Preliminary Drainage Report

Villas at Aspen Trails
El Paso County, Colorado

PCD File No.: PUDSP208
SF-21-025
SP234

Prepared for:
ROS Equity Holdings – Independence, LLC
17 S. Wahsatch Avenue
Colorado Springs, Colorado 80903

Prepared by:
Kimley-Horn and Associates, Inc.
2 North Nevada Ave
Suite 900
Colorado Springs, CO 80903
(719) 453-0180
Contact: Mitchell Hess, P.E.

Project #: 096668022

Prepared: March 2023

Kimley»Horn

Table of Contents

CERTIFICATION

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.

SIGNATURE (Affix Seal): _____

Colorado P.E. No. 53916 Date

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 STATEMENT

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.

_____ _____

County Engineer/ECM Administrator Date

Conditions:

GENERAL LOCATION AND DESCRIPTION

PURPOSE AND SCOPE OF STUDY

The purpose of this Preliminary Drainage Report (PDR) is to provide the hydrologic and hydraulic calculations and to document and finalize the drainage design methodology in support of the proposed Villas at Aspen Trails residential development (the "Project"). The Project is located within the jurisdictional limits of El Paso County (the "County"). Thus, the guidelines for the hydrologic and hydraulic design were based on the criteria outlined by the County's Engineering Criteria Manual.

LOCATION

The Project is located south of the Colorado Springs Airport and at the southeast corner of Bradley Road and Legacy Hill Drive. More specifically, the Project is within portions of Section 8 & 9, Township 15 South, Range 65 West of the 6th Principal Meridian, County of El Paso, State of Colorado (parcel number 5509200003). A vicinity map is provided below.

VICINITY MAP

LOCATION MAP
NTS

DESCRIPTION OF PROPERTY

The Project is located on approximately 4.25 acres of undeveloped land with limited vegetation and grass cover. The site is currently vacant and does not provide stormwater quality or detention and there are no known major drainage ways or irrigation facilities on the site. The proposed services in the development include the following: water, sewer, electric service, natural gas service, telephone service, and fire protection. The site generally drains from the north to south with slopes ranging from 1.75% to 3.60%. The Project is not adjacent to any major drainageways and does not outfall directly to any major drainageways. The Project will release treated and detained flows into an existing 18" RCP storm sewer stub which connects to the public storm sewer system at a curb inlet located along Frontside Drive.

NRCS soil data is available for the Site (See Appendix) and the onsite soils are USCS Hydrologic Soil Group B. Group B soils have a moderate infiltration rate when thoroughly wet and mainly consist of well drained soils that have moderately fine texture to moderately coarse texture. This site specifically is predominately comprised of fine sandy loams, with a mix of stoneham sandy loam. A Soils and Geology Study was prepared for the site by Entech Engineering, Inc. dated June 20, 2023.

PROJECT CHARACTERISTICS

The Project is a proposed single family attached development that will include single-family lots attached with private road access. The site will be configured in seven attached (townhome) 3-plex units across 21 lots and five attached (townhome) 4-plex units across 20 lots. The project will include the construction of tracts for buffering, landscaping, open spaces, pedestrian corridors, private roads, and a full-spectrum extended detention basin to serve the Project. Water quaility and detention is required for the site improvements and will be accomplished with the construction of a full-spectrum extended detention basin located on the southwest corner of the site. As part of the utility infrastructure improvements, a proposed storm sewer system will be constructed to collect runoff. Stormwater will be conveyed via overland flow across the lots, within the curb and gutter of the proposed streets before being captured in proposed storm inlets. The storm sewer system will then convey runoff into the full-spectrum extended detention basin before being discharged offsite.

DRAINAGE BASINS AND SUB-BASINS

MAJOR BASIN DESCRIPTIONS

The site is located within the Jimmy Camp Creek Basin. It is within the service area of the Widefield Water and Sanitation District (WWSD).

The Site is also located outside the 100-year floodplain and within Zone X (an area of minimal flood hazard) as noted on the FEMA FIRM Map No. 08041C0752G revised on December 7, 2018 (See Appendix).

There are no identified nearby irrigation facilities or other obstructions which could influence the local drainage.

SUB-BASIN DESCRIPTION

Historic Drainage Patterns

The existing drainage is divided into five sub-basins, Basin E1-E5, as shown on the Existing Drainage Map in the Appendix. Sub-Basin E1 is approximately 2.13 acres and consists of most of the on-site area within the property line. Runoff generated from this Sub-Basin drains overland from north to south. The weighted imperviousness for Sub-Basin E1 with existing conditions is 2% and the runoff for the 5-year and 100-year storm events are 0.64 cfs and 4.69 cfs respectively. Sub-Basin E2 is approximately 1.24 acres and consists of the central portion of this site. Runoff generated from this Sub-Basin drains overland from north to south. The weighted imperviousness of Sub-Basin E2 is 2% and the runoff for the 5-year and 100-year storm events are 0.37 cfs and 2.74 cfs respectively. Sub-Basin E3 is approximately 0.88 acres and consists of the eastern portion of this site. Runoff generated from this Sub-Basin drains overland from northwest to southeast. The weighted imperviousness of Sub-Basin E2 is 2% and

the runoff for the 5-year and 100-year storm events are 0.27 cfs and 2.02 cfs respectively. Sub-basins E4 and E5 consists of the area north of the Site which flows onto the Site and merges with sub-basins E1, E2, and E3. The direct runoff for sub-basins E4 in the 5-year and 100-year storm events are 0.02 cfs and 0.17 cfs respectively. The direct runoff for sub-basins E5 in the 5-year and 100-year storm events are 0.02 cfs and 0.14 cfs respectively.

The Final Drainage Report for Trails at Aspen Ridge, prepared by Matrix Design Group January 2020 (the "Master FDR") outlines the overall proposed drainage features for the Waterview East (Waterview II) Subdivision and complies with the Waterview Master Development Drainage Study (MDDP) (the "MDDP") and subsequent amendments. The proposed East Pond in the Master FDR is downstream of the Site and accepts all developed flows from the Project and surrounding area. This report dictates that the Site must provide full-spectrum detention as part of the development and anticipates release rates from the Project of 0.3 cfs and 4.4 cfs in the 5-year and 100-year events respectively. These treated and detained flows are to tie-in to an existing 18" RCP storm sewer stub which connects to the public storm infrastructure at the curb inlet located in Frontside Drive. The flows are then routed to the East Pond per the Master FDR. Excerpts from the Master FDR are included in the Appendix for reference.

Off-Site Drainage Flow Patterns

The site experiences offsite runoff from the north delineated by sub-basins OF3 and OF4. Sub-Basin OF3 will be captured by the proposed on-site storm sewer infrastructure and routed to the detention pond for water quality treatment and detention. Flows generated sun-basin OF4 are routed briefly on-site where they join sub-basin OS1, but return to the Bradley Road right-of-way where they follow historic drainage patterns. Flows generated to the east of the site remain off-site. Flows generated to the south of the site will remain off-site and be conveyed past the site via the proposed concrete pan across the proposed driveway.

DRAINAGE DESIGN CRITERIA

DEVELOPMENT CRITERIA REFERENCE

The proposed storm facilities follow the El Paso County Drainage Criteria Manual (the "CRITERIA"), El Paso Engineering Criteria Manual (the "ECM"), and the Mile High Flood Control District Urban Storm Drainage Criteria Manual (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 chapter 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. The detention storage requirement was calculated using Full Spectrum Detention methods as specified in the CRITERIA and MANUAL. The Full Spectrum Extended Detention Basin's outlet structure will be designed to release the Water Quality Capture Volume (WQCV) in at least 40 hours and the EURV will be released with a 72 hour drain time. Outlet structure calculations will be provided in the Final Drainage Report. Based upon this approach, we feel that the drainage

design provided for the Site is conservative and in keeping with the historic drainage patterns for the Site.

The proposed drainage facilities are designed in accordance with the CRITERIA and MANUAL. Floodplain identification was determined using FIRM panels by FEMA. Hydraulic calculations will be computed using StormCAD for the proposed storm sewer system and provided in the Final Drainage Report.

DRAINAGE FACILITY DESIGN

GENERAL CONCEPT

PROPOSED DRAINAGE PATTERNS

The developed runoff from the Project will generally be collected by means of curb and gutter and storm sewer system with inlets located on the C Street within each delineated sub-basin area. Additionally, there will be a proposed 6' wide concrete v-gutter that captures flows and routes them to a 8' curb cut to discharge directly into the proposed private full-spectrum extended detention basin. A proposed 6' vegetated swale will be located on the south portion of the project within sub-basin A2 to convey runoff to the proposed private full-spectrum extended detention basin. The runoff collected from sub-basins A1 and A2 will be captured by storm inlets and conveyed through storm pipes to the proposed private full-spectrum extended detention basin located in the southwest corner of the site.

SPECIFIC DETAILS

The property has been divided into eleven sub-basins, A1-A5, OS1-OS2, and OF1-OF4. Sub-basins A1 through A5 make up the Project on-site area which are captured and routed to the proposed private full-spectrum extended detention basin where they are treated and detained before release. Sub-basins OS1 and OS2 consist of the on-site area which is not captured by the proposed private full-spectrum extended detention basin and flows off-site. Sub-basins OF1-OF4 consist of the basins residing off-site, but either flow on-site and are captured by the proposed private full-spectrum extended detention basin or are disturbed and whose flows remain off-site.

The weighted imperviousness of the Site area (Sub-basins A1-A5, OS1, OS2) is 48.1% with combined runoff of 7.69 cfs and 17.84 cfs in the 5-year and 100-year events respectively. The weighted imperviousness for the entire studied area is 46.9% with combined runoff of 7.83 cfs and 18.33 cfs in the 5-year and 100-year events respectively.

Sub-Basin A1

Sub-basin A1 consists of approximately 0.69 acres and is the area along the north and central portions of the site, consisting of rooftops, landscaping, pavement, D Street and a portion of C Street. A Proposed 5' CDOT Type R curb inlet (Design Point A1) on C Street captures this runoff and routes it to the proposed private full-spectrum extended detention basin. A small portion of flows from sub-basin A1 will bypass the curb inlet and be captured by the 10' curb inlet located in sub-basin A2. These inlet capacity calculations are provided in Appendix C for reference. Developed runoff during the 5-year and 100-year events are 1.27 cfs and 3.03 cfs respectively.

Sub-Basin A2

Sub-basin A2 consists of approximately 0.59 acres and is made up of a portion of the west buildings along C Street, a portion of C Street, and a section of landscaping in the central portion of the site. A proposed 10' CDOT Type R curb inlet on C Street (Design Point A2) will capture the runoff and convey it to the proposed private full-spectrum extended detention basin. A small portion of flows from sub-basin A1 will bypass the curb inlet and be captured by the 10' curb inlet located in sub-basin A2. These inlet capacity calculations are provided in Appendix C for reference. Developed runoff during the 5-year and 100-year events are 1.21 cfs and 2.67 cfs respectively.

Sub-Basin A3

Sub-basin A3 consists of approximately 1.87 acres and is the south and eastern portions of the site, consisting of pavement, landscaping, and building rooftops. The runoff from this area is conveyed via curb and gutter and concrete v-gutter before entering an 8-foot wide curb cut with rip-rap rundown (Design Point A3) that is discharged directly into the proposed private full-spectrum extended detention basin. Developed runoff during the 5-year and 100-year events are 3.86 cfs and 8.10 cfs respectively.

Sub-Basin A4

Sub-basin A4 consists of approximately 0.40 acres and consists of runoff generated directly within the proposed private full-spectrum extended detention basin. Runoff developed directly in this sub-basin during the 5-year and 100-year events are 0.31 cfs and 1.30 cfs respectively. The total runoff at Design Point A4 equals the total flow entering the proposed private full-spectrum extended detention basin, 7.00 cfs and 16.15 cfs in the 5-year and 100-year events respectively.

Sub-Basin A5

Sub-basin A5 consists of approximately 0.24 acres and consists of landscaping and an associated drainage swale directed from east to west into the proposed private full-spectrum extended detention basin. Developed runoff during the 5-year and 100-year events are 0.30 cfs and 0.82 cfs respectively.

Sub-Basin OS1

Sub-basin OS1 consists of approximately 0.08 acres and consists of the northeast corner of the site, vegetated hillside. Runoff will sheet flow to the portion of land that is northeast of the project (Design Point OS1), following historic drainage patterns within the right-of-way along Bradley Road. Flows from this sub-basin are not treated by an on-site PBMP and excluded per ECM App I.7.1.C.1, which allows for up to 20% of the site development area to remain uncaptured. This 0.08 acre basin totals to 1.88% of the total site development area. Developed runoff during the 5-year and 100-year events are 0.03 cfs and 0.20 cfs respectively.

Sub-Basin OS2

Sub-basin OS2 consists of approximately 0.38 acres and consists of the southeast portion of the site, including driveway and vegetated hillside. Runoff will sheet flow to the portion of land that is east of the project and eventually into the right-of-way of Frontside Drive (Design Point OS2), following historic drainage patterns. Flows from this sub-basin are not treated by a PBMP and excluded per ECM App I.7.1.C.1, which allows for up to 20% of the site development area to remain uncaptured. This 0.38 acre basin totals to 8.94% of the total site development area. Flows from this sub-basin are captured and conveyed in the public storm sewer infrastructure

within the proposed Schoonover Drive to the East Pond where they are detained and treated per the Trails at Aspen Ridge Filing No. 4 Final Drainage Report. Developed runoff during the 5-year and 100-year events are 0.72 cfs and 1.73 cfs respectively.

Sub-Basin OF1

Sub-basin OF1 consists of approximately 0.01 acres and consists of the portion of the western driveway access that is not located on the Site, but which is captured by the proposed private full-spectrum extended detention basin. Runoff from this sub-basin combine with flows of sub-basin A4 and are collected at Design Point A4. Developed flows during the 5-year and 100-year events are 0.03 cfs and 0.06 cfs respectively.

Sub-Basin OF2

Sub-basin OF2 consists of approximately 0.01 acres and consists of the portion of the western driveway access that is not located on the Site, and is conveyed offsite to the intersection of Legacy Hill Drive and B Street (Design Point OF2). Flows from this sub-basin are not detained or treated on-site, but are conveyed through the public storm sewer infrastructure to the East Pond proposed in the Master FDR where they are detained and treated. Developed flows during the 5-year and 100-year events are 0.06 cfs and 0.12 cfs respectively.

Sub-Basin OF3

Sub-basin OF3 consists of approximately 0.08 acres and consists of a the area north of the site which surface flows directly into sub-basin A1 and follows similar drainage patters to the on-site basin. Flows from sub-basin OF3 are captured on-site in the proposed private full-spectrum extended detention basin. Developed flows during the 5-year and 100-year events are 0.02 cfs and 0.17 cfs respectively.

Sub-Basin OF4

Sub-basin OF4 consists of approximately 0.06 acres and consists of a the area north of the site which surface flows directly into sub-basin OS1 and follows similar drainage patters to the on-site basin. Flows from this sub-basin are captured and conveyed in the public storm sewer infrastructure within Frontside Drive to the East Pond proposed in the Master FDR where they are detained and treated. Developed flows during the 5-year and 100-year events are 0.02 cfs and 0.14 cfs respectively.

EMERGENCY OVERFLOW ROUTING

Emergency overflow routing consists of flows following historic drainage patterns from north to south and discharging into Frontside Drive.

DETENTION AND WATER QUALITY

The WQCV and 100-year detention is required for this Project. This is accomplished through the proposed private full-spectrum extended detention basin on the southwest corner of the Site. The basin was sized to provide water quality and detention for the entire Site (sub-basins A1-A5, OS1 and OS2) per UDFCD criteria. The water quality and detention calculations are provided in the Appendix of this report. The proposed private full-spectrum extended detention basin will be maintained by the homeowner's association.

Four-Step Process

The four-step process per the MANUAL provides guidance and requirements for the selection of siting of structural Construction Control Measures (CCMs) for new development and significant redevelopment.

Step 1: Employ Runoff Reduction Practices
Currently the site is vacant undeveloped land. Development of the site will increase current runoff conditions due to increased imperviousness values. However, implementation of landscaping throughout the site, the proposed storm sewer infrastructure, and the proposed private full-spectrum extended detention basin will help slow runoff and encourage infiltration.

Step 2: Provide Water Quality Capture Volume (WQCV)
The water quality capture volume will be detained using a full-spectrum extended detention basin on the southwest corner of the Site. The water quality outlet structure will control the release of stormwater to at or less than historic rates.

