

**FINAL DRAINAGE REPORT  
LOT 2, BENT GRASS EAST COMMERCIAL FILING NO. 4  
CARUBIA PROPERTIES**

PCD FILE NO. PPR256

**PREPARED FOR:**

CARUBIA PROPERTIES  
8035 MERIDIAN PARK DRIVE  
FALCON, CO 80831  
719-640-1962  
CONTACT: LUCAS CARUBIA

**PREPARED BY:**

PERCEPTION DESIGN GROUP, INC.  
6901 SOUTH PIERCE STREET, SUITE 220  
LITTLETON, CO 80128  
CONTACT: JERRY W. DAVIDSON, P.E.  
(303) 232-8088

JOB #2024-019

JULY 11, 2025

Engineers Statement:

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

\_\_\_\_\_  
Jerry W. Davidson, P.E.  
CO Reg No. 30226  
For and On Behalf Of  
Perception Design Group, Inc.

Developer's Statement:

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

Business Name: \_\_\_\_\_

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

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

Address: \_\_\_\_\_

El Paso County:

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

\_\_\_\_\_  
Joshua Palmer, P.E.  
County Engineer / ECM Administrator

\_\_\_\_\_  
Date

Conditions:

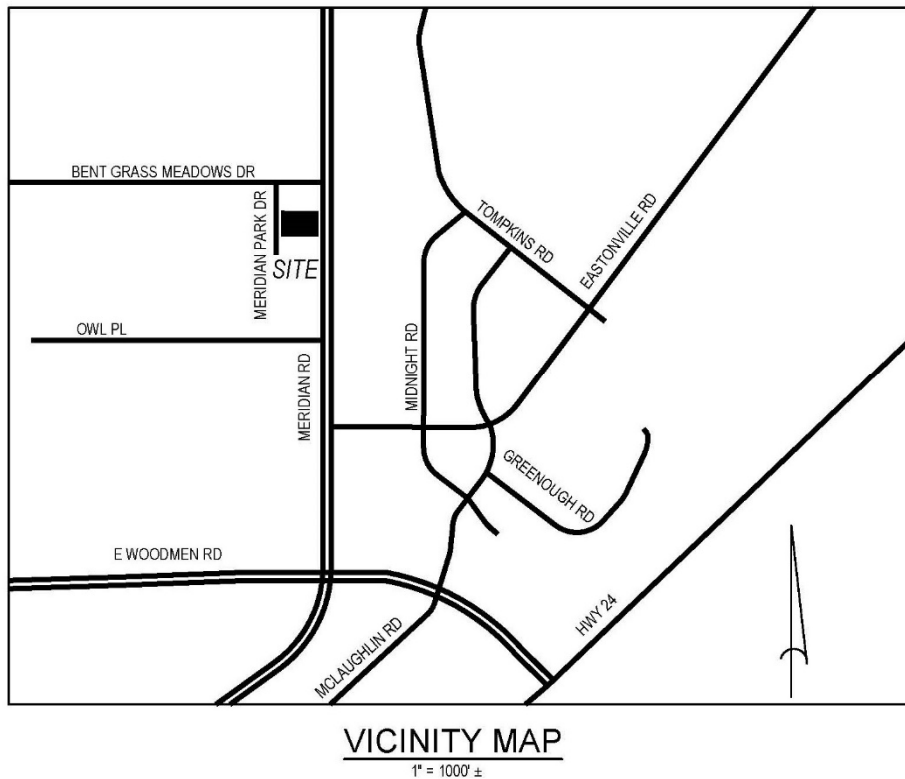
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## Section A: GENERAL LOCATION

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The Carubia Properties project is located on the east side of Meridian Park Drive approximately 300 feet south of Bent Grass Meadows Drive in Falcon, Colorado. The site address is 8035 Meridian Park Drive, Falcon, CO 80831. It is in unincorporated El Paso County. Meridian Park Drive is located to the west of the property and Meridian Road is to the east.



By rectangular survey coordinates the project is located in the Northeast Quarter of Section 1, Township 13 South, Range 65 West of the 6th P.M. County Of El Paso, State of Colorado.

There are no major drainageways within the property. There are no existing stormwater facilities within the property.

Surrounding developments include Lot 1 Bent Grass East Commercial Filing No.1 to the north. This site is developed as a 7-Eleven fuel station and convenience store. To the west is Bent Grass East Commercial Filing No 2B and Filing No. 3 which are vacant ground and a veterinary clinic. To the south is vacant ground in Bent Grass East Commercial Filing No 4. To the east is Woodmen Hills Fil No 8, a residential subdivision.

## Section B: DESCRIPTION OF PROPERTY

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The subject property contains 0.87 acres of land and is zoned CS. Ground cover consists of bare dirt and native grass. Site topography slopes from north to south at average 3%. The easterly side of the site discharges to the roadside ditch of Meridian Road while the westerly side of the site discharges onto the adjacent property south.

Site soils as illustrated on the NRCS Web Soil Survey indicate Columbine gravelly sandy loam soils are present at the site. This soil is a well-drained soil with hydrologic soil group A designation.

There are no major drainageways or irrigation facilities on the property.

The property is generally free of encumbrances with utility easements around the perimeter of the property. These easements are generally free of utilities with the exception of dry utilities along the west side of the property.

Proposed development includes the construction of a commercial medical office building with associated parking and utilities.

## Section C: MAJOR BASIN DESCRIPTIONS

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There are no major drainageways thru or adjacent to the property. By graphic plotting only the subject property is situated in flood zone "X" according to Flood Insurance Rate Map (FIRM) community panel no. 08041C0553G with an effective date of December 17, 2018. Zone X Flood Areas are "Areas determined to be outside the 100-year floodplain". The Site falls in the Middle Tributary Basin within the Falcon Drainage Basin. Receiving waters is the Falcon Drainage Basin. Major basin characteristics include a mixture of residential, commercial and open range land. There are no obstructions on the property that would affect the major basin drainage flow patterns.

Drainage basin fees were paid when the property was platted.

## Section D: SUB-BASIN DESCRIPTIONS

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In the existing / historic condition, site topography slopes from north to south at an average of 3%. The easterly side of the site discharges to the roadside ditch of Meridian Road while the westerly side of the site discharges onto the adjacent property south. Offsite flow patterns have no impact on the property. Up-gradient flows are intercepted along the north property line and conveyed around the property via storm sewer. Historic sub-basins are described below:

Basin Dn: This basin represents the adjusted historic basin D. Basin D is illustrated on the drainage map prepared for the Bent Grass East report and included in the appendix. Basin Dn is 82.9% of the original basin D area. Allowable runoff from Dn is adjusted from the allowable reported in the Bent Grass East report based upon the size percentage of the new Dn Basin. Basin Dn defines allowable flows to the roadside ditch of Meridian Road. Basin parameters are summarized as follows:

Design Point	A
Area	0.34 ac
Percentage of original basin D	82.9 %
Q5 Allowable	1.7 cfs
Q100 Allowable	2.5 cfs

Basin D1n: This basin represents the adjusted historic basin D1. Basin D1 is illustrated on the drainage map prepared for the Bent Grass East report and included in the appendix. Basin D1n is 68.2% of the original basin D1 area. Allowable runoff from D1n is adjusted from the allowable reported in the Bent Grass East report based upon the size percentage of the new D1n basin. Basin D1n defines allowable flows to Meridian Drive and thence to the existing detention and water quality facility. Basin parameters are summarized as follows:

Design Point	B
Area	0.43 ac
Percentage of original basin D	68.2 %
Q5 Allowable	2.0 cfs
Q100 Allowable	3.4 cfs

## Section E: DRAINAGE DESIGN CRITERIA

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### 1. Hydrologic Criteria

Minor and major storm frequencies used in the design are 5 year for the minor, and 100 year for the major. Rainfall data was obtained from the Bent Grass East Commercial Phase 1 Preliminary Drainage Report to provide continuity. Results are summarized below.

<b>Storm Frequency (Year)</b>	<b>Rainfall Intensity (in/hr)</b>
5	5.10
100	9.07

The rational method was used, as described in MHFD manual, to calculate developed direct runoff for the 5-year and 100-year storm frequencies. As the site is relatively small, a time of concentration value of 5 minutes is used for a conservative solution. Composite C values are calculated per MHFD criteria.

The rational method equation ( $Q=CIA$ ) is used to determine the maximum rate of runoff for each basin. In which:

Q= the maximum rate of runoff (cubic feet per second)

C= the runoff coefficient

I= the average intensity of rainfall for a duration equal to the time of concentration (inches/hour)

A= basin area (acres)

Water quality volumes are calculated using MHFD equations 3-1 and 3-2. Water quality discharge is calculated based upon 12 hour minimum drain time.

### 2. Hydraulic Criteria

Minor and major storm frequencies used in the design are 5 year for the minor, and 100 year for the major. The storm sewer pipes and inlets will be sized for the 100 year storm.

### 3. Previous Reports and Studies

The site was previously studied in a report entitled "Preliminary Drainage Report for Bent Grass East Commercial – Phase 1 (Preliminary Plan) and Final Drainage Report for Bent Grass East Commercial Filing No. 1 – Lot 1 (Final Plat)," prepared by Classic Consulting Engineers & Surveyors, approved March 15, 2013.

The site was further studied in a report entitled "Dunkin Bent Grass Lot 1A of Bent Grass East Commercial Filing No. 2A 8035 Meridian Park Drive, Peyton, CO 80831 Final Drainage Report" prepared by M&S Civil Consultants, Inc, approved September 06, 2023.

The Dunkin project has not been built to date thus the Bent Grass East report is used as a reference in this study.



In the Bent Grass East report, the Carubia site is shown in Basins D and D1. Subsequent re-plat has changed the property such that a portion of basins D and D1 are no longer contained within the site. New basins Dn (D new) and D1n (D1 new) are established to assist in runoff analysis. These new basins are compared by area to the original establishing a percentage of the original size. This percentage is then applied to the allowable runoff to determine compliance with the original report. Results are presented in the table below:

Basin	Area (Acres)	Percentage of Original Basin	Q5 (cfs)	Q100 (cfs)
D	0.41	100%	2	3
D1	0.63	100%	3	5
Dn	0.34	82.9%	1.7	2.5
D1n	0.43	68.2%	2.0	3.4

The Bent Grass East report further provides for detention and water quality for basin D1, while neither detention nor water quality are provided for basin D. The report calls for water quality only for basin D to be provided on-site.

## Section F: FOUR STEP PROCESS

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### 1. Step 1 – Runoff Reduction

Runoff reduction is achieved for a portion of the site. The roof area of basin E is routed via a 1' curb chase to a level spreader just past the rock to slow down the flow for better infiltration through the Grass Buffer B and proposed Grass Swale C. Grass Swale C is for water quality only. Detention is not provided. The roof area of basin G is routed via pipes to a level spreader just past the rock to slow down the flow for better infiltration through the Grass Buffer J. The parking areas for basin F is surface discharge via 12" curb cuts with 10' spacing O.C. through grass buffer F and existing Grass Swale G.

### 2. Step 2 – Stabilization of Drainageways

As no drainageways exist on the site, no stabilization is proposed.

### 3. Step 3 – Stormwater Quality Capture Volume

Stormwater Quality Capture Volume is provided for basins A, B, and C in the existing detention and water quality facility offsite to the southwest of the property. This pond is known as Pond 2 designed with SF1411 and SF1412. Stormwater Quality Capture Volume is provided for basin E, F, G and OS-1 via Runoff Reduction. The table below illustrates water quality treatment for the site:

<u>Basin ID(s)</u>	<u>PCM Trib. Area (ac)</u>	<u>PCM ID</u>
A,B,C	0.43	Pond 2 designed with SF1411 and SF1412
E	0.13	WQ treatment via Runoff Reduction via Grass Swale C and RPA Grass Buffer B
F and OS-1	0.10	WQ treatment via Runoff Reduction via Grass Swale G and RPA Grass Buffer F
G	0.16	WQ treatment via Runoff Reduction via Grass Buffer J

### 4. Step 4 – BMP's for Commercial and Industrial Pollutants

Industrial and commercial pollutants will be limited for the site. No industrial activities are proposed, and commercial activities are limited to a parking lot.

## Section G: DRAINAGE FACILITY DESIGN

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### 1. General Concept

The general drainage concept is to grade the site such that the original basin division line of basins D and D1 dividing runoff between flows east and west are more or less maintained. Basins A, B, and C are directed to the west to the adjacent street and conveyed southwesterly to the existing detention and water quality facility for the site known as Pond 2 designed with SF1411 and SF1412. Examination of aerial google photography indicates the pond is constructed. As discussed in E.3 above, the allowable runoff to pond 2 is 3.4 cfs 100 year. Runoff generated for the development in this report is 2.93 cfs 100 year indicating the pond is adequately sized for this development. Basins E, F, and G are directed to the east to Meridian Road. Water quality will be provided in grass swale A for basin E with exclusion for basins F and G as noted in section F.3 above.

