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Info Only: Engineering comments are in blue text.

PRELIMINARY DRAINAGE REPORT FOR URBAN LANDING PRELIMINARY PLAN

CCES Responses

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Job No. 1308.01 PUDSP243
PCD File No.



PRELIMINARY DRAINAGE REPORT FOR URBAN LANDING PRELIMINARY PLAN

ENGINEER'S 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 County for drainage reports and said report is in conformity with the applicable 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.

Marc A. Whorton (Colorado P.E. #37155	 Date	
•	•	oly with all of the requirements s	pecified in this
Business Name:	CLASSIC COMPANIES		
Ву:			
Title:			
Address:	2138 Flying Horse Club Dri	ve	
	Colorado Springs, CO 8092	21	
	e with the requirements of the g Criteria Manual and Land De	Drainage Criteria Manual, Volumovelopment Code as amended.	es 1 and 2, El Paso
Joshua Palmer, P.E County Engineer /	ECM Administrator	Date	
Conditions:			



PRELIMINARY DRAINAGE REPORT FOR URBAN LANDING PRELIMINARY PLAN

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PRELIMINARY DRAINAGE REPORT FOR URBAN LANDING PRELIMINARY PLAN

PURPOSE

The intent of the owner/developer is to develop the Urban Landing Property. The purpose of this Preliminary Drainage Report, as part of the Preliminary Plan submittal, is to identify all drainage features and facilities and to estimate peak rates of stormwater runoff, from on-site and off-site sources. Also, the purpose is to outline the necessary improvements to safely route developed storm water runoff to adequate outfall facilities. The drainage improvements proposed in this report are preliminary in nature and a final drainage report is required upon any development within the property that detail the 'to be constructed' drainage systems and detention ponds.

GENERAL DESCRIPTION

The Urban Landing Preliminary Plan property is 6.576 acres, as located in a portion of section 36, township 11 south, range 67 west of the sixth principal meridian. The site is bounded on the north by Spanish Bit Dr., to the south by existing undeveloped property owned by a church, to the east by an existing rural residential 5-ac. lot and to the west by Struthers Road. The site is within the Jackson Creek drainage basin. The proposed use as shown on the concurrent Preliminary Plan submittal is single family residential (detached) with a total of 49 units, private roads, open space and detention/SWQ pond. Public roadway access will be from Spanish Bit Dr.

The average soil condition reflects Hydrologic Group "B" (Peyton-Pring complex, Pring coarse sandy loam and a small portion of Brussett loam) as determined by the "Soil Survey of El Paso County Area," prepared by the Soil Conservation Service (see map in Appendix).

EXISTING DRAINAGE CONDITIONS

This property is located in the Jackson Creek drainage basin. Existing conditions across this property are mainly native grasses and yucca with a natural ravine traversing the site draining from northeast to southwest. Existing slopes range from 2% to 12% across the site. The entire



property generally drains in a southwesterly direction towards the existing lowpoint on the property at the southeast corner of Spanish Bit Dr. and Struthers Road. Spanish Bit Dr. is currently constructed as a rural local roadway with sideroad ditches. This public road is paved up to the Big R access to the north and then gravel east of that intersection. Along with the development of the Big R, rip-rap was installed along the north side of the roadway to facilitate drainage along that side of the road down to the intersection with Struthers Road. The Big R development also constructed a detention/SWQ facility on the northwest corner of the intersection. The outfall for this pond is dual 36" RCP culverts under Spanish Bit Dr. that daylight into an informal holding basin that is partially rip-rapped on the proposed development property. These flows are then conveyed westerly under Struthers Road in an existing 6'x4' CBC. Struthers Road to the south of this intersection (approx. 350 LF) drains north towards this intersection. The east side of the roadway drains around the corner into Spanish Bit Dr. and then immediately down a paved rundown into this existing holding basin.

East of this property exists the Chaparral Hills 5-ac. rural residential neighborhood. A significant portion of this off-site development is tributary to the existing natural ravine on the property. This off-site flow enters the property as sheet flow at the northeast corner from Lot 26, Chaparral Hills Subd. This large off-site basin has been accounted for in both the predevelopment and developed drainage calculations.

The following descriptions represent the existing on and off-site basins and design points affecting this property: (Reference the Pre-development Drainage Map in the Appendix)

Design Point E1 (Q₅ = **5 cfs, Q**₁₀₀ = **22 cfs)** consists of the 12.8-acre off-site tributary area from Basin OS-1. As mentioned earlier, this area is developed as large lot rural residential (5-ac. lots) sheet flowing towards the northeast corner of the property. These off-site flows then enter the property and travel within the natural ravine towards Struthers Road and the existing 6'x4' CBC.



Design Point E2 ($Q_5 = 0.5$ cfs, $Q_{100} = 3.3$ cfs) consists of the off-site tributary area from Basin OS-3 (0.49 ac.) and the on-site Basin EX-2 (1.3 ac.). Basin OS-3 is also currently developed as large lot rural residential. These minor off-site flows then enter the property within Basin EX-2 as sheet flow. The combined sheet flows continue to sheet flow off-site into the undeveloped church property within Basin OS-4.

Design Point E3 ($Q_5 = 2$ cfs, $Q_{100} = 8$ cfs) consists of the sheet flow from Design Point E2 combining with the sheet flow of Basin OS-4 (2.1 ac.). These sheet flows then enter Struthers Road, travel as C&G flow in a northerly direction towards Spanish Bit Dr. The flows then turn the corner and are conveyed down the paved rundown within the property.

Design Point E4 (Q₅ = **7 cfs, Q**₁₀₀ = **31 cfs)** consists of the off-site flows described above along with the major portion of the property within Basin EX-1 (5.8 ac.). These flows represent the total combined runoff from both on-site and off-site tributary area across this property except those coming from the existing dual 36" RCP culverts under Spanish Bit Dr.

PROPOSED DRAINAGE CONDITIONS

Development within the proposed Preliminary Plan is planned for urban residential with associated curb, gutter, sidewalk and paved private streets. Overlot grading is anticipated for the majority of the development along with installation of urban services provided through the Donala Water and Sanitation District. Proposed impervious areas will sheet flow across yards and landscape areas to slow runoff and increase time of concentration. This will minimize the effects of impervious areas. At design points where developed flows are greater than in the existing condition, detention facilities will be proposed providing an Excess Urban Runoff Volume (EURV) in the lower portion of the facility storage volume with an outlet control device. Frequent and infrequent inflows are released at rates approximating undeveloped conditions. This concept provides some mitigation of increased runoff volume by releasing a portion of the



increased runoff at a low rate over an extended period of time, up to 72 hours. This means that frequent storms, smaller than the 2-year event, will be reduced to very low flows near or below the sediment carrying threshold value for downstream drainage ways. Also, by incorporating an outlet structure that limits the 100-year runoff to the undeveloped condition rate, the discharge hydrograph for storms between the 2-year and the 100-year event will approximate the hydrograph for the undeveloped conditions and will help effectively mitigate the effects of development. Prior to development within this property, a final drainage report and construction plans will be required detailing the requirements and specifics of proposed facilities.

Due to current drainage criteria, detention/stormwater quality facilities are proposed. The following are preliminary design points for developed conditions with descriptions of anticipated basin areas and preliminary storm systems:

Design Point 1 (Q₅ = **5 cfs, Q**₁₀₀ = **23 cfs)** consists of off-site sheet flows from Basin OS-1 (12.8 ac.) east of the site and the minor developed flows from Basin A (0.10 ac.). These combined flows will be collected by a proposed 30" RCP within a drainage tract maintained by the HOA and routed further downstream within the public right-of-way for Spanish Bit Dr.

Design Point 2 ($Q_5 = 1.5$ cfs, $Q_{100} = 3.2$ cfs) consists of the minor off-site sheet flows from Basin OS-2A (0.13 ac.) and developed flows from Basin B (0.75 ac.). These combined flows will be collected by a proposed 5' Type R symp inlet within the private roadway. A proposed 18" RCP will then route the collected flows downstream towards Design Point 3. Design Point 3 ($Q_5 = 0.6$ cfs, $Q_{100} = 1.1$ cfs) consists of the minor developed flows from Basin C (0.18 ac.). A proposed 5' Type R sump inlet will collect the flows and then combine with the upstream flows from Design Point 2. A proposed 18" RCP will then route the collected flows towards the proposed public 30" RCP within the public right-of-way for Spanish Bit Dr.

Please discuss emergency overflow path of all sump inlets in the case that the inlet becomes fully clogged. This is a PDR but have added such language for all sump conditions.



Design Point 4 (Q₅ = **2.4 cfs, Q**₁₀₀ = **6.8 cfs)** consists of the off-site sheet flows from Basin OS-2B (1.5 ac.) and developed flows from Basin D (1.1 ac.). These combined flows will be collected by a proposed area drain behind the curb and a 5' Type R sump inlet within the private roadway. A proposed private 18" RCP will then route the collected flows downstream towards Design Point 5. **Design Point 5 (Q**₅ = **1.0 cfs, Q**₁₀₀ = **2.0 cfs)** consists of the minor developed flows from Basin E (0.31 ac.). These flows will also be collected by a proposed 5' Type R sump inlet within the private roadway. The flows combine with the upstream flows collected from Design Point 4 and are routed via a proposed 24" RCP towards Design Point 6.

Design Point 6 (Q₅ = **0.6 cfs, Q**₁₀₀ = **1.8 cfs)** consists of the developed sheet flows from Basin F (0.60 ac.). These flows will be collected by a proposed area drain within the open space area. The collected flows then combine with the upstream flows and are then routed via a proposed private 24" RCP towards Design Point 7.

Design Point 7 (Q_5 = 4.6 cfs, Q_{100} = 9.4 cfs) consists of the developed flows from Basin G (0.58 ac.) and flows from Basin H (1.6 ac.). These combined flows will be collected by a proposed 5' Type R sump inlet within the private roadway. The collected flows then combine with the upstream flows and are then routed via a proposed private 24" RCP towards the proposed public 30" RCP within the public right-of-way for Spanish Bit Dr. Design Point 8 (Q_5 = 2.3 cfs, Q_{100} = 5.1 cfs) consists of off-site sheet flows from Basin OS-3A (0.37 ac.) and developed flows from Basin I (1.3 ac.). The combined flows will be collected by a proposed 5' Type R sump inlet within the private roadway. These collected flows then combine with the upstream flows and are then routed via a proposed private 24" RCP towards the proposed public 30" RCP within the public right-of-way for Spanish Bit Dr.