Step 3: Stabilize Drainageways
There are no current drainageways conveyed through this property. No improvements to stabilize drainageways are a part of this Project.

Step 4: Consider need for Industrial and Commercial BMPs
Erosion control features for the final stages of the Project will be designed to reduce contamination. Source control BMPs will include the use of, inlet protection, silt fences, concrete washout areas, stockpile management, and stabilized staging areas. The Grading and Erosion Control Plans will be submitted as a separate construction document set.

Detention and Water Quality Design

The proposed private Full Spectrum Extended Detention Basin will be designed with an outlet structure that is fitted with an orifice plate and restrictor plate to release the WQCV in at least a 40-hour drain time period and the EURV in a 72 hour drain time period per the MANUAL.

Calculations included in the Appendix provide details regarding the private water quality and detention basins design. The calculations include determination of the storage volumes required for full spectrum detention for the WQCV and 100 year detention and allowable release rates. The Final Drainage Report will provide calculations for the proposed outlet structure.

Overall, 0.387 acre-feet of detained volume is required, with the WQCV consisting of 0.071 ac-ft of the total volume. The total area contributing to the Extended Detention Basin consists of 4.25 acres (48.1% imperviousness).

Outlet Requirements

The water quality standards established by the CRITERIA are met by the proposed private full-spectrum extended detention basin. The water quality outlet structure will be designed per the specifications in the CRITERIA. The outlet structure for the proposed private full-spectrum extended detention basin will meet the micro-pool requirement that it be integrated into the design of the structure with an additional initial surcharge volume. The orifice plates of the structures will be designed based on the CRITERIA. The orifice plates will allow the WQCV to be drained from the structure in at least 40 hours and the EURV in 72 hours. The outlet pipe from the outlet structure will connect to the storm infrastructure in the public right-of-way with an existing 18” RCP storm sewer stub that extends from the back of an existing inlet located in

Frontside Drive. Per the Master FDR, this stub is anticipated to accept 0.3 cfs and 4.4 cfs in the 5-year and 100-year events respectively. The proposed outlet structure from the full-spectrum extended detention basin will release flows at 0.4 cfs and 4.0 cfs in the 5-year and 100-year events respectively. The calculations for the design of the outlet structures will be provided in the Final Drainage Report.

Emergency Spillway Path

The emergency overflow from the Extended Detention Basin will be located on the south side of the pond and will discharge into Frontside Drive. The Final Drainage Report will provide calculations on the emergency overflow spillway for the pond which will be located on the south side of the detention pond.

COST OF PROPOSED DRAINAGE FACILITIES

An Estimated Opinion of Probable Construction Cost (EOPCC) is provided in the Appendix of the report. There are no public drainage facilities. All improvements with this Project will be private.

DRAINAGE AND BRIDGE FEES

The Site is located in the Jimmy Camp Creek Drainage Basin. The total impervious acreage of the parcel (5509200003) is 4.25 total acres x 48.1% imperviousness = 2.04 impervious acres. The total drainage fees due for the Site is $35,748.96.
There are no applicable bridge fees for the Jimmy Camp Creek Drainage Basin.

	2022 Fees ($ / Impervious acre)	Impervious Area (Acre)	Amount Due ($)
Drainage Fee	$9,185	2.04	$18,737.40
Bridge Fee	Closed	-	-
		Total amount due:	**$18,737.46**

GRADING AND EROSION CONTROL

The GEC plans will be submitted to El Paso County Planning and Community Development Department for review and approval prior to construction.

MAINTENANCE AND OPERATIONS

Maintenance of the extended detention basin will be provided by the homeowner's association.

OTHER GOVERNMENT AGENCY REQUIREMENTS

Approval from other agencies such as the FEMA, the Army Corps of Engineers, Colorado State Engineer, Colorado Water Conservation Board, and others are not needed with this Project.

SUMMARY

The Project will provide water quality and detention for the Site per a proposed private full-spectrum extended detention basin located in the southwest corner of the Site. The proposed cumulative 5-year runoff for the study area is 7.83 cfs and the cumulative 100-year runoff is 18.33 cfs. The proposed cumulative 5-year runoff for the Site is 7.69 cfs and the cumulative

100-year runoff is 17.84 cfs. Flows are to be released at rates in compliance with the previously approved Master FDR.

COMPLIANCE WITH STANDARDS

The drainage design presented within this report for Villas at Aspen Trails, conforms to the El Paso County Drainage Criteria Manual and the Mile High Flood District Urban Storm Drainage Criteria Manual. Additionally, the Site runoff and storm drain facilities will not adversely affect the downstream and surrounding developments. The proposed flows entering the extended detention basin will be released at or less than historic rates via an outlet structure which will be designed with the Final Drainage Report.

REFERENCES

1. City of Colorado Springs Drainage Criteria Manual, May 2014, Revised January 2021.

2. El Paso County Drainage Criteria Manual, Vol. 1 and 2, October 1994.

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

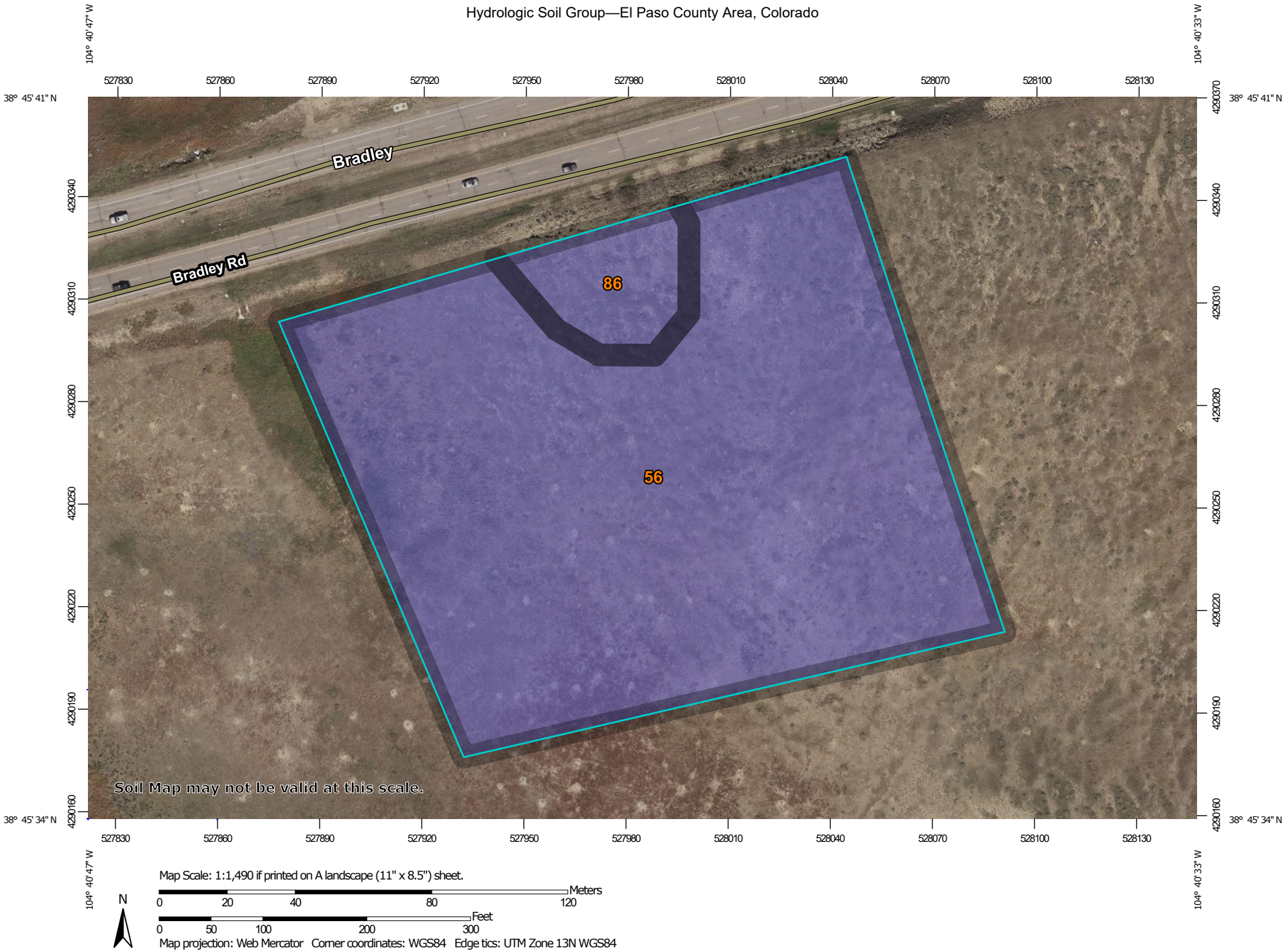
4. Flood Insurance Rate Map, El Paso County, Colorado and Incorporated Areas, Map Number 08041C0459G, Effective Date December 7, 2018, prepared by the Federal Emergency Management Agency (FEMA).

5. Final Drainage Report for Trails at Aspen Ridge, Prepared By Matrix Design Group, January 2020. El Paso County PCD File No. SF-19-002

6. Final Drainage Report for Trails at Aspen Ridge Filing No. 4, Prepared By Matrix Design Group, August 2021. El Paso County PCD File No. SF-21-024

APPENDIX

APPENDIX A – FEMA FIRM MAP AND USGS SOILS MAP



Map Scale: 1:1,490 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 20 40 80 120

Feet
0 50 100 200 300

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 19, Aug 31, 2021

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
56	Nelson-Tassel fine sandy loams, 3 to 18 percent slopes	B	5.5	93.1%
86	Stoneham sandy loam, 3 to 8 percent slopes	B	0.4	6.9%
Totals for Area of Interest			**5.9**	**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

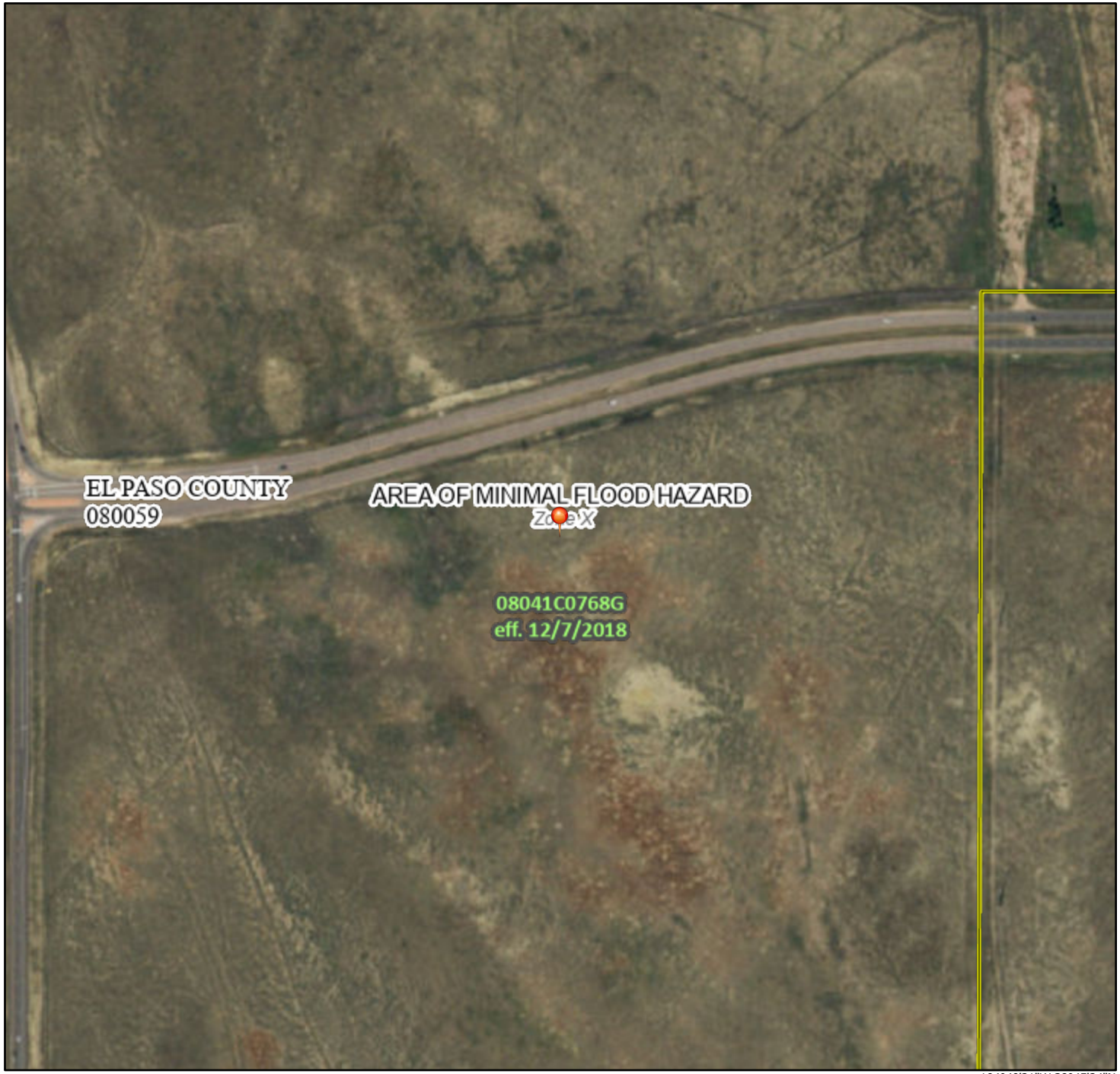
Component Percent Cutoff: None Specified

Tie-break Rule: Higher

National Flood Hazard Layer FIRMette

FEMA

104°40'58"W 38°45'52"N



104°40'21"W 38°45'24"N

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

1:6,000

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

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

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

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

OTHER FEATURES
- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

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

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 2/21/2022 at 7:00 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.

APPENDIX B – SITE DRAINAGE CALCULATIONS (EXISTING)

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

Time Intensity Frequency Tabulation

Time	2 YR	5 YR	10 YR	25 YR	50 YR	100 YR
5	4.12	5.17	6.03	6.89	7.75	8.68
10	3.29	4.13	4.82	5.51	6.19	6.93
15	2.81	3.52	4.11	4.69	5.28	5.91
30	1.99	2.48	2.89	3.31	3.72	4.16
60	1.16	1.44	1.68	1.92	2.16	2.42
120	0.34	0.40	0.47	0.54	0.60	0.67

*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

	AREA	AREA	ROOF	ROOF	ROOF				LANDSCAPE	LANDSCAPE	LANDSCAPE				PAVEMENT	PAVEMENT	PAVEMENT				WEIGHTED	WEIGHTED COEFFICIENTS			
SUB-BASIN	(SF)	(Acres)	AREA	IMPERVIOUSNESS	C2	C5	C10	C100	AREA	IMPERVIOUSNESS	C2	C5	C10	C100	AREA	IMPERVIOUSNESS	C2	C5	C10	C100	IMPERVIOUSNESS	C2	C5	C10	C100
E1	92,766	2.13	0	90%	0.71	0.73	0.75	0.81	92,766	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	54,088	1.24	0	90%	0.71	0.73	0.75	0.81	54,088	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	38,378	0.88	0	90%	0.71	0.73	0.75	0.81	38,378	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
E4	3,280	0.08	0	90%	0.71	0.73	0.75	0.81	3,280	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
E5	2,533	0.06	0	90%	0.71	0.73	0.75	0.81	2,533	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
Site	185,232	4.25	0	90%	0.71	0.73	0.75	0.81	185,232	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	191,045	4.39	0	90%	0.71	0.73	0.75	0.81	191,045	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

Villas at Aspen Trails - 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.
1	E1	92,766	2.13	0.08	300	5.6%	18.3	215	5.6%	7.00	1.7	2.2	20.5	515	12.9	12.9
2	E2	54,088	1.24	0.08	300	4.7%	19.3	210	2.8%	7.00	1.2	3.0	22.3	510	12.8	12.8
3	E3	38,378	0.88	0.08	300	2.3%	24.5	0	0.0%	7.00	0.0	0.0	24.5	300	11.7	11.7
1/2	E4	3,280	0.08	0.08	100	0.5%	23.5	153	3.2%	7.00	1.3	2.0	25.5	253	11.4	11.4
3	E5	2,533	0.06	0.08	100	0.7%	21.0	100	4.6%	7.00	1.5	1.1	22.1	200	11.1	11.1

