DRAINAGE STUDY for

Colorado Springs Utilities Advanced Technology Campus Colorado Springs, CO

Prepared for:

Colorado Springs Utilities
456 West Fontanero Street
Colorado Springs, CO 80907
Contact: Jessica Davis

Prepared by:

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Contact: John Heiberger, P.E.

Project #: 196030003

Prepared: November 13, 2020

Kimley»Horn

CERTIFICATION

ENGINEER'S STATEMENT

This report and plan for the drainage design of CSU ATC was prepared by me (or under my direct supervision) and is correct to the best of my knowledge and belief. Said report and plan has been prepared in accordance with the City of Colorado Springs Drainage Criteria Manual and is in conformity with the master plan of the drainage basin. I understand that the City of Colorado Springs does not and will not assume liability for drainage facilities designed by others. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparing this report.

SIGNATURE (Affix Seal): _____

Colorado P.E. No. 50096 Date

DEVELOPER'S STATEMENT

Colorado Springs Utilities hereby certifies that the drainage facilities for CSU ATC shall be constructed according to the design presented in this report. I understand that the City of Colorado Springs does not and will not assume liability for the drainage facilities designed and/or certified by my engineer and that are submitted to the City of Colorado Springs pursuant to section 7.7.906 of the City Code; and cannot, on behalf of CSU ATC guarantee that final drainage design review will absolve Colorado Springs Utilities and/or their successors and/or assigns of future liability for improper design. I further understand that approval of the final plat does not imply approval of my engineer's drainage design.

_____

Name of Developer

_____

Authorized Signature Date

_____

Printed Name

_____

Title

_____

Address:

CITY OF COLORADO SPRINGS STATEMENT

Filed in accordance with Section 7.7.906 of the Code of the City of Colorado Springs, 2001, as amended.

_____ _____

For City Engineer Date

Conditions:

TABLE OF CONTENTS

APPENDIX

INTRODUCTION

PURPOSE AND SCOPE OF STUDY

The purpose of this report is to outline the Drainage Study for Colorado Springs Utilities Advanced Technology Center (the "CSU ATC") located on two parcels near 8655 Drennan Road (the "Site"), City of Colorado Springs, Colorado (the "City"). The Site is proceeding through the annexation process into the City of Colorado Springs. The Site will ultimately be replatted into a single parcel. This Drainage Study identifies on-site and offsite drainage patterns, areas tributary to the site and proposes to safely route developed storm water to adequate outfalls at less than historic flow rates. The Site is 160.05 acres in size and is located within the Jimmy Camp Creek Basin which is mostly vacant land. The Site is ultimately tributary to Jimmy Camp Creek.

GENERAL PROJECT DESCRIPTION

The proposed improvements consist of the construction of a solar field, three buildings of utility infrastructure (aeroderivative CT's, hydrogen cell, and microgrid platform), a substation, a service center building, and an office building (the "Project") within the Site. The Project will be processed through the City of Colorado Springs. Additional outside agency review or processing is not anticipated as part of the Project due to the annexation of the Site into the City of Colorado Springs.

The Project is located in the northeast quarter and a portion of the southeast quarter of Section 4, Township 15 South, Range 65 West of the 6th Principal Meridian, within the City of Colorado Springs, County of El Paso, State of Colorado. **Appendix A** includes a vicinity map for the Project. The Site will be split into four phases: Phase 1 consisting of the construction of the Horizon substation and full spectrum detention pond; Phase 2 consisting of the construction of the Advanced Technology Campus, Innovation and Collaboration Park, and lab; Phase 3 consisting of the construction of the Service Center; and Phase 4 consisting of the construction of a solar field, labs, Aeroderivative CT's, Hydrogen Cell, and Microgrid Platform.

The Site is currently undeveloped and consists of natural vegetation. The following provides plat information for the adjacent properties:

- South of the Site (vacant land): Reception #200900268
- North of the Site (Drennan Road and north of Drennan Road is vacant land): Tract of Land, reference El Paso County Assessor
- West of the Site (vacant land): Lot 7 of Colorado Springs Airport Filing No. 10
- East of the Site (vacant land): Tract of Land, reference El Paso County Assessor

The Site is planned to be replatted into a single parcel.

PROJECT CHARACTERISTICS

The Project Site is 160.05 acres and involves the construction of a solar field, three buildings of utility infrastructure (aeroderivative CT's, hydrogen cell, and microgrid platform), a substation, a service center building, and an office building

The proposed buildings, pavements, and other impervious surfaces comprise 36.6 percent (3,383,465 square feet) of the overall Project Site. Landscape and open space areas comprise

63.4 percent (5,852,299 square feet) of the overall Project Site.

The proposed Project will route stormwater for the entire development to a proposed private full spectrum detention pond located in the center and east portion of the Site. Flows will outfall from a proposed private outlet structure to the existing culvert within Foreign Trade Zone Boulevard and eventually to Jimmy Camp Creek.

There are no major irrigation facilities within the Site. The Site does not currently provide on-site water quality or detention for the Project area. There is no regional detention pond for the Project Site. The existing land use is vacant land. The proposed land use is public facility.

SOILS CONDITIONS

NRCS soil data is available for this Site and it has been noted that soils onsite are generally USCS Type A and B. The NRSC Soils map is provided in **Appendix B**.

DRAINAGE DESIGN CRITERIA

REGULATIONS

Water quality and detention are required for this Project per the City of Colorado Springs Drainage Criteria Manual (the "Criteria"), dated May 2014. The project proposes a private full spectrum detention pond.

The required 4-Step Process is addressed in the Proposed Drainage Conditions section of this report.

There currently are no publicly available existing drainage reports or Master Drainage Plans associated with this Site.

DEVELOPMENT DESIGN CRITERIA REFERENCE AND CONSTRAINTS

The proposed Site follows the City of Colorado Springs Storm Drainage Criteria Manual, Volumes 1 and 2 (the "CRITERIA") and the Urban Storm Drainage Criteria Manual Volumes 1, 2, and 3 (the "MANUAL"). Site drainage is not significantly impacted by such constraints as utilities or existing development. Further detail regarding onsite drainage patterns is provided in the Proposed Drainage Conditions Section.

HYDROLOGIC CRITERIA

The 5-year and 100-year design storm events were used in determining rainfall and runoff for the proposed drainage system per section 6 of the CRITERIA. Table 6-2 of the CRITERIA is the source for rainfall data for the 5-year and 100-year design storm events. Design runoff was calculated using the Rational Method for developed conditions as established in the CRITERIA and MANUAL. Runoff coefficients for the proposed development were determined using Table 6-6 of the CRITERIA by calculating weighted impervious values for each specific site basin. Results of the hydrologic calculations are summarized in **Appendix C**.

HYDRAULIC CRITERIA

The proposed drainage facilities are designed in accordance with the CRITERIA and MANUAL. Floodplain identification was determined using FIRM panels by FEMA (see **Appendix B**) and information provided in the CRITERIA. Hydraulic calculations will be computed in the Final Drainage Report required during the Development Plan process for each proposed phase respectively.

VARIANCES FROM CRITERIA

There are no proposed variances from the Criteria.

EXISTING DRAINAGE CONDITIONS

EXISTING DRAINAGE BASIN

The Site generally slopes from west to east at approximately 2.0-7.0%. The existing runoff from the Site is captured by culverts within Foreign Trade Zone Boulevard. The runoff then continues east and eventually outfalls to Jimmy Camp Creek.

