Kimley»Horn

DRAFT DRAINAGE MEMORANDUM

To:	Colorado Department of Transportation (CDOT) Region 2
From:	Kimley-Horn and Associates, Inc.
Date:	November 14, 2024
Subject:	Venetucci Blvd. and B St. Access Road Draft Drainage Memorandum

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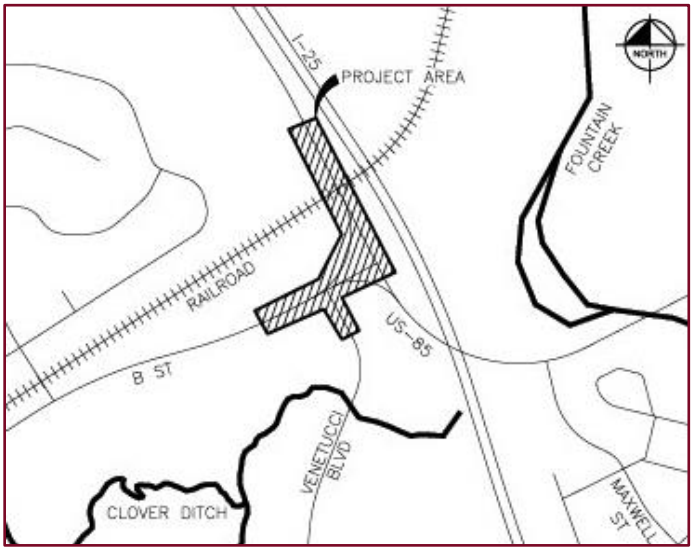
This memorandum provides an overview of the drainage and water quality study conducted in association with the proposed Venetucci Blvd. and B St. Access Road improvements project.

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_5	19.8	21.6	1.8
Q_{100}	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.

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- Existing Channel Worksheet

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- Proposed Basin Imperviousness and Runoff Coefficient Calculations
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- Proposed Area-Weighted Runoff Coefficient Calculations
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- 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 FIRMette

FEMA

104°47'23"W 38°46'52"N

104°46'46"W 38°46'24"N

Feet

0 250 500 1,000 1,500 2,000

1:6,000

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
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 / 17.5 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

N

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

October 3, 2024

Preface

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).

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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Contents

How Soil Surveys Are Made

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

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

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

Map Scale: 1:10,000 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 100 200 400 600

Feet: 0 450 900 1800 2700

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

MAP LEGEND

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

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

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 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%
Totals for Area of Interest		**480.4**	**100.0%**

Map Unit Descriptions

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

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

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a

particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

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

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

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

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

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

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

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

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

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

El Paso County Area, Colorado

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

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)

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: 2yvrd
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

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

Forage suitability group: Loamy (G069XW017CO)
Other vegetative classification: Loamy (G069XW017CO), Loamy Plains #6 (069XY006CO_2)
Hydric soil rating: No

Minor Components

Wilid

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

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

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)

Hydric soil rating: No

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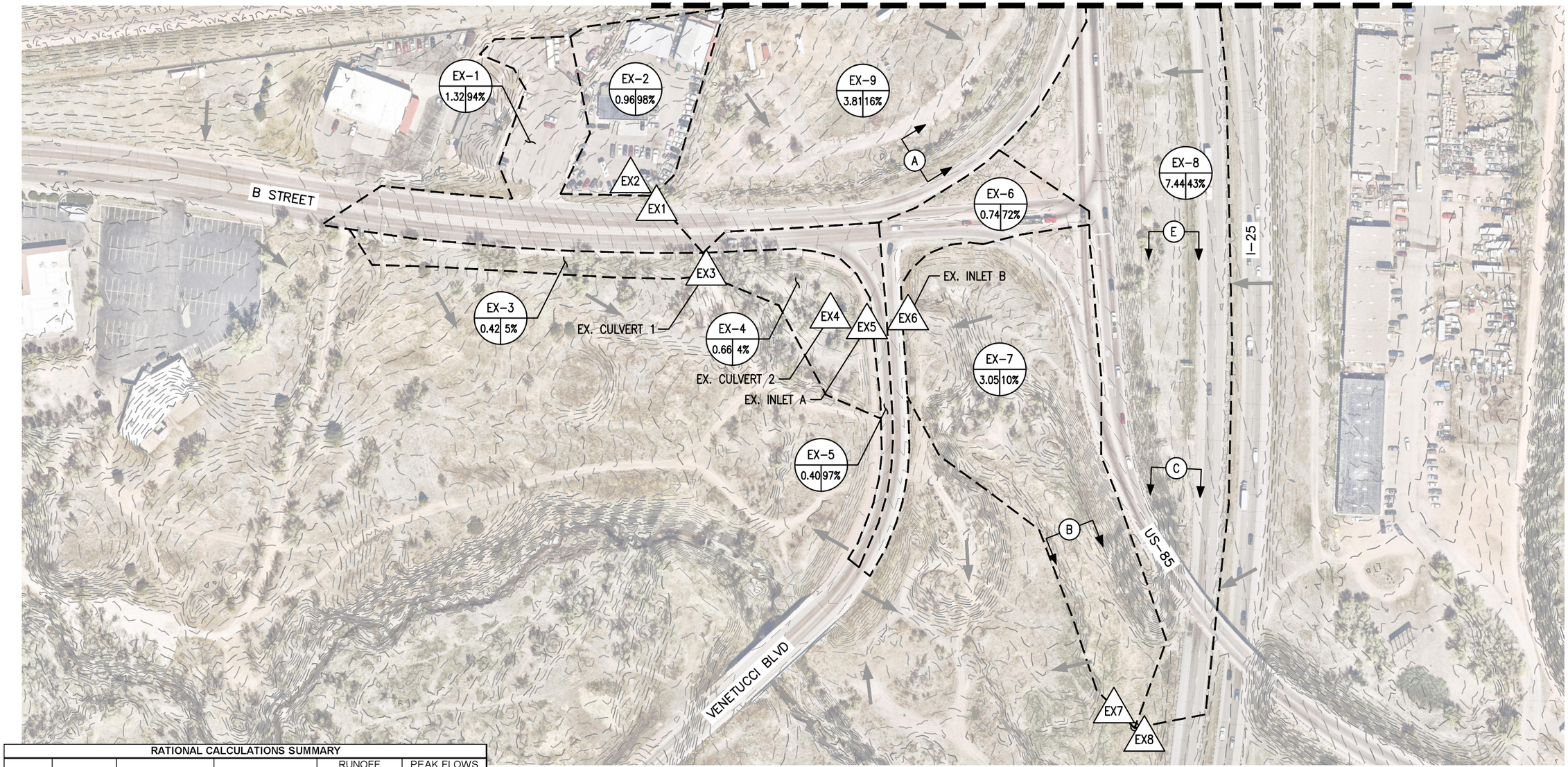
APPENDIX B – DRAINAGE MAPS