Basin OS-3B (0.04 ac.) ($Q_5 = 0.02$ cfs, $Q_{100} = 0.12$ cfs) consists of minor off-site sheet flows from the adjacent property that sheet flow directly into Basin J. Basin J (1.0 ac.) ($Q_5 = 0.8$ cfs, $Q_{100} = 0.$



2.7 cfs) consists of developed flows that are routed via a proposed grass lined swale within the

open space Tract C and directly into the proposed pond.

Concentrated flow from the proposed swale cannot be discharged directly into the proposed pond. Please provide a riprap rundown.

Basin OS-4 (2.1 ac.) ($Q_5 = 1.6$ cfs, $Q_{100} = 5.1$ cfs) consists of the off-site sheet flows from the undeveloped church property to the south. These existing sheet Rip-Rap Rundown now provided side of Struthers Road and then travel as curb and gutter flow in a nortnerly direction towards Spanish Bit Dr. Once at the intersection with Spanish Bit Dr., the flows travel around the corner, combine with the developed flows from Basin K and are then conveyed directly into the existing holding basin on the southeast corner via an existing paved rundown. These existing flows are then routed under Struthers Road via the existing 6'x4'CBC. Basin K (0.20 ac.) ($Q_5 = 0.6$ cfs, Q_{100} = 1.2 cfs) consists of the developed flows from a small portion of the development property and the south side of Spanish Bit Road. These develope Added additional gutter flows language. See revised towards the existing paved rundown. Basin L (0.16 ac s) consists of

the area of the existing holding basin. These existing flows continue to directly enter the existing

6'x4' CBC under Struthers Road.

Please discuss whether the existing culvert and existing holding basin have sufficient capacity to handle the increased runoff flows. Calculations will be required in the Final Drainage Report.

Design Point 9 (Q₅ = 14 cfs, Q₁₀₀ = 44 cfs) represents the total area and developed flows tributary to the proposed on-site detention/SWQ pond. The total tributary area is 22.36 ac. with a 30.6%

weighted imperviousness. (See Appendix) Please discuss the design point where the discharge leaves the site. Please also discuss if there is a suitable outfall Additional comments ouality may be generated once the initial comments are

Please compare the discharge leaving the site in the existing condition with the discharge in the proposed condition.

This comparison is provided addressetimal design of this recommended facility that include plan on the next page under the nt of Detention Facilities section. osed

Added additional language. See revised es will be designed during final de ...

ter quality measures will be utilized in order to reduce the amount of

sediment, debris and pollutants that are allowed to be released downstream. These features include Full Spectrum Extended Detention Basin Sedimentation Facilities. Site Planning and design techniques should limit impervious area, minimize directly impervious area, lengthen time of travel and increase infiltration in order to decrease the rate and volume of stormwater runoff.



Facilities that require detention will provide an Excess Urban Runoff Volume (EURV) in the lower portion of the facility storage volume that will release the more frequent storms at a slower rate to help minimize the effects of development of this property.

The proposed Pond is intended to provide detention and stormwater quality for nearly the entire property, including the off-site basins tributary to this site as described above. The total anticipated developed flows entering this facility are as follows:

(See Appendix for MHFD-Detention pond design sheets):

Pond (Full Spectrum EDB)

Total Tributary Acreage: 22.36 ac.

Total Site Impervious tributary to Pond 1: 30.6%

0.286 Ac.-ft. WQCV required

0.418 Ac.-ft. EURV required with 4:1 max. slopes

0.800 Ac.-ft. 100-yr. required storage

1.504 Ac.-ft. required total

Total Peak In-flow: $Q_5 = 14 \text{ cfs}$, $Q_{100} = 44 \text{ cfs}$

Pond Peak Design Release: $Q_5 = 4.5 \text{ cfs}, Q_{100} = 31 \text{ cfs}$

Release per Pre-development Conditions (Design Point E4): $Q_5 = 7$ cfs, $Q_{100} = 31$ cfs

This proposed detention facility is to be private with maintenance of all private drainage facilities outside the public Right-of-Way including the pond by the Urban Landing HOA. All drainage facilities within the public Right of Way to be public with maintenance by El Paso County.

DRAINAGE CRITERIA

Hydrologic calculations were performed using the City of Colorado Springs/El Paso County Drainage Criteria Manual, as revised in November 1991 and October 1994 with County adopted Chapter 6 and Section 3.2.1 of Chapter 13 of the City of Colorado Springs/El Paso County Drainage



Criteria Manual as revised in May 2014. Individual basin design used for detention/SWQ basin sizing was calculated using the Rational Method. Runoff Coefficients are based on the imperviousness of the particular land use and the hydrologic soil type in accordance with Table 6-6. The average rainfall intensity, by recurrence interval found in the Intensity-Duration-Frequency (IDF) curves in Figure 6-5. Mile High Flood District (MHFD)-Detention spreadsheet Ver. 4.06 used for Preliminary Detention/SWQ design. (See Appendix)

The City of Colorado Springs/El Paso County DCM requires the Four Step Process for receiving water protection that focuses on reducing runoff volumes, treating the water quality capture volume (WQCV), stabilizing drainage ways, and implementing long-term source controls. The Four Step Process pertains to management of smaller, frequently occurring storm events, as opposed to larger storms for which drainage and flood control infrastructure are sized. Implementation of these four steps helps to achieve storm water permit requirements.

This site adheres to this **Four Step Process** as follows:

- Employ Runoff Reduction Practices: Proposed urban lot impervious areas (roof tops, patios, etc.) will sheet flow across landscaped yards and through open space areas to slow runoff and increase time of concentration prior to being conveyed to the proposed public streets or detention facilities. This will minimize directly connected impervious areas within the project site.
- 2. Stabilize Drainageways: The existing natural drainageway on-site will be overlot graded and urbanized with the proposed residential development. Within this development, private urban street sections will be constructed along with buried storm systems to handle the developed runoff. The final drainage report will better detail these capture methods and any required improvements to do so along with necessary hydraulic analysis and emergency overflow routing methods per County standards. After developed flows



utilize the runoff reduction practices through the yards and open spaces, developed flows will travel via curb and gutter within the private streets and eventually public/private storm systems. These collected flows are then routed directly to the proposed on-site extended detention basin (full-spectrum facility).

- 3. **Provide Water Quality Capture Volume (WQCV):** Runoff from this development will be treated through capture and slow release of the WQCV and excess urban runoff volume (EURV) in the proposed Full-Spectrum permanent Extended Detention Basin designed per current El Paso County drainage criteria. The few basins that are not able to be captured and routed to a permanent extended detention basin (K and L) qualify for an exclusion 1.7.1.C.1 20% exclusion less than 1 acre.
- 4. Consider need for Industrial and Commercial BMPs: No industrial uses are proposed within this development. However, a site-specific storm water quality and erosion control plan and narrative will be submitted along with the grading and erosion control plan. Details such as site-specific sediment and erosion control construction BMP's will be detailed in this plan and narrative to protect receiving waters. BMP's will be constructed and maintained as the development has been graded and erosion control methods employed.

FLOODPLAIN STATEMENT

No portion of this site is located within a floodplain as determined by the Flood Insurance Rate Maps (F.I.R.M.) Map Numbers 08041C0286G and 0841C0287G, effective date, December 7, 2018 (See Appendix).



DRAINAGE AND BRIDGE FEES

Any applicable drainage and bridge fees shall be provided prior to final plat recordation of any

development within this site. These fees will be calculated in the FDR for County review and

approval.

SUMMARY

The proposed Urban Landing property development is within the Jackson Creek Drainage Basin.

The points of storm water release from the proposed site are required to be at or below the

calculated historic flow quantities. This development does not impact any downstream facility

or property to an extent greater than that which currently exists in the 'historic' conditions. All

drainage facilities within this report were sized according to the Drainage Criteria Manuals and

the full-spectrum storm water quality requirements. Prior to development of this property, a

separate Final Drainage Report will be required to be submitted and approved by El Paso County

that details all storm systems, pond design and fee calculation.

PREPARED BY:

Classic Consulting Engineers & Surveyors, LLC

Marc A. Whorton, P.E.

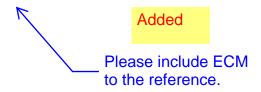
Project Manager

maw/1308.01/130801PDR.doc



REFERENCES

- 1. City of Colorado Springs/County of El Paso Drainage Criteria Manual as revised in November 1991 and October 1994 with County adopted Chapter 6 and Section 3.2.1 of Chapter 13 of the City of Colorado Springs/El Paso County Drainage Criteria Manual as revised in May 2014.
- 2. "Urban Storm Drainage Criteria Manual Volume 1, 2 & 3" Urban Drainage and Flood Control District, dated January 2016.
- 3. "Big R Retail Center Final Drainage Report", M&S Civil Consultants, Inc., dated March 2012
- 4. "Preliminary & Final Drainage Report for Cathedral Rock Commons Commercial", JPS Engineering, approved April, 2023.
- 5. "Drainage Report for Chaparral Hills", Colorado Engineering, Inc., dated 1971



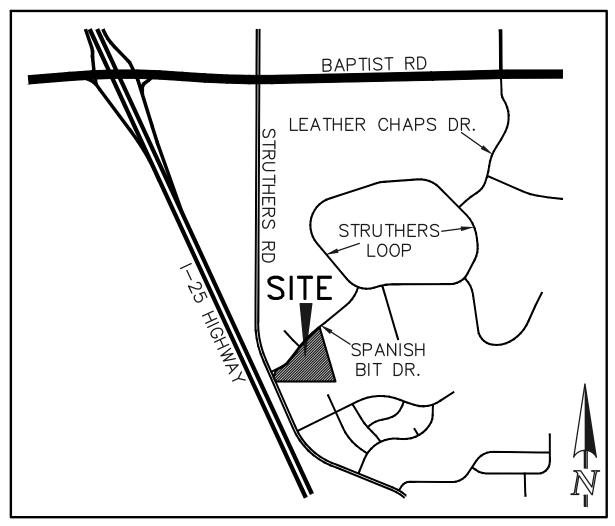


APPENDIX



VICINITY MAP





VICINITY MAP

SOILS MAP (S.C.S SURVEY)





MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Unit Polygons



Soil Map Unit Points

Special Point Features

Blowout

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

Miscellaneous Water

Perennial Water

Rock Outcrop

Saline Spot

Sandy Spot

Severely Eroded Spot

Sinkhole

Slide or Slip

Sodic Spot

LOLIND

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot
Other

Special Line Features

Water Features

Δ

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 21, Aug 24, 2023

Soil map units are labeled (as space allows) for map scales 1:50.000 or larger.