There are no known major irrigation facilities within 100 feet of the property. The Site has been divided into 3 existing sub-basins, as described below and shown in the existing conditions map in **Appendix D**.

Sub-Basin E1

Sub-basin E1 is 108.85 acres and consists of the north portion of the Site. The runoff from this sub-basin surface flows to the east to an existing culvert within Foreign Trade Zone Boulevard (Design Point E1). The 5-year and 100-year storm event runoffs are 22.84 cfs and 167.69 cfs, respectively. The runoff within this sub-basin is ultimately discharged into Jimmy Camp Creek.

Sub-Basin E2

Sub-basin E2 is 88.64 acres and consists of the south portion of the Site. The runoff within this sub-basin surface flows east to an existing culvert within Foreign Trade Zone Boulevard (Design Point E2). The 5-year and 100-year storm event runoffs are 19.60 cfs and 143.89 cfs, respectively. The runoff developed within this sub-basin is ultimately discharged into Jimmy Camp Creek.

Sub-Basin E3

Sub-basin E3 is 14.54 acres and consists of a small portion in the southeast corner of the Site. The runoff within this sub-basin surface flows east to an existing culvert within Foreign Trade Zone Boulevard (Design Point E3). The 5-year and 100-year storm event runoffs are 4.56 cfs and 33.50 cfs, respectively. The runoff developed within this sub-basin is ultimately discharged into Jimmy Camp Creek.

OFFSITE FLOWS

Offsite flows consist of a portion of land west and south of the Site. These areas were captured in existing sub-basins E1 and E2. Adjacent areas north of the site flow to Drennan Road and adjacent areas to the east flow to Jimmy Camp Creek.

PROPOSED DRAINAGE CONDITIONS

The proposed Site has been divided into one sub-basin, Sub-Basin P1. A proposed conditions map is provided in **Appendix D**. Offsite area flowing onto the Project Site was included in Sub-Basin P1.

Sub-Basin P1

Sub-basin P1 is 212.02 acres and consists of multiple buildings, parking lots, open spaces, and a solar field. The runoff within this sub-basin sheet flows to the proposed private full spectrum detention pond at Design Point P1. The 5-year and 100-year storm event runoffs are 269.35 cfs and 649.05 cfs, respectively. The runoff developed within this sub-basin is ultimately discharged into Jimmy Camp Creek.

EMERGENCY OVERFLOW ROUTING

In the event that the proposed private full spectrum detention pond becomes full, flows will overtop the east portion of the pond and sheet flow to the culvert within Foreign Trade Zone Boulevard.

MAJOR DRAINAGEWAYS

There are no major drainageways on site or adjacent to the site.

HYDRAULIC ANALYSIS METHODOLOGY

The proposed drainage facilities are designed in accordance with the CRITERIA and MANUAL. Floodplain identification was determined using FIRM panels by FEMA and information provided in the CRITERIA.

Four-Step Process

The four-step process per the MANUAL provides guidance and requirements for the selection of siting of structural Best Management Practices (BMPs) for new development and significant redevelopment.

Step 1: Employ Runoff Reduction Practices
Landscaping and open space areas are implemented throughout the Project Site and make up a large portion of the Site. Proposed landscaping and open space areas will help slow runoff and encourage infiltration.

Step 2: Implement BMPs That Provide a Water Quality Capture Volume with Slow Release
The water quality capture volume will be provided within the private full spectrum detention pond.

Step 3: Stabilize Drainageways
The Project Site is located more than 500’ away from any major drainageways and there are no open channels located on or adjacent to the Site. Therefore, stabilization of drainageways is not required. The Project outfall is to the existing culvert within Foreign Trade Zone Boulevard and ultimately to Jimmy Camp Creek.

Step 4: Implement Site Specific and Other Source Control BMPs
The Site does not require "Covering of Storage/Handling Areas" or "Spill Containment and Control" (specialized BMPs) in the final constructed condition. There is no proposed material storage or other site operations that would introduce contaminants to the City's MS4 that would require site specific control or source control BMP for the proposed project.

Water Quality and Detention

A private full spectrum detention pond is proposed to provide water quality and detention for the entire P1 sub-basin (212.02 acres). An assumed imperviousness of 80% was used in the Mile High Flood District detention spreadsheet to determine the WQCV and 100-year detention volume for the Site. This imperviousness was assumed to ensure adequate pond volume for future development of the Project Site. The calculations for the pond volume were provided in the **Appendix C**.

The detention structure and water quality outlet structure will be designed per the specifications in section 13.5.10 of the CRITERIA. The orifice plate of the structure will be designed based on section 13.4.2.2 of the CRITERIA. The orifice plate will allow the Water Quality Capture Volume to be drained from the structure in 40 hours and the EURV to be drained within 72 hours. The 100-year design release rate was determined by using Table 13-2 of the CRITERIA.

EROSION CONTROL PLAN

Erosion Control Plans will be submitted separately as a standalone construction document.

FLOODPLAIN STATEMENT

The Flood Insurance Rate Maps (FIRM) 08041C0768G effective date December 7, 2018, by FEMA, indicates that the Site is located in Zone X (outside of the 500-year flood plain). This panel is included in **Appendix B**.

FEES DEVELOPMENT

DRAINAGE AND BRIDGE FEES

The Project Site is located in the Jimmy Camp Creek Basin. The Jimmy Camp Creek requires the following fees:

Drainage Fee	$8,294/acre
Pond Land Fee	$2,703/acre

Total: $1,759,520.00

MAINTENANCE AND OPERATIONS

An Inspection and Maintenance Agreement was submitted to the City of Colorado Springs for the proposed private full spectrum detention pond.

GROUNDWATER CONSIDERATIONS

Groundwater is not anticipated to be encountered. A perimeter drain system will not be provided for this Project.

SUMMARY

COMPLIANCE WITH STANDARDS

The drainage design presented within this report for CSU ATC conforms to the City of Colorado Springs Storm Drainage Criteria Manual, Volumes 1 and 2 and the Mile High Flood District Manual. Additionally, the Site runoff and storm drain facilities will not adversely affect the downstream and surrounding developments.

This report and findings are in general conformance with all previously approved reports and/or studies which include this Site. The proposed Project does not adversely impact the peak flows downstream within Jimmy Camp Creek.