RATIONAL CALCULATIONS SUMMARY

DESIGN POINT	TRIBUTARY BASIN	TRIBUTARY AREA (AC)	IMPERVIOUSNESS (%)	RUNOFF COEFFICIENT C_5	RUNOFF COEFFICIENT C_{100}	PEAK FLOWS (CFS) DIRECT Q_5	PEAK FLOWS (CFS) DIRECT Q_{100}
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 / B C): A = BASIN DESIGNATION, B = AREA IN ACRES, C = IMPERVIOUSNESS
- EXISTING FLOW ARROW

GRAPHIC SCALE IN FEET
0 75 150 300

NORTH

October 22, 2024

Print Date: October 22, 2024
Drawing File Name: ex-drainage-map-196825002.dwg
Horiz. Scale: 1' = 150' Vert. Scale: N/A

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Sheet Revisions

	Date:	Comments:	Init.
R-X			
R-X			
R-X			
R-X			

VENETUCCI BLVD. & B ST.
ACCESS PERMIT #XXXXXX

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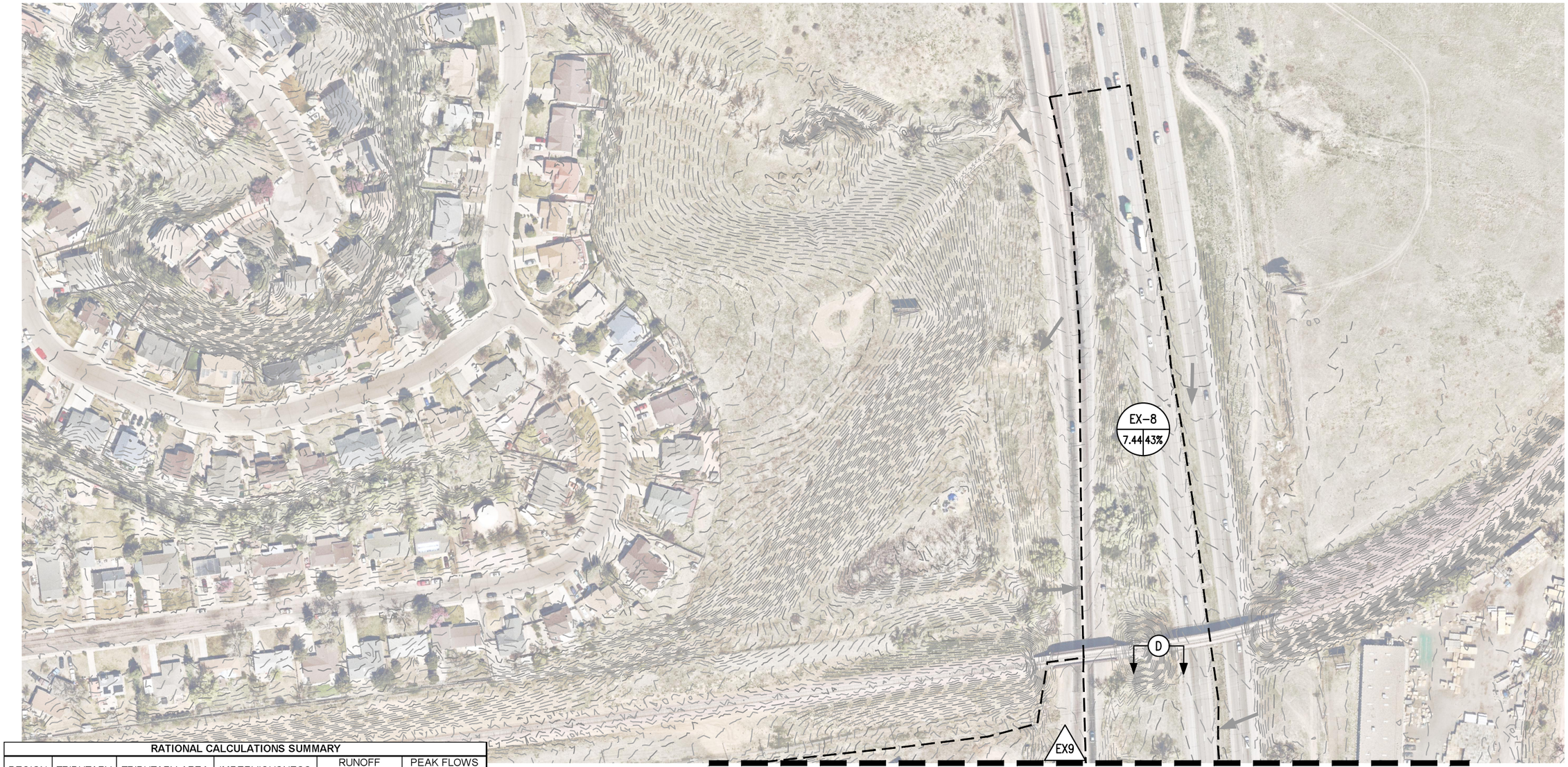
As Constructed
No Revisions:
Revised:
Void:

VENETUCCI BLVD. & B ST.
EXISTING DRAINAGE MAP

Designer: SMH
Detailer: CAS
Sheet Subset: DRAINAGE
Subset Sheet: 1 of 4

Project No./Code
PROJECT NO
196825002
Sheet Number A



RATIONAL CALCULATIONS SUMMARY							
DESIGN POINT	TRIBUTARY BASIN	TRIBUTARY AREA (AC)	IMPERVIOUSNESS (%)	RUNOFF COEFFICIENT		PEAK FLOWS (CFS) DIRECT	
				C_5	C_{100}	Q_5	Q_{100}
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:

MATCHLINE SEE SHEET A

EXISTING DRAINAGE BASIN BOUNDARY

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

EXISTING DESIGN POINT DESIGNATION

EXISTING FLOW ARROW

GRAPHIC SCALE IN FEET
0 75 150 300

NORTH

October 22, 2024

Print Date: October 22, 2024
Drawing File Name: ex-drainage-map-196825002.dwg
Horiz. Scale: 1" = 150' Vert. Scale: N/A

