DRAINAGE LETTER REPORT
FOR
YARBROUGH SUBDIVISION

Prepared for:

Mr. Rick Yarbrough
5180 Meadowgreen Drive
Colorado Springs, CO 80919

May 5, 2010

Prepared by:

JPS ENGINEERING

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JPS Project No. 031004

See MDT Letter for Engineer comments.

YARBROUGH SUBDIVISION
DRAINAGE REPORT STATEMENTS

1. Engineer's Statement:

The attached drainage plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the City/County for drainage reports and said report is in conformity with the master plan for the drainage basin. I accept responsibility for liability caused by negligent acts, errors or omissions on my part in preparing this report:

____

John P. Schwab Colorado P.E. No. 29891

2. Developer's Statement:

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

By:

____________________________________ ____________________

Printed Name: Date

Title:

3. El Paso County Statement:

Filed in accordance with the requirements of the El Paso County Land Development Code, Drainage Criteria Manual, Volumes 1 and 2, and Engineering Criteria Manual as amended.

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County Engineer / ECM Administrator Date

Conditions:

I. INTRODUCTION

A. Property Location and Description

Yarbrough Subdivision is a proposed minor subdivision consisting of a single 1.7-acre residential lot located in the Palmer Lake area of northern El Paso County, Colorado. The parcel (El Paso County Assessor's Parcel No. 71090-00-053) is currently unplatted and vacant. The Owners plan to build a single-family residence on the property, and a minor subdivision is required by El Paso County prior to obtaining a building permit. The property is located in the south half of the southeast quarter of Section 9, Township 11 South, Range 67 West of the 6th P.M., which is at the south end of Rockbrook Road (see Figure A1). An existing shared driveway follows the west boundary of the property, providing access to the existing residence south of this lot. Rockbrook Road is an existing gravel public road, which currently terminates in a non-standard cul-de-sac at the north end of the Yarbrough property. Based on an agreement with the County and Tri-Lakes Fire Protection District, the proposed subdivision will include upgrade of the south end of Rockbrook Road to provide a "hammerhead turnaround."

The parcel is zoned RR-0.5 (rural residential – 0.5-acre minimum lots), and the proposed minor subdivision is consistent with the existing zoning of this site. The proposed minor subdivision will create a single residential building lot. The property is bounded by existing rural residential lots on the north, west, and south sides, and a large undeveloped property (Nevins, 27.6 acres) on the west side. The major drainage channel of Monument Creek flows through the adjacent property to the west, and the FEMA floodplain of Monument Creek impacts the west side of this property.

This report is intended to meet the requirements of a site-specific "Letter Type" drainage report in accordance with El Paso County subdivision drainage criteria.

B. Drainage Analysis Methods and Criteria

ITEM	DESCRIPTION	REFERENCE
Design Storm (initial/major)	5-year/100-year	CS/EPC DCM
Storm Runoff	Rational Method	CS/EPC DCM
Major Drainage Basin	Monument Creek	
Floodplain Impacts	West side of property is impacted by FEMA 100-year floodplain	FIRM
General Site Drainage Patterns	Sheet flow, swales, and ditches flowing towards existing major drainage channel west of property	
Existing Downstream Facilities	Existing Monument Creek channel	

CS/EPC DCM = City of Colorado Springs & El Paso County Drainage Criteria Manual

II. EXISTING / PROPOSED DRAINAGE CONDITIONS

As shown on the enclosed Drainage Plan (Figures EX1, EX2, and D1), the parcel has been delineated as two on-site drainage basins (Basins A and B). The north end of the site is impacted by a small off-site basin to the northeast (Basin OA1). These basins call sheet flow southwesterly to the adjacent major drainage channel of Monument Creek.

The site slopes downward to the west, with average grades of 4-20 percent. According to the USDA Soil Conservation Service (SCS) "Soil Survey of El Paso County," the soils on site consist primarily Type 41, "Kettle gravelly loamy sand" soils (see Figure B). These soils are classified as deep, well-drained soils formed in sandy arkosic deposits on uplands. These soils have rapid permeability and slow surface runoff characteristics, and the hazard of erosion is moderate. The soils are classified as hydrologic soils group B.

The majority of the subdivision area has been delineated as Basin A. Off-site flows from Basin OA1 combine with on-site flow within Basin A, and these combined flows drain westerly to the existing drainage channel at the west boundary of the site (Design Point #1). The calculated historic peak flows at Design Point #1 are $Q_5 = 2.2$ cfs and $Q_{100} = 4.7$ cfs.

The southeast part of the site has been delineated as Basin B, which sheet flows southwesterly towards the Monument Creek channel. The calculated historic peak flows at Design Point #2 are $Q_5 = 0.4$ cfs and $Q_{100} = 0.8$ cfs.

According to the FEMA Flood Insurance Study, the adjacent major drainage channel of Monument Creek experiences 100-year flows of approximately 13,850 cfs at "Section CV" downstream of this site. As such, the total developed flows from this small site represent a negligible percentage of total flows in the main channel.