### 2. Specific Details

Site development is to be accomplished in a single phase. The site is divided into sub-basins to quantify flows at various locations in the site. Sub-basins are described as follows:

**Basin A:** This basin represents paved parking areas and landscape areas west of the proposed building. 100-year runoff is collected at a curb chase at the southwest corner of the basin and conveyed into Meridian Park Drive. Runoff is then conveyed to the detention and water quality pond 2 designed with SF1411 and SF1412 via surface flow and underground storm sewer. Basin parameters are summarized as follows:

Area	0.21 ac
Imperviousness	91 %
C5	0.77
C100	0.82
Q5	0.67 cfs
Q100	1.48 cfs

**Basin B:** This basin represents a paved driveway area northwest of the proposed building and landscaped area along the east edge of Meridian Park Drive. 100-year runoff is discharged directly into Meridian Park Drive. Runoff is then conveyed to the detention and water quality pond 2 designed with SF1411 and SF1412 via surface flow and underground storm sewer. Basin parameters are summarized as follows:

Area	0.08 ac
Imperviousness	67 %
C5	0.52
C100	0.63
Q5	0.17 cfs
Q100	0.43 cfs

**Basin C:** This basin represents paved parking, landscape, and driveway area southwest of the proposed building. 100-year runoff is directed out the proposed access offsite south of the property and discharged directly into Meridian Park Drive. Runoff is then conveyed to the

detention and water quality pond 2 designed with SF1411 and SF1412 via surface flow and underground storm sewer. Basin parameters are summarized as follows:

Area	0.14 ac
Imperviousness	75 %
C5	0.59
C100	0.69
Q5	0.29 cfs
Q100	0.86 cfs

Basin E: This basin represents the roof of the proposed building and landscape areas south of the building. 100-year runoff is directed south into a proposed water quality grass swale. Water quality is achieved for this basin through runoff reduction and a level spreader. 1' wide curb chases are connected to the roof drains and directed into a concrete pad connected to the level spreader. Detention is not provided per the Bent Grass East report. Basin parameters are summarized as follows:

Area	0.13 ac
Imperviousness	58 %
C5	0.43
C100	0.56
Q5	0.23 cfs
Q100	0.62 cfs

Basin F: This basin represents paved areas north of the proposed building. 100-year runoff is directed northeast to an existing curb cut. Runoff thence travels overland east to an existing culvert with discharge into the roadside ditch adjacent to Meridian Road. Water quality is provided for this basin using a slotted curb that utilizes runoff reduction into the connected buffer and existing swale. Detention is not provided per the Bent Grass East report. Basin parameters are summarized as follows:

Area	0.07 ac
Imperviousness	95 %
C5	0.81
C100	0.85
Q5	0.23 cfs
Q100	0.29 cfs

Basin G: This basin represents the eastern half of the roof and the landscape areas east of the proposed building. 100-year runoff is directed east to the roadside ditch adjacent to Meridian Road. Water quality is achieved for this basin through runoff reduction and a level spreader. 6" PVC pipes are connected to the roof drains daylighting into a concrete pad connected to the level spreader. Detention is not provided per the Bent Grass East report. Basin parameters are summarized as follows:

Area	0.16 ac
Imperviousness	59 %
C5	0.44
C100	0.57
Q5	0.29 cfs
Q100	0.47 cfs

As presented in section 3B above, proposed runoff rates are reduced from that anticipated in the original Bent Grass East report. The channel is fully vegetated and stable per google drive by photography. The flow entering the channel for the 100-year is 1.53 cfs. From the final Drainage Report for Bent Grass East Commercial Filing No. 2 (SF1411) the calculated 100-year flow from OS-3 is 11 cfs. Therefore, downstream facilities are assumed to be adequate to service the Carubia project. Summarized flow rates are presented below:

Design Point 1 is a summation of flows entering Meridian Park Drive via overland flow. Basins A, B, and C are tributary to design point 1.

Q5	1.14 cfs
Q100	2.67 cfs
Allowable Q5	2.0 cfs
Allowable Q100	3.4 cfs

Design Point 2 is a summation of flows entering the roadside ditch of Meridian Road. Basins E, F, and G are tributary to design point 2.

Q5	0.76 cfs
Q100	1.38 cfs
Allowable Q5	1.7 cfs
Allowable Q100	2.5 cfs

A portion of the site is to be serviced by a new private grass swale located along the south side of the property. SCM Design – v4.01 is used to size the grass swale C. Maintenance of the grass swale will be by the property owner.

Grass Swale Results are summarized below:

Total Area for Design Point 6	4,606 sf
UIA-A Area	3,443 sf
RPA-B Area	610 sf
RPA-C Area	125 sf
SPA-D Area	428sf
Imperviousness	58%
Length of Swale	50 ft
Bottom Width	2.5 ft
Bottom Area	125 sf
Side Slopes	4:1
Longitudinal Slope	0.03
2-year Discharge	0.2 cfs
Flow Depth	0.10 ft
Flow Area	0.3 sf
Top Width	3.3 ft
Hydraulic Radius	0.09 ft
VR Product	0.06 sf/sec
Manning's n value	0.08
Froude Number	0.07

## Section H: OTHER GOVERNMENT AGENCY REQUIREMENTS

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Government approvals are limited to EL Paso County.

## Section I: LIST OF REFERENCES

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1. Urban Storm Drainage Criteria Manual, Vol. 1 and Vol. 2, Urban Drainage and Flood Control District, 2024.
2. Urban Storm Drainage Criteria Manual, Vol. 3, Urban Drainage and Flood Control District, November 2024.
3. Federal Emergency Management Agency, Flood Insurance Rate Map (FIRM) 08041C0553G Effective Date December 7, 2018
4. USDA Web Soil Survey
5. El Paso County Drainage Criteria Manual
6. Preliminary Drainage Report for Bent Grass East Commercial – Phase 1 (Preliminary Plan) and Final Drainage Report for Bent Grass East Commercial Filing No. 1 – Lot 1 (Final Plat),” prepared by Classic Consulting Engineers & Surveyors, approved March 15, 2013.
7. Final Drainage Report for Bent Grass East Commercial Filing No. 2 prepared by Classic Consulting Engineer & Surveyors, approved July 2014.

## Section J: APPENDICES

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1. Soil, Floodplain
2. Hydrologic Computations
3. Grass Swale Computations
4. Excerpts from Prior Report
5. Drainage Plans



# 1. Soil, Precipitation, Floodplain

NRCS Custom Soil Resource Report – Geotech Report Excerpts  
FEMA Firmette



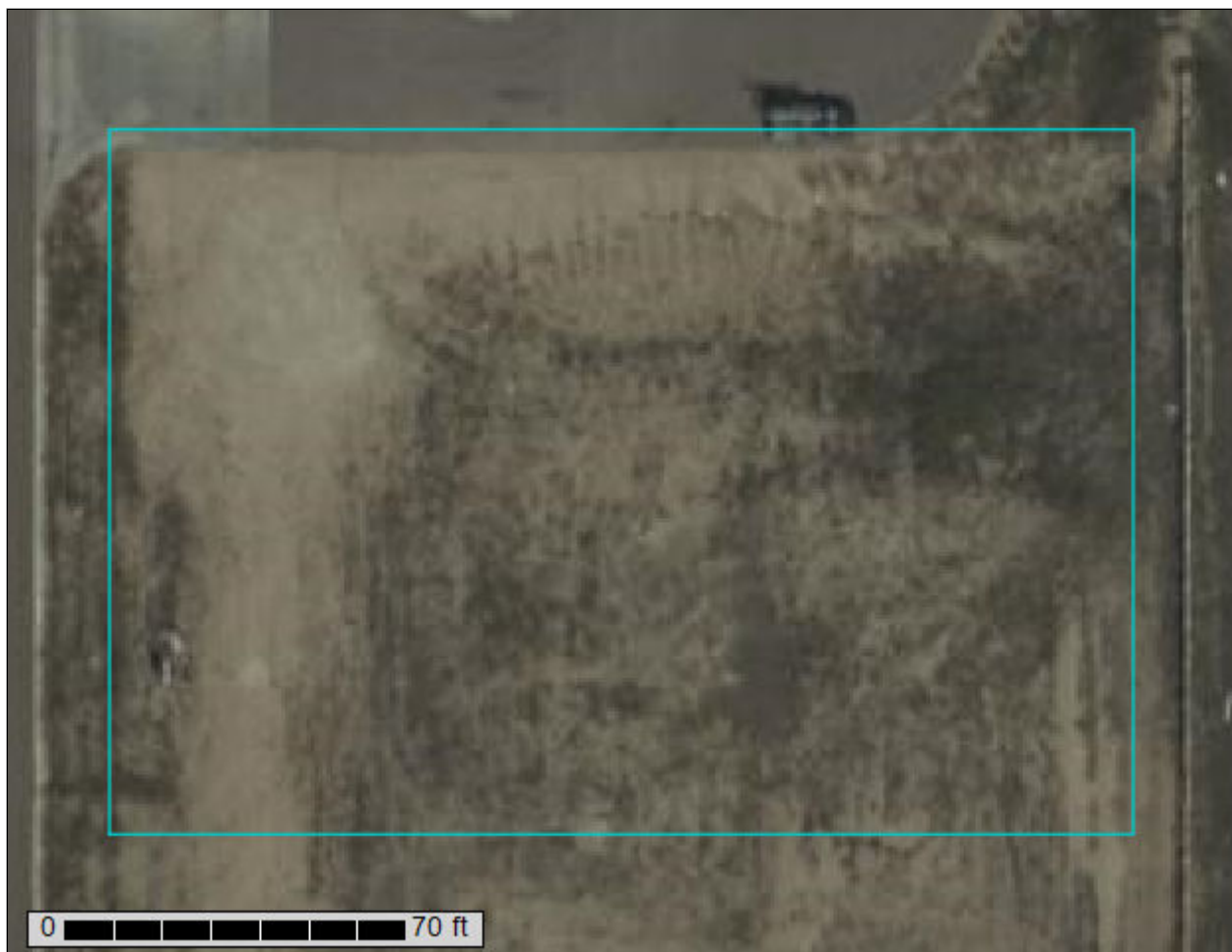
United States  
Department of  
Agriculture

NRCS

Natural  
Resources  
Conservation  
Service

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

# Custom Soil Resource Report for El Paso County Area, Colorado



# Preface

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

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

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

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

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

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

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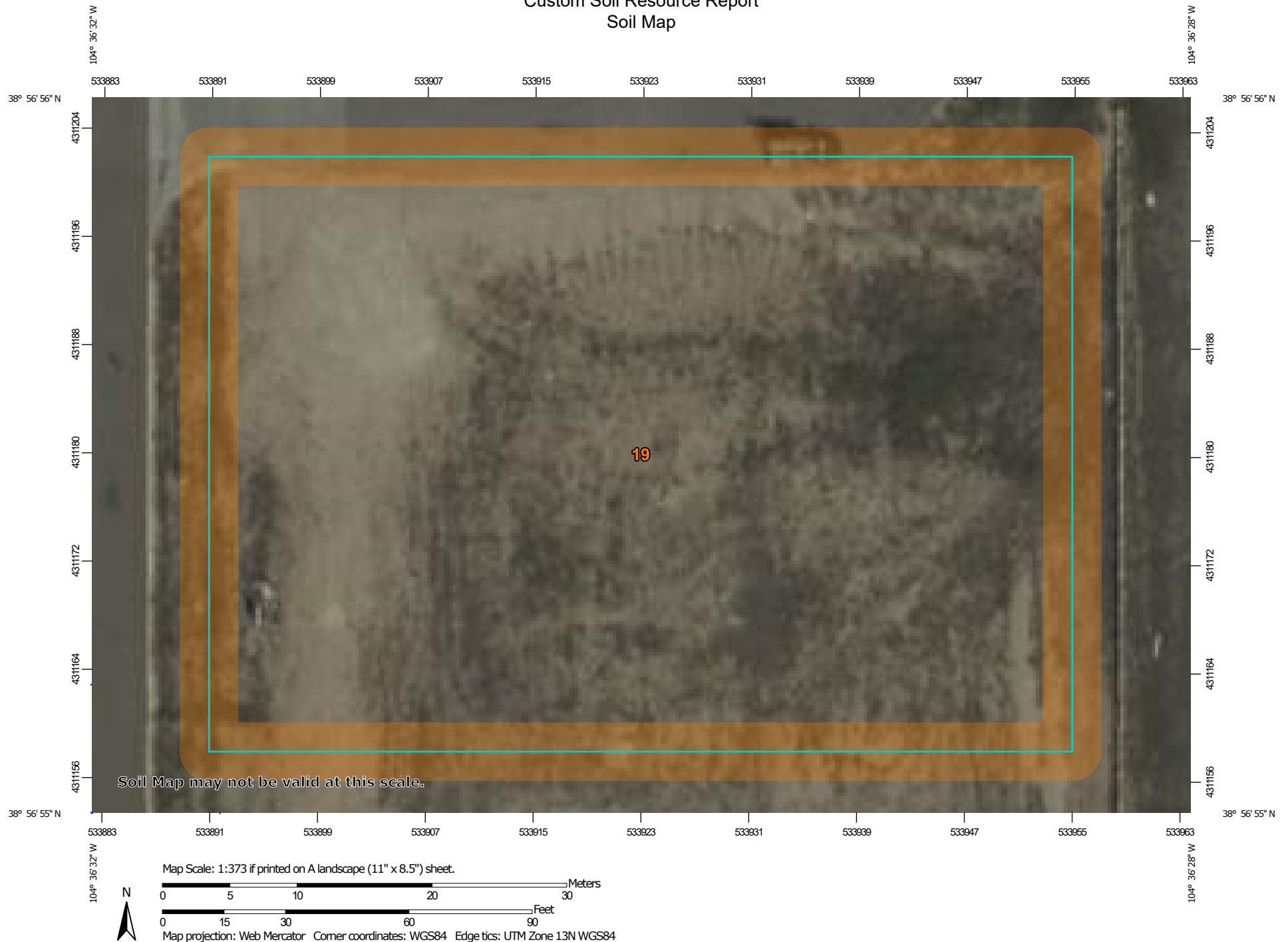
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# Soil Map