Kimley»Horn
KIMLEY-HORN AND ASSOCIATES, INC.
6200 SOUTH SYRACUSE WAY
SUITE 300
GREENWOOD VILLAGE, COLORADO 80111
(303) 228-2300

Sheet Revisions		
Date:	Comments:	Init.
R-X		
R-X		
R-X		
R-X		

VENETUCCI BLVD. & B ST.
ACCESS PERMIT #XXXXXX

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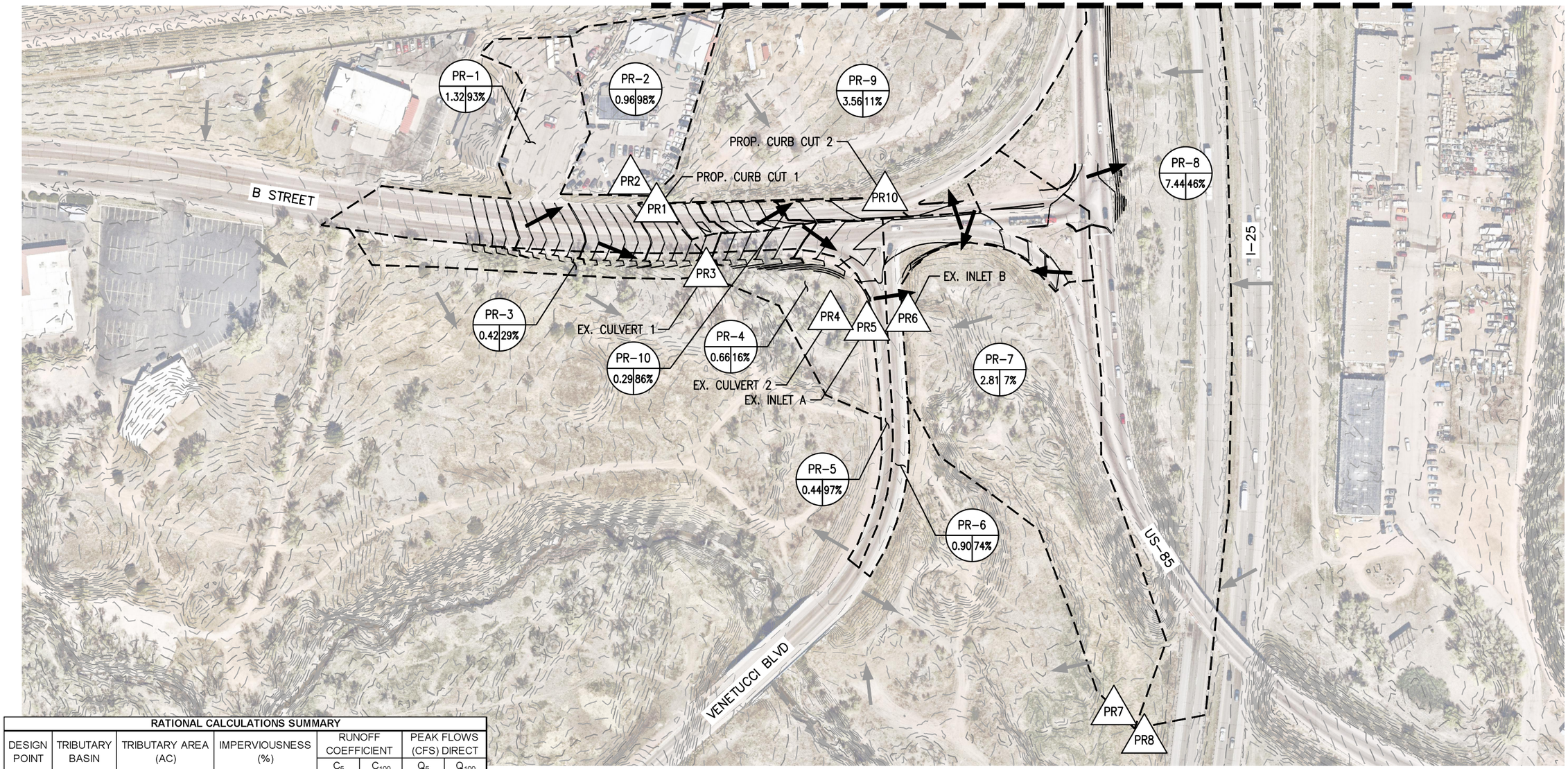
No Revisions:
Revised:
Void:

VENETUCCI BLVD. & B ST.
EXISTING DRAINAGE MAP

Designer: SMH
Detailer: CAS
Sheet Subset: DRAINAGE
Subset Sheet: 2 of 4

Project No./Code
PROJECT NO
196825002
Sheet Number B



RATIONAL CALCULATIONS SUMMARY							
DESIGN POINT	TRIBUTARY BASIN	TRIBUTARY AREA (AC)	IMPERVIOUSNESS (%)	RUNOFF COEFFICIENT		PEAK FLOWS (CFS) DIRECT	
				C_5	C_{100}	Q_5	Q_{100}
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

GRAPHIC SCALE IN FEET
0 75 150 300

NORTH

October 22, 2024

Print Date: October 22, 2024
Drawing File Name: prop-drainage-map-196825002.dwg
Horiz. Scale: 1" = 150' Vert. Scale: N/A

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Date:	Comments:	Init.