The developed drainage concept will be to provide positive drainage away from proposed structures and generally conform to historic drainage patterns. The low density of the proposed development will result in a minimal impact to downstream facilities. Based on the small size of the developed drainage area in comparison to the large off-site drainage basin area of Monument Creek, the developed drainage impact is negligible. Developed peak flows at Design Point #1 are calculated as $Q_5 = 2.4$ cfs and $Q_{100} = 5.4$ cfs, and developed peak flows at Design Point #2 are calculated as $Q_5 = 0.5$ cfs and $Q_{100} = 1.2$ cfs. The developed drainage calculations indicate a minor increase in developed flows, which is consistent with the existing rural residential zoning of the property.

Development of this subdivision will include construction of a "hammerhead turnaround" at the southern termination of Rockbrook Road, and minor widening of the existing shared driveway along the west boundary of the property. As noted in Appendix B, an 18-inch culvert is recommended at the low point in the profile of the shared driveway.

Hydrologic calculations for the parcel are detailed in Appendix A, and peak flows are identified on Figure D1. Proper erosion control measures will be required for development of the site, including silt fence along downstream limits of excavation to minimize off-site transport of construction sediment.

Based on the rural density of the proposed subdivision, and the small size of the developed basins in comparison to flows in the adjacent major drainage channel, no significant impact on downstream drainage facilities is anticipated.

The Developed Drainage Plan includes the following notes for Builders and Property Owners:

1. Individual builders shall provide positive drainage away from structures and account for potential cross-lot drainage impacts within each lot.
2. Builders and property owners shall implement and maintain erosion control best management practices for protection of downstream properties and facilities.
3. Recognizing the location of this subdivision adjacent to the major drainage channel of Monument Creek, individual builders and owners shall take extra care in providing and maintaining erosion control BMP"s at downstream property boundaries.

III. FLOODPLAIN IMPACTS

According to the FEMA floodplain map for this area, El Paso County FIRM Panel No. 08041C0260F, dated March 17, 1997 (see Figure A2), the west boundary of the site is impacted by the delineated FEMA 100-year floodplain limits. The proposed shared driveway improvements will not include any fill within the floodplain, to ensure zero-rise in the floodplain. A floodplain development permit will be required through the Pikes Peak Regional Building Department for the proposed shared driveway improvements within the floodplain.

IV. PUBLIC IMPROVEMENTS / DRAINAGE BASIN FEES

No public drainage improvements are required or proposed for this project. According to El Paso County policies, drainage basin fees are due based on the impervious area projected for the new subdivision.

This parcel is located entirely within the Palmer Lake Drainage Basin (FOM 05400), which has a 2010 basin fee of $9,403 per impervious acre and no bridge fee requirement. Applicable drainage basin fees are calculated as follows:

Subdivision Area = 1.71 acres
Percent Impervious = 15.74% (interpolated from Table 3-1)
Calculated Impervious Area = (1.71 ac) * 15.74 % = 0.269 ac.

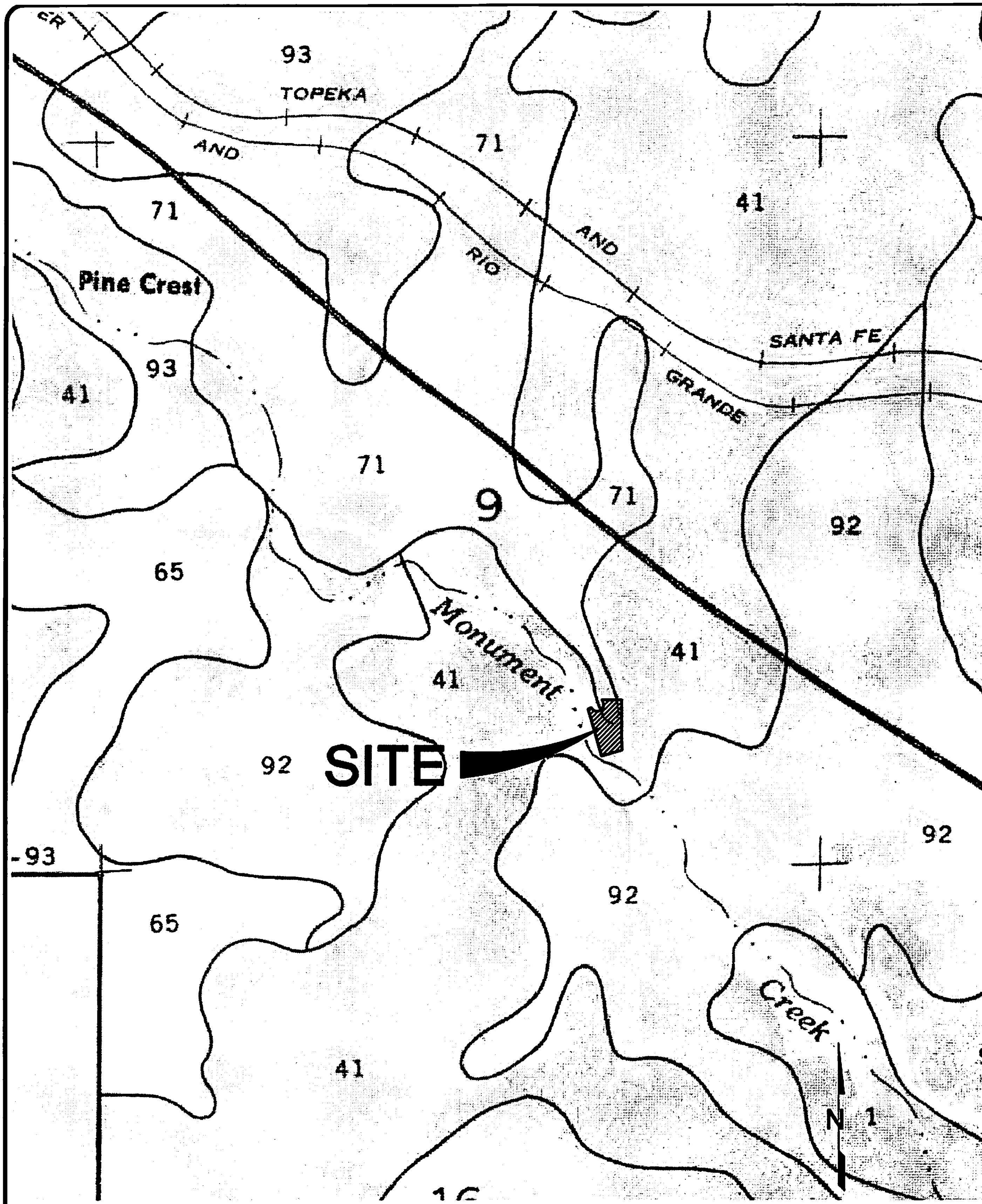
Drainage Basin Fee = (0.269 ac.) @ $9,403/ac. = <u>$2,530.86</u>