Villas at Aspen Trails - Drainage Report
Existing Runoff Calculations ***Design Storm 5 Year***
(Rational Method Procedure)

BASIN INFORMATION				DIRECT RUNOFF			
DESIGN POINT	DRAIN BASIN	AREA ac.	RUNOFF COEFF	T(c) min	C x A	I in/hr	Q cfs
1	E1	2.13	0.08	12.9	0.17	3.75	0.64
2	E2	1.24	0.08	12.8	0.10	3.76	0.37
3	E3	0.88	0.08	11.7	0.07	3.89	0.27
1/2	E4	0.08	0.08	11.4	0.01	3.93	0.02
3	E5	0.06	0.08	11.1	0.00	3.97	0.02

Villas at Aspen Trails - Drainage Report
Existing Runoff Calculations ***Design Storm 100 Year***
(Rational Method Procedure)

BASIN INFORMATION				DIRECT RUNOFF			
DESIGN POINT	DRAIN BASIN	AREA ac.	RUNOFF COEFF	T(c) min	C x A	I in/hr	Q cfs
1	E1	2.13	0.35	12.9	0.75	6.29	4.69
2	E2	1.24	0.35	12.8	0.43	6.31	2.74
3	E3	0.88	0.35	11.7	0.31	6.54	2.02
1/2	E4	0.08	0.35	11.4	0.03	6.60	0.17
3	E5	0.06	0.35	11.1	0.02	6.67	0.14

SUMMARY - EXISTING RUNOFF TABLE

DESIGN POINT	BASIN DESIGNATION	BASIN AREA (ACRES)	DIRECT 5-YR RUNOFF (CFS)	DIRECT 100-YR RUNOFF (CFS)	CUMULATIVE 5-YR RUNOFF (CFS)	CUMULATIVE 100-YR RUNOFF (CFS)	BASIN IMP. (%)	100-YR RUNOFF COEF.
1	E1	2.13	0.64	4.69	0.66	4.86	2.0%	0.35
2	E2	1.24	0.37	2.74	0.37	2.74	2.0%	0.35
3	E3	0.88	0.27	2.02	0.29	2.15	2.0%	0.35
1/2	E4	0.08	0.02	0.17	0.02	0.17	2.0%	0.35
3	E5	0.06	0.02	0.14	0.02	0.14	2.0%	0.35
SITE:		4.25	1.29	9.45	1.29	9.45	2.0%	0.35
TOTAL:		4.39	1.33	9.76	1.33	9.76	2.0%	0.35

APPENDIX C – SITE DRAINAGE CALCULATIONS (PROPOSED)

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

Time Intensity Frequency Tabulation

Time	2 YR	5 YR	10 YR	25 YR	50 YR	100 YR
5	4.12	5.17	6.03	6.89	7.75	8.68
10	3.29	4.13	4.82	5.51	6.19	6.93
15	2.81	3.52	4.11	4.69	5.28	5.91
30	1.99	2.48	2.89	3.31	3.72	4.16
60	1.16	1.44	1.68	1.92	2.16	2.42
120	0.34	0.40	0.47	0.54	0.60	0.67

*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

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
A1	30,274	0.69	4,987	90%	0.71	0.73	0.75	0.81	16,545	0%	0.02	0.08	0.15	0.35	8,742	100%	0.89	0.90	0.92	0.96	43.7%	0.38	0.42	0.47	0.60
A2	25,547	0.59	10,187	90%	0.71	0.73	0.75	0.81	10,525	0%	0.02	0.08	0.15	0.35	4,835	100%	0.89	0.90	0.92	0.96	54.8%	0.46	0.49	0.53	0.65
A3	81,363	1.87	18,032	90%	0.71	0.73	0.75	0.81	29,681	0%	0.02	0.08	0.15	0.35	33,650	100%	0.89	0.90	0.92	0.96	61.3%	0.53	0.56	0.60	0.70
A4	17,452	0.40	0	90%	0.71	0.73	0.75	0.81	15,701	0%	0.02	0.08	0.15	0.35	1,751	100%	0.89	0.90	0.92	0.96	10.0%	0.11	0.16	0.23	0.41
A5	10,402	0.24	3,311	90%	0.71	0.73	0.75	0.81	6,671	0%	0.02	0.08	0.15	0.35	420	100%	0.89	0.90	0.92	0.96	32.7%	0.27	0.32	0.37	0.52
OS1	3,612	0.08	0	90%	0.71	0.73	0.75	0.81	3,612	0%	0.02	0.08	0.15	0.35	0	100%	0.89	0.90	0.92	0.96	0.0%	0.02	0.08	0.15	0.35
OS2	16,590	0.38	0	90%	0.71	0.73	0.75	0.81	9,808	0%	0.02	0.08	0.15	0.35	6,782	100%	0.89	0.90	0.92	0.96	40.9%	0.38	0.42	0.46	0.60
OF1	304	0.01	0	90%	0.71	0.73	0.75	0.81	0	0%	0.02	0.08	0.15	0.35	304	100%	0.89	0.90	0.92	0.96	100.0%	0.89	0.90	0.92	0.96
OF2	603	0.01	0	90%	0.71	0.73	0.75	0.81	0	0%	0.02	0.08	0.15	0.35	603	100%	0.89	0.90	0.92	0.96	100.0%	0.89	0.90	0.92	0.96
OF3	3,280	0.08	0	90%	0.71	0.73	0.75	0.81	3,280	0%	0.02	0.08	0.15	0.35	0	100%	0.89	0.90	0.92	0.96	0.0%	0.02	0.08	0.15	0.35
OF4	2,533	0.06	0	90%	0.71	0.73	0.75	0.81	2,533	0%	0.02	0.08	0.15	0.35	0	100%	0.89	0.90	0.92	0.96	0.0%	0.02	0.08	0.15	0.35
ON-SITE	185,240	4.25	36,517	90%	0.71	0.73	0.75	0.81	92,543	0%	0.02	0.08	0.15	0.35	56,180	100%	0.89	0.90	0.92	0.96	48.1%	0.42	0.46	0.50	0.63
OFF-SITE	6,720	0.15	0	90%	0.71	0.73	0.75	0.81	5,813	0%	0.02	0.08	0.15	0.35	907	100%	0.89	0.90	0.92	0.96	13.5%	0.14	0.19	0.25	0.43

Villas at Aspen Trails - Drainage Report
Proposed 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.
A1	A1	30,274	0.69	0.42	100	3.4%	8.2	115	2.2%	20.00	3.0	0.6	8.8	215	11.2	8.8
A2	A2	25,547	0.59	0.49	24	20.0%	2.0	260	0.7%	7.00	0.6	7.7	9.7	284	11.6	9.7
A3	A3	81,363	1.87	0.56	100	0.9%	10.2	550	1.7%	20.00	2.6	3.5	13.7	650	13.6	13.6
A4	A4	17,452	0.40	0.16	40	17.0%	4.2	130	1.3%	7.00	0.8	2.7	6.9	170	10.9	6.9
A5	A5	10,402	0.24	0.32	40	1.3%	8.2	240	0.6%	7.00	0.5	7.7	15.9	280	11.6	11.6
OS1	OS1	3,612	0.08	0.08	100	3.9%	11.8	50	1.4%	7.00	0.8	1.0	12.8	150	10.8	10.8
OS2	OS2	16,590	0.38	0.42	70	3.6%	6.9	200	4.4%	20.00	4.2	0.8	7.7	270	11.5	7.7
OF1	OF1	304	0.01	0.90	65	11.8%	1.3	130	1.3%	20.00	2.3	0.9	5.0	195	11.1	5.0
OF2	OF2	603	0.01	0.90	35	4.6%	1.3	0	1.0%	20.00	2.0	0.0	5.0	35	10.2	5.0
OF3	OF3	3,280	0.08	0.08	100	0.5%	24.0	153	3.2%	7.00	1.3	2.0	26.0	253	11.4	11.4
OS1	OF4	2,533	0.06	0.08	100	0.7%	20.6	100	4.6%	7.00	1.5	1.1	21.7	200	11.1	11.1

Villas at Aspen Trails - Drainage Report
Proposed Runoff Calculations ***Design Storm 5 Year***
(Rational Method Procedure)

BASIN INFORMATION				DIRECT RUNOFF			
DESIGN POINT	DRAIN BASIN	AREA ac.	RUNOFF COEFF	T(c) min	C x A	I in/hr	Q cfs
A1	A1	0.69	0.42	8.8	0.29	4.31	1.27
A2	A2	0.59	0.49	9.7	0.29	4.18	1.21
A3	A3	1.87	0.56	13.6	1.05	3.67	3.86
A4	A4	0.40	0.16	6.9	0.07	4.69	0.31
A5	A5	0.24	0.32	11.6	0.08	3.91	0.30
OS1	OS1	0.08	0.08	10.8	0.01	4.01	0.03
OS2	OS2	0.38	0.42	7.7	0.16	4.52	0.72
OF1	OF1	0.01	0.90	5.0	0.01	5.17	0.03
OF2	OF2	0.01	0.90	5.0	0.01	5.17	0.06
OF3	OF3	0.08	0.08	11.4	0.01	3.93	0.02
OS1	OF4	0.06	0.08	11.1	0.00	3.97	0.02

Villas at Aspen Trails - Drainage Report
Proposed Runoff Calculations ***Design Storm 100 Year***
(Rational Method Procedure)

BASIN INFORMATION				DIRECT RUNOFF			
DESIGN POINT	DRAIN BASIN	AREA ac.	RUNOFF COEFF	T(c) min	C x A	I in/hr	Q cfs
A1	A1	0.69	0.60	8.8	0.42	7.24	3.03
A2	A2	0.59	0.65	9.7	0.38	7.02	2.67
A3	A3	1.87	0.70	13.6	1.32	6.16	8.10
A4	A4	0.40	0.41	6.9	0.16	7.88	1.30
A5	A5	0.24	0.52	11.6	0.12	6.56	0.82
OS1	OS1	0.08	0.35	10.8	0.03	6.74	0.20
OS2	OS2	0.38	0.60	7.7	0.23	7.59	1.73
OF1	OF1	0.01	0.96	5.0	0.01	8.68	0.06
OF2	OF2	0.01	0.96	5.0	0.01	8.68	0.12
OF3	OF3	0.08	0.35	11.4	0.03	6.60	0.17
OS1	OF4	0.06	0.35	11.1	0.02	6.67	0.14

SUMMARY - PROPOSED RUNOFF TABLE

DESIGN POINT	BASIN DESIGNATION	BASIN AREA (ACRES)	DIRECT 5-YR RUNOFF (CFS)	DIRECT 100-YR RUNOFF (CFS)	CUMULATIVE 5-YR RUNOFF (CFS)	CUMULATIVE 100-YR RUNOFF (CFS)	BASIN IMP. (%)	100-YR RUNOFF COEF.
A1	A1	0.69	1.27	3.03	1.29	3.20	43.7%	0.60
A2	A2	0.59	1.21	2.67	2.51	5.87	54.8%	0.65
A3	A3	1.87	3.86	8.10	3.89	8.16	61.3%	0.70
A4	A4	0.40	0.31	1.30	7.00	16.15	10.0%	0.41
A5	A5	0.24	0.30	0.82	0.30	0.82	32.7%	0.52
OS1	OS1	0.08	0.03	0.20	0.03	0.20	0.0%	0.35
OS2	OS2	0.38	0.72	1.73	0.72	1.73	40.9%	0.60
OF1	OF1	0.01	0.03	0.06	0.03	0.06	100.0%	0.96
OF2	OF2	0.01	0.06	0.12	0.06	0.12	100.0%	0.96
OF3	OF3	0.08	0.02	0.17	0.02	0.17	0.0%	0.35
OS1	OF4	0.06	0.02	0.14	0.02	0.14	0.0%	0.35
SITE (A1-A5, OS1, OS2):		4.25	7.69	17.84			48.1%	
TOTAL:		4.41	7.83	18.33			46.9%	

APPENDIX D – HYDRAULIC CALCULATIONS

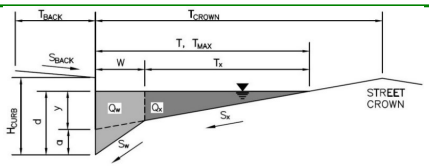
MHFD-Inlet, Version 5.01 (April 2021)

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Villas at Aspen Trails**

Inlet ID: **Sub-Basin A1**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	17.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.010	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	24.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.034	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	24.0	24.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

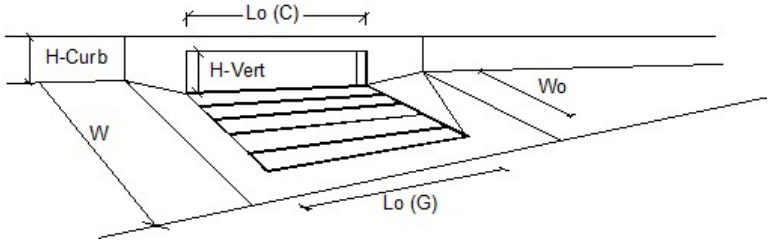
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**17.1**	**17.1**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	

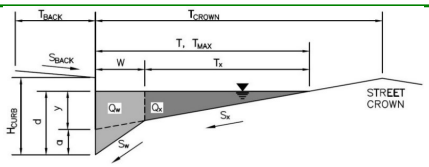
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**1.3**	**2.3**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0**	**0.9**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**98**	**72**	**%**

MHFD-Inlet, Version 5.01 (April 2021)

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Villas at Aspen Trails**
Inlet ID: **Sub-Basin A2**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	17.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.010	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	24.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.034	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

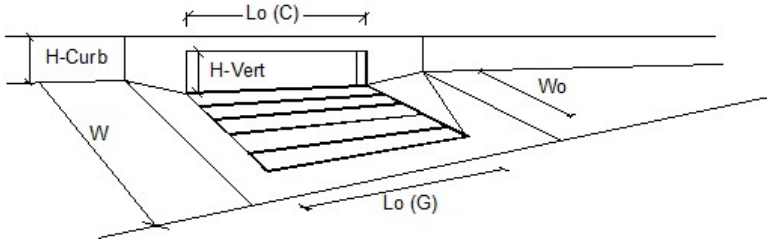
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	24.0	24.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**17.1**	**17.1**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	

Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**1.2**	**3.6**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.0**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**100**	**%**

MHFD-Inlet, Version 5.01 (April 2021)

INLET MANAGEMENT

Worksheet Protected

INLET NAME	Sub-Basin A1	Sub-Basin A2
Site Type (Urban or Rural)	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET
Hydraulic Condition	On Grade	On Grade
Inlet Type	CDOT Type R Curb Opening	CDOT Type R Curb Opening

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	1.3	1.2
Major Q_{Known} (cfs)	3.2	2.7

Bypass (Carry-Over) Flow from Upstream

Receive Bypass Flow from:	No Bypass Flow Received	User-Defined
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0
Major Bypass Flow Received, Q_b (cfs)	0.0	0.9

Watershed Characteristics

Subcatchment Area (acres)		
Percent Impervious		
NRCS Soil Type		

Watershed Profile

Overland Slope (ft/ft)		
Overland Length (ft)		
Channel Slope (ft/ft)		
Channel Length (ft)		

Minor Storm Rainfall Input

Design Storm Return Period, T_r (years)		
One-Hour Precipitation, P_1 (inches)		

Major Storm Rainfall Input

Design Storm Return Period, T_r (years)		
One-Hour Precipitation, P_1 (inches)		

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**1.3**	**1.2**
Major Total Design Peak Flow, Q (cfs)	**3.2**	**3.6**
Minor Flow Bypassed Downstream, Q_b (cfs)	0.0	0.0
Major Flow Bypassed Downstream, Q_b (cfs)	0.9	0.0

Worksheet for Design Point A3 Curb Cut

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data		
Roughness Coefficient	0.013	
Channel Slope	0.005	ft/ft
Bottom Width	8.00	ft
Discharge	8.16	cfs

Combined flow from sub-basins A3 + OF1

Results		
Normal Depth	3.6	in
Flow Area	2.4	ft²
Wetted Perimeter	8.6	ft
Hydraulic Radius	3.3	in
Top Width	8.00	ft
Critical Depth	3.8	in
Critical Slope	0.004	ft/ft
Velocity	3.43	ft/s
Velocity Head	0.18	ft
Specific Energy	0.48	ft
Froude Number	1.111	
Flow Type	Supercritical	

