Master Development Drainage Report

for

"Interquest Marketplace Addition"

Prepared for:
City of Colorado Springs, Colorado
Engineering Division

On Behalf of:
Southwest Equity Associates, LLP
1450 North Gate Road
Colorado Springs, CO 80921

Prepared by:

Matrix Design Group, Inc.
Integrated Design Solutions
Infrastructure Engineering
Community Development
Program Management

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CPC A 06-162
CPC PUZ 06-163
CPC PUP 06-164

Revised October 2007

05.203.001

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.

Brady A. Shyrock
Registered Professional Engineer
State of Colorado
No. 38164

SEAL

Developer's Statement:

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

Southwest Equity Associates, LLP
Business Name

By: _____

Title: General Partner
Address: 1450 North Gate Road
Colorado Springs, CO 80921

City of Colorado Springs:

Filed in accordance with Section 7.7.906 of the Code of the City of Colorado Springs, 2001, as amended.

_____ Nov 9, 2007
City Engineer Date

Conditions:

TABLE OF CONTENTS

APPENDIX

I. INTRODUCTION

A. Background

Interquest Market Place Addition is a 5.451-acre commercial parcel to be annexed into the City of Colorado Springs. The site is located northeast of Interquest Parkway and Interstate 25 and will be developed in similar fashion to the adjacent Interquest Market Place master planned area, located to the north and east of the site. The parcel is being master planned and has no definitive site layout at this time. This study has been completed to provide initial guidance to the drainage requirements at the site, and to provide a preliminary sizing of drainage facilities needed when the site is developed.

B. Project Location

Interquest Market Place Addition is located in northern Colorado Springs. The area is comprised primarily of proposed commercial use. More specifically, the site is located as follows.

1. General Location. Northwest ¼ of Section 20, Township 12 South, Range 66 West of the 6th P.M. in El Paso County, Colorado.
2. Surrounding Streets. Interquest Parkway is located immediately to the south of the property. Interstate 25 is located approximately 750 feet to the west.
3. Drainageway. The site is located in the Elkhorn Drainage Fee Basin. There are no existing or proposed drainageways located within the property limits.
4. Surrounding Developments. Development within the area is mostly in planning stages at this time. The following are the existing or planned general land uses adjacent to the property.

   North: Unplatted vacant land exists to the north. The area has been included within the Interquest Marketplace, Phase 1 Master Plan area commercial development.

   East: Unplatted vacant land. This area has also been included within the Interquest Marketplace, Phase 1 Master Plan area commercial development.

   West: Unplatted vacant land belonging to the United States Air Force Academy.

   South: Fairlane Industrial Park, Filing No. 2, an undeveloped parcel.

C. Property Description

Interquest Market Place Addition is unplatted and undeveloped. The site will be annexed into the City of Colorado Springs Corporate Limits.

1. Drainage Area. The site has a historic upstream tributary area of approximately 9.5 acres. The upstream area sheet flows across the property and into existing roadside ditches.

2. Ground Cover. This site is covered with native grasses and significant areas of natural brush along the western half of the property.

3. General Topography. The site drains to the west with an average grade of approximately 3%.

4. General Soil Conditions. The *Soil Conservation Service of El Paso County Area, Colorado*, published by the United States Department of Agriculture, dated November 1991, has been utilized to investigate the existing general soil types within and tributary to the area impacting Interquest Market Place Addition. The following is a summary of the area soils.

Table 1.1
Soil Conservation Service Soil Survey for El Paso County

Soil ID No.	*Soil*	*Hydrologic Classification*	*Permeability*	*Erosion Hazard*
8	Blakeland loamy sand	A	Rapid	Moderate
83	Stapleton sandy loam	B	Rapid	Moderate

Soils can be classified in four different hydrologic groups, A, B, C, or D to help predict stormwater runoff rates. Hydrologic group "A" is characterized by deep, well-drained coarse-grained soils with a rapid infiltration rate when thoroughly wet and having a low runoff potential. Group "D" typically has a clay layer at or near to the surface, or a very shallow depth to impervious bedrock and has a very slow infiltration rate and a high runoff potential. For the purposes of this Final Drainage Report, it has been assumed that hydrologic group "B" characteristics exist upstream and at the site.

5. Major Drainageways. The historic conditions show flow from the site being directed to the south where an existing swale within Interquest Parkway ROW conveys flows to the west and ultimately to Elkhorn. Flows from the Interquest Marketplace Addition will be directed to a proposed detention pond at the southwest corner of the site. The detention pond will be designed to mitigate the impacts of the additional minor tributary area to the basin. No major drainage ways exist within the limits of the development. The proposed conditions at the site will direct flows to storm sewers, which outfall to a proposed detention pond located at the southwest corner of the site.

6. Irrigation Facilities. No known functioning irrigation facilities are located on the site.

7. Utilities and other Encumbrances. There are no known public utility lines or easements located within the site boundaries.

II. DRAINAGE BASINS AND SUB-BASINS

A. Major Basin Description

Interquest Market Place Addition is located within the Elkhorn Drainage Basin. The area was originally studied within the Fairlane Technology Park Master Development Drainage Plan. The site was subsequently studied within the Master Development Drainage Plan for the original Interquest Market Place Annexation into the City of Colorado Springs.

Per the requirements for the area, the site shall be detained to release historic runoff rates. Water Quality Capture Volume (WQCV) has also been considered for the site and will be provided within the detention pond design. The WQCV is comprised of an Extended Detention Basin, where the "initial flush" of storm water will be drained over a 40-hour time period.

B. Floodplain Statement

Review of the ***Flood Insurance Rate Map (FIRM) 506 (08041CO506 F)***, effective date March 17, 1997, published by the Federal Emergency Management Agency (FEMA) reveals that no portion of ***Interquest Market Place Addition*** lies within any designated 100-year floodplain. See Floodplain Map, Appendix.

C. Sub-Basin Description

Historically, the drainage basins have had runoff sheet flow to the existing roadside ditch along Interquest Parkway. Within the existing Interquest Parkway ROW, there are two small grassed swales. The first runs parallel to and along the property line and the second runs along the edge of Interquest Parkway with a dirt road running in between. The sheet flow collects in the swale running along the property to the southwest corner and then overtops the dirt road and is then conveyed within the swale running at the edge of Interquest Parkway. The development of the site will require that an onsite storm drainage system be constructed, and a detention/water quality pond to reduce the peak developed runoff rates to historic levels prior to exiting the property. Detained flows will be discharged to the roadside ditch along Interquest Parkway. The existing roadside ditch currently is a naturally grassed swale, which is being upgraded by Nor'Wood Development Group for the Marketplace at Interquest development. The outfall point for Interquest Marketplace Addition will conform to the MDDP done by Classic Consulting LLC.

III. DRAINAGE DESIGN CRITERIA

A. Development Criteria

This report has been prepared in accordance to the criteria set forth in the ***City of Colorado Springs & El Paso County Drainage Criteria Manual, Volumes I and II***, dated November 1991 and including subsequent updates. In addition to the City Criteria Manual, the ***Urban Storm Drainage Criteria Manuals, Volumes 1-3***, published by the Urban Drainage and Flood Control District, latest update 2003, has also been used to supplement the City Criteria Manual.

The project area has been previously studied within the following studies.

- *Master Development Drainage Plan for Marketplace at Interquest and Final Drainage Report for Marketplace at Interquest Filing No. 1 and Filing No. 2*, prepared by Classic Consulting Engineers & Surveyors, LLC, April 2007.

- *Interstate 25 & Fairlane Parkway Interchange- Final Hydraulic Report (Phase I)*, prepared by Daniel, Mann, Johnson, & Mendenhall, Inc. (DMJM), August 26 1998.

A couple subdivision drainage reports have been found within the files of the City Subdivision Engineering Review Unit that have been completed for specific developments adjacent to and within the study area. The aforementioned reports have been listed as references with this report. Each study has been reviewed to ensure compliance with the recommendations and drainage facilities proposed.

B. Hydrologic Criteria

Due to the small areas evaluated within the limits of development the Rational Method has been used to size inlets and pipe laterals and the sub-trunk storm system for areas less than 100-acres in tributary size.

$$Q=C*I*A$$

Where:

Q = Maximum runoff rate in cubic feet per second
C = Runoff coefficient
I = Average rainfall intensity in inches per hour
A = Area of drainage sub-basin in acres

The Subdivision Engineering Review Unit issued an update to the rainfall intensity frequency curves for the City of Colorado Springs on January 7, 2003. The updated information has been utilized in this study. The revised storm rainfall time intensity-frequency curves have been used for the Rational Method analysis.

Due to the fact that runoff from the site passes through the United States Air Force Academy, there are additional storm events that need to be analyzed. The design storm events are:

- Initial Storm = 2-Year Storm
- Initial Storm = 5-Year Storm
- Intermediate Storm = 10-Year Storm
- Major Storm = 50-Year Storm
- Major Storm = 100-Year Storm

Runoff coefficients are based upon field observations of the area, and master planning documents completed earlier for the area. Type "B" hydrologic soil characteristics have been assumed throughout the area. Weighted runoff coefficients and the ground percent impervious have been calculated based upon the following land uses as outlined in *Table 5-1, Recommended Average Runoff Coefficients and Percent Impervious* as given within the City Drainage Criteria Manual.