V. SUMMARY

The proposed drainage patterns for Yarbrough Subdivision will remain consistent with historic conditions and the overall drainage plan for this area. The proposed minor subdivision to create a single platted rural residential lot will result in a negligible impact on downstream facilities. Installation and maintenance of proper erosion control practices during and after construction will ensure that this developed site will not adversely affect downstream or surrounding areas.

APPENDIX A

FIGURES



(EL PASO COUNTY SCS MAP NO. 30)

SCALE: 1"=1000'

SCS SOILS MAP	JPS ENGINEERING	YARBROUGH SUBDIVISION FIGURE A2 JPS PROJ NO. 031004

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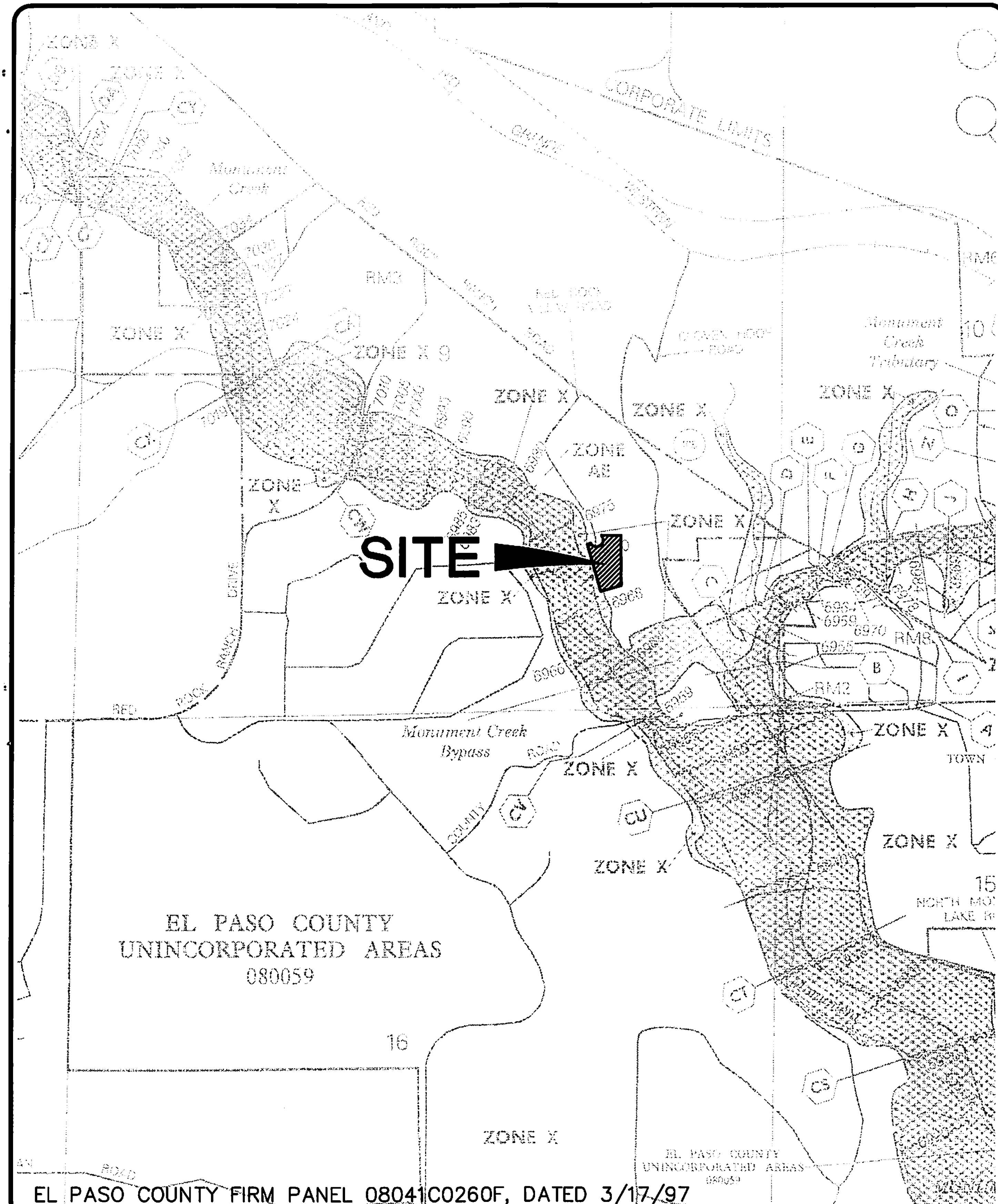