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

# Custom Soil Resource Report Soil Map



# Custom Soil Resource Report


## MAP LEGEND

### Area of Interest (AOI)

 Area of Interest (AOI)

### Soils


 Soil Map Unit Polygons


 Soil Map Unit Lines


 Soil Map Unit Points

### Special Point Features

 Blowout

 Borrow Pit


 Clay Spot

 Closed Depression

 Gravel Pit

 Gravelly Spot

 Landfill

 Lava Flow

 Marsh or swamp

 Mine or Quarry

 Miscellaneous Water


 Perennial Water

 Rock Outcrop

 Saline Spot

 Sandy Spot

 Severely Eroded Spot


 Sinkhole


 Slide or Slip

 Sodic Spot


 Spoil Area

 Stony Spot


 Very Stony Spot

 Wet Spot

 Other

 Special Line Features

### Water Features

 Streams and Canals

### Transportation

 Rails


 Interstate Highways

 US Routes

 Major Roads

 Local Roads

### Background

 Aerial Photography

## MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: El Paso County Area, Colorado  
Survey Area Data: Version 22, Sep 3, 2024

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

Date(s) aerial images were photographed: Sep 11, 2018—Oct 20, 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
19	Columbine gravelly sandy loam, 0 to 3 percent slopes	0.7	100.0%
<b>Totals for Area of Interest</b>		<b>0.7</b>	<b>100.0%</b>

## Map Unit Descriptions

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

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

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

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

## Custom Soil Resource Report

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

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

#### Map Unit Setting

*National map unit symbol:* 367p  
*Elevation:* 6,500 to 7,300 feet  
*Mean annual precipitation:* 14 to 16 inches  
*Mean annual air temperature:* 46 to 50 degrees F  
*Frost-free period:* 125 to 145 days  
*Farmland classification:* Not prime farmland

#### Map Unit Composition

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

#### Description of Columbine

##### Setting

*Landform:* Fans, fan terraces, flood plains  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Parent material:* Alluvium

##### Typical profile

*A - 0 to 14 inches:* gravelly sandy loam  
*C - 14 to 60 inches:* very gravelly loamy sand

##### Properties and qualities

*Slope:* 0 to 3 percent  
*Depth to restrictive feature:* More than 80 inches  
*Drainage class:* Well drained  
*Runoff class:* Very low  
*Capacity of the most limiting layer to transmit water (Ksat):* High to very high (5.95 to 19.98 in/hr)  
*Depth to water table:* More than 80 inches  
*Frequency of flooding:* None  
*Frequency of ponding:* None  
*Available water supply, 0 to 60 inches:* Very low (about 2.5 inches)

##### Interpretive groups

*Land capability classification (irrigated):* 4e  
*Land capability classification (nonirrigated):* 6e  
*Hydrologic Soil Group:* A  
*Ecological site:* R049XY214CO - Gravelly Foothill  
*Hydric soil rating:* No

#### Minor Components

##### Fluvaquentic haplaquolls

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

## Custom Soil Resource Report

### **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

# References

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- American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.
- American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.
- Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.
- Federal Register. July 13, 1994. Changes in hydric soils of the United States.
- Federal Register. September 18, 2002. Hydric soils of the United States.
- Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.
- National Research Council. 1995. Wetlands: Characteristics and boundaries.
- Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. [http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2\\_054262](http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262)
- Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. [http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2\\_053577](http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577)
- Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. [http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2\\_053580](http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580)
- Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.
- United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.
- United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. [http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2\\_053374](http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374)
- United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. <http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084>

## Custom Soil Resource Report

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. [http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2\\_054242](http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242)

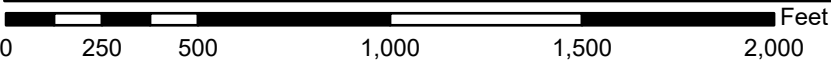
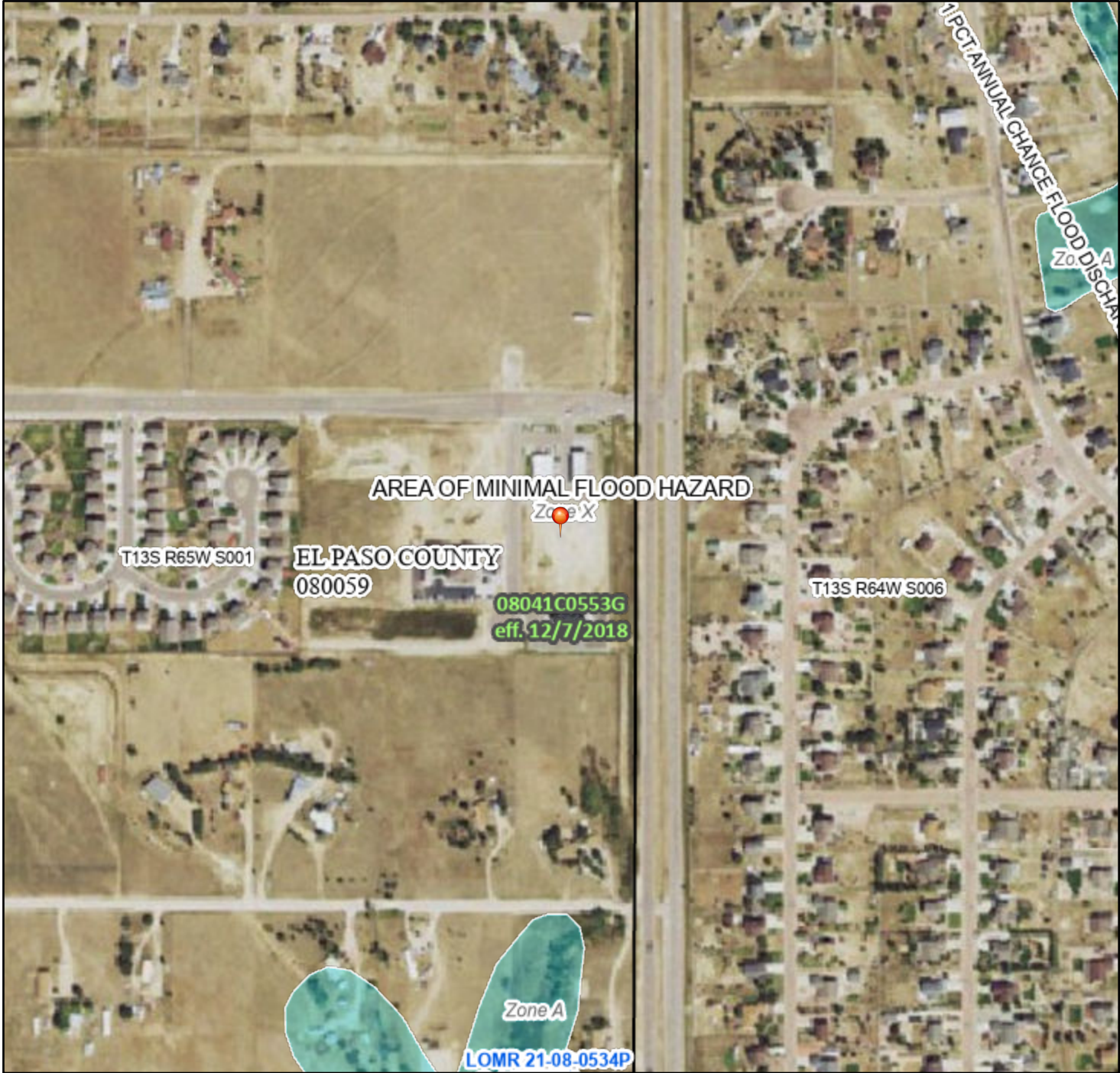
United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. [http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2\\_053624](http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624)

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

# National Flood Hazard Layer FIRMette



104°36'50"W 38°57'10"N



1:6,000

104°36'12"W 38°56'42"N

Basemap Imagery Source: USGS National Map 2023

## Legend

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

SPECIAL FLOOD HAZARD AREAS		Without Base Flood Elevation (BFE) Zone A, V, A99
		With BFE or Depth Zone AE, AO, AH, VE, AR
		Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD		0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
		Future Conditions 1% Annual Chance Flood Hazard Zone X
		Area with Reduced Flood Risk due to Levee. See Notes. Zone X
		Area with Flood Risk due to Levee Zone D
OTHER AREAS		NO SCREEN Area of Minimal Flood Hazard Zone X
		Effective LOMRs
GENERAL STRUCTURES		Area of Undetermined Flood Hazard Zone D
		Channel, Culvert, or Storm Sewer
OTHER FEATURES		Levee, Dike, or Floodwall
		20.2 Cross Sections with 1% Annual Chance Water Surface Elevation
OTHER FEATURES		17.5 Coastal Transect
		Base Flood Elevation Line (BFE)
OTHER FEATURES		Limit of Study
		Jurisdiction Boundary
OTHER FEATURES		Coastal Transect Baseline
		Profile Baseline
OTHER FEATURES		Hydrographic Feature
MAP PANELS		Digital Data Available
		No Digital Data Available
		Unmapped



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

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on **12/13/2024 at 8:38 PM** 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.



## 2. Hydrologic Computations

Land Use Assumptions, C Values

Determination of Runoff Coefficients, Time of Concentration, Runoff Calculations

Peak Flow Rate Calculations



4.5 RAINFALL INTENSITY

The calculated rainfall intensity,  $I$ , is the average rainfall rate in inches per hour over a duration equal to  $t_c$ . Obtain 1-hour point precipitation depths from National Oceanic and Atmospheric Administration (NOAA) Atlas 14 for the average return periods of interest and apply Equation 5-1 in the *Rainfall* chapter using  $t_c$  as the storm duration,  $t_d$ . Use the centroid of the catchment to determine the 1-hour point precipitation depths. The MHFD-Rational and MHFD-Inlet Excel workbooks automatically calculate rainfall intensity based on 1-hour point precipitation depths for a specified location.

4.6 RUNOFF COEFFICIENTS

Any watershed can be conceptualized as a combination of pervious and impervious surfaces. Pervious surfaces allow water to infiltrate into the ground, while impervious surfaces do not allow for infiltration. In urban hydrology, the relationships between pervious and impervious surfaces is important. Urbanization increases impervious area, causing rainfall-runoff relationships to change significantly. In the absence of stormwater management controls that infiltrate or detain runoff, urbanization increases peak runoff rates, volumes, and frequency of runoff and decreases the time to peak.

When analyzing a catchment for planning or design purposes, estimates of the existing and probable future imperviousness of the drainage area are needed. In some cases, the pre-development (i.e., historic) condition also must be analyzed. Table 6-2 provides recommended imperviousness values based on land use types and is appropriate for master planning analysis and conceptual design. Note that the land use classifications in Table 6-2 incorporate roads that are included within the land use. Table 6-3 provides recommended imperviousness values for different surface types and is appropriate for use during later stages of design when the layout of different types of impervious and pervious areas on the site is known and the area of each surface type can be quantified.

The runoff coefficient,  $C$ , represents the integrated effects of infiltration, evaporation, depression storage, and interception, all of which affect the rate and volume of runoff. Determining representative runoff coefficients requires judgment based on the experience and expertise of the engineer.

Volume-based runoff coefficients were derived to improve consistency between CUHP and the Rational Method for peak flow predictions (Guo 2013; Guo and Urbonas 2013). The coefficients developed by Dr. Guo were recalibrated using CUHP Version 2.0.0 (Rapp et al. 2017). Using imperviousness, expressed as a decimal, and the Natural Resources Conservation Service (NRCS) Hydrologic Soil Group (HSG), the equations in Table 6-5 can be used to calculate runoff coefficients for design storm return periods for the Rational Method.