R-X R-X R-X R-X

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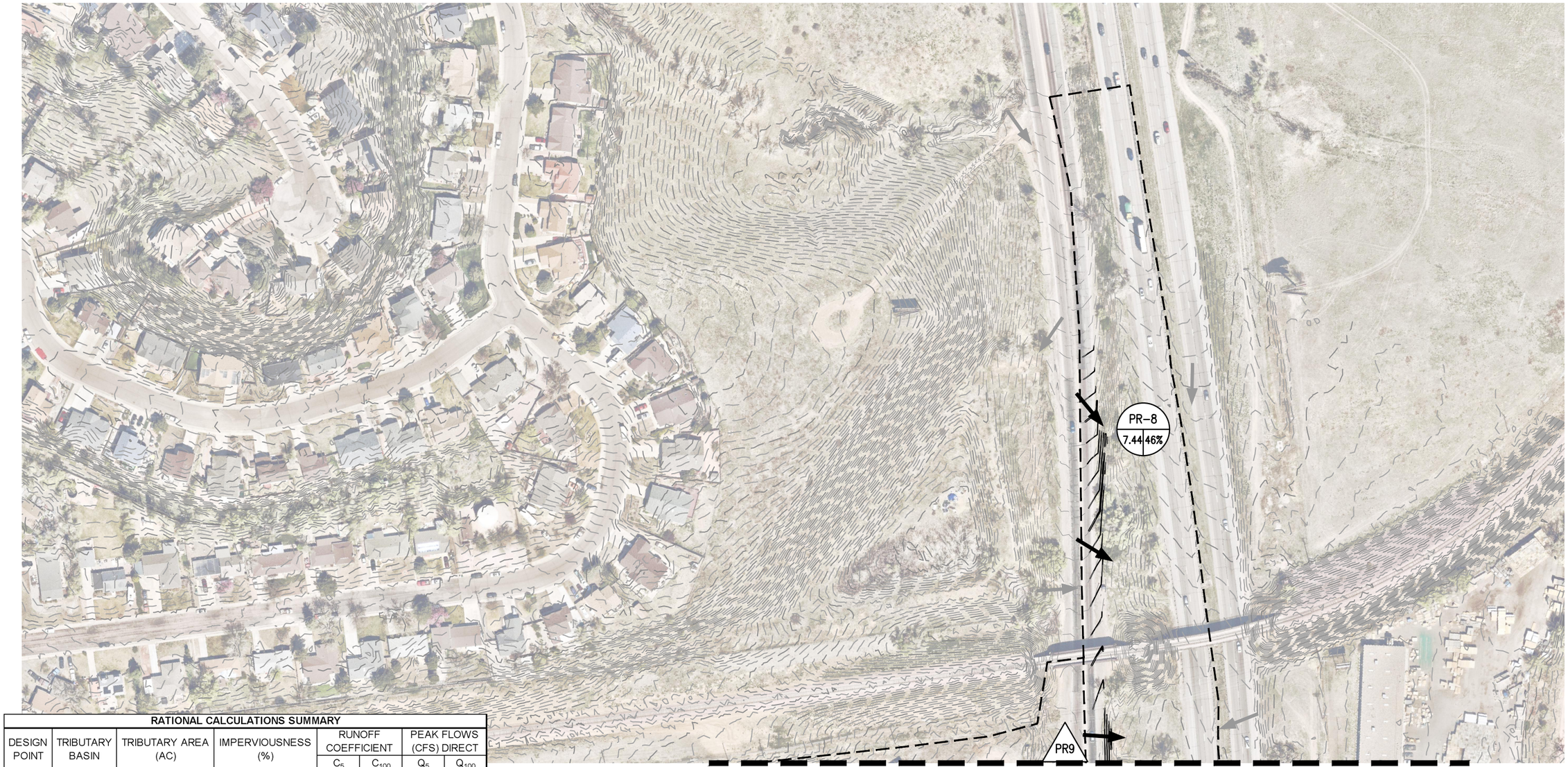
Revised:
Void:

VENETUCCI BLVD. & B ST.
PROPOSED DRAINAGE MAP

Designer: SMH
Detailer: CAS
Sheet Subset: DRAINAGE
Subset Sheet: 3 of 4

Project No./Code
PROJECT NO
196825002
Sheet Number C



RATIONAL CALCULATIONS SUMMARY							
DESIGN POINT	TRIBUTARY BASIN	TRIBUTARY AREA (AC)	IMPERVIOUSNESS (%)	RUNOFF COEFFICIENT		PEAK FLOWS (CFS) DIRECT	
				C_5	C_{100}	Q_5	Q_{100}
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

GRAPHIC SCALE IN FEET
0 75 150 300

NORTH

October 22, 2024

Print Date: October 22, 2024
Drawing File Name: prop-drainage-map-196825002.dwg
Horiz. Scale: 1" = 150' Vert. Scale: N/A

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Sheet Revisions		
Date:	Comments:	Init.
R-X		
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R-X		
R-X		

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Revised:
Void:

VENETUCCI BLVD. & B ST.
PROPOSED DRAINAGE MAP

Designer: SMH
Detailer: CAS
Sheet Subset: DRAINAGE
Subset Sheet: 4 of 4

Project No./Code
PROJECT NO
196825002
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_{TOTAL} (AC)	A_{TOTAL} (SF)	$A_{LANDSCAPE}$ (SF)	$A_{ROOF/DRIVES\ \&\ WALKS}$ (SF)	$A_{STREETS}$ (SF)	$I_{WEIGHTED}$
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%
TOTAL	**18.80**	**819099.47**	**511522.86**	**9302.13**	**298274.49**	**39%**

Calculation of Peak Runoff using Rational Method

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

Version 2.00 released May 2017

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

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L_i}}{S_i^{0.33}}$$

$$t_t = \frac{L_t}{60K\sqrt{S_t}} = \frac{L_t}{60V_t}$$

Computed $t_c = t_i + t_t$

Regional $t_c = (26 - 17i) + \frac{L_t}{60(14i + 9)\sqrt{S_t}}$

$t_{minimum}$ = 5 (urban)
$t_{minimum}$ = 10 (non-urban)

Selected $t_c = \max\{t_{minimum}, \min(\text{Computed } t_c, \text{Regional } t_c)\}$

Select UDFCD location for NOAA Atlas 14 Rainfall Depths from the pulldown list OR enter your own depths obtained from the NOAA website (click this link)

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
1-hour rainfall depth, P1 (in) =	1.06	1.46	1.66	1.90	2.24	2.60	3.62
	a	b	c				
Rainfall Intensity Equation Coefficients =	28.50	10.00	0.786				

