

# **PRELIMINARY/FINAL DRAINAGE REPORT FOR JUDGE ORR RANCHETTES**

October, 2017

Prepared for:

John Jennings  
2030 Tabor Ct.  
Colorado Springs, CO 80919

Prepared By:



**CATAMOUNT  
ENGINEERING**  
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PCD FILE NO's: SP-17-011  
SF-17-021

PRELIMINARY/FINAL DRAINAGE REPORT  
JUDGE ORR RANCHETTES

**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 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.

**Certification Statement:**

This report and plan for the preliminary and final drainage design for the Judge Orr Ranchettes was prepared by me (or under my direct supervision) in accordance with the provisions of City of Colorado Springs/El Paso County Drainage Criteria Manual Volumes 1 and 2 Drainage Design and Technical Criteria for the owners thereof. I understand that El Paso County does not and will not assume liability for drainage facilities designed by others.

  
\_\_\_\_\_  
David L. Mijares, Colorado PE #40510  
For and on behalf of Catamount Engineering

Date

1.30.19

**Developer's Statement:**

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

John Jennings hereby certifies that the drainage facilities for Judge Orr Ranchettes shall be constructed according to the design presented in this report. I understand that El Paso County does not and will not assume liability for the drainage facilities designed and or certified by my engineer and that the El Paso County reviews drainage plans pursuant to Colorado Revised Statutes, Title 30, Article 28; but cannot, on behalf of Judge Orr Ranchettes, guarantee that final drainage design review will absolve John Jennings and/or their successors and/or assigns of future liability for improper design. I further understand that approval of the final plat does not imply approval of my engineer's drainage design.

\_\_\_\_\_  
John R. Jennings

Business Name

By: \_\_\_\_\_

Title: \_\_\_\_\_

Address: \_\_\_\_\_  
2030 Tabor Ct.

\_\_\_\_\_  
Colorado Springs, CO 80919

**El Paso County:**

Filed in accordance with the requirements of the El Paso County land Development Code and the Drainage Criteria manual Volumes 1 and 2, and the El Paso County Engineering Criteria Manual, latest revision.

\_\_\_\_\_  
Jennifer Irvine, PE  
County Engineer/ECM Administrator

\_\_\_\_\_  
Date

Conditions:

# **PRELIMINARY/FINAL DRAINAGE REPORT for JUDGE ORR RANCHETTES**

## **PURPOSE**

The purpose of this drainage report is to identify existing drainage patterns, quantify developed storm water runoff, and establish outfall scenarios from the proposed development. Additionally this analysis will establish compliance with previous drainage studies.

## **GENERAL LOCATION AND DESCRIPTION**

The subject 40.67 acres is proposed to be platted into 7 residential lots and public ROW and is located within the southeast  $\frac{1}{4}$  of Section 33, Township 12 South, Range 64 West of the 6<sup>th</sup> principal meridian El Paso County, Colorado.

The parcel is bounded on the north by unplatted land and Stapleton Drive, on the east by unplatted residential parcels, on the south by Judge Orr Road, and on the west by residential parcels.

The site is sparsely vegetated with native grasses. Some volunteer shrubs and trees are evident within the roadside ditch along the north side of Judge Orr Road. The existing terrain generally slopes to the east and southeast at a 1.9% grade. A swale along the south edge of the project running from west to east has been formed adjacent to the Judge Orr Road embankment. The site lies within the Haegler Ranch Basin.

Soils in the development parcel consist of Columbine gravelly sandy loam and Blakeland loamy sand, both Hydrologic Group 'A' soils, as determined by the Natural Resources Conservation Service Web Soil Survey. Hydrologic Group A soils were used in analysis.

A portion of the development lies within an F.E.M.A. designated floodplain, Zone AE with base flood elevations determined, per FIRM 08041C0575 F, as revised to reflect LOMR Case No16-08-1065P. The revised F.E.M.A. Flood Insurance Rate Map and LOMR determination have been provided in the appendix. The area identified as Zone AE has been included in a no build easement to be dedicated to El Paso County with plat recordation.

## **EXISTING DRAINAGE CONDITIONS**

The site was previously studied in the "GIECK RANCH DRAINAGE BASIN PLANNING STUDY", prepared by Drexel, Barrell & Co., revised February 10, 2010. In the DBPS the parcel is indicated as the parcel is identified as tributary to reach HD-R4 of the Haegler basin diversion. The estimated major storm event exhibits a flow of  $Q_{100}=468$  cfs at the eastern end of the reach. The reach was not proposed to receive structural improvements in implementation of the DBPS plan.

Flows through the reach were further studied with development of LOMR case No. 16-08-1065P, developed by Kiowa Engineering for implementation of Stapleton Road Improvements. The Kiowa LOMR finalized in Stapleton road crossing. The LOMR analysis, Effective Date June 15, 2017, provided base flood elevations for the reach through the Judge Orr Ranchettes property. Flows of  $Q_{100}=592$  cfs were utilized in analysis of the reach identified as Haegler Ranch Tributary 2 in the LOMR. Flows of 592 CFS were accepted in the Preliminary/Final Drainage Report for Judge Orr Ranchettes.

A swale exists along the western edge of the property conveying offsite flows from the northern portion of the property to reach HD-R4 of Haegler Creek. An additional small swale is evident along the southern portion of the property conveying offsite flows to the roadside ditch along Judge Orr Rd. At the north easterly limit of the parcel a dual 36" RCP crossing was installed with Stapleton Road Improvements conveying flows across Stapleton to the west prior to entering the property. A small offsite basin tributary to the northerly limits of the parcel, Basin OS-A (2.22 Acres,  $Q_2=0.1$  cfs,  $Q_5=0.4$  cfs,  $Q_{10}=0.9$  cfs,  $Q_{25}=1.6$  cfs,  $Q_{50}=2.2$  cfs, and  $Q_{100}=2.8$  cfs), was modeled as this basin will be diverted to the dual 36" RCP crossing with installation of temporary gravel roadway until El Paso County secures right of way to develop permanent connection to Stapleton Road.

Off-site Basin OS-B (8.00 Acres,  $Q_2=0.5$  cfs,  $Q_5=1.4$  cfs,  $Q_{10}=2.9$  cfs,  $Q_{25}=4.9$  cfs,  $Q_{50}=6.6$  cfs, and  $Q_{100}=8.5$  cfs) represents the southerly limits of the Haegler Basin tributary to the existing roadside ditch north of Judge Orr Road. Existing basins were modeled as agricultural land as the tributary portions of upstream properties to basin OS-A and OS-B remain largely in an undeveloped state.

The northern portion of the parcel modeled as basin EX-A (31.32 Acres,  $Q_2=0.9$  cfs,  $Q_5=3.2$  cfs,  $Q_{10}=7.1$  cfs,  $Q_{25}=12.5$  cfs,  $Q_{50}=16.7$  cfs, and  $Q_{100}=21.7$  cfs) sheet flows to the southeast and is intercepted either by reach HD-R4 of Haegler Creek or Stapleton Road improvements and is conveyed to the dual 4'x8' box culvert crossing of Stapleton Drive.

The southern portion of the parcel modeled as basin EX-B (9.31 Acres,  $Q_2=1.0$  cfs,  $Q_5=2.3$  cfs,  $Q_{10}=4.3$  cfs,  $Q_{25}=7.0$  cfs,  $Q_{50}=9.3$  cfs, and  $Q_{100}=11.8$  cfs) sheet flows to the southeast and is tributary to the existing Judge Orr Road side ditch. Combined flows from basin EX-B and OS-B at design point 3 of  $Q_2=1.2$  cfs,  $Q_5=3.0$  cfs,  $Q_{10}=5.9$  cfs,  $Q_{25}=9.8$  cfs,  $Q_{50}=12.9$  cfs, and  $Q_{100}=16.6$  cfs are conveyed in the roadside ditches of Judge Orr Road and Stapleton Road to the Box Culvert Crossing of Stapleton Drive.

## **DEVELOPED DRAINAGE BASINS**

Due to the 5.0 minimum lot size developed basins were modeled as predominantly agricultural land with 1.0 acre of each parcel to be developed at a residential density. Roadways and shoulders were modeled as pavement and gravel roadways where proposed.



Basin A-1 (0.81 Acres,  $Q_2=1.4$  cfs,  $Q_5=1.8$  cfs,  $Q_{10}=2.2$  cfs,  $Q_{25}=2.6$  cfs,  $Q_{50}=2.9$  cfs, and  $Q_{100}=3.3$  cfs) represents the westerly portion of the proposed roadway north of Haegler Creek. Runoff generated within this basin will be collected in the roadside swale and conveyed south to Haegler Creek.

Basin A-2 (30.33 Acres,  $Q_2=1.9$  cfs,  $Q_5=4.8$  cfs,  $Q_{10}=9.2$  cfs,  $Q_{25}=15.2$  cfs,  $Q_{50}=20.2$  cfs, and  $Q_{100}=25.6$  cfs) consists of the easterly half of the roadway, the southerly portion of the proposed temporary access, and proposed 5 acre lots north of Haegler Creek. Runoff generated within basin A-1 will sheetflow to the southeast and is intercepted either by reach HD-R4 of Haegler Creek or Stapleton Road improvements and is conveyed to the dual 4'x8' box culvert crossing of Stapleton Drive. Runoff from Basin A-2 represents a minor increase in flows to undeveloped flows from basin EX-A.

Basin A-3 (0.18 Acres,  $Q_2=0.4$  cfs,  $Q_5=0.5$  cfs,  $Q_{10}=0.6$  cfs,  $Q_{25}=0.7$  cfs,  $Q_{50}=0.8$  cfs, and  $Q_{100}=0.9$  cfs) consist of the northerly half of the proposed temporary gravel roadway. Flows from Basin A-3 will be conveyed in a constructed roadside ditch with flows from Basin OS-A to the existing dual 36" RCP outfall at Design Point P1. Design Point P-1 representing off-site and site addition to the existing crossing of Stapleton is  $Q_2=0.3$  cfs,  $Q_5=0.6$  cfs,  $Q_{10}=1.2$  cfs,  $Q_{25}=2.0$  cfs,  $Q_{50}=2.6$  cfs, and  $Q_{100}=3.3$  cfs).

Basin B-1 (0.54 Acres,  $Q_2=1.2$  cfs,  $Q_5=1.6$  cfs,  $Q_{10}=1.9$  cfs,  $Q_{25}=2.3$  cfs,  $Q_{50}=2.6$  cfs, and  $Q_{100}=2.9$  cfs) consists of the westerly half of the proposed roadway south of Haegler Creek. Runoff generated within this basin will be collected in the roadside swale and conveyed south to the existing Judge Orr Road ditch. Runoff from Basin B-1 will be combined with runoff from Basin OS-B at design point P4. Flows from design point P-4 of  $Q_2=1.0$  cfs,  $Q_5=2.1$  cfs,  $Q_{10}=3.7$  cfs,  $Q_{25}=5.9$  cfs,  $Q_{50}=7.7$  cfs, and  $Q_{100}=9.7$  cfs will be conveyed in a 30" RCP culvert under the proposed roadway and continue in the Judge Orr Road ditch to design point P3.

Basin B-2 (8.76 Acres,  $Q_2=1.1$  cfs,  $Q_5=2.6$  cfs,  $Q_{10}=4.6$  cfs,  $Q_{25}=7.4$  cfs,  $Q_{50}=9.7$  cfs, and  $Q_{100}=12.2$  cfs) consist of the easterly half of the proposed roadway and proposed 5 acre residential lots south of Haegler Creek and tributary to the Judge Orr Roadside ditch. Runoff from basin B-2 will sheetflow to the southeast and the Judge Orr Roadside ditch to design point P3. Anticipated flows at design point P-3 of  $Q_2=1.7$  cfs,  $Q_5=3.6$  cfs,  $Q_{10}=6.4$  cfs,  $Q_{25}=10.3$  cfs,  $Q_{50}=13.4$  cfs, and  $Q_{100}=17.0$  cfs represents a minor increase in flows at Design Point P3.

## CONVEYANCE

### DP-P1-

100-Yr flow of 3.3 cfs will be conveyed to the existing dual 36" RCP crossing of Stapleton Boulevard in a proposed 17' wide roadside swale with 4:1 side slopes and a longitudinal slope of 2% at a depth of 0.55' with a velocity of 3.5 ft/s.

