

## DRAINAGE MEMORANDUM

To: Colorado Department of Transportation (CDOT) Region 2

From: Kimley-Horn and Associates, Inc.

Date: March 14, 2025

Subject: Venetucci Blvd. and B St. Access Road Draft Drainage Memorandum

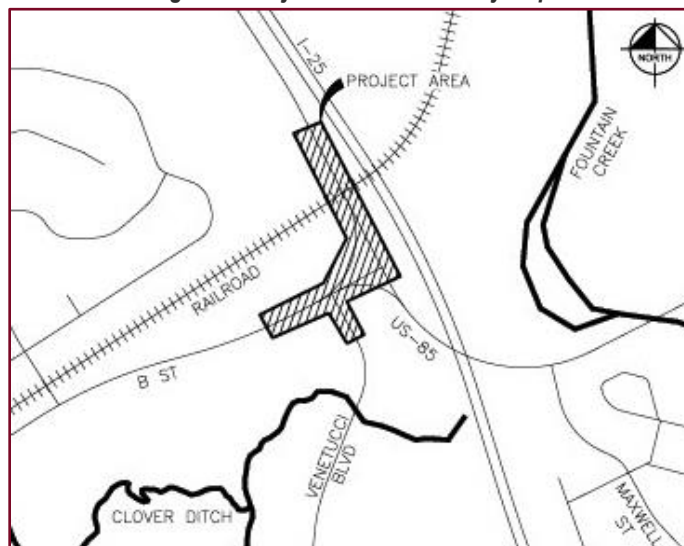
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This memorandum provides an overview of the drainage and water quality study conducted in association with the proposed Venetucci Blvd. and B St. Access Road improvements project.

Proposed improvements for this project include widening the southern side of B Street to accommodate a right turn lane onto Venetucci Boulevard that will be approximately 305 feet in length with a 160-foot taper, a dual left turn lane serving US-85 from B Street that will be approximately 325 feet in length, and a northbound acceleration lane on US-85 that will be approximately 775 feet in length. Additionally, the existing median on B Street will be reconstructed and will be partially concrete and partially planted with native seed and mulch. The combined added impervious area will be approximately 20,500 square feet (0.46 acres). These improvements have been designed to meet CDOT criteria.

Figure 1, below, shows a vicinity map of this project for reference.

*Figure 1. Project Location Vicinity Map*



## **DRAINAGE BACKGROUND**

US-85 is partially curbed along both the east and west sides of the highway, with curbing generally located along the south leg of US-85 and through the flyover up to approximately 300-feet north of the intersection. Within the curbed segments on the east side of the highway, there are two outfall locations, one directly north of the intersection and another approximately 125-feet from the first. These outfall locations channel flows off of US-85 into the existing ditch adjacent to Interstate 25 (I-25). There is an existing 24-inch CMP culvert that crosses US-85 approximately 300' north of the intersection that directs flow from the west side of US-85 into the existing ditch adjacent to I-25.

B Street currently is curbed along both the south and north sides of the roadway with a mixture of asphalt curb and concrete curb and gutter. Along the south side of B St. approximately 150' west of the beginning of the curb return is an existing 24-inch corrugated metal pipe that conveys flows through the roadside swale, and underneath the existing maintenance access pullout.

Venetucci Blvd. currently has curb and gutter with two catch basins located approximately 100' southeast from the intersection of Venetucci Blvd. and B St. Current flows along Venetucci Blvd. go from south to north and are collected in the catch basins where the flows then outfall through existing culverts to the Clover Ditch. On the west side of Venetucci Blvd., the culvert is an 18-inch reinforced concrete pipe, while on the east side, the culvert is a 24-inch reinforced concrete pipe.

With these improvements, no impacts are anticipated to the existing culverts or swales. All flows will outfall to the same location and maintain the existing condition.

## **HYDROLOGY BACKGROUND**

The topography within the project limits causes water to flow towards an existing low point at the western end of the existing porkchop island at the northwest corner of B Street and US-85, to an existing low point where the two existing inlets are on Venetucci Blvd., and to the existing channel west of US-85 and east of I-25. Water is conveyed beyond the project limits by both swales and overland flows to Fisher's Canyon Creek, Fountain Creek, and the Clover Ditch. A geotechnical investigation was not performed as part of the project. Within the project limits, the soil type varies between a Limon Clay and a Nunn Clay Loam as determined by the Colorado Department of Natural Resources and the US Natural Resources Conservation Service. Both soils exceed a depth of 80 inches to the water table. Excavation for this project will not exceed 4 feet.

The existing hydrology of the project area was analyzed in preparation of this drainage memorandum, along with the impacts to the existing hydrology associated with the project improvements. **Appendix A** contains the FEMA FIRMette maps and the NRCS soil resource report within the project limits.

## **RECOMMENDED DRAINAGE DESIGN**

The 5-year and 100-year design storms were analyzed per CDOT standard. It was determined from this analysis, and shown in Table 1, that the following changes in peak flow rate will occur:

Design Storm	Existing Peak Flow Rate (CFS)	Proposed Peak Flow Rate (CFS)	Net Change (CFS)
Q <sub>5</sub>	19.8	21.6	1.8
Q <sub>100</sub>	58.6	61.3	2.7

**Table 1. Existing and Proposed Peak Flow Rates**

Peak flow rates are the sum of sub basin flows within the project limits at the given design storm. **Appendix B** contains the existing and proposed drainage maps, including sub basin delineation. Rational method calculations for the existing and proposed conditions are included in **Appendix C** and **Appendix D** respectively.

### **Drainage Swale**

The existing drainage swales are adequate for the proposed improvements for both the 5-year and 100-year storm events. No changes to the existing drainage swales have been proposed as part of this project. For calculations and values on the proposed storm events, refer to **Appendix D**.

### **Cross Culverts**

The existing culverts are adequate for the proposed improvements for both the 5-year and 100-year storm events. No changes to the existing culverts have been proposed as part of this project. Headwaters will not encroach onto the adjacent roadway or inundate upstream properties. For culvert calculations and values in relation to the storm events, refer to **Appendix D**.

### **Water Quality**

The proposed improvements fall within the CDOT MS4 permit area and were evaluated accordingly. Per section 16.2.2.4.2 of the CDOT Drainage Design Manual, the following criteria were evaluated to determine if permanent water quality (PWQ) would be required:

1. Results in land disturbance of greater than or equal to one acre.
  - Yes, this project does disturb greater than 1 acre (2.36 acre).
2. Either discharge to a stream segment that is on 303(d) list for a roadway pollutant of concern or discharges to the Cherry Creek Reservoir drainage basin and is exempted under section 72.7.2(c)(4) of Regulation 72.
  - Yes, does discharge to a stream segment on the 303(d) list.
3. Has a 20 percent or more increase of impervious surface.
  - No, the impervious surface does not increase 20 percent or greater (2%).

Since the impervious area is not increased by a factor of 20% or greater, permanent water quality is not required for the project. See **Appendix D** for the completed CDOT PWQ Program PET form.

## **CONCLUSION**

In summary, the recommended drainage design will adequately convey the design storm runoff from existing and new impervious surfaces on US-85, B St., and Venetucci Blvd. No improvements to the existing swales, culverts, or inlets will be required. The project is proposing two curb cuts along the north side of B St. to accommodate the existing drainage patterns in conjunction with the proposed curb and gutter. The total impervious area will increase by 2%, which is less than 20% which triggers permanent water quality under CDOT MS4. Stormwater management plans (SWMP) and report have been prepared and submitted separately. These include inlet and outfall protection.

Please contact us with any questions, or if you require additional information.

Sincerely,

**KIMLEY-HORN & ASSOCIATES, INC.**

**Sean Hays, P.E.**



## **LIST OF APPENDICES**

### **APPENDIX A – FEMA FIRM MAP & NRCS DATA**

- National Flood Hazard Layer FIRMette Map
- NRCS Soil Resource Report for El Paso County Area, Colorado

### **APPENDIX B – DRAINAGE MAPS**

- Existing Drainage Map
- Proposed Drainage Map

### **APPENDIX C – EXISTING HYDRAULIC CALCULATIONS**

- Existing Basin Imperviousness and Runoff Coefficient Calculations
- Existing Rational Method Calculations
- Existing Area-Weighted Runoff Coefficient Calculations
- Existing Reach-Weighted Time of Concentration Calculations
- Existing Runoff Summary
- Existing Culvert Calculator Report
- Existing Channel Worksheet

### **APPENDIX D – PROPOSED HYDRAULIC CALCULATIONS**

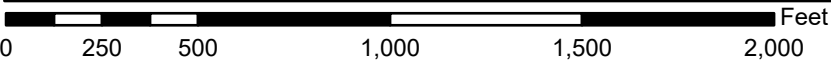
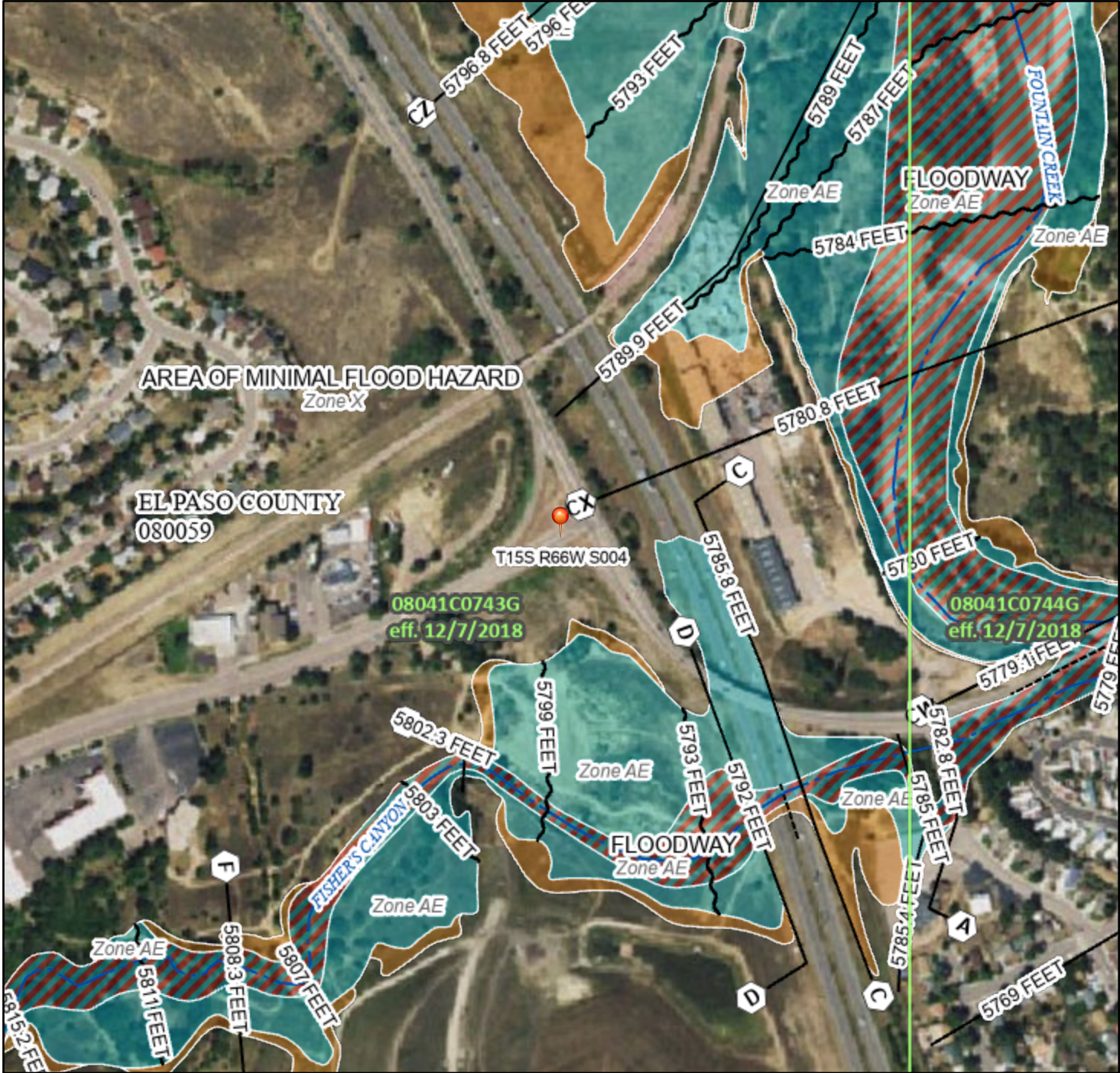
- Proposed Basin Imperviousness and Runoff Coefficient Calculations
- Proposed Rational Method Calculations
- Proposed Area-Weighted Runoff Coefficient Calculations
- Proposed Reach-Weighted Time of Concentration Calculations
- Proposed Runoff Summary
- Proposed Design Storm Calculations Summary
- Proposed Culvert Calculator Report
- Proposed Channel Worksheet
- PWQ Program PET Form

## APPENDIX A – FEMA FIRM MAP & NRCS DATA

# National Flood Hazard Layer FIRMMette



104°47'23"W 38°46'52"N



1:6,000

104°46'46"W 38°46'24"N

Basemap Imagery Source: USGS National Map 2023

## Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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
OTHER AREAS OF FLOOD HAZARD		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
		Area with Flood Risk due to Levee Zone D
OTHER AREAS		NO SCREEN Area of Minimal Flood Hazard Zone X
		Effective LOMRs
GENERAL STRUCTURES		Area of Undetermined Flood Hazard Zone D
		Channel, Culvert, or Storm Sewer
OTHER FEATURES		Levee, Dike, or Floodwall
		Cross Sections with 1% Annual Chance Water Surface Elevation
		Coastal Transect
		Base Flood Elevation Line (BFE)
		Limit of Study
		Jurisdiction Boundary
		Coastal Transect Baseline
		Profile Baseline
		Hydrographic Feature
MAP PANELS		Digital Data Available
		No Digital Data Available
		Unmapped



The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on **10/3/2024 at 10:26 AM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.





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



# Preface

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Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (<http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/>) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (<https://offices.sc.egov.usda.gov/locator/app?agency=nrcs>) or your NRCS State Soil Scientist ([http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2\\_053951](http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951)).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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# How Soil Surveys Are Made

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Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil



scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

## Custom Soil Resource Report

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

# Soil Map

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The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

# Custom Soil Resource Report Soil Map






# Custom Soil Resource Report


## 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 22, Sep 3, 2024

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

Date(s) aerial images were photographed: Aug 19, 2018—Sep 23, 2018

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
8	Blakeland loamy sand, 1 to 9 percent slopes	7.6	1.6%
16	Chaseville gravelly sandy loam, 1 to 8 percent slopes	26.6	5.5%
28	Ellicott loamy coarse sand, 0 to 5 percent slopes	75.9	15.8%
47	Limon clay, 0 to 3 percent slopes	63.8	13.3%
59	Nunn clay loam, 0 to 3 percent slopes	121.0	25.2%
82	Schamber-Razor complex, 8 to 50 percent slopes	129.7	27.0%
96	Truckton sandy loam, 0 to 3 percent slopes	0.3	0.1%
111	Water	16.1	3.4%
118	Fort loam, 1 to 5 percent slopes, cool	15.9	3.3%
127	Midway-Razor clay loams, dry, 1 to 18 percent slopes	21.1	4.4%
128	Razor clay loam, dry, 2 to 5 percent slopes	2.3	0.5%
<b>Totals for Area of Interest</b>		<b>480.4</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 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.

