of Q_5 = 4.2 cfs and Q_{100} = 7.8 cfs collected by this inlet will be discharged directly to the proposed 27" RCP traversing this basin.

Likewise, Basin XI consisting of the western half of North Pointe Centre Filing No. 4, generates runoff rates of 4.3 cfs during the 5 year storm and 8.0 cfs during the 100 year storm. These flows will be collected within another 4' inlet and will be conveyed to the existing 27" RCP.

The total flows reaching Design Point #6 are Q_5 = 58.6 cfs and Q_{100} = 105.1 cfs. The existing 36" RCP's under Rockrimmon Boulevard have a normal flow capacity of 150 cfs. The 100 year storm flow rate reaching Design Point #6 is consistent with the 100 year flows reaching this same design point as presented in the VTN Report (98.3 cfs). The developer of North Pointe Centre Filing No. 4 also owns the parcel to the north and will accept the developed flows generated from the area north of Filing No. 4.

DRAINAGE FEES

North Pointe Centre Filing No. 4 is within the North Rockrimmon Drainage Basin and consists of 2.960 acres. The 1998 drainage fees for this parcel are listed below. There are no bridge or pond fees within the North Rockrimmon Drainage Basin.

Drainage Fees: 2.960 Acres x $3,081.00/Ac = $9,119.76

The drainage fees for the remaining parcels will be determined at the time of final platting.

CONSTRUCTION COST ESTIMATE

Following is a preliminary cost estimate for the proposed drainage improvements within the North Pointe Centre Filing No. 4. All on-site drainage facilities will be private.

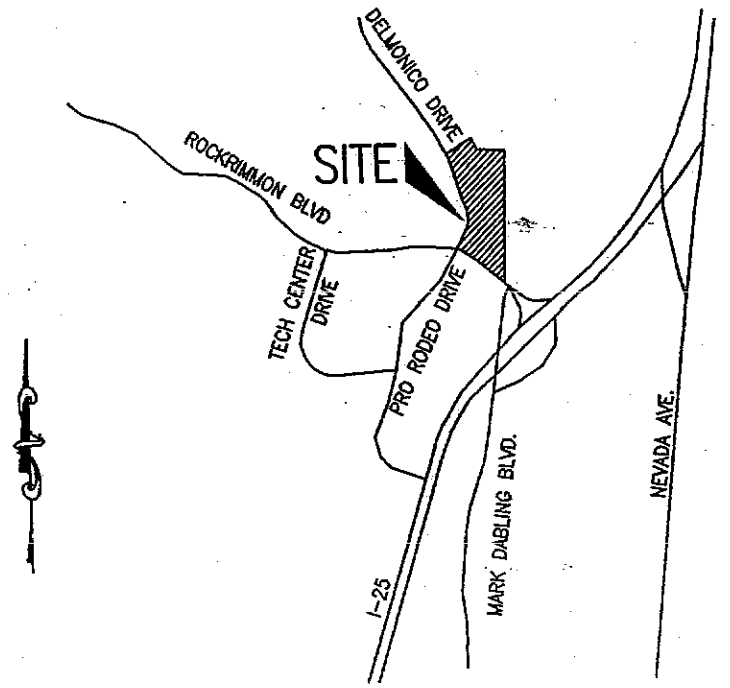
Item	Quantity	Unit Cost	Extended Cost
4' D-10-R Inlet	2 EA	$2,000.00/EA	$ 4,000.00
27" RCP	390 LF	$ 38.00/LF	$ 14,820.00
18" RCP	140 LF	$ 27.00/LF	$ 3,780.00
		Sub-Total:	$ 22,600.00
		15% Engineering & Contingency	$ 3,390.00
		Total:	**$ 25,990.00**

The cost of future facilities within the remaining undeveloped portion of North Pointe Centre is difficult to determine until future development plans are generated. A 24" RCP and 27" RCP system and a series of inlets are anticipated for the future development. Below is a preliminary cost estimate for the future drainage facilities required within the undeveloped portion of North Pointe Center.

Item	Quantity	Unit Cost	Extended Cost
20' D-10-R Inlet	1 EA	$5,0000.00/EA	$ 5,000.00
3' x 3' Area Inlets	6 EA	$1,800.00/EA	$ 10,800.00
24" RCP	650 LF	$ 32.00/LF	$ 20,800.00
27" RCP	600 LF	$ 38.00/LF	$ 22,800.00
		Sub-Total:	$ 59,400.00
		15% Engineering & Contingency	$ 8,910.00
		Total:	**$ 68,310.00**