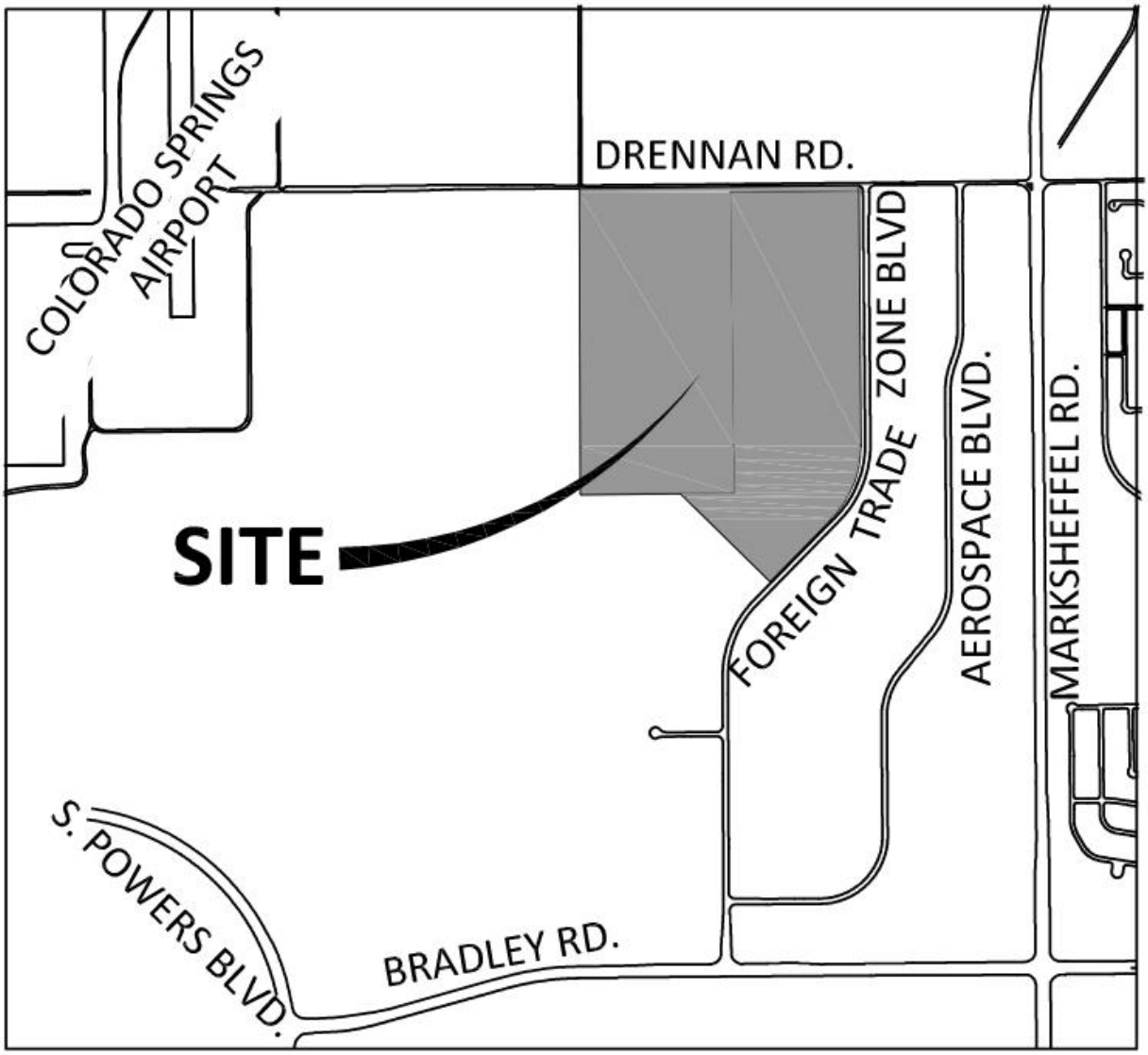
REFERENCES

1. City of Colorado Springs Drainage Criteria Manual, May 2014.

2. Mile High Flood District Drainage Criteria Manual Vol. 1, prepared by Wright-McLaughlin Engineers, June 2001, with latest revisions.

3. Flood Insurance Rate Map, El Paso County, Colorado and Incorporated Areas, Map Number 08041C0768G, Effective Date December 7, 2018, prepared by the Federal Emergency Management Agency (FEMA).

APPENDIX A – VICINITY MAP



VICINITY MAP - N.T.S.

APPENDIX B – SOILS MAP AND FEMA FIRM PANEL

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 13. The **horizontal datum** was NAD83, GRS80 spheroid. Differences in datum, spheroid, projection or UTM zones zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the **North American Vertical Datum of 1988 (NAVD88)**. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov/ or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, MD 20910-3282

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at (301) 713-3242 or visit its website at http://www.ngs.noaa.gov/.

Base Map information shown on this FIRM was provided in digital format by El Paso County, Colorado Springs Utilities, and Anderson Consulting Engineers, Inc. These data are current as of 2006.

This map reflects more detailed and up-to-date **stream channel configurations and floodplain delineations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map. The profile baselines depicted on this map represent the hydraulic modeling baselines that match the flood profiles and Floodway Data Tables if applicable, in the FIS report. As a result, the profile baselines may deviate significantly from the new base map channel representation and may appear outside of the floodplain.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

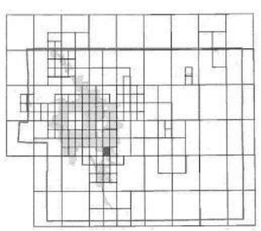
Contact **FEMA Map Service Center** (MSC) via the FEMA Map Information eXchange (FMIX) 1-877-336-2627 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. The MSC may also be reached by Fax at 1-800-358-9620 and its website at http://www.msc.fema.gov/.

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.

El Paso County Vertical Datum Offset Table

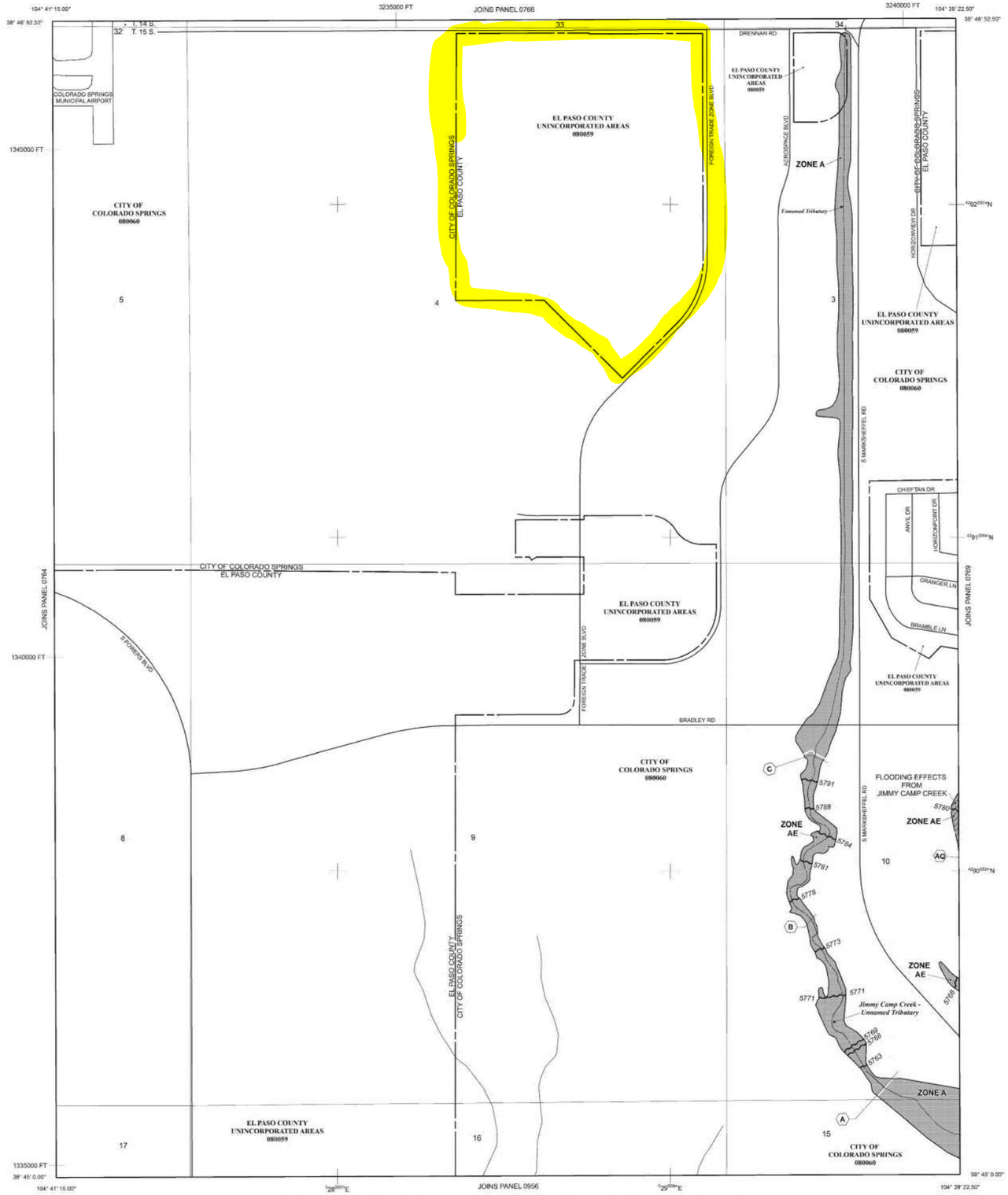
Flooding Source	Vertical Datum Offset (ft)
REFER TO SECTION 3.3 OF THE EL PASO COUNTY FLOOD INSURANCE STUDY FOR STREAM BY STREAM VERTICAL DATUM CONVERSION INFORMATION	