### DP-P3-

100-Yr flow of 17.0 cfs will be conveyed in the existing Judge Orr Road ditch to design point DP-P3. The existing roadside ditch was modeled from the topographic survey as approximately 30' wide from top of bank on the north to pavement edge as approximately 30' wide with an

average depth of 6.0'. The existing ditch has an approximately 2.5:1 cross slope and a longitudinal slope of .033%. 100-YR flows will be conveyed at a depth of 1.16' and a velocity of 5.12 ft/s. The downstream 30" driveway culvert has adequate capacity to convey the 17.0 cfs anticipated 100-YR flow.

#### DP-P4-

100-yr flow of 9.7 cfs will be conveyed in a proposed 17' wide roadside swale with 4:1 side slopes and a longitudinal slope of 1.6% at a depth of 0.84' with a velocity of 4.1 ft/s to the proposed 30" RCP culvert. The proposed 30" RCP culvert will convey developed flows generating an approximate headwater depth of 1.5'.

See Appendix for Calculations.

### **WATER QUALITY/4-STEP PROCESS**

The development addresses Low Impact Development strategies primarily through the utilization of large impervious areas and utilization of landscape swales receiving runoff generated within impervious roadways.

#### Step 1: Employ Runoff Reduction Practices

Impervious areas generated within the development will flow across pervious disconnected areas prior to offsite discharge. Runoff generated within roadway improvements will be directed to grassed roadside ditches and conveyed to grassed channels. Curb or storm sewer improvements are not proposed within the development.

#### Step2: Stabilize Drainageway

The historic reach of Haegler Basin that runs through the project is defined as 100-YR ZONE AE floodplain. The drainageway is characterized by a wide shallow floodway and is fully vegetated with native grasses. No disturbance will be allowed within the reach and all areas within the floodplain are designated as a no build zone.

#### Step3: Provide Water Quality Capture Volume

Permanent water quality facility is not proposed for development of 5 acre lots per the requirements of El Paso County Engineering Criteria Manual Section I.7.1B.

#### Step4: Consider Need for Industrial and Commercial BMP's

A Grading, Erosion Control, and Stormwater Quality Plan and narrative have been submitted concurrently for the development and will be subject to county approval prior to any soil disturbance. The erosion control plan included specific source control BMP's as well as defined overall site management practices for the construction period.

## **COST ESTIMATE**

### Private Improvements Non-reimbursable

30" RCP	75 LF	@ \$	65/LF	\$	4,875
30" FES	2 EA	@ \$	350/EA	\$	700
Rip Rap Outfall	1 EA	@ \$	300/EA	\$	300
<b>SUBTOTAL</b>				<b>\$</b>	<b>5,875</b>
<i>15% CONTINGENCY</i>				<i>\$</i>	<i>881</i>
<b><u>TOTAL</u></b>				<b><u>\$</u></b>	<b><u>6,756</u></b>

## **DRAINAGE FEE CALCULATION**

The development proposes to plat 40.67 acres within El Paso County, all contained within the Haegler Drainage Basin. ECM Appendix L part 1 Section 3.10.2a allows for a 25% reduction in drainage fees for low density lots.

### Impervious Acreage Calculation:

Single Family-5 acre lots is given a typical value of 7% impervious from EMC Appendix L table 3-1.

### Impervious Acres:

40.67 Acres X 7% = 2.847 Impervious Acres

### Drainage Fee:

(2.847 X Impervious Acres X 75% X \$8,844/ac) = \$ 18,884.15

### Bridge Fee:

(2.847 Impervious Acres X 75% X \$1,305/ac) = \$ 2,786.50

**TOTAL** **\$ 21,670.65**

## **DRAINAGE METHODOLOGY**

This drainage report was prepared in accordance to the criteria established in the City of Colorado Springs/El Paso County Drainage Criteria Manual Volumes 1 and 2, as revised May 2014.

The rational method for drainage basin study areas of less than 100 acres was utilized in the analysis. For the Rational Method, flows were calculated for the 2, 5, 10, 25, 50, and 100-year recurrence intervals. The average runoff coefficients, 'C' values, are taken from Table 6-6 and the Intensity-Duration-Frequency curves are taken from Figure 6-5 of the City Drainage Criteria Manual. Time of concentration for overland flow and storm drain or gutter flow are calculated per Section 3.2 of the City Drainage Criteria Manual. Calculations for the Rational Method are shown in the Appendix of this report. Flows developed in LOMR Case No. 16-08-1065P were accepted for the reach of Haegler Creek flowing through the parcel.

## **SUMMARY**

The Judge Orr Ranchettes Development consists of large lot development with minor increases in impervious areas consistent with development proposed in the Drainage Basin Planning Study. The development proposes no development and a setback approach in regards to the reach of the Haegler drainage within the parcel. A no-build easement has been established outside of the limits of the 100-YR floodplain. Development of the parcel is in conformance of current El Paso County criteria and will not adversely affect downstream properties or facilities.

## **REFERENCES:**

City of Colorado Springs Engineering Division Drainage Criteria Manual Volumes 1 and 2, revised May 2014

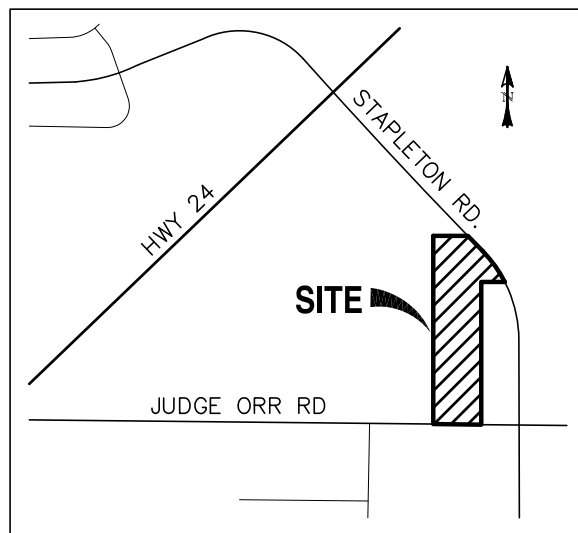
“Geick Ranch Drainage Basin Planning Study El Paso County, Colorado”, prepared by Drexel, Barrell & Co., revised February 10, 2010.

“Conditional Letter of Map Revision (CLOMR) Stapleton Drive”, prepared by Kiowa Engineering Corporation, dated December 20, 2013

Flood Insurance rate map 08041C0575 F, as revised to reflect LOMR Case No. 16-08-1065P

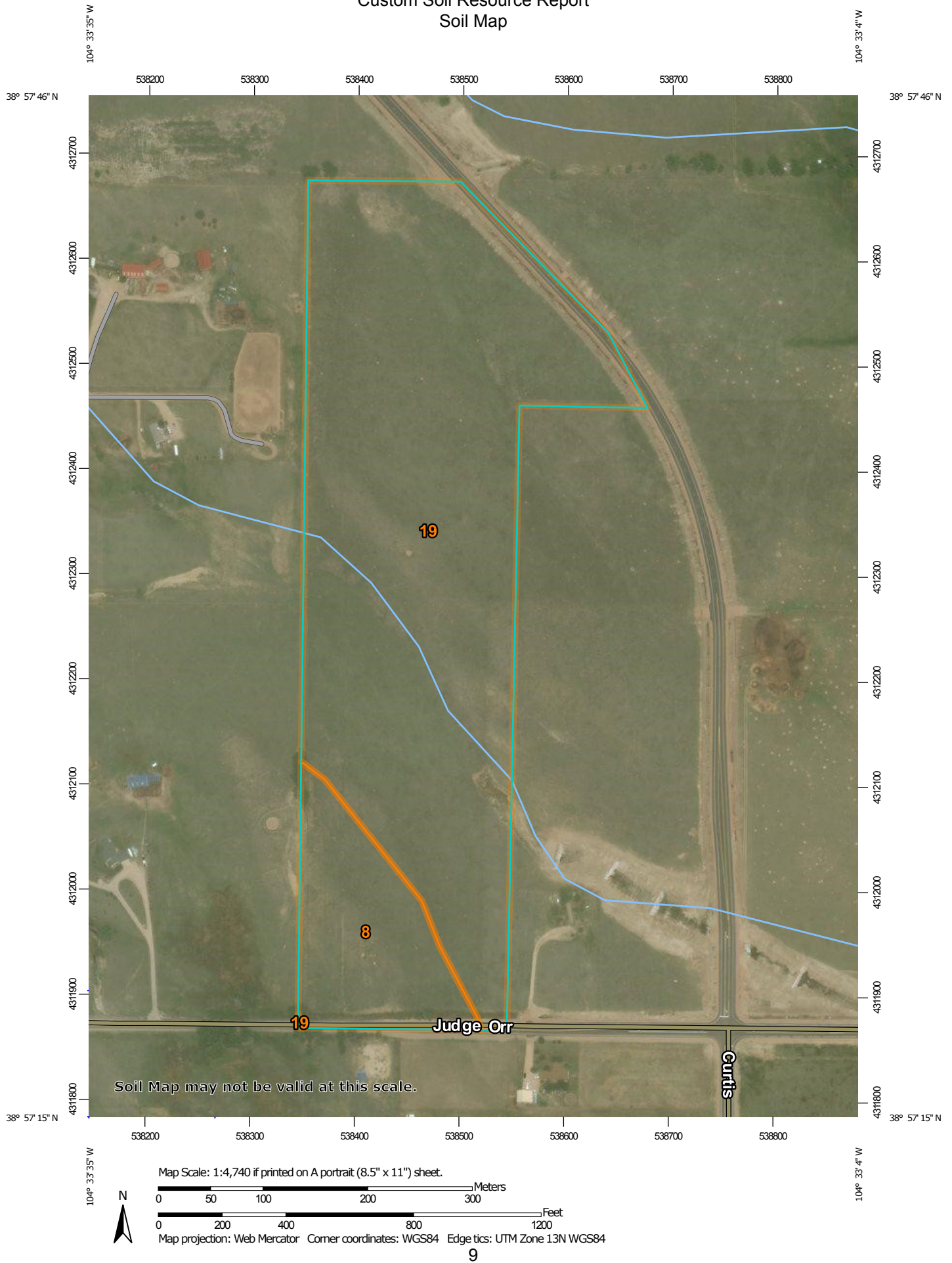
Natural Resources Conservation Service Web Soil Survey

## APPENDIX



**VICINITY MAP**  
SCALE: N.T.S.

# Custom Soil Resource Report Soil Map





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 14, Sep 23, 2016

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

Date(s) aerial images were photographed: May 22, 2016—Mar 9, 2017

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

El Paso County Area, Colorado (CO625)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
8	Blakeland loamy sand, 1 to 9 percent slopes	6.4	15.0%
19	Columbine gravelly sandy loam, 0 to 3 percent slopes	36.4	85.0%
<b>Totals for Area of Interest</b>		<b>42.8</b>	<b>100.0%</b>

## 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

## El Paso County Area, Colorado

### 8—Blakeland loamy sand, 1 to 9 percent slopes

#### Map Unit Setting

*National map unit symbol:* 369v  
*Elevation:* 4,600 to 5,800 feet  
*Mean annual precipitation:* 14 to 16 inches  
*Mean annual air temperature:* 46 to 48 degrees F  
*Frost-free period:* 125 to 145 days  
*Farmland classification:* Not prime farmland

#### Map Unit Composition

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

#### Description of Blakeland

##### Setting

*Landform:* Flats, hills  
*Landform position (three-dimensional):* Side slope, tal  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Parent material:* Alluvium derived from sedimentary rock and/or eolian deposits  
derived from sedimentary rock

##### Typical profile

*A - 0 to 11 inches:* loamy sand  
*AC - 11 to 27 inches:* loamy sand  
*C - 27 to 60 inches:* sand

##### Properties and qualities

*Slope:* 1 to 9 percent  
*Depth to restrictive feature:* More than 80 inches  
*Natural drainage class:* Somewhat excessively drained  
*Runoff class:* 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:* None  
*Frequency of ponding:* None  
*Calcium carbonate, maximum in profile:* 5 percent  
*Available water storage in profile:* Low (about 4.5 inches)

