



Info Only: Comments from Service
Engineering and Stormwater Engineering
are in blue text.

Flying Horse North Filing No. 4 Final Drainage Report

September 2024

Prepared For:

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HRG Response:
Added

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Engineer’s Statement

This report and plan for the drainage design of the development, Flying Horse North, 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 *El Paso County Drainage Criteria* Manual and is in conformity with the master plan of the drainage basin. I understand that El Paso County does not and will not assume liability for drainage facilities designed by others. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparing this report.

Richie Lyon, PE Date

State of Colorado No. 53921

For and on behalf of HR Green Development, LLC

Developer’s Statement

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

Flying Horse Development, LLC

Drew Balsick Date

Vice President

Flying Horse Development, LLC

2138 Flying Horse Club Drive

Colorado Springs, CO 80921

El Paso County:

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

Joshua Palmer, P.E.

Date

County Engineer/ECM Administrator

Final Drainage Report – Flying Horse North

I. General Purpose, Location and Description

a. Purpose and Scope

The Purpose of this Final Drainage Report (FDR) is to identify specific solutions to drainage concerns for onsite and offsite tributary areas resulting from the development of the subdivision to be platted. The FDR is to describe the onsite and offsite drainage patterns, existing and proposed storm infrastructure as it relates to water quality and stormwater detention for any proposed or existing facilities, the planned storm water management for the Flying Horse North development for Filing No. 4.

The Preliminary Drainage Report for Flying Horse North Preliminary Plan and Final Drainage Report for Flying Horse North Filing No. 1 is a combined Preliminary Drainage Report (PDR) and Final Drainage Report (FDR) that was developed by Classic Consulting, latest revision June 2018. The combined PDR/FDR was approved by the County in September of 2018 and is included in Appendix E. This approved report identifies the proposed Filing No. 4 area for the PDR and Preliminary Plan portion of the report.

A more recent Master Development Drainage Plan (MDDP) was prepared by HR Green Development, LLC. and was approved by the County in September of 2022, entitled *Flying Horse North Master Development Drainage Plan* latest revision date of September 9, 2022. This MDDP also referenced the Classic Consulting report from 2018 for master drainage design of the proposed Filing No. 4 area.

The items discussed in this FDR include final plat layout, land uses, and drainage patterns for Filing No. 4. Included in this report are final hydrologic and hydraulic drainage calculations and design as required for the final design of the development of the single-family residential estate lot areas with assumed conservative drainage analysis for a future Flats area. This report references the aforementioned reports to compare and contrast findings in the final design to ensure that existing infrastructure and facilities are not negatively impacted by this development.

b. DBPS Investigations

Flying Horse North is split by the Arkansas River Basin and South Platte Basin. Within the South Platte Basin, the site is within the East Cherry Creek Drainage Basin. A Drainage Basin Planning Study (DBPS) does not currently exist for the East Cherry Creek Drainage Basin. This FDR is consistent with the 2022 MDDP which complies with standard El Paso County regulations regarding drainage within this corridor.

The Filing No. 4 area falls within the East Cherry Creek Basin which is to consist of 2.5-acre single-family residential estate lots. Proposed developed areas are provided with water quality and full spectrum detention (FSD) prior to release offsite. Areas that are tributary to Flying Horse Filing No. 4 have no increase in required stormwater quality or detention volumes. There is a relatively small area of 2.5-acre single-family lots that drain directly offsite. There is no proposed basin transfer and therefore the historical drainage patterns are to remain in place including at the roadway and lots at the major basin delineation.

c. Stakeholder Process

There are no amendments to the current DBPS.

d. Agency Jurisdictions

Listed below are the jurisdictions that this project will conform to:

El Paso County

Federal Emergency Management Agency

e. General Project Description

Flying Horse North Filing No. 4 is in El Paso County jurisdiction and is located within the larger Flying Horse North subdivision. The overall Flying Horse North development is bordered by Highway 83 to the west, Black Forest Road to the east, Cathedral Pines to the south, and High Forest Ranch to the north. The greater Flying Horse North area contains approximately 1,459 acres within the whole Section 36, Township 11 South, Range 66 West of the Sixth Principal Meridian, and a portion of Section 30 and 31, Township 11 South, and Range 65 West of the Sixth Principal Meridian. The Flying Horse Filing No. 4 area is 175.76 acres in total.

This FDR covers Filing No. 4 and includes offsite upstream and downstream areas to analyze existing and proposed drainageways and facilities. The Filing No. 4 area totals approximately 175.8 acres including 48 total 2.5-acre single-family residential estate lots. The development includes the single-family residential estate lots, 60' width rights-of-way that consist of asphalt paved roadways with roadside swale sections and electric easements, and three full spectrum detention pond facilities.

Filing No. 4 was previously assessed in the 2018 Classic Consulting report with a similar land use plan that included 2-acre single-family residential estate lots and roadways. This report assesses the lots as 2.5-acre lots. The layout shown in the developed conditions hydrology map of this report and the corresponding construction drawings differs slightly from the approved FDR/PDR with adjusted roadway alignments and lot lines. However, the drainage patterns, typical roadway section, and land use densities are similar.

The existing vegetative cover is 90 percent as evidenced by a field survey and aerial imagery. The existing vegetation includes native grasses and weeds, shrubs, and pinyon pine trees. Previous clearing of future planned roadways was done several years ago, and native grass and weeds have covered those areas.

f. Data Sources

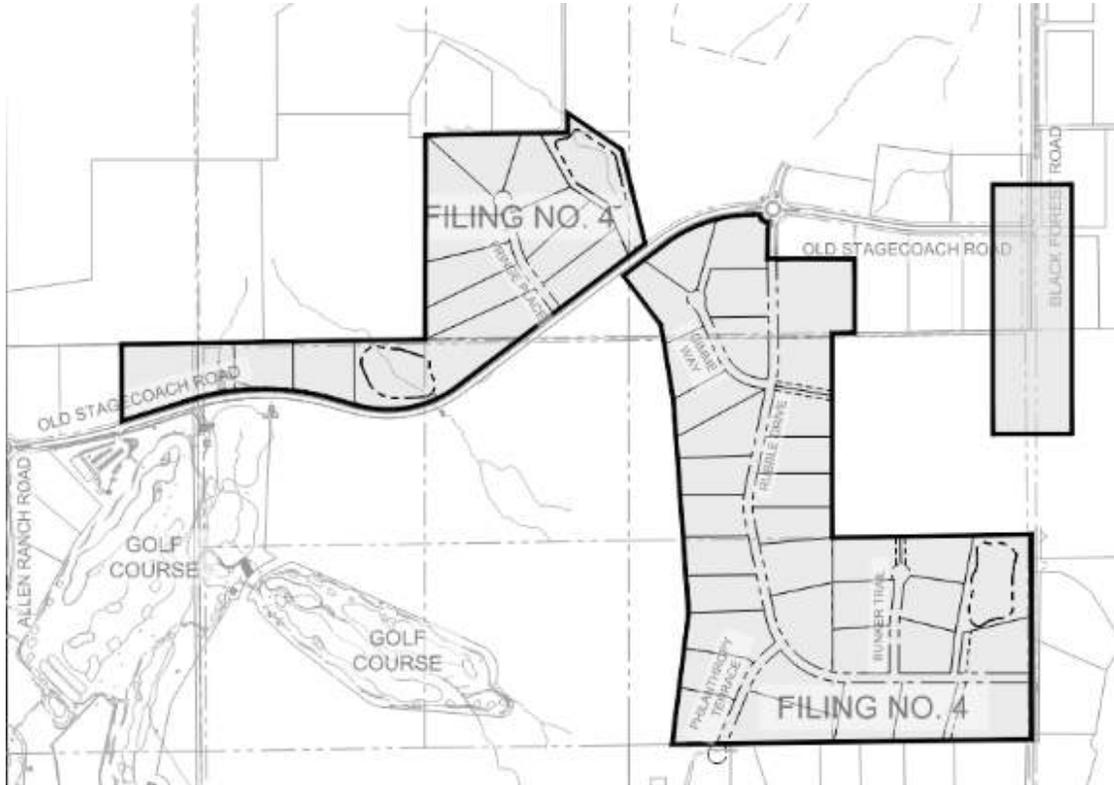


Figure 1 – Vicinity Map

Listed Below are the technical resources reviewed in the preparation of this MDDP:

El Paso County Drainage Criteria Manual (DCM)

Mile High Flood District

NOAA Atlas 14

NRCS Soil Survey for El Paso County Area, Colorado

FEMA FIRM 08041C0305G and FIRM 08041C0315G (eff. 12/7/2018)

El Paso County Assessor Property Records

Preliminary Drainage Report for Flying Horse North Preliminary Plan and Final Drainage Report for Flying Horse North Filing No. 1 prepared by Classic Consulting – June 2018

Flying Horse North Master Development Drainage Report prepared by HR Green Development, LLC. – latest revision September 9, 2022

g. Applicable Criteria and Standards

Per El Paso County Criteria Manual, flows from the proposed site will be limited to historic flows to maintain the stability of the existing channels within the drainage basins. The master plan follows the Drainage Criteria Manual for El Paso County which refers to the City of Colorado Springs Drainage Criteria Manuals as amended. Criteria within the County and City manuals refer to the Mile High Flood District manuals, particularly for extended detention basin design and runoff reduction calculations which are utilized in this report.

A distinct difference in the 2018 FDR/PDR and this report are the hydrologic methodologies utilized to compute peak runoff values. The 2018 Classic Consulting report utilized the NRCS Curve Number method in order to be consistent with their previous MDDP for the greater Flying Horse North master development. The NRCS Curve Number method was used for the future development of the area that is now proposed as Filing No. 4 for the portion of the report considered to be a Preliminary Drainage Report and it was used for sub-basins that did not exceed 100 acres. Typically, the Rational Method is used for hydrologic computations when basin analysis is under 100 acres due to the NRCS Curve Number method yielding smaller minor and major storm event peak runoff values. The resultant hydraulics in this report are similar to that of the approved 2018 FDR/PDR on a basin-by-basin basis, however, any differences in calculated stormwater runoff will be discussed. The difference in methodologies between the 2018 report and this report result in larger cumulative stormwater runoff values reported for the minor and major storm events. Due to the more conservative nature of the Rational Method, cumulative peak flow rates are greater than that of the 2018 FDR/PDR for the minor and major storm events for downstream design points. Because of the discrepancy between methodologies of the NRCS Curve Number and Rational Method's, existing hydrology calculations have been completed on the proposed Filing No. 4 area. This was done to determine if any downstream mitigation was needed, which will be discussed later in this report.