Date(s) aerial images were photographed: Jun 9, 2021—Jun 12, 2021

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
14	Brussett loam, 1 to 3 percent slopes	11.5	4.2%
45	Kutch clay loam, 5 to 20 percent slopes	0.5	0.2%
68	Peyton-Pring complex, 3 to 8 percent slopes	97.4	36.0%
71	Pring coarse sandy loam, 3 to 8 percent slopes	64.4	23.8%
92	Tomah-Crowfoot loamy sands, 3 to 8 percent slopes	0.7	0.2%
93	Tomah-Crowfoot complex, 8 to 15 percent slopes	96.5	35.6%
Totals for Area of Interest		270.9	100.0%

El Paso County Area, Colorado

14—Brussett loam, 1 to 3 percent slopes

Map Unit Setting

National map unit symbol: 367j Elevation: 7,200 to 7,500 feet Frost-free period: 115 to 125 days

Farmland classification: Prime farmland if irrigated

Map Unit Composition

Brussett and similar soils: 85 percent

Estimates are based on observations, descriptions, and transects of

the mapunit.

Description of Brussett

Setting

Landform: Flats

Landform position (three-dimensional): Talf

Down-slope shape: Linear Across-slope shape: Linear Parent material: Eolian deposits

Typical profile

A - 0 to 8 inches: loam
BA - 8 to 12 inches: loam
Bt - 12 to 26 inches: clay loam
Bk - 26 to 60 inches: silt loam

Properties and qualities

Slope: 1 to 3 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Well drained

Runoff class: Low

Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None Frequency of ponding: None

Calcium carbonate, maximum content: 5 percent

Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0

mmhos/cm)

Available water supply, 0 to 60 inches: High (about 9.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 3c

Hydrologic Soil Group: B

Ecological site: R048AY222CO - Loamy Park

Hydric soil rating: No



Minor Components

Other soils

Percent of map unit: Hydric soil rating: No

Data Source Information

Soil Survey Area: El Paso County Area, Colorado Survey Area Data: Version 21, Aug 24, 2023

El Paso County Area, Colorado

68—Peyton-Pring complex, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 369f Elevation: 6,800 to 7,600 feet

Farmland classification: Not prime farmland

Map Unit Composition

Peyton and similar soils: 40 percent Pring and similar soils: 30 percent

Estimates are based on observations, descriptions, and transects of

the mapunit.

Description of Peyton

Setting

Landform: Hills

Landform position (three-dimensional): Side slope

Down-slope shape: Linear Across-slope shape: Linear

Parent material: Arkosic alluvium derived from sedimentary rock and/or arkosic residuum weathered from sedimentary rock

Typical profile

A - 0 to 12 inches: sandy loam

Bt - 12 to 25 inches: sandy clay loam

BC - 25 to 35 inches: sandy loam

C - 35 to 60 inches: sandy loam

Properties and qualities

Slope: 3 to 5 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Well drained

Runoff class: Low

Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None Frequency of ponding: None

Available water supply, 0 to 60 inches: Moderate (about 7.3

inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 4c

Hydrologic Soil Group: B

Ecological site: R049XY216CO - Sandy Divide

Hydric soil rating: No

Description of Pring

Setting

Landform: Hills

Landform position (three-dimensional): Side slope

Down-slope shape: Linear Across-slope shape: Linear

Parent material: Arkosic alluvium derived from sedimentary rock

Typical profile

A - 0 to 14 inches: coarse sandy loam
C - 14 to 60 inches: gravelly sandy loam

Properties and qualities

Slope: 3 to 8 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Well drained

Runoff class: Low

Capacity of the most limiting layer to transmit water (Ksat): High

(2.00 to 6.00 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None Frequency of ponding: None

Available water supply, 0 to 60 inches: Low (about 6.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 3e

Hydrologic Soil Group: B

Ecological site: R048AY222CO - Loamy Park

Hydric soil rating: No

Minor Components

Other soils

Percent of map unit: Hydric soil rating: No

Pleasant

Percent of map unit: Landform: Depressions Hydric soil rating: Yes

Data Source Information

Soil Survey Area: El Paso County Area, Colorado Survey Area Data: Version 21, Aug 24, 2023

El Paso County Area, Colorado

71—Pring coarse sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 369k Elevation: 6,800 to 7,600 feet

Farmland classification: Not prime farmland

Map Unit Composition

Pring and similar soils: 85 percent

Estimates are based on observations, descriptions, and transects of

the mapunit.

Description of Pring

Setting

Landform: Hills

Landform position (three-dimensional): Side slope

Down-slope shape: Linear Across-slope shape: Linear

Parent material: Arkosic alluvium derived from sedimentary rock

Typical profile

A - 0 to 14 inches: coarse sandy loam
C - 14 to 60 inches: gravelly sandy loam

Properties and qualities

Slope: 3 to 8 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Well drained

Runoff class: Low

Capacity of the most limiting layer to transmit water (Ksat): High

(2.00 to 6.00 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None Frequency of ponding: None

Available water supply, 0 to 60 inches: Low (about 6.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 3e

Hydrologic Soil Group: B

Ecological site: R048AY222CO - Loamy Park

Hydric soil rating: No

Minor Components

Pleasant

Percent of map unit: Landform: Depressions Hydric soil rating: Yes

Other soils

Percent of map unit: Hydric soil rating: No

Data Source Information

Soil Survey Area: El Paso County Area, Colorado Survey Area Data: Version 21, Aug 24, 2023

F.E.M.A. MAP



NOTES TO USERS

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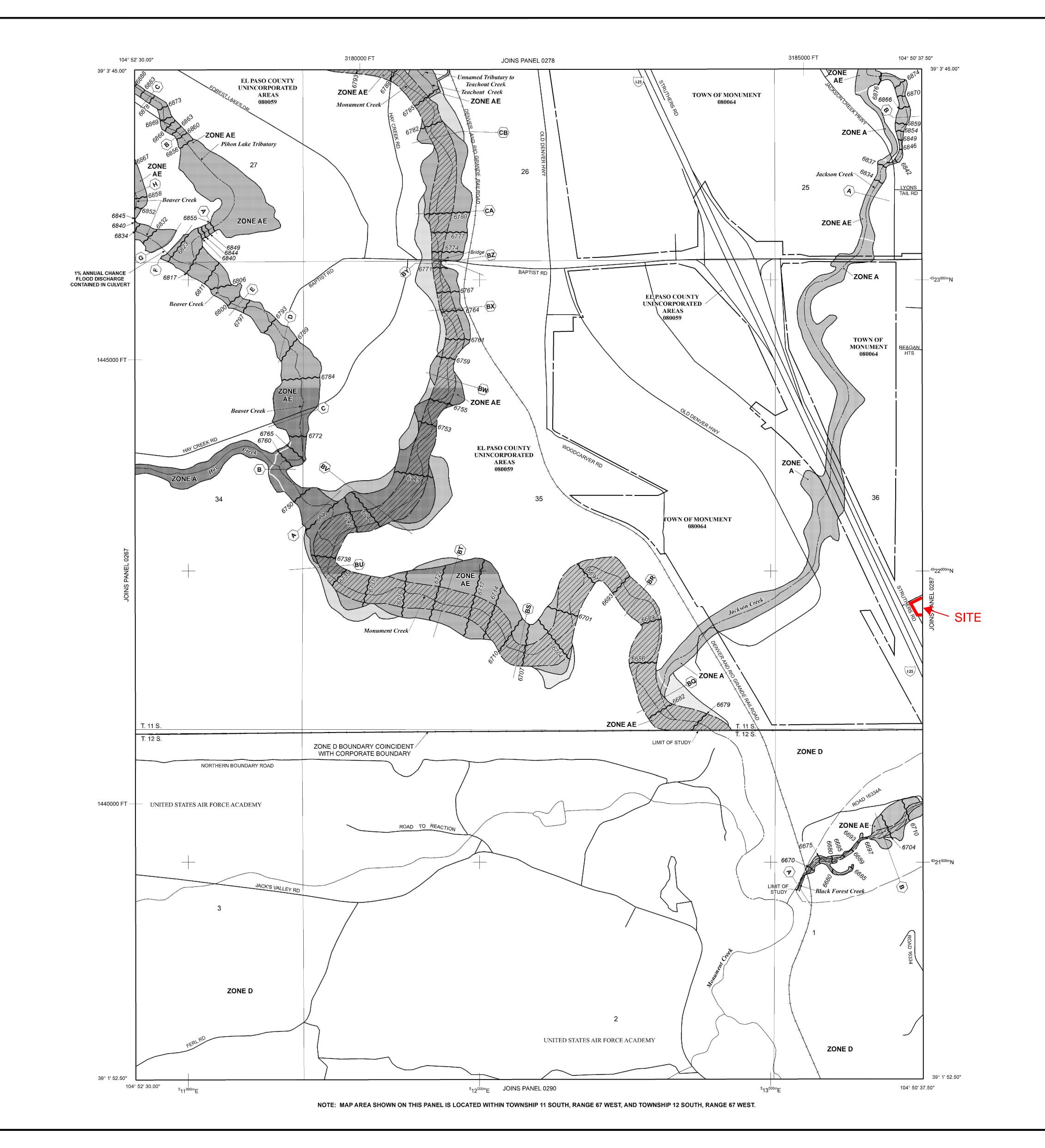
El Paso County Vertical Datum Offset Table Flooding Source REFER TO SECTION 3.3 OF THE EL PASO COUNTY FLOOD INSURANCE STUDY FOR STREAM BY STREAM VERTICAL DATUM CONVERSION INFORMATION

Panel Location Map

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LEGEND

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

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ZONE A No Base Flood Elevations determined. **ZONE AE** Base Flood Elevations determined.

Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood

Elevations determined **ZONE AO** Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average

depths determined. For areas of alluvial fan flooding, velocities also **ZONE AR** Special Flood Hazard Area Formerly protected from the 1% annual chance

flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.

ZONE A99 Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations Coastal flood zone with velocity hazard (wave action); no Base Flood

ZONE VE Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

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

OTHER FLOOD AREAS

Elevations determined.