Panel Location Map



This Digital Flood Insurance Rate Map (DFIRM) was produced through a Cooperating Technical Partner (CTP) agreement between the State of Colorado Water Conservation Board (CWCB) and the Federal Emergency Management Agency (FEMA).

Additional Flood Hazard information and resources are available from local communities and the Colorado Water Conservation Board.



NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 14 SOUTH, RANGE 65 WEST, AND TOWNSHIP 15 SOUTH, RANGE 65 WEST.

LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAS) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area Formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X — Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X — Areas determined to be outside the 0.2% annual chance floodplain.

ZONE D — Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

	Floodplain boundary
	Floodway boundary
	Zone D Boundary
	CBRS and OPA boundary
	Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
513	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

A — A	Cross section line
23 - - - 23	Transect line
97° 07' 30.00" 32° 22' 30.00"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
4775000mN	1000-meter Universal Transverse Mercator grid ticks, zone 13
6000000 FT	5000-foot grid ticks: Colorado State Plane coordinate system, central zone (FIPSZONE 0502), Lambert Conformal Conic Projection
DX5510 ×	Bench mark (see explanation in Notes to Users section of this FIRM panel)
• M1.5	River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

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

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
DECEMBER 7, 2018 - to update corporate limits, to change Base Flood Elevations and Special Flood Hazard Areas, to update map format, to add roads and road names, and to incorporate previously issued Letters of Map Revision.

For community map revision history prior to countywide mapping, refer to the Community Map History Table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

250 0 500 1000 FEET

150 0 150 300 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0768G

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO

AND INCORPORATED AREAS

PANEL 768 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS

COMMUNITY	NUMBER	PANEL	SUFFIX
COLORADO SPRINGS, CITY OF	080060	0768	G
EL PASO COUNTY	080059	0768	G

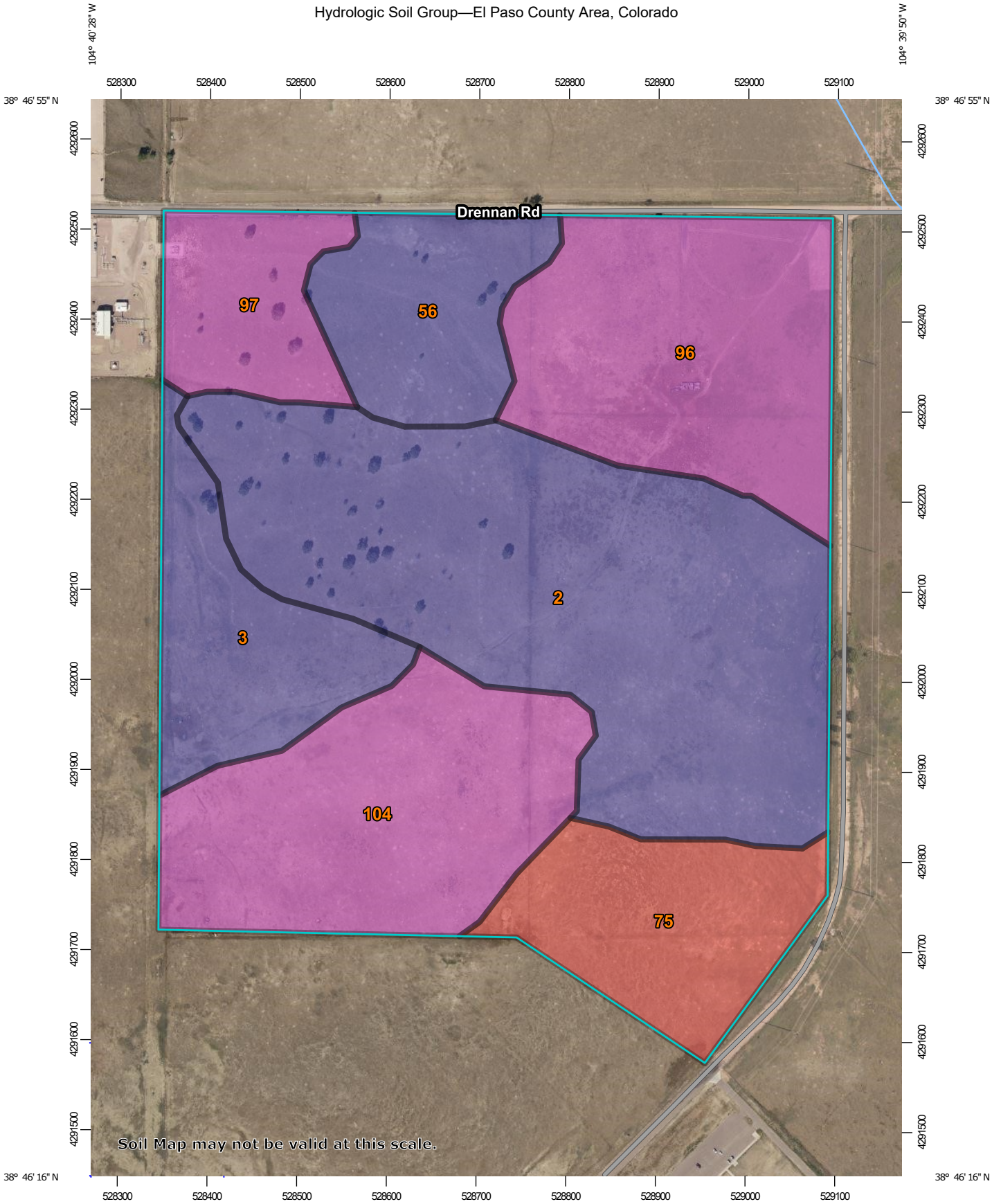
Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
08041C0768G