APPENDIX

APPENDIX



Vicinity Map

Figure 1

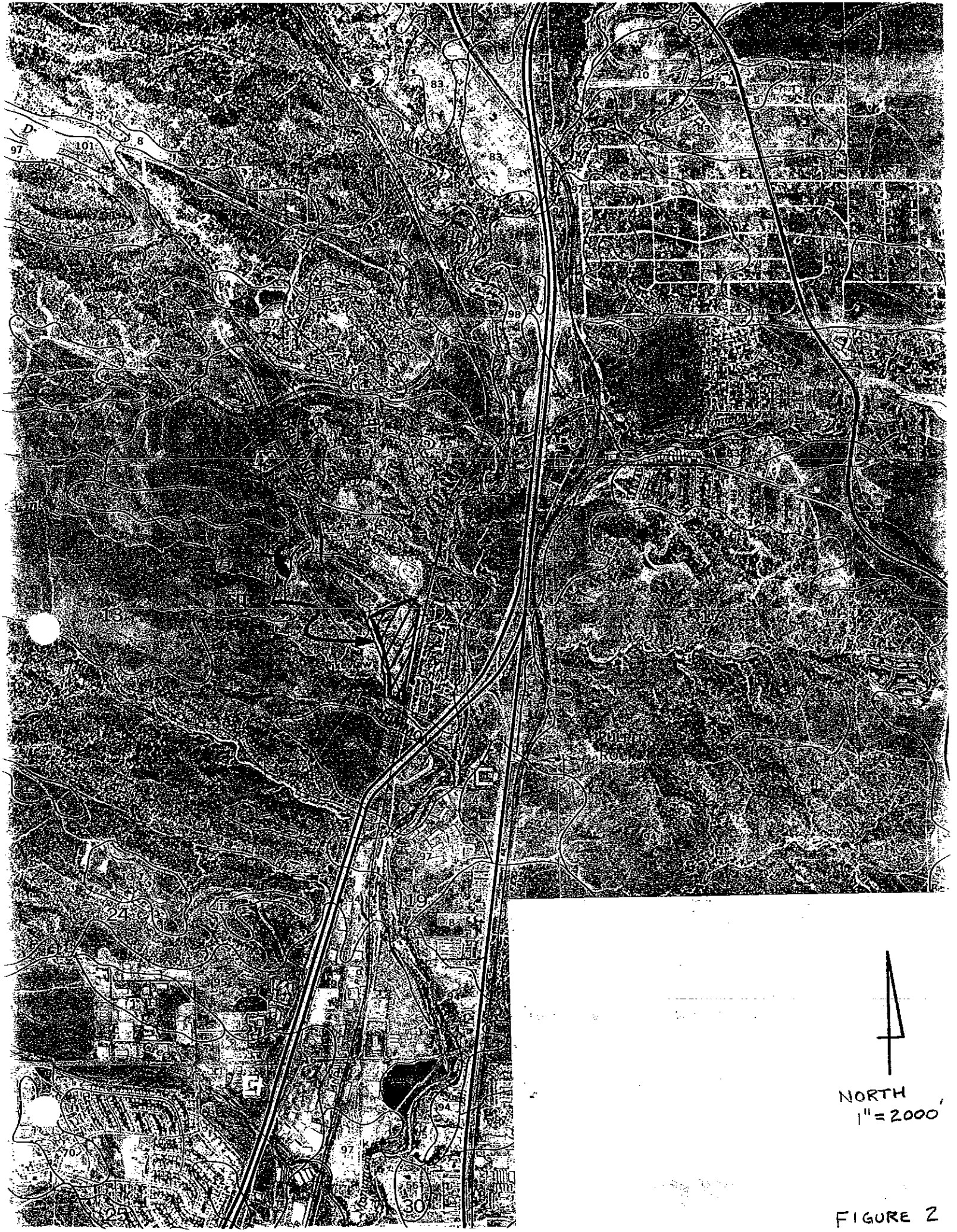
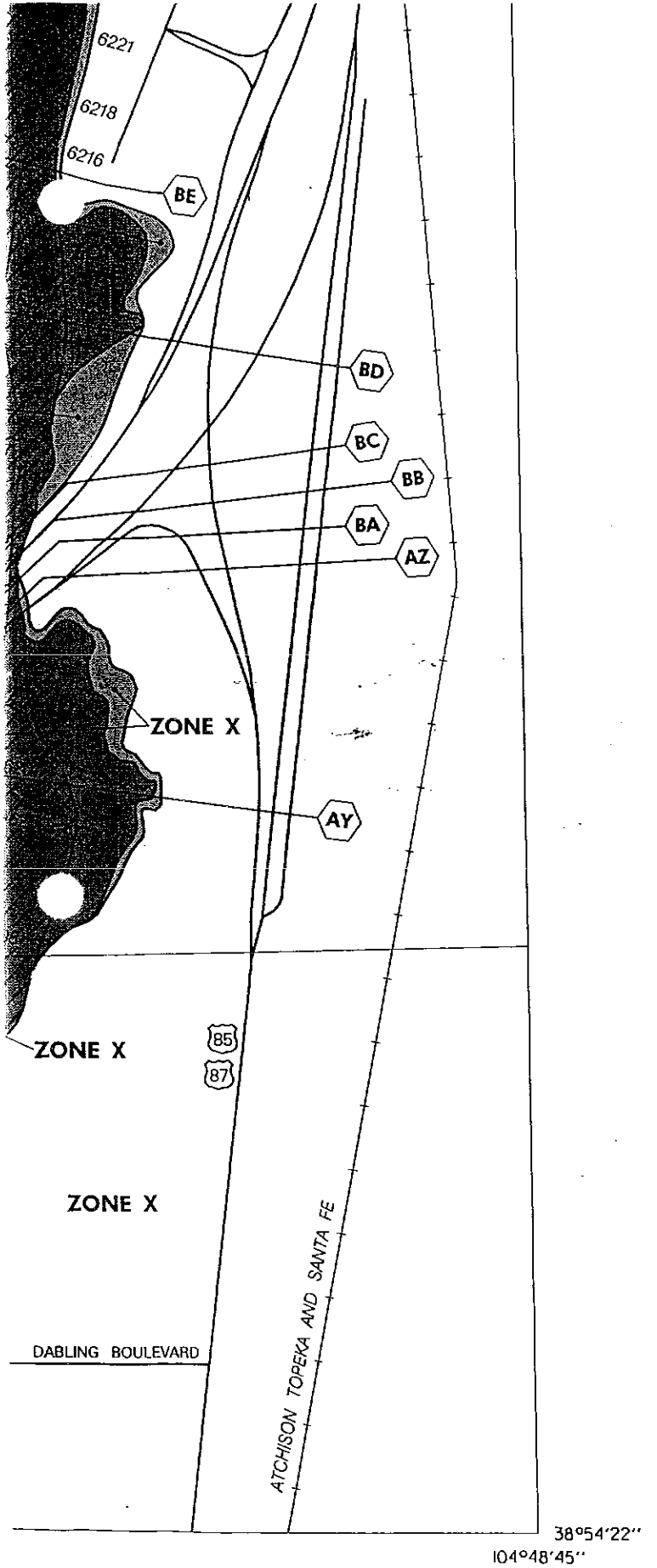