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

OTHER AREAS

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COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs) CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

> Floodplain boundary Floodway boundary

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1000-meter Universal Transverse Mercator grid ticks, 5000-foot grid ticks: Colorado State Plane coordinate

system, central zone (FIPSZONE 0502), Bench mark (see explanation in Notes to Users section of

6000000 FT

MAP REPOSITORIES Refer to Map Repositories list on Map Index EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP

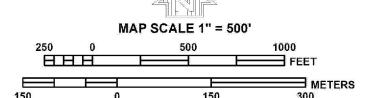
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PANEL 0286G

FIRM FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 286 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT) CONTAINS

MONUMENT, TOWN OF

Notice: This map was reissued on 05/15/2020 to make a correction. This version

replaces any previous versions. See the

Notice-to-User Letter that accompanied

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> MAP REVISED **DECEMBER 7, 2018**

Federal Emergency Management Agency

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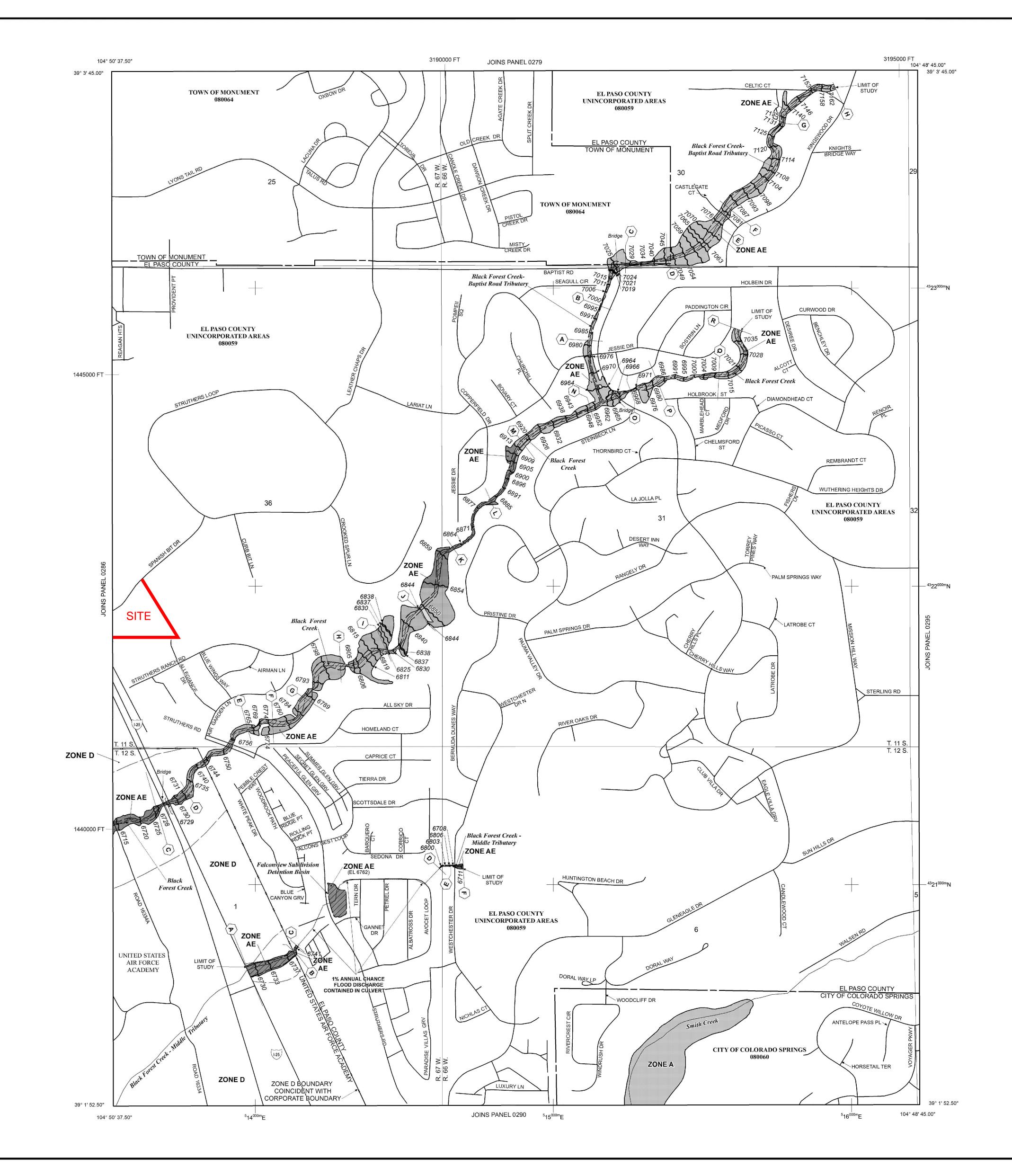
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Bench mark (see explanation in Notes to Users section of this FIRM panel)

system, central zone (FIPSZONE 0502),

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PANEL 0287G

FIRM FLOOD INSURANCE RATE MAP **EL PASO COUNTY,**

MONUMENT, TOWN OF

PANEL 287 OF 1300

COLORADO

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

AND INCORPORATED AREAS

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MAP REVISED **DECEMBER 7, 2018**

Federal Emergency Management Agency

HYDROLOGIC / STORMWATER QUALITY CALCULATIONS



For Colorado Springs and much of the Fountain Creek watershed, the 1-hour depths are fairly uniform and are summarized in Table 6-2. Depending on the location of the project, rainfall depths may be calculated using the described method and the NOAA Atlas maps shown in Figures 6-6 through 6-17.

Return	1-Hour	6-Hour	24-Hour
Period	Depth	Depth	Depth
2	1.19	1.70	2.10
5	1.50	2.10	2.70
10	1.75	2.40	3.20
25	2.00	2.90	3.60
50	2.25	3.20	4.20
100	2.52	3.50	4.60

Table 6-2. Rainfall Depths for Colorado Springs

Where Z = 6.840 ft/100

These depths can be applied to the design storms or converted to intensities (inches/hour) for the Rational Method as described below. However, as the basin area increases, it is unlikely that the reported point rainfalls will occur uniformly over the entire basin. To account for this characteristic of rain storms an adjustment factor, the Depth Area Reduction Factor (DARF) is applied. This adjustment to rainfall depth and its effect on design storms is also described below. The UDFCD UD-Rain spreadsheet, available on UDFCD's website, also provides tools to calculate point rainfall depths and Intensity-Duration-Frequency curves² and should produce similar depth calculation results.

2.2 Design Storms

Design storms are used as input into rainfall/runoff models and provide a representation of the typical temporal distribution of rainfall events when the creation or routing of runoff hydrographs is required. It has long been observed that rainstorms in the Front Range of Colorado tend to occur as either short-duration, high-intensity, localized, convective thunderstorms (cloud bursts) or longer-duration, lower-intensity, broader, frontal (general) storms. The significance of these two types of events is primarily determined by the size of the drainage basin being studied. Thunderstorms can create high rates of runoff within a relatively small area, quickly, but their influence may not be significant very far downstream. Frontal storms may not create high rates of runoff within smaller drainage basins due to their lower intensity, but tend to produce larger flood flows that can be hazardous over a broader area and extend further downstream.

■ Thunderstorms: Based on the extensive evaluation of rain storms completed in the Carlton study (Carlton 2011), it was determined that typical thunderstorms have a duration of about 2 hours. The study evaluated over 300,000 storm cells using gage-adjusted NEXRAD data, collected over a 14-year period (1994 to 2008). Storms lasting longer than 3 hours were rarely found. Therefore, the results of the Carlton study have been used to define the shorter duration design storms.

To determine the temporal distribution of thunderstorms, 22 gage-adjusted NEXRAD storm cells were studied in detail. Through a process described in a technical memorandum prepared by the City of Colorado Springs (City of Colorado Springs 2012), the results of this analysis were interpreted and normalized to the 1-hour rainfall depth to create the distribution shown in Table 6-3 with a 5 minute time interval for drainage basins up to 1 square mile in size. This distribution represents the rainfall

Table 6-6. Runoff Coefficients for Rational Method

(Source: UDFCD 2001)

Land Use or Surface	Percent	Runoff Coefficients													
Characteristics	Impervious	2-у	ear	5-y	ear	10-1	/ear	25-	25-year 50-year		25-year 50-γear		100-γear		
		HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D		
Business													1100 000		
Commercial Areas	95	0.79	0.80	0.81	0.82	0.83	0.84	0.85	0.87	0.87	0.88	0.88	0.89		
Neighborhood Areas	70	0.45	0.49	0.49	0.53	0.53	0.57	0.58	0.62	0.60	0.65	0.62	0.68		
Residential				_											
1/8 Acre or less	65	0.41	0.45	0.45	0.49	0.49	0.54	0.54	0.59	0.57	0.62	0.59	0.65		
1/4 Acre	40	0.23	0.28	0.30	0.35 0.30 0.28 0.26	0.36 0.32 0.30 0.27	0.42 0.38 0.36 0.34	0.42	0.50	0.46	0.54	0.50	0.58		
1/3 Acre	30	0.18	0.22	0.25				0.39 0.37 0.35	D.47	0.43	0.52	0.47	0.57		
1/2 Acre	25	0.15	0.20	0.22					0:46	0.41	0.51	0.46	0.56 0.55		
1 Acre	20	0.12	0.17	0.20					0.44	0.40	0.50	0.44			
Industrial	 				_							-			
Light Areas	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74		
Heavy Areas	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83		
Parks and Cemeteries	7	0.05	0.09	0.12	0.19	0.20	0.29	0.30	0.40	0.34	0.46	0.39	0.52		
Playgrounds	13	0.07	0.13	0.16	0.23	0.24	0.31	0.32	0.42	0.37	D.48	0.41	0.54		
Railroad Yard Areas	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58		
Undeveloped Areas				-	_										
Historic Flow Analysis Greenbelts, Agriculture	2	0.03	0.05	0.09	0.16	0.17	0.26	0.26	0.38	0.31	0.45	0.36	0.51		
Pasture/Meadow	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50		
Forest	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50		
Exposed Rock	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96		
Offsite Flow Analysis (when	i						0.52	0.5+	0.57	0.55	0.55	0.50	0.50		
landuse is undefined)	45	0.26	0.31	0.32	0.37	0.38	0.44	0.44	0.51	0.48	0.55	0.51	0.59		
	<u> </u>														
Streets	ļi		_								'`]				
Paved	100	0.89	0.89	0.90	D.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96		
Gravel	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74		
Drive and Walks	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96		
Roofs	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83		
Lawns	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50		

3.2 Time of Concentration

One of the basic assumptions underlying the Rational Method is that runoff is a function of the average rainfall rate during the time required for water to flow from the hydraulically most remote part of the drainage area under consideration to the design point. However, in practice, the time of concentration can be an empirical value that results in reasonable and acceptable peak flow calculations.

