Matrix

City of Fountain
Engineering Department
116 South Main St.
Fountain, CO 80817

February 2022

RE: Corvallis MDDP

Dear Sir or Madam,

Please find enclosed the MDDP Amendment for the proposed Corvallis development. The purpose of this amendment is to address the addition of the 22-acre "Lacy Parcel" to the Corvallis development. This parcel will add 9.7 acres of Open Space, 9.9 acres of single-family, and 2.4 acres of roadways. The site indicated in the original ODP included 140.8 acres of single-family, 16.1 acres of multi-family, and 36 acres of commercial. 45.6 acres as park area or open space were also proposed, in addition to the open spaces associated with the gas easement running through the property. Additionally, 12 acres will be used for a school.

Drainage analysis for the project has been completed in accordance with the current City of Colorado Springs drainage criteria manual which the city of Fountain has adopted as its governing drainage criteria.

If there are any comments or questions regarding this submittal, please feel free to contact me by phone: 719-575-0100 or email: jesse.sullivan@matrixdesigngroup.com.

Thank you,

Jesse Sullivan, P.E.

Enclosures.

MASTER DEVELOPMENT DRAINAGE PLAN AMENDMENT

For

CORVALLIS

Prepared for:
City of Fountain
116 S. Main Street
Fountain, CO 80817

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

Prepared by:

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

February 2022

Project No. 20.1105.002

ENGINEER'S STATEMENT:

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

Signature: _____

Jesse Sullivan
Colorado Professional Engineer No. 55600

DEVELOPER'S STATEMENT:

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

Name of Developer: HPHR Properties, LLC

Authorized Signature: _____ ***Date:*** _____

Printed Name: Ed Houle

Title: Director of Land Acquisition and Development

Address: 14160 Gleneagle Drive
Colorado Springs, CO 80921

CITY OF FOUNTAIN STATEMENT:

Filed in accordance with the Code of the City of Fountain, 2009, as amended.

_____ _____

For the City Engineer Date

Conditions:

TABLE OF CONTENTS

I. Introduction

A. PURPOSE AND SCOPE OF STUDY

The purpose of this report is to amend the approved Master Development Drainage Plan (MDDP) to account for the inclusion of the previously excluded 22.072-acre Lacy Parcel to the development. This revision will be submitted to the City as an Overall Development Plan for the (ODP) for the parcel. This Master Development Drainage Plan Amendment (MDDPA) report provides a summary of the site drainage issues impacting the overall proposed Corvallis development, including identification and evaluation of the offsite and onsite drainage patterns associated with the project, analysis of upstream impacts from upstream drainage, and impacts to downstream facilities. This MDDPA has been prepared based on the guidelines and criteria presented in the City of Colorado Springs Drainage Criteria Manual (DCM).

B. AGENCY JURISDICTIONS

This project is located within the City of Fountain and is subject to the design criteria set forth in the ***City of Colorado Springs Drainage Criteria Manual, Volumes I and II, dated May 2014 (DCM).***

C. GENERAL PROJECT DESCRIPTION

Corvallis is a 297-acre (22 Acre "Lacy Parcel" & 275 Acre Original ODP) mixed-use parcel located at the southwest intersection of Marksheffel Road and Fontaine Boulevard. The Corvallis ODP amendment prepared by Matrix Design Group, Inc dated October 2021 includes single-family and multi-family residential units, commercial development, a school site, and dedicated open space. Figure 1 below displays in further detail the Land Use Summary:

Figure 1. Land Use Summary of proposed Corvallis site

Original ODP			
	Commercial (office/retail)	36.0	Acres
	Residential (single-family)	140.8	Acres
	Residential (multi-family)	16.1	Acres
	School Site	12	Acres
	Collector Roadways	25.4	Acres
	Open Space	45.6	Acres
Lacy Parcel			
	Open Space	10.3	Acres
	Residential (single-family)	9.9	Acres
	Collector Roadways	1.8	Acres

More specifically, the site is located as follows:

1. General Location: Part of the Northeast ¼ of Section 21, and the Northwest ¼ and a Portion of the Southwest ¼ of the Northeast ¼ of Section 22, all in Township 15 South, Range 65 West of the 6th P.M. in the City of Fountain, County of El Paso, State of Colorado.
2. Surrounding Streets: Fontaine Boulevard directly borders the parcel to the north, and a portion of the eastern boundary is bordered directly by Marksheffel Road. Powers Boulevard (State Highway 21) is located approximately ½ mile to the west.
3. Drainageway: The proposed site lies entirely within the West Fork Jimmy Camp Creek Drainage Basin and is currently undeveloped land, mostly covered by natural vegetation. The Fountain Mutual Irrigation Company (FMIC) irrigation ditch also enters and exits the site multiple times.
4. Surrounding Developments: The site is bound by vacant land to the north, the Peaceful Valley Estates development to the West, The Glen at Widefield Subdivisions to the south, and Lorson Ranch to the east.

   Refer to Appendix D for the Vicinity Map.

D. DATA SOURCES

Topographical information for the site was found using a combination of ***United States Geological Survey*** (USGS) mapping, GIS LIDAR, as well as field surveying. The ***Web Soil Survey,*** created by the ***Natural Resources Conservation Service,*** was utilized to investigate the existing general soil types within the site.

E. APPLICABLE CRITERIA AND STANDARDS

As required by the City of Fountain, Colorado, this report has been prepared in accordance to the criteria set forth in the ***City of Colorado Springs Drainage Criteria Manual Volume 1*** (Drainage Criteria Manual), dated May 2014, updated January 2021 and ***Volume 2 Stormwater Quality Policies, Procedures, and BMP's***, dated May 2014, updated December 2020.

In addition to the City Criteria Manual, the ***Urban Storm Drainage Criteria Manuals, Volumes 1-3*** (UDFCD), published by the Urban Drainage and Flood Control District, latest update, have been used to supplement the Drainage Criteria Manual for water quality capture volume (WQCV).

F. REFERENCED DRAINAGE REPORTS

West Fork Jimmy Camp Creek Drainage Basin Planning Study (WFJCC DBPS), by Kiowa Engineering Corp. October 2003.

Master Drainage Development Plan (MDDP) The Glen at Widefield, by Kiowa Engineering Corp. December 1999.

Master Drainage Development Plan Amendment (MDDPA) The Glen at Widefield, by Kiowa Engineering Corp. June 2007.

Final Drainage Report (FDR F9) The Glen at Widefield Filing No. 9, by Kiowa Engineering Corp. July 2018.

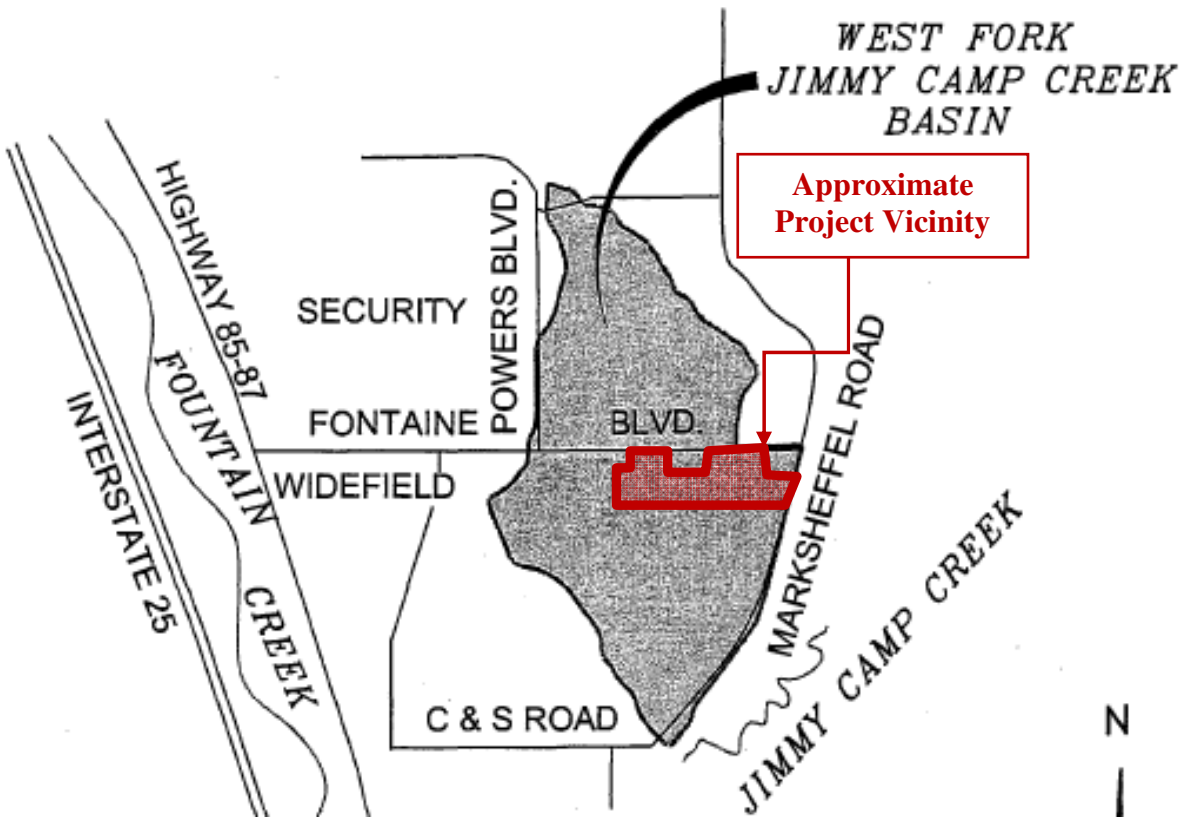
Final Drainage Report (FDR F11) The Glen at Widefield Filing No. 11, by Kiowa Engineering Corp. December 2019.

Master Drainage Development Plan (MDDP) Corvallis, by Matrix Design Group, September 2021.

II. Project Characteristics

A. MAJOR BASIN

Corvallis lies entirely within the West Fork Jimmy Camp Creek (WFJCC) Drainage Basin. The project includes offsite and onsite drainage area with the major confluence of offsite drainage happening at an existing bridge crossing that conveys the WFJCC flows southerly across Fontaine Boulevard. These flows continue south through the Corvallis site until they enter the Glen at Widefield Subdivision Filing No. 9. Two more natural channels run through the site, draining north to south, and join with the WFJCC after they have left the Corvallis development. The West Fork of Jimmy Camp Creek covers a total of 4 square miles. The developed area for the site of 297-acres is approximately 11.6% of the total drainage area within the WFJCC.



B. COMPLIANCE WITH DBPS

This study complies with the latest DBPS study (***WFJCC DBPS***) of the West Fork Jimmy Camp Creek basin dated October 2003. All developed runoff from the site will be detained and released at pre-development peak rates, and the water quality volume will be treated. Both as determined by the UDFCD detention spreadsheet UD-Detention.

C. GEOLOGY

The majority of the site is currently undeveloped and consists of natural vegetative land cover, as well as multiple natural creeks.

Soils can be classified in four different hydrologic groups, A, B, C, or D to help predict storm water runoff rates. Hydrologic group "A" is characterized by deep, well-drained coarse-grained soils with a rapid infiltration rate when thoroughly wet and having a low runoff potential. Group "D" typically has a clay layer at or near to the surface, or a very shallow depth to impervious bedrock and has a very slow infiltration rate and a high runoff potential. See Soils Map; Appendix D. Table 1.1, below, indicates which soil types are present in the development area:

Table 1.1 – NRCS Soil Survey for El Paso County

Soil ID Number	***Soil***	***Hydrologic Classification***	***Permeability***	***Percent on Site***
30	Fort Collins Loam (0% - 3% slopes)	B	Moderately Rapid	3.9%
52	Manzanst Clay Loam (0% - 3% slopes)	C	Low Rapidity	1.8%
56	Nelson-Tassel Fine Sandy Loams (3% - 18% slopes)	B	Moderately Rapid	34.5%
59	Nunn Clay Loam (0% - 3% slopes)	C	Low Rapidity	16.2%
75	Razor-Midway Complex	D	Very Low Rapidity	0.9%
86	Stoneham Sandy Loam (3% - 8% slopes)	B	Moderately Rapid	35.6%
101	Ustic Torrifluvents, Loamy	B	Moderately Rapid	0.8%
108	Wiley Silt Loam (3% - 9% slopes)	B	Moderately Rapid	6.3%

D. GROUNDWATER

According to the Geo-tech report for the site, groundwater levels vary. There is some seasonal and temporary raising of the water table along the FMIC and natural ditches. This fluctuation is likely due to irrigation water releases during the growing season; therefore, it is anticipated that the rerouting of the FMIC ditch via storm sewer, described in Section F below, will mitigate some of the water table fluctuations. Groundwater will be mitigated for in the construction plans as recommended in future Geo-tech reports which will be referenced in the appropriate future PDR/FDRs.

E. LAND USES

Presently, the site is unplatted and consists of undeveloped land. Corvallis is a proposed planned unit development (PUD) which includes both residential and commercial uses. Development of utilities and internal roadways are to be included in this parcel.

F. UTILITIES AND ENCUMBERANCES

- **Storm Sewer**: Existing storm sewer includes a 30-inch CMP culvert that crosses Fontaine Boulevard. In addition, WFJCC and associated proposed storm infrastructure will run through the site. Sizing is as described within this report and subject to change as site design progresses.
- **Sanitary Sewer**: An existing 24-inch sanitary sewer main lies within the intersection of Marksheffel Road and Lorson Boulevard near the site's southeast corner which will take flow east of the ridge internal to Corvallis Development. There is also an existing 12-inch sanitary sewer main which runs north-south through the site that will tie into the sanitary system at The Glen at Widefield development to the south of the site and will take the site's internal sanitary flow west of the ridge.
- **Gas**: Gas service to the proposed development will be provided by Black Hills Energy through the extension of the existing gas main infrastructure that currently lies adjacent to the site. No encumbrance to the project is anticipated.
- **Water**: The following existing water mains surround the site: a 16-inch water main in Marksheffel Road, a 24-inch water main in Spring Glen, a 12-inch water stub at Dutch Loop, and an 8-inch water main at Fontaine Boulevard near Cottonwood Grove. A network of new 12-inch and 8-inch water mains will be constructed throughout the Corvallis site to provide looping and water services to the development.
- **Electric:** There is existing overhead electric power in Fontaine Boulevard along the north side of the property and along the site's western property line. Underground electric power is also located within the residential developments to the south and east of the site. Electric service will be provided to the Corvallis Development by extending underground electric throughout the subdivision for residential and commercial services. No encumbrance to the project is anticipated.
- **Communications:** Underground communication lines currently serve the residential neighborhoods adjacent to the project site which will be extended underground to serve Corvallis Development. No encumbrance to the project is anticipated.
- **Irrigation:** There is an existing FMIC irrigation ditch meandering through both the east and west portions of the site. Both sections of the FMIC ditch running through the Corvallis site will be rerouted via 60-inch storm pipes sized to convey the 60 cfs that FMIC has indicated as a peak irrigation flow. Due to the lack of grade in the existing ditch, both sections of pipe are very flat with the west section at 0.06% and the east section at 0.08% grade. Entry and exit locations to and from the site will remain unchanged.

  Written acceptance of planned modifications to FMIC ditch must be acquired from FMIC prior to beginning construction of these improvements. Pursuit of this acceptance is in progress. Documentation will be added to the MDDP when it is available.

  Once completed, the FMIC approved irrigation conveyances will be privately owned and maintained by the FMIC.

III. Hydrologic Analysis

A. GENERAL CONCEPT

The general concept for management of storm water for the proposed Corvallis development will be to provide clear conveyance through the property to the multiple onsite detention facilities to mitigate developed runoff flows from the site. Development of the site will require over-lot grading, roadway paving, residential and commercial construction which will increase the imperviousness of the property from existing conditions. The general drainage patterns will consist of positive drainage away from building sites, across lawns, parking lots, or open space, to curb and gutter within the internal roadways. Storm water within the roadways will be directed to inlet collection points, where it is captured and conveyed through a pipe network system to a full spectrum detention pond. Majority of offsite runoff will be either be diverted around the site or collected and directed separately through the site before being discharged at historic drainage locations and discharge.

The Water Quality Capture Volume (WQCV) is comprised within the proposed Full Spectrum Extended Detention Basin (EDB), where the "initial flush" of storm water will be drained over a 40-hour time period. The onsite ponds have been evaluated to reduce the developed flows from the site to a maximum of the historic peak flows. The detention pond has been sized and evaluated based upon the 100-year storm events in accordance with City Criteria.

B. METHODOLOGY

a. Rational Method

i. Method of Analysis

Storm sewer sizing for this project uses the Rational Method as recommended by the Drainage Criteria Manual for the minor and major storms for drainage basins less than 100-acres in size (Inlets will also be sized using this method in the subsequent FDRs). The Rational Method uses the following equation:

Q=C*i*A

Where:

Q	=	Maximum runoff rate in cubic feet per second (cfs)
C	=	Runoff coefficient
i	=	Average rainfall intensity (inches per hour)
A	=	Area of drainage sub-basin (acres)

ii. Runoff Coefficient

Coefficients from Table 6-6 of the Drainage Criteria Manual for developed land were utilized in the Rational Method calculations. See Appendix B for more information.

iii. Time of Concentration

The time of concentration consists of the initial time of overland flow and the travel time in a channel to the inlet or point of interest. A minimum time of concentrations of 5 minutes is utilized for urban areas.

iv. Rainfall Intensity

The hypothetical rainfall depths for the 1-hour storm duration were taken from Table 6-2 of the Colorado Springs Drainage Criteria Manual. Table 3.1, below, lists the rainfall depth for the Major and Minor 1-hour storm events.

Table 3.1 – Project Area 1-Hour Rainfall Depth

Storm Recurrence Interval	Rainfall Depth (inches)
5-year	1.50
100-year	2.52

The rainfall intensity equation for the Rational Method was taken from Drainage Criteria Manual Volume 1 Figure 6-5.

C. BASIN HYDROLOGY

EXISTING DRAINAGE CONDITIONS

Under the existing conditions, the site flows in a general north to south pattern until reaching one of three low points. As such, the site has been divided into major basin delineations (west, central, east) which collect flow at these three discharge points, in conformance with the ***WFJCC DBPS***, ***MDDP,*** and ***FDR***s for the area.

West Basin:

Sub-basin OS-1 borders the site to the west and is comprised of large lot, single-family residential homes. Runoff from this site drains to the east until reaching the Corvallis boundary, represented at Design Point E1.

Sub-basin OS-2 borders the site to the northwest and consists of drainage on Fontaine Boulevard from the crown of the roadway to the south. These flows drain from the existing roadway high point to the east until reaching the existing low point at Design Point E2. In the existing conditions, this road corridor drainage connects with a 30-inch CMP that directs localized flows from the north underneath Fontaine Boulevard and discharging into the WFJCC.

Sub-basin EX-2 is an onsite, undeveloped basin that sheet flows in a general southwest to northeast pattern until it combines with Sub-basin OS-2 at Design Point E2. Runoff from this design point discharges directly into the WFJCC.

Sub-basin OS-3 is an offsite, undeveloped basin that drains to the southeast until reaching the WFJCC floodway at Design Point E3.

Sub-basin OS-4 is an offsite, undeveloped basin adjacent to the WFJCC which drains to the southeast until reaching Design Point E3.

In addition to the above listed sub-basin flows that reach Design Point E3, the approved ***WFJCC DBPS*** also specifies a Design Point 3020 which consists of the upstream flows, including the existing 30" CMP mentioned previously) collected in the WFJCC as it enters the Corvallis site. In a conservative effort, the approved existing ***WFJCC DBPS*** flows have been added to the previously described sub-basins to achieve the flows at Design Point E3.

Sub-basin EX-1 is comprised of the west quarter of the Corvallis site. Currently undeveloped, flows generated in this basin combine with offsite flows from Sub-basin OS-1 and drain in a general northwest to south east pattern until reaching the WFJCC at Design Point E4.

Sub-basin 1-D (Formerly OS-8) is now included in the project by the new Lacy ODP. Under existing conditions this area is agriculturally zoned and sheet flows from west to east until reaching the WFJCC at Design Point E4.

Sub-basin OS-5 contains the southern half of Fontaine Boulevard as it drains from an existing roadway high point to the west until discharging and combining with onsite drainage.

Sub-basin EX-3 accepts the flows from Sub-basin OS-5 and continues to drain from the northeast to southwest until reaching Design Point E5 at the site's southern border.

Flows from Design Points E4 and E5 combine at the West Basin's final discharge point, Design Point E8. This is located at the flowline of the WFJCC drainageway as it leaves the Corvallis development and continues into the Glen at Widefield development located to the south. In both the approved ***WFJCC DBPS*** and ***MDDP***, the flowrates at this point are Q_5 = 601 cfs and Q_{100} = 2216 cfs. As previously mentioned, rational calculations were performed for all onsite basins and added to the ***MDDPA*** Design Point R3030 existing condition flows (Q_5 = 347 cfs and Q_{100} = 1761 cfs) located at the WFJCC entrance into the site. This results in Design Point 8 flows of Q_5 = 403.5 cfs and Q_{100} = 2040.7 cfs. The previously approved ***WFJCC DBPS*** and ***MDDP*** will govern on the discharge flows at this point.

A summary of the existing basins and design points contributing to the West Basin are shown below. Calculations can be found in Appendix A. Please refer to Appendix D for the Existing Conditions Map.

West Basin			
Basin Name	Acreage	Peak Flows	
		5-Year	100-Year
OS-1a	38.5	19.2	70.9
OS-1b	38.3	12.3	47.7
OS-2	1.0	3.9	7.1
OS-3	1.9	0.6	4.0
OS-4	18.3	3.3	21.8
OS-5	0.8	3.2	5.8
OS-8	22.1	4.2	28.1
EX-1	67.9	9.0	60.3
EX-2	10.3	2.5	17.0
EX-3	51.9	8.2	54.8

West Basin		
Design Point	Peak Flows	
	5-Year	100-Year
E1: OS-1	25.3	98.5
E2: OS-2, EX-2	5.4	22.5
E3: E2, OS-3, OS-4	6.5	34.4
E4: E1, E3, EX-1, OS-8	46.3	222.3
E5: OS-5, EX-3	10.2	57.5
E8: E4, E5, +DPBS3020	403.5	2040.7

Central Basin

Sub-basin EX-4 is an onsite, undeveloped portion of land that drains from the northeast to the southwest until reaching Design Point E6, the final discharge point of the Central Basin.

This discharge point is centrally located on the southern border of the Corvallis development. An existing area inlet and corresponding 48-inch RCP collects the flows (Q_5 = 7.2 cfs and Q_{100} = 48.1 cfs) and conveys them directly to the WFJCC. Per the approved FDR for the Glen at Widefield Filing No. 9, this point collects 44.8 cfs in the 5-year storm and 163 cfs in the 100-year storm. As with Design Point E8, the allowable release of flows for this point are set by the approved ***WFJCC DPBS*** and ***MDDP***.

A summary of the existing basins and design points contributing to the Central Basin are shown below. Calculations can be found in Appendix A. Please refer to Appendix D for the Existing Conditions Map.

Central Basin			
Basin Name	**Acreage**	**Peak Flows**	
		5-Year	**100-Year**
EX-4	58.6	7.2	48.1

Central Basin		
Design Point	**Peak Flows**	
	5-Year	**100-Year**
E6: EX-4	7.2	48.1

East Basin

Sub-basin OS-6 contains the southern portion of Fontaine Boulevard, to the crown of the roadway, that the borders the site to the northeast. These flows are collected in a roadside swale and discharge onsite.

Sub-basin OS-7 consists of a single-family residential development located on the east side of the side. The back half of the existing residential lots drain to the south and west until discharging onto the Corvallis site.

Sub-basin EX-5 is the easternmost onsite basin. Currently undeveloped, this basin collects the flows from Sub-basins OS-6 and OS-7 and slopes from the northwest to the southeast until reaching Design Point E7.

The final discharge point for the East Basin (Design Point E7, Q_5 = 16.5 cfs and Q_{100} = 93.1 cfs) is located at the southeast corner of the site. These flows will be conveyed to the south in the existing roadside swale that runs parallel to Marksheffel Road. Discharge at this design point was set in the ***WFJCC DBPS*** and ***MDDP*** as Q_5 = 38 cfs and Q_{100} = 153 cfs and will control the allowable discharge in developed conditions.

A summary of all existing basins and design points, offsite and onsite, as well as a summary of design points contributing to the East Basin are shown below. Calculations can be found in Appendix A. Please refer to Appendix D for the Existing Conditions drainage maps.

East Basin			
Basin Name	Acreage	Peak Flows	
		5-Year	100-Year
OS-6	0.8	3.2	5.8
OS-7	2.9	2.5	9.4
EX-5	86.5	12.8	86.3

East Basin		
Design Point	Peak Flows	
	5-Year	100-Year
E7: EX-5, OS-6, OS-7	16.5	93.1

As previously mentioned, the Fountain Mutual Irrigation Company (FMIC) ditch system enters and exits the site periodically. The ditch in this area is approximated to have flows of 60 cfs as it meanders through the Corvallis site. This MDDP follows the guidelines previously set in the ***WFJCC DPBS*** that states, "Existing and proposed runoff was assumed to be passed over or under the ditch in the hydrologic modeling of the basin. There was no diversion of runoff by the ditch assumed in compilation of the hydrologic model for this basin." As such, no additional drainage from the site is anticipated to be conveyed by the FMIC and all flows released into the ditch are assumed to remain within the canal. There is a possibility of a bypass pipeline being constructed that will convey flows from Big Johnson Reservoir to the east side of Marksheffel Road, near Jimmy Camp Creek, however this has not been considered for this report.

DEVELOPED DRAINAGE CONDITIONS

As explained in the existing conditions, the developed site drainage will also discharge at three site low points and has been broken down into three drainage basins for clarity. These design points have been specified in the ***WFJCC DBPS*** and subsequent reports as the discharge points from the Corvallis development. Runoff from the developed site will conform to these specified flows. Developed hydrology calculations for the basins and design points can be found in Appendix A. Preliminary hydraulic calculations have been completed for the anticipated trunk mains. Storm infrastructure internal to the sub-basins will be completed with each filing's Final Drainage Report.

West Basin:

Sub-basin OS-1 previously explained in the existing conditions will continue to drain easterly until reaching the Corvallis site boundary. At this point, the offsite flows will either be conveyed via swale or pipe to the north and east until reaching Design Point E1. Preliminary calculations have been completed for this swale (OS-1 Swale) or pipe (OS-1 Pipe) and can be found in Appendix A. Once entering the Corvallis site, these offsite flows will be conveyed via storm drain to the east and south until reaching DP1. This drainage will be kept separate from any untreated, developed runoff and will therefore not require any detention or water quality treatment.

Sub-basin OS-2 collects the runoff from required improvements to Fontaine Boulevard, adjacent to the Corvallis development which will have the required improvements at the time of development. Runoff from the roadway crown to the south will be collected in the proposed curb and gutter and directed to required inlets at the road low point. From here, flows will be conveyed to Sub-basin 2 via proposed storm drain.

Sub-basin 1B includes both commercial and multi-family development at the northwest corner of the site. The commercial and multi-family parcels will each have their own onsite water quality and detention facilities, DF-1 and DF-2, respectively. Discharge from these facilities will be

released at prehistoric peak flow values as required per the City criteria. Treated flows leaving DF-1 will be conveyed to the south via an 18-inch storm drain until reaching DP1. Preliminary calculations for the ponds and storm drain have been calculated and can be found in Appendix A. Discharge from DF-2 will be conveyed to DP2 via a 24-inch storm drain.

Design Point DP1 combines Design Point E1 and Sub-basin 1B. At this point, treated flows combine with routed flows. In an effort to be conservative, the treated discharge has simply been added to the routed flow, resulting in 25.0 cfs and 107.0 cfs in the minor and major storms, respectively. These combined flows will be carried in a 36-inch storm drain to along Autumn Glen and Residential Collector A road corridors until reaching Design Point DP3.

Sub-basin 1A is comprised of 1/8 acre or less, single-family residential lots. Runoff generated from this basin will be conveyed via curb and gutter and storm drain eventually to be collected and conveyed via 42-inch storm sewer to DF-3 (at DP2).

Sub-basin 2 is planned for 1/8 acre (or less) single-family residential. Developed runoff will be directed to the south via curb, gutter, and proposed internal storm drains, crossing beneath Residential Collector A, until reaching Design Point DP2.

Sub-basin 3 will consist of undeveloped land and detention and water quality pond DF-3.

Detention facility DF-3 will collect developed runoff from Sub-basins 1A, 1D, 2, 3, and OS-2 and will then release at historic rates via a 36-inch storm drain until combining with flows from DP 1 in a storm manhole where the combined flows will be conveyed via 54-inch storm sewer until reaching Design Point DP3.

Sub-basin 1-D (Formerly OS-8) is now included in the Corvallis development per the Lacy ODP. The developed portion of this sub-basin will sheet flow towards the adjacent road which will convey the flows towards curb inlets near DP2. The captured flows will be directed into DF-3 for water quality treatment and detention.

Sub-basin 7 will remain undeveloped open space in the proposed conditions and, therefore, does not require any detention or water quality. This sub-basin will drain to the south and west until reaching Sub-basin OS-4 and Design Point DP5.

Sub-basin OS-3 is unchanged from the existing conditions and will continue to drain to the south and east until reaching Design Point DP5.

Sub-basin OS-4 is unchanged from the existing conditions and will continue to drain to the south and west until reaching Design Point DP5.

As previously mentioned, flow at Design Point 5 (E3 in the existing conditions discussion) includes ***WFJCC DBPS*** Design Point 3020 existing flows. The approved ***WFJCC DBPS*** also recommends removal of the existing 30-inch CMP crossing Fontaine Boulevard and, instead, routing these flows to the east until reaching the WFJCC bridge crossing at the north side of Fontaine Boulevard. The DBPS includes calculations show that this crossing is adequately sized to handle the additional flows. As such, it has been assumed that the ***WFJCC DBPS*** Design Point 3020 flows include those from the 30-inch CMP, and all converge north of Fontaine

Boulevard. From here, Design Point DP5 flows continue south within the WFJCC floodway until reaching the West Basin discharge point at DP 7.

Sub-basin 5 will be a proposed single-family development with lot sizes equal or lesser than 1/8 of an acre. Developed runoff will be taken to the south and west by internal curb, gutter and storm drain. The collected stormwater will cross underneath Residential Collector A, until reaching Sub-basin 4.

Sub-basin 4 will be comprised of 1/8 acre, or less, single-family lots. This basin will accept flows from Sub-basin 6 and continue to direct them to the basin low point, located at the southwest corner, Design Point DP6. At this point, detention and water quality pond DF-4 will accept and treat the flows, then discharge into the WFJCC via a 24-inch storm drain.

The convergence of Design Points DP3, DP5, and DP6 results in the ultimate West Basin discharge point, DP7 (Q_5 = 391.0 cfs and Q_{100} = 2006.1 cfs). These flows are less than both the routed calculations completed for Design Point E8, as well as the previously approved and governing releases specified in the ***WFJCC DBPS*** and ***MDDP***. Drainage from this point will continue to the south until reaching the Glen at Widefield developments.

A summary of the sub-basins and design points within the West Basin is shown below:

West Basin			
Basin Name	Acreage	Peak Flows	
		5-Year	100-Year
OS-1a	38.5	12.7	49.3
OS-1b	38.3	12.3	47.7
OS-2	1.0	3.9	7.1
OS-3	1.9	0.5	3.5
OS-4	18.3	2.5	16.6
OS-5	0.8	3.2	5.8
1-D	22.1	18.4	40.5
1A	28.3	43.1	94.9
1B	15.9	51.4	99.3
2	26.9	40.5	89.2
3	7.5	2.7	13.6
4	17.0	25.9	53.8
6	10.0	15.5	34.1
7	19.3	2.6	17.8

West Basin		
Design Point	Peak Flows	
	5-Year	100-Year
E1	21.7	84.4
DP1	25.3	110.3
DP2	127.1	311.7
DP3	33.6	185.2
DP4	2.6	17.8
DP5	352.6	1798.9
DP6	22.3	47.7
DP7	391.0	2006.1

DP7 Summary							
Approved DBPS/MDDP		Glen at Widefield FDR 9		MDDPA (Dev. Cond.)		MDDP (Pr. Cond.)	
5-Year	100-Year	5-Year	100-Year	5-Year	100-Year	5-Year	100-Year
601.0	2216.0	601.0	2216.0	401.0	2020.0	391.0	2006.1

Central Basin:

Sub-basin OS-5 collects the runoff from required improvements to Fontaine Boulevard, adjacent to the Corvallis development which will have the required improvements at the time of development. Runoff from the roadway crown to the south will be collected in the proposed curb and gutter and directed to required inlets at the road low point. From here, flows will be conveyed to Sub-basin 9 via proposed storm drain.

Sub-basins 9 & 10 includes single-family development with lots equal to or less than 1/8 of an acre in size. Proposed curb, gutter, and storm drain will collect the developed runoff and direct it to the south, until reaching Residential Collector A. Flows will cross underneath this roadway and join with Sub-basin 10.

Sub-basin 11 is currently designated single-family residential. Runoff from this site will join with incoming Sub-basin 9 & 10 flows and continue to the south and west until crossing underneath the proposed Spring Glen Drive roadway, discharging into detention and water quality pond DF-5 at Design Point DP10. This basin is considered to be approximately 65 percent impervious per Table 6-3 of the USDCM.

Sub-basin 5 contains single-family residential units with maximum lot sizes of 1/8 acre. Developed runoff will be accumulated within the internal curb, gutter, and storm drain system until discharging into pond DF-5 at Design Point DP9.

Design Point DP11 is the ultimate discharge point for the Central Basin and consists of the historical release from proposed detention and water quality pond DF-5 (Q_5 = 6.6 cfs and Q_{100} = 48.1 cfs). This discharge point is comparative to Design Point E6 in the existing conditions. The prehistoric discharge is equal to the calculated routed flows in the existing conditions and well underneath the approved flows from the ***WFJCC DBPS*** and ***MDDP***, as well as the anticipated flows per the Glen at Widefield Filing No. 9 FDR.

A summary of the sub-basins and design points within the Central Basin are summarized below:

Central Basin			
Basin Name	**Acreage**	**Peak Flows**	
		5-Year	**100-Year**
OS-5	0.8	3.2	5.8
5	5.9	19.4	38.6
9	20.1	34.4	80.5
10	15.8	24.3	57.2
11	14.9	21.8	49.8

Central Basin		
Design Point	**Peak Flows**	
	5-Year	**100-Year**
DP8	45.8	106.9
DP9	33.4	74.7
DP10	54.9	123.8
DP11	6.6	48.1

DP11 Summary							
Approved DBPS/MDDP		**Glen at Widefield FDR 9**		**MDDP (Ex. Cond.)**		**MDDP (Pr. Cond.)**	
5-Year	**100-Year**	**5-Year**	**100-Year**	**5-Year**	**100-Year**	**5-Year**	**100-Year**
48.0	163.0	44.8	163.0	7.2	48.1	7.2	48.1

East Basin:

Sub-basin OS-6 consists of the southern half of Fontaine Boulevard, to include the proposed improvements that will be required adjacent to the Corvallis development. Inlets will need to be designed to capture this flow and route it south to Sub-basin 12 at time of Final Drainage Report for the adjacent filing.

Sub-basin 8 is a proposed commercial development that will have its own onsite water quality and detention pond, DF-6. Once treated, the historic release will be directed to the west in an 18-inch storm drain, combining with discharges from DF-7 at DP 12a.

Sub-basin 12 is a proposed multi-family development that will convey drainage via proposed curb, gutter, and storm drain to the south and east until reaching Design Point DP12 at detention facility DF-7. This parcel will have its own onsite water quality and detention to treat its runoff as well as the runoff from Sub-basin OS-6. Treated runoff will be released at historical peak discharge by a 30-inch storm drain. This storm drain will combine with flows from Sub-basin 8 at DP 12a and continue to the south and east, separated from any untreated flows, until reaching Design Point DP15.

Sub-basin OS-7 is a large acre, single-family subdivision located at the Corvallis site's northeastern corner. Stormwater from the backs of these lots will drain through side lot swales until discharging onto Sub-basin 16 and eventually being treated in detention and water quality pond DF-9.

Sub-basin 16 is a proposed commercial development. Developed runoff will drain to the southeast via internal curb, gutter, and storm drain until reaching the onsite water quality and detention facility, DF-9. This pond will release the treated flow via a 36-inch storm drain, combining with the above-mentioned East Basin flows at DP15.

Treated flows from Design Point DP15 will be conveyed in a 42-inch storm drain until reaching Design Point DP16.

Sub-basin 13 is to be comprised of single-family housing. The lots within this basin are expected to have a maximum size of 1/8 acre. Internal site curb, gutter, and storm drain will direct the flows to the south and east until reaching Sub-basin 14.

Sub-basin 14 will also be single-family residential with lot sizes equal or less than 1/8 of an acre. Runoff internal to this basin, as well as the accepted flows from Sub-basin 13, will be routed via curb, gutter, and storm drain to the south and east until entering Sub-basin 15.

Sub-basin 15 is a proposed single-family subdivision with 1/8 acre, or less, lot sizes. Developed runoff from this basin (as well as Sub-basins 13 and 14) will be collected in the onsite curb, gutter, and storm drain and directed to the basin low point at the southeastern corner. At this point, detention and water quality facility DF-8 will accept the flows at Design Point DP14.

Sub-basin 17 is currently designated as commercial. Runoff from this site will be collected in curb, gutter, and onsite storm drain and directed to the west to discharge into detention and water quality pond DF-8 at Design Point DP14.

Discharge from DF-8 will be equal to or lesser than the historical peak discharge as required by the City. From here, flows will be conveyed to the south via a 36-inch storm drain until reaching Design Point DP16.

Design Point DP16 is the ultimate discharge for the East Basin. The combined flows calculated for this design point result in 12.8 cfs in the minor storm event and 110.1 cfs in the major storm event. In the existing conditions, this discharge point was estimated to have 16.5 cfs in the minor storm and 93.1 cfs in the major storm. However, the previously approved ***MDDP*** and ***WFJCC DBPS*** for the area specify an allowable release of 38 cfs for the 5-year storm and 153 cfs in the 100-year storm.

The current report in review with the City of Fountain for the Glen at Widefield Filing No. 11, which receives the discharge from Corvallis DP16 has proposed two 36-inch culverts to convey the drainage from the Corvallis East Basin to the roadside swale being constructed as a part of the Marksheffel Road improvements. The capacity of these culverts is 87.06 cfs. Refer to Appendix C for the structures (CV177) referenced from the Final Drainage Report for the Glen at Widefield Filing No. 11.

As basins tributary to the East Basin are designed, additional analysis will be required in order to confirm the downstream capacity available.

A summary of the sub-basins and design points within the East Basin are summarized below:

East Basin			
Basin Name	**Acreage**	**Peak Flows**	
		5-Year	**100-Year**
OS-6	0.8	3.2	5.8
OS-7	2.9	2.5	9.4
8	6.5	28.7	52.2
12	17.2	28.3	62.4
13	5.2	10.6	23.3
14	11.1	18.5	40.6
15	17.6	30.1	66.2
16	32.5	96.9	184.8
17	3.3	14.6	26.5

Central Basin		
Design Point	**Peak Flows**	
	5-Year	**100-Year**
DP12	24.5	53.5
DP12a	3.2	28.8
DP13	20.4	44.9
DP14	35.3	76.2
DP15	7.8	65.8
DP16	12.8	110.1

DP16 Summary							
Approved DBPS/MDDP		**Glen at Widefield FDR 11**		**MDDP (Ex. Cond.)**		**MDDP (Pr. Cond.)**	
5-Year	**100-Year**	**5-Year**	**100-Year**	**5-Year**	**100-Year**	**5-Year**	**100-Year**
38.0	153.0	N/A	87.1	16.5	93.1	12.8	110.1

Full Spectrum Detention Facilities

In accordance with the City of Fountain drainage criteria, the proposed Corvallis development will provide onsite full spectrum detention facilities to mitigate developed drainage impacts. Detained flows will release at historic rates and drainage patterns. At this time, ponds in series are not anticipated. This requires treated flows and offsite flows to be conveyed separately from untreated flows. Further design will need to be done if this design intent changes. A breakdown of the required storage volume and historic release rates for each of the water quality and detention facilities are summarized below:

PROPOSED WATER QUALITY AND DETENTION SUMMARY
Corvallis

Detention/ WQ Pond	*TOTAL AREA (AC)*	*CONTRIBUTING BASINS*	*% IMPERVIOUS*	*VOLUME REQUIRED (AC-FT)*	*Q(5) DISCHARGE (cfs)*	*Q(100) DISCHARGE (cfs)*	*DESCRIPTION:*
DF-1	5.65	1B-COMMERCIAL	95%	0.89	**2.1**	**8.8**	*Northwest Commercial*
DF-2	8.25	1B-MULTIFAMILY	70%	1.00	**1.2**	**13.8**	*Northwest Multi-Family*
DF-3*	61.51	1A, 1D, 2, 3, OS-2	65%	7.22	**8.3**	**74.9**	*West Single-Family (Slight over-detention to maintain flows listed in Glen at Widefield MDDP Amendment)*
DF-4*	23.14	4, 6	65%	2.64	**4.8**	**22.0**	*Southwest Single-Family*
DF-5*	57.54	5, 9,10, 11, OS-5	70%	6.98	**6.6**	**48.1**	*South Single-Family & School Site*
DF-6	6.50	8	95%	1.02	**0.2**	**9.3**	*Northeast Commercial*
DF-7	18.00	12, OS-6	70%	2.18	**3.0**	**19.5**	*Northeast Multi-Family*
DF-8*	37.24	13, 14, 15, 17	70%	4.51	**5.0**	**44.3**	*Southeast Single-Family & Commercial*
DF-9*	35.45	16	80%	4.79	**4.8**	**46.3**	*Southeast Commercial Pond*

*Asterisk * denotes "Sub-Regional" Detention. The other ponds are considered "Onsite" Detention.*

IV. Hydraulic Analysis

A. OVERVIEW, METHODOLOGY & DESIGN

Developed sub-basins and proposed drainage improvements are depicted on the attached Developed Drainage Basin Map (DR02) in Appendix D. Preliminary hydraulic design calculations for sizing of onsite facilities are provided for in Appendix A. In general, the hydraulic criteria and intent are summarized as follows:

In accordance with City of Fountain drainage criteria, major drainage will be conveyed through the Corvallis development using a combination of open channels, underground storm sewer capacity and allowable street capacity. For local residential streets, the maximum allowable depth during the 100-year event is 8-inches or the extent of the street right-of-way such that buildings are not inundated at the ground line.

The interior roads will be graded with a minimum longitudinal slope of 1.0 percent. In accordance with the street spread calculations in the DCM, the allowable minor storm street capacity is 8 cfs per side for 6-inch ramp curb and 12 cfs per side for 6-inch vertical curb. The allowable major storm street capacity is approximately 36 cfs per side (72 cfs full width). Reference Appendix B for sizing chart.

Curb inlets (CDOT Type R or equivalent City approved 6-inch curb inlet type) will be specified where required for at-grade and sump collection point locations. Inlets will convey runoff to a storm sewer consisting of reinforced pipes (RCP) with a minimum pipe diameter of 18-inches. Preliminary storm sewer sizing has been provided based on full flow capacity at a minimum slope of 1.0 percent and can be referenced in Appendix A. Riprap stilling basins will be utilized at storm pipe outfalls. Detailed inlet, storm sewer and riprap sizing calculations will be provided with the Final Drainage Reports for each filing.

A preliminary hydraulic analysis been completed as part of this study to determine the required storm pipe sizing for the site trunk mains. Hydraulic grade lines (calculated in StormCAD and using head loss coefficients from Table 9-4 of the DCM) will be provided with either the FDR or along with construction drawings. Initial sizing of the onsite detention ponds was completed using UDFCD Detention Pond software for Extended Detention Basins. The ponds have been evaluated to determine the peak release rates from the proposed detention ponds and the storage required for the 100-year storm event. Most proposed storm pipes have been upsized to accommodate larger flows as a conservative design.

If further design of the site alters the design intent as discussed within this MDDP, an amendment will be required to show compliance with the City of Fountain criteria.

B. FLOODPLAINS

Per the ***Flood Insurance Rate Map (FIRM) 08041C 0956 G and 08041C 0957 G***, effective date December 7, 2018, published by the Federal Emergency Management Agency (FEMA), a portion of Corvallis lies within the designated 100-year floodplain of Jimmy Camp Creek West Tributary. A FIRMette of the project area is included in Appendix D.

Per the approved ***WFJCC DBPS***, as land is developed adjacent to the WFJCC (Corvallis-West Basin), channel improvements (and associated Channel Design Report) will be required.

WFJCC DBPS Map 4A (Appendix D) shows the existing 30-inch culvert to be removed north of Fontaine Boulevard and directed to the existing bridge crossing. The sections of the WFJCC that traverse through the Corvallis site are specified as 3030-2 and 3030-1. The ***WFJCC DBPS*** recommends channel improvements to include a rip-rap lined channel up to the 100-year water surface elevation as well as check dams at 150' intervals in both sections (These are anticipated to be replaced with less frequent grouted rip rap drop structures with larger drops). Actual channel design will differ from the DBPS recommendations slightly and will follow the governing channel design criteria at that time and likely act to preserve the existing wetlands (to be delineated in the future).

Creek improvements will be triggered when development within the sub-basins listed as a part of this MDDP's West Basin begins and will be paid for by the Metropolitan District via mill levees. After this trigger occurs, further investigation into the true creek requirements based on actual field conditions will be required.

A Letter of Map Amendment (LOMA) and/or Letter of Map Revision (CLOMR/LOMR) will be required once channel improvements are triggered by the above indicated criteria in order to show the revised extent of the regulatory floodplain through the site. The channel and improvements will be located within a tract and will be owned and maintained by the metro district. Maintenance access to the channel must also be provided in accordance with Channel Design Criteria.

V. Environmental Evaluations

A. WETLAND IMPACTS

Per the U.S. Fish and Wildlife National Wetlands Inventory, there are freshwater emergent wetlands located onsite. *Wetland delineation will be required once channel improvements are triggered by future development in the Corvallis-West Basin.*

B. STORMWATER QUALITY

All onsite detention facilities shall be designed to accommodate water quality requirements. As the development of each parcel progresses, the detention guidelines outlined in this report are to be upheld.

Per the DCM Chapter 1, Section 4, the City of Fountain requires the UDFCD Four Step Process for receiving water protection that focuses on reducing runoff volumes, treating the water quality capture volume (WQCV), stabilizing drainageways, and implementing long-term source controls.

Step 1: ***Reduce runoff by disconnecting impervious area, eliminating "unnecessary" impervious area and encouraging infiltration into soils that are suitable.***
Site specific landscaping will be done on each lot to decrease the connectivity of impervious areas. Grass lined swales will be used where possible to allow ground infiltration. The open

space running along the existing gas right of way is a site-specific example of disconnection between impervious surfaces on this project.

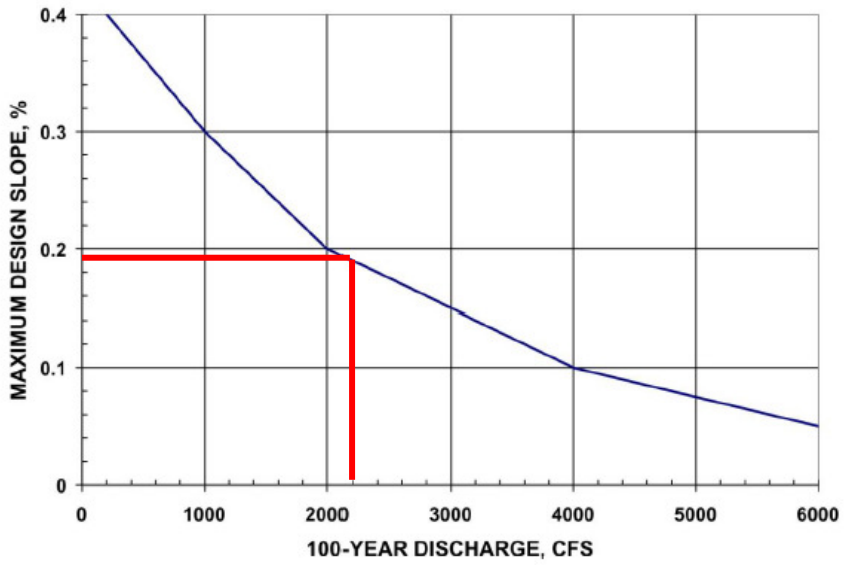
Step 2: ***Treat and slowly release the WQCV.***
The proposed detention ponds meet or exceed the DCM standards for the release rates of Full Spectrum Detention Ponds for Water Quality Capture Volumes.

Step 3: ***Stabilize stream channels.***

Drainage fees paid at the time of platting will be utilized in the construction of the future stream improvements in the Jimmy Camp Creek Drainage Fee Basin according to the City.

Onsite
Based on the available LIDAR contour data for the site, the existing channel has a slope of approximately 0.65%. Field investigations of the site appear to show a stable channel. There are four pond areas in the channel bottom providing stilling and energy dissipation. Per the DCM Figure 12-4 and the indicated DBPS Q100 of 2216 cfs the anticipated design slope for channel changes is 0.19%. Using these two slopes and a channel length through the Corvallis site of 2,652 feet, we anticipate approximately 12 feet of drop structures will be required. This will likely mean three 4' drop structures designed and placed to preserve the existing ponds. Depth of drop may vary slightly if the future channel improvements recommend changes to the sinuosity of the stream bed to optimize the synergy between the channel and the development and thereby alter the length and slope of the channel through this development.

Figure 12-4. Maximum Low-flow Channel Design Slope for Sand-bed Channels



Another likely improvement will be rip rap slope protection along the outside banks on the bends of the channel meander to preserve the current or, if modifications are required, future planned stream path and protect adjacent infrastructure.

Field investigations of the channel show a series of three small, elongated ponds and one smaller pond.

Figure 1-South Pond

Southernmost pond above. The southernmost, as shown above, and the northernomost two ponds have flat and stable banks. (Note: Based on the South Pond's stable banks, improvements on the property to the west of Parcel D are not anticipated; however, if such improvements prove to be necessary, the developer will be required to coordinate with the owner of said property to achieve a construction easement or other form of access in order to complete channel improvements.)

Other ponds, as shown below, have short sections with steeper banks.

Figure 2-North End of Middle Pond

Sloughing of banks is very minimal and only evident in a couple of instances. One instance is visible in the upper right bank in the photo above. Most of the bare soil along the channel is caused by cattle grazing the area. The south end of the same pond shown in Figure 2 shows stable banks

Figure 3-South end of Middle Pond

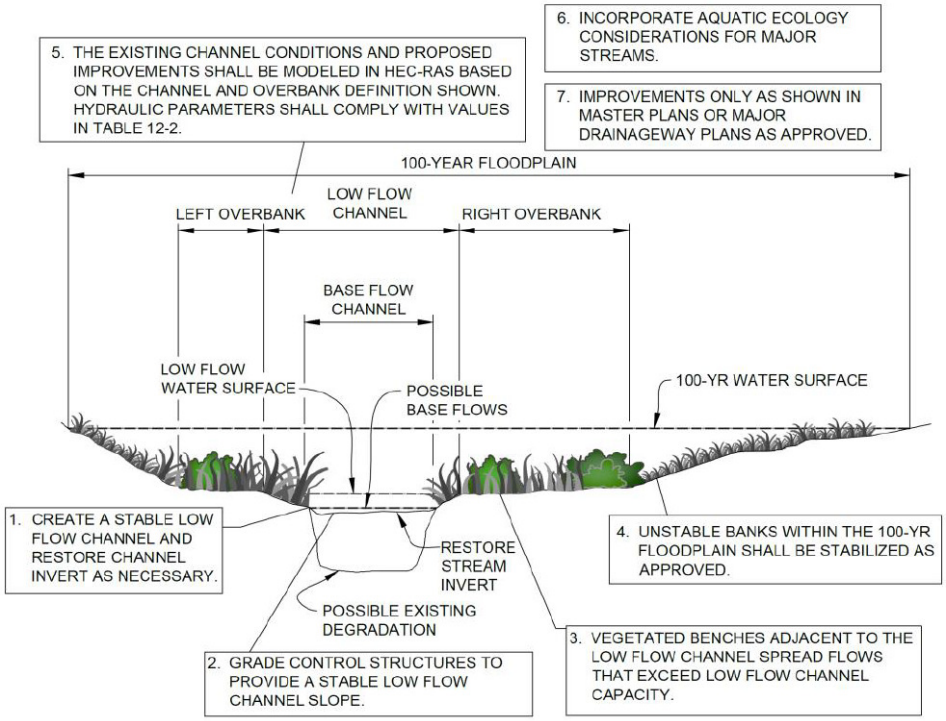
Figure 4-North Elongated Pond Looking South

The northernmost of the elongated ponds is shown above. Note the shallow, steeper banks closer to the north end of the pond and the flatter banks towards the south end of the pond.

Figure 5-Northernmost Pond

Future improvements to the channel will likely involve laying back some of the steeper banks and providing a channel section more in line with the typical section indicated in the DCM.

Figure 12-3. Design Elements Associated With Major Natural Drainageways



The above section is already reflected in much of the channel. It is anticipated that future improvements will regrade the steeper banks of the channel to more closely match this section, add overbanks for lower probability flows where they are lacking, and armor the outside banks of bends in the stream. Drop structures will likely be constructed between the existing pond areas in an attempt to preserve, and limit disturbance to, the wetlands, but some minor modifications of the middle pond location may be required to facilitate the proposed crossing of the stream by Residential Collector A.

Given the existing apparent stability of much of the channel, it may be more optimal to use some buried drop structures in some locations of the channel design to preserve the existing channel conditions, spot fix areas with bank issues and place normal drop structures as appropriate to preserve the channel flow line and ponded areas.

The future channel design report will consider the above factors as well as any potential changes to the design criteria which have arisen in the interim.

Figure 6 & 7-Jimmy Camp Creek-West Fork Looking North from South End of Property

Downstream of Corvallis

Just south of the south boundary of this proposed development Jimmy Camp Creek-West Fork discharges across what appears to be an existing utility maintenance road. HEC-RAS analysis of the stream using the 2018 LIDAR elevation info and the MDDPA flows indicates that both the 5-year and the 100-year events will surcharge the road (See section below). The analysis also indicates that the velocities anticipated across the structure appear to be within the DCM criteria for stable channel design in erosive soils (Q100 < 5.0 ft/s and Q5 < 3.5 ft/s).