Detention at the site will be required due to the fact that the United States Air Force Academy property and Interstate 25, a Colorado Department of Transportation roadway exist immediately downstream of the site. Development criteria for these two agencies require that peak stormwater runoff rates from upstream areas be reduced to historic levels. Due to the fact that the project site is upstream from the United States Air Force Academy, runoff rates for the site must be reduced to historic levels for the 2-year, 5-year, 10-year, 50-year, and 100-year storm events. To provide a preliminary pond sizing, the Rational Method has been utilized. Additional volume within the detention pond will be provided to accommodate water quality requirements.

C. Hydraulic Criteria

A preliminary estimate of the detention pond and outfall structure has been completed as part of this study. When a final site layout is completed for the parcel, it is anticipated that a private site storm sewer may be constructed and outfall to the pond. The extent of the storm sewer system, or determining if there is a need for a system will be completed within the Final Drainage Report for the site.

IV. DRAINAGE FACILITY DESIGN

A. Existing Conditions (Pre-Development Conditions)

The site has been evaluated to determine flow rates based upon the historic conditions at the site. The area is currently undeveloped and covered with native grasses and shrubs within the Elkhorn Drainage Basin.

Sub-basin EX-1 comprises the entire 5.45 acres of the development. The peak calculated runoff rates for this area are Q(2)= 1.9 cfs, Q(5)= 2.6 cfs, Q(10)= 3.0 cfs, Q(50)= 5.8 cfs, and Q(100)= 6.1 cfs. These runoff rates are the maximum peak discharge rates allowed from the site. Flows from the existing basin currently sheet flow to the west to the United States Air Force Academy property.

Sub-basin EX-2 comprises 9.53 acres of upstream area flowing through the site. Flows from the upstream area have been calculated as Q(2)= 2.9 cfs, Q(5)= 3.9 cfs, Q(10)= 4.6 cfs, Q(50)= 8.9 cfs, and Q(100)= 9.3 cfs. Runoff from this area passes through the property as either overland flow, or very shallow concentrated flow.

Total combined flows from EX-1 and EX-2 have been calculated as Q(2)= 4.3 cfs, Q(5)= 5.9 cfs, Q(10)= 6.9 cfs, Q(50)= 13.4 cfs, and Q(100)= 14.1 cfs at design point E1. Historic conditions for stormwater flow convey runoff to the west onto the undeveloped Air Force property.

B. Developed Conditions

The analysis completed for this development has assumed the site will be developed as a commercial area with 95% impervious cover. The corresponding 5-year and 100-year runoff coefficients are C(5)=0.90 and C(100)=0.90. The impervious cover has also been used to calculate the water quality requirements as well. When a final site plan is completed, the exact percent impervious cover can then be calculated. The assumptions used for this analysis are based upon master planning values suggested within the City of Colorado Springs Drainage Criteria Manual.

The site, when the surrounding area is developed, will have the upstream offsite tributary area significantly reduced from the historic conditions. The offsite tributary area runoff will be captured in a proposed detention pond located to the east of the Interquest Marketplace Addition site. The offsite tributary area accepted by the Interquest Marketplace Addition site in the developed condition will consist of minor landscaped areas. If the Interquest Market Place Addition parcel is developed ahead of the offsite area, the site drainage system shall either accommodate the offsite flows, or divert the flows around the property. These details will be finalized, if required, within the Final Drainage Report for the site. This developed conditions analysis assumes the upstream area has been developed.

Sub-basin PE-1 comprises the commercial development of the site. The 5.45 acre sub-basin has calculated peak runoff rates of Q(2)= 18.2 cfs, Q(5)= 25.0 cfs, Q(10)= 29.2 cfs, Q(50)= 42.6 cfs, and Q(100)= 44.6 cfs. These flows shall be diverted through the proposed detention pond, also located within this sub-basin. Based upon the current master planning completed for the area, the site has been integrated into the surrounding development to provided access. This layout will help to eliminate upstream offsite tributary areas flowing through the parcel.

Sub-basin PE-2 comprises the offsite tributary landscaping area of the site. The 0.56 acre sub-basin has calculated peak runoff rates of Q(2)= 0.6 cfs, Q(5)= 0.9 cfs, Q(10)= 1.0 cfs, Q(50)= 2.7 cfs, and Q(100)= 2.8 cfs. These flows shall be diverted through the proposed detention pond, also located within this sub-basin.

Total combined flows from PE-1 and PE-2 have been calculated as Q(2)= 18.8 cfs, Q(5)= 25.9 cfs, Q(10)= 30.2 cfs, Q(50)= 45.3 cfs, and Q(100)= 47.4 cfs at design point P1.

Flows from the site shall be routed through a proposed private detention pond with a water quality feature. The preliminary design of the pond has sized the water quality capture volume as 0.25 acre feet of storage. The volume is based upon an Extended Detention Basin with a 40-hour drain time. This volume is independent of the detention volume for the site and will help to treat the "initial" flush of storm water through the system. The water quality capture volume includes an additional 20% increase to account for sedimentation of suspended soils within the storm water.

The detention requirements for the site have been calculated as 0.124 acre-feet of storage for the 2-year storm, 0.199 acre-feet of storage for the 10-year storm, and 0.282 acre-feet of storage for the 100-year storm. The 2-year, 5-year, 10-year, 50-year, and 100-year flows into the pond have been calculated as Q(2)= 18.8 cfs, Q(5)= 25.9 cfs, Q(10)= 30.2 cfs, Q(50)= 45.3 cfs, and Q(100)= 47.4 cfs. The peak release rates for the development have been reduced down to historic levels of Q(2)= 4.3 cfs, Q(5)= 5.9 cfs, Q(10)= 6.9 cfs, Q(50)= 13.4 cfs, and Q(100)= 14.1 cfs. The exact outfall design for the system will be determined within the Final Drainage Report for the site. An 18" RCP outfall pipe will discharge the detained stormwater into the roadside ditch along Interquest Parkway. Adequate armoring at the pipe discharge point will be required for the ditch, presumably a riprap pad. The roadside ditch along Interquest Parkway is maintained by CDOT and therefore the outfall design will require CDOT approval.

The owner/ developer may be required to widen Interquest Parkway to three lanes along the property's frontage. This will not impact the site proposed drainage patterns.