##### Interpretive groups

*Land capability classification (irrigated):* 3e  
*Land capability classification (nonirrigated):* 6e  
*Hydrologic Soil Group:* A  
*Ecological site:* Sandy Foothill (R049BY210CO)  
*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

**19—Columbine gravelly sandy loam, 0 to 3 percent slopes**

**Map Unit Setting**

*National map unit symbol:* 367p

*Elevation:* 6,500 to 7,300 feet

*Mean annual precipitation:* 14 to 16 inches

*Mean annual air temperature:* 46 to 50 degrees F

*Frost-free period:* 125 to 145 days

*Farmland classification:* Not prime farmland

**Map Unit Composition**

*Columbine and similar soils:* 85 percent

*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Columbine**

**Setting**

*Landform:* Flood plains, fan terraces, fans

*Down-slope shape:* Linear

*Across-slope shape:* Linear

*Parent material:* Alluvium

**Typical profile**

*A - 0 to 14 inches:* gravelly sandy loam

*C - 14 to 60 inches:* very gravelly loamy sand

**Properties and qualities**

*Slope:* 0 to 3 percent

*Depth to restrictive feature:* More than 80 inches

*Natural drainage class:* Well 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:* None

*Frequency of ponding:* None

*Available water storage in profile:* Very low (about 2.5 inches)

**Interpretive groups**

*Land capability classification (irrigated):* 4e

*Land capability classification (nonirrigated):* 6e

*Hydrologic Soil Group:* A

*Ecological site:* Gravelly Foothill (R049BY214CO)

*Hydric soil rating:* No

**Minor Components**

**Fluvaquentic haplaquolls**

*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





# Federal Emergency Management Agency

Washington, D.C. 20472

## LETTER OF MAP REVISION DETERMINATION DOCUMENT

COMMUNITY AND REVISION INFORMATION		PROJECT DESCRIPTION	BASIS OF REQUEST
COMMUNITY	El Paso County Colorado (Unincorporated Areas)	CHANNELIZATION CULVERT	HYDRAULIC ANALYSIS UPDATED TOPOGRAPHIC DATA
	COMMUNITY NO.: 080059		
IDENTIFIER	Stapleton Drive LOMR	APPROXIMATE LATITUDE AND LONGITUDE: 38.961, -104.559 SOURCE: USGS QUADRANGLE      DATUM: NAD 83	
ANNOTATED MAPPING ENCLOSURES		ANNOTATED STUDY ENCLOSURES	
TYPE: FIRM*      NO.: 08041C0575F      DATE: March 17, 1997		DATE OF EFFECTIVE FLOOD INSURANCE STUDY: August 23, 1999 PROFILES: 367P, 367P(a)	

Enclosures reflect changes to flooding sources affected by this revision.

\* FIRM - Flood Insurance Rate Map

### FLOODING SOURCE AND REVISED REACH

Haegler Ranch Tributary 2 – from approximately 3,300 feet upstream of the confluence with Geick Ranch West Tributary to U.S. Highway 24

### SUMMARY OF REVISIONS

Flooding Source	Effective Flooding	Revised Flooding	Increases	Decreases
Haegler Ranch Tributary 2	Zone A	Zone AE	YES	YES
	No BFEs*	BFEs	YES	NONE

\* BFEs - Base Flood Elevations

### DETERMINATION

This document provides the determination from the Department of Homeland Security's Federal Emergency Management Agency (FEMA) regarding a request for a Letter of Map Revision (LOMR) for the area described above. Using the information submitted, we have determined that a revision to the flood hazards depicted in the Flood Insurance Study (FIS) report and/or National Flood Insurance Program (NFIP) map is warranted. This document revises the effective NFIP map, as indicated in the attached documentation. Please use the enclosed annotated map panel revised by this LOMR for floodplain management purposes and for all flood insurance policies and renewals in your community.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Information eXchange toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMC Clearinghouse, 847 South Pickett Street, Alexandria, VA 22304-4605. Additional information about the NFIP is available on our website at <http://www.fema.gov/national-flood-insurance-program>.

Patrick "Rick" F. Sacibit, P.E., Branch Chief  
Engineering Services Branch  
Federal Insurance and Mitigation Administration

16-08-1065P

102-I-A-C





# Federal Emergency Management Agency

Washington, D.C. 20472

## LETTER OF MAP REVISION DETERMINATION DOCUMENT (CONTINUED)

### COMMUNITY INFORMATION

#### APPLICABLE NFIP REGULATIONS/COMMUNITY OBLIGATION

We have made this determination pursuant to Section 206 of the Flood Disaster Protection Act of 1973 (P.L. 93-234) and in accordance with the National Flood Insurance Act of 1968, as amended (Title XIII of the Housing and Urban Development Act of 1968, P.L. 90-448), 42 U.S.C. 4001-4128, and 44 CFR Part 65. Pursuant to Section 1361 of the National Flood Insurance Act of 1968, as amended, communities participating in the NFIP are required to adopt and enforce floodplain management regulations that meet or exceed NFIP criteria. These criteria, including adoption of the FIS report and FIRM, and the modifications made by this LOMR, are the minimum requirements for continued NFIP participation and do not supersede more stringent State/Commonwealth or local requirements to which the regulations apply.

NFIP regulations Subparagraph 60.3(b)(7) requires communities to ensure that the flood-carrying capacity within the altered or relocated portion of any watercourse is maintained. This provision is incorporated into your community's existing floodplain management ordinances; therefore, responsibility for maintenance of the altered or relocated watercourse, including any related appurtenances such as bridges, culverts, and other drainage structures, rests with your community. We may request that your community submit a description and schedule of maintenance activities necessary to ensure this requirement.

#### COMMUNITY REMINDERS

We based this determination on the 1-percent-annual-chance flood discharges computed in Letter of Map Revision 04-08-0587P, without considering subsequent changes in watershed characteristics that could increase flood discharges. Future development of projects upstream could cause increased flood discharges, which could cause increased flood hazards. A comprehensive restudy of your community's flood hazards would consider the cumulative effects of development on flood discharges subsequent to the publication of the FIS report for your community and could, therefore, establish greater flood hazards in this area.

Your community must regulate all proposed floodplain development and ensure that permits required by Federal and/or State/Commonwealth law have been obtained. State/Commonwealth or community officials, based on knowledge of local conditions and in the interest of safety, may set higher standards for construction or may limit development in floodplain areas. If your State/Commonwealth or community has adopted more restrictive or comprehensive floodplain management criteria, those criteria take precedence over the minimum NFIP requirements.

We will not print and distribute this LOMR to primary users, such as local insurance agents or mortgage lenders; instead, the community will serve as a repository for the new data. We encourage you to disseminate the information in this LOMR by preparing a news release for publication in your community's newspaper that describes the revision and explains how your community will provide the data and help interpret the NFIP maps. In that way, interested persons, such as property owners, insurance agents, and mortgage lenders, can benefit from the information.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Information eXchange toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMC Clearinghouse, 847 South Pickett Street, Alexandria, VA 22304-4605. Additional information about the NFIP is available on our website at <http://www.fema.gov/national-flood-insurance-program>.

Patrick "Rick" F. Sacbibit, P.E., Branch Chief  
Engineering Services Branch  
Federal Insurance and Mitigation Administration





**Federal Emergency Management Agency**  
Washington, D.C. 20472

**LETTER OF MAP REVISION  
DETERMINATION DOCUMENT (CONTINUED)**

We have designated a Consultation Coordination Officer (CCO) to assist your community. The CCO will be the primary liaison between your community and FEMA. For information regarding your CCO, please contact:

Ms. Jeanine D. Petterson  
Director, Mitigation Division  
Federal Emergency Management Agency, Region VIII  
Denver Federal Center, Building 710  
P.O. Box 25267  
Denver, CO 80225-0267  
(303) 235-4830

**STATUS OF THE COMMUNITY NFIP MAPS**

We are processing a revised FIRM and FIS report for El Paso County in our countywide format; therefore, we will not physically revise and republish the FIRM and FIS report for your community to incorporate the modifications made by this LOMR at this time. Preliminary copies of the countywide FIRM and FIS report, which present information from the effective FIRMs and FIS reports for your community and other incorporated communities in El Paso County, were submitted to your community for review on July 29, 2015. We will incorporate the modifications made by this LOMR into the countywide FIRM and FIS report before they become effective.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Information eXchange toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMC Clearinghouse, 847 South Pickett Street, Alexandria, VA 22304-4605. Additional information about the NFIP is available on our website at <http://www.fema.gov/national-flood-insurance-program>.

A handwritten signature in black ink, appearing to read "Rick F. Sacbibit".

Patrick "Rick" F. Sacbibit, P.E., Branch Chief  
Engineering Services Branch  
Federal Insurance and Mitigation Administration





# Federal Emergency Management Agency

Washington, D.C. 20472

## LETTER OF MAP REVISION DETERMINATION DOCUMENT (CONTINUED)

### PUBLIC NOTIFICATION OF REVISION

A notice of changes will be published in the *Federal Register*. This information also will be published in your local newspaper on or about the dates listed below, and through FEMA's Flood Hazard Mapping website at [https://www.floodmaps.fema.gov/fhm/bfe\\_status/bfe\\_main.asp](https://www.floodmaps.fema.gov/fhm/bfe_status/bfe_main.asp).

#### LOCAL NEWSPAPER

Name: *The Colorado Springs Gazette*

Dates: February 8, 2017 and February 15, 2017

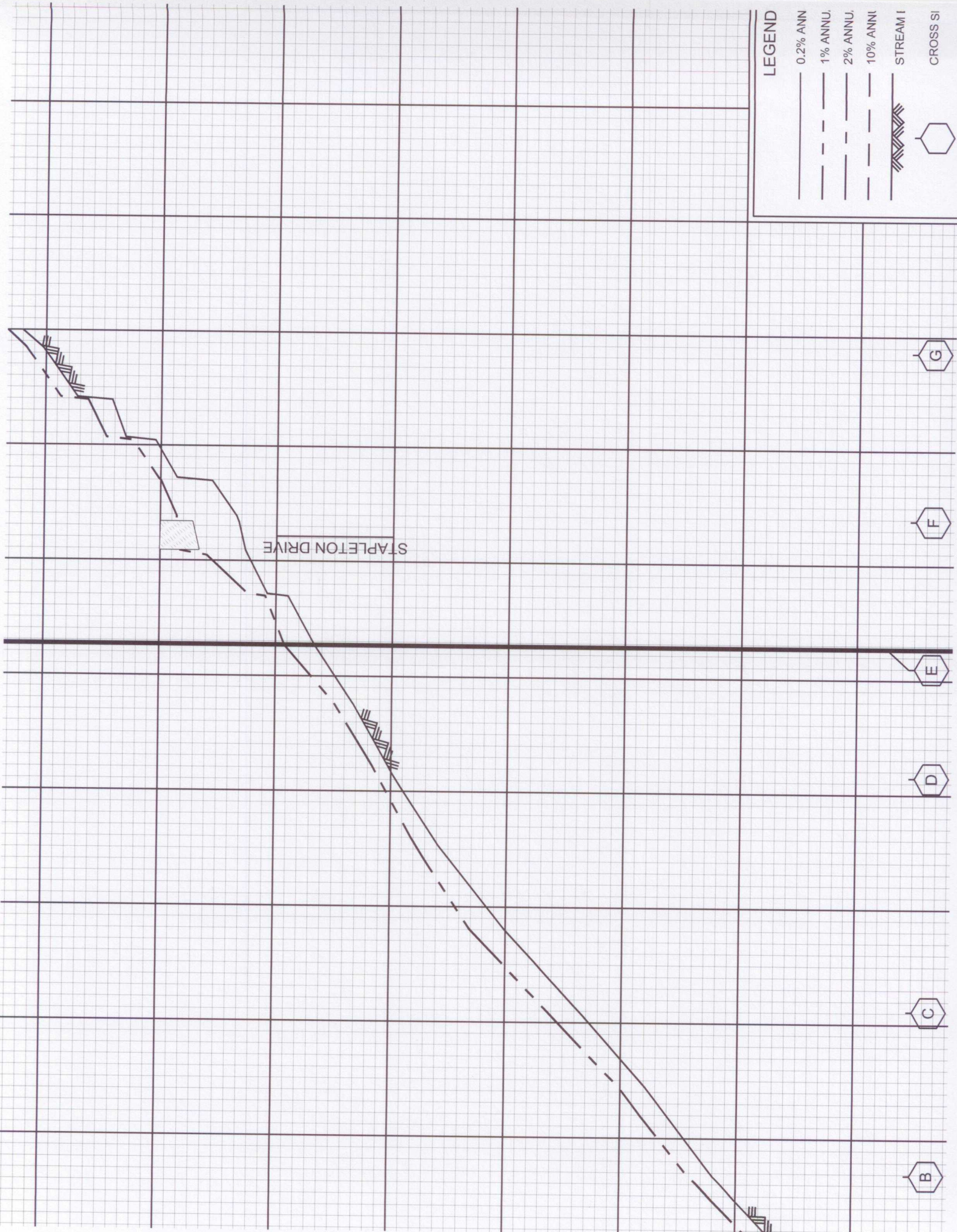
Within 90 days of the second publication in the local newspaper, any interested party may request that we reconsider this determination. Any request for reconsideration must be based on scientific or technical data. Therefore, this letter will be effective only after the 90-day appeal period has elapsed and we have resolved any appeals that we receive during this appeal period. Until this LOMR is effective, the revised flood hazard determination presented in this LOMR may be changed.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Information eXchange toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMC Clearinghouse, 847 South Pickett Street, Alexandria, VA 22304-4605. Additional information about the NFIP is available on our website at <http://www.fema.gov/national-flood-insurance-program>.

