RICE RANCH

EL PASO COUNTY, CO
FINAL DRAINAGE REPORT

Submittal Date: August 20, 2018
Revision Date:

OWNER/APPLICANT

RICE RANCH LLC
PO Box 26571
Colorado Springs, Colorado 80936
719-640-0232

CONSULTANT

CD Civil Design LLC
2013 Stoneleigh Trail2013 Stoneleigh Trail
Monument, CO 80132
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CD Civil Project No. 18002
PPR-18-024

Table Of Contents

Certifications

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 established criteria 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.

_____ Seal

Name

Owner's Statement:

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

_____

Business Name

By: _____

Title: _____

Address: _____

_____

El Paso County:

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

_____ _____

Name: Date

Jennifer Irvine, P.E.

County Engineer/ECM Administrator

Conditions:

Floodplain Statement

To the best of my knowledge and belief, a portion of the Rice Ranch is located within a designated 100 year floodplain as shown on FIRM map numbers 08041C0953F & 08041C0954F (effective date March 17, 1997). A copy of the FIRM maps are included as an attachment to this report. It is noted that the floodplain limits shown on the Drainage Plan and Grading and Erosion Control Plan are not accurate and are currently undergoing revision by EPC at this time.

_____

Christian L. Day, PE Colorado 35037

Introduction

The purpose of the following Final Drainage Report (FDR) is to present and analyze final drainage improvements for Rice Ranch. The format of this report follows the requirements in the Drainage Criteria Manual, Volume I, page 4-10, section 4.4, "Final Drainage Report (FDR)", with the exception of this Introductory section. Per the DCM the FDR shall contain all components of the PDR (Preliminary Drainage Report) plus the required components of the FDR.

Rice Ranch has been slowly developed over the years, adding agricultural storage land uses to the property. As such, El Paso County (EPC) is requesting that the drainage characteristics of the property be studied as part of a recent rezoning process and hence a FDR produced.

Although the site is already in its fully developed condition, for hydrologic purposes, the existing condition will be considered as the vacant land containing only the two northeastern-most structures. The proposed condition will then consist of all current structures and land uses for the site.

General Location And Description

Location

Rice Ranch is located in unincorporated El Paso County Colorado, near the City of Fountain. The area of study is bounded by Rice Lane/Willow Springs Road to the north, the Fountain Creek Regional Trail to the west and south and the east side contains unplatted/undeveloped land. The proposed site is zoned Heavy Industrial (I-3) in unincorporated El Paso County. The surrounding areas are zoned Small Office/Warehouse (SO) in the City of Fountain.

The site is located Southeast Quarter of The Northeast Quarter of Section 25 In Township 15 South, Range 66 West of The 6th P.M.

There are no major drainageways or drainage facilities on the site. There is an existing lake along the south and west edges of the property. Fountain Creek flows generally south on the west side of the Fountain Creek Regional Trail and does not cross the Rice Ranch property.

The surrounding developments include a radio station and Scott's landscape material to the north, the Fountain Creek Regional Trail to the west and south, and an undeveloped parcel to the east.

Description of Property

Rice Ranch encompasses 42.2 acres in both the existing and proposed conditions, including the lake.

Although the site is already in its fully developed condition, for hydrologic purposes, the existing condition will be considered as the vacant land containing only the two northeastern-most structures. The proposed condition will then consist of all current structures and land uses for the site. The existing ground cover contains meadow grasses, wooded areas, a lake to the south and west, and residential to the northeast. The proposed ground cover contains meadow grasses, wooded areas, industrial/agricultural product storage areas and structures, a lake to the south and west, and residential to the northeast.

The topography of the surrounding area through the pasture and wooded areas feature relatively flat slopes generally of 2%. The area generally sheet flows to the south and west across the vacant site, into the lake which abuts the south and west portions of the property. The lake serves as a retention pond, and does not have a apparent outlet. There are a series of smaller lakes through Fountain Creek Regional Park below it which discharge into each other. At the culmination of the series of lakes, water it discharged back into Fountain Creek.

Soil Conservation Service soil survey records indicate the project area is covered by soils classified in the Ellicott and Schamber-Razor Series, which are both categorized in the Hydrological Group "A". See the attached soil report in the appendix for further details on each.

There are no major drainageways to describe on the property.

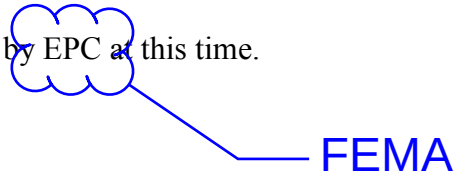
Rice Ranch does not have any irrigation facilities in either the existing or proposed conditions.

Drainage Basins And Sub-Basins

Major Basin Descriptions

The Rice Ranch is located in the East Big Johnson Drainage Basin (FOFO2400). This basin has not been studied.

The Flood Insurance Rate Maps (FIRM No. 08041C0953F & No. 08041C0954F dated 3/17/99) indicate that there is a floodplain on the site. The development site is located with an area Federal Emergency Management Agency (FEMA) has designated as "Zone AE" and "Zone X". Zone AE designates areas where base flood elevations have been determined, and Zone X identifies areas of a 500-year flood, area of 100-year flooding with an average depth less than 1 foot or a drainage area less than 1 square mile, or an area protected by levees from a 100-year flood. FEMA does not require any modifications to the floodplain maps when construction is located in this zone area. Floodplain limits per FEMA are incorrect and it is understood that currently FEMA is revising these, and upon revision they will be off of the property. It is noted that the floodplain limits shown on the Drainage Plan and Grading and Erosion Control Plan are not accurate and are currently undergoing revision by EPC at this time.



The East Big Johnson Drainage Basin (FOFO2400) has not been studied. However from aerial imagery, the land use includes residential and agricultural/light industrial usage.

There are no known irrigation facilities which will influence local drainage.

Sub-basin Description

On the Rice Ranch site, the drainage historically sheet flows generally from the northeast to the southwest, and collects in the lake along the south and west edges of the property. There are no concentrated flows on the site. According to El Paso County and the USACE, the lake is considered a water of the state.

There is very little off-site drainage from the north that enters Rice Ranch property, and hence a negligible impact to the development.

Drainage Design Criteria

Development Criteria Reference and Constraints

Peak existing flows are derived from the Rational Method as described on page 5-5 of the Drainage Criteria Manual, Volume I.

There are no previous drainage studies for Rice Ranch.

Sheet flow will runoff from the northeast to the south and west, though there will be a proposed grass lined swale intercepting it and directing it into one of two sand filters. There are no proposed streets, utilities or structures that will be impacted by the sheet flow.

Hydrologic Criteria

IDF curves presented in the Drainage Criteria Manual Volume I are based on rainfall depths at an elevation of 6,840 feet in the Colorado Springs area. These depths are found in the publication from National Oceanic and Atmospheric Administration, Precipitation-Frequency Atlas of the Western United States, Volume III-Colorado (NOAA Atlas 2), published in 1973. Precipitation depth maps shown in the NOAA Atlas were used to determine representative 6-hour and 24-hour point rainfall values.

Peak existing flows are derived from the Rational Method as described on page 5-5 of the Drainage Criteria Manual, Volume I and shown in the Appendices of this report.

Both the 5-year and 100-year recurrence intervals were analyzed in the calculations shown in the Appendices of this report.

There is no detention proposed as part of this project, hence no discharge and storage methodology employed.

Drainage Facility Design

General Concept

Any increase in off-site runoff volumes between historic and developed conditions will be ultimately by mitigated by the lake. The lake serves as a retention pond, and does not have an apparent outlet.

The proposed drainage patterns on site will remain somewhat consistent with those of the historic condition. Sheet flow will runoff from the northeast to the south and west, though there will be a proposed grass lined swale intercepting it. The swale's function will be to reduce runoff, according to the Step 1 of "minimizing directly connected impervious areas" (MDCIA). The principal behind MDCIA is twofold -- to reduce impervious areas and to route runoff from impervious surfaces over grassy areas to slow down runoff and promote infiltration. The use of grass swales instead of storm sewers, like grass buffers, slows down runoff and promotes infiltration, also reducing effective imperviousness. It also may reduce the size and cost of downstream storm sewers and detention.

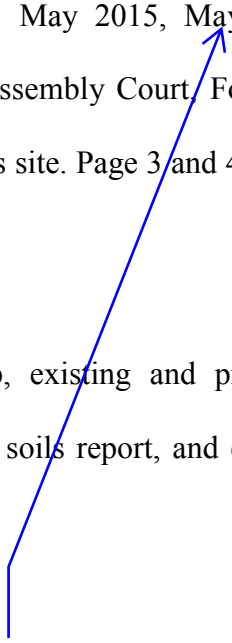
Step 2 of the MDCIA will stabilize drainage ways. Within drainage ways, natural and manmade, erosion can be a major source of sediment and associated constituents, such as phosphorus. Natural drainage ways are often subject to bed and bank erosion when urbanizing areas increase the frequency, rate, and volume of runoff. Therefore, drainage ways are required to be stabilized.

As mentioned the swales will be stabilized by dense grass turf. See the details on the Grading and Erosion Control Plans.