HR Green has previously discussed this discrepancy in hydrologic methodology with El Paso County engineering staff. The chosen method for most hydrologic computations included with this Report is the Rational Method to ensure sound design of the storm infrastructure for Filing No. 4 including swales, channels, culvert pipes, inlets, and roadway capacities. In addition to the Rational Method, major and minor storm events have also been modeled using the Colorado Urban Hydrograph Procedure (CUHP), version 2.0.0, and EPA Storm Water Management Model (SWMM), version 5.1. This methodology allows CUHP generated hydrographs from a number of sub-catchments, to be combined and routed through a series of links (channels, gutters, pipes, dummy links, etc.) and nodes (junctions, storage, diversion, etc.) to compute the resultant hydrographs at any number of design points within the watershed. CUHP / SWMM calculations were performed primarily for sizing the site detention facilities.

It was discussed that no existing drainage infrastructure will require redesign or retrofits unless explicit discrepancies in detention volumes are discovered as the tributary areas and percent imperviousness for respective detention ponds have not changed significantly between the 2018 FDR/PDR and this report for Filing No. 4. Due to the use of the NRCS Curve Number method in the 2018 FDR/PDR, the peak runoff values in this report are larger than that of the approved 2018 FDR/PDR. To complete a fair assessment of the impacts downstream of the site, existing hydrology calculations have been completed and included in Appendix B. As discussed with County engineering staff, while peak runoff values have increased due to the use of the Rational Method, there are no anticipated negative impacts to downstream offsite infrastructure because of this development as all other drainage parameters remain consistent with the

2018 FDR/PDR. Review of the CUHP / SWMM generated hydrology results in peak values generally less than calculated with the Rational Method. The resultant peak runoff figures are used to assess all existing and proposed stormwater infrastructure associated with Filing No. 4’s development, as well as a future Filing No. 5 development for Pond B in particular.

II. Project Characteristics

a. Location in Drainage Basin, Offsite Flows, Size

Filing No. 4 is located within the East Cherry Creek Basin. There is not a current planning study of the drainage basin, but generally it slopes from southwest to northeast. The basin eventually flows into the South Platte River.

Within the portion of the East Cherry Creek Basin investigated with this Report, three major drainage basins have been designated by the proposed pond in which the area is draining to. One drainage basin consists of seven sub-basins, “A” basins, conveyed to the proposed detention pond at Design Point A6, Pond A. The respective contributing flow from the sub-basins is shown in the table below:

Basin Name	Acreage	5 Year Flow (cfs)	100 Year Flow (cfs)
A1	9.6	5.2	22.1
A2	10.8	6.7	27.6
A3	72.7	21.2	126.2
A4	18.4	10.2	42.0
A5	6.1	3.7	15.4
A6	2.8	1.8	7.2
A7	8.1	5.1	20.9

Drainage within the “A” drainage basin flows ultimately from the southwest to northeast to reach Pond A. Design points are located at proposed culverts underneath roadways and proposed swales that direct flow to the detention pond. Drainage outfalls from Pond A into an existing channel that ultimately outfalls to the South Platte River.

The second drainage basin consists of six sub-basins, “B” basins, conveyed to the proposed detention pond at Design Point B3, Pond B. Two Basins, B5 and B6, flow directly offsite. Additional volume has been included in Pond B to compensate for these basins, see additional discussion below. The respective contributing flow from the sub-basins is shown in the table below:

Basin Name	Acreage	5 Year Flow (cfs)	100 Year Flow (cfs)
B1	57.8	15.9	97.5
B2	35.8	18.2	73.1
B3	1.1	1.4	3.8
B4	11.0	8.0	28.1
B5	10.6	6.3	25.9
B6	16.0	8.7	35.8

Drainage within the “B” drainage basin flows ultimately from the southeast to northwest to reach Pond B. Design points are located at an existing culvert under Old Stagecoach Road and at existing and proposed

swales that direct flow to the detention pond. Drainage outfalls from Pond B into an existing channel that ultimately outfalls to the South Platte River.

The third drainage basin consists of five sub-basins, “C” basins, conveyed to the proposed detention pond at Design Point C2, Pond C. Two of the basins, C4 and C5, flow directly offsite. Additional volume has been included in Pond C to compensate for these basins, see additional discussion below. The respective contributing flow from the sub-basins is shown in the table below:

Basin Name	Acreage	5 Year Flow (cfs)	100 Year Flow (cfs)
C1	10.5	8.7	37.2
C2	20.9	1.9	5.9
C3	9.3	11.3	50.6
C4	11.0	2.9	11.8
C5	11.0	1.4	5.7

Drainage within the “C” drainage basin flows ultimately from south to north to reach Pond C. Design points are located at existing and proposed culverts underneath roadways and proposed swales that direct flow to the detention pond. Drainage outfalls from Pond C into an existing channel that ultimately outfalls to the South Platte River.

There are five sub-basins that drain directly offsite due to the natural drainage patterns. These sub-basins have relatively small areas within Filing No. 4 and include parts of the 2.5-acre single-family residential estate lots at the northeast & western edges of the development. Additional volume has been included in Pond A to compensate for these basins, see additional discussion below.

Basin Name	Acreage	5 Year Flow (cfs)	100 Year Flow (cfs)
G1	2.6	1.7	6.9
G2	4.4	1.3	9.7
H1	5.2	3.4	13.9
H2	14.5	9.1	37.5
H3	36.8	9.1	66.9

There are two sub-basins that will drain to future proposed detention ponds. Currently, drainage from these basins will follow historic drainage patterns flowing to the northeast utilizing existing culverts within Old Stagecoach Road to outfall into existing channels. The respective flow from the sub-basins are shown in the table below:

Basin Name	Acreage	5 Year Flow (cfs)	100 Year Flow (cfs)
F1	12.8	7.7	31.6
F2	13.2	7.7	31.7

This Filing No. 4 FDR utilizes tributary areas, runoff coefficients (when comparing the NRCS Curve Number method and the Rational Method), and percent imperviousness for respective sub-basins and downstream detention facilities that match the amended layout as compared to 2018 Classic Consulting FDR/PDR which utilized its 2016 PUD layout of the subdivision. Changes in the peak runoff numbers as compared to the 2018 report are due to the change in hydrologic computation methodology as well as the



There is no existing condition shown in appendix. Cannot use future developed condition by Classic to be existing condition for this project.

HRG Response: Existing condition calculations included in the Appendix B for the rational and the CUHP/SWMM modeling. Existing conditions map included in Appendix F.

change in the overall layout within Filing No. 4 per the PUD Minor Amendment. Due to these differences in the computational methodology between the previously approved 2018 FDR and the values being calculated in this report, additional analysis of existing conditions has been completed. The existing conditions major flow values have been added to Appendix B. A table showing the Classic 2018 FDR/PDR NRCS Method peak runoff values compared to the HR Green 2024 FDR Rational Method peak runoff values for proposed conditions is provided below. This table is for basins that qualify for large lot exclusion under ECM code I-7.1.B.5.

Basin Name		Area (acre)		Proposed Q100 (cfs)	
Classic	HRG	Classic	HRG	Classic	HRG
CC-13C	A1	9.9	9.6	16.5	22.1
OS-15	A3	70.8	72.7	84.2	126.2
CC-13A	A4	19.3	18.4	27.3	42.0
CC-13B	A2	25.5	10.8	36.1	27.6
	A5		2.5		15.4
	A6		6.4		7.2
	A7		8.1		20.9
CC-10	B1	85.6	99.6	91.9	111.4
CC-8	B2	7.7	35.8	12.0	63.3
CC-11	B3	18.6	1.1	28.1	2.9
	B4		11.0		34.8
CC-12	B5	12.2	10.6	18.7	27.9
not labeled	B6		16.0		35.8
CC-15	C1	12.8	15.9	20.4	37.9
CC-20	C2	39.3	2.0	61.0	5.1
	C3		21.4		59.9
	C4		4.3		11.4
	C5		2.3		5.7
CC-16	F1	16.3	12.8	23.6	31.6
CC-17	F2	25.0	13.2	32.8	31.7
OS-16	F3	4.5	16.7	7.2	
CC-14	G1	4.6	2.5	7.8	6.9
not labeled	G2		4.4		11.5
CC-13D	H1	18.8	5.2	29.2	11.6
	H2		14.5		
not labeled	H3		36.8		

This statement is not clear. Why all these basins are qualified for exclusion under ECM code I.7.1.B.5. The large lot exclusion only applies to water quality and the need for detention still needs to be analyzed, and roadways are not included in the large lot exclusion, only driveways

HRG Response: This sentence has been updated to identify which basins in the table are included in the large lot exclusion.

Please include proposed Q5
 HRG Response: Q5 added to the table

This conclusion is not correct. There are some basins have runoff increase significantly compared to the proposed calculations by Classic. Please see additional comments in the proposed condition part.

HRG Response: Agreed, the difference in peak runoffs are significant for some basins, the intent of this paragraph was to emphasize that these new runoffs have been modeled to ensure that the overall release rates are reduced before being discharged offsite into the major basin. The language in the text has been updated to clearly express this.

While there is an increase in peak runoff for these basins as compared to the previous report, the discrepancy in methodology. The difference is insignificant as proposed using the updated values and pond sizing, which relies on a historic model / SWMM including a historic model. Additionally, as seen in Appendix



The large lot exclusion only applies to water quality and the need for detention still needs to be analyzed, and roadways are not included in the large lot exclusion, only driveways.

HRG Response: Understood, over-detention has been provided in all the ponds for these large lot exclusions. This sentence was misleading and has been updated to correctly express what analysis has been done in our modeling to account for detention in these basins.

combined for all three site outfalls providing detention. The peak flow rate has been reduced by 4% in the major storm event. The detention provided in the proposed detention ponds. While there is a large lot exclusion and do not require detention. Because of this no downstream

b. Compliance with DDTs

This FDR is in general conformance with the current drainage flows of the East Cherry Creek Basin. Flying Horse North will construct multiple full spectrum detention facilities to limit the effects of development and mimic natural flow patterns. The Filing No. 4 development will follow historic drainage patterns and utilize the existing natural swales throughout the area for conveyance of stormwater runoff toward respective proposed detention facilities.

Existing downstream infrastructure is currently limited to the historic drainage channels and minimal downstream improvements exist. As such, the site restricts offsite flow rates to not exceed historic flow rates. The site's ultimate outfalls will generally be along the same historic tributaries. Although outfall rates will be at or below historic, the cumulative volume of runoff will increase and therefore downstream facilities may see an increase in the duration of flows. This may provide a net benefit to the downstream facilities by providing more water to assist with the sustenance of vegetation, however it should be noted that increased volume may expedite potential erosion or channel movement. Any deviations from the approved 2018 Classic Consulting PDR/FDR in terms of runoff flow rate and water quality and detention volumes are assessed within this report to show compliance with the previously approved report in terms of capacities for drainage facilities including roadside swales, natural drainageways, and detention ponds.

c. Site Characteristics

Per the NRCS web soil survey, the site is made up entirely of Type B soils. Filing No. 4 is within the East Cherry Creek Basin which consists of Peyton sandy loam and Peyton-Pring complex. See Appendix A for the NRCS soil map.