A handwritten signature in black ink, appearing to read "Rick F. Sacbitt".

Patrick "Rick" F. Sacbitt, P.E., Branch Chief  
Engineering Services Branch  
Federal Insurance and Mitigation Administration





LEGEND

	0.2% ANN
	1% ANNU
	2% ANNU
	10% ANNI
	STREAM I
	CROSS SI

G

F

E

D

C

B

STAPLETON DRIVE



LEGEND

0.2% ANN

1% ANNU.

2% ANNU.

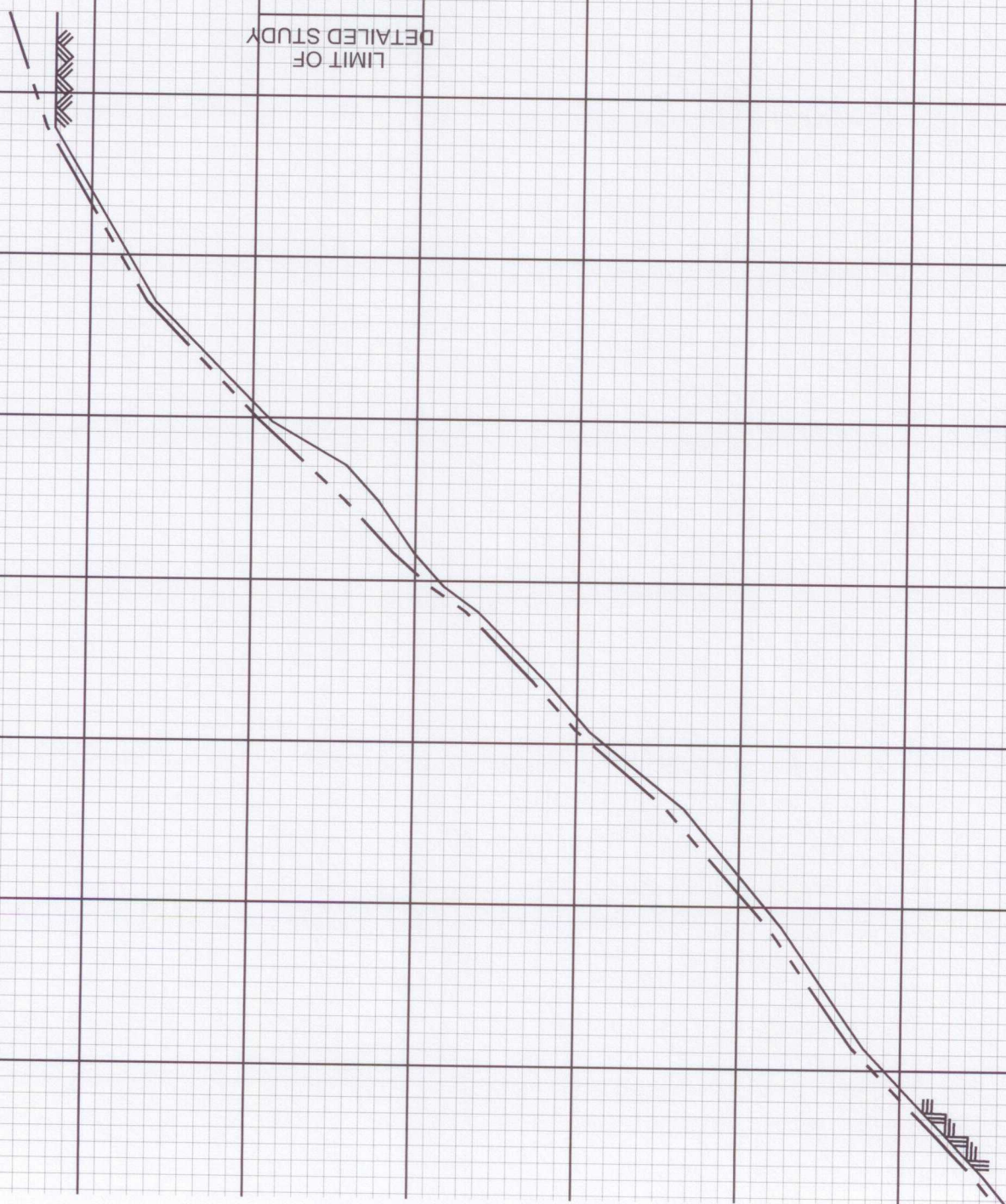
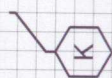
10% ANNI

STREAM I

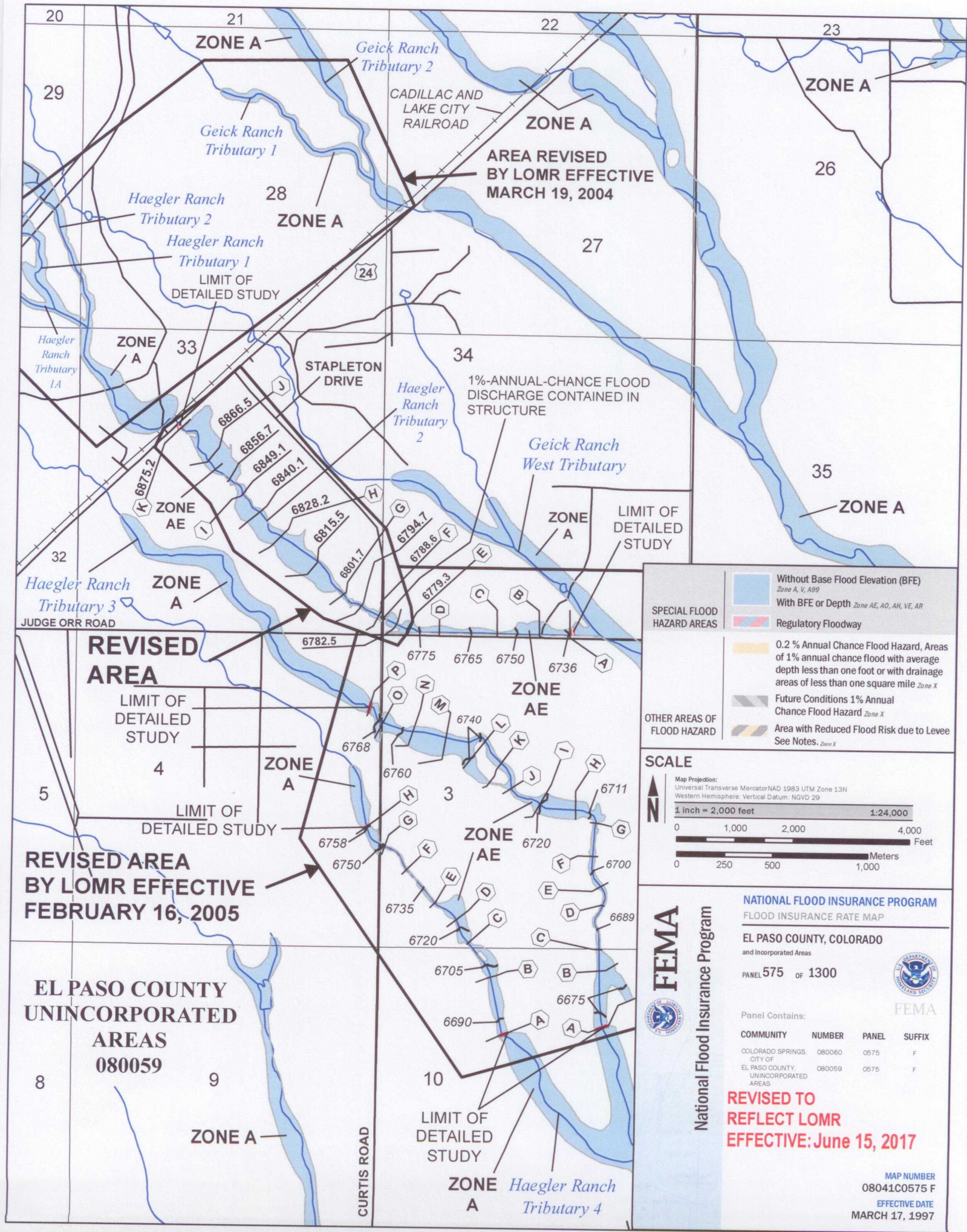
CROSS SI



LIMIT OF  
DETAILED STUDY







**SPECIAL FLOOD HAZARD AREAS**

- Without Base Flood Elevation (BFE)  
Zone A, V, A99
- With BFE or Depth Zone AE, AO, AH, VE, AR
- Regulatory Floodway
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
- Future Conditions 1% Annual Chance Flood Hazard Zone X
- Area with Reduced Flood Risk due to Levee See Notes, Zone X

**OTHER AREAS OF FLOOD HAZARD**

**SCALE**

Map Projection:  
Universal Transverse Mercator NAD 1983 UTM Zone 13N  
Western Hemisphere, Vertical Datum: NGVD 29

1 inch = 2,000 feet 1:24,000

0 1,000 2,000 4,000 Feet

0 250 500 1,000 Meters

**FEMA**  
National Flood Insurance Program

**NATIONAL FLOOD INSURANCE PROGRAM**  
FLOOD INSURANCE RATE MAP  
EL PASO COUNTY, COLORADO  
and Incorporated Areas  
PANEL 575 OF 1300

Panel Contains:

COMMUNITY	NUMBER	PANEL	SUFFIX
COLORADO SPRINGS, CITY OF	080060	0575	F
EL PASO COUNTY UNINCORPORATED AREAS	080059	0575	F

**REVISED TO REFLECT LOMR EFFECTIVE: June 15, 2017**

MAP NUMBER  
08041C0575 F  
EFFECTIVE DATE  
MARCH 17, 1997

## EXISTING HYDROLOGY



DESIGN POINT	AREA TOTAL (Acres)	WEIGHTED					TT TOTAL (min)	INTENSITY						TOTAL FLOWS					
		C <sub>2</sub>	C <sub>5</sub>	C <sub>10</sub>	C <sub>25</sub>	C <sub>50</sub>		I <sub>2</sub> (in/hr)	I <sub>5</sub> (in/hr)	I <sub>10</sub> (in/hr)	I <sub>25</sub> (in/hr)	I <sub>50</sub> (in/hr)	I <sub>100</sub> (in/hr)	Q <sub>2</sub> (c.f.s.)	Q <sub>5</sub> (c.f.s.)	Q <sub>10</sub> (c.f.s.)	Q <sub>25</sub> (c.f.s.)	Q <sub>50</sub> (c.f.s.)	Q <sub>100</sub> (c.f.s.)
		0.03	0.09	0.17	0.26	0.31													
DP-1 BASIN OS-A	2.22						38.6	1.7	2.1	2.5	2.8	3.2	3.5	0.1	0.4	0.9	1.6	2.2	2.8
DP-2 LOMR																			592.0
DP-3 BASIN OS-B BASIN EX-B	17.31 8.00 9.31	0.05 0.04 0.07	0.11 0.10 0.12	0.19 0.18 0.20	0.28 0.27 0.29	0.33 0.32 0.34	57.1	1.2	1.5	1.8	2.0	2.3	2.5	1.2	3.0	5.9	9.8	12.9	16.6