From the swale, flow will be directed into one of two sand filters. The sand filters will fulfill Step 3 of the MDCIA, which is to provide water quality capture volume (WQCV). See the details on the Grading and Erosion Control Plans for the sand filters. Also included in this FDR's Appendices are the calculations for the WQCV and sand filters.

Step 4 of the MDCIA considers the need for industrial and commercial BMPs. If a new development or significant redevelopment activity is planned for an industrial or commercial site, the need for specialized BMPs must be considered. Two approaches are covering of storage/handling areas, and spill containment and control. See "Storm Water Pollution Prevention Plan", original issue date: April 2013, revision date(s): May 2015, May 2018, prepared by the Scotts Company, Hyponex Corporation # 1023, 3 Assembly Court, Fountain, CO 80817, for the Industrial Permit and Pollution plan in place for this site. Page 3 and 4 of this document verifies inclusion of the Rice Ranch property.

In the Appendices, the supporting content includes: location map, existing and proposed hydrologic calculations, IDF graph, C value chart, floodplain panels, soils report, and existing and proposed drainage plans.



Specific Details

Peak existing flows are derived from the Rational Method as described on page 5-5 of the Drainage Criteria Manual, Volume I. Using this method, the existing runoff rates for the 5 and 100 year storms are 10.42 cfs and 68.86 cfs respectfully. This is summarized on the page entitled "Hydrologic Summary, Rice Ranch Existing Conditions", found in the appendices of this report.

The proposed runoff rates for the 5 and 100 year storms are 46.70 cfs and 109.36 cfs respectfully. This is summarized on the page entitled "Hydrologic Summary, Rice Ranch Proposed Conditions", found in the appendices of this report.

The proposed drainage patterns on site will remain somewhat consistent with those of the historic condition. Sheet flow will runoff from the northeast to the south and west, though there will be a proposed grass lined swale intercepting it. From the swale, flow will be directed into one of two sand filters which provide WQCV for the entire site. Both sand filters will infiltrate and filter the WQCV. The excess runoff will leave the filter through a weir and level-spread via riprap which lines the outlet. The flow will then resume its historical pattern of sheet-flowing through the extensive vegetative buffer and into the existing lake on the west side of the property.

According to the USACE, the pond is a water of the state. As such, the proposed upstream BMP's treat all of the developed runoff prior to entering the lake.

The site will be accessible by truck or similar maintenance vehicle. Both the grass swales and sand filters are designed with slopes no steeper than 4:1, allowing trucks and tractors to traverse the features and gain access for maintenance purposes.

There is a proposed easement for the grass lined swales and sand filters. The purpose of this easement is to preserve the BMP's and allow for periodic, routine maintenance. No other storage, development or changes will be allowed within this easement.

As mentioned, there will be no detention facility proposed as part of this project. Hence there are not storage and outlet designs presented in this report.

A cost estimate of the proposed facilities is included with this report, and includes the costs to construct the swale and sand filters.

There are no basin or bridge fees listed on the El Paso County Drainage Basin Fees, Resolution No. 17-348 for 2018 for East Big Johnson drainage basin.

References

"Drainage Basins", map published by El Paso County, 2005.

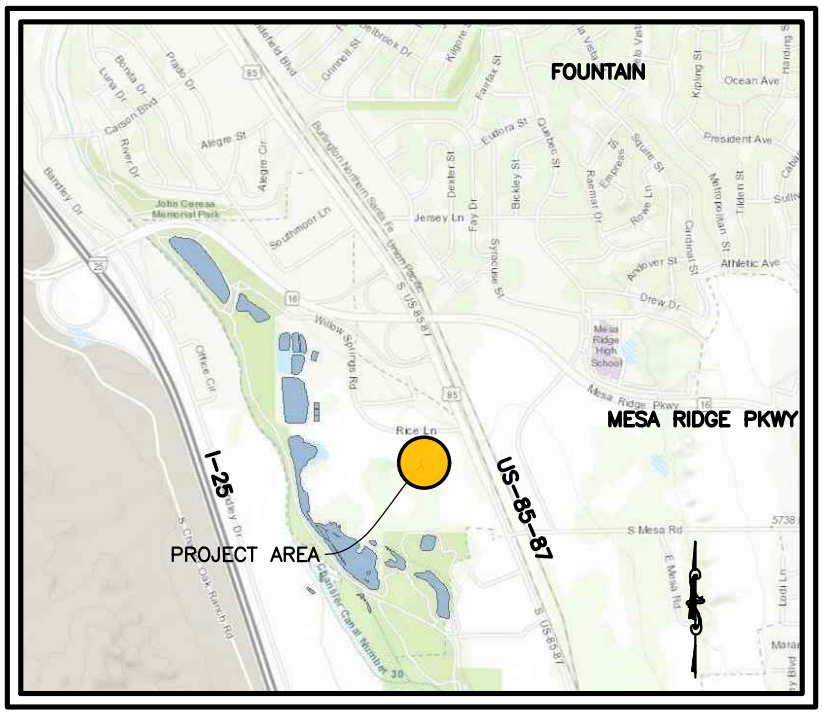
"Drainage Criteria Manual, Volume I", by El Paso County, October 14, 1994.

"Custom Soil Resource Report for El Paso County Area, Colorado", NRCS, April 24, 2018.

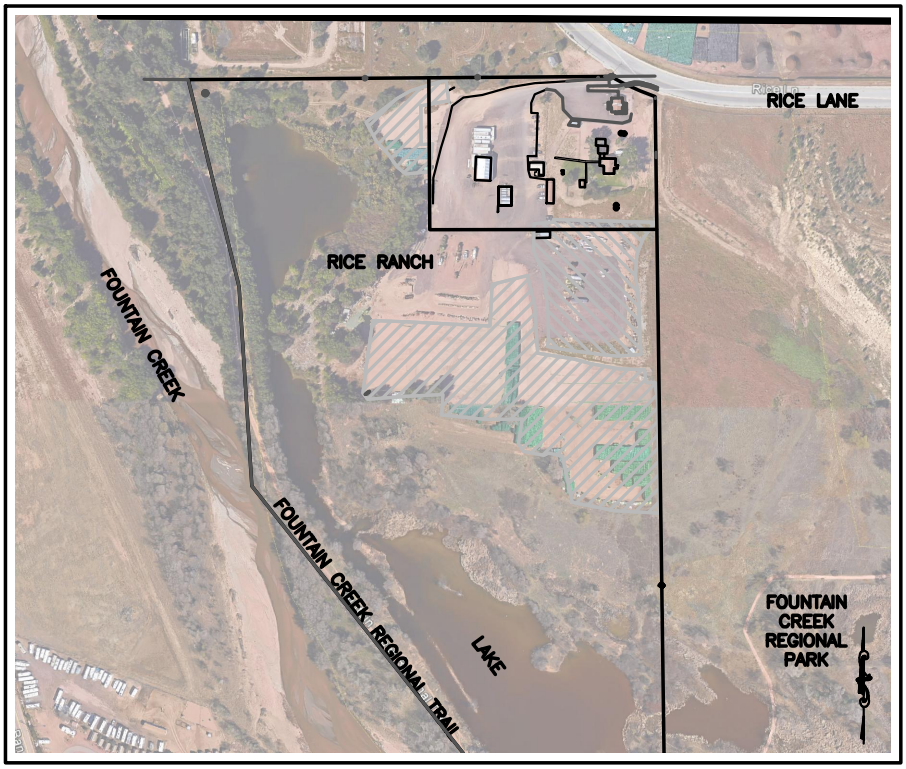
"Flood Insurance Rate Map", Panels 953 and 954, FEMA, March 17, 1997.

"Storm Water Pollution Prevention Plan", original issue date: April 2013, revision date(s): May 2015, May 2018, prepared by the Scotts Company, Hyponex Corporation # 1023, 3 Assembly Court, Fountain, CO 80817