The current ground cover in Filing No. 4 is short to mid-grass prairie grasslands and former farmland which consists of non-native weeds and grasses. This portion of the site has very few, if any, trees and a minimal number of shrubs are found on the site.

d. Major Drainage Ways and Structures

No major drainage ways exist within the development; however, small tertiary tributaries are within the site currently and function to convey flows to unnamed tributaries. These informal drainage ways are assessed within this report for stormwater runoff capacity and water surface elevations during the 100-year event as future development of single-family residential lots with basement or walkout conditions is considered. Roadside swales are included as a part of the typical roadway section and are assessed within sub-basins to ensure that swale and culvert pipe capacities are met and do not result in excessive pooling in the roadway sections, per code.

The existing minor drainage channels within the site are planned to be maintained to the maximum extent possible, however, do not require improvements or formal platting of drainage easements as a part of this filing as none of these drainageways exceed criteria requiring permanent control measures or platting for continued maintenance by the Metro District or County. These channels will continue to be used for

conveyance of storm drainage flows in their natural state. The limits of construction and disturbance plan for no significant earthwork alterations to the existing minor drainage channels that would affect the drainage patterns or capacity of the sections throughout the filing as they are proven to have sufficient capacities for their respective tributary areas and to maintain the natural features of the site including existing trees and vegetation. These natural tertiary channels do not have the requisite velocities or scouring to justify permanent control measures such as turf rolled matting.

Other drainageways of note including roadside swales are described within this report with parameters to demonstrate compliance with swale design criteria and capacities. Culvert pipes are sized to convey upstream flow under proposed roadways and maintain historic drainage patterns. Roadside swales are prescribed matting products for various areas in order to minimize erosion and sediment runoff downstream per hydraulic analysis.

e. Existing and proposed land uses

The existing Filing No. 4 area is open rangeland within a forested area consisting of sparse native grasses, weeds, and pinyon pine trees as well as baren pervious soil. The existing Filing No. 4 area consists of no development other than a previously cut-in maintenance pathway that was originally planned as the future roadway corridor and golf cart paths. As part of Filing No. 1, a road was constructed along with facilities to support a golf course. The Filing No. 4 development will connect to these existing roadways at the boundary between the two filings.

The 2018 Classic Consulting PDR/FDR assumed 2-acre single-family residential estate lot development with the same percent imperviousness within the filing area. This report includes the final design layout of 2.5-acre lots with rural roadway sections. Any deviations in basin areas, land use acreages, and resultant composite coefficients are shown within this report and demonstrated to meet downstream stormwater runoff and volume capacities for proposed and existing facilities.

III. Hydrologic Analysis

a. Major Basins and Sub-basins

Major Basin Description

Per FEMA FIRM 08041C0305G and 08041C0315G (eff. 12/7/2018), Flying Horse North has the East Cherry Creek run through the northwest portion of the site. This portion is not within Filing No. 4 boundary. Currently, FEMA shows a LOMR effective April 4th, 2019 Base Flood Elevations and Zone A. Per the El Paso County Land Development Code Chapter 8 Section 8.4.2.B.1.e.i, the base flood elevations for Zone A will be determined once the platted lots are solidified and are confirmed within 300-ft of the current floodplain designation. Certification of the flood elevations will be via the FEMA CLOMR/LOMR process or Floodplain Certification Letter. This LOMR or any FEMA floodplain identified in the FIRM maps do not have any affect on Filing No. 4 as there are no FEMA Floodplains within this Filing.

The site has been divided into several major drainage basins where each basin is tributary to a full spectrum detention pond facility with the exception of basins that drain directly offsite which have supporting water quality runoff reduction calculations. These basins and associated sub-basins are described in more detail in the next section of this report.



The excerpts only show the proposed condition, not the existing condition. Please provide excerpts of the existing condition, including a text discussion, calculations, and a map. Proposed condition in the excerpts cannot be used as existing conditions.

Existing Subbasin Description

The existing conditions for Filing No. 4 are consistent within the 2022 HR Green Development MDDP. The drainage maps are included in Appendix E of this report.

The 2022 HR Green Development MDDP is a comprehensive assessment of the Filing No. 4 development as well as the developed Filing No. 1 and Filing No. 3 area. Therefore, all existing topography and historical drainage patterns remain the same.

The onsite basins relevant to this report that are utilized in the 2018 report are the following: Basins CC-8, CC-10, CC-11, CC-12, CC-13A, CC-13B, CC-13C, CC-13D, CC-14, CC-15, CC-16, CC-17, and CC-20

The offsite basins relevant to this report that are utilized in the 2018 report are the following: OS-15

HRG Response: Existing condition calculations included in the Appendix B for the rational and the CUHP/SWMM modeling. Existing conditions map included in Appendix F. Text discussion and basin descriptions for existing basins has been added

Proposed Subbasin Description

The net area of some basins described in this report may differ from the 2018 Classic Consulting FDR/PDR due to changes of alignment of proposed roads and slight adjustments of the delineations with new topographic survey information. The net Q_5 & Q_{100} values may differ in this report because of the different methodologies used between the reports. Classic Consulting's FDR had used a Curve Number Method to report 5-year and 100-year drainage flows while this report utilizes the Rational Method to determine peak flow values. The Rational Method yields higher minor and major storm peak runoff values. Because of these two discrepancies, the values reported in this FDR may be higher across all design points that had also been evaluated in Classic Consulting's FDR from 2018. After conversations with El Paso County, discrepancies in design, basin delineation, and calculation methodology do not require HR Green to redesign any existing storm infrastructure that has been built in the Flying Horse North including culvert pipes, channels, and rock chutes.

HRG Response: Suggestions removed. Please remove suggestions from El Paso County.

The following design points are presented on the Developed Conditions Drainage map within the

Please include information of Q_5 and Q_{100} for all sub-basins through the text.

HRG Response: Q_5 and Q_{100} added to each subbasin description

idential (2.5 acre lots)

Runoff generated in this basin travels first overland from west to east through proposed 2.5-acre lots then through a shallow concentrated flow in the proposed roadside ditch to the east. The flow enters the Le Drive through a proposed 18-inch RCP culvert (Culvert 1) and continues to the east through a proposed 18-inch RCP culvert (Culvert 2).

Please specify type and ownership of channel. This comment is applied to all swales.

0.79 acres, residential (2.5 acre lots)

Runoff generated in this basin combines with upstream tributary runoff from 2.5-acre lots and shallow concentrated flow in the proposed roadside ditch. The flows are directed to the east to the Le Drive through a proposed 18-inch RCP culvert (Culvert 1).

HRG Response: Ownership identified for channels and swales

HRG Response: This is an existing swale, it was mislabeled on the drainage map but has been adjusted to show an existing swale. Channel Lining will be added to this existing swale. Channel lining calculations are included in Appendix C.

idential (5.0 acre lots)

Runoff generated in this basin travels first overland from south to north through proposed 2.0-acre lots within the basin. The flows are directed to the east through the planes and directed to the Le Drive through a proposed 18-inch RCP culvert (Culvert 1).

HRG Response: Ownership identified for storm infrastructures.

Please clarify this swale as it was mentioned in the Basin A4, and labeled on the map that it is a proposed swale.

Please clearly state ownership (private/public) of all storm infrastructures through the text.

Basin A4: 18.39 acres, residential (2.5 acre lots)

Runoff generated in this basin combines with upstream tributary basins and travels overland through the 2.5-acre lots and via shallow concentrated flow in the proposed roadside ditches and a proposed channel represented as section A-A. Developed flows are directed to the north to design point A6 through a 28-inch RCP culvert (Culvert 2).

From Classic Consulting's FDR for Flying Horse North Filing No. 1, Basin A4 was identified as Basin CC-13A. Classic's FDR reported a total basin area for CC-13A to be 19.3 acres with a $Q_5=5.4$ CFS and a $Q_{100}=27.3$ CFS. The cumulative flow at design point 28 (this includes basins CC-13A and OS-15) shown in this report has a net area of 90.1 acres, a net $Q_5=19.8$ CFS, and a net $Q_{100}=110$ CFS. See the statement preceding Basin A1 description for an explanation of discrepancies between values reported here and values reported in Classic Consulting's 2018 FDR.

Basin A5: 6.10 acres, residential (2.5 acre lots)

Runoff generated in this basin combines with upstream tributary basins and travels overland through the 2.5-acre lots and via shallow concentrated flow in the proposed roadside ditches and a proposed channel represented as section I-I. The flows are directed to the northeast to design point A6 through a 30-inch RCP culvert (Culvert 12).

Basin A6: 2.76 acres, residential (2.5 acre lots)

Runoff generated in this basin combines with upstream tributary basins and travels overland through the 2.5-acre lots and via shallow concentrated flow in the proposed roadside ditches and a proposed channel represented as section H-H. The flows are directed to the northeast to design point A6 through a 30-inch RCP culvert (Culvert 12).

From Classic Consulting's FDR for Flying Horse North Filing No. 1, Basin A6 was identified as Basin CC-13B. Classic's FDR reported a total basin area for CC-13B to be 2.76 acres with a $Q_5=3.1$ CFS and a $Q_{100}=36.1$ CFS. The cumulative flow at design point 15) shown in this report has a net area of 90.1 acres, a net $Q_5=19.8$ CFS, and a net $Q_{100}=110$ CFS. See the statement preceding Basin A1 description for an explanation of discrepancies between values reported here and values reported in Classic Consulting's 2018 FDR.

HRG Response: Overland flow is referring to sheet flow over natural topography within the basin. There are no concentrated flows entering into the pond within Basin A7. It does not make sense for us to create concentrated conditions where the surface is not being developed, instead runoff will follow the existing conditions via sheet flow to the pond. Further description has been added to the report text for clarification

See the statement preceding Basin A1 description for an explanation of discrepancies between values reported here and values reported in Classic Consulting's 2018 FDR.

Basin A7: 8.11 acres, residential (2.5 acre lots)

Runoff generated in this basin travels via overland flow into the proposed Pond A. Within the pond, flows travel through trickle channels and outfall through an outlet structure. The reduced 100-year flow from Pond A is 156 CFS.

Direct overland runoff into the pond is not allowed due to the risk of erosion. Please revise.

Basin B1: 57.78 acres, undeveloped / roadway (minor collector) / residential (2.5 acre lots)

Runoff generated in this basin travels overland east to west first through two acre-lots and over the terrain. Discharge is eventually collected in existing channels proposed roadside ditches. The flows are directed to the northwest to design point B2.

HRG Response: Added.

Basin B2: 35.77 acres, residential (2.5 acre lots)

Runoff generated in this basin travels overland east to west first through two acre-lots and over the terrain. Discharge is eventually collected in existing channels proposed roadside ditches. The flows are directed to the northwest to design point B2.