FLOODPLAIN MAP

JPS ENGINEERING

YARBROUGH SUBDIVISION

FIGURE A3

JPS PROJ NO. 031004

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APPENDIX B

DRAINAGE CALCULATIONS

pricklypear occur. Ample amounts of litter and forage should be left on the soil because of the high hazard of soil blowing.

Windbreaks and environmental plantings are generally well suited to this soil. Summer fallow a year prior to planting and continued cultivation for weed control are needed to insure establishment and survival of plantings. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. Shrubs that are best suited are skunkbush sumac, lilac, Siberian peashrub, and American plum.

Depending on land use, this soil can produce habitat that is suitable for either rangeland wildlife, such as antelope, or for openland wildlife, such as pheasant, cottontail, and mourning dove. Availability of irrigation water largely determines the land use. Where no irrigation water is available, this soil is mainly used as rangeland, a use that favors rangeland wildlife. If this soil is used as rangeland, fences, livestock water developments, and proper livestock grazing use are practices that enhance habitat for rangeland wildlife. Production of crops such as wheat, corn, and alfalfa provides suitable habitat for openland wildlife, especially pheasant. Among the practices that increase openland wildlife populations are planting trees and shrubs and providing undisturbed nesting cover.

The main limitation of this soil for urban use is shrink-swell potential. Buildings and roads need to be designed to overcome this limitation. Roads need to be designed to minimize frost-heave damage. Capability subclasses IVe, nonirrigated, and IIe, irrigated.

40—Kettle gravelly loamy sand, 3 to 8 percent slopes. This deep, well drained soil formed in sandy arkosic deposits on uplands. Elevation ranges from 7,000 to 7,700 feet. The average annual precipitation is about 18 inches, the average annual air temperature is about 43 degrees F, and the average frost-free period is about 120 days.

Typically, the surface layer is gray gravelly loamy sand about 3 inches thick. The subsurface layer is light gray gravelly loamy sand about 13 inches thick. The subsoil is very pale brown gravelly sandy loam about 24 inches thick. It consists of a matrix of loamy coarse sand that has thin bands of coarse sandy loam or sandy clay loam. The substratum to a depth of 60 inches or more is light yellowish brown extremely gravelly loamy sand.

Included with this soil in mapping are small areas of Alamosa loam, 1 to 3 percent slopes; Elbeth sandy loam, 3 to 8 percent slopes; Pring coarse sandy loam, 3 to 8 percent slopes; Tomah-Crowfoot loamy sands, 3 to 8 percent slopes; and a few rock outcrops.

Permeability of this Kettle soil is rapid. Effective rooting depth is 60 inches or more. Available water capacity is low to moderate. Surface runoff is slow, and the hazard of erosion is slight to moderate. A few gullies have formed in drainageways.

This soil is used for woodland, livestock grazing, wildlife habitat, recreation, and homesites.

This soil is suited to the production of ponderosa pine. It is capable of producing about 2,240 cubic feet or 4,900 board feet (International rule), of merchantable timber per acre from a fully stocked, even-aged stand of 80-year-old trees. The main limitation for the production or harvesting of timber is the low available water capacity. The low available water capacity also influences seedling survival, especially in areas where understory plants are plentiful. Erosion must be kept to a minimum when harvesting timber.

This soil has good potential for mule deer, tree squirrels, cottontail rabbit, and wild turkey. These animals obtain their food and shelter from pine trees, shrubs, and ground cover, which provide browse, forbs, fruit, and seeds. The presence of ponderosa pine and Gambel oak should encourage wild turkey populations; however, where water is not naturally present, wildlife watering facilities must be provided to attract and maintain wild turkey and other wildlife species. Livestock grazing management is vital on this soil if wildlife populations are to be maintained.

This soil has good potential for use as homesites. Plans for homesite development on this soil should provide for the preservation of as many trees as possible in order to maintain the esthetic value of the sites. During seasons of low precipitation, fire may become a hazard to homesites. This hazard can be minimized by installing firebreaks and reducing the amount of litter on the forest floor. Capability subclass VIe.