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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

### 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:* 98 percent  
*Minor components:* 2 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, talf  
*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  
*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 content:* 5 percent  
*Available water supply, 0 to 60 inches:* Low (about 4.5 inches)

##### Interpretive groups

*Land capability classification (irrigated):* 3e  
*Land capability classification (nonirrigated):* 6e  
*Hydrologic Soil Group:* A  
*Ecological site:* R049XB210CO - Sandy Foothill  
*Hydric soil rating:* No

#### Minor Components

##### Other soils

*Percent of map unit:* 1 percent

*Hydric soil rating:* No

**Pleasant**

*Percent of map unit:* 1 percent

*Landform:* Depressions

*Hydric soil rating:* Yes

**16—Chaseville gravelly sandy loam, 1 to 8 percent slopes**

**Map Unit Setting**

*National map unit symbol:* 367l

*Elevation:* 6,100 to 7,000 feet

*Mean annual precipitation:* 16 to 18 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**

*Chaseville and similar soils:* 98 percent

*Minor components:* 2 percent

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

**Description of Chaseville**

**Setting**

*Landform:* Hills, alluvial fans, terraces

*Landform position (three-dimensional):* Side slope

*Down-slope shape:* Linear

*Across-slope shape:* Linear

*Parent material:* Alluvium derived from arkose

**Typical profile**

*A1 - 0 to 6 inches:* gravelly sandy loam

*A2 - 6 to 19 inches:* very gravelly sandy loam

*C1 - 19 to 40 inches:* extremely gravelly loamy coarse sand

*C2 - 40 to 60 inches:* very gravelly loamy sand

**Properties and qualities**

*Slope:* 1 to 8 percent

*Depth to restrictive feature:* More than 80 inches

*Drainage class:* Somewhat excessively drained

*Runoff class:* Low

*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

*Available water supply, 0 to 60 inches:* Very low (about 2.4 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified

## Custom Soil Resource Report

*Land capability classification (nonirrigated): 6e*  
*Hydrologic Soil Group: A*  
*Ecological site: R049XY214CO - Gravelly Foothill*  
*Hydric soil rating: No*

### Minor Components

#### Other soils

*Percent of map unit: 1 percent*  
*Hydric soil rating: No*

#### Pleasant

*Percent of map unit: 1 percent*  
*Landform: Depressions*  
*Hydric soil rating: Yes*

## 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: 97 percent*  
*Minor components: 3 percent*  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of Ellicott

#### Setting

*Landform: Stream terraces, flood plains*  
*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*  
*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)*

## Custom Soil Resource Report

*Depth to water table:* More than 80 inches  
*Frequency of flooding:* Frequent  
*Frequency of ponding:* None  
*Available water supply, 0 to 60 inches:* Low (about 4.1 inches)

### Interpretive groups

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

### Minor Components

#### Fluvaquentic haplaquoll

*Percent of map unit:* 1 percent  
*Landform:* Swales  
*Hydric soil rating:* Yes

#### Other soils

*Percent of map unit:* 1 percent  
*Hydric soil rating:* No

#### Pleasant

*Percent of map unit:* 1 percent  
*Landform:* Depressions  
*Hydric soil rating:* Yes

## 47—Limon clay, 0 to 3 percent slopes

### Map Unit Setting

*National map unit symbol:* 368p  
*Elevation:* 5,200 to 6,200 feet  
*Mean annual precipitation:* 12 to 14 inches  
*Mean annual air temperature:* 48 to 52 degrees F  
*Frost-free period:* 135 to 155 days  
*Farmland classification:* Not prime farmland

### Map Unit Composition

*Limon, occasionally flooded, and similar soils:* 95 percent  
*Minor components:* 5 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of Limon, Occasionally Flooded

#### Setting

*Landform:* Alluvial fans, flood plains  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Parent material:* Clayey alluvium derived from shale

**Typical profile**

*A - 0 to 4 inches:* clay  
*AC - 4 to 12 inches:* silty clay  
*C - 12 to 60 inches:* silty clay loam

**Properties and qualities**

*Slope:* 0 to 3 percent  
*Depth to restrictive feature:* More than 80 inches  
*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:* Occasional  
*Frequency of ponding:* None  
*Calcium carbonate, maximum content:* 10 percent  
*Gypsum, maximum content:* 2 percent  
*Maximum salinity:* Very slightly saline to moderately saline (2.0 to 8.0 mmhos/cm)  
*Sodium adsorption ratio, maximum:* 10.0  
*Available water supply, 0 to 60 inches:* High (about 9.9 inches)

**Interpretive groups**

*Land capability classification (irrigated):* 3e  
*Land capability classification (nonirrigated):* 4e  
*Hydrologic Soil Group:* C  
*Ecological site:* R069XY033CO - Salt Flat  
*Hydric soil rating:* No

**Minor Components**

**Other soils**

*Percent of map unit:* 4 percent  
*Hydric soil rating:* No

**Pleasant**

*Percent of map unit:* 1 percent  
*Landform:* Depressions  
*Hydric soil rating:* Yes

**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: 95 percent*

*Minor components: 5 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*

*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 content: 15 percent*

*Gypsum, maximum content: 2 percent*

*Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)*

*Available water supply, 0 to 60 inches: High (about 9.8 inches)*

**Interpretive groups**

*Land capability classification (irrigated): 2e*

*Land capability classification (nonirrigated): 3c*

*Hydrologic Soil Group: C*

*Ecological site: R069XY042CO - Clayey Plains*

*Other vegetative classification: CLAYEY PLAINS (069AY042CO)*

*Hydric soil rating: No*

**Minor Components**

**Other soils**

*Percent of map unit: 4 percent*

*Hydric soil rating: No*

**Pleasant**

*Percent of map unit: 1 percent*

*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:* 55 percent  
*Razor and similar soils:* 43 percent  
*Minor components:* 2 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  
*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 content:* 15 percent  
*Maximum salinity:* Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)  
*Available water supply, 0 to 60 inches:* Low (about 3.0 inches)

#### **Interpretive groups**

*Land capability classification (irrigated):* None specified  
*Land capability classification (nonirrigated):* 7e  
*Hydrologic Soil Group:* A  
*Ecological site:* R069XY064CO - Gravel Breaks  
*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

*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 content:* 15 percent

*Gypsum, maximum content:* 5 percent

*Maximum salinity:* Moderately saline to strongly saline (8.0 to 16.0 mmhos/cm)

*Sodium adsorption ratio, maximum:* 15.0

*Available water supply, 0 to 60 inches:* Low (about 5.5 inches)

### Interpretive groups

*Land capability classification (irrigated):* 6e

*Land capability classification (nonirrigated):* 6e

*Hydrologic Soil Group:* D

*Ecological site:* R069XY047CO - Alkaline Plains

*Other vegetative classification:* ALKALINE PLAINS (069AY047CO)

*Hydric soil rating:* No

## Minor Components

### Other soils

*Percent of map unit:* 1 percent

*Hydric soil rating:* No

### Pleasant

*Percent of map unit:* 1 percent

*Landform:* Depressions

*Hydric soil rating:* Yes



## 96—Truckton sandy loam, 0 to 3 percent slopes

### Map Unit Setting

*National map unit symbol:* 2yvrđ

*Elevation:* 5,400 to 7,000 feet

*Mean annual precipitation:* 14 to 23 inches

*Mean annual air temperature:* 45 to 52 degrees F

*Frost-free period:* 90 to 155 days

*Farmland classification:* Prime farmland if irrigated and the product of I (soil erodibility) x C (climate factor) does not exceed 60

### Map Unit Composition

*Truckton and similar soils:* 85 percent

*Minor components:* 15 percent

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

### Description of Truckton

#### Setting

*Landform:* Fan remnants, interfluves

*Down-slope shape:* Linear

*Across-slope shape:* Linear

*Parent material:* Wind re-worked alluvium derived from arkose

#### Typical profile

*A - 0 to 4 inches:* sandy loam

*Bt1 - 4 to 12 inches:* sandy loam

*Bt2 - 12 to 19 inches:* sandy loam

*C - 19 to 80 inches:* sandy loam

#### Properties and qualities

*Slope:* 0 to 3 percent

*Depth to restrictive feature:* More than 80 inches

*Drainage class:* Well drained

*Runoff class:* Very low

*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 content:* 1 percent

*Maximum salinity:* Nonsaline to very slightly saline (0.1 to 2.0 mmhos/cm)

*Available water supply, 0 to 60 inches:* Moderate (about 6.6 inches)

#### Interpretive groups

*Land capability classification (irrigated):* 3e

*Land capability classification (nonirrigated):* 4e

*Hydrologic Soil Group:* A

*Ecological site:* R049XB210CO - Sandy Foothill

## Custom Soil Resource Report

*Hydric soil rating:* No

### Minor Components

#### **Blakeland**

*Percent of map unit:* 5 percent

*Landform:* Hills, interfluves

*Landform position (two-dimensional):* Shoulder, backslope, summit

*Landform position (three-dimensional):* Side slope, crest

*Down-slope shape:* Convex, linear

*Across-slope shape:* Convex, linear

*Ecological site:* R049XB210CO - Sandy Foothill

*Hydric soil rating:* No

#### **Bresser**

*Percent of map unit:* 5 percent

*Landform:* Terraces, interfluves

*Landform position (three-dimensional):* Tread

*Down-slope shape:* Linear

*Across-slope shape:* Linear

*Ecological site:* R049XB210CO - Sandy Foothill

*Hydric soil rating:* No

#### **Pleasant, frequently ponded**

*Percent of map unit:* 2 percent

*Landform:* Closed depressions

*Down-slope shape:* Concave, linear

*Across-slope shape:* Concave

*Ecological site:* R067BY010CO - Closed Depression

*Hydric soil rating:* Yes

#### **Urban land**

*Percent of map unit:* 2 percent

*Hydric soil rating:* No

#### **Ellicott, occasionally flooded**

*Percent of map unit:* 1 percent

*Landform:* Drainageways, flood plains

*Down-slope shape:* Linear

*Across-slope shape:* Concave, linear

*Ecological site:* R067BY031CO - Sandy Bottomland

*Hydric soil rating:* No

## 111—Water

### Map Unit Composition

*Water:* 100 percent

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

## 118—Fort loam, 1 to 5 percent slopes, cool

### Map Unit Setting

*National map unit symbol:* 2rgqs  
*Elevation:* 5,500 to 6,500 feet  
*Mean annual precipitation:* 12 to 14 inches  
*Mean annual air temperature:* 48 to 54 degrees F  
*Frost-free period:* 125 to 160 days  
*Farmland classification:* Prime farmland if irrigated

### Map Unit Composition

*Fort and similar soils:* 85 percent  
*Minor components:* 15 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of Fort

#### Setting

*Landform:* Interfluves, fans  
*Landform position (two-dimensional):* Backslope, footslope  
*Landform position (three-dimensional):* Side slope  
*Down-slope shape:* Convex  
*Across-slope shape:* Linear  
*Parent material:* Loamy alluvium and/or eolian deposits

#### Typical profile

*A - 0 to 4 inches:* loam  
*Bt - 4 to 12 inches:* clay loam  
*Btk - 12 to 33 inches:* clay loam  
*Bk1 - 33 to 47 inches:* loam  
*Bk2 - 47 to 79 inches:* sandy loam

#### Properties and qualities

*Slope:* 1 to 5 percent  
*Depth to restrictive feature:* More than 80 inches  
*Drainage class:* Well drained  
*Runoff class:* Low  
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high (0.20 to 0.60 in/hr)  
*Depth to water table:* More than 80 inches  
*Frequency of flooding:* None  
*Frequency of ponding:* None  
*Calcium carbonate, maximum content:* 25 percent  
*Gypsum, maximum content:* 2 percent  
*Maximum salinity:* Nonsaline to very slightly saline (0.5 to 2.0 mmhos/cm)  
*Sodium adsorption ratio, maximum:* 3.0  
*Available water supply, 0 to 60 inches:* Moderate (about 8.5 inches)

#### Interpretive groups

*Land capability classification (irrigated):* 3e  
*Land capability classification (nonirrigated):* 4c  
*Hydrologic Soil Group:* C  
*Ecological site:* R069XY006CO - Loamy Plains

## Custom Soil Resource Report

*Forage suitability group:* Loamy (G069XW017CO)

*Other vegetative classification:* Loamy (G069XW017CO), Loamy Plains #6  
(069XY006CO\_2)

*Hydric soil rating:* No

### Minor Components

#### Willid

*Percent of map unit:* 10 percent

*Landform:* Interfluves

*Landform position (two-dimensional):* Summit

*Landform position (three-dimensional):* Interfluve

*Down-slope shape:* Linear

*Across-slope shape:* Linear

*Ecological site:* R069XY006CO - Loamy Plains

*Other vegetative classification:* Loamy (G069XW017CO), Loamy Plains #6  
(069XY006CO\_2)

*Hydric soil rating:* No

#### Oterodry

*Percent of map unit:* 5 percent

*Landform:* Hillslopes

*Landform position (two-dimensional):* Backslope

*Landform position (three-dimensional):* Side slope

*Down-slope shape:* Convex

*Across-slope shape:* Linear

*Ecological site:* R069XY026CO - Sandy Plains

*Other vegetative classification:* Not Suited (G069XW000CO)

*Hydric soil rating:* No

## 127—Midway-Razor clay loams, dry, 1 to 18 percent slopes

### Map Unit Setting

*National map unit symbol:* 2t52f

*Elevation:* 3,700 to 6,400 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

*Midway, dry, and similar soils:* 46 percent

*Razor, dry, and similar soils:* 44 percent

*Minor components:* 10 percent

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

### Description of Midway, Dry

#### Setting

*Landform:* Hillslopes, ridges

## Custom Soil Resource Report

*Landform position (two-dimensional):* Backslope

*Landform position (three-dimensional):* Crest, side slope

*Down-slope shape:* Convex

*Across-slope shape:* Convex

*Parent material:* Slope alluvium and/or residuum weathered from shale

### Typical profile

*A - 0 to 3 inches:* clay loam

*AC - 3 to 9 inches:* clay

*C - 9 to 16 inches:* paragravelly clay

*Cr - 16 to 79 inches:* bedrock

### Properties and qualities

*Slope:* 3 to 18 percent

*Depth to restrictive feature:* 11 to 20 inches to paralithic bedrock

*Drainage class:* Well drained

*Runoff class:* High

*Capacity of the most limiting layer to transmit water (Ksat):* Low to moderately high  
(0.00 to 0.21 in/hr)

*Depth to water table:* More than 80 inches

*Frequency of flooding:* None

*Frequency of ponding:* None

*Calcium carbonate, maximum content:* 15 percent

*Gypsum, maximum content:* 5 percent

*Maximum salinity:* Very slightly saline to slightly saline (2.0 to 7.9 mmhos/cm)

*Sodium adsorption ratio, maximum:* 10.0

*Available water supply, 0 to 60 inches:* Very low (about 2.2 inches)

### Interpretive groups

*Land capability classification (irrigated):* 6e

*Land capability classification (nonirrigated):* 6e

*Hydrologic Soil Group:* D

*Ecological site:* R069XY046CO - Shaly Plains

*Hydric soil rating:* No

## Description of Razor, Dry

### Setting

*Landform:* Hillslopes, pediments

*Landform position (two-dimensional):* Backslope

*Landform position (three-dimensional):* Side slope

*Down-slope shape:* Linear

*Across-slope shape:* Convex

*Parent material:* Slope alluvium and/or residuum weathered from shale

### Typical profile

*A - 0 to 4 inches:* clay loam

*Bw - 4 to 15 inches:* silty clay

*Bky - 15 to 30 inches:* clay

*Cr - 30 to 79 inches:* bedrock

### Properties and qualities

*Slope:* 1 to 9 percent

*Depth to restrictive feature:* 20 to 39 inches to paralithic bedrock

*Drainage class:* Well drained

*Runoff class:* Medium

## Custom Soil Resource Report

*Capacity of the most limiting layer to transmit water (Ksat):* Low to moderately high  
(0.00 to 0.21 in/hr)

*Depth to water table:* More than 80 inches

*Frequency of flooding:* None

*Frequency of ponding:* None

*Calcium carbonate, maximum content:* 15 percent

*Gypsum, maximum content:* 5 percent

*Maximum salinity:* Very slightly saline to slightly saline (2.0 to 7.9 mmhos/cm)

*Sodium adsorption ratio, maximum:* 10.0

*Available water supply, 0 to 60 inches:* Low (about 4.7 inches)

### Interpretive groups

*Land capability classification (irrigated):* 6e

*Land capability classification (nonirrigated):* 6e

*Hydrologic Soil Group:* D

*Ecological site:* R069XY047CO - Alkaline Plains

*Hydric soil rating:* No

### Minor Components

#### Manzanola

*Percent of map unit:* 9 percent

*Landform:* Hillslopes, fan remnants

*Landform position (two-dimensional):* Footslope, backslope

*Landform position (three-dimensional):* Base slope, side slope

*Down-slope shape:* Linear

*Across-slope shape:* Linear

*Ecological site:* R069XY042CO - Clayey Plains

*Other vegetative classification:* Loamy Plains #6 (069XY006CO\_2)