HRG Response: Discrepancies in the flow rates are due to the different methodologies used across reports. The culvert at design point B1 does not have the capacity to handle the increase in flows and will be made from a single 48-inch RCP culvert to a dual 48-inch RCP pipe to safely pass flows. See Appendix C for calculations.

There appears to be a significant increase in runoff flows from the developed Basins B1 and B2 compared to the developed Basins CC-10 and CC-8, respectively. These increased flows will be directed



Please refer to the previous comment. When comparing DP 26, calculated for the existing culvert, with DP B2 (Q5 = 33 cfs, Q100 = 285 cfs), the discrepancy in values is significant. Please review and address

HRG Response: Discrepancies in the flow rates are due to the different methodologies used across reports. The culvert at design point B1 does not have the capacity to handle the increase in flows and will be made from a single 48-inch RCP culvert to a dual 48-inch RCP pipe to safely pass flows. See Appendix C for calculations.

p. 1, Basin B2 (and Basin B1) was area for CC-10 to be 85.6 acres with a design point 26 (this includes basins CC-8 and CC-9) with a net Q₅= 15.9 CFS, and a net Q₁₀₀=102

CFS. See the statement preceding Basin A1 description for an explanation of discrepancies between values reported here and values reported in Classic Consulting's 2018 FDR.

HRG Response: Overland flow is referring to sheet flow over natural topography within the basin. There are no concentrated flows entering into the pond within Basin B4. It does not make sense for us to create concentrated conditions where the surface is not being developed, instead runoff will follow the existing conditions via sheet flow to the pond. Further description has been added to the report text for clarification

Direct overland runoff into the pond is not allowed due to the risk of erosion, and water quality. Please revise.

Runoff generated in this basin travels overland to Pond B. Within Pond B, runoff travels through trickle channels to a Type-C modified outfall structure. The reduced 100-year flow from Pond B is 214.6 CFS

Basin B5: 10.62 acres, residential (2.5 acre lots)

Runoff in from this basin is generated completely within the proposed 2.5 acres lots. The runoff will follow existing drainage patterns and sheet flow directly offsite to the west to existing channels and tributaries.

The drainage from this basin is included in the water quality calculation

Please clarify why runoff from Basin B5 and B6 flow directly offsite without undergoing water quality treatment, and detention, yet is mentioned that flows from these basins are included in the water quality calculation for Pond B. Also, please explain whether existing channel has capacity to carry the increase of flows.

Basin B6: 15.96 acres, residential (2.5 acre lots)

Runoff in from this basin is generated completely within the proposed existing drainage patterns and sheet flow directly offsite to the north to existing channels and tributaries.

The drainage from this basin is included in the water quality calculation

Basin C1: 15.94 acres, undeveloped / roadway (minor collector)

Runoff generated from this basin will overland flow to the north to proposed roadside ditches along Gimme Way and will concentrate into Culvert 7. Runoff outfalls from this culvert into a proposed swale that flows to an existing 30-inch culvert under Old Stage Coach Road.

Basin C2: 1.98 acres, roadway (minor collector) / residential

Runoff generated in this basin overland flows to a proposed swale that is collected in the swale from Basin C1 when it outfalls from the Coach Road. The combined flows of Basin C1 and C2 travel to a detention basin via a rundown rock chute.

HRG Response: Overdetention has been incorporated in the ponds for the basins that flow directly offsite. Water quality is not required per the large lot exclusions. Existing channel calculations have been included in Appendix C to ensure they can carry the increase flows.

From Classic Consulting's FDR for Flying Horse North Filing No. 1, Basin C2 was identified as Basin CC-20. Classic's FDR reported a total basin area for CC-20 to be 39.3 acres with a Q₅= 12.9 CFS and a Q₁₀₀= 61.0 CFS. The cumulative flow at design point 29 (this includes basins CC-15 and CC-20) shown in this report have a net area of 52.1 acres, a net Q₅= 17.2 CFS, and a net Q₁₀₀= 81 CFS. See the statement preceding Basin A1 description for an explanation of discrepancies between values reported here and values reported in Classic Consulting's 2018 FDR.

HRG Response: Overland flow is referring to sheet flow over natural topography within the basin. There are no concentrated flows entering into the pond within Basin C3. It does not make sense for us to create concentrated conditions where the surface is not being developed, instead runoff will follow the existing conditions via sheet flow to the pond. Further description has been added to the report text for clarification

Direct overland runoff into the pond is not allowed due to the risk of erosion, and water quality. Please revise.

Basin C3: 21.39 acres, undeveloped / roadway (minor collection)

Runoff generated in this basin mostly overland flows to Pond C. Runoff from Fringe Place and is collected in the roadside ditches before traveling through Culvert 10) to outfall towards Pond C. The concentrated flow is being spreader to change the flow from concentrated flow to sheet flow. Flow within the pond will travel via trickle channels and outfall to Pond C.

HRG Response: Overdetention has been incorporated in the ponds for the basins that flow directly offsite. Water quality is not required per the large lot exclusions. Historical basin descriptions are included in the text with flow rates listed for ease of comparison.

Basin C4: 4.31 acres, residential (2.5 acre lots)

Runoff in from this basin is generated completely within the proposed 2.5 acres lots. The runoff will follow existing drainage patterns and sheet flow directly offsite to the north. The runoff from this basin is included in the water quality calculations for Pond C.

Please clarify why runoff from Basin C4 and C5 flows directly offsite without undergoing water quality treatment, and detention, yet it is mentioned that flows from these basins are included in the water quality calculations for Pond C. Also, please explain whether the discharge at DP C4 and DPC5 is the same or under the historical discharge.

Basin C5: 2.27 acres, residential (2.5 acre lots)

Runoff in from this basin is generated on existing ground cover. The runoff will follow existing drainage patterns and sheet flow directly offsite to the north to existing channels and tributaries. The drainage from this basin is included in the water quality calculations for Pond C.

Runoff from this basin is significantly higher than the flows proposed by Classic. Please evaluate whether the existing culvert has the capacity to handle this increase. Additionally, what is the construction timeline of the future detention pond? Will the proposed detention pond be built before the infrastructure for this project? If not, the project must provide a safe and stabilized discharge for these basins.

Basin F1: 12.83 acres, residential (2.5 acre lots)

Runoff generated in this basin will travel overland flow and concentrated flow in the proposed roadside ditches along Rubble Drive. Flows from this basin will eventually travel through a 30-inch culvert under Old Stagecoach Road and outfall to the north where it will continue to follow existing drainage conditions. Runoff from this basin is anticipated to be collected in a future detention pond that is to be built with the future filing to the north of Filing No. 4.

Basin F2: 13.21 acres, residential (2.5 acre lots)

Runoff generated in this basin will travel overland flow and concentrated flow in the existing roadside ditches along Old Stagecoach Road to the east until eventually flowing to the north under the road and following existing drainage conditions. Runoff from this basin is anticipated to be collected in a future detention pond that is to be built with the future filing to the north of Filing No. 4.

HRG Response: Analysis has been done on the downstream culverts. F1 is sized appropriately to handle the increase in flows. The downstream culvert in basin F3 will be upsized to safely pass the flows from basin F2 and basin F3. Outlet protection has been added to this culvert to ensure safe and stabilized discharge.

Basin G2: 5.5 acre lots)

Runoff from residential lots. The runoff will follow existing drainage patterns and be collected in an existing swale in Basin G2.

Basin G3: (for arterial)

Runoff on existing ground cover. The runoff will follow existing drainage patterns and concentrated flow through an existing swale to an existing detention pond. Runoff from this basin is collected into an existing channel represented as D-D in the Appendix C calculations.

Basin H1: 5.20 acres,

Runoff generated in this basin travels shallow concentrated flow under Rubble Drive through a proposed 18-inch RCP culvert (Culvert 5) to Basin H2.

HRG Response: This is an existing stock pond that has no records or design plans. Text has been updated to clarify this.

Runoff from proposed 2.5 acre-lots then flows are directed to the east

Please include excerpt of the existing detention pond showing that it accounts for the discharges from basin G1,2 and H1,2 from this project. Excerpts must include text discussion, calculations, and drainage map.

Basin H2: 14.46 acres, residential (2.5 acre lots)

Runoff generated in this basin travels overland through 2.5-acre lots and travels shallow concentrated flow in an existing channel represented as section C-C. The flows in this channel are directed to the east offsite further downstream the existing channel.

Basin H3: 36.80 acres, roadway (minor arterial) ($Q_5 = 15.6$ CFS, $Q_{100} = 26.3$ CFS)

Runoff generated in this basin is offsite flow collected in an existing channel that captures all the flows from Basins G1 and G2 and Basins H1 and H2. This existing channel flows offsite to the east and its and is represented as section D-D in calculations in Appendix C. **Please compare the runoff at the design points (DPs) between the existing and proposed conditions as they leave the site.**

b. Water Quality and Detention Facilities

There are three Full Spectrum Detention ponds that are proposed. Full Spectrum Detention (FSD) is a design concept introduced by the Mile High Flood District (Mile High Flood District and Wulliman 2005) that provides better control of the full range of runoff volumes than the conventional multi-stage concept. This concept provides mitigation of increased runoff volumes by releasing a portion of the increased runoff volume at a low rate over an extended period of time. Site detention ponds are designed as FSDs to provide the required volume stages for Water Quality Capture Volume (WQCV), Excess Urban Runoff Volume (EURV), and the 100-year stage (flood control volume). In FSDs, the flood volume is equal to the entire volume and is inclusive of the EURV and the WQCV.

**HRG Response:
Summary table of
comparisons provided**

Areas tributary to storage facilities are greater than 5 acres. Therefore, detention volumes have been determined using the CUHP/MHFD SWMM methodology. When multiple basins are tributary to a single pond, basins are first routed together within the SWMM program to develop a combined detention pond inflow hydrograph. The hydrographs were then added to a Mile High Flood District MHFD-Detention workbook for each pond. Then the release curve / estimated outlet condition was adjusted until the desired peak pond outflow was achieved. Once the 100-year peak release rate was confirmed, resultant stage-release curves were transferred back to the prepared SWMMs and re-run to confirm the similar results as found with the MHFD-Detention analysis.

The MHFD-Detention workbook is utilized to design the outlet structures with orifice plates and restrictor plates. The outlet structures and plates are designed to achieve the target release rates of the various stages: WQCV at 40 hours, and EURV and 100-year release rates within the requisite 120 hours, with the goal of being in the range of 52 to 72 hours, as feasible for the runoff conditions. The developed condition outlet flow rates are not to exceed predeveloped conditions, and over-detention is provided within the three ponds to account for sub-basins that drain directly offsite without capture per the existing drainage patterns of the site.