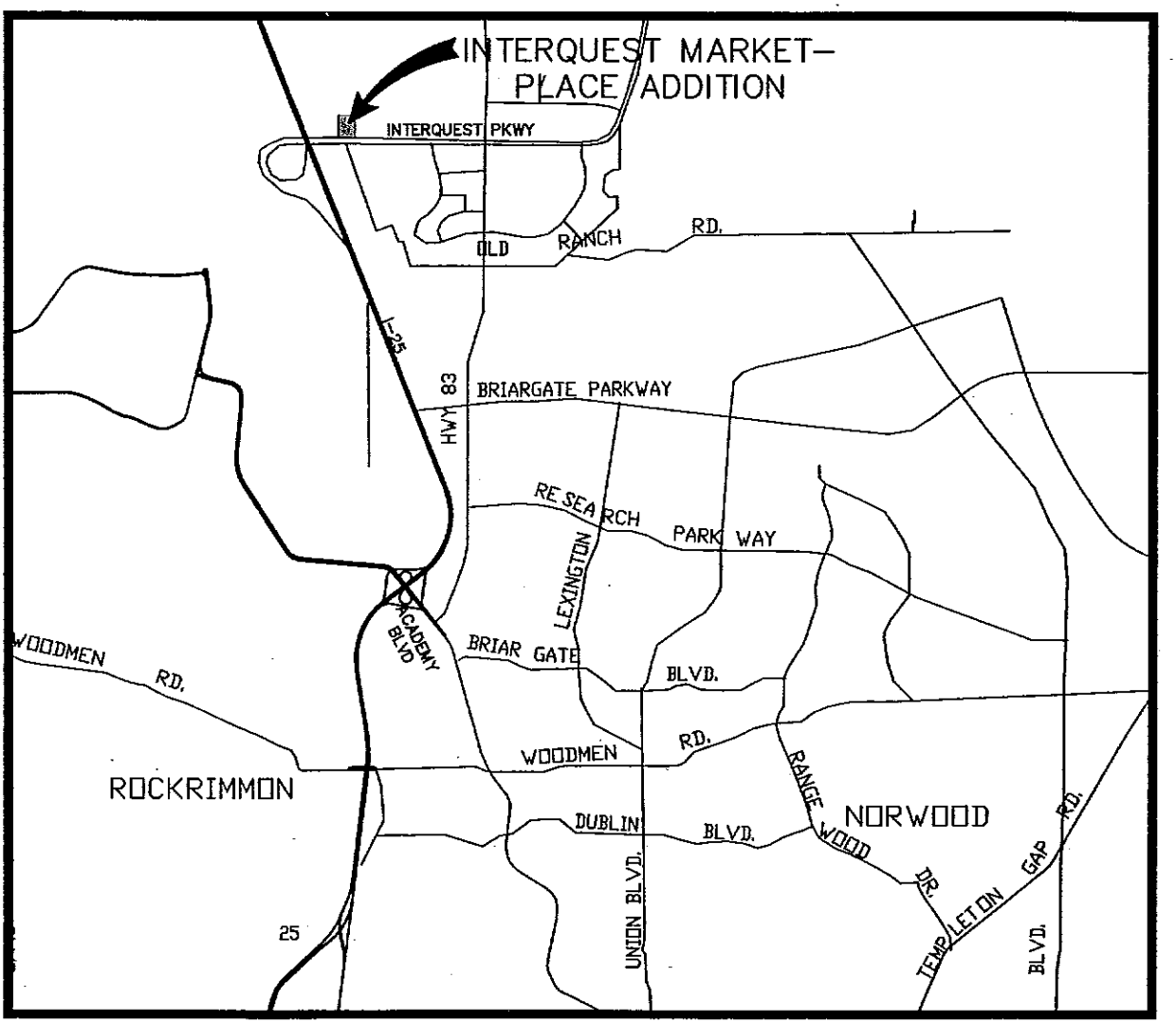
C. Drainage and Bridge Fees

Interquest Market Place Addition is located within the Elkhorn Drainage Fee Basin. This basin is a non-fee basin, and no drainage, bridge, or pond fees will be due for the site when it is platted.

V. APPENDICIES

APPENDIX A

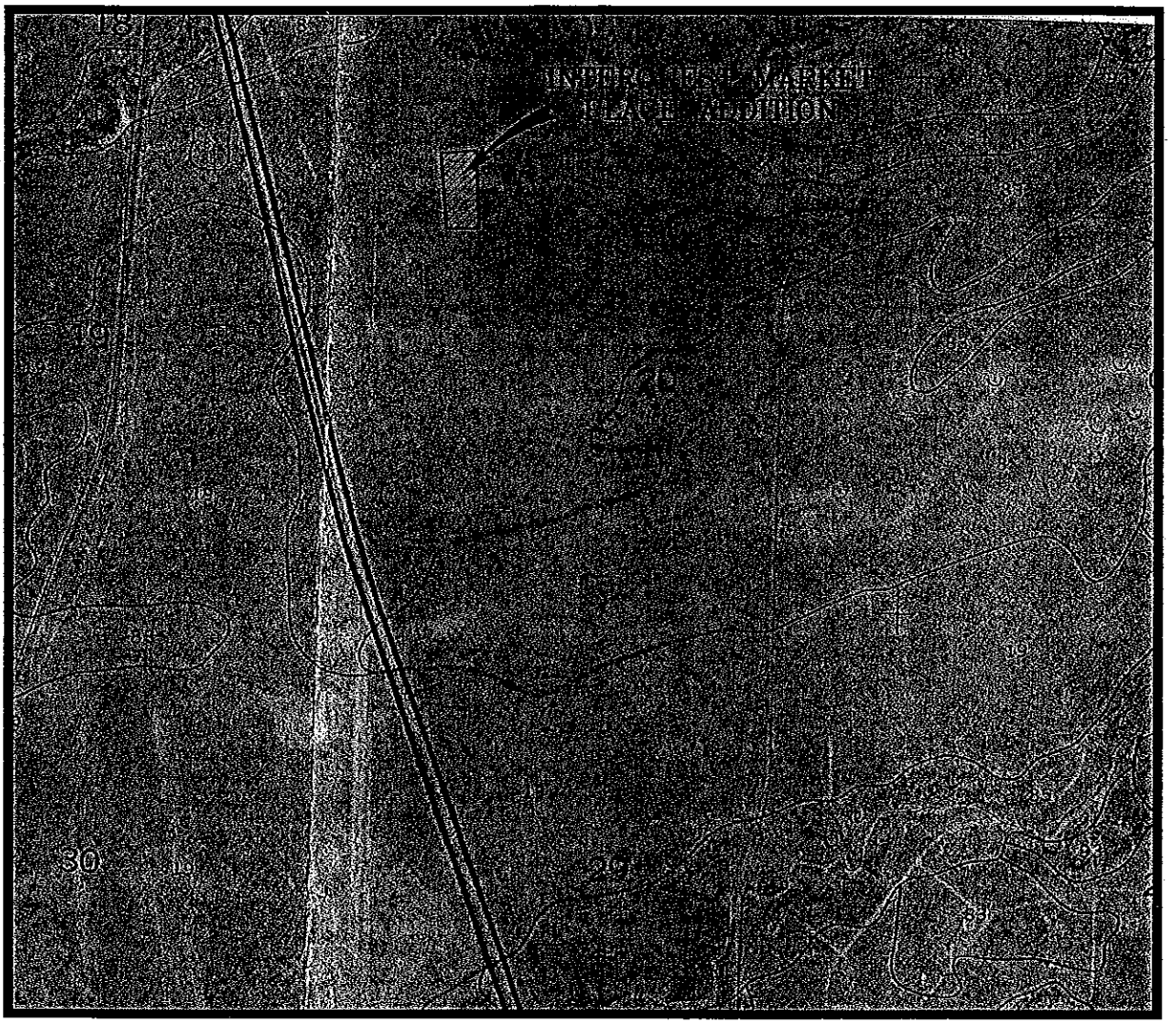
MAPS



VICINITY MAP

NORTH
N.T.S.

Matrix Design Group, Inc.
Integrated Design Solutions
2435 Research Parkway, Suite 300
Colorado Springs, CO 80920
Phone 719-575-0100
Fax 719-575-0208



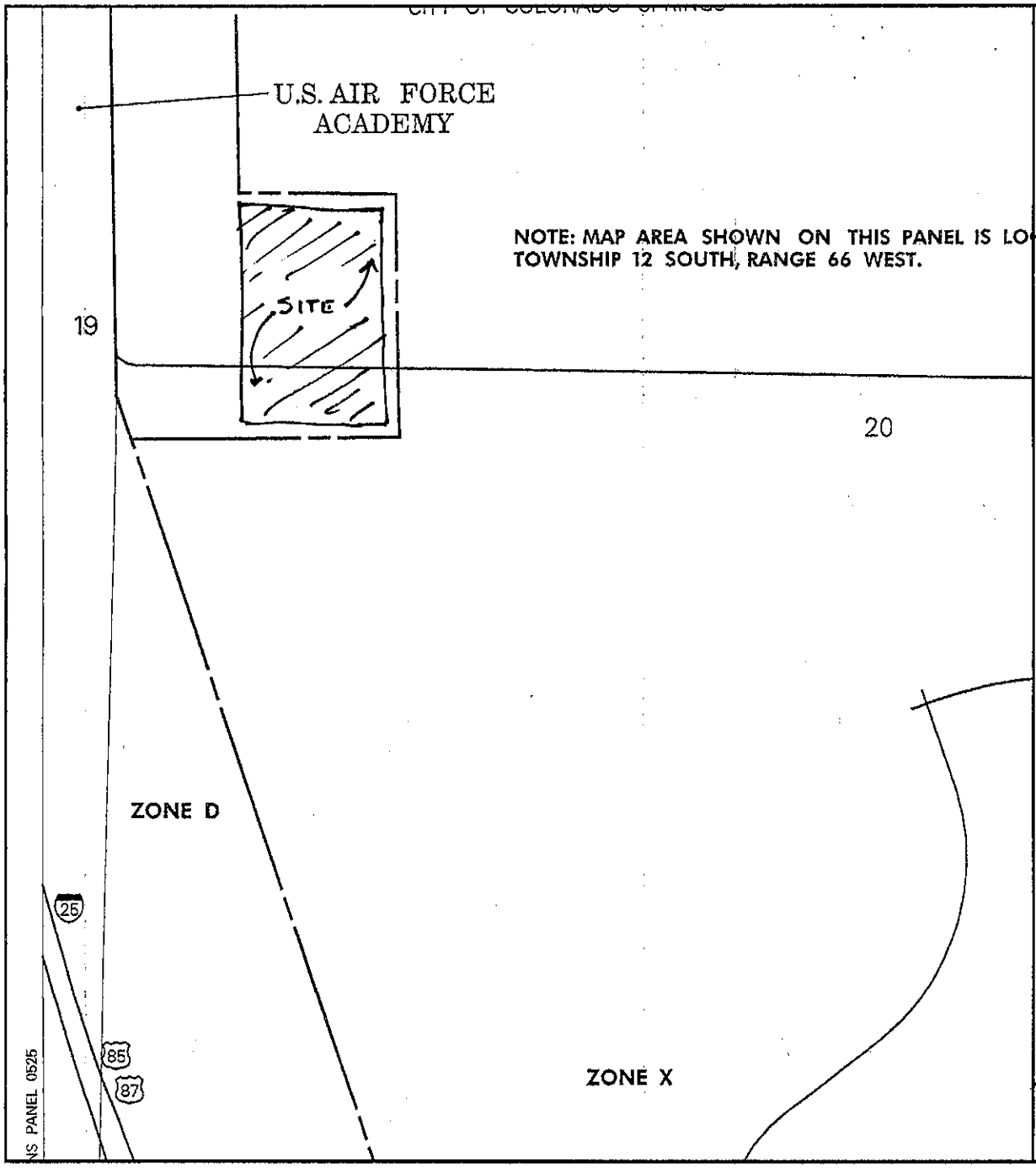
SOILS MAP

NORTH
N.T.S.