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

GVF Output Data		
Upstream Depth	0.0	in
Profile Description	N/A	
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	3.6	in
Critical Depth	3.8	in
Channel Slope	0.005	ft/ft
Critical Slope	0.004	ft/ft

Worksheet for Swale A1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.016	ft/ft
Left Side Slope	25.000	H:V
Right Side Slope	3.000	H:V
Bottom Width	5.00	ft
Discharge	2.04	cfs

25% of cumulative flows from basin A3 + OF1

Results

Normal Depth	2.1	in
Flow Area	1.3	ft²
Wetted Perimeter	9.8	ft
Hydraulic Radius	1.6	in
Top Width	9.81	ft
Critical Depth	1.8	in
Critical Slope	0.027	ft/ft
Velocity	1.60	ft/s
Velocity Head	0.04	ft
Specific Energy	0.21	ft
Froude Number	0.784	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.0	in
Length	0.0	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.0	in
Profile Description	N/A	
Profile Headloss	0.00	ft
Downstream Velocity	0.00	ft/s
Upstream Velocity	0.00	ft/s
Normal Depth	2.1	in
Critical Depth	1.8	in
Channel Slope	0.016	ft/ft
Critical Slope	0.027	ft/ft

Worksheet for Swale A2

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data		
Roughness Coefficient	0.030	
Channel Slope	0.060	ft/ft
Left Side Slope	50.000	H:V
Right Side Slope	4.000	H:V
Bottom Width	5.00	ft
Discharge	2.67	cfs

Total sub-basin A2 flows

Results		
Normal Depth	1.5	in
Flow Area	1.1	ft²
Wetted Perimeter	11.9	ft
Hydraulic Radius	1.1	in
Top Width	11.92	ft
Critical Depth	1.9	in
Critical Slope	0.028	ft/ft
Velocity	2.46	ft/s
Velocity Head	0.09	ft
Specific Energy	0.22	ft
Froude Number	1.438	
Flow Type	Supercritical	

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

GVF Output Data		
Upstream Depth	0.0	in
Profile Description	N/A	
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.5	in
Critical Depth	1.9	in
Channel Slope	0.060	ft/ft
Critical Slope	0.028	ft/ft

Worksheet for Swale A3

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data		
Roughness Coefficient	0.030	
Channel Slope	0.060	ft/ft
Left Side Slope	20.000	H:V
Right Side Slope	3.000	H:V
Bottom Width	5.00	ft
Discharge	0.82	cfs

Total sub-basin A5 flows

Results		
Normal Depth	0.9	in
Flow Area	0.4	ft²
Wetted Perimeter	6.7	ft
Hydraulic Radius	0.8	in
Top Width	6.68	ft
Critical Depth	1.1	in
Critical Slope	0.031	ft/ft
Velocity	1.93	ft/s
Velocity Head	0.06	ft
Specific Energy	0.13	ft
Froude Number	1.346	
Flow Type	Supercritical	

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

GVF Output Data		
Upstream Depth	0.0	in
Profile Description	N/A	
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.9	in
Critical Depth	1.1	in
Channel Slope	0.060	ft/ft
Critical Slope	0.031	ft/ft

Worksheet for Storm Line A1-2

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.010	ft/ft
Diameter	18.0	in
Discharge	2.30	cfs

Captured flow per UD_Inlet calculations

Results

Normal Depth	5.7	in
Flow Area	0.5	ft²
Wetted Perimeter	1.8	ft
Hydraulic Radius	3.2	in
Top Width	1.40	ft
Critical Depth	6.9	in
Percent Full	31.8	%
Critical Slope	0.005	ft/ft
Velocity	4.76	ft/s
Velocity Head	0.35	ft
Specific Energy	0.83	ft
Froude Number	1.427	
Maximum Discharge	11.30	cfs
Discharge Full	10.50	cfs
Slope Full	0.000	ft/ft
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.0	in
Length	0.0	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.0	in
Profile Description	N/A	
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.0	%
Normal Depth Over Rise	31.8	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	5.7	in
Critical Depth	6.9	in
Channel Slope	0.010	ft/ft
Critical Slope	0.005	ft/ft

Worksheet for Storm Line A2-3

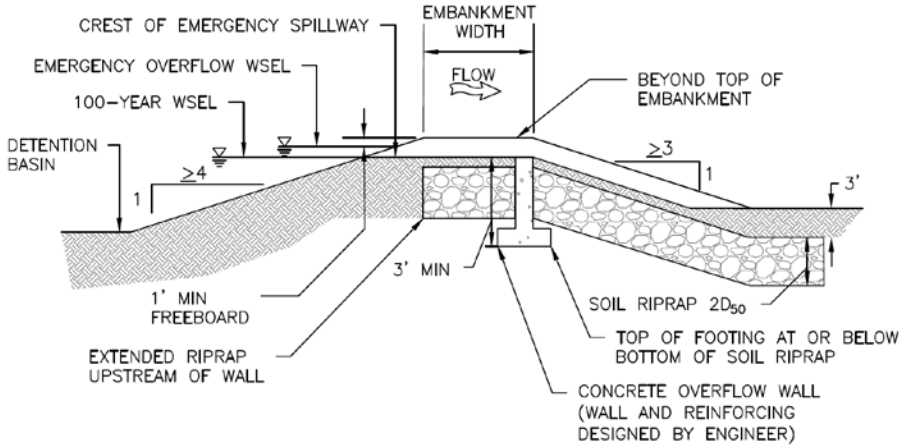
Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data		
Roughness Coefficient	0.013	
Channel Slope	0.010	ft/ft
Diameter	18.0	in
Discharge	5.87	cfs

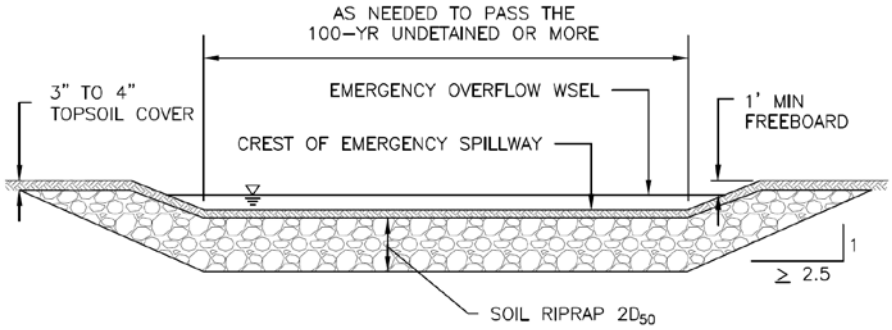
Results		
Normal Depth	9.6	in
Flow Area	1.0	ft²
Wetted Perimeter	2.5	ft
Hydraulic Radius	4.7	in
Top Width	1.50	ft
Critical Depth	11.2	in
Percent Full	53.4	%
Critical Slope	0.006	ft/ft
Velocity	6.11	ft/s
Velocity Head	0.58	ft
Specific Energy	1.38	ft
Froude Number	1.344	
Maximum Discharge	11.30	cfs
Discharge Full	10.50	cfs
Slope Full	0.003	ft/ft
Flow Type	Supercritical	

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

GVF Output Data		
Upstream Depth	0.0	in
Profile Description	N/A	
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.0	%
Normal Depth Over Rise	53.4	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	9.6	in
Critical Depth	11.2	in
Channel Slope	0.010	ft/ft
Critical Slope	0.006	ft/ft



EMERGENCY SPILLWAY PROFILE



EMERGENCY SPILLWAY SECTION AND SPILLWAY CHANNEL

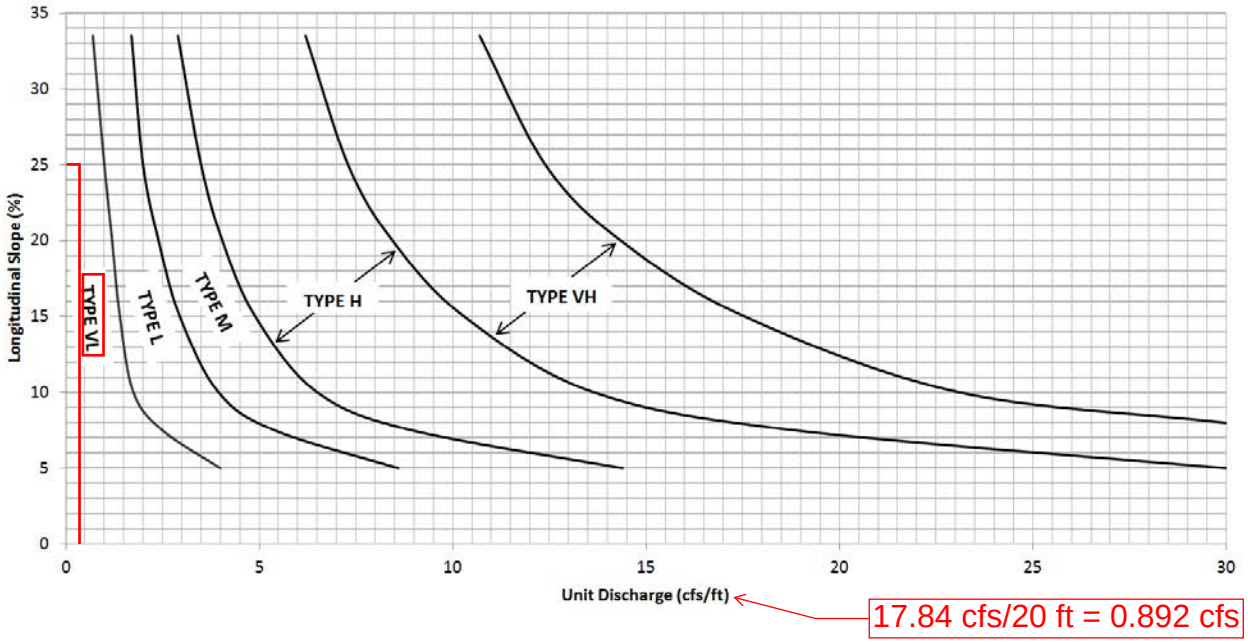


Figure 12-21. Embankment protection details and rock sizing chart (adapted from Arapahoe County)

Kimley»Horn

Forebay Sizing Calculations

Contributing Sub-Basins: A1, A2, OF3

Date	2/26/2024	
Prepared By	JWM	
Checked By	MOH	

	Required	Forebay A Flow: Q_{100} = (cfs)	Forebay A Release Rate
Forebay Release and Configuration	Release 2% of the undetained 100-year peak discharge by way of a wall/notch or berm/pipe configuration	5.87	0.12

			Required (CF)	Provided (CF)
Minimum Forebay Volume Required	2% of the WQCV	40hr drain time a = 1 I = 0.59 A = 1.94 AC	19.34	43.00

	Required	Provided	
Maximum Forebay Depth	18" Max	12"	Concrete Forebay Structure

Forebay Notch Calculations			
$Q = C_o A_o (2gH_o)^{0.5}$			
Q_a	0.12	cfs	2% of Peak 100 YR Discharge for contributing Sub-Basins
C_o	0.6		
H_o	0.5	ft	
g	32.2	ft/s^2	
A_a	0.03	ft^2	
L_a	0.02	ft	
	0.28	**in**	3" Minimum per Criteria

$$WQCV = a(0.91I^3 - 1.19I^2 + 0.78I)$$ Equation 3-1

Where:

WQCV = Water Quality Capture Volume (watershed inches)

a = Coefficient corresponding to WQCV drain time (Table 3-2)

I = Imperviousness (%/100) (see Figures 3-3 through 3-5 [single family land use] and /or the *Runoff* chapter of Volume 1[other typical land uses])

Table 3-2. Drain Time Coefficients for WQCV Calculations

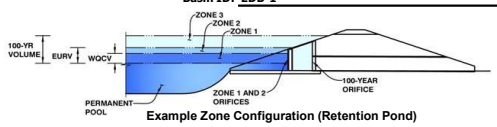
Drain Time (hrs)	Coefficient, a
12 hours	0.8
24 hours	0.9
40 hours	1.0

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: **Villas at Aspen Trails**

Basin ID: **EDB-1**



Example Zone Configuration (Retention Pond)

Depth Increment = ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft²)	Optional Override Area (ft²)	Area (acre)	Volume (ft³)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	16	0.000		
5911.5	--	0.50	--	--	--	141	0.003	39	0.001
5912	--	1.00	--	--	--	782	0.018	270	0.006
5912.5	--	1.50	--	--	--	3,710	0.085	1,393	0.032
5913	--	2.00	--	--	--	6,671	0.153	3,988	0.092
5913.5	--	2.50	--	--	--	7,675	0.176	7,574	0.174
5914	--	3.00	--	--	--	8,448	0.194	11,605	0.266
5914.5	--	3.50	--	--	--	9,250	0.212	16,030	0.368
5915	--	4.00	--	--	--	10,080	0.231	20,862	0.479
5915.5	--	4.50	--	--	--	11,007	0.253	26,134	0.600
5916	--	5.00	--	--	--	13,376	0.307	32,230	0.740
5916.2	--	5.20	--	--	--	14,991	0.344	35,066	0.805

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	4.25	acres
Watershed Length =	500	ft
Watershed Length to Centroid =	250	ft
Watershed Slope =	0.018	ft/ft
Watershed Imperviousness =	48.10%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	100.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	Denver - Capitol Building	

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) =	0.071	acre-feet	acre-feet
Excess Urban Runoff Volume (EURV) =	0.218	acre-feet	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.198	acre-feet	1.19 inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.285	acre-feet	1.50 inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.362	acre-feet	1.75 inches
25-yr Runoff Volume (P1 = 1.69 in.) =	0.364	acre-feet	inches
50-yr Runoff Volume (P1 = 1.99 in.) =	0.463	acre-feet	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	0.657	acre-feet	2.52 inches
500-yr Runoff Volume (P1 = 3.14 in.) =	0.874	acre-feet	inches
Approximate 2-yr Detention Volume =	0.164	acre-feet	
Approximate 5-yr Detention Volume =	0.225	acre-feet	
Approximate 10-yr Detention Volume =	0.300	acre-feet	
Approximate 25-yr Detention Volume =	0.278	acre-feet	
Approximate 50-yr Detention Volume =	0.305	acre-feet	
Approximate 100-yr Detention Volume =	0.387	acre-feet	