41—Kettle gravelly loamy sand, 8 to 40 percent slopes. This deep, well drained soil formed in sandy arkosic deposits on uplands. Elevation ranges from 7,000 to 7,700 feet. The average annual precipitation is about 18 inches, the average annual air temperature is about 43 degrees F, and the average frost-free period is about 120 days.

Typically, the surface layer is gray gravelly loamy sand about 3 inches thick. The subsurface layer is light gray gravelly loamy sand about 13 inches thick. The subsoil is very pale brown gravelly sandy loam about 24 inches thick. It consists of a matrix of loamy coarse sand that has thin bands of coarse sandy loam or sandy clay loam. The substratum to a depth of 60 inches or more is light yellowish brown extremely gravelly loamy sand.

Included with this soil in mapping are small areas of Elbeth sandy loam, 8 to 15 percent slopes; Pring coarse sandy loam, 8 to 15 percent slopes; Tomah-Crowfoot loamy sands, 8 to 15 percent slopes; and a few rock outcrops.

Permeability of this Kettle soil is rapid. Effective rooting depth is 60 inches or more. Available water capacity is low to moderate. Surface runoff is medium, and the hazard of erosion is moderate. Some gullies have formed in drainageways.

The soil is used for woodland, livestock grazing, wildlife habitat, recreation, and homesites.

This soil is suited to the production of ponderosa pine. It is capable of producing 2,240 cubic feet, or 4,900 board

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			Bedrock		Potential frost action
		Frequency	Duration	Months	Depth	Hardness	
					In		
Elbeth:							
Pring part	B	None	---	---	>60	---	Moderate.
Ellicott:							
28	A	Frequent	Brief	Mar-Jun	>60	---	Low.
Fluvaquentic Haplaquolls:							
29	B/D	Frequent	Brief	Mar-Jul	>60	---	High.
Fort Collins:							
30, 31	B	None to rare	---	---	>60	---	Moderate.
Fortwingate:							
[1]32:							
Fortwingate part	C	None	---	---	20-40	Hard	Low.
Rock outcrop part	D	---	---	---	---	---	---
Heldt:							
33	C	None	---	---	>60	---	Moderate.
Holderness:							
34, 35, 36	C	None	---	---	>60	---	Moderate.
Jarre:							
37	B	None	---	---	>60	---	Moderate.
[1]38:							
Jarre part	B	None	---	---	>60	---	Moderate.
Tecolote part	B	None	---	---	>60	---	Moderate.
Keith:							
39	B	None	---	---	>60	---	High.
Kettle:							
40, 41	B	None	---	---	>60	---	Moderate.
[1]42:							
Kettle part	B	None	---	---	>60	---	Moderate.
Rock outcrop part	D	---	---	---	---	---	---
Kim:							
43	B	None	---	---	>60	---	Moderate.
Kutch:							
44, 45	C	None	---	---	20-40	Rippable	Moderate.
Kutler:							
[1]46:							
Kutler part	C	None	---	---	20-40	Rippable	Low.
Broadmoor part	C	None	---	---	20-40	Rippable	Low.
Rock outcrop part	D	---	---	---	---	---	---
Limon:							
47	C	Occasional	Brief	May-Sep	>60	---	Moderate.
Louviers:							
48	D	None	---	---	10-20	Rippable	Moderate.
49	D	None	---	---	10-20	Rippable	Low.

See footnote at end of table.

7.4 HYDROLOGIC PROCEDURE SELECTION

7.4.1 Overview

Streamflow measurements for determining a flood frequency relationship at or near a site are usually unavailable. In such cases, it is accepted practice to estimate peak runoff rates and hydrographs using statistical or empirical methods. In general, results from using several methods should be compared, not averaged. The discharge that best reflects local project conditions, with the reasons documented, will be used.

7.4.2 Peak Flow Rates or Hydrographs

A consideration of peak runoff rates for design conditions is generally adequate for conveyance systems such as storm drains or open channels. However, if the design must include flood routing, a hydrograph is required. Although hydrograph development (more complex than estimating peak runoff rates) is often accomplished using computer programs, some methods are adaptable to desktop procedures. See the AASHTO Model Drainage Manual, Chapter 7 Appendix.

7.4.3 Time of Concentration

The time of concentration, T_c, is defined as the time it takes a drop of rain falling on the hydraulically most remote point in the watershed to travel through the watershed to the first design point. It is a very important parameter at which the entire drainage basin is contributing runoff to the design point. The time of concentration usually has two components. The first is the initial time, T_i; which is the time runoff is sheet flowing. The travel time, T_t, is the time runoff is in a channel.

$$T_c = T_i + T_c$$

For overland flow in a small basin:

$$T_i = \frac{1.8\,(1.1 - C)\,D^{0.5}}{S^{0.33}}$$

where

T_i = minutes
C = runoff coefficient as defined in the rational equation
D = distance of flow path in feet
(500 ft. max. non-urban areas)
(300 ft. max. urban areas)
S = average slope of basin in %

See Figure 7-1.