LEGEND

ID	SOIL NAME	HYD. GROUP
8	BLAKELAND LOAMY SAND	A
83	STAPLETON SANDY LOAM	B

Matrix Design Group, Inc.
Integrated Design Solutions
2435 Research Parkway, Suite 300
Colorado Springs, CO 80920
Phone 719-575-0100
Fax 719-575-0208



NOTE: MAP AREA SHOWN ON THIS PANEL IS LO
TOWNSHIP 12 SOUTH, RANGE 66 WEST.

APPROXIMATE SCALE IN FEET
500 0 500

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 506 OF 1300
(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS: COMMUNITY	NUMBER	PANEL	SUFFIX
COLORADO SPRINGS, CITY OF	080060	0506	F
EL PASO COUNTY, UNINCORPORATED AREAS	080059	0506	F

MAP NUMBER
08041C0506 F

EFFECTIVE DATE:
MARCH 17, 1997

Federal Emergency Management Agency

APPENDIX B

HYDROLOGIC AND HYDRAULIC CALCULATIONS

Interquest Market Place Addition - Annexation
Final Drainage Calculation for Existing & Developed Conditions
Average Channel Velocity 5 ft/s
Average Slope 0.02 ft/ft (If Elevations are used, this will be ignored)
Note: Q2, Q5 & Q10 are based on C10, Q25, Q50 & Q100 are based on C100

Basin	Total Area sf	Total Area acres	Surface Type 1 C10	Surface Type 1 C100	Surface Type 1 Area	Surface Type 2 C10	Surface Type 2 C100	Surface Type 2 Area	Surface Type 3 C10	Surface Type 3 C100	Surface Type 3 Area	Surface Type 4 C10	Surface Type 4 C100	Surface Type 4 Area	Average C10	Average C100	Initial Length ft	True Initial Length ft	Channel flow Length ft	True Channel Length ft	High Point Elevation	Low Point Elevation	Average Slope	Initial Tc	Channe Tc	Total Tc	i2 in/hr	Q2 cfs	i5 in/hr	Q5 cfs	i10 in/hr	Q10 cfs	i25 in/hr	Q25 cfs	i50 in/hr	Q50 cfs	i100 in/hr	Q100 cfs
EX-1	240888	5.53	0.15	0.20	240888										0.15	0.20	300.00	300.00	100.00	100.00	6642.00	6626.00	0.040	19.38	0.33	19.72	2.25	**1.86**	3.09	**2.57**	3.61	**2.99**	4.64	**5.13**	5.26	**5.82**	5.51	**6.09**
EX-2	415128	9.53	0.15	0.20	415128										0.15	0.20	300.00	300.00	1100.00	1100.00	6682.00	6636.00	0.031	21.01	3.67	24.67	1.99	**2.85**	2.74	**3.92**	3.20	**4.57**	4.11	**7.84**	4.66	**8.88**	4.88	**9.30**
E-1	656016	15.06	0.15	0.20	656016			0							0.15	0.20	300.00	300.00	1500.00	1500.00	6682.00	6626.00	0.031	21.08	5.00	26.08	1.91	**4.31**	2.62	**5.93**	3.06	**6.92**	3.94	**11.86**	4.46	**13.44**	4.67	**14.07**
PE-1	237440	5.45	0.90	0.90	237440			0							0.90	0.90	50.00	50.00	400.00	400.00	6646.00	6626.00	0.044	1.61	1.33	5.00	3.71	**18.20**	5.10	**25.04**	5.96	**29.22**	7.66	**37.56**	8.68	**42.57**	9.09	**44.57**
PE-2	24403	0.56	0.30	0.55	24403			0							0.30	0.55	25.00	25.00	0.00	0.00	6648.00	6646.00	0.080	3.74	0.00	5.00	3.71	**0.62**	5.10	**0.86**	5.96	**1.00**	7.66	**2.36**	8.68	**2.67**	9.09	**2.80**
P-1	261843	6.01	0.90	0.90	237440	0.30	0.55	24403							0.84	0.87	25.00	25.00	450.00	450.00	6648.00	6626.00	0.046	1.44	1.50	5.00	3.71	**18.82**	5.10	**25.90**	5.96	**30.22**	7.66	**39.92**	8.68	**45.25**	9.09	**47.37**

Inflow Hydrograph Storm 1
2-Year Storm

Hydrograph #1
x SCS Unit Hydrograph 5 Time to peak (min)
User Input Hydrograph 18.82 Peak flow (cfs)

Hydrograph #2
SCS Unit Hydrograph Time to peak (min)
x User Input Hydrograph Peak flow (cfs)
Input Hydrograph Manually

Hydrograph #3
SCS Unit Hydrograph Time to peak (min)
x User Input Hydrograph Peak flow (cfs)
Input Hydrograph Manually

Time	Hydrograph #1			Hydrograph #2			Hydrograph #	
(min)	SCS	User	Actual	SCS	User	Actual	SCS	User
0	0		0	0		0	0	
1	1.882		1.882	0		0	0	
2	5.8342		5.8342	0		0	0	
3	12.4212		12.4212	0		0	0	
4	17.5026		17.5026	0		0	0	
5	18.82		18.82	0		0	0	
6	17.5026		17.5026	0		0	0	
7	14.6796		14.6796	0		0	0	
8	10.5392		10.5392	0		0	0	
9	7.3398		7.3398	0		0	0	
10	5.2696		5.2696	0		0	0	
11	3.9522		3.9522	0		0	0	
12	2.823		2.823	0		0	0	
13	2.0702		2.0702	0		0	0	
14	1.5056		1.5056	0		0	0	
15	1.1292		1.1292	0		0	0	
16	0.7528		0.7528	0		0	0	
17	0.5646		0.5646	0		0	0	
18	0.3764		0.3764	0		0	0	
19	0.3764		0.3764	0		0	0	
20	0.1882		0.1882	0		0	0	
21	0.1882		0.1882	0		0	0	
22	0.1882		0.1882	0		0	0	
23	0.1882		0.1882	0		0	0	
24	0.1882		0.1882	0		0	0	
25	0		0	0		0	0	
26	0		0	0		0	0	
27	0		0	0		0	0	
28	0		0	0		0	0	
29	0		0	0		0	0	
30	0		0	0		0	0	
31	0		0	0		0	0	
32	0		0	0		0	0	
33	0		0	0		0	0	
34	0		0	0		0	0	

Inflow Hydrograph Storm 2
10-Year Storm

Hydrograph #1
x SCS Unit Hydrograph 5 Time to peak (min)
User Input Hydrograph 30.22 Peak flow (cfs)

Hydrograph #2
SCS Unit Hydrograph Time to peak (min)
x User Input Hydrograph Peak flow (cfs)
Input Hydrograph Manually

Hydrograph #3
SCS Unit Hydrograph Time to peak (min)
x User Input Hydrograph Peak flow (cfs)
Input Hydrograph Manually

Time	Hydrograph #1			Hydrograph #2			Hydrograph #	
(min)	SCS	User	Actual	SCS	User	Actual	SCS	User
0	0		0	0		0	0	
1	3.022		3.022	0		0	0	
2	9.3682		9.3682	0		0	0	
3	19.9452		19.9452	0		0	0	
4	28.1046		28.1046	0		0	0	
5	30.22		30.22	0		0	0	
6	28.1046		28.1046	0		0	0	
7	23.5716		23.5716	0		0	0	
8	16.9232		16.9232	0		0	0	
9	11.7858		11.7858	0		0	0	
10	8.4616		8.4616	0		0	0	
11	6.3462		6.3462	0		0	0	
12	4.533		4.533	0		0	0	
13	3.3242		3.3242	0		0	0	
14	2.4176		2.4176	0		0	0	
15	1.8132		1.8132	0		0	0	
16	1.2088		1.2088	0		0	0	
17	0.9066		0.9066	0		0	0	
18	0.6044		0.6044	0		0	0	
19	0.6044		0.6044	0		0	0	
20	0.3022		0.3022	0		0	0	
21	0.3022		0.3022	0		0	0	
22	0.3022		0.3022	0		0	0	
23	0.3022		0.3022	0		0	0	
24	0.3022		0.3022	0		0	0	
25	0		0	0		0	0	
26	0		0	0		0	0	
27	0		0	0		0	0	
28	0		0	0		0	0	
29	0		0	0		0	0	
30	0		0	0		0	0	
31	0		0	0		0	0	
32	0		0	0		0	0	
33	0		0	0		0	0	
34	0		0	0		0	0	