TABLE 6-5. RUNOFF COEFFICIENT EQUATIONS BASED ON NRCS HSG AND STORM RETURN PERIOD

NRCS HSG	STORM RETURN PERIOD						
	WQE & 2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year
A	$C_A = 0.840I^{1.302}$	$C_A = 0.861I^{1.276}$	$C_A = 0.873I^{1.232}$	$C_A = 0.884I^{1.124}$	$C_A = 0.854I + 0.025$	$C_A = 0.779I + 0.110$	$C_A = 0.645I + 0.254$
B	$C_B = 0.835I^{1.169}$	$C_B = 0.857I^{1.088}$	$C_B = 0.807I + 0.057$	$C_B = 0.628I + 0.249$	$C_B = 0.558I + 0.328$	$C_B = 0.465I + 0.426$	$C_B = 0.366I + 0.536$
C/D	$C_{C/D} = 0.834I^{1.122}$	$C_{C/D} = 0.815I + 0.035$	$C_{C/D} = 0.735I + 0.132$	$C_{C/D} = 0.560I + 0.319$	$C_{C/D} = 0.494I + 0.393$	$C_{C/D} = 0.409I + 0.484$	$C_{C/D} = 0.315I + 0.588$

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 Littleton, Colorado 80128  
 (303) 232-8088 Fax (303) 232-5255

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Project: Carubia Dental

## RAINFALL INTENSITIES

$$\text{RAINFALL INTENSITY, } I = (28.5 * P1) / [(10 + Tc)^{0.786}]$$

STORM DURATION, Tc = MINUTES

ONE-HOUR POINT RAINFALL, P1 = INCHES

Tc	P1	P1	P1			
	2-yr -1 hr	5-yr -1 hr	100-yr - 1 hr	2-yr Intensity	5-yr Intensity	100-yr Intensity
	Point Rainfall	Point Rainfall	Point Rainfall	in/hr	in/hr	in/hr
min	in	in	in			
5.0	0.94	1.22	2.53	3.20	4.14	8.58

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 6901 South Pierce Street, Suite 220  
 Littleton, Colorado 80128  
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**COMPOSITE RUNOFF COEFFICIENTS - TYPE A SOIL**

	<u>ROOF</u>	<u>PAVEMENT</u>	<u>LANDSCAPING</u>	<u>GRAVEL PATHS</u>	<u>OPEN WATER</u>	<u>NATIVE GRASS</u>			
Catchment	Area (Ac.)	Area (Ac.)	Area (Ac.)	Area (Ac.)	Area (Ac.)	Area (Ac.)	Catchment Area	Composite Imperviousness	Composite C
	Imperviousness = 95%	Imperviousness = 95%	Imperviousness = 20%	Imperviousness = 60%	Imperviousness = 100%	Imperviousness = 5%	(Ac.)	%	
A (2-Year)	0.00	0.20	0.01	0.00	0.00	0.00	<b>0.21</b>	<b>91%</b>	<b>0.75</b>
A (5-Year)	0.00	0.20	0.01	0.00	0.00	0.00	<b>0.21</b>	<b>91%</b>	<b>0.77</b>
A (100-Year)	0.00	0.20	0.01	0.00	0.00	0.00	<b>0.21</b>	<b>91%</b>	<b>0.82</b>
B (2-Year)	0.00	0.05	0.03	0.00	0.00	0.00	<b>0.08</b>	<b>67%</b>	<b>0.50</b>
B (5-Year)	0.00	0.05	0.03	0.00	0.00	0.00	<b>0.08</b>	<b>67%</b>	<b>0.52</b>
B (100-Year)	0.00	0.05	0.03	0.00	0.00	0.00	<b>0.08</b>	<b>67%</b>	<b>0.63</b>
C (2-Year)	0.00	0.10	0.04	0.00	0.00	0.00	<b>0.14</b>	<b>75%</b>	<b>0.58</b>
C (5-Year)	0.00	0.10	0.04	0.00	0.00	0.00	<b>0.14</b>	<b>75%</b>	<b>0.59</b>
C (100-Year)	0.00	0.10	0.04	0.00	0.00	0.00	<b>0.14</b>	<b>75%</b>	<b>0.69</b>
To Ex Pond (2-Year)	0.00	0.35	0.08	0.00	0.00	0.00	<b>0.43</b>	<b>81%</b>	<b>0.64</b>
To Ex Pond (5-Year)	0.00	0.35	0.08	0.00	0.00	0.00	<b>0.43</b>	<b>81%</b>	<b>0.66</b>
To Ex Pond (100-Year)	0.00	0.35	0.08	0.00	0.00	0.00	<b>0.43</b>	<b>81%</b>	<b>0.74</b>
E (2-Year)	0.06	0.00	0.03	0.02	0.00	0.00	<b>0.13</b>	<b>58%</b>	<b>0.41</b>
E (5-Year)	0.06	0.00	0.03	0.02	0.00	0.00	<b>0.13</b>	<b>58%</b>	<b>0.43</b>
E (100-Year)	0.06	0.00	0.03	0.02	0.00	0.00	<b>0.13</b>	<b>58%</b>	<b>0.56</b>
F (2-Year)	0.00	0.07	0.00	0.00	0.00	0.00	<b>0.07</b>	<b>95%</b>	<b>0.79</b>
F (5-Year)	0.00	0.07	0.00	0.00	0.00	0.00	<b>0.07</b>	<b>95%</b>	<b>0.81</b>
F (100-Year)	0.00	0.07	0.00	0.00	0.00	0.00	<b>0.07</b>	<b>95%</b>	<b>0.85</b>
G (2-Year)	0.07	0.00	0.06	0.04	0.00	0.00	<b>0.16</b>	<b>59%</b>	<b>0.42</b>
G (5-Year)	0.07	0.00	0.06	0.04	0.00	0.00	<b>0.16</b>	<b>59%</b>	<b>0.44</b>
G (100-Year)	0.07	0.00	0.06	0.04	0.00	0.00	<b>0.16</b>	<b>59%</b>	<b>0.57</b>
OS1 (2-Year)	0.00	0.02	0.00	0.00	0.00	0.01	<b>0.03</b>	<b>58%</b>	<b>0.41</b>

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### COMPOSITE RUNOFF COEFFICIENTS - TYPE A SOIL

	ROOF	PAVEMENT	LANDSCAPING	GRAVEL PATHS	OPEN WATER	NATIVE GRASS			
Catchment	Area (Ac.)	Area (Ac.)	Area (Ac.)	Area (Ac.)	Area (Ac.)	Area (Ac.)	Catchment Area	Composite Imperviousness	Composite C
	Imperviousness = 95%	Imperviousness = 95%	Imperviousness = 20%	Imperviousness = 60%	Imperviousness = 100%	Imperviousness = 5%	(Ac.)	%	
OS1 (5-Year)	0.00	0.02	0.00	0.00	0.00	0.01	0.03	58%	0.43
OS1 (100-Year)	0.00	0.02	0.00	0.00	0.00	0.01	0.03	58%	0.56
To Meridian Rd (2-Year)	0.13	0.09	0.09	0.05	0.00	0.01	0.37	69%	0.52
To Meridian Rd (5-Year)	0.13	0.09	0.09	0.05	0.00	0.01	0.37	69%	0.54
To Meridian Rd (100-Year)	0.13	0.09	0.09	0.05	0.00	0.01	0.37	69%	0.65
F + OS1 (2-Year)	0.00	0.09	0.00	0.00	0.00	0.01	0.10	86%	0.69
F + OS1 (5-Year)	0.00	0.09	0.00	0.00	0.00	0.01	0.10	86%	0.71
F + OS1 (100-Year)	0.00	0.09	0.00	0.00	0.00	0.01	0.10	86%	0.78
ROOF E (100-YR)	0.06	0.00	0.00	0.00	0.00	0.00	0.06	95%	0.85
ROOF G (100-YR)	0.07	0.00	0.00	0.00	0.00	0.00	0.07	95%	0.85

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## RUNOFF CALCULATIONS

(RATIONAL METHOD)

Design Storm: 2-Yr.

		Direct Runoff						
	Design	Basin	Area	Runoff	C*A	Tc	I	Q=CIA
	Point	Desig.	(Acres)	Coefficient		(min)	(in/hr)	(cfs)
	3	A	0.21	0.75	0.16	5.0	3.20	0.50
	4	B	0.08	0.50	0.04	5.0	3.20	0.13
	1	C	0.14	0.58	0.08	5.0	3.20	0.25
Flow to Pond								0.89
	6	E	0.13	0.41	0.05	5.0	3.20	0.17
	7	F	0.07	0.79	0.06	5.0	3.20	0.18
	5	G	0.16	0.42	0.07	5.0	3.20	0.22
		OS1	0.03	0.41	0.01	5.0	3.20	0.04
Flow to Meridian Rd								0.56
F+OS1								0.22

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## RUNOFF CALCULATIONS

(RATIONAL METHOD)

Design Storm: 5-Yr.

		Direct Runoff						
	Design	Basin	Area	Runoff	C*A	Tc	I	Q=CIA
	Point	Desig.	(Acres)	Coefficient		(min)	(in/hr)	(cfs)
	3	A	0.21	0.77	0.16	5.0	4.14	0.67
	4	B	0.08	0.52	0.04	5.0	4.14	0.17
	1	C	0.14	0.52	0.07	5.0	4.14	0.29
Flow to Pond								1.14
	6	E	0.13	0.43	0.06	5.0	4.14	0.23
	7	F	0.07	0.81	0.06	5.0	4.14	0.23
	5	G	0.16	0.44	0.07	5.0	4.14	0.29
		OS1	0.03	0.43	0.01	5.0	4.14	0.05
Flow to Meridian Rd								0.76

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 Littleton, Colorado 80128  
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## RUNOFF CALCULATIONS

(RATIONAL METHOD)

Design Storm: 100-Yr.

		Direct Runoff						
	Design	Basin	Area	Runoff	C*A	Tc	I	Q=CI <sup>A</sup>
	Point	Desig.	(Acres)	Coefficient		(min)	(in/hr)	(cfs)
	3	A	0.21	0.82	0.17	5.0	8.58	1.48
	4	B	0.08	0.63	0.05	5.0	8.58	0.43
	1	C	0.14	0.63	0.09	5.0	8.58	0.76
Flow to Pond								2.67
	6	E	0.13	0.56	0.07	5.0	8.58	0.62
	7	F	0.06	0.57	0.03	5.0	8.58	0.29
	5	G	0.16	0.34	0.05	5.0	8.58	0.47
		OS1	0.03	0.56	0.02	5.0	8.58	0.14
Flow to Meridian Rd								1.38

Roof E		E	0.06	0.85	0.05	5.0	8.58	0.44
Roof G		G	0.07	0.85	0.06	5.0	8.58	0.51

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MANNING'S EQUATION  
100-YEAR STORM

Contributing Basins	Pipe Location Design Points	Q req'd (cfs)	Slope (%)	n	Diam (in)	Q calc (cfs)	V (Full Flow) (fps)	Friction Slope (%)
E	Grass Swale C - DP2	0.62	5.41	0.013	18	24.50	0.35	0.00
Roof Drains E		0.44	2.00	0.011	6	0.94	2.24	0.44
Roof Drains G		0.51	2.00	0.011	6	0.94	2.60	0.59

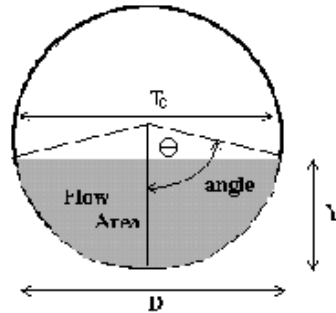


# CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

MHFD-Culvert, Version 4.01 (April 2025)

Project: Carubia Dental

Pipe ID: Swale



## Design Information (Input)

Pipe Invert Slope	So =	0.0866	ft/ft
Pipe Manning's n-value	n =	0.0130	
Pipe Diameter	D =	18.00	inches
Design discharge	Q =	0.46	cfs

## Full-Flow Capacity (Calculated)

Full-flow area	Af =	1.77	sq ft
Full-flow wetted perimeter	Pf =	4.71	ft
Half Central Angle	Theta =	3.14	radians
Full-flow capacity	Qf =	31.00	cfs

## Calculation of Normal Flow Condition

Half Central Angle ( $0 < \theta < 3.14$ )	Theta =	0.59	radians
Flow area	An =	0.07	sq ft
Top width	Tn =	0.84	ft
Wetted perimeter	Pn =	0.89	ft
Flow depth	Yn =	0.13	ft
Flow velocity	Vn =	6.35	fps
Discharge	Qn =	0.46	cfs
Percent of Full Flow	Flow =	1.5%	of full flow
Normal Depth Froude Number	Fr <sub>n</sub> =	3.80	supercritical

## Calculation of Critical Flow Condition

Half Central Angle ( $0 < \theta_c < 3.14$ )	Theta-c =	0.84	radians
Critical flow area	Ac =	0.19	sq ft
Critical top width	Tc =	1.12	ft
Critical flow depth	Yc =	0.25	ft
Critical flow velocity	Vc =	2.37	fps
Critical Depth Froude Number	Fr <sub>c</sub> =	1.00	

### 3. Grass Swale Computations

SCM Site Layout

RPA 6 Spreadsheet (Basin E)

RPA 7 Spreadsheet (Basin F and OS-1)

RPA 5 Spreadsheet (Basin G)

## Site Layout

SCM Design, Version 4.01 (December 2024)

Designer: **Jerry Davidson**

Company: **Perception Design Group**

Date: **July 14, 2025**

Project: **Carubia Dental**

Location: **8059 Meridian Park Dr.**

### SITE LAYOUT INFO (User Input in Blue Cells)

Water Quality Event (WQE)  inches

Does not match basin labels in drainage map

Outfall ID	6	5	7									
Total Tributary Area (ft <sup>2</sup> )	4,606	7,051	4,821									
Total Tributary Area (ac)	0.11	0.16	0.11									
Imperviousness (%)	58.0%	59.0%	86.0%									
MS4 Design Standard	Runoff	Runoff	Runoff									
SCM Type	RPA	RPA	RPA									

Notes:

Provide area-weighted imperviousness, not just % of area that is roof/asphalt. See MHFD USDCM vol. 1 Ch. 6 for recommended imperviousness values.