For urban areas, the time of concentration (t_c) consists of an initial time or overland flow time (t_i) plus the travel time (t_i) in the storm sewer, paved gutter, roadside drainage ditch, or drainage channel. For non-urban areas, the time of concentration consists of an overland flow time (t_i) plus the time of travel in a concentrated form, such as a swale or drainageway. The travel portion (t_i) of the time of concentration can be estimated from the hydraulic properties of the storm sewer, gutter, swale, ditch, or drainageway. Initial time, on the other hand, will vary with surface slope, depression storage, surface cover, antecedent rainfall, and infiltration capacity of the soil, as well as distance of surface flow. The time of concentration is represented by Equation 6-7 for both urban and non-urban areas.

Table 6-10. NRCS Curve Numbers for Frontal Storms & Thunderstorms for Developed Conditions (ARCII)

		Hydrologic	.	Pre-Development CN					
Fully Developed Urban Areas (vegetation established) ¹	Treatment	Condition	% I	HSG A	HSG B	HSG C	HSG D		
Open space (lawns, parks, golf courses, cemeteries, etc.):									
Poor condition (grass cover < 50%)				68	79	86	89		
Fair condition (grass cover 50% to 75%)				49	69	79	84		
Good condition (grass cover > 75%)				39	61	74	80		
Impervious areas:									
Paved parking lots, roofs, driveways, etc. (excluding right-of-way				98	98	98	98		
Streets and roads:									
Paved; curbs and storm sewers (excluding right-of-way)				98	98	98	98		
Paved; open ditches (Including right-of-way)				83	89	92	93		
Gravel (including right-of-way)				76	85	89	91		
Dirt (including right-of-way)				72	82	87	89		
Western desert urban areas:									
Natural desert landscaping (pervious areas only)				63	77	85	88		
Artificial desert landscaping (impervious weed barrier, desert				96	96	96	96		
shrub with 1- to 2-inch sand or gravel mulch and basin borders)							30		
Urban districts:									
Commercial and business			85	89	92	94	95		
Industrial			72	81	88	91	93		
Residential districts by average lot size:									
1/8 acre or less (town houses)			65	77	85	90	92		
1/4 acre			38	61	75	83	87		
1/3 acre			30	57	72	81	86		
1/2 acre			25	54	70	80	85		
1 acre			20	51	68	79	84		
2 acres			12	46	65	77	82		
Developing Urban Areas ¹	Treatment ²	Hydrologic	% I	HSG A	HSG B	HSG C	HSG D		
Developing Orban Areas	rreatment	Condition ³	76.1	1130 X	1139 0	1130 C	139		
Newly graded areas (pervious areas only, no vegetation)				77	. 86	91	94		
Cultivated Agricultural Lands ¹	Treatment	Hydrologic Condition	% I	HSG A	HSG B	HSG C	HSG D		
	Bare soil			77	86	91	94		
Fallow	Crop residue	Poor		76	85	90	93		
	cover (CR)	Good		74	83	88	90		
	Straight row	Poor		72	81	88	91		
	(SR)	Good		67	78	85	89		
	SR+CR	Poor		71	80	87	90		
	JA T CA	Good		64	75	82	85		
	Contoured (C)	Poor		70	79	84	88		
Row crops	Contoured (C)	Good		65	75	82	86		
Now Clops	C+CR	Poor		69	78	83	87		
	CTCK	Good		64	74	81	85		
·	Contoured &	Poor		6 6	74	80	82		
	terraced (C&T)	Good		62	71	78	81		
	C&T+CR	Poor		6 5	73	79	81		
	CALITOR	Good		61	70	77	80		
	SR	Poor		65	76	84	88		
	JK	Good		63	75	83	87		
	SR + CR	Poor		64	75	83	86		
	J.C.F.CIN	Good		60	72	80	84		
	С	Poor		63	74	82	85		
Small grain		Good		61	73	81	84		
Action Brain.	C + CR Poor	Poor		62	73	81	84		
	CTCKPOOI	Good		60	72	80	83		
		Poor		61	72	79	82		
	CS.T	, , ,							
	C&T	Good		59	70	78	81		
	C&T C&T+ CR			59 60	70 71	78 78	81 81		

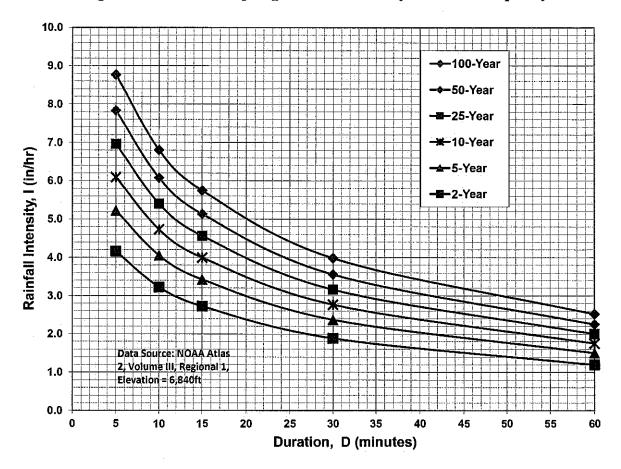


Figure 6-5. Colorado Springs Rainfall Intensity Duration Frequency

IDF Equations

 $I_{100} = -2.52 \ln(D) + 12.735$

 $I_{50} = -2.25 \ln(D) + 11.375$

 $I_{25} = -2.00 \ln(D) + 10.111$

 $I_{10} = -1.75 \ln(D) + 8.847$

 $I_5 = -1.50 \ln(D) + 7.583$

 $I_2 = -1.19 ln(D) + 6.035$

Note: Values calculated by equations may not precisely duplicate values read from figure.
 JOB NAME:
 URBAN LANDING PRELIMINARY PLAN - PDR

 JOB NUMBER:
 1308,01

 DATE:
 04/23/24

 CALCULATED BY:
 MAW

BASIN RUNOFF COEFFICIENT SUMMARY

			C VALUE DCM TABLE 6-6						C VAI	LUE DCM TAB	LE 6-6			WEIGHTED "C" VALUE			WEIGHTED CA			WEIGHTED IMP.
BASIN	TOTAL AREA (AC)	LAND USE	PERCENT IMP.	AREA (AC)	C(2)	C(5)	C(100)	LAND USE	PERCENT IMP.	AREA (AC)	C(2)	C(5)	C(100)	C(2)	C(5)	C(100)	CA(2)	CA(5)	CA(100)	PERCENT
OS-1	12.80	RES. 5 AC,	7.0%	12.00	0.05	0.12	0.39	GRAVEL RD.	80.0%	0.80	0.57	0.59	0.70	0.08	0.15	0.41	1.06	1.91	5.24	11.6%
OS-2A	0.13	RES. 5 AC.	7.0%	0.13	0.05	0.12	0.39			0.00	0.02	0.08	0.35	0.05	0.12	0.39	0.01	0.02	0.05	7.0%
OS-2B	1.50	RES. 5 AC.	7.0%	1.50	0.05	0.12	0.39			0.00	0.02	0.08	0.35	0.05	0.12	0.39	0.08	0.18	0.59	7.0%
OS-3A	0.37	RES. 5 AC.	7.0%	0.37	0.05	0.12	0.39			0.00	0.02	0.08	0.35	0.05	0.12	0.39	0.02	0.04	0.14	7.0%
OS-3B	0.04	RES. 5 AC.	7.0%	0.04	0.05	0.12	0.39			0.00	0.02	0.08	0.35	0.05	0.12	0.39	0.00	0.00	0.02	7.0%
OS-4	2.10	UNDEV.	2.0%	1.68	0.03	0.09	0.36	PAVED RD.	100.0%	0.42	0.89	0.90	0.96	0.20	0.25	0.48	0.42	0.53	1.01	21.6%
	0.10	DE0 4/0.40		0.40	0.41	0.45	0.50				0.18	0.05	0.47	0.44	0.45	0.50	0.04	0.05	0.00	65.0%
B A	0.10 0.75	RES. 1/8 AC. RES. 1/8 AC.	65.0% 65.0%	0.10 0.45	0.41	0.45	0.59 0.59	PAVED RD.	100.0%	0.00	0.18	0.25	0.47	0.41	0.45 0.63	0.59 0.74	0.04	0.05	0.06 0.55	79.0%
C	0.75	RES. 1/8 AC.	65.0%	0.45	0.41	0.45	0.59	PAVED RD. PAVED RD.	100.0%	0.30	0.89	0.90	0.96	0.60	0.63	0.74	0.45	0.47	0.55	78.6%
	1.10	RES. 1/8 AC.	65.0%	0.11	0.41	0.45	0.59	PAVED RD. PAVED RD.	100.0%	0.07	0.89	0.90	0.96	0.50	0.63	0.73	0.11	0.11	0.13	71.4%
F	0.31	RES. 1/8 AC.	65.0%	0.90	0.41	0.45	0.59	PAVED RD.	100.0%	0.20	0.89	0.90	0.96	0.60	0.53	0.00	0.33	0.39	0.72	78.5%
F	0.60	RES. 1/8 AC.	65.0%	0.13	0.41	0.45	0.59	OPEN SPACE	7.0%	0.12	0.05	0.30	0.39	0.00	0.02	0.73	0.10	0.15	0.28	31.2%
G	0.58	RES. 1/8 AC.	65.0%	0.25	0.41	0.45	0.59	PAVED RD.	100.0%	0.23	0.89	0.90	0.96	0.60	0.63	0.74	0.35	0.36	0.43	78.9%
Н Н	1.60	RES. 1/8 AC.	65.0%	1.35	0.41	0.45	0.59	PAVED RD.	100.0%	0.25	0.89	0.90	0.96	0.49	0.52	0.65	0.78	0.83	1.04	70.5%
	1.30	RES. 1/8 AC.	65.0%	1.05	0.41	0.45	0.59	PAVED RD.	100.0%	0.25	0.89	0.90	0.96	0.50	0.54	0.66	0.65	0.70	0.86	71.7%
 J	1.00	RES. 1/8 AC.	65.0%	0.35	0.41	0.45	0.59	OPEN SPACE	7.0%	0.65	0.05	0.12	0.39	0.18	0.24	0.46	0.18	0.24	0.46	27.3%
K	0.20	RES. 1/8 AC.	65.0%	0.10	0.41	0.45	0.59	PAVED RD.	100.0%	0.10	0.89	0.90	0.96	0.65	0.68	0.78	0.13	0.14	0.16	82.5%
L	0.16	OPEN SPACE	13.0%	0.16	0.07	0.16	0.41			0.00	0.89	0.90	0.96	0.07	0.16	0.41	0.01	0.03	0.07	13.0%