Appendices

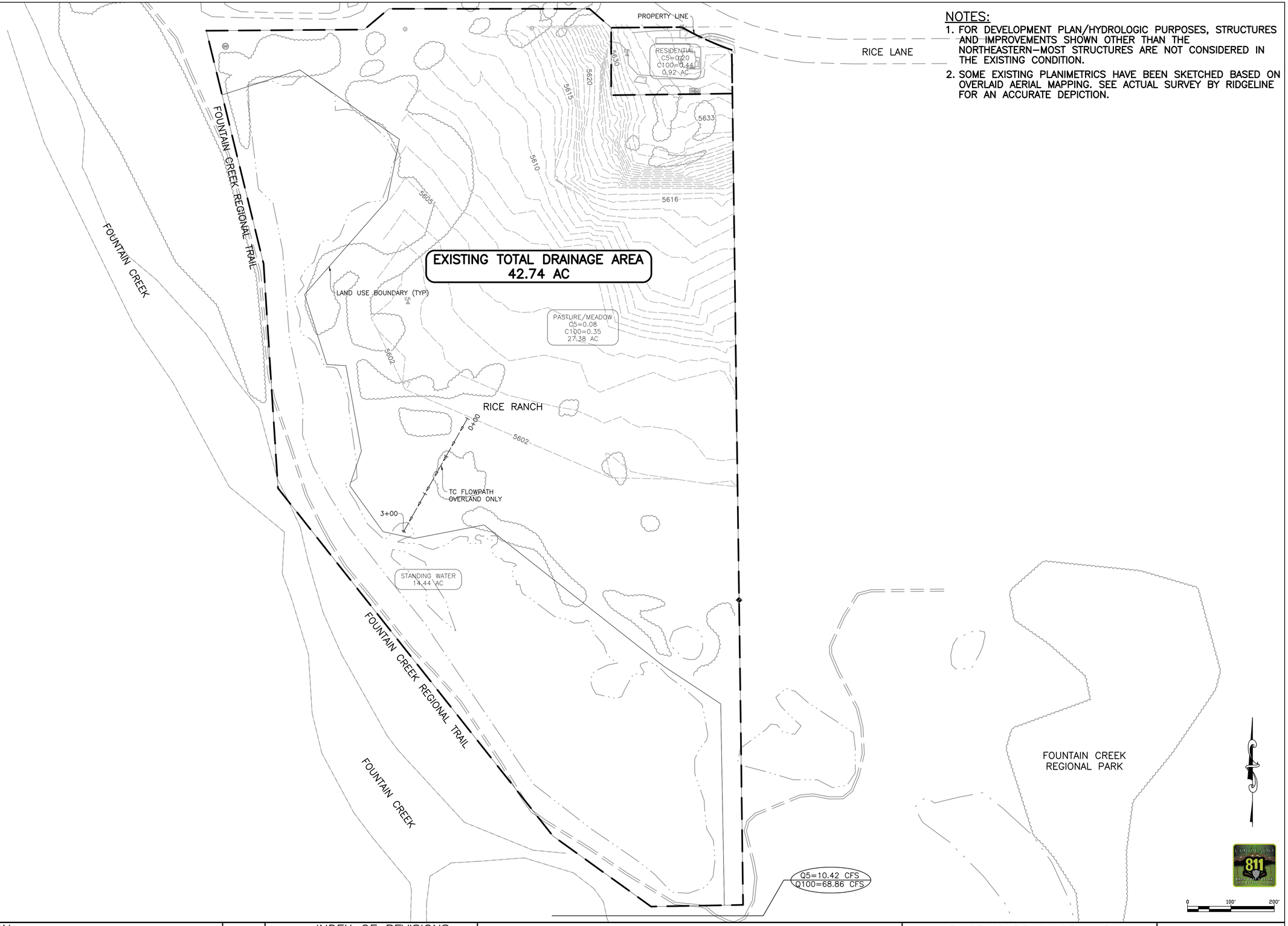


VICINITY MAP NTS



LOCATION MAP

VICINITY AND LOCATION MAPS



NOTES:

1. FOR DEVELOPMENT PLAN/HYDROLOGIC PURPOSES, STRUCTURES AND IMPROVEMENTS SHOWN OTHER THAN THE NORTHEASTERN-MOST STRUCTURES ARE NOT CONSIDERED IN THE EXISTING CONDITION.
2. SOME EXISTING PLANIMETRICS HAVE BEEN SKETCHED BASED ON OVERLAID AERIAL MAPPING. SEE ACTUAL SURVEY BY RIDGELINE FOR AN ACCURATE DEPICTION.

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LAST MODIFICATION DATE:	INITIALS: 8/15/2018 2:46 PM			
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ACAD VER. 2013 SCALE:	UNITS: SCALE IS 100'			

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8/15/2018 2:46 PM

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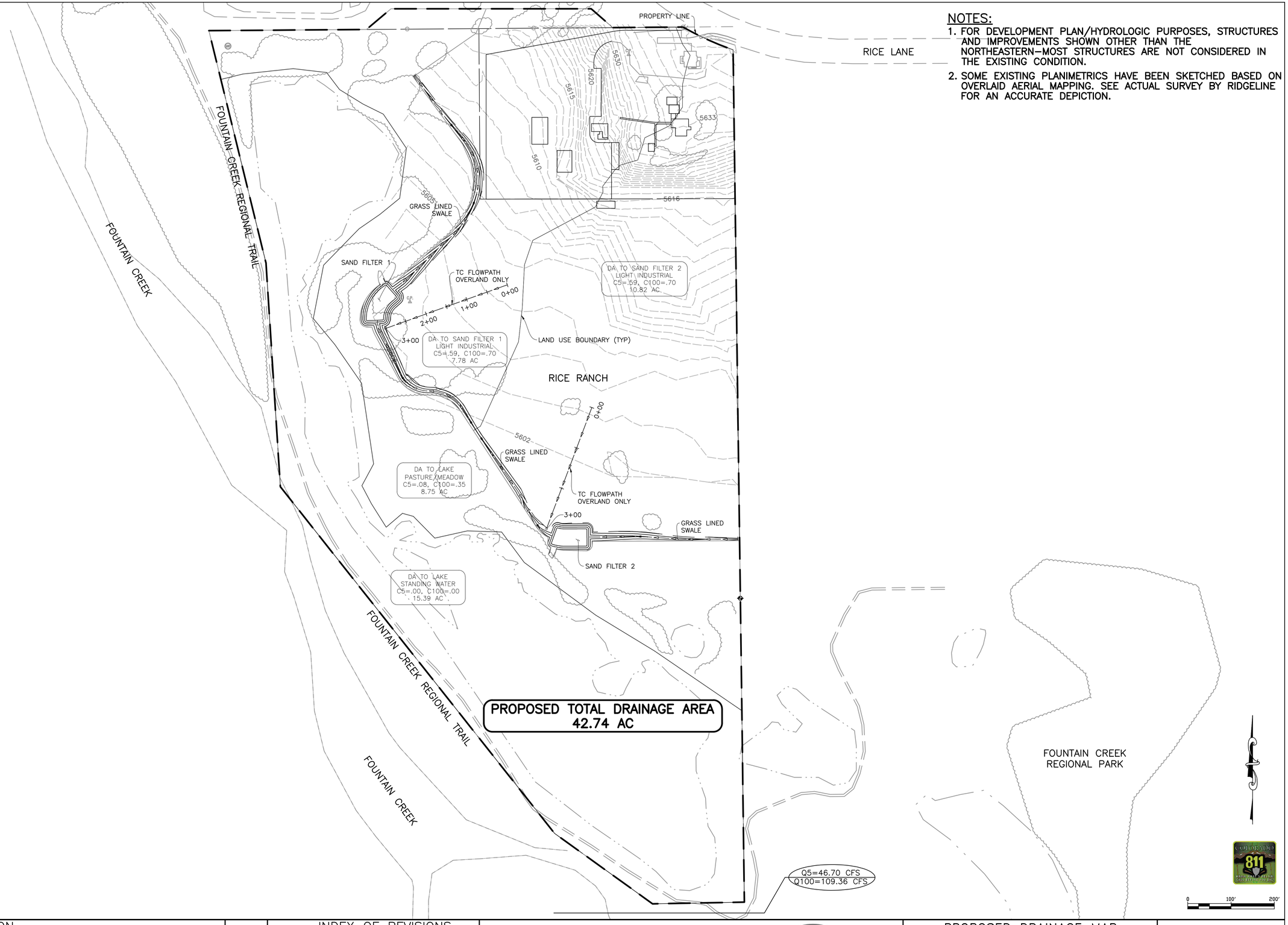
Email: cdcivildesign@gmail.com

EXISTING DRAINAGE MAP

RICE RANCH
COLORADO SPRINGS, COLORADO

DESIGNER:	STRUCTURE NUMBERS	PROJECT NO./CODE
DETAILER:		Sheet Subset Number
SHEET SUBSET:		Sheet Number **DP-1**



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PROPOSED DRAINAGE MAP

RICE RANCH
COLORADO SPRINGS, COLORADO

DESIGNER:	STRUCTURE NUMBERS:	PROJECT NO./CODE
DETAILER:		Sheet Subset Number
SHEET SUBSET:		Sheet Number

Table 6-6. Runoff Coefficients for Rational Method
(Source: UDFCD 2001)

Land Use or Surface Characteristics	Percent Impervious	Runoff Coefficients											
		2-year		5-year		10-year		25-year		50-year		100-year	
		HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D
Business													
Commercial Areas	95	0.79	0.80	0.81	0.82	0.83	0.84	0.85	0.87	0.87	0.88	0.88	0.89
Neighborhood Areas	70	0.45	0.49	0.49	0.53	0.53	0.57	0.58	0.62	0.60	0.65	0.62	0.68
Residential													
1/8 Acre or less	65	0.41	0.45	0.45	0.49	0.49	0.54	0.54	0.59	0.57	0.62	0.59	0.65
1/4 Acre	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
1/3 Acre	30	0.18	0.22	0.25	0.30	0.32	0.38	0.39	0.47	0.43	0.52	0.47	0.57
1/2 Acre	25	0.15	0.20	0.22	0.28	0.30	0.36	0.37	0.46	0.41	0.51	0.46	0.56
1 Acre	20	0.12	0.17	0.20	0.26	0.27	0.34	0.35	0.44	0.40	0.50	0.44	0.55
Industrial													
Light Areas	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Heavy Areas	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Parks and Cemeteries	7	0.05	0.09	0.12	0.19	0.20	0.29	0.30	0.40	0.34	0.46	0.39	0.52
Playgrounds	13	0.07	0.13	0.16	0.23	0.24	0.31	0.32	0.42	0.37	0.48	0.41	0.54
Railroad Yard Areas	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
Undeveloped Areas													
Historic Flow Analysis--Greenbelts, Agriculture	2	0.03	0.05	0.09	0.16	0.17	0.26	0.26	0.38	0.31	0.45	0.36	0.51
Pasture/Meadow	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Forest	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Exposed Rock	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Offsite Flow Analysis (when landuse is undefined)	45	0.26	0.31	0.32	0.37	0.38	0.44	0.44	0.51	0.48	0.55	0.51	0.59
Streets													
Paved	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Gravel	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Drive and Walks	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Roofs	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Lawns	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50

3.2 Time of Concentration

One of the basic assumptions underlying the Rational Method is that runoff is a function of the average rainfall rate during the time required for water to flow from the hydraulically most remote part of the drainage area under consideration to the design point. However, in practice, the time of concentration can be an empirical value that results in reasonable and acceptable peak flow calculations.