### OUTFALL RESULTS

SCM Worksheet Name	RPA_6	RPA_5	RPA_7									
Untreated Area (ft <sup>3</sup> )	0	0	0									
Default WQCV (ft <sup>3</sup> )	88	137	148									
Optional Override WQCV (ft <sup>3</sup> )												
WQCV Reduction (ft <sup>3</sup> )	88	137	126									
Remaining WQCV (ft <sup>3</sup> )	0	0	23									
WQCV Reduction (%)	100%	100%	85%									
Design WQCV of SCM (ft <sup>3</sup> )	0	0	0									
Pollutant Removal (ft <sup>3</sup> )	0	0	0									
Untreated WQCV (ft <sup>3</sup> )	0	0	23									

### TOTAL SITE RESULTS (Sums results from all Outfalls)

Total Site Area	16,477	ft <sup>2</sup>	0.38	acres
Treated Area	16,477	ft <sup>2</sup>	0.38	acres
Untreated Area	0	ft <sup>2</sup>	0.00	acres
Total Site Imperviousness	66.6%	%		
Default (or Override) WQCV	373	ft <sup>3</sup>	0.009	acre-feet
Remaining WQCV	23	ft <sup>3</sup>	0.001	acre-feet
WQCV Reduction	94%	%		
Design WQCV	0	ft <sup>3</sup>	0.000	acre-feet
Untreated WQCV	23	ft <sup>3</sup>	0.001	acre-feet

Confirm with local jurisdiction whether design meets Runoff Reduction Standard

## Receiving Pervious Areas (Including Grass Buffers and Grass Swales)

SCM Design, Version 4.01 (December 2024)

Designer: Jerry Davidson

Company: Perception Design Group

Date: July 14, 2025

Project: Carubia Dental

Location: 8059 Meridian Park Dr.

Outfall ID: 6

### DESIGN PROCEDURE AND CRITERIA FOR ALL RPAs (User Input in Blue Cells)

#### 1. Apply Four-Cover Land Use Model to Site Layout

Design Point ID	6	A	B	C	D						
Area Type	RPA	UIA	RPA_Buffer	RPA_Swale	SPA						
Downstream Design Point ID	--	B	C	6	6						
DCIA (ft <sup>2</sup> )	--	--	--	--	--						
UIA (ft <sup>2</sup> )	--	3,443	--	--	--						
RPA (ft <sup>2</sup> )	--	--	610	125	--						
SPA (ft <sup>2</sup> )	--	--	--	--	428						

#### 2. Protect the RPA from Traffic

RPA Protection Type	--	--	None	None	--						
---------------------	----	----	------	------	----	--	--	--	--	--	--

#### 3. Characterize On-site Topsoil and Determine Suitability for the RPA

HSG A (%)	--	--	100.0%	100.0%	--						
HSG B (%)	--	--	0.0%	0.0%	--						
HSG C/D (%)	--	--	0.0%	0.0%	--						

#### 4. Select Appropriate Vegetation

RPA Vegetation Type	--	--	Seed	Seed	--						
Irrigation Type	--	--	Permanent	Permanent	--						

Notes: The buffer and swale are on the south side of the building with no access to cars. No RPA Protection needed.

### GRASS BUFFER ADDITIONAL DESIGN PROCEDURE AND CRITERIA (User Input in Blue Cells)

#### 1. Define the UIA:RPA pair, Ratio, and Interface Width

Sheet Flow Inflow Feature	--	--	Spreader	--	--						
Is Concrete Edger used?	--	--	--	--	--						
Spacing between slots (ft)	--	--	--	--	--						
Slot Opening Length (in)	--	--	--	--	--						
Blind Swale Type	--	--	Concrete	--	--						
Spreader Energy Dissipation	--	--	None	--	--						
Total Area of UIA:RPA (ft <sup>2</sup> )	--	--	4,053	--	--						
UIA:RPA Ratio	--	--	5.6	--	--						
UIA:RPA Interface Width (ft)	--	--	37	--	--						
L / W Ratio of UIA:RPA	--	--	2.96	--	--						

40ft in CDs

#### 2. Buffer Length

Average Buffer Length (ft)	--	--	16	--	--						
----------------------------	----	----	----	----	----	--	--	--	--	--	--

#### 3. Buffer Slope

Average Buffer Slope (ft/ft)	--	--	0.250	--	--						
Effective Distance (ft)	--	--	17	--	--						
Number of Level Spreaders	--	--	1	--	--						

#### 4. Provide a Vertical Drop

Vertical Drop (in)	--	--	3.00	--	--						
Mowing Strip Provided?	--	--	NO	--	--						

#### 5. Calculate Runoff for UIA and RPA Pair

Imperviousness (%)	--	--	84.9%	--	--						
UIA:RPA Runoff (in)	--	--	0.10	--	--						
UIA:RPA Runoff (ft <sup>3</sup> )	--	--	35	--	--						

#### 6. Compare Runoff from UIA:RPA Pair to Runoff from UIA Only

UIA Runoff (ft <sup>3</sup> )	--	--	143	--	--						
Runoff Reduction (ft <sup>3</sup> )	--	--	108	--	--						
Runoff Reduction (%)	--	--	75.5%	--	--						

Notes: The flow rate exiting the level spreader is very low and no energy dissipation is needed.

**GRASS SWALE ADDITIONAL DESIGN PROCEDURE AND CRITERIA (User Input in Blue Cells)**
**1. Delineate Areas Tributary to Swale**

Total Tributary Area (ft <sup>2</sup> )	--	--	--	4,178	--						
Imperviousness (%)	--	--	--	82.4%	--						

**2. Swale Inflows**

Concentrated Flow Type	--	--	--	Other	--						
Blind Swale Type	--	--	--	--	--						
Spreader Energy Dissipation	--	--	--	--	--						
Vertical Drop (in)	--	--	--	--	--						
Gutter Depression (in)	--	--	--	--	--						
Curb Opening Length (ft)	--	--	--	--	--						
Concrete Sediment Pad	--	--	--	--	--						
Min. Forebay Volume (ft <sup>3</sup> )	--	--	--	--	--						
Design Forebay Volume (ft <sup>3</sup> )	--	--	--	--	--						
Max. Forebay Depth (in)	--	--	--	--	--						
Design Forebay Depth (in)	--	--	--	--	--						
Calculated Notch Width (in)	--	--	--	--	--						
Design Notch Width (in)	--	--	--	--	--						
Drain Time (minutes)	--	--	--	--	--						
Energy Dissipation Type	--	--	--	Vegetation	--						

**3. Swale Cross Section**

Length of Swale (ft)	--	--	--	50.00	--						
Bottom Width (ft)	--	--	--	2.50	--						
Bottom Area (ft <sup>2</sup> )	--	--	--	125	--						
Side Slopes (horiz/vert)	--	--	--	4.00	--						

**4. Longitudinal Slope**

Available Slope (ft/ft)	--	--	--	0.030	--						
Design Slope (ft/ft)	--	--	--	0.030	--						
Total Drop Height (ft)	--	--	--	0.00	--						
Underdrains Provided?	--	--	--	NO	--						

**5. Calculate Runoff from Tributary Area**

Tributary Runoff (ft <sup>3</sup> )	--	--	--	150	--						
Reduced Trib. Runoff (ft <sup>3</sup> )	--	--	--	41	--						

**6. Calculate Runoff Reduction through Swale Bottom**

Volume Infiltrated (ft <sup>3</sup> )	--	--	--	21	--						
Swale Discharge (ft <sup>3</sup> )	--	--	--	21	--						
Runoff Reduction (%)	--	--	--	50.4%	--						

**7. Design Discharge**

2-year Discharge, Q2 (cfs)	--	--	--	0.2	--						
----------------------------	----	----	----	-----	----	--	--	--	--	--	--

**8. Design Velocity**

Vegetal Retardance Curve	--	--	--	E	--						
Velocity, V2 (fps)	--	--	--	0.7	--						

**9. Design Flow Depth**

Flow Depth, D2 (ft)	--	--	--	0.10	--						
Flow Area, A (ft <sup>2</sup> )	--	--	--	0.3	--						
Wetted Perimeter, P (ft)	--	--	--	3.3	--						
Top Width, T (ft)	--	--	--	3.3	--						
Hydraulic Radius, Rh (ft)	--	--	--	0.09	--						
VR Product (ft <sup>2</sup> /sec)	--	--	--	0.06	--						
Manning's n value	--	--	--	0.080	--						
Hydraulic Depth, Dh (ft)	--	--	--	0.09	--						
Froude Number	--	--	--	0.07	--						

**10. Swale Outflows**

Outflows Considered?	--	--	--	YES	--						
----------------------	----	----	----	-----	----	--	--	--	--	--	--

**Notes:** The concreted flow is from the buffer listed as other above.

**DESIGN POINT RESULT (Sums results for current column and all upstream design point columns.)**

Design Point ID	6	A	B	C	D						
Area Type	RPA	UTA	RPA_Buffer	RPA_Swale	SPA						
Total Area (ft <sup>2</sup> )	4,606	3,443	4,053	4,178	428						
Imperviousness (%)		100.0%	84.9%	82.4%	0.0%						
Tributary Runoff (ft <sup>3</sup> )	150	143	143	150	0						
Runoff Reduction (ft <sup>3</sup> )	129	0	108	129	0						
Runoff Remaining (ft <sup>3</sup> )	21	143	35	21	0						

Total Tributary Area entered on Site Layout Worksheet is: 4,606 square feet

## Receiving Pervious Areas (Including Grass Buffers and Grass Swales)

SCM Design, Version 4.01 (December 2024)

Designer: Jerry Davidson

Company: Perception Design Group

Date: July 14, 2025

Project: Carubia Dental

Location: 8059 Meridian Park Dr.

Outfall ID: 7

### DESIGN PROCEDURE AND CRITERIA FOR ALL RPAs (User Input in Blue Cells)

#### 1. Apply Four-Cover Land Use Model to Site Layout

Design Point ID	7	E	F	G	H						
Area Type	RPA	UIA	RPA_Buffer	RPA_Swale	SPA						
Downstream Design Point ID	--	F	G	7	G						
DCIA (ft <sup>2</sup> )	--	--	--	--	--						
UIA (ft <sup>2</sup> )	--	3,620	--	--	--						
RPA (ft <sup>2</sup> )	--	--	650	81	--						
SPA (ft <sup>2</sup> )	--	--	--	--	470						

#### 2. Protect the RPA from Traffic

RPA Protection Type	--	--	Slotted Curb	None	--						
---------------------	----	----	--------------	------	----	--	--	--	--	--	--

#### 3. Characterize On-site Topsoil and Determine Suitability for the RPA

HSG A (%)	--	--	100.0%	100.0%	--						
HSG B (%)	--	--	0.0%	0.0%	--						
HSG C/D (%)	--	--	0.0%	0.0%	--						

#### 4. Select Appropriate Vegetation

RPA Vegetation Type	--	--	Seed	Seed	--						
Irrigation Type	--	--	Permanent	Permanent	--						

Notes:

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### GRASS BUFFER ADDITIONAL DESIGN PROCEDURE AND CRITERIA (User Input in Blue Cells)

#### 1. Define the UIA:RPA pair, Ratio, and Interface Width

Sheet Flow Inflow Feature	--	--	Slotted	--	--						
Is Concrete Edger used?	--	--	--	--	--						
Spacing between slots (ft)	--	--	2.00	--	--						
Slot Opening Length (in)	--	--	1.50	--	--						
Blind Swale Type	--	--	--	--	--						
Spreader Energy Dissipation	--	--	--	--	--						
Total Area of UIA:RPA (ft <sup>2</sup> )	--	--	4,270	--	--						
UIA:RPA Ratio	--	--	5.6	--	--						
UIA:RPA Interface Width (ft)	--	--	50	--	--						
L / W Ratio of UIA:RPA	--	--	1.71	--	--						

#### 2. Buffer Length

Average Buffer Length (ft)	--	--	13	--	--						
----------------------------	----	----	----	----	----	--	--	--	--	--	--

#### 3. Buffer Slope

Average Buffer Slope (ft/ft)	--	--	0.333	--	--						
Effective Distance (ft)	--	--	17	--	--						
Number of Level Spreaders	--	--	1	--	--						

#### 4. Provide a Vertical Drop

Vertical Drop (in)	--	--	2.00	--	--						
Mowing Strip Provided?	--	--	NO	--	--						

Design shows 3 in drop.