$$I(in/hr) = \frac{a * P_1}{(b + t_c)^c}$$

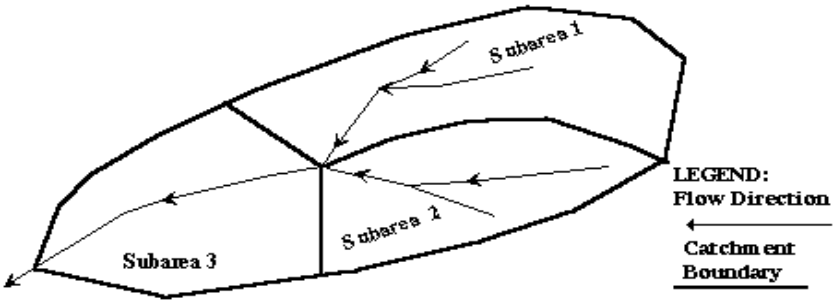
$Q(cfs) = CIA$

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_i (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Overland Flow Slope S_i (ft/ft)	Overland Flow Time t_i (min)	Channelized Flow Length L_t (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Channelized Flow Slope S_t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Velocity V_t (ft/sec)	Channelized Flow Time t_t (min)	Computed t_c (min)	Regional t_c (min)	Selected t_c (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
EX-1	1.32	C	93.6	0.77	0.80	0.82	0.84	0.86	0.87	0.88	240.00			0.040	5.38	395.00			0.053	20	4.60	1.43	6.81	11.39	6.81	3.29	4.53	5.15	5.89	6.95	8.06	11.23	3.35	4.76	5.56	6.55	7.83	9.21	13.06
EX-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
EX-3	0.42	C	4.9	0.03	0.07	0.17	0.35	0.42	0.50	0.60	50.00			0.052	7.58	510.00			0.047	10	2.16	3.94	11.52	29.24	11.52	2.71	3.73	4.24	4.85	5.72	6.64	9.25	0.03	0.12	0.30	0.70	0.99	1.39	2.32
EX-4	0.66	C	4.0	0.02	0.07	0.16	0.34	0.41	0.50	0.60	165.00			0.048	14.32	170.00			0.007	10	0.82	3.46	17.78	28.94	17.78	2.22	3.05	3.47	3.97	4.68	5.43	7.56	0.03	0.14	0.37	0.90	1.28	1.81	3.02
EX-5	0.40	C	96.9	0.81	0.82	0.84	0.86	0.87	0.88	0.89	70.00			0.009	4.32	350.00			0.017	20	2.62	2.23	6.55	11.50	6.55	3.33	4.58	5.21	5.97	7.03	8.16	11.37	1.07	1.51	1.76	2.05	2.45	2.87	4.05
EX-6	0.74	C	71.5	0.57	0.62	0.66	0.72	0.75	0.78	0.81	135.00			0.003	14.58	375.00			0.014	20	2.38	2.62	17.20	16.60	16.60	2.29	3.16	3.59	4.11	4.84	5.62	7.83	0.97	1.44	1.75	2.19	2.67	3.23	4.71
EX-7	3.05	C	9.8	0.06	0.12	0.20	0.37	0.44	0.52	0.62	250.00			0.027	20.18	780.00			0.019	10	1.39	9.38	29.57	33.37	29.57	1.68	2.31	2.63	3.01	3.54	4.11	5.73	0.32	0.81	1.64	3.43	4.78	6.58	10.82
EX-8	7.44	C	43.5	0.33	0.39	0.45	0.56	0.61	0.66	0.72	160.00			0.004	22.14	2005.00			0.013	10	1.16	28.87	51.01	37.74	37.74	1.45	1.99	2.27	2.59	3.06	3.55	4.94	3.53	5.78	7.62	10.86	13.83	17.48	26.67
EX-9	3.81	C	15.6	0.10	0.16	0.25	0.41	0.47	0.55	0.64	395.00			0.065	18.13	725.00			0.014	10	1.17	10.32	28.45	32.57	28.45	1.72	2.36	2.69	3.08	3.63	4.21	5.86	0.68	1.46	2.53	4.77	6.50	8.79	14.23

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

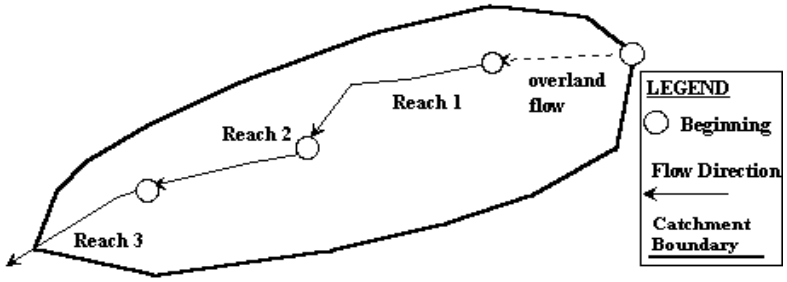
See sheet "Design Info" for imperviousness-based runoff coefficient values.

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_i (ft)	Overland Flow Slope S_i (ft/ft)	5-yr Runoff Coefficient, C_5	Overland Flow Time t_i (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_i (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 (AC)	Q_5 (CFS)	Q_{100} (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 Formula
Solve For	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	ft²
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	

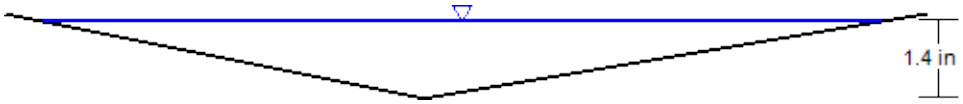
GVF Input Data		
Downstream Depth	0.0	in
Length	0.0	ft
Number Of Steps	0	

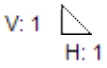
GVF Output Data		
Upstream Depth	0.0	in
Profile Description	N/A	
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.4	in
Critical Depth	1.5	in
Channel Slope	0.047	ft/ft
Critical Slope	0.034	ft/ft

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





Worksheet 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
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	ft²
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	

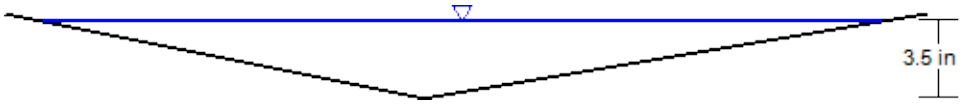
GVF Input Data		
Downstream Depth	0.0	in
Length	0.0	ft
Number Of Steps	0	

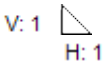
GVF Output Data		
Upstream Depth	0.0	in
Profile Description	N/A	
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	3.5	in
Critical Depth	4.0	in
Channel Slope	0.047	ft/ft
Critical Slope	0.024	ft/ft

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





Worksheet 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
Left Side Slope	4.000	H:V
Right Side Slope	4.000	H:V
Discharge	0.14	cfs

Results		
Normal Depth	2.4	in
Flow Area	0.2	ft²
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	