TOTAL AREA
TRIBUTARY TO
POND 1 22.36 30.6%

Job nai	ME:	URBAN L	ANDING P.	RELIM	INARY	PLAN -	PDR											
JOB NU	JOB NUMBER: 1308.01							_					Table 6	-7. Con	veyance	Coeffi	cient, C	v
DATE:		04/23/24						_					Type	of I on	d Surfac			Cv
CALC'D	BY:	MAW			Plea	ase se	e map).				Heav	v meadov		u Suriac	e		2.5
Retur		T				basins						-	e/field		$t_c = \frac{1}{18}$			5
Perio 2	d Depth	+			rura	I resid	ential	basins	3.			Ripra	p (not bu	ried)*	$t_c = \frac{18}{18}$	- + 10		6.5
5	1.50	Overlan	d length	for $_{i}$	Per	DCM,	overla	and flo	W	0.5		Short	pasture a	and lawn	5			7
10	1.75	∮ urban a	rea cann	ot/be	for non-urban lar				$\frac{1}{2}$ uses $C_{\nu}S_{\nu}$ Tc=L/V	Nearl	Nearly bare ground					10		
25	2.00	dreater	than 100	ft.	can	be 30	0 ft. m	ax.				Grass	ed water	way				15
50	2.25	Please													w paved			20
100	2.52	+	1									For bu	ried riprap,	select C _v	value based	i on type o	f vegetativ	e cover.
100	2.32	1				BAS	IN RU	NOFF	SUMI	MARY								
		WEIGHTEI	,		OVEF	RLAND		STRE	ET / CH	ANNEL	FLOW	Tc	IN	NTENSIT	Υ	ТОТ	AL FLO	ows
BASIN	CA(2)	CA(5)	CA(100)	C(5)	Length (ft)	Height (ft)	Tc (min)	Length (ft)	Slope (%)	Velocity (fps)	Tc (min)	TOTAL (min)	l(2) (in/hr)	l(5) (in/hr)	I(100) (in/hr)	Q(2) (cfs)	Q(5) (cfs)	Q(100) (cfs)
OS-1	1.06	1.91	5.24	0.15	300	9	20.7	530	2.5%	1.1	8.0	28.7	2.04	2.55	4.28	2	5	22
OS-2A	0.01	0.02	0.05	0.08	100	3	12.8					12.8	3.00	3.76	6.31	0.02	0.06	0.32
1																		

18.4

7.5

21.2

9.1

14.0

5.0

13.0

5.0

12.2

12.2

12.1

13.1

2.7

0.9

8.0

1.2

2.2

2.0

2.8

2.1

3.2

3.5

2.57

3.64

2.40

3.41

2.90

4.12

2.98

4.12

3.06

3.06

3.07

2.97

3.21

4.56

3.00

4.28

3.63

5.17

3.74

5.17

3.83

3.83

3.84

3.73

5.39

7.66

5.04

7.18

6.09

8.68

6.27

8.68

6.43

6.43

6.45

6.25

0.0

0.01

1.0

0.1

1.3

0.4

1.6

8.0

0.4

1.1

2.4

1.9

0.1

0.02

1.6

0.2

1.7

0.6

2.2

1.0

0.6

1.4

3.2

2.6

8.0

0.12

5.1

0.4

3.4

1.1

4.5

2.0

1.8

2.7

6.7

5.4

240

55

300

50

80

100

100

100

80

80

8

9

1.5

1.6

2

2

2

1.6

1.6

18.4

7.5

18.5

9.1

13.1

5.0

12.2

5.0

12.2

12.2

10.9

10.9

320

150

100

225

1.0%

2.0%

2.0%

2.5%

3.0%

0.12

0.12

0.25

0.08

0.08

0.25

0.25

0.25

0.25

0.25

OS-3A

OS-3B

OS-4

Α

В

С

D

Ε

G

Η

0.02

0.00

0.42

0.04

0.45

0.11

0.55

0.18

0.12

0.35

0.78

0.65

0.04

0.00

0.53

0.05

0.47

0.11

0.59

0.19

0.15

0.36

0.83

0.70

0.14

0.02

1.01

0.06

0.55

0.13

0.72

0.23

0.28

0.43

1.04

0.86

JOB NAME:	URBAN LANDING PRELIMINARY PLAN - PDR
JOB NUMBER:	1308.01
DATE:	04/23/24
CALC'D BY:	MAW

5.	
Return	1-Hour
Period	Depth
2	1.19
5	1.50
10	1.75
25	2.00
50	2.25
100	2.52

+	$0.395(1.1-C_5)\sqrt{L}$	$V = C_v S_w^{0.5}$
ι_i	C 0.33	· · · · · · · · · · · · · · · · · · ·

Table 6-7.	Conveyance	Coefficient, C,
------------	------------	-----------------

Type of Land Surface	Cv
Heavy meadow	2.5
Tillage/field L	5
Riprap (not buried)* $I_c = \frac{180}{180}$	6.5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

*For buried riprap, select C_v value based on type of vegetative cover.

BASIN RUNOFF SUMMARY

Tc=L/V

		WEIGHTED)		OVER	LAND		STRE	ET / CH	IANNEL	FLOW	Tc	IN	ITENSIT	Υ	TOT	AL FLO	ows
BASIN	CA(2)	CA(5)	CA(100)	C(5)	Length (ft)	Height (ft)	Tc (min)	Length (ft)	Slope (%)	Velocity (fps)	Tc (min)	TOTAL (min)	l(2) (in/hr)	l(5) (in/hr)	l(100) (in/hr)	Q(2) (cfs)	Q(5) (cfs)	Q(100) (cfs)
J	0.18	0.24	0.46	0.25	100	2	12.2	420	2.0%	2.1	3.3	15.5	2.77	3.47	5.83	0.5	0.8	2.7
К	0.13	0.14	0.16	0.25	30	0.6	6.7	85	1.5%	2.4	0.6	7.3	3.68	4.61	7.74	0.5	0.6	1.2
L	0.01	0.03	0.07	0.25	80	3.2	8.7					8.7	3.46	4.34	7.29	0.0	0.1	0.5

JOB NAME: URBAN LANDING PRELIMINARY PLAN - PDR

JOB NUMBER: 1308.01
DATE: 05/01/24

CALCULATED BY: MAW

*ALL STORM SEWER TO BE PRIVATE UNLESS OTHERWISE NOTED

SURFACE ROUTING SUMMARY

					Inten	sity	Fle	ow	
Design Point(s)	Contributing Basins / Design Point	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	I(5)	I(100)	Q(5)	Q(100)	Facility/ Inlet Size*
1	OS-1, A	1.96	5.30	28.7	2.55	4.28	5	23	PROP. 30" RCP
2	OS-2A, B	0.49	0.60	19.4	3.13	5.26	1.5	3.2	5' TYPE R SUMP INLET
3	С	0.11	0.13	5.0	5.17	8.68	0.6	1.1	5' TYPE R SUMP INLET
4	OS-2B, D	0.77	1.31	19.8	3.10	5.21	2.4	6.8	5' TYPE R SUMP INLET
5	Е	0.19	0.23	5.0	5.17	8.68	1.0	2.0	5' TYPE R SUMP INLET
6	F	0.15	0.28	12.2	3.83	6.43	0.6	1.8	AREA DRAIN
7	G, H	1.20	1.46	12.4	3.81	6.39	4.6	9.4	10' TYPE R AT- GRADE INLET
8	OS-3A, I	0.74	1.00	20.6	3.05	5.11	2.3	5.1	5' TYPE R SUMP INLET
9	TOTAL INFLOW TO POND 1 (INCL. BASINS OS-3B, J)	5.70	10.51	30.0	2.48	4.17	14	44	POND 1

Please include hydrologic calculations for the existing condition.

Now included Pre-development calculations in report.

Note that MHFD has a new workbook for designing EDBs that replaces this UD-BMP workbook. See the SCM workbook on their website.

	Thank you.	ign Procedure Form:	Extended Detention Basin (EDB)
	At this point we will	UD-BMP	(Version 3.07, March 2018) Sheet 1 of 3
Designer: Company:	continue to use this		
Date:	valid spreadsheet for		
Project: Location:	forebay sizing.	N - PDR	
Location.	Torebay Sizing.		
1. Basin Sto	orage Volume		
A) Effecti	ve Imperviousness of Tributary Area, I _a		I _a = 30.6 %
B) Tributa	ary Area's Imperviousness Ratio (i = I _a / 100)		i = 0.306
C) Contr	ibuting Watershed Area		Area = 22.360 ac
D) For W	/atersheds Outside of the Denver Region, Depth	of Average	$d_6 = $
Runo	ff Producing Storm		[Choose One
	n Concept ct EURV when also designing for flood control)		○ Water Quality Capture Volume (WQCV)
	,		Excess Urban Runoff Volume (EURV)
F) Desig	n Volume (WQCV) Based on 40-hour Drain Time		V _{DESION} = ac-ft
	$_{\text{IGN}} = (1.0 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12 * Ar$		
	Vatersheds Outside of the Denver Region, r Quality Capture Volume (WQCV) Design Volun	e	V _{DESIGN OTHER} = 0.279 ac-ft
	CV OTHER = $(d_6*(V_{DESIGN}/0.43))$		
	Input of Water Quality Capture Volume (WQCV) if a different WQCV Design Volume is desired)	Design Volume	V _{DESIGN USER} = ac-ft
` '			
i) Pe	Hydrologic Soil Groups of Tributary Watershed ercentage of Watershed consisting of Type A Soil		HSG _A = 0 %
	ercentage of Watershed consisting of Type B So Percentage of Watershed consisting of Type C/D		$\begin{array}{c} \text{HSG }_{\text{B}} = & 100 & \% \\ \text{HSG }_{\text{CID}} = & 0 & \% \end{array}$
	ss Urban Runoff Volume (EURV) Design Volume		
For H	HSG A: EURV _A = 1.68 * i ^{1.28} HSG B: EURV _B = 1.36 * i ^{1.08}		EURV _{DESIGN} = 0.705 ac-f t
For h	HSG C/D: EURV _{C/D} = 1.20 * i ^{1.08}		
	Input of Excess Urban Runoff Volume (EURV) Do if a different EURV Design Volume is desired)	esign Volume	EURV _{DESIGN USER} = ac-f t
	ape: Length to Width Ratio length to width ratio of at least 2:1 will improve TS	S reduction.)	L:W= 2.0 : 1
3. Basin Sid	le Slopes		
	Maximum Side Slopes zontal distance per unit vertical, 4:1 or flatter pref	erred)	Z = 4.00 ft / ft
<u> </u>	· · · · · · · · · · · · · · · · · · ·		
4. Inlet			
	ribe means of providing energy dissipation at con locations:	centrated	
5. Forebay			
	num Forebay Volume (V _{FMIN} = 3% of the WQCV)		V _{FMIN} = 0.008 ac-ft
	I Forebay Volume		V _F = 0.008 ac-ft
C) Foreb	•		30.0
3, 5105	(D _F = 18 inch maximum)		D _F = 18.0 in
D) Foreb	ay Discharge		
i) Un	detained 100-year Peak Discharge		Q ₁₀₀ = 44.00 cfs
	orebay Discharge Design Flow F = 0.02 * Q ₁₀₀)		Q _F = 0.88 cfs
E) Foreba	ay Discharge Design		Choose One Berm With Pipe Flow too small for berm w/ pipe
			Wall with Rect. Notch Wall with V-Notch Weir
	arge Pipe Size (minimum 8-inches)		Calculated D _P =in
G) Recta	ngular Notch Width		Calculated W _N = 5.3 in