#### 5. Calculate Runoff for UIA and RPA Pair

Imperviousness (%)	--	--	84.8%	--	--						
UIA:RPA Runoff (in)	--	--	0.11	--	--						
UIA:RPA Runoff (ft <sup>3</sup> )	--	--	39	--	--						

#### 6. Compare Runoff from UIA:RPA Pair to Runoff from UIA Only

UIA Runoff (ft <sup>3</sup> )	--	--	151	--	--						
Runoff Reduction (ft <sup>3</sup> )	--	--	112	--	--						
Runoff Reduction (%)	--	--	74.3%	--	--						

Notes:

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## GRASS SWALE ADDITIONAL DESIGN PROCEDURE AND CRITERIA (User Input in Blue Cells)

## 1. Delineate Areas Tributary to Swale

Total Tributary Area (ft <sup>2</sup> )	--	--	--	4,821	--						
Imperviousness (%)	--	--	--	75.1%	--						

## 2. Swale Inflows

Concentrated Flow Type	--	--	--	Other	--						
Blind Swale Type	--	--	--	--	--						
Spreader Energy Dissipation	--	--	--	--	--						
Vertical Drop (in)	--	--	--	--	--						
Gutter Depression (in)	--	--	--	--	--						
Curb Opening Length (ft)	--	--	--	--	--						
Concrete Sediment Pad	--	--	--	--	--						
Min. Forebay Volume (ft <sup>3</sup> )	--	--	--	--	--						
Design Forebay Volume (ft <sup>3</sup> )	--	--	--	--	--						
Max. Forebay Depth (in)	--	--	--	--	--						
Design Forebay Depth (in)	--	--	--	--	--						
Calculated Notch Width (in)	--	--	--	--	--						
Design Notch Width (in)	--	--	--	--	--						
Drain Time (minutes)	--	--	--	--	--						
Energy Dissipation Type	--	--	--	Vegetation	--						

## 3. Swale Cross Section

Length of Swale (ft)	--	--	--	23.00	--						
Bottom Width (ft)	--	--	--	3.50	--						
Bottom Area (ft <sup>2</sup> )	--	--	--	81	--						
Side Slopes (horiz/vert)	--	--	--	4.00	--						

## 4. Longitudinal Slope

Available Slope (ft/ft)	--	--	--	0.030	--						
Design Slope (ft/ft)	--	--	--	0.030	--						
Total Drop Height (ft)	--	--	--	0.00	--						
Underdrains Provided?	--	--	--	NO	--						

## 5. Calculate Runoff from Tributary Area

Tributary Runoff (ft <sup>3</sup> )	--	--	--	155	--						
Reduced Trib. Runoff (ft <sup>3</sup> )	--	--	--	43	--						

## 6. Calculate Runoff Reduction through Swale Bottom

Volume Infiltrated (ft <sup>3</sup> )	--	--	--	13	--						
Swale Discharge (ft <sup>3</sup> )	--	--	--	29	--						
Runoff Reduction (%)	--	--	--	31.4%	--						

## 7. Design Discharge

2-year Discharge, Q2 (cfs)	--	--	--	0.2	--						
----------------------------	----	----	----	-----	----	--	--	--	--	--	--

## 8. Design Velocity

Vegetal Retardance Curve	--	--	--	E	--						
Velocity, V2 (fps)	--	--	--	0.6	--						

## 9. Design Flow Depth

Flow Depth, D2 (ft)	--	--	--	0.09	--						
Flow Area, A (ft <sup>2</sup> )	--	--	--	0.3	--						
Wetted Perimeter, P (ft)	--	--	--	4.2	--						
Top Width, T (ft)	--	--	--	4.2	--						
Hydraulic Radius, Rh (ft)	--	--	--	0.08	--						
VR Product (ft <sup>2</sup> /sec)	--	--	--	0.05	--						
Manning's n value	--	--	--	0.080	--						
Hydraulic Depth, Dh (ft)	--	--	--	0.08	--						
Froude Number	--	--	--	0.07	--						

## 10. Swale Outflows

Outflows Considered?	--	--	--	NO	--						
----------------------	----	----	----	----	----	--	--	--	--	--	--

Notes: The concentrated flow is from the buffer listed as other in the tab. The swale is existing.

## DESIGN POINT RESULT (Sums results for current column and all upstream design point columns.)

Design Point ID	7	E	F	G	H						
Area Type	RPA	UTA	RPA_Buffer	RPA_Swale	SPA						
Total Area (ft <sup>2</sup> )	4,821	3,620	4,270	4,821	470						
Imperviousness (%)		100.0%	84.8%	75.1%	0.0%						
Tributary Runoff (ft <sup>3</sup> )	155	151	151	155	0						
Runoff Reduction (ft <sup>3</sup> )	126	0	112	126	0						
Runoff Remaining (ft <sup>3</sup> )	29	151	39	29	0						

Total Tributary Area entered on Site Layout Worksheet is: 4,821 square feet

## Receiving Pervious Areas (Including Grass Buffers and Grass Swales)

SCM Design, Version 4.01 (December 2024)

Designer: Jerry Davidson

Company: Perception Design Group

Date: July 14, 2025

Project: Carubia Dental

Location: 8059 Meridian Park Dr.

Outfall ID: 5

### DESIGN PROCEDURE AND CRITERIA FOR ALL RPAs (User Input in Blue Cells)

#### 1. Apply Four-Cover Land Use Model to Site Layout

Design Point ID	5	I	J	K							
Area Type	RPA	UIA	RPA_Buffer	SPA							
Downstream Design Point ID	--	J	5	5							
DCIA (ft <sup>2</sup> )	--	--	--	--							
UIA (ft <sup>2</sup> )	--	4,348	--	--							
RPA (ft <sup>2</sup> )	--	--	1,591	--							
SPA (ft <sup>2</sup> )	--	--	--	1,112							

#### 2. Protect the RPA from Traffic

RPA Protection Type	--	--	None	--							
---------------------	----	----	------	----	--	--	--	--	--	--	--

#### 3. Characterize On-site Topsoil and Determine Suitability for the RPA

HSG A (%)	--	--	100.0%	--							
HSG B (%)	--	--	0.0%	--							
HSG C/D (%)	--	--	0.0%	--							

#### 4. Select Appropriate Vegetation

RPA Vegetation Type	--	--	Seed	--							
Irrigation Type	--	--	Permanent	--							

**Notes:** This is behind the building with no access to cars. A RPA Protection is not needed in this area.

### GRASS BUFFER ADDITIONAL DESIGN PROCEDURE AND CRITERIA (User Input in Blue Cells)

#### 1. Define the UIA:RPA pair, Ratio, and Interface Width

Sheet Flow Inflow Feature	--	--	Spreader	--							
Is Concrete Edger used?	--	--	--	--							
Spacing between slots (ft)	--	--	--	--							
Slot Opening Length (in)	--	--	--	--							
Blind Swale Type	--	--	Concrete	--							
Spreader Energy Dissipation	--	--	None	--							
Total Area of UIA:RPA (ft <sup>2</sup> )	--	--	5,939	--							
UIA:RPA Ratio	--	--	2.7	--							
UIA:RPA Interface Width (ft)	--	--	80	--							
L / W Ratio of UIA:RPA	--	--	0.93	--							

#### 2. Buffer Length

Average Buffer Length (ft)	--	--	20	--							
----------------------------	----	----	----	----	--	--	--	--	--	--	--

#### 3. Buffer Slope

Average Buffer Slope (ft/ft)	--	--	0.333	--							
Effective Distance (ft)	--	--	17	--							
Number of Level Spreaders	--	--	2	--							

#### 4. Provide a Vertical Drop

Vertical Drop (in)	--	--	2.00	--							
Mowing Strip Provided?	--	--	NO	--							

3in drop shown in CDs

#### 5. Calculate Runoff for UIA and RPA Pair

Imperviousness (%)	--	--	73.2%	--							
UIA:RPA Runoff (in)	--	--	0.00	--							
UIA:RPA Runoff (ft <sup>3</sup> )	--	--	0	--							

#### 6. Compare Runoff from UIA:RPA Pair to Runoff from UIA Only

UIA Runoff (ft <sup>3</sup> )	--	--	181	--							
Runoff Reduction (ft <sup>3</sup> )	--	--	181	--							
Runoff Reduction (%)	--	--	100.0%	--							

**Notes:** One level spreader is sufficient that is 80 ft long. The width of the buffer is 20 ft wide which is barely under the effective distance of 17 ft. The flow rate exiting the level spreader is very low so no energy dissipation is needed.



## GRASS SWALE ADDITIONAL DESIGN PROCEDURE AND CRITERIA (User Input in Blue Cells)

## 1. Delineate Areas Tributary to Swale

Total Tributary Area (ft <sup>2</sup> )	--	--	--	--							
Imperviousness (%)	--	--	--	--							

## 2. Swale Inflows

Concentrated Flow Type	--	--	--	--							
Blind Swale Type	--	--	--	--							
Spreader Energy Dissipation	--	--	--	--							
Vertical Drop (in)	--	--	--	--							
Gutter Depression (in)	--	--	--	--							
Curb Opening Length (ft)	--	--	--	--							
Concrete Sediment Pad	--	--	--	--							
Min. Forebay Volume (ft <sup>3</sup> )	--	--	--	--							
Design Forebay Volume (ft <sup>3</sup> )	--	--	--	--							
Max. Forebay Depth (in)	--	--	--	--							
Design Forebay Depth (in)	--	--	--	--							
Calculated Notch Width (in)	--	--	--	--							
Design Notch Width (in)	--	--	--	--							
Drain Time (minutes)	--	--	--	--							
Energy Dissipation Type	--	--	--	--							

## 3. Swale Cross Section

Length of Swale (ft)	--	--	--	--							
Bottom Width (ft)	--	--	--	--							
Bottom Area (ft <sup>2</sup> )	--	--	--	--							
Side Slopes (horiz/vert)	--	--	--	--							

## 4. Longitudinal Slope

Available Slope (ft/ft)	--	--	--	--							
Design Slope (ft/ft)	--	--	--	--							
Total Drop Height (ft)	--	--	--	--							
Underdrains Provided?	--	--	--	--							

## 5. Calculate Runoff from Tributary Area

Tributary Runoff (ft <sup>3</sup> )	--	--	--	--							
Reduced Trib. Runoff (ft <sup>3</sup> )	--	--	--	--							

## 6. Calculate Runoff Reduction through Swale Bottom

Volume Infiltrated (ft <sup>3</sup> )	--	--	--	--							
Swale Discharge (ft <sup>3</sup> )	--	--	--	--							
Runoff Reduction (%)	--	--	--	--							

## 7. Design Discharge

2-year Discharge, Q <sub>2</sub> (cfs)	--	--	--	--							
--	----	----	----	----	--	--	--	--	--	--	--

## 8. Design Velocity

Vegetal Retardance Curve	--	--	--	--							
Velocity, V <sub>2</sub> (fps)	--	--	--	--							

## 9. Design Flow Depth

Flow Depth, D <sub>2</sub> (ft)	--	--	--	--							
Flow Area, A (ft <sup>2</sup> )	--	--	--	--							
Wetted Perimeter, P (ft)	--	--	--	--							
Top Width, T (ft)	--	--	--	--							
Hydraulic Radius, R <sub>h</sub> (ft)	--	--	--	--							
VR Product (ft <sup>2</sup> /sec)	--	--	--	--							
Manning's n value	--	--	--	--							
Hydraulic Depth, D <sub>h</sub> (ft)	--	--	--	--							
Froude Number	--	--	--	--							

## 10. Swale Outflows

Outflows Considered?	--	--	--	--							
----------------------	----	----	----	----	--	--	--	--	--	--	--

Notes:

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## DESIGN POINT RESULT (Sums results for current column and all upstream design point columns.)