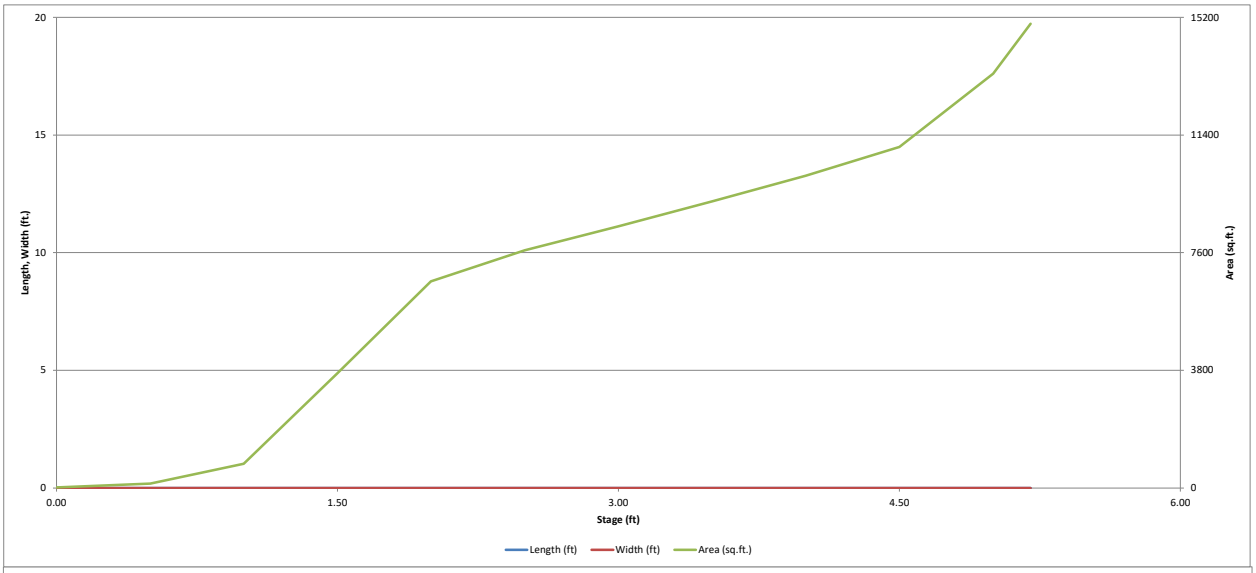
Define Zones and Basin Geometry

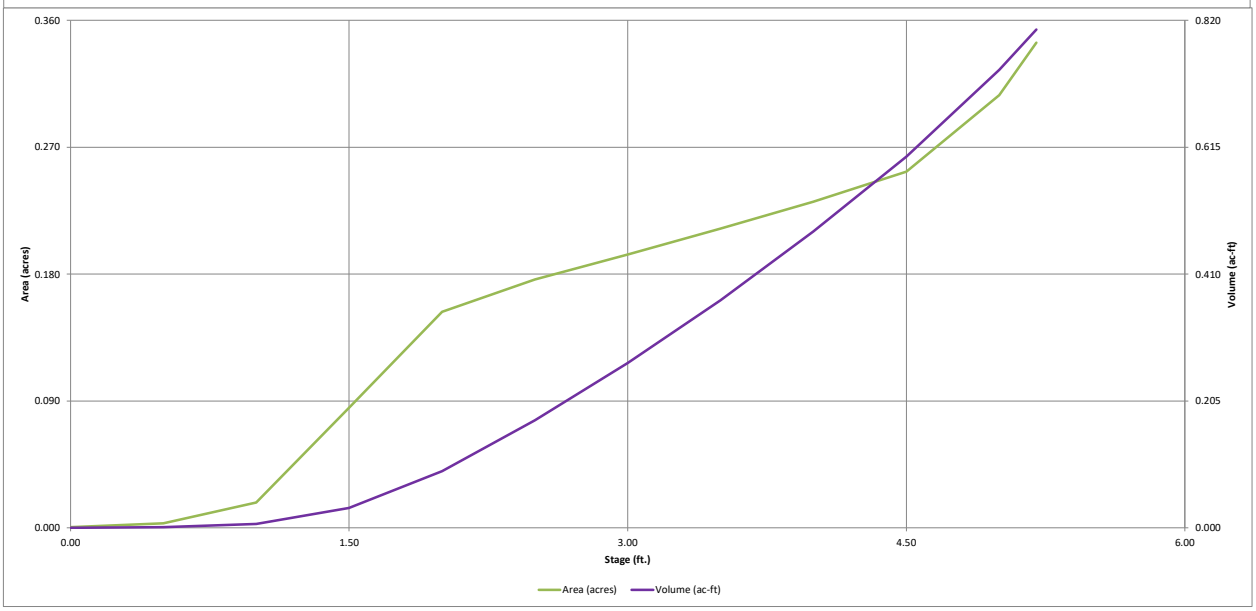
Zone 1 Volume (WQCV) =	0.071	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.147	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.169	acre-feet
Total Detention Basin Volume =	0.387	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (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

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

E



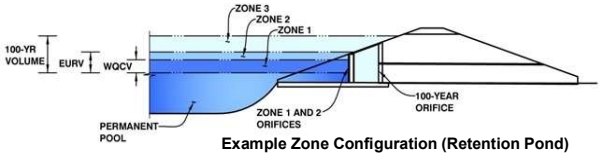


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: Villas at Aspen Trails

Basin ID: EDB-1



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.86	0.071	Orifice Plate
Zone 2 (EURV)	2.75	0.147	Orifice Plate
Zone 3 (100-year)	3.59	0.169	Weir&Pipe (Restrict)
Total (all zones)		0.387	

User Input: Orifice at Underdrain Outlet (typically used to drain WQCV in a Filtration BMP)

			Calculated Parameters for Underdrain		
Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)	Underdrain Orifice Area =	N/A	ft²
Underdrain Orifice Diameter =	N/A	inches	Underdrain Orifice Centroid =	N/A	feet

User Input: Orifice Plate with one or more orifices or Elliptical Slot Weir (typically used to drain WQCV and/or EURV in a sedimentation BMP)

			Calculated Parameters for Plate		
Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	N/A	ft²
Depth at top of Zone using Orifice Plate =	2.75	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	N/A	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	N/A	sq. inches	Elliptical Slot Area =	N/A	ft²

User Input: Stage and Total Area of Each Orifice Row (numbered from lowest to highest)

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.83	2.33					
Orifice Area (sq. inches)	0.53	0.53	12.56					

	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)								
Orifice Area (sq. inches)								

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected		Calculated Parameters for Vertical Orifice	Not Selected	Not Selected	
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	N/A	N/A	ft²
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	N/A	N/A	feet
Vertical Orifice Diameter =	N/A	N/A	inches				

User Input: Overflow Weir (Dropbox with Flat or Sloped Grate and Outlet Pipe OR Rectangular/Trapezoidal Weir and No Outlet Pipe)

	Zone 3 Weir	Not Selected		Calculated Parameters for Overflow Weir	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	2.90	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	3.63	N/A	feet
Overflow Weir Front Edge Length =	3.42	N/A	feet	Overflow Weir Slope Length =	3.01	N/A	feet
Overflow Weir Grate Slope =	4.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	17.89	N/A	
Horiz. Length of Weir Sides =	2.92	N/A	feet	Overflow Grate Open Area w/o Debris =	7.16	N/A	ft²
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	3.58	N/A	ft²
Debris Clogging % =	50%	N/A	%				

User Input: Outlet Pipe w/ Flow Restriction Plate (Circular Orifice, Restrictor Plate, or Rectangular Orifice)

	Zone 3 Restrictor	Not Selected		Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.75	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	0.40	N/A	ft²
Outlet Pipe Diameter =	18.00	N/A	inches	Outlet Orifice Centroid =	0.25	N/A	feet
Restrictor Plate Height Above Pipe Invert =	5.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	1.11	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

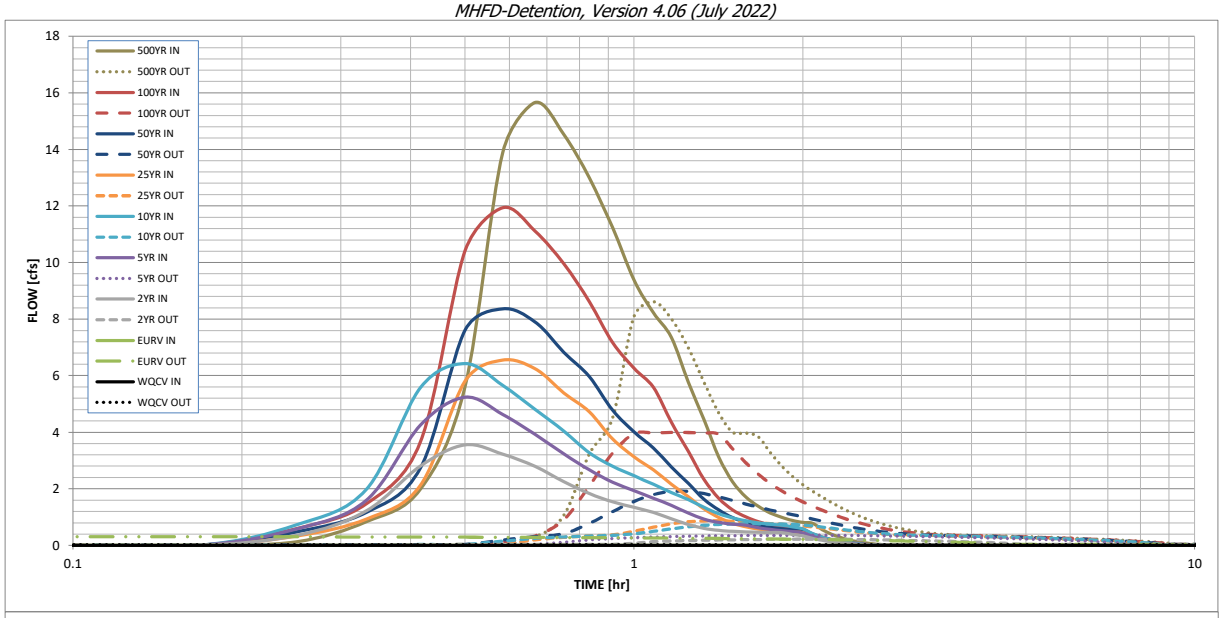
			Calculated Parameters for Spillway		
Spillway Invert Stage=	3.80	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.32	feet
Spillway Crest Length =	20.00	feet	Stage at Top of Freeboard =	5.12	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.33	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	0.78	acre-ft

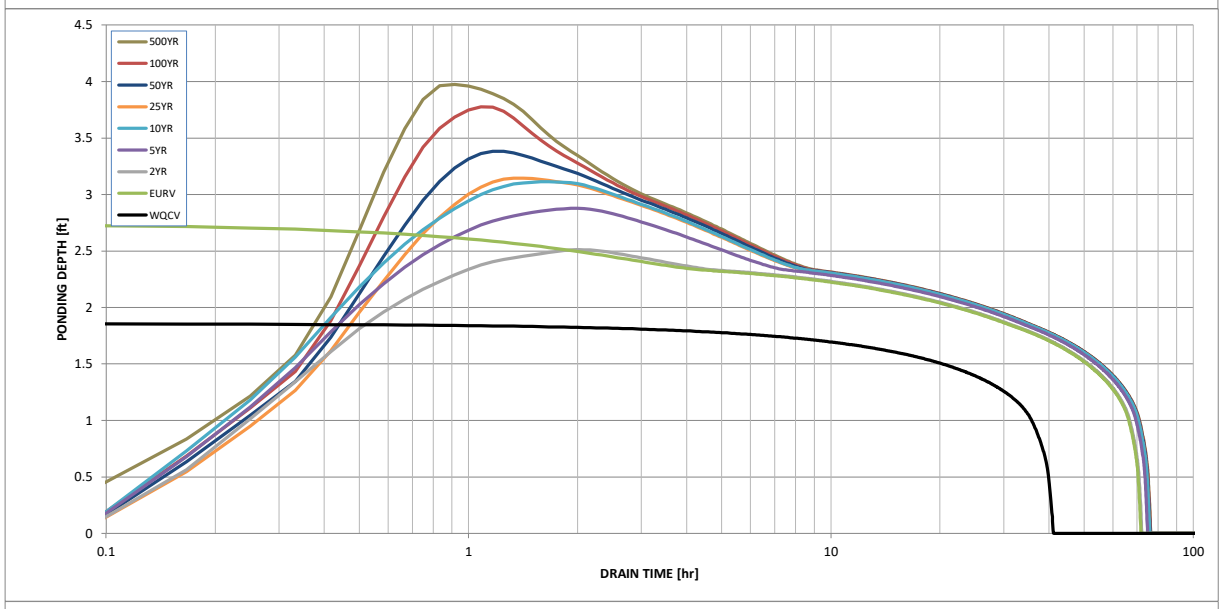
Routed Hydrograph Results — *The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).*

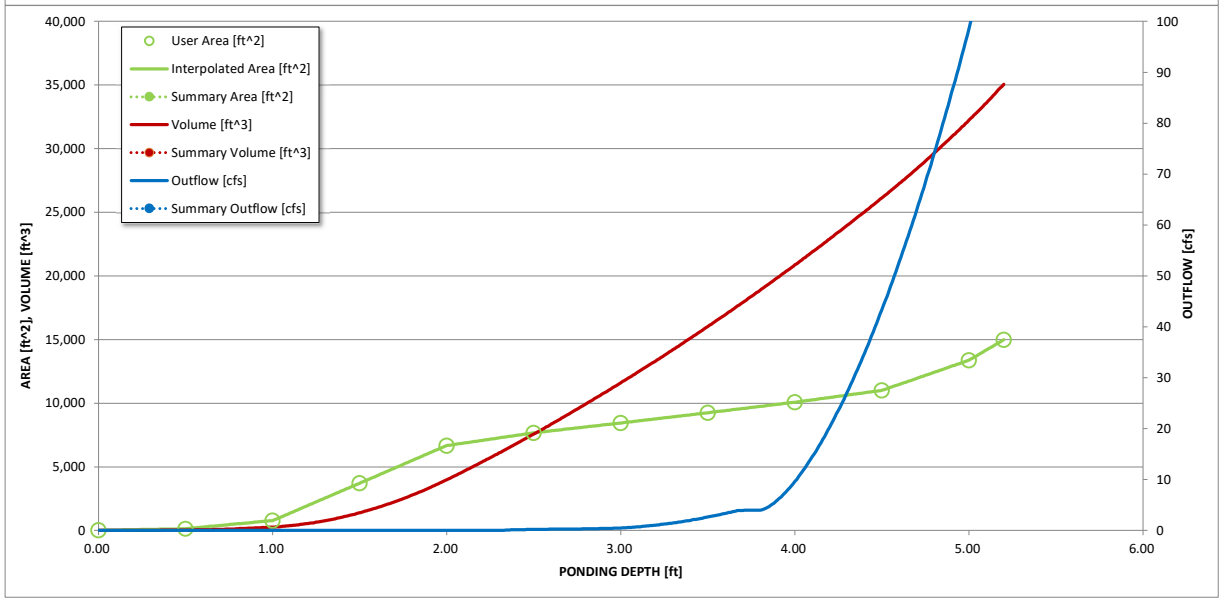
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	1.69	1.99	2.52	3.14
CUHP Runoff Volume (acre-ft) =	0.071	0.218	0.198	0.285	0.362	0.364	0.463	0.657	0.874
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.198	0.285	0.362	0.364	0.463	0.657	0.874
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.5	1.5	2.3	2.8	4.0	6.3	8.8
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.13	0.36	0.54	0.65	0.94	1.48	2.07
Peak Inflow Q (cfs) =	N/A	N/A	3.6	5.2	6.4	6.5	8.4	11.9	15.7
Peak Outflow Q (cfs) =	0.0	0.315	0.2	0.4	0.8	0.9	1.9	4.0	8.6
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.2	0.3	0.3	0.5	0.6	1.0
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.0	0.1	0.2	0.5	0.5
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	39	66	67	68	68	68	66	63	59
Time to Drain 99% of Inflow Volume (hours) =	**40**	69	70	72	72	72	72	71	69
Maximum Ponding Depth (ft) =	1.86	2.75	2.51	2.88	3.11	3.15	3.38	3.78	3.98
Area at Maximum Ponding Depth (acres) =	0.13	0.19	0.18	0.19	0.20	0.20	0.21	0.22	0.23
Maximum Volume Stored (acre-ft) =	0.071	0.219	0.176	0.242	0.288	0.294	0.343	0.427	0.472

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)







S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename: _____

Inflow Hydrographs

The user can override the calculated inflow hydrographs from this workbook with inflow hydrographs developed in a separate program.