130801 UD-BMP_v3.07, EDB 4/24/2024, 3:38 PM

	Design Procedure Form: I	Extended Detention Basin (EDB)
Designer: Company: Date: Project: Location:	MARC A. WHORTON, P.E. CLASSIC CONSULTING April 24, 2024 URBAN LANDING PRELIMINNARY PLAN - PDR POND 1	Sheet 2 of 3
Trickle Channel A) Type of Trick F) Slope of Trick		Choose One
B) Surface Area C) Outlet Type	ropool (2.5-feet minimum) a of Micropool (10 ft ² minimum) nension of Orifice Opening Based on Hydrograph Routing	$D_{M} = 2.5$ $A_{M} = 107$ $sq ft$ $Choose One$ $Orifice Plate$ $Other (Describe):$ $D_{orifice} = 1.38$ inches
E) Total Outlet A		A _{ct} = 4.80 square inches
A) Depth of Initi (Minimum rec B) Minimum Initia (Minimum volu	al Surcharge Volume commended depth is 4 inches) al Surcharge Volume ume of 0.3% of the WQCV) rge Provided Above Micropool	$D_{IS} = 6$ in $V_{IS} = 36$ cu ft $V_{s} = 53.5$ cu ft
B) Type of Screen in the USDCM, i	by Screen Open Area: $A_t = A_{ct} * 38.5^{\circ}(e^{-0.0950})$ en (If specifying an alternative to the materials recommended indicate "other" and enter the ratio of the total open are to the for the material specified.) Other (Y/N): N	A _t = 162 square inches Aluminum Amico-Klemp SR Series with Cross Rods 2" O.C.
D) Total Water C E) Depth of Des (Based on d F) Height of Wat	Open Area to Total Area (only for type 'Other') Quality Screen Area (based on screen type) ign Volume (EURV or WQCV) design concept chosen under 1E) ter Quality Screen (H _{TR}) ter Quality Screen Opening (W _{opening}) inches is recommended)	User Ratio =

130801 UD-BMP_v3.07, EDB 4/24/2024, 3:38 PM

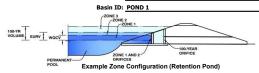
	Design Procedure Form:	Extended Detention Basin (EDB)	
Designer: Company: Date: Project: Location:	MARC A. WHORTON, P.E. CLASSIC CONSULTING April 24, 2024 URBAN LANDING PRELIMINNARY PLAN - PDR POND 1		Sheet 3 of 3
B) Slope of C	bankment embankment protection for 100-year and greater overtopping: Dverflow Embankment al distance per unit vertical, 4:1 or flatter preferred)	Ze = 4.00 ft / ft Choose One Irrigated Not Irrigated	
12. Access A) Describe s	Sediment Removal Procedures		

130801 UD-BMP_v3.07, EDB 4/24/2024, 3:38 PM

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: URBAN LANDING PRELIMINARY PLAN - PDR



Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	22.36	acres
Watershed Length =	1,800	ft
Watershed Length to Centroid =	900	ft
Watershed Slope =	0.035	ft/ft
Watershed Imperviousness =	30.60%	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 =	User Input	

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

trie embedded Colorado Orban Hydro	grapii Procedu	re.
Water Quality Capture Volume (WQCV) =	0.286	acre-feet
Excess Urban Runoff Volume (EURV) =	0.703	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.709	acre-feet
5-yr Runoff Volume (P1 = 1.5 in.) =	1.145	acre-feet
10-yr Runoff Volume (P1 = 1.75 in.) =	1.546	acre-feet
25-yr Runoff Volume (P1 = 2 in.) =	2.148	acre-feet
50-yr Runoff Volume (P1 = 2.25 in.) =	2.604	acre-feet
100-yr Runoff Volume (P1 = 2.52 in.) =	3.212	acre-feet
500-yr Runoff Volume (P1 = 3.1 in.) =	4.312	acre-feet
Approximate 2-yr Detention Volume =	0.504	acre-feet
Approximate 5-yr Detention Volume =	0.720	acre-feet
Approximate 10-yr Detention Volume =	1.046	acre-feet
Approximate 25-yr Detention Volume =	1.210	acre-feet
Approximate 50-yr Detention Volume =	1.274	acre-feet
Approximate 100-yr Detention Volume =	1.504	acre-feet

otional User Overrides

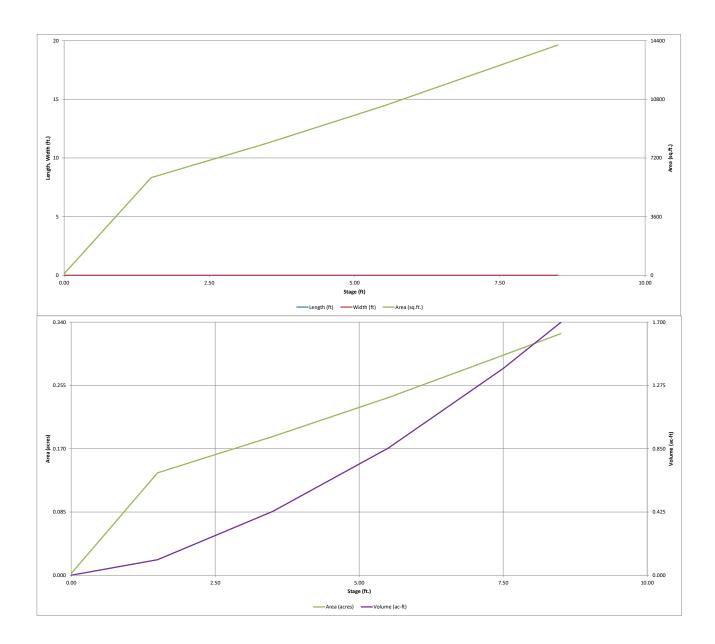
Optional User	Overnues
	acre-feet
	acre-feet
1.19	inches
1.50	inches
1.75	inches
2.00	inches
2.25	inches
2.52	inches
3.10	inches

Define Zones and Basin Geometry

0.286	acre-feet
0.418	acre-feet
0.800	acre-feet
1.504	acre-feet
user	ft ³
user	ft
user	ft
user	ft
user	ft/ft
user	H:V
user	
	0.418 0.800 1.504 user user user user user user

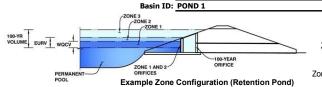
user	ft ²
user	ft
user	ft ²
user	ft ³
user	ft
user	ft
user	ft
user	ft²
user	ft ³
user	acre-f
	user user user user user user user user

Double Townson	0.50].							
Depth Increment =	0.50	ft Optional				Optional			
Stage - Storage	Stage	Override	Length	Width	Area	Override	Area	Volume	Volume
Description	(ft)	Stage (ft)	(ft)	(ft)	(ft 2)	Area (ft 2)	(acre)	(ft 3)	(ac-ft)
Top of Micropool		0.00				100	0.002	4 505	0.405
68		1.50				6,000	0.138	4,575	0.105
70		3.50				8,121	0.186	18,696	0.429
72		5.50				10,393	0.239	37,210	0.854
74		7.50				12,882	0.296	60,485	1.389
75		8.50				14,138	0.325	73,995	1.699
	-								
	-								
				-					
				-					
	-								
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								_	
								-	



DETENTION BASIN OUTLET STRUCTURE DESIGN

Project: URBAN LANDING PRELIMINARY PLAN - PDR



	Estimated	Estimated	
_	Stage (ft)	Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.69	0.286	Orifice Plate
Zone 2 (EURV)	4.85	0.418	Orifice Plate
ne 3 (100-year)	7.89	0.800	Weir&Pipe (Restrict)
_	Total (all zones)	1.504	

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

ft (distance below the filtration media surface) Underdrain Orifice Invert Depth = N/A Underdrain Orifice Diameter = N/A inches

Calculated Parameters for Underdrain Underdrain Orifice Area N/A ft2 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) Centroid of Lowest Orifice = ft (relative to basin bottom at Stage = 0 ft) 0.00 ft (relative to basin bottom at Stage = 0 ft)

Depth at top of Zone using Orifice Plate = 4.85 Orifice Plate: Orifice Vertical Spacing = 19.40 inches Orifice Plate: Orifice Area per Row = N/A sq. inches

Calculated Parameters for Plate WO Orifice Area per Row = N/A lft² Elliptical Half-Width = N/A feet Elliptical Slot Centroid = N/A feet Elliptical Slot Area = ft2 N/A

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 1.62 3.23 Orifice Area (sq. inches) 1.50 1.50 1.80

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)

Invert of Vertical Orifice = N/A N/A Depth at top of Zone using Vertical Orifice = N/A N/A Vertical Orifice Diameter = N/A N/A

Calculated Parameters for Vertical Orifice Not Selected Not Selected Not Selected Not Selected ft² ft (relative to basin bottom at Stage = 0 ft) Vertical Orifice Area N/A N/A ft (relative to basin bottom at Stage = 0 ft) Vertical Orifice Centroid = 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) Calculated Parameters for Overflow Weir Zone 3 Weir Not Selected Zone 3 Weir Not Selected Overflow Weir Front Edge Height, Ho = 4.85 ft (relative to basin bottom at Stage = 0 ft) Height of Grate Upper Edge, H_t = N/A 5.85 N/A feet Overflow Weir Slope Length = Overflow Weir Front Edge Length = 8.00 N/A feet 4.12 N/A feet Overflow Weir Grate Slope = 4.00 N/A H:V Grate Open Area / 100-yr Orifice Area = 8.31 N/A Horiz. Length of Weir Sides = Overflow Grate Open Area w/o Debris = ft² 4.00 N/A feet 26.09 N/A Close Mesh Grate Overflow Grate Open Area w/ Debris = Overflow Grate Type = N/A 13.05 N/A fť