Inflow Hydrograph Storm 3
100 Year Storm

Hydrograph #1
x SCS Unit Hydrograph 5 Time to peak (min)
User Input Hydrograph 47.37 Peak flow (cfs)

Hydrograph #2
SCS Unit Hydrograph Time to peak (min)
x User Input Hydrograph Peak flow (cfs)
Input Hydrograph Manually

Hydrograph #3
SCS Unit Hydrograph Time to peak (min)
x User Input Hydrograph Peak flow (cfs)
Input Hydrograph Manually

Time	Hydrograph #1			Hydrograph #2			Hydrograph #	
(min)	SCS	User	Actual	SCS	User	Actual	SCS	User
0	0		0	0		0	0	
1	4.737		4.737	0		0	0	
2	14.6847		14.6847	0		0	0	
3	31.2642		31.2642	0		0	0	
4	44.0541		44.0541	0		0	0	
5	47.37		47.37	0		0	0	
6	44.0541		44.0541	0		0	0	
7	36.9486		36.9486	0		0	0	
8	26.5272		26.5272	0		0	0	
9	18.4743		18.4743	0		0	0	
10	13.2636		13.2636	0		0	0	
11	9.9477		9.9477	0		0	0	
12	7.1055		7.1055	0		0	0	
13	5.2107		5.2107	0		0	0	
14	3.7896		3.7896	0		0	0	
15	2.8422		2.8422	0		0	0	
16	1.8948		1.8948	0		0	0	
17	1.4211		1.4211	0		0	0	
18	0.9474		0.9474	0		0	0	
19	0.9474		0.9474	0		0	0	
20	0.4737		0.4737	0		0	0	
21	0.4737		0.4737	0		0	0	
22	0.4737		0.4737	0		0	0	
23	0.4737		0.4737	0		0	0	
24	0.4737		0.4737	0		0	0	
25	0		0	0		0	0	
26	0		0	0		0	0	
27	0		0	0		0	0	
28	0		0	0		0	0	
29	0		0	0		0	0	
30	0		0	0		0	0	
31	0		0	0		0	0	
32	0		0	0		0	0	
33	0		0	0		0	0	
34	0		0	0		0	0	

Estimated Detention for Storm 1
2-Year Storm

4.31 Target Flow (cfs) **5403.714 Estimated Storage (cf)**

Time (min)	Total (cfs)	Volume (cf)	Decreasing	Match Value	Estimated Volume out (cf)
0	0				
1	1.882	56.46	NO	NO	0
2	5.8342	287.946	NO	NO	0
3	12.4212	835.608	NO	NO	0
4	17.5026	1733.322	NO	NO	0
5	18.82	2823	NO	NO	0
6	17.5026	3912.678	YES	NO	0
7	14.6796	4878.144	YES	NO	0
8	10.5392	5634.708	YES	NO	0
9	7.3398	6171.078	YES	NO	0
10	5.2696	6549.36	YES	NO	0
11	3.9522	6826.014	YES	YES	1422.3
12	2.823	7029.27	YES	NO	0
13	2.0702	7176.066	YES	NO	0
14	1.5056	7283.34	YES	NO	0
15	1.1292	7362.384	YES	NO	0
16	0.7528	7418.844	YES	NO	0
17	0.5646	7458.366	YES	NO	0
18	0.3764	7486.596	YES	NO	0
19	0.3764	7509.18	YES	NO	0
20	0.1882	7526.118	YES	NO	0
21	0.1882	7537.41	YES	NO	0
22	0.1882	7548.702	YES	NO	0
23	0.1882	7559.994	YES	NO	0
24	0.1882	7571.286	YES	NO	0
25	0	7576.932	YES	NO	0
26	0	7576.932	YES	NO	0
27	0	7576.932	YES	NO	0
28	0	7576.932	YES	NO	0
29	0	7576.932	YES	NO	0
30	0	7576.932	YES	NO	0
31	0	7576.932	YES	NO	0
32	0	7576.932	YES	NO	0
33	0	7576.932	YES	NO	0
34	0	7576.932	YES	NO	0
35	0	7576.932	YES	NO	0
36	0	7576.932	YES	NO	0
37	0	7576.932	YES	NO	0
38	0	7576.932	YES	NO	0
39	0	7576.932	YES	NO	0
40	0	7576.932	YES	NO	0
41	0	7576.932	YES	NO	0
42	0	7576.932	YES	NO	0
43	0	7576.932	YES	NO	0
44	0	7576.932	YES	NO	0

Estimated Detention for Storm 2
10-Year Storm

6.92 Target Flow (cfs) **8677.194 Estimated Storage (cf)**

Time (min)	Total (cfs)	Volume (cf)	Decreasing	Match Value	Estimated Volume out (cf)
0	0				
1	3.022	90.66	NO	NO	0
2	9.3682	462.366	NO	NO	0
3	19.9452	1341.768	NO	NO	0
4	28.1046	2783.262	NO	NO	0
5	30.22	4533	NO	NO	0
6	28.1046	6282.738	YES	NO	0
7	23.5716	7833.024	YES	NO	0
8	16.9232	9047.868	YES	NO	0
9	11.7858	9909.138	YES	NO	0
10	8.4616	10516.56	YES	NO	0
11	6.3462	10960.79	YES	YES	2283.6
12	4.533	11287.17	YES	NO	0
13	3.3242	11522.89	YES	NO	0
14	2.4176	11695.14	YES	NO	0
15	1.8132	11822.06	YES	NO	0
16	1.2088	11912.72	YES	NO	0
17	0.9066	11976.19	YES	NO	0
18	0.6044	12021.52	YES	NO	0
19	0.6044	12057.78	YES	NO	0
20	0.3022	12084.98	YES	NO	0
21	0.3022	12103.11	YES	NO	0
22	0.3022	12121.24	YES	NO	0
23	0.3022	12139.37	YES	NO	0
24	0.3022	12157.51	YES	NO	0
25	0	12166.57	YES	NO	0
26	0	12166.57	YES	NO	0
27	0	12166.57	YES	NO	0
28	0	12166.57	YES	NO	0
29	0	12166.57	YES	NO	0
30	0	12166.57	YES	NO	0
31	0	12166.57	YES	NO	0
32	0	12166.57	YES	NO	0
33	0	12166.57	YES	NO	0
34	0	12166.57	YES	NO	0
35	0	12166.57	YES	NO	0
36	0	12166.57	YES	NO	0
37	0	12166.57	YES	NO	0
38	0	12166.57	YES	NO	0
39	0	12166.57	YES	NO	0
40	0	12166.57	YES	NO	0
41	0	12166.57	YES	NO	0
42	0	12166.57	YES	NO	0
43	0	12166.57	YES	NO	0
44	0	12166.57	YES	NO	0

Estimated Detention for Storm 3
100-Year Storm

14.07 Target Flow (cfs) **12263.76 Estimated Storage (cf)**

Time (min)	Total (cfs)	Volume (cf)	Decreasing	Match Value	Estimated Volume out (cf)
0	0				
1	4.737	142.11	NO	NO	0
2	14.6847	724.761	NO	NO	0
3	31.2642	2103.228	NO	NO	0
4	44.0541	4362.777	NO	NO	0
5	47.37	7105.5	NO	NO	0
6	44.0541	9848.223	YES	NO	0
7	36.9486	12278.3	YES	NO	0
8	26.5272	14182.58	YES	NO	0
9	18.4743	15532.62	YES	NO	0
10	13.2636	16484.76	YES	YES	4221
11	9.9477	17181.1	YES	NO	0
12	7.1055	17692.7	YES	NO	0
13	5.2107	18062.18	YES	NO	0
14	3.7896	18332.19	YES	NO	0
15	2.8422	18531.14	YES	NO	0
16	1.8948	18673.25	YES	NO	0
17	1.4211	18772.73	YES	NO	0
18	0.9474	18843.79	YES	NO	0
19	0.9474	18900.63	YES	NO	0
20	0.4737	18943.26	YES	NO	0
21	0.4737	18971.69	YES	NO	0
22	0.4737	19000.11	YES	NO	0
23	0.4737	19028.53	YES	NO	0
24	0.4737	19056.95	YES	NO	0
25	0	19071.16	YES	NO	0
26	0	19071.16	YES	NO	0
27	0	19071.16	YES	NO	0
28	0	19071.16	YES	NO	0
29	0	19071.16	YES	NO	0
30	0	19071.16	YES	NO	0
31	0	19071.16	YES	NO	0
32	0	19071.16	YES	NO	0
33	0	19071.16	YES	NO	0
34	0	19071.16	YES	NO	0
35	0	19071.16	YES	NO	0
36	0	19071.16	YES	NO	0
37	0	19071.16	YES	NO	0
38	0	19071.16	YES	NO	0
39	0	19071.16	YES	NO	0
40	0	19071.16	YES	NO	0
41	0	19071.16	YES	NO	0
42	0	19071.16	YES	NO	0
43	0	19071.16	YES	NO	0
44	0	19071.16	YES	NO	0