For channel flow:

$$T_t = \left[\frac{11.9\ L^3}{H}\right]^{0.385}$$

where

T_t = hours
L = distance of flow path in miles
H = elevation difference from beginning of defined channel flow to the site in feet.

or when a channel velocity is known:

$$T_t = \frac{L}{60\ V}$$

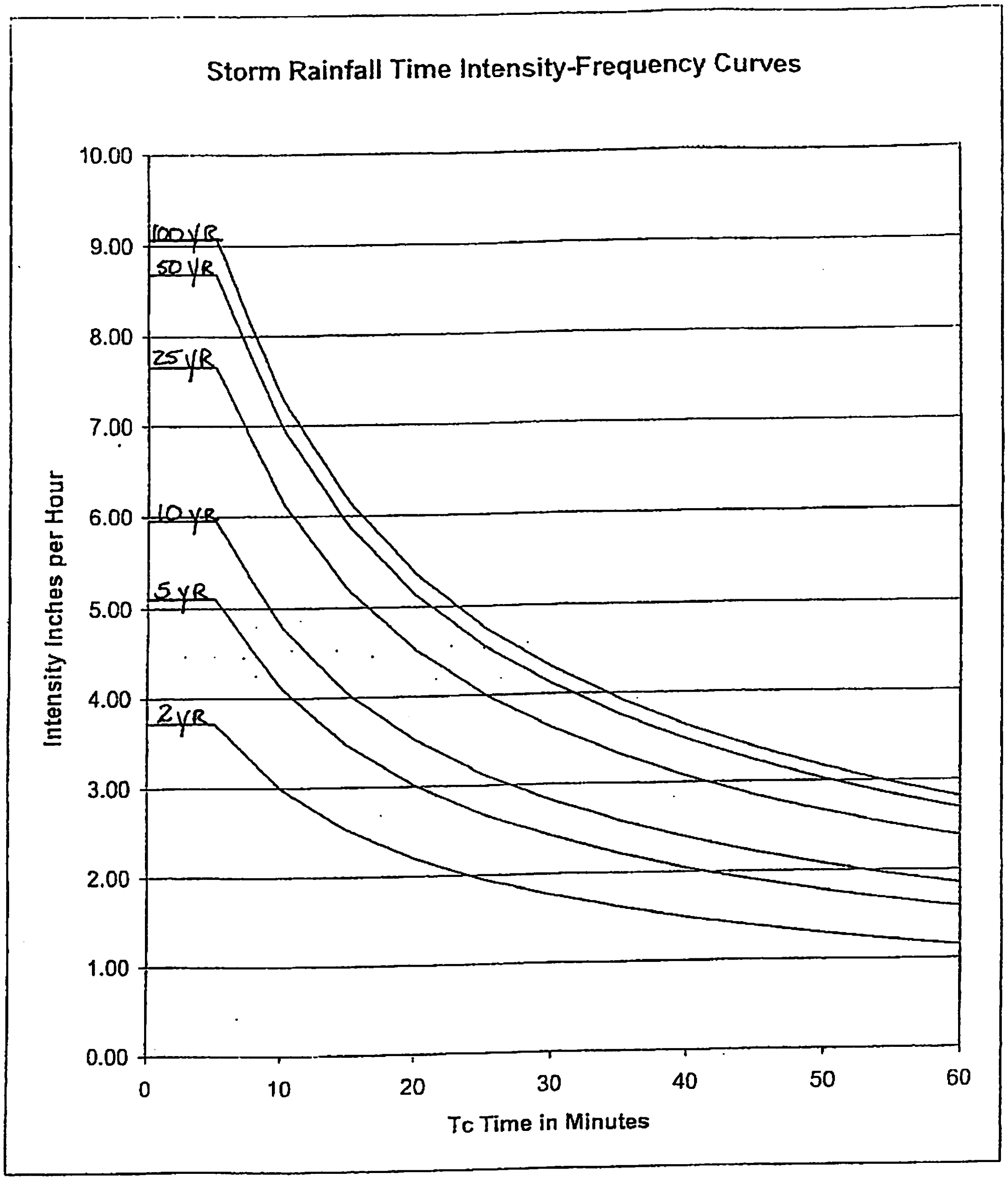
where

T_t = minutes
V = channel velocity in feet per second (meters per second)
L = distance in feet (meters)

See Figure 7-2.

In urban watersheds, the time of concentration at the first design point (including both channel and overland flow), shall not exceed the following:

$$T_c = \frac{L}{180} + 10$$



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.