For urban areas, the time of concentration (t_c) consists of an initial time or overland flow time (t_i) plus the travel time (t_t) in the storm sewer, paved gutter, roadside drainage ditch, or drainage channel. For non-urban areas, the time of concentration consists of an overland flow time (t_i) plus the time of travel in a concentrated form, such as a swale or drainageway. The travel portion (t_t) of the time of concentration can be estimated from the hydraulic properties of the storm sewer, gutter, swale, ditch, or drainageway. Initial time, on the other hand, will vary with surface slope, depression storage, surface cover, antecedent rainfall, and infiltration capacity of the soil, as well as distance of surface flow. The time of concentration is represented by Equation 6-7 for both urban and non-urban areas.

Hydrologic Summary

Rice Ranch Existing Conditions

Basin	Area	Tc	C5	C100	I5	I100	Q5	Q100
Existing	42.74	10.00	0.06	0.24	4.00	6.80	10.42	68.86
Total	0.00							

WEIGHTED RATIONAL COEFFICIENT

Rice Ranch Existing Conditions

			5 Year		100 Year	
	Land Use	Area (AC)	C	CxA	C	CxA
P-2	Residential	0.92	0.45	0.41	0.59	0.54
	Pasture/Meadow	27.38	0.08	2.19	0.35	9.58
	Standing Water	14.44	0.00	0.00	0.00	0.00
				0.00		0.00
				0.00		0.00
				0.00		0.00
				0.00		0.00
				0.00		0.00
	TOTALS	42.74		2.60		10.13
	Cw			0.06		0.24
TOTAL		42.74				

NOTE: HYDROLOGIC SOIL TYPE A.

Time of Concentration

Rice Ranch Existing Conditions

	OVERLAND FLOW						TRAVEL TIME								
DESIGN POINT	C5	$D_{OVERLAND}$	ELEV $_{UPPER}$ OVERLAND PATH	ELEV $_{LOWER}$ OVERLAND PATH	$S_{OVERLAND}$	$Ti_{OVERLAND}$	$L_{TOTAL\ FLOW\ PATH}$	$L_{CHANNEL\ FLOW\ PATH}$	ELEV $_{UPPER}$ CHANNEL PATH	ELEV $_{LOWER}$ CHANNEL PATH	H	S0	Cv	V	Tt	TC
		FT	FT	FT	%	MIN	FT	FT	FT	FT	FT	%		FPS	MIN	MIN
Existing Basin A3	0.06	300.00	5602.00	5600.00	1	8.13	301.00	1.00	5600.00	5599.00	1.00	100.00%	5.0	5.00	0.00	10.00

Hydrologic Summary

Rice Ranch Proposed Conditions

Basin	Area	Tc	C2	C5	C100	I2	I5	I100	Q2	Q5	Q100
Sand Filter 1	7.78	10.00	0.57	0.59	0.70	3.20	4.00	6.80	14.19	18.36	37.03
Sand Filter 2	10.82	10.00	0.57	0.59	0.70	3.20	4.00	6.80	19.74	25.54	51.50
Lake	24.14	10.00	0.02	0.03	0.13	3.20	4.00	6.80	1.40	2.80	20.83
Total	42.74								35.33	46.70	109.36

WEIGHTED RATIONAL COEFFICIENT

Rice Ranch Proposed Conditions

			2 Year		5 Year		100 Year	
Sand Filter 1	Land Use	Area (AC)	C	CxA	C	CxA	C	CxA
	Light Industrial	7.78	0.57	4.43	0.59	4.59	0.70	5.45
	TOTALS	7.78		4.43		4.59		5.45
	Cw			0.57		0.59		0.70

			2 Year		5 Year		100 Year	
Sand Filter 2	Land Use	Area (AC)	C	CxA	C	CxA	C	CxA
	Light Industrial	10.82	0.57	6.17	0.59	6.38	0.70	7.57
	TOTALS	10.82		6.17		6.38		7.57
	Cw			0.57		0.59		0.70

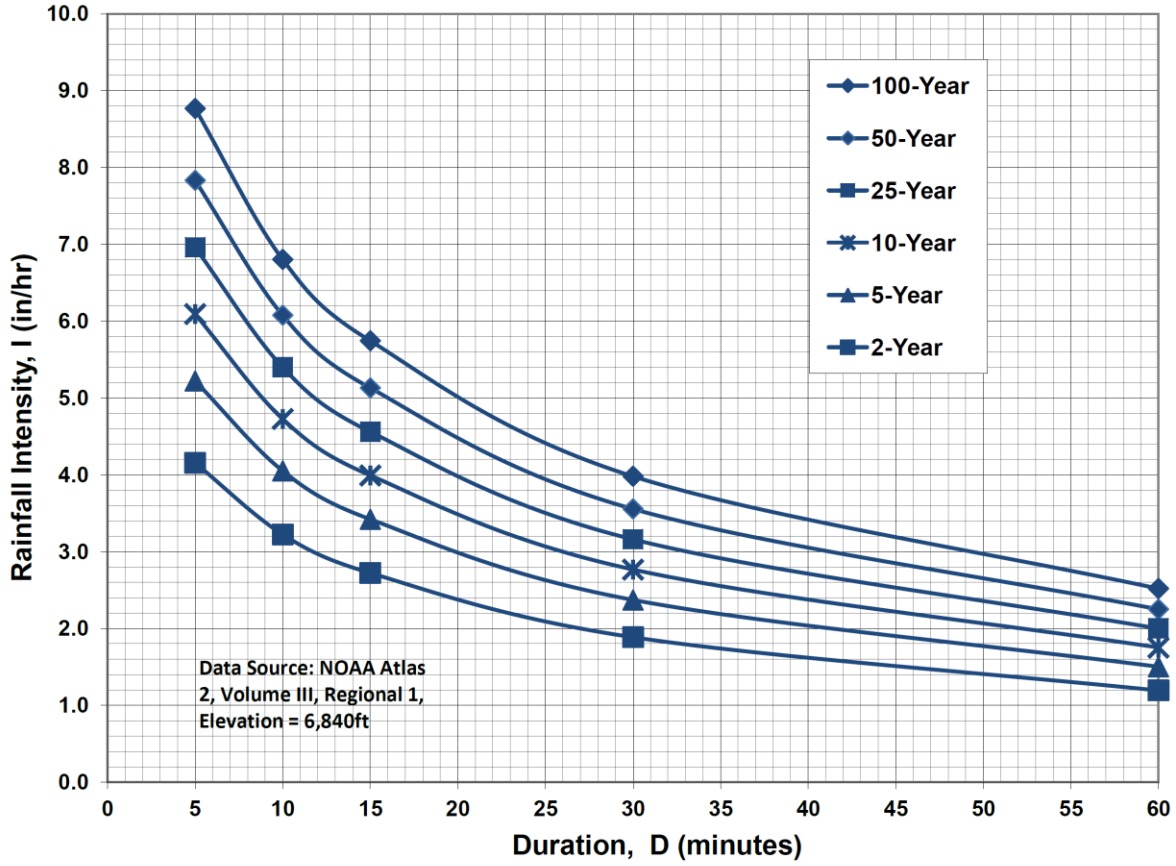
			2 Year		5 Year		100 Year	
Lake	Land Use	Area (AC)	C	CxA	C	CxA	C	CxA
	Pasture/Meadow	8.75	0.05	0.44	0.08	0.70	0.35	3.06
	Standing Water	15.39	0.00	0.00	0.00	0.00	0.00	0.00
				0.00		0.00		0.00
	TOTALS	24.14		0.44		0.70		3.06
	Cw			0.02		0.03		0.13

Time of Concentration

Rice Ranch Proposed Conditions

	OVERLAND FLOW						TRAVEL TIME									
DESIGN POINT	C5	$D_{OVERLAND}$	ELEV $_{UPPER}$ OVERLAND PATH	ELEV $_{LOWER}$ OVERLAND PATH	$S_{OVERLAND}$	$Ti_{OVERLAND}$	$L_{TOTAL\ FLOW\ PATH}$	$L_{CHANNEL\ FLOW\ PATH}$	ELEV $_{UPPER}$ CHANNEL PATH	ELEV $_{LOWER}$ CHANNEL PATH	H	S0	Cv	V	Tt	TC
		FT	FT	FT	%	MIN	FT	FT	FT	FT	FT	%		FPS	MIN	MIN
Sand Filter 1	0.59	300.00	5605.50	5602.00	1	3.32	331.00	1.00	5602.00	5601.00	1.00	100.00%	5.0	5.00	0.00	10.00
Sand Filter 2	0.59	300.00	5603.40	5599.50	1	3.20	331.00	1.00	5599.50	5598.00	1.50	150.00%	5.0	6.12	0.00	10.00

Figure 6-5. Colorado Springs Rainfall Intensity Duration Frequency



IDF Equations

$I_{100} = -2.52 \ln(D) + 12.735$

$I_{50} = -2.25 \ln(D) + 11.375$

$I_{25} = -2.00 \ln(D) + 10.111$

$I_{10} = -1.75 \ln(D) + 8.847$

$I_{5} = -1.50 \ln(D) + 7.583$

$I_{2} = -1.19 \ln(D) + 6.035$

Note: Values calculated by equations may not precisely duplicate values read from figure.