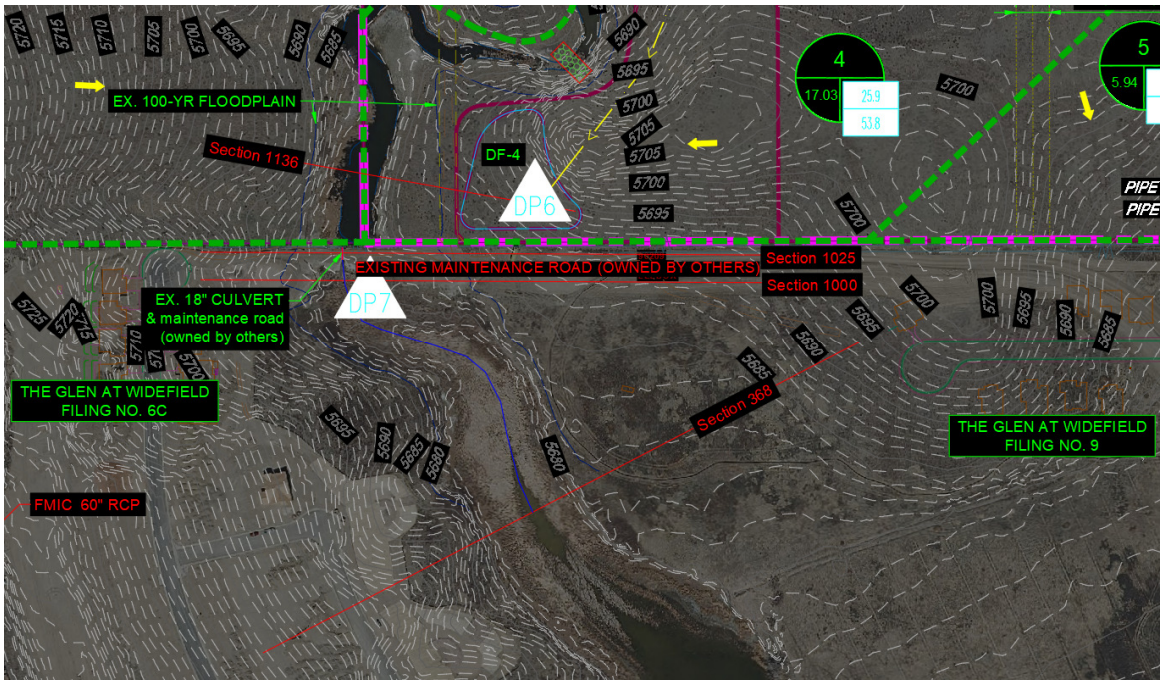


Figure 7 - HEC-RAS: Layout

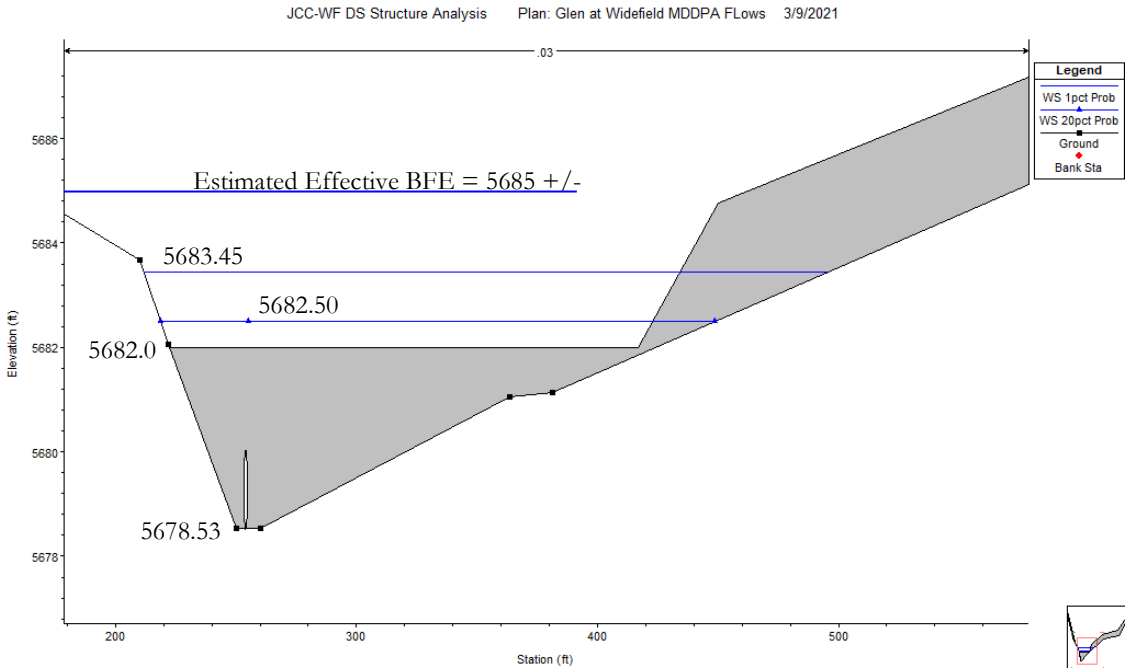


Figure 8 - HEC-RAS: Maintenance Road Section

Reach	River Sta	Profile	E.G. US.	W.S. US.	E.G. IC	E.G. OC	Min El Weir Flow	Q Culv Group	Q Weir	Delta WS	Culv Vel US	Culv Vel DS
			(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(ft)	(ft/s)	(ft/s)
WF	1012.5 Culvert #2	1pct Prob	5684.61	5684.54	5682.05	5684.61	5682.01	13.57	2017.97	2.09	7.68	7.68
WF	1012.5 Culvert #2	20pct Prob	5682.94	5682.94	5682.93	5682.94	5682.01	14.00	388.20	2.30	7.92	7.92

Figure 9 - HEC-RAS: Culvert Analysis Results

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
WF	1851	1pct Prob	2020.00	5680.00	5684.73		5684.77	0.000202	1.69	1219.95	358.39	0.15
WF	1851	20pct Prob	401.00	5680.00	5682.96		5682.97	0.000068	0.64	624.39	317.40	0.08
WF	1686	1pct Prob	2020.00	5677.20	5684.71		5684.75	0.000113	1.50	1390.34	401.09	0.12
WF	1686	20pct Prob	401.00	5677.20	5682.96		5682.96	0.000017	0.46	871.17	255.99	0.04
WF	1637	1pct Prob	2020.00	5677.20	5684.70		5684.74	0.000113	1.50	1387.99	400.80	0.12
WF	1637	20pct Prob	401.00	5677.20	5682.96		5682.96	0.000017	0.46	870.92	255.98	0.04
WF	1136	1pct Prob	2020.00	5678.70	5684.56		5684.65	0.000324	2.35	875.24	264.83	0.20
WF	1136	20pct Prob	401.00	5678.70	5682.94		5682.95	0.000043	0.72	553.86	166.40	0.07
WF	1025	1pct Prob	2020.00	5678.70	5684.54	5680.64	5684.61	0.000230	2.19	944.30	257.31	0.17
WF	1025	20pct Prob	401.00	5678.70	5682.94	5679.37	5682.94	0.000029	0.63	632.19	173.53	0.06
WF	1012.5		Culvert									
WF	1000	1pct Prob	2020.00	5678.53	5682.45	5681.69	5682.77	0.003526	4.58	441.30	226.99	0.58
WF	1000	20pct Prob	401.00	5678.53	5680.64	5680.09	5680.78	0.003246	3.09	129.86	113.29	0.51
WF	368	1pct Prob	2020.00	5678.00	5680.84	5679.70	5681.11	0.002002	4.15	486.25	188.99	0.46
WF	368	20pct Prob	401.00	5678.00	5679.09	5678.59	5679.18	0.002002	2.29	175.36	167.11	0.39

Figure 10 - HEC-RAS: Cross Section Analysis *(Maintenance Road at Section 1012.5)*

Jimmy Camp Creek-West Fork, immediately downstream of the above-mentioned structure, runs through the Glen at Widefield development in El Paso County. Specifically, the stream runs between Filings 6 and 9 of Glen at Widefield. (The photo below is looking southeasterly towards Filing 6.) As part of these developments, improvements to WFJCC were required and have been constructed. According to MDDPA, these improvements anticipated flows of Q5: 401 cfs and Q100: 2020 cfs. Our proposed discharge from the site is lower for both storms. (Q5: 396.4 cfs & Q100: 2009.1 cfs); therefore, the proposed Corvallis development complies with the design of the downstream infrastructure. Field visits to the site appear to confirm that the channel through Glen at Widefield has been stabilized. Please note the well vegetated channel in the photo looking southwesterly into Glen at Widefield below:

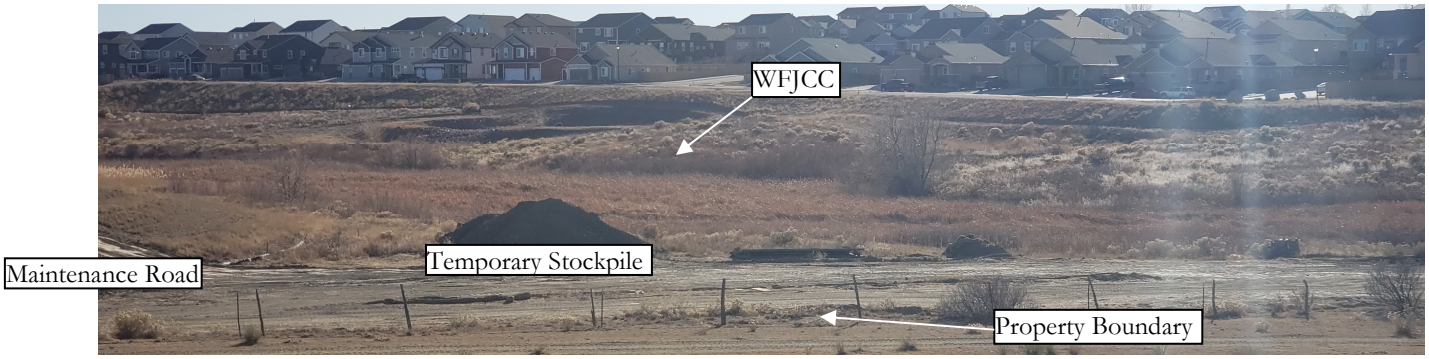


Figure 11- Jimmy Camp Creek-West Fork Looking South into Glenn at Widefield

Step 4: ***Implement source controls.***

During construction, the contractor will have designated concrete washout areas and will implement sediment control logs and inlet protection in order to control pollutants at their source. If long term stockpiling of materials is desired, further source controls must be designed to comply with the GEC and SWMP criteria.

C. PERMITTING REQUIREMENTS

A USACE 404 permit and PPRBD floodplain development permit are anticipated permits which will be required along with the future channel improvements.

VI. Selected Plan

A. PLAN HYDROLOGY

Land Use

In the approved ***WFJCC DBPS***, this area was specified as the "Crescent Heights Development" and was anticipated to have medium/high density residential as well as office and commercial. In compliance with the ***WFJCC DBPS***, Corvallis is anticipated to be a multi-use planned unit development. Anticipated developed uses include commercial, multi-family residential, and single-family residential (1/8 acre or less). Some portions of the site will remain as undeveloped open space. The land use map from the ***WFJCC DBPS*** is included in the Appendix D.

Runoff

The proposed 297-acre site is located entirely within the West Fork Jimmy Camp Creek. This tributary has a drainage area of 4 square miles according to ***WFJCC DBPS.*** The developed area makes up less than 11% of the tributary's drainage area.

As noted in Section II-C, 81 percent of the site is made up of Type B soils. Drainage coefficients for HSG A&B soil types used were per Table 6-6 in the DCM. Refer to Appendix A for specific runoff coefficient values.

Flows

According to ***WFJCC DBPS***, the Corvallis (Crescent Heights) development will discharge at 3 separate points. Per UD-Detention modeling of the proposed detention basin, detention from this project will either be equal to or reduce the Q100 (Major Storm) discharge from the property from the pre-development. As the proposed development is not projected to increase runoff from the site, no additional burden should be placed on downstream drainage and detention basins. Additionally, due to the large size of the offsite drainage areas, the peak discharges from the proposed detention ponds are significantly offset from the peak flows from the offsite basins.

The hydrology for the site, which has been provided above, shows that this development complies with the latest study (***WFJCC DBPS***).

B. SYSTEM PRIORITIES/PHASING

No phasing of the development has been provided at this time. Once development of any portion of the site begins, the owner will be responsible for providing detention and water quality in accordance with this ***MDDP*** and the ***WFJCC DBPS***, before releasing downstream.

Additionally, any proposed development within the West Basin (Which contains all portions of the first developable piece of property measured perpendicularly from the channel outwards.) within Corvallis will initiate the requirement for a channel design study of WFJCC through the development to be submitted to the City along with the PDR/FDR.

C. GOVERNMENTAL AGENCY REQUIREMENTS

Other than the USACE 404 permit, there are no external governmental agency requirements for this development. A final Drainage Report for each future phase of development will be presented to the City of Fountain with the development of the construction documents.

D. MAINTENANCE REQUIREMENTS

All proposed road and drainage construction within the Corvallis development will be performed to City of Fountain standards. Proposed roads and drainage facilities within the public right of way will be maintained by the City of Fountain upon acceptance of these facilities after the warranty period. The proposed detention ponds will be privately owned and maintained by the metropolitan district. Maintenance requirements for all stormwater quality and erosion control procedures will be outlined in individual Erosion Control and Storm Water Management Plans. A Maintenance Road (as well as access to this road from public right-of-way) for the portion of West Fork of Jimmy Camp Creek running through the Corvallis site must be provided.

E. RECOMMENDATION FOR IMPLEMENTATION

It is recommended that any development of the site initiates the implementation of the detention and water quality procedures that have been detailed in this report. In doing so, the developed conditions will produce runoff comparable to or lower than existing conditions, which allows continued adherence to ***WFJCC DBPS*** and protects downstream owners and facilities.

F. EXCLUSIONS FROM ORIGINAL DBPS RECOMMENDATIONS:

A few items which are recommended in the initial DBPS have fallen out of favor in the governing drainage design criteria and will not be implemented in the proposed development. One item is the on-stream detention pond located on Jimmy Camp Creek-West Fork (Detention Basin 3031). This will be replaced by on-site or sub-regional detention basins which are offline from West Fork Jimmy Camp Creek.

The other item is the concrete checks called out every 150-200 feet along the channels through the site. Current best practice channel design criteria do not recommend these checks in this application due to associated channel maintenance/stability issues. The general guidelines (described in Section V. B. Step 3) call for grouted rip rap drop structures which is a current best practice device for channel drops, however this item will be subject to the best practices at time of design.

Other than the two above items, proposed detention pond locations for this development do not match exactly the locations indicated in the DBPS, but fulfill the intent described in that report. The proposed development will discharge to downstream infrastructure at or below the pre-development rates indicated in the referenced studies.

VII. Fee Development

A. Construction Cost Opinion

An engineer's estimate of probable construction costs will be provided with the Final Drainage Report for each phase of the development. The developer will pay all capital costs for the proposed roadway and drainage facilities.

B. Drainage Basin Fees

Drainage basin fees will be paid at the time of plat recordation. More detailed analysis of these fees will be completed in the appropriate PDR/FDR for each phase of the development.

a. Estimated Cost of Channel Improvements

Corvallis PUD
West Fork - Jimmy Camp Creek
Engineer's Opinion of Probable Cost

BID ITEM NO.	DESCRIPTION OF BID ITEM	QUANTITY	PAY UNIT	UNIT PRICE	TOTAL COST OF BID ITEM
1	Mobilization	1	LS	$100,000.00	$100,000
2	Water Control & Dewatering	1	LS	$60,000.00	$60,000
3	Erosion & Sediment Control	1	LS	$30,000.00	$30,000
4	Clearing & Grubbing	1	LS	$10,000.00	$10,000
5	Drop Structures (4 ft)	4	EA	$190,000.00	$760,000
6	Seeding (Wetland, Riparian, Upland)	1	LS	$20,000.00	$20,000
7	Willow Stakes	1	LS	$10,000.00	$10,000
8	Erosion Control Blanket	500	SY	$20.00	$10,000
9	Earthwork (Onsite Cut & Fill)	1	LS	$20,000.00	$20,000
10	Soil Rip Rap (Outside Bends)	2,200	SY	$100.00	$220,000
11	CDOT Class II Road Base (Access Road)	765	CY	$85.00	$65,000
				Subtotal	$1,305,000
				10% Contingency	$130,500
				Engineering	$78,300
				Estimated Total Cost	$1,513,800
				Developed Acres	297
				Anticipated Cost / Developed AC.	$5,093

Since the engineer has no control over the cost of labor, materials, equipment or services furnished by others, or over the contractor's method of determining prices, or over the competitive bidding or market conditions, the opinion of probable construction costs provided herein are made on the basis of the engineer's experience and qualifications and represents the best judgment as an experienced and qualified professional familiar with the construction industry. The engineer cannot, and does not guarantee that proposals, bid or actual construction costs will not vary from the opinion of probable costs.

Construction costs for channel improvements will be paid for by the Metropolitan District and provided by the developer. The Metropolitan District will be reimbursed via mill levees. To the extent possible, acquisition of easements, tracts or land will be the responsibility of the developer.

VIII. Summary

As described above, this report demonstrates compliance with the governing DCM and DBPS and will comply with downstream drainage reports.

IX. References

1. ***City of Colorado Springs Drainage Criteria Manual***, City of Colorado Springs, May 2014
2. ***Web Soil Survey of El Paso County Area, Colorado. Unites States Department of Agriculture Soil Conservation Service***, November 2015.
3. ***Flood Insurance Rate Maps for El Paso County, Colorado and Incorporated Areas, Panel 958 of 1300, Federal Emergency Management Agency***, Effective Date December 7, 2018.
4. ***Urban Storm Drainage Criteria Manual, Vol. 1-3*** by Urban Drainage and Flood Control District (UDFCD), January 2016
5. ***West Fork Jimmy Camp Creek Drainage Basin Planning Study (WFJCC DBPS),*** by Kiowa Engineering Corp. October 2003.
6. ***Master Drainage Development Plan (MDDP) The Glen at Widefield,*** by Kiowa Engineering Corp. December 1999.
7. ***Master Drainage Development Plan Amendment (MDDPA) The Glen at Widefield,*** by Kiowa Engineering Corp. June 2007.
8. ***Final Drainage Report (FDR F9) The Glen at Widefield Filing No. 9,*** by Kiowa Engineering Corp. July 2018.
9. ***Final Drainage Report (FDR F11) The Glen at Widefield Filing No. 11,*** by Kiowa Engineering Corp. December 2019.

APPENDIX A

HYDROLOGIC AND HYDRAULIC CALCULATIONS

Project Name:	Corvallis
Project Location:	Fountain, CO
Designer	NMS
Notes:	Existing Conditions

Matrix

Channel Flow Type Key

Heavy Meadow	2
Tillage/Field	3
Short Pasture and Lawns	4
Nearly Bare Ground	5
Grassed Waterway	6
Paved Areas	7

Average Channel Velocity: 5 ft/s (If specific channel vel is used, this will be ignored)
Average Slope for Initial Flow: 0.04 ft/ft (If Elevations are used, this will be ignored)

	Impervious %	7	2	65	100

Basin	Description	Area		Rational 'C' Values: Surface Type 1 (Single-Family 1 & 1/3 Ac. Lots)			Surface Type 2 (Greenbelts & Agriculture)			Surface Type 3 (Single-Family 1/8 Ac. Lots & Multi-Family)			Surface Type 4 (Impervious)			Weighted C-Factor		Flow Lengths: Initial	True Initial	Channel	True Channel	Initial Flow: High Point	Low Point	Average Slope	Initial Tc (min)	Channel Flow: High Point	Low Point	Average Slope	Channel Flow Type (See Key above)	Velocity (ft/s)	Channel Tc (min)	Tc Total (min)	Rainfall Intensity & Rational Flow Rate: i2	Q2	i5	Q5	i10	Q10	i100	Q100	% Imp
		SF	Acres	C5	C100	Area (SF)	C5	C100	Area (SF)	C5	C100	Area	C5	C100	Area	C5	C100	ft	Length ft	ft	Length ft	Elevation	Elevation	Slope		Elevation	Elevation	Slope	Ground Type	(ft/s)		(min)	in/hr	cfs	in/hr	cfs	in/hr	cfs	in/hr	cfs	
OS-1a	*Single Family > 2.5 Acre Lots (12% Impervious (min.))*	1,675,407	38.46	0.20	0.44		0.09	0.36	1474358	0.45	0.59		0.90	0.96	201049	0.19	0.44	300	300	2,290	2290	5,807	5,800	0.023	22.2	5800	5,725	3.28	4	1.3	30.5	52.7	1.4	**10.1**	1.7	**12.7**	2.0	**14.8**	2.9	**49.3**	13.8%
OS-1b	*Single Family > 2.5 Acre Lots (12% Impervious (min.))*	1,668,351	38.30	0.20	0.44		0.09	0.36	1468149	0.45	0.59		0.90	0.96	200202	0.19	0.44	900	300	1,871	2471	5,894	5,820	0.082	14.6	5820	5,780	2.14	4	1.0	40.6	55.2	1.3	**9.7**	1.7	**12.3**	1.9	**14.3**	2.8	**47.7**	13.8%
OS-2	*Fontaine Boulevard to crown of road*	42809	0.98	0.20	0.44		0.09	0.36		0.45	0.59		0.90	0.96	42809	0.90	0.96	25	25	1362	1362	5758	5757	0.040	1.2	5757	5719	2.79	7	3.3	6.9	8.1	3.5	**3.1**	4.4	**3.9**	5.2	**4.6**	7.4	**7.1**	100.0%
OS-3	*Offsite undeveloped parcel*	80878	1.86	0.20	0.44		0.09	0.36	80878	0.45	0.59		0.90	0.96		0.09	0.36	170	170	275	275	5739	5718	0.124	10.7	5718	5703	5.45	3	1.2	3.9	14.6	2.8	**0.5**	3.5	**0.6**	4.1	**0.7**	5.9	**4.0**	2.0%
OS-4	*Offsite undeveloped parcel*	797941	18.32	0.20	0.44		0.09	0.36	797941	0.45	0.59		0.90	0.96		0.09	0.36	301	300	1018	1019	5732	5719	0.043	20.1	5719	5696	2.26	3	0.7	22.9	43.0	1.6	**2.6**	2.0	**3.3**	2.3	**3.8**	3.3	**21.8**	2.0%
OS-5	*Fontaine Boulevard to crown of road*	32917	0.76	0.20	0.44		0.09	0.36		0.45	0.59		0.90	0.96	32917	0.90	0.96	25	25	1100	1100	5771	5770	0.040	1.2	5770	5740	2.73	7	3.3	3.6	6.8	3.7	**2.6**	4.7	**3.2**	5.5	**3.8**	7.9	**5.8**	100.0%
OS-6	*Fontaine Boulevard to crown of road*	33529	0.77	0.20	0.44		0.09	0.36		0.45	0.59		0.90	0.96	33529	0.90	0.96	25	25	1100	1100	5771	5770	0.040	1.2	5770	5743	2.45	7	3.1	5.9	7.1	3.7	**2.6**	4.6	**3.2**	5.4	**3.8**	7.8	**5.8**	100.0%
OS-7	*Single Family Residential to east*	126529	2.90	0.20	0.44	126529	0.09	0.36		0.45	0.59		0.90	0.96		0.20	0.44	40	40	160	160	5708	5706	0.050	6.2	5706	5702	2.50	4	1.1	2.4	8.6	3.4	**2.0**	4.3	**2.5**	5.1	**3.0**	7.3	**9.4**	7.0%
1-D (OS-8)	*Offsite undeveloped parcel*	961463	22.07	0.20	0.44		0.09	0.36	961463	0.45	0.59		0.90	0.96		0.09	0.36	300	300	1055	1055	5731	5715	0.053	18.7	5715	5682	3.13	3	0.9	20.0	38.7	1.7	**3.3**	2.1	**4.2**	2.4	**4.9**	3.5	**28.1**	2.0%
EX-1	*West side of site*	2959892	67.95	0.20	0.44		0.09	0.36	2959892	0.45	0.59		0.90	0.96		0.09	0.36	300	300	2266	2266	5753	5736	0.057	18.3	5736	5682	2.38	3	0.8	49.8	68.2	1.2	**7.1**	1.5	**9.0**	1.7	**10.5**	2.4	**60.3**	2.0%
EX-2	*Northwest corner*	449242	10.31	0.20	0.44		0.09	0.36	449242	0.45	0.59		0.90	0.96		0.09	0.36	300	300	350	350	5752	5738	0.047	19.6	5738	5719	5.43	3	1.2	5.0	24.6	2.1	**2.0**	2.7	**2.5**	3.2	**3.0**	4.5	**17.0**	2.0%
EX-3	*Central-west*	2262585	51.94	0.20	0.44		0.09	0.36	2262585	0.45	0.59		0.90	0.96		0.09	0.36	300	300	1530	1530	5740	5728	0.040	20.6	5728	5688	2.61	3	0.8	31.6	52.2	1.4	**6.5**	1.7	**8.2**	2.0	**9.5**	2.9	**54.8**	2.0%
EX-4	*Central-east*	2551274	58.57	0.20	0.44		0.09	0.36	2551274	0.45	0.59		0.90	0.96		0.09	0.36	300	300	2710	2710	5768	5756	0.040	20.6	5756	5685	2.62	3	0.8	56.0	76.6	1.1	**5.7**	1.3	**7.2**	1.6	**8.3**	2.3	**48.1**	2.0%
EX-5	*East side of site*	3769253	86.53	0.20	0.44		0.09	0.36	3769253	0.45	0.59		0.90	0.96		0.09	0.36	300	300	1830	1830	5770	5765	0.017	27.6	5765	5686	4.32	3	1.0	29.4	57.0	1.3	**10.2**	1.6	**12.8**	1.9	**15.0**	2.7	**86.3**	2.0%

DESIGN POINT		Area		Rational 'C' Values: Surface Type 1 (Single-Family 1 & 1/3 Ac. Lots)			Surface Type 2 (Greenbelts & Agriculture)			Surface Type 3 (Single-Family 1/8 Ac. Lots & Multi-Family)			Surface Type 4 (Impervious)			Weighted C-Factor		Flow Lengths: Initial	True Initial	Channel	True Channel	Initial Flow: High Point	Low Point	Average Slope	Initial Tc (min)	Channel Flow: High Point	Low Point	Average Slope	Channel Flow Type (See Key above)	Velocity (ft/s)	Channel Tc (min)	Tc Total (min)	Rainfall Intensity & Rational Flow Rate: i2	Q2	i5	Q5	i10	Q10	i100	Q100	% Imp
	Description	SF	Acres	C5	C100	Area (SF)	C5	C100	Area (SF)	C5	C100	Area	C10	C100	Area	C5	C100	ft	Length ft	ft	Length ft	Elevation	Elevation	Slope		Elevation	Elevation	Slope	Ground Type	(ft/s)		(min)	in/hr	cfs	in/hr	cfs	in/hr	cfs	in/hr	cfs	
E1	*OS-1, OS-2*	3343757	76.76	0.20	0.44	0	0.09	0.36	2942507	0.45	0.59	0	0.90	0.96	401251	0.19	0.44	300	300	2290	2290	5807	5800	0.023	22.2	5800	5725	3.28	4	1.3	30.5	52.7	1.4	**20.1**	1.7	**25.3**	2.0	**29.5**	2.9	**98.5**	13.8%
E2	*OS-3, EX-2*	492051	11.30	0.20	0.44	0	0.09	0.36	449242	0.45	0.59	0	0.90	0.96	42809	0.17	0.42	300	300	350	350	5752	5738	0.047	18.0	5738	5719	5.43	3	1.2	5.0	23.0	2.2	**4.3**	2.8	**5.4**	3.3	**6.3**	4.7	**22.5**	10.5%
E3	*E2, OS-3, OS-4*	1370870	31.47	0.20	0.44	0	0.09	0.36	1328061	0.45	0.59	0	0.90	0.96	42809	0.12	0.38	300	300	1550	1550	5752	5738	0.047	19.0	5738	5703	2.26	3	0.7	34.8	53.8	1.3	**5.1**	1.7	**6.5**	2.0	**7.5**	2.9	**34.4**	5.1%
E4	*E1, E3, EX-1, OS-8*	8635982	198.25	0.20	0.44	0	0.09	0.36	8191923	0.45	0.59	0	0.90	0.96	444060	0.14	0.40	300	300	2290	2290	5807	5800	0.023	22.2	5800	5682	5.15	3	1.1	33.8	56.0	1.3	**36.7**	1.7	**46.3**	1.9	**54.0**	2.8	**222.3**	7.0%
E5	*OS-5, EX-3*	2295502	52.70	0.20	0.44	0	0.09	0.36	2262585	0.45	0.59	0	0.90	0.96	32917	0.11	0.37	300	300	1530	1530	5740	5728	0.040	20.2	5728	5688	2.61	3	0.8	31.6	51.8	1.4	**8.1**	1.7	**10.2**	2.0	**11.9**	2.9	**57.5**	3.4%
E6	*EX4*	2551274	58.57	0.20	0.44	0	0.09	0.36	2551274	0.45	0.59	0	0.90	0.96	0	0.09	0.36	300	300	2710	2710	5768	5756	0.040	20.6	5756	5685	2.62	3	0.8	56.0	76.6	1.1	**5.7**	1.3	**7.2**	1.6	**8.3**	2.3	**48.1**	2.0%
E7	*EX-5, OS-6, OS-7*	3929311	90.20	0.20	0.44	126529	0.09	0.36	3769253	0.45	0.59	0	0.90	0.96	33529	0.11	0.37	300	300	1830	1830	5770	5765	0.017	27.0	5765	5686	4.32	3	1.0	29.4	56.5	1.3	**13.1**	1.6	**16.5**	1.9	**19.2**	2.8	**93.1**	3.0%
E8	*E4, E5 + MDDPA R3030*	10931485	250.95	0.20	0.44	0	0.09	0.36	10454508	0.45	0.59	0	0.90	0.96	476977	0.13	0.39	300	300	2290	2290	5807	5800	0.023	23.7	5800	5682	5.15	3	1.1	33.8	57.5	1.3	**42.5**	1.6	**403.5**	1.9	**62.5**	2.7	**2040.7**	6.3%

Note: Q2, Q5 & Q10 are based on C5; Q25, Q50 & Q100 are based on C100

RATIONAL METHOD - PROPOSED CONDITIONS

Project Name: Corvallis
Project Location: Fountain, CO
Designer NMS
Notes: Proposed Conditions

Matrix

Channel Flow Type Key
Heavy Meadow 2
Tillage/Field 3
Short Pasture and Lawns 4
Nearly Bare Ground 5
Grassed Waterway 6
Paved Areas 7

Average Channel Velocity: 5 ft/s (If specific channel vel is used, this will be ignored)
Average Slope for Initial Flow: 0.04 ft/ft (If Elevations are used, this will be ignored)

Impervious %: 30 | 2 | 65 | 100

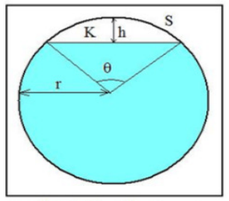
Basin	Description	Area SF	Area Acres	Rational 'C' Values: Surface Type 1 (Single-Family 1 & 1/3 Ac. Lots) C5	C100	Area (SF)	Surface Type 2 (Greenbelts & Agriculture) C5	C100	Area (SF)	Surface Type 3 (Single-Family 1/8 Ac. Lots & Multi-Family) C5	C100	Area	Surface Type 4 (Impervious) C10	C100	Area	Weighted C-Factor C5	C100	Flow Lengths: Initial ft	True Initial Length ft	Channel ft	True Channel Length ft	Initial Flow: High Point Elevation	Low Point Elevation	Average Slope	Initial Tc (min)	Channel Flow: High Point Elevation	Low Point Elevation	Average Slope	Channel Flow Type (See Key above) Ground Type	Velocity (ft/s)	Channel Tc (min)	Tc Total (min)	Rainfall Intensity & Rational Flow Rate: Q2 cfs	i5 in/hr	Q5 cfs	i100 in/hr	Q100 cfs	% Imp	Impervious (Acres)
OS-1a	*Single Family > 2.5 Acre Lots (12% Impervious (min.))*	1,675,407	38.46	0.20	0.44		0.09	0.36	1474358	0.45	0.59		0.90	0.96	201049	0.19	0.44	300	300	2,290	2290	5,807	5,800	0.023	22.2	5800	5,725	3.28	4	1.3	30.5	52.7	**10.1**	1.7	**12.7**	2.9	**49.3**	13.8%	
OS-1b	*Single Family > 2.5 Acre Lots (12% Impervious (min.))*	1,668,351	38.30	0.20	0.44		0.09	0.36	1468149	0.45	0.59		0.90	0.96	200202	0.19	0.44	900	300	1,871	2471	5,894	5,820	0.082	14.6	5820	5,780	2.14	4	1.0	40.6	55.2	**9.7**	1.7	**12.3**	2.8	**47.7**	13.8%	
OS-2	*Fontaine BLVD*	42,809	0.98	0.20	0.44		0.09	0.36		0.45	0.59		0.90	0.96	42809	0.90	0.96	25	25	1,362	1362	5,758	5,757	0.040	1.2	5757	5,719	2.79	7	3.3	6.9	8.1	**3.1**	4.4	**3.9**	7.4	**7.1**	100.0%	
OS-3	*Aggricultural Land*	80,878	1.86	0.20	0.44		0.09	0.36	80878	0.45	0.59		0.90	0.96		0.09	0.36	170	170	275	275	5,739	5,718	0.124	10.7	5718	5,703	5.45	2	0.6	7.9	18.5	**0.4**	3.1	**0.5**	5.3	**3.5**	2.0%	
OS-4	*Aggricultural Land*	797,941	18.32	0.20	0.44		0.09	0.36	797941	0.45	0.59		0.90	0.96		0.09	0.36	300	300	1,018	1018	5,732	5,719	0.043	20.1	5719	5,696	2.26	2	0.4	45.8	65.8	**2.0**	1.5	**2.5**	2.5	**16.6**	2.0%	
OS-5	*Fontaine BLVD*	32,917	0.76	0.20	0.44		0.09	0.36		0.45	0.59		0.90	0.96	32917	0.90	0.96	25	25	1,100	1100	5,771	5,770	0.040	1.2	5770	5,740	2.73	7	3.3	5.6	6.8	**2.6**	4.7	**3.2**	7.9	**5.8**	100.0%	
OS-6	*Fontaine BLVD*	33,529	0.77	0.20	0.44		0.09	0.36		0.45	0.59		0.90	0.96	33529	0.90	0.96	25	25	1,100	1100	5,771	5,770	0.040	1.2	5770	5,743	2.45	7	3.1	5.9	7.1	**2.6**	4.6	**3.2**	7.8	**5.8**	100.0%	
OS-7	*Back of Lots in Cottonwood Grove V1*	126,529	2.90	0.20	0.44	126529	0.09	0.36		0.45	0.59		0.90	0.96		0.20	0.44	40	40	160	160	5,708	5,706	0.050	6.2	5706	5,702	2.50	4	1.1	2.4	8.6	**2.0**	4.3	**2.5**	7.3	**9.4**	30.0%	
1A	*Single Family Residential*	1,205,866	27.68	0.20	0.44		0.09	0.36		0.45	0.59	1205866	0.90	0.96		0.45	0.59	50	50	2,025	2025	5,775	5,772	0.070	4.5	5772	5,694	3.85	6	2.9	11.5	16.0	**33.4**	3.4	**42.2**	5.6	**92.9**	65.0%	17.99
1B	*Commercial*	693,868	15.93	0.20	0.44		0.09	0.36	146832	0.45	0.59		0.90	0.96	547036	0.73	0.84	50	50	940	940	5,745	5,744	0.020	3.9	5744	5,714	3.19	7	3.5	4.4	8.3	**40.8**	4.4	**51.4**	7.4	**99.3**	79.3%	12.63
1D (Formerly OS-8)	*Single-Family Residential/ Open Space*	961,463	22.07	0.20	0.44		0.09	0.36	426983	0.45	0.59	534480	0.90	0.96		0.30	0.49	50	50	940	940	5,745	5,744	0.020	8.4	5744	5,714	3.19	7	3.5	4.4	12.8	**19.6**	3.7	**24.8**	6.2	**67.9**	37.0%	8.17
2	*Single Family Residential*	1,171,681	26.90	0.20	0.44		0.09	0.36		0.45	0.59	1171681	0.90	0.96		0.45	0.59	50	50	1,916	1916	5,758	5,746	0.240	3.0	5746	5,698	2.51	6	2.4	13.5	16.4	**32.1**	3.3	**40.5**	5.6	**89.2**	65.0%	17.48
3	*Open Space*	701,988	16.12	0.20	0.44		0.09	0.36	647388	0.45	0.59	54600	0.90	0.96		0.12	0.38	50	50	875	875	5,714	5,712	0.040	8.2	5712	5,682	3.43	3	0.9	15.8	24.0	**4.2**	2.7	**5.3**	4.6	**28.4**	6.9%	1.11
4	*School*	741,755	17.03	0.20	0.44		0.09	0.36	97368	0.45	0.59	417195	0.90	0.96	227192	0.55	0.68	50	50	1,390	1390	5,707	5,704	0.060	4.0	5704	5,695	0.65	6	1.2	19.9	23.9	**20.6**	2.7	**25.9**	4.6	**53.8**	67.5%	11.49
5	*School*	258,738	5.94	0.20	0.44		0.09	0.36	77622	0.45	0.59		0.90	0.96	181117	0.66	0.78	50	50	425	425	5,710	5,708	0.040	3.7	5708	5,686	5.18	6	3.4	2.1	5.8	**15.4**	4.9	**19.4**	8.3	**38.6**	70.6%	4.19
6	*Single-Family Residential*	437,611	10.05	0.20	0.44		0.09	0.36		0.45	0.59	437611	0.90	0.96		0.45	0.59	50	50	1,039	1039	5,717	5,716	0.020	6.8	5716	5,698	1.78	6	2.0	8.9	15.7	**12.3**	3.4	**15.5**	5.7	**34.1**	65.0%	6.53
7	*Open Space / Single-Family Residential*	840,270	19.29	0.20	0.44		0.09	0.36	840270	0.45	0.59		0.90	0.96		0.09	0.36	300	300	1,477	1477	5,739	5,736	0.010	32.7	5736	5,700	2.44	3	0.8	31.8	64.5	**2.1**	1.5	**2.6**	2.5	**17.8**	2.0%	0.39
8	*Commercial*	282,934	6.50	0.20	0.44		0.09	0.36	14147	0.45	0.59		0.90	0.96	268787	0.86	0.93	50	50	610	610	5,767	5,763	0.080	1.6	5763	5,749	2.30	7	3.0	3.4	5.0	**22.8**	5.1	**28.7**	8.6	**52.2**	95.1%	6.18
9	*Single-Family Residential*	875,972	20.11	0.20	0.44		0.09	0.36	106346	0.45	0.59	769626	0.90	0.96		0.41	0.57	50	50	827	827	5,767	5,764	0.060	5.0	5764	5,732	3.87	6	2.9	4.7	9.7	**27.3**	4.1	**34.4**	7.0	**80.5**	57.4%	11.53
10	*Single-Family Residential*	688,524	15.81	0.20	0.44		0.09	0.36	112459	0.45	0.59	576065	0.90	0.96		0.40	0.56	50	50	960	960	5,730	5,728	0.050	5.4	5728	5,702	2.66	6	2.4	6.6	12.0	**19.3**	3.8	**24.3**	6.4	**57.2**	54.7%	8.65
11	*Multi-Family Residential*	650,506	14.93	0.20	0.44		0.09	0.36	68366	0.45	0.59	582140	0.90	0.96		0.42	0.57	50	50	1,241	1241	5,725	5,724	0.020	7.1	5724	5,686	3.06	6	2.6	8.0	15.1	**17.3**	3.5	**21.8**	5.8	**49.8**	58.4%	8.72
12	*Single-Family Residential*	750,753	17.23	0.20	0.44		0.09	0.36		0.45	0.59	750753	0.90	0.96		0.45	0.59	50	50	1,484	1484	5,770	5,768	0.040	5.4	5768	5,733	2.36	7	3.0	8.2	13.6	**22.5**	3.6	**28.3**	6.1	**62.4**	65.0%	11.20
13	*Single-Family Residential*	227,943	5.23	0.20	0.44		0.09	0.36		0.45	0.59	227943	0.90	0.96		0.45	0.59	50	50	484	484	5,756	5,754	0.040	5.4	5754	5,731	4.75	6	3.3	2.5	7.9	**8.4**	4.5	**10.6**	7.5	**23.3**	65.0%	3.40
14	*Single-Family Residential*	485,474	11.14	0.20	0.44		0.09	0.36		0.45	0.59	485474	0.90	0.96		0.45	0.59	50	50	1,030	1030	5,728	5,727	0.020	6.8	5727	5,695	3.11	6	2.6	6.5	13.3	**14.6**	3.7	**18.5**	6.1	**40.6**	65.0%	7.24
15	*Single-Family Residential*	765,200	17.57	0.20	0.44		0.09	0.36		0.45	0.59	765200	0.90	0.96		0.45	0.59	50	50	1,095	1095	5,725	5,723	0.040	5.4	5723	5,688	3.20	6	2.6	6.9	12.3	**23.9**	3.8	**30.1**	6.3	**66.2**	65.0%	11.42
16	*Commercial and Park*	1,417,785	32.55	0.20	0.44		0.09	0.36	286493	0.45	0.59		0.90	0.96	1131292	0.74	0.84	50	50	1,511	1511	5,727	5,724	0.060	2.6	5724	5,687	2.45	7	3.1	8.1	10.7	**76.9**	4.0	**96.9**	6.7	**184.8**	80.2%	26.10
17	*Commercial*	143,572	3.30	0.20	0.44		0.09	0.36	7179	0.45	0.59		0.90	0.96	136393	0.86	0.93	50	50	175	175	5,688	5,687	0.020	2.5	5687	5,686	0.57	7	1.4	2.1	5.0	**11.6**	5.1	**14.6**	8.6	**26.5**	95.1%	3.13
																																						44%	**177.56**

PROPOSED DESIGN POINT	Description	Area SF	Area Acres	Rational 'C' Values: Surface Type 1 (Single-Family 1 & 1/3 Ac. Lots) C5	C100	Area (SF)	Surface Type 2 (Greenbelts & Agriculture) C5	C100	Area (SF)	Surface Type 3 (Single-Family 1/8 Ac. Lots & Multi-Family) C5	C100	Area	Surface Type 4 (Impervious) C10	C100	Area	Weighted C-Factor C5	C100	Flow Lengths: Initial ft	True Initial Length ft	Channel ft	True Channel Length ft	Initial Flow: High Point Elevation	Low Point Elevation	Average Slope	Initial Tc (min)	Channel Flow: High Point Elevation	Low Point Elevation	Average Slope	Channel Flow Type (See Key above) Ground Type	Velocity (ft/s)	Channel Tc (min)	Tc Total (min)	Rainfall Intensity & Rational Flow Rate: Q2 cfs	i5 in/hr	Q5 cfs	i100 in/hr	Q100 cfs	% Imp	
E1	*OS-1a and OS-1b*	3,343,757	76.76	0.20	0.44	0	0.09	0.36	2942507	0.45	0.59	0	0.90	0.96	401251	0.19	0.44	900	300	3,152	3752	5,885	5,820	0.072	15.2	5820	5,725	3.01	4	1.2	51.6	66.8	**17.2**	1.5	**21.7**	2.5	**84.4**	13.8%	10.56
DP1	*E1+DF-1 Release+DF-2 Release*	4,549,623	104.44	0.20	0.44	0	0.09	0.36	2942507	0.45	0.59	1205866	0.90	0.96	401251	0.26	0.48	900	300	5,177	5777	5,885	5,820	0.072	14.1	5820	5,694	2.44	7	3.1	31.1	45.2			**25.3**		**110.3**	27.3%	28.56
DP2	*OS-2, 1A, 1D, 2, 3*	4,083,807	93.75	0.20	0.44	0	0.09	0.36	1,074,371	0.45	0.59	2,966,627	0.90	0.96	42,809	0.37	0.54	50	50	1,916	1916	5,758	5,746	0.240	3.3	5746	5,698	2.51	7	3.2	10.1	13.4	**100.9**	3.6	**127.1**	6.1	**311.7**	48.8%	45.74
DP3	*DP1+DP2 Treated (DF-3 Release)*	8,633,430	198.20	0.20	0.44	0	0.09	0.36	4016878	0.45	0.59	4172493	0.90	0.96	444060	0.31	0.51	900	300	5,177	5777	5,885	5,820	0.072	13.2	5820	5,681	2.68	7	3.2	29.9	43.1	**96.0**		**33.6**		**185.2**	37.5%	74.30
DP4	*7*	840,270	19.29	0.20	0.44	0	0.09	0.36	854416	0.45	0.59	0	0.90	0.96	268787	0.38	0.68	50	50	2,087	2087	5,767	5,763	0.080	4.8	5763	5,700	3.02	7	3.5	10.0	14.8	**20.4**		**2.6**		**17.8**	34.0%	6.56
DP5	*OS-3, OS4, DPBS 3020, DP4*	2,011,951	46.19	0.20	0.44	0	0.09	0.36	1733235	0.45	0.59	0	0.90	0.96	268787	0.20	0.44	300	300	1,018	1018	5,732	5,719	0.043	17.9	5719	5,696	2.26	6	2.2	7.6	25.5	**19.6**		**352.6**		**1798.9**	15.1%	6.97
DP6	*4, 6*	1,179,366	27.07	0.20	0.44	0	0.09	0.36	97368	0.45	0.59	854806	0.90	0.96	227192	0.51	0.65	50	50	2,106	2106	5,717	5,716	0.020	6.2	5716	5,695	1.00	4	0.7	52.9	59.0	**17.7**	1.6	**22.3**	2.7	**47.7**	66.5%	18.02
DP7	*DP3+DP5+DP6 Treated (DF-4 Release)*	11,824,747	271.46	0.20	0.44	0	0.09	0.36	5847481	0.45	0.59	5127299	0.90	0.96	940039	0.33	0.51	300	300	5,177	5177	5,885	5,820	0.217	9.2	5820	5,695	2.41	6	2.3	17.1	46.3	**125.7**		**391.0**		**2006.1**	36.6%	99.28
DP8	*9, 10, OS-5*	1,597,413	36.67	0.20	0.44	0	0.09	0.36	218805	0.45	0.59	1345691	0.90	0.96	32917	0.41	0.57	25	25	2,887	2887	5,771	5,770	0.040	4.1	5770	5,702	2.36	7	3.0	15.9	19.9	**36.3**	3.0	**45.8**	5.1	**106.9**	57.1%	20.94
DP9	*DP8, 5*	1,856,152	42.61	0.20	0.44	0	0.09	0.36	296426	0.45	0.59	1345691	0.90	0.96	214034	0.45	0.60	25	25	4,128	4128	5,771	5,770	0.040	3.8	5770	5,686	2.03	5	1.4	48.6	52.5	**26.5**	1.7	**33.4**	2.9	**74.7**	59.0%	25.13
DP10	*DP9, 11*	2,506,658	57.54	0.20	0.44	0	0.09	0.36	364792	0.45	0.59	1927831	0.90	0.96	214034	0.44	0.59	25	25	4,178	4178	5,771	5,770	0.040	3.9	5770	5,686	2.01	6	2.1	32.8	36.7	**43.6**	2.2	**54.9**	3.6	**123.8**	58.8%	33.85
DP11	*DP10 Treated (DF-5 Release)*	2,506,658	57.54	0.20	0.44	0	0.09	0.36	364792	0.45	0.59	1927831	0.90	0.96	441226	0.52	0.68	25	25	4,178	4178	5,771	5,770	0.040	3.4	5770	5,686	2.01	6	2.1	32.8	36.2	**51.9**		**6.6**		**48.1**	67.9%	39.06
DP12	*OS-6, 12*	784,282	18.00	0.20	0.44	0	0.09	0.36	0	0.45	0.59	750753	0.90	0.96	33529	0.47	0.61	25	25	2,584	2584	5,771	5,770	0.040	3.7	5770	5,733	1.43	7	2.4	18.2	21.9	**19.5**	2.9	**24.5**	4.8	**53.5**	66.5%	11.97
DP12a	*DP-12 Treated (DF-7 Release) & DF-6 Release*	1,067,216	24.50	0.20	0.44	0	0.09	0.36	14,147	0.45	0.59	750,753	0.90	0.96	302,316	0.58	0.70	25	25	2,584	2584	5,708	5,706	0.080	2.4	5706	5,731	1.43	7	2.4	18.2	20.6	**33.7**		**3.2**		**28.8**	74.1%	18.15
DP13	*13, 14*	713,417	16.38	0.20	0.44	0	0.09	0.36	0	0.45	0.59	713417	0.90	0.96	0	0.45	0.59	50	50	1,514	1514	5,756	5,754	0.040	5.4	5754	5,695	3.90	4	1.4	18.5	23.9	**16.2**	2.7	**20.4**	4.6	**44.9**	65.0%	10.65
DP14	*DP13, 15, 17*	1,622,189	37.24	0.20	0.44	0	0.09	0.36	7179	0.45	0.59	1478617	0.90	0.96	136393	0.49	0.63	50	50	2,609	2609	5,756	5,754	0.040	5.1	5754	5,688	2.53	4	1.1	39.3	44.4	**28.0**	1.9	**35.3**	3.2	**76.2**	67.7%	25.20
DP15	*DP12 Treated (DF-7Release), 16 Treated (DF-9 Release), & DF-6 Release*	2,611,529	59.95	0.20	0.44	0	0.09	0.36	300,640	0.45	0.59	750,753	0.90	0.96	1,433,608	0.64	0.74	50	50	4,095	4095	5,727	5,724	0.060	3.3	5724	5,687	0.90	7	1.9	36.0	39.3	**63.4**		**7.8**		**65.8**	73.8%	44.25
DP16	*DP14 Treated (DF-8 Release)+DP15*	4,233,718	97.19	0.20	0.44	0	0.09	0.36	307818	0.45	0.59	2229370	0.90	0.96	1570001	0.58	0.70	50	50	6,704	6704	5,727	5,724	0.060	3.8	5724	5,687	0.55	7	1.4	79.0	82.8	**57.6**		**12.8**		**110.1**	71.5%	69.45

Note: DPs 3, 5, & 7 were updated to reflect an altered value at upstream Design Point R3030 (Q100: 1761 cfs & Q5: 347 cfs)from the MDDP Amendment for Glen at Widefield. The Amendment reduced flows to the north boundary of Glen at Widefield at DP 7 to Q100: 2,020 cfs and Q5: 401.

Note: Q2, Q5 & Q10 are based on C5; Q25, Q50 & Q100 are based on C100

Design Point	Notes		Max Q (Q100) Proposed	Capacity Analysis	Storm Pipe Calculated Max Q for Pipe (CFS)	Percent of Pipe Capacity Used	n(full)	Slope (ft/ft)	n	Pipe Diameter (ft)	Width (ft) Box Culvert Only	Pipe Depth (inches)	Optimum Flow Depth (+/- 0.94 x D)	Θ (Radians)	A (Sq. Ft.)	Wetted Perimeter (ft)	Velocity at Max Pipe Capacity
E1	OS-1a and OS-1b		84.4	Adequate	105.4	80%	0.013	0.010	0.013	3.5		42	3.29	0.990	9.385	9.263	11.23
DP1	E1+DF-1 Release+DF-2 Release		107.0	Adequate	150.4	71%	0.013	0.010	0.013	4		48	3.76	0.990	12.259	10.587	12.27
1A	Sub-basin 1A		92.9	Adequate	105.4	88%	0.013	0.010	0.013	3.5		42	3.29	0.990	9.385	9.263	11.23
DP2	OS-2, 1A, 1D, 2, 3	Very Conservative at Residential Collector. Flows will likely be split by a future FDR.	283.4	Pressure Flow	272.7	104%	0.013	0.010	0.013	5		60	4.7	0.990	19.154	13.233	14.24
DP3	DP1+DP2 Treated (DF-3 Release)		181.9	Adequate	205.9	88%	0.013	0.010	0.013	4.5		54	4.23	0.990	15.515	11.910	13.27
DP4	7		17.8	Adequate	43.0	41%	0.013	0.010	0.013	2.5		30	2.35	0.990	4.788	6.617	8.97
6	Sub-basin 6		34.1	Adequate	43.0	79%	0.013	0.010	0.013	2.5		30	2.35	0.990	4.788	6.617	8.97
DP6	4, 6		47.7	Adequate	52.6	91%	0.013	0.015	0.013	2.5		30	2.35	0.990	4.788	6.617	10.99
DP8	9, 10, OS-5		106.9	Adequate	129.0	83%	0.013	0.015	0.013	3.5		42	3.29	0.990	9.385	9.263	13.75
DP9	DP8, 5		74.7	Adequate	105.4	71%	0.013	0.010	0.013	3.5		42	3.29	0.990	9.385	9.263	11.23
DP11	DP10 Treated (DF-5 Release)		48.1	Adequate	69.8	69%	0.013	0.010	0.013	3		36	2.82	0.990	6.895	7.940	10.13
DP12a	DP-12 Treated (DF-7 Release) & DF-6 Release		28.8	Adequate	43.0	67%	0.013	0.010	0.013	2.5		30	2.35	0.990	4.788	6.617	8.97
13	Sub-basin 13		23.3	Adequate	43.0	54%	0.013	0.010	0.013	2.5		30	2.35	0.990	4.788	6.617	8.97
DP13	13, 14		44.9	Adequate	69.8	64%	0.013	0.010	0.013	3		36	2.82	0.990	6.895	7.940	10.13
DP15	DP12 Treated (DF-7Release), 16 Treated (DF-9 Release), & DF6 Release		65.8	Adequate	105.4	62%	0.013	0.010	0.013	3.5		42	3.29	0.990	9.385	9.263	11.23
DF-1	PRELIMINARY DETENTION POND OUTFALL PIPE		8.8	Adequate	11.0	80%	0.013	0.010	0.013	1.5		18	1.41	0.990	1.724	3.970	6.38
DF-2	PRELIMINARY DETENTION POND OUTFALL PIPE		13.8	Adequate	23.7	58%	0.013	0.010	0.013	2		24	1.88	0.990	3.065	5.293	7.73
DF-3	PRELIMINARY DETENTION POND OUTFALL PIPE		74.9	Pressure Flow	69.8	107%	0.013	0.010	0.013	3		36	2.82	0.990	6.895	7.940	10.13
DF-4	PRELIMINARY DETENTION POND OUTFALL PIPE		22.0	Adequate	23.7	93%	0.013	0.010	0.013	2		24	1.88	0.990	3.065	5.293	7.73
DF-5	PRELIMINARY DETENTION POND OUTFALL PIPE		48.1	Adequate	69.8	69%	0.013	0.010	0.013	3		36	2.82	0.990	6.895	7.940	10.13
DF-6	PRELIMINARY DETENTION POND OUTFALL PIPE		9.3	Adequate	11.0	85%	0.013	0.010	0.013	1.5		18	1.41	0.990	1.724	3.970	6.38
DF-7	PRELIMINARY DETENTION POND OUTFALL PIPE		19.5	Adequate	43.0	45%	0.013	0.010	0.013	2.5		30	2.35	0.990	4.788	6.617	8.97
DF-8	PRELIMINARY DETENTION POND OUTFALL PIPE		44.3	Adequate	69.8	63%	0.013	0.010	0.013	3		36	2.82	0.990	6.895	7.940	10.13
DF-9	PRELIMINARY DETENTION POND OUTFALL PIPE		46.3	Adequate	69.8	66%	0.013	0.010	0.013	3		36	2.82	0.990	6.895	7.940	10.13



Partially Full Pipe Flow Parameters
(More Than Half Full)

r = D/2

h = 2r - y

(hydraulic radius)

R = A/P

(Manning Equation)

$Q = (1.49/n)(A)(R^{2/3})(S^{1/2})$

V = Q/A

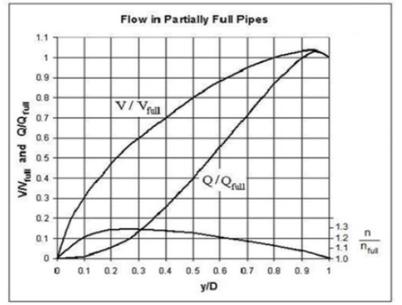
P

$$\theta = 2\arccos\left(\frac{r - h}{r}\right)$$

$$A = \pi r^2 - \frac{r^2(\theta - \sin\theta)}{2}$$

$$P = 2\pi r - r * \theta$$

Equation used for n/n_{full}: $n/n_{full} = 1.25 - (y/D - 0.5)^{*}0.5$ (for $0.5 \leq y/D \leq 1$)



Flow In Partially Full Pipes

PROPOSED WATER QUALITY AND DETENTION SUMMARY

Corvallis

Detention/WQ Pond	TOTAL AREA (AC)	CONTRIBUTING SUB-BASINS	% IMPERVIOUS	VOLUME REQUIRED (AC-FT)	Q(5) DISCHARGE (cfs)	Q(100) DISCHARGE (cfs)	DESCRIPTION:	Discharge Pipe Size
DF-1	5.65	1B-COMMERCIAL	95%	0.89	2.1	8.8	Northwest Commercial	18.0
DF-2	8.25	1B-MULTIFAMILY	70%	1.00	1.2	13.8	Northwest Multi-Family	24.0
DF-3*	81.82	1A, 1D, 2, 3,OS-2	65%	7.22	8.3	74.9	West Single-Family (Slight over-detention to maintain Q listed in Glen at Widefield MDDP Amendment)	36.0
DF-4*	23.14	4, 6	65%	2.64	4.8	22.0	Southwest Single-Family	24.0
DF-5*	57.54	5, 9,10, 11, OS-5	70%	6.98	6.6	48.1	South Single-Family & School Site	36.0
DF-6	6.50	8	95%	1.02	0.2	9.3	Northeast Commercial	18.0
DF-7	18.00	12, OS-6	70%	2.18	3.0	19.5	Northeast Multi-Family	30.0
DF-8*	37.24	13, 14, 15, 17	70%	4.51	5.0	44.3	Southeast Single-Family & Commercial	36.0
DF-9*	35.45	16	80%	4.79	4.8	46.3	Southeast Commercial Pond	36.0

Culvert Calculator Report
CV177

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	5,688.70	ft	Headwater Depth/Height	1.13	
Computed Headwater Elevation	5,688.17	ft	Discharge	87.06	cfs
Inlet Control HW Elev.	5,688.06	ft	Tailwater Elevation	5,684.52	ft
Outlet Control HW Elev.	5,688.17	ft	Control Type	Outlet Control	

Grades					
Upstream Invert	5,684.78	ft	Downstream Invert	5,684.52	ft
Length	77.00	ft	Constructed Slope	0.003377	ft/ft

Hydraulic Profile					
Profile	M2		Depth, Downstream	2.15	ft
Slope Type	Mild		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	2.15	ft
Velocity Downstream	8.03	ft/s	Critical Slope	0.005723	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Concrete		Span	3.00	ft
Section Size	36 inch		Rise	3.00	ft
Number Sections	2				

Outlet Control Properties					
Outlet Control HW Elev.	5,688.17	ft	Upstream Velocity Head	0.74	ft
Ke	0.20		Entrance Loss	0.15	ft

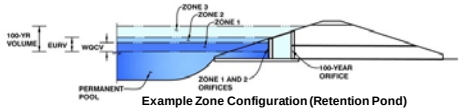
Inlet Control Properties					
Inlet Control HW Elev.	5,688.06	ft	Flow Control	Transition	
Inlet Type	Beveled ring, 33.7° bevels		Area Full	14.1	ft²
K	0.00180		HDS 5 Chart	3	
M	2.50000		HDS 5 Scale	B	
C	0.02430		Equation Form	1	
Y	0.83000				

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.02 (February 2020)

Project: Singer Ranch

Basin ID: DF-1 (NW Commercial Pond)



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	5.66	acres
Watershed Length =	585	ft
Watershed Length to Centroid =	430	ft
Watershed Slope =	0.055	ft/ft
Watershed Imperviousness =	95.00%	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.

		Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.211 acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.605 acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.498 acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.643 acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.760 acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.880 acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.998 acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	1.127 acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.55 in.) =	1.615 acre-feet	3.55	inches
Approximate 2-yr Detention Volume =	0.488 acre-feet		
Approximate 5-yr Detention Volume =	0.633 acre-feet		
Approximate 10-yr Detention Volume =	0.771 acre-feet		
Approximate 25-yr Detention Volume =	0.827 acre-feet		
Approximate 50-yr Detention Volume =	0.858 acre-feet		
Approximate 100-yr Detention Volume =	0.885 acre-feet		

Define Zones and Basin Geometry

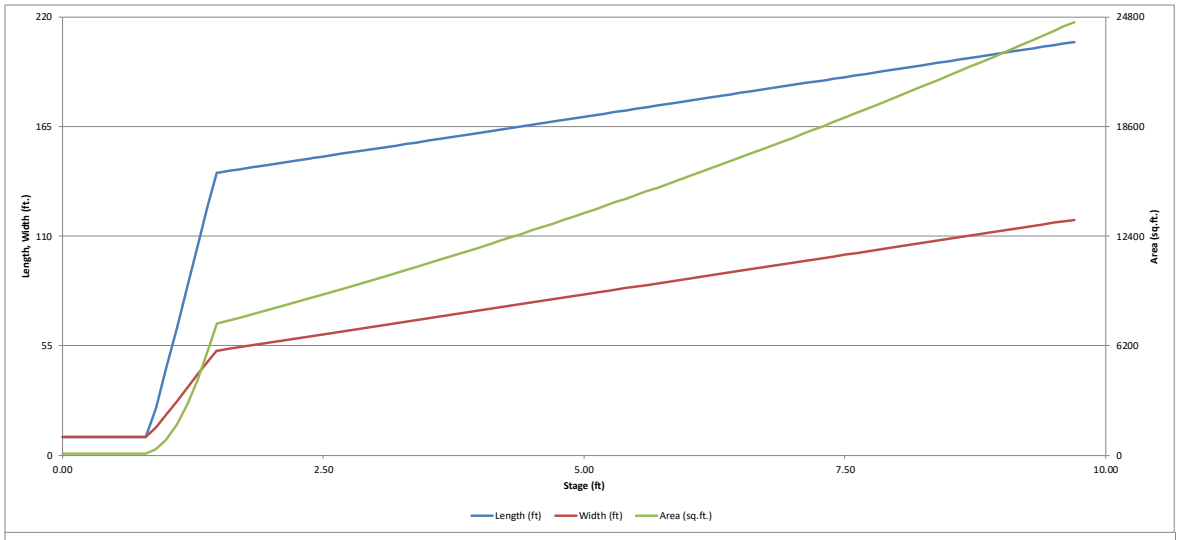
Zone 1 Volume (WQCV) =	0.211	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.394	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.281	acre-feet
Total Detention Basin Volume =	0.885	acre-feet
Initial Surcharge Volume (ISV) =	28	ft^3
Initial Surcharge Depth (ISD) =	0.33	ft
Total Available Detention Depth (H_{total}) =	5.00	ft
Depth of Trickle Channel (H_{TC}) =	0.50	ft
Slope of Trickle Channel (S_{TC}) =	0.005	ft/ft
Slopes of Main Basin Sides (S_{main}) =	4	H:V
Basin Length-to-Width Ratio (R_{LW}) =	3	
Initial Surcharge Area (A_{ISV}) =	83	ft^2
Surcharge Volume Length (L_{ISV}) =	9.1	ft
Surcharge Volume Width (W_{ISV}) =	9.1	ft
Depth of Basin Floor (H_{FLOOR}) =	0.65	ft
Length of Basin Floor (L_{FLOOR}) =	141.7	ft
Width of Basin Floor (W_{FLOOR}) =	52.5	ft
Area of Basin Floor (A_{FLOOR}) =	7,437	ft^2
Volume of Basin Floor (V_{FLOOR}) =	1,800	ft^3
Depth of Main Basin (H_{MAIN}) =	3.52	ft
Length of Main Basin (L_{MAIN}) =	169.9	ft
Width of Main Basin (W_{MAIN}) =	80.6	ft
Area of Main Basin (A_{MAIN}) =	13,699	ft^2
Volume of Main Basin (V_{MAIN}) =	36,642	ft^3
Calculated Total Basin Volume (V_{total}) =	**0.884**	acre-feet

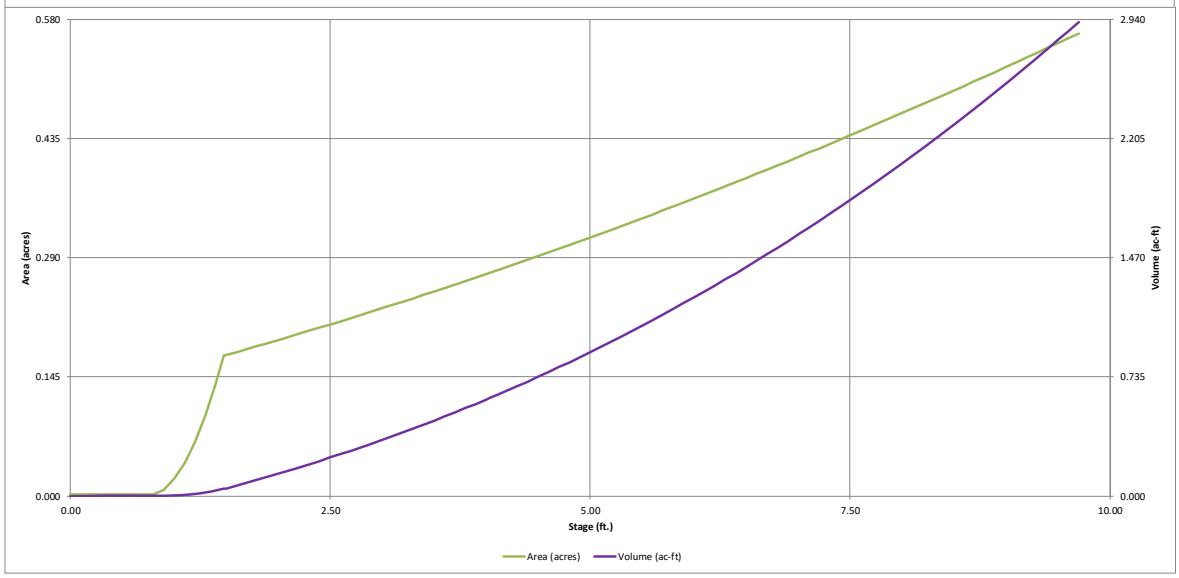
Depth Increment = 0.10 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	0.00		9.1	9.1	83		0.002		
ISV	0.33		9.1	9.1	83		0.002	28	0.001
	0.40		9.1	9.1	83		0.002	33	0.001
	0.50		9.1	9.1	83		0.002	42	0.001
	0.60		9.1	9.1	83		0.002	50	0.001
	0.70		9.1	9.1	83		0.002	58	0.001
	0.80		9.1	9.1	83		0.002	67	0.002
	0.90		23.4	13.8	323		0.007	83	0.002
	1.00		43.8	20.5	897		0.021	141	0.003
	1.10		64.2	27.1	1,743		0.040	271	0.006
	1.20		84.6	33.8	2,860		0.066	499	0.011
	1.30		105.0	40.5	4,250		0.098	852	0.020
	1.40		125.4	47.1	5,912		0.136	1,358	0.031
Floor	1.48		141.7	52.5	7,437		0.171	1,891	0.043
	1.50		141.9	52.6	7,468		0.171	2,040	0.047
	1.60		142.7	53.4	7,624		0.175	2,795	0.064
	1.70		143.5	54.2	7,782		0.179	3,565	0.082
	1.80		144.3	55.0	7,941		0.182	4,351	0.100
	1.90		145.1	55.8	8,101		0.186	5,153	0.118
	2.00		145.9	56.6	8,262		0.190	5,971	0.137
	2.10		146.7	57.4	8,425		0.193	6,805	0.156
	2.20		147.5	58.2	8,589		0.197	7,656	0.176
	2.30		148.3	59.0	8,754		0.201	8,523	0.196
Zone 1 (WQCV)	2.38		148.9	59.7	8,887		0.204	9,229	0.212
	2.40		149.1	59.8	8,920		0.205	9,407	0.216
	2.50		149.9	60.6	9,088		0.209	10,307	0.237
	2.60		150.7	61.4	9,257		0.213	11,225	0.258
	2.70		151.5	62.2	9,428		0.216	12,159	0.279
	2.80		152.3	63.0	9,599		0.220	13,110	0.301
	2.90		153.1	63.8	9,772		0.224	14,079	0.323
	3.00		153.9	64.6	9,946		0.228	15,065	0.346
	3.10		154.7	65.4	10,122		0.232	16,068	0.369
	3.20		155.5	66.2	10,299		0.236	17,089	0.392
	3.30		156.3	67.0	10,477		0.241	18,128	0.416
	3.40		157.1	67.8	10,656		0.245	19,184	0.440
	3.50		157.9	68.6	10,836		0.249	20,259	0.465
	3.60		158.7	69.4	11,018		0.253	21,352	0.490
	3.70		159.5	70.2	11,201		0.257	22,463	0.516
	3.80		160.3	71.0	11,386		0.261	23,592	0.542
	3.90		161.1	71.8	11,572		0.266	24,740	0.568
	4.00		161.9	72.6	11,759		0.270	25,906	0.595
Zone 2 (EURV)	4.04		162.2	72.9	11,834		0.272	26,378	0.606
	4.10		162.7	73.4	11,947		0.274	27,092	0.622
	4.20		163.5	74.2	12,136		0.279	28,296	0.650
	4.30		164.3	75.0	12,327		0.283	29,519	0.678
	4.40		165.1	75.8	12,519		0.287	30,761	0.706
	4.50		165.9	76.6	12,713		0.292	32,023	0.735
	4.60		166.7	77.4	12,907		0.296	33,304	0.765
	4.70		167.5	78.2	13,103		0.301	34,604	0.794
	4.80		168.3	79.0	13,300		0.305	35,925	0.825
	4.90		169.1	79.8	13,499		0.310	37,265	0.855
Zone 3 (100-year)	5.00		169.9	80.6	13,699		0.314	38,624	0.887
	5.10		170.7	81.4	13,900		0.319	40,004	0.918
	5.20		171.5	82.2	14,102		0.324	41,404	0.951
	5.30		172.3	83.0	14,306		0.328	42,825	0.983
	5.40		173.1	83.8	14,511		0.333	44,266	1.016
	5.50		173.9	84.6	14,717		0.338	45,727	1.050
	5.60		174.7	85.4	14,924		0.343	47,209	1.084
	5.70		175.5	86.2	15,133		0.347	48,712	1.118
	5.80		176.3	87.0	15,343		0.352	50,236	1.153
	5.90		177.1	87.8	15,554		0.357	51,781	1.189
	6.00		177.9	88.6	15,767		0.362	53,347	1.225
	6.10		178.7	89.4	15,981		0.367	54,934	1.261
	6.20		179.5	90.2	16,196		0.372	56,543	1.298
	6.30		180.3	91.0	16,412		0.377	58,173	1.335
	6.40		181.1	91.8	16,630		0.382	59,825	1.373
	6.50		181.9	92.6	16,849		0.387	61,499	1.412
	6.60		182.7	93.4	17,069		0.392	63,195	1.451
	6.70		183.5	94.2	17,291		0.397	64,913	1.490
	6.80		184.3	95.0	17,514		0.402	66,653	1.530
	6.90		185.1	95.8	17,738		0.407	68,416	1.571
	7.00		185.9	96.6	17,963		0.412	70,201	1.612
	7.10		186.7	97.4	18,190		0.418	72,009	1.653
	7.20		187.5	98.2	18,418		0.423	73,839	1.695
	7.30		188.3	99.0	18,647		0.428	75,692	1.738
	7.40		189.1	99.8	18,877		0.433	77,568	1.781
	7.50		189.9	100.6	19,109		0.439	79,468	1.824
	7.60		190.7	101.4	19,342		0.444	81,390	1.868
	7.70		191.5	102.2	19,577		0.449	83,336	1.913
	7.80		192.3	103.0	19,812		0.455	85,306	1.958
	7.90		193.1	103.8	20,049		0.460	87,299	2.004
	8.00		193.9	104.6	20,287		0.466	89,316	2.050
	8.10		194.7	105.4	20,527		0.471	91,356	2.097
	8.20		195.5	106.2	20,768		0.477	93,421	2.145
	8.30		196.3	107.0	21,010		0.482	95,510	2.193
	8.40		197.1	107.8	21,253		0.488	97,623	2.241
	8.50		197.9	108.6	21,497		0.494	99,760	2.290
	8.60		198.7	109.4	21,743		0.499	101,922	2.340
	8.70		199.5	110.2	21,990		0.505	104,109	2.390
	8.80		200.3	111.0	22,239		0.511	106,321	2.441
	8.90		201.1	111.8	22,489		0.516	108,557	2.492
	9.00		201.9	112.6	22,740		0.522	110,818	2.544
	9.10		202.7	113.4	22,992		0.528	113,105	2.597
	9.20		203.5	114.2	23,245		0.534	115,417	2.650
	9.30		204.3	115.0	23,500		0.539	117,754	2.703
	9.40		205.1	115.8	23,756		0.545	120,117	2.758
	9.50		205.9	116.6	24,014		0.551	122,505	2.812
	9.60		206.7	117.4	24,272		0.557	124,920	2.868
	9.70		207.5	118.2	24,532		0.563	127,360	2.924

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.02 (February 2020)



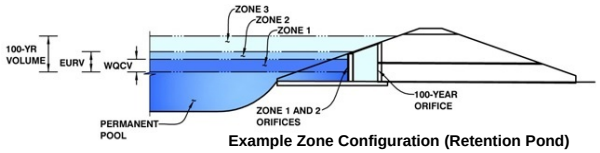


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.02 (February 2020)

Project: Singer Ranch

Basin ID: DF-1 (NW Commercial Pond)



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.38	0.211	Orifice Plate
Zone 2 (EURV)	4.04	0.394	Circular Orifice
Zone 3 (100-year)	5.00	0.281	Weir&Pipe (Restrict)
Total (all zones)		0.885	

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

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)	Underdrain Orifice Area =	N/A	ft^2
Underdrain Orifice Diameter =	N/A	inches	Underdrain Orifice Centroid =	N/A	feet

Calculated Parameters for Underdrain

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)

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	5.069E-03	ft^2
Depth at top of Zone using Orifice Plate =	2.38	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	9.50	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	0.73	sq. inches (diameter = 15/16 inch)	Elliptical Slot Area =	N/A	ft^2

Calculated Parameters for Plate

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	0.79	1.59					
Orifice Area (sq. inches)	0.73	0.73	0.73					

	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)

	Zone 2 Circular	Not Selected			Zone 2 Circular	Not Selected	
Invert of Vertical Orifice =	2.38	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	0.01	N/A	ft^2
Depth at top of Zone using Vertical Orifice =	4.04	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.05	N/A	feet
Vertical Orifice Diameter =	1.23	N/A	inches				

Calculated Parameters for Vertical Orifice

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			Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	4.04	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	4.04	N/A	feet
Overflow Weir Front Edge Length =	6.00	N/A	feet	Overflow Weir Slope Length =	4.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	22.14	N/A	
Horiz. Length of Weir Sides =	4.00	N/A	feet	Overflow Grate Open Area w/o Debris =	16.80	N/A	ft^2
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area	Overflow Grate Open Area w/ Debris =	8.40	N/A	ft^2
Debris Clogging % =	50%	N/A	%				

Calculated Parameters for Overflow Weir

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

	Zone 3 Restrictor	Not Selected			Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.30	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	0.76	N/A	ft^2
Outlet Pipe Diameter =	18.00	N/A	inches	Outlet Orifice Centroid =	0.39	N/A	feet
Restrictor Plate Height Above Pipe Invert =	8.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	1.46	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	4.50	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.79	feet
Spillway Crest Length =	7.00	feet	Stage at Top of Freeboard =	6.29	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.38	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	1.33	acre-ft

Calculated Parameters for Spillway

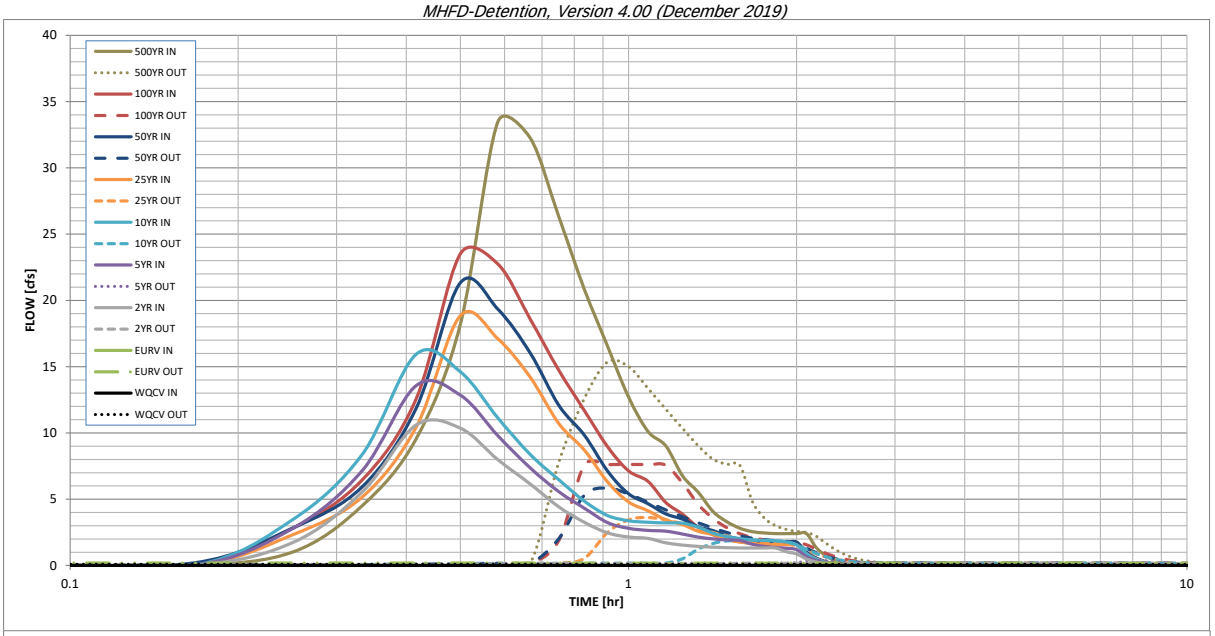
Routed Hydrograph Results

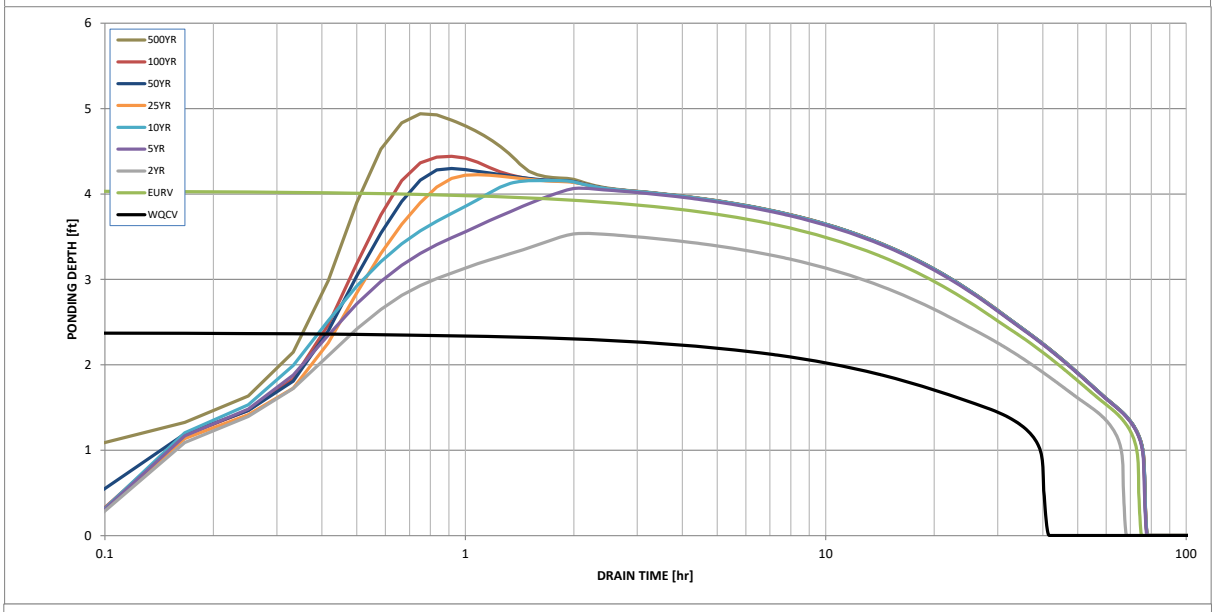
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

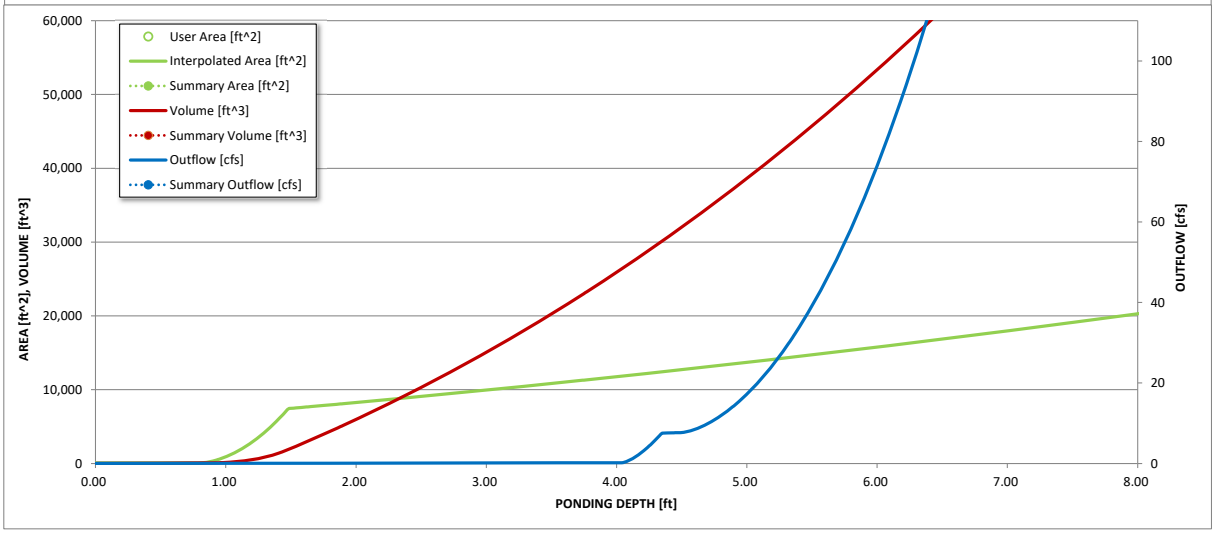
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.55
CUHP Runoff Volume (acre-ft) =	0.211	0.605	0.498	0.643	0.760	0.880	0.998	1.127	1.615
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.498	0.643	0.760	0.880	0.998	1.127	1.615
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.8	2.1	3.2	5.6	7.0	8.8	14.6
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.14	0.38	0.56	0.99	1.24	1.55	2.58
Peak Inflow Q (cfs) =	N/A	N/A	10.6	13.6	15.9	18.8	21.3	23.5	33.5
Peak Outflow Q (cfs) =	0.1	0.2	0.2	0.4	1.9	3.6	5.8	7.6	15.3
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.2	0.6	0.6	0.8	0.9	1.1
Structure Controlling Flow =	Vertical Orifice 1	Overflow Weir 1	Vertical Orifice 1	Overflow Weir 1	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	0.0	0.1	0.2	0.3	0.4	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) =	38	69	63	71	70	69	68	68	64
Time to Drain 99% of Inflow Volume (hours) =	**40**	72	66	75	75	74	74	73	72
Maximum Ponding Depth (ft) =	2.38	4.04	3.54	4.07	4.16	4.22	4.30	4.44	4.94
Area at Maximum Ponding Depth (acres) =	0.20	0.27	0.25	0.27	0.28	0.28	0.28	0.29	0.31
Maximum Volume Stored (acre-ft) =	0.212	0.606	0.473	0.611	0.636	0.655	0.675	0.718	0.865

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.00 (December 2019)







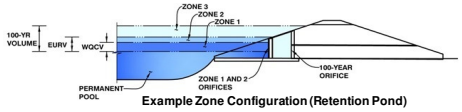
S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.02 (February 2020)

Project: Singer Ranch

Basin ID: DF-2 (NW Multi-Family Pond)



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB		**Note: L / W Ratio < 1**
Watershed Area =	10.30	acres	**L / W Ratio = 0.67**
Watershed Length =	550	ft	**Note: Lc/L Ratio > 0.9**
Watershed Length to Centroid =	540	ft	**Lc / L Ratio = 0.98**
Watershed Slope =	0.060	ft/ft	
Watershed Imperviousness =	70.00%	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.

			Optional User Overrides
Water Quality Capture Volume (WQCV) =	0.236	acre-feet	acre-feet
Excess Urban Runoff Volume (EURV) =	0.792	acre-feet	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.673	acre-feet	1.19 inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.907	acre-feet	1.50 inches
10-yr Runoff Volume (P1 = 1.75 in.) =	1.105	acre-feet	1.75 inches
25-yr Runoff Volume (P1 = 2 in.) =	1.338	acre-feet	2.00 inches
50-yr Runoff Volume (P1 = 2.25 in.) =	1.545	acre-feet	2.25 inches
100-yr Runoff Volume (P1 = 2.52 in.) =	1.791	acre-feet	2.52 inches
500-yr Runoff Volume (P1 = 3.55 in.) =	2.665	acre-feet	3.55 inches
Approximate 2-yr Detention Volume =	0.619	acre-feet	
Approximate 5-yr Detention Volume =	0.824	acre-feet	
Approximate 10-yr Detention Volume =	1.041	acre-feet	
Approximate 25-yr Detention Volume =	1.118	acre-feet	
Approximate 50-yr Detention Volume =	1.163	acre-feet	
Approximate 100-yr Detention Volume =	1.246	acre-feet	

Define Zones and Basin Geometry

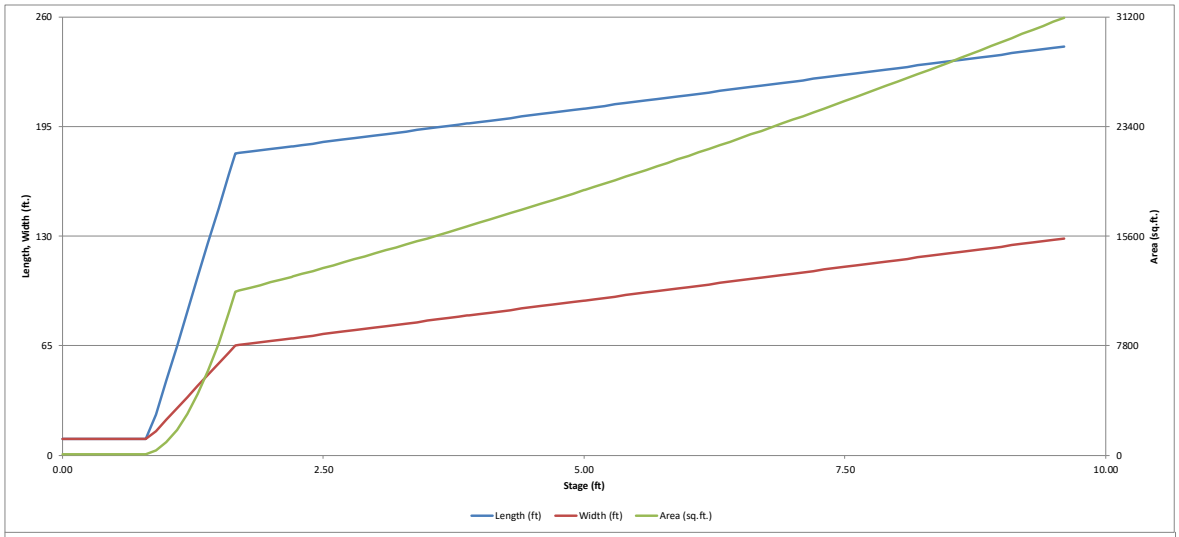
Zone 1 Volume (WQCV) =	0.236	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.556	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.454	acre-feet
Total Detention Basin Volume =	1.246	acre-feet
Initial Surcharge Volume (ISV) =	31	ft^3
Initial Surcharge Depth (ISD) =	0.33	ft
Total Available Detention Depth (H_{total}) =	5.00	ft
Depth of Trickle Channel (H_{TC}) =	0.50	ft
Slope of Trickle Channel (S_{TC}) =	0.005	ft/ft
Slopes of Main Basin Sides (S_{main}) =	4	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	3	
Initial Surcharge Area (A_{ISV}) =	93	ft^2
Surcharge Volume Length (L_{ISV}) =	9.7	ft
Surcharge Volume Width (W_{ISV}) =	9.7	ft
Depth of Basin Floor (H_{FLOOR}) =	0.83	ft
Length of Basin Floor (L_{FLOOR}) =	179.0	ft
Width of Basin Floor (W_{FLOOR}) =	65.0	ft
Area of Basin Floor (A_{FLOOR}) =	11,635	ft^2
Volume of Basin Floor (V_{FLOOR}) =	3,533	ft^3
Depth of Main Basin (H_{MAIN}) =	3.34	ft
Length of Main Basin (L_{MAIN}) =	205.7	ft
Width of Main Basin (W_{MAIN}) =	91.7	ft
Area of Main Basin (A_{MAIN}) =	18,868	ft^2
Volume of Main Basin (V_{MAIN}) =	50,455	ft^3
Calculated Total Basin Volume (V_{total}) =	**1.241**	acre-feet

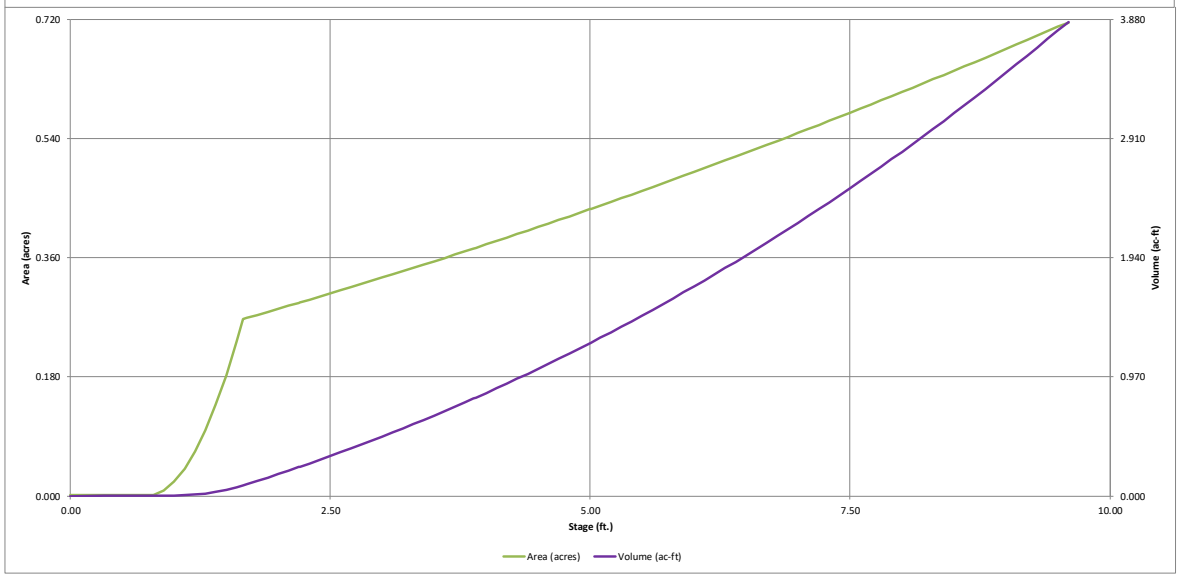
Depth Increment = 0.10 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	0.00		9.7	9.7	93		0.002		
ISV	0.33		9.7	9.7	93		0.002	31	0.001
	0.40		9.7	9.7	93		0.002	37	0.001
	0.50		9.7	9.7	93		0.002	47	0.001
	0.60		9.7	9.7	93		0.002	56	0.001
	0.70		9.7	9.7	93		0.002	65	0.002
	0.80		9.7	9.7	93		0.002	75	0.002
	0.90		23.9	14.3	343		0.008	92	0.002
	1.00		44.3	21.0	931		0.021	154	0.004
	1.10		64.7	27.7	1,792		0.041	287	0.007
	1.20		85.1	34.3	2,924		0.067	521	0.012
	1.30		105.5	41.0	4,328		0.099	881	0.020
	1.40		125.9	47.7	6,004		0.138	1,396	0.032
	1.50		146.3	54.3	7,952		0.183	2,091	0.048
	1.60		166.7	61.0	10,172		0.234	2,995	0.069
Floor	1.66		179.0	65.0	11,635		0.267	3,649	0.084
	1.70		179.3	65.3	11,713		0.269	4,116	0.094
	1.80		180.1	66.1	11,909		0.273	5,297	0.122
	1.90		180.9	66.9	12,107		0.278	6,498	0.149
	2.00		181.7	67.7	12,306		0.282	7,718	0.177
	2.10		182.5	68.5	12,506		0.287	8,959	0.206
	2.20		183.3	69.3	12,707		0.292	10,219	0.235
Zone 1 (WQCV)	2.21		183.4	69.4	12,728		0.292	10,347	0.238
	2.30		184.1	70.1	12,910		0.296	11,500	0.264
	2.40		184.9	70.9	13,114		0.301	12,801	0.294
	2.50		185.7	71.7	13,319		0.306	14,123	0.324
	2.60		186.5	72.5	13,526		0.311	15,465	0.355
	2.70		187.3	73.3	13,734		0.315	16,828	0.386
	2.80		188.1	74.1	13,943		0.320	18,212	0.418
	2.90		188.9	74.9	14,153		0.325	19,617	0.450
	3.00		189.7	75.7	14,365		0.330	21,043	0.483
	3.10		190.5	76.5	14,578		0.335	22,490	0.516
	3.20		191.3	77.3	14,792		0.340	23,959	0.550
	3.30		192.1	78.1	15,008		0.345	25,449	0.584
	3.40		192.9	78.9	15,225		0.350	26,960	0.619
	3.50		193.7	79.7	15,443		0.355	28,494	0.654
	3.60		194.5	80.5	15,662		0.360	30,049	0.690
	3.70		195.3	81.3	15,883		0.365	31,626	0.726
	3.80		196.1	82.1	16,105		0.370	33,225	0.763
Zone 2 (EURV)	3.88		196.7	82.8	16,283		0.374	34,521	0.792
	3.90		196.9	82.9	16,328		0.375	34,847	0.800
	4.00		197.7	83.7	16,553		0.380	36,491	0.838
	4.10		198.5	84.5	16,778		0.385	38,158	0.876
	4.20		199.3	85.3	17,005		0.390	39,847	0.915
	4.30		200.1	86.1	17,234		0.396	41,559	0.954
	4.40		200.9	86.9	17,463		0.401	43,294	0.994
	4.50		201.7	87.7	17,694		0.406	45,051	1.034
	4.60		202.5	88.5	17,926		0.412	46,832	1.075
	4.70		203.3	89.3	18,160		0.417	48,637	1.117
	4.80		204.1	90.1	18,395		0.422	50,464	1.159
	4.90		204.9	90.9	18,631		0.428	52,316	1.201
	5.00		205.7	91.7	18,868		0.433	54,191	1.244
Zone 3 (100-year)	5.01		205.8	91.8	18,892		0.434	54,379	1.248
	5.10		206.5	92.5	19,107		0.439	56,089	1.288
	5.20		207.3	93.3	19,346		0.444	58,012	1.332
	5.30		208.1	94.1	19,588		0.450	59,959	1.376
	5.40		208.9	94.9	19,830		0.455	61,930	1.422
	5.50		209.7	95.7	20,074		0.461	63,925	1.468
	5.60		210.5	96.5	20,319		0.466	65,944	1.514
	5.70		211.3	97.3	20,565		0.472	67,989	1.561
	5.80		212.1	98.1	20,813		0.478	70,057	1.608
	5.90		212.9	98.9	21,061		0.484	72,151	1.656
	6.00		213.7	99.7	21,311		0.489	74,270	1.705
	6.10		214.5	100.5	21,563		0.495	76,413	1.754
	6.20		215.3	101.3	21,815		0.501	78,582	1.804
	6.30		216.1	102.1	22,069		0.507	80,777	1.854
	6.40		216.9	102.9	22,325		0.513	82,996	1.905
	6.50		217.7	103.7	22,581		0.518	85,242	1.957
	6.60		218.5	104.5	22,839		0.524	87,513	2.009
	6.70		219.3	105.3	23,098		0.530	89,809	2.062
	6.80		220.1	106.1	23,358		0.536	92,132	2.115
	6.90		220.9	106.9	23,620		0.542	94,481	2.169
	7.00		221.7	107.7	23,883		0.548	96,856	2.224
	7.10		222.5	108.5	24,147		0.554	99,258	2.279
	7.20		223.3	109.3	24,413		0.560	101,686	2.334
	7.30		224.1	110.1	24,679		0.567	104,140	2.391
	7.40		224.9	110.9	24,947		0.573	106,622	2.448
	7.50		225.7	111.7	25,217		0.579	109,130	2.505
	7.60		226.5	112.5	25,487		0.585	111,665	2.563
	7.70		227.3	113.3	25,759		0.591	114,227	2.622
	7.80		228.1	114.1	26,032		0.598	116,817	2.682
	7.90		228.9	114.9	26,307		0.604	119,434	2.742
	8.00		229.7	115.7	26,582		0.610	122,078	2.803
	8.10		230.5	116.5	26,859		0.617	124,750	2.864
	8.20		231.3	117.3	27,138		0.623	127,450	2.926
	8.30		232.1	118.1	27,417		0.629	130,178	2.988
	8.40		232.9	118.9	27,698		0.636	132,934	3.052
	8.50		233.7	119.7	27,980		0.642	135,717	3.116
	8.60		234.5	120.5	28,263		0.649	138,530	3.180
	8.70		235.3	121.3	28,548		0.655	141,370	3.245
	8.80		236.1	122.1	28,834		0.662	144,239	3.311
	8.90		236.9	122.9	29,121		0.669	147,137	3.378
	9.00		237.7	123.7	29,410		0.675	150,064	3.445
	9.10		238.5	124.5	29,700		0.682	153,019	3.513
	9.20		239.3	125.3	29,991		0.688	156,003	3.581
	9.30		240.1	126.1	30,283		0.695	159,017	3.651
	9.40		240.9	126.9	30,577		0.702	162,060	3.720
	9.50		241.7	127.7	30,872		0.709	165,133	3.791
	9.60		242.5	128.5	31,168		0.716	168,234	3.862

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.02 (February 2020)



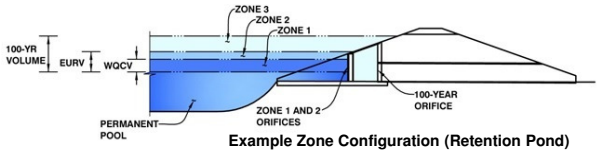


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.02 (February 2020)

Project: Singer Ranch

Basin ID: DF-2 (NW Multi-Family Pond)



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.21	0.236	Orifice Plate
Zone 2 (EURV)	3.88	0.556	Circular Orifice
Zone 3 (100-year)	5.01	0.454	Weir&Pipe (Restrict)
Total (all zones)		1.246	

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

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

Calculated Parameters for Underdrain

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)

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	5.417E-03	ft²
Depth at top of Zone using Orifice Plate =	2.18	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	8.70	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	0.78	sq. inches (diameter = 1 inch)	Elliptical Slot Area =	N/A	ft²

Calculated Parameters for Plate

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	0.73	1.45					
Orifice Area (sq. inches)	0.78	0.78	0.78					

	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)

	Zone 2 Circular	Not Selected			Zone 2 Circular	Not Selected	
Invert of Vertical Orifice =	2.21	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	0.03	N/A	ft²
Depth at top of Zone using Vertical Orifice =	3.88	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.09	N/A	feet
Vertical Orifice Diameter =	2.15	N/A	inches				

Calculated Parameters for Vertical Orifice

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			Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	3.87	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	3.87	N/A	feet
Overflow Weir Front Edge Length =	6.00	N/A	feet	Overflow Weir Slope Length =	4.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	9.51	N/A	
Horiz. Length of Weir Sides =	4.00	N/A	feet	Overflow Grate Open Area w/o Debris =	16.80	N/A	ft²
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area	Overflow Grate Open Area w/ Debris =	8.40	N/A	ft²
Debris Clogging % =	50%	N/A	%				

Calculated Parameters for Overflow Weir

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

	Zone 3 Restrictor	Not Selected			Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.30	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	1.77	N/A	ft²
Outlet Pipe Diameter =	18.00	N/A	inches	Outlet Orifice Centroid =	0.75	N/A	feet
Restrictor Plate Height Above Pipe Invert =	18.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	3.14	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	4.80	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.86	feet
Spillway Crest Length =	14.00	feet	Stage at Top of Freeboard =	6.66	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.53	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	2.04	acre-ft

Calculated Parameters for Spillway

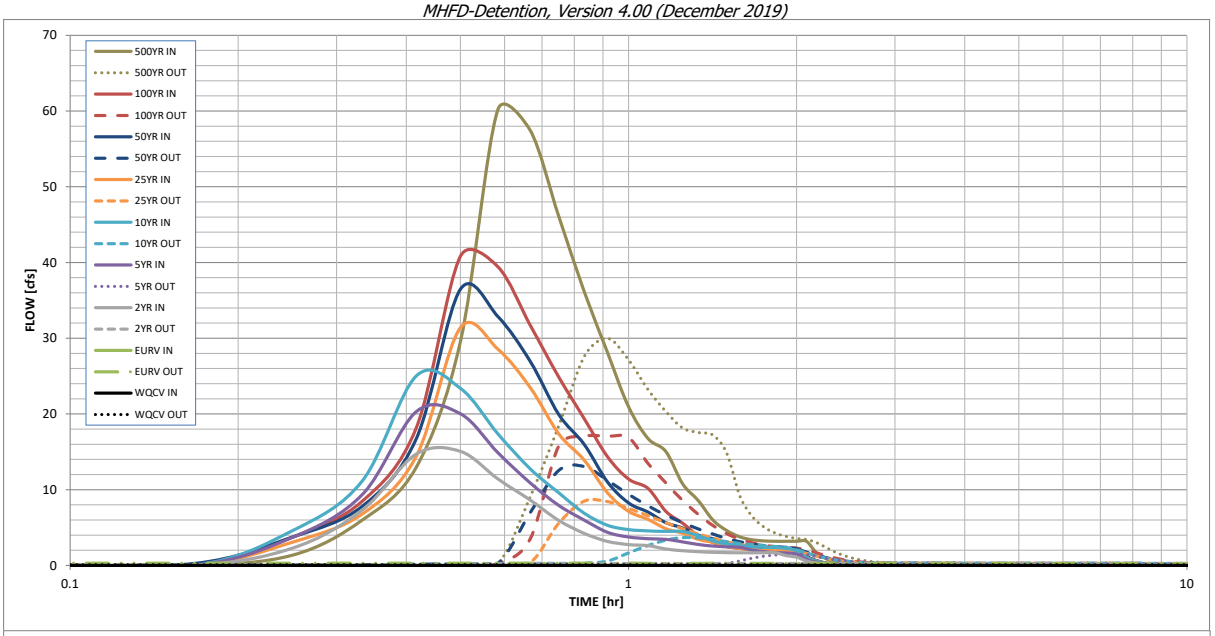
Routed Hydrograph Results

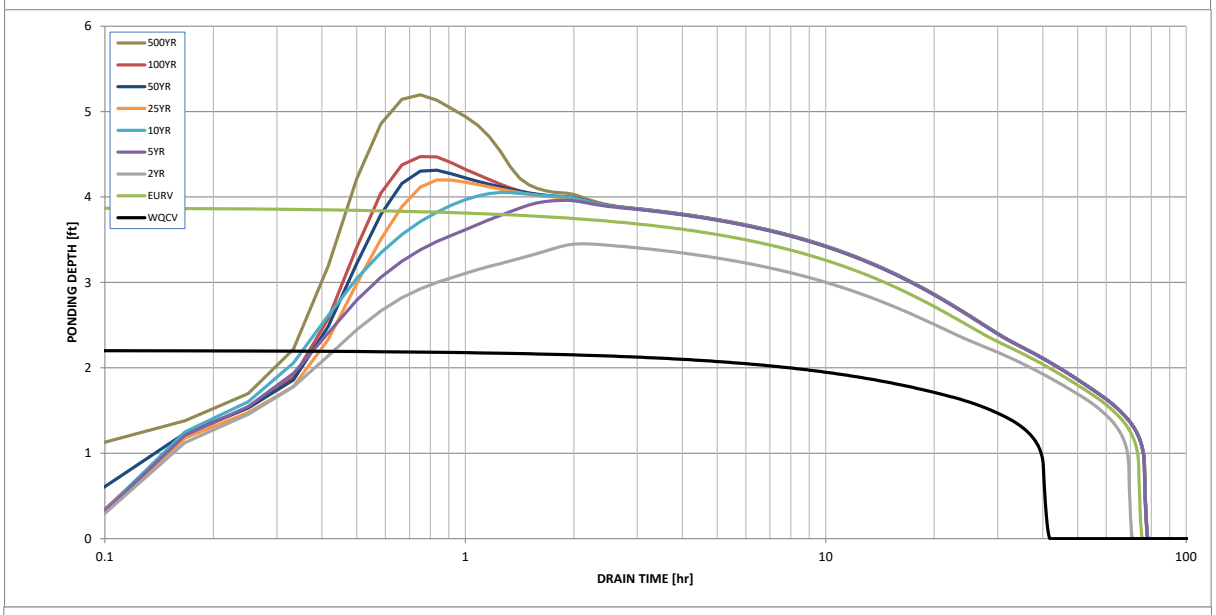
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

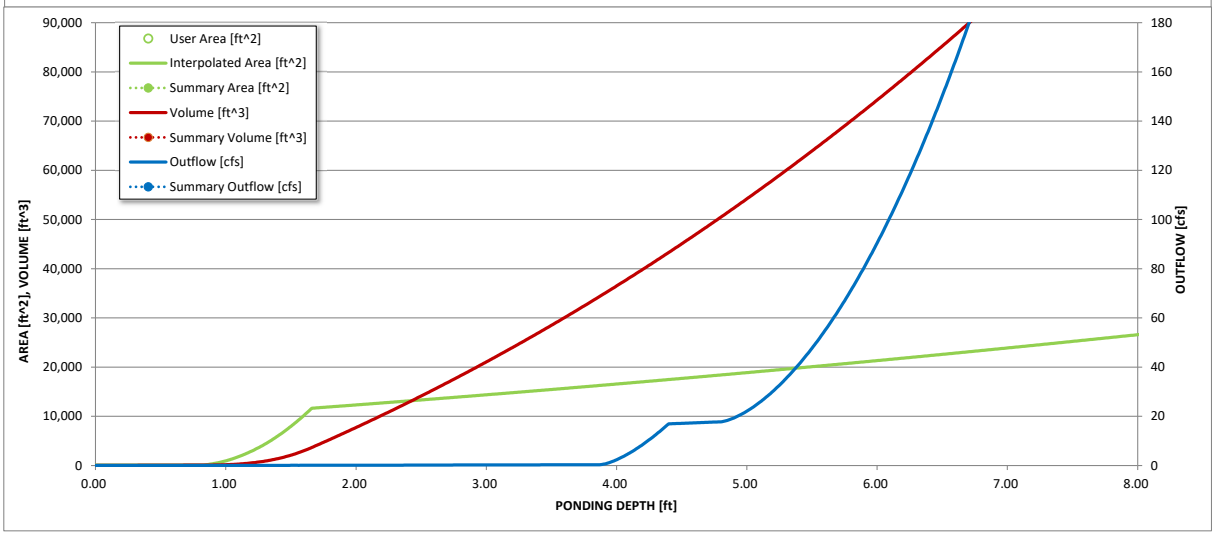
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.55
CUHP Runoff Volume (acre-ft) =	0.236	0.792	0.673	0.907	1.105	1.338	1.545	1.791	2.665
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.673	0.907	1.105	1.338	1.545	1.791	2.665
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	1.7	4.5	6.8	11.8	14.7	18.4	30.4
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.16	0.44	0.66	1.14	1.43	1.79	2.95
Peak Inflow Q (cfs) =	N/A	N/A	15.1	20.3	25.0	31.4	36.5	40.8	60.2
Peak Outflow Q (cfs) =	0.1	0.3	0.3	1.5	3.7	8.5	13.1	17.1	30.0
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.3	0.5	0.7	0.9	0.9	1.0
Structure Controlling Flow =	Plate	Overflow Weir 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	0.00	N/A	0.1	0.2	0.5	0.7	1.0	1.1
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	68	64	70	69	67	66	64	60
Time to Drain 99% of Inflow Volume (hours) =	**40**	72	68	74	74	73	73	72	70
Maximum Ponding Depth (ft) =	2.21	3.88	3.45	3.96	4.05	4.20	4.31	4.47	5.20
Area at Maximum Ponding Depth (acres) =	0.29	0.37	0.35	0.38	0.38	0.39	0.40	0.40	0.44
Maximum Volume Stored (acre-ft) =	0.238	0.792	0.636	0.823	0.857	0.911	0.958	1.022	1.327

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.00 (December 2019)







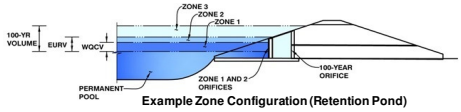
S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.02 (February 2020)

Project: Singer Ranch

Basin ID: DF-3 (W Single Family Pond)(Sub-basin 1-D Added)



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	83.58	acres
Watershed Length =	2,720	ft
Watershed Length to Centroid =	1,735	ft
Watershed Slope =	0.030	ft/ft
Watershed Imperviousness =	65.00%	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.

			Optional User Overrides
Water Quality Capture Volume (WQCV) =	1.770	acre-feet	acre-feet
Excess Urban Runoff Volume (EURV) =	5.931	acre-feet	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	5.483	acre-feet	1.19 inches
5-yr Runoff Volume (P1 = 1.5 in.) =	7.478	acre-feet	1.50 inches
10-yr Runoff Volume (P1 = 1.75 in.) =	9.176	acre-feet	1.75 inches
25-yr Runoff Volume (P1 = 2 in.) =	11.254	acre-feet	2.00 inches
50-yr Runoff Volume (P1 = 2.25 in.) =	13.050	acre-feet	2.25 inches
100-yr Runoff Volume (P1 = 2.52 in.) =	15.227	acre-feet	2.52 inches
500-yr Runoff Volume (P1 = 3.55 in.) =	22.864	acre-feet	3.55 inches
Approximate 2-yr Detention Volume =	4.599	acre-feet	
Approximate 5-yr Detention Volume =	6.166	acre-feet	
Approximate 10-yr Detention Volume =	7.860	acre-feet	
Approximate 25-yr Detention Volume =	8.468	acre-feet	
Approximate 50-yr Detention Volume =	8.817	acre-feet	
Approximate 100-yr Detention Volume =	9.532	acre-feet	

Define Zones and Basin Geometry

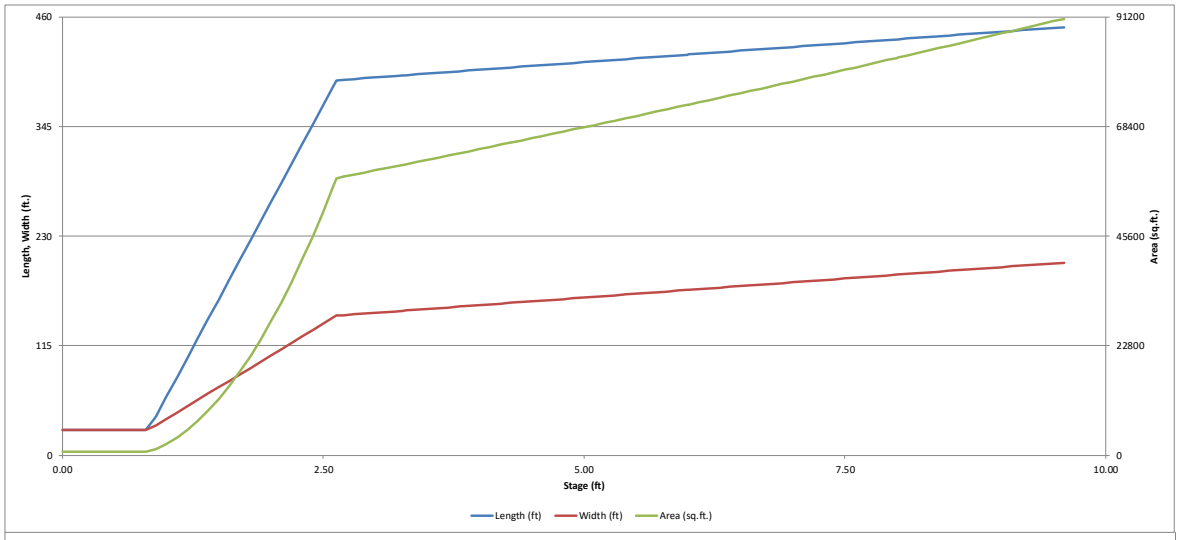
Zone 1 Volume (WQCV) =	1.770	acre-feet
Zone 2 Volume (EURV - Zone 1) =	4.161	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	3.601	acre-feet
Total Detention Basin Volume =	9.532	acre-feet
Initial Surcharge Volume (ISV) =	231	ft^3
Initial Surcharge Depth (ISD) =	0.33	ft
Total Available Detention Depth (H_{total}) =	8.00	ft
Depth of Trickle Channel (H_{TC}) =	0.50	ft
Slope of Trickle Channel (S_{TC}) =	0.005	ft/ft
Slopes of Main Basin Sides (S_{main}) =	4	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	3	
Initial Surcharge Area (A_{ISV}) =	701	ft^2
Surcharge Volume Length (L_{ISV}) =	26.5	ft
Surcharge Volume Width (W_{ISV}) =	26.5	ft
Depth of Basin Floor (H_{FLOOR}) =	1.80	ft
Length of Basin Floor (L_{FLOOR}) =	393.7	ft
Width of Basin Floor (W_{FLOOR}) =	146.5	ft
Area of Basin Floor (A_{FLOOR}) =	57,664	ft^2
Volume of Basin Floor (V_{FLOOR}) =	38,833	ft^3
Depth of Main Basin (H_{MAIN}) =	5.37	ft
Length of Main Basin (L_{MAIN}) =	436.6	ft
Width of Main Basin (W_{MAIN}) =	189.4	ft
Area of Main Basin (A_{MAIN}) =	82,714	ft^2
Volume of Main Basin (V_{MAIN}) =	374,898	ft^3
Calculated Total Basin Volume (V_{total}) =	**9.511**	acre-feet

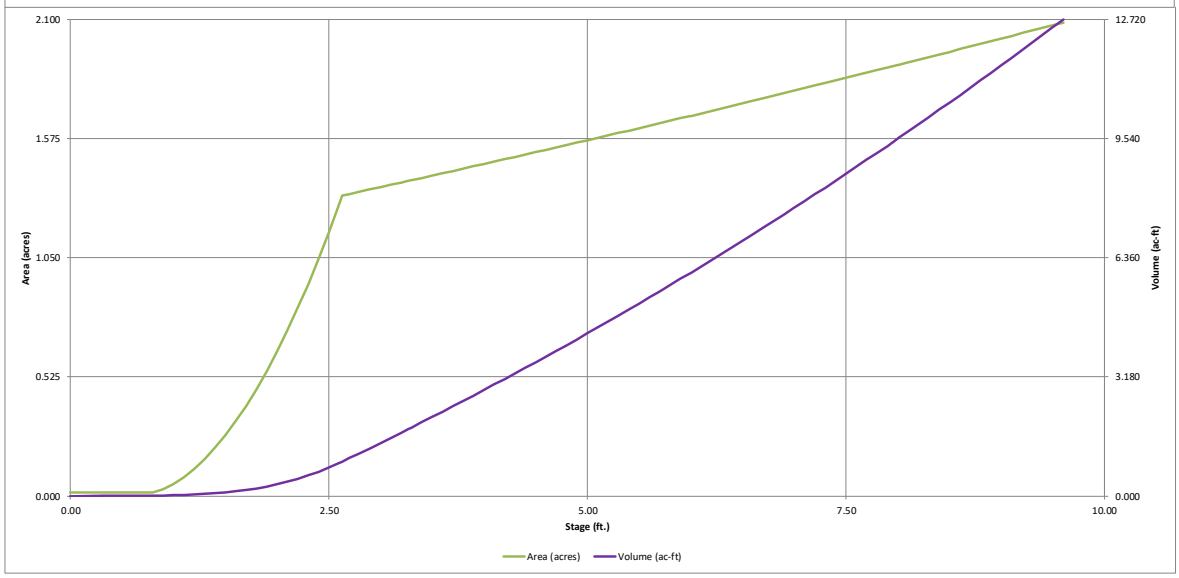
Depth Increment = 0.10 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	0.00		26.5	26.5	701		0.016		
ISV	0.33		26.5	26.5	701		0.016	231	0.005
	0.40		26.5	26.5	701		0.016	280	0.006
	0.50		26.5	26.5	701		0.016	350	0.008
	0.60		26.5	26.5	701		0.016	421	0.010
	0.70		26.5	26.5	701		0.016	491	0.011
	0.80		26.5	26.5	701		0.016	561	0.013
	0.90		40.8	31.1	1,269		0.029	650	0.015
	1.00		61.2	37.8	2,312		0.053	827	0.019
	1.10		81.6	44.5	3,627		0.083	1,121	0.026
	1.20		102.0	51.1	5,214		0.120	1,561	0.036
	1.30		122.4	57.8	7,073		0.162	2,173	0.050
	1.40		142.8	64.5	9,204		0.211	2,985	0.069
	1.50		163.2	71.1	11,607		0.266	4,023	0.092
	1.60		183.6	77.8	14,282		0.328	5,315	0.122
	1.70		204.0	84.5	17,229		0.396	6,889	0.158
	1.80		224.4	91.1	20,448		0.469	8,770	0.201
	1.90		244.8	97.8	23,939		0.550	10,987	0.252
	2.00		265.2	104.5	27,702		0.636	13,567	0.311
	2.10		285.6	111.1	31,737		0.729	16,537	0.380
	2.20		306.0	117.8	36,044		0.827	19,924	0.457
	2.30		326.4	124.5	40,623		0.933	23,755	0.545
	2.40		346.8	131.1	45,474		1.044	28,057	0.644
	2.50		367.2	137.8	50,597		1.162	32,859	0.754
	2.60		387.6	144.5	55,992		1.285	38,186	0.877
Floor	2.63		393.7	146.5	57,664		1.324	39,891	0.916
	2.70		394.2	147.0	57,966		1.331	43,938	1.009
	2.80		395.0	147.8	58,400		1.341	49,756	1.142
	2.90		395.8	148.6	58,835		1.351	55,618	1.277
	3.00		396.6	149.4	59,271		1.361	61,523	1.412
	3.10		397.4	150.2	59,709		1.371	67,472	1.549
	3.20		398.2	151.0	60,148		1.381	73,465	1.687
Zone 1 (WQCV)	3.27		398.8	151.6	60,455		1.388	77,686	1.783
	3.30		399.0	151.8	60,588		1.391	79,502	1.825
	3.40		399.8	152.6	61,029		1.401	85,582	1.965
	3.50		400.6	153.4	61,472		1.411	91,707	2.105
	3.60		401.4	154.2	61,915		1.421	97,877	2.247
	3.70		402.2	155.0	62,361		1.432	104,091	2.390
	3.80		403.0	155.8	62,807		1.442	110,349	2.533
	3.90		403.8	156.6	63,255		1.452	116,652	2.678
	4.00		404.6	157.4	63,704		1.462	123,000	2.824
	4.10		405.4	158.2	64,154		1.473	129,393	2.970
	4.20		406.2	159.0	64,606		1.483	135,831	3.118
	4.30		407.0	159.8	65,059		1.494	142,314	3.267
	4.40		407.8	160.6	65,513		1.504	148,843	3.417
	4.50		408.6	161.4	65,968		1.514	155,417	3.568
	4.60		409.4	162.2	66,425		1.525	162,036	3.720
	4.70		410.2	163.0	66,883		1.535	168,702	3.873
	4.80		411.0	163.8	67,342		1.546	175,413	4.027
	4.90		411.8	164.6	67,803		1.557	182,170	4.182
	5.00		412.6	165.4	68,264		1.567	188,973	4.338
	5.10		413.4	166.2	68,727		1.578	195,823	4.495
	5.20		414.2	167.0	69,192		1.588	202,719	4.654
	5.30		415.0	167.8	69,658		1.599	209,661	4.813
	5.40		415.8	168.6	70,124		1.610	216,651	4.974
	5.50		416.6	169.4	70,593		1.621	223,686	5.135
	5.60		417.4	170.2	71,062		1.631	230,769	5.298
	5.70		418.2	171.0	71,533		1.642	237,899	5.461
	5.80		419.0	171.8	72,005		1.653	245,076	5.626
	5.90		419.8	172.6	72,478		1.664	252,300	5.792
Zone 2 (EURV)	5.99		420.6	173.4	72,905		1.674	258,842	5.942
	6.00		420.6	173.4	72,953		1.675	259,571	5.959
	6.10		421.4	174.2	73,429		1.686	266,891	6.127
	6.20		422.2	175.0	73,906		1.697	274,257	6.296
	6.30		423.0	175.8	74,384		1.708	281,672	6.466
	6.40		423.8	176.6	74,864		1.719	289,134	6.638
	6.50		424.6	177.4	75,345		1.730	296,645	6.810
	6.60		425.4	178.2	75,828		1.741	304,203	6.984
	6.70		426.2	179.0	76,311		1.752	311,810	7.158
	6.80		427.0	179.8	76,796		1.763	319,466	7.334
	6.90		427.8	180.6	77,282		1.774	327,169	7.511
	7.00		428.6	181.4	77,770		1.785	334,922	7.689
	7.10		429.4	182.2	78,258		1.797	342,723	7.868
	7.20		430.2	183.0	78,748		1.808	350,574	8.048
	7.30		431.0	183.8	79,239		1.819	358,473	8.229
	7.40		431.8	184.6	79,732		1.830	366,422	8.412
	7.50		432.6	185.4	80,226		1.842	374,420	8.595
	7.60		433.4	186.2	80,721		1.853	382,467	8.780
	7.70		434.2	187.0	81,217		1.864	390,564	8.966
	7.80		435.0	187.8	81,715		1.876	398,710	9.153
	7.90		435.8	188.6	82,214		1.887	406,907	9.341
	8.00		436.6	189.4	82,714		1.899	415,153	9.531
Zone 3 (100-year)	8.01		436.7	189.5	82,764		1.900	415,981	9.550
	8.10		437.4	190.2	83,216		1.910	423,450	9.721
	8.20		438.2	191.0	83,718		1.922	431,796	9.913
	8.30		439.0	191.8	84,222		1.933	440,193	10.105
	8.40		439.8	192.6	84,728		1.945	448,641	10.299
	8.50		440.6	193.4	85,234		1.957	457,139	10.494
	8.60		441.4	194.2	85,742		1.968	465,688	10.691
	8.70		442.2	195.0	86,251		1.980	474,287	10.888
	8.80		443.0	195.8	86,762		1.992	482,938	11.087
	8.90		443.8	196.6	87,274		2.004	491,640	11.286
	9.00		444.6	197.4	87,787		2.015	500,393	11.487
	9.10		445.4	198.2	88,301		2.027	509,197	11.690
	9.20		446.2	199.0	88,817		2.039	518,053	11.893
	9.30		447.0	199.8	89,333		2.051	526,961	12.097
	9.40		447.8	200.6	89,852		2.063	535,920	12.303
	9.50		448.6	201.4	90,371		2.075	544,931	12.510
	9.60		449.4	202.2	90,892		2.087	553,994	12.718