*Hydric soil rating:* No

#### Rock outcrop

*Percent of map unit:* 1 percent

*Hydric soil rating:* No

## 128—Razor clay loam, dry, 2 to 5 percent slopes

### Map Unit Setting

*National map unit symbol:* 2t529

*Elevation:* 3,700 to 6,400 feet

*Mean annual precipitation:* 10 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

*Razor, dry, and similar soils:* 85 percent

*Minor components:* 15 percent

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

## **Description of Razor, Dry**

### **Setting**

*Landform:* Pediments

*Down-slope shape:* Linear

*Across-slope shape:* Convex

*Parent material:* Slope alluvium and/or residuum weathered from shale

### **Typical profile**

*A - 0 to 4 inches:* clay loam

*Bw - 4 to 15 inches:* silty clay

*Bky - 15 to 30 inches:* clay

*Cr - 30 to 79 inches:* bedrock

### **Properties and qualities**

*Slope:* 2 to 5 percent

*Depth to restrictive feature:* 20 to 39 inches to paralithic bedrock

*Drainage class:* Well drained

*Runoff class:* Low

*Capacity of the most limiting layer to transmit water (Ksat):* Low to moderately high  
(0.00 to 0.21 in/hr)

*Depth to water table:* More than 80 inches

*Frequency of flooding:* None

*Frequency of ponding:* None

*Calcium carbonate, maximum content:* 15 percent

*Gypsum, maximum content:* 5 percent

*Maximum salinity:* Very slightly saline to slightly saline (2.0 to 7.9 mmhos/cm)

*Sodium adsorption ratio, maximum:* 10.0

*Available water supply, 0 to 60 inches:* Low (about 4.7 inches)

### **Interpretive groups**

*Land capability classification (irrigated):* 6s

*Land capability classification (nonirrigated):* 6s

*Hydrologic Soil Group:* D

*Ecological site:* R069XY047CO - Alkaline Plains

*Hydric soil rating:* No

## **Minor Components**

### **Midway, dry**

*Percent of map unit:* 10 percent

*Landform:* Hillslopes

*Landform position (two-dimensional):* Backslope

*Landform position (three-dimensional):* Crest, side slope

*Down-slope shape:* Convex

*Across-slope shape:* Convex

*Ecological site:* R069XY046CO - Shaly Plains

*Hydric soil rating:* No

### **Manzanola, dry**

*Percent of map unit:* 5 percent

*Landform:* Fan remnants

*Down-slope shape:* Linear

*Across-slope shape:* Linear

*Ecological site:* R069XY042CO - Clayey Plains

*Other vegetative classification:* Loamy Plains #6 (069XY006CO\_2)

## Custom Soil Resource Report

*Hydric soil rating:* No



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## Custom Soil Resource Report

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United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. [http://www.nrcs.usda.gov/Internet/FSE\\_DOCUMENTS/nrcs142p2\\_052290.pdf](http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf)

## APPENDIX B – DRAINAGE MAPS



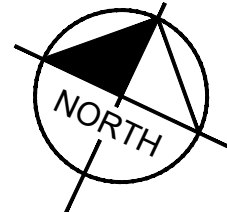
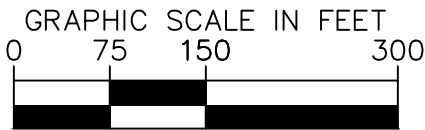
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RATIONAL CALCULATIONS SUMMARY							
DESIGN POINT	TRIBUTARY BASIN	TRIBUTARY AREA (AC)	IMPERVIOUSNESS (%)	RUNOFF COEFFICIENT		PEAK FLOWS (CFS) DIRECT	
				C <sub>5</sub>	C <sub>100</sub>	Q <sub>5</sub>	Q <sub>100</sub>
EXISTING BASINS							
EX1	EX-1	1.32	94%	0.85	0.93	4.76	9.21
EX2	EX-2	0.96	98%	0.89	0.95	3.85	7.26
EX3	EX-3	0.42	5%	0.18	0.52	0.12	1.39
EX4	EX-4	0.66	4%	0.17	0.52	0.14	1.81
EX5	EX-5	0.40	97%	0.87	0.94	1.51	2.87
EX6	EX-6	0.74	72%	0.67	0.82	1.44	3.23
EX7	EX-7	3.05	10%	0.22	0.55	0.81	6.58
EX8	EX-8	7.44	43%	0.47	0.70	5.78	17.48
EX9	EX-9	3.81	16%	0.26	0.57	1.46	8.79

LEGEND:

- EXISTING DRAINAGE BASIN BOUNDARY
- EXISTING DESIGN POINT DESIGNATION
- EXISTING  
A = BASIN DESIGNATION  
B = AREA IN ACRES  
C = IMPERVIOUSNESS
- 
- EXISTING FLOW ARROW



Print Date: October 22, 2024

Drawing File Name: ex-drainage-map-196825002.dwg

Horiz. Scale: 1' = 150'

Vert. Scale: N/A

R-X

R-X

R-X

R-X

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Sheet Revisions		
Date:	Comments:	Init.

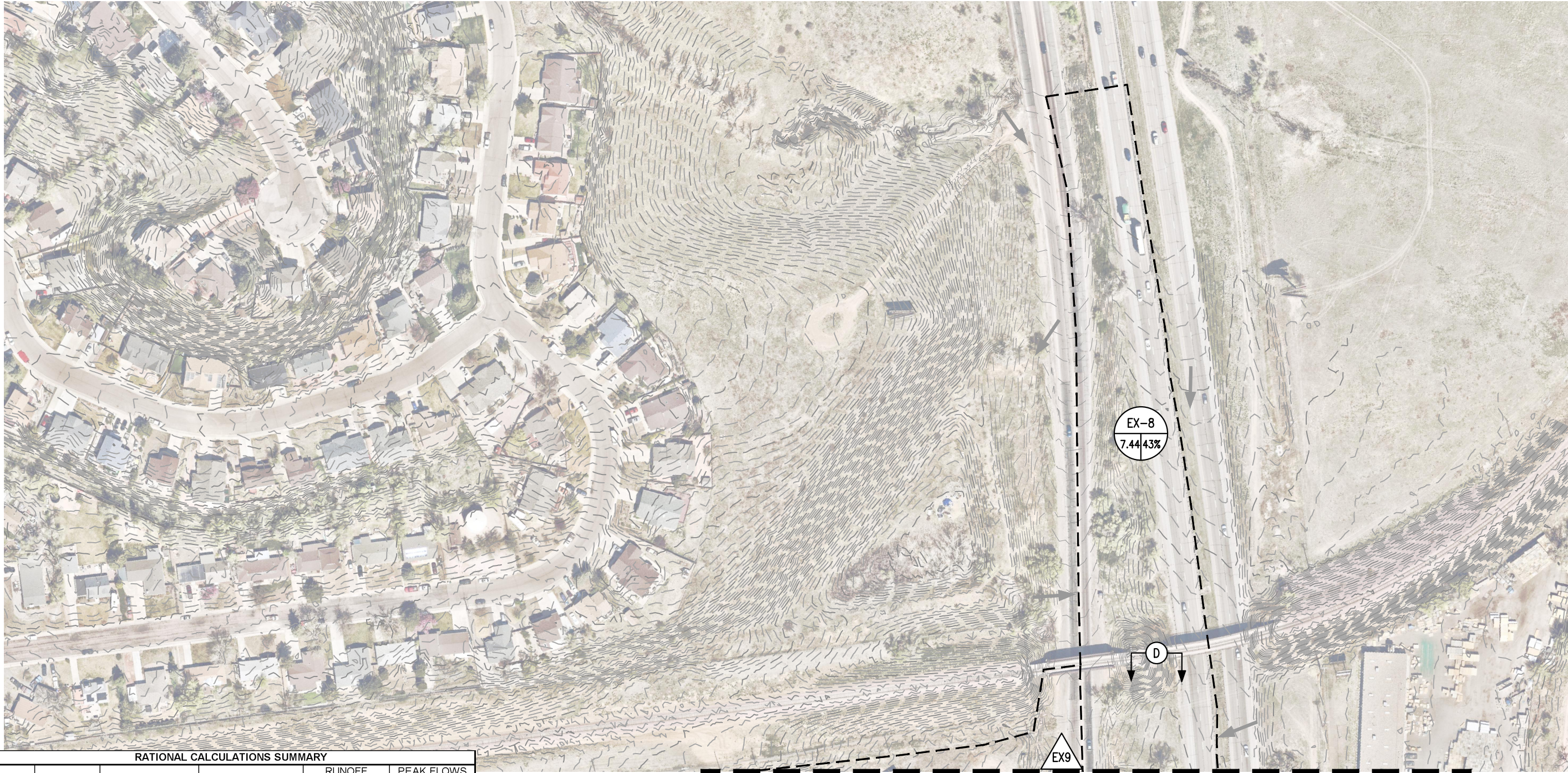
VENETUCCI BLVD. & B ST.  
ACCESS PERMIT #XXXXXX



As Constructed	VENETUCCI BLVD. & B ST. EXISTING DRAINAGE MAP			Project No./Code	
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Revised:		Detailer: CAS		196825002	
Void:		Sheet Subset: DRAINAGE	Subset Sheet: 1 of 4	Sheet Number A	



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RATIONAL CALCULATIONS SUMMARY							
DESIGN POINT	TRIBUTARY BASIN	TRIBUTARY AREA (AC)	IMPERVIOUSNESS (%)	RUNOFF COEFFICIENT		PEAK FLOWS (CFS) DIRECT	
				C <sub>5</sub>	C <sub>100</sub>	Q <sub>5</sub>	Q <sub>100</sub>
EXISTING BASINS							
EX1	EX-1	1.32	94%	0.85	0.93	4.76	9.21
EX2	EX-2	0.96	98%	0.89	0.95	3.85	7.26
EX3	EX-3	0.42	5%	0.18	0.52	0.12	1.39
EX4	EX-4	0.66	4%	0.17	0.52	0.14	1.81
EX5	EX-5	0.40	97%	0.87	0.94	1.51	2.87
EX6	EX-6	0.74	72%	0.67	0.82	1.44	3.23
EX7	EX-7	3.05	10%	0.22	0.55	0.81	6.58
EX8	EX-8	7.44	43%	0.47	0.70	5.78	17.48
EX9	EX-9	3.81	16%	0.26	0.57	1.46	8.79

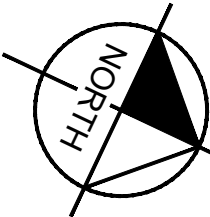
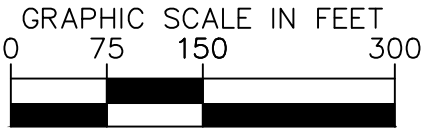
LEGEND:

- EXISTING DRAINAGE BASIN BOUNDARY
- EXISTING DESIGN POINT DESIGNATION
- EXISTING

A = BASIN DESIGNATION

B = AREA IN ACRES

C = IMPERVIOUSNESS
- EXISTING FLOW ARROW



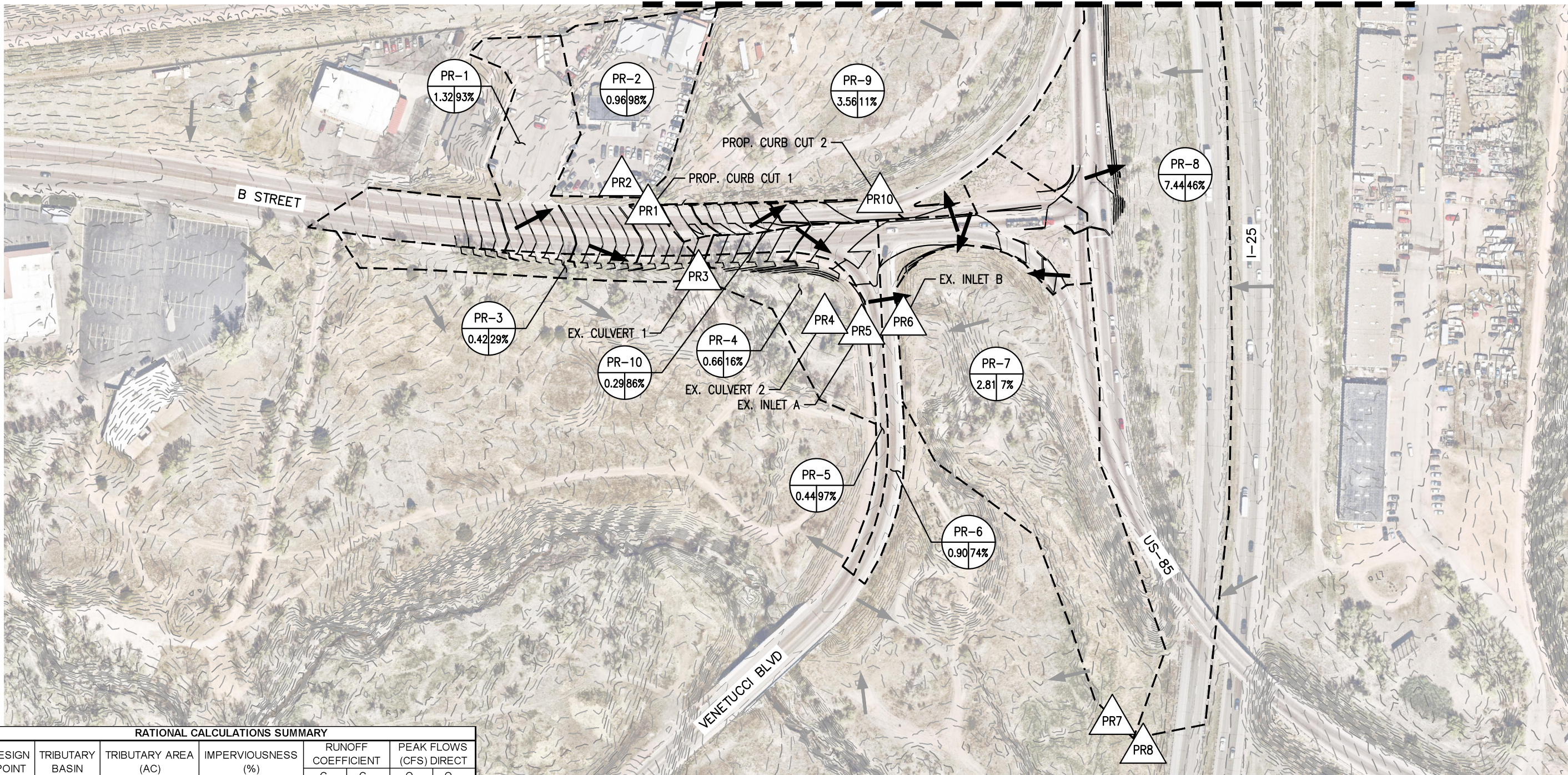
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RATIONAL CALCULATIONS SUMMARY							
DESIGN POINT	TRIBUTARY BASIN	TRIBUTARY AREA (AC)	IMPERVIOUSNESS (%)	RUNOFF COEFFICIENT		PEAK FLOWS (CFS) DIRECT	
				C <sub>5</sub>	C <sub>100</sub>	Q <sub>5</sub>	Q <sub>100</sub>
PROPOSED BASINS							
PR1	PR-1	1.32	93%	0.85	0.93	4.71	9.14
PR2	PR-2	0.96	98%	0.89	0.95	3.85	7.26
PR3	PR-3	0.42	29%	0.35	0.62	0.44	1.75
PR4	PR-4	0.66	16%	0.26	0.57	0.34	2.06
PR5	PR-5	0.44	97%	0.86	0.93	1.70	3.23
PR6	PR-6	0.90	74%	0.70	0.83	1.84	4.04
PR7	PR-7	2.81	7%	0.20	0.53	0.64	6.23
PR8	PR-8	7.44	46%	0.49	0.71	6.01	17.67
PR9	PR-9	3.56	11%	0.23	0.55	1.02	7.80
PR10	PR-10	0.29	86%	0.78	0.88	1.05	2.13
BASIN TOTAL		18.80	41%			21.6	61.31

LEGEND:

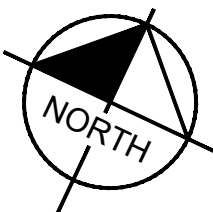
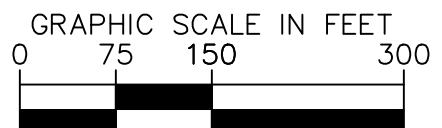
- PROPOSED DRAINAGE BASIN BOUNDARY
- A

B

C

PROPOSED  
A = BASIN DESIGNATION  
B = AREA IN ACRES  
C = IMPERVIOUSNESS
- #

PROPOSED DESIGN POINT DESIGNATION
- EXISTING FLOW ARROW
- PROPOSED FLOW ARROW



Print Date: October 22, 2024

Drawing File Name: prop-drainage-map-196825002.dwg

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Date:	Comments:	Init.