The ponds include the required infrastructure such as concrete forebays, an emergency spillway with rip-rap weirs, concrete trickle channels, and a 2.5-foot depth micro-pool attached to the outlet structure. Ponds include 15'-20' width maintenance paths with vehicular access to the bottom of pond to access forebays and outlet structures for continued maintenance. The pathways have access from the public right-of-way and proper turning radii and longitudinal and cross slopes for a maintenance vehicle. The ponds include 1.0-foot of freeboard to the emergency spillway berm of the pond with the crest elevation at or above the 100-year water surface elevation. The spillways are sized with a trapezoidal weir for the 100-year inflow with rip-rap prescribed for the outflow velocity as energy dissipation.

The proposed ponds are described below.

Pond A (Design Point A5) provides WQCV and EURV for the stormwater runoff from the A basins and includes over-detention to account for nearby sub-basins that drain directly offsite to ensure that the released stormwater to downstream properties and infrastructure is equal to or less than historical runoff. This is confirmed by comparing the routed peak flows of similar basins in the historic condition, to the routed peak flows inclusive of detention in the developed condition. Both historic and developed SWMM models note this location as O_BASIN_H and modeling results at this location are included in the table below.

The A basins include areas of upstream offsite developed single-family residence RR-5 lots, undeveloped open space area, onsite developed area for proposed 2.5-acre single-family residential lots and rural local residential roadways. The pond includes a minimum 1.0-foot of freeboard to the top of berm and the 100-year water surface elevation is below the crest of the emergency spillway weir.

The MHFD-Detention / SWMM analysis yields the following pond sizing results:

Proposed Pond A

(Ownership and maintenance by the Flying Horse North HOA)

WQCV (ac-ft)	EURV (ac-ft)	100-year / Total Volume (ac-ft)
0.53	0.83	2.23

Pond A hydraulics are summarized in the following table:

	Peak Inflow (cfs)	Design Release / Outflow (cfs)	Time to Drain 99% of Inflow Volume (hrs)	Historic Peak Flowrate at O_BASIN_H	Developed Peak Flowrate at O_BASIN_H
Minor Storm (Q5)	42.5	31.3	52	52	38
Major Storm (Q100)	183.8	156.0	41	267	249

Pond A includes a concrete forebay sized for the required volume of the inflow, a 4-foot width concrete trickle channel with 6" vertical concrete curb, a 2.5-foot depth concrete micro pool, and an outlet structure that includes a top trash rack, orifice plate, and restrictor plate on the outlet pipe.

Pond B (Design Point B) provides WQCV and EURV for the stormwater runoff from the B basins as well as over-detention of nearby sub-basins that drain directly offsite and converge with the ultimate downstream drainageway that Pond B outfalls to. This is confirmed by comparing the routed peak flows of similar basins in the historic condition, to the routed peak flows inclusive of detention in the developed condition. Both historic and developed SWMM models note this location as O_BASIN_B and modeling results at this location are included in the table below.

It is noted that the B basins include future developed conditions for a future Filing No. 5 so that this future development may be designed and constructed to drain to Pond B with minimal future improvements or retrofits to the pond.

The B basins consist of Filing No. 4 site area for 2.5-acre single-family residential development and local rural residential roadways. The pond includes a minimum 1.0-foot of freeboard to the top of berm and the 100-year water surface elevation is below the crest of the emergency spillway weir.

The MHFD-Detention / SWMM analysis yields the following pond sizing results:

Proposed Pond B

(Ownership and maintenance by the Flying Horse North HOA)

WQCV (ac-ft)	EURV (ac-ft)	100-year / Total Volume (ac-ft)
0.50	0.81	2.17

Pond B hydraulics are described in the following table:

	Peak Inflow (cfs)	Design Release/Outflow (cfs)	Time to Drain 99% of Inflow Volume (hrs)	Historic Peak Flowrate at O_BASIN_B	Developed Peak Flowrate at O_BASIN_B
Minor Storm (Q5)	59.1	49.2	50	58	54
Major Storm (Q100)	247.1	216.0	36	263	262

Pond B includes a concrete forebay sized for the required volume of the inflow, a 4-foot width concrete trickle channel with 6" vertical concrete curb, a 2.5-foot depth concrete micro pool, and an outlet structure that includes a top trash rack, orifice plate, and restrictor plate on the outlet pipe.

Pond C (Design Point C) provides WQCV and EURV for the stormwater runoff from the C basins as well as over-detention of nearby sub-basins that drain directly offsite and converge with the ultimate downstream drainageway that Pond C outfalls to. This is confirmed by comparing the routed peak flows of similar basins in the historic condition, to the routed peak flows inclusive of detention in the developed condition. Both historic and developed SWMM models note this location as O_BASIN_C and modeling results at this location are included in the table below.

Proposed Pond C

(Ownership and maintenance by the Flying Horse North HOA)

WQCV (ac-ft)	EURV (ac-ft)	100-year / Total Volume (ac-ft)
0.23	0.39	0.90

Pond C hydraulics are described in the following table:

	Peak Inflow (cfs)	Design Release/Outflow (cfs)	Time to Drain 99% of Inflow Volume (hrs)	Historic Peak Flowrate at O_BASIN_C	Developed Peak Flowrate at O_BASIN_C
Minor Storm (Q5)	18.0	10.2	59	19	11
Major Storm (Q100)	69.0	62.4	50	78	73

Pond C includes a concrete forebay sized for the required volume of the inflow, a 4-foot width concrete trickle channel with 6” vertical concrete curb, a 2.5-foot depth concrete micro pool, and an outlet structure that includes a top trash rack, orifice plate, and restrictor plate on the outlet pipe.

A comparison of the existing conditions as identified in the 2022 MDDP, and proposed conditions releasing off-site from the identified Filing No. 4 boundary into Cherry Creek is provided below to show that the detention being provided on site from the proposed ponds in Filing No. 4 will negate any impact downstream.

Basin ID	Existing Conditions (HRG MDDP 2022)	Proposed Conditions (HRG Filing 4 FDR 2024)
Cherry Creek	371.2 CFS	24.0 CFS

c. Methodology

Design rainfall was determined utilizing Table 6-2 from the City of Colorado Springs Drainage Criteria Manual to determine the 5-year and 100-year rainfall values for the 1-hour events. The 1-hour rainfall depths are 1.5 and 2.52 in/hr respectively.

The proposed development will consist of 48 2.5-acre single-family residential estate lots which are assumed at a percent imperviousness of 11% per the County ECM Table 3-1 Typical Values of Percent Impervious within Appendix L of the ECM which provides guidance for larger rural lot developments. Existing golf course areas are to remain undisturbed and utilize a land use category of “lawn” with a percent imperviousness of 2% per the County ECM Table 6-6 land use table. Composite coefficients, rainfall intensities, and runoff flow rates are calculated on a Rational Method spreadsheet and provided within the Appendix. As discussed previously, the Rational Method used in this report will result in higher peak flow rates for the minor and major storm events as compared to the 2018 Classic Consulting FDR/PDR which utilized the NRCS Curve Number Method. Design points within Filing No. 4 are designed per the findings of this report which utilizes the Rational Method and CUHP/SWMM modeling.

Mile High Flood District (MHFD) UD-BMP Runoff Reduction calculations are provided to demonstrate WQCV reduction for the sub-basins that drain directly offsite, however the sub-basins that drain directly off-site do fall under ECM code I.7.1.B.5, which excludes areas of “large lots” to require detention. The provided Runoff Reduction calculations are to show the good stormwater management practices of the site.

Areas tributary to storage facilities are greater than 5 acres. Therefore, detention volumes have been determined using the CUHP/MHFD SWMM methodology. When multiple basins are tributary to a single pond, basins are first routed together within the SWMM program to develop a combined detention pond inflow hydrograph. The hydrographs were then added to a MHFD-Detention workbook for each pond. Then the release curve / estimated outlet condition was adjusted until the desired peak pond outflow was achieved. Once the 100-year peak release rate was confirmed, resultant stage-release curves were transferred back to the prepared SWMMs and re-run to confirm the similar results as found with the MHFD-Detention analysis.

The MHFD-Detention workbook is utilized to design the outlet structures with orifice plates and restrictor plates. The outlet structures and plates are designed to achieve the target release rates of the various stages: WQCV at 40 hours, and EURV and 100-year release rates within the requisite 120 hours, with the goal of being in the range of 52 to 72 hours, as feasible for the runoff conditions.

Reference to the 2018 Classic Consulting PDR/FDR set of calculations and spreadsheets is included to demonstrate compliance and consistency with the previously approved report which anticipated similar land uses and basin acreages tributary to existing stormwater facilities.

IV. Hydraulic Analysis

a. Major Drainageways

There are no major drainageways that exist within the development of Filing No. 4; however, small tertiary tributaries are within the site currently and function to convey flows to unnamed tributaries. These tertiary drainage ways are analyzed within this report to assess the water surface elevation within the swales during the 100-year storm event and determine buildability of lots adjacent to these sections. Roadside swales are to be constructed at a minimum to meet the typical roadway section (4:1 for 10' and 3:1 for 9' resulting in a total swale depth of 2.5'). The roadside swales are assessed along the roadways that capture sub-basins and result in cumulative flow.

b. Storm Sewer Infrastructure and Culvert Pipes

The Filing No. 4 development consists of rural development with 2.5-acre single family residential estate lots and rural roadway sections with roadside swales. The storm infrastructure within these areas consist of public culvert pipes for roadway crossings and consideration for future public culvert pipes for future driveways for each lot. Culvert calculations and graphics are provided within the Appendix of this report to demonstrate culvert capacities and show any roadway/driveway overtopping as a result of peak flows. The culverts are designed to have full capacity of the minor (5-year) storm event and a maximum of 4" of roadway or driveway pooling during the major (100-year) storm event.

V. Environmental Evaluations

a. Significant Existing or Potential Wetland and Riparian Areas Impacts

As part of this work, the developer has engaged Bristlecone Ecology, LLC to perform environmental studies of the site that will be submitted with the planning documents. These documents have been included in the greater 2016 PUD as well as previous Final Plat filings. Major information in the report concerning wetlands concludes that there is a wetland associated with Black Squirrel Creek. Black Squirrel Creek is known to be a jurisdictional stream. This filing does not include this drainage basin.

At this time, there are no improvements proposed for Black Squirrel Creek. The minimal impact to the stream will keep the natural habitat intact and the natural function of the Creek as it is to maintain the wetland habitat.

b. Stormwater Quality Considerations and Proposed Practices

As part of the development, full spectrum detention facilities will be installed to provide water quality for the development. The facilities are designed using El Paso County criteria and provide stormwater quality by slowing the release of stormwater captured by the ponds and allowing solids to settle out. Additionally, when possible, the existing natural drainage ways will be used to convey stormwater to more closely mimic the natural hydrologic and hydraulic cycle. Some of the drainage ways will be used to convey water to the ponds and others will receive water from the ponds and in both scenarios will provide additional water quality benefits.