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.02 (February 2020)



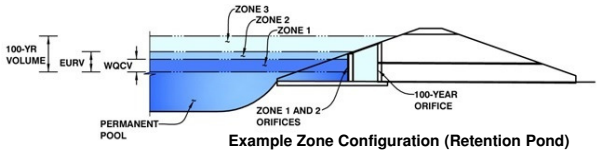


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.02 (February 2020)

Project: Singer Ranch

Basin ID: DF-3 (W Single Family Pond)(Sub-basin 1-D Added)



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.27	1.770	Orifice Plate
Zone 2 (EURV)	5.99	4.161	Circular Orifice
Zone 3 (100-year)	8.01	3.601	Weir&Pipe (Restrict)
Total (all zones)		9.532	

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

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

Calculated Parameters for Underdrain

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)

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	3.590E-02	ft²
Depth at top of Zone using Orifice Plate =	3.27	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	12.60	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	5.17	sq. inches (use rectangular openings)	Elliptical Slot Area =	N/A	ft²

Calculated Parameters for Plate

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	1.09	2.18					
Orifice Area (sq. inches)	5.17	5.17	5.17					

	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)

	Zone 2 Circular	Not Selected		Zone 2 Circular	Not Selected	
Invert of Vertical Orifice =	3.27	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	0.13	N/A	ft²
Depth at top of Zone using Vertical Orifice =	5.99	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.20	N/A	feet
Vertical Orifice Diameter =	4.90	N/A	inches				

Calculated Parameters for Vertical Orifice

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		Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	6.10	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	7.10	N/A	feet
Overflow Weir Front Edge Length =	12.00	N/A	feet	Overflow Weir Slope Length =	4.12	N/A	feet
Overflow Weir Grate Slope =	4.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	6.09	N/A	
Horiz. Length of Weir Sides =	4.00	N/A	feet	Overflow Grate Open Area w/o Debris =	34.63	N/A	ft²
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area	Overflow Grate Open Area w/ Debris =	17.32	N/A	ft²
Debris Clogging % =	50%	N/A	%				

Calculated Parameters for Overflow Weir

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

	Zone 3 Restrictor	Not Selected		Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.30	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	5.69	N/A	ft²
Outlet Pipe Diameter =	36.00	N/A	inches	Outlet Orifice Centroid =	1.24	N/A	feet
Restrictor Plate Height Above Pipe Invert =	27.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	2.09	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	9.25	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.96	feet
Spillway Crest Length =	58.00	feet	Stage at Top of Freeboard =	11.21	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	2.28	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	16.23	acre-ft

Calculated Parameters for Spillway

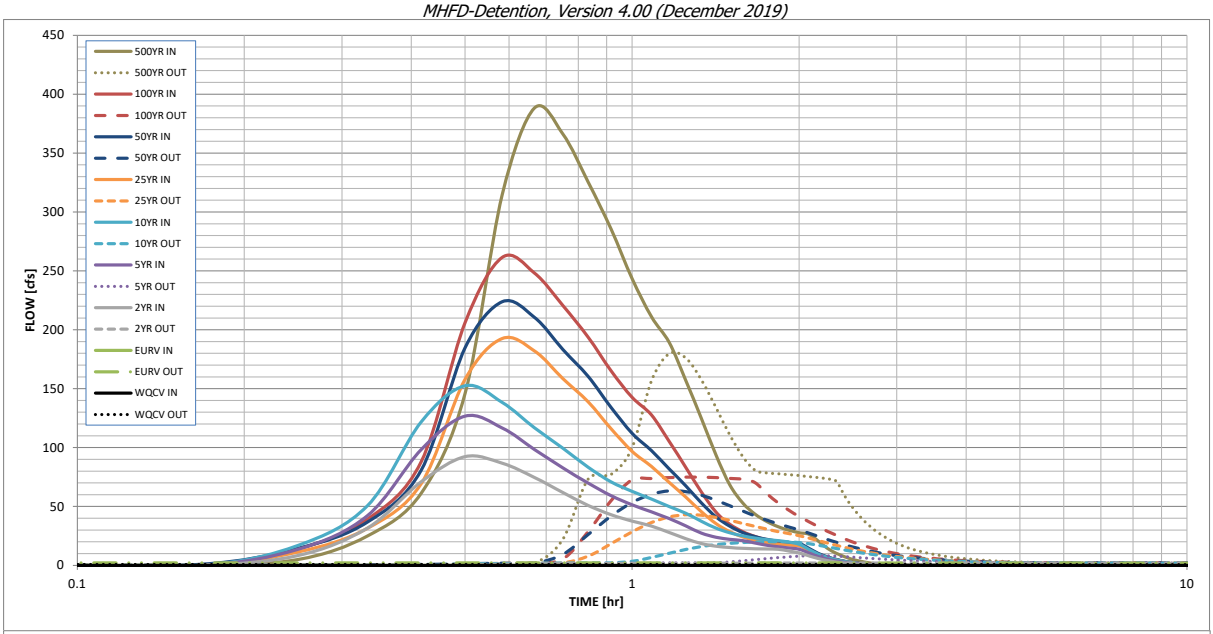
Routed Hydrograph Results

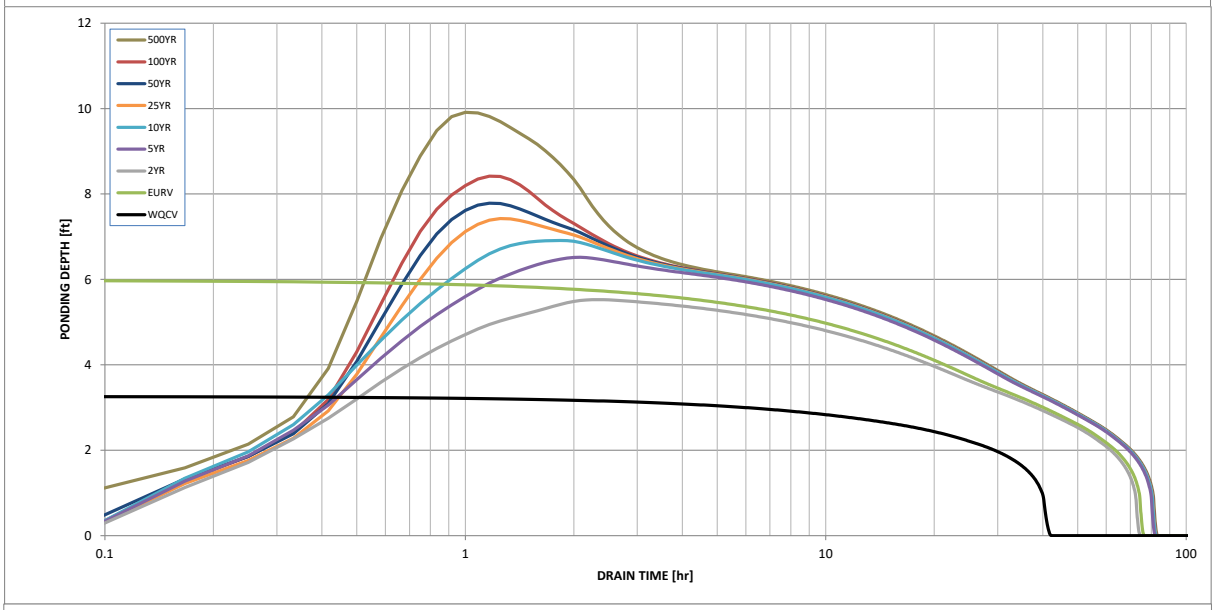
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

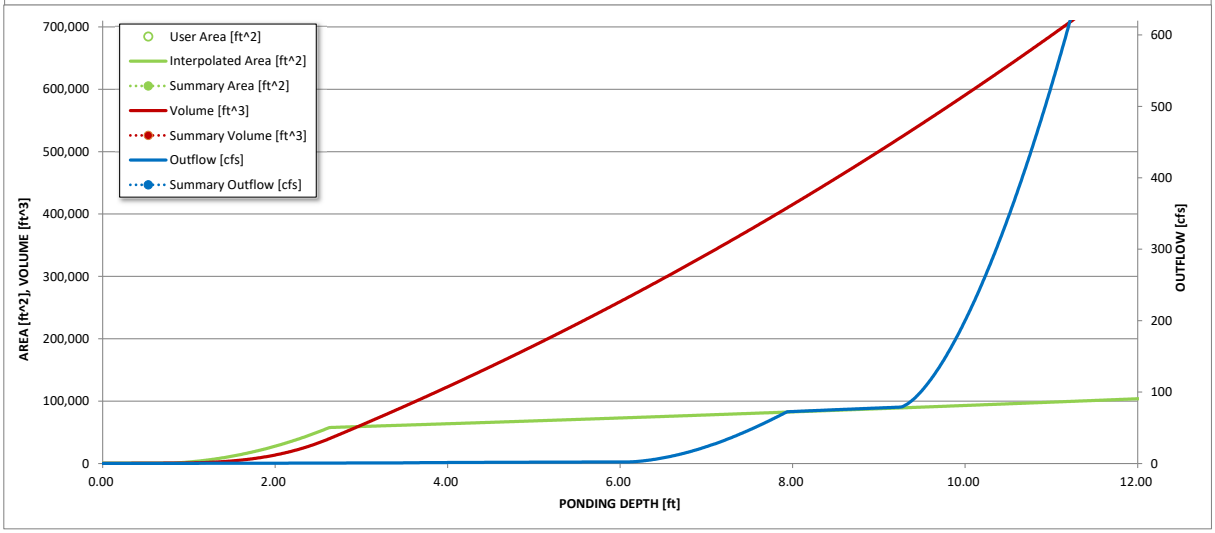
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.55
CUHP Runoff Volume (acre-ft) =	1.770	5.931	5.483	7.478	9.176	11.254	13.050	15.227	22.864
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	5.483	7.478	9.176	11.254	13.050	15.227	22.864
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	8.6	24.3	36.9	66.0	82.8	105.1	175.9
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.10	0.29	0.44	0.79	0.99	1.26	2.10
Peak Inflow Q (cfs) =	N/A	N/A	92.2	126.7	152.5	192.6	223.8	261.5	388.1
Peak Outflow Q (cfs) =	0.7	2.1	2.0	8.3	20.1	43.0	63.2	74.9	179.6
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.3	0.5	0.7	0.8	0.7	1.0
Structure Controlling Flow =	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	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	0.2	0.5	1.2	1.8	2.1	2.3
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) =	38	68	66	72	71	69	68	66	61
Time to Drain 99% of Inflow Volume (hours) =	**40**	72	70	77	77	76	76	75	73
Maximum Ponding Depth (ft) =	3.27	5.99	5.53	6.52	6.91	7.42	7.79	8.42	9.91
Area at Maximum Ponding Depth (acres) =	1.39	1.67	1.62	1.73	1.78	1.83	1.87	1.95	2.12
Maximum Volume Stored (acre-ft) =	1.783	5.942	5.168	6.827	7.529	8.449	9.116	10.319	13.371

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.00 (December 2019)







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	0.95	0.10	5.01
	0:15:00	0.00	0.00	8.41	13.72	16.98	11.40	14.42	13.90	24.97
	0:20:00	0.00	0.00	31.65	42.17	50.61	31.46	36.74	39.14	61.26
	0:25:00	0.00	0.00	70.93	98.29	121.78	69.32	80.81	87.94	145.77
	0:30:00	0.00	0.00	92.24	126.71	152.46	157.88	184.62	205.94	314.53
	0:35:00	0.00	0.00	86.69	116.67	138.30	192.58	223.78	261.45	388.14
	0:40:00	0.00	0.00	74.67	98.48	116.87	182.14	210.64	248.19	366.31
	0:45:00	0.00	0.00	61.91	82.73	99.55	158.62	183.32	220.66	325.51
	0:50:00	0.00	0.00	50.91	69.93	83.33	138.85	160.44	193.74	285.41
	0:55:00	0.00	0.00	42.96	59.13	70.89	115.92	134.04	165.05	243.48
	1:00:00	0.00	0.00	37.64	51.44	62.86	96.83	112.19	142.63	211.10
	1:05:00	0.00	0.00	33.41	45.40	56.32	83.96	97.46	127.75	189.27
	1:10:00	0.00	0.00	27.93	39.71	49.95	70.46	81.90	105.27	156.81
	1:15:00	0.00	0.00	22.63	33.44	44.21	57.88	67.39	83.05	124.70
	1:20:00	0.00	0.00	18.54	27.39	37.41	45.56	53.00	62.28	93.59
	1:25:00	0.00	0.00	16.23	23.91	31.62	35.37	41.11	45.16	68.26
	1:30:00	0.00	0.00	15.09	22.14	27.69	28.66	33.23	34.85	52.87
	1:35:00	0.00	0.00	14.47	21.00	25.06	24.12	27.83	28.60	43.45
	1:40:00	0.00	0.00	14.14	18.98	23.19	21.25	24.39	24.47	37.14
	1:45:00	0.00	0.00	13.88	17.09	21.87	19.28	22.02	21.62	32.80
	1:50:00	0.00	0.00	13.68	15.78	20.94	18.03	20.51	19.68	29.83
	1:55:00	0.00	0.00	12.15	14.81	19.79	17.14	19.42	18.31	27.71
	2:00:00	0.00	0.00	10.54	13.73	17.92	16.55	18.69	17.51	26.44
	2:05:00	0.00	0.00	8.06	10.54	13.58	12.88	14.53	13.65	20.56
	2:10:00	0.00	0.00	5.75	7.45	9.52	9.04	10.18	9.60	14.42
	2:15:00	0.00	0.00	4.07	5.27	6.74	6.41	7.21	6.87	10.31
	2:20:00	0.00	0.00	2.86	3.67	4.75	4.53	5.08	4.87	7.31
	2:25:00	0.00	0.00	1.95	2.47	3.26	3.11	3.49	3.35	5.01
	2:30:00	0.00	0.00	1.29	1.64	2.20	2.12	2.38	2.28	3.41
	2:35:00	0.00	0.00	0.80	1.09	1.42	1.41	1.58	1.51	2.26
	2:40:00	0.00	0.00	0.44	0.64	0.82	0.85	0.95	0.91	1.35
	2:45:00	0.00	0.00	0.19	0.32	0.38	0.42	0.47	0.45	0.67
	2:50:00	0.00	0.00	0.07	0.10	0.12	0.14	0.16	0.15	0.22
	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

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.02 (February 2020)

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 [ft ^{2}]	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'.

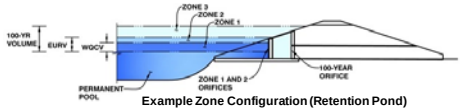
Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.02 (February 2020)

Project: Singer Ranch

Basin ID: DF-4 (SW Single Family Pond)



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	23.14	acres
Watershed Length =	1,970	ft
Watershed Length to Centroid =	991	ft
Watershed Slope =	0.013	ft/ft
Watershed Imperviousness =	65.00%	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.

		Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.490 acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	1.642 acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	1.513 acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	2.063 acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	2.531 acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	3.104 acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	3.598 acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	4.197 acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.55 in.) =	6.300 acre-feet	3.55	inches
Approximate 2-yr Detention Volume =	1.273 acre-feet		
Approximate 5-yr Detention Volume =	1.707 acre-feet		
Approximate 10-yr Detention Volume =	2.176 acre-feet		
Approximate 25-yr Detention Volume =	2.344 acre-feet		
Approximate 50-yr Detention Volume =	2.441 acre-feet		
Approximate 100-yr Detention Volume =	2.639 acre-feet		

Define Zones and Basin Geometry

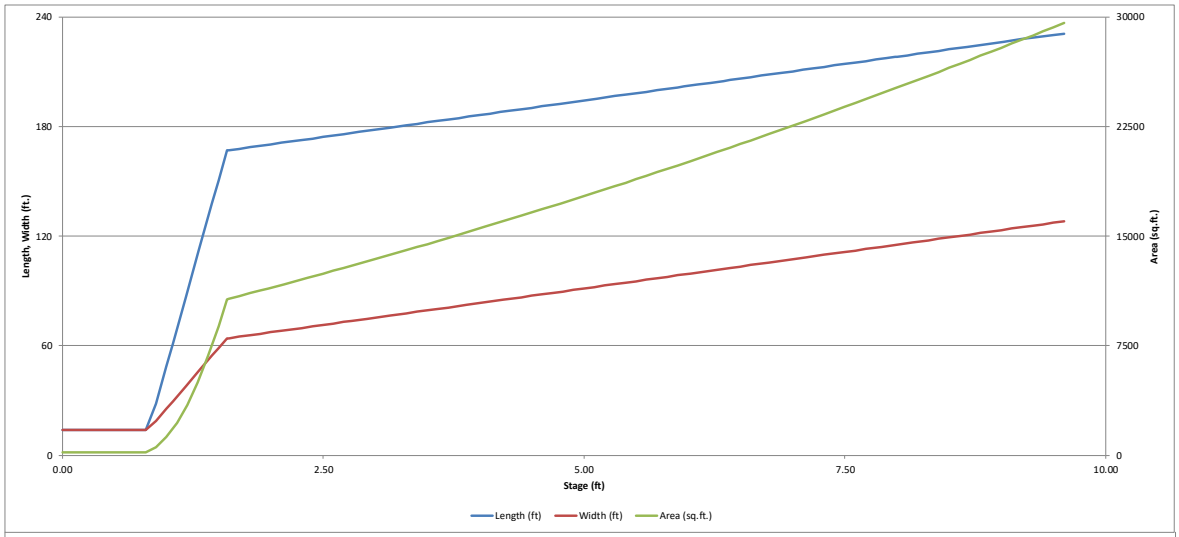
Zone 1 Volume (WQCV) =	0.490	acre-feet
Zone 2 Volume (EURV - Zone 1) =	1.152	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.997	acre-feet
Total Detention Basin Volume =	2.639	acre-feet
Initial Surcharge Volume (ISV) =	64	ft^3
Initial Surcharge Depth (ISD) =	0.33	ft
Total Available Detention Depth (H_{total}) =	8.00	ft
Depth of Trickle Channel (H_{TC}) =	0.50	ft
Slope of Trickle Channel (S_{TC}) =	0.005	ft/ft
Slopes of Main Basin Sides (S_{main}) =	4	H:V
Basin Length-to-Width Ratio (R_{LW}) =	3	
Initial Surcharge Area (A_{ISV}) =	194	ft^2
Surcharge Volume Length (L_{ISV}) =	13.9	ft
Surcharge Volume Width (W_{ISV}) =	13.9	ft
Depth of Basin Floor (H_{FLOOR}) =	0.75	ft
Length of Basin Floor (L_{FLOOR}) =	166.9	ft
Width of Basin Floor (W_{FLOOR}) =	63.9	ft
Area of Basin Floor (A_{FLOOR}) =	10,672	ft^2
Volume of Basin Floor (V_{FLOOR}) =	3,076	ft^3
Depth of Main Basin (H_{MAIN}) =	6.42	ft
Length of Main Basin (L_{MAIN}) =	218.3	ft
Width of Main Basin (W_{MAIN}) =	115.3	ft
Area of Main Basin (A_{MAIN}) =	25,167	ft^2
Volume of Main Basin (V_{MAIN}) =	111,766	ft^3
Calculated Total Basin Volume (V_{total}) =	**2.640**	acre-feet

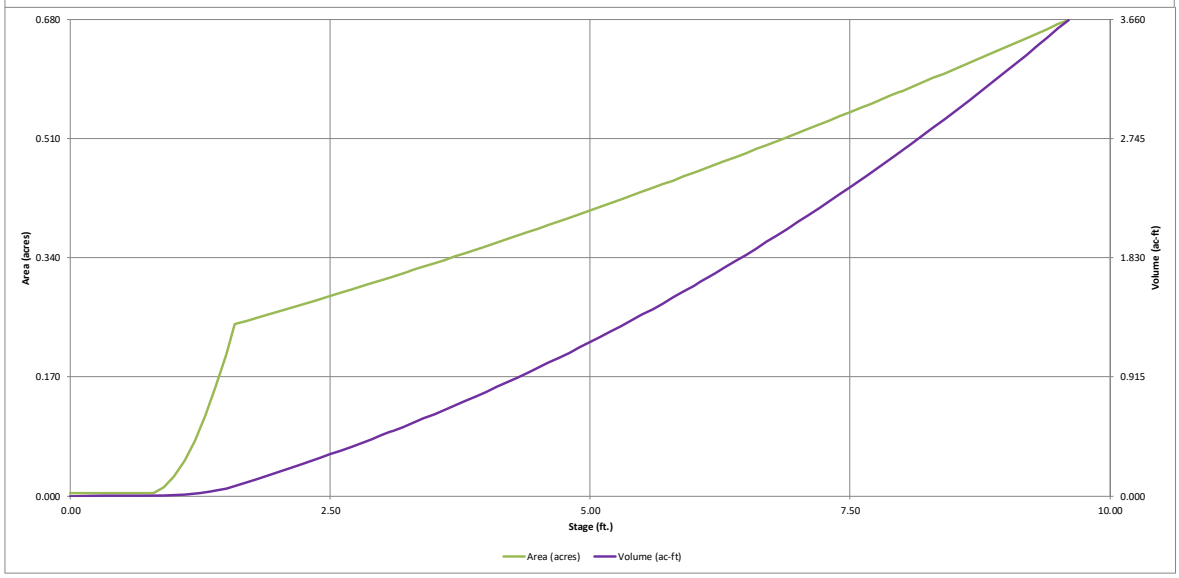
Depth Increment = 0.10 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	0.00		13.9	13.9	194		0.004		
ISV	0.33		13.9	13.9	194		0.004	64	0.001
	0.40		13.9	13.9	194		0.004	78	0.002
	0.50		13.9	13.9	194		0.004	97	0.002
	0.60		13.9	13.9	194		0.004	116	0.003
	0.70		13.9	13.9	194		0.004	136	0.003
	0.80		13.9	13.9	194		0.004	155	0.004
	0.90		28.2	18.6	525		0.012	185	0.004
	1.00		48.6	25.3	1,228		0.028	271	0.006
	1.10		69.0	31.9	2,204		0.051	440	0.010
	1.20		89.4	38.6	3,451		0.079	721	0.017
	1.30		109.8	45.3	4,970		0.114	1,139	0.026
	1.40		130.2	51.9	6,762		0.155	1,724	0.040
	1.50		150.6	58.6	8,825		0.203	2,501	0.057
Floor	1.58		166.9	63.9	10,672		0.245	3,280	0.075
	1.60		167.1	64.1	10,709		0.246	3,493	0.080
	1.70		167.9	64.9	10,895		0.250	4,574	0.105
	1.80		168.7	65.7	11,081		0.254	5,672	0.130
	1.90		169.5	66.5	11,270		0.259	6,790	0.156
	2.00		170.3	67.3	11,459		0.263	7,926	0.182
	2.10		171.1	68.1	11,650		0.267	9,082	0.208
	2.20		171.9	68.9	11,842		0.272	10,256	0.235
	2.30		172.7	69.7	12,035		0.276	11,450	0.263
	2.40		173.5	70.5	12,229		0.281	12,663	0.291
	2.50		174.3	71.3	12,425		0.285	13,896	0.319
	2.60		175.1	72.1	12,622		0.290	15,148	0.348
	2.70		175.9	72.9	12,821		0.294	16,421	0.377
	2.80		176.7	73.7	13,020		0.299	17,713	0.407
	2.90		177.5	74.5	13,221		0.304	19,025	0.437
	3.00		178.3	75.3	13,424		0.308	20,357	0.467
Zone 1 (WQCV)	3.08		178.9	75.9	13,586		0.312	21,437	0.492
	3.10		179.1	76.1	13,627		0.313	21,709	0.498
	3.20		179.9	76.9	13,832		0.318	23,082	0.530
	3.30		180.7	77.7	14,038		0.322	24,476	0.562
	3.40		181.5	78.5	14,245		0.327	25,890	0.594
	3.50		182.3	79.3	14,454		0.332	27,325	0.627
	3.60		183.1	80.1	14,664		0.337	28,781	0.661
	3.70		183.9	80.9	14,875		0.341	30,258	0.695
	3.80		184.7	81.7	15,087		0.346	31,756	0.729
	3.90		185.5	82.5	15,301		0.351	33,275	0.764
	4.00		186.3	83.3	15,516		0.356	34,816	0.799
	4.10		187.1	84.1	15,733		0.361	36,379	0.835
	4.20		187.9	84.9	15,950		0.366	37,963	0.872
	4.30		188.7	85.7	16,169		0.371	39,569	0.908
	4.40		189.5	86.5	16,389		0.376	41,197	0.946
	4.50		190.3	87.3	16,611		0.381	42,847	0.984
	4.60		191.1	88.1	16,833		0.386	44,519	1.022
	4.70		191.9	88.9	17,057		0.392	46,213	1.061
	4.80		192.7	89.7	17,283		0.397	47,930	1.100
	4.90		193.5	90.5	17,509		0.402	49,670	1.140
	5.00		194.3	91.3	17,737		0.407	51,432	1.181
	5.10		195.1	92.1	17,966		0.412	53,217	1.222
	5.20		195.9	92.9	18,196		0.418	55,025	1.263
	5.30		196.7	93.7	18,428		0.423	56,857	1.305
	5.40		197.5	94.5	18,661		0.428	58,711	1.348
	5.50		198.3	95.3	18,895		0.434	60,589	1.391
	5.60		199.1	96.1	19,131		0.439	62,490	1.435
	5.70		199.9	96.9	19,368		0.445	64,415	1.479
	5.80		200.7	97.7	19,606		0.450	66,364	1.523
	5.90		201.5	98.5	19,845		0.456	68,336	1.569
	6.00		202.3	99.3	20,086		0.461	70,333	1.615
Zone 2 (EURV)	6.06		202.8	99.8	20,231		0.464	71,542	1.642
	6.10		203.1	100.1	20,327		0.467	72,353	1.661
	6.20		203.9	100.9	20,571		0.472	74,398	1.708
	6.30		204.7	101.7	20,815		0.478	76,467	1.755
	6.40		205.5	102.5	21,061		0.483	78,561	1.804
	6.50		206.3	103.3	21,308		0.489	80,680	1.852
	6.60		207.1	104.1	21,556		0.495	82,823	1.901
	6.70		207.9	104.9	21,806		0.501	84,991	1.951
	6.80		208.7	105.7	22,057		0.506	87,184	2.001
	6.90		209.5	106.5	22,309		0.512	89,402	2.052
	7.00		210.3	107.3	22,562		0.518	91,646	2.104
	7.10		211.1	108.1	22,817		0.524	93,915	2.156
	7.20		211.9	108.9	23,073		0.530	96,209	2.209
	7.30		212.7	109.7	23,330		0.536	98,529	2.262
	7.40		213.5	110.5	23,589		0.542	100,875	2.316
	7.50		214.3	111.3	23,849		0.547	103,247	2.370
	7.60		215.1	112.1	24,110		0.553	105,645	2.425
	7.70		215.9	112.9	24,372		0.560	108,069	2.481
	7.80		216.7	113.7	24,636		0.566	110,520	2.537
	7.90		217.5	114.5	24,901		0.572	112,996	2.594
Zone 3 (100-year)	7.98		218.1	115.1	25,114		0.577	114,997	2.640
	8.00		218.3	115.3	25,167		0.578	115,500	2.652
	8.10		219.1	116.1	25,434		0.584	118,030	2.710
	8.20		219.9	116.9	25,703		0.590	120,587	2.768
	8.30		220.7	117.7	25,973		0.596	123,170	2.828
	8.40		221.5	118.5	26,245		0.602	125,781	2.888
	8.50		222.3	119.3	26,517		0.609	128,419	2.948
	8.60		223.1	120.1	26,791		0.615	131,085	3.009
	8.70		223.9	120.9	27,066		0.621	133,778	3.071
	8.80		224.7	121.7	27,343		0.628	136,498	3.134
	8.90		225.5	122.5	27,620		0.634	139,246	3.197
	9.00		226.3	123.3	27,900		0.640	142,022	3.260
	9.10		227.1	124.1	28,180		0.647	144,826	3.325
	9.20		227.9	124.9	28,461		0.653	147,658	3.390
	9.30		228.7	125.7	28,744		0.660	150,519	3.455
	9.40		229.5	126.5	29,028		0.666	153,407	3.522
	9.50		230.3	127.3	29,314		0.673	156,324	3.589
	9.60		231.1	128.1	29,601		0.680	159,270	3.656

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.02 (February 2020)



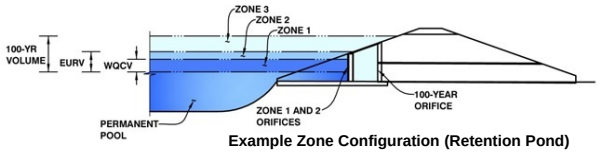


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.02 (February 2020)

Project: Singer Ranch

Basin ID: DF-4 (SW Single Family Pond)



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.08	0.490	Orifice Plate
Zone 2 (EURV)	6.06	1.152	Circular Orifice
Zone 3 (100-year)	7.98	0.997	Weir&Pipe (Restrict)
Total (all zones)		2.639	

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

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)	Underdrain Orifice Area =	N/A	ft^2
Underdrain Orifice Diameter =	N/A	inches	Underdrain Orifice Centroid =	N/A	feet

Calculated Parameters for Underdrain

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)

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	1.139E-02	ft^2
Depth at top of Zone using Orifice Plate =	3.08	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	12.30	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	1.64	sq. inches (diameter = 1-7/16 inches)	Elliptical Slot Area =	N/A	ft^2

Calculated Parameters for Plate

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	1.03	2.05					
Orifice Area (sq. inches)	1.64	1.64	1.64					

	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)

	Zone 2 Circular	Not Selected		Zone 2 Circular	Not Selected	
Invert of Vertical Orifice =	3.08	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	0.02	N/A	ft^2
Depth at top of Zone using Vertical Orifice =	6.06	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.08	N/A	feet
Vertical Orifice Diameter =	1.97	N/A	inches				

Calculated Parameters for Vertical Orifice

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		Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	6.25	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	6.25	N/A	feet
Overflow Weir Front Edge Length =	6.00	N/A	feet	Overflow Weir Slope Length =	4.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	10.16	N/A	
Horiz. Length of Weir Sides =	4.00	N/A	feet	Overflow Grate Open Area w/o Debris =	16.80	N/A	ft^2
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area	Overflow Grate Open Area w/ Debris =	8.40	N/A	ft^2
Debris Clogging % =	50%	N/A	%				

Calculated Parameters for Overflow Weir

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

	Zone 3 Restrictor	Not Selected		Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.30	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	1.65	N/A	ft^2
Outlet Pipe Diameter =	24.00	N/A	inches	Outlet Orifice Centroid =	0.60	N/A	feet
Restrictor Plate Height Above Pipe Invert =	12.50		inches	Half-Central Angle of Restrictor Plate on Pipe =	1.61	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	7.80	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.89	feet
Spillway Crest Length =	19.00	feet	Stage at Top of Freeboard =	9.69	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.69	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	3.72	acre-ft

Calculated Parameters for Spillway

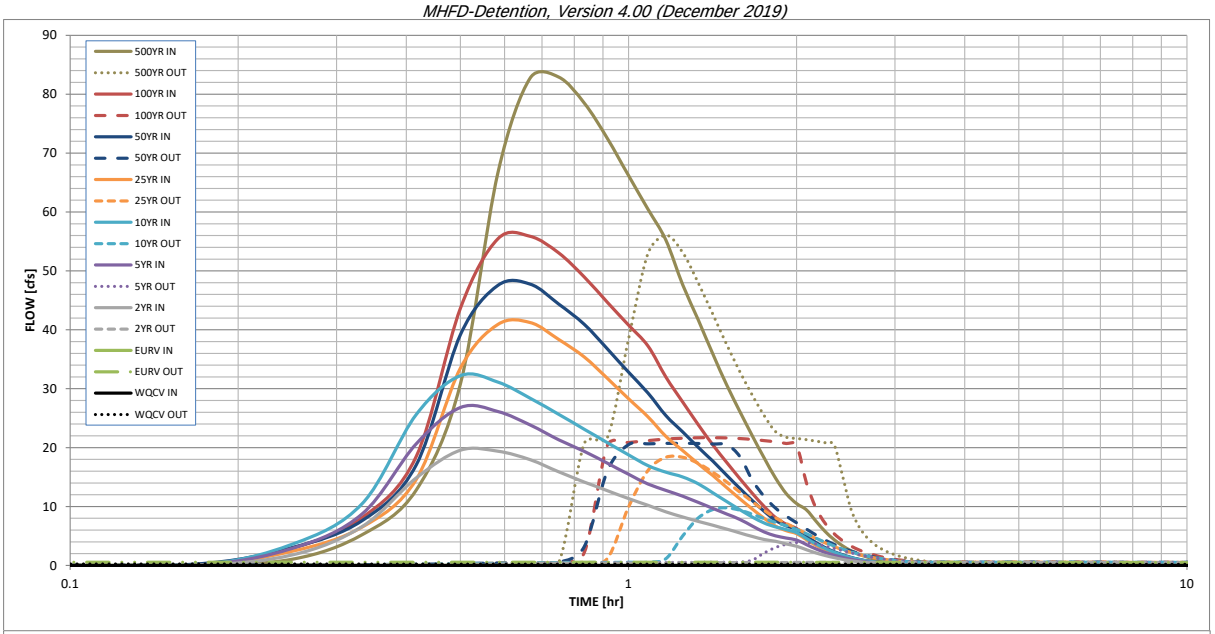
Routed Hydrograph Results

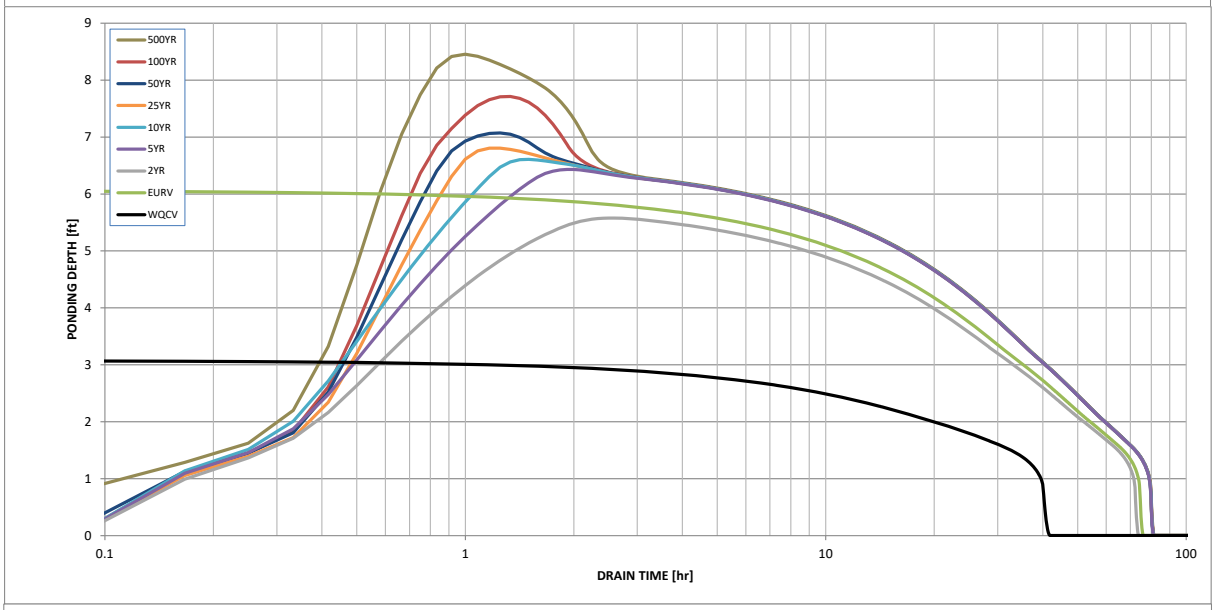
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

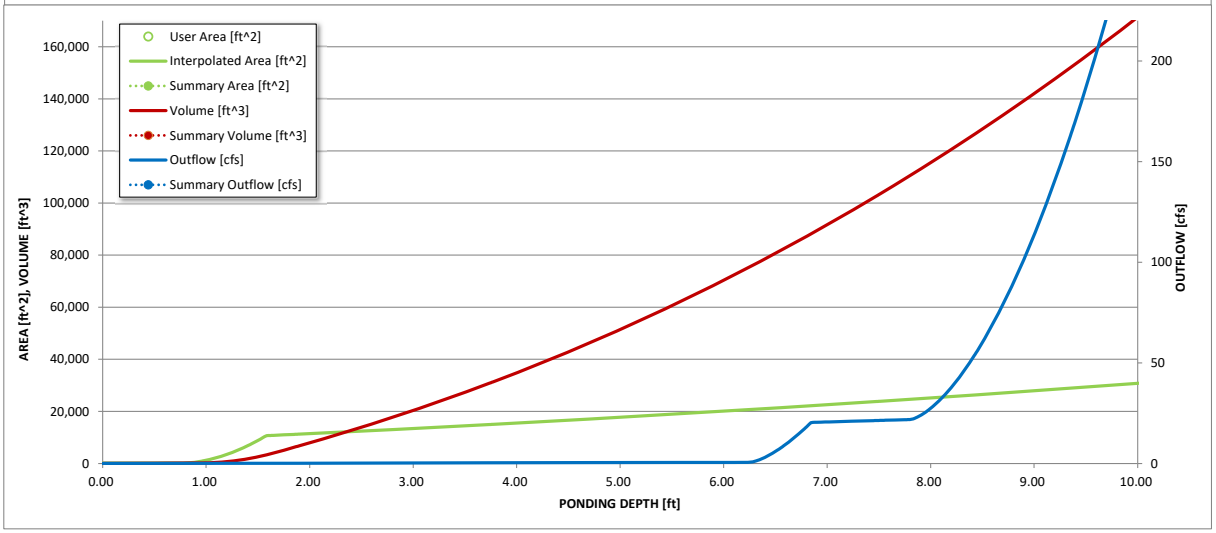
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.55
CUHP Runoff Volume (acre-ft) =	0.490	1.642	1.513	2.063	2.531	3.104	3.598	4.197	6.300
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	1.513	2.063	2.531	3.104	3.598	4.197	6.300
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	1.7	4.8	7.4	13.7	17.2	22.0	36.9
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.07	0.21	0.32	0.59	0.74	0.95	1.60
Peak Inflow Q (cfs) =	N/A	N/A	19.5	26.8	32.2	41.2	47.8	55.9	82.9
Peak Outflow Q (cfs) =	0.2	0.5	0.5	3.9	9.8	18.4	20.7	21.7	56.1
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.8	1.3	1.3	1.2	1.0	1.5
Structure Controlling Flow =	Plate	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.2	0.6	1.0	1.2	1.3	1.3
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) =	38	68	66	72	70	68	67	65	59
Time to Drain 99% of Inflow Volume (hours) =	**40**	72	70	77	76	75	75	74	72
Maximum Ponding Depth (ft) =	3.08	6.06	5.58	6.43	6.61	6.80	7.07	7.71	8.45
Area at Maximum Ponding Depth (acres) =	0.31	0.46	0.44	0.49	0.49	0.51	0.52	0.56	0.61
Maximum Volume Stored (acre-ft) =	0.492	1.642	1.421	1.818	1.901	2.001	2.140	2.487	2.918

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.00 (December 2019)







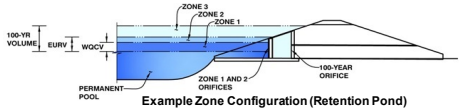
S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.02 (February 2020)

Project: Singer Ranch

Basin ID: DF-5 (S Single Family & School Pond)



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	57.54	acres
Watershed Length =	2,851	ft
Watershed Length to Centroid =	1,555	ft
Watershed Slope =	0.013	ft/ft
Watershed Imperviousness =	70.00%	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.

			Optional User Overrides
Water Quality Capture Volume (WQCV) =	1.319	acre-feet	acre-feet
Excess Urban Runoff Volume (EURV) =	4.423	acre-feet	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	4.049	acre-feet	1.19 inches
5-yr Runoff Volume (P1 = 1.5 in.) =	5.460	acre-feet	1.50 inches
10-yr Runoff Volume (P1 = 1.75 in.) =	6.650	acre-feet	1.75 inches
25-yr Runoff Volume (P1 = 2 in.) =	8.056	acre-feet	2.00 inches
50-yr Runoff Volume (P1 = 2.25 in.) =	9.300	acre-feet	2.25 inches
100-yr Runoff Volume (P1 = 2.52 in.) =	10.782	acre-feet	2.52 inches
500-yr Runoff Volume (P1 = 3.55 in.) =	16.053	acre-feet	3.55 inches
Approximate 2-yr Detention Volume =	3.456	acre-feet	
Approximate 5-yr Detention Volume =	4.606	acre-feet	
Approximate 10-yr Detention Volume =	5.814	acre-feet	
Approximate 25-yr Detention Volume =	6.247	acre-feet	
Approximate 50-yr Detention Volume =	6.498	acre-feet	
Approximate 100-yr Detention Volume =	6.961	acre-feet	

Define Zones and Basin Geometry

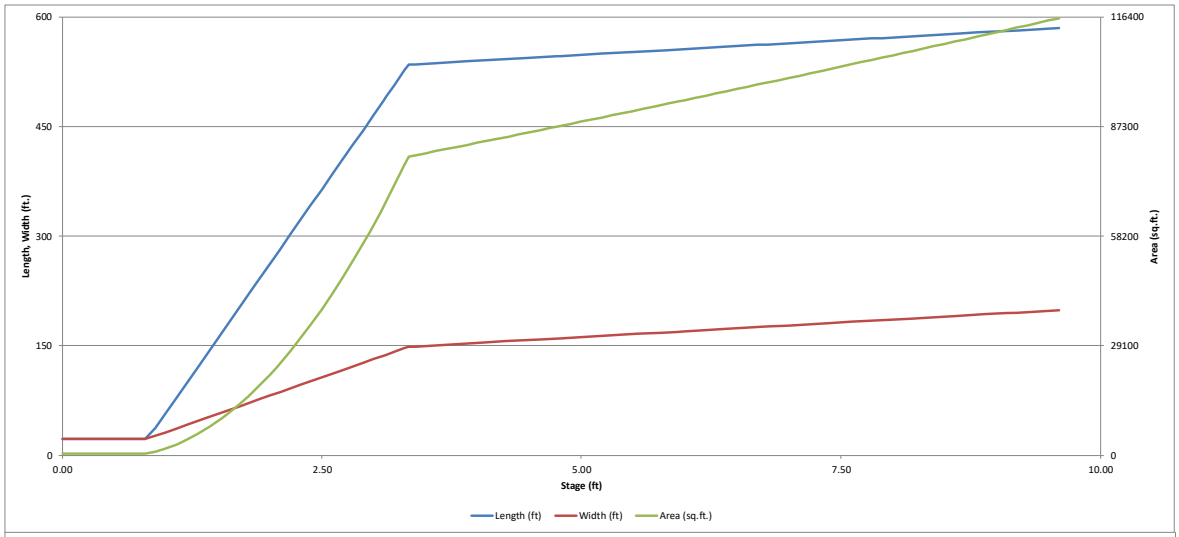
Zone 1 Volume (WQCV) =	1.319	acre-feet
Zone 2 Volume (EURV - Zone 1) =	3.105	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	2.538	acre-feet
Total Detention Basin Volume =	6.961	acre-feet
Initial Surcharge Volume (ISV) =	172	ft^3
Initial Surcharge Depth (ISD) =	0.33	ft
Total Available Detention Depth (H_{total}) =	6.00	ft
Depth of Trickle Channel (H_{TC}) =	0.50	ft
Slope of Trickle Channel (S_{TC}) =	0.005	ft/ft
Slopes of Main Basin Sides (S_{main}) =	4	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	4	
Initial Surcharge Area (A_{ISV}) =	522	ft^2
Surcharge Volume Length (L_{ISV}) =	22.9	ft
Surcharge Volume Width (W_{ISV}) =	22.9	ft
Depth of Basin Floor (H_{FLOOR}) =	2.51	ft
Length of Basin Floor (L_{FLOOR}) =	534.9	ft
Width of Basin Floor (W_{FLOOR}) =	148.4	ft
Area of Basin Floor (A_{FLOOR}) =	79,353	ft^2
Volume of Basin Floor (V_{FLOOR}) =	72,215	ft^3
Depth of Main Basin (H_{MAIN}) =	2.66	ft
Length of Main Basin (L_{MAIN}) =	556.2	ft
Width of Main Basin (W_{MAIN}) =	169.6	ft
Area of Main Basin (A_{MAIN}) =	94,345	ft^2
Volume of Main Basin (V_{MAIN}) =	230,730	ft^3
Calculated Total Basin Volume (V_{total}) =	**6.965**	acre-feet

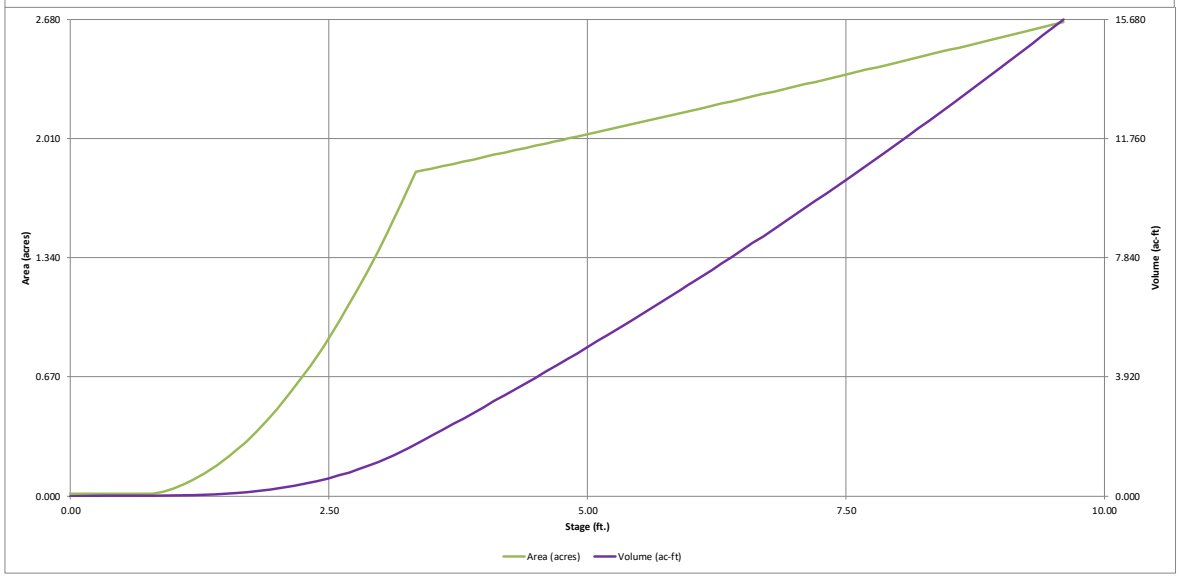
Depth Increment = 0.10 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	0.00		22.9	22.9	522		0.012		
ISV	0.33		22.9	22.9	522		0.012	172	0.004
	0.40		22.9	22.9	522		0.012	209	0.005
	0.50		22.9	22.9	522		0.012	261	0.006
	0.60		22.9	22.9	522		0.012	313	0.007
	0.70		22.9	22.9	522		0.012	366	0.008
	0.80		22.9	22.9	522		0.012	418	0.010
	0.90		37.1	26.4	979		0.022	485	0.011
	1.00		57.5	31.4	1,804		0.041	623	0.014
	1.10		77.9	36.4	2,833		0.065	853	0.020
	1.20		98.3	41.4	4,066		0.093	1,196	0.027
	1.30		118.7	46.4	5,504		0.126	1,673	0.038
	1.40		139.1	51.4	7,145		0.164	2,304	0.053
	1.50		159.5	56.4	8,990		0.206	3,109	0.071
	1.60		179.9	61.4	11,039		0.253	4,109	0.094
	1.70		200.3	66.4	13,293		0.305	5,323	0.122
	1.80		220.7	71.4	15,750		0.362	6,774	0.156
	1.90		241.1	76.4	18,411		0.423	8,480	0.195
	2.00		261.5	81.4	21,276		0.488	10,463	0.240
	2.10		281.9	86.4	24,346		0.559	12,742	0.293
	2.20		302.3	91.4	27,619		0.634	15,339	0.352
	2.30		322.7	96.4	31,096		0.714	18,273	0.419
	2.40		343.1	101.4	34,777		0.798	21,565	0.495
	2.50		363.5	106.4	38,663		0.888	25,235	0.579
	2.60		383.9	111.4	42,752		0.981	29,304	0.673
	2.70		404.3	116.4	47,045		1.080	33,792	0.776
	2.80		424.7	121.4	51,542		1.183	38,720	0.889
	2.90		445.1	126.4	56,244		1.291	44,107	1.013
	3.00		465.5	131.4	61,149		1.404	49,975	1.147
	3.10		485.9	136.4	66,258		1.521	56,344	1.293
Zone 1 (WQCV)	3.12		490.0	137.4	67,304		1.545	57,680	1.324
	3.20		506.3	141.4	71,571		1.643	63,234	1.452
	3.30		526.7	146.4	77,089		1.770	70,665	1.622
Floor	3.34		534.9	148.4	79,353		1.822	73,794	1.694
	3.40		535.4	148.8	79,681		1.829	78,565	1.804
	3.50		536.2	149.6	80,229		1.842	86,560	1.987
	3.60		537.0	150.4	80,778		1.854	94,611	2.172
	3.70		537.8	151.2	81,329		1.867	102,716	2.358
	3.80		538.6	152.0	81,880		1.880	110,876	2.545
	3.90		539.4	152.8	82,434		1.892	119,092	2.734
	4.00		540.2	153.6	82,988		1.905	127,363	2.924
	4.10		541.0	154.4	83,544		1.918	135,690	3.115
	4.20		541.8	155.2	84,101		1.931	144,072	3.307
	4.30		542.6	156.0	84,659		1.944	152,510	3.501
	4.40		543.4	156.8	85,218		1.956	161,004	3.696
	4.50		544.2	157.6	85,779		1.969	169,554	3.892
	4.60		545.0	158.4	86,341		1.982	178,160	4.090
	4.70		545.8	159.2	86,905		1.995	186,822	4.289
Zone 2 (EURV)	4.77		546.3	159.8	87,300		2.004	192,919	4.429
	4.80		546.6	160.0	87,469		2.008	195,541	4.489
	4.90		547.4	160.8	88,035		2.021	204,316	4.690
	5.00		548.2	161.6	88,602		2.034	213,148	4.893
	5.10		549.0	162.4	89,171		2.047	222,036	5.097
	5.20		549.8	163.2	89,741		2.060	230,982	5.303
	5.30		550.6	164.0	90,312		2.073	239,984	5.509
	5.40		551.4	164.8	90,884		2.086	249,044	5.717
	5.50		552.2	165.6	91,458		2.100	258,161	5.927
	5.60		553.0	166.4	92,033		2.113	267,336	6.137
	5.70		553.8	167.2	92,609		2.126	276,568	6.349
	5.80		554.6	168.0	93,186		2.139	285,858	6.562
	5.90		555.4	168.8	93,765		2.153	295,205	6.777
Zone 3 (100-year)	5.99		556.1	169.6	94,287		2.165	303,667	6.971
	6.00		556.2	169.6	94,345		2.166	304,611	6.993
	6.10		557.0	170.4	94,926		2.179	314,074	7.210
	6.20		557.8	171.2	95,509		2.193	323,596	7.429
	6.30		558.6	172.0	96,093		2.206	333,176	7.649
	6.40		559.4	172.8	96,678		2.219	342,814	7.870
	6.50		560.2	173.6	97,264		2.233	352,512	8.093
	6.60		561.0	174.4	97,852		2.246	362,267	8.317
	6.70		561.8	175.2	98,441		2.260	372,082	8.542
	6.80		562.6	176.0	99,031		2.273	381,955	8.768
	6.90		563.4	176.8	99,622		2.287	391,888	8.997
	7.00		564.2	177.6	100,215		2.301	401,880	9.226
	7.10		565.0	178.4	100,809		2.314	411,931	9.457
	7.20		565.8	179.2	101,405		2.328	422,042	9.689
	7.30		566.6	180.0	102,001		2.342	432,212	9.922
	7.40		567.4	180.8	102,599		2.355	442,442	10.157
	7.50		568.2	181.6	103,199		2.369	452,732	10.393
	7.60		569.0	182.4	103,799		2.383	463,082	10.631
	7.70		569.8	183.2	104,401		2.397	473,492	10.870
	7.80		570.6	184.0	105,004		2.411	483,962	11.110
	7.90		571.4	184.8	105,608		2.424	494,493	11.352
	8.00		572.2	185.6	106,214		2.438	505,084	11.595
	8.10		573.0	186.4	106,821		2.452	515,736	11.840
	8.20		573.8	187.2	107,429		2.466	526,448	12.086
	8.30		574.6	188.0	108,038		2.480	537,221	12.333
	8.40		575.4	188.8	108,649		2.494	548,056	12.582
	8.50		576.2	189.6	109,261		2.508	558,951	12.832
	8.60		577.0	190.4	109,874		2.522	569,908	13.083
	8.70		577.8	191.2	110,489		2.536	580,926	13.336
	8.80		578.6	192.0	111,105		2.551	592,006	13.591
	8.90		579.4	192.8	111,722		2.565	603,147	13.846
	9.00		580.2	193.6	112,340		2.579	614,350	14.104
	9.10		581.0	194.4	112,960		2.593	625,615	14.362
	9.20		581.8	195.2	113,581		2.607	636,942	14.622
	9.30		582.6	196.0	114,203		2.622	648,331	14.884
	9.40		583.4	196.8	114,827		2.636	659,783	15.147
	9.50		584.2	197.6	115,451		2.650	671,297	15.411
	9.60		585.0	198.4	116,077		2.665	682,873	15.677

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.02 (February 2020)



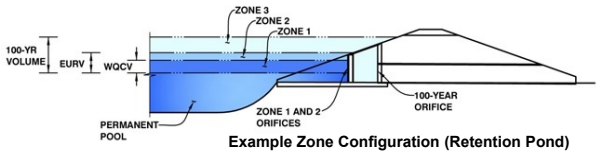


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.02 (February 2020)

Project: Singer Ranch

Basin ID: DF-5 (S Single Family & School Pond)



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.12	1.319	Orifice Plate
Zone 2 (EURV)	4.77	3.105	Circular Orifice
Zone 3 (100-year)	5.99	2.538	Weir&Pipe (Restrict)
Total (all zones)		6.961	

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

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

Calculated Parameters for Underdrain

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)

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	2.632E-02	ft²
Depth at top of Zone using Orifice Plate =	3.12	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	12.50	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	3.79	sq. inches (use rectangular openings)	Elliptical Slot Area =	N/A	ft²

Calculated Parameters for Plate

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	1.04	2.08					
Orifice Area (sq. inches)	3.79	3.79	3.79					

	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)

	Zone 2 Circular	Not Selected			Zone 2 Circular	Not Selected	
Invert of Vertical Orifice =	3.12	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	0.18	N/A	ft²
Depth at top of Zone using Vertical Orifice =	4.77	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.24	N/A	feet
Vertical Orifice Diameter =	5.74	N/A	inches				

Calculated Parameters for Vertical Orifice

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			Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	4.82	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	4.82	N/A	feet
Overflow Weir Front Edge Length =	6.00	N/A	feet	Overflow Weir Slope Length =	6.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	5.84	N/A	
Horiz. Length of Weir Sides =	6.00	N/A	feet	Overflow Grate Open Area w/o Debris =	25.20	N/A	ft²
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area	Overflow Grate Open Area w/ Debris =	12.60	N/A	ft²
Debris Clogging % =	50%	N/A	%				