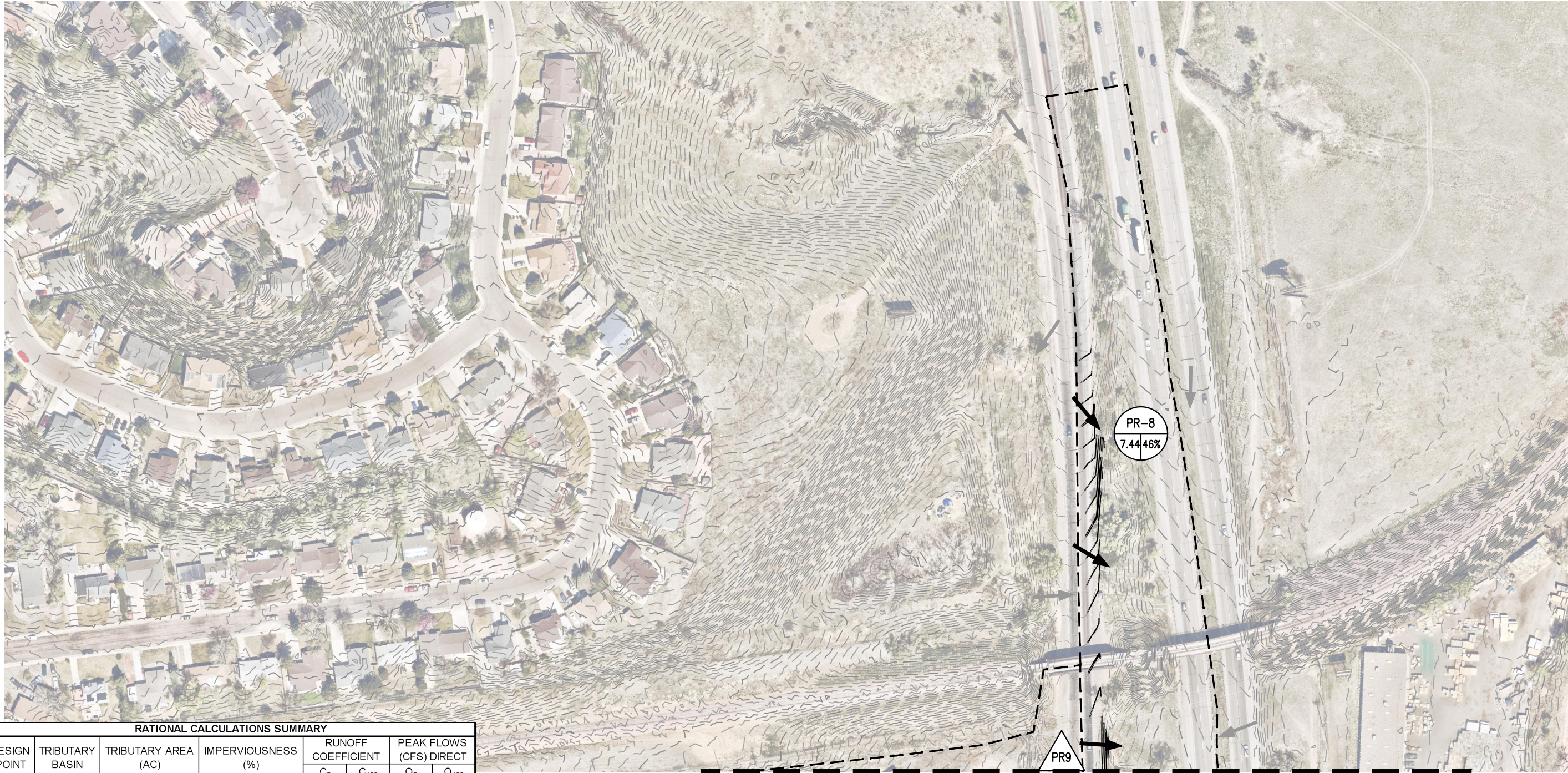
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		Subset Sheet: 3 of 4			

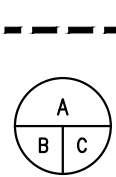


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RATIONAL CALCULATIONS SUMMARY							
DESIGN POINT	TRIBUTARY BASIN	TRIBUTARY AREA (AC)	IMPERVIOUSNESS (%)	RUNOFF COEFFICIENT		PEAK FLOWS (CFS) DIRECT	
				C <sub>5</sub>	C <sub>100</sub>	Q <sub>5</sub>	Q <sub>100</sub>
PROPOSED BASINS							
PR1	PR-1	1.32	93%	0.85	0.93	4.71	9.14
PR2	PR-2	0.96	98%	0.89	0.95	3.85	7.26
PR3	PR-3	0.42	29%	0.35	0.62	0.44	1.75
PR4	PR-4	0.66	16%	0.26	0.57	0.34	2.06
PR5	PR-5	0.44	97%	0.86	0.93	1.70	3.23
PR6	PR-6	0.90	74%	0.70	0.83	1.84	4.04
PR7	PR-7	2.81	7%	0.20	0.53	0.64	6.23
PR8	PR-8	7.44	46%	0.49	0.71	6.01	17.67
PR9	PR-9	3.56	11%	0.23	0.55	1.02	7.80
PR10	PR-10	0.29	86%	0.78	0.88	1.05	2.13
BASIN TOTAL		18.80	41%			21.6	61.31

LEGEND:



PROPOSED DRAINAGE BASIN BOUNDARY

PROPOSED  
A = BASIN DESIGNATION  
B = AREA IN ACRES  
C = IMPERVIOUSNESS



PROPOSED DESIGN POINT DESIGNATION

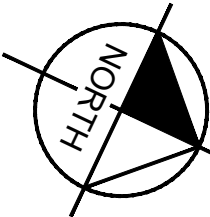
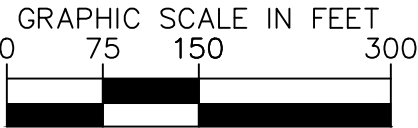


EXISTING FLOW ARROW



PROPOSED FLOW ARROW

MATCHLINE SEE SHEET C



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No Revisions:		Designer: SMH		PROJECT NO	
Revised:		Detailer: CAS		196825002	
Void:		Sheet Subset: DRAINAGE		Subset Sheet: 4 of 4	
				Sheet Number D	



## APPENDIX C – EXISTING HYDRAULIC CALCULATIONS



**Venetucci Blvd. and B St. Access**  
**El Paso County, Colorado**

## EXISTING BASIN IMPERVIOUSNESS AND RUNOFF COEFFICIENT

EXISTING BASIN IMPERVIOUSNESS AND RUNOFF COEFFICIENT						
BASIN DESIGNATION	A <sub>TOTAL</sub>	A <sub>TOTAL</sub>	A <sub>LANDSCAPE</sub>	A <sub>ROOF/DRIVES &amp; WALKS</sub>	A <sub>STREETS</sub>	I <sub>WEIGHTED</sub>
	(AC)	(SF)	(SF)	(SF)	(SF)	
EX-1	1.32	57424.19	3677.68	941.41	52805.10	94%
EX-2	0.96	41943.48	747.08	99.61	41096.79	98%
EX-3	0.42	18095.22	17568.17	0.00	527.05	5%
EX-4	0.66	28933.04	28329.04	112.96	491.04	4%
EX-5	0.40	17395.42	391.00	1527.70	15476.72	97%
EX-6	0.74	32217.92	8911.63	4401.43	18904.86	72%
EX-7	3.05	132893.55	122159.88	1147.93	9585.74	10%
EX-8	7.44	324160.32	186831.24	980.37	136348.71	43%
EX-9	3.81	166036.34	142907.14	90.72	23038.48	16%
<b>TOTAL</b>	<b>18.80</b>	<b>819099.47</b>	<b>511522.86</b>	<b>9302.13</b>	<b>298274.49</b>	<b>39%</b>

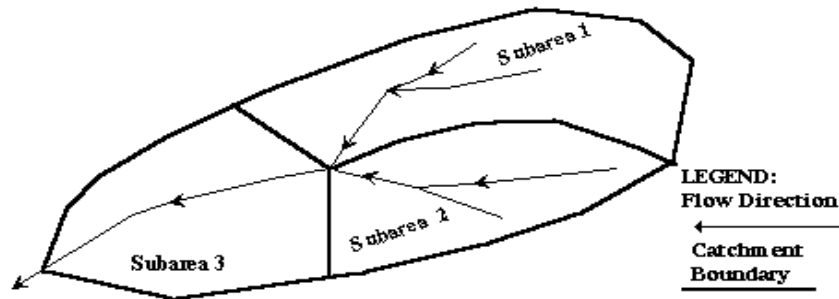
Calculation of Peak Runoff using Rational Method	
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$$Q(cfs) = CIA$$
[illegible]

# Area-Weighted Runoff Coefficient Calculations

Version 2.00 released May 2017

Designer: \_\_\_\_\_  
 Company: Kimley-Horn and Associates \_\_\_\_\_  
 Date: 10/18/2024 \_\_\_\_\_  
 Project: Venetucci Blvd. & B St. Access \_\_\_\_\_  
 Location: El Paso County, Colorado \_\_\_\_\_



Subcatchment  
 Name  
 Venetucci

Cells of this color are for required user-input  
 Cells of this color are for optional override values  
 Cells of this color are for calculated results based on overrides

See sheet "Design Info" for imperviousness-based runoff coefficient values.

Sub-Area ID	Area (ac)	NRCS Hydrologic Soil Group	Percent Imperviousness	Runoff Coefficient, C						
				2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
EX-1	1.32	C	93.6	0.77	0.80	0.82	0.84	0.86	0.87	0.88
EX-2	0.96	C	98.2	0.82	0.84	0.85	0.87	0.88	0.89	0.90
EX-3	0.42	C	4.9	0.03	0.07	0.17	0.35	0.42	0.50	0.60
EX-4	0.66	C	4.0	0.02	0.07	0.16	0.34	0.41	0.50	0.60
EX-5	0.40	C	96.9	0.81	0.82	0.84	0.86	0.87	0.88	0.89
EX-6	0.74	C	71.5	0.57	0.62	0.66	0.72	0.75	0.78	0.81
EX-7	3.05	C	9.8	0.06	0.12	0.20	0.37	0.44	0.52	0.62
EX-8	7.44	C	43.5	0.33	0.39	0.45	0.56	0.61	0.66	0.72
EX-9	3.81	C	15.6	0.10	0.16	0.25	0.41	0.47	0.55	0.64
Total Area (ac)	18.80	Area-Weighted C		0.30	0.35	0.42	0.54	0.58	0.64	0.71
		Area-Weighted Override C		0.30	0.35	0.42	0.54	0.58	0.64	0.71

# Reach-Weighted Time of Concentration Calculations

Version 2.00 released May 2017

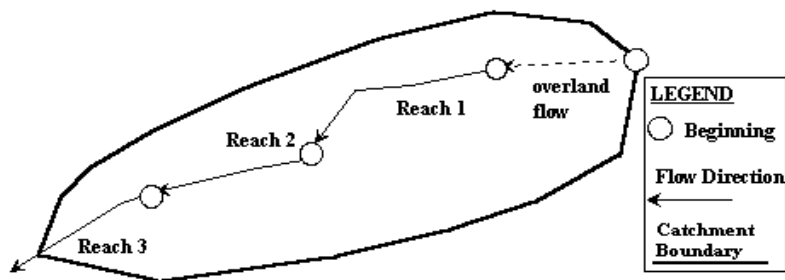
Designer:

Company: Kimley-Horn and Associates

Date: 10/18/2024

Project: Venetucci Blvd. & B St. Access

Location: El Paso County, Colorado



Subcatchment Name	Percent Imperviousness (%)
Venetucci	39

## OVERLAND FLOW

Reach ID	Overland Flow Length $L_t$ (ft)	Overland Flow Slope $S_t$ (ft/ft)	5-yr Runoff Coefficient, $C_s$	Overland Flow Time $t_t$ (min)
EX-1	240.00	0.040	0.80	5.38
EX-2	290.00	0.040	0.84	5.15
EX-3	50.00	0.052	0.07	7.58
EX-4	165.00	0.048	0.07	14.32
EX-5	70.00	0.009	0.82	4.32
EX-6	135.00	0.003	0.62	14.58
EX-7	250.00	0.027	0.12	20.18
EX-8	160.00	0.004	0.39	22.14
EX-9	395.00	0.065	0.16	18.13
Weighted Totals	1755.00	0.037	Total $t_t$ (min)	111.78

## CHANNELIZED FLOW

Reach ID	Channelized Flow Length $L_t$ (ft)	Channelized Flow Slope $S_t$ (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Time $t_t$ (min)
EX-1	395.00	0.053	20	1.43
EX-2	125.00	0.037	20	0.54
EX-3	510.00	0.047	10	3.94
EX-4	170.00	0.007	10	3.46
EX-5	350.00	0.017	20	2.23
EX-6	375.00	0.014	20	2.62
EX-7	780.00	0.019	10	9.38
EX-8	2005.00	0.013	10	28.87
EX-9	725.00	0.014	10	10.32
Weighted Totals	5435.00	0.021	Total $t_t$ (min)	62.80

Computed $t_c$ (min)	174.58
Regional $t_c$ (min)	62.72
Selected $t_c$ (min)	62.72

**Venetucci Blvd. and B St. Access  
El Paso County, Colorado****EXISTING RUNOFF SUMMARY**

EXISTING RUNOFF SUMMARY			
BASIN ID	AREA	Q <sub>5</sub>	Q <sub>100</sub>
	(AC)	(CFS)	(CFS)
EX-1	1.32	4.76	9.21
EX-2	0.96	3.85	7.26
EX-3	0.42	0.12	1.39
EX-4	0.66	0.14	1.81
EX-5	0.40	1.51	2.87
EX-6	0.74	1.44	3.23
EX-7	3.05	0.81	6.58
EX-8	7.44	5.78	17.48
EX-9	3.81	1.46	8.79

Culvert 1 - Existing Flow Q5  
FlexTable: Conduit Table

ID	Label	Start Node	Set Invert to Start?	Invert (Start) (ft)	Stop Node
35	CO-1	H-1	False	5,809.40	H-2
Set Invert to Stop?	Invert (Stop) (ft)	Has User Defined Length?	Length (User Defined) (ft)	Length (Scaled) (ft)	Slope (Calculated) (ft/ft)
False	5,806.59	True	56.0	107.9	0.050
Section Type	Diameter (in)	Manning's n	Flow (cfs)	Velocity (ft/s)	Depth (Out) (ft)
Circle	24.0	0.024	0.12	2.18	0.10
Capacity (Full Flow) (cfs)	Flow / Capacity (Design) (%)	Depth (Normal) / Rise (%)	Notes		
27.45	0.4	4.8			

Culvert 1 - Existing Flow Q100  
FlexTable: Conduit Table

ID	Label	Start Node	Set Invert to Start?	Invert (Start) (ft)	Stop Node
35	CO-1	H-1	False	5,809.40	H-2
Set Invert to Stop?	Invert (Stop) (ft)	Has User Defined Length?	Length (User Defined) (ft)	Length (Scaled) (ft)	Slope (Calculated) (ft/ft)
False	5,806.59	True	56.0	107.9	0.050
Section Type	Diameter (in)	Manning's n	Flow (cfs)	Velocity (ft/s)	Depth (Out) (ft)
Circle	24.0	0.024	1.39	4.57	0.31
Capacity (Full Flow) (cfs)	Flow / Capacity (Design) (%)	Depth (Normal) / Rise (%)	Notes		
27.45	5.1	15.3			