Calculated by: DLM

Date: 10/1/2017

## PROPOSED HYDROLOGY





DESIGN POINT	AREA TOTAL (Acres)	WEIGHTED						TT TOTAL (min)	INTENSITY						TOTAL FLOWS					
		C <sub>2</sub>	C <sub>5</sub>	C <sub>10</sub>	C <sub>25</sub>	C <sub>50</sub>	C <sub>100</sub>		I <sub>2</sub> (in/hr)	I <sub>5</sub> (in/hr)	I <sub>10</sub> (in/hr)	I <sub>25</sub> (in/hr)	I <sub>50</sub> (in/hr)	I <sub>100</sub> (in/hr)	Q <sub>2</sub> (c.f.s.)	Q <sub>5</sub> (c.f.s.)	Q <sub>10</sub> (c.f.s.)	Q <sub>25</sub> (c.f.s.)	Q <sub>50</sub> (c.f.s.)	Q <sub>100</sub> (c.f.s.)
		0.08	0.14	0.22	0.31	0.37	0.42		1.7	2.1	2.5	2.8	3.2	3.5	0.3	0.6	1.2	2.0	2.6	3.3
DP-P1 BASIN OS-A Basin A3	2.22 2.22 0.18	0.03 0.09 0.57	0.17 0.63	0.26 0.66	0.31 0.68	0.36 0.70		38.6												
DP-2 LOMR																				592.0
DP-P3 Basin B-2 DP-P4	17.30 8.76 8.54	0.08 0.07 0.08	0.14 0.13 0.14	0.21 0.20 0.22	0.29 0.29 0.30	0.34 0.33 0.35	0.39 0.37 0.40	57.1	1.2	1.5	1.8	2.0	2.3	2.5	1.7	3.6	6.4	10.3	13.4	17.0
DP-P4 Bosin OS-B Basin B-1	8.54 8.00 0.54	0.08 0.04 0.72	0.14 0.10 0.73	0.22 0.18 0.76	0.30 0.27 0.79	0.35 0.32 0.81	0.40 0.37 0.82	49.9	1.4	1.7	2.0	2.3	2.6	2.9	1.0	2.1	3.7	5.9	7.7	9.7

Calculated by: DLM

Date: 10/1/2017

# HYDRAULIC CALCULATIONS

DESIGN POINT ~~PI~~ P1

## Other Calculators

- [Air Flow Conversion Calculator](#)
- [Atmospheric Calculator](#)
- [Block Wall Calculator](#)
- [Concrete Column Calculator](#)
- [Concrete Volume Calculator](#)
- [Energy Conversion Calculator](#)
- [Isentropic Flow Relations Calculator](#)
- [Laser Real Time Unit Converter](#)
- [Normal Flow Relations Calculator](#)
- [Oblique Flow Relations Calculator](#)
- [Open-channel Flow Calculator](#)
- [Properties of Welds Treated as Lines Calculator](#)
- [Shaft Speed Calculator](#)
- [Torque Transmitted by Clutch Calculator](#)
- [Water Pump Engineering](#)
- [Back to ENGINEERING.com](#)

## Open-Channel Flow

This calculator uses Chézy and Manning's formula to calculate the wetted perimeter, hydraulic radius, flow area, Chézy coefficient and flow velocity.

For experimental values of Manning's n factor, [click here](#)

## Required Information

Enter the Slope:	<input type="text" value=".02"/>	Enter the Channel Top Width (ft):	<input type="text" value="17"/>
Enter the Channel Bottom Width (ft):	<input type="text" value="0"/>	Enter the Channel Height (ft):	<input type="text" value="2.5"/>
Enter the Flow Depth (ft):	<input type="text" value=".55"/>	Enter the n value:	<input type="text" value=".025"/>

## Results

The wetted perimeter is 3.89840 ft      → The flow is 3.565962 ft<sup>3</sup>/s ←

The flow area is 1.02850 ft<sup>2</sup>      The flow is 1600.40388 gal/min

The hydraulic radius is 0.26382 ft      The velocity is 3.467148 ft/s

The C value is 47.73083

Calculate

Reset

DESIGN POINT P3

## Other Calculators

- [Air Flow Conversion Calculator](#)
- [Atmospheric Calculator](#)
- [Block Wall Calculator](#)
- [Concrete Column Calculator](#)
- [Concrete Volume Calculator](#)
- [Energy Conversion Calculator](#)
- [Isentropic Flow Relations Calculator](#)
- [Laser Real Time Unit Converter](#)
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- [Shaft Speed Calculator](#)
- [Torque Transmitted by Clutch Calculator](#)
- [Water Pump Engineering](#)
- [Back to ENGINEERING.com](#)

## Open-Channel Flow

This calculator uses Chézy and Manning's formula to calculate the wetted perimeter, hydraulic radius, flow area, Chézy coefficient and flow velocity.

For experimental values of Manning's  $n$  factor, [click here](#)

## Required Information

Enter the Slope:	<input type="text" value=".033"/>	Enter the Channel Top Width (ft):	<input type="text" value="30"/>
Enter the Channel Bottom Width (ft):	<input type="text" value="0"/>	Enter the Channel Height (ft):	<input type="text" value="6"/>
Enter the Flow Depth (ft):	<input type="text" value="1.16"/>	Enter the $n$ value:	<input type="text" value=".035"/>

## Results

The wetted perimeter is 6.24679 ft      → The flow is 17.21989 ft<sup>3</sup>/s ←

The flow area is 3.364 ft<sup>2</sup>      The flow is 7728.28913 gal/min

The hydraulic radius is 0.53851 ft      The velocity is 5.118875 ft/s

The C value is 38.39883

Calculate

Reset

DESIGN POINT P4

## Other Calculators

- [Air Flow Conversion Calculator](#)
- [Atmospheric Calculator](#)
- [Block Wall Calculator](#)
- [Concrete Column Calculator](#)
- [Concrete Volume Calculator](#)
- [Energy Conversion Calculator](#)
- [Isentropic Flow Relations Calculator](#)
- [Laser Real Time Unit Converter](#)
- [Normal Flow Relations Calculator](#)
- [Oblique Flow Relations Calculator](#)
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- [Properties of Welds Treated as Lines Calculator](#)
- [Shaft Speed Calculator](#)
- [Torque Transmitted by Clutch Calculator](#)
- [Water Pump Engineering](#)
- [Back to ENGINEERING.com](#)

## Open-Channel Flow

This calculator uses Chézy and Manning's formula to calculate the wetted perimeter, hydraulic radius, flow area, Chézy coefficient and flow velocity.

For experimental values of Manning's  $n$  factor, [click here](#)

## Required Information

Enter the Slope:	<input type="text" value=".016"/>	Enter the Channel Top Width (ft):	<input type="text" value="17"/>
Enter the Channel Bottom Width (ft):	<input type="text" value="0"/>	Enter the Channel Height (ft):	<input type="text" value="2.5"/>
Enter the Flow Depth (ft):	<input type="text" value=".84"/>	Enter the $n$ value:	<input type="text" value=".025"/>

## Results

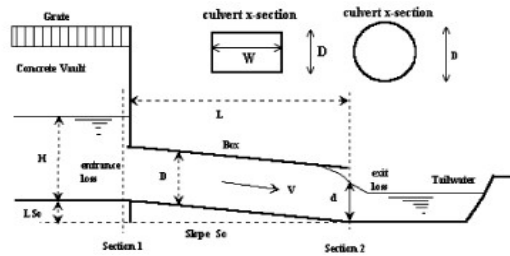
The wetted perimeter is 5.95393 ft	→ The flow is 9.866565 ft <sup>3</sup> /s ←
The flow area is 2.39904 ft <sup>2</sup>	The flow is 4428.11454 gal/min
The hydraulic radius is 0.40293 ft	The velocity is 4.112714 ft/s
The C value is 51.22144	

# CULVERT STAGE-DISCHARGE SIZING (INLET vs. OUTLET CONTROL WITH TAILWATER EFFECTS)

Project: **JUDGE ORR RANCHETTES**

Basin ID: **DP-P4**

Status:



## Design Information (Input):

**Circular Culvert:** Barrel Diameter in Inches

Inlet Edge Type (choose from pull-down list)

D = 30 inches

Grooved End Projection

OR:

**Box Culvert:** Barrel Height (Rise) in Feet

Barrel Width (Span) in Feet

Inlet Edge Type (choose from pull-down list)

Height (Rise) =

Width (Span) =

Square Edge w/ 30-78 deg. Flared Wingwall

Number of Barrels

Inlet Elevation at Culvert Invert

Outlet Elevation at Culvert Invert OR Slope of Culvert (ft v./ft h.)

Culvert Length in Feet

Manning's Roughness

Bend Loss Coefficient

Exit Loss Coefficient

No = 1

Inlet Elev = 6803 ft. elev.

Outlet Elev = 6802.25 ft. elev.

L = 75 ft.