FIGURE 2



Refer to the FLOOD INSURANCE RATE MAP EFFECTIVE DATE shown on this map to determine when actuarial rates apply to structures in zones where elevations or depths have been established.

To determine if flood insurance is available, contact an insurance agent or call the National Flood Insurance Program at (800) 638-6620.

APPROXIMATE SCALE IN FEET

500 0 500

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 512 OF 1300

(SEE MAP INDEX FOR PANELS NOT PRINTED)

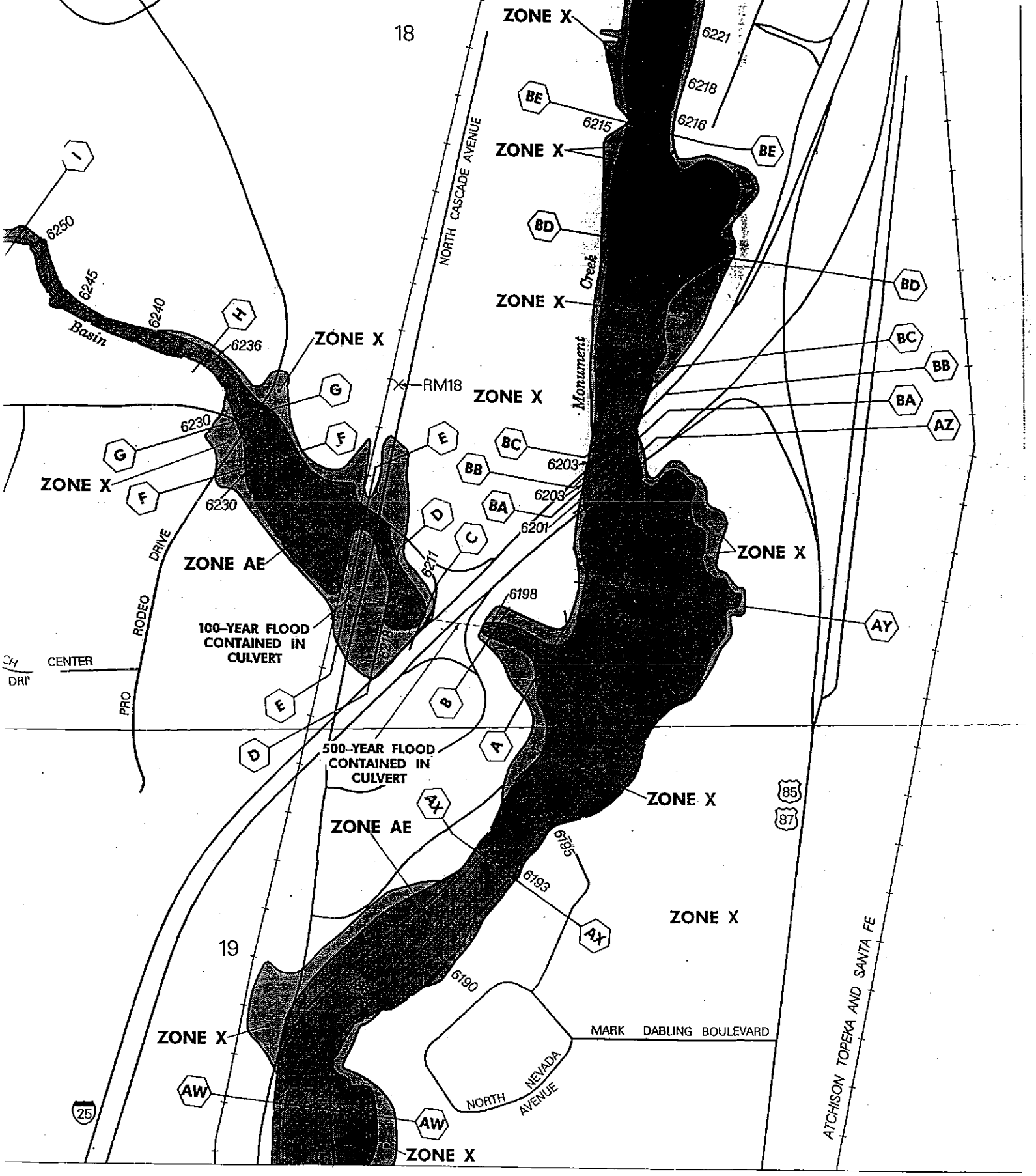
CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
COLORADO SPRINGS, CITY OF	080060	0512	F
EL PASO COUNTY, UNINCORPORATED AREAS	080059	0512	F