MAP REVISED
DECEMBER 7, 2018

Federal Emergency Management Agency

Hydrologic Soil Group—El Paso County Area, Colorado



Map Scale: 1:5,830 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 250 500 1000 1500

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 Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

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 18, Jun 5, 2020

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.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
2	Ascalon sandy loam, 1 to 3 percent slopes	B	52.0	33.9%
3	Ascalon sandy loam, 3 to 9 percent slopes	B	13.4	8.8%
56	Nelson-Tassel fine sandy loams, 3 to 18 percent slopes	B	12.1	7.9%
75	Razor-Midway complex	D	15.1	9.8%
96	Truckton sandy loam, 0 to 3 percent slopes	A	25.1	16.4%
97	Truckton sandy loam, 3 to 9 percent slopes	A	9.5	6.2%
104	Vona sandy loam, warm, 0 to 3 percent slopes	A	26.1	17.0%
Totals for Area of Interest			**153.4**	**100.0%**

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

APPENDIX C – HYDROLOGIC CALCULATIONS

IDF Equations:

I_{100} = -2.52ln(D) + 12.735
I_{50} = -2.25ln(D) + 11.375
I_{25} -2.00ln(D) + 10.111
I_{10} -1.75ln(D) + 8.847
I_{5} -1.50ln(D) + 7.583
I_{2} -1.19ln(D) + 6.035

Where:
I = Rainfall Intensity (in/hr)
D= Duration (minutes)

	2-yr	5-yr	10-yr	100-yr
P_1 =	1.19	1.5	1.75	2.52

*The Design Point Rainfall Values and Time Intensity Frequency Tabulation are found in Table 6-2 and Figure 6-5 respectively, of the Colorado Springs Drainage Criteria Manual, Volume 1

Weighted Imperviousness Calculations - Existing Basins

SUB-BASIN	AREA (SF)	AREA (Acres)	ROOF AREA	ROOF IMPERVIOUSNESS	ROOF C2	ROOF C5	ROOF C10	ROOF C100	LANDSCAPE AREA	LANDSCAPE IMPERVIOUSNESS	LANDSCAPE C2	LANDSCAPE C5	LANDSCAPE C10	LANDSCAPE C100	PAVEMENT AREA	PAVEMENT IMPERVIOUSNESS	PAVEMENT C2	PAVEMENT C5	PAVEMENT C10	PAVEMENT C100	WEIGHTED IMPERVIOUSNESS	WEIGHTED COEFFICIENTS C2	WEIGHTED COEFFICIENTS C5	WEIGHTED COEFFICIENTS C10	WEIGHTED COEFFICIENTS C100
E1	4,741,371	108.85	0	90%	0.71	0.73	0.75	0.81	4,741,371	2%	0.02	0.08	0.15	0.35	0	100%	0.89	0.90	0.92	0.96	2.0%	0.02	0.08	0.15	0.35
E2	3,861,076	88.64	0	90%	0.71	0.73	0.75	0.81	3,861,076	2%	0.02	0.08	0.15	0.35	0	100%	0.89	0.90	0.92	0.96	2.0%	0.02	0.08	0.15	0.35
E3	633,317	14.54	0	90%	0.71	0.73	0.75	0.81	633,317	2%	0.02	0.08	0.15	0.35	0	100%	0.89	0.90	0.92	0.96	2.0%	0.02	0.08	0.15	0.35
TOTAL	9,235,764	212.02	0	90%	0.71	0.73	0.75	0.81	9,235,764	2%	0.02	0.08	0.15	0.35	0	100%	0.89	0.90	0.92	0.96	2.0%	0.02	0.08	0.15	0.35

CSU ATC - Drainage Report
Existing Runoff Calculations
Time of Concentration

Watercourse Coefficient					
Forest & Meadow	2.50	Short Grass Pasture & Lawns	7.00	Grassed Waterway	15.00
Fallow or Cultivation	5.00	Nearly Bare Ground	10.00	Paved Area & Shallow Gutter	20.00

	SUB-BASIN DATA				INITIAL / OVERLAND TIME			TRAVEL TIME T(t)					T(c) CHECK (URBANIZED BASINS)			FINAL T(c)
DESIGN POINT	DRAIN BASIN	AREA sq. ft.	AREA ac.	C(5)	Length ft.	Slope %	T(i) min	Length ft.	Slope %	Coeff.	Velocity fps	T(t) min.	COMP. T(c)	TOTAL LENGTH	L/180+10	min.
E1	E1	4,741,371	108.85	0.08	100	7.0%	9.8	3320	2.5%	20.00	3.2	17.5	27.3	3420	29.0	27.3
E2	E2	3,861,076	88.64	0.08	100	7.0%	9.8	3023	2.8%	20.00	3.3	15.1	24.9	3123	27.4	24.9
E3	E3	633,317	14.54	0.08	100	8.0%	9.3	650	5.6%	21.00	4.9	2.2	11.5	750	14.2	11.5

CSU ATC - Drainage Report
Existing Runoff Calculations
(Rational Method Procedure)

Design Storm *5 Year*

BASIN INFORMATION				DIRECT RUNOFF				CUMMULATIVE RUNOFF				NOTES
DESIGN POINT	DRAIN BASIN	AREA ac.	RUNOFF COEFF	T(c) min	C x A	I in/hr	Q cfs	T(c) min	C x A	I in/hr	Q cfs	
E1	E1	108.85	0.08	27.3	8.71	2.62	22.84					
E2	E2	88.64	0.08	24.9	7.09	2.76	19.60					
E3	E3	14.54	0.08	11.5	1.16	3.92	4.56					

CSU ATC - Drainage Report
Existing Runoff Calculations
(Rational Method Procedure)

Design Storm *100 Year*

BASIN INFORMATION				DIRECT RUNOFF				CUMMULATIVE RUNOFF				NOTES
DESIGN POINT	DRAIN BASIN	AREA ac.	RUNOFF COEFF	T(c) min	C x A	I in/hr	Q cfs	T(c) min	C x A	I in/hr	Q cfs	
E1	E1	108.85	0.35	27.3	38.10	4.40	167.69					
E2	E2	88.64	0.35	24.9	31.02	4.64	143.89					
E3	E3	14.54	0.35	11.5	5.09	6.58	33.50					

SUMMARY - EXISTING RUNOFF TABLE				
DESIGN POINT	BASIN DESIGNATION	BASIN AREA (ACRES)	DIRECT 5-YR RUNOFF (CFS)	DIRECT 100-YR RUNOFF (CFS)
E1	E1	108.85	22.84	167.69
E2	E2	88.64	19.60	143.89
E3	E3	14.54	4.56	33.50

IDF Equations:

I_{100} = -2.52ln(D) + 12.735
I_{50} = -2.25ln(D) + 11.375
I_{25} -2.00ln(D) + 10.111
I_{10} -1.75ln(D) + 8.847
I_5 -1.50ln(D) + 7.583
I_2 -1.19ln(D) + 6.035

Where:
I = Rainfall Intensity (in/hr)
D= Duration (minutes)

	2-yr	5-yr	10-yr	100-yr
P_1 =	1.19	1.5	1.75	2.52

*The Design Point Rainfall Values and Time Intensity Frequency Tabulation are found in Table 6-2 and Figure 6-5 respectively, of the Colorado Springs Drainage Criteria Manual, Volume 1