**Culvert 2 - Existing Flow Q5**  
**FlexTable: Conduit Table**

ID	Label	Start Node	Set Invert to Start?	Invert (Start) (ft)	Stop Node
35	CO-1	H-1	False	5,799.88	Inlet A
37	CO-2	Inlet A	False	5,798.86	CB-2
39	CO-3	CB-2	False	5,798.48	H-2
Set Invert to Stop?	Invert (Stop) (ft)	Has User Defined Length?	Length (User Defined) (ft)	Length (Scaled) (ft)	Slope (Calculated) (ft/ft)
False	5,798.88	True	32.5	74.5	0.031
False	5,798.50	True	34.0	101.4	0.011
False	5,798.35	True	34.0	79.4	0.004
Section Type	Diameter (in)	Manning's n	Flow (cfs)	Velocity (ft/s)	Depth (Out) (ft)
Circle	18.0	0.013	0.14	3.09	0.44
Circle	18.0	0.013	1.51	4.31	0.38
Circle	24.0	0.013	1.44	2.87	0.41
Capacity (Full Flow) (cfs)	Flow / Capacity (Design) (%)	Depth (Normal) / Rise (%)	Notes		
18.42	0.8	6.2			
10.81	14.0	25.3			
13.99	10.3	21.7			



## Culvert 2 - Existing Flow Q100

### FlexTable: Conduit Table

ID	Label	Start Node	Set Invert to Start?	Invert (Start) (ft)	Stop Node
35	CO-1	Culvert 2	False	5,799.88	Inlet A
37	CO-2	Inlet A	False	5,798.86	Inlet B
39	CO-3	Inlet B	False	5,798.48	H-2
Set Invert to Stop?	Invert (Stop) (ft)	Has User Defined Length?	Length (User Defined) (ft)	Length (Scaled) (ft)	Slope (Calculated) (ft/ft)
False	5,798.88	True	32.5	74.5	0.031
False	5,798.50	True	34.0	101.4	0.011
False	5,798.35	True	34.0	79.4	0.004
Section Type	Diameter (in)	Manning's n	Flow (cfs)	Velocity (ft/s)	Depth (Out) (ft)
Circle	18.0	0.013	1.81	6.63	0.62
Circle	18.0	0.013	2.87	5.17	0.53
Circle	24.0	0.013	3.23	3.62	0.63
Capacity (Full Flow) (cfs)	Flow / Capacity (Design) (%)	Depth (Normal) / Rise (%)	Notes		
18.42	9.8	21.2			
10.81	26.6	35.2			
13.99	23.1	32.7			

Culvert 3 - Existing Flow Q5  
FlexTable: Conduit Table

ID	Label	Start Node	Set Invert to Start?	Invert (Start) (ft)	Stop Node
35	CO-1	H-1	False	5,795.14	H-2
Set Invert to Stop?	Invert (Stop) (ft)	Has User Defined Length?	Length (User Defined) (ft)	Length (Scaled) (ft)	Slope (Calculated) (ft/ft)
False	5,794.68	True	91.0	107.9	0.005
Section Type	Diameter (in)	Manning's n	Flow (cfs)	Velocity (ft/s)	Depth (Out) (ft)
Circle	24.0	0.024	1.46	2.06	0.42
Capacity (Full Flow) (cfs)	Flow / Capacity (Design) (%)	Depth (Normal) / Rise (%)	Notes		
8.71	16.8	27.7			

Culvert 3 - Existing Flow Q100  
FlexTable: Conduit Table

ID	Label	Start Node	Set Invert to Start?	Invert (Start) (ft)	Stop Node
35	CO-1	H-1	False	5,795.14	H-2
Set Invert to Stop?	Invert (Stop) (ft)	Has User Defined Length?	Length (User Defined) (ft)	Length (Scaled) (ft)	Slope (Calculated) (ft/ft)
False	5,794.68	True	91.0	107.9	0.005
Section Type	Diameter (in)	Manning's n	Flow (cfs)	Velocity (ft/s)	Depth (Out) (ft)
Circle	24.0	0.024	8.79	3.16	1.06
Capacity (Full Flow) (cfs)	Flow / Capacity (Design) (%)	Depth (Normal) / Rise (%)	Notes		
8.71	100.9	82.8			

Culvert 3 - Existing Flow Q5  
FlexTable: Conduit Table

ID	Label	Start Node	Set Invert to Start?	Invert (Start) (ft)	Stop Node
35	CO-1	H-1	False	5,795.14	H-2
Set Invert to Stop?	Invert (Stop) (ft)	Has User Defined Length?	Length (User Defined) (ft)	Length (Scaled) (ft)	Slope (Calculated) (ft/ft)
False	5,794.68	True	91.0	107.9	0.005
Section Type	Diameter (in)	Manning's n	Flow (cfs)	Velocity (ft/s)	Depth (Out) (ft)
Circle	24.0	0.024	1.46	2.06	0.42
Capacity (Full Flow) (cfs)	Flow / Capacity (Design) (%)	Depth (Normal) / Rise (%)	Notes		
8.71	16.8	27.7			

Culvert 3 - Existing Flow Q100  
FlexTable: Conduit Table

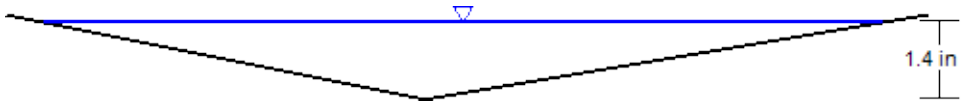
ID	Label	Start Node	Set Invert to Start?	Invert (Start) (ft)	Stop Node
35	CO-1	H-1	False	5,795.14	H-2
Set Invert to Stop?	Invert (Stop) (ft)	Has User Defined Length?	Length (User Defined) (ft)	Length (Scaled) (ft)	Slope (Calculated) (ft/ft)
False	5,794.68	True	91.0	107.9	0.005
Section Type	Diameter (in)	Manning's n	Flow (cfs)	Velocity (ft/s)	Depth (Out) (ft)
Circle	24.0	0.024	8.79	3.16	1.06
Capacity (Full Flow) (cfs)	Flow / Capacity (Design) (%)	Depth (Normal) / Rise (%)	Notes		
8.71	100.9	82.8			

## Worksheet for Triangular Channel - EX3 Q5

Project Description	
Friction Method	Manning
Solve For	Formula Normal Depth
Input Data	
Roughness Coefficient	0.030
Channel Slope	0.047 ft/ft
Left Side Slope	5.000 H:V
Right Side Slope	6.000 H:V
Discharge	0.12 cfs
Results	
Normal Depth	1.4 in
Flow Area	0.1 ft <sup>2</sup>
Wetted Perimeter	1.3 ft
Hydraulic Radius	0.7 in
Top Width	1.29 ft
Critical Depth	1.5 in
Critical Slope	0.034 ft/ft
Velocity	1.59 ft/s
Velocity Head	0.04 ft
Specific Energy	0.16 ft
Froude Number	1.162
Flow Type	Supercritical
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	1.4 in
Critical Depth	1.5 in
Channel Slope	0.047 ft/ft
Critical Slope	0.034 ft/ft

Cross Section for Triangular Channel - EX3 Q5

Project Description	
Friction Method	Manning
	Formula
Solve For	Normal Depth
Input Data	
Roughness Coefficient	0.030
Channel Slope	0.047 ft/ft
Normal Depth	1.4 in
Left Side Slope	5.000 H:V
Right Side Slope	6.000 H:V
Discharge	0.12 cfs



V: 1  
H: 1

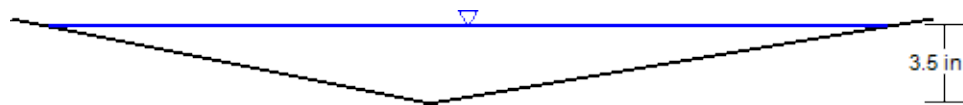
## Worksheet for Triangular Channel - EX3 Q100

Project Description	
Friction Method	Manning
Solve For	Formula Normal Depth
Input Data	
Roughness Coefficient	0.030
Channel Slope	0.047 ft/ft
Left Side Slope	5.000 H:V
Right Side Slope	6.000 H:V
Discharge	1.39 cfs
Results	
Normal Depth	3.5 in
Flow Area	0.5 ft <sup>2</sup>
Wetted Perimeter	3.3 ft
Hydraulic Radius	1.7 in
Top Width	3.22 ft
Critical Depth	4.0 in
Critical Slope	0.024 ft/ft
Velocity	2.95 ft/s
Velocity Head	0.14 ft
Specific Energy	0.43 ft
Froude Number	1.360
Flow Type	Supercritical
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	3.5 in
Critical Depth	4.0 in
Channel Slope	0.047 ft/ft
Critical Slope	0.024 ft/ft



## Cross Section for Triangular Channel - EX3 Q100

Project Description	
Friction Method	Manning
	Formula
Solve For	Normal Depth
Input Data	
Roughness Coefficient	0.030
Channel Slope	0.047 ft/ft
Normal Depth	3.5 in
Left Side Slope	5.000 H:V
Right Side Slope	6.000 H:V
Discharge	1.39 cfs



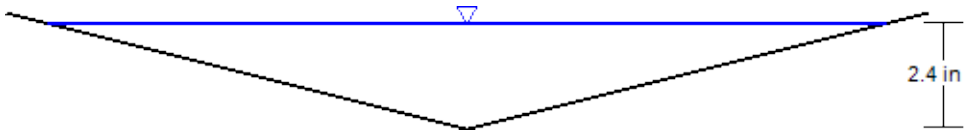
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H: 1

## Worksheet for Triangular Channel - EX4 Q5

Project Description	
Friction Method	Manning
	Formula
Solve For	Normal Depth
<b>Input Data</b>	
Roughness Coefficient	0.030
Channel Slope	0.007 ft/ft
Left Side Slope	4.000 H:V
Right Side Slope	4.000 H:V
Discharge	0.14 cfs
<b>Results</b>	
Normal Depth	2.4 in
Flow Area	0.2 ft <sup>2</sup>
Wetted Perimeter	1.6 ft
Hydraulic Radius	1.2 in
Top Width	1.60 ft
Critical Depth	1.8 in
Critical Slope	0.032 ft/ft
Velocity	0.88 ft/s
Velocity Head	0.01 ft
Specific Energy	0.21 ft
Froude Number	0.488
Flow Type	Subcritical
<b>GVF Input Data</b>	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0
<b>GVF Output Data</b>	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	2.4 in
Critical Depth	1.8 in
Channel Slope	0.007 ft/ft
Critical Slope	0.032 ft/ft

Cross Section for Triangular Channel - EX4 Q5

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Roughness Coefficient	0.030
Channel Slope	0.007 ft/ft
Normal Depth	2.4 in
Left Side Slope	4.000 H:V
Right Side Slope	4.000 H:V
Discharge	0.14 cfs



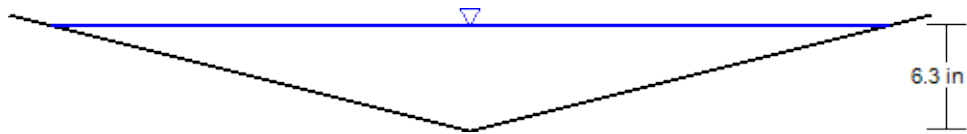
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## Worksheet for Triangular Channel - EX4 Q100

Project Description	
Friction Method	Manning
	Formula
Solve For	Normal Depth
<b>Input Data</b>	
Roughness Coefficient	0.030
Channel Slope	0.007 ft/ft
Left Side Slope	4.000 H:V
Right Side Slope	4.000 H:V
Discharge	1.81 cfs
<b>Results</b>	
Normal Depth	6.3 in
Flow Area	1.1 ft <sup>2</sup>
Wetted Perimeter	4.3 ft
Hydraulic Radius	3.0 in
Top Width	4.18 ft
Critical Depth	5.0 in
Critical Slope	0.023 ft/ft
Velocity	1.66 ft/s
Velocity Head	0.04 ft
Specific Energy	0.57 ft
Froude Number	0.572
Flow Type	Subcritical
<b>GVF Input Data</b>	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0
<b>GVF Output Data</b>	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	6.3 in
Critical Depth	5.0 in
Channel Slope	0.007 ft/ft
Critical Slope	0.023 ft/ft

## Cross Section for Triangular Channel - EX4 Q100

Project Description	
Friction Method	Manning
	Formula
Solve For	Normal Depth
Input Data	
Roughness Coefficient	0.030
Channel Slope	0.007 ft/ft
Normal Depth	6.3 in
Left Side Slope	4.000 H:V
Right Side Slope	4.000 H:V
Discharge	1.81 cfs



V: 1  
H: 1

## Worksheet for Triangular Channel - EX7 Q5

Project Description	
Friction Method	Manning
	Formula
Solve For	Normal Depth
<b>Input Data</b>	
Roughness Coefficient	0.030
Channel Slope	0.019 ft/ft
Left Side Slope	5.000 H:V
Right Side Slope	8.000 H:V
Discharge	0.81 cfs
<b>Results</b>	
Normal Depth	3.2 in
Flow Area	0.5 ft <sup>2</sup>
Wetted Perimeter	3.5 ft
Hydraulic Radius	1.6 in
Top Width	3.46 ft
Critical Depth	3.0 in
Critical Slope	0.027 ft/ft
Velocity	1.76 ft/s
Velocity Head	0.05 ft
Specific Energy	0.31 ft
Froude Number	0.853
Flow Type	Subcritical
<b>GVF Input Data</b>	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0
<b>GVF Output Data</b>	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	3.2 in
Critical Depth	3.0 in
Channel Slope	0.019 ft/ft
Critical Slope	0.027 ft/ft

Cross Section for Triangular Channel - EX7 Q5

Project Description	
Friction Method	Manning
	Formula
Solve For	Normal Depth
Input Data	
Roughness Coefficient	0.030
Channel Slope	0.019 ft/ft
Normal Depth	3.2 in
Left Side Slope	5.000 H:V
Right Side Slope	8.000 H:V
Discharge	0.81 cfs



V: 1  
H: 1

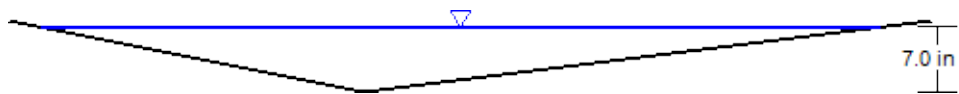
## Worksheet for Triangular Channel - EX7 Q100

Project Description	
Friction Method	Manning
Solve For	Formula Normal Depth
Input Data	
Roughness Coefficient	0.030
Channel Slope	0.019 ft/ft
Left Side Slope	5.000 H:V
Right Side Slope	8.000 H:V
Discharge	6.58 cfs
Results	
Normal Depth	7.0 in
Flow Area	2.2 ft <sup>2</sup>
Wetted Perimeter	7.7 ft
Hydraulic Radius	3.5 in
Top Width	7.58 ft
Critical Depth	6.9 in
Critical Slope	0.020 ft/ft
Velocity	2.98 ft/s
Velocity Head	0.14 ft
Specific Energy	0.72 ft
Froude Number	0.972
Flow Type	Subcritical
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	7.0 in
Critical Depth	6.9 in
Channel Slope	0.019 ft/ft
Critical Slope	0.020 ft/ft



## Cross Section for Triangular Channel - EX7 Q100

Project Description	
Friction Method	Manning
	Formula
Solve For	Normal Depth
Input Data	
Roughness Coefficient	0.030
Channel Slope	0.019 ft/ft
Normal Depth	7.0 in
Left Side Slope	5.000 H:V
Right Side Slope	8.000 H:V
Discharge	6.58 cfs



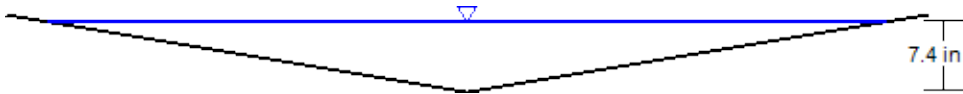
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## Worksheet for Triangular Channel - EX8 Q5