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for El Paso County Area, Colorado

April 20, 2018

Custom Soil Resource Report
Soil Map

Map Scale: 1:4,400 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 200 400 800 1200

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 15, Oct 10, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Apr 15, 2011—Jun 17, 2014

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
28	Ellicott loamy coarse sand, 0 to 5 percent slopes	57.5	54.9%
29	Fluvaquentic Haplaquolls, nearly level	10.9	10.4%
59	Nunn clay loam, 0 to 3 percent slopes	1.3	1.2%
82	Schamber-Razor complex, 8 to 50 percent slopes	19.2	18.3%
101	Ustic Torrifluvents, loamy	9.0	8.6%
111	Water	3.8	3.6%
MzA	Manzanola silty clay loam, saline, 0 to 2 percent slopes	3.2	3.1%
Totals for Area of Interest		**104.8**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not

mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

El Paso County Area, Colorado

28—Ellicott loamy coarse sand, 0 to 5 percent slopes

Map Unit Setting

National map unit symbol: 3680
Elevation: 5,500 to 6,500 feet
Mean annual precipitation: 13 to 15 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 125 to 145 days
Farmland classification: Not prime farmland

Map Unit Composition

Ellicott and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ellicott

Setting

Landform: Flood plains, stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy alluvium

Typical profile

A - 0 to 4 inches: loamy coarse sand
C - 4 to 60 inches: stratified coarse sand to sandy loam

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Available water storage in profile: Low (about 4.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: A
Ecological site: Sandy Bottomland LRU's A & B (R069XY031CO)
Other vegetative classification: SANDY BOTTOMLAND (069AY031CO)
Hydric soil rating: No

Minor Components

Fluvaquentic haplaquoll

Percent of map unit:
Landform: Swales
Hydric soil rating: Yes

Other soils

Percent of map unit:
Hydric soil rating: No

Pleasant

Percent of map unit:
Landform: Depressions
Hydric soil rating: Yes

29—Fluvaquentic Haplaquolls, nearly level

Map Unit Setting

National map unit symbol: 3681
Elevation: 5,000 to 7,800 feet
Mean annual precipitation: 13 to 15 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 110 to 165 days
Farmland classification: Not prime farmland

Map Unit Composition

Fluvaquentic haplaquolls and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Fluvaquentic Haplaquolls

Setting

Landform: Flood plains, marshes, swales
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 6.00 in/hr)
Depth to water table: About 0 to 24 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: D
Ecological site: Sandy Meadow (R067BY029CO)
Hydric soil rating: Yes

Minor Components

Haplaquolls

Percent of map unit:
Landform: Domes
Hydric soil rating: Yes

Other soils

Percent of map unit:
Hydric soil rating: No

59—Nunn clay loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 3693
Elevation: 5,400 to 6,500 feet
Mean annual precipitation: 13 to 15 inches
Mean annual air temperature: 46 to 50 degrees F
Frost-free period: 135 to 155 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Nunn and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Nunn

Setting

Landform: Terraces, fans
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Mixed alluvium

Typical profile

A - 0 to 12 inches: clay loam
Bt - 12 to 26 inches: clay loam
BC - 26 to 30 inches: clay loam
Bk - 30 to 58 inches: sandy clay loam
C - 58 to 72 inches: clay

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Calcium carbonate, maximum in profile: 15 percent
Gypsum, maximum in profile: 2 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: High (about 9.8 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 3c
Hydrologic Soil Group: C
Ecological site: Clayey Plains LRU's A & B (R069XY042CO)
Other vegetative classification: CLAYEY PLAINS (069AY042CO)
Hydric soil rating: No

Minor Components

Other soils

Percent of map unit:
Hydric soil rating: No

Pleasant

Percent of map unit:
Landform: Depressions
Hydric soil rating: Yes

82—Schamber-Razor complex, 8 to 50 percent slopes

Map Unit Setting

National map unit symbol: 369y
Elevation: 5,500 to 6,500 feet
Mean annual precipitation: 12 to 14 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 135 to 170 days
Farmland classification: Not prime farmland

Map Unit Composition

Schamber and similar soils: 40 percent
Razor and similar soils: 30 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Schamber

Setting

Landform: Breaks
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite and/or colluvium derived from granite and/or eolian deposits derived from granite

Typical profile

A - 0 to 5 inches: gravelly loam

AC - 5 to 15 inches: very gravelly loam
C - 15 to 60 inches: very gravelly sand

Properties and qualities

Slope: 8 to 50 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Low (about 3.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: A
Ecological site: Gravel Breaks LRU's A & B (R069XY064CO)
Hydric soil rating: No

Description of Razor

Setting

Landform: Breaks
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Clayey slope alluvium over residuum weathered from shale

Typical profile

A - 0 to 3 inches: clay loam
Bw - 3 to 9 inches: clay loam
Bk - 9 to 31 inches: clay
Cr - 31 to 35 inches: weathered bedrock

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Gypsum, maximum in profile: 5 percent
Salinity, maximum in profile: Moderately saline to strongly saline (8.0 to 16.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 15.0
Available water storage in profile: Low (about 5.5 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Ecological site: Alkaline Plains LRU's A & B (R069XY047CO)
Other vegetative classification: ALKALINE PLAINS (069AY047CO)
Hydric soil rating: No

Minor Components

Other soils

Percent of map unit:
Hydric soil rating: No

Pleasant

Percent of map unit:
Landform: Depressions
Hydric soil rating: Yes

101—Ustic Torrifluvents, loamy

Map Unit Setting

National map unit symbol: 3673
Elevation: 5,500 to 7,000 feet
Mean annual precipitation: 13 to 16 inches
Mean annual air temperature: 47 to 52 degrees F
Frost-free period: 125 to 155 days
Farmland classification: Not prime farmland

Map Unit Composition

Ustic torrifluvents and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ustic Torrifluvents

Setting

Landform: Flood plains, stream terraces
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy, clayey, stratified loamy

Typical profile

A - 0 to 6 inches: variable
C - 6 to 60 inches: stratified loamy sand to clay loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low

Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 10 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Moderate (about 8.6 inches)

Interpretive groups
Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: Saline Overflow LRU's A & B (R069XY037CO)
Other vegetative classification: OVERFLOW (069BY036CO)
Hydric soil rating: No

Minor Components

Other soils
Percent of map unit:
Hydric soil rating: No

Pleasant
Percent of map unit:
Landform: Depressions
Hydric soil rating: Yes

111—Water

Map Unit Composition
Water: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

MzA—Manzanola silty clay loam, saline, 0 to 2 percent slopes

Map Unit Setting
National map unit symbol: 2rgrg
Elevation: 3,900 to 6,000 feet
Mean annual precipitation: 12 to 14 inches
Mean annual air temperature: 48 to 54 degrees F
Frost-free period: 130 to 170 days
Farmland classification: Not prime farmland

Map Unit Composition
Manzanola and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Manzanola

Setting

Landform: Fan remnants, interfluves, terraces, drainageways
Landform position (two-dimensional): Footslope, summit
Landform position (three-dimensional): Side slope, tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from shale

Typical profile

A - 0 to 4 inches: silty clay loam
Bt1 - 4 to 11 inches: silty clay loam
Bt2 - 11 to 26 inches: silty clay loam
Bk1 - 26 to 38 inches: silty clay loam
Bk2 - 38 to 79 inches: silty clay loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 14 percent
Gypsum, maximum in profile: 3 percent
Salinity, maximum in profile: Moderately saline (8.0 to 15.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 13.0
Available water storage in profile: Very high (about 12.1 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 4c
Hydrologic Soil Group: C
Ecological site: Saline Overflow LRU's A & B (R069XY037CO)
Other vegetative classification: Saline Overflow (069XY037CO_1)
Hydric soil rating: No

Minor Components

Aguilar

Percent of map unit: 5 percent
Landform: Fan remnants
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Salt Flat LRU's A & B (R069XY033CO)
Other vegetative classification: Salt Flat #33 (069AY033CO_2)
Hydric soil rating: No

Haversid

Percent of map unit: 5 percent
Landform: Terraces, drainageways

Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Saline Overflow LRU's A & B (R069XY037CO)
Hydric soil rating: No

Soil Information for All Uses

Soil Properties and Qualities

The Soil Properties and Qualities section includes various soil properties and qualities displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each property or quality.