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

50%

N/A

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate Zone 3 Restrictor Not Selected

Zone 3 Restrictor Not Selected Depth to Invert of Outlet Pipe = 0.50 Outlet Orifice Area = N/A ft (distance below basin bottom at Stage = 0 ft) 3.14 N/A Outlet Pipe Diameter = 24.00 N/A inches Outlet Orifice Centroid : 1.00 N/A feet Restrictor Plate Height Above Pipe Invert = 24.00 inches Half-Central Angle of Restrictor Plate on Pipe = 3.14 N/A radians

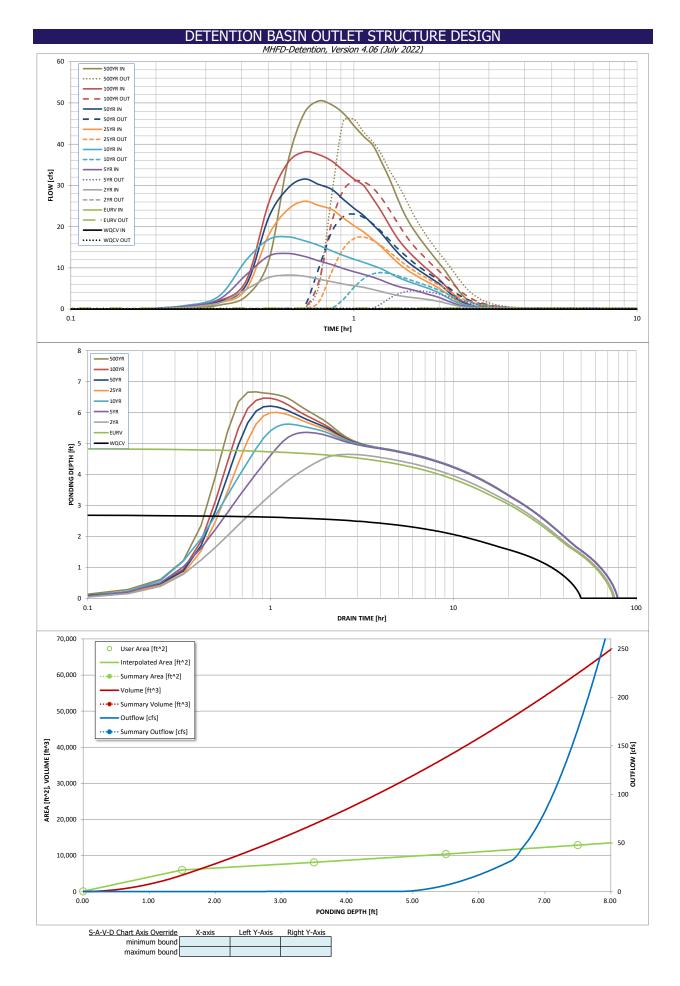
User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage= 6.50 ft (relative to basin bottom at Stage = 0 ft) Spillway Crest Length = 40.00 feet Spillway End Slopes = 3.00 H:V Freeboard above Max Water Surface = 1.00 feet

Debris Clogging % =

Calculated Parameters for Spillway feet Spillway Design Flow Depth= 0.45 Stage at Top of Freeboard = 7.95 feet Basin Area at Top of Freeboard 0.31 acres Basin Volume at Top of Freeboard = 1.52 acre-ft

Routed Hydrograph Results **EURV** Design Storm Return Period = WQCV 2 Year 5 Year 10 Year 25 Year 50 Year 100 Year 500 Year One-Hour Rainfall Depth (in) = 1.50 3.10 4.312 N/A N/A 1.19 1.75 2.00 0.709 CUHP Runoff Volume (acre-ft) 0.286 0.703 1.145 1.546 2.148 2.604 3.212 Inflow Hydrograph Volume (acre-ft) : 3.212 N/A N/A 0.709 1.145 2.148 2.604 4.312 CUHP Predevelopment Peak O (cfs) : N/A N/A 9.3 21.0 36.8 2.2 6.1 16.8 OPTIONAL Override Predevelopment Peak Q (cfs) = N/A N/A 31.0 Predevelopment Unit Peak Flow, g (cfs/acre) : N/A N/A 0.10 0.31 0.42 0.75 0.94 1.39 1.65 Peak Inflow Q (cfs) 17.5 38.1 50.5 26.2 31.5 N/A N/A 8.3 13.5 Peak Outflow Q (cfs) : 0.1 0.3 8.9 31.0 46.0 23.1 Ratio Peak Outflow to Predevelopment Q = N/A N/A N/A 0.6 1.0 1.0 1.1 1.0 Structure Controlling Flow : Plate Overflow Weir 1 Plate Overflow Weir 1 Overflow Weir 1 Overflow Weir 1 Overflow Weir 1 Overflow Weir Spillway 1.4 Max Velocity through Grate 1 (fps) = N/A N/A N/A 0.2 0.3 0.7 0.9 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) = Time to Drain 99% of Inflow Volume (hours) 48 74 65 71 72 72 71 69 68 Maximum Ponding Depth (ft) = 2.69 4.85 4.65 5.36 5.63 6.01 6.21 6.47 6.67 Area at Maximum Ponding Depth (acres) 0.22 0.23 0.25 0.24 0.26 0.27 0.286 Maximum Volume Stored (acre-ft) = 0.66 0.883 1.03 1 096 1 150



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.

1	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Taken al										
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]		25 Year [cfs]	50 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	0.05	0.00	0.14
	0:15:00	0.00	0.00	0.40	0.66	0.83	0.56	0.71	0.69	1.00
	0:20:00 0:25:00	0.00	0.00	1.48	2.37	3.14	1.50	1.77	2.01	3.16
	0:30:00	0.00	0.00	4.83 7.67	8.35 12.87	11.92 16.92	4.85 18.02	5.90 22.25	6.90 25.79	11.74 35.51
	0:35:00	0.00	0.00	8.25	13.51	17.54	24.07	29.24	35.43	47.42
	0:40:00	0.00	0.00	8.00	12.82	16.60	26.16	31.54	38.09	50.46
	0:45:00	0.00	0.00	7.30	11.74	15.47	25.14	30.25	37.48	49.57
	0:50:00	0.00	0.00	6.68	10.84	14.18	24.20	29.09	35.95	47.51
	0:55:00	0.00	0.00	6.10	9.87	13.02	22.13	26.66	33.63	44.49
	1:00:00	0.00	0.00	5.66	9.09	12.12	20.25	24.47	31.55	41.85
	1:05:00	0.00	0.00	5.28	8.42	11.34	18.70	22.67	29.92	39.73
	1:10:00	0.00	0.00	4.78	7.77	10.57	16.87	20.50	26.81	35.74
	1:15:00	0.00	0.00	4.28	7.03	9.80	15.09	18.38	23.68	31.73
	1:20:00	0.00	0.00	3.80	6.25	8.79	13.22	16.07	20.40	27.33
	1:25:00	0.00	0.00	3.39	5.61	7.86	11.49	13.96	17.45	23.43
}	1:30:00 1:35:00	0.00	0.00	3.09	5.17 4.83	7.14	10.08	12.28	15.23	20.52
ŀ	1:40:00	0.00	0.00	2.88 2.69	4.83	6.54 6.00	8.98 8.06	10.95 9.83	13.50 12.02	18.21 16.20
ŀ	1:45:00	0.00	0.00	2.51	3.98	5.50	7.24	8.82	10.69	14.39
	1:50:00	0.00	0.00	2.34	3.59	5.03	6.48	7.90	9.47	12.73
	1:55:00	0.00	0.00	2.10	3.22	4.52	5.77	7.02	8.31	11.15
ļ	2:00:00	0.00	0.00	1.86	2.84	3.96	5.08	6.17	7.22	9.67
	2:05:00	0.00	0.00	1.57	2.36	3.27	4.24	5.13	5.99	7.97
	2:10:00	0.00	0.00	1.28	1.89	2.61	3.40	4.11	4.78	6.31
	2:15:00	0.00	0.00	1.01	1.46	2.02	2.61	3.13	3.62	4.74
	2:20:00	0.00	0.00	0.77	1.09	1.56	1.89	2.26	2.57	3.40
	2:25:00	0.00	0.00	0.59	0.85	1.25	1.37	1.66	1.86	2.52
	2:30:00	0.00	0.00	0.47	0.69	1.02	1.03	1.26	1.39	1.90
	2:35:00 2:40:00	0.00	0.00	0.38	0.57	0.84	0.79	0.97	1.03	1.43
	2:45:00	0.00	0.00	0.32 0.26	0.46	0.68 0.55	0.61 0.47	0.75 0.58	0.76 0.56	1.06 0.78
	2:50:00	0.00	0.00	0.20	0.30	0.33	0.36	0.45	0.40	0.56
	2:55:00	0.00	0.00	0.17	0.24	0.35	0.28	0.34	0.29	0.41
	3:00:00	0.00	0.00	0.14	0.19	0.27	0.22	0.27	0.23	0.33
	3:05:00	0.00	0.00	0.11	0.15	0.21	0.17	0.21	0.19	0.26
	3:10:00	0.00	0.00	0.09	0.12	0.17	0.14	0.17	0.15	0.21
	3:15:00	0.00	0.00	0.07	0.09	0.13	0.11	0.13	0.12	0.16
	3:20:00	0.00	0.00	0.06	0.07	0.10	0.08	0.10	0.09	0.12
	3:25:00	0.00	0.00	0.04	0.05	0.07	0.06	0.07	0.06	0.09
	3:30:00	0.00	0.00	0.03	0.03	0.05	0.04	0.05	0.04	0.06
	3:35:00	0.00	0.00	0.02	0.02	0.03	0.03	0.03	0.03	0.03
	3:40:00 3:45:00	0.00	0.00	0.01	0.01	0.01	0.01	0.02	0.01	0.02
ŀ	3:50:00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.00	0.01
	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
ļ	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 4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ŀ	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ļ	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
ŀ	4:45:00 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
ļ	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00 5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ŀ	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 5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ŀ	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ļ	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 6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
l	0.00.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically. The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

Stage - Storage Description	Stage [ft]	Area [ft²]	Area [acres]	Volume [ft ³]	Volume [ac-ft]	Total Outflow [cfs]	
							For best results, include the
							stages of all grade slope
							changes (e.g. ISV and Floor) from the S-A-V table on
							Sheet 'Basin'.
							Also include the inverts of al
							outlets (e.g. vertical orifice,
							overflow grate, and spillway where applicable).
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DRAINAGE MAPS