Design Procedure Form: Extended Detention Basin (EDB) - Sedimentation Facility

Designer:	Brady A. Shyrock
Company:	Matrix Design Group
Date:	November 8, 2007
Project:	Interquest Marketplace Addition
Location:	Northern Colorado Springs

1. Basin Storage Volume	
A) Tributary Area's Imperviousness Ratio ($i = I_a / 100$)	I_a = 92.00 % i = 0.92
B) Contributing Watershed Area (Area)	Area = 6.01 acres
C) Water Quality Capture Volume (WQCV) (WQCV =1.0 * (0.91 * I^3 - 1.19 * I^2 + 0.78 * I))	WQCV = 0.42 watershed inches
D) Design Volume: Vol = (WQCV / 12) * Area * 1.2	Vol = 0.252 acre-feet
2. Outlet Works	
A) Outlet Type (Check One)	X Orifice Plate Perforated Riser Pipe Other:
B) Depth at Outlet Above Lowest Perforation (H)	H = 1.00 feet
C) Required Maximum Outlet Area per Row, (A_o)	A_o = 1.58 square inches
D) Perforation Dimensions **(enter one only)**: i) Circular Perforation Diameter **OR** ii) 2" Height Rectangular Perforation Width	D = 1.3330 inches, **OR** W = inches
E) Number of Columns (nc, See Table 6a-1 For Maximum)	nc = 1 number
F) Actual Design Outlet Area per Row (A_o)	A_o = 1.40 square inches
G) Number of Rows (nr)	nr = 3 number
H) Total Outlet Area (A_{ot})	A_{ot} = 4.19 square inches
3. Trash Rack	
A) Needed Open Area: A_t = 0.5 * (Figure 7 Value) * A_{ot}	A_t = 1.37 square inches
B) Type of Outlet Opening (Check One)	X ≤ 2" Diameter **Round** 2" High **Rectangular** Other:
C) For 2", or Smaller, **Round Opening** (Ref.: Figure 6a):	
i) Width of Trash Rack and Concrete Opening (W_{conc}) from Table 6a-1	W_{conc} = 9 inches
ii) Height of Trash Rack Screen (H_{TR})	H_{TR} = 36 inches

APPENDIX C

STANDARD DESIGN CHARTS AND TABLES

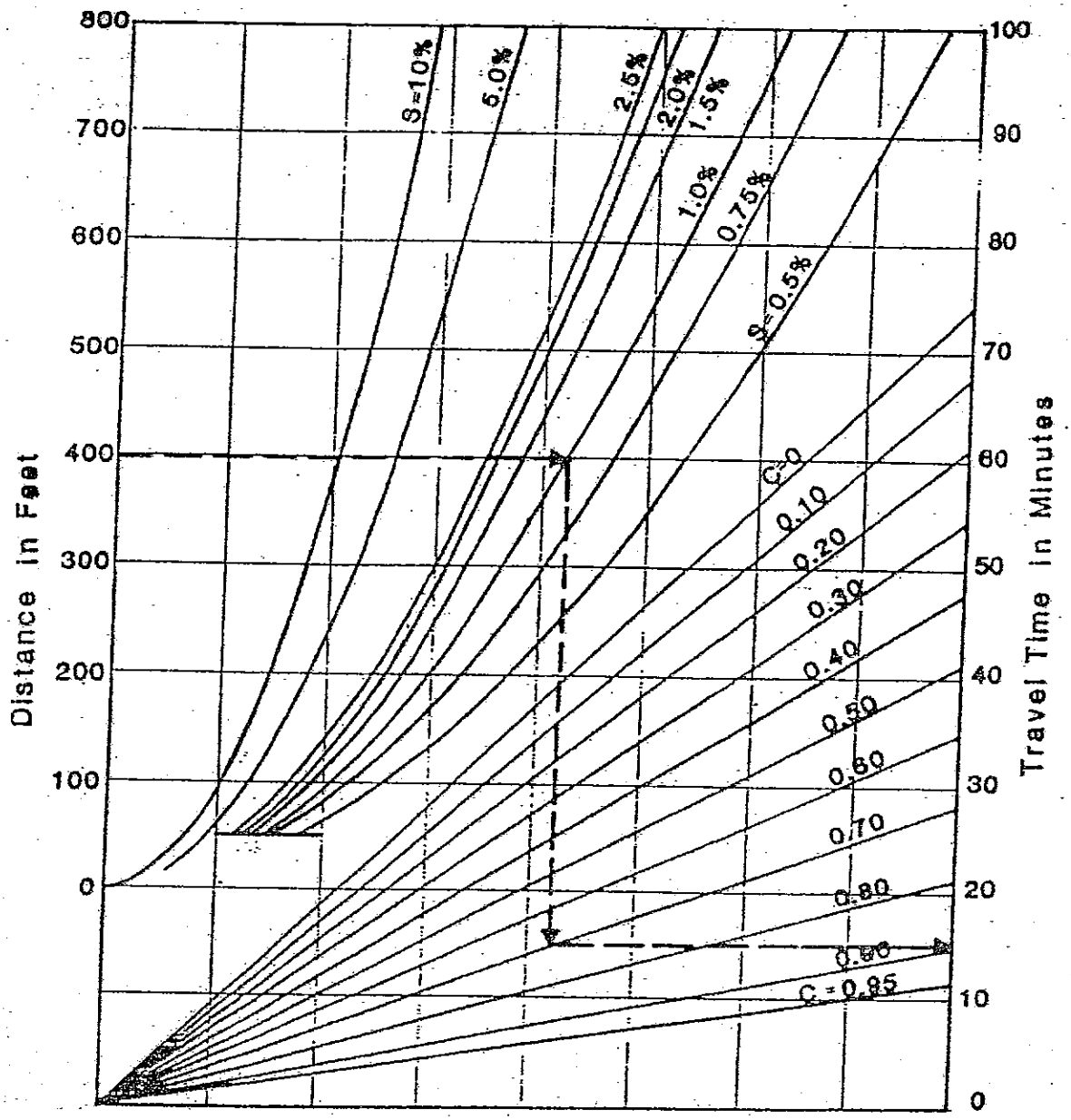
TABLE 5-1

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

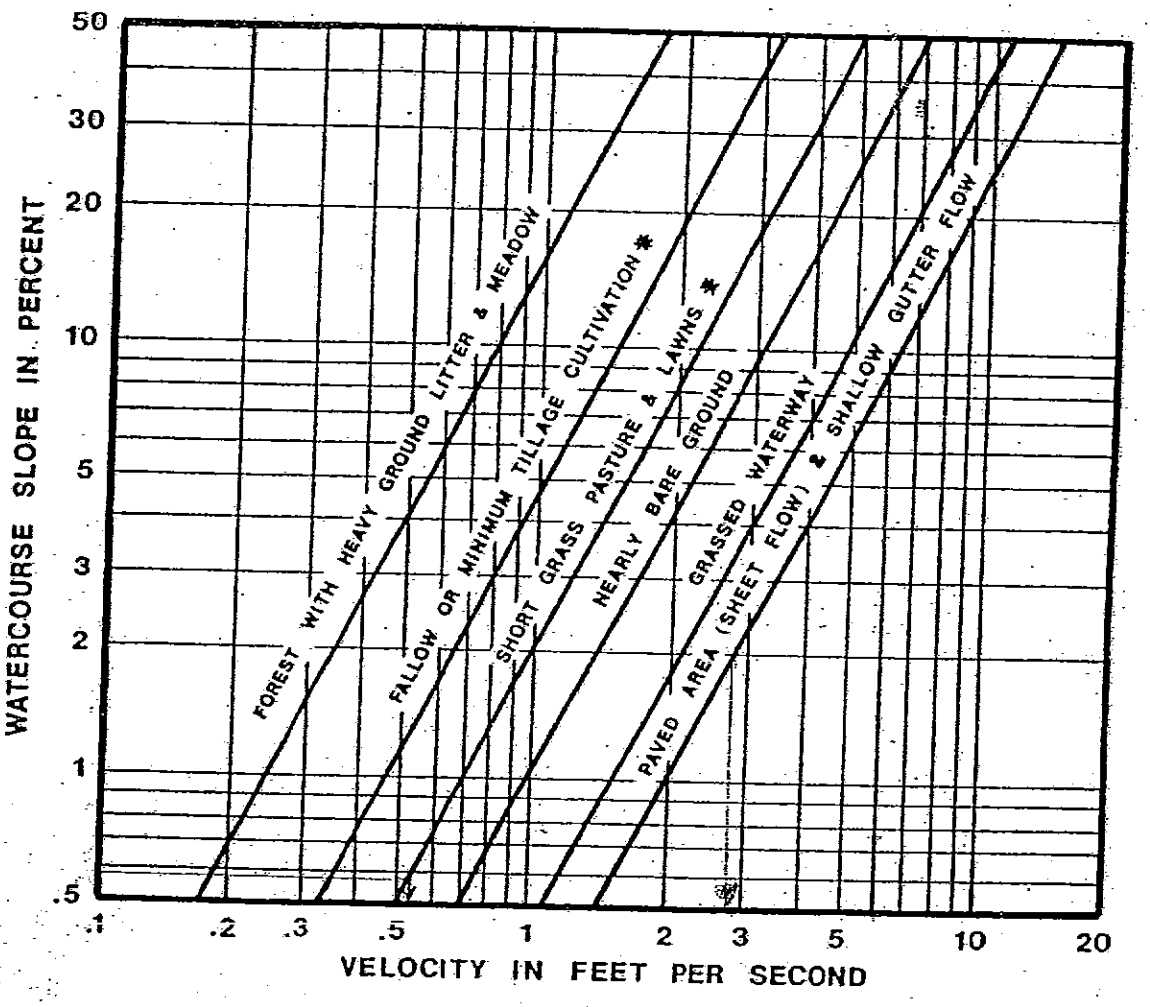
HDR Infrastructure, Inc.
A Centerra Company

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

Overland Flow Curves

Date: OCT. 1987

Figure: 5–2



ESTIMATE OF AVERAGE FLOW VELOCITY FOR USE WITH THE RATIONAL FORMULA.