Calculated Parameters for Overflow Weir

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

	Zone 3 Restrictor	Not Selected			Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.30	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	4.32	N/A	ft²
Outlet Pipe Diameter =	36.00	N/A	inches	Outlet Orifice Centroid =	1.00	N/A	feet
Restrictor Plate Height Above Pipe Invert =	21.15		inches	Half-Central Angle of Restrictor Plate on Pipe =	1.75	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	6.10	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.96	feet
Spillway Crest Length =	50.00	feet	Stage at Top of Freeboard =	8.06	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	2.45	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	11.72	acre-ft

Calculated Parameters for Spillway

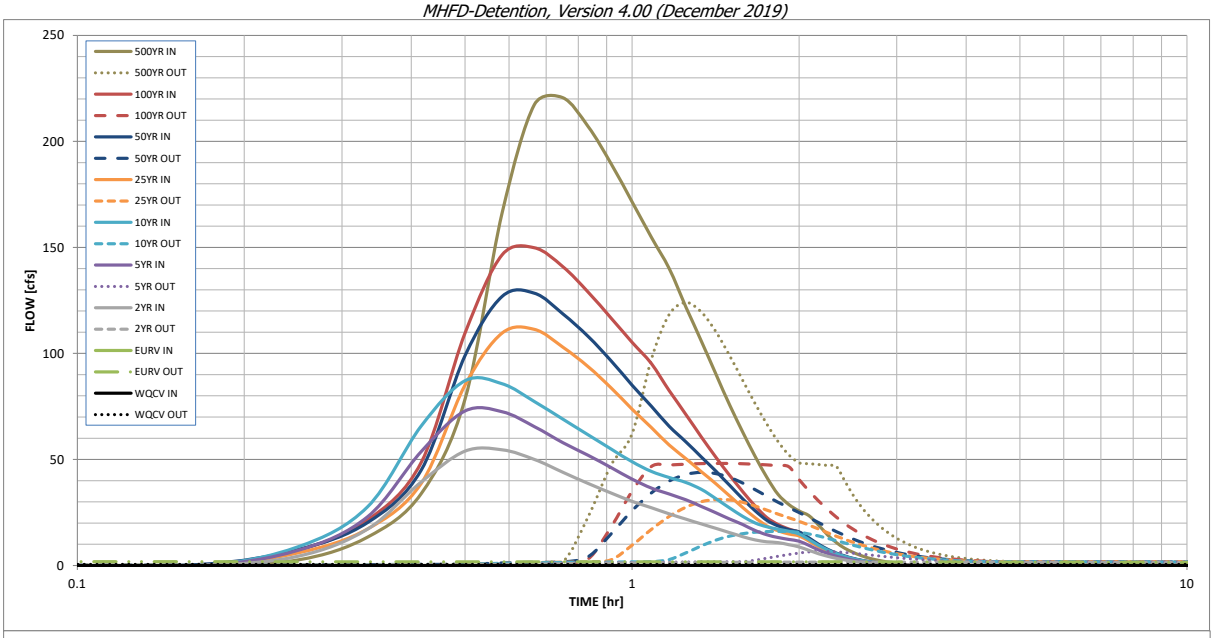
Routed Hydrograph Results

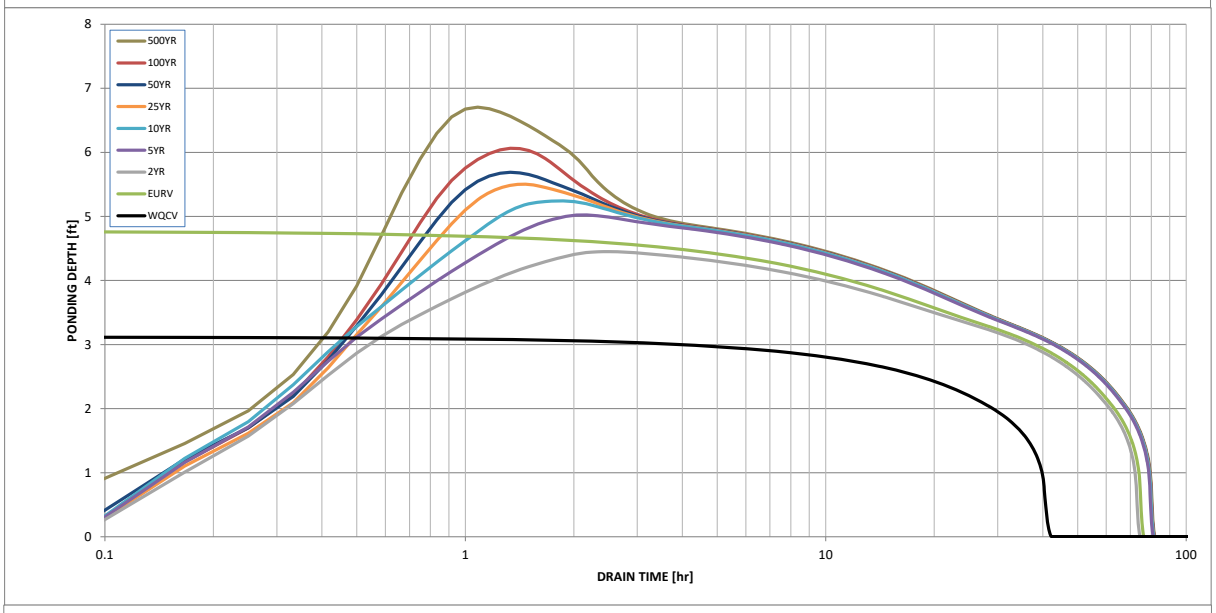
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

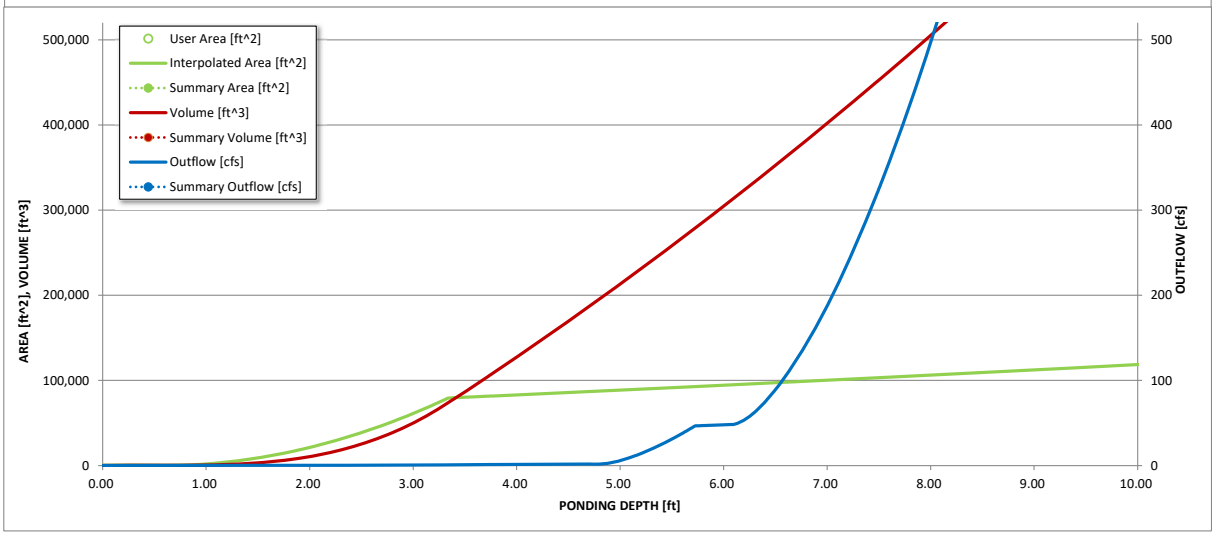
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.55
CUHP Runoff Volume (acre-ft) =	1.319	4.423	4.049	5.460	6.650	8.056	9.300	10.782	16.053
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	4.049	5.460	6.650	8.056	9.300	10.782	16.053
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	4.3	12.2	18.9	34.6	43.4	56.0	93.8
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.08	0.21	0.33	0.60	0.75	0.97	1.63
Peak Inflow Q (cfs) =	N/A	N/A	54.5	72.9	87.1	111.3	128.4	149.8	220.6
Peak Outflow Q (cfs) =	0.5	1.8	1.6	6.6	16.1	31.1	43.9	48.1	124.0
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.5	0.9	0.9	1.0	0.9	1.3
Structure Controlling Flow =	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	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	0.2	0.6	1.2	1.7	1.8	1.9
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) =	38	68	67	71	70	68	67	66	61
Time to Drain 99% of Inflow Volume (hours) =	**40**	72	71	76	76	75	75	74	72
Maximum Ponding Depth (ft) =	3.12	4.77	4.45	5.02	5.24	5.50	5.69	6.06	6.70
Area at Maximum Ponding Depth (acres) =	1.55	2.00	1.96	2.04	2.07	2.10	2.12	2.17	2.26
Maximum Volume Stored (acre-ft) =	1.324	4.429	3.774	4.934	5.385	5.927	6.307	7.123	8.542

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.00 (December 2019)





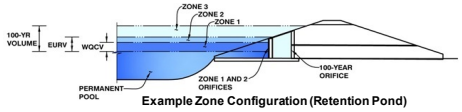


DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.02 (February 2020)

Project: Singer Ranch

Basin ID: DF-6 (NE Commercial Pond)



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	6.50	acres
Watershed Length =	660	ft
Watershed Length to Centroid =	175	ft
Watershed Slope =	0.030	ft/ft
Watershed Imperviousness =	95.00%	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.

		Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.242 acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.695 acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.544 acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.703 acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.831 acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.961 acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	1.091 acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	1.232 acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.55 in.) =	1.765 acre-feet	3.55	inches
Approximate 2-yr Detention Volume =	0.561 acre-feet		
Approximate 5-yr Detention Volume =	0.728 acre-feet		
Approximate 10-yr Detention Volume =	0.886 acre-feet		
Approximate 25-yr Detention Volume =	0.950 acre-feet		
Approximate 50-yr Detention Volume =	0.986 acre-feet		
Approximate 100-yr Detention Volume =	1.017 acre-feet		

Define Zones and Basin Geometry

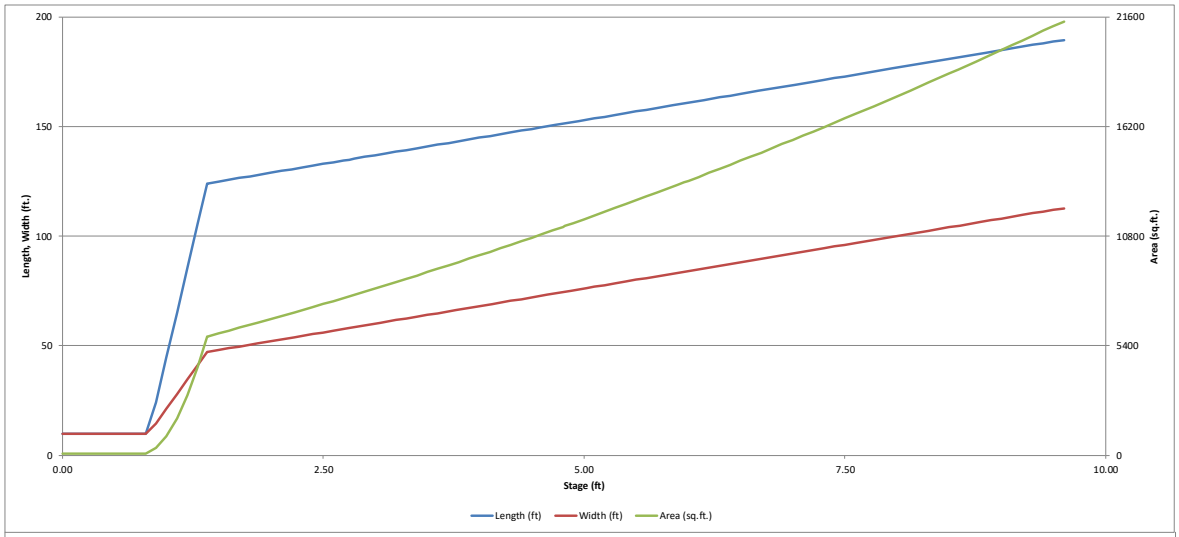
Zone 1 Volume (WQCV) =	0.242	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.453	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.322	acre-feet
Total Detention Basin Volume =	1.017	acre-feet
Initial Surcharge Volume (ISV) =	32	ft^3
Initial Surcharge Depth (ISD) =	0.33	ft
Total Available Detention Depth (H_{total}) =	6.00	ft
Depth of Trickle Channel (H_{TC}) =	0.50	ft
Slope of Trickle Channel (S_{TC}) =	0.005	ft/ft
Slopes of Main Basin Sides (S_{main}) =	4	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	3	
Initial Surcharge Area (A_{ISV}) =	96	ft^2
Surcharge Volume Length (L_{ISV}) =	9.8	ft
Surcharge Volume Width (W_{ISV}) =	9.8	ft
Depth of Basin Floor (H_{FLOOR}) =	0.56	ft
Length of Basin Floor (L_{FLOOR}) =	124.0	ft
Width of Basin Floor (W_{FLOOR}) =	47.1	ft
Area of Basin Floor (A_{FLOOR}) =	5,845	ft^2
Volume of Basin Floor (V_{FLOOR}) =	1,249	ft^3
Depth of Main Basin (H_{MAIN}) =	4.61	ft
Length of Main Basin (L_{MAIN}) =	160.9	ft
Width of Main Basin (W_{MAIN}) =	84.0	ft
Area of Main Basin (A_{MAIN}) =	13,518	ft^2
Volume of Main Basin (V_{MAIN}) =	43,415	ft^3
Calculated Total Basin Volume (V_{total}) =	**1.027**	acre-feet

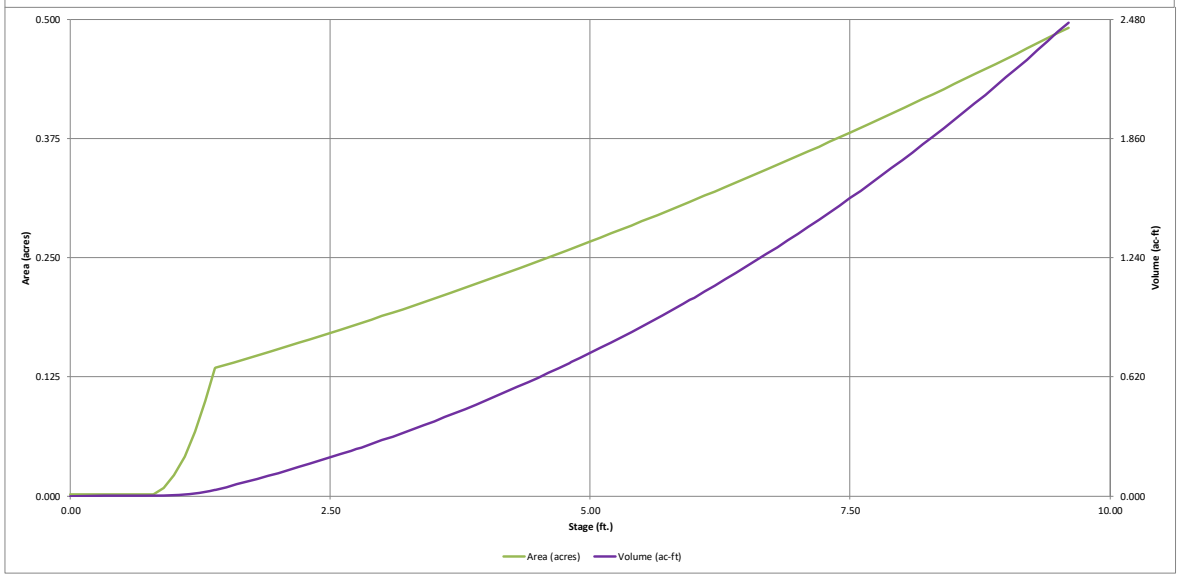
Depth Increment = 0.10 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	0.00		9.8	9.8	96		0.002		
ISV	0.33		9.8	9.8	96		0.002	32	0.001
	0.40		9.8	9.8	96		0.002	38	0.001
	0.50		9.8	9.8	96		0.002	48	0.001
	0.60		9.8	9.8	96		0.002	58	0.001
	0.70		9.8	9.8	96		0.002	67	0.002
	0.80		9.8	9.8	96		0.002	77	0.002
	0.90		24.1	14.5	348		0.008	94	0.002
	1.00		44.5	21.1	940		0.022	157	0.004
	1.10		64.9	27.8	1,803		0.041	291	0.007
	1.20		85.3	34.5	2,939		0.067	526	0.012
	1.30		105.7	41.1	4,346		0.100	888	0.020
Floor	1.39		124.0	47.1	5,845		0.134	1,345	0.031
	1.40		124.1	47.2	5,859		0.135	1,404	0.032
	1.50		124.9	48.0	5,997		0.138	1,996	0.046
	1.60		125.7	48.8	6,136		0.141	2,603	0.060
	1.70		126.5	49.6	6,276		0.144	3,224	0.074
	1.80		127.3	50.4	6,418		0.147	3,858	0.089
	1.90		128.1	51.2	6,560		0.151	4,507	0.103
	2.00		128.9	52.0	6,705		0.154	5,170	0.119
	2.10		129.7	52.8	6,850		0.157	5,848	0.134
	2.20		130.5	53.6	6,997		0.161	6,541	0.150
	2.30		131.3	54.4	7,145		0.164	7,248	0.166
	2.40		132.1	55.2	7,294		0.167	7,969	0.183
	2.50		132.9	56.0	7,444		0.171	8,706	0.200
	2.60		133.7	56.8	7,596		0.174	9,458	0.217
	2.70		134.5	57.6	7,749		0.178	10,226	0.235
Zone 1 (WQCV)	2.75		134.9	58.0	7,826		0.180	10,615	0.244
	2.80		135.3	58.4	7,903		0.181	11,008	0.253
	2.90		136.1	59.2	8,059		0.185	11,806	0.271
	3.00		136.9	60.0	8,216		0.189	12,620	0.290
	3.10		137.7	60.8	8,374		0.192	13,450	0.309
	3.20		138.5	61.6	8,534		0.196	14,295	0.328
	3.30		139.3	62.4	8,694		0.200	15,156	0.348
	3.40		140.1	63.2	8,856		0.203	16,034	0.368
	3.50		140.9	64.0	9,020		0.207	16,928	0.389
	3.60		141.7	64.8	9,184		0.211	17,838	0.409
	3.70		142.5	65.6	9,350		0.215	18,765	0.431
	3.80		143.3	66.4	9,517		0.218	19,708	0.452
	3.90		144.1	67.2	9,686		0.222	20,668	0.474
	4.00		144.9	68.0	9,855		0.226	21,645	0.497
	4.10		145.7	68.8	10,026		0.230	22,639	0.520
	4.20		146.5	69.6	10,199		0.234	23,650	0.543
	4.30		147.3	70.4	10,372		0.238	24,679	0.567
	4.40		148.1	71.2	10,547		0.242	25,725	0.591
	4.50		148.9	72.0	10,723		0.246	26,788	0.615
	4.60		149.7	72.8	10,900		0.250	27,869	0.640
	4.70		150.5	73.6	11,079		0.254	28,968	0.665
	4.80		151.3	74.4	11,259		0.258	30,085	0.691
Zone 2 (EURV)	4.82		151.5	74.6	11,295		0.259	30,311	0.696
	4.90		152.1	75.2	11,440		0.263	31,220	0.717
	5.00		152.9	76.0	11,623		0.267	32,373	0.743
	5.10		153.7	76.8	11,806		0.271	33,545	0.770
	5.20		154.5	77.6	11,992		0.275	34,735	0.797
	5.30		155.3	78.4	12,178		0.280	35,943	0.825
	5.40		156.1	79.2	12,365		0.284	37,170	0.853
	5.50		156.9	80.0	12,554		0.288	38,416	0.882
	5.60		157.7	80.8	12,745		0.293	39,681	0.911
	5.70		158.5	81.6	12,936		0.297	40,965	0.940
	5.80		159.3	82.4	13,129		0.301	42,269	0.970
	5.90		160.1	83.2	13,323		0.306	43,591	1.001
Zone 3 (100-year)	5.96		160.6	83.7	13,440		0.309	44,394	1.019
	6.00		160.9	84.0	13,518		0.310	44,933	1.032
	6.10		161.7	84.8	13,715		0.315	46,295	1.063
	6.20		162.5	85.6	13,913		0.319	47,676	1.094
	6.30		163.3	86.4	14,112		0.324	49,077	1.127
	6.40		164.1	87.2	14,312		0.329	50,498	1.159
	6.50		164.9	88.0	14,514		0.333	51,940	1.192
	6.60		165.7	88.8	14,717		0.338	53,401	1.226
	6.70		166.5	89.6	14,921		0.343	54,883	1.260
	6.80		167.3	90.4	15,127		0.347	56,385	1.294
	6.90		168.1	91.2	15,333		0.352	57,908	1.329
	7.00		168.9	92.0	15,541		0.357	59,452	1.365
	7.10		169.7	92.8	15,751		0.362	61,017	1.401
	7.20		170.5	93.6	15,961		0.366	62,602	1.437
	7.30		171.3	94.4	16,173		0.371	64,209	1.474
	7.40		172.1	95.2	16,387		0.376	65,837	1.511
	7.50		172.9	96.0	16,601		0.381	67,487	1.549
	7.60		173.7	96.8	16,817		0.386	69,157	1.588
	7.70		174.5	97.6	17,034		0.391	70,850	1.626
	7.80		175.3	98.4	17,252		0.396	72,564	1.666
	7.90		176.1	99.2	17,472		0.401	74,300	1.706
	8.00		176.9	100.0	17,693		0.406	76,059	1.746
	8.10		177.7	100.8	17,915		0.411	77,839	1.787
	8.20		178.5	101.6	18,138		0.416	79,642	1.828
	8.30		179.3	102.4	18,363		0.422	81,467	1.870
	8.40		180.1	103.2	18,589		0.427	83,314	1.913
	8.50		180.9	104.0	18,817		0.432	85,185	1.956
	8.60		181.7	104.8	19,045		0.437	87,078	1.999
	8.70		182.5	105.6	19,275		0.442	88,994	2.043
	8.80		183.3	106.4	19,506		0.448	90,933	2.088
	8.90		184.1	107.2	19,739		0.453	92,895	2.133
	9.00		184.9	108.0	19,972		0.458	94,881	2.178
	9.10		185.7	108.8	20,207		0.464	96,890	2.224
	9.20		186.5	109.6	20,443		0.469	98,922	2.271
	9.30		187.3	110.4	20,681		0.475	100,978	2.318
	9.40		188.1	111.2	20,920		0.480	103,058	2.366
	9.50		188.9	112.0	21,160		0.486	105,162	2.414
	9.60		189.7	112.8	21,401		0.491	107,290	2.463

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.02 (February 2020)



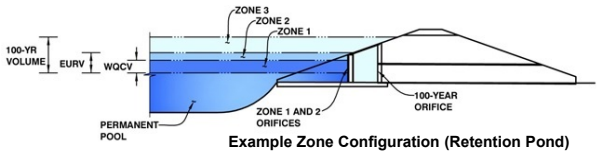


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.02 (February 2020)

Project: Singer Ranch

Basin ID: DF-6 (NE Commercial Pond)



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.75	0.242	Orifice Plate
Zone 2 (EURV)	4.82	0.453	Circular Orifice
Zone 3 (100-year)	5.96	0.322	Weir&Pipe (Restrict)
Total (all zones)		1.017	

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

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

Calculated Parameters for Underdrain

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)

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	5.903E-03	ft²
Depth at top of Zone using Orifice Plate =	2.81	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	11.20	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	0.85	sq. inches (diameter = 1 inch)	Elliptical Slot Area =	N/A	ft²

Calculated Parameters for Plate

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	0.94	1.87					
Orifice Area (sq. inches)	0.85	0.85	0.85					

	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)

	Zone 2 Circular	Not Selected			Zone 2 Circular	Not Selected	
Invert of Vertical Orifice =	2.75	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	0.01	N/A	ft²
Depth at top of Zone using Vertical Orifice =	4.82	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.04	N/A	feet
Vertical Orifice Diameter =	0.97	N/A	inches				

Calculated Parameters for Vertical Orifice

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			Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	4.82	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	4.82	N/A	feet
Overflow Weir Front Edge Length =	6.00	N/A	feet	Overflow Weir Slope Length =	4.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	13.42	N/A	
Horiz. Length of Weir Sides =	4.00	N/A	feet	Overflow Grate Open Area w/o Debris =	16.80	N/A	ft²
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area	Overflow Grate Open Area w/ Debris =	8.40	N/A	ft²
Debris Clogging % =	50%	N/A	%				

Calculated Parameters for Overflow Weir

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

	Zone 3 Restrictor	Not Selected			Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.30	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	1.25	N/A	ft²
Outlet Pipe Diameter =	18.00	N/A	inches	Outlet Orifice Centroid =	0.56	N/A	feet
Restrictor Plate Height Above Pipe Invert =	12.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	1.91	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	6.00	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.79	feet
Spillway Crest Length =	8.00	feet	Stage at Top of Freeboard =	7.79	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.40	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	1.66	acre-ft

Calculated Parameters for Spillway

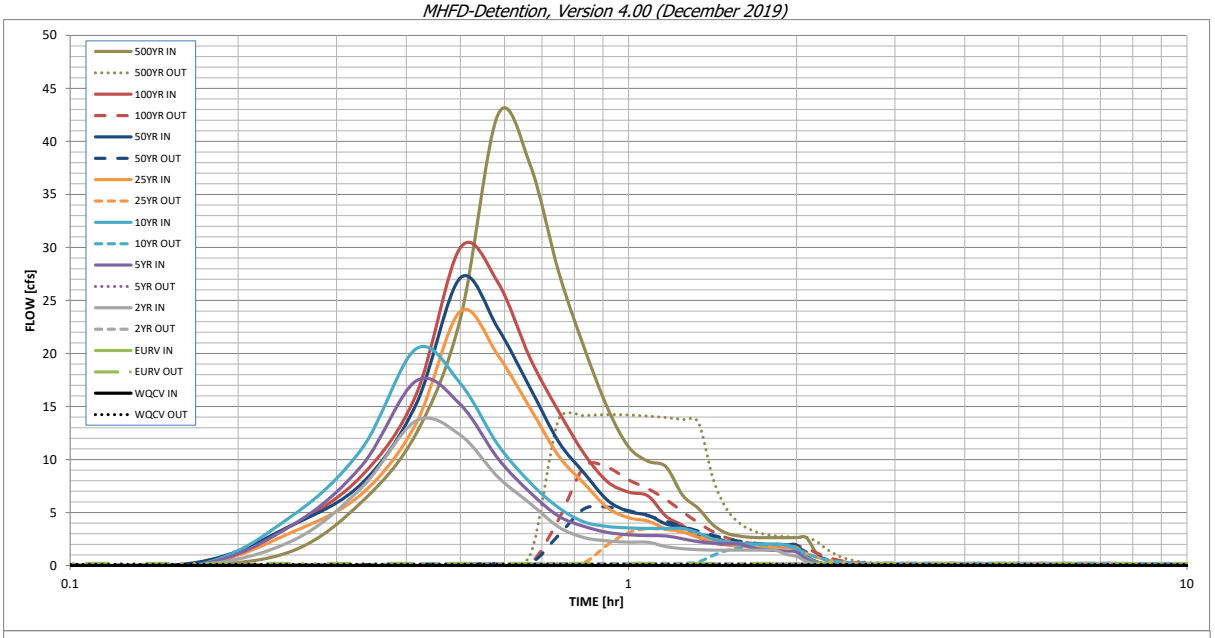
Routed Hydrograph Results

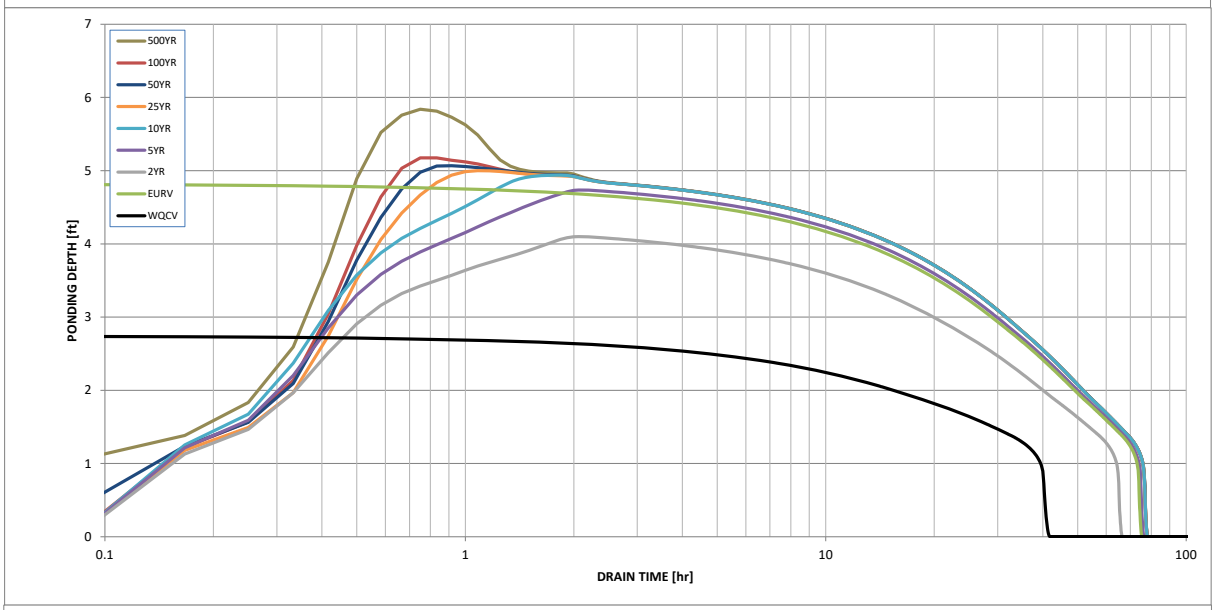
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

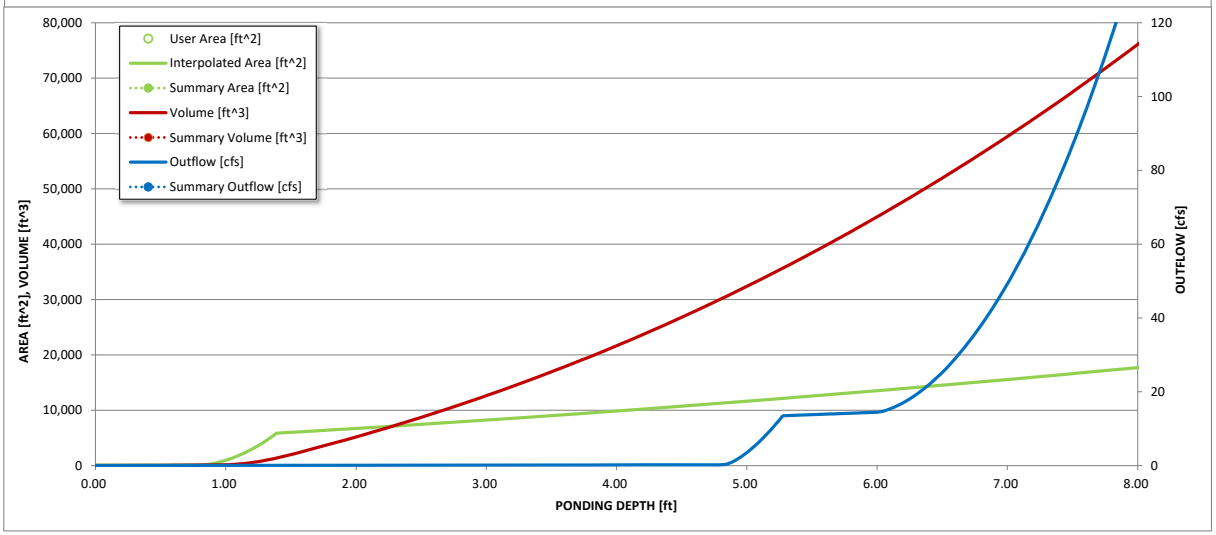
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.55
CUHP Runoff Volume (acre-ft) =	0.242	0.695	0.544	0.703	0.831	0.961	1.091	1.232	1.765
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.544	0.703	0.831	0.961	1.091	1.232	1.765
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	1.1	3.0	4.6	7.8	9.7	12.1	20.2
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.17	0.47	0.71	1.20	1.49	1.87	3.11
Peak Inflow Q (cfs) =	N/A	N/A	13.7	17.4	20.4	24.0	27.1	30.0	42.5
Peak Outflow Q (cfs) =	0.1	0.2	0.2	0.2	2.0	3.5	5.5	9.3	14.2
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.1	0.4	0.4	0.6	0.8	0.7
Structure Controlling Flow =	Plate	Overflow Weir 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.1	0.2	0.3	0.5	0.8
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) =	38	68	61	69	70	69	68	67	64
Time to Drain 99% of Inflow Volume (hours) =	**40**	72	64	73	74	74	74	73	72
Maximum Ponding Depth (ft) =	2.75	4.82	4.10	4.74	4.94	5.00	5.07	5.17	5.84
Area at Maximum Ponding Depth (acres) =	0.18	0.26	0.23	0.26	0.26	0.27	0.27	0.27	0.30
Maximum Volume Stored (acre-ft) =	0.244	0.696	0.517	0.673	0.725	0.741	0.759	0.789	0.979

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.00 (December 2019)





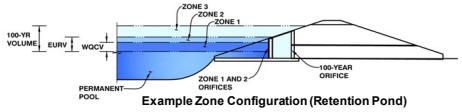


DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.02 (February 2020)

Project: Singer Ranch

Basin ID: DF-7 (NE Multi-Family Pond)



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	18.00	acres
Watershed Length =	1,535	ft
Watershed Length to Centroid =	525	ft
Watershed Slope =	0.030	ft/ft
Watershed Imperviousness =	70.00%	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.

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.413	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	1.384	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	1.222	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	1.648	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	2.007	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	2.432	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	2.808	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	3.256	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.55 in.) =	4.847	acre-feet	3.55	inches
Approximate 2-yr Detention Volume =	1.081	acre-feet		
Approximate 5-yr Detention Volume =	1.441	acre-feet		
Approximate 10-yr Detention Volume =	1.819	acre-feet		
Approximate 25-yr Detention Volume =	1.954	acre-feet		
Approximate 50-yr Detention Volume =	2.033	acre-feet		
Approximate 100-yr Detention Volume =	2.178	acre-feet		

Define Zones and Basin Geometry

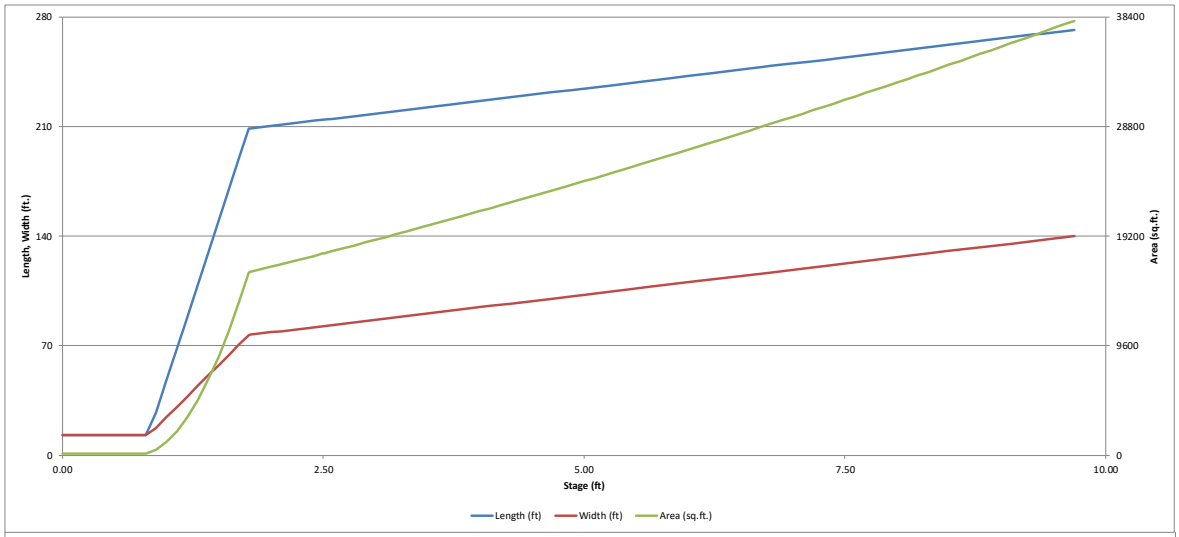
Zone 1 Volume (WQCV) =	0.413	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.971	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.794	acre-feet
Total Detention Basin Volume =	2.178	acre-feet
Initial Surcharge Volume (ISV) =	54	ft^3
Initial Surcharge Depth (ISD) =	0.33	ft
Total Available Detention Depth (H_{total}) =	6.00	ft
Depth of Trickle Channel (H_{TC}) =	0.50	ft
Slope of Trickle Channel (S_{TC}) =	0.005	ft/ft
Slopes of Main Basin Sides (S_{main}) =	4	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	3	
Initial Surcharge Area (A_{ISV}) =	163	ft^2
Surcharge Volume Length (L_{ISV}) =	12.8	ft
Surcharge Volume Width (W_{ISV}) =	12.8	ft
Depth of Basin Floor (H_{FLOOR}) =	0.96	ft
Length of Basin Floor (L_{FLOOR}) =	208.6	ft
Width of Basin Floor (W_{FLOOR}) =	76.8	ft
Area of Basin Floor (A_{FLOOR}) =	16,018	ft^2
Volume of Basin Floor (V_{FLOOR}) =	5,696	ft^3
Depth of Main Basin (H_{MAIN}) =	4.21	ft
Length of Main Basin (L_{MAIN}) =	242.3	ft
Width of Main Basin (W_{MAIN}) =	110.5	ft
Area of Main Basin (A_{MAIN}) =	26,765	ft^2
Volume of Main Basin (V_{MAIN}) =	89,096	ft^3
Calculated Total Basin Volume (V_{total}) =	**2.179**	acre-feet

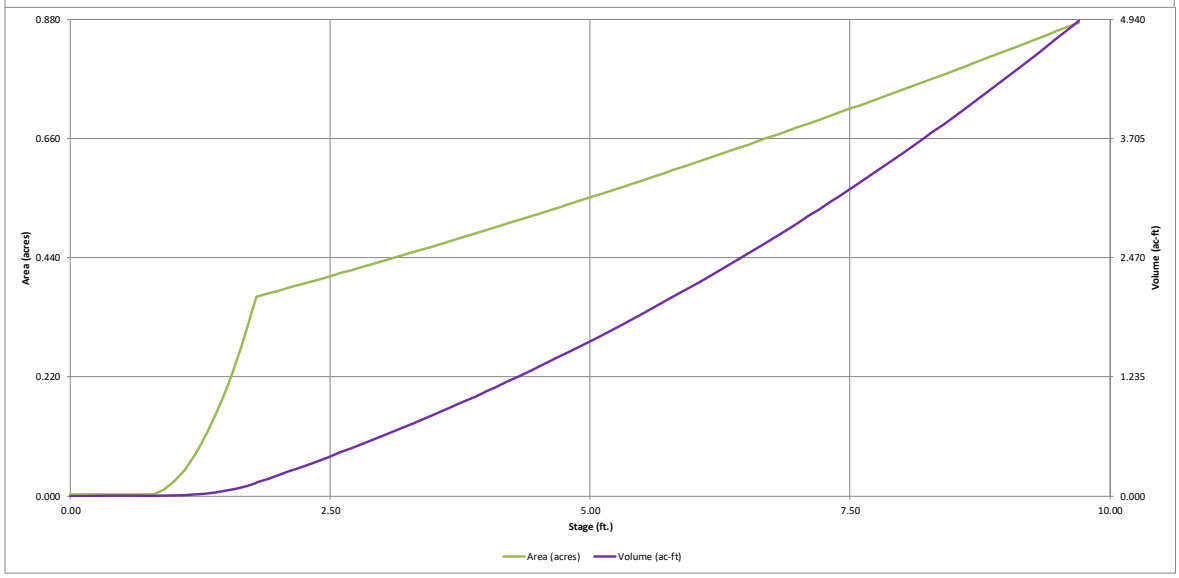
Depth Increment = 0.10 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	0.00		12.8	12.8	163		0.004		
ISV	0.33		12.8	12.8	163		0.004	54	0.001
	0.40		12.8	12.8	163		0.004	65	0.002
	0.50		12.8	12.8	163		0.004	82	0.002
	0.60		12.8	12.8	163		0.004	98	0.002
	0.70		12.8	12.8	163		0.004	114	0.003
	0.80		12.8	12.8	163		0.004	131	0.003
	0.90		27.1	17.4	472		0.011	157	0.004
	1.00		47.5	24.1	1,145		0.026	236	0.005
	1.10		67.9	30.8	2,089		0.048	395	0.009
	1.20		88.3	37.4	3,305		0.076	662	0.015
	1.30		108.7	44.1	4,794		0.110	1,065	0.024
	1.40		129.1	50.8	6,554		0.150	1,630	0.037
	1.50		149.5	57.4	8,586		0.197	2,385	0.055
	1.60		169.9	64.1	10,891		0.250	3,357	0.077
	1.70		190.3	70.8	13,467		0.309	4,572	0.105
Floor	1.79		208.6	76.8	16,018		0.368	5,897	0.135
	1.80		208.7	76.9	16,041		0.368	6,058	0.139
	1.90		209.5	77.7	16,270		0.374	7,673	0.176
	2.00		210.3	78.5	16,501		0.379	9,312	0.214
	2.10		211.1	79.3	16,732		0.384	10,973	0.252
	2.20		211.9	80.1	16,965		0.389	12,658	0.291
	2.30		212.7	80.9	17,199		0.395	14,366	0.330
	2.40		213.5	81.7	17,435		0.400	16,098	0.370
	2.50		214.3	82.5	17,672		0.406	17,853	0.410
Zone 1 (WQCV)	2.51		214.4	82.5	17,695		0.406	18,030	0.414
	2.60		215.1	83.3	17,910		0.411	19,633	0.451
	2.70		215.9	84.1	18,149		0.417	21,435	0.492
	2.80		216.7	84.9	18,390		0.422	23,262	0.534
	2.90		217.5	85.7	18,632		0.428	25,113	0.577
	3.00		218.3	86.5	18,875		0.433	26,989	0.620
	3.10		219.1	87.3	19,119		0.439	28,888	0.663
	3.20		219.9	88.1	19,365		0.445	30,813	0.707
	3.30		220.7	88.9	19,612		0.450	32,761	0.752
	3.40		221.5	89.7	19,860		0.456	34,735	0.797
	3.50		222.3	90.5	20,110		0.462	36,734	0.843
	3.60		223.1	91.3	20,361		0.467	38,757	0.890
	3.70		223.9	92.1	20,613		0.473	40,806	0.937
	3.80		224.7	92.9	20,866		0.479	42,880	0.984
	3.90		225.5	93.7	21,121		0.485	44,979	1.033
	4.00		226.3	94.5	21,377		0.491	47,104	1.081
	4.10		227.1	95.3	21,634		0.497	49,254	1.131
	4.20		227.9	96.1	21,893		0.503	51,431	1.181
	4.30		228.7	96.9	22,152		0.509	53,633	1.231
	4.40		229.5	97.7	22,413		0.515	55,861	1.282
	4.50		230.3	98.5	22,676		0.521	58,116	1.334
Zone 2 (EURV)	4.60		231.1	99.3	22,939		0.527	60,396	1.387
	4.70		231.9	100.1	23,204		0.533	62,704	1.439
	4.80		232.7	100.9	23,471		0.539	65,037	1.493
	4.90		233.5	101.7	23,738		0.545	67,398	1.547
	5.00		234.3	102.5	24,007		0.551	69,785	1.602
	5.10		235.1	103.3	24,277		0.557	72,199	1.657
	5.20		235.9	104.1	24,548		0.564	74,640	1.714
	5.30		236.7	104.9	24,821		0.570	77,109	1.770
	5.40		237.5	105.7	25,095		0.576	79,605	1.827
	5.50		238.3	106.5	25,370		0.582	82,128	1.885
	5.60		239.1	107.3	25,646		0.589	84,679	1.944
	5.70		239.9	108.1	25,924		0.595	87,257	2.003
	5.80		240.7	108.9	26,203		0.602	89,864	2.063
	5.90		241.5	109.7	26,483		0.608	92,498	2.123
Zone 3 (100-year)	5.99		242.2	110.4	26,737		0.614	94,893	2.178
	6.00		242.3	110.5	26,765		0.614	95,160	2.185
	6.10		243.1	111.3	27,048		0.621	97,851	2.246
	6.20		243.9	112.1	27,332		0.627	100,570	2.309
	6.30		244.7	112.9	27,617		0.634	103,317	2.372
	6.40		245.5	113.7	27,904		0.641	106,093	2.436
	6.50		246.3	114.5	28,192		0.647	108,898	2.500
	6.60		247.1	115.3	28,481		0.654	111,732	2.565
	6.70		247.9	116.1	28,772		0.661	114,594	2.631
	6.80		248.7	116.9	29,064		0.667	117,486	2.697
	6.90		249.5	117.7	29,357		0.674	120,407	2.764
	7.00		250.3	118.5	29,651		0.681	123,358	2.832
	7.10		251.1	119.3	29,947		0.687	126,338	2.900
	7.20		251.9	120.1	30,244		0.694	129,347	2.969
	7.30		252.7	120.9	30,542		0.701	132,386	3.039
	7.40		253.5	121.7	30,841		0.708	135,455	3.110
	7.50		254.3	122.5	31,142		0.715	138,555	3.181
	7.60		255.1	123.3	31,444		0.722	141,684	3.253
	7.70		255.9	124.1	31,748		0.729	144,844	3.325
	7.80		256.7	124.9	32,052		0.736	148,033	3.398
	7.90		257.5	125.7	32,358		0.743	151,254	3.472
	8.00		258.3	126.5	32,665		0.750	154,505	3.547
	8.10		259.1	127.3	32,974		0.757	157,787	3.622
	8.20		259.9	128.1	33,283		0.764	161,100	3.698
	8.30		260.7	128.9	33,594		0.771	164,444	3.775
	8.40		261.5	129.7	33,907		0.778	167,819	3.853
	8.50		262.3	130.5	34,220		0.786	171,225	3.931
	8.60		263.1	131.3	34,535		0.793	174,663	4.010
	8.70		263.9	132.1	34,851		0.800	178,132	4.089
	8.80		264.7	132.9	35,169		0.807	181,633	4.170
	8.90		265.5	133.7	35,487		0.815	185,166	4.251
	9.00		266.3	134.5	35,807		0.822	188,731	4.333
	9.10		267.1	135.3	36,129		0.829	192,328	4.415
	9.20		267.9	136.1	36,451		0.837	195,956	4.499
	9.30		268.7	136.9	36,775		0.844	199,618	4.583
	9.40		269.5	137.7	37,100		0.852	203,312	4.667
	9.50		270.3	138.5	37,426		0.859	207,038	4.753
	9.60		271.1	139.3	37,754		0.867	210,797	4.839
	9.70		271.9	140.1	38,083		0.874	214,589	4.926

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.02 (February 2020)



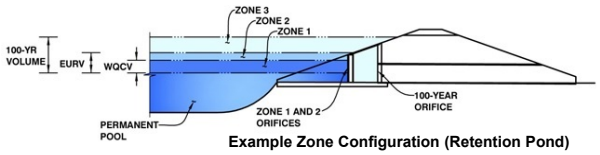


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.02 (February 2020)

Project: Singer Ranch

Basin ID: DF-7 (NE Multi-Family Pond)



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.51	0.413	Orifice Plate
Zone 2 (EURV)	4.60	0.971	Circular Orifice
Zone 3 (100-year)	5.99	0.794	Weir&Pipe (Restrict)
Total (all zones)		2.178	

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

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

Calculated Parameters for Underdrain

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)

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	9.306E-03	ft²
Depth at top of Zone using Orifice Plate =	2.51	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	10.00	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	1.34	sq. inches (diameter = 1-5/16 inches)	Elliptical Slot Area =	N/A	ft²

Calculated Parameters for Plate

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	0.84	1.67					
Orifice Area (sq. inches)	1.34	1.34	1.34					

	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)

	Zone 2 Circular	Not Selected			Zone 2 Circular	Not Selected	
Invert of Vertical Orifice =	2.51	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	0.04	N/A	ft²
Depth at top of Zone using Vertical Orifice =	4.60	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.11	N/A	feet
Vertical Orifice Diameter =	2.55	N/A	inches				

Calculated Parameters for Vertical Orifice

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			Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	4.60	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	4.60	N/A	feet
Overflow Weir Front Edge Length =	5.00	N/A	feet	Overflow Weir Slope Length =	5.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	10.07	N/A	
Horiz. Length of Weir Sides =	5.00	N/A	feet	Overflow Grate Open Area w/o Debris =	17.50	N/A	ft²
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area	Overflow Grate Open Area w/ Debris =	8.75	N/A	ft²
Debris Clogging % =	50%	N/A	%				

Calculated Parameters for Overflow Weir

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

	Zone 3 Restrictor	Not Selected			Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.30	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	1.74	N/A	ft²
Outlet Pipe Diameter =	24.00	N/A	inches	Outlet Orifice Centroid =	0.62	N/A	feet
Restrictor Plate Height Above Pipe Invert =	13.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	1.65	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	5.80	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.89	feet
Spillway Crest Length =	21.00	feet	Stage at Top of Freeboard =	7.69	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.73	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	3.31	acre-ft

Calculated Parameters for Spillway

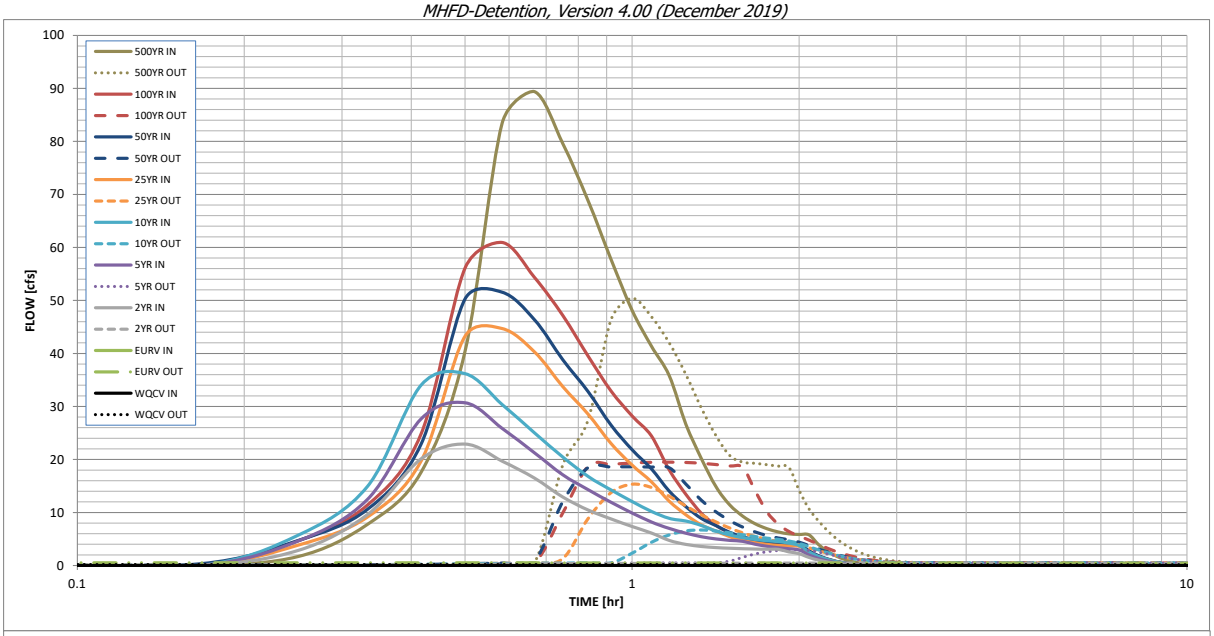
Routed Hydrograph Results

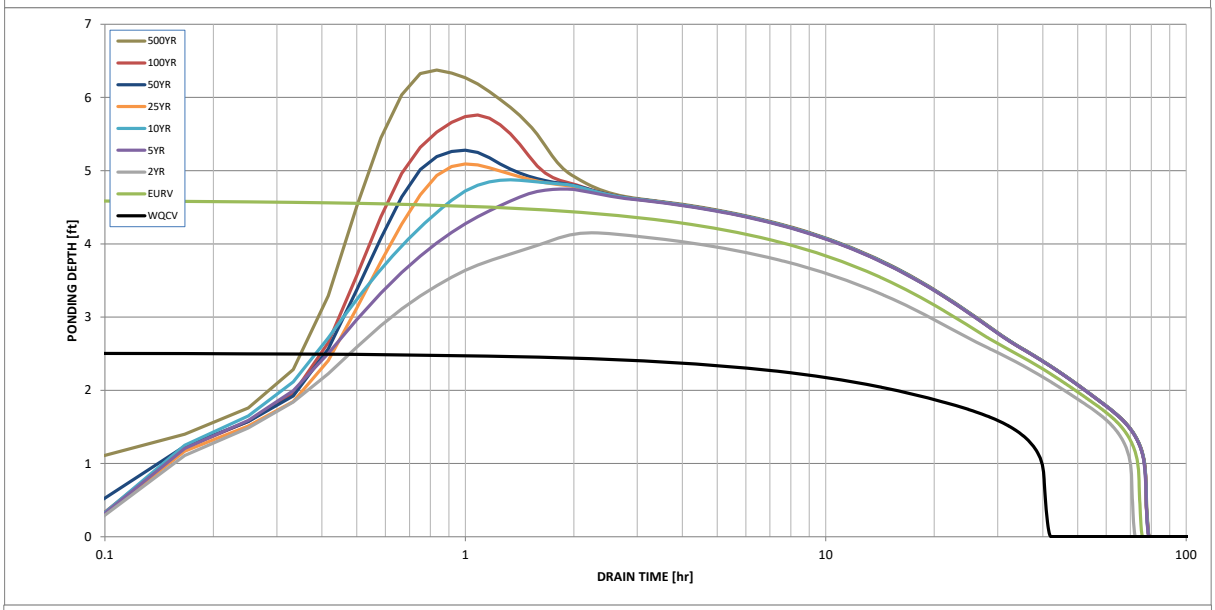
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

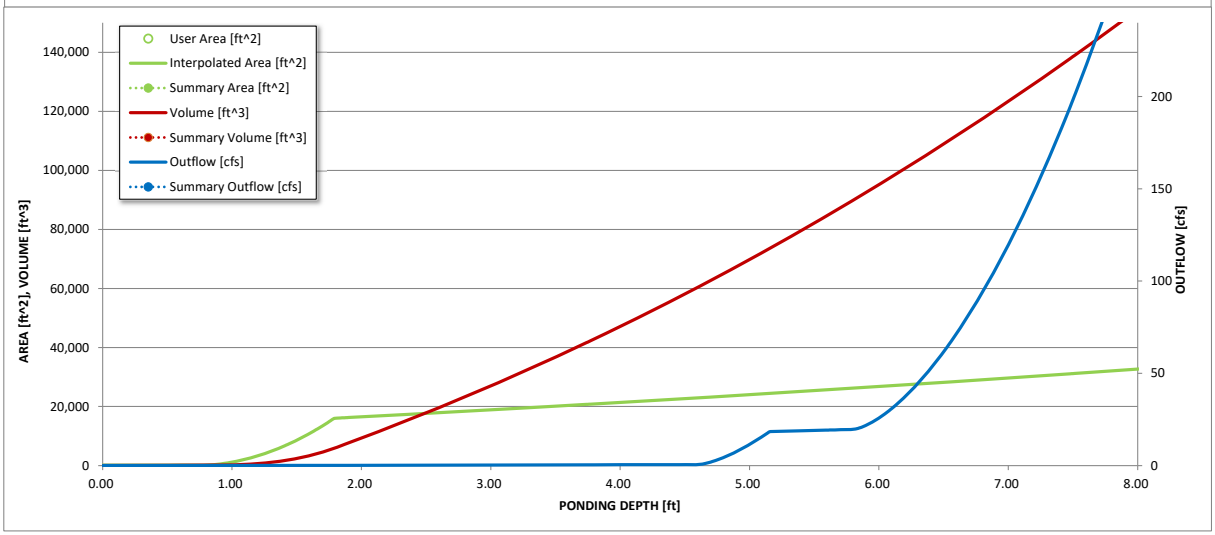
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.55
CUHP Runoff Volume (acre-ft) =	0.413	1.384	1.222	1.648	2.007	2.432	2.808	3.256	4.847
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	1.222	1.648	2.007	2.432	2.808	3.256	4.847
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	2.1	5.9	8.9	15.7	19.7	24.8	41.3
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.12	0.33	0.49	0.87	1.10	1.38	2.29
Peak Inflow Q (cfs) =	N/A	N/A	22.9	30.7	36.2	44.7	51.6	60.9	89.4
Peak Outflow Q (cfs) =	0.2	0.5	0.5	3.0	6.7	15.3	18.6	19.5	50.4
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.5	0.8	1.0	0.9	0.8	1.2
Structure Controlling Flow =	Plate	Overflow Weir 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.1	0.3	0.8	1.0	1.1	1.1
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	68	65	70	69	67	66	64	59
Time to Drain 99% of Inflow Volume (hours) =	**40**	72	69	75	74	74	73	72	70
Maximum Ponding Depth (ft) =	2.51	4.60	4.15	4.75	4.87	5.09	5.28	5.76	6.37
Area at Maximum Ponding Depth (acres) =	0.41	0.53	0.50	0.54	0.54	0.56	0.57	0.60	0.64
Maximum Volume Stored (acre-ft) =	0.414	1.387	1.151	1.461	1.531	1.646	1.753	2.033	2.416

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.00 (December 2019)





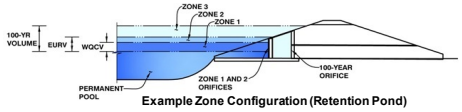


DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.02 (February 2020)

Project: Singer Ranch

Basin ID: DF-8 (SE Single-Family & Commercial Pond)



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	37.24	acres
Watershed Length =	2,040	ft
Watershed Length to Centroid =	925	ft
Watershed Slope =	0.030	ft/ft
Watershed Imperviousness =	70.00%	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.

		Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.854 acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	2.863 acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	2.594 acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	3.498 acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	4.260 acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	5.161 acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	5.958 acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	6.907 acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.55 in.) =	10.282 acre-feet	3.55	inches
Approximate 2-yr Detention Volume =	2.237 acre-feet		
Approximate 5-yr Detention Volume =	2.981 acre-feet		
Approximate 10-yr Detention Volume =	3.763 acre-feet		
Approximate 25-yr Detention Volume =	4.043 acre-feet		
Approximate 50-yr Detention Volume =	4.206 acre-feet		
Approximate 100-yr Detention Volume =	4.505 acre-feet		

Define Zones and Basin Geometry

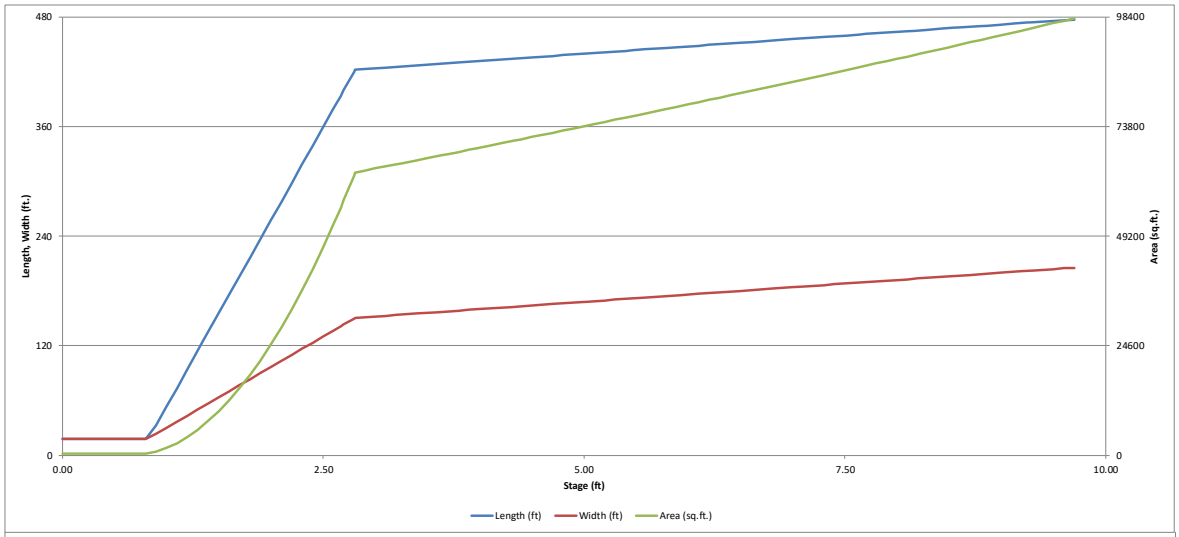
Zone 1 Volume (WQCV) =	0.854	acre-feet
Zone 2 Volume (EURV - Zone 1) =	2.009	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.642	acre-feet
Total Detention Basin Volume =	4.505	acre-feet
Initial Surcharge Volume (ISV) =	112	ft^3
Initial Surcharge Depth (ISD) =	0.33	ft
Total Available Detention Depth (H_{total}) =	5.00	ft
Depth of Trickle Channel (H_{TC}) =	0.50	ft
Slope of Trickle Channel (S_{TC}) =	0.005	ft/ft
Slopes of Main Basin Sides (S_{main}) =	4	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	3	
Initial Surcharge Area (A_{ISV}) =	338	ft^2
Surcharge Volume Length (L_{ISV}) =	18.4	ft
Surcharge Volume Width (W_{ISV}) =	18.4	ft
Depth of Basin Floor (H_{FLOOR}) =	1.98	ft
Length of Basin Floor (L_{FLOOR}) =	422.3	ft
Width of Basin Floor (W_{FLOOR}) =	150.4	ft
Area of Basin Floor (A_{FLOOR}) =	63,508	ft^2
Volume of Basin Floor (V_{FLOOR}) =	45,196	ft^3
Depth of Main Basin (H_{MAIN}) =	2.19	ft
Length of Main Basin (L_{MAIN}) =	439.8	ft
Width of Main Basin (W_{MAIN}) =	167.9	ft
Area of Main Basin (A_{MAIN}) =	73,849	ft^2
Volume of Main Basin (V_{MAIN}) =	150,263	ft^3
Calculated Total Basin Volume (V_{total}) =	**4.494**	acre-feet

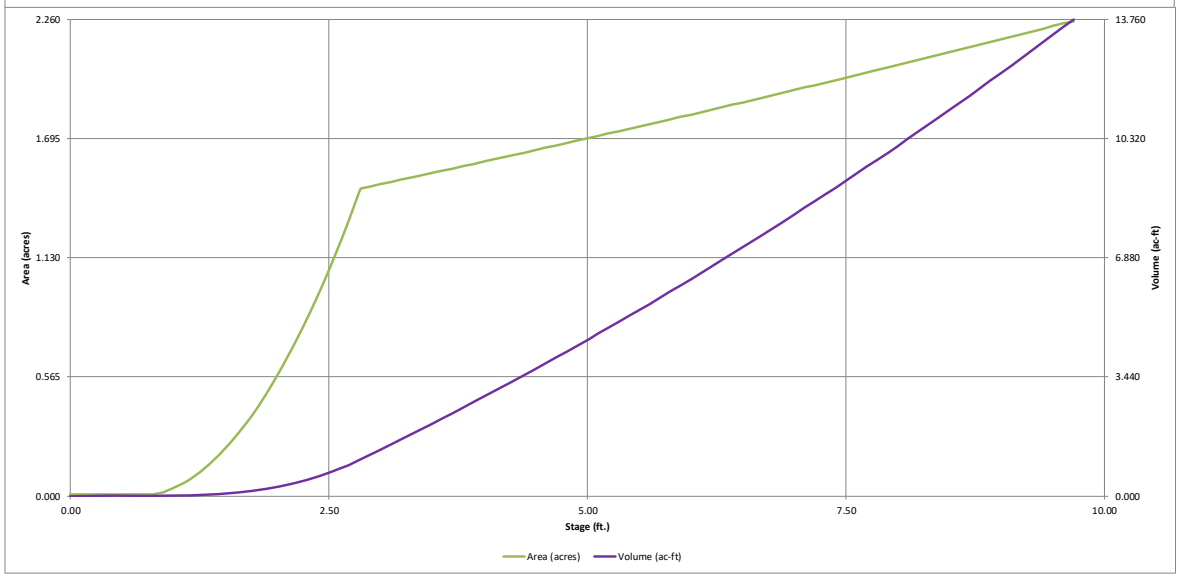
Depth Increment = 0.10 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	0.00		18.4	18.4	338		0.008		
ISV	0.33		18.4	18.4	338		0.008	112	0.003
	0.40		18.4	18.4	338		0.008	135	0.003
	0.50		18.4	18.4	338		0.008	169	0.004
	0.60		18.4	18.4	338		0.008	203	0.005
	0.70		18.4	18.4	338		0.008	237	0.005
	0.80		18.4	18.4	338		0.008	270	0.006
	0.90		32.7	23.1	753		0.017	318	0.007
	1.00		53.1	29.7	1,577		0.036	432	0.010
	1.10		73.5	36.4	2,673		0.061	642	0.015
	1.20		93.9	43.1	4,041		0.093	976	0.022
	1.30		114.3	49.7	5,681		0.130	1,460	0.034
	1.40		134.7	56.4	7,593		0.174	2,121	0.049
	1.50		155.1	63.1	9,777		0.224	2,987	0.069
	1.60		175.5	69.7	12,233		0.281	4,086	0.094
	1.70		195.9	76.4	14,961		0.343	5,443	0.125
	1.80		216.3	83.1	17,961		0.412	7,087	0.163
	1.90		236.7	89.7	21,233		0.487	9,044	0.208
	2.00		257.1	96.4	24,777		0.569	11,342	0.260
	2.10		277.5	103.1	28,593		0.656	14,009	0.322
	2.20		297.9	109.7	32,681		0.750	17,070	0.392
	2.30		318.3	116.4	37,041		0.850	20,554	0.472
	2.40		338.7	123.1	41,673		0.957	24,487	0.562
	2.50		359.1	129.7	46,577		1.069	28,898	0.663
	2.60		379.5	136.4	51,753		1.188	33,812	0.776
Zone 1 (WQCV)	2.67		393.7	141.1	55,538		1.275	37,566	0.862
	2.70		399.9	143.1	57,201		1.313	39,257	0.901
	2.80		420.3	149.7	62,921		1.444	45,261	1.039
Floor	2.81		422.3	150.4	63,508		1.458	45,893	1.054
	2.90		423.0	151.1	63,921		1.467	51,628	1.185
	3.00		423.8	151.9	64,381		1.478	58,043	1.332
	3.10		424.6	152.7	64,842		1.489	64,504	1.481
	3.20		425.4	153.5	65,305		1.499	71,011	1.630
	3.30		426.2	154.3	65,768		1.510	77,565	1.781
	3.40		427.0	155.1	66,233		1.521	84,165	1.932
	3.50		427.8	155.9	66,700		1.531	90,812	2.085
	3.60		428.6	156.7	67,167		1.542	97,505	2.238
	3.70		429.4	157.5	67,636		1.553	104,245	2.393
	3.80		430.2	158.3	68,106		1.564	111,032	2.549
	3.90		431.0	159.1	68,578		1.574	117,866	2.706
Zone 2 (EURV)	4.00		431.8	159.9	69,051		1.585	124,748	2.864
	4.10		432.6	160.7	69,525		1.596	131,677	3.023
	4.20		433.4	161.5	70,000		1.607	138,653	3.183
	4.30		434.2	162.3	70,477		1.618	145,677	3.344
	4.40		435.0	163.1	70,954		1.629	152,748	3.507
	4.50		435.8	163.9	71,434		1.640	159,868	3.670
	4.60		436.6	164.7	71,914		1.651	167,035	3.835
	4.70		437.4	165.5	72,396		1.662	174,250	4.000
	4.80		438.2	166.3	72,879		1.673	181,514	4.167
	4.90		439.0	167.1	73,363		1.684	188,826	4.335
	5.00		439.8	167.9	73,849		1.695	196,187	4.504
Zone 3 (100-year)	5.01		439.9	168.0	73,897		1.696	196,925	4.521
	5.10		440.6	168.7	74,335		1.707	203,596	4.674
	5.20		441.4	169.5	74,823		1.718	211,054	4.845
	5.30		442.2	170.3	75,313		1.729	218,561	5.017
	5.40		443.0	171.1	75,803		1.740	226,116	5.191
	5.50		443.8	171.9	76,295		1.752	233,721	5.366
	5.60		444.6	172.7	76,789		1.763	241,376	5.541
	5.70		445.4	173.5	77,283		1.774	249,079	5.718
	5.80		446.2	174.3	77,779		1.786	256,832	5.896
	5.90		447.0	175.1	78,276		1.797	264,635	6.075
	6.00		447.8	175.9	78,774		1.808	272,488	6.255
	6.10		448.6	176.7	79,274		1.820	280,390	6.437
	6.20		449.4	177.5	79,775		1.831	288,342	6.619
	6.30		450.2	178.3	80,277		1.843	296,345	6.803
	6.40		451.0	179.1	80,781		1.854	304,398	6.988
	6.50		451.8	179.9	81,285		1.866	312,501	7.174
	6.60		452.6	180.7	81,791		1.878	320,655	7.361
	6.70		453.4	181.5	82,299		1.889	328,859	7.550
	6.80		454.2	182.3	82,807		1.901	337,115	7.739
	6.90		455.0	183.1	83,317		1.913	345,421	7.930
	7.00		455.8	183.9	83,828		1.924	353,778	8.122
	7.10		456.6	184.7	84,341		1.936	362,187	8.315
	7.20		457.4	185.5	84,854		1.948	370,646	8.509
	7.30		458.2	186.3	85,369		1.960	379,157	8.704
	7.40		459.0	187.1	85,886		1.972	387,720	8.901
	7.50		459.8	187.9	86,403		1.984	396,335	9.099
	7.60		460.6	188.7	86,922		1.995	405,001	9.298
	7.70		461.4	189.5	87,442		2.007	413,719	9.498
	7.80		462.2	190.3	87,963		2.019	422,489	9.699
	7.90		463.0	191.1	88,486		2.031	431,312	9.902
	8.00		463.8	191.9	89,010		2.043	440,187	10.105
	8.10		464.6	192.7	89,535		2.055	449,114	10.310
	8.20		465.4	193.5	90,062		2.068	458,094	10.516
	8.30		466.2	194.3	90,590		2.080	467,126	10.724
	8.40		467.0	195.1	91,119		2.092	476,212	10.932
	8.50		467.8	195.9	91,649		2.104	485,350	11.142
	8.60		468.6	196.7	92,181		2.116	494,541	11.353
	8.70		469.4	197.5	92,713		2.128	503,786	11.565
	8.80		470.2	198.3	93,248		2.141	513,084	11.779
	8.90		471.0	199.1	93,783		2.153	522,436	11.993
	9.00		471.8	199.9	94,320		2.165	531,841	12.209
	9.10		472.6	200.7	94,858		2.178	541,300	12.427
	9.20		473.4	201.5	95,397		2.190	550,812	12.645
	9.30		474.2	202.3	95,938		2.202	560,379	12.865
	9.40		475.0	203.1	96,480		2.215	570,000	13.085
	9.50		475.8	203.9	97,023		2.227	579,675	13.308
	9.60		476.6	204.7	97,567		2.240	589,405	13.531
	9.70		477.4	205.5	98,113		2.252	599,189	13.755

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.02 (February 2020)



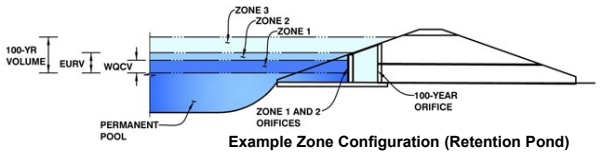


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.02 (February 2020)

Project: Singer Ranch

Basin ID: DF-8 (SE Single-Family & Commercial Pond)



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.67	0.854	Orifice Plate
Zone 2 (EURV)	4.00	2.009	Circular Orifice
Zone 3 (100-year)	5.01	1.642	Weir&Pipe (Restrict)
Total (all zones)		4.505	

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

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

Calculated Parameters for Underdrain

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)

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	1.778E-02	ft²
Depth at top of Zone using Orifice Plate =	2.66	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	10.60	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	2.56	sq. inches (diameter = 1-13/16 inches)	Elliptical Slot Area =	N/A	ft²

Calculated Parameters for Plate

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	0.89	1.77					
Orifice Area (sq. inches)	2.56	2.56	2.56					

	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)

	Zone 2 Circular	Not Selected		Calculated Parameters for Vertical Orifice	Zone 2 Circular	Not Selected	
Invert of Vertical Orifice =	2.67	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	0.15	N/A	ft²
Depth at top of Zone using Vertical Orifice =	4.00	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.22	N/A	feet
Vertical Orifice Diameter =	5.27	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 =	4.00	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	4.00	N/A	feet
Overflow Weir Front Edge Length =	6.00	N/A	feet	Overflow Weir Slope Length =	6.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	5.63	N/A	
Horiz. Length of Weir Sides =	6.00	N/A	feet	Overflow Grate Open Area w/o Debris =	25.20	N/A	ft²
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area	Overflow Grate Open Area w/ Debris =	12.60	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 =	0.30	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	4.48	N/A	ft²
Outlet Pipe Diameter =	36.00	N/A	inches	Outlet Orifice Centroid =	1.03	N/A	feet
Restrictor Plate Height Above Pipe Invert =	21.80		inches	Half-Central Angle of Restrictor Plate on Pipe =	1.78	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	5.00	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.95	feet
Spillway Crest Length =	40.00	feet	Stage at Top of Freeboard =	6.95	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	1.92	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	8.03	acre-ft

Calculated Parameters for Spillway

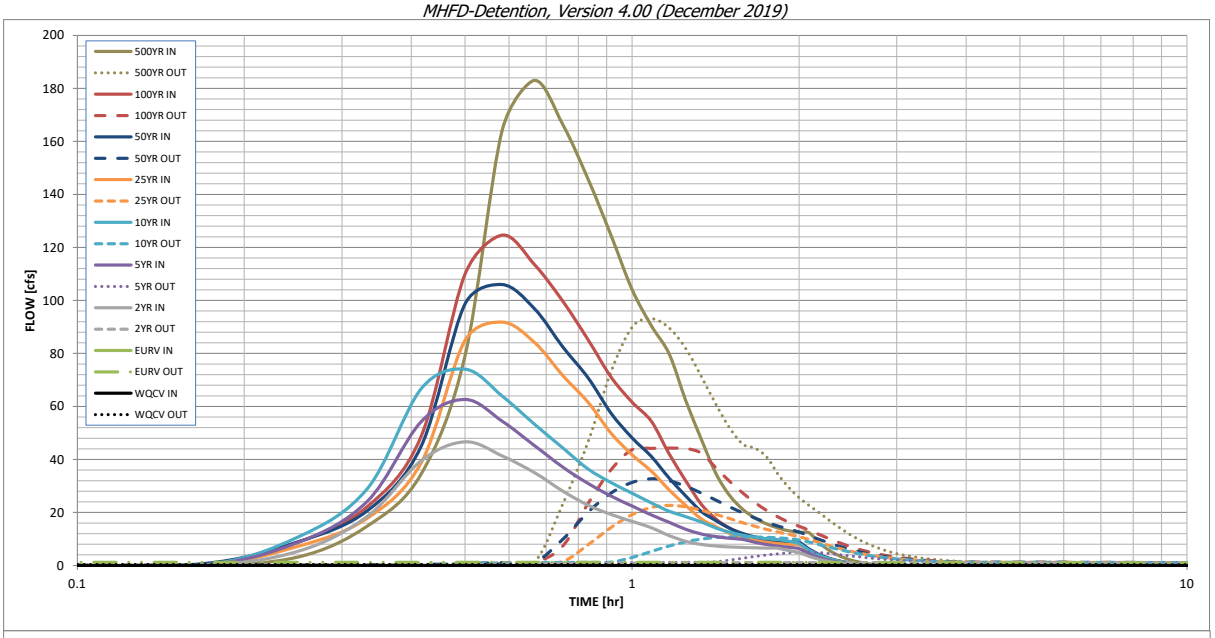
Routed Hydrograph Results

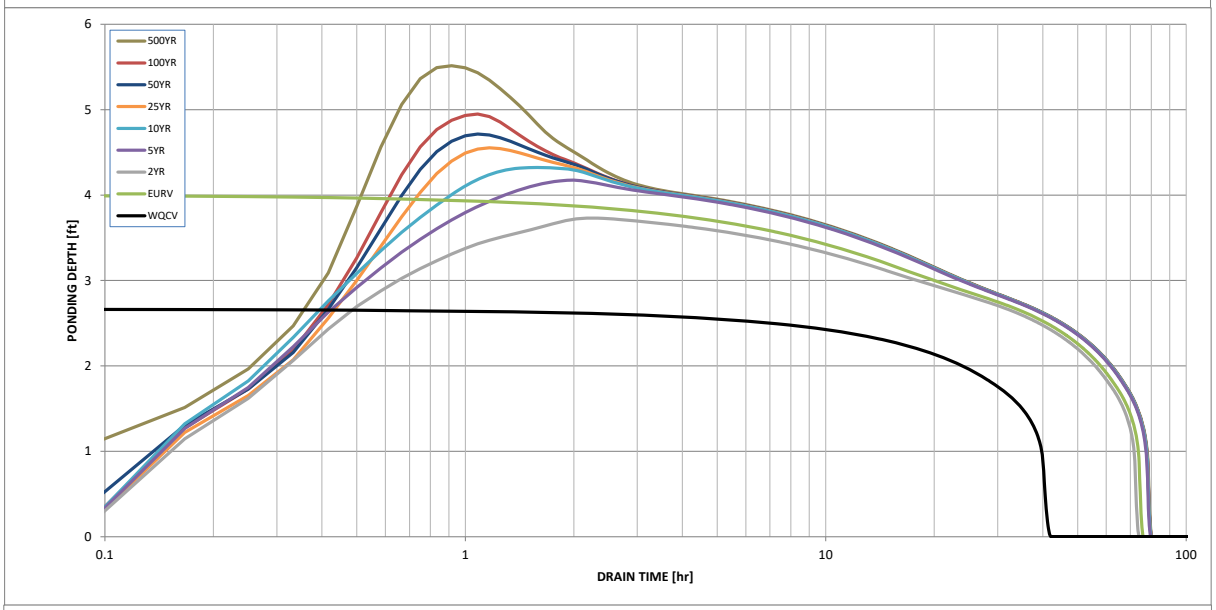
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

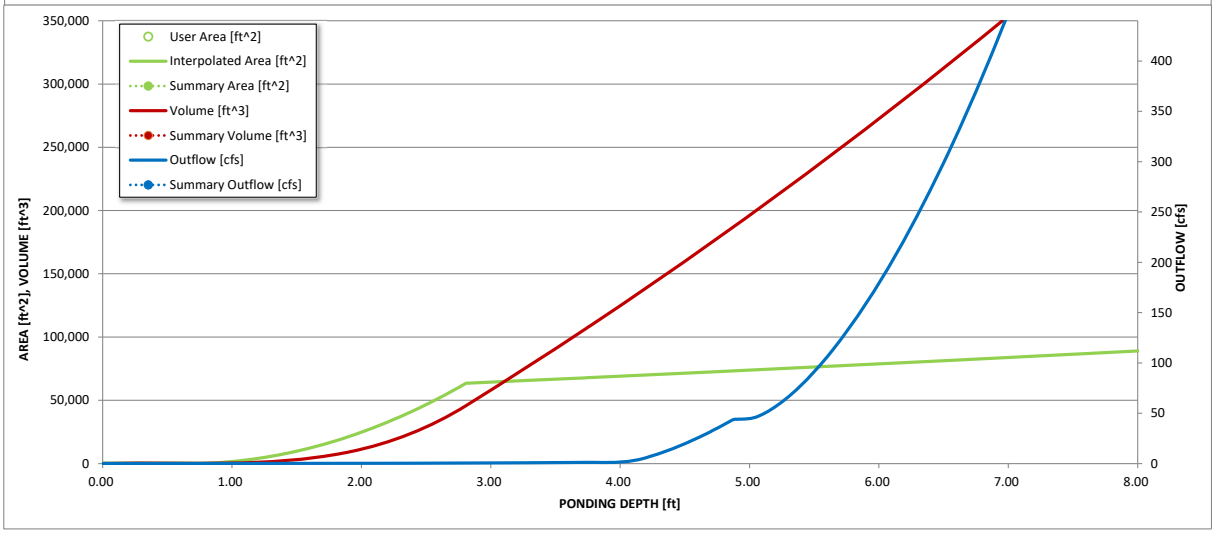
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.55
CUHP Runoff Volume (acre-ft) =	0.854	2.863	2.594	3.498	4.260	5.161	5.958	6.907	10.282
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	2.594	3.498	4.260	5.161	5.958	6.907	10.282
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	4.1	11.3	17.1	30.8	38.6	49.3	81.9
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.11	0.30	0.46	0.83	1.04	1.32	2.20
Peak Inflow Q (cfs) =	N/A	N/A	46.6	62.6	74.1	91.8	106.0	124.6	183.0
Peak Outflow Q (cfs) =	0.3	1.2	1.1	5.0	10.8	22.7	32.7	44.3	93.1
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.4	0.6	0.7	0.8	0.9	1.1
Structure Controlling Flow =	Vertical Orifice 1	Overflow Weir 1	Vertical Orifice 1	Overflow Weir 1	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	0.1	0.4	0.8	1.2	1.7	1.8
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) =	38	68	66	70	69	68	66	65	60
Time to Drain 99% of Inflow Volume (hours) =	**40**	72	70	75	75	74	74	73	71
Maximum Ponding Depth (ft) =	2.67	4.00	3.73	4.17	4.32	4.55	4.71	4.95	5.51
Area at Maximum Ponding Depth (acres) =	1.27	1.59	1.55	1.60	1.62	1.65	1.66	1.69	1.75
Maximum Volume Stored (acre-ft) =	0.862	2.864	2.424	3.135	3.377	3.752	4.017	4.402	5.383

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.00 (December 2019)





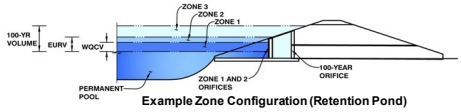


DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.02 (February 2020)

Project: Singer Ranch

Basin ID: DF-9 (SE Commercial Pond)



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	35.45	acres
Watershed Length =	1,960	ft
Watershed Length to Centroid =	730	ft
Watershed Slope =	0.030	ft/ft
Watershed Imperviousness =	80.00%	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.

		Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.970 acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	3.148 acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	2.780 acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	3.677 acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	4.421 acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	5.244 acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	6.012 acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	6.889 acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.55 in.) =	10.097 acre-feet	3.55	inches
Approximate 2-yr Detention Volume =	2.494 acre-feet		
Approximate 5-yr Detention Volume =	3.286 acre-feet		
Approximate 10-yr Detention Volume =	4.080 acre-feet		
Approximate 25-yr Detention Volume =	4.373 acre-feet		
Approximate 50-yr Detention Volume =	4.542 acre-feet		
Approximate 100-yr Detention Volume =	4.786 acre-feet		

Define Zones and Basin Geometry

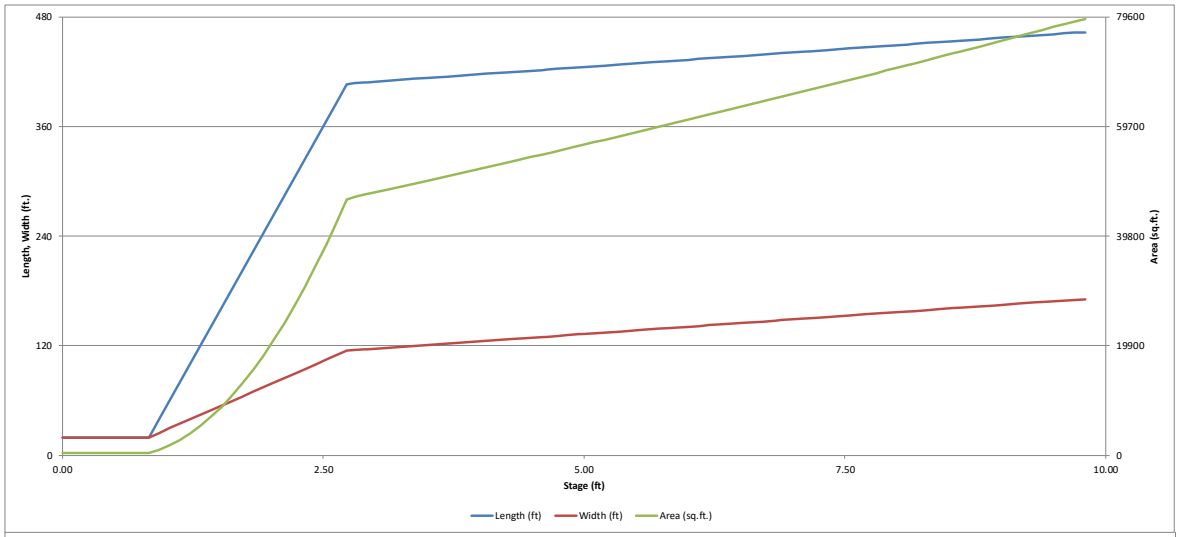
Zone 1 Volume (WQCV) =	0.970	acre-feet
Zone 2 Volume (EURV - Zone 1) =	2.178	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.638	acre-feet
Total Detention Basin Volume =	4.786	acre-feet
Initial Surcharge Volume (ISV) =	127	ft^3
Initial Surcharge Depth (ISD) =	0.33	ft
Total Available Detention Depth (H_{total}) =	6.00	ft
Depth of Trickle Channel (H_{TC}) =	0.50	ft
Slope of Trickle Channel (S_{TC}) =	0.005	ft/ft
Slopes of Main Basin Sides (S_{main}) =	4	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	4	
Initial Surcharge Area (A_{ISV}) =	381	ft^2
Surcharge Volume Length (L_{ISV}) =	19.5	ft
Surcharge Volume Width (W_{ISV}) =	19.5	ft
Depth of Basin Floor (H_{FLOOR}) =	1.90	ft
Length of Basin Floor (L_{FLOOR}) =	407.1	ft
Width of Basin Floor (W_{FLOOR}) =	114.5	ft
Area of Basin Floor (A_{FLOOR}) =	46,618	ft^2
Volume of Basin Floor (V_{FLOOR}) =	32,434	ft^3
Depth of Main Basin (H_{MAIN}) =	3.27	ft
Length of Main Basin (L_{MAIN}) =	433.2	ft
Width of Main Basin (W_{MAIN}) =	140.6	ft
Area of Main Basin (A_{MAIN}) =	60,934	ft^2
Volume of Main Basin (V_{MAIN}) =	175,165	ft^3
Calculated Total Basin Volume (V_{total}) =	**4.773**	acre-feet

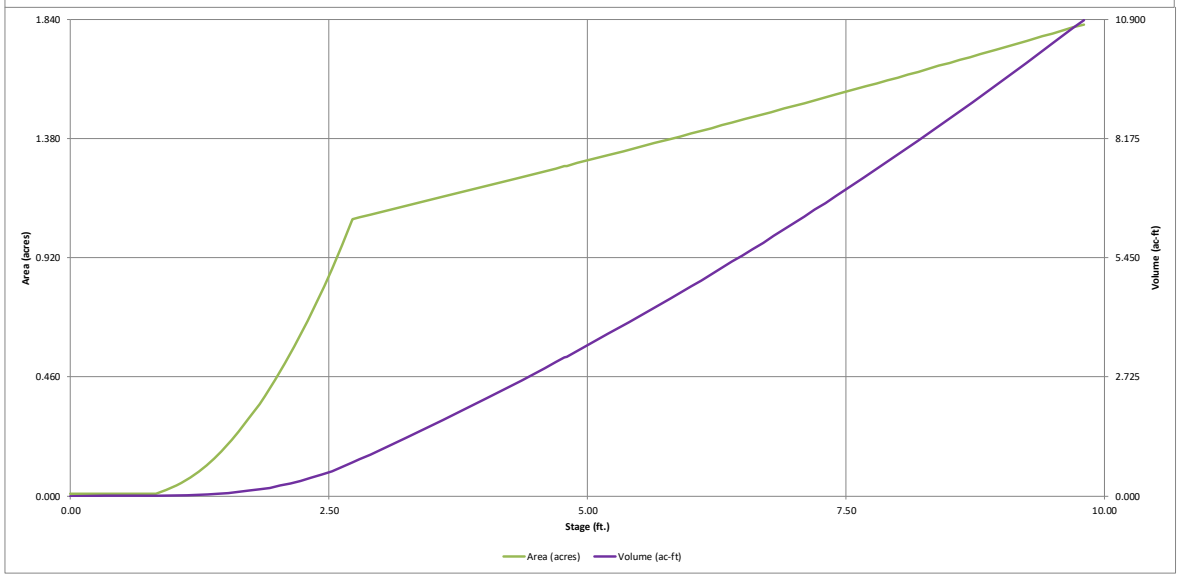
Depth Increment = 0.10 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	0.00		19.5	19.5	381		0.009		
	0.33		19.5	19.5	381		0.009	126	0.003
	0.43		19.5	19.5	381		0.009	164	0.004
	0.53		19.5	19.5	381		0.009	202	0.005
	0.63		19.5	19.5	381		0.009	240	0.006
	0.73		19.5	19.5	381		0.009	278	0.006
	0.83		19.5	19.5	381		0.009	316	0.007
	0.93		39.3	24.4	957		0.022	380	0.009
	1.03		59.7	29.4	1,753		0.040	514	0.012
	1.13		80.1	34.4	2,752		0.063	738	0.017
	1.23		100.5	39.4	3,956		0.091	1,071	0.025
	1.33		120.9	44.4	5,363		0.123	1,536	0.035
	1.43		141.3	49.4	6,974		0.160	2,151	0.049
	1.53		161.7	54.4	8,790		0.202	2,937	0.067
	1.63		182.1	59.4	10,809		0.248	3,916	0.090
	1.73		202.5	64.4	13,033		0.299	5,106	0.117
	1.83		222.9	69.4	15,460		0.355	6,529	0.150
	1.93		243.3	74.4	18,092		0.415	8,205	0.188
	2.03		263.7	79.4	20,927		0.480	10,154	0.233
	2.13		284.1	84.4	23,966		0.550	12,397	0.285
	2.23		304.5	89.4	27,210		0.625	14,954	0.343
	2.33		324.9	94.4	30,657		0.704	17,846	0.410
	2.43		345.3	99.4	34,309		0.788	21,092	0.484
	2.53		365.7	104.4	38,164		0.876	24,714	0.567
	2.63		386.1	109.4	42,223		0.969	28,732	0.660
Floor	2.73		406.5	114.4	46,487		1.067	33,166	0.761
	2.80		407.6	115.0	46,898		1.077	36,438	0.836
	2.90		408.4	115.8	47,317		1.086	41,149	0.945
Zone 1 (WQCV)	2.93		408.7	116.1	47,443		1.089	42,570	0.977
	3.00		409.2	116.6	47,737		1.096	45,901	1.054
	3.10		410.0	117.4	48,158		1.106	50,696	1.164
	3.20		410.8	118.2	48,581		1.115	55,533	1.275
	3.30		411.6	119.0	49,005		1.125	60,412	1.387
	3.40		412.4	119.8	49,430		1.135	65,334	1.500
	3.50		413.2	120.6	49,856		1.145	70,298	1.614
	3.60		414.0	121.4	50,284		1.154	75,305	1.729
	3.70		414.8	122.2	50,713		1.164	80,355	1.845
	3.80		415.6	123.0	51,143		1.174	85,448	1.962
	3.90		416.4	123.8	51,575		1.184	90,584	2.080
	4.00		417.2	124.6	52,008		1.194	95,763	2.198
	4.10		418.0	125.4	52,442		1.204	100,985	2.318
	4.20		418.8	126.2	52,877		1.214	106,251	2.439
	4.30		419.6	127.0	53,314		1.224	111,561	2.561
	4.40		420.4	127.8	53,752		1.234	116,914	2.684
	4.50		421.2	128.6	54,191		1.244	122,311	2.808
	4.60		422.0	129.4	54,632		1.254	127,752	2.933
	4.70		422.8	130.2	55,074		1.264	133,238	3.059
Zone 2 (EURV)	4.78		423.5	130.9	55,428		1.272	137,658	3.160
	4.80		423.6	131.0	55,517		1.274	138,767	3.186
	4.90		424.4	131.8	55,961		1.285	144,341	3.314
	5.00		425.2	132.6	56,407		1.295	149,960	3.443
	5.10		426.0	133.4	56,854		1.305	155,623	3.573
	5.20		426.8	134.2	57,302		1.315	161,330	3.704
	5.30		427.6	135.0	57,752		1.326	167,083	3.836
	5.40		428.4	135.8	58,202		1.336	172,881	3.969
	5.50		429.2	136.6	58,655		1.347	178,724	4.103
	5.60		430.0	137.4	59,108		1.357	184,612	4.238
	5.70		430.8	138.2	59,563		1.367	190,545	4.374
	5.80		431.6	139.0	60,018		1.378	196,524	4.512
	5.90		432.4	139.8	60,476		1.388	202,549	4.650
Zone 3 (100-year)	6.00		433.2	140.6	60,934		1.399	208,619	4.789
	6.10		434.0	141.4	61,394		1.409	214,736	4.930
	6.20		434.8	142.2	61,855		1.420	220,898	5.071
	6.30		435.6	143.0	62,317		1.431	227,107	5.214
	6.40		436.4	143.8	62,781		1.441	233,362	5.357
	6.50		437.2	144.6	63,246		1.452	239,663	5.502
	6.60		438.0	145.4	63,712		1.463	246,011	5.648
	6.70		438.8	146.2	64,179		1.473	252,405	5.794
	6.80		439.6	147.0	64,648		1.484	258,847	5.942
	6.90		440.4	147.8	65,118		1.495	265,335	6.091
	7.00		441.2	148.6	65,589		1.506	271,870	6.241
	7.10		442.0	149.4	66,062		1.517	278,453	6.392
	7.20		442.8	150.2	66,536		1.527	285,083	6.545
	7.30		443.6	151.0	67,011		1.538	291,760	6.698
	7.40		444.4	151.8	67,487		1.549	298,485	6.852
	7.50		445.2	152.6	67,965		1.560	305,258	7.008
	7.60		446.0	153.4	68,444		1.571	312,078	7.164
	7.70		446.8	154.2	68,924		1.582	318,946	7.322
	7.80		447.6	155.0	69,405		1.593	325,863	7.481
	7.90		448.4	155.8	69,888		1.604	332,827	7.641
	8.00		449.2	156.6	70,372		1.616	339,840	7.802
	8.10		450.0	157.4	70,858		1.627	346,902	7.964
	8.20		450.8	158.2	71,344		1.638	354,012	8.127
	8.30		451.6	159.0	71,832		1.649	361,171	8.291
	8.40		452.4	159.8	72,321		1.660	368,379	8.457
	8.50		453.2	160.6	72,812		1.672	375,635	8.623
	8.60		454.0	161.4	73,304		1.683	382,941	8.791
	8.70		454.8	162.2	73,797		1.694	390,296	8.960
	8.80		455.6	163.0	74,291		1.705	397,700	9.130
	8.90		456.4	163.8	74,787		1.717	405,154	9.301
	9.00		457.2	164.6	75,283		1.728	412,658	9.473
	9.10		458.0	165.4	75,782		1.740	420,211	9.647
	9.20		458.8	166.2	76,281		1.751	427,814	9.821
	9.30		459.6	167.0	76,782		1.763	435,467	9.997
	9.40		460.4	167.8	77,284		1.774	443,171	10.174
	9.50		461.2	168.6	77,787		1.786	450,924	10.352
	9.60		462.0	169.4	78,292		1.797	458,728	10.531
	9.70		462.8	170.2	78,797		1.809	466,582	10.711
	9.80		463.6	171.0	79,305		1.821	474,487	10.893

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.02 (February 2020)



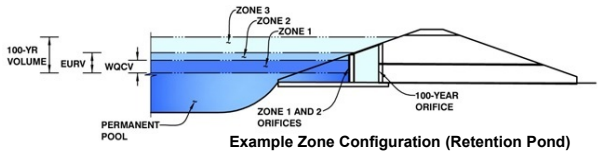


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.02 (February 2020)

Project: Singer Ranch

Basin ID: DF-9 (SE Commercial Pond)



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.93	0.970	Orifice Plate
Zone 2 (EURV)	4.78	2.178	Circular Orifice
Zone 3 (100-year)	6.00	1.638	Weir&Pipe (Restrict)
Total (all zones)		4.786	

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

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

Calculated Parameters for Underdrain

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)

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	1.972E-02	ft²
Depth at top of Zone using Orifice Plate =	2.91	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	11.60	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	2.84	sq. inches (diameter = 1-7/8 inches)	Elliptical Slot Area =	N/A	ft²

Calculated Parameters for Plate

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	0.97	1.94					
Orifice Area (sq. inches)	2.84	2.84	2.84					

	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)

	Zone 2 Circular	Not Selected		Calculated Parameters for Vertical Orifice	Zone 2 Circular	Not Selected	
Invert of Vertical Orifice =	2.93	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	0.10	N/A	ft²
Depth at top of Zone using Vertical Orifice =	4.78	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.18	N/A	feet
Vertical Orifice Diameter =	4.23	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 =	4.78	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	4.78	N/A	feet
Overflow Weir Front Edge Length =	6.00	N/A	feet	Overflow Weir Slope Length =	6.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	5.89	N/A	
Horiz. Length of Weir Sides =	6.00	N/A	feet	Overflow Grate Open Area w/o Debris =	25.20	N/A	ft²
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area	Overflow Grate Open Area w/ Debris =	12.60	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 =	0.30	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	4.28	N/A	ft²
Outlet Pipe Diameter =	36.00	N/A	inches	Outlet Orifice Centroid =	1.00	N/A	feet
Restrictor Plate Height Above Pipe Invert =	21.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	1.74	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	5.80	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.96	feet
Spillway Crest Length =	44.00	feet	Stage at Top of Freeboard =	7.76	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	1.59	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	7.42	acre-ft

Calculated Parameters for Spillway

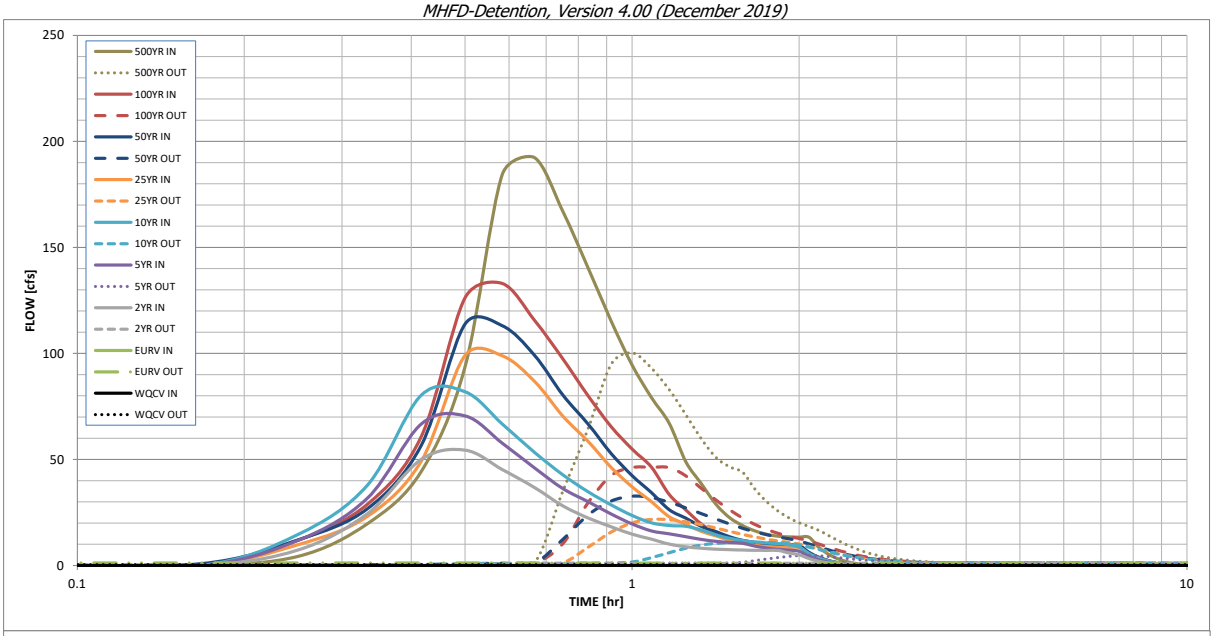
Routed Hydrograph Results

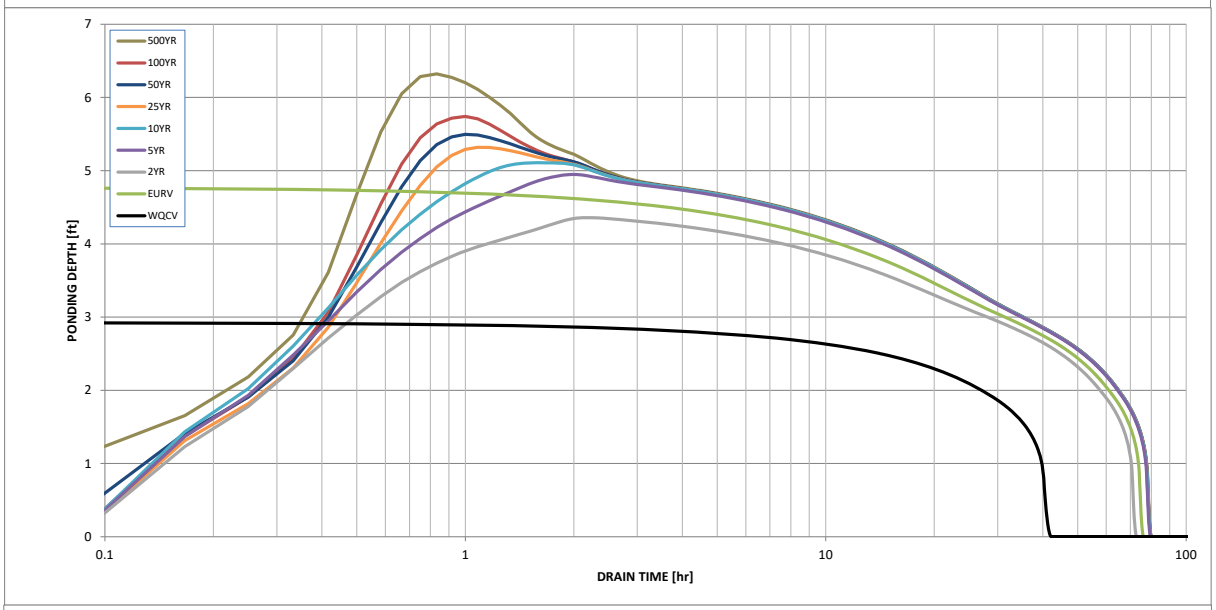
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

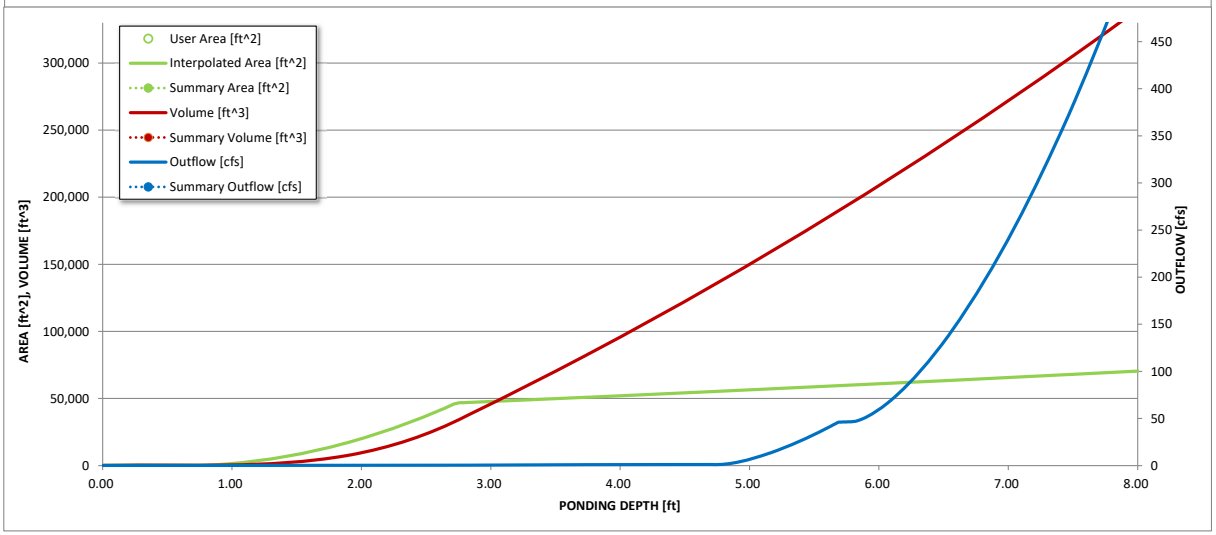
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.55
CUHP Runoff Volume (acre-ft) =	0.970	3.148	2.780	3.677	4.421	5.244	6.012	6.889	10.097
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	2.780	3.677	4.421	5.244	6.012	6.889	10.097
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	4.2	11.9	18.0	31.7	39.8	50.4	83.7
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.12	0.34	0.51	0.89	1.12	1.42	2.36
Peak Inflow Q (cfs) =	N/A	N/A	54.4	70.6	81.9	99.0	113.8	133.0	192.4
Peak Outflow Q (cfs) =	0.4	1.2	1.0	4.8	10.9	21.7	32.7	46.3	100.3
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.4	0.6	0.7	0.8	0.9	1.2
Structure Controlling Flow =	Plate	Overflow Weir 1	Vertical Orifice 1	Overflow Weir 1	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	0.1	0.4	0.8	1.3	1.8	1.9
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) =	38	68	65	71	70	68	67	66	61
Time to Drain 99% of Inflow Volume (hours) =	**40**	72	69	75	75	74	74	73	72
Maximum Ponding Depth (ft) =	2.93	4.78	4.36	4.95	5.11	5.32	5.50	5.74	6.32
Area at Maximum Ponding Depth (acres) =	1.09	1.27	1.23	1.29	1.31	1.33	1.35	1.37	1.43
Maximum Volume Stored (acre-ft) =	0.977	3.160	2.622	3.365	3.573	3.849	4.089	4.415	5.242

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.00 (December 2019)







APPENDIX B

STANDARD DESIGN CHARTS AND TABLES

Table 6-6. Runoff Coefficients for Rational Method
(Source: UDFCD 2001)

Land Use or Surface Characteristics	Percent Impervious	Runoff Coefficients											
		2-year		5-year		10-year		25-year		50-year		100-year	
		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													
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	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
1/3 Acre	30	0.18	0.22	0.25	0.30	0.32	0.38	0.39	0.47	0.43	0.52	0.47	0.57
1/2 Acre	25	0.15	0.20	0.22	0.28	0.30	0.36	0.37	0.46	0.41	0.51	0.46	0.56
1 Acre	20	0.12	0.17	0.20	0.26	0.27	0.34	0.35	0.44	0.40	0.50	0.44	0.55
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	0.48	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 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
Streets													
Paved	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
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_t) 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_t) 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.

Figure 6-25. Estimate of Average Concentrated Shallow Flow

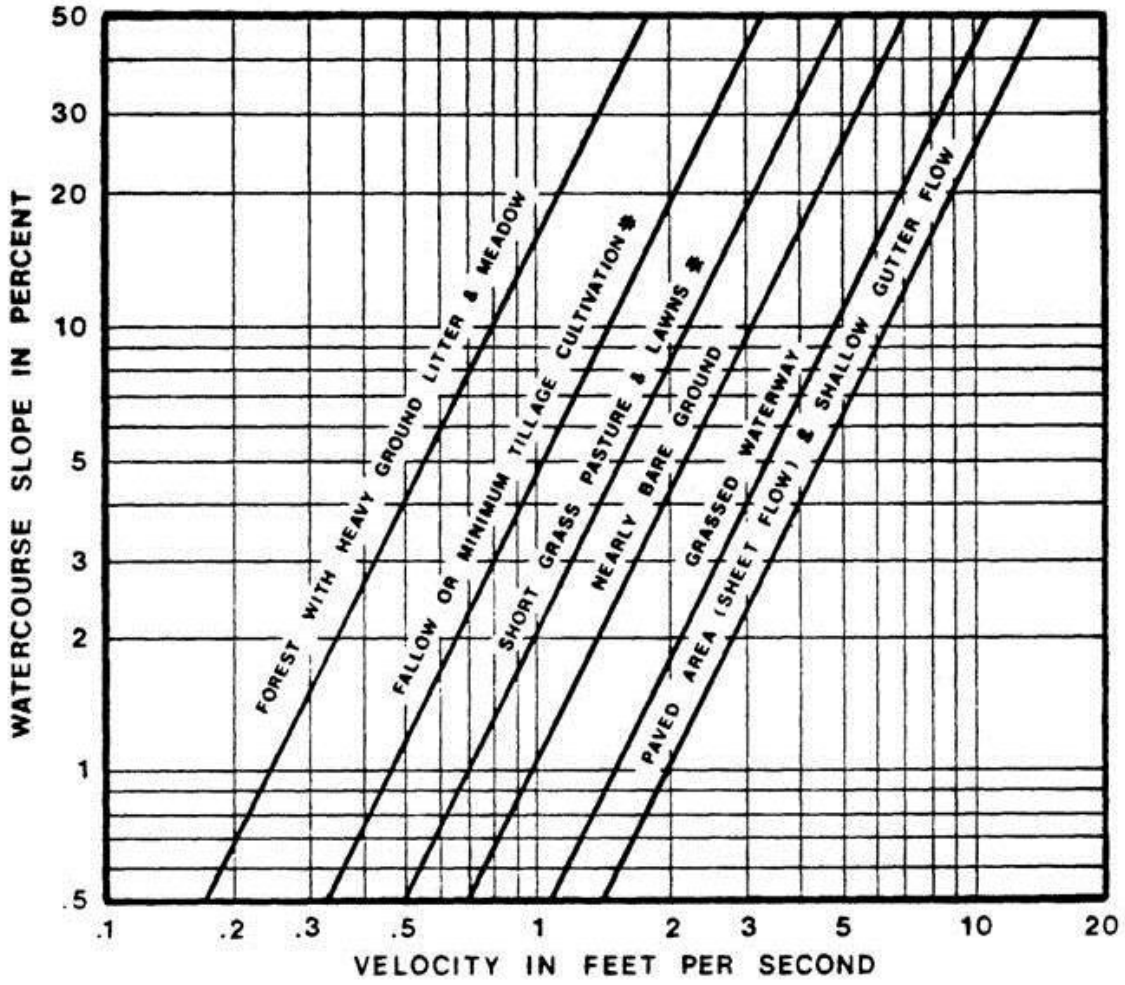
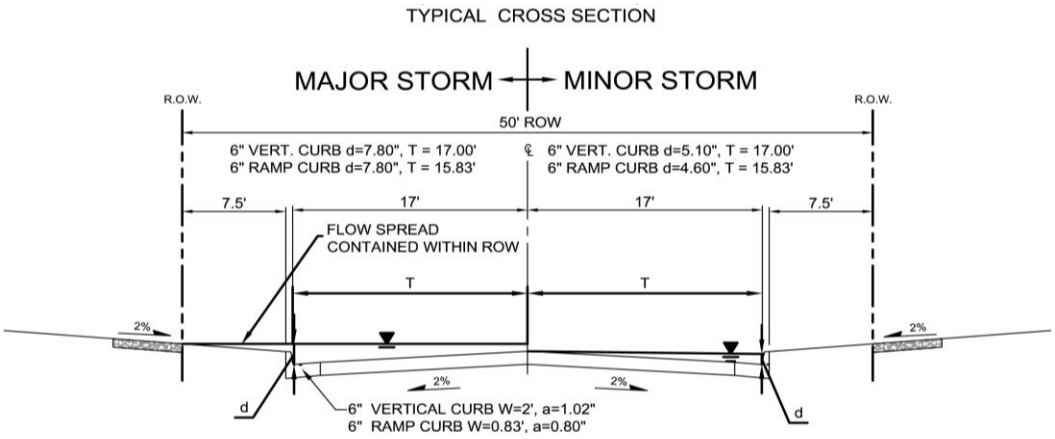
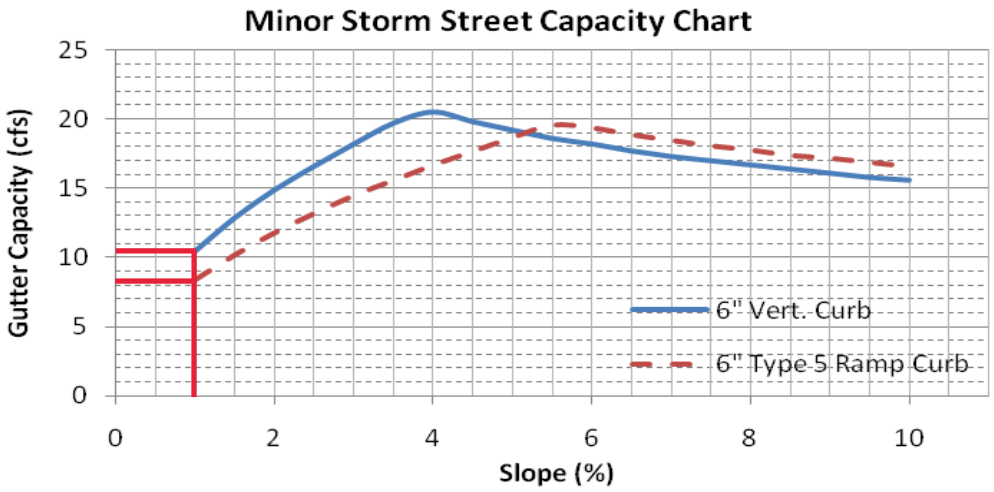
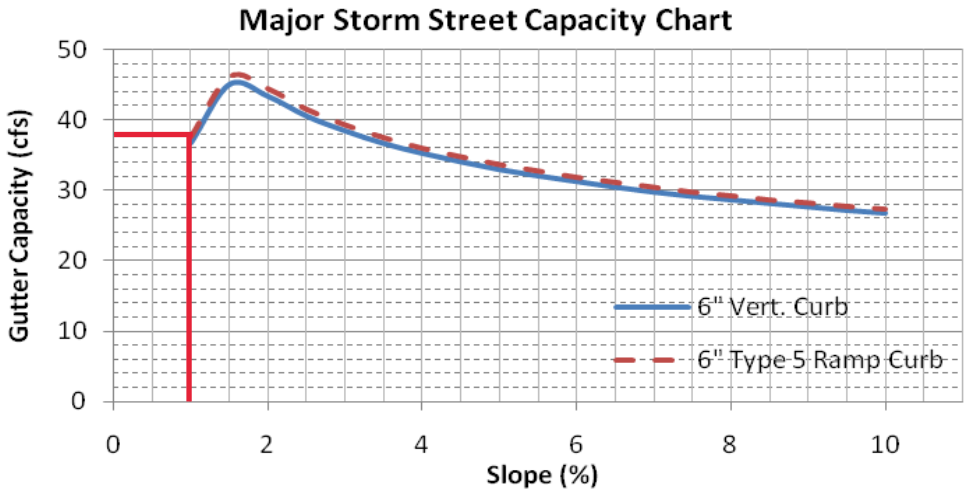


Figure 7-7. Street Capacity Charts Residential (Detached Sidewalk)







These charts shall only be used for the standard street sections as shown. The capacity shown is based on ½ the street section as calculated by the UD-Inlet spreadsheets. Minor storm capacities are based on no crown overtopping, curb height or maximum allowable spread widths. Major storm capacities are based on flow being containing within the public right-of-way, including conveyance capacity behind the curb. The UDFCD Safety Reduction Factor was applied. An 'n_{STREET}' of 0.016 and 'n_{BACK}' of 0.020 was used. Calculations were done using UD-Inlet 3.00.xls, March, 2011.

Table 6-3. Recommended percentage imperviousness values

Land Use or Surface Characteristics	Percentage Imperviousness (%)
Business:	
Downtown Areas	95
Suburban Areas	75
Residential lots (lot area only)**:**	
Single-family	
2.5 acres or larger	12
0.75 – 2.5 acres	20
0.25 – 0.75 acres	30
0.25 acres or less	45
Apartments	75
Industrial:	
Light areas	80
Heavy areas	90
Parks, cemeteries	10
Playgrounds	25
Schools	55
Railroad yard areas	50
Undeveloped Areas:	
Historic flow analysis	2
Greenbelts, agricultural	2
Off-site flow analysis (when land use not defined)	45
Streets:	
Paved	100
Gravel (packed)	40
Drive and walks	90
Roofs	90
Lawns, sandy soil	2
Lawns, clayey soil	2

APPENDIX C

REPORT REFERENCES

EX 30", TO BE REMOVED
FLOW TO BE DIRECTED
TO DETENTION BASIN 3021

5752

CITY OF COLORADO SPRINGS

FONTAINE BLVD.