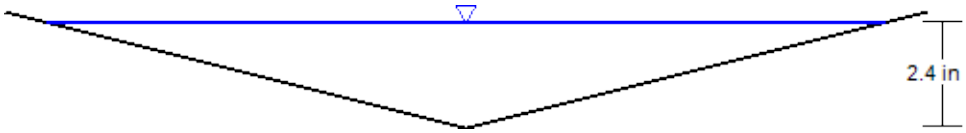
GVF Input Data		
Downstream Depth	0.0	in
Length	0.0	ft
Number Of Steps	0	

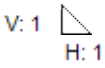
GVF Output Data		
Upstream Depth	0.0	in
Profile Description	N/A	
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.4	in
Critical Depth	1.8	in
Channel Slope	0.007	ft/ft
Critical Slope	0.032	ft/ft

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





Worksheet 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
Left Side Slope	4.000	H:V
Right Side Slope	4.000	H:V
Discharge	1.81	cfs

Results		
Normal Depth	6.3	in
Flow Area	1.1	ft²
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	

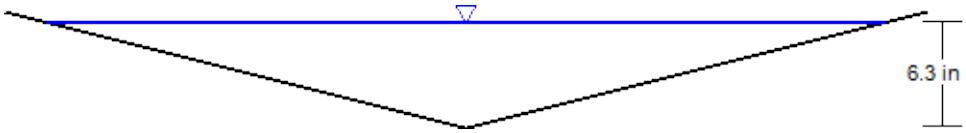
GVF Input Data		
Downstream Depth	0.0	in
Length	0.0	ft
Number Of Steps	0	

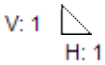
GVF Output Data		
Upstream Depth	0.0	in
Profile Description	N/A	
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	6.3	in
Critical Depth	5.0	in
Channel Slope	0.007	ft/ft
Critical Slope	0.023	ft/ft

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





Worksheet 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
Left Side Slope	5.000	H:V
Right Side Slope	8.000	H:V
Discharge	0.81	cfs

Results		
Normal Depth	3.2	in
Flow Area	0.5	ft²
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	

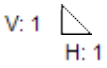
GVF Input Data		
Downstream Depth	0.0	in
Length	0.0	ft
Number Of Steps	0	

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	3.2	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



Worksheet 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
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	ft²
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	

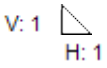
GVF Input Data		
Downstream Depth	0.0	in
Length	0.0	ft
Number Of Steps	0	

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



Worksheet 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
Left Side Slope	6.000	H:V
Right Side Slope	6.000	H:V
Discharge	5.78	cfs

Results		
Normal Depth	7.4	in
Flow Area	2.3	ft²
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	

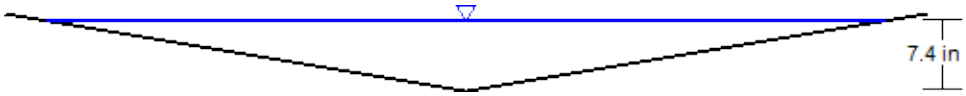
GVF Input Data		
Downstream Depth	0.0	in
Length	0.0	ft
Number Of Steps	0	

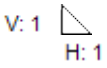
GVF Output Data		
Upstream Depth	0.0	in
Profile Description	N/A	
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	7.4	in
Critical Depth	6.8	in
Channel Slope	0.013	ft/ft
Critical Slope	0.020	ft/ft

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





Worksheet 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
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	ft²
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	

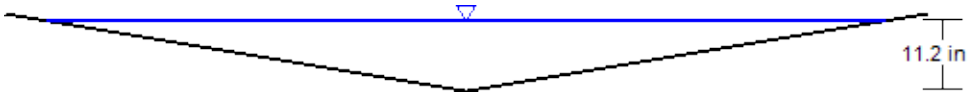
GVF Input Data		
Downstream Depth	0.0	in
Length	0.0	ft
Number Of Steps	0	

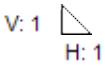
GVF Output Data		
Upstream Depth	0.0	in
Profile Description	N/A	
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	11.2	in
Critical Depth	10.6	in
Channel Slope	0.013	ft/ft
Critical Slope	0.018	ft/ft

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





Worksheet 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
Left Side Slope	3.000	H:V
Right Side Slope	6.000	H:V
Discharge	1.46	cfs

Results		
Normal Depth	4.9	in
Flow Area	0.7	ft²
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	

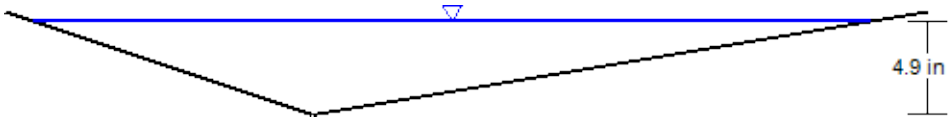
GVF Input Data		
Downstream Depth	0.0	in
Length	0.0	ft
Number Of Steps	0	

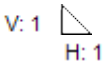
GVF Output Data		
Upstream Depth	0.0	in
Profile Description	N/A	
Profile Headloss	0.00	ft
Downstream Velocity	0.00	ft/s
Upstream Velocity	0.00	ft/s
Normal Depth	4.9	in
Critical Depth	4.4	in
Channel Slope	0.014	ft/ft
Critical Slope	0.024	ft/ft

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





Worksheet 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
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	ft²
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	

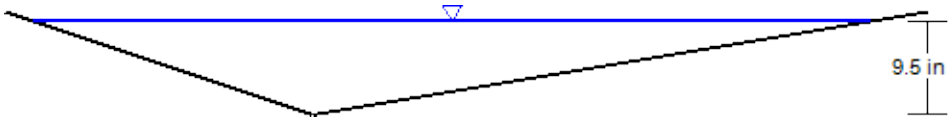
GVF Input Data		
Downstream Depth	0.0	in
Length	0.0	ft
Number Of Steps	0	

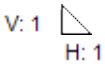
GVF Output Data		
Upstream Depth	0.0	in
Profile Description	N/A	
Profile Headloss	0.00	ft
Downstream Velocity	0.00	ft/s
Upstream Velocity	0.00	ft/s
Normal Depth	9.5	in
Critical Depth	9.0	in
Channel Slope	0.014	ft/ft
Critical Slope	0.019	ft/ft

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





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_{TOTAL} (AC)	A_{TOTAL} (SF)	$A_{LANDSCAPE}$ (SF)	$A_{ROOF/DRIVES\ \&\ WALKS}$ (SF)	$A_{STREETS}$ (SF)	$I_{WEIGHTED}$
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%
TOTAL	**18.80**	**819129.43**	**491330.00**	**17631.86**	**310167.58**	**41%**