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-	2	0.15	0.25	0.20	0.30
Greenbelts, Agricultural					
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

YARBROUGH SUBDIVISION
RATIONAL METHOD
HISTORIC FLOWS

BASIN	DESIGN POINT	AREA (AC)	C 5-YEAR[7]	C 100-YEAR[7]	Overland Flow LENGTH (FT)	Overland Flow SLOPE (%)	Overland Flow Tco[1] (MIN)	Channel flow HIGH ELEV. (FT)	Channel flow LOW ELEV. (FT)	Channel flow H (FT)	Channel flow CHANNEL LENGTH (FT)	Channel flow CHANNEL LENGTH (MI)	Channel flow SLOPE (%)	Channel flow Tt[1] (MIN)	TOTAL Tc[4] (MIN)	INTENSITY[5] 5-YR (IN/HR)	INTENSITY[5] 100-YR (IN/HR)	PEAK FLOW Q5[6] (CFS)	PEAK FLOW Q100[6] (CFS)
OA1		1.43	0.250	0.300	280	20.0	9.4	6972	6967	5	270	0.05	1.9%	2.70	12.1	3.80	6.76	1.36	2.90
A		1.26	0.250	0.300			0.0	7485	7325	160	1420	0.27	11.3%	4.84	4.8				
OA1,OA2,A	**1**	**2.69**	**0.250**	**0.300**											**17.0**	**3.27**	**5.82**	**2.20**	**4.69**
B	**2**	**0.45**	**0.250**	**0.300**	**400**	**9.3**	**14.6**							**0.00**	**14.6**	**3.51**	**6.24**	**0.39**	**0.84**

DEVELOPED FLOWS

BASIN	DESIGN POINT	AREA (AC)	C 5-YEAR[7]	C 100-YEAR[7]	Overland Flow LENGTH (FT)	Overland Flow SLOPE (%)	Overland Flow Tco[1] (MIN)	Channel flow HIGH ELEV. (FT)	Channel flow LOW ELEV. (FT)	Channel flow H (FT)	Channel flow CHANNEL LENGTH (FT)	Channel flow CHANNEL LENGTH (MI)	Channel flow SLOPE (%)	Channel flow Tt[1] (MIN)	TOTAL Tc[4] (MIN)	INTENSITY[5] 5-YR (IN/HR)	INTENSITY[5] 100-YR (IN/HR)	PEAK FLOW Q5[6] (CFS)	PEAK FLOW Q100[6] (CFS)
OA1		1.43	0.250	0.300	280	20.0	9.4	6972	6967	5	270	0.05	1.9%	2.70	12.1	3.80	6.76	1.36	2.90
A		1.26	0.300	0.400			0.0	7485	7325	160	1420	0.27	11.3%	4.84	4.8				
OA1,OA2,A	**1**	**2.69**	**0.273**	**0.347**											**17.0**	**3.27**	**5.82**	**2.40**	**5.43**
B	**2**	**0.45**	**0.300**	**0.400**	**400**	**9.3**	**13.7**							**0.00**	**13.7**	**3.60**	**6.41**	**0.49**	**1.15**

1) OVERLAND FLOW Tco = (1.8*(1.1-RUNOFF COEFFICIENT)*(OVERLAND FLOW LENGTH^(0.5)/(SLOPE^(0.333))
2) SCS CHANNEL TRAVEL TIME, Tt = ((11.9*L^3)/H)^(0.385)
3) MANNING'S CHK = 0.70 FOR MEADOW / FOREST
4) Tc = Tco + Tt K = 1.0 FOR BARE SOIL
*** IF TOTAL TIMEK = 1.5 FOR GRASS CHANNEL
5) INTENSITY BA K = 2.0 FOR PAVEMENT
I = (A * P) / B + Td)^C
5-YEAR VALUES: A = 26.65; P1 = 1.5 IN (1-HOUR DEPTH); B = 10.0; C = 0.76
100-YEAR VALUES: A = 26.65; P = 2.67 IN (1-HOUR DEPTH); B = 10.0; C = 0.76
6) Q = CiA
7) WEIGHTED AVERAGE C VALUES FOR COMBINED BASINS