n = 0.012

K<sub>b</sub> = 0

K<sub>x</sub> = 1

## Design Information (calculated):

Entrance Loss Coefficient

Friction Loss Coefficient

Sum of All Loss Coefficients

Orifice Inlet Condition Coefficient

Minimum Energy Condition Coefficient

K<sub>e</sub> = 0.20

K<sub>f</sub> = 0.59

K<sub>s</sub> = 1.79

C<sub>d</sub> = 0.95

KE<sub>low</sub> = -0.0373

## Calculations of Culvert Capacity (output):

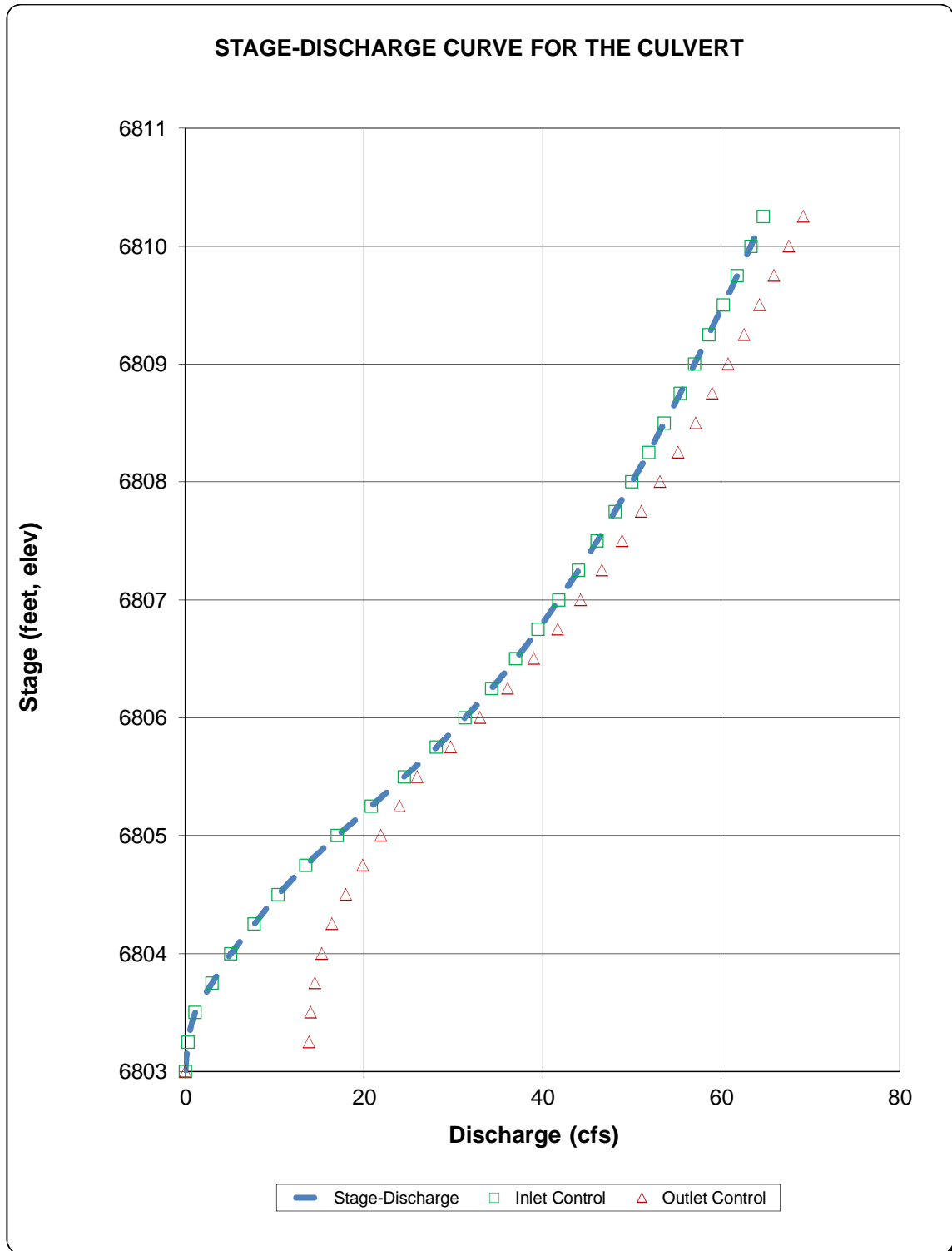
Water Surface Elevation (ft., linked)	Tailwater Surface Elevation ft	Culvert Inlet-Control Flowrate cfs	Culvert Outlet-Control Flowrate cfs	Controlling Culvert Flowrate cfs (output)	Inlet Equation Used:	Flow Control Used
6803.00		0.00	0.00	0.00	No Flow (WS < inlet)	N/A
6803.25		0.30	13.82	0.30	Min. Energy. Eqn.	INLET
6803.50		1.10	14.02	1.10	Min. Energy. Eqn.	INLET
6803.75		3.00	14.49	3.00	Min. Energy. Eqn.	INLET
6804.00		5.10	15.24	5.10	Min. Energy. Eqn.	INLET
6804.25		7.70	16.40	7.70	Min. Energy. Eqn.	INLET
6804.50		10.40	17.95	10.40	Regression Eqn.	INLET
6804.75		13.50	19.84	13.50	Regression Eqn.	INLET
6805.00		17.00	21.91	17.00	Regression Eqn.	INLET
6805.25		20.80	23.95	20.80	Regression Eqn.	INLET
6805.50		24.50	25.95	24.50	Regression Eqn.	INLET
6805.75		28.10	29.68	28.10	Regression Eqn.	INLET
6806.00		31.30	32.97	31.30	Regression Eqn.	INLET
6806.25		34.30	36.10	34.30	Regression Eqn.	INLET
6806.50		37.00	39.01	37.00	Regression Eqn.	INLET
6806.75		39.50	41.70	39.50	Regression Eqn.	INLET
6807.00		41.80	44.24	41.80	Regression Eqn.	INLET
6807.25		44.00	46.61	44.00	Regression Eqn.	INLET
6807.50		46.10	48.90	46.10	Regression Eqn.	INLET
6807.75		48.10	51.06	48.10	Regression Eqn.	INLET
6808.00		50.00	53.14	50.00	Regression Eqn.	INLET
6808.25		51.90	55.17	51.90	Regression Eqn.	INLET
6808.50		53.60	57.10	53.60	Regression Eqn.	INLET
6808.75		55.40	58.97	55.40	Regression Eqn.	INLET
6809.00		57.00	60.79	57.00	Regression Eqn.	INLET
6809.25		58.60	62.54	58.60	Regression Eqn.	INLET
6809.50		60.20	64.25	60.20	Regression Eqn.	INLET
6809.75		61.80	65.92	61.80	Regression Eqn.	INLET
6810.00		63.30	67.54	63.30	Regression Eqn.	INLET
6810.25		64.70	69.14	64.70	Regression Eqn.	INLET

Processing Time: 01.58 Seconds

## CULVERT STAGE-DISCHARGE SIZING (INLET vs. OUTLET CONTROL WITH TAILWATER EFFECTS)

Project: JUDGE ORR RANCHETTES

Basin ID: DP-P4

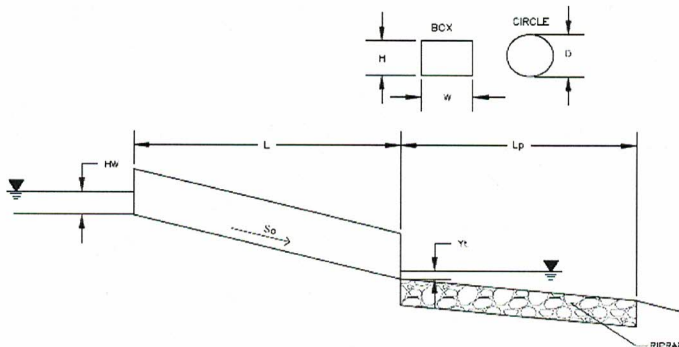




## Determination of Culvert Headwater and Outlet Protection

Project: **Judge Orr Ranchettes**

Basin ID: **Design Point P4 (30" Culvert)**



Soil Type:

Choose One:

☒ Sandy

☐ Non-Sandy

Supercritical Flow! Using Da to calculate protection type.

### Design Information (Input):

Design Discharge

Q = 9.7 cfs

Circular Culvert:

Barrel Diameter in Inches

D = 30 inches

Inlet Edge Type (Choose from pull-down list)

Grooved End Projection

OR

Height (Rise) = ft

Width (Span) = ft

1.5 : 1 Bevel w/ 18-34 Deg. Flared Wingwall

Box Culvert:

Barrel Height (Rise) in Feet

Barrel Width (Span) in Feet

Inlet Edge Type (Choose from pull-down list)

Number of Barrels

No = 1

Inlet Elevation

Elev IN = 6803 ft

Outlet Elevation OR Slope

Elev OUT = 6802.25 ft

Culvert Length

L = 75 ft

Manning's Roughness

n = 0.012

Bend Loss Coefficient

$k_b$  = 0

Exit Loss Coefficient

$k_x$  = 1

Tailwater Surface Elevation

Elev  $Y_t$  = 6803.25 ft

Max Allowable Channel Velocity

V = 5 ft/s

### Required Protection (Output):

Tailwater Surface Height

$Y_t$  = 1.00 ft

Flow Area at Max Channel Velocity

$A_v$  = 1.94 ft<sup>2</sup>

Culvert Cross Sectional Area Available

A = 4.91 ft<sup>2</sup>

Entrance Loss Coefficient

$k_e$  = 0.20

Friction Loss Coefficient

$k_f$  = 0.59

Sum of All Losses Coefficients

$k_s$  = 1.79

Culvert Normal Depth

$Y_n$  = 0.79 ft

Culvert Critical Depth

$Y_c$  = 1.04 ft

Tailwater Depth for Design

d = 1.77 ft

Adjusted Diameter OR Adjusted Rise

$D_a$  = 1.65 ft

Expansion Factor

$1/(2 \cdot \tan(\theta))$  = 6.70

Flow/Diameter<sup>2.5</sup> OR Flow/(Span \* Rise<sup>1.5</sup>)

$Q/D^{2.5}$  = 0.98 ft<sup>0.5</sup>/s

Froude Number

Fr = 1.69 Supercritical!

Tailwater/Adjusted Diameter OR Tailwater/Adjusted Rise

$Y_t/D$  = 0.61

Inlet Control Headwater

$HW_i$  = 1.45 ft

Outlet Control Headwater

$HW_o$  = 1.13 ft

Design Headwater Elevation

HW = 6,804.45 ft

Headwater/Diameter OR Headwater/Rise Ratio

$HW/D$  = 0.58

Minimum Theoretical Riprap Size

$d_{50}$  = 2 in

Nominal Riprap Size

$d_{50}$  = 6 in

UDFCD Riprap Type

Type = VL

Length of Protection

$L_p$  = 8 ft

Width of Protection

T = 4 ft

UDFCD  
MINIMUM

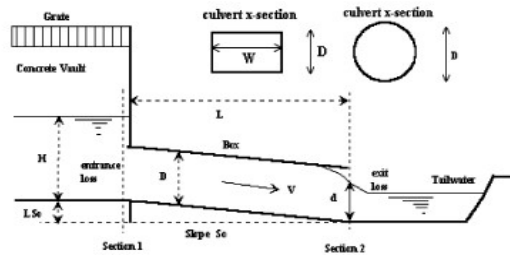
USE: 10' WIDE x 15' LONG x 2' DEPTH OF  $D_{50}=12"$  RIPRAP  
OVER 6" CDOT CLASS 6 BASE

# CULVERT STAGE-DISCHARGE SIZING (INLET vs. OUTLET CONTROL WITH TAILWATER EFFECTS)

Project: **JUDGE ORR RANCHETTES**

Basin ID: **DP-P3**

Status:



## Design Information (Input):

**Circular Culvert:** Barrel Diameter in Inches

Inlet Edge Type (choose from pull-down list)

D = 30 inches

Grooved End Projection

OR:

**Box Culvert:** Barrel Height (Rise) in Feet

Barrel Width (Span) in Feet

Inlet Edge Type (choose from pull-down list)

Height (Rise) =

Width (Span) =

Square Edge w/ 30-78 deg. Flared Wingwall

Number of Barrels

Inlet Elevation at Culvert Invert

Outlet Elevation at Culvert Invert OR Slope of Culvert (ft v./ft h.)

Culvert Length in Feet

Manning's Roughness

Bend Loss Coefficient

Exit Loss Coefficient

No = 1

Inlet Elev = 6795.37 ft. elev.

Outlet Elev = 6793.34 ft. elev.

L = 60.36 ft.