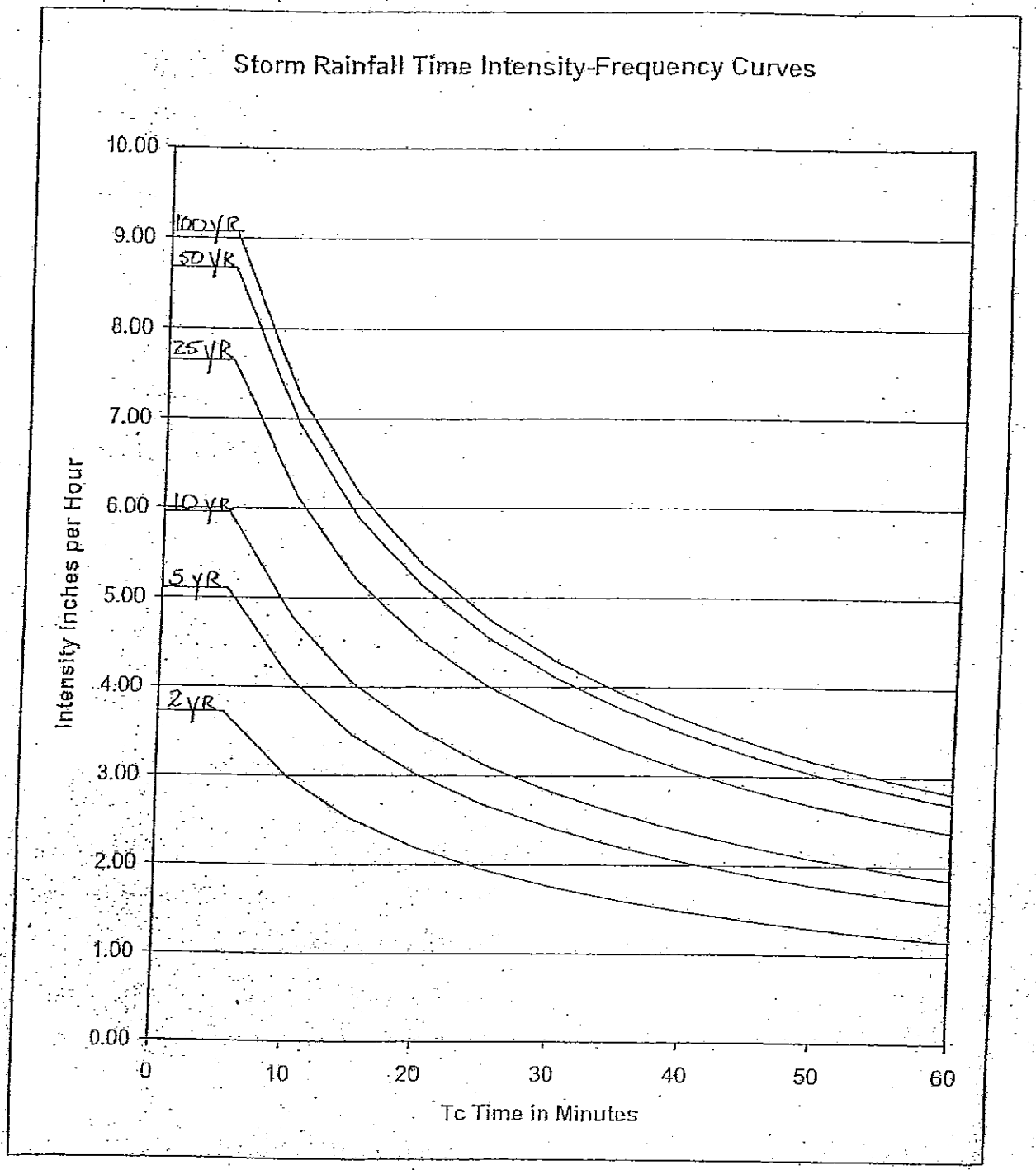
* MOST FREQUENTLY OCCURRING "UNDEVELOPED" LAND SURFACES IN THE DENVER REGION.

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

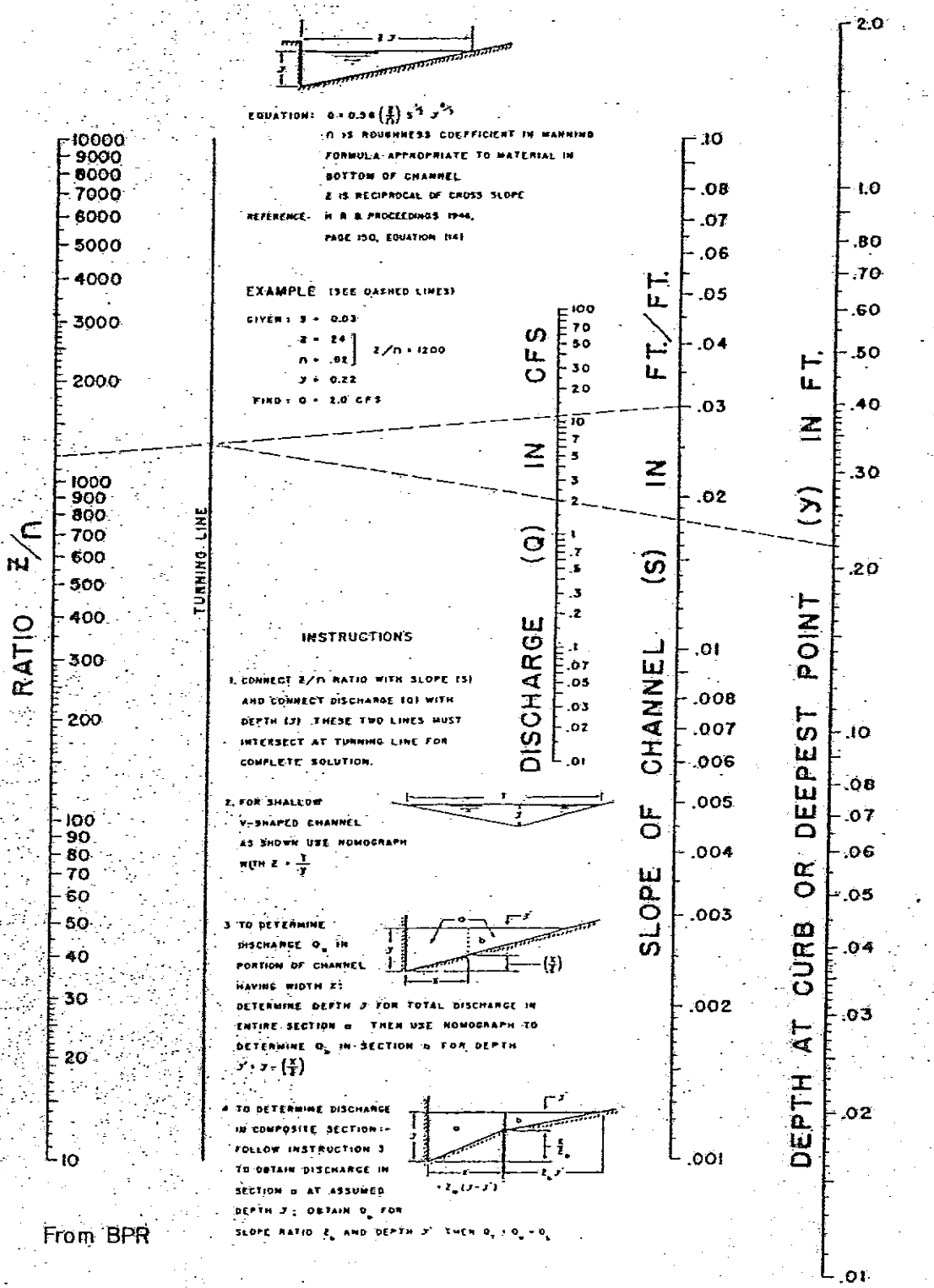
FIGURE 2

5-1-84

URBAN DRAINAGE & FLOOD CONTROL DISTRICT



Rainfall Depth - Duration - Frequency Table derived from Rainfall Atlas III for Colorado
Resource: Guo, James C.Y., (2001) "Urban Storm Water Modeling", Chapter 5: Runoff Prediction for Small Catchment, published by Auraria Campus Book Company, University of Colorado at Denver, Denver, Colorado.