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13
	0:15:00	0.00	0.00	0.36	0.58	0.72	0.33	0.48	0.59	0.83
	0:20:00	0.00	0.00	1.22	1.59	1.98	0.93	1.17	1.47	1.99
	0:25:00	0.00	0.00	2.81	4.26	5.58	2.13	2.74	3.66	5.60
	0:30:00	0.00	0.00	3.56	5.24	6.43	5.80	7.60	10.41	13.88
	0:35:00	0.00	0.00	3.22	4.63	5.66	6.55	8.36	11.94	15.66
	0:40:00	0.00	0.00	2.79	3.92	4.81	6.24	7.90	11.11	14.53
	0:45:00	0.00	0.00	2.26	3.23	4.04	5.39	6.82	9.95	12.98
	0:50:00	0.00	0.00	1.83	2.67	3.27	4.72	5.96	8.61	11.22
	0:55:00	0.00	0.00	1.54	2.23	2.80	3.75	4.77	7.17	9.39
	1:00:00	0.00	0.00	1.34	1.93	2.46	3.14	4.02	6.26	8.23
	1:05:00	0.00	0.00	1.17	1.67	2.16	2.67	3.44	5.59	7.35
	1:10:00	0.00	0.00	0.94	1.42	1.87	2.16	2.77	4.35	5.77
	1:15:00	0.00	0.00	0.74	1.14	1.62	1.72	2.19	3.32	4.44
	1:20:00	0.00	0.00	0.60	0.93	1.34	1.29	1.63	2.33	3.13
	1:25:00	0.00	0.00	0.53	0.81	1.12	0.99	1.25	1.66	2.25
	1:30:00	0.00	0.00	0.49	0.75	0.97	0.78	0.98	1.26	1.71
	1:35:00	0.00	0.00	0.48	0.71	0.87	0.66	0.82	1.01	1.38
	1:40:00	0.00	0.00	0.47	0.63	0.80	0.58	0.71	0.84	1.15
	1:45:00	0.00	0.00	0.46	0.56	0.75	0.53	0.64	0.72	0.99
	1:50:00	0.00	0.00	0.45	0.52	0.71	0.49	0.59	0.64	0.88
	1:55:00	0.00	0.00	0.39	0.49	0.66	0.47	0.56	0.59	0.81
	2:00:00	0.00	0.00	0.34	0.45	0.59	0.46	0.54	0.57	0.78
	2:05:00	0.00	0.00	0.25	0.32	0.42	0.33	0.39	0.41	0.56
	2:10:00	0.00	0.00	0.18	0.23	0.30	0.23	0.28	0.30	0.40
	2:15:00	0.00	0.00	0.12	0.16	0.21	0.17	0.19	0.21	0.28
	2:20:00	0.00	0.00	0.09	0.11	0.14	0.11	0.13	0.14	0.20
	2:25:00	0.00	0.00	0.06	0.07	0.10	0.08	0.09	0.10	0.13
	2:30:00	0.00	0.00	0.04	0.05	0.06	0.05	0.06	0.07	0.09
	2:35:00	0.00	0.00	0.02	0.03	0.04	0.03	0.04	0.04	0.06
	2:40:00	0.00	0.00	0.01	0.02	0.02	0.02	0.02	0.02	0.03
	2:45:00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
	2:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

APPENDIX E – OPINION OF PROBABLE CONSTRUCTION COST

Kimley»Horn

Kimley-Horn & Associates, Inc. **Opinion of Probable Construction Cost**

Client:	**ROS Equity Holdings - Independence, LLC**	**Date:**	**2/26/2024**
Project:	**Villas at Aspen Trails**	**Prepared By:**	**JWM**
KHA No.:	**096668022**	**Checked By:**	**MOH**

No:		**Sheet:**	**1 of 1**

This OPC is not intended for basing financial decisions, or securing funding. Review all notes and assumptions. Since Kimley-Horn & Associates, Inc. has no control over the cost of labor, materials, equipment, or services furnished by others, or over methods of determining price, or over competitive bidding or market conditions, any and all opinions as to the cost herein, including but not limited to opinions as to the costs of construction materials, shall be made on the basis of experience and best available data. Kimley-Horn & Associates, Inc. cannot and does not guarantee that proposals, bids, or actual costs will not vary from the opinions on costs shown herein. The total costs and other numbers in this Opinion of Probable Cost have been rounded.

Item No.	Item Description	Quantity	Unit	Unit Price	Item Cost
	Private Permanent Control Measures (Non-Reimbursable)				
1	3/4" Fractured Face Granite Mixed w/Class 5 Roadbase	700	CF	$12.00	$8,400
2	Concrete Trickle Channel	310	SF	$15.00	$4,650
3	18" RCP outlet pipe	24	LF	$55.00	$1,320
4	Outlet Structure	1	EA	$5,000.00	$5,000
5	Type VL Riprap - Emergency Overflow	7.1	Ton	$2,500.00	$17,750
6	Concrete Forebay	1	EA	$3,000.00	$3,000
		Subtotal:			$40,120
		Contingency (%,+/-)		10%	$4,012
		Project Total:			**$44,132**

Basis for Cost Projection:

- ☐ No Design Completed
- ☐ Preliminary Design
- ☑ Final Design

Design Engineer:

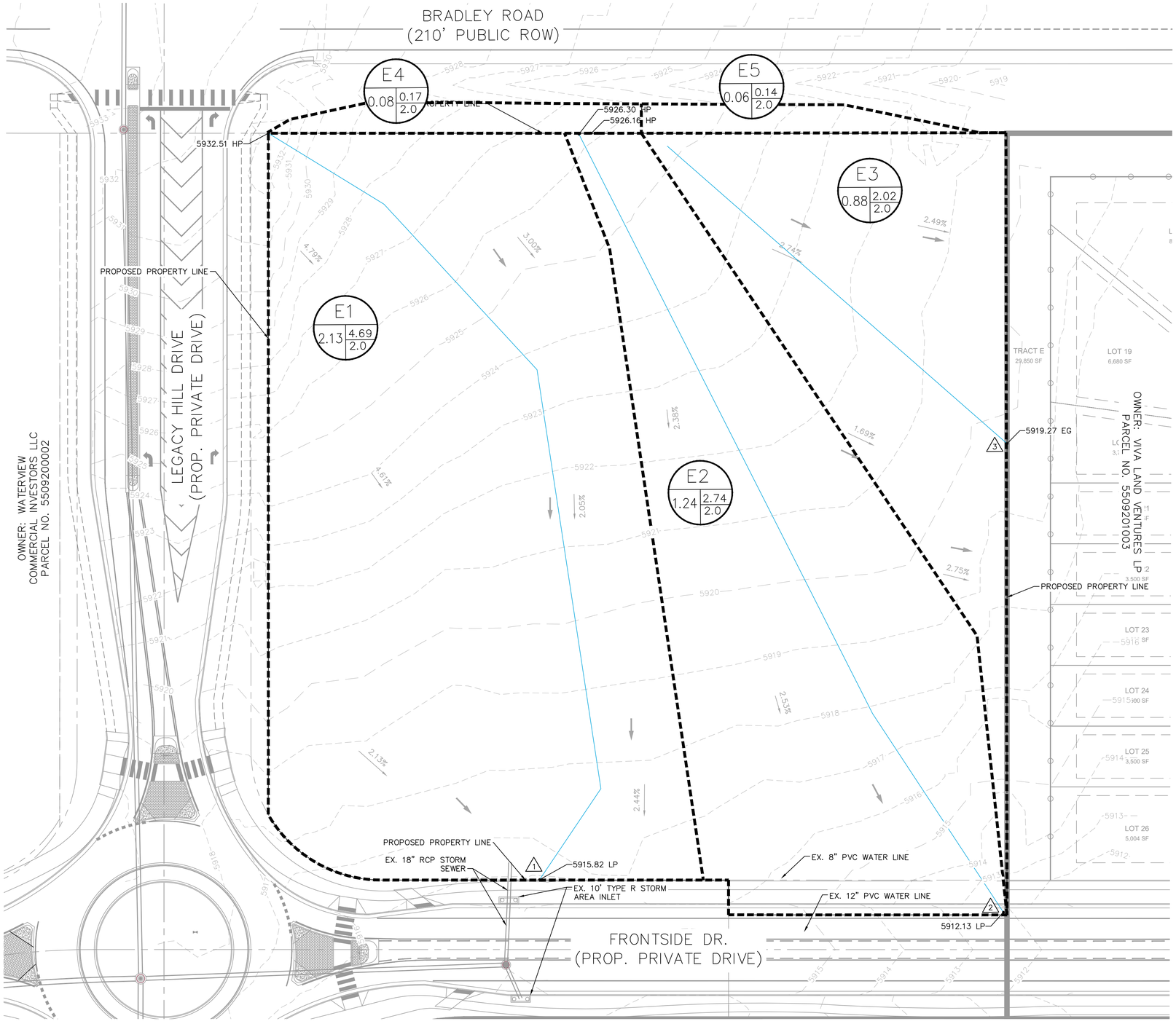
Mitchell O. Hess
Registered Professional Engineer, State of Colorado No. 53916

APPENDIX F – SITE DRAINAGE MAP (PROPOSED AND EXISTING)

VILLAS AT ASPEN TRAILS

EXISTING DRAINAGE EXHIBIT

SITUATED IN A PORTION OF SECTION 9, TOWNSHIP 15 SOUTH, RANGE 65 WEST OF THE 6TH P.M. CITY OF COLORADO SPRINGS, COUNTY OF EL PASO, STATE OF COLORADO



LEGEND

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

= DESIGN POINT

FLOW DIRECTION

PROPERTY LINE

DRAINAGE SUB-BASIN BOUNDARY

FLOW PATH

XXXX EXISTING MAJOR CONTOUR

XXXX EXISTING MINOR CONTOUR

EG EXISTING GRADE
HP HIGH POINT
LP LOW POINT

SUMMARY - EXISTING RUNOFF TABLE

DESIGN POINT	BASIN DESIGNATION	BASIN AREA (ACRES)	DIRECT 5-YR RUNOFF (CFS)	DIRECT 100-YR RUNOFF (CFS)	CUMULATIVE 5-YR RUNOFF (CFS)	CUMULATIVE 100-YR RUNOFF (CFS)	BASIN IMP. (%)	100-YR RUNOFF COEF.
1	E1	2.13	0.64	4.69	0.66	4.86	2.0%	0.35
2	E2	1.24	0.37	2.74	0.37	2.74	2.0%	0.35
3	E3	0.88	0.27	2.02	0.29	2.15	2.0%	0.35
1/2	E4	0.08	0.02	0.17	0.02	0.17	2.0%	0.35
3	E5	0.06	0.02	0.14	0.02	0.14	2.0%	0.35
	SITE:	4.25	1.29	9.45	1.29	9.45	2.0%	0.35
	TOTAL:	4.39	1.33	9.76	1.33	9.76	2.0%	0.35

GRAPHIC SCALE IN FEET
0 15 30 60

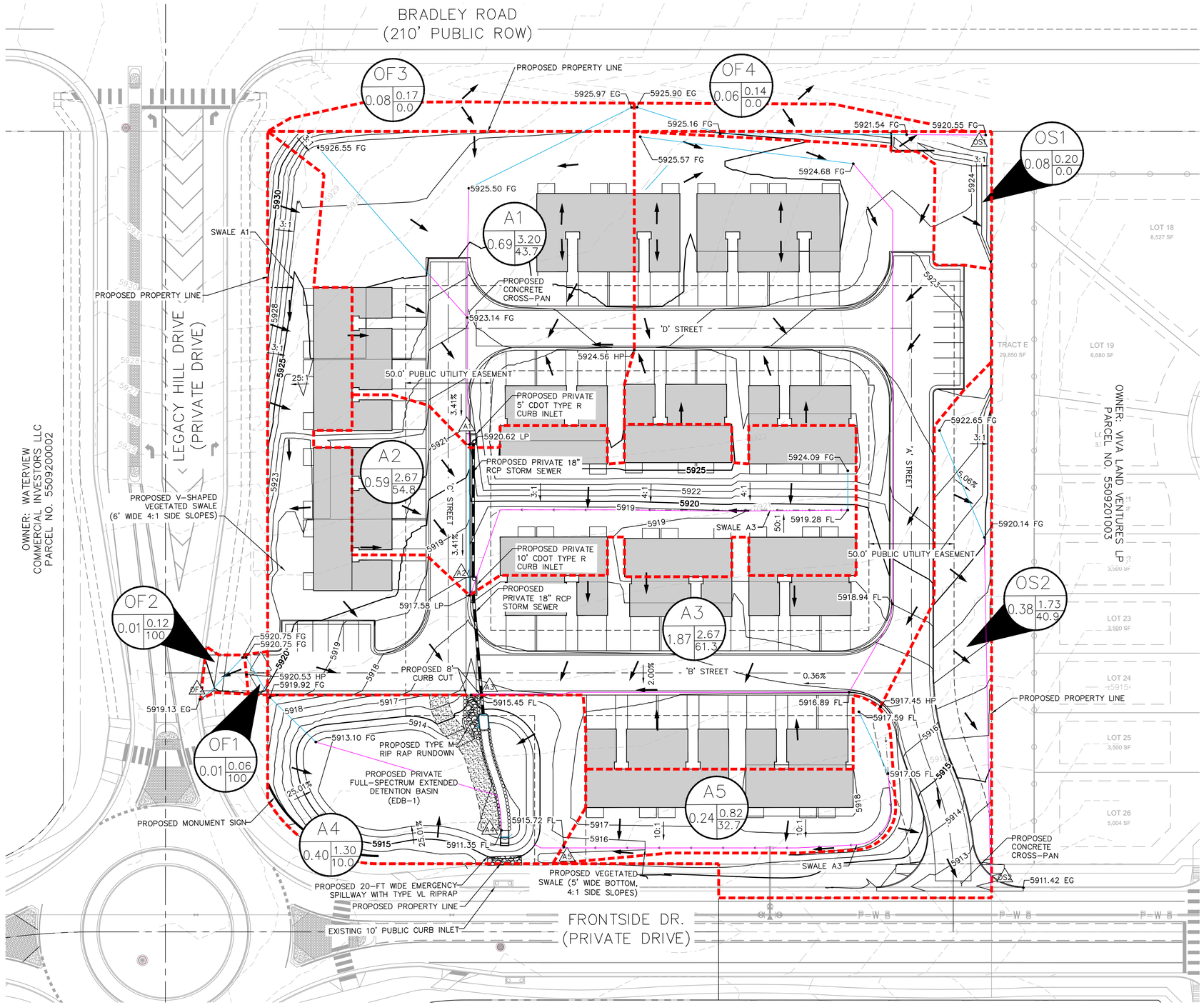
NORTH

Kimley»Horn
2 NORTH NEVADA AVENUE, SUITE 900
COLORADO SPRINGS, COLORADO 80903 (719) 453-0180

VILLAS AT ASPEN TRAILS

PROPOSED DRAINAGE EXHIBIT

SITUATED IN A PORTION OF SECTION 9, TOWNSHIP 15 SOUTH, RANGE 65 WEST OF THE 6TH P.M. CITY OF COLORADO SPRINGS,
COUNTY OF EL PASO, STATE OF COLORADO



LEGEND

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

= DESIGN POINT

FLOW DIRECTION

PROPERTY LINE

PROPOSED EASEMENT LINE

DRAINAGE SUB-BASIN BOUNDARY

OVERLAND FLOW PATH

CHANNELIZED FLOW PATH

PROPOSED STORM SEWER

PROPOSED STORM INLET

XXXX PROPOSED MAJOR CONTOUR

XXXX PROPOSED MINOR CONTOUR

XXXX EXISTING MAJOR CONTOUR

XXXX EXISTING MINOR CONTOUR

EG	EXISTING GRADE
HP	HIGH POINT
LP	LOW POINT
GB	GRADE BREAK
ME	MATCH EXISTING
FG	FINISHED GRADE
FL	FLOW LINE

PBMP SUMMARY TABLE

BASIN	PBMP TRIBUTARY AREA (AC)	PBMP
A1	0.69	EDB-1
A2	0.59	EDB-1
A3	1.87	EDB-1
A4	0.40	EDB-1
A5	0.24	EDB-1
OS1	0.08	EXCLUSION I.7.1.C.1
OS2	0.38	EXCLUSION I.7.1.C.1
OF1	0.01	EDB-1
OF2	0.01	NONE, OFFSITE
OF3	0.08	EDB-1
OF4	0.06	NONE, OFFSITE

SUMMARY - PROPOSED RUNOFF TABLE

DESIGN POINT	BASIN DESIGNATION	BASIN AREA (ACRES)	DIRECT 5-YR RUNOFF (CFS)	DIRECT 100-YR RUNOFF (CFS)	CUMULATIVE 5-YR RUNOFF (CFS)	CUMULATIVE 100-YR RUNOFF (CFS)	BASIN IMP. (%)	100-YR RUNOFF COEF.
A1	A1	0.69	1.27	3.03	1.29	3.20	43.7%	0.60
A2	A2	0.59	1.21	2.67	2.51	5.87	54.8%	0.65
A3	A3	1.87	3.86	8.10	3.89	8.16	61.3%	0.70
A4	A4	0.40	0.31	1.30	6.94	15.91	10.0%	0.41
A5	A5	0.24	0.30	0.82	0.30	0.82	32.7%	0.52
OS1	OS1	0.08	0.03	0.20	0.03	0.20	0.0%	0.35
OS2	OS2	0.38	0.72	1.73	0.72	1.73	40.9%	0.60
OF1	OF1	0.01	0.03	0.06	0.03	0.06	100.0%	0.96
OF2	OF2	0.01	0.06	0.12	0.06	0.12	100.0%	0.96
OF3	OF3	0.08	0.02	0.17	0.02	0.17	0.0%	0.35
OS1	OF4	0.06	0.02	0.14	0.02	0.14	0.0%	0.35
SITE (A1-A5, OS1, OS2):		4.25	7.69	17.84			48.1%	
TOTAL:		4.41	7.83	18.33			46.9%	