n = 0.012

K<sub>b</sub> = 0

K<sub>x</sub> = 1

## Design Information (calculated):

Entrance Loss Coefficient

Friction Loss Coefficient

Sum of All Loss Coefficients

Orifice Inlet Condition Coefficient

Minimum Energy Condition Coefficient

K<sub>e</sub> = 0.20

K<sub>f</sub> = 0.47

K<sub>s</sub> = 1.67

C<sub>d</sub> = 0.95

KE<sub>low</sub> = -0.1122

## Calculations of Culvert Capacity (output):

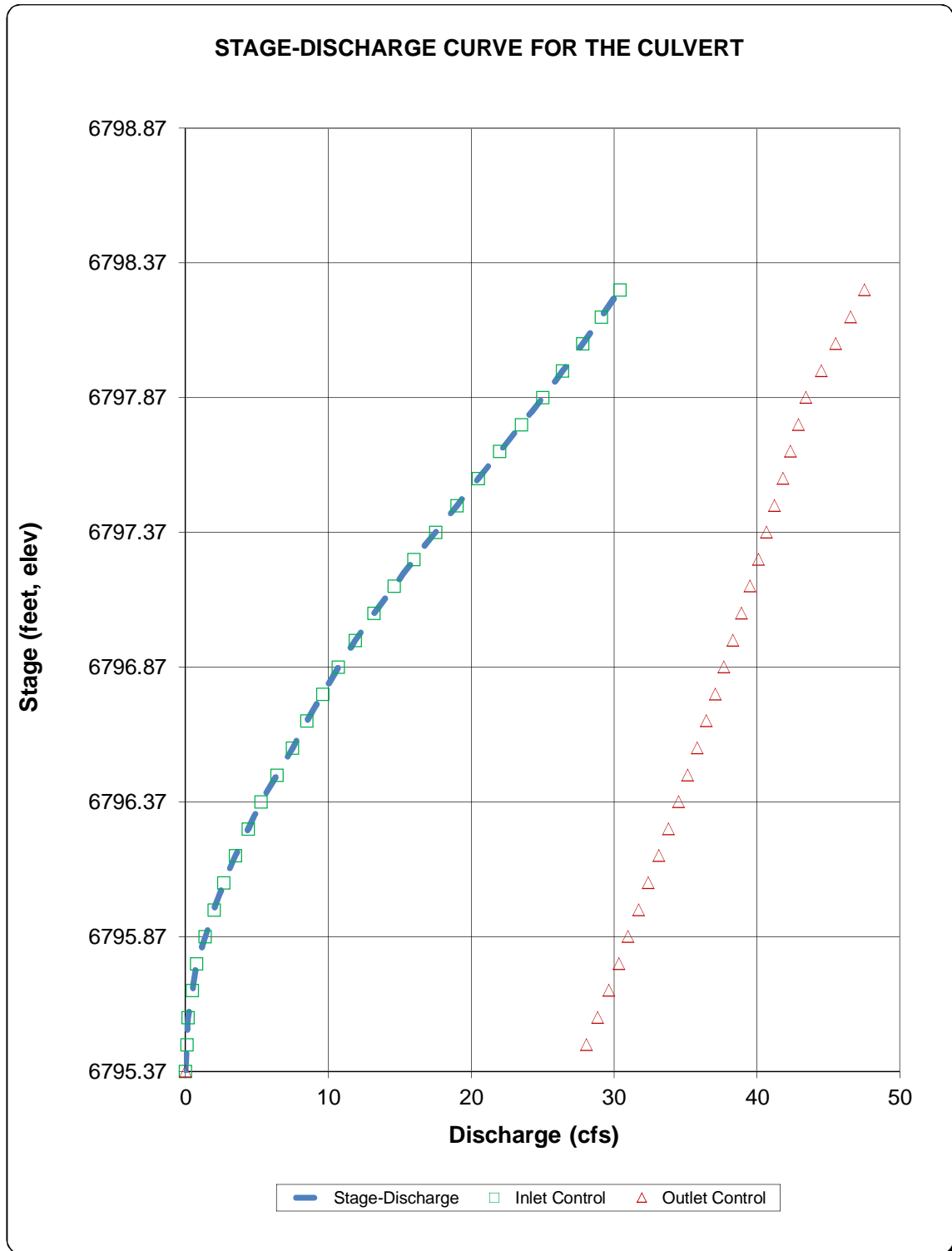
Water Surface Elevation (ft., linked)	Tailwater Surface Elevation ft	Culvert Inlet-Control Flowrate cfs	Culvert Outlet-Control Flowrate cfs	Controlling Culvert Flowrate cfs (output)	Inlet Equation Used:	Flow Control Used
6795.37		0.00	0.00	0.00	No Flow (WS < inlet)	N/A
6795.47		0.10	28.07	0.10	Min. Energy. Eqn.	INLET
6795.57		0.20	28.85	0.20	Min. Energy. Eqn.	INLET
6795.67		0.50	29.62	0.50	Min. Energy. Eqn.	INLET
6795.77		0.80	30.35	0.80	Min. Energy. Eqn.	INLET
6795.87		1.40	30.97	1.40	Min. Energy. Eqn.	INLET
6795.97		2.00	31.70	2.00	Min. Energy. Eqn.	INLET
6796.07		2.70	32.39	2.70	Min. Energy. Eqn.	INLET
6796.17		3.50	33.13	3.50	Min. Energy. Eqn.	INLET
6796.27		4.40	33.82	4.40	Min. Energy. Eqn.	INLET
6796.37		5.30	34.51	5.30	Min. Energy. Eqn.	INLET
6796.47		6.40	35.16	6.40	Min. Energy. Eqn.	INLET
6796.57		7.50	35.81	7.50	Min. Energy. Eqn.	INLET
6796.67		8.50	36.47	8.50	Regression Eqn.	INLET
6796.77		9.60	37.08	9.60	Regression Eqn.	INLET
6796.87		10.70	37.69	10.70	Regression Eqn.	INLET
6796.97		11.90	38.30	11.90	Regression Eqn.	INLET
6797.07		13.20	38.91	13.20	Regression Eqn.	INLET
6797.17		14.60	39.52	14.60	Regression Eqn.	INLET
6797.27		16.00	40.09	16.00	Regression Eqn.	INLET
6797.37		17.50	40.66	17.50	Regression Eqn.	INLET
6797.47		19.00	41.23	19.00	Regression Eqn.	INLET
6797.57		20.50	41.80	20.50	Regression Eqn.	INLET
6797.67		22.00	42.33	22.00	Regression Eqn.	INLET
6797.77		23.50	42.90	23.50	Regression Eqn.	INLET
6797.87		25.00	43.43	25.00	Regression Eqn.	INLET
6797.97		26.40	44.49	26.40	Regression Eqn.	INLET
6798.07		27.80	45.51	27.80	Regression Eqn.	INLET
6798.17		29.10	46.53	29.10	Regression Eqn.	INLET
6798.27		30.40	47.51	30.40	Regression Eqn.	INLET

Processing Time: 01.79 Seconds

# CULVERT STAGE-DISCHARGE SIZING (INLET vs. OUTLET CONTROL WITH TAILWATER EFFECTS)

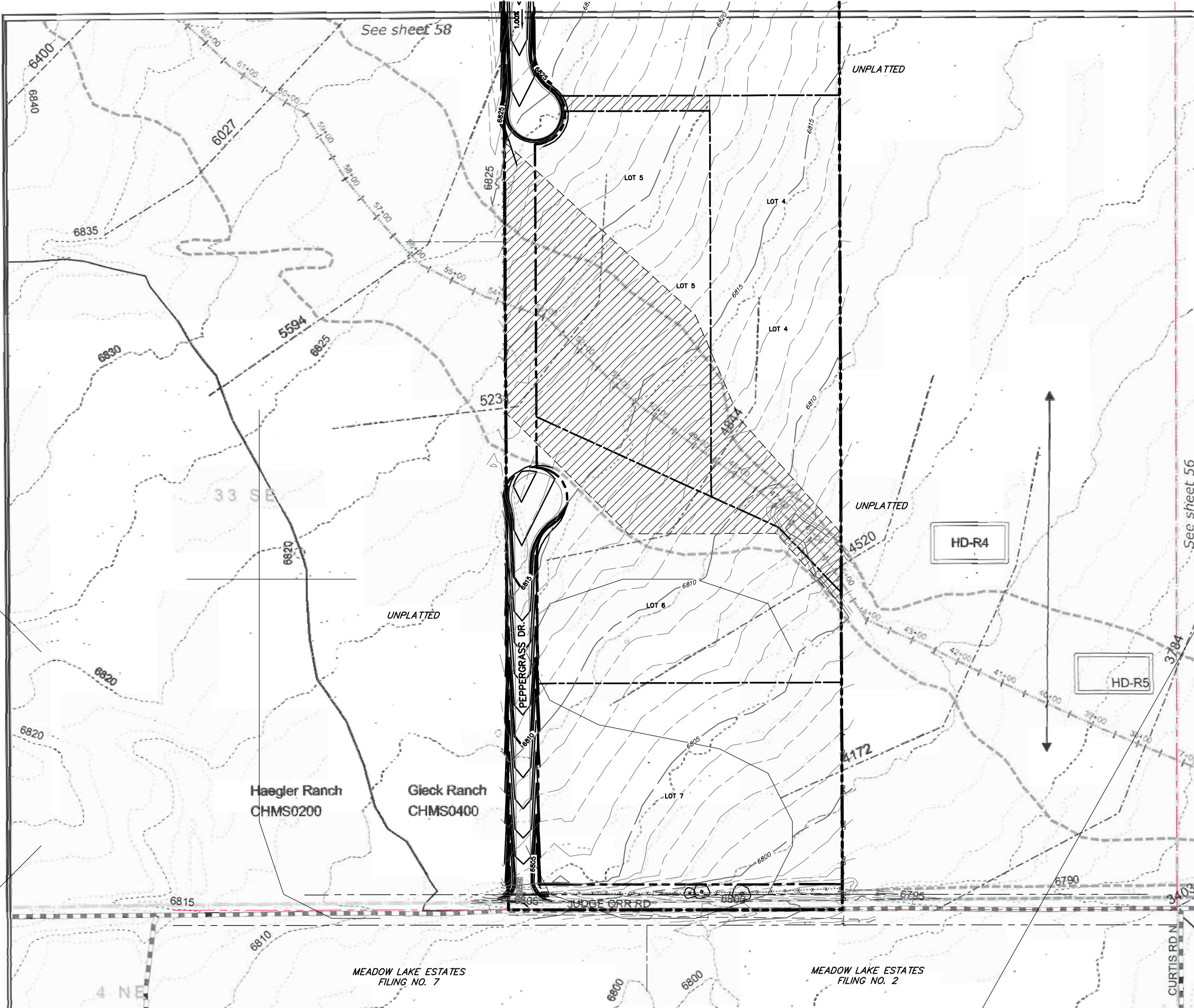
Project: JUDGE ORR RANCHETTES

Basin ID: DP-P3



## DRAINAGE MAPS





**Environmental Key**  
 Ponds  
 Riparian: Good  
 Riparian: Poor  
 Potential Wetlands  

The channel is considered dry unless shown as one of the above environmental categories.

**Legend**  
 Proposed Future Conditions 100-yr Flood Limits  
 Streams  
 Reaches  
 Reach Breaklines  
 Cross-sections  
 Roads  
 Structures  
 Section Lines  
 5-ft contours  
 2-ft contours

0 100 200 Feet

Reach	Slope (%)	Q <sub>100</sub> (cfs)	V <sub>100</sub> (ft/s)
HD-R4	1.75	429	2.71
HD-R5	1.67	468	2.87

**RECOMMENDED PLAN IMPROVEMENTS**  
Reach  
HD-R4      Vegetation Augmentation  
HD-R5      Selective Stabilization

THIS DRAWING IS CONCEPTUAL IN NATURE AND IS NOT TO BE USED AS THE SOLE BASIS FOR FINAL DESIGN, CONSTRUCTION, OR REMEDIAL ACTION. FURTHER STUDIES UNDER EPC DOT'S DIRECTION SHOULD BE PERFORMED PRIOR TO SUCH DECISIONS.