MAP NUMBER 08041C0512 F

EFFECTIVE DATE: MARCH 17, 1997

Federal Emergency Management Agency


18
19
ZONE X
ZONE AE
ZONE X
ZONE X
ZONE X
ZONE X
ZONE X
ZONE X
ZONE X
ZONE AE
ZONE X
ZONE X
ZONE X
100-YEAR FLOOD CONTAINED IN CULVERT
500-YEAR FLOOD CONTAINED IN CULVERT
RM18
NORTH CASCADE AVENUE
Monument Creek
RODEO DRIVE
CENTER
MARK DABLING BOULEVARD
NORTH NEVADA AVENUE
ATCHISON TOPEKA AND SANTA FE
Basin
6250
6245
6240
6236
6230
6230
6221
6218
6216
6215
6203
6203
6201
6198
6195
6193
6190
BE
BD
BC
BB
BA
AZ
AY
AX
AW
A
B
C
D
E
F
G
H
I
85
87
25

HISTORIC BASINS

Hydrology

Location: A
Area: 2.96 Ac.
Soil or Land Use: B

Runoff Coefficient, C:

Area Zone	C5	C100	%Area	Area
OPEN SPACE	0.25	0.35	80%	2.36
BUILDINGS & PAVING	0.90	0.95	20%	0.60

Composite: C5 0.38 C100 0.47 100%

Time of Concentration: T_c in minutes:

Travel Type	L(ft)	H	s%	V(fps)	T_c
OVERLAND	225	10	4.4%		12.90

T, Total: 12.90

Intensity, I (inches/hr) from Fig 5-1

I5: 3.7 in/hr I100 6.2 in/hr

Peak Flow: Q = CIA in cfs

Q5 4.2 cfs Q100: 8.6 cfs

Hydrology

Location: B
Area: 17.42 Ac.
Soil or Land Use: B

Runoff Coefficient, C:

Area Zone	C5	C100	%Area	Area
OPEN SPACE	0.25	0.35	71.3%	12.42
BUILDINGS & PAVING	0.90	0.95	28.7%	5.00

Composite: C5 0.44 C100 0.52 100%

Time of Concentration: T_c in minutes:

Travel Type	L(ft)	H	s%	V(fps)	T_c
OVERLAND	1000	40	4%		28.1
SWALE	860	18	2%	2.5	5.7

T, Total: 33.8

Intensity, I (inches/hr) from Fig 5-1

I5: 2.2 in/hr I100 3.8 in/hr

Peak Flow: Q = CIA in cfs

Q5 16.9 cfs Q100: 34.4 cfs

Hydrology

Location: C
Area: 1.56 Ac.
Soil or Land Use:

Runoff Coefficient, C:

Area Zone	C5	C100	%Area	Area
OPEN SPACE	0.25	0.35	17.9%	0.28
BUILDINGS & PAVING	0.90	0.95	82.1%	1.28

Composite: C5 0.78 C100 0.84 100%

Time of Concentration: T_c in minutes:

Travel Type	L(ft)	H	s%	v(fps)	T_c
OVERLAND	30	10	33.3%		2.4
CURB	380		2.7%	3.2	2.0