Soil Qualities and Features

Soil qualities are behavior and performance attributes that are not directly measured, but are inferred from observations of dynamic conditions and from soil properties. Example soil qualities include natural drainage, and frost action. Soil features are attributes that are not directly part of the soil. Example soil features include slope and depth to restrictive layer. These features can greatly impact the use and management of the soil.

Hydrologic Soil Group

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

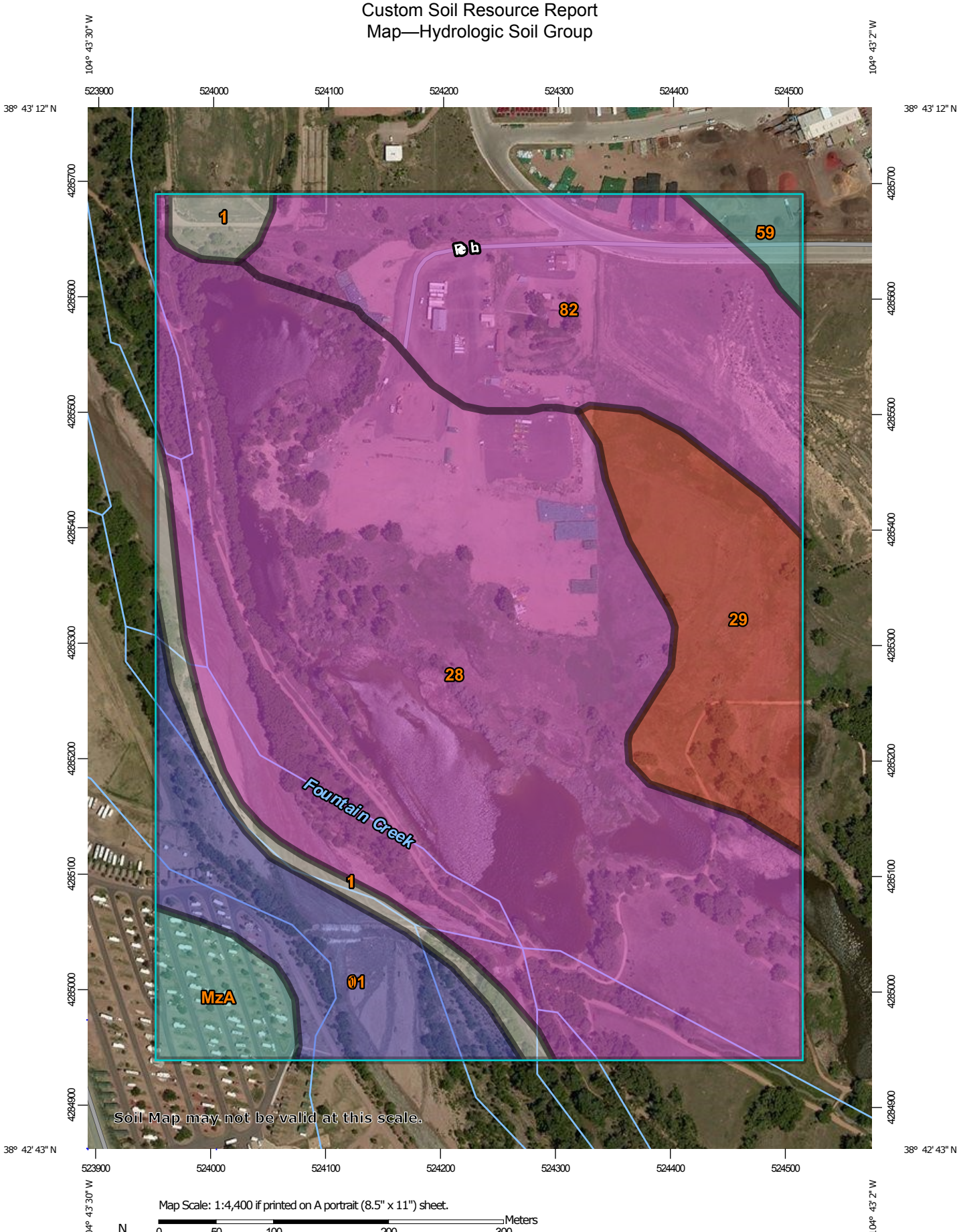
Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Custom Soil Resource Report
Map—Hydrologic Soil Group



Map Scale: 1:4,400 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 200 400 800 1200

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

Table—Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
28	Ellicott loamy coarse sand, 0 to 5 percent slopes	A	57.5	54.9%
29	Fluvaquentic Haplaquolls, nearly level	D	10.9	10.4%
59	Nunn clay loam, 0 to 3 percent slopes	C	1.3	1.2%
82	Schamber-Razor complex, 8 to 50 percent slopes	A	19.2	18.3%
101	Ustic Torrifluvents, loamy	B	9.0	8.6%
111	Water		3.8	3.6%
MzA	Manzanola silty clay loam, saline, 0 to 2 percent slopes	C	3.2	3.1%
Totals for Area of Interest			**104.8**	**100.0%**

Rating Options—Hydrologic Soil Group

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Hydrologic Soil Group

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

ELEVATION REFERENCE MARKS

REFERENCE MARK	ELEVATION (FEET NGVD)	DESCRIPTION OF LOCATION
RM26	5621.69	Benchmark disk stamped T347 1953 set in top of southwest end of the southwest concrete abutment of bridge. Located in Section 31.T.15S.R.65 W., 5.2 feet southwest of the D&RGW Railroad rail

LEGEND

SPECIAL FLOOD HAZARD AREAS INUNDATED BY 100-YEAR FLOOD

- **ZONE A** No base flood elevations determined.
- **ZONE AE** Base flood elevations determined.
- **ZONE AH** Flood depths of 1 to 3 feet (usually areas of ponding); base flood elevations determined.
- **ZONE AO** Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
- **ZONE A99** To be protected from 100-year flood by Federal flood protection system under construction; no base elevations determined.
- **ZONE V** Coastal flood with velocity hazard (wave action); no base flood elevations determined.
- **ZONE VE** Coastal flood with velocity hazard (wave action); base flood elevations determined.

FLOODWAY AREAS IN ZONE AE

OTHER FLOOD AREAS

- **ZONE X** Areas of 500-year flood; areas of 100-year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 100-year flood.

OTHER AREAS

- **ZONE X** Areas determined to be outside 500-year floodplain.
- **ZONE D** Areas in which flood hazards are undetermined.

UNDEVELOPED COASTAL BARRIERS

Identified 1983 | Identified 1990 | Otherwise Protected Areas

Coastal barrier areas are normally located within or adjacent to Special Flood Hazard Areas.

- Flood Boundary
- Floodway Boundary
- Zone D Boundary
- Boundary Dividing Special Flood Hazard Zones, and Boundary Dividing Areas of Different Coastal Base Flood Elevations Within Special Flood Hazard Zones.
- 513 — Base Flood Elevation Line; Elevation in Feet. See Map Index for Elevation Datum.
- D — D — Cross Section Line
- (EL 987) — Base Flood Elevation in Feet Where Uniform Within Zone. See Map Index for Elevation Datum.
- RM7 — Elevation Reference Mark
- M2 — River Mile
- 97°07'30", 32°22'30" — Horizontal Coordinates Based on North American Datum of 1927 (NAD 27) Projection.

NOTES

This map is for use in administering the National Flood Insurance Program; it does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size, or all planimetric features outside Special Flood Hazard Areas.

Coastal base flood elevations apply only landward of 0.0 NGVD, and include the effects of wave action; these elevations may also differ significantly from those developed by the National Weather Service for hurricane evacuation planning.

Areas of Special Flood Hazard (100-year flood) include Zones A, AE, AH, AO, A99, V, and VE.

Certain areas not in Special Flood Hazard Areas may be protected by flood control structures.

Boundaries of the floodways were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the Federal Emergency Management Agency.

Floodway widths in some areas may be too narrow to show to scale. Floodway widths are provided in the Flood Insurance Study Report.

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For community map revision history prior to countywide mapping, see Section 6.0 of the Flood Insurance Study Report.

For adjoining map panels and base map source see separately printed Map Index.