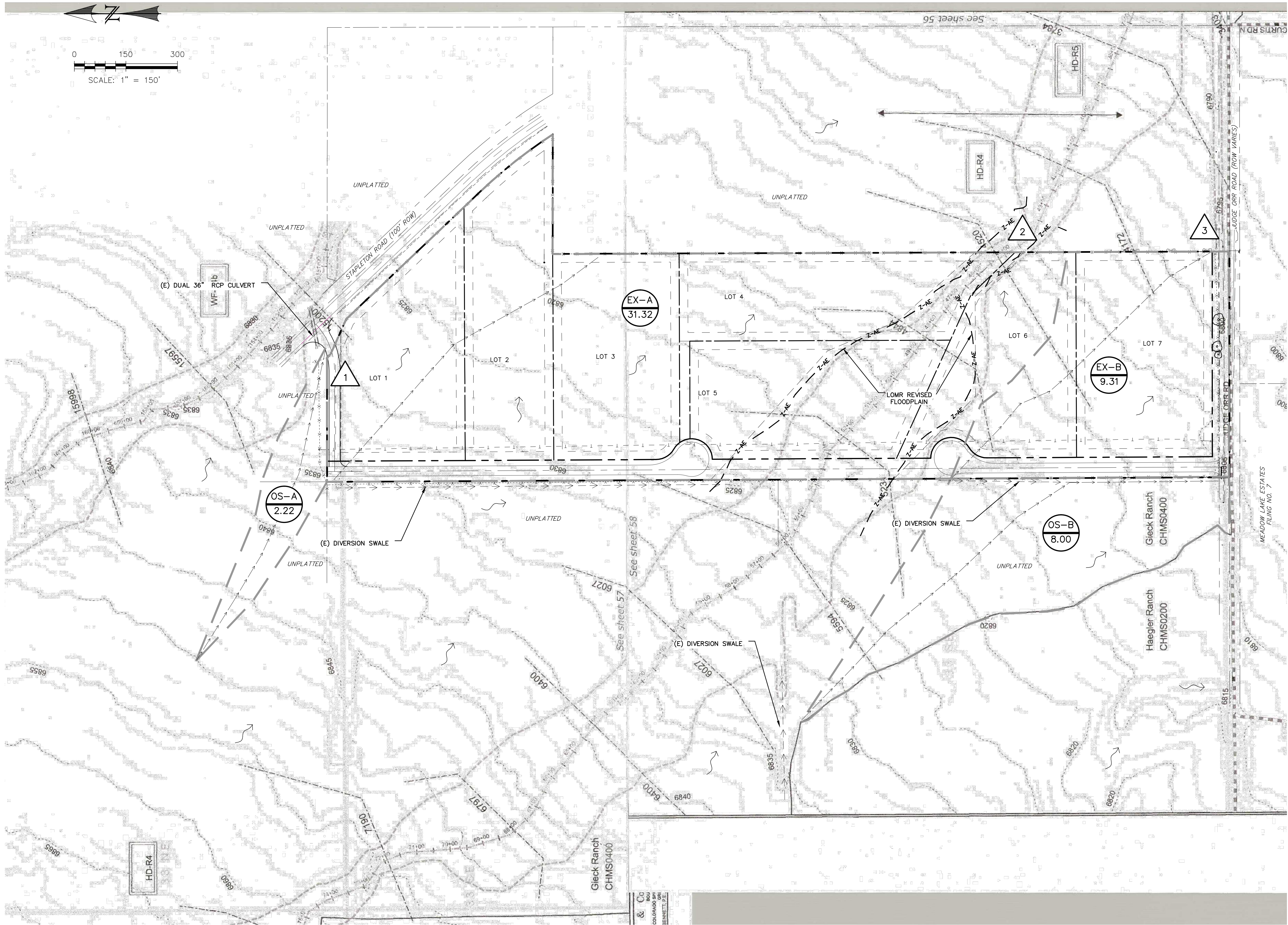






# JUDGE ORR RANCHETTES

## EXISTING DRAINAGE MAP



EXISTING DRAINAGE BASINS							
BASIN	AREA (ACRES)	Q2 (CFS)	Q5 (CFS)	Q10 (CFS)	Q25 (CFS)	Q50 (CFS)	Q100 (CFS)
OS-A	2.22	0.1	0.4	0.9	1.6	2.2	2.8
OS-B	8.00	0.5	1.4	2.9	4.9	6.6	8.5
EX-A	31.32	0.9	3.2	7.1	12.5	16.7	21.7
EX-B	9.31	1.0	2.3	4.3	7.0	9.3	11.8

EXISTING DESIGN POINTS						
DESIGN POINT	Q2 (CFS)	Q5 (CFS)	Q10 (CFS)	Q25 (CFS)	Q50 (CFS)	Q100 (CFS)
DP-1	0.1	0.4	0.9	1.6	2.2	2.8
DP-2						
DP-3	1.2	3.0	5.9	9.8	12.9	16.6

### DRAINAGE LEGEND

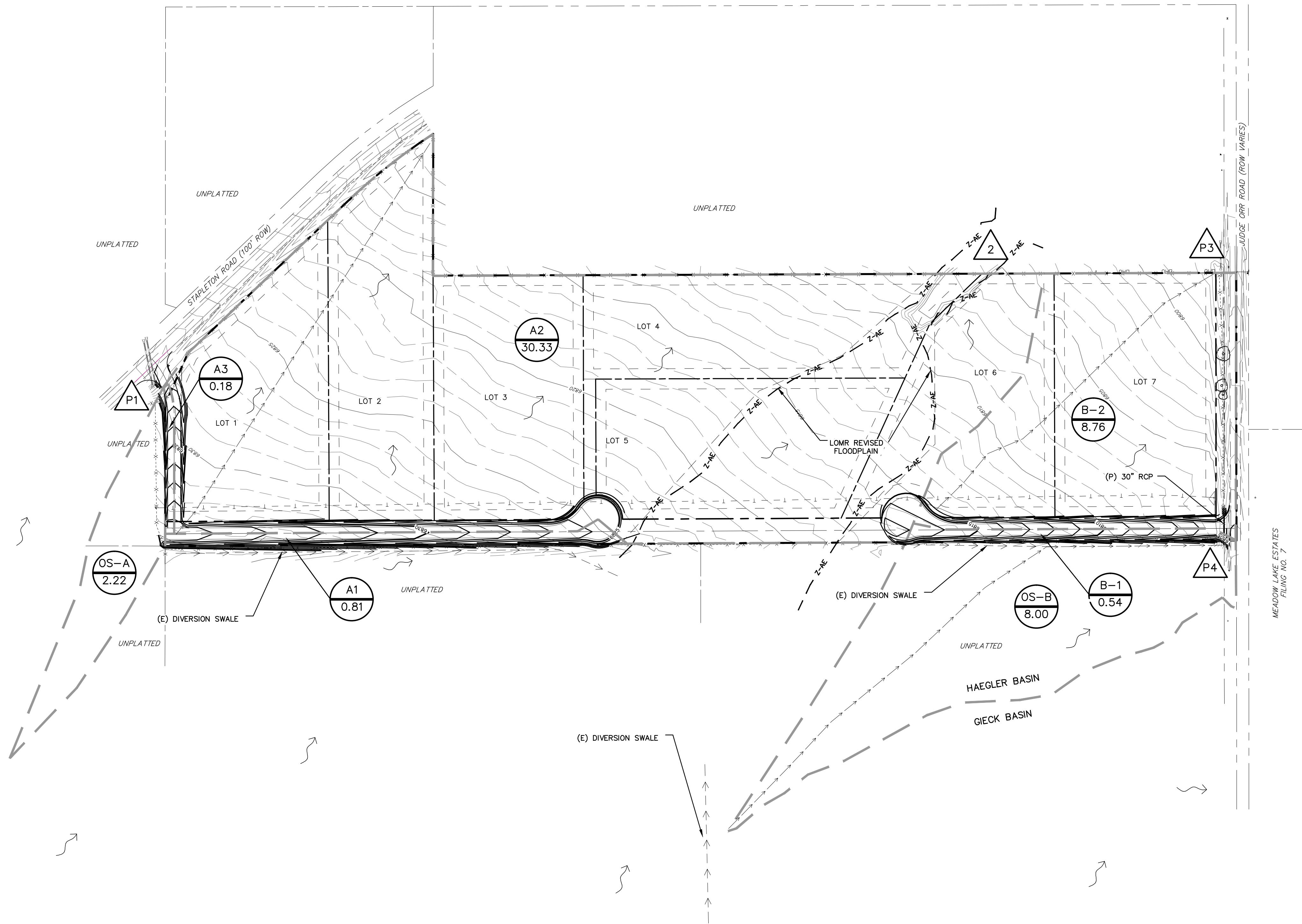
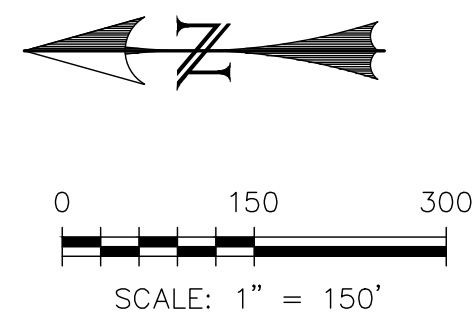
BASIN IDENTIFIER	
BASIN AREA [AC]	
DESIGN POINT IDENTIFIERS	
DRAINAGE BASIN BOUNDARY	
SURFACE SHEET FLOW DIRECTION	
EXISTING MAJOR CONTOUR (10')	
EXISTING MINOR CONTOUR (2')	
PROPOSED MAJOR CONTOUR (10')	
PROPOSED MINOR CONTOUR (2')	
EXISTING	(E)
PROPOSED	(P)
FUTURE	(F)
SLOPE/DIRECTION	
(E) STORM SEWER	
(P) STORM SEWER	

PREPARED FOR: <b>JOHN JENNINGS</b>  2030 TABOR CT. COLORADO SPRINGS, CO 80919	 PO BOX 692    DIVIDE, CO 80814    (719) 426-2124	JUDGE ORR RANCHETTES		DRAWN BY: DLM
		EXISTING DRAINAGE MAP		SCALE: 1"=150'    DATE: 10/01/17
		16-093		JOB NUMBER    SHEET 1 OF 1



# JUDGE ORR RANCHETTES

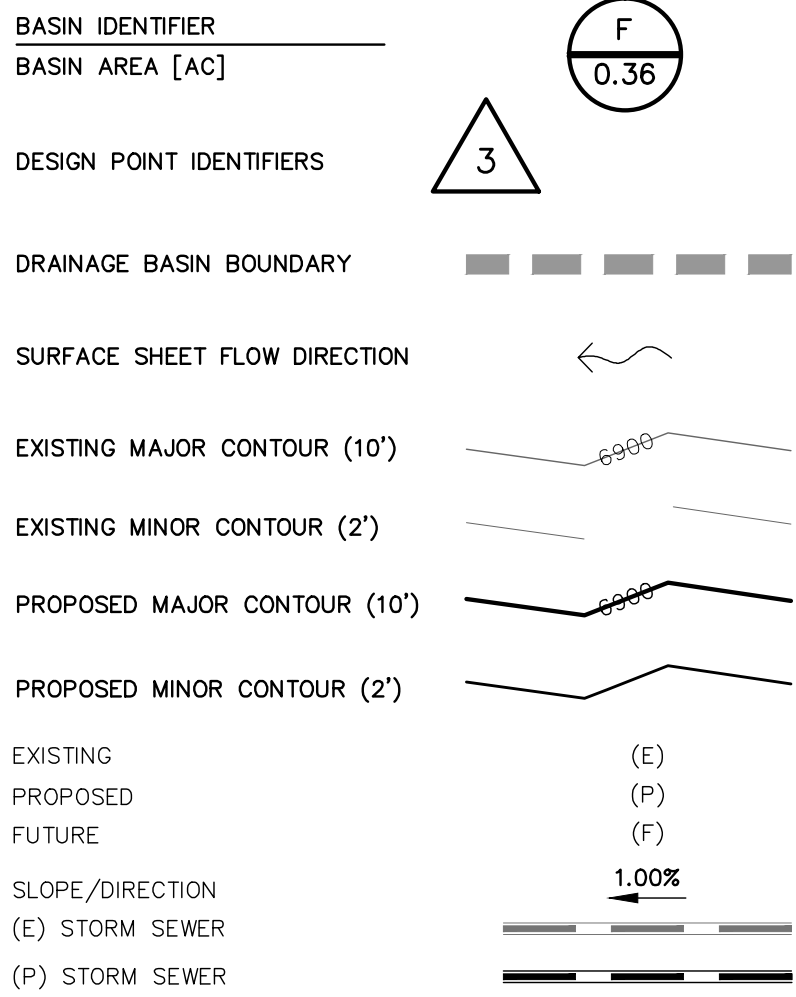
## PROPOSED DRAINAGE MAP




PROPOSED DRAINAGE BASINS							
BASIN	AREA (ACRES)	Q2 (CFS)	Q5 (CFS)	Q10 (CFS)	Q25 (CFS)	Q50 (CFS)	Q100 (CFS)
OS-A	2.22	0.1	0.4	0.9	1.6	2.2	2.8
OS-B	8.00	0.5	1.4	2.9	4.9	6.6	8.5
A-1	0.81	1.4	1.8	2.2	2.6	2.9	3.3
A-2	30.33	1.9	4.8	9.2	15.2	20.2	25.6
A-3	0.18	0.4	0.5	0.6	0.7	0.8	0.9
B-1	0.54	1.2	1.6	1.9	2.3	2.6	2.9
B-2	8.76	1.1	2.6	4.6	7.4	9.7	12.2

PROPOSED DESIGN POINTS						
DESIGN POINT	Q2 (CFS)	Q5 (CFS)	Q10 (CFS)	Q25 (CFS)	Q50 (CFS)	Q100 (CFS)
P1	0.3	0.6	1.2	2.0	2.6	3.3
2						592.0
P3	1.7	3.6	6.4	10.3	13.4	17.0
P4	1.0	2.1	3.7	5.9	7.7	9.7

### DRAINAGE LEGEND



PREPARED FOR:  JOHN JENNINGS  2030 TABOR CT. COLORADO SPRINGS, CO 80919	  PO BOX 692      DIVIDE, CO 80814      (719) 426-2124	JUDGE ORR RANCHETTES		DRAWN BY: DLM	
		PROPOSED DRAINAGE MAP		SCALE: 1"=150'	DATE: 10/01/17
				JOB NUMBER 16-093	SHEET 1 OF 1