Design Point ID	5	I	J	K							
Area Type	RPA	UIA	RPA Buffer	SPA							
Total Area (ft <sup>2</sup> )	7,051	4,348	5,939	1,112							
Imperviousness (%)		100.0%	73.2%	0.0%							
Tributary Runoff (ft <sup>3</sup> )	181	181	181	0							
Runoff Reduction (ft <sup>3</sup> )	181	0	181	0							
Runoff Remaining (ft <sup>3</sup> )	0	181	0	0							

Total Tributary Area entered on Site Layout Worksheet is: 7,051 square feet

4.       *Excerpts from Prior Report*









**Innovative Design. Classic Results.**

NEW DOC



**FINAL DRAINAGE REPORT  
FOR  
BENT GRASS EAST COMMERCIAL FILING NO. 2**

**MAY 2014  
REVISED JULY 2014**

Prepared for:

**LAND FIRST, INC.**  
154 DEL ORO CIRCLE  
COLORADO SPRINGS, CO 80919  
Contact: Ron Waldthasuen

Prepared by:

**CLASSIC CONSULTING ENGINEERS & SURVEYORS, LLC**  
6385 CORPORATE DRIVE, SUITE 101  
COLORADO SPRINGS, CO 80919  
(719) 785-0790

RECEIVED  
VERSION  
AUG 20 2014 2

Job no. 2177.53



JOB NAME: BENT GRASS EAST COMMERCIAL FIL. 2  
 JOB NUMBER: 2177.53  
 DATE: 07/01/14  
 CALCD BY: MAW

**FINAL DRAINAGE REPORT ~ BASIN RUNOFF SUMMARY**

BASIN	WEIGHTED		OVERLAND				STREET / CHANNEL FLOW				Tc	INTENSITY						TOTAL FLOWS					
	CA(5)	CA(100)	C(5)	Length (ft)	Height (ft)	Tc (min)	Length (ft)	Slope (%)	Velocity (fps)	Tc (min)	TOTAL (min)	I(2) (in/hr)	I(5) (in/hr)	I(10) (in/hr)	I(25) (in/hr)	I(50) (in/hr)	I(100) (in/hr)	Q(2) (cfs)	Q(5) (cfs)	Q(10) (cfs)	Q(25) (cfs)	Q(50) (cfs)	Q(100) (cfs)
OS-1	6.05	8.47	0.25	950	22	37.1					37.1	1.55	2.14	2.49	3.21	3.63	3.80	9	13	15	27	31	32
OS-2	1.38	1.46	0.25								5.0	3.71	5.10	5.96	7.66	8.68	9.07	5	7	8	11	13	13
OS-3	1.34	1.44	0.25	30	0.6	6.9	200	1.5%	4.3	0.8	7.7	3.27	4.50	5.25	6.75	7.65	8.00	4	6	7	10	11	11
H3	0.85	1.00	0.25	100	2	12.6	350	2.0%	4.9	1.2	13.8	2.61	3.59	4.19	5.39	6.11	6.38	2	3	4	5	6	8
H4	0.23	0.27	0.25	50	1	8.9	150	2.0%	4.9	0.5	9.4	3.05	4.19	4.89	6.29	7.12	7.45	0.7	1.0	1.1	1.7	1.9	2.0
I1	1.65	1.95	0.25	50	1	8.9	550	2.0%	4.9	1.9	10.8	2.89	3.98	4.65	5.97	6.77	7.08	5	7	8	12	13	14
I2	0.94	1.11	0.25	50	1	8.9	300	2.0%	4.9	1.0	10.0	2.99	4.11	4.79	6.16	6.99	7.31	3	4	4	7	8	8
J	0.66	0.90	0.25	75	4	7.9					7.9	3.24	4.46	5.20	6.69	7.58	7.93	2	3	3	6	7	7
K	0.40	0.55	0.25	65	3	7.7					7.7	3.27	4.49	5.24	6.74	7.64	7.99	1	2	2	4	4	4
L	4.60	4.93	0.25	30	0.6	6.9	800	1.0%	3.5	3.8	10.7	2.90	3.99	4.66	5.99	6.78	7.10	13	18	21	29	33	35
M1	1.33	1.40	0.25	30	0.6	6.9	300	1.0%	3.5	1.4	8.4	3.18	4.38	5.11	6.57	7.44	7.78	4	6	7	9	10	11
M2	0.37	0.40	0.25								5.0	3.71	5.10	5.96	7.66	8.68	9.07	1.4	1.9	2.2	3.0	3.4	3.6
N	1.12	1.19	0.25	20	0.4	5.7	330	2.0%	4.9	1.1	6.8	3.41	4.69	5.47	7.04	7.97	8.34	4	6	6	8	9	10
O	0.15	0.20	0.25	60	5	6.1					6.1	3.51	4.83	5.64	7.25	8.22	8.59	0.5	0.7	0.8	1.5	1.7	1.7



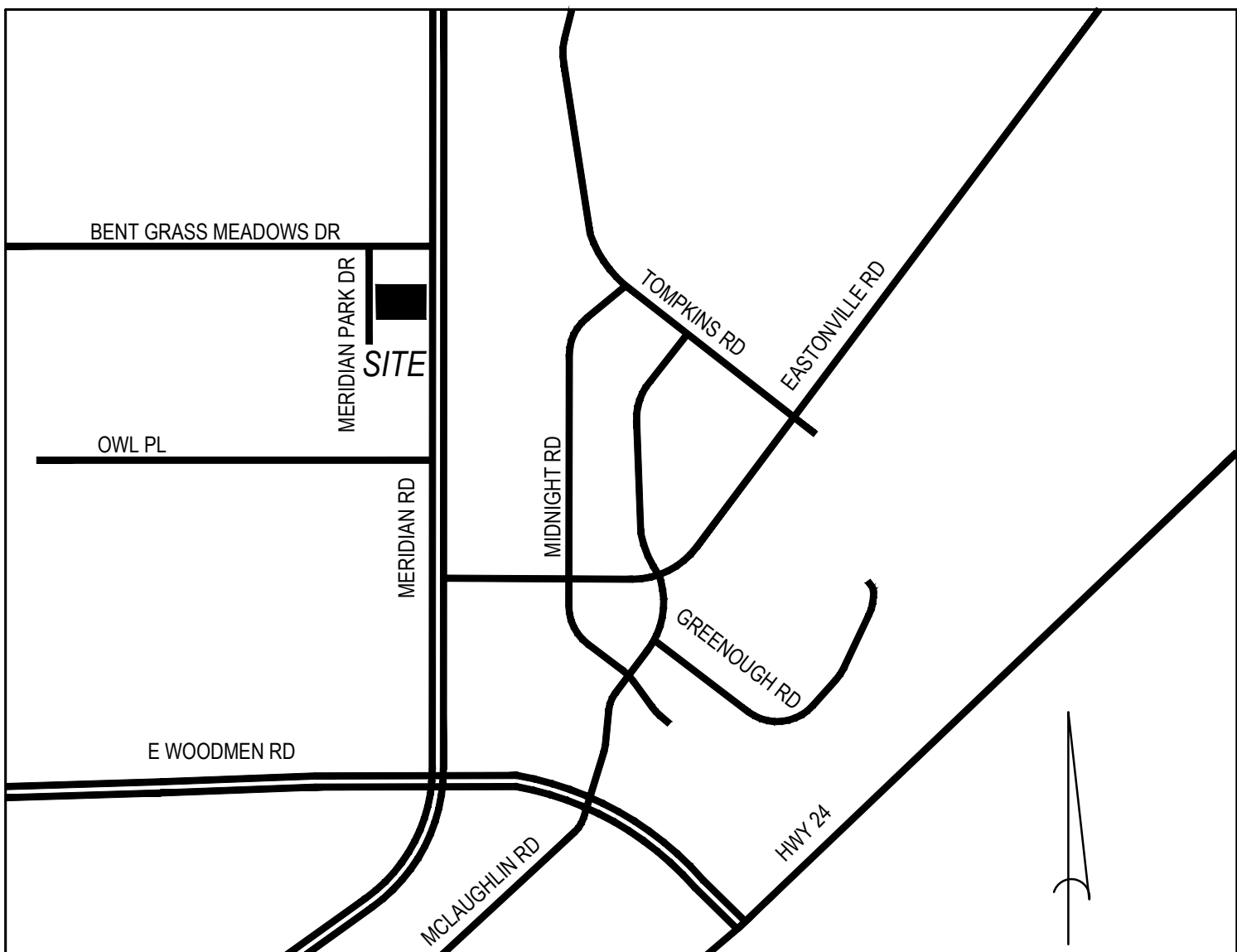
5.        *Drainage Plans*



# CARUBIA PROPERTIES - EXISTING DRAINAGE PLAN

## LOT 2, BENT GRASS EAST COMMERCIAL FILING NO. 4

A PORTION OF THE NORTHEAST QUARTER OF SECTION 1, TOWNSHIP 13 SOUTH, RANGE 65 WEST OF THE 6TH P.M.  
COUNTY OF EL PASO, STATE OF COLORADO



VICINITY MAP

1" = 1000' ±

### RUNOFF SUMMARY

DATA FROM ORIGINAL BASINS D AND D1 AS PRESENTED IN BENT GRASS EAST COMMERCIAL PHASE 1 REPORT

BASIN	AREA	Q5 (CFS)	Q100 (CFS)
D	0.41	2	3
D1	0.63	3	5

MODIFIED BASINS D AND D1 AS PRESENTED IN THIS REPORT

BASIN	AREA	IMP (%)	Q5 (CFS)	Q100 (CFS)
Dn	0.34	91	0.82	1.56
D1n	0.43	67	0.21	0.46

PRORATED BASINS Dn AND D1n BASED UPON NEW REDUCED AREAS

BASIN	% OF D AND D1	ALLOWABLE Q5 (CFS)	ALLOWABLE Q100 (CFS)
Dn	82.9%	1.7	2.5
D1n	68.3%	2.0	3.4

### LEGAL DESCRIPTION

**PARCEL A:**  
LOT 2, BENT GRASS EAST COMMERCIAL FILING NO. 4, COUNTY OF EL PASO, STATE OF COLORADO.  
THE ABOVE LOT CONTAINS 33,776 SQUARE FEET, MORE OR LESS.

**PARCEL B:**  
THOSE NON-EXCLUSIVE EASEMENT RIGHTS FOR VEHICULAR AND PEDESTRIAN INGRESS AND EGRESS AS CREATED BY RECIPROCAL ACCESS EASEMENT AND TEMPORARY CONSTRUCTION AND MAINTENANCE EASEMENT AGREEMENT RECORDED JUNE 04, 2013 UNDER RECEPTION NO. 213072561 AND FIRST AMENDMENT TO RECIPROCAL ACCESS EASEMENT AND TEMPORARY CONSTRUCTION AND MAINTENANCE EASEMENT AGREEMENT RECORDED JULY 07, 2013 UNDER RECEPTION NO. 213098588.

**PARCEL C:**  
THOSE NON-EXCLUSIVE EASEMENT RIGHTS FOR PEDESTRIAN AND VEHICULAR INGRESS AND EGRESS AS CREATED BY DECLARATION OF CROSS-ACCESS EASEMENT RECORDED NOVEMBER 3, 2023 UNDER RECEPTION NO. 223092254 AND JUNE 11, 2024 UNDER RECEPTION NO. 224044076.

### BENCHMARK

1.5" ALUMINUM CAP PLS 30118 BEING THE SOUTHWEST CORNER OF LOT 1, BENT GRASS EAST COMMERCIAL FILING NO. 4, RECORDED AT RECEPTION NO. 224715331, IN THE RECORDS OF EL PASO COUNTY COLORADO.

ELEV. = 6927.80' NVGD29

### BASIS OF BEARINGS:

BEARINGS ARE BASED ON THE SOUTH LINE OF LOT 1, BENT GRASS EAST COMMERCIAL FILING NO. 4, RECORDED AT RECEPTION NO. 224715331, IN THE RECORDS OF EL PASO COUNTY COLORADO. SAID LINE BEARS N89°30'48"E FROM MONUMENTS SHOWN.