Please specify the outfall basin and the percentage of total disturbed areas for these lots, indicating which areas are receiving water treatment and which are not

Please include a note to the that per ECM Section I.7.1.B.5, the residential lots impervious area may not exceed 10 percent unless a study is prepared in compliance with the requirements laid out in the above ECM Section and the impervious area may not exceed 20 percent. This impervious area for each lot must include the proposed driveway.

Step 3 – Provide WQCV via detention ponds. Proposed ponds are tributary to a detention pond under the “large lot” category for these areas, it

HRG Response: Details have been included in the text to specify the area being disturbed and treated for water quality and the areas that are running directly offsite. A note has been added per the ECM I.7.1.B.5 to include the maximum percent imperviousness under the exclusion.

as that are not...nts as they fall... is not required

Step 4 – Consider the need for industrial and Commercial BMPs. A site specific storm water quality and erosion control plan and narrative will be prepared with subsequent land use approvals prepared in conjunction with the report prior to any construction. Site specific temporary source control BMPs as well as permanent BMPs are detailed in this plan and narrative. Guidelines detailed in the El Paso DCM V2 4.2 pertaining to the covering and storage handline and spill containment and control shall be followed as necessary. This filing does not contain any commercial or industrial land use.

VI. Drawings

Please refer to the appendices for the Vicinity Map, FEMA Floodplain Map, NRCS Soils Map, hydrology and hydraulic calculations, and drainage basin maps. Reference materials from previously approved reports are included in the appendix including the 2018 Classic Consulting FDR/PDR calculations and drainage maps.

VII. Drainage and Bridge Fees

The East Cherry Creek Basin does not currently have a Drainage Basin Fee.

VIII. Summary

Flying Horse North Filing No. 4 is a 175.8-acre single-family residential estate lot development area that will contain paved roadways and roadside ditch sections and three Full Spectrum Detention ponds.

Pond B accounts for future development within Filing No. 5, anticipated to consist of local rural residential roadways within 60’ public rights-of-way and single-family residential estate lots of 2.5 acres FSDs are proposed to provide water quality and detention to release the stormwater at or below historical rates.

The Filing No. 4 final design is assessed for stormwater capacity of roadway sections, roadside swales and the existing tertiary drainage ways to ensure that development of the 2.5-acre single-family residential estate lots will not be negatively impacted by drainage conditions, including existing and proposed altered areas for the roadway and lot construction phases.

All County and MHFD drainage design standards are met. It is anticipated that there will be no negative impacts to downstream and surrounding developments and facilities due to the development of Filing No.

4.

IX. References

El Paso County – Drainage Criteria Manual, 2014

City of Colorado Springs – Drainage Criteria Manual, May 2014

Urban Storm Drainage Criteria Manual, Urban Drainage Flood Control District, January 2018

Mile High Flood District Urban Storm Drainage Criteria Manual Volumes 1, 2, and 3; latest revisions

Mile High Flood District Software Resources and Tools (MHFD-Detention, UD-Inlet, UD-BMP)

United States Department of Agriculture National Resources Conservation Service Rock Chute Design Data Spreadsheet

Preliminary Drainage Report for Flying Horse North Preliminary Plan and Final Drainage Report for Flying Horse North Filing No. 1, Classic Consulting Engineers and Surveyors, November 2017

Flying Horse North Master Development Drainage Plan, HR Green Development, LLC., September 2022

Flying Horse North Irrigation Reservoir Embankment Design Report, Classic Consulting Engineers and Surveyors, latest revision June 2018, County approved on September 25, 2018

Black Squirrel Drainage Basin Planning Study (DBPS), URS Consultants, January 1989



Flying Horse North Filing No. 3
Final Drainage Report
Project No.: 211030.20
El Paso County, Colorado

APPENDIX A

VICINITY MAP

NRCS SOILS MAP

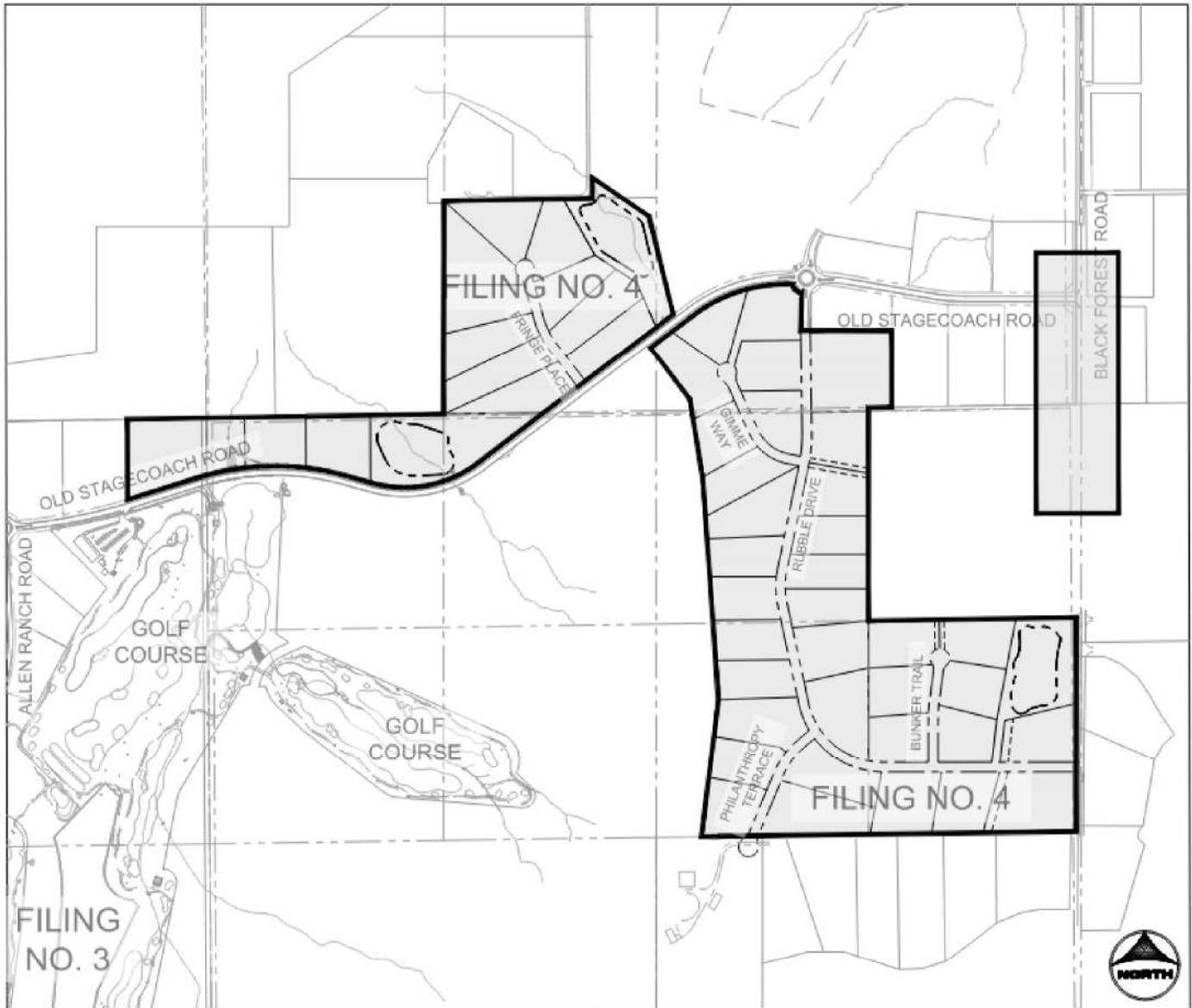
FEMA FLOODPLAIN MAP

EL PASO COUNTY MAJOR DRAINAGE BASINS MAP

VICINITY MAP

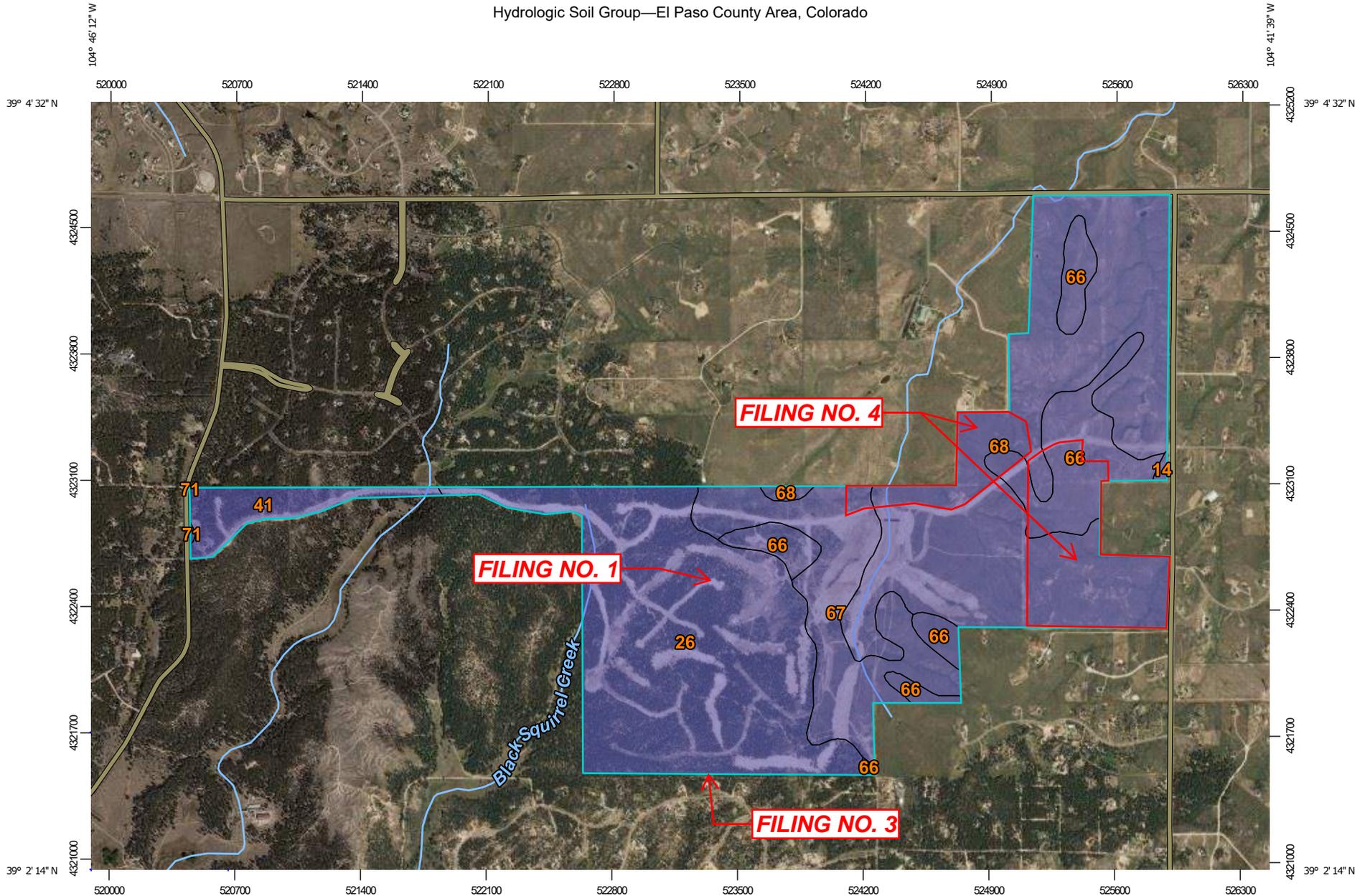
FLYING HORSE NORTH FILING NO. 4

A PORTION OF SECTION 36, TOWNSHIP 11 SOUTH, RANGE 66 WEST OF THE SIXTH
PRINCIPAL MERIDIAN COUNTY OF EL PASO, STATE OF COLORADO



NO SCALE

Hydrologic Soil Group—El Paso County Area, Colorado



Map Scale: 1:30,000 if printed on A landscape (11" x 8.5") sheet.



Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84



MAP LEGEND

- Area of Interest (AOI)**
 - Area of Interest (AOI)
- Soils**
 - Soil Rating Polygons**
 - A
 - A/D
 - B
 - B/D
 - C
 - C/D
 - D
 - Not rated or not available
 - Soil Rating Lines**
 - A
 - A/D
 - B
 - B/D
 - C
 - C/D
 - D
 - Not rated or not available
 - Soil Rating Points**
 - A
 - A/D
 - B
 - B/D
- C
- C/D
- D
- Not rated or not available
- Water Features**
 - Streams and Canals
- Transportation**
 - Rails
 - Interstate Highways
 - US Routes
 - Major Roads
 - Local Roads
- Background**
 - Aerial Photography

MAP INFORMATION

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

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

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

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

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

Soil Survey Area: El Paso County Area, Colorado
 Survey Area Data: Version 19, Aug 31, 2021

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

Date(s) aerial images were photographed: Aug 19, 2018—May 26, 2019

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
14	Brussett loam, 1 to 3 percent slopes	B	1.9	0.1%
26	Elbeth sandy loam, 8 to 15 percent slopes	B	474.2	33.7%
41	Kettle gravelly loamy sand, 8 to 40 percent slopes	B	53.4	3.8%
66	Peyton sandy loam, 1 to 5 percent slopes	B	160.9	11.4%
67	Peyton sandy loam, 5 to 9 percent slopes	B	182.8	13.0%
68	Peyton-Pring complex, 3 to 8 percent slopes	B	533.4	37.9%
71	Pring coarse sandy loam, 3 to 8 percent slopes	B	0.6	0.0%
Totals for Area of Interest			1,407.3	100.0%

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

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

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

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

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

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

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

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

Base Map information shown on this FIRM was provided in digital format by El Paso County, Colorado Springs Utilities, City of Fountain, Bureau of Land Management, National Oceanic and Atmospheric Administration, United States Geological Survey, and Anderson Consulting Engineers, Inc. These data are current as of 2006.

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

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

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

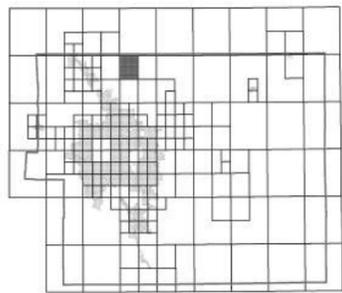
Contact **FEMA Map Service Center (MSC)** via the FEMA Map Information eXchange (FMIX) 1-877-336-2627 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this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

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

El Paso County Vertical Datum Offset Table

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

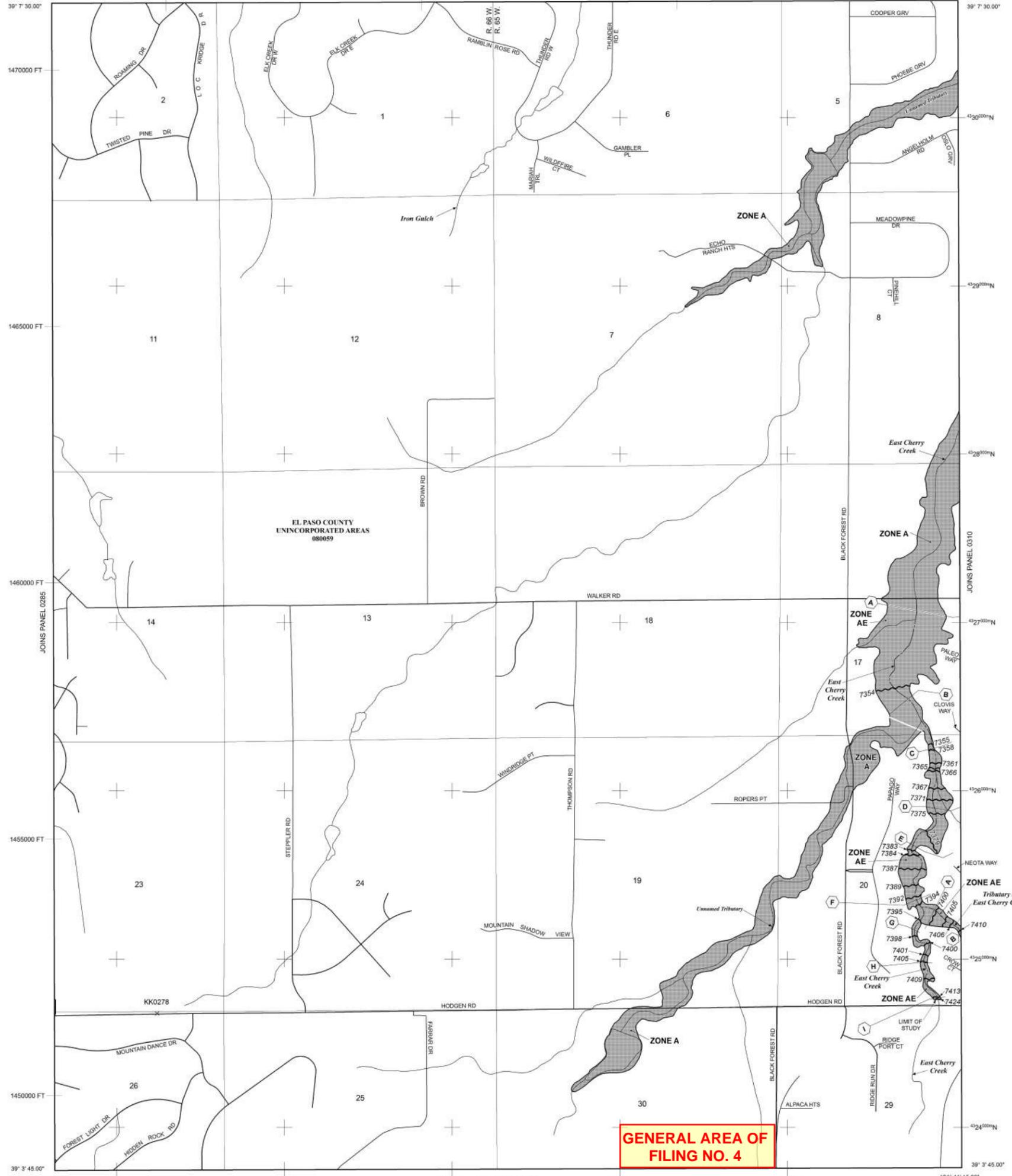
Panel Location Map



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



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



ZONE A No Base Flood Elevations determined.

ZONE AE Base Flood Elevations determined.

ZONE AH Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.

ZONE AO Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.

ZONE AR Special Flood Hazard Area Formerly protected from the 1% annual chance flood by a flood control system that was subsequently deteriorated. 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.
Base Flood Elevation line and value; elevation in feet*
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 Transsect line
97° 07' 30.00" 32° 22' 30.00" Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
4750000N 1000-meter Universal Transverse Mercator grid ticks, zone 13
6000000 FT 5000-foot grid ticks; Colorado State Plane coordinate system, central zone (FIPSZONE 6502), 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, 1987

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 1-800-638-6626.

MAP SCALE 1" = 1000'

0 1000 2000 FEET
0 300 600 METERS

NFIP

PANEL 0305G

FIRM
FLOOD INSURANCE RATE MAP
EL PASO COUNTY,
COLORADO
AND INCORPORATED AREAS

PANEL 305 OF 1300
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
EL PASO COUNTY	08059	0305	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 insurance community.

MAP NUMBER
08041C0305G

MAP REVISED

NOTES TO USERS

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

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

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

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

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

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

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

NGS Information Services
NOAA, NUNCS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, MD 20910-3282

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

Base Map information shown on this FIRM was provided in digital format by El Paso County, Colorado Springs Utilities, City of Fountain, Bureau of Land Management, National Oceanic and Atmospheric Administration, United States Geological Survey, and Anderson Consulting Engineers, Inc. These data are current as of 2006.

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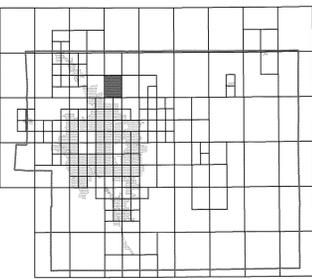
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El Paso County Vertical Datum Offset Table