Calculation of Peak Runoff using Rational Method

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

Version 2.00 released May 2017

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

$t_i = \frac{0.395(1.1 - C_5)\sqrt{L_i}}{S_i^{0.33}}$

$t_t = \frac{L_t}{60K\sqrt{S_t}} = \frac{L_t}{60V_t}$

Computed $t_c = t_i + t_t$

Regional $t_c = (26 - 17i) + \frac{L_t}{60(14i + 9)\sqrt{S_t}}$

$t_{minimum}$ = 5 (urban)
$t_{minimum}$ = 10 (non-urban)

Selected $t_c = \max\{t_{minimum}, \min(\text{Computed } t_c, \text{Regional } t_c)\}$

Select UDFCD location for NOAA Atlas 14 Rainfall Depths from the pulldown list OR enter your own depths obtained from the NOAA website (click this link)

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
1-hour rainfall depth, P1 (in) =	1.06	1.46	1.66	1.90	2.24	2.60	3.62
	a	b	c				
Rainfall Intensity Equation Coefficients =	28.50	10.00	0.786				

$I(in/hr) = \frac{a * P_1}{(b + t_c)^c}$

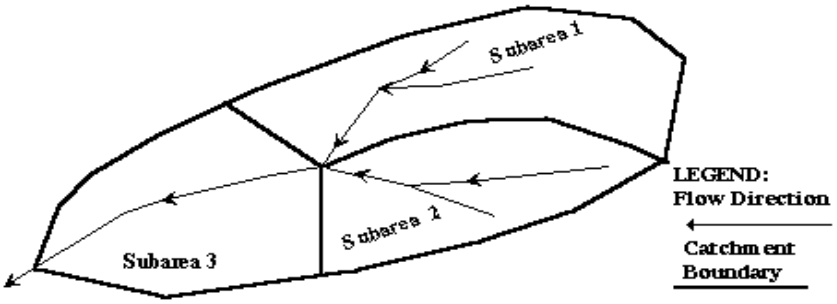
$Q(cfs) = CIA$

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_i (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Overland Flow Slope S_i (ft/ft)	Overland Flow Time t_i (min)	Channelized Flow Length L_t (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Channelized Flow Slope S_t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Velocity V_t (ft/sec)	Channelized Flow Time t_t (min)	Computed t_c (min)	Regional t_c (min)	Selected t_c (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

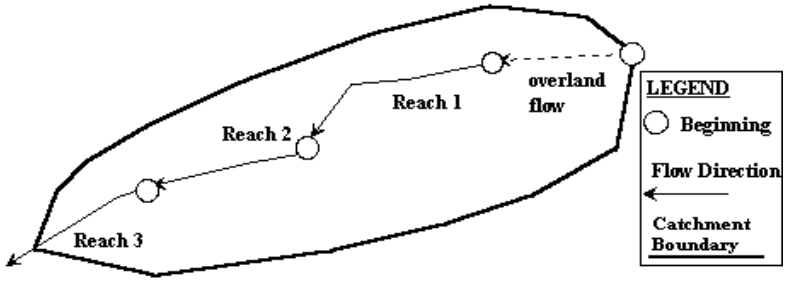
See sheet "Design Info" for imperviousness-based runoff coefficient values.

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**	**0.32**	**0.37**	**0.43**	**0.55**	**0.60**	**0.65**	**0.72**
			Area-Weighted Override C	**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_i (ft)	Overland Flow Slope S_i (ft/ft)	5-yr Runoff Coefficient, C_5	Overland Flow Time t_i (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_i (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 (AC)	Q_5 (CFS)	Q_{100} (CFS)
PR-1	1.32	4.71	9.14
PR-2	**0.96**	3.85	7.26
PR-3	0.42	0.44	1.75
PR-4	**0.66**	0.34	2.06
PR-5	0.44	1.70	3.23
PR-6	**0.90**	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
	28.50	10.00	0.786

$$I(in/hr) = \frac{a * P_1}{(b + t_c)^c}$$

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_5 (CFS)	T_C MIN	SUM C X A	I IN/HR	Q 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} (CFS)	T_C MIN	SUM C X A	I IN/HR	Q 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	
TOTAL RUNOFF		**61.31**					

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

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	0.44	cfs

Results		
Normal Depth	2.3	in
Flow Area	0.2	ft²
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	

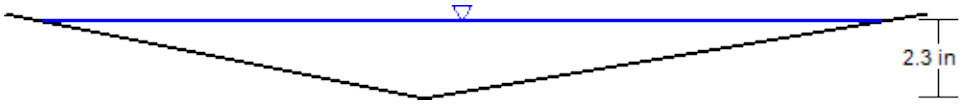
GVF Input Data		
Downstream Depth	0.0	in
Length	0.0	ft
Number Of Steps	0	

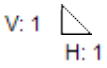
GVF Output Data		
Upstream Depth	0.0	in
Profile Description	N/A	
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.3	in
Critical Depth	2.5	in
Channel Slope	0.047	ft/ft
Critical Slope	0.028	ft/ft

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





Worksheet 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
Left Side Slope	5.000	H:V
Right Side Slope	6.000	H:V
Discharge	1.75	cfs

Results		
Normal Depth	3.8	in
Flow Area	0.6	ft²
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	

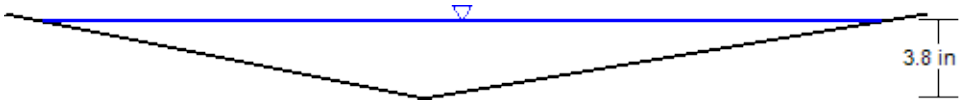
GVF Input Data		
Downstream Depth	0.0	in
Length	0.0	ft
Number Of Steps	0	

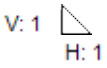
GVF Output Data		
Upstream Depth	0.0	in
Profile Description	N/A	
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	3.8	in
Critical Depth	4.4	in
Channel Slope	0.047	ft/ft
Critical Slope	0.024	ft/ft

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





Worksheet 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
Left Side Slope	4.000	H:V
Right Side Slope	4.000	H:V
Discharge	0.34	cfs

Results		
Normal Depth	3.3	in
Flow Area	0.3	ft²
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	