MAP REPOSITORY
Refer to Repository Listing on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP:
MARCH 17, 1997

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL:

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

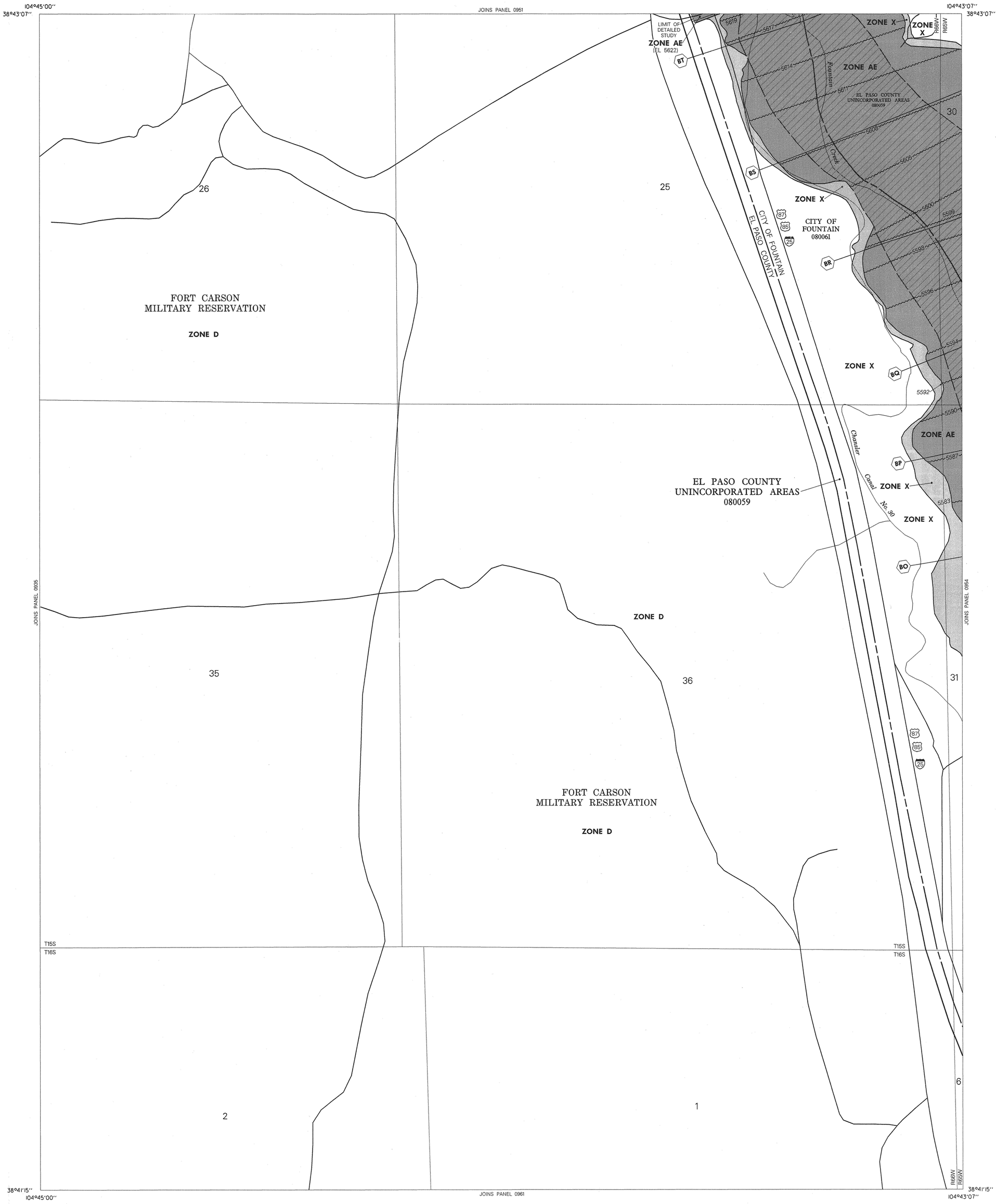
PANEL 954 OF 1300
(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS: COMMUNITY	NUMBER	PANEL	SUFFIX
EL PASO COUNTY, UNINCORPORATED AREAS	080059	0954	F
FOUNTAIN, CITY OF	080061	0954	F

MAP NUMBER 08041C0954 F

EFFECTIVE DATE: MARCH 17, 1997

Federal Emergency Management Agency



LEGEND

SPECIAL FLOOD HAZARD AREAS INUNDATED BY 100-YEAR FLOOD

- **ZONE A** No base flood elevations determined.
- **ZONE AE** Base flood elevations determined.
- **ZONE AH** Flood depths of 1 to 3 feet (usually areas of ponding); base flood elevations determined.
- **ZONE AO** Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
- **ZONE A99** To be protected from 100-year flood by Federal flood protection system under construction; no base elevations determined.
- **ZONE V** Coastal flood with velocity hazard (wave action); no base flood elevations determined.
- **ZONE VE** Coastal flood with velocity hazard (wave action); base flood elevations determined.

FLOODWAY AREAS IN ZONE AE

OTHER FLOOD AREAS

- **ZONE X** Areas of 500-year flood; areas of 100-year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 100-year flood.

OTHER AREAS

- **ZONE X** Areas determined to be outside 500-year floodplain.
- **ZONE D** Areas in which flood hazards are undetermined.

UNDEVELOPED COASTAL BARRIERS

Identified 1983 | Identified 1990 | Otherwise Protected Areas

Coastal barrier areas are normally located within or adjacent to Special Flood Hazard Areas.

- Flood Boundary
- Floodway Boundary
- Zone D Boundary
- Boundary Dividing Special Flood Hazard Zones, and Boundary Dividing Areas of Different Coastal Base Flood Elevations Within Special Flood Hazard Zones.
- 513 — Base Flood Elevation Line; Elevation in Feet. See Map Index for Elevation Datum.
- D — D — Cross Section Line
- (EL 987) — Base Flood Elevation in Feet Where Uniform Within Zone. See Map Index for Elevation Datum.
- RM7 — Elevation Reference Mark
- M2 — River Mile
- 97°07'30", 32°22'30" — Horizontal Coordinates Based on North American Datum of 1927 (NAD 27) Projection.

NOTES

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For adjoining map panels and base map source see separately printed Map Index.

MAP REPOSITORY
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EFFECTIVE DATE OF
COUNTYWIDE FLOOD INSURANCE RATE MAP:

MARCH 17, 1997

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL:

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APPROXIMATE SCALE IN FEET
500 0 500

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

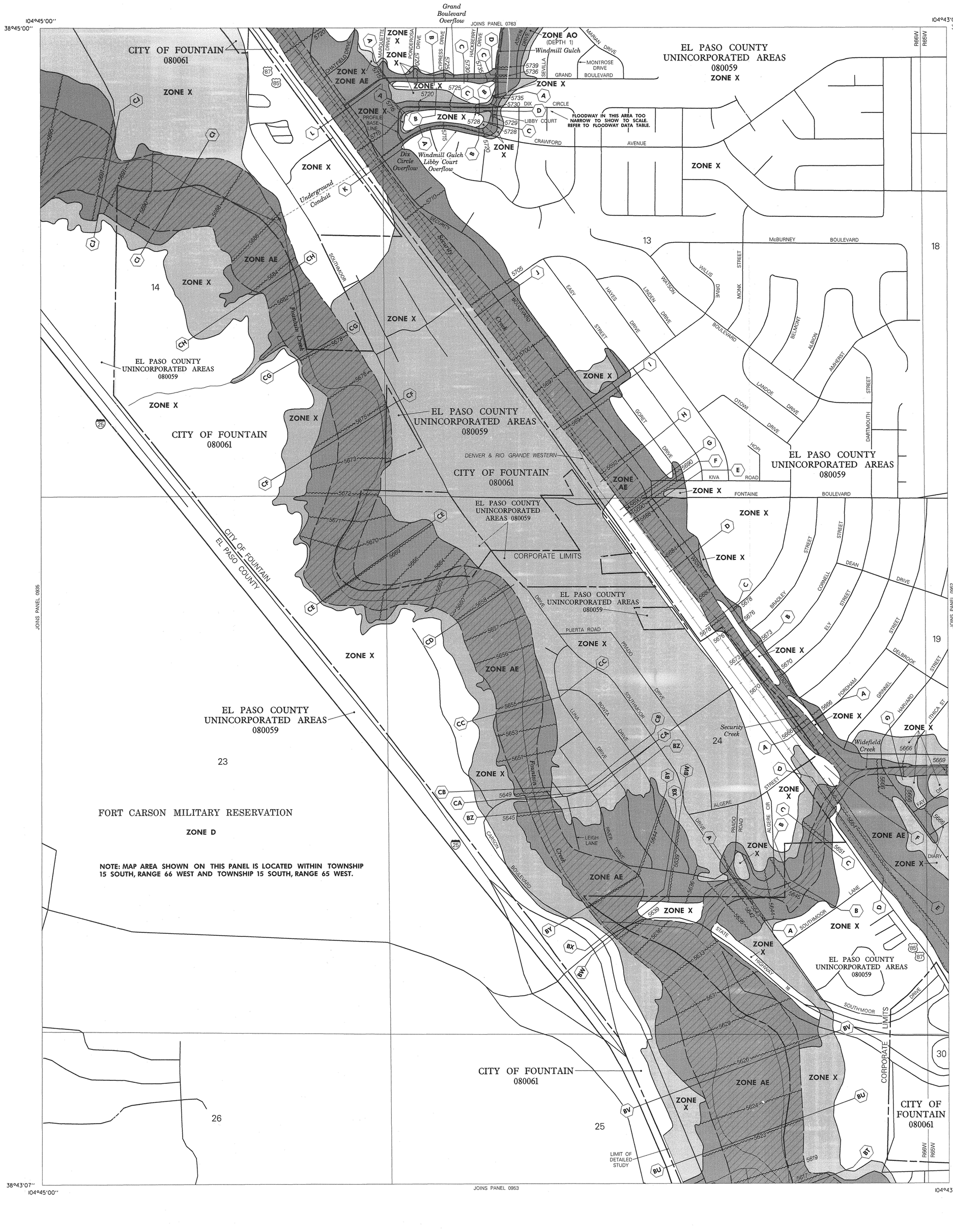
PANEL 953 OF 1300
(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS: COMMUNITY	NUMBER	PANEL	SUFFIX
EL PASO COUNTY, UNINCORPORATED AREAS	080059	0953	F
FOUNTAIN, CITY OF	080061	0953	F

MAP NUMBER
08041C0953 F

EFFECTIVE DATE:
MARCH 17, 1997

Federal Emergency Management Agency



LEGEND

SPECIAL FLOOD HAZARD AREAS INUNDATED BY 100-YEAR FLOOD

- **ZONE A** — No base flood elevations determined.
- **ZONE AE** — Base flood elevations determined.
- **ZONE AH** — Flood depths of 1 to 3 feet (usually areas of ponding); base flood elevations determined.
- **ZONE AO** — Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
- **ZONE A99** — To be protected from 100-year flood by Federal flood protection system under construction; no base elevations determined.
- **ZONE V** — Coastal flood with velocity hazard (wave action); no base flood elevations determined.
- **ZONE VE** — Coastal flood with velocity hazard (wave action); base flood elevations determined.