Project Description	
Friction Method	Manning
	Formula
Solve For	Normal Depth
<b>Input Data</b>	
Roughness Coefficient	0.030
Channel Slope	0.013 ft/ft
Left Side Slope	6.000 H:V
Right Side Slope	6.000 H:V
Discharge	5.78 cfs
<b>Results</b>	
Normal Depth	7.4 in
Flow Area	2.3 ft <sup>2</sup>
Wetted Perimeter	7.5 ft
Hydraulic Radius	3.6 in
Top Width	7.38 ft
Critical Depth	6.8 in
Critical Slope	0.020 ft/ft
Velocity	2.55 ft/s
Velocity Head	0.10 ft
Specific Energy	0.72 ft
Froude Number	0.810
Flow Type	Subcritical
<b>GVF Input Data</b>	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0
<b>GVF Output Data</b>	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	7.4 in
Critical Depth	6.8 in
Channel Slope	0.013 ft/ft
Critical Slope	0.020 ft/ft

Cross Section for Triangular Channel - EX8 Q5

Project Description	
Friction Method	Manning
	Formula
Solve For	Normal Depth
Input Data	
Roughness Coefficient	0.030
Channel Slope	0.013 ft/ft
Normal Depth	7.4 in
Left Side Slope	6.000 H:V
Right Side Slope	6.000 H:V
Discharge	5.78 cfs



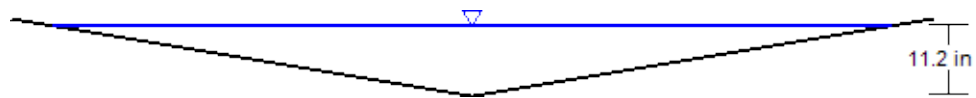
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## Worksheet for Triangular Channel - EX8 Q100

Project Description	
Friction Method	Manning
Solve For	Formula Normal Depth
Input Data	
Roughness Coefficient	0.030
Channel Slope	0.013 ft/ft
Left Side Slope	6.000 H:V
Right Side Slope	6.000 H:V
Discharge	17.48 cfs
Results	
Normal Depth	11.2 in
Flow Area	5.2 ft <sup>2</sup>
Wetted Perimeter	11.3 ft
Hydraulic Radius	5.5 in
Top Width	11.17 ft
Critical Depth	10.6 in
Critical Slope	0.018 ft/ft
Velocity	3.36 ft/s
Velocity Head	0.18 ft
Specific Energy	1.11 ft
Froude Number	0.869
Flow Type	Subcritical
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	11.2 in
Critical Depth	10.6 in
Channel Slope	0.013 ft/ft
Critical Slope	0.018 ft/ft

## Cross Section for Triangular Channel - EX8 Q100

Project Description	
Friction Method	Manning
	Formula
Solve For	Normal Depth
Input Data	
Roughness Coefficient	0.030
Channel Slope	0.013 ft/ft
Normal Depth	11.2 in
Left Side Slope	6.000 H:V
Right Side Slope	6.000 H:V
Discharge	17.48 cfs



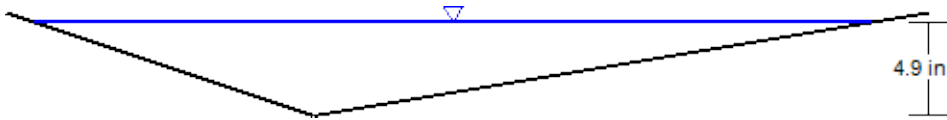
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## Worksheet for Triangular Channel - EX9 Q5

Project Description	
Friction Method	Manning
	Formula
Solve For	Normal Depth
<b>Input Data</b>	
Roughness Coefficient	0.030
Channel Slope	0.014 ft/ft
Left Side Slope	3.000 H:V
Right Side Slope	6.000 H:V
Discharge	1.46 cfs
<b>Results</b>	
Normal Depth	4.9 in
Flow Area	0.7 ft <sup>2</sup>
Wetted Perimeter	3.7 ft
Hydraulic Radius	2.4 in
Top Width	3.64 ft
Critical Depth	4.4 in
Critical Slope	0.024 ft/ft
Velocity	1.98 ft/s
Velocity Head	0.06 ft
Specific Energy	0.47 ft
Froude Number	0.777
Flow Type	Subcritical
<b>GVF Input Data</b>	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0
<b>GVF Output Data</b>	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	4.9 in
Critical Depth	4.4 in
Channel Slope	0.014 ft/ft
Critical Slope	0.024 ft/ft

Cross Section for Triangular Channel - EX9 Q5

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Roughness Coefficient	0.030
Channel Slope	0.014 ft/ft
Normal Depth	4.9 in
Left Side Slope	3.000 H:V
Right Side Slope	6.000 H:V
Discharge	1.46 cfs



V: 1  
H: 1

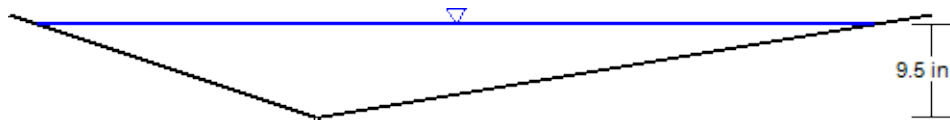
## Worksheet for Triangular Channel - EX9 Q100

Project Description	
Friction Method	Manning
Solve For	Formula Normal Depth
Input Data	
Roughness Coefficient	0.030
Channel Slope	0.014 ft/ft
Left Side Slope	3.000 H:V
Right Side Slope	6.000 H:V
Discharge	8.79 cfs
Results	
Normal Depth	9.5 in
Flow Area	2.8 ft <sup>2</sup>
Wetted Perimeter	7.3 ft
Hydraulic Radius	4.6 in
Top Width	7.14 ft
Critical Depth	9.0 in
Critical Slope	0.019 ft/ft
Velocity	3.11 ft/s
Velocity Head	0.15 ft
Specific Energy	0.94 ft
Froude Number	0.869
Flow Type	Subcritical
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	9.5 in
Critical Depth	9.0 in
Channel Slope	0.014 ft/ft
Critical Slope	0.019 ft/ft



## Cross Section for Triangular Channel - EX9 Q100

Project Description	
Friction Method	Manning
	Formula
Solve For	Normal Depth
Input Data	
Roughness Coefficient	0.030
Channel Slope	0.014 ft/ft
Normal Depth	9.5 in
Left Side Slope	3.000 H:V
Right Side Slope	6.000 H:V
Discharge	8.79 cfs



V: 1  
H: 1

## APPENDIX D – PROPOSED HYDRAULIC CALCULATIONS

**Venetucci Blvd. and B St. Access**  
**El Paso County, Colorado**

## PROPOSED BASIN IMPERVIOUSNESS AND RUNOFF COEFFICIENT

PROPOSED BASIN IMPERVIOUSNESS AND RUNOFF COEFFICIENT						
BASIN DESIGNATION	A <sub>TOTAL</sub> (AC)	A <sub>TOTAL</sub> (SF)	A <sub>LANDSCAPE</sub> (SF)	A <sub>ROOF/DRIVES &amp; WALKS</sub> (SF)	A <sub>STREETS</sub> (SF)	I <sub>WEIGHTED</sub>
PR-1	1.32	57418.02	4044.15	986.02	52387.84	93%
PR-2	0.96	41943.48	747.08	99.61	41096.79	98%
PR-3	0.42	18096.70	12877.40	3092.25	2127.05	29%
PR-4	0.66	28933.05	24656.05	2085.03	2191.96	16%
PR-5	0.44	19078.80	377.23	2759.28	15942.29	97%
PR-6	0.90	39095.08	9704.02	5499.99	23891.07	74%
PR-7	2.81	122569.39	116116.49	232.05	6220.85	7%
PR-8	7.44	324185.95	180017.65	709.92	143458.38	46%
PR-9	3.56	155268.25	141250.02	134.85	13883.39	11%
PR-10	0.29	12540.72	1539.91	2032.86	8967.95	86%
<b>TOTAL</b>	<b>18.80</b>	<b>819129.43</b>	<b>491330.00</b>	<b>17631.86</b>	<b>310167.58</b>	<b>41%</b>

Calculation of Peak Runoff using Rational Method	
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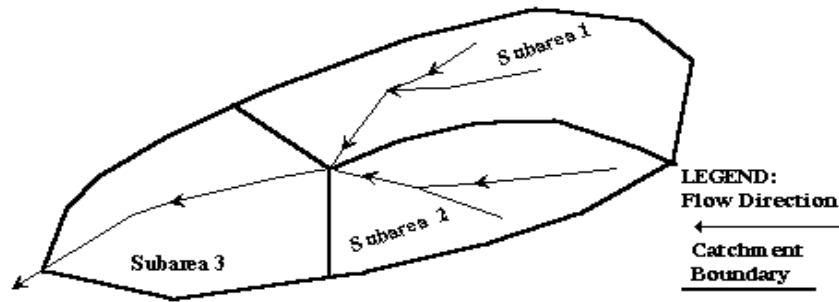
$$Q(cfs) = CIA$$
$$\text{Selected } t_c = \max\{t_{\text{minimum}}, \min(\text{Computed } t_c, \text{Regional } t_c)\}$$

Subcatchment Name	Area (ac)	NRCS Hydrologic Soil Group	Percent Imperviousness	Runoff Coefficient, C							Overland (Initial) Flow Time					Channelized (Travel) Flow Time						Time of Concentration			Rainfall Intensity, I (in/hr)								Peak Flow, Q (cfs)							
				2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr	Overland Flow Length L <sub>i</sub> (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Overland Flow Slope S <sub>i</sub> (ft/ft)	Overland Flow Time t <sub>i</sub> (min)	Channelized Flow Length L <sub>c</sub> (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Channelized Flow Slope S <sub>c</sub> (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Velocity V <sub>i</sub> (ft/sec)	Channelized Flow Time t <sub>c</sub> (min)	Computed t <sub>c</sub> (min)	Regional t <sub>c</sub> (min)	Selected t <sub>c</sub> (min)	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr	
PR-1	1.32	C	92.9	0.77	0.79	0.82	0.84	0.85	0.86	0.88	240.00			0.040	5.47	395.00			0.053	20	4.59	1.44	6.90	11.51	6.90	3.27	4.51	5.13	5.87	6.92	8.03	11.18	3.31	4.71	5.51	6.49	7.77	9.14	12.98	
PR-2	0.96	C	98.2	0.82	0.84	0.85	0.87	0.88	0.89	0.90	290.00			0.040	5.15	125.00			0.037	20	3.86	0.54	5.69	9.77	5.69	3.47	4.78	5.43	6.22	7.33	8.51	11.85	2.73	3.85	4.47	5.20	6.20	7.26	10.24	
PR-3	0.42	C	28.6	0.20	0.27	0.34	0.48	0.53	0.60	0.68	50.00			0.052	6.15	510.00			0.047	10	2.16	3.94	10.09	24.17	10.09	2.86	3.94	4.48	5.12	6.04	7.01	9.76	0.24	0.44	0.64	1.02	1.34	1.75	2.75	
PR-4	0.66	C	15.8	0.10	0.16	0.25	0.41	0.47	0.55	0.64	165.00			0.048	12.99	170.00			0.007	10	0.82	3.46	16.45	26.41	16.45	2.30	3.17	3.61	4.13	4.86	5.65	7.86	0.16	0.34	0.59	1.12	1.52	2.06	3.33	
PR-5	0.44	C	96.6	0.80	0.82	0.84	0.86	0.87	0.88	0.89	70.00			0.014	3.75	350.00			0.017	20	2.62	2.23	5.98	11.56	5.98	3.42	4.71	5.36	6.13	7.23	8.39	11.68	1.20	1.70	1.98	2.31	2.76	3.23	4.57	
PR-6	0.90	C	74.3	0.60	0.64	0.68	0.73	0.76	0.79	0.82	135.00			0.001	23.19	375.00			0.014	20	2.38	2.62	25.82	16.08	16.08	2.33	3.21	3.65	4.17	4.92	5.71	7.95	1.25	1.84	2.22	2.75	3.35	4.04	5.86	
PR-7	2.81	C	7.1	0.04	0.09	0.18	0.36	0.43	0.51	0.61	250.00			0.027	20.63	660.00			0.028	10	1.67	6.59	27.22	31.37	27.22	1.76	2.42	2.76	3.15	3.72	4.32	6.01	0.21	0.64	1.43	3.19	4.48	6.23	10.33	
PR-8	7.44	C	45.6	0.35	0.41	0.47	0.57	0.62	0.67	0.73	75.00			0.018	8.95	2065.00			0.013	10	1.14	30.19	39.14	37.88	37.88	1.44	1.99	2.26	2.59	3.05	3.54	4.93	3.71	6.01	7.86	11.06	14.03	17.67	26.84	
PR-9	3.56	C	10.8	0.07	0.12	0.21	0.38	0.45	0.53	0.62	395.00			0.065	18.89	725.00			0.014	10	1.17	10.32	29.21	33.97	29.21	1.69	2.33	2.65	3.03	3.57	4.14	5.77	0.42	1.02	2.00	4.10	5.68	7.80	12.79	
PR-10	0.29	C	86.3	0.71	0.74	0.77	0.80	0.82	0.84	0.86	50.00			0.029	3.26	320.00			0.031	20	3.51	1.52	4.78	12.76	5.00	3.60	4.95	5.63	6.44	7.60	8.82	12.28	0.73	1.05	1.24	1.49	1.79	2.13	3.04	

# Area-Weighted Runoff Coefficient Calculations

Version 2.00 released May 2017

Designer: \_\_\_\_\_  
 Company: Kimley-Horn and Associates \_\_\_\_\_  
 Date: 10/18/2024 \_\_\_\_\_  
 Project: Venetucci Blvd. & B St. Access \_\_\_\_\_  
 Location: El Paso County, Colorado \_\_\_\_\_



Subcatchment  
 Name  
 Venetucci

Cells of this color are for required user-input  
 Cells of this color are for optional override values  
 Cells of this color are for calculated results based on overrides

See sheet "Design Info" for imperviousness-based runoff coefficient values.

Sub-Area ID	Area (ac)	NRCS Hydrologic Soil Group	Percent Imperviousness	Runoff Coefficient, C						
				2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
PR-1	1.32	C	92.9	0.77	0.79	0.82	0.84	0.85	0.86	0.88
PR-2	0.96	C	98.2	0.82	0.84	0.85	0.87	0.88	0.89	0.90
PR-3	0.42	C	28.6	0.20	0.27	0.34	0.48	0.53	0.60	0.68
PR-4	0.66	C	15.8	0.10	0.16	0.25	0.41	0.47	0.55	0.64
PR-5	0.44	C	96.6	0.80	0.82	0.84	0.86	0.87	0.88	0.89
PR-6	0.90	C	74.3	0.60	0.64	0.68	0.73	0.76	0.79	0.82
PR-7	2.81	C	7.1	0.04	0.09	0.18	0.36	0.43	0.51	0.61
PR-8	7.44	C	45.6	0.35	0.41	0.47	0.57	0.62	0.67	0.73
PR-9	3.56	C	10.8	0.07	0.12	0.21	0.38	0.45	0.53	0.62
PR-10	0.29	C	86.3	0.71	0.74	0.77	0.80	0.82	0.84	0.86
Total Area (ac)		18.80		Area-Weighted C						
				Area-Weighted Override C						
				0.32	0.37	0.43	0.55	0.60	0.65	0.72
				0.32	0.37	0.43	0.55	0.60	0.65	0.72

# Reach-Weighted Time of Concentration Calculations

Version 2.00 released May 2017

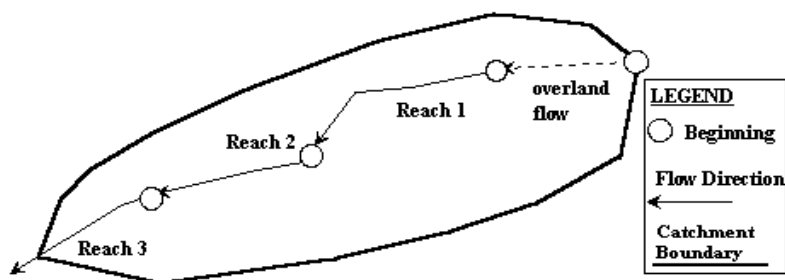
Designer:

Company: Kimley-Horn and Associates

Date: 10/18/2024

Project: Venetucci Blvd. & B St. Access

Location: El Paso County, Colorado



Subcatchment Name	Percent Imperviousness (%)
Venetucci	41

## OVERLAND FLOW

Reach ID	Overland Flow Length $L_t$ (ft)	Overland Flow Slope $S_t$ (ft/ft)	5-yr Runoff Coefficient, $C_s$	Overland Flow Time $t_t$ (min)
PR-1	240.00	0.04	0.79	5.47
PR-2	290.00	0.04	0.84	5.07
PR-3	50.00	0.05	0.27	6.13
PR-4	165.00	0.05	0.16	13.04
PR-5	70.00	0.01	0.82	3.79
PR-6	135.00	0.00	0.64	23.21
PR-7	250.00	0.03	0.09	20.70
PR-8	75.00	0.02	0.41	8.90
PR-9	395.00	0.07	0.12	18.95
PR-10	250.00	0.03	0.74	7.27
Weighted Totals	1920.00	0.038	Total $t_t$ (min)	112.52

## CHANNELIZED FLOW

Reach ID	Channelized Flow Length $L_t$ (ft)	Channelized Flow Slope $S_t$ (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Time $t_t$ (min)
PR-1	395.00	0.053	20	1.44
PR-2	125.00	0.037	20	0.54
PR-3	510.00	0.047	10	3.94
PR-4	170.00	0.007	10	3.46
PR-5	350.00	0.017	20	2.23
PR-6	375.00	0.014	20	2.62
PR-7	660.00	0.028	10	6.59
PR-8	2065.00	0.013	10	30.19
PR-9	725.00	0.014	10	10.32
PR-10	320.00	0.031	20	1.52
Weighted Totals	5695.00	0.022	Total $t_t$ (min)	62.84

Computed $t_c$ (min)	175.36
Regional $t_c$ (min)	62.20
Selected $t_c$ (min)	62.20

Venetucci Blvd. and B St. Access  
El Paso County, Colorado

## PROPOSED RUNOFF SUMMARY

PROPOSED RUNOFF SUMMARY			
BASIN ID	AREA	Q <sub>5</sub>	Q <sub>100</sub>
	(AC)	(CFS)	(CFS)
PR-1	1.32	4.71	9.14
PR-2	<b>0.96</b>	3.85	7.26
PR-3	0.42	0.44	1.75
PR-4	<b>0.66</b>	0.34	2.06
PR-5	0.44	1.70	3.23
PR-6	<b>0.90</b>	1.84	4.04
PR-7	2.81	0.64	6.23
PR-8	7.44	6.01	17.67
PR-9	3.56	1.02	7.80
PR-10	0.29	1.05	2.13

**Venetucci Blvd. and B St. Access**  
**El Paso County, Colorado**

## PROPOSED DESIGN STORM TOTAL RUNOFF

PROPOSED DESIGN STORM TOTAL RUNOFF							
RAINFALL INTENSITY EQUATION COEFFICIENTS:		a	b	c	$I(in/hr) = \frac{a * P_1}{(b + t_c)^c}$		
		28.50	10.00	0.786			
PROPOSED 5 YEAR DESIGN STORM							
1-HOUR RAINFALL DEPTH P1 (IN) FOR 5-YEAR STORM:				1.46			
BASIN INFORMATION		PEAK FLOW (CFS) DIRECT RUNOFF	TOTAL RUNOFF				REMARKS
DESIGN POINT	TRIBUTARY BASIN	Q <sub>5</sub>	T <sub>C</sub>	SUM	I	Q	
		(CFS)	MIN	C X A	IN/HR	CFS	
PR1	PR-1	4.71	10.00	1.04	3.95	4.12	
PR2	PR-2	3.85	10.00	0.81	3.95	3.19	
PR3	PR-3	0.44	10.09	0.11	3.94	0.45	
PR4	PR-4	0.34	16.45	0.11	3.17	0.33	
PR5	PR-5	1.70	10.00	0.36	3.95	1.43	
PR6	PR-6	1.84	16.08	0.58	3.21	1.85	
PR7	PR-7	0.64	27.22	0.25	2.42	0.61	
PR8	PR-8	6.01	37.88	3.05	1.99	6.07	
PR9	PR-9	1.02	29.21	0.43	2.33	0.99	
PR10	PR-10	1.05	10.00	0.21	3.95	0.85	
TOTAL RUNOFF		21.6					

SEE RATIONAL CALCULATIONS (APPENDIX D) FOR SOURCE DATA. TO BE CONSERVATIVE, TIME OF CONCENTRATION FOR TOTAL RUNOFF IS ASSUMED TO BE THE LESSER VALUE OF THE RESPECTIVE TRIBUTARY BASINS INTENSITY.

PROPOSED 100 YEAR DESIGN STORM							
1-HOUR RAINFALL DEPTH P1 (IN) FOR 100-YEAR STORM:				2.60			
BASIN INFORMATION		PEAK FLOW (CFS) DIRECT RUNOFF	TOTAL RUNOFF				REMARKS
DESIGN POINT	TRIBUTARY BASIN	$Q_{100}$	$T_c$	SUM	I	Q	
		(CFS)	MIN	C X A	IN/HR	CFS	
PR1	PR-1	9.14	10.00	1.14	7.03	7.99	
PR2	PR-2	7.26	10.00	0.85	7.03	6.01	
PR3	PR-3	1.75	10.09	0.25	7.01	1.77	
PR4	PR-4	2.06	16.45	0.36	5.65	2.05	
PR5	PR-5	3.23	10.00	0.39	7.03	2.72	
PR6	PR-6	4.04	16.08	0.71	5.71	4.06	
PR7	PR-7	6.23	27.22	1.43	4.32	6.19	
PR8	PR-8	17.67	37.88	4.98	3.54	17.65	
PR9	PR-9	7.80	29.21	1.89	4.14	7.82	
PR10	PR-10	2.13	10.00	0.24	7.03	1.71	
<b>TOTAL RUNOFF</b>		<b>61.31</b>					

SEE RATIONAL CALCULATIONS (APPENDIX D) FOR SOURCE DATA. TO BE CONSERVATIVE, TIME OF CONCENTRATION FOR TOTAL RUNOFF IS ASSUMED TO BE THE LESSER VALUE OF THE RESPECTIVE TRIBUTARY BASINS INTENSITY.



Culvert 1 - Proposed Flow Q5  
FlexTable: Conduit Table

ID	Label	Start Node	Set Invert to Start?	Invert (Start) (ft)	Stop Node
35	CO-1	H-1	False	5,809.40	H-2
Set Invert to Stop?	Invert (Stop) (ft)	Has User Defined Length?	Length (User Defined) (ft)	Length (Scaled) (ft)	Slope (Calculated) (ft/ft)
False	5,806.59	True	56.0	107.9	0.050
Section Type	Diameter (in)	Manning's n	Flow (cfs)	Velocity (ft/s)	Depth (Out) (ft)
Circle	24.0	0.024	0.44	3.24	0.18
Capacity (Full Flow) (cfs)	Flow / Capacity (Design) (%)	Depth (Normal) / Rise (%)	Notes		
27.45	1.6	8.8			

**Culvert 1 - Proposed Flow Q100**  
**FlexTable: Conduit Table**

ID	Label	Start Node	Set Invert to Start?	Invert (Start) (ft)	Stop Node
35	CO-1	H-1	False	5,809.40	H-2
Set Invert to Stop?	Invert (Stop) (ft)	Has User Defined Length?	Length (User Defined) (ft)	Length (Scaled) (ft)	Slope (Calculated) (ft/ft)
False	5,806.59	True	56.0	107.9	0.050
Section Type	Diameter (in)	Manning's n	Flow (cfs)	Velocity (ft/s)	Depth (Out) (ft)
Circle	24.0	0.024	1.75	4.90	0.34
Capacity (Full Flow) (cfs)	Flow / Capacity (Design) (%)	Depth (Normal) / Rise (%)	Notes		
27.45	6.4	17.1			

Culvert 2 - Proposed Flow Q5  
FlexTable: Conduit Table

ID	Label	Start Node	Set Invert to Start?	Invert (Start) (ft)	Stop Node
35	CO-1	H-1	False	5,799.88	Inlet A
37	CO-2	Inlet A	False	5,798.86	CB-2
39	CO-3	CB-2	False	5,798.48	H-2
Set Invert to Stop?	Invert (Stop) (ft)	Has User Defined Length?	Length (User Defined) (ft)	Length (Scaled) (ft)	Slope (Calculated) (ft/ft)
False	5,798.88	True	32.5	74.5	0.031
False	5,798.50	True	34.0	101.4	0.011
False	5,798.35	True	34.0	79.4	0.004
Section Type	Diameter (in)	Manning's n	Flow (cfs)	Velocity (ft/s)	Depth (Out) (ft)
Circle	18.0	0.013	0.34	4.04	0.47
Circle	18.0	0.013	1.70	4.46	0.40
Circle	24.0	0.013	1.84	3.08	0.47
Capacity (Full Flow) (cfs)	Flow / Capacity (Design) (%)	Depth (Normal) / Rise (%)	Notes		
18.42	1.8	9.4			
10.81	15.7	26.8			
13.99	13.2	24.5			

**Culvert 2 - Proposed Flow Q100**  
**FlexTable: Conduit Table**

ID	Label	Start Node	Set Invert to Start?	Invert (Start) (ft)	Stop Node
35	CO-1	Culvert 2	False	5,799.88	Inlet A
37	CO-2	Inlet A	False	5,798.86	Inlet B
39	CO-3	Inlet B	False	5,798.48	H-2
Set Invert to Stop?	Invert (Stop) (ft)	Has User Defined Length?	Length (User Defined) (ft)	Length (Scaled) (ft)	Slope (Calculated) (ft/ft)
False	5,798.88	True	32.5	74.5	0.031
False	5,798.50	True	34.0	101.4	0.011
False	5,798.35	True	34.0	79.4	0.004
Section Type	Diameter (in)	Manning's n	Flow (cfs)	Velocity (ft/s)	Depth (Out) (ft)
Circle	18.0	0.013	2.06	6.89	0.66
Circle	18.0	0.013	3.23	5.34	0.72
Circle	24.0	0.013	4.04	3.85	0.71
Capacity (Full Flow) (cfs)	Flow / Capacity (Design) (%)	Depth (Normal) / Rise (%)	Notes		
18.42	11.2	22.6			
10.81	29.9	37.5			
13.99	28.9	36.8			

Culvert 3 - Proposed Flow Q5  
FlexTable: Conduit Table

ID	Label	Start Node	Set Invert to Start?	Invert (Start) (ft)	Stop Node
35	CO-1	H-1	False	5,795.14	H-2
Set Invert to Stop?	Invert (Stop) (ft)	Has User Defined Length?	Length (User Defined) (ft)	Length (Scaled) (ft)	Slope (Calculated) (ft/ft)
False	5,794.68	True	91.0	107.9	0.005
Section Type	Diameter (in)	Manning's n	Flow (cfs)	Velocity (ft/s)	Depth (Out) (ft)
Circle	24.0	0.024	1.02	1.86	0.35
Capacity (Full Flow) (cfs)	Flow / Capacity (Design) (%)	Depth (Normal) / Rise (%)	Notes		
8.71	11.7	23.1			

Culvert 3 - Proposed Flow Q100  
FlexTable: Conduit Table

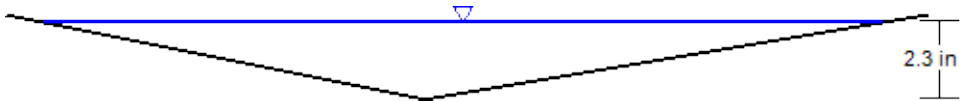
ID	Label	Start Node	Set Invert to Start?	Invert (Start) (ft)	Stop Node
35	CO-1	H-1	False	5,795.14	H-2
Set Invert to Stop?	Invert (Stop) (ft)	Has User Defined Length?	Length (User Defined) (ft)	Length (Scaled) (ft)	Slope (Calculated) (ft/ft)
False	5,794.68	True	91.0	107.9	0.005
Section Type	Diameter (in)	Manning's n	Flow (cfs)	Velocity (ft/s)	Depth (Out) (ft)
Circle	24.0	0.024	7.80	3.14	0.99
Capacity (Full Flow) (cfs)	Flow / Capacity (Design) (%)	Depth (Normal) / Rise (%)	Notes		
8.71	89.5	73.8			

## Worksheet for Triangular Channel - PR3 Q5

Project Description	
Friction Method	Manning
	Formula
Solve For	Normal Depth
<b>Input Data</b>	
Roughness Coefficient	0.030
Channel Slope	0.047 ft/ft
Left Side Slope	5.000 H:V
Right Side Slope	6.000 H:V
Discharge	0.44 cfs
<b>Results</b>	
Normal Depth	2.3 in
Flow Area	0.2 ft <sup>2</sup>
Wetted Perimeter	2.1 ft
Hydraulic Radius	1.1 in
Top Width	2.09 ft
Critical Depth	2.5 in
Critical Slope	0.028 ft/ft
Velocity	2.21 ft/s
Velocity Head	0.08 ft
Specific Energy	0.27 ft
Froude Number	1.266
Flow Type	Supercritical
<b>GVF Input Data</b>	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0
<b>GVF Output Data</b>	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	2.3 in
Critical Depth	2.5 in
Channel Slope	0.047 ft/ft
Critical Slope	0.028 ft/ft

Cross Section for Triangular Channel - PR3 Q5

Project Description	
Friction Method	Manning
	Formula
Solve For	Normal Depth
Input Data	
Roughness Coefficient	0.030
Channel Slope	0.047 ft/ft
Normal Depth	2.3 in
Left Side Slope	5.000 H:V
Right Side Slope	6.000 H:V
Discharge	0.44 cfs



V: 1  
H: 1

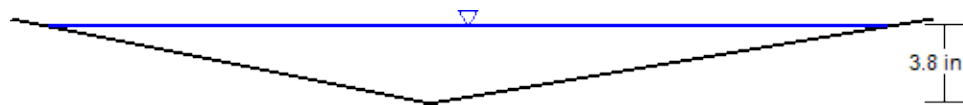


## Worksheet for Triangular Channel - PR3 Q100

Project Description	
Friction Method	Manning
	Formula
Solve For	Normal Depth
<b>Input Data</b>	
Roughness Coefficient	0.030
Channel Slope	0.047 ft/ft
Left Side Slope	5.000 H:V
Right Side Slope	6.000 H:V
Discharge	1.75 cfs
<b>Results</b>	
Normal Depth	3.8 in
Flow Area	0.6 ft <sup>2</sup>
Wetted Perimeter	3.6 ft
Hydraulic Radius	1.9 in
Top Width	3.51 ft
Critical Depth	4.4 in
Critical Slope	0.024 ft/ft
Velocity	3.12 ft/s
Velocity Head	0.15 ft
Specific Energy	0.47 ft
Froude Number	1.379
Flow Type	Supercritical
<b>GVF Input Data</b>	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0
<b>GVF Output Data</b>	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	3.8 in
Critical Depth	4.4 in
Channel Slope	0.047 ft/ft
Critical Slope	0.024 ft/ft

## Cross Section for Triangular Channel - PR3 Q100

Project Description	
Friction Method	Manning
	Formula
Solve For	Normal Depth
Input Data	
Roughness Coefficient	0.030
Channel Slope	0.047 ft/ft
Normal Depth	3.8 in
Left Side Slope	5.000 H:V
Right Side Slope	6.000 H:V
Discharge	1.75 cfs



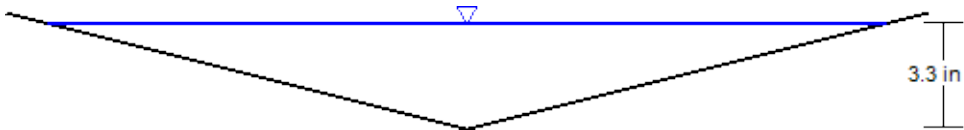
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## Worksheet for Triangular Channel - PR4 Q5