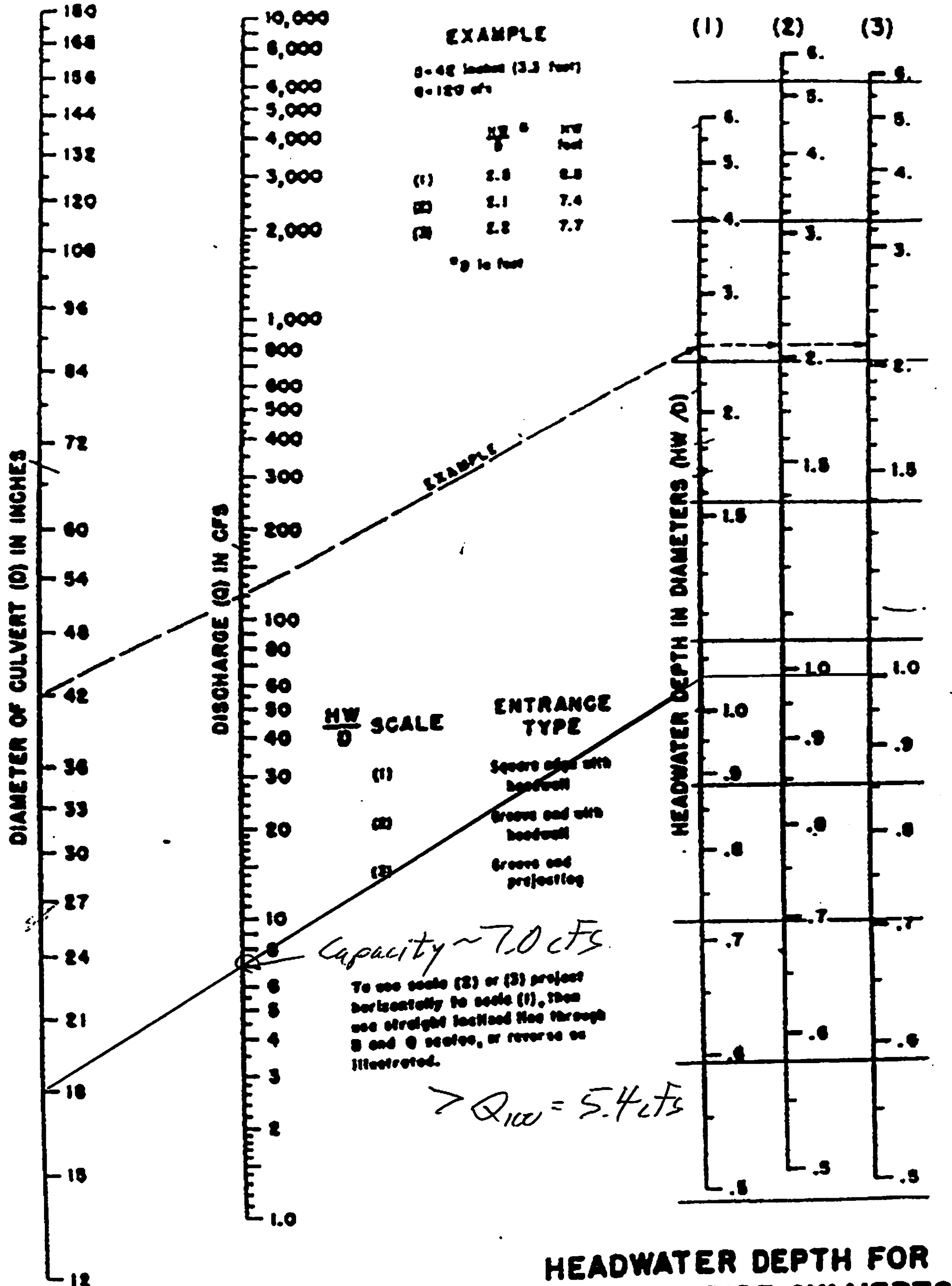
JPS
ENGINEERING

YARBROUGH SUBDIVISION
CULVERT SIZING SUMMARY

Design Point	Drainage Basin	Basin Peak Flow (Q_5, cfs)	% of Basin at Driveway Culvert	Driveway Peak Flow (Q_5, cfs)	Culvert Size (in)
Private Culvert:					
DP#1	A	2.4	100%	2.4	18"

- Culvert Capacity based on Inlet Control Nomographs (Fig. 9-32, assuming RCP or HDPE Culverts, with maximum 5-year HW/D = 1.0)

Culvert at DP #1



HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

HEADWATER SCALES 2&3
REVISED MAY 1964

BUREAU OF PUBLIC ROADS JAN. 1963

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

Date
OCT. 1987

Figure
9 - 32

HDR Infrastructure, Inc.
A Centerra Company

Table 3-1
Typical Values of Percent Impervious

Type of Development	Percent Impervious
Commercial	95%
Industrial	85%
Multi-Family	65%
Single Family - 0.1377 acre lots (6,000 SF)	53%
Single-Family – 0.20 acre lots	43%
Single-Family – 0.25 acre lots	40%
Single-Family – 0.33 acre lots	30%
Single-Family – 0.5 acre lots	25%
Single-Family – 1.0 acre lots < 1.71 ac.	20% < 15.74%
Single-Family – 2.5 acre lots	11%
Single-Family – 5 acre lots	7%

The total impervious area may also be determined from direct measurement made by the developer. A developer may wish to do this if the average numbers presented in Table 3-1 do not apply to a specific development. If the developer chooses to do this, all impervious areas within the development should be included. These areas include streets, parking lots, residential, commercial, tax exempt, parks, golf courses, and any other land use within the development. When different land uses are included in a development a composite percent impervious should be used.

3.8a Computation of the Basin Fee

The following example uses the typical impervious area numbers. In the computation of the basin fee, the developer or their representative shall obtain the appropriate basin fee from Exhibit 1 of the September 13, 1999 BOCC Resolution No. 99-383, or more current revision.

Example 1:

What is the fee for a 40-acre residential development in Dirty Woman Creek basin with 0.5-acre lots? The developer is not required to build any reimbursable stormwater facilities in this example and does not qualify for a low-density reduction or an on-site detention pond credit.

From Table 3-1, the percent impervious is 25%.

Calculate the impervious area for the site:

25% x 40 acres = 10 acres

Calculate the fee for the entire development:

$14,454 per impervious acre x 10 impervious acres = **$144,540**

Alternatively, the developer in each case could determine impervious area from the property plat, as illustrated in Example 2 below.

Markup Summary

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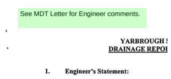

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Author: dsdsevigny
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See MDT Letter for Engineer comments.