GRAPHIC SCALE IN FEET
0 15 30 60

NORTH

Kimley»Horn

2 NORTH NEVADA AVENUE, SUITE 900
COLORADO SPRINGS, COLORADO 80903 (719) 453-0180

APPENDIX G – EXCEPRTS FROM PREVIOUSLY APPROVED REPORTS

FINAL DRAINAGE REPORT

For

TRAILS AT ASPEN RIDGE

Prepared for:
EL PASO COUNTY
Engineering Development Review Team
2880 International Circle
Colorado Springs, CO 80910

On Behalf of:
COLA, LLC.
555 Middle Creek Parkway, Suite 380
Colorado Springs, CO 80921

Prepared by:

Matrix Design Group
2435 Research Parkway, Suite 300
Colorado Springs, CO 80920
(719) 575-0100
fax (719) 572-0208

January 2020

Project No. 19.866.008

PCD File No. SF-19-002

Table 7.7a Design Point Summary						
StormCAD						
Design Point	Total Drainage Area	Surface		Storm Sewer		Downstream Design Point
		Q5 (cfs)	Q100 (cfs)	Q5 (cfs)	Q100 (cfs)	
1-OS	**19.67**	4.0	26.8	-	-	A
1-A	**12.34**	3.5	17.6	-	-	A
2-A	**1.09**	2.7	5.2	-	-	A
3-A	**4.98**	2.2	8.9	-	-	A
4-A	**0.12**	0.6	1.0	-	-	A
A	**38.20**	-	-	12.0	55.6	B
1-B	**1.06**	1.8	4.1	-	-	B
B	**39.26**	-	-	12.7	57.1	C
1-C	**3.27**	5.9	12.9	-	-	C
2-C	**1.19**	2.4	5.3	-	-	C
3-C	**4.60**	8.4	18.5	-	-	C
4-C	**0.36**	1.6	3.0	-	-	C
5-C	**3.13**	5.7	12.5	-	-	C
6-C	**0.07**	0.3	0.6	-	-	C
7-C	**2.20**	4.0	8.8	-	-	C
8-C	**0.06**	0.3	0.5	-	-	C
C	**54.13**	-	-	27.6	90.2	D
1-D	**2.21**	1.6	5.2	-	-	D
D	**56.34**	0.0	0.0	28.1	92.1	E
1-E	**6.43**	2.6	11.4	-	-	E
2-E	**2.14**	3.9	8.7	-	-	E
E	**64.91**	-	-	33.7	108.8	F
1-F	**2.07**	2.7	6.0	2.7	6.0	3-F
2-F	**0.58**	1.1	2.5	1.6	3.6	3-F
3-F	**3.32**	2.3	5.0	3.8	8.4	4-F
4-F	**3.89**	1.1	2.5	5.0	11.1	5-F
5-F	**6.16**	3.5	7.8	6.6	14.6	6-F
6-F	**7.16**	1.7	3.9	7.9	17.5	8-F
7-F	**5.06**	7.5	16.5	7.5	16.5	8-F
8-F	**13.07**	1.5	3.3	16.2	35.8	F
F	**77.97**	-	-	43.5	131.0	G
1-G	**1.11**	2.1	4.6	-	-	G
G	**79.08**	-	-	44.2	132.7	M
1-H	**3.60**	5.9	13.1	-	-	1-2 H
2-H	**1.16**	1.9	4.2	-	-	1-2 H
1-2 H	**4.76**	-	-	9.0	19.8	1-4 H

Table 7.8a Design Point Descriptions		
Design Point	**Description**	**Downstream Design Point**
1-OS	- This design point is at the downstream end of the offsite sub-basin (OS-1) north of Bradley Road. Flows in Sub-basin OS-1 will sheet flow to the road ditch running along Bradley and Powers Boulevard. Once channelized in the ditch flows will be directed to a proposed 24-inch RCP storm pipe sleeved into one of the existing 36-inch CMP cross road pipes to minimize disturbance to Bradley Road and avoid conflicts with existing utilities along the north side of Bradley Road. From there flows will be conveyed on to design point A. The second existing 42" CMP will be plugged. - Please note that approximately 7.3 acres of the area tributary to this design point have been diverted from the Big Johnson Reservoir by CDOT construction of Powers Boulevard. Future development of that portion of the tributary sub-basin must redirect these flows to the Big Johnson Reservoir to maintain compliance with the two relevant DBPS reports. - Development of the OS-1 Sub-basin will require onsite detention and an FDR.	A
1-A	-This design point is located at a sump inlet on the north side of Frontside Drive and just west of the Legacy Hill Drive Roundabout. -Please note that the commercial lot to within Sub-basin A-1 will be treated as undeveloped for the purposes of this report. Per MDDPA-Matrix, future development of this lot will require on-site detention as described in the referenced MDDP. -Development of this basin will require **full spectrum onsite detention** and an FDR. -Onsite detention shall tie into the back of the curb inlet at Design Point 1-A via the 18" storm sewer stubbed out of the back of the inlet to the road right of way	A
2-A	-This design point is located at a sump inlet on the south side of Frontside Drive and just west of the Legacy Hill Drive Roundabout. -Flow to This design point is primarily from street drainage along Frontside Drive.	A
3-A	-This design point is located at a sump inlet on the north side of Frontside Drive and just east of the Legacy Hill Drive Roundabout. -Please note that the commercial lot within Sub-basin A-3 will be treated as undeveloped for the purposes of this report. Per MDDPA-Matrix, future development of this lot will require on-site detention as shown in MDDPA-Matrix. -Development of this basin will require **full spectrum onsite detention** and an FDR. -On-site detention shall tie into the back of the adjacent curb inlet via the 18-inch storm sewer stubbed out of the back of the inlet to the road right of way.	A
4-A	-This design point is located at a sump inlet on the south side of Frontside Drive and just east of the Legacy Hill Drive Roundabout. -Flow to This design point is almost exclusively from street drainage along Frontside Drive.	A
A	-This design point represents the manhole combining drainage from Design points OS-1 and 1-A through 4-A.	B
1-B	-This design point represents the on-grade inlet south of Frontside Drive.	B
B	-This design point represents the manhole on Legacy Hill Drive combining the flows from design point A with design point 1-B.	C

C. Storm Sewer Capacities

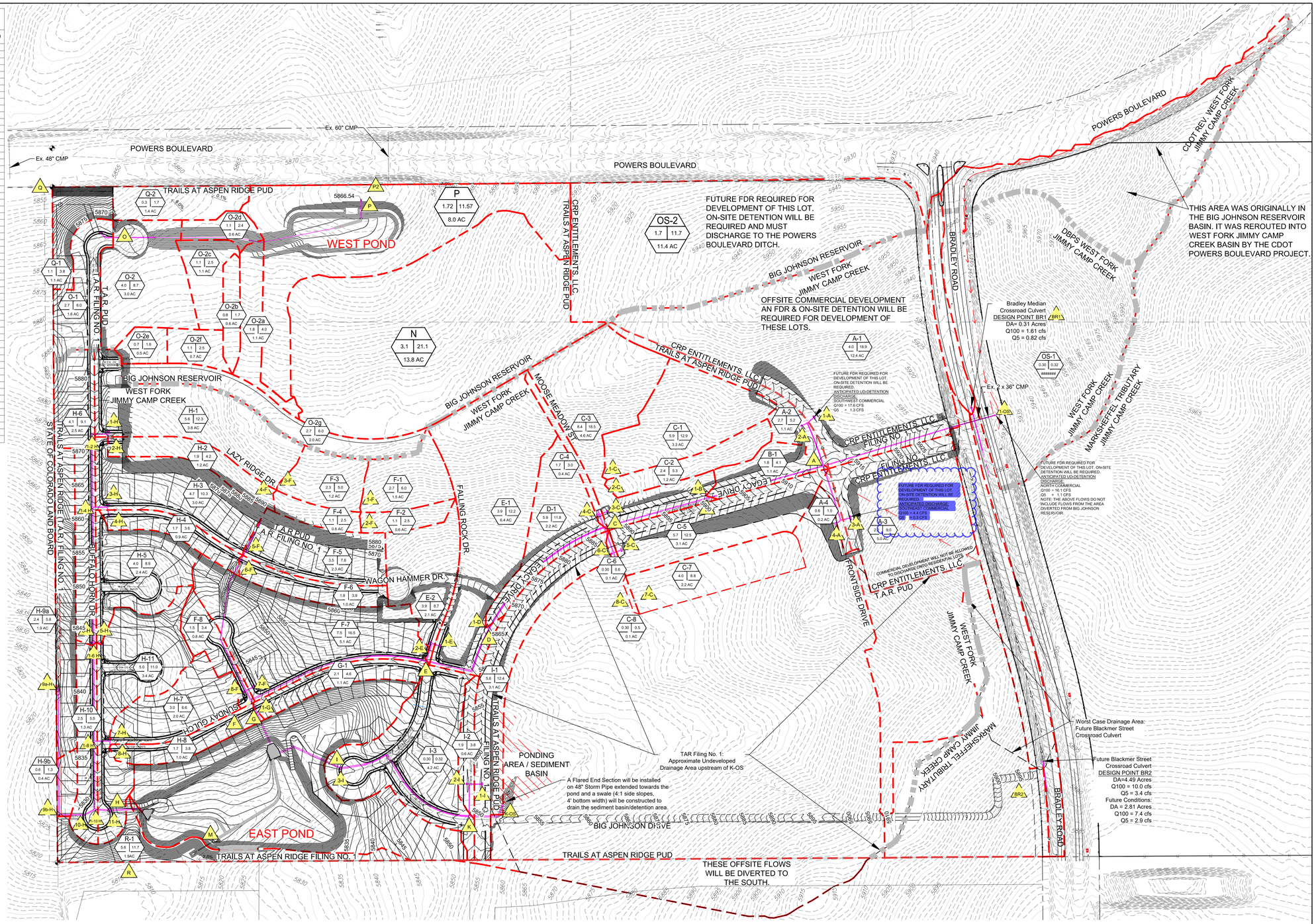
Storm sewer capacities and HGL's were analyzed in StormCAD. The table below lists relevant pipe information. HGL profiles for the Q5 and Q100 events can be found in Appendix A.

Table 8.4a STORM PIPE SUMMARY TABLE					
PIPE LABEL	**PIPE DIA. (IN)**	**PIPE LENGTH (FT)**	**% GRADE**	**Q100 PIPE FLOW (cfs)**	**Velocity (Ft/s)**
PIPE 1	24	168.3	3.4%	26.80	14.0
PIPE 2	24	488.9	2.7%	26.80	12.9
PIPE 3	30	169.4	0.5%	20.62	4.2
PIPE 4	30	33.8	0.5%	19.40	3.6
PIPE 5	30	23.1	0.5%	5.20	1.1
PIPE 6	24	210.3	0.5%	7.48	3.0
PIPE 7	18	37.1	0.5%	8.90	5.0
PIPE 8	18	21.1	0.5%	1.00	0.6
PIPE 9	30	444.0	3.0%	52.34	15.9
PIPE 10	18	13.8	2.0%	4.10	6.8
PIPE 11	30	396.7	3.0%	53.83	16.2
PIPE 12	30	49.9	1.0%	38.04	7.8
PIPE 13	18	30.7	1.0%	18.50	10.9
PIPE 14	18	7.7	1.0%	3.00	4.7
PIPE 15	24	15.8	1.0%	17.47	5.6
PIPE 16	30	101.2	1.0%	21.29	4.4
PIPE 17	24	30.7	1.0%	12.50	4.0
PIPE 18	18	7.7	1.0%	0.60	0.3
PIPE 19	24	25.7	0.9%	9.16	5.2
PIPE 20	42	201.7	3.0%	85.82	18.1
PIPE 21	42	193.4	3.0%	85.59	18.1
PIPE 22	42	184.7	3.0%	85.36	18.1
PIPE 23	24	15.3	1.0%	5.20	5.3
PIPE 24	42	169.7	3.0%	89.61	18.2
PIPE 25	42	172.5	1.4%	89.40	13.5
PIPE 26	30	68.3	0.5%	33.48	3.7
PIPE 27	18	7.6	1.0%	8.70	15.6
PIPE 28	18	30.8	1.0%	11.40	4.3
PIPE 29	48	226.6	1.5%	113.17	14.6
PIPE 30	48	244.1	1.5%	112.76	14.6
PIPE 31	48	211.9	2.5%	112.31	17.7
PIPE 32	48	31.7	2.2%	134.59	17.7
PIPE 33	48	147.4	2.2%	136.31	17.8
PIPE 34	30	39.6	1.2%	35.81	10
PIPE 35	18	29.9	1.0%	16.50	9.3
PIPE 36	18	8.4	1.0%	3.30	1.9
PIPE 37	24	212.9	2.1%	17.31	10.7
PIPE 38	18	210.4	3.0%	17.35	11.7

Know what's below. Call before you dig.

Trails at Aspen Ridge Proposed Conditions Sub-basin Summary			
Basin	**Area**	Q5	Q100
	acres	cfs	cfs
West Fork - Jimmy Camp Creek			
OS-1	19.67	4.0	26.8
A-1	12.34	4.4	18.9
A-2	1.09	2.7	5.2
A-3	4.98	2.2	9.0
A-4	0.12	0.6	1.0
B-1	1.06	1.8	4.1
C-1	3.27	5.9	12.9
C-2	1.19	2.4	5.3
C-3	4.60	8.4	18.5
C-4	0.36	1.6	3.0
C-5	3.13	5.7	12.5
C-6	0.07	0.3	0.6
C-7	2.20	4.0	8.8
C-8	0.06	0.3	0.5
D-1	2.21	1.6	5.2
E-1	6.43	3.9	12.2
E-2	2.14	3.9	8.7
F-1	1.49	2.7	6.0
F-2	0.58	1.1	2.5
F-3	1.25	2.3	5.0
F-4	0.58	1.1	2.5
F-5	2.27	3.5	7.8
F-6	1.00	1.7	3.9
F-7	5.06	7.5	16.5
F-8	0.84	1.5	3.3
G-1	1.11	2.1	4.6
H-1	3.60	5.6	12.3
H-2	1.16	1.9	4.2
H-3	2.97	4.7	10.3
H-4	0.92	1.6	3.6
H-5	2.42	4.0	8.9
H-6	2.46	4.1	9.1
H-7	2.03	3.0	6.6
H-8	0.97	1.7	3.8
H-9a	1.95	2.3	5.8
H-10	1.33	2.5	5.5
H-11	3.42	5.0	11.0
I-1	3.13	5.6	12.4
I-2	0.59	1.9	3.8
I-3	4.18	7.1	15.6
R-1	1.87	2.3	7.4
BR1	0.31	0.8	1.6
BR2	4.49	3.4	10.0
Big Johnson Reservoir			
O-1 (Filing No. 1)	1.63	2.7	6.0
O-2 (Future)	2.97	4.0	8.7
O-2a (Future)	1.13	1.8	4.0
O-2b (Future)	0.57	0.8	1.7
O-2c (Future)	1.05	1.1	2.5
O-2d (Future)	0.60	1.1	2.4
O-2e (Future)	0.51	0.7	1.6
O-2f (Future)	0.65	1.1	2.5
O-2g (Future)	2.04	2.7	6.0
P (Future)	8.01	1.7	11.6
Q-1	1.09	1.1	3.8
Q-2	1.36	0.2	1.6
OS-2	11.44	1.7	11.7