Weighted Imperviousness Calculations - Proposed Basins

SUB-BASIN	AREA (SF)	AREA (Acres)	ROOF AREA	ROOF IMPERVIOUSNESS	ROOF C2	ROOF C5	ROOF C10	ROOF C100	LANDSCAPE AREA	LANDSCAPE IMPERVIOUSNESS	LANDSCAPE C2	LANDSCAPE C5	LANDSCAPE C10	LANDSCAPE C100	PAVEMENT AREA	PAVEMENT IMPERVIOUSNESS	PAVEMENT C2	PAVEMENT C5	PAVEMENT C10	PAVEMENT C100	WEIGHTED IMPERVIOUSNESS	WEIGHTED COEFFICIENTS C2	WEIGHTED COEFFICIENTS C5	WEIGHTED COEFFICIENTS C10	WEIGHTED COEFFICIENTS C100
P1	9,235,764	212.02	868,108	90%	0.71	0.73	0.75	0.81	5,852,299	2%	0.02	0.08	0.15	0.35	2,515,357	100%	0.89	0.90	0.92	0.96	37.0%	0.32	0.36	0.42	0.56
TOTAL	9,235,764	212.02	868,108	90%	0.71	0.73	0.75	0.81	5,852,299	2%	0.02	0.08	0.15	0.35	2,515,357	100%	0.89	0.90	0.92	0.96	37.0%	0.32	0.36	0.42	0.56

CSU ATC - Drainage Report
Proposed Runoff Calculations
Time of Concentration

Watercourse Coefficient			
Forest & Meadow	2.50	Short Grass Pasture & Lawns	7.00
Fallow or Cultivation	5.00	Nearly Bare Ground	10.00
Grassed Waterway	15.00		
Paved Area & Shallow Gutter	20.00		

	SUB-BASIN DATA				INITIAL / OVERLAND TIME			TRAVEL TIME T(t)					T(c) CHECK (URBANIZED BASINS)			FINAL T(c)
DESIGN POINT	DRAIN BASIN	AREA sq. ft.	AREA ac.	C(5)	Length ft.	Slope %	T(i) min	Length ft.	Slope %	Coeff.	Velocity fps	T(t) min.	COMP. T(c)	TOTAL LENGTH	L/180+10	min.
P1	P1	9,235,764	212.02	0.36	100	5.0%	7.9	2000	5.0%	20.00	4.5	7.5	15.4	2100	21.7	15.4

CSU ATC - Drainage Report
Proposed Runoff Calculations
(Rational Method Procedure)

Design Storm *5 Year*

BASIN INFORMATION				DIRECT RUNOFF				CUMMULATIVE RUNOFF				NOTES
DESIGN POINT	DRAIN BASIN	AREA ac.	RUNOFF COEFF	T(c) min	C x A	I in/hr	Q cfs	T(c) min	C x A	I in/hr	Q cfs	
P1	P1	212.02	0.36	15.4	77.27	3.49	269.35					

CSU ATC - Drainage Report
Proposed Runoff Calculations
(Rational Method Procedure)

Design Storm *100 Year*

BASIN INFORMATION				DIRECT RUNOFF				CUMMULATIVE RUNOFF				NOTES
DESIGN POINT	DRAIN BASIN	AREA ac.	RUNOFF COEFF	T(c) min	C x A	I in/hr	Q cfs	T(c) min	C x A	I in/hr	Q cfs	
P1	P1	212.02	0.56	15.4	118.60	5.85	694.05					0.00

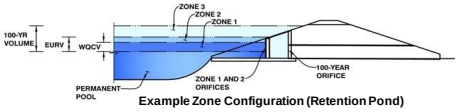
SUMMARY - PROPOSED RUNOFF TABLE				
DESIGN POINT	BASIN DESIGNATION	BASIN AREA (ACRES)	DIRECT 5-YR RUNOFF (CFS)	DIRECT 100-YR RUNOFF (CFS)
P1	P1	212.02	269.35	694.05

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.03 (May 2020)

Project: CSU ATC

Basin ID: Entire Site



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type = EDB
Watershed Area = 212.02 acres
Watershed Length = 3,100 ft
Watershed Length to Centroid = 1,000 ft
Watershed Slope = 0.050 ft/ft
Watershed Imperviousness = 80.00% percent
Percentage Hydrologic Soil Group A = 50.0% percent
Percentage Hydrologic Soil Group B = 50.0% percent
Percentage Hydrologic Soil Groups C/D = 0.0% percent
Target WQCV Drain Time = 40.0 hours
Location for 1-hr Rainfall Depths = User Input

After providing required inputs above including 1-hour rainfall depths, click 'Run CUHP' to generate runoff hydrographs using the embedded Colorado Urban Hydrograph Procedure.

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	5.801	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	20.568	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	17.135	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	22.356	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	26.870	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	32.050	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	36.780	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	42.414	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	54.439	acre-feet		inches
Approximate 2-yr Detention Volume =	14.781	acre-feet		
Approximate 5-yr Detention Volume =	19.350	acre-feet		
Approximate 10-yr Detention Volume =	23.569	acre-feet		
Approximate 25-yr Detention Volume =	26.576	acre-feet		
Approximate 50-yr Detention Volume =	28.333	acre-feet		
Approximate 100-yr Detention Volume =	30.217	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) = 5.801 acre-feet
Zone 2 Volume (EURV - Zone 1) = 14.767 acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) = 9.649 acre-feet
Total Detention Basin Volume = 30.217 acre-feet
Initial Surcharge Volume (ISV) = user ft^3
Initial Surcharge Depth (ISD) = user ft
Total Available Detention Depth (H_{total}) = user ft
Depth of Trickle Channel (H_{TC}) = user ft
Slope of Trickle Channel (S_{TC}) = user ft/ft
Slopes of Main Basin Sides (S_{main}) = user H:V
Basin Length-to-Width Ratio ($R_{L/W}$) = user

Initial Surcharge Area (A_{ISV}) = user ft^2
Surcharge Volume Length (L_{ISV}) = user ft
Surcharge Volume Width (W_{ISV}) = user ft
Depth of Basin Floor (H_{FLOOR}) = user ft
Length of Basin Floor (L_{FLOOR}) = user ft
Width of Basin Floor (W_{FLOOR}) = user ft
Area of Basin Floor (A_{FLOOR}) = user ft^2
Volume of Basin Floor (V_{FLOOR}) = user ft^3
Depth of Main Basin (H_{MAIN}) = user ft
Length of Main Basin (L_{MAIN}) = user ft
Width of Main Basin (W_{MAIN}) = user ft
Area of Main Basin (A_{MAIN}) = user ft^2
Volume of Main Basin (V_{MAIN}) = user ft^3
Calculated Total Basin Volume (V_{total}) = user acre-feet