CITY OF FOUNTAIN

EX 12'x28' CBC
TO REMAIN

FOUNTAIN MUTUAL DITCH

3030-2

PROPOSED RIPRAP CHANNEL
W/CHECKS @150' INTERVALS
60' BW, d=4', S=0.4%
Q_{100}=1760 cfs

PROPOSED 100 LF
2-8'Hx15'W CBC @1%
Q_{100}=1850 cfs

PROPOSED RIPRAP CHANNEL
W/CHECKS @200' INTERVALS
20' BW, d=3'
Q_{100}=360 cfs

3040

PROPOSED 120 LF
5'Hx10'W CBC @1%
Q_{100}=360cfs

PROPOSED COLLECTOR

5700

PROPOSED RIPRAP CHANNEL
W/CHECKS @150' INTERVALS
65' BW, d=4', S=0.4%
Q_{100}=1850 cfs

WEST FORK JIMMY CAMP CREEK

3030-1

3040

POWERS BLVD.

PEACEFUL VALLEY
SUBDIVISION
(EL PASO COUNTY)

CITY OF FOUNTAIN

PROPOSED WEST ARTERIAL

PROPOSED 120 LF
2-8'Hx15'W CBC @1%
Q_{100}=1970 cfs

EL PASO COUNTY

DETENTION BASIN 3031
VOL_{100}= 12.0 AF
$Q_{100\ IN}$ = 2010 cfs
$Q_{100\ OUT}$ = 1970 cfs

3040

THIS DRAWING IS A MASTER PLANNING SHEET REPRESENTING PRELIMINARY AND CONCEPTUAL ENGINEERING. IT SHOULD NOT BE USED FOR CONSTRUCTION PURPOSES.

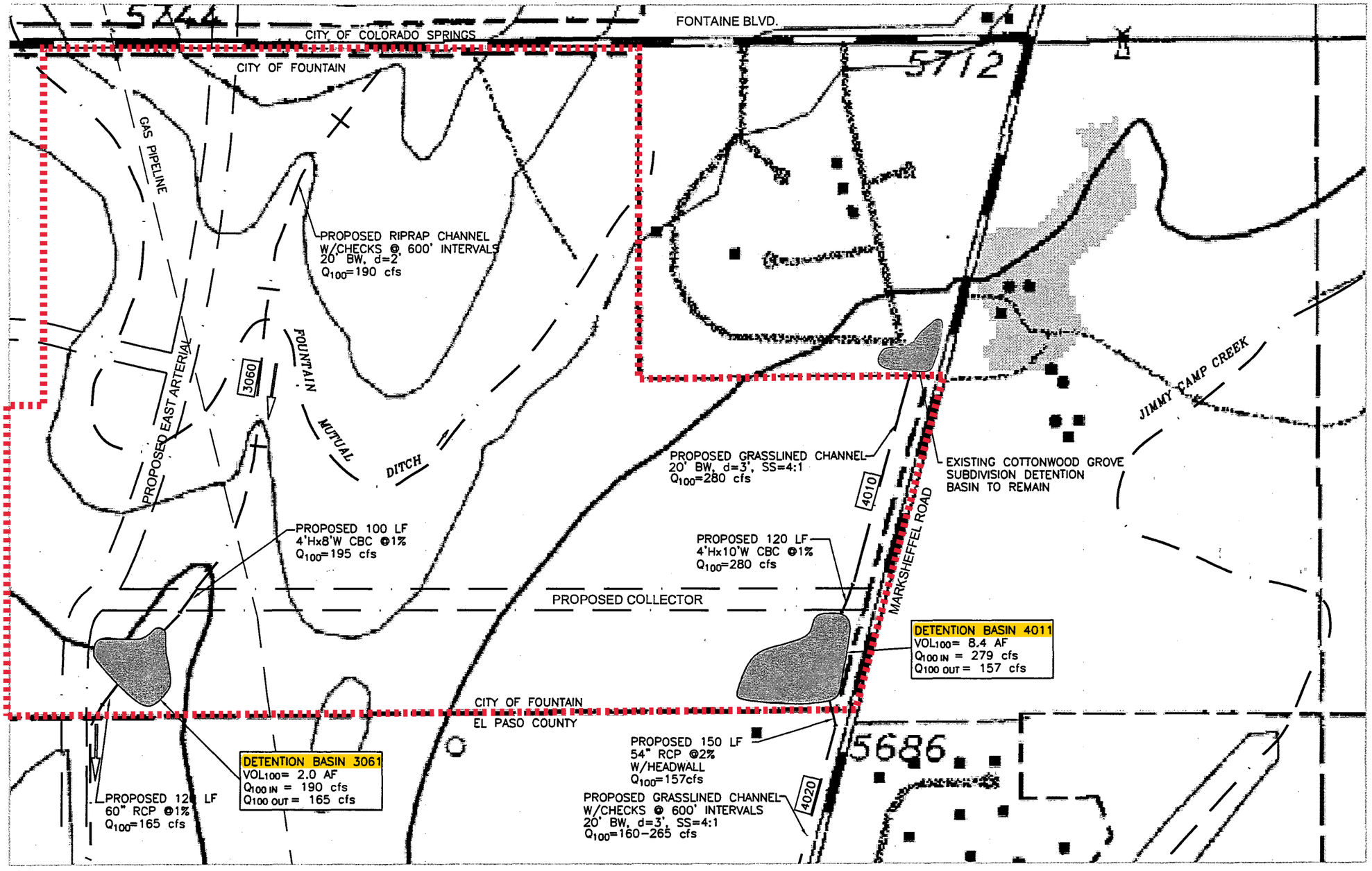
0' 200' 400'

Kiowa Engineering Corporation
1604 South 21st Street
Colorado Springs, Colorado
80904
(719) 630-7342

WEST FORK JIMMY CAMP CREEK
DRAINAGE BASIN PLANNING STUDY
PRELIMINARY PLAN
EL PASO COUNTY, COLORADO

Project No.:	9893
Date:	7/00
Design:	RNW
Drawn:	CAD
Check:	RNW
Revisions:	

4A



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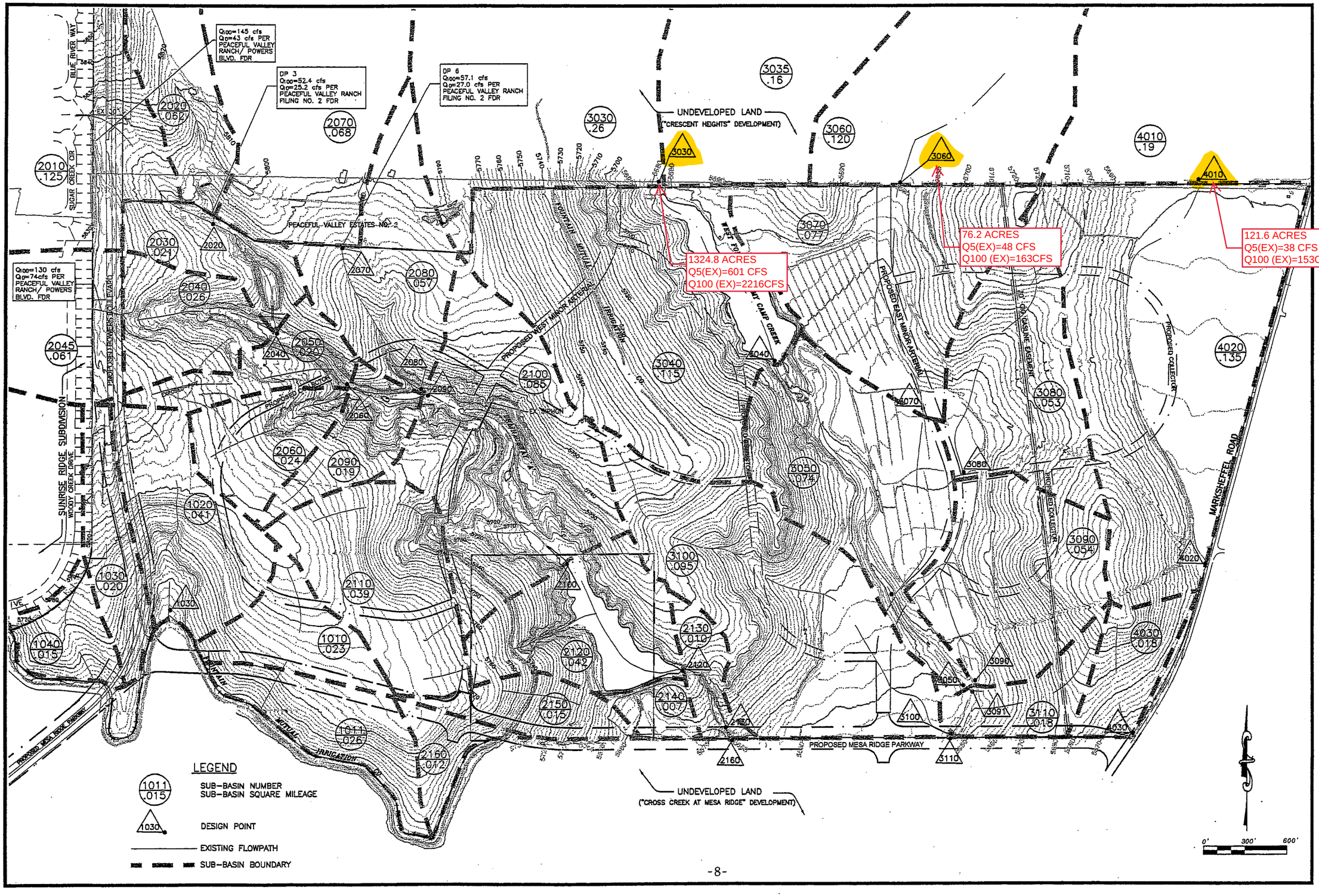
Revisions:	

4B



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1604 S. 21st Street
Colorado Springs, Colorado
80904
(719) 630-7342

West Fork Jimmy Camp Creek
Drainage Basin Planning Study
HYDROLOGIC SUB-BASIN MAP
EL PASO COUNTY, COLORADO

Project No.:	9893
Date:	7/00
Design:	RNW
Drawn:	CAD
Check:	RNW
Revisions:	

FIG.3A

TABLE 3: SUMMARY OF DESIGN POINT DISCHARGES
WEST FORK JIMMY CAMP CREEK DRAINAGE BASIN PLANNING STUDY

DESIGN POINT NUMBER	EX/FUT DRAINAGE AREA (sm)	EX/FUT DRAINAGE AREA (acres)	EXISITING CONDITION 5 YR cfs	EXISITING CONDITION 100 YR cfs	FUTURE CONDITION 5 YR cfs	FUTURE CONDITION 100YR cfs
2020	0.190	121.6	47	189	57	210
2040	0.300	192.0	97	335	109	362
2060	0.340	217.6	105	372	120	406
2080	0.130	83.2	17	88	28	113
2090	0.480	307.2	123	473	152	535
2100	0.610	390.4	140	558	181	651
2120	0.660	422.4	148	600	189	692
2130	0.670	428.8	145	594	186	687
2160	0.700	448.0	151	624	196	723
3000	0.660	422.4	147	233	317	935
3020	1.650	1056.0	528	1857	1059	2737
3030	2.070	1324.8	601	2216	1209	3267
3040	2.180	1395.2	618	2316	1239	3364
3050	2.26/2.23	1446/1427	627	2351	1275	3444
3070	0.200	128.0	67	235	86	270
3080	.25/.05	160/32	82	290	23	72
3090	.33/.11	211/70	106	373	44	138
3091	2.560	1638.4	732	2722	1380	3843
3100	2.660	1702.4	757	2828	1428	3990
3110	2.670	1708.8	761	2845	1442	4022
4020	0.320	204.8	63	238	145	383
5010	3.530	2259.2	943	3550	1722	4904

TABLE 2: SUMMARY OF SUB- BASIN DISCHARGES
WEST FORK JIMMY CAMP CREEK DRAINAGE BASIN PLANNING STUDY

SUB-BASIN NUMBER	EX/FUT DRAINAGE AREA (sm)	EX/FUT DRAINAGE AREA (ac)	EXISITING CONDITION (cfs) 5 YR	EXISITING CONDITION (cfs) 100 YR	FUTURE CONDITION (cfs) 5 YR	FUTURE CONDITION (cfs) 100YR
2010	0.125	80.0	40	142	40	142
2020	0.082	39.7	9	47	19	68
2030	0.021	13.4	5	22	6	24
2040	0.026	16.6	5	26	7	29
2045	0.061	39.0	48	124	48	124
2050	0.020	12.8	4	17	4	19
2060	0.024	15.4	5	24	8	30
2070	0.068	43.5	8	44	17	65
2080	0.057	36.5	12	58	15	64
2090	0.019	12.2	3	14	5	19
2100	0.095	60.8	13	64	24	89
2110	0.034	21.8	6	29	8	33
2120	0.047	30.1	9	45	9	45
2130	0.010	6.4	2	11	2	11
2140	0.007	4.5	2	4	2	9
2150	0.015	9.6	6	20	6	21
2160	0.012	7.7	8	18	17	35
3000	0.420	268.8	140	474	190	568
3005	0.240	153.6	107	347	144	407
3010	0.220	140.8	81	288	138	383
3012	0.210	134.4	54	199	94	272
3015	0.110	70.4	55	181	75	212
3020	0.190	121.6	69	231	204	428
3025	0.260	166.4	82	324	347	712
3030	0.260	166.4	65	262	116	361
3035	0.160	102.4	63	234	106	306
3040	0.115	73.6	23	110	31	129
3050	0.049/074	31.4/47.4	18	61	56	136
3060	0.119	76.2	48	163	63	189
3070	0.077	49.3	23	78	27	87
3080	0.050	32.0	16	58	23	68
3090	0.082/.05	52.5/32.0	27	93	21	67
3100	0.095	60.8	35	123	61	166
3110	0.018	11.5	5	17	14	31
4010	0.190	121.6	38	153	108	279
4020	0.135	86.4	26	90	39	114
4030	0.018	11.5	7	25	20	44
5010	0.156	99.8	35	133	101	246
5020	0.200	128.0	52	200	1514	362

FOR SUB-BASIN AND DESIGN POINTS IN THE GLEN AT WIDEFIELD AREA SEE FIGURE 3A

NORTH
SCALE: 1-INCH = 1000-FEET

LEGEND
- SUB-BASIN BOUNDARY
- FLOW PATH
- DRAINAGE BASIN NUMBER (3010)
- DESIGN POINT NUMBER (500)

Kiowa Engineering Corporation
1604 South 21st Street
Colorado Springs, Colorado
80904
(719) 630-7342

West Fork Jimmy Camp Creek Drainage Basin Planning Study
HYDROLOGIC SUB-BASIN MAP
EL PASO COUNTY, COLORADO

Project No.:	9893
Date:	6/99
Design:	RNW
Drawn:	CAD
Check:	RNW
Revisions:	

FIGURE 3

9893\F3[24X36](1/99)

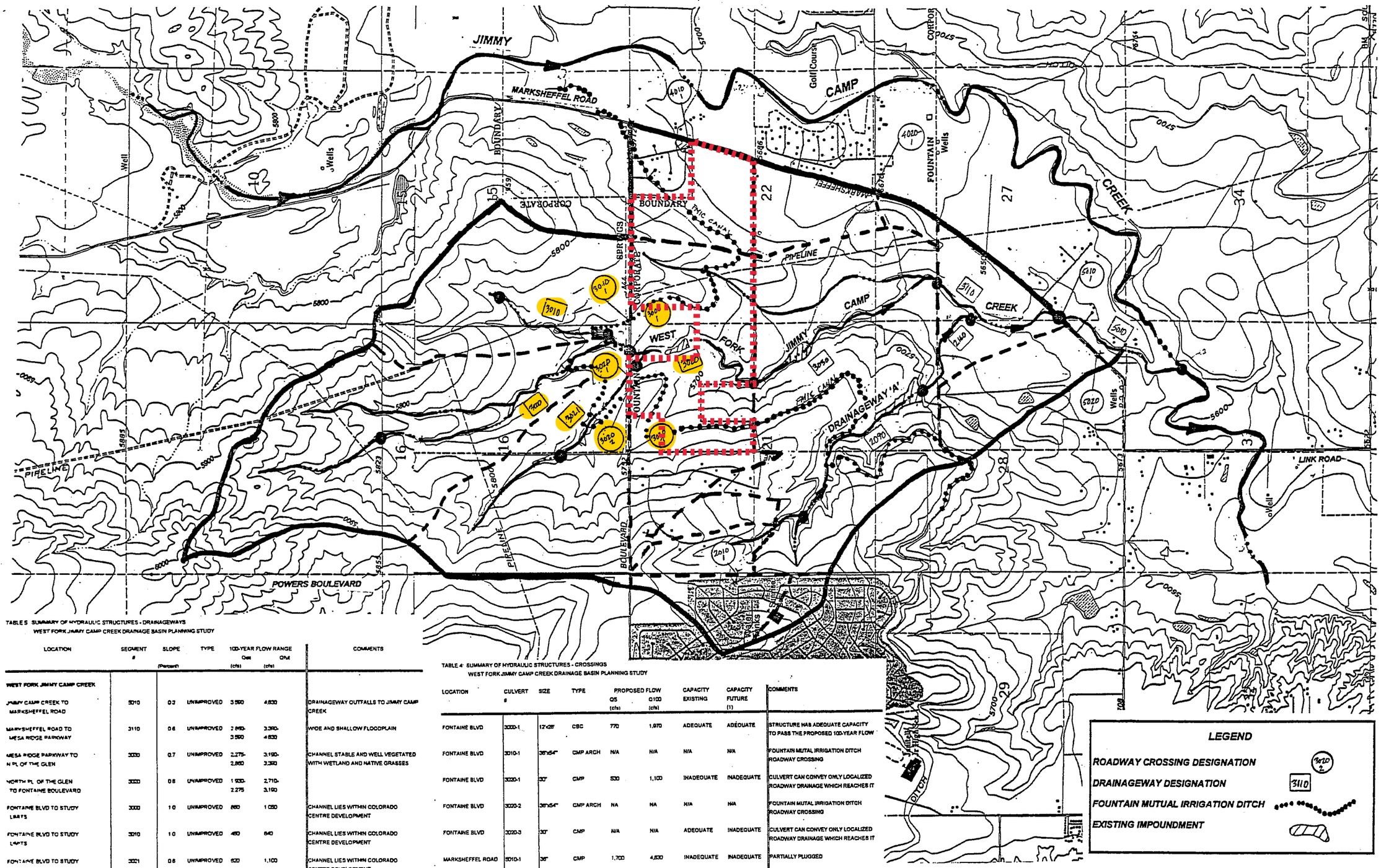

TABLE 5 SUMMARY OF HYDRAULIC STRUCTURES - DRAINAGEWAYS
WEST FORK JIMMY CAMP CREEK DRAINAGE BASIN PLANNING STUDY

LOCATION	SEGMENT #	SLOPE (Percent)	TYPE	100-YEAR FLOW RANGE Qmin (cfs)	100-YEAR FLOW RANGE Qmax (cfs)	COMMENTS
WEST FORK JIMMY CAMP CREEK						
JIMMY CAMP CREEK TO MARKSHEFFEL ROAD	5010	0.3	UNIMPROVED	3,550	4,830	DRAINAGEWAY OUTFALLS TO JIMMY CAMP CREEK
MARKSHEFFEL ROAD TO MESA RIDGE PARKWAY	3110	0.6	UNIMPROVED	2,960-3,550	3,380-4,830	WIDE AND SHALLOW FLOODPLAIN
MESA RIDGE PARKWAY TO N PL OF THE GLEN	3030	0.7	UNIMPROVED	2,275-2,960	3,190-3,380	CHANNEL STABLE AND WELL VEGETATED WITH WETLAND AND NATIVE GRASSES
NORTH PL OF THE GLEN TO FONTAINE BOULEVARD	3020	0.6	UNIMPROVED	1,930-2,275	2,710-3,190	
FONTAINE BLVD TO STUDY LIMITS	3000	1.0	UNIMPROVED	880	1,050	CHANNEL LIES WITHIN COLORADO CENTRE DEVELOPMENT
FONTAINE BLVD TO STUDY LIMITS	3010	1.0	UNIMPROVED	480	640	CHANNEL LIES WITHIN COLORADO CENTRE DEVELOPMENT
FONTAINE BLVD TO STUDY LIMITS	3021	0.6	UNIMPROVED	620	1,100	CHANNEL LIES WITHIN COLORADO CENTRE DEVELOPMENT
DRAINAGEWAY A						
CONFLUENCE WITH WEST FORK JIMMY TO LAKE	2160	2.6	UNIMPROVED	620	720	
LAKE TO DESIGN POINT DP2040	2030	1.8	UNIMPROVED	305-620	390-720	CHANNEL STABLE AND WELL VEGETATED WITH WETLAND AND NATIVE GRASSES

TABLE 4 SUMMARY OF HYDRAULIC STRUCTURES - CROSSINGS
WEST FORK JIMMY CAMP CREEK DRAINAGE BASIN PLANNING STUDY

LOCATION	CULVERT #	SIZE	TYPE	PROPOSED FLOW Q5 (cfs)	PROPOSED FLOW Q100 (cfs)	CAPACITY EXISTING	CAPACITY FUTURE (1)	COMMENTS
FONTAINE BLVD	3000-1	12'x8'	CBC	770	1,970	ADEQUATE	ADEQUATE	STRUCTURE HAS ADEQUATE CAPACITY TO PASS THE PROPOSED 100-YEAR FLOW
FONTAINE BLVD	3010-1	36"x54"	CMP ARCH	N/A	N/A	N/A	N/A	FOUNTAIN MUTAL IRRIGATION DITCH ROADWAY CROSSING
FONTAINE BLVD	3020-1	30"	CMP	530	1,100	INADEQUATE	INADEQUATE	CULVERT CAN CONVEY ONLY LOCALIZED ROADWAY DRAINAGE WHICH REACHES IT
FONTAINE BLVD	3020-2	36"x54"	CMP ARCH	N/A	N/A	N/A	N/A	FOUNTAIN MUTAL IRRIGATION DITCH ROADWAY CROSSING
FONTAINE BLVD	3020-3	30"	CMP	N/A	N/A	ADEQUATE	INADEQUATE	CULVERT CAN CONVEY ONLY LOCALIZED ROADWAY DRAINAGE WHICH REACHES IT
MARKSHEFFEL ROAD	5010-1	36"	CMP	1,700	4,830	INADEQUATE	INADEQUATE	PARTIALLY PLUGGED
MARKSHEFFEL ROAD	5020-1	36"	CMP	150	360	INADEQUATE	INADEQUATE	PARTIALLY PLUGGED
POWERS BOULEVARD	2010-1	30"	CMP	40	142	ADEQUATE	ADEQUATE	CULVERT TO BE REPLACED WITH CONSTRUCTION OF POWERS BOULEVARD
MARKSHEFFEL ROAD	4010-1	N/A	DETENTION BASIN	N/A	N/A	ADEQUATE	ADEQUATE	DETENTION BASIN SERVES THE COTTONWOOD GROVE SUBDIVISION
MARKSHEFFEL ROAD	4020-1	36" (est)	CMP	145	393	INADEQUATE	INADEQUATE	PARTIALLY PLUGGED

LEGEND

ROADWAY CROSSING DESIGNATION (3010-2)

DRAINAGEWAY DESIGNATION (3110)

FOUNTAIN MUTUAL IRRIGATION DITCH

EXISTING IMPOUNDMENT

0' 1000' 2000'

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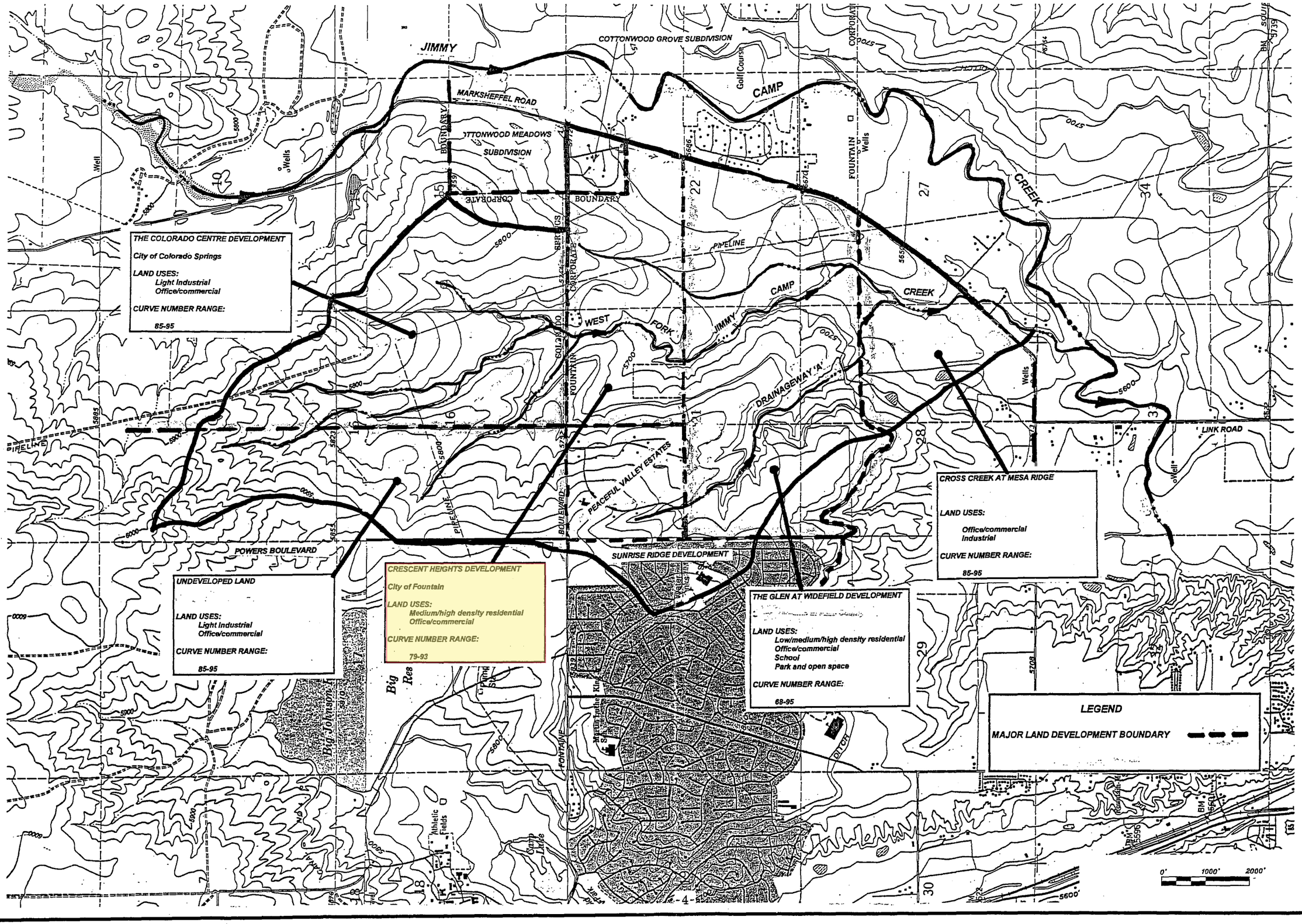
West Fork Jimmy Camp Creek
Drainage Basin Planning Study
INVENTORY OF EXISTING DRAINAGE STRUCTURES
EL PASO COUNTY, COLORADO

Project No.:	9893
Date:	6/99
Design:	RNW
Drawn:	CAD
Check:	RNW
Revisions:	

FIGURE 4



Kiowa Engineering Corporation
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Colorado Springs, Colorado
80904
(719) 630-7342

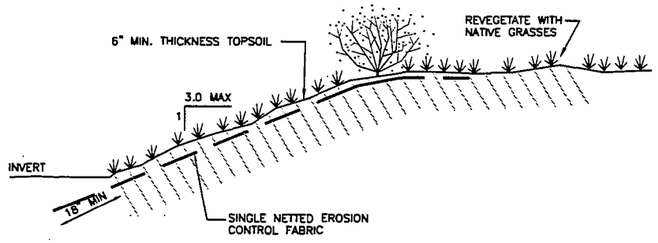
West Fork Jimmy Camp Creek Drainage Basin Planning Study

MAJOR DEVELOPMENT & LAND USE MAP

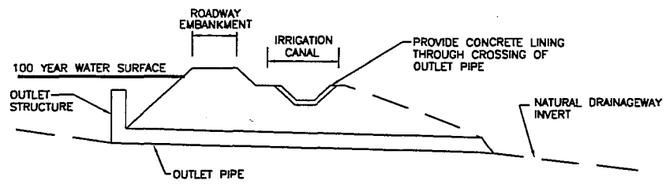
EL PASO COUNTY, COLORADO

Project No.:	9893
Date:	6/99
Design:	RNW
Drawn:	CAD
Check:	RNW
Revisions:	

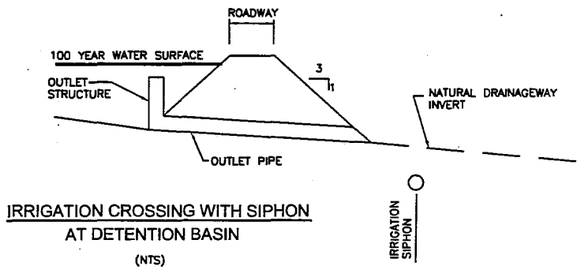
FIGURE 2



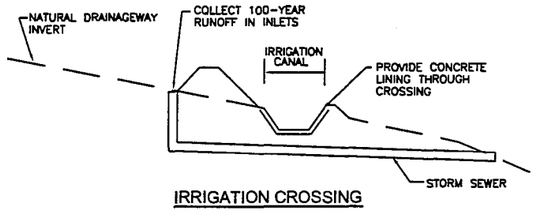
GRASSLINED BANK DETAIL



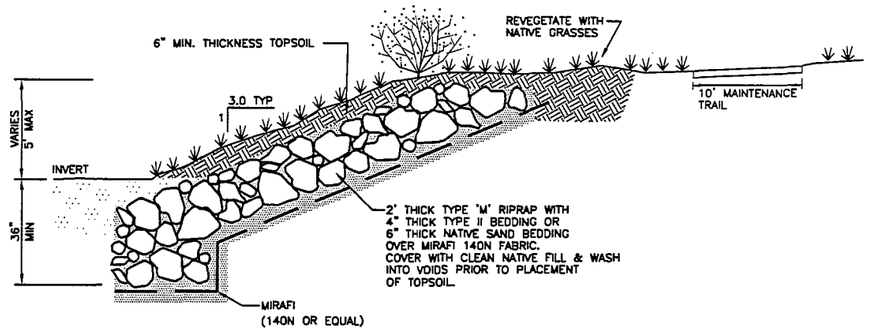
IRRIGATION CANAL CROSSING
AT DETENTION BASIN
(NTS)



IRRIGATION CROSSING WITH SIPHON
AT DETENTION BASIN
(NTS)



IRRIGATION CROSSING
AT SEWER CROSSING
(NTS)



RIPRAP BANK LINING DETAIL
NTS

RIPRAP GRADATIONS

TYPE H RIPRAP

INTERMEDIATE ROCK DIMENSION IN INCHES	% SMALLER THAN GIVEN SIZE BY WEIGHT	D_{50} INCHES
30	100	18
24	50–70	
18	35–50	
6	2–10	

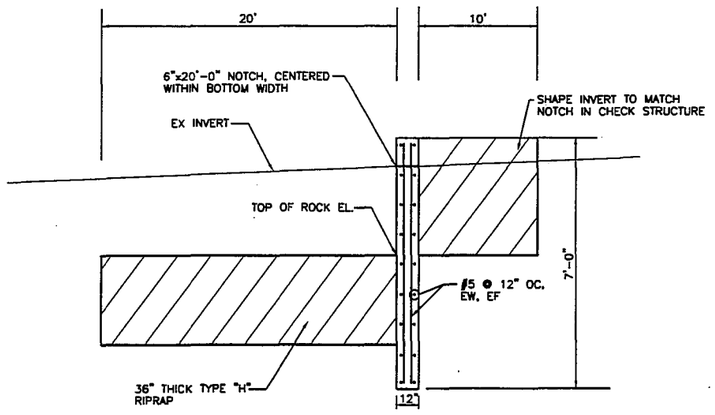
TYPE M RIPRAP

INTERMEDIATE ROCK DIMENSION IN INCHES	% SMALLER THAN GIVEN SIZE BY WEIGHT	D_{50} INCHES
21	100	12
18	50–70	
12	35–50	
4	2–10	

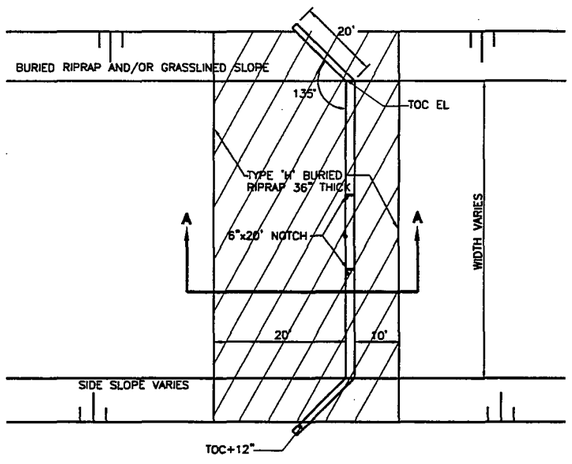
SEED MIX

AREAS DISTURBED BY THE EARTHWORK SHALL BE PERMANENTLY REVEGETATED WITH NATIVE GRASSES. NATIVE SEED MIX FOR THIS PROJECT SHALL BE AS FOLLOWS:

NATIVE SEED MIX		pls/acre
BLUE GRAMA	*Chondrosum hirsutum*	2.0
SIDEOATS GRAMA	*Bouteloua curtipendula*	3.0
SLENDER WHEATGRASS	*Agropyron trachycaulm trachycaulm*	2.0
WESTERN WHEATGRASS	*Agropyron smithii*	4.0
		11.0 lbs



SECTION A–A



TYPICAL CHECK STRUCTURE PLAN
NO SCALE

Kiowa Engineering Corporation
1604 South 21st Street
Colorado Springs, Colorado
8004
(719) 630-7342

West Fork Jimmy Camp Creek
Drainage Basin Planning Study
TYPICAL DRAINAGEWAY DETAILS
EL PASO COUNTY, COLORADO

Project No.:	9893
Date:	7/00
Design:	RNW
Drawn:	CAD
Check:	RNW
Revisions:	

SHEET 7

TABLE 2: SUMMARY OF SUB- BASIN DISCHARGES

WEST FORK JIMMY CAMP CREEK DRAINAGE BASIN PLANNING STUDY

SUB-BASIN NUMBER	EX/FUT DRAINAGE AREA (sm)	EX/FUT DRAINAGE AREA (ac)	XISITING CONDITION (cfs) 5 YR	XISITING CONDITION (cfs) 100 YR	FUTURE CONDITION (cfs) 5 YR	FUTURE CONDITION (cfs) 100YR
2010	0.125	80.0	40	142	40	142
2020	0.062	39.7	9	47	19	68
2030	0.021	13.4	5	22	6	24
2040	0.026	16.6	5	26	7	29
2045	0.061	39.0	48	124	48	124
2050	0.020	12.8	4	17	4	19
2060	0.024	15.4	5	24	8	30
2070	0.068	43.5	8	44	17	65
2080	0.057	36.5	12	58	15	64
2090	0.019	12.2	3	14	5	19
2100	0.095	60.8	13	64	24	89
2110	0.034	21.8	6	29	8	33
2120	0.047	30.1	9	45	9	45
2130	0.010	6.4	2	11	2	11
2140	0.007	4.5	2	4	2	9
2150	0.015	9.6	6	20	6	21
2160	0.012	7.7	8	18	17	35
3000	0.420	268.8	140	474	190	568
3005	0.240	153.6	107	347	144	407
3010	0.220	140.8	81	288	138	383
3012	0.210	134.4	54	199	94	272
3015	0.110	70.4	55	181	75	212
3020	0.190	121.6	69	231	204	428
3025	0.260	166.4	82	324	347	712
3030	0.260	166.4	65	262	116	361
3035	0.160	102.4	63	234	106	306
3040	0.115	73.6	23	110	31	129
3050	0.049/074	31.4/47.4	18	61	56	136
3060	0.119	76.2	48	163	63	189
3070	0.077	49.3	23	78	27	87
3080	0.050	32.0	16	58	23	68
3090	0.082/.05	52.5/32.0	27	93	21	67
3100	0.095	60.8	35	123	61	166
3110	0.018	11.5	5	17	14	31
4010	0.190	121.6	38	153	108	279
4020	0.135	86.4	26	90	39	114
4030	0.018	11.5	7	25	20	44
5010	0.156	99.8	35	133	101	246
5020	0.200	128.0	52	200	1514	362

TABLE 3: SUMMARY OF DESIGN POINT DISCHARGES

WEST FORK JIMMY CAMP CREEK DRAINAGE BASIN PLANNING STUDY

DESIGN POINT NUMBER	EX/FUT DRAINAGE AREA (sm)	EX/FUT DRAINAGE AREA (acres)	EXISITING CONDITION 5 YR cfs	EXISITING CONDITION 100 YR cfs	FUTURE CONDITION 5 YR cfs	FUTURE CONDITION 100YR cfs
2020	0.190	121.6	47	189	57	210
2040	0.300	192.0	97	335	109	362
2060	0.340	217.6	105	372	120	406
2080	0.130	83.2	17	88	28	113
2090	0.480	307.2	123	473	152	535
2100	0.610	390.4	140	558	181	651
2120	0.660	422.4	148	600	189	692
2130	0.670	428.8	145	594	186	687
2160	0.700	448.0	151	624	196	723
3000	0.660	422.4	147	233	317	935
3020	1.650	1056.0	528	1857	1059	2737
3030	2.070	1324.8	601	2216	1209	3267
3040	2.180	1395.2	618	2316	1239	3364
3050	2.26/2.23	1446/1427	627	2351	1275	3444
3070	0.200	128.0	67	235	86	270
3080	.25/.05	160/32	82	290	23	72
3090	.33/.11	211/70	106	373	44	138
3091	2.560	1638.4	732	2722	1380	3843
3100	2.660	1702.4	757	2828	1428	3990
3110	2.670	1708.8	761	2845	1442	4022
4020	0.320	204.8	63	238	145	383
5010	3.730	2387.2	943	3550	1722	4904

WFCC FLOWS @ SITE ENTRANCE

WFCC FLOWS @ SITE EXIT

Amended Master Development Drainage Plan
The Glen at Widefield

El Paso County, Colorado

Prepared for:
New Generation Homes
3 Widefield Boulevard
Colorado Springs, Colorado 80911

Prepared by:
Kiowa Engineering Corporation
1604 South 21st Street
Colorado Springs, Colorado 80904-4208

Kiowa Project No. 06026

June 21, 2007

```
1****************************************
 *                                      *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
 *               JUN   1998             *
 *            VERSION 4.1               *
 *                                      *
 *  RUN DATE   04MAY07  TIME  17:33:30  *
 *                                      *
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*                                      *
*    U.S. ARMY CORPS OF ENGINEERS      *
*    HYDROLOGIC ENGINEERING CENTER     *
*          609 SECOND STREET           *
*       DAVIS, CALIFORNIA 95616        *
*          (916) 756-1104              *
*                                      *
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XXXXXXX  XXXX     X        XXXXX   X
X     X  X        X                X
X     X  X        X     X          X
X     X  XXXXXXX   XXXXX           XXX
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THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

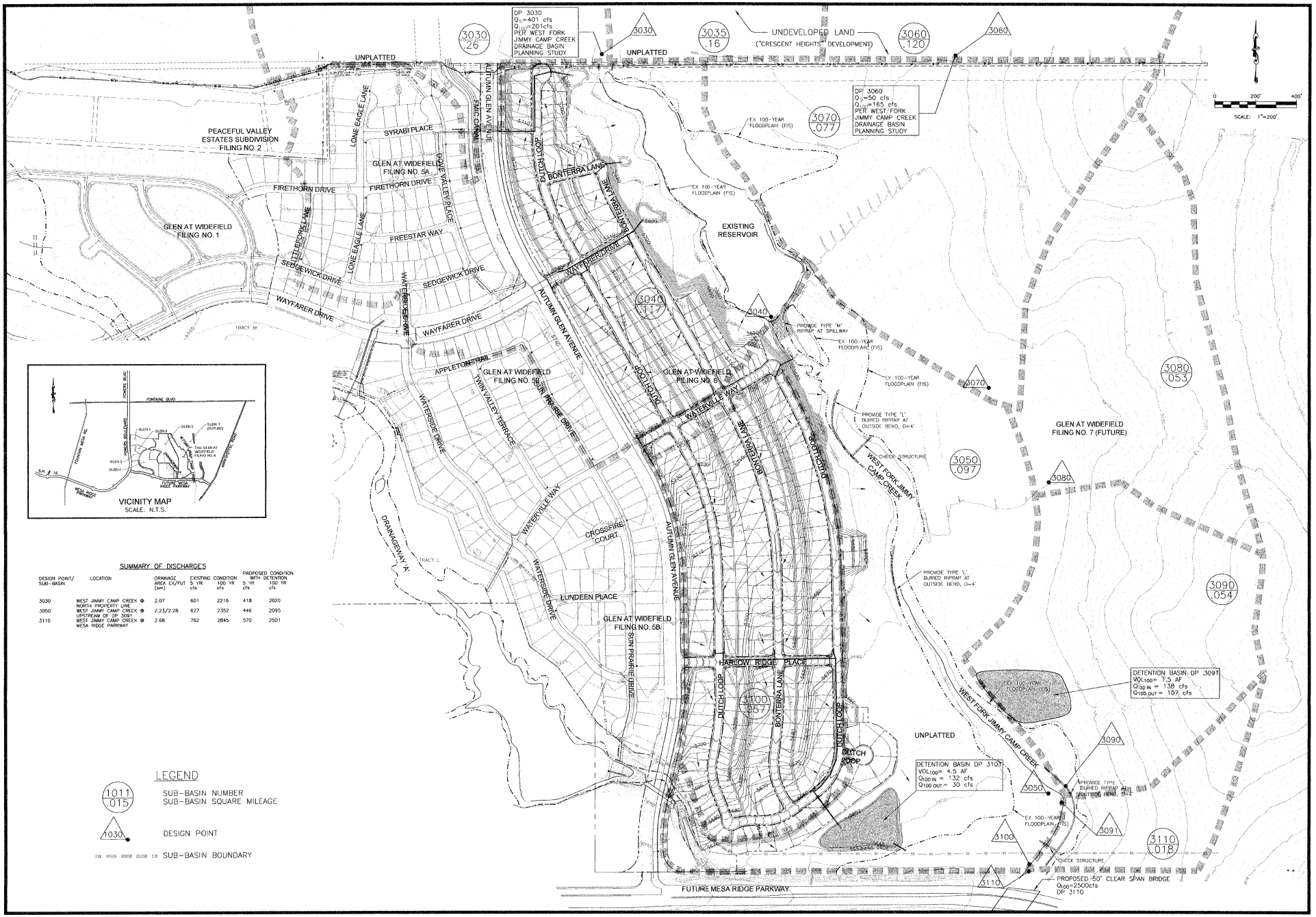
THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM


```
LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

   1          ID   THE GLEN AT WIDEFIELD FILING NO. 6
   2          ID   KIOWA ENGINEERING  -  PROJECT NO. 06026
   3          ID   2, 5, 10 & 100 YEAR STORMS FILENAME: GLEN6DET.DAT DEV COND WITH DETENTION
   4          ID   24HR STORM DURATION
              *DIAGRAM
   5          IT       5       0       0     250
   6          IO       5
   7          JR    PREC     .47     .56     .70       1