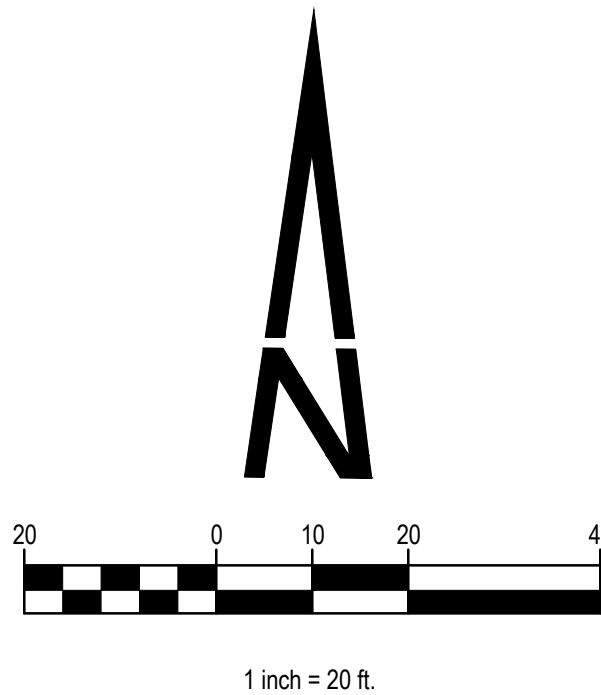
### LEGEND

- PROPERTY LINE
- LS PROPOSED LANDSCAPED AREA
- PROPOSED SIDEWALK
- PROPOSED HANDICAP RAMP
- PROPOSED HEAVY-DUTY CONCRETE PAVEMENT
- EXISTING CURB AND GUTTER
- PROPOSED CURB AND GUTTER

- SN EXISTING SANITARY SEWER
- G EXISTING GAS
- W EXISTING WATER
- UE EXISTING ELECTRIC
- FO EXISTING FIBER OPTIC
- ST EXISTING STORM SEWER
- 5340 EXISTING CONTOUR
- 5340 PROPOSED CONTOUR

- R1 BASIN DESIGNATION
- 0.20 5 YR RUNOFF COEFFICIENT
- 0.76 100 YR RUNOFF COEFFICIENT
- 0.83 BASIN AREA

- BASIN BOUNDARY LINE
- DESIGN POINT



DATE: JULY 11, 2025  
SCALE: AS INDICATED  
DRAWN BY: JWD  
CHECKED BY: JWD  
PROJECT NUMBER  
2024-019

SHEET  
1 OF 3  
EXISTING  
DRAINAGE PLAN

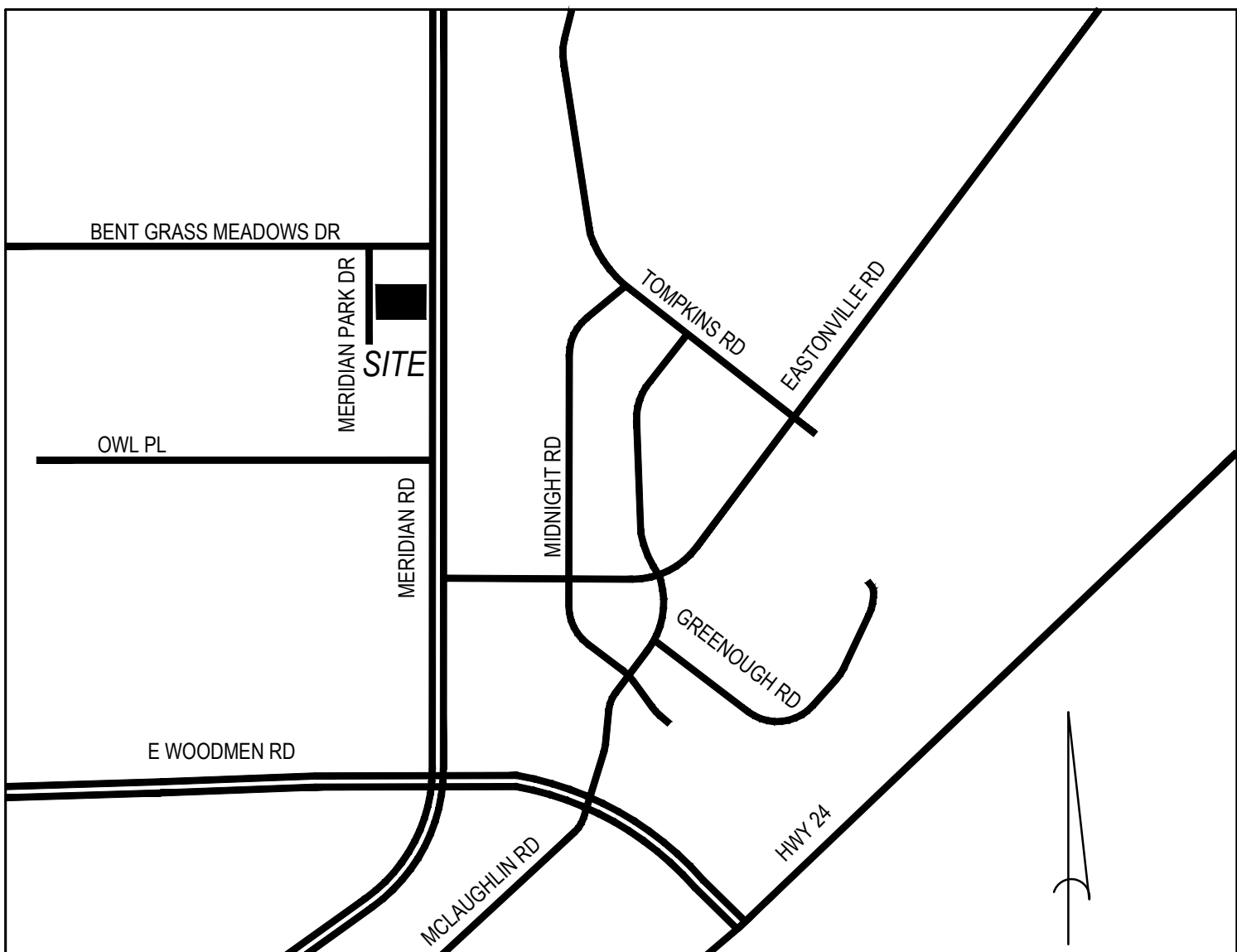




# CARUBIA PROPERTIES - PROPOSED DRAINAGE PLAN

## LOT 2, BENT GRASS EAST COMMERCIAL FILING NO. 4

A PORTION OF THE NORTHEAST QUARTER OF SECTION 1, TOWNSHIP 13 SOUTH, RANGE 65 WEST OF THE 6TH P.M.  
COUNTY OF EL PASO, STATE OF COLORADO



VICINITY MAP

1" = 1000' ±

### RUNOFF SUMMARY

BASIN	DESIGN POINT	AREA	IMP (%)	Q5 (CFS)	Q100 (CFS)
A	3	0.21	91	0.67	1.48
B	4	0.08	67	0.17	0.43
C	1	0.14	75	0.29	0.86
E	6	0.13	58	0.23	0.62
F	7	0.07	95	0.23	0.29
G	5	0.16	59	0.29	0.47
OS1		0.03	58	0.05	0.14

### ACCUMULATED RUNOFF SUMMARY

DESIGN POINT	BASINS	Q5 (CFS)	Q100 (CFS)	ALLOWABLE Q5 (CFS)	ALLOWABLE Q100 (CFS)
1	A,B,C	1.14	2.67	2.5	3.4
2	E,F,G	0.76	1.38	1.7	2.5

### LEGAL DESCRIPTION

PARCEL A:  
LOT 2, BENT GRASS EAST COMMERCIAL FILING NO. 4, COUNTY OF EL PASO, STATE OF COLORADO.  
THE ABOVE LOT CONTAINS 33,776 SQUARE FEET, MORE OR LESS.

PARCEL B:  
THOSE NON-EXCLUSIVE EASEMENT RIGHTS FOR VEHICULAR AND PEDESTRIAN INGRESS AND EGRESS AS CREATED BY RECIPROCAL ACCESS EASEMENT AND TEMPORARY CONSTRUCTION AND MAINTENANCE EASEMENT AGREEMENT RECORDED JUNE 04, 2013 UNDER RECEPTION NO. 213072561 AND FIRST AMENDMENT TO RECIPROCAL ACCESS EASEMENT AND TEMPORARY CONSTRUCTION AND MAINTENANCE EASEMENT AGREEMENT RECORDED JULY 07, 2013 UNDER RECEPTION NO. 213098588.

PARCEL C:  
THOSE NON-EXCLUSIVE EASEMENT RIGHTS FOR PEDESTRIAN AND VEHICULAR INGRESS AND EGRESS AS CREATED BY DECLARATION OF CROSS-ACCESS EASEMENT RECORDED NOVEMBER 3, 2023 UNDER RECEPTION NO. 223092254 AND JUNE 11, 2024 UNDER RECEPTION NO. 224044076.

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ELEV. = 6927.80' NVGD29

### BASIS OF BEARINGS:

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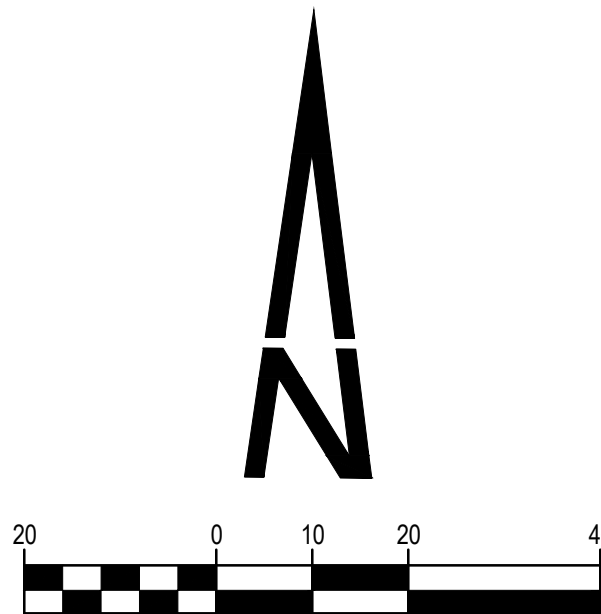
### LEGEND

- PROPERTY LINE
- PROPOSED LANDSCAPED AREA
- PROPOSED SIDEWALK
- PROPOSED HANDICAP RAMP
- PROPOSED HEAVY-DUTY CONCRETE PAVEMENT
- EXISTING CURB AND GUTTER
- PROPOSED CURB AND GUTTER

- EXISTING SANITARY SEWER
- EXISTING GAS
- EXISTING WATER
- EXISTING ELECTRIC
- EXISTING FIBER OPTIC
- EXISTING STORM SEWER
- EXISTING CONTOUR
- PROPOSED CONTOUR

- BASIN DESIGNATION
- 5 YR RUNOFF COEFFICIENT
- 100 YR RUNOFF COEFFICIENT
- BASIN AREA

- BASIN BOUNDARY LINE
- DESIGN POINT



1 inch = 20 ft.



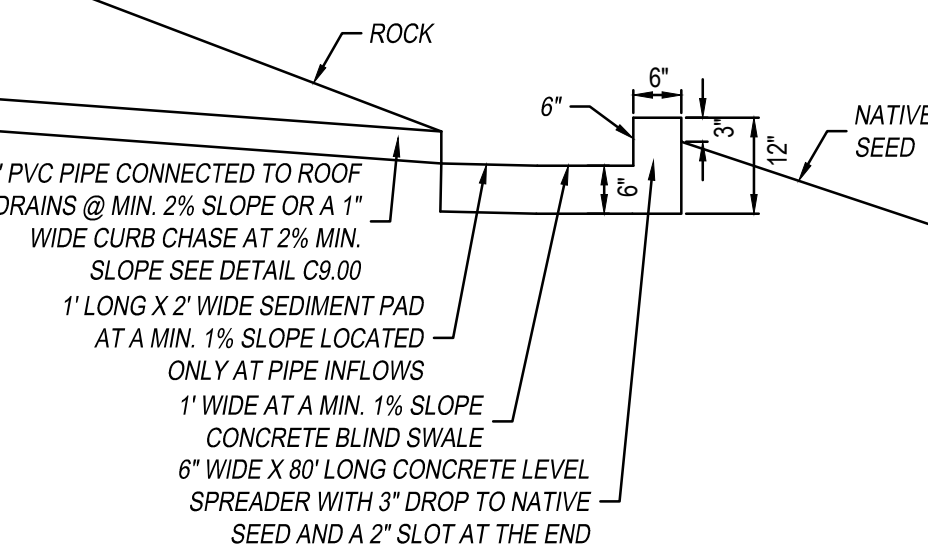
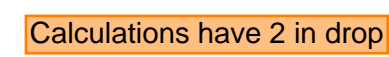
A PORTION OF THE NORTHEAST QUARTER OF SECTION 1, TOWNSHIP 13 SOUTH, RANGE 65 WEST OF THE 6TH P.M.  
COUNTY OF EL PASO, STATE OF COLORADO

The diagram illustrates a drainage system layout with the following components and labels:

- PROPERTY LINE**: Indicated by a horizontal line at the top.
- EXISTING CONTOUR**: A dashed line representing the ground surface.
- PROPOSED CONTOUR**: A solid line representing the proposed ground surface.
- EXISTING CURB AND GUTTER**: A cross-section of an existing curb and gutter.
- PROPOSED CURB AND GUTTER SPILL PAN**: A cross-section of a proposed curb and gutter spill pan.
- PROPOSED CURB AND GUTTER CATCH PAN**: A cross-section of a proposed curb and gutter catch pan.
- FINISHED GRADE AT BOTTOM OF WALL**: A horizontal line indicating the finished grade at the base of a wall.
- TOP OF WALL**: A horizontal line indicating the top of a wall.
- PROPOSED SPOT ELEVATION**: A spot elevation of 59.40.
- EXISTING SPOT ELEVATION**: A spot elevation of 59.40.
- FLOW DIRECTION**: Indicated by a large arrow pointing left.
- RECEIVING PERVIOUS AREA**: A rectangular area with diagonal hatching, representing a receiving pervious area.
- UNCONNECTED IMPERVIOUS AREA**: A rectangular area with a pattern of small circles, representing an unconnected impervious area.
- SEPARATE PERVIOUS AREA**: A rectangular area with diagonal hatching, representing a separate pervious area.
- DIRECTLY CONNECTED IMPERVIOUS AREA**: A rectangular area with a solid fill, representing a directly connected impervious area.



March 2024 | 31 of 47



1 inch = 20 ft.



UIA - RPA EXHIBIT

UJA - RPA EXHIBIT