T_c Total: USE 5.0

Intensity, I (inches/hr) from Fig 5-1

I5: 5.2 in/hr I100 9.0 in/hr

Peak Flow: Q = CIA in cfs

Q5 6.3 cfs Q100: 11.8 cfs

Hydrology

Location: D
Area: 2.23 Ac.
Soil or Land Use:

Runoff Coefficient, C:

Area Zone	C5	C100	%Area	Area
OPEN SPACE	0.25	0.35		

Composite: C5 0.25 C100 0.35 100%

Time of Concentration: T_c in minutes:

Travel Type	L(ft)	H	s%	v(fps)	T_c
OVERLAND	80	26	32.5%		4.0

T_c Total: USE 5.0

Intensity, I (inches/hr) from Fig 5-1

I5: 5.2 in/hr I100 9.0 in/hr

Peak Flow: Q = CIA in cfs

Q5 2.9 cfs Q100: 7.0 cfs

Hydrology

Location: E
Area: 3.36 Ac.
Soil or Land Use: _____

Runoff Coefficient, C:

Area Zone	C5	C100	%Area
OPEN SPACE	0.25	0.35	

Composite: C5 0.25 C100 0.35 100%

Time of Concentration: T_c in minutes:

Travel Type	L(ft)	H	s%	v(fps)	T_c
OVERLAND	40	12	30%		2.9
SWALE	1600	32	2%	2.0	13.3

T_c Total: 16.2

Intensity, I (inches/hr) from Fig 5-1

I5: 3.3 in/hr I100 5.7 in/hr

Peak Flow: Q = CIA in cfs

Q5 2.8 cfs Q100: 6.7 cfs

Hydrology

Location: _____
Area: _____ Ac.
Soil or Land Use: _____

Runoff Coefficient, C:

Area Zone	C5	C100	%Area

Composite: C5 _____ C100 _____ 100%

Time of Concentration: T_c in minutes:

Travel Type	L(ft)	s%	v(fps)	T_c

T_c Total: _____

Intensity, I (inches/hr) from Fig 5-1

I5: _____ in/hr I100 _____ in/hr

Peak Flow: Q = CIA in cfs

Q5 _____ cfs Q100: _____ cfs

HIS RIC

Hydrology

Location: DP # 1

Area: 20.38 Ac.

Soil or Land Use:

Runoff Coefficient, C:

Area Zone	Area	C5	C100	%Area
Basin A	2.96	0.38	0.47	14.5%
Basin B	17.42	0.44	0.52	85.5%
	20.38			

Composite: C5 0.43 C100 0.51 100%

Time of Concentration: T_c in minutes:

Travel Type	L(ft)	s%	v(fps)	T_c
USE Tc FROM Basin B				

T_c Total: 33.8

Intensity, I (inches/hr) from Fig 5-1

I5: 2.2 in/hr I100 3.8 in/hr

Peak Flow: Q = CIA in cfs

Q5 19.3 cfs Q100: 39.5 cfs

Hydrology

Location: DP # 2

Area: 27.53 Ac.

Soil or Land Use:

Runoff Coefficient, C:

Area Zone	Area	C5	C100	%Area
A	2.96	0.38	0.47	
B	17.42	0.44	0.52	
C	1.56	0.78	0.84	
D	2.23	0.25	0.35	
E	3.36	0.25	0.35	

Composite: C5 0.41 C100 0.50 100%

Time of Concentration: T_c in minutes:

Travel Type	L(ft)	s%	v(fps)	T_c
USE Tc FROM Basin B				

T_c Total: 33.8

Intensity, I (inches/hr) from Fig 5-1

I5: 2.2 in/hr I100 3.8 in/hr

Peak Flow: Q = CIA in cfs

Q5 24.9 cfs Q100: 52.3 cfs

Hydrology

Location: I
Area: 1.75 Ac.
Soil or Land Use:

Runoff Coefficient, C:

Area Zone	AREA	C5	C100	%Area
ASPHALT	1.43	0.90	0.95	79%
LANDSCAPING	0.38	0.25	0.35	21%

Composite: C5 0.76 C100 0.82 100%

Time of Concentration: T_c in minutes:

Travel Type	L(ft)	s%	v(fps)	T_t
OVERLAND	240	3.8%		3.7

T_c Total: USE 5.0

Intensity, I (inches/hr) from Fig 5-1

I5: 5.2 in/hr I100 9.0 in/hr

Peak Flow: Q = CIA in cfs

Q5 6.9 cfs Q100: 12.9 cfs

Hydrology

Location: II
Area: 0.90 Ac.
Soil or Land Use:

Runoff Coefficient, C:

Area Zone	AREA	C5	C100	%Area
ASPHALT	0.58	0.90	0.95	64.4 %
LANDSCAPING	0.32	0.25	0.35	35.6 %

Composite: C5 0.67 C100 0.73 100%

Time of Concentration: T_c in minutes:

Travel Type	L(ft)	s%	v(fps)	T_t
OVERLAND	180	5%		12.5

T_c Total: 12.5

Intensity, I (inches/hr) from Fig 5-1

I5: 3.7 in/hr I100 6.4 in/hr

Peak Flow: Q = CIA in cfs

Q5 2.2 cfs Q100: 4.2 cfs

Hydrology

Location: III
Area: 0.71 Ac.
Soil or Land Use:

Runoff Coefficient, C:

Area Zone	AREA	C5	C100	%Area
ASPHALT /BLDG	0.47	0.90	0.95	66%
LANDSCAPING	0.25	0.25	0.35	34%

Composite: C5 0.68 C100 0.75 100%

Time of Concentration: T_c in minutes:

Travel Type	L(ft)	s%	v(fps)	T_c
OVERLAND	60	25%		4.3
STREET	140	8%		0.2

T_c Total: USE 5.0

Intensity, I (inches/hr) from Fig 5-1

I5: 5.2 in/hr I100 9.0 in/hr

Peak Flow: Q = CIA in cfs

Q5 2.5 cfs Q100: 4.8 cfs

Hydrology

Location: IV
Area: 1.87 Ac.
Soil or Land Use:

Runoff Coefficient, C:

Area Zone	AREA	C5	C100	%Area
LANDSCAPING	0.58	0.25	0.35	31%
ASPHALT	1.29	0.90	0.95	69%

Composite: C5 0.70 C100 0.76 100%

Time of Concentration: T_c in minutes:

Travel Type	L(ft)	s%	v(fps)	T_c
OVERLAND	40	30%		2.9
STREET	540	2%	2.5	3.6

T_c Total: 6.5

Intensity, I (inches/hr) from Fig 5-1

I5: 4.7 in/hr I100 8.3 in/hr

Peak Flow: Q = CIA in cfs

Q5 6.2 cfs Q100: 11.8 cfs

Hydrology

Location: V
Area: 8.07 Ac.
Soil or Land Use:

Runoff Coefficient, C:

Area Zone	Area	CS	C100	%Area
LANDSCAPING	0.72	0.25	0.35	9%
ASPHALT/BLDG	7.35	0.90	0.95	91%

Composite: CS 0.84 C100 0.90 100%

Time of Concentration: T_c in minutes:

Travel Type	L(ft)	s%	v(fps)	T_c
OVERLAND	50	25		3.9
STREET	1000	2%	2.5	6.7

T_c Total: 10.6

Intensity, I (inches/hr) from Fig 5-1

I5: 4.0 in/hr I100 6.9 in/hr

Peak Flow: Q = CIA in cfs

Q5 27.1 cfs Q100: 50.1 cfs

Hydrology

Location: VI
Area: 2.92 Ac.
Soil or Land Use:

Runoff Coefficient, C:

Area Zone	Area	CS	C100	%Area
LANDSCAPING	0.38	0.25	0.35	13%
ASPHALT/BLDG	2.54	0.90	0.95	87%

Composite: CS 0.82 C100 0.87 100%

Time of Concentration: T_c in minutes:

Travel Type	L(ft)	s%	v(fps)	T_c
OVERLAND	50	25		3.9
STREET	880	2%	2.5	5.9

T_c Total: 9.8

Intensity, I (inches/hr) from Fig 5-1

I5: 4.1 in/hr I100 7.0 in/hr

Peak Flow: Q = CIA in cfs

Q5 9.8 cfs Q100: 17.8 cfs

Hydrology

Location: VII
Area: 3.77 Ac.
Soil or Land Use:

Runoff Coefficient, C:

Area Zone	Area	C5	C100	%Area
LANDSCAPING	0.50	0.25	0.35	13%
ASPHALT/BLDG	3.27	0.90	0.95	87%

Composite: C5 0.82 C100 0.87 100%

Time of Concentration: T_c in minutes:

Travel Type	L(ft)	s%	v(fps)	T_c
OVERLAND	40	2%		8.0
STREET	500	2%	2.5	3.3

T_c Total: 11.3

Intensity, I (inches/hr) from Fig 5-1

I5: 3.9 in/hr I100 6.7 in/hr

Peak Flow: Q = CIA in cfs

Q5 12.1 cfs Q100: 22.0 cfs

Hydrology

Location: VIII
Area: 1.56 Ac
Soil or Land Use:

Runoff Coefficient, C:

Area Zone	C5	C100	%Area	Acres
LANDSCAPING	0.25	0.35	17.9%	0.28
ASPHALT/BLDG	0.90	0.95	82.1%	1.28

Composite: C5 0.78 C100 0.84 100%

Time of Concentration: T_c in minutes:

Travel Type	L(ft)	s%	v(fps)	T_c
OVERLAND	30	33.3%		3.0
STREET	380	2.7%	3.2	2.0

T_c Total: Use 5.0

Intensity, I (inches/hr) from Fig 5-1

I5: 5.2 in/hr I100 9.0 in/hr

Peak Flow: Q = CIA in cfs

Q5 6.3 cfs Q100: 11.8 cfs

Hydrology

Location: IX
Area: 2.26 Ac.
Soil or Land Use:

Runoff Coefficient, C:

Area Zone	C5	C100	%Area
LANDSCAPING	0.25	0.35	100%

Composite: C5 0.25 C100 0.35 100%

Time of Concentration: T_c in minutes:

Travel Type	L(ft)	s%	v(fps)	T_c
OVERLAND	180	4.4%		13.0

T_c Total: 13.0

Intensity, I (inches/hr) from Fig 5-1

I5: 3.6 in/hr I100 6.1 in/hr

Peak Flow: Q = CIA in cfs

Q5 2.0 cfs Q100: 4.8 cfs

Hydrology

Location: X
Area: 1.10 Ac.
Soil or Land Use:

Runoff Coefficient, C:

Area Zone	C5	C100	%Area
LANDSCAPING	0.25	0.35	10%
ASPHALT/BLDG	0.90	0.95	90%

Composite: C5 0.84 C100 0.89 100%

Time of Concentration: T_c in minutes:

Travel Type	L(ft)	s%	v(fps)	T_c
OVERLAND	20	2%		5.7
STREET	260	3.5	4.0	1.1

T_c Total: 6.8

Intensity, I (inches/hr) from Fig 5-1

I5: 4.6 in/hr I100 8.0 in/hr

Peak Flow: Q = CIA in cfs

Q5 4.2 cfs Q100: 7.8 cfs

Hyurology

Location: XI
Area: 1.12 Ac.
Soil or Land Use:

Runoff Coefficient, C:

Area Zone	Area	C5	C100	%Area
LANDSCAPING	0.11	0.25	0.35	10 %
ASPHALT/BLDG	1.01	0.90	0.95	90 %

Composite: C5 0.84 C100 0.89 100%

Time of Concentration: T_c in minutes:

Travel Type	L(ft)	s%	v(fps)	T_c
OVERLAND	20	2%		5.7
STREET	300	3.5	4.0	1.4

T_c Total: 7.1

Intensity, I (inches/hr) from Fig 5-1

I5: 4.6 in/hr I100 8.0 in/hr

Peak Flow: Q = CIA in cfs

Q5 4.3 cfs Q100: 8.0 cfs

Hydrology

Location: XII
Area: 2.45 Ac.
Soil or Land Use:

Runoff Coefficient, C:

Area Zone	C5	C100	%Area
LANDSCAPING	0.25	0.35	

Composite: C5 0.25 C100 0.35 100%

Time of Concentration: T_c in minutes:

Travel Type	L(ft)	s%	v(fps)	T_c
OVERLAND	40	30 %		2.9
SWALE	1600	2%		13.3

T_c Total: 16.2

Intensity, I (inches/hr) from Fig 5-1

I5: 3.3 in/hr I100 5.7 in/hr

Peak Flow: Q = CIA in cfs

Q5 2.0 cfs Q100: 4.9 cfs

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Hydrology

Location: DP #1
Area: 2.65 Ac.
Soil or Land Use:

Runoff Coefficient, C:

Area Zone	Area	CS	C100	%Area
I	1.75	0.76	0.82	
II	0.90	0.67	0.73	

Composite: CS 0.73 C100 0.79 100%

Time of Concentration: T_c in minutes:

Travel Type	L(ft)	s%	v(fps)	T_c
Use T_c from Basin II				

T_c Total: 12.5

Intensity, I (inches/hr) from Fig 5-1

I5: 3.7 in/hr I100 6.4 in/hr

Peak Flow: Q = CIA in cfs

Q5 7.2 cfs Q100: 13.4 cfs

Hydrology

Location: DP #2
Area: 11.43 Ac.
Soil or Land Use:

Runoff Coefficient, C:

Area Zone	Area	CS	C100	%Area
I	1.75	0.76	0.82	
II	0.90	0.67	0.73	
III	0.71	0.68	0.75	
IV	8.07	0.84	0.90	

Composite: CS 0.80 C100 0.87 100%

Time of Concentration: T_c in minutes:

Travel Type	L(ft)	s%	v(fps)	T_c
Use Basin IV T_c				10.6

T_c Total: 10.6

Intensity, I (inches/hr) from Fig 5-1

I5: 4.0 in/hr I100 6.9 in/hr

Peak Flow: Q = CIA in cfs

Q5 36.6 cfs Q100: 68.6 cfs

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Hydrology

Location: DP #3
Area: 4.79 Ac.
Soil or Land Use:

Runoff Coefficient, C:

Area Zone	Area	CS	C100	%Area
BASIN IV	1.87	0.70	0.76	
BASIN VI	2.92	0.82	0.87	

Composite: CS 0.77 C100 0.83 100%

Time of Concentration: T_c in minutes:

Travel Type	L(ft)	s%	v(fps)	T_c
USE BASIN VI T_c				

T_c Total: 9.8

Intensity, I (inches/hr) from Fig 5-1

I5: 4.1 in/hr I100 7.0 in/hr

Peak Flow: Q = CIA in cfs

Q5 15.1 cfs Q100: 27.8 cfs

Hydrology

Location: DP #4
Area: 16.22 Ac
Soil or Land Use:

Runoff Coefficient, C:

Area Zone	Area	CS	C100	%Area
DP #2	11.43	0.80	0.87	
DP #3	4.79	0.77	0.83	

Composite: CS 0.79 C100 0.86 100%

Time of Concentration: T_c in minutes:

Travel Type	L(ft)	s%	v(fps)	T_c
BASIN IV				6.5
STREET	1120	2%	2.5	7.5

T_c Total: 14.0

Intensity, I (inches/hr) from Fig 5-1

I5: 3.5 in/hr I100 6.0 in/hr

Peak Flow: Q = CIA in cfs

Q5 44.8 cfs Q100: 83.7 cfs

Hydrology

Location: DP #5
Area: 19.99 Ac.
Soil or Land Use:

Runoff Coefficient, C:

Area Zone	AREA	CS	C100	%Area
DP #4	16.22	0.79	0.86	
BASIN VII	3.77	0.82	0.87	

Composite: CS 0.80 C100 0.86 100%

Time of Concentration: T_c in minutes:

Travel Type	L(ft)	s%	v(fps)	T_c
DP # 4				14.0
STREET	300	2%	2.5	2.0

T_c Total: 16.0

Intensity, I (inches/hr) from Fig 5-1

I5: 3.4 in/hr I100 5.7 in/hr

Peak Flow: Q = CIA in cfs

Q5 54.4 cfs Q100: 98.0 cfs

Hydrology

Location: DP #6
Area: 22.21 Ac.
Soil or Land Use:

Runoff Coefficient, C:

Area Zone	AREA	CS	C100	%Area
DP #5	19.99	0.80	0.86	
BASIN X	1.10	0.84	0.89	
BASIN XI	1.12	0.84	0.89	

Composite: CS 0.80 C100 0.86 100%

Time of Concentration: T_c in minutes:

Travel Type	L(ft)	s%	v(fps)	T_c
DP # 5				16.0
STREET	300	4%	5	1.0

T_c Total: 17.0

Intensity, I (inches/hr) from Fig 5-1

I5: 3.3 in/hr I100 5.5 in/hr

Peak Flow: Q = CIA in cfs

Q5 58.6 cfs Q100: 105.1 cfs

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name:

Comment:

Solve For Actual Depth

Given Input Data:

Diameter.....	1.25 ft
Slope.....	0.0270 ft/ft
Manning's n.....	0.013
Discharge.....	10.00 cfs

Computed Results:

Depth.....	0.97 ft
Velocity.....	9.84 fps
Flow Area.....	1.02 sf
Critical Depth....	1.18 ft
Critical Slope....	0.0207 ft/ft
Percent Full.....	77.21 %
Full Capacity.....	10.61 cfs
QMAX @.94D.....	11.42 cfs
Froude Number.....	1.76 (flow is Supercritical)

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name:

Comment:

Solve For Actual Depth

Given Input Data:

Diameter.....	2.25 ft
Slope.....	0.0200 ft/ft
Manning's n.....	0.013
Discharge.....	47.00 cfs

Computed Results:

Depth.....	2.07 ft
Velocity.....	12.29 fps
Flow Area.....	3.83 sf
Critical Depth....	2.16 ft
Critical Slope....	0.0201 ft/ft
Percent Full.....	91.93 %
Full Capacity.....	43.80 cfs
QMAX @.94D.....	47.11 cfs
Froude Number.....	1.23 (flow is Supercritical)

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name:

Comment:

Solve For Actual Depth

Given Input Data:

Diameter.....	2.25 ft
Slope.....	0.0312 ft/ft
Manning's n.....	0.013
Discharge.....	58.00 cfs

Computed Results:

Depth.....	2.00 ft
Velocity.....	15.52 fps
Flow Area.....	3.74 sf
Critical Depth....	2.21 ft
Critical Slope....	0.0316 ft/ft
Percent Full.....	88.96 %
Full Capacity.....	54.70 cfs
QMAX @.94D.....	58.85 cfs
Froude Number.....	1.68 (flow is Supercritical)

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name:

Comment:

Solve For Actual Depth

Given Input Data:

Diameter.....	3.00 ft
Slope.....	0.0100 ft/ft
Manning's n.....	0.013
Discharge.....	71.00 cfs

Computed Results:

Depth.....	2.69 ft
Velocity.....	10.62 fps
Flow Area.....	6.69 sf
Critical Depth....	2.67 ft
Critical Slope....	0.0101 ft/ft
Percent Full.....	89.74 %
Full Capacity.....	66.70 cfs
QMAX @.94D.....	71.75 cfs
Froude Number.....	0.98 (flow is Subcritical)

Open Channel Flow Module, Version 3.12 (c) 1990
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