   8          KK   E1010
   9          BA     .05
  10          IN      15
  11          PB     4.4
  12          PC     0.0   .0005   .0015   .0030   .0045   .0060   .0080   .0100   .0120   .0143
```

2 COMBINED AT								
+	DP3000	.66	1	FLOW	215.	317.	493.	935.
				TIME	6.25	6.25	6.25	6.17
ROUTED TO								
+	R3015	.66	1	FLOW	210.	313.	493.	925.
				TIME	6.33	6.25	6.25	6.25
HYDROGRAPH AT								
+	E3015	.11	1	FLOW	51.	75.	115.	212.
				TIME	6.08	6.08	6.08	6.08
2 COMBINED AT								
+	DP3020	.77	1	FLOW	245.	365.	570.	1077.
				TIME	6.25	6.25	6.25	6.17
HYDROGRAPH AT								
+	E3010	.22	1	FLOW	96.	138.	211.	383.
				TIME	6.17	6.17	6.17	6.17
ROUTED TO								
+	R3012	.22	1	FLOW	93.	134.	204.	378.
				TIME	6.25	6.25	6.17	6.17
HYDROGRAPH AT								
+	E3012	.21	1	FLOW	64.	94.	147.	272.
				TIME	6.33	6.33	6.33	6.33
HYDROGRAPH AT								
+	E3020	.19	1	FLOW	159.	204.	275.	428.
				TIME	6.17	6.17	6.17	6.17
ROUTED TO								
+	R3025	.19	1	FLOW	158.	201.	270.	418.
				TIME	6.25	6.25	6.25	6.25
HYDROGRAPH AT								
+	E3025	.26	1	FLOW	273.	347.	463.	712.
				TIME	6.08	6.08	6.08	6.08
5 COMBINED AT								
+	DP3020	1.65	1	FLOW	761.	1059.	1562.	2737.
				TIME	6.17	6.17	6.17	6.17
ROUTED TO								
+	DB3021	1.65	1	FLOW	255.	348.	554.	1808.
				TIME	6.75	6.75	6.67	6.42
			** PEAK STAGES IN FEET **					
			1	STAGE	102.84	103.58	105.54	108.68
				TIME	6.75	6.75	6.67	6.42



SUMMARY OF DISCHARGES

DESIGN POINT/ SUB-BASIN	LOCATION	DRAINAGE AREA EX/FUT (sm)	EXISTING CONDITION 5 YR cfs	EXISTING CONDITION 100 YR cfs	PROPOSED CONDITION WITH DETENTION 5 YR cfs	PROPOSED CONDITION WITH DETENTION 100 YR cfs
3030	WEST JIMMY CAMP CREEK @ NORTH PROPERTY LINE	2.07	601	2216	418	2020
3050	WEST JIMMY CAMP CREEK @ UPSTREAM OF DP 3091	2.23/2.28	627	2352	446	2095
3110	WEST JIMMY CAMP CREEK @ MESA RIDGE PARKWAY	2.68	762	2845	570	2501

LEGEND

1011 .015 — SUB-BASIN NUMBER / SUB-BASIN SQUARE MILEAGE

1030 — DESIGN POINT

SUB-BASIN BOUNDARY

Kiowa Engineering Corporation
1604 South 21st Street
Colorado Springs, Colorado 80904
(719) 630-7342

THE GLEN AT WIDEFIELD
AMENDED MASTER DEVELOPMENT DRAINAGE PLAN
WEST FORK JIMMY CAMP CREEK DEVELOPED CONDITION
EL PASO COUNTY, COLORADO

Project No.:	06026
Date:	June 21, 2007
Design:	JGD
Drawn:	JGD
Check:	AWMc
Revisions:	

SHEET

FIG. 3

NOTES TO USERS

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

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

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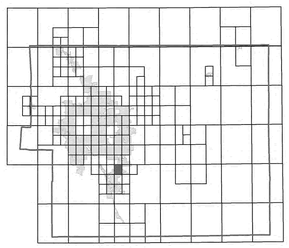
El Paso County Vertical Datum Offset Table

Flooding Source	Vertical Datum Offset (ft)

REFER TO SECTION 3.3 OF THE EL PASO COUNTY FLOOD INSURANCE STUDY FOR STREAM BY STREAM VERTICAL DATUM CONVERSION INFORMATION

Panel Location Map



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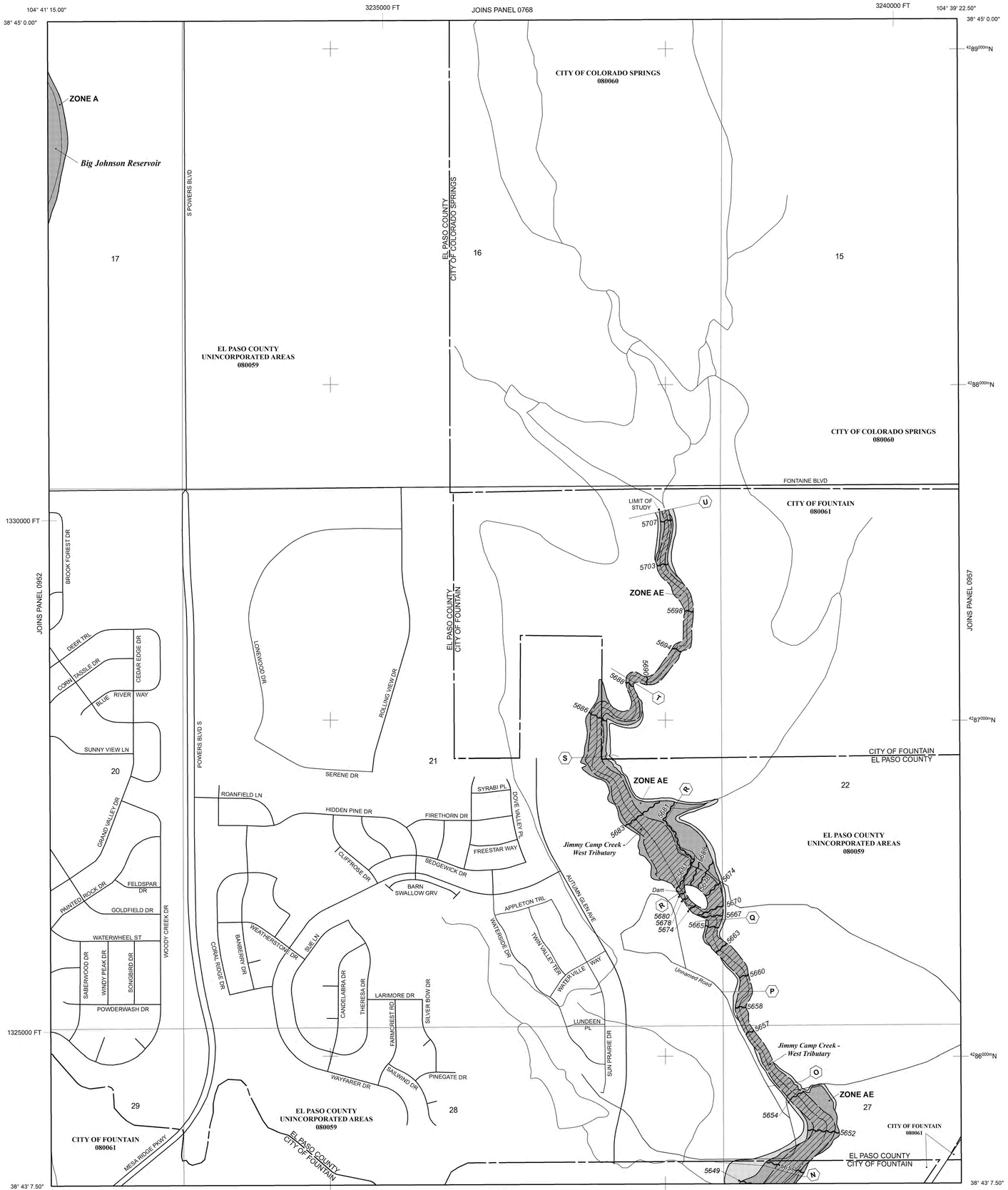

NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 15 SOUTH, RANGE 65 WEST.

LEGEND

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

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

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

FLOODWAY AREAS IN ZONE AE

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

OTHER FLOOD AREAS

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

OTHER AREAS

ZONE X Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

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

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

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A — A — Cross section line
23 — 23 — Transect line
97° 07' 30.00" / 32° 22' 30.00" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
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M1.5 — River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

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

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

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MAP SCALE 1" = 500'

250 0 500 1000 FEET
150 0 150 300 METERS

NFIP

PANEL 0956G

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 956 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
COLORADO SPRINGS, CITY OF	080060	0956	G
EL PASO COUNTY	080059	0956	G
FOUNTAIN, CITY OF	080061	0956	G

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

MAP NUMBER
08041C0956G

MAP REVISED
DECEMBER 7, 2018

Federal Emergency Management Agency

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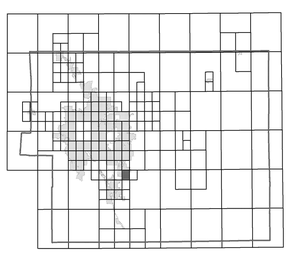
Panel Location Map



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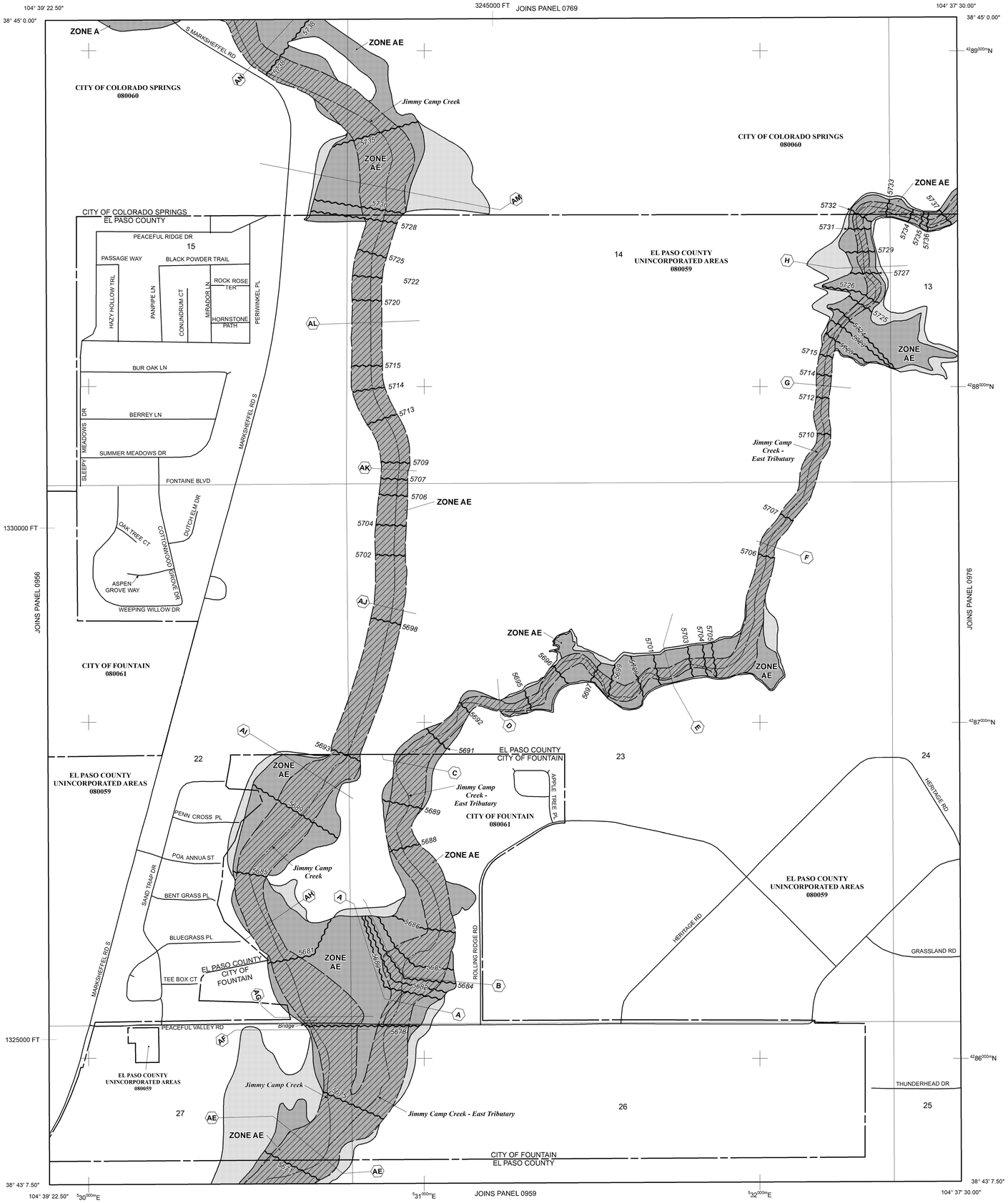

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OTHER FLOOD AREAS

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MARCH 17, 1997

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
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NFIP

PANEL 0957G

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 957 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
COLORADO SPRINGS, CITY OF	080090	0957	G
EL PASO COUNTY	080059	0957	G
FOUNTAIN, CITY OF	080061	0957	G

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 this correction for details.

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MAP NUMBER 08041C0957G

MAP REVISED DECEMBER 7, 2018

Federal Emergency Management Agency

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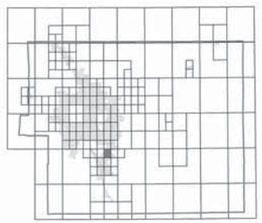

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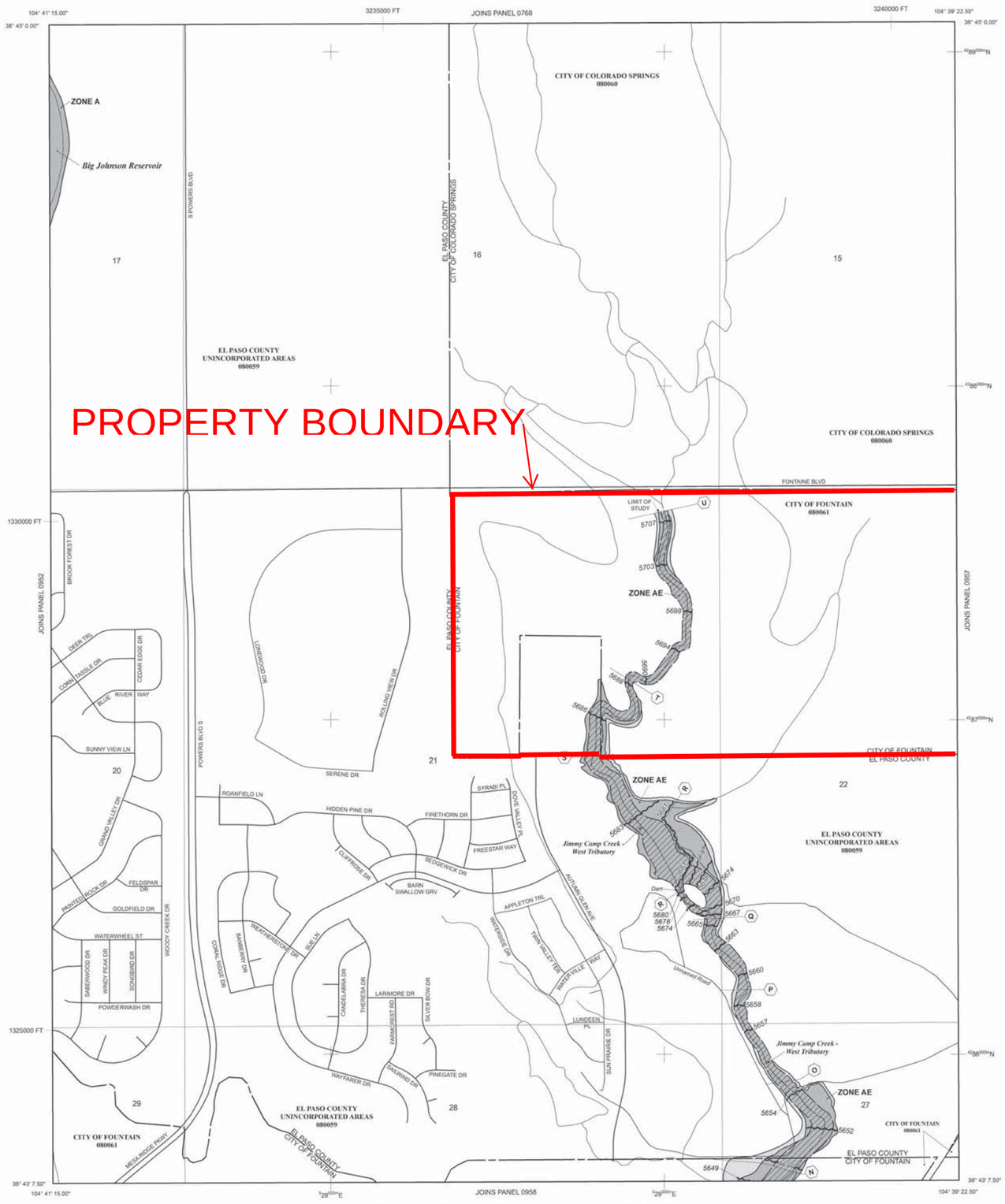

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OTHER AREAS

- **ZONE X** Areas determined to be outside the 0.2% annual chance floodplain.
- **ZONE D** Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

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

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

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

- A — A — Cross section line
- 23 — 23 — Transect line
- 97° 07' 30.00" / 32° 22' 30.00" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
- 4275000mN — 1000-meter Universal Transverse Mercator grid ticks, zone 13
- 6000000 FT — 5000-foot grid ticks: Colorado State Plane coordinate system, central zone (FIPSZONE 0502), Lambert Conformal Conic Projection
- DX5510 — Bench mark (see explanation in Notes to Users section of this FIRM panel)
- M1.5 — River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

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

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

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

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

MAP SCALE 1" = 500'

250 0 500 1000 FEET
150 0 150 300 METERS

NFIP

PANEL 0956G

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 956 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
COLORADO SPRINGS, CITY OF	080060	0956	G
EL PASO COUNTY	080059	0956	G
FOUNTAIN, CITY OF	080061	0956	G

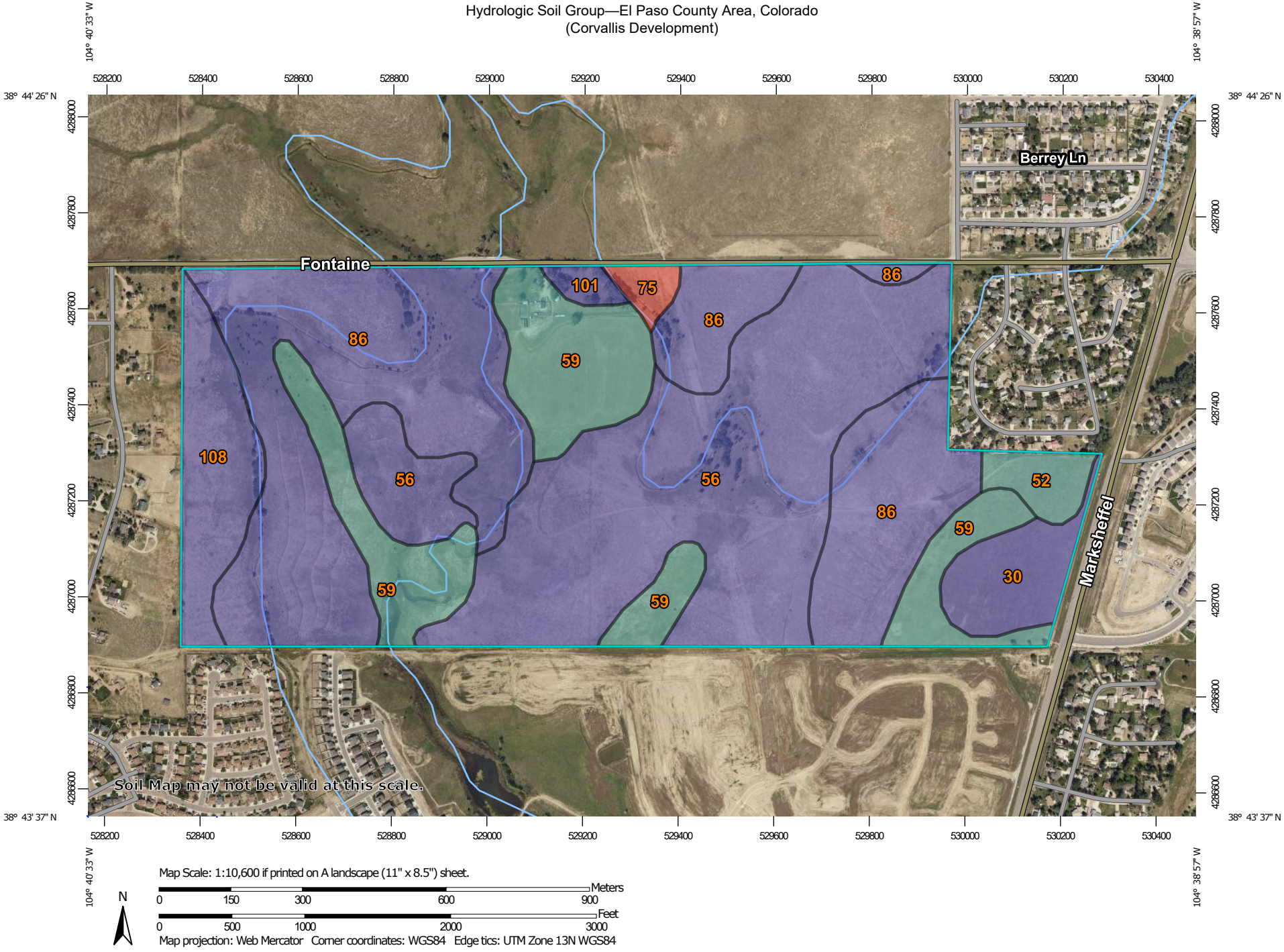
Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
08041C0956G

MAP REVISED
DECEMBER 7, 2018

Federal Emergency Management Agency

Hydrologic Soil Group—El Paso County Area, Colorado
(Corvallis Development)



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 17, Sep 13, 2019

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

Date(s) aerial images were photographed: Aug 14, 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
30	Fort Collins loam, 0 to 3 percent slopes	B	13.3	3.9%
52	Manzanst clay loam, 0 to 3 percent slopes	C	6.3	1.8%
56	Nelson-Tassel fine sandy loams, 3 to 18 percent slopes	B	118.2	34.5%
59	Nunn clay loam, 0 to 3 percent slopes	C	55.5	16.2%
75	Razor-Midway complex	D	3.1	0.9%
86	Stoneham sandy loam, 3 to 8 percent slopes	B	122.1	35.6%
101	Ustic Torrifluvents, loamy	B	2.6	0.8%
108	Wiley silt loam, 3 to 9 percent slopes	B	21.4	6.3%
Totals for Area of Interest			**342.5**	**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

Figure 1-Existing 34" HDPE FMIC Pipe at Weeping Willow and Fontaine (Northeast of Corvallis)

Figure 2-Existing 56" x 38" CMAP FMIC Culvert across Fontaine

Figure 3-Existing 10' x 28' Concrete Box Culvert across Fontaine (Jimmy Camp Creek-West Fork)

Figure 4-Existing 69" x 46" CMAP FMIC Culvert across Fontaine

Figure 5-Existing 29" x 19" CMAP Fontaine Road Ditch Across Rolling View Drive (Appears to be grouted in insert) (NW of development)

Figure 6-Existing 60" RCP FMIC Culvert in Glens at Widefield Filing No. 6 (South of Corvallis)

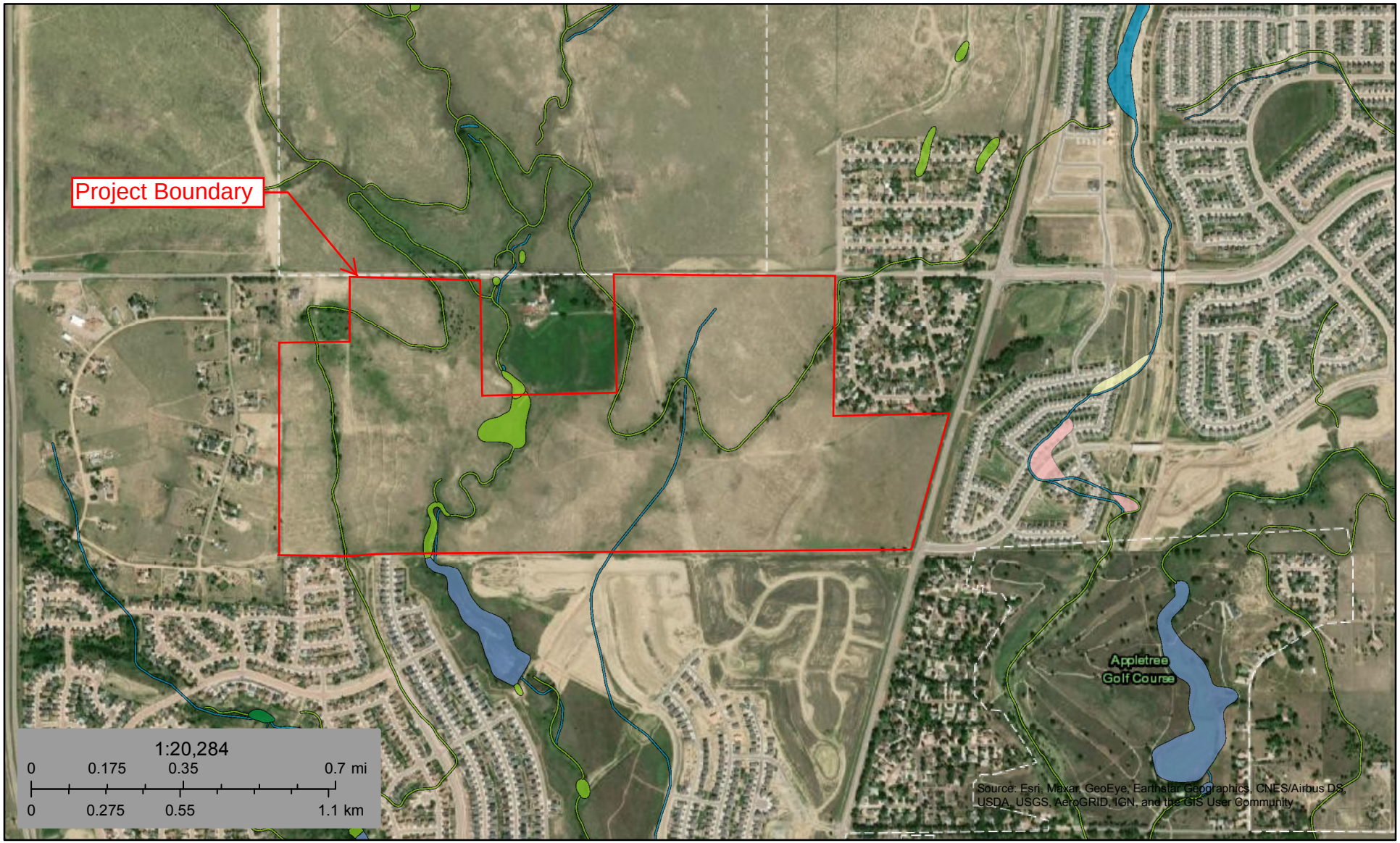
Figure 7-Existing 18" CMP and Embankment (Jimmy Camp Creek-West Fork) Located south of proposed Corvallis Development


Figure 8-Existing 18" CMP and Embankment (Jimmy Camp Creek-West Fork) Located south of proposed Corvallis Development

U.S. Fish and Wildlife Service

National Wetlands Inventory

Corvallis



September 10, 2020

Wetlands

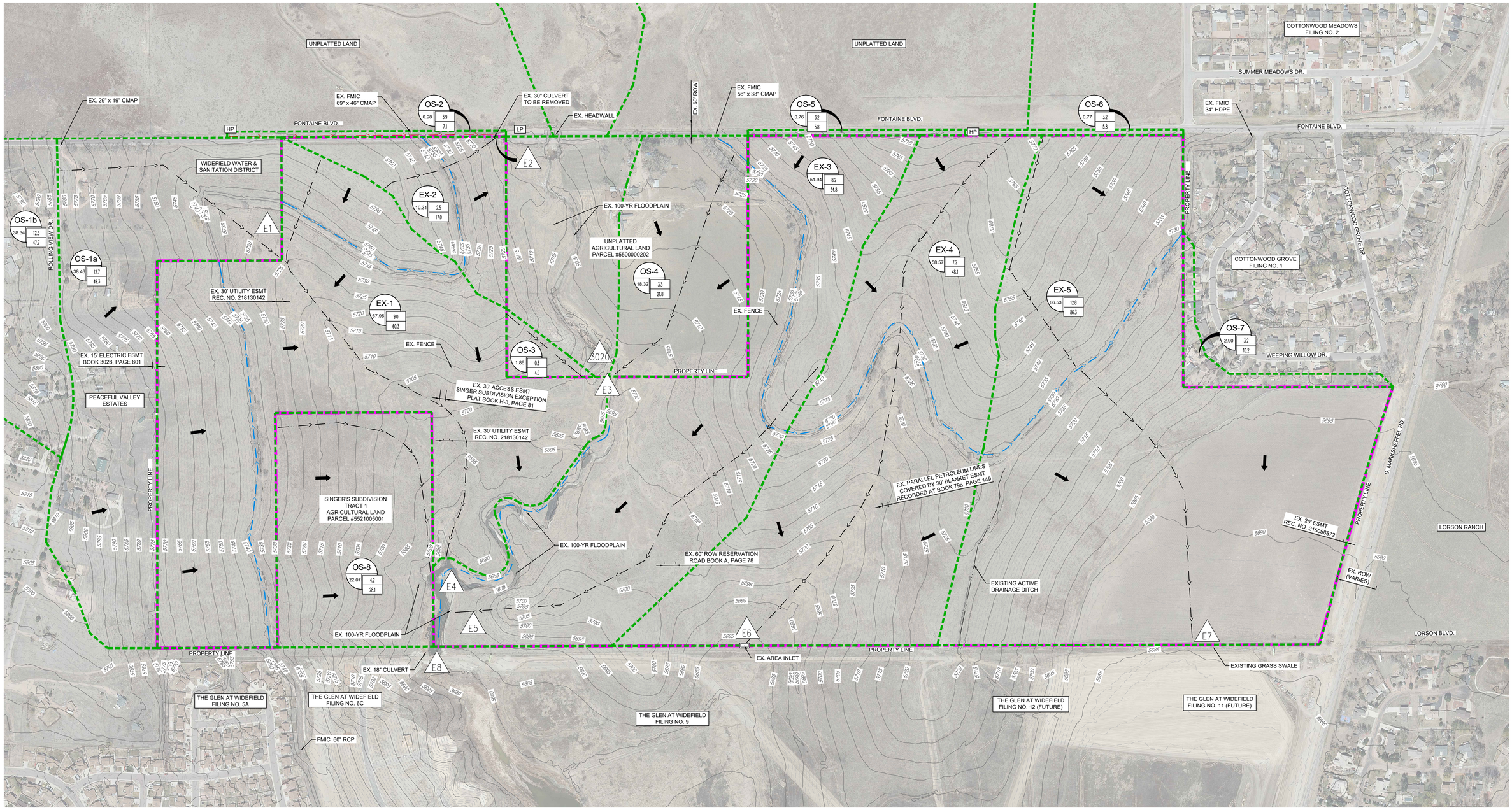
- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Other
- Riverine

This map is for general reference only. The US Fish and Wildlife Service is not responsible for the accuracy or currentness of the base data shown on this map. All wetlands related data should be used in accordance with the layer metadata found on the Wetlands Mapper web site.

APPENDIX D

MAPS

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



Corvallis
Existing Conditions
Basin Summary Table

Area ID	Area (Acres)	Q5 (cfs)	Q100 (cfs)
OS-1a	38.5	12.7	49.3
OS-1b	38.3	12.3	47.7
OS-2	1.0	3.9	7.1
OS-3	1.9	0.6	4.0
OS-4	18.3	3.3	21.8
OS-5	0.8	3.2	5.8
OS-6	0.8	3.2	5.8
OS-7	2.9	2.5	9.4
OS-8	22.1	4.2	28.1
EX-1	67.9	9.0	60.3
EX-2	10.3	2.5	17.0
EX-3	51.9	8.2	54.8
EX-4	58.6	7.2	48.1
EX-5	86.5	12.8	86.3

Corvallis
Existing Conditions
Design Point Summary Table

Area ID	Area (Acres)	Q5 (cfs)	Q100 (cfs)
E1: OS-1	76.8	25.3	98.5
E2: OS-2, EX-2	11.3	5.4	22.5
E3: E2, OS-3, OS-4	31.5	6.5	34.4
E4: E1, E3, EX-1, OS-8	198.3	46.3	222.3
E5: OS-5, EX-3	52.7	10.2	57.5
E6: EX-4	58.6	7.2	48.1
E7: EX-5, OS-6, OS-7	90.2	16.5	93.1
E8: E4, E5, +DPBS3020	251.0	403.5	2040.7

N

GRAPHIC SCALE
200 0 100 200 400
(IN FEET)
1 inch = 200 ft.

LEGEND

- EXISTING BASIN BOUNDARY
- EXISTING CONTOUR
- DRAINAGE CHANNEL
- PROPOSED PROPERTY LINE
- EXISTING FLOW DIRECTION
- EXISTING FLOW PATH
- E1 — DESIGN POINT
- EX-2 — SUB BASIN DESIGNATION
- ### / XX.XX / XX.XX — 5-YEAR STORM EVENT PEAK FLOW (CFS) / 100-YEAR STORM EVENT PEAK FLOW (CFS) / SUB BASIN AREA (AC.)

PREPARED BY:
Matrix
2435 Research Pkwy, Suite300
Colorado Springs, CO 80920
Phone 719.575.0100

CORVALLIS

MASTER DRAINAGE DEVELOPMENT PLAN
FOUNTAIN, CO

EXISTING CONDITIONS

DESIGNED BY:	NMS	SCALE	DATE ISSUED:	MARCH 2021	DRAWING No.
DRAWN BY:	JTS	HORIZ. 1" = 200'			
CHECKED BY:	NMS	VERT. N/A	SHEET	01 OF 04	DR01

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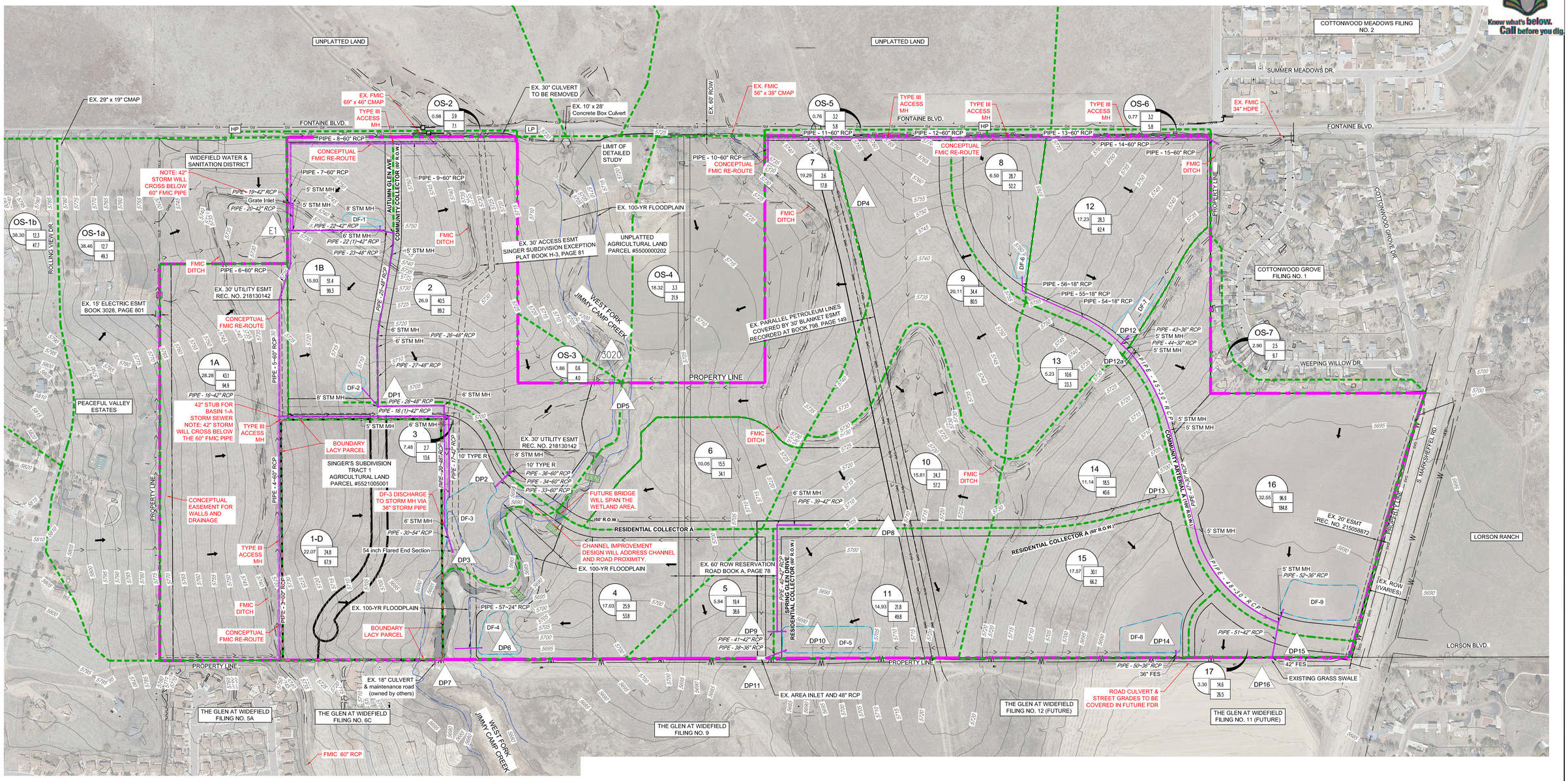

Corvallis
Proposed Conditions
Basin Summary Table

Area ID	Area (Acres)	Q5 (cfs)	Q100 (cfs)
OS-1a	38.46	12.7	49.3
OS-2	0.98	3.9	7.1
OS-3	1.86	0.5	3.5
OS-4	18.32	2.5	16.6
OS-5	0.76	3.2	5.8
OS-6	0.77	3.2	5.8
OS-7	2.90	2.5	9.4
1A	27.68	42.2	92.9
1B	15.93	51.4	99.3
1D (Formerly OS-8)	22.07	24.8	67.9
2	26.90	40.5	89.2
3	16.12	5.3	28.4
4	17.03	25.9	53.8
5	5.94	19.4	38.6
6	10.05	15.5	34.1
7	19.29	2.6	17.8
8	6.50	28.7	52.2
9	20.11	34.4	80.5
10	15.81	24.3	57.2
11	14.93	21.8	49.8
12	17.23	28.3	62.4
13	5.23	10.6	23.3
14	11.14	18.5	40.6
15	17.57	30.1	66.2
16	32.55	96.9	184.8
17	3.30	14.6	26.5

Corvallis
Proposed Conditions
Design Point Summary Table

Design Point	Description	Area (Acres)	Q5 (cfs)	Q100 (cfs)
E1	OS-1a and OS-1b	76.8	21.7	84.4
DP1	E1+DF-1 Release+DF-2 Release	104.4	25.3	110.3
DP2	OS-2, 1A, 1D, 2, 3	93.8	127.1	311.7
DP3	DP1+DP2 Treated (DF-3 Release)	198.2	33.6	185.2
DP4	7	19.3	2.6	17.8
DP5	OS-3, OS4, DPBS 3020, DP4	46.2	352.6	1798.9
DP6	4, 6	27.1	22.3	47.7
DP7	DP3+DP5+DP6 Treated (DF-4 Release)	271.5	391.0	2006.1
DP8	9, 10, OS-5	36.7	45.8	106.9
DP9	DP8, 5	42.6	33.4	74.7
DP10	DP9, 11	57.5	54.9	123.8
DP11	DP10 Treated (DF-5 Release)	57.5	6.6	48.1
DP12	OS-6, 12	18.0	24.5	53.5
DP13	13, 14	16.4	20.4	44.9
DP14	DP13, 15, 17	37.2	35.3	76.2
DP15	DP12 Treated (DF-7Release), 16 Treated (DF-9 Release), & DF6 Release	60.0	7.8	65.8
DP16	DP14 Treated (DF-8 Release)+DP15	97.2	12.8	110.1

LEGEND

N

GRAPHIC SCALE
200 0 100 200 400
(IN FEET)
1 inch = 200 ft.

- PROPOSED BASIN BOUNDARY
- EXISTING CONTOUR
- DRAINAGE CHANNEL
- PROPOSED PROPERTY LINE
- PROPOSED FLOW DIRECTION
- PROPOSED FLOW PATH
- POTENTIAL DROP STRUCTURE LOCATION
- E1 — DESIGN POINT
- EX-2 — SUB BASIN DESIGNATION
- #### / ##.## — 5-YEAR STORM EVENT PEAK FLOW (CFS)
- ##.## — 100-YEAR STORM EVENT PEAK FLOW (CFS)
- SUB BASIN AREA (AC.)

PREPARED BY:
Matrix
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Phone 719.575.0100

CORVALLIS
MASTER DRAINAGE DEVELOPMENT PLAN
FOUNTAIN, CO

PROPOSED CONDITIONS

DESIGNED BY:	NMS	SCALE		DATE ISSUED: FEBRUARY 2022	DRAWING No.
DRAWN BY:	JTS	HORIZ.	1" = 200'		
CHECKED BY:	NMS	VERT.	N/A	SHEET 02 OF 04	DR02

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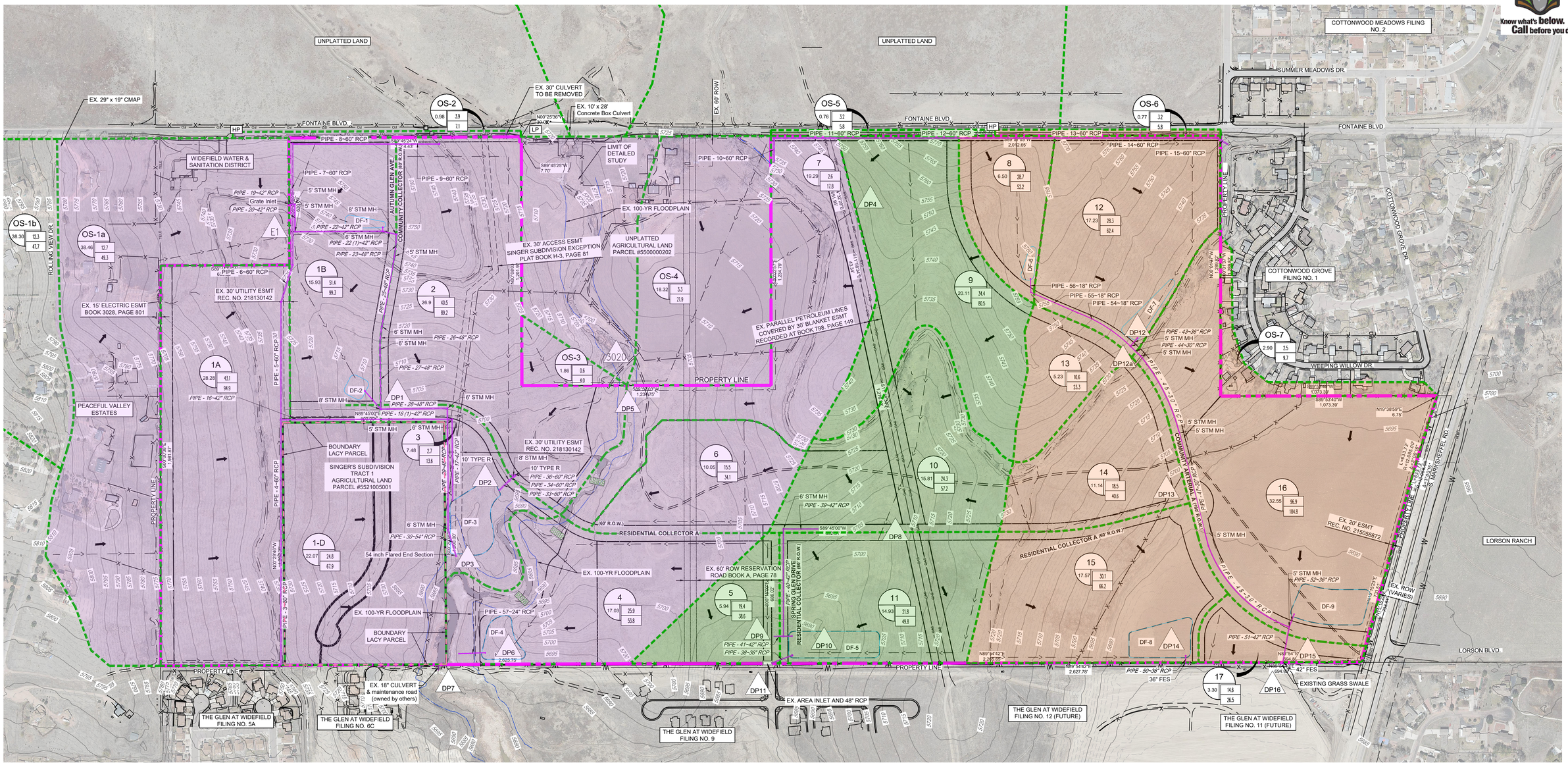

LEGEND

- PROPOSED BASIN BOUNDARY
- EXISTING CONTOUR
- DRAINAGE CHANNEL
- PROPOSED PROPERTY LINE
- PROPOSED FLOW DIRECTION
- PROPOSED FLOW PATH
- DESIGN POINT
- SUB BASIN DESIGNATION
- 5-YEAR STORM EVENT PEAK FLOW (CFS)
- 100-YEAR STORM EVENT PEAK FLOW (CFS)
- SUB BASIN AREA (AC.)

EX-2 | #### | xx.xx | xx.xx

- WEST BASIN DESIGN FLOW
- CENTRAL BASIN DESIGN FLOW
- EAST BASIN DESIGN FLOW

SEE DR-02 FOR STORM SEWER LABELS

N

GRAPHIC SCALE

200 0 100 200 400

(IN FEET)

1 inch = 200 ft.

PREPARED BY:

Matrix

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Colorado Springs, CO 80920
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CORVALLIS

MASTER DRAINAGE DEVELOPMENT PLAN
FOUNTAIN, CO

DRAINAGE BASIN EXHIBIT

DESIGNED BY:	NMS	SCALE		DATE ISSUED:	FEBRUARY 2022	DRAWING No.
DRAWN BY:	JTS	HORIZ.	1" = 200'			
CHECKED BY:	NMS	VERT.	N/A	SHEET	03 OF 04	DR03

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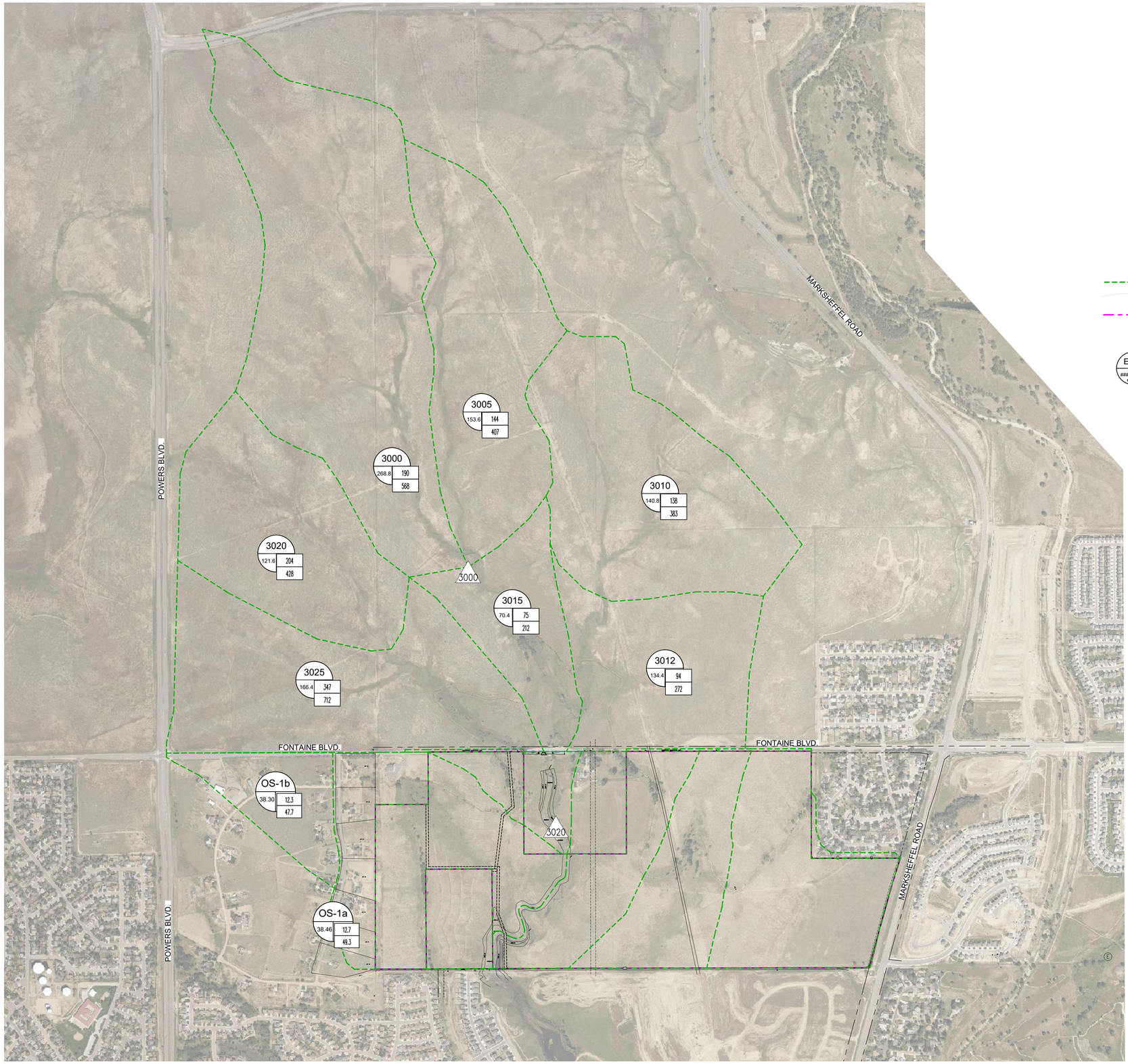

LEGEND

- EXISTING BASIN BOUNDARY
- EXISTING CONTOUR
- PROPOSED PROPERTY LINE
- E1 — DESIGN POINT
- EX-2 — SUB BASIN DESIGNATION
- #### — 5-YEAR STORM EVENT PEAK FLOW (CFS)
- xx.x — 100-YEAR STORM EVENT PEAK FLOW (CFS)
- xx.x — SUB BASIN AREA (AC.)

N

GRAPHIC SCALE

500 0 250 500 1000

(IN FEET)
1 inch = 500 ft.

THIS DRAWING IS CURRENT AS OF PLOT DATE AND MAY BE SUBJECT TO CHANGE.
January 5, 2021 8:52 AM
S:\20.1105.002 Singer Ranch\200 Drainage\201 Drainage Reports\MDDP\DWG\DROS.dwg

PREPARED BY:
Matrix
2435 Research Pkwy, Suite300
Colorado Springs, CO 80920
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CORVALLIS

MASTER DRAINAGE DEVELOPMENT PLAN
FOUNTAIN, CO

OFFSITE EXISTING CONDITIONS

DESIGNED BY:	NMS	SCALE	DATE ISSUED:	JANUARY 2021	DRAWING No.
DRAWN BY:	JTS	HORIZ. 1" = 200'	SHEET	04 OF 04	DROS
CHECKED BY:	NMS	VERT. N/A			

N

GRAPHIC SCALE
150 0 75 150 300
(IN FEET)
1 inch = 150 ft.

FONTAINE BLVD.
(PRINCIPAL ARTERIAL)
(EX. 60' R.O.W.) (PR. 107' R.O.W.)

ZONING: PIP2/CR M2/CR AO
LAND USE: AG. GRAZING LAND
BLH NO 4 LLC
111 S TEJON ST STE 222
COLORADO SPRINGS CO,
80903-2246

EL PASO COUNTY
CITY OF FOUNTAIN

S89°45'24"W 1144.43'

N00°25'36"W 30.00'

S89°45'25"W 7.70'

EX. UNDERGROUND
COMMUNICATION LINES

MATCHLINE
SEE SHEET 4 OF 4

FOI
(PRINC
(EX. 60' R
EX.
COMMU

23.5' R.O.W.
DEDICATION
0.6 acres

ZONE: VC
PARCEL "N"
5.0 acres

ZONING: NEIGHBORHOOD
COMMERCIAL (NC)
WIDEFIELD WATER &
SANITATION DISTRICT

ZONING: RA
LAND USE: COUNTY
EL PASO COUNTY
200 S CASCADE AVE, STE 150
COLORADO SPRINGS CO, 80903

EXISTING GAS LINE EASEMENT

110.00'

LOT 42

S00°18'00"E 630.00'

COLLECTOR (80' R.O.W.)

ZONE: RH
PARCEL "B"
12-24 DU/AC
7.0 acres

ZONE: RM
PARCEL "C"
1.0-11.99 DU/AC
24.3 acres

S89°45'18"W 638.89'

LOT 43

N00°08'03"W 1201.97'

EX. 60' ROW RESERVATION
ROAD BOOK A, PAGE 78

ZONING: RA
LAND USE: IRRIGATED
LAND, AC. GRAZING LAND,
WELL AND SEPTIC
RONALD P SINGER
8805 FONTAINE BLVD

S00°20'57"E 1234.79'

EX. UNDERGROUND
PETROLEUM LINES

OPEN SPACE
4.9 acres

AUTUMN GLEN AVE.

FUTURE
ACCESS, TYP.

EL PASO COUNTY
CITY OF FOUNTAIN

EX. FMIC DITCH TO BE
REMOVED AND CONVEYED
VIA UNDERGROUND PIPE

EX. 30 FEET WIDE ACCESS
EASEMENT SINGER
SUBDIVISION EXCEPTION
PLAT BOOK H-3, PAGE 81
[TO BE VACATED]

LOT 44

ZONING: A-5
VACATION AND REPLAT
OF LOTS 42 THRU 48
PEACEFUL VALLEY
ESTATES, PLAT BOOK Y2,
PAGE 26

S89°57'03"W 1234.75'

100-YR
FLOODPLAIN

EX. FMIC DITCH TO BE
REMOVED AND CONVEYED
VIA UNDERGROUND PIPE

OPEN SPACE
(FUTURE PARK SITE)
20.8 acres

EX. 15' ELECTRIC
EASEMENT BOOK
3028, PAGE 801

S00°00'38"E 1981.87'

EX. 30 FEET WIDE UTILITY EASEMENT REC. NO. 218130142 [TO REMAIN]

N89°45'00"E 800.00'

FUTURE
COLLECTOR

EX. 30 FEET WIDE UTILITY
EASEMENT REC. NO. 218130142
[TO REMAIN]

LOT 45

ZONE: RM
PARCEL "A"
1.0-11.99 DU/AC
25.5 acres

OPEN SPACE 2.8 acres

ZONED: PUD
LAND USE: AG. GRAZING LAND

SINGER SUBDIVISION
EXCEPTION
PLAT BOOK H-3, PAGE 81

FUTURE
BRIDGE

JIMMY CAMP CREEK
WEST TRIBUTARY

ZONE: RM
PARCEL "E"
1.0-11.99 DU/AC
13.6 acres

EX. OVERHEAD
ELECTRIC

LOT 46

N00°29'46"W 1200.00'

S00°29'46"E 1200.00'

EX. 60' ROW RESERVATION ROAD BOOK A, PAGE 78
[TO BE VACATED BY SEPARATE INSTRUMENT]

FUTURE
ACCESS,
TYP.

DETENTION
FACILITY

100-YR
FLOODPLAIN

COLLECTOR A (80' R.O.W.)

OPEN SPACE
10.3 acres

JIMMY CAMP CREEK
WEST TRIBUTARY

LOT 47

100-YR
FLOODPLAIN

SCHOOL SITE
PARCEL "J"
12.0 acres

SPRING GLEN DRIVE

COLLECTOR (80' R.O.W.)

EX. UNDE
PETROLI

ZONE: RH
PARCEL "F"
12-24 DU/AC
9.1 acres

EX. FMIC DITCH TO BE
REMOVED AND CONVEYED
VIA UNDERGROUND PIPE

ZONE: RM
PARCEL "D"
1.0-11.99 DU/AC
5.5 acres

DETENTION
FACILITY

FUTURE
ACCESS,
TYP.

DETENTION
FACILITY

EX. PERM WATER
EASEMENT REC.
208076275 [TO REMAIN]

LOT 48

N89°45'00"E 2625.75'

CITY OF FOUNTAIN
EL PASO COUNTY

CITY OF FOUNTAIN
EL PASO COUNTY

EX. WATER LINE

TRACT A
TRACT C
TRACT B
TRACT H

LOT 32 LOT 31 LOT 24 LOT 23 LOT 22 LOT 25 LOT 30 LOT 33

ZONING: PUD
THE GLEN AT WIDEFIELD
FILING NO. 5A
RECEPTION NO.
205204377

AUTUMN GLEN AVE.
(EX. 70' R.O.W.)

TRACT A
LOT 1

ZONING: PUD
THE GLEN AT
WIDEFIELD
FILING NO. 6C
RECEPTION NO.
2157135589

LOT 81

ZONING: RS-6000
GLEN INVESTMENT GROUP
NO VIII LLC

MATCHLINE
SEE SHEET 4 OF 4

LOT 7

ZONING: RR-2.5
PEACEFUL VALLEY ESTATES
SUBDIVISION FILING NO.2
PLAT BOOK H-5, PAGE 72

FILE LOCATION:

CONSULTANTS:

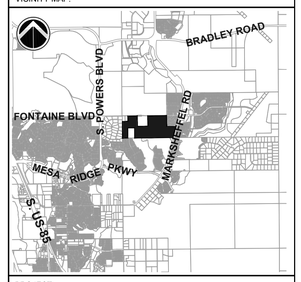
PLANNER/ LANDSCAPE ARCHITECT/ CIVIL ENGINEER:

Matrix
2435 RESEARCH PARKWAY,
SUITE 300
COLORADO SPRINGS, CO 80920
PHONE: (719) 575-0100
FAX : (719) 575-0208

OWNER/DEVELOPER:

HPHR PROPERTIES, LLC
14160 GLENEAGLE DRIVE
COLORADO SPRINGS, CO 80921

VICINITY MAP:



PROJECT:

CORVALLIS
CITY OF FOUNTAIN
OVERALL DEVELOPMENT PLAN

DATE: THIRD SUBMITTAL: 03/15/2021

REVISION HISTORY:

NO.	DATE	DESCRIPTION	BY
0	09/15/2020	INITIAL SUBMITTAL	RAF
1	01/08/2021	REVISED PER CITY COMMENTS	RAF
2	03/15/2021	REVISED PER CITY COMMENTS	RAF

DRAWING INFORMATION:

PROJECT NO:	20.1105.002
DRAWN BY:	RAF
CHECKED BY:	JAA
APPROVED BY:	JAA

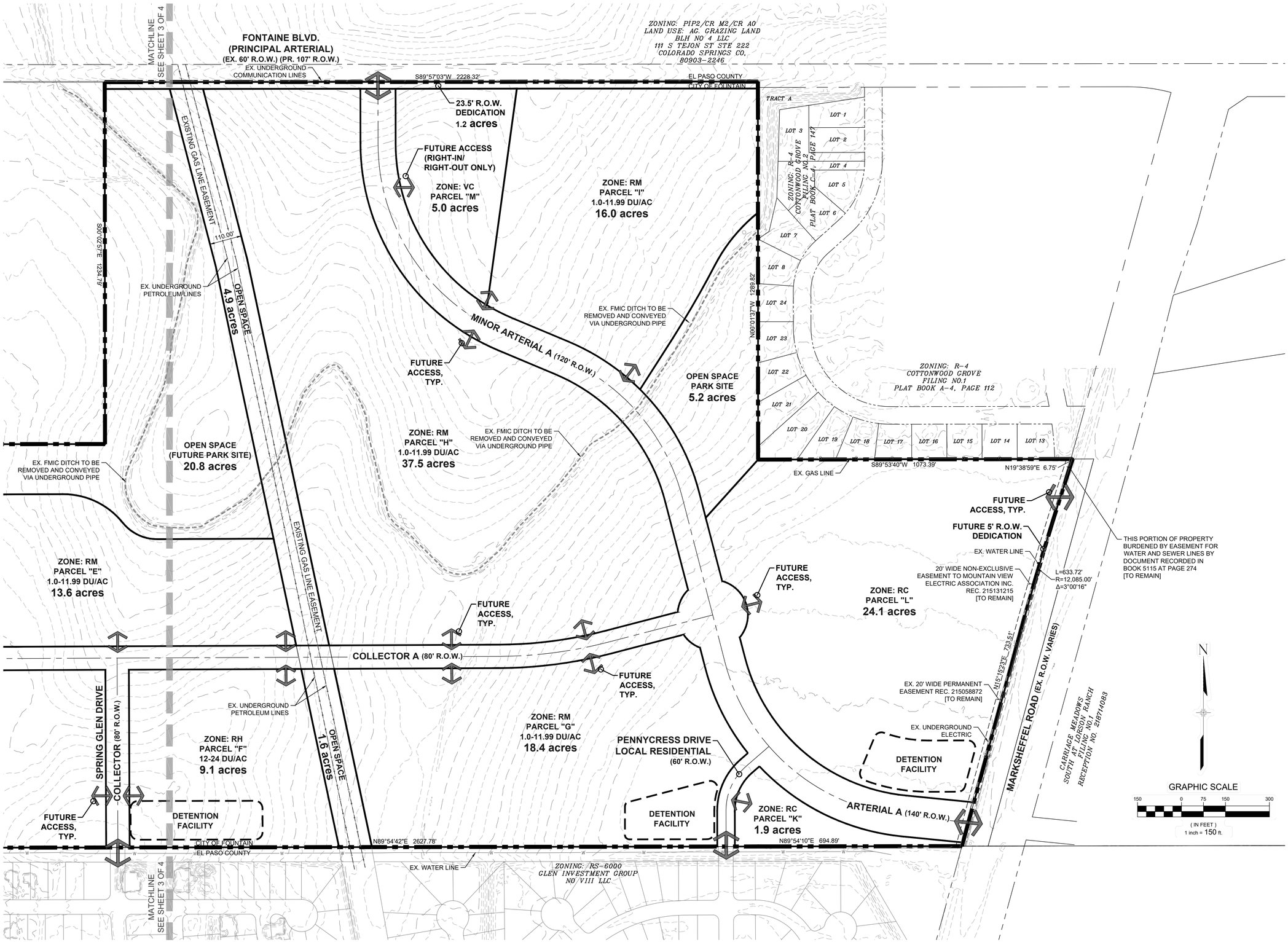
SHEET TITLE:

OVERALL DEVELOPMENT PLAN (1)

ODP03

SHEET 03 OF 04

PCD FILE NO.:



PILE LOCATION:

CONSULTANTS:

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Matrix
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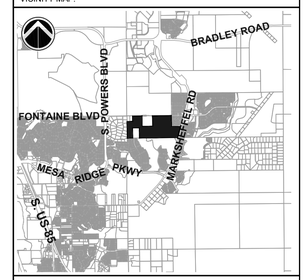
COLORADO SPRINGS, CO 80921

VICINITY MAP:



PROJECT:

CORVALLIS

CITY OF FOUNTAIN

OVERALL DEVELOPMENT PLAN

DATE: THIRD SUBMITTAL: 03/15/2021

REVISION HISTORY:

NO.	DATE	DESCRIPTION	BY
0	09/15/2020	INITIAL SUBMITTAL	RAF
1	01/08/2021	REVISED PER CITY COMMENTS	RAF
2	03/15/2021	REVISED PER CITY COMMENTS	RAF

DRAWING INFORMATION:

PROJECT NO:	20.1105.002
DRAWN BY:	RAF
CHECKED BY:	JAA
APPROVED BY:	JAA

SHEET TITLE:

OVERALL DEVELOPMENT PLAN (2)

ODP04

SHEET 04 OF 04

PCD FILE NO.:

CORVALLIS - LACY PARCEL

CITY OF FOUNTAIN

OVERALL DEVELOPMENT PLAN

DIMENSIONAL STANDARDS AND GUIDELINES:

ZONE DISTRICT: RESIDENTIAL MEDIUM (RM) 1-10 DU/AC
DIMENSIONAL STANDARDS FOR PARCEL A

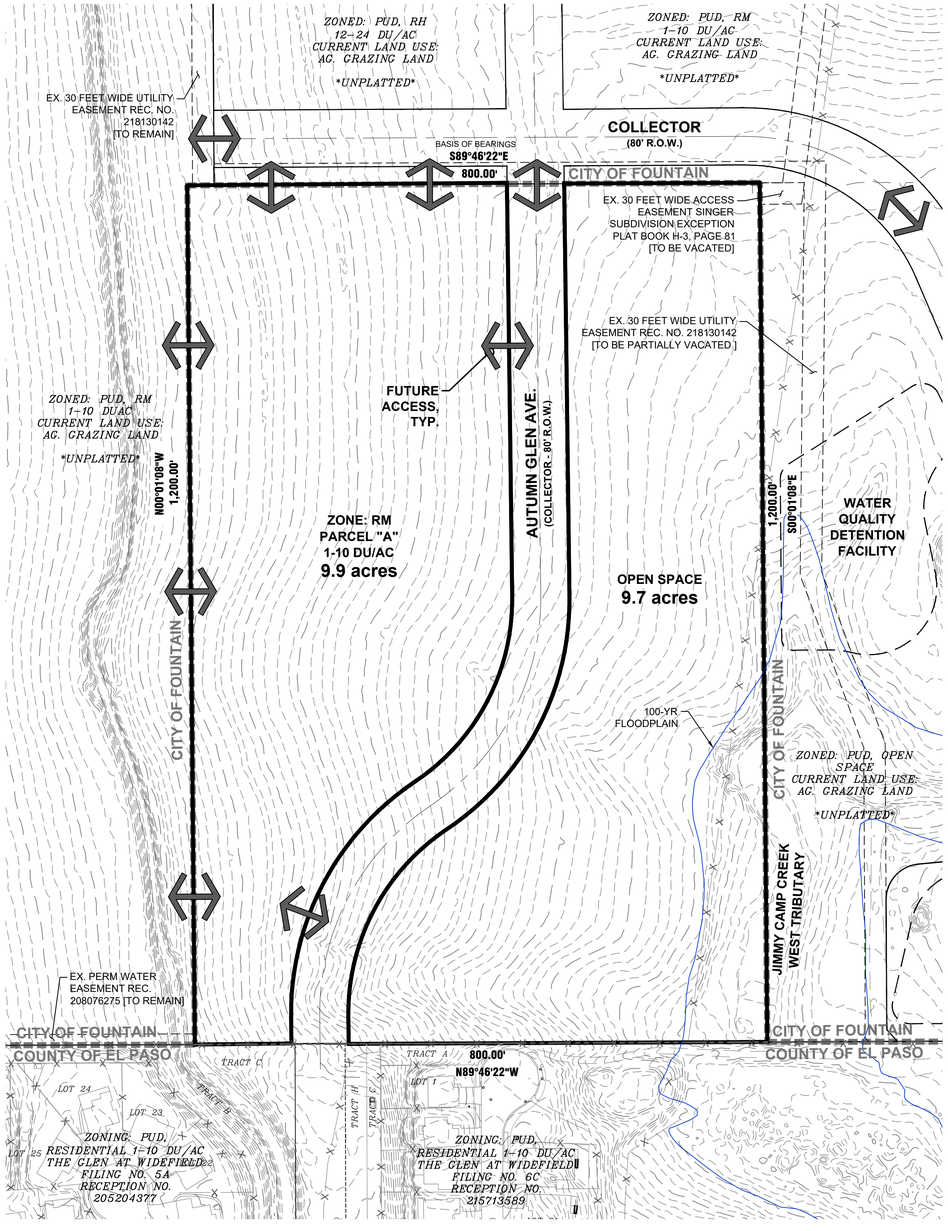
1. PERMITTED LAND USE: SINGLE FAMILY RESIDENTIAL, MAIL KIOSKS, TRAIL CORRIDORS, DEVELOPMENT SIGNAGE, ENTRY MONUMENT SIGNAGE, PEDESTRIAN WALKWAYS, FENCING, UTILITIES, METRO DISTRICT MAINTENANCE FACILITIES, STORMWATER FACILITIES, DRAINAGE IMPROVEMENTS, OPEN SPACE AND LANDSCAPE IMPROVEMENTS, PARKS AND ASSOCIATED PARK RELATED EQUIPMENT, COMMUNITY CLUBHOUSE.
2. MINIMUM LOT AREA FOR SINGLE FAMILY DETACHED:
   A. SINGLE FAMILY DWELLING: 3,800 SF
3. MAXIMUM PERCENTAGE OF STRUCTURAL COVERAGE: 50%
4. MAXIMUM STRUCTURAL HEIGHT: 40'
5. MINIMUM WIDTH OF LOT AT FRONT BUILDING SETBACK LINE: 30' OR AS OTHERWISE SHOWN
6. PROJECTIONS INTO SETBACKS ARE GOVERNED BY THE CITY OF FOUNTAIN ZONING CODE, AS AMENDED
7. MINIMUM SETBACK REQUIREMENTS:
   A. FRONT YARD: 18' TO FACE OF GARAGE FROM PROPERTY LINE
      15' TO FRONT PROJECTION OF HOUSE FROM PROPERTY LINE
   B. SIDE YARD: 5'
   C. REAR YARD: 15'
   D. CORNER YARD (NON-DRIVEWAY SIDE): 10'
      18' IF SIDE GARAGE ACCESS IS PROVIDED
   E. CHAMFERED CORNER FRONT SETBACK: 8'

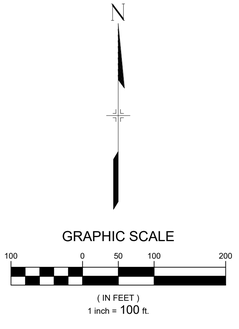
DEVELOPMENT STANDARDS AND GUIDELINES

1. TEMPORARY USES ARE SUBJECT TO THE REQUIREMENTS OF THE CITY OF FOUNTAIN ZONING CODE, AS AMENDED.
2. ACCESSORY USES ARE SUBJECT TO THE REQUIREMENTS OF THE CITY OF FOUNTAIN ZONING CODE, AS AMENDED.
3. FENCING GUIDELINES TO BE PER THE FUTURE CORVALLIS CC&R'S AND/ OR DESIGN GUIDELINES
4. A MINIMUM 4' FRONT YARD BUILDING STAGGER IS REQUIRED BETWEEN ADJACENT UNITS.

GENERAL LOT DEVELOPMENT NOTES:

1. LOCATION OF PRIVATE SIDEWALKS TO FRONT ENTRY TO BE DETERMINED BY INDIVIDUAL HOUSE INGRESS/ EGRESS CONFIGURATION.
2. OWNER/ BUILDER TO ENSURE DRIVEWAYS DO NOT CONFLICT WITH PEDESTRIAN RAMP TRANSITIONS.
3. ALL SIGHT DISTANCE TRIANGLES MUST BE WITHIN THE PUBLIC RIGHT-OF-WAY OR A SIGHT DISTANCE EASEMENT. IF THE LINE OF SIGHT CROSSES ONTO PRIVATE PROPERTY, A "SIGHT DISTANCE EASEMENT" SHALL BE DEDICATED TO PROVIDE THE REQUIRED SIGHT DISTANCE AT TIME OF FINAL PLAT. MAINTENANCE OF A SIGHT DISTANCE EASEMENT SHALL BE THE RESPONSIBILITY OF THE PROPERTY OWNER OR METROPOLITAN DISTRICT UNLESS OTHERWISE APPROVED BY THE CITY OF FOUNTAIN.





CONSULTANTS:

PLANNER/ LANDSCAPE ARCHITECT/ CIVIL ENGINEER:

Matrix

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PHONE: (719) 575-0100
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OWNER/DEVELOPER:

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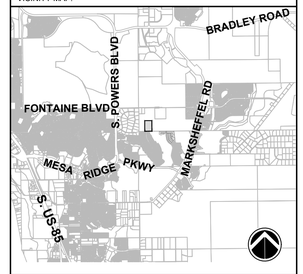
14160 GLENEAGLE DRIVE
COLORADO SPRINGS, CO 80921
(XXX) XXX-XXXX

APPROVAL:

VICINITY MAP:



PROJECT:

CORVALLIS - LACY PARCEL
OVERALL DEVELOPMENT PLAN

SOUTH SEGMENT OF CORVALLIS
10/22/2021

REVISION HISTORY:

NO.	DATE	DESCRIPTION	BY
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DRAWING INFORMATION:

PROJECT NO:	21.1105.009
DRAWN BY:	KMM
CHECKED BY:	JAA
APPROVED BY:	JAA

SHEET TITLE:

OVERALL DEVELOPMENT PLAN

ODP02

SHEET 2 OF 2

CITY FILE NO.: X

FILE LOCATION: S:\21.1105.009 LACY PARCEL-CORVALLIS ENTITLEMENT\100 DWG\104 PLAN SET\SCONCEPT PLAN ODP\1105.009-ODP.DWG