Depth Increment = ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	371,101	8.519		
	--	1.00	--	--	--	380,890	8.744	375,995	8.632
	--	2.00	--	--	--	390,779	8.971	761,830	17.489
	--	3.00	--	--	--	400,769	9.200	1,157,604	26.575
	--	4.00	--	--	--	410,859	9.432	1,563,418	35.891
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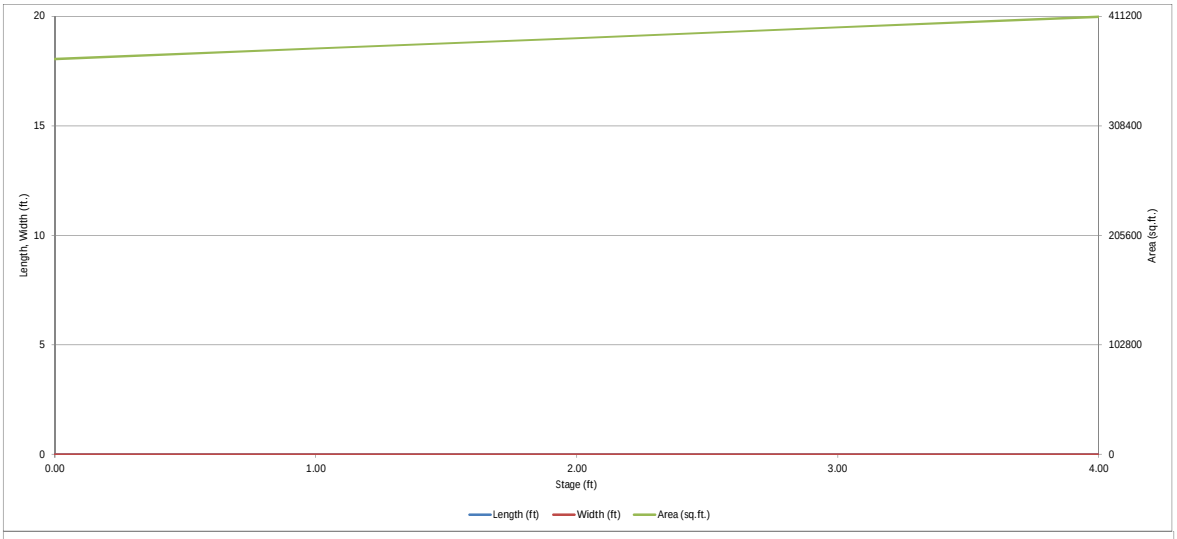
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15
10
5
0
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411200
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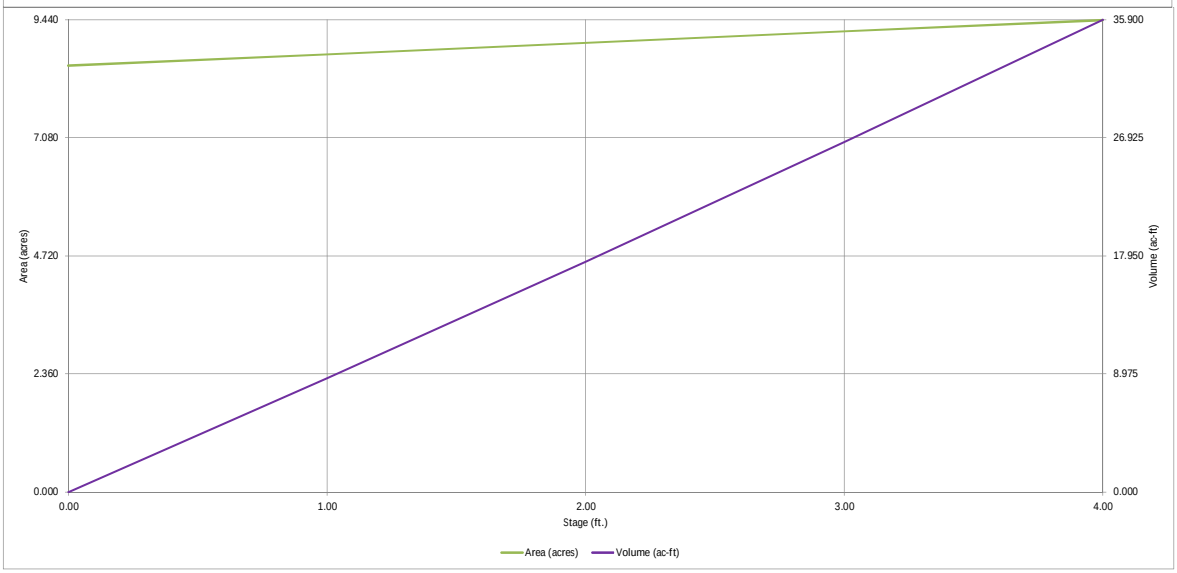
205600
102800
0
Area (sq.ft.)
0.00
1.00
2.00
3.00
4.00
Stage (ft)
Length (ft)
Width (ft)
Area (sq.ft.)


9.440
7.080
4.720
2.360
0.000
Area (acres)
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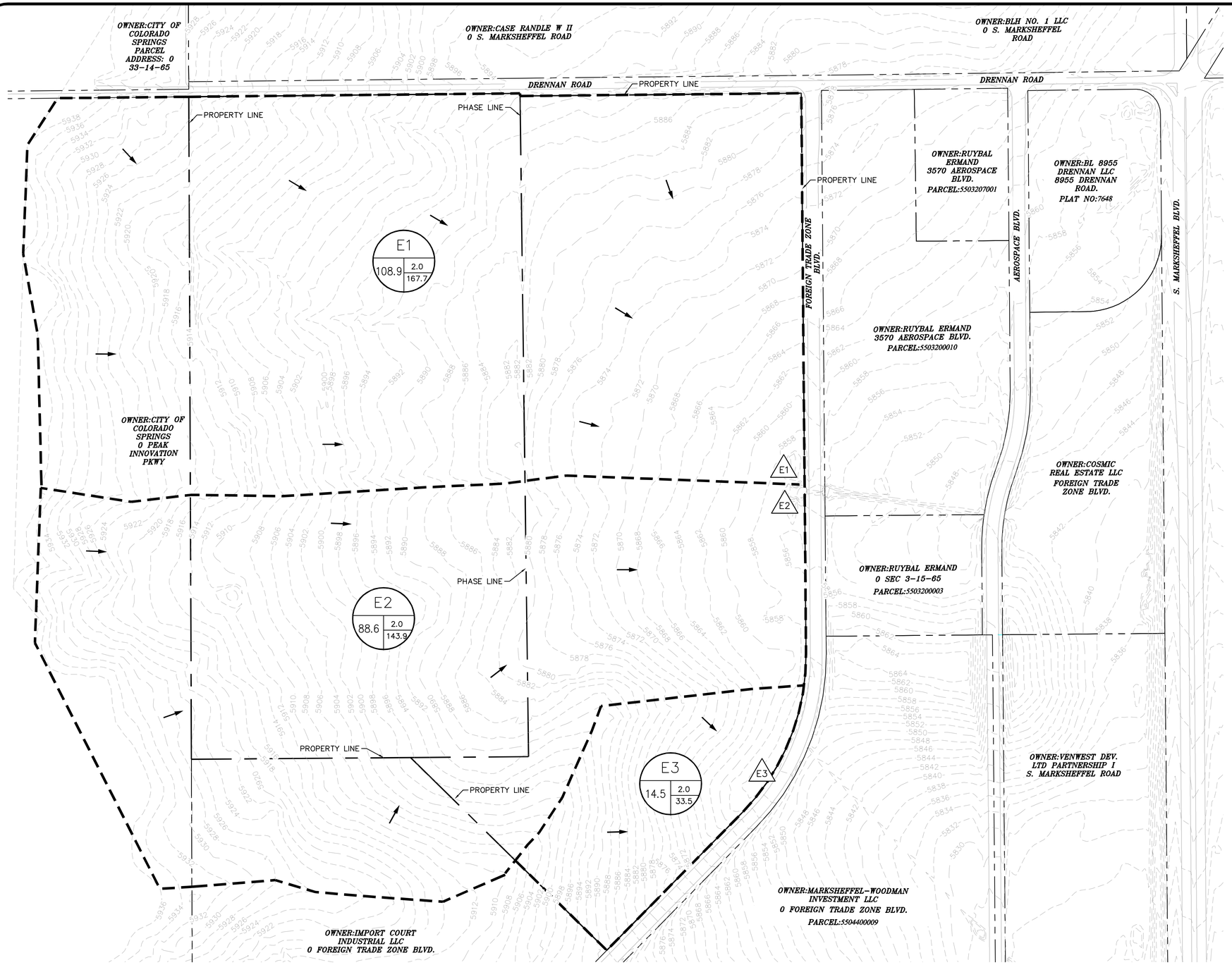
26.925
17.950
8.975
0.000
Volume (ac-ft)
0.00
1.00
2.00
3.00
4.00
Stage (ft.)
Area (acres)
Volume (ac-ft)