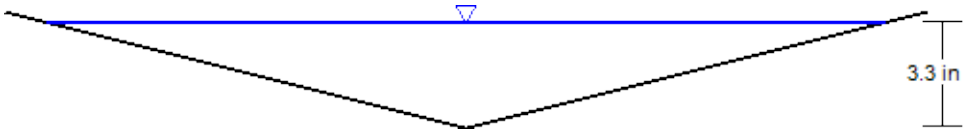
GVF Input Data		
Downstream Depth	0.0	in
Length	0.0	ft
Number Of Steps	0	

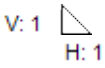
GVF Output Data		
Upstream Depth	0.0	in
Profile Description	N/A	
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	3.3	in
Critical Depth	2.6	in
Channel Slope	0.007	ft/ft
Critical Slope	0.029	ft/ft

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





Worksheet 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
Left Side Slope	4.000	H:V
Right Side Slope	4.000	H:V
Discharge	2.06	cfs

Results		
Normal Depth	6.6	in
Flow Area	1.2	ft²
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	

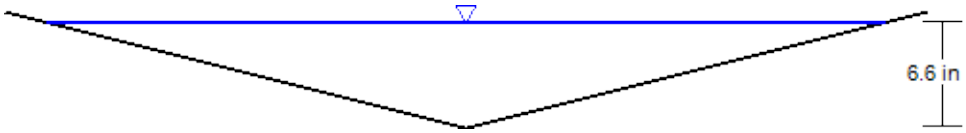
GVF Input Data		
Downstream Depth	0.0	in
Length	0.0	ft
Number Of Steps	0	

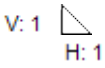
GVF Output Data		
Upstream Depth	0.0	in
Profile Description	N/A	
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	6.6	in
Critical Depth	5.3	in
Channel Slope	0.007	ft/ft
Critical Slope	0.023	ft/ft

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





Worksheet 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
Left Side Slope	8.000	H:V
Right Side Slope	8.000	H:V
Discharge	0.64	cfs

Results		
Normal Depth	2.5	in
Flow Area	0.3	ft²
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	

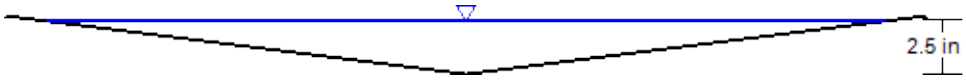
GVF Input Data		
Downstream Depth	0.0	in
Length	0.0	ft
Number Of Steps	0	

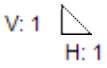
GVF Output Data		
Upstream Depth	0.0	in
Profile Description	N/A	
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.5	in
Critical Depth	2.5	in
Channel Slope	0.028	ft/ft
Critical Slope	0.028	ft/ft

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 Formula
Solve For	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	ft²
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	

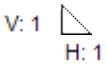
GVF Input Data		
Downstream Depth	0.0	in
Length	0.0	ft
Number Of Steps	0	

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



Worksheet 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
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	ft²
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	

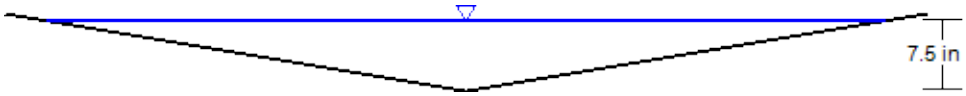
GVF Input Data		
Downstream Depth	0.0	in
Length	0.0	ft
Number Of Steps	0	

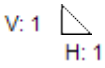
GVF Output Data		
Upstream Depth	0.0	in
Profile Description	N/A	
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	7.5	in
Critical Depth	6.9	in
Channel Slope	0.013	ft/ft
Critical Slope	0.020	ft/ft

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





Worksheet 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
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	ft²
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	

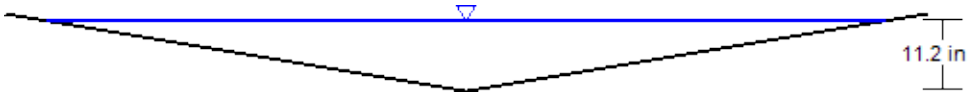
GVF Input Data		
Downstream Depth	0.0	in
Length	0.0	ft
Number Of Steps	0	

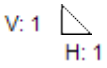
GVF Output Data		
Upstream Depth	0.0	in
Profile Description	N/A	
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	11.2	in
Critical Depth	10.6	in
Channel Slope	0.013	ft/ft
Critical Slope	0.018	ft/ft

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





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	ft²
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	

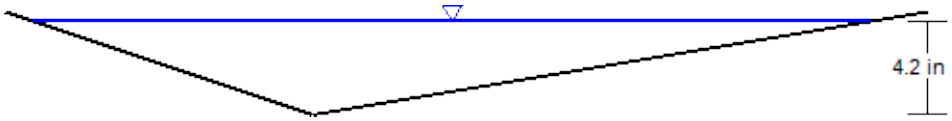
GVF Input Data		
Downstream Depth	0.0	in
Length	0.0	ft
Number Of Steps	0	

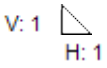
GVF Output Data		
Upstream Depth	0.0	in
Profile Description	N/A	
Profile Headloss	0.00	ft
Downstream Velocity	0.00	ft/s
Upstream Velocity	0.00	ft/s
Normal Depth	4.2	in
Critical Depth	3.8	in
Channel Slope	0.014	ft/ft
Critical Slope	0.025	ft/ft

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





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	ft²
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	

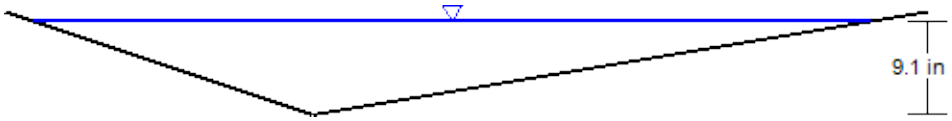
GVF Input Data		
Downstream Depth	0.0	in
Length	0.0	ft
Number Of Steps	0	

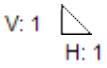
GVF Output Data		
Upstream Depth	0.0	in
Profile Description	N/A	
Profile Headloss	0.00	ft
Downstream Velocity	0.00	ft/s
Upstream Velocity	0.00	ft/s
Normal Depth	9.1	in
Critical Depth	8.6	in
Channel Slope	0.014	ft/ft
Critical Slope	0.019	ft/ft

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





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. 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
(Y) or N	(Y) or N	Y or (N)

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[1]?
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:

[1] 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_2 + NO_3	
Total Phosphorus	TP	
Chloride	Cl^-	
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.