Project Description	
Friction Method	Manning
	Formula
Solve For	Normal Depth
<b>Input Data</b>	
Roughness Coefficient	0.030
Channel Slope	0.007 ft/ft
Left Side Slope	4.000 H:V
Right Side Slope	4.000 H:V
Discharge	0.34 cfs
<b>Results</b>	
Normal Depth	3.3 in
Flow Area	0.3 ft <sup>2</sup>
Wetted Perimeter	2.3 ft
Hydraulic Radius	1.6 in
Top Width	2.23 ft
Critical Depth	2.6 in
Critical Slope	0.029 ft/ft
Velocity	1.09 ft/s
Velocity Head	0.02 ft
Specific Energy	0.30 ft
Froude Number	0.516
Flow Type	Subcritical
<b>GVF Input Data</b>	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0
<b>GVF Output Data</b>	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	3.3 in
Critical Depth	2.6 in
Channel Slope	0.007 ft/ft
Critical Slope	0.029 ft/ft

Cross Section for Triangular Channel - PR4 Q5

Project Description	
Friction Method	Manning
	Formula
Solve For	Normal Depth
Input Data	
Roughness Coefficient	0.030
Channel Slope	0.007 ft/ft
Normal Depth	3.3 in
Left Side Slope	4.000 H:V
Right Side Slope	4.000 H:V
Discharge	0.34 cfs



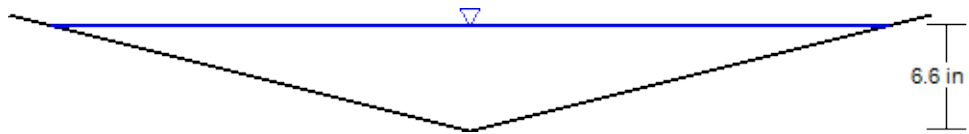
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## Worksheet for Triangular Channel - PR4 Q100

Project Description	
Friction Method	Manning
	Formula
Solve For	Normal Depth
<b>Input Data</b>	
Roughness Coefficient	0.030
Channel Slope	0.007 ft/ft
Left Side Slope	4.000 H:V
Right Side Slope	4.000 H:V
Discharge	2.06 cfs
<b>Results</b>	
Normal Depth	6.6 in
Flow Area	1.2 ft <sup>2</sup>
Wetted Perimeter	4.5 ft
Hydraulic Radius	3.2 in
Top Width	4.38 ft
Critical Depth	5.3 in
Critical Slope	0.023 ft/ft
Velocity	1.71 ft/s
Velocity Head	0.05 ft
Specific Energy	0.59 ft
Froude Number	0.577
Flow Type	Subcritical
<b>GVF Input Data</b>	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0
<b>GVF Output Data</b>	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	6.6 in
Critical Depth	5.3 in
Channel Slope	0.007 ft/ft
Critical Slope	0.023 ft/ft

## Cross Section for Triangular Channel - PR4 Q100

Project Description	
Friction Method	Manning
	Formula
Solve For	Normal Depth
Input Data	
Roughness Coefficient	0.030
Channel Slope	0.007 ft/ft
Normal Depth	6.6 in
Left Side Slope	4.000 H:V
Right Side Slope	4.000 H:V
Discharge	2.06 cfs



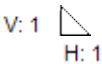
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## Worksheet for Triangular Channel - PR7 Q5

Project Description	
Friction Method	Manning
	Formula
Solve For	Normal Depth
<b>Input Data</b>	
Roughness Coefficient	0.030
Channel Slope	0.028 ft/ft
Left Side Slope	8.000 H:V
Right Side Slope	8.000 H:V
Discharge	0.64 cfs
<b>Results</b>	
Normal Depth	2.5 in
Flow Area	0.3 ft <sup>2</sup>
Wetted Perimeter	3.4 ft
Hydraulic Radius	1.2 in
Top Width	3.35 ft
Critical Depth	2.5 in
Critical Slope	0.028 ft/ft
Velocity	1.83 ft/s
Velocity Head	0.05 ft
Specific Energy	0.26 ft
Froude Number	0.998
Flow Type	Subcritical
<b>GVF Input Data</b>	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0
<b>GVF Output Data</b>	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	2.5 in
Critical Depth	2.5 in
Channel Slope	0.028 ft/ft
Critical Slope	0.028 ft/ft

Cross Section for Triangular Channel - PR7 Q5

Project Description	
Friction Method	Manning
	Formula
Solve For	Normal Depth
Input Data	
Roughness Coefficient	0.030
Channel Slope	0.028 ft/ft
Normal Depth	2.5 in
Left Side Slope	8.000 H:V
Right Side Slope	8.000 H:V
Discharge	0.64 cfs



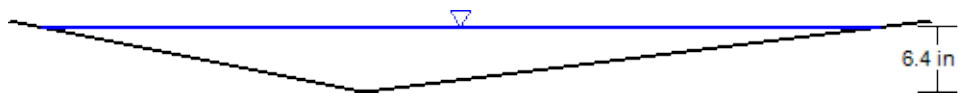


## Worksheet for Triangular Channel - PR7 Q100

Project Description	
Friction Method	Manning
Solve For	Formula Normal Depth
Input Data	
Roughness Coefficient	0.030
Channel Slope	0.028 ft/ft
Left Side Slope	5.000 H:V
Right Side Slope	8.000 H:V
Discharge	6.23 cfs
Results	
Normal Depth	6.4 in
Flow Area	1.8 ft <sup>2</sup>
Wetted Perimeter	7.0 ft
Hydraulic Radius	3.1 in
Top Width	6.91 ft
Critical Depth	6.8 in
Critical Slope	0.020 ft/ft
Velocity	3.40 ft/s
Velocity Head	0.18 ft
Specific Energy	0.71 ft
Froude Number	1.162
Flow Type	Supercritical
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	6.4 in
Critical Depth	6.8 in
Channel Slope	0.028 ft/ft
Critical Slope	0.020 ft/ft

## Cross Section for Triangular Channel - PR7 Q100

Project Description	
Friction Method	Manning
	Formula
Solve For	Normal Depth
Input Data	
Roughness Coefficient	0.030
Channel Slope	0.028 ft/ft
Normal Depth	6.4 in
Left Side Slope	5.000 H:V
Right Side Slope	8.000 H:V
Discharge	6.23 cfs



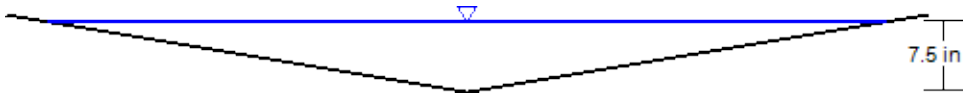
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## Worksheet for Triangular Channel - PR8 Q5

Project Description	
Friction Method	Manning
Solve For	Formula Normal Depth
Input Data	
Roughness Coefficient	0.030
Channel Slope	0.013 ft/ft
Left Side Slope	6.000 H:V
Right Side Slope	6.000 H:V
Discharge	6.01 cfs
Results	
Normal Depth	7.5 in
Flow Area	2.3 ft <sup>2</sup>
Wetted Perimeter	7.6 ft
Hydraulic Radius	3.7 in
Top Width	7.49 ft
Critical Depth	6.9 in
Critical Slope	0.020 ft/ft
Velocity	2.57 ft/s
Velocity Head	0.10 ft
Specific Energy	0.73 ft
Froude Number	0.812
Flow Type	Subcritical
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	7.5 in
Critical Depth	6.9 in
Channel Slope	0.013 ft/ft
Critical Slope	0.020 ft/ft

Cross Section for Triangular Channel - PR8 Q5

Project Description	
Friction Method	Manning
	Formula
Solve For	Normal Depth
Input Data	
Roughness Coefficient	0.030
Channel Slope	0.013 ft/ft
Normal Depth	7.5 in
Left Side Slope	6.000 H:V
Right Side Slope	6.000 H:V
Discharge	6.01 cfs



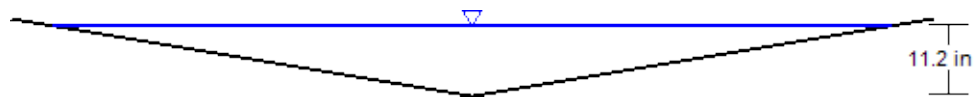
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## Worksheet for Triangular Channel - PR8 Q100

Project Description	
Friction Method	Manning
Solve For	Formula Normal Depth
Input Data	
Roughness Coefficient	0.030
Channel Slope	0.013 ft/ft
Left Side Slope	6.000 H:V
Right Side Slope	6.000 H:V
Discharge	17.67 cfs
Results	
Normal Depth	11.2 in
Flow Area	5.2 ft <sup>2</sup>
Wetted Perimeter	11.4 ft
Hydraulic Radius	5.5 in
Top Width	11.22 ft
Critical Depth	10.6 in
Critical Slope	0.018 ft/ft
Velocity	3.37 ft/s
Velocity Head	0.18 ft
Specific Energy	1.11 ft
Froude Number	0.869
Flow Type	Subcritical
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	11.2 in
Critical Depth	10.6 in
Channel Slope	0.013 ft/ft
Critical Slope	0.018 ft/ft

## Cross Section for Triangular Channel - PR8 Q100

Project Description	
Friction Method	Manning
	Formula
Solve For	Normal Depth
Input Data	
Roughness Coefficient	0.030
Channel Slope	0.013 ft/ft
Normal Depth	11.2 in
Left Side Slope	6.000 H:V
Right Side Slope	6.000 H:V
Discharge	17.67 cfs



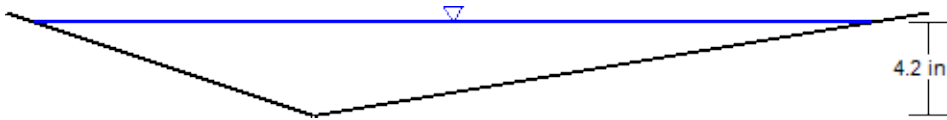
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## Worksheet for Triangular Channel - PR9 Q5

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Roughness Coefficient	0.030
Channel Slope	0.014 ft/ft
Left Side Slope	3.000 H:V
Right Side Slope	6.000 H:V
Discharge	1.02 cfs
Results	
Normal Depth	4.2 in
Flow Area	0.6 ft <sup>2</sup>
Wetted Perimeter	3.3 ft
Hydraulic Radius	2.1 in
Top Width	3.18 ft
Critical Depth	3.8 in
Critical Slope	0.025 ft/ft
Velocity	1.81 ft/s
Velocity Head	0.05 ft
Specific Energy	0.40 ft
Froude Number	0.760
Flow Type	Subcritical
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	4.2 in
Critical Depth	3.8 in
Channel Slope	0.014 ft/ft
Critical Slope	0.025 ft/ft

Cross Section for Triangular Channel - PR9 Q5

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Roughness Coefficient	0.030
Channel Slope	0.014 ft/ft
Normal Depth	4.2 in
Left Side Slope	3.000 H:V
Right Side Slope	6.000 H:V
Discharge	1.02 cfs



V: 1  
H: 1



## Worksheet for Triangular Channel - PR9 Q100

Project Description	
Friction Method	Manning
	Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.030
Channel Slope	0.014 ft/ft
Left Side Slope	3.000 H:V
Right Side Slope	6.000 H:V
Discharge	7.80 cfs

Results	
Normal Depth	9.1 in
Flow Area	2.6 ft <sup>2</sup>
Wetted Perimeter	7.0 ft
Hydraulic Radius	4.4 in
Top Width	6.82 ft
Critical Depth	8.6 in
Critical Slope	0.019 ft/ft
Velocity	3.01 ft/s
Velocity Head	0.14 ft
Specific Energy	0.90 ft
Froude Number	0.863
Flow Type	Subcritical

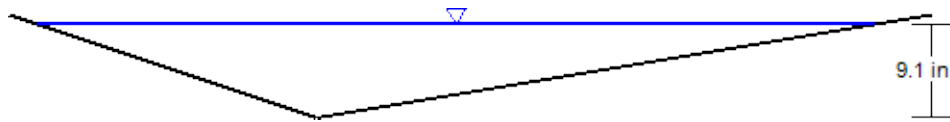
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	9.1 in
Critical Depth	8.6 in
Channel Slope	0.014 ft/ft
Critical Slope	0.019 ft/ft

## Cross Section for Triangular Channel - PR9 Q100

Project Description	
Friction Method	Manning
	Formula
Solve For	Normal Depth
Input Data	
Roughness Coefficient	0.030
Channel Slope	0.014 ft/ft
Normal Depth	9.1 in
Left Side Slope	3.000 H:V
Right Side Slope	6.000 H:V
Discharge	7.80 cfs



V: 1  
H: 1

# Permanent Water Quality Form

Please complete this form for every transportation and Property Management project in your Region to assess PWQ requirements per CDOT's MS4 permit. Information about number of projects reviewed for PWQ requirements and projects that install PWQ is reported to CDPHE in annual reports. Please email the completed Form and any changes to PWQ Program Manager [Rachel.hansgen@state.co.us](mailto:Rachel.hansgen@state.co.us). Thank you!

Date 11/13/2024

Region 2 Completed by Sean Hays

Subaccount # & Project Description Venetucci Blvd. & B St. Access

## Please circle Y or N for the Primary Criteria

Primary Criteria		
1. Inside or partially inside CDOT MS4 area	2. Disturb more than 1 acre or disturb less than 1 acre but is part of a larger common plan of development	3. Increases impervious surface by 20% or more
<u>Y</u> or N	<u>Y</u> or N	Y or <u>N</u>

Is/Does the project:

1. Inside or partially inside CDOT's MS4 area?

Use C-Plan

<https://cdot.maps.arcgis.com/apps/webappviewer/index.html?id=129bef3793774ade81cfca5ec9baff7d>

2. Disturb more than 1 acre or disturb less than 1 acre but is part of a larger common plan of development<sup>1</sup>?
3. Increase impervious surface by 20% or more?

Use formula: New Impervious Surface / Existing Impervious Surface X 100

New 20,223 SF Existing 307,577 SF Percent Increase 2%

If the answer to one or more of questions 1-3 is NO, PWQ is NOT required on the project.

If the answer to ALL questions above is YES, answer the following 3 questions:

<sup>1</sup> Common Plan of Development A "common plan of development or sale" is a contiguous area where multiple separate and distinct construction activities may be taking place at different times on different schedules, but remain related. Consistent with EPA guidance, "contiguous" is interpreted to mean construction activities located in close proximity to each other (within ¼ mile). Construction activities are considered to be "related" if they share the same development plan, builder or contractor, equipment, storage areas, etc. (CDOT MS4 Permit)

## Please circle Y or N for the Secondary Criteria

Secondary Criteria		
4. Discharges to a 303(d) listed stream for a CDOT Roadway Pollutant of Concern	5. Discharges to the Cherry Creek Reservoir drainage basin	6. Is part of an EA or EIS
Y or N	Y or N	Y or N

Is/Does the project:

4. Discharge to a 303(d) listed stream for a CDOT pollutant of concern?

Use CDPHE map and identify 303 (d) list pollutants

<https://cdphe.maps.arcgis.com/apps/Viewer/index.html?appid=f1541d2f21834642ba1551c674fd4a79>

Use table of CDOT “Roadway pollutants of concern” and check the “Yes only” column if the stream is listed on the 303(d) list:

Roadway pollutant and (form)	Chemical Formula	YES only
Total Suspended Solids	TSS	
Cadmium (total & potentially dissolved)	Cd	
Chromium (total & potentially dissolved)	Cr	
Copper (total & potentially dissolved)	Cu	
Iron (total & potentially dissolved)	Fe	
Lead (total & potentially dissolved)	Pb	
Magnesium (total & potentially dissolved)	Mg	
Manganese (total & potentially dissolved)	Mn	
Nickel (total & potentially dissolved)	Ni	
Zinc	Zn	
Total Inorganic Nitrogen	TKN + NO <sub>2</sub> + NO <sub>3</sub>	
Total Phosphorus	TP	
Chloride	Cl <sup>-</sup>	
Sodium	Na	
Oil		
Grease		

5. Discharge to the Cherry Creek Reservoir Basin?

Use Environmental Scoping Tool - sign on using your CDOT login:

<https://dtdinternalapps.dot.state.co.us/environmentalscoping/>

Or view Cherry Creek Drainage Basin Map here:

<https://www.cherrycreekbasin.org/maps>

6. Part of an Environmental Assessment or Environmental Impact Statement?

Check with Region NEPA or Environmental staff

*If answer to any question 4-6 is YES, PWQ is REQUIRED on the project. Please access the PWQ Program Manual and [website](#) for information about next steps or contact PWQ Program Manager [Rachel.hansgen@state.co.us](mailto:Rachel.hansgen@state.co.us).*