APPENDIX D – DRAINAGE EXHIBITS



LEGEND

A = BASIN DESIGNATION
B = AREA (ACRES)
C = BASIN IMPERVIOUSNESS
D = 100YR DESIGN STORM RUNOFF (CFS)

= DESIGN POINT

FLOW DIRECTION

PROPERTY BOUNDARY
PARCEL LINE
DRAINAGE BASIN BOUNDARY
EXISTING MAJOR CONTOUR
EXISTING MINOR CONTOUR

SUMMARY - EXISTING RUNOFF TABLE

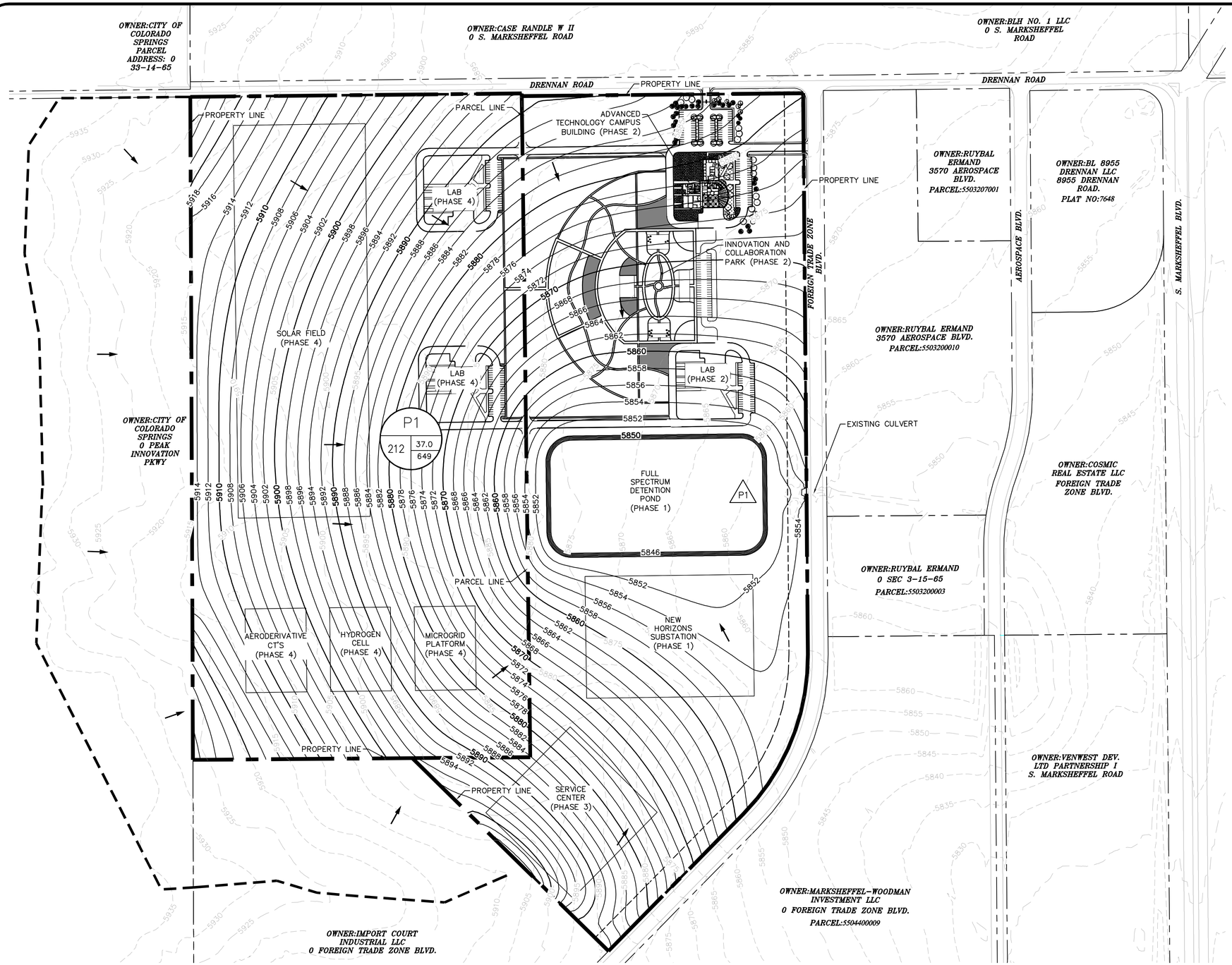
DESIGN POINT	BASIN DESIGNATION	BASIN AREA (ACRES)	DIRECT 5-YR RUNOFF (CFS)	DIRECT 100-YR RUNOFF (CFS)
E1	E1	108.85	22.84	167.69
E2	E2	88.64	19.60	143.89
E3	E3	14.54	4.56	33.50

NORTH

GRAPHIC SCALE IN FEET
0 100 200 400

EXISTING DRAINAGE EXHIBIT – CSU ATC, COLORADO SPRINGS, CO

Kimley»Horn



LEGEND

A = BASIN DESIGNATION
B = AREA (ACRES)
C = BASIN IMPERVIOUSNESS
D = 100YR DESIGN STORM RUNOFF (CFS)

= DESIGN POINT

FLOW DIRECTION

PROPERTY BOUNDARY
PARCEL LINE
DRAINAGE BASIN BOUNDARY
XXXX PROPOSED MAJOR CONTOUR
XXXX PROPOSED MINOR CONTOUR
XXXX EXISTING MAJOR CONTOUR
XXXX EXISTING MINOR CONTOUR

SUMMARY - PROPOSED RUNOFF TABLE

DESIGN POINT	BASIN DESIGNATION	BASIN AREA (ACRES)	DIRECT 5-YR RUNOFF (CFS)	DIRECT 100-YR RUNOFF (CFS)
A1	A1	212.02	269.35	694.05

NORTH

GRAPHIC SCALE IN FEET
0 100 200 400

PROPOSED DRAINAGE EXHIBIT – CSU ATC, COLORADO SPRINGS, CO

Kimley»Horn