FLOODWAY AREAS IN ZONE AE

OTHER FLOOD AREAS

- **ZONE X** — Areas of 500-year flood; areas of 100-year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 100-year flood.

OTHER AREAS

- **ZONE X** — Areas determined to be outside 500-year floodplain.
- **ZONE D** — Areas in which flood hazards are undetermined.

UNDEVELOPED COASTAL BARRIERS

Identified 1983 | Identified 1990 | Otherwise Protected Areas

Coastal barrier areas are normally located within or adjacent to Special Flood Hazard Areas.

- Flood Boundary
- Floodway Boundary
- Zone D Boundary
- Boundary Dividing Special Flood Hazard Zones, and Boundary Dividing Areas of Different Coastal Base Flood Elevations Within Special Flood Hazard Zones.
- 513 — Base Flood Elevation Line; Elevation in Feet. See Map Index for Elevation Datum.
- D — D — Cross Section Line
- (EL 987) — Base Flood Elevation in Feet Where Uniform Within Zone. See Map Index for Elevation Datum.
- RM7 × — Elevation Reference Mark
- ● M2 — River Mile
- 97°07'30", 32°22'30" — Horizontal Coordinates Based on North American Datum of 1927 (NAD 27) Projection.

NOTES

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MAP REPOSITORY
Refer to Repository Listing on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP:
MARCH 17, 1997

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL:

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APPROXIMATE SCALE IN FEET
500 0 500

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 951 OF 1300
(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS: COMMUNITY	NUMBER	PANEL	SUFFIX
EL PASO COUNTY, UNINCORPORATED AREAS	080059	0951	F
FOUNTAIN, CITY OF	080061	0951	F

MAP NUMBER 08041C0951 F

EFFECTIVE DATE: MARCH 17, 1997

Federal Emergency Management Agency

Design Procedure Form: Sand Filter (SF)

UD-BMP (Version 3.07, March 2018)

Designer:
Company:
Date: August 15, 2018
Project:
Location: SAND FILTER 1

1. Basin Storage Volume	
A) Effective Imperviousness of Tributary Area, I_a (100% if all paved and roofed areas upstream of sand filter)	I_a = 60.0 %
B) Tributary Area's Imperviousness Ratio (i = I_a/100)	i = 0.600
C) Water Quality Capture Volume (WQCV) Based on 12-hour Drain Time WQCV= 0.8 * (0.91* i^3 - 1.19 * i^2 + 0.78 * i)	WQCV = 0.19 watershed inches
D) Contributing Watershed Area (including sand filter area)	Area = 388,991 sq ft
E) Water Quality Capture Volume (WQCV) Design Volume V_{WQCV} = WQCV / 12 * Area	V_{WQCV} = cu ft
F) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm	d_6 = in
G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume	$V_{WQCV\ OTHER}$ = cu ft
H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired)	$V_{WQCV\ USER}$ = 775 cu ft
2. Basin Geometry	
A) WQCV Depth	D_{WQCV} = 1.0 ft
B) Sand Filter Side Slopes (Horizontal distance per unit vertical, 4:1 or flatter preferred). Use "0" if sand filter has vertical walls.	Z = 4.00 ft / ft
C) Minimum Filter Area (Flat Surface Area)	A_{Min} = 2917 sq ft
D) Actual Filter Area	A_{Actual} = 3200 sq ft
E) Volume Provided	V_T = 3200 cu ft
3. Filter Material	Choose One: (●) 18" CDOT Class B or C Filter Material ( ) Other (Explain):
4. Underdrain System	
A) Are underdrains provided?	Choose One: (●) YES ( ) NO
B) Underdrain system orifice diameter for 12 hour drain time	
i) Distance From Lowest Elevation of the Storage Volume to the Center of the Orifice	y = 1.0 ft
ii) Volume to Drain in 12 Hours	Vol_{12} = 775 cu ft
iii) Orifice Diameter, 3/8" Minimum	D_O = 3/4 in

Design Procedure Form: Sand Filter (SF)

Designer:
Company:
Date: August 15, 2018
Project:
Location: SAND FILTER 1

5. Impermeable Geomembrane Liner and Geotextile Separator Fabric A) Is an impermeable liner provided due to proximity of structures or groundwater contamination?	Choose One ○ YES ◉ NO
6. Inlet / Outlet Works A) Describe the type of energy dissipation at inlet points and means of conveying flows in excess of the WQCV through the outlet	

Notes:

Design Procedure Form: Sand Filter (SF)

UD-BMP (Version 3.07, March 2018)

Designer:
Company:
Date: August 15, 2018
Project:
Location: Sand Filter 1

1. Basin Storage Volume

A) Effective Imperviousness of Tributary Area, I_a
(100% if all paved and roofed areas upstream of sand filter)
I_a = 73.0 %

B) Tributary Area's Imperviousness Ratio (i = I_a/100)
i = 0.730

C) Water Quality Capture Volume (WQCV) Based on 12-hour Drain Time
WQCV= 0.8 * (0.91* i^3 - 1.19 * i^2 + 0.78 * i)
WQCV = 0.23 watershed inches

D) Contributing Watershed Area (including sand filter area)
Area = 334,976 sq ft

E) Water Quality Capture Volume (WQCV) Design Volume
V_{WQCV} = WQCV / 12 * Area
V_{WQCV} = cu ft

F) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm
d_6 = in

G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume
$V_{WQCV\ OTHER}$ = cu ft

H) User Input of Water Quality Capture Volume (WQCV) Design Volume
(Only if a different WQCV Design Volume is desired)
$V_{WQCV\ USER}$ = 620 cu ft

2. Basin Geometry

A) WQCV Depth
D_{WQCV} = 1.0 ft

B) Sand Filter Side Slopes (Horizontal distance per unit vertical, 4:1 or flatter preferred). Use "0" if sand filter has vertical walls.
Z = 4.00 ft / ft

C) Minimum Filter Area (Flat Surface Area)
A_{Min} = 3057 sq ft

D) Actual Filter Area
A_{Actual} = 3200 sq ft

E) Volume Provided
V_T = 3200 cu ft

3. Filter Material

Choose One
- (●) 18" CDOT Class B or C Filter Material
- ( ) Other (Explain):

4. Underdrain System

A) Are underdrains provided?

Choose One
- (●) YES
- ( ) NO

B) Underdrain system orifice diameter for 12 hour drain time

i) Distance From Lowest Elevation of the Storage Volume to the Center of the Orifice
y = 1.0 ft

ii) Volume to Drain in 12 Hours
Vol_{12} = 620 cu ft

iii) Orifice Diameter, 3/8" Minimum
D_O = 11/16 in

Design Procedure Form: Sand Filter (SF)

Designer:
Company:
Date: August 15, 2018
Project:
Location: Sand Filter 1

5. Impermeable Geomembrane Liner and Geotextile Separator Fabric A) Is an impermeable liner provided due to proximity of structures or groundwater contamination?	Choose One: ○ YES ◉ NO
6. Inlet / Outlet Works A) Describe the type of energy dissipation at inlet points and means of conveying flows in excess of the WQCV through the outlet	

Notes:

Rice Ranch					
El Paso County, Colorado					
Opinion Of Probable Cost					
8/20/2018					
Reference	**Description**	**Unit**	**Unit Cost**		
	Major Items			Quantity	Cost
	Unclassified Excavation	CY	$20.00	2,500	$50,000.00
	Sand	CY	$40.00	600	$24,000.00
	Riprap 6"	CY	$100.00	100	$10,000.00
	Topsoiling, Seeding & Mulching	CY	$20.00	500	$10,000.00
	Sub Total				$94,000.00
	Contingency/Minor Items	%	10	$94,000.00	$9,400.00
	Grand Total				$103,400.00

Assumptions & Notes	
1	Quantities based on plans prepared by CD Civil Design LLC, and by general assumptions.
2	The cost estimate submitted herein is based on time-honored practices within the construction industry. As such the engineer does not control the cost of labor, materials, equipment, or a contractor's methods of determining prices and competitive bidding practices or market conditions. The estimate represents our best judgment as design professionals using current information available at the time of preparation. The engineer cannot guarantee that proposals, bids and/or construction costs
3	This estimate is subject to change. It generally attempts to quantify drainage construction costs. Other project related costs are not included.
4	Estimate does not include construction management and materials testing which could be a major project expense.
5	Unit costs are based on CDOT cost data from, and general assumptions.