NONOGRAPH FOR FLOW IN TRIANGULAR GUTTERS
(From U.S. Dept. of Commerce, Bureau of Public Roads, 1965)

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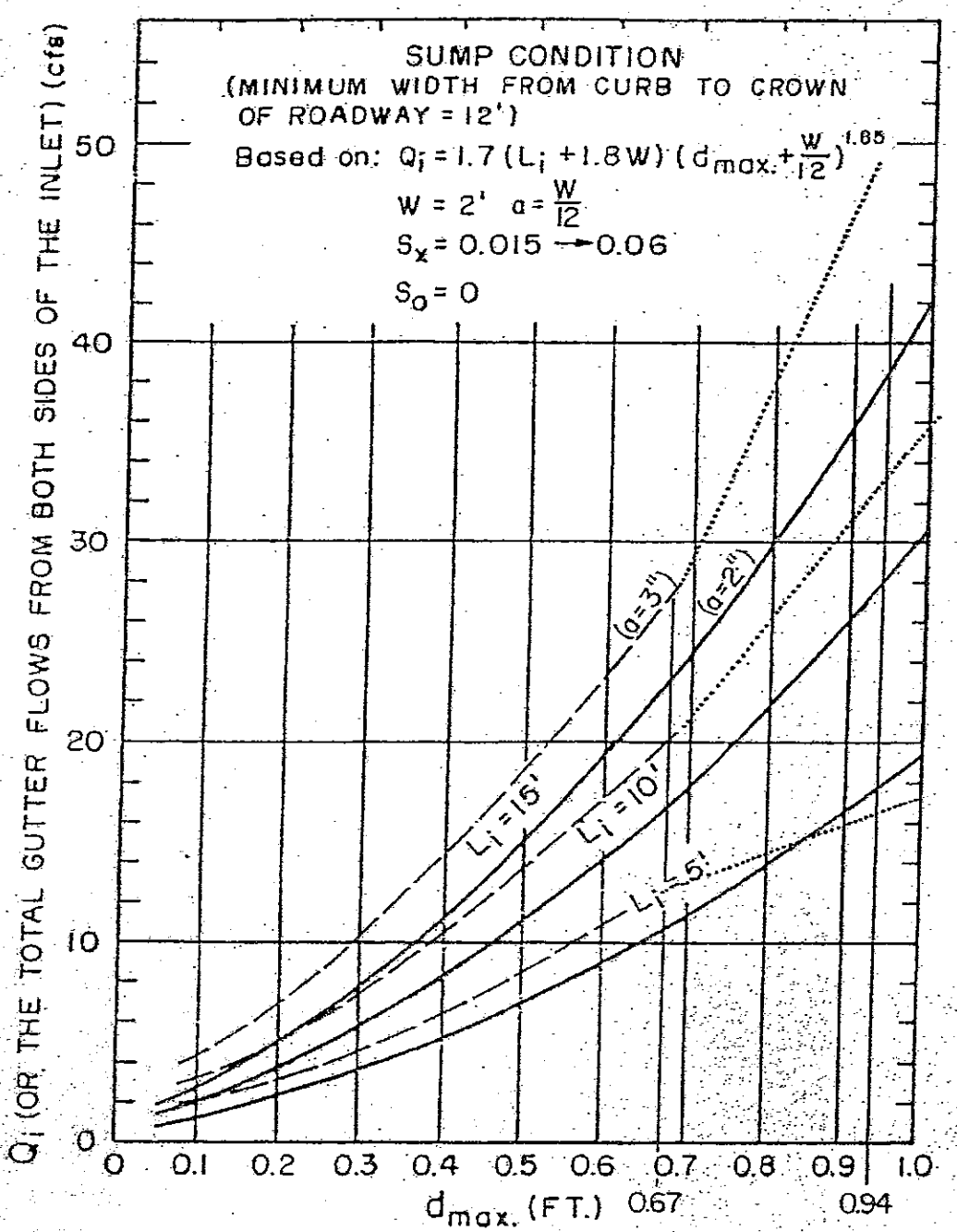
NOMOGRAPH FOR FLOW IN TRIANGULAR GUTTERS.

Date: OCT. 1967

Figure: T - 2



REFERENCE : Izzard, Carl. f., Report presented at the Annual Meeting of the National Transportation Board, January 1977; Simplified Method For Design of Curb-opening Inlets

——— (As Modified by El Paso County, per Type R Inlet)

Note: Depth of ponding measured at curb above depressed area ; a = 3", For $d \leq .67$

$Q_i = (1.7 L_i + 6.12)(d_{max} + .25)^{1.85}$; $Q_i = 3.60 L_i (d - .08)^{.5}$ For $d \geq .94$; Note : No Clogging Factor

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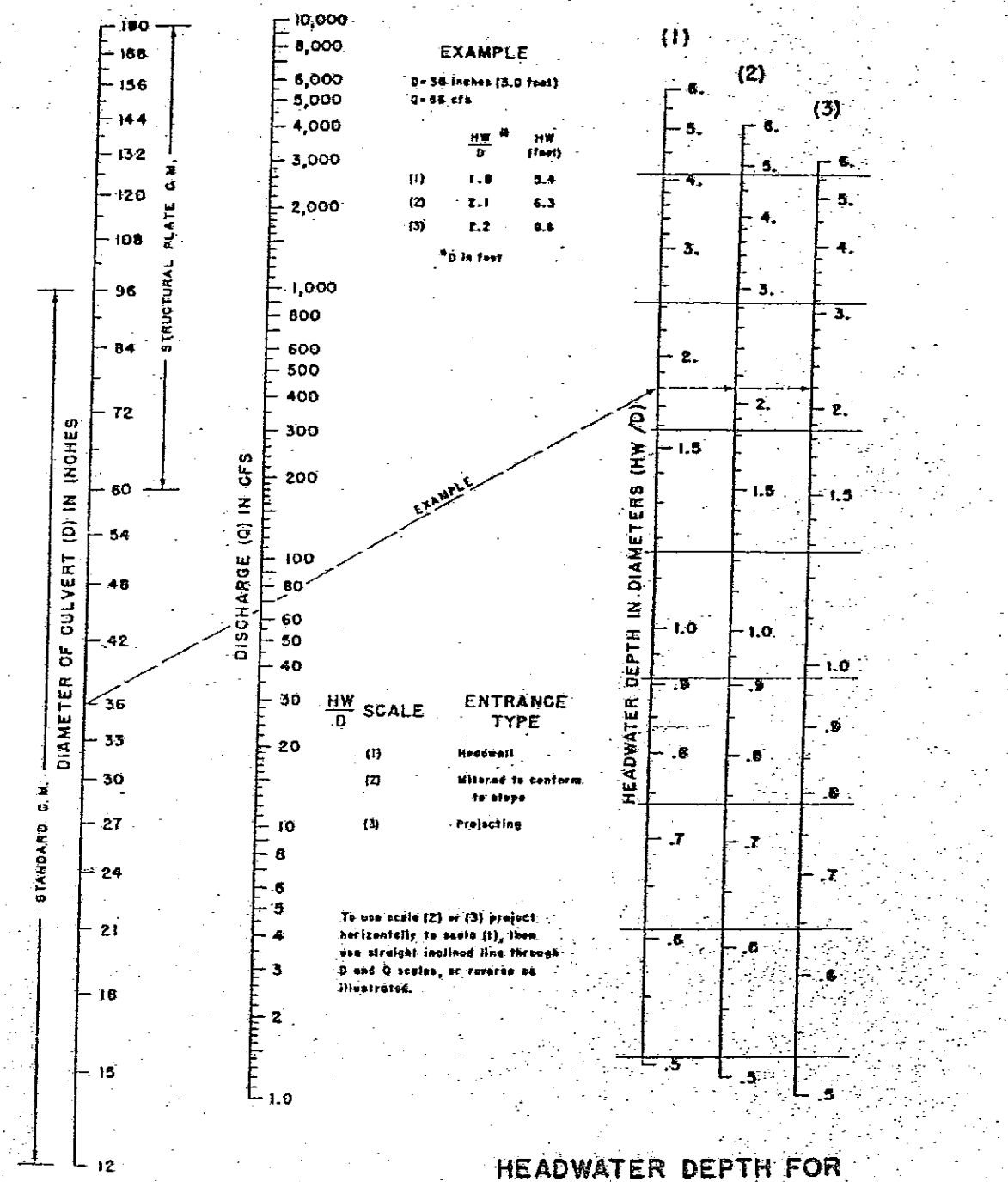
Date
OCT. 1987

Figure
7-11

Sump Capacity for Curb-opening Inlets



BUREAU OF PUBLIC ROADS JAN. 1963

HEADWATER DEPTH FOR C. M. PIPE CULVERTS WITH INLET CONTROL