Design Point Routing StormCAD					
Design Point	**Total Drainage Area**	**Surface** Q5	Q100	**Storm Sewer** Q5	Q100
1-OS	**19.67**	4.0	26.8	-	-
1-A	**12.34**	3.5	17.6	-	-
2-A	**1.09**	2.7	5.2	-	-
3-A	**4.98**	2.2	8.9	-	-
4-A	**0.12**	0.6	1.0	-	-
A	**38.20**	-	-	12.0	55.6
1-B	**1.06**	1.8	4.1	-	-
B	**39.26**	-	-	12.7	57.1
1-C	**3.27**	5.9	12.9	-	-
2-C	**1.19**	2.4	5.3	-	-
3-C	**4.60**	8.4	18.5	-	-
4-C	**0.36**	1.6	3.0	-	-
5-C	**3.13**	5.7	12.5	-	-
6-C	**0.07**	0.3	0.6	-	-
7-C	**2.20**	4.0	8.8	-	-
8-C	**0.06**	0.3	0.5	-	-
C	**54.13**	-	-	27.6	90.2
1-D	**2.21**	1.6	5.2	-	-
D	**56.34**	0.0	0.0	28.1	92.1
1-E	**6.43**	2.6	11.4	-	-
2-E	**2.14**	3.9	8.7	-	-
E	**64.91**	-	-	33.7	108.8
1-F	**2.07**	2.7	6.0	2.7	6.0
2-F	**0.58**	1.1	2.5	1.6	3.6
3-F	**3.32**	2.3	5.0	3.8	8.4
4-F	**3.89**	1.1	2.5	5.0	11.1
5-F	**6.16**	3.5	7.8	6.6	14.6
6-F	**7.16**	1.7	3.9	7.9	17.5
7-F	**5.06**	7.5	16.5	7.5	16.5
8-F	**13.07**	1.5	3.3	16.2	35.8
F	**77.97**	-	-	43.5	131.0
1-G	**1.11**	2.1	4.6	-	-
G	**79.08**	-	-	44.2	132.7
1-H	**3.60**	5.9	13.1	-	-
2-H	**1.16**	1.9	4.2	-	-
1-2 H	**4.76**	-	-	9.0	19.8
3-H	**2.97**	4.7	10.3	-	-
4-H	**0.92**	1.6	3.6	-	-
1-4 H	**8.65**	-	-	16.4	36.1
5-H	**2.42**	4.0	8.9	-	-
6-H	**2.46**	3.9	8.6	-	-
1-6 H	**13.53**	-	-	20.2	44.9
7-H	**2.03**	2.9	6.4	-	-
8-H	**0.97**	1.7	3.7	-	-
1-8 H	**16.52**	-	-	23.3	49.3
9a-H	**1.95**	2.3	5.7	-	-
9b-H	**0.38**	0.6	1.4	2.8	6.5
10-H	**1.33**	2.4	5.2	-	-
1-10 H	**20.17**	-	-	29.6	66.5
11-H	**3.42**	5.0	11.0	-	-
H	**23.59**			37.4	83.0
1-I	**3.13**	5.6	12.4	-	-
2-I	**0.59**	1.9	3.8	-	-
K-OS	**37.74**			57.3	122.1
K	**41.46**	-	-	62.2	133.3
3-I	**4.18**	7.8	17.2	7.8	17.2
I	**45.64**	-	-	66.5	143.4
M	**195.07**	-	-	**158.2**	**426.5**
East Pond Discharge SWMM Discharge (MDDPA-Matrix)	**195.07**	-	-	21.1	127.4
R Rational Method	**1.09**	-	-	1.1	3.7
O	**11.91**	-	-	6.4	14.0
P	**34.69**	13.4	47.6	-	-
P2	**34.69**	-	-	0.2	23.9
Q Rational Method	**2.04**	1.1	3.8	-	-
BR1	**0.31**	-	-	0.8	1.6
BR2	**4.49**	-	-	3.4	10



Pond Summary Table									
Major Basin	**Pond ID**	**Analysis Method**	**Contributing Basins**	Approximate Detention Volumes WQCV Ac.-Ft.	EURV Ac.-Ft.	Q100 Ac.-Ft.	**EX 5-YR (CFS)**	**PR 5-YR (CFS)**	**EX 100-YR (CFS)**	**PR 100-YR (CFS)**
West Fork - Jimmy Camp Creek	East Pond	UD-Detention	OS-1, A, B, C, D, E, F, G, J, K, I, H, M	**F1:** 1.472	3.117	16.137	22.3	**1.2**	144.6	**72**
				FB: 4.890	6.581	18.041	22.3	**5.6**	144.6	**138.2**
Big Johnson Reservoir	West Pond	UD-Detention	O, P	**F1:** 0.06	0.098	1.366	0.7	0.2	30.1	23.9
				FB: 0.453	1.917	4.52	0.7	0.7	30.1	15.5

Trails at Aspen Ridge, Filing No. 1 = F1, Trails at Aspen Ridge, Full Buildout = FB

LEGEND

DESIGN POINT IDENTIFIER
BASIN IDENTIFICATION
BASIN FLOWS (Q5 / Q100)
BASIN AREA
BASIN BOUNDARY
DBPS BASIN BOUNDARY
EXISTING CONTOURS
PROPOSED CONTOURS

GRAPHIC SCALE
150'-0"
(IN FEET)
1 inch = 150 ft.

REFERENCE DRAWINGS
X-886-PR SITE
10415-Storm Base-2017
886-PR Legacy Drive
X-Title(Drainage)
19-886-PR-UTIL
X-886-PR SITE_F1
X-886-PR STORM_F1
X-886-EX SURVEY

NO.	DATE	DESCRIPTION	BY

REVISIONS

NAME: S:\19.886.008 Trails at Aspen Ridge\200 Drainage\201 Drainage Reports\FDR\DWG\DR02 Sheet 1 Basins20190923.dwg
PCP: Matrix.ctb
PLOT DATE: Tue Sep 24, 2019 3:59pm

BENCHMARK DATA(ELEV.) _____
(DATUM) _____
(DESCRIPTION/LOCATION) _____

VERTICAL BENCHMARK:

BASIS OF BEARING:

PREPARED UNDER MY DIRECT SUPERVISION, FOR AND ON BEHALF OF MATRIX DESIGN GROUP, INC.

Matrix DESIGN GROUP
2435 Research Parkway, Suite
300 Colorado Springs, CO 80920
Phone 719-575-0100
Fax 719-575-0208

COLA, LLC.

TRAILS AT ASPEN RIDGE FILING #1

FINAL DRAINAGE REPORT

DESIGNED BY: JTS
DRAWN BY: JTS
CHECKED BY:
SCALE
HORIZ:
VERT:
DATE ISSUED: September 2019
SHEET NO. 2 OF 4 SHEETS

DR-02

FINAL DRAINAGE REPORT

For

TRAILS AT ASPEN RIDGE
Filing No. 4

Prepared for:
EL PASO COUNTY
Engineering Development Review Team
2880 International Circle
Colorado Springs, CO 80910

On Behalf of:
COLA, LLC.
555 Middle Creek Parkway, Suite 380
Colorado Springs, CO 80921

Prepared by:

Matrix Design Group
2435 Research Parkway, Suite 300
Colorado Springs, CO 80920
(719) 575-0100
fax (719) 572-02f08

August 2021

Project No. 21.886.038

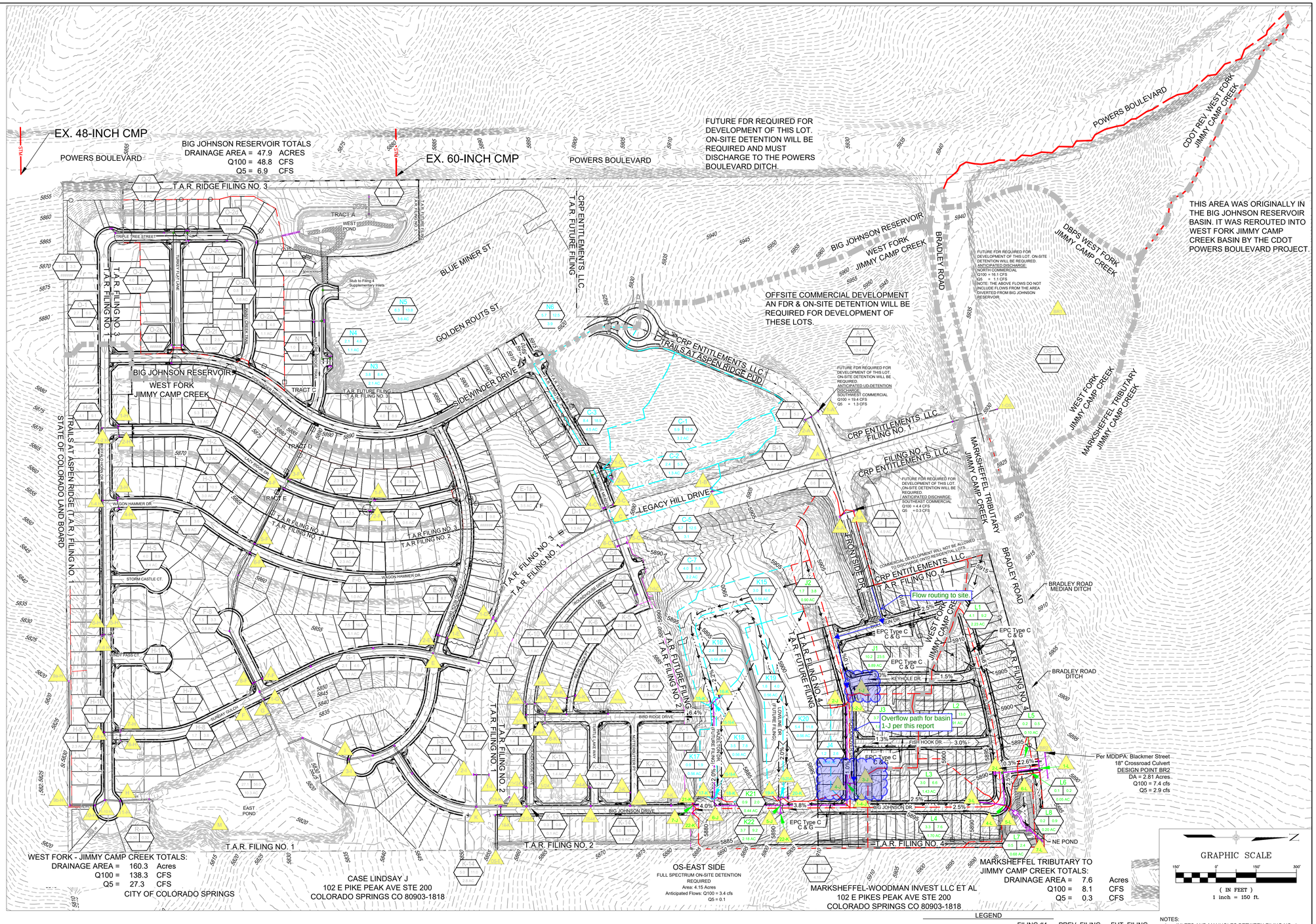
PCD File No. SF-21-024

DESIGN POINT DESCRIPTIONS *(Gray shading: Covered in previous drainage report)*		
Design Point	**Description**	**Downstream Design Point**
10-H	-This design point is at a sump inlet on the south side of the cul-de-sac at the east end of Buffalo Horn Drive. Surface flows from Sub-basin H-10 are combined with storm sewer flows from design point 9-H.	1-10 H
1-10 H	-Flows from design points 10-H and 1-8 H are combined at a manhole towards the north side of the cul-de-sac at the east end of Buffalo Horn Drive.	11-H
11-H	-This design point is at a sump inlet on the north side of the cul-de-sac at the east end of Buffalo Horn Drive. -This inlet captures flows from Sub-basin H-11	H
H	-This design point combines storm sewer flows from design point 11-H and 1-10 H	M
1-J	-This is design point is at an at-grade inlet on the north side of Schoonover Drive just east of the intersection of Keyhole Drive and Schoonover Drive. Bypass flows to DP 3-J	1-2-J
2-J	-This is design point is at an at-grade inlet on the sourth side of Schoonover Drive just east of the intersection of Keyhole Drive and Schoonover Drive. Bypass flows to DP 3-J	1-2-J
1-2-J	This design point represents a manhole combining flows from design points 1-J and 2-J	1-4-J
3-J	-This design point is at a 10-foot Type R Sump inlet on the north side of Schoonover Drive and between its intersections with Big Johnson Drive and Fishhook Drive. Q100 equalizes between inlets at 3-J and 4-J.	1-4-J
4-J	-This design point is at a 10-foot Type R Sump inlet on the sourth side of Schoonover Drive and between its intersections with Big Johnson Drive and Fishhook Drive.	1-4-J
1-4-J	-This design point represents a manhole combining flows from Design Point 3-J and 4-J with flows from design point 1-2-J.	5-J
15-K	This is an at-grade inlet in a future filing on the south side of Hazelton Drive just west of its intersection with Bird Ridge Drive.	15-16-K
16-K	This is an at-grade inlet in a future filing on the north side of Hazelton Drive just west of its intersection with Bird Ridge Drive.	15-16-K
15-16-K	This design point (future filing) represents the combination of flows from Design Points 15-J and 16-J.	15-18-K
17-K	This design point represents a sump inlet on the south side of Hazelton Drive just west of its intersection with Big Johnson Drive. This inlet will be constructed as part of a future filing.	15-18-K
18-K	This design point represents a sump inlet on the north side of Hazelton Drive just west of its intersection with Big Johnson Drive. This inlet will be constructed as part of a future filing.	15-18-K

Table 6.3 ***Overflow Routing*** ***Trails at Aspen Ridge, Filing No. 4***	
Inlet	***Overflow Routing Under Inlet Blockage Conditions***
5-L	In case of blockage of this inlet flows will surcharge the curb and gutter and flow directly into the NE Detention pond.
3-J	In case of blockage flows will surcharge the crown of the road and enter inlet 4-J. If both inlets are blocked flows will back up the curb and gutter to Big Johnson Drive and continue downstream along Big Johnson Drive to the next inlet.
4-J	In case of blockage flows will surcharge the crown of the road and enter inlet 3-J. If both inlets are blocked flows will back up the curb and gutter to Big Johnson Drive and continue downstream along Big Johnson Drive to the next inlet.
17-K	In case of blockage flows will continue up the curb and gutter to and along Big Johnson Drive until reaching the next downstream inlet.
18-K	In case of blockage flows will continue up the curb and gutter to and along Big Johnson Drive until reaching the next downstream inlet.
19-K	In case of blockage flows will continue up the curb and gutter to and along Big Johnson Drive until reaching the next downstream inlet.
20-K	In case of blockage flows will continue up the curb and gutter to and along Big Johnson Drive until reaching the next downstream inlet.

811 Know what's below. Call before you dig.

PLEASE SEE FOLLOWING SHEET DR-03 FOR SUB-BASIN AND DESIGN POINT SUMMARIES.



LEGEND

DESIGN POINT IDENTIFIER — FILING #4: L; PREV. FILING: A; FUT. FILING: E

BASIN IDENTIFICATION / BASIN FLOWS (Q5 / Q100) / BASIN AREA

BASIN BOUNDARY

DBPS BASIN BOUNDARY

EXISTING CONTOURS 5975

PROPOSED CONTOURS 7050

NOTES:

1. INLETS AND MANHOLES BETWEEN FILING NO. 4 AND FILING NO. 2 WHICH ARE NOT ON THE BIG JOHNSON STORM MAIN WILL NOT BE INSTALLED AS PART OF THIS FILING. STORM PIPES WILL BE STUBBED OUT FROM THE MAIN AND PLUGGED UNTIL THE FUTURE FILING IS CONSTRUCTED.
2. ALL STORM SEWER SHALL BE PUBLICLY OWNED AND MAINTAINED.
3. THE DETENTION PONDS AND INTERNAL STRUCTURES WILL BE PRIVATELY OWNED AND MAINTAINED BY THE WATERVIEW II METRO DIST.
4. SEE SHEET DR-03 FOR SUB-BASIN AND DESIGN POINT SUMMARIES.

REFERENCE DRAWINGS
X-886-PR SITE - F4
X-886-PR SITE - F3
X-886-PR SITE_F1
X-Title(Drainage)
X-886-PR SITE-F2
886-PR Legacy Drive-Roundabout
886-pr legacy drive

NO.	DATE	DESCRIPTION	BY

REVISIONS

NAME: S:\21.886.038 (Trails F6)\200 Drainage\201 Drainage Reports\FDR\DWG\DR-02.dwg
PCP: Matrix.ctb
PLOT DATE: Thu Aug 26, 2021 11:17am

BENCHMARK DATA(ELEV.)
(DATUM)
(DESCRIPTION/LOCATION)

VERTICAL BENCHMARK:

BASIS OF BEARING:

PREPARED UNDER MY DIRECT SUPERVISION, FOR AND ON BEHALF OF MATRIX DESIGN GROUP, INC.

Matrix
2435 Research Parkway, Suite
300 Colorado Springs, CO 80920
Phone 719-575-0100
Fax 719-575-0208

COLA, LLC.

TRAILS AT ASPEN RIDGE FILING #4

FINAL DRAINAGE REPORT

PROPOSED CONDITIONS

DESIGNED BY: JTS
DRAWN BY: JTS
CHECKED BY:
SCALE
HORIZ:
VERT:
DATE ISSUED: AUGUST 2021
SHEET NO. 2 OF 5 SHEETS

DR-02