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	

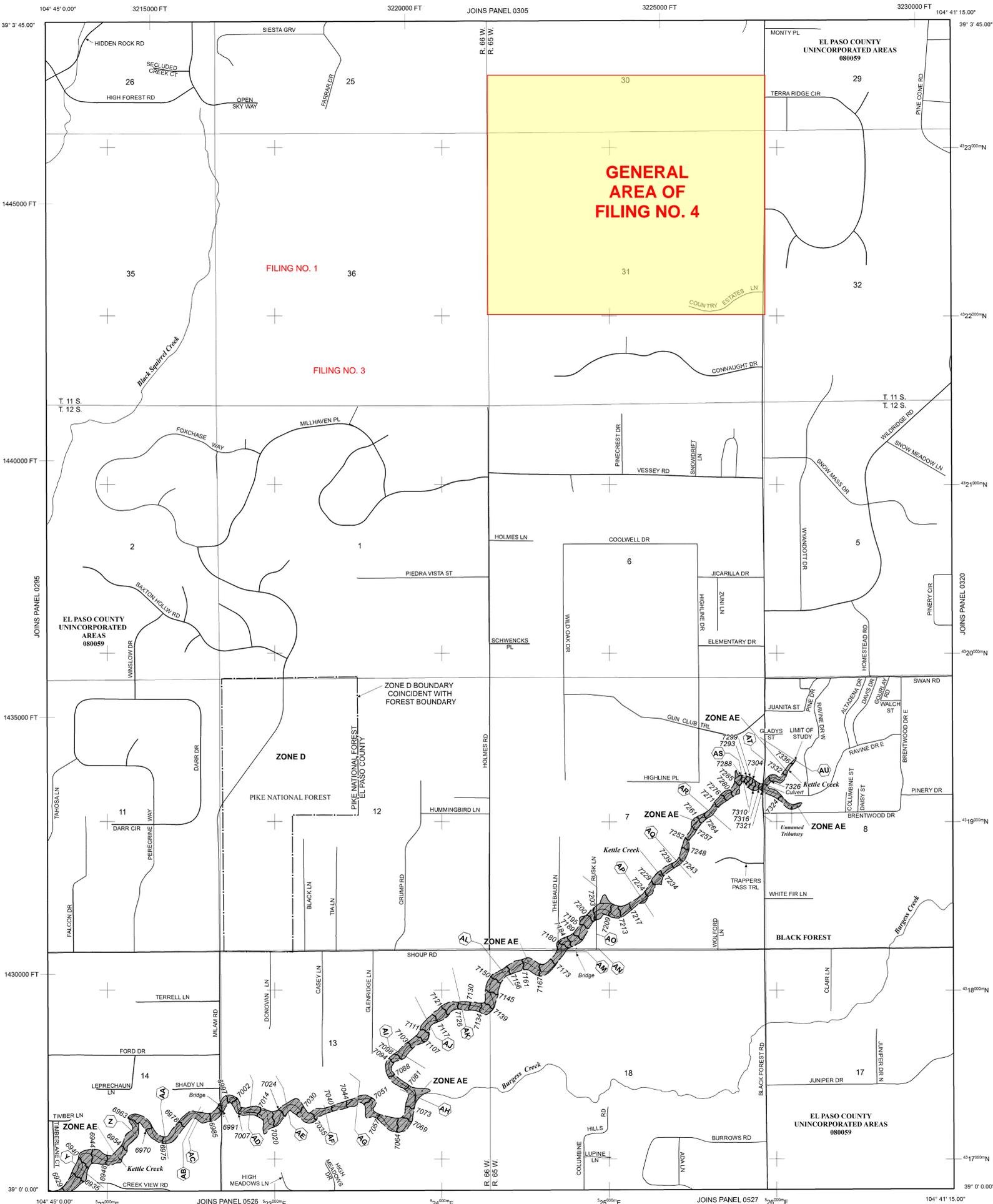
Panel Location Map



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



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



LEGEND

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

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

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

FLOODWAY AREAS IN ZONE AE

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

OTHER FLOOD AREAS

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

OTHER AREAS

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

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

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

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

- Floodplain boundary
- Floodway boundary
- Zone D boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.

513 Base Flood Elevation line and value; elevation in feet* (EL 987)

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

A—A Cross section line

23-23 Transsect line

57° 07' 30.00" 32° 22' 30.00" Datum of 1983 (NAD 83)

4750000N 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

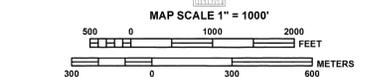
MAP REPOSITORIES Refer to Map Repositories list on Map Index

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.



NFP **PANEL 0315G**

FIRM
FLOOD INSURANCE RATE MAP
EL PASO COUNTY,
COLORADO
AND INCORPORATED AREAS

PANEL 315 OF 1300
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:
COMMUNITY NUMBER PANEL SUFFIX
EL PASO COUNTY 080059 0315 0

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
08041C0315G

MAP REVISED
DECEMBER 7, 2018
Federal Emergency Management Agency



4) 688 85(8) 888 888

688 85(8) 888 888	L:VHFW %DVHJRRG OHVWL RQ % =RQ\$ 9 \$ L:WK%RU#BWK =RQ\$ 888 888 \$HODVWU)DRRQ
2688 2688	\$DQD &OOFHJRRG EPUG \$HJ/ R DQDQ FROFHJRRG ZWKDUDH G-BWKOHV WKOQRQHRRW RU ZWKDUDH DJH/ R OHV WKOQRQHVTXUHOH#CH; XWXH&QGLVLRQ/\$DQD &OOFHJRRG EPUG =RQ#; \$HJZWK&G#GDRRG&LVNGHWR HHH &H RVH =RQ#; \$HJZWKDRRG&LVNGHWRHHH =RQ#
2688	\$HJ R OQLD DRRG EPUG =RQ#; (HFWLYH#V \$HJ R &GWHUHQ#GDRRG EPUG =RQ#
688 688	&OQD &OYHUW RU &VRUR#ZU HHH LNH RU DRRQD
26	&JRW &FVLRQ/ ZWKSDQD &OOFH DVHU &UIDFH OHVWL RQ &FDWDD 7UDQFW %DVHJRRG OHVWL RQ LQ % LEW R &VXG -XULVGLFVLRQ%&OQDU &FDWDD 7UDQFW %DVHJRRG &JROH%&DVHJRRG &JURD&L F#DVXUH
688	L:LWDD DWD\$DLODQD RL:LWDD DWD\$DLODQD &BSS-G

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7 4 H I O R R G K Q U G L Q R U B W L R Q L V G H U L Y H G L U H F W O I U R W K H
 D A V K R U L W D M L Y H 5 Z E V H U L F H V S U R L G G B 0 7 4 L V B S
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7 4 L V B S L B H L V Y R L G L I W K H R Q H R U R H R W K H I R O O R Z Q J B S
 H O H R Q W V G R Q R W D S S D U J E D H B S L B H U I O R R G J R Q H D E H O V
 O H H G G V R D D H E D U B S F U H D W L R Q C D W H F F R Q W L G Q M L L H U V
) 5 5 0 0 0 Q H E U 0 0 G) 5 H I F W L Y H G D W H D S L B H V I R U
 X 0 5 5 5 G 0 0 G X R G U Q L J G D U H D F R Q R W E H X H G I R U
 U H K O D W R U J S U S R V H



Flying Horse North Filing No. 4
Final Drainage Report
Project No.: 211030
El Paso County, Colorado

APPENDIX B

HYDROLOGY CALCULATIONS



RATIONAL METHOD CALCULATIONS

Please include
calculations for
existing condition.

HRG Response: Calculations for
existing conditions are now
included.



FLYING HORSE NORTH FILING NO. 4
PROPOSED CONDITIONS
EL PASO COUNTY, COLORADO

Calc'd by:	TMM
Checked by:	RDL
Date:	9/11/2024

TIME OF CONCENTRATION

BASIN DATA			OVERLAND TIME (T_t)			TRAVEL TIME (T_t)					TOTAL	$tc=(L/180)+10$	Design tc
DESIGNATION	C_s	AREA (ac)	LENGTH (ft)	SLOPE %	t_t (min)	C_v	LENGTH (ft)	SLOPE %	V (ft/s)	t_t (min)	t_c (min)	tc max	tc design (min)
A1	0.16	9.57	300	7.0	15.6	10	908	4.00	2.0	7.6	23.2	16.7	16.7
A2	0.17	10.79	300	5.7	16.5	10	372	2.60	1.6	3.8	20.4	13.7	13.7
A3	0.10	72.74	300	11.0	14.2	10	2230	4.00	2.0	18.6	32.8	24.1	24.1
A4	0.17	18.39	300	6.3	16.0	10	1115	2.20	1.5	12.5	28.5	17.9	17.9
A5	0.17	6.10	300	7.4	15.2	10	442	7.40	2.7	2.7	17.9	14.1	14.1
A6	0.17	2.76	300	11.0	13.3	10	227	11.40	3.4	1.1	14.4	12.9	12.9
A7	0.17	8.11	300	7.6	15.0	10	317	7.70	2.8	1.9	16.9	13.4	13.4
B1	0.18	57.78	300	4.5	17.8	10	2400	6.70	2.6	15.5	33.2	25.0	25.0
B2	0.21	35.77	300	11.4	12.5	10	2014	6.70	2.6	13.0	25.5	22.9	22.9
B3	0.16	11.00	300	12.0	13.0	10	293	11.60	3.4	1.4	14.5	13.3	13.3
B4	0.25	10.62	300	12.0	11.8	10	844	3.70	1.9	7.3	19.1	16.4	16.4
B5	0.12	10.62	300	6.1	17.0	10	658	5.20	2.3	4.8	21.8	15.3	15.3
B6	0.00	15.96	300	5.4	19.9	10	1238	3.80	1.9	10.6	30.5	18.5	18.5
C1	0.17	15.94	300	6.0	16.2	10	842	4.30	2.1	6.8	23.0	16.3	16.3
C2	0.17	1.98	300	5.2	17.0	10	257	6.00	2.4	1.7	18.8	13.1	13.1
C3	0.17	21.39	300	5.2	17.0	10	650	5.00	2.2	4.8	21.9	15.3	15.3
C4	0.14	4.31	130	7.4	10.3	10	188	6.30	2.5	1.2	11.5	11.8	11.5
C5	0.14	2.27	300	4.5	18.5	10	494	6.70	2.6	3.2	21.7	14.4	14.4
F1	0.17	12.83	300	3.3	19.8	10	600	2.00	1.4	7.1	26.9	15.0	15.0
F2	0.17	13.21	300	3.0	20.5	10	780	3.00	1.7	7.5	28.0	16.0	16.0
G1	0.17	2.58	300	7.4	15.2	10	90	7.40	2.7	0.6	15.7	12.2	12.2
G2	0.17	4.42	300	6.9	15.5	10	250	6.90	2.6	1.6	17.1	13.1	13.1
H1	0.17	5.20	166	10.1	10.2	10	268	1.20	1.1	4.1	14.2	12.4	12.4
H2	0.17	14.46	300	5.0	17.3	10	286	3.10	1.8	2.7	20.0	13.3	13.3
H3	0.00	36.80	300	5.0	20.4	10	1489	3.10	1.8	14.1	34.5	19.9	19.9



FLYING HORSE NORTH FILING NO. 4

Calc'd by:

TMM

PROPOSED CONDITIONS

Checked by:

RDL

DESIGN STORM: 5-YEAR

Date:

9/11/2024

			DIRECT RUNOFF					TOTAL RUNOFF					REMARKS
STREET	DESIGN POINT	BASIN ID	AREA (ac)	C _s	t _c (min)	C _s *A (ac)	I (in./hr.)	Q (cfs)	t _c (min)	C _s *A (ac)	I (in./hr.)	Q (cfs)	
	A1	A1	9.57	0.16	16.7	1.54	3.36	5.2					OVERLAND FLOW TO DP A1
	A2	A2	10.79	0.17	13.7	1.84	3.65	6.7	16.7	3.37	3.36	11.3	COMBINED BASIN A1 AND A2 FLOW IN PROPOSED SWALE TO DPA2
	A3	A3	72.74	0.10	24.1	7.53	2.81	21.2					FLOW TO DPA3
	A4	A4	18.39	0.17	17.9	3.13	3.26	10.2	24.1	10.66	2.81	30.0	COMBINED BASIN A3 AND A4 FLOW IN EXISTING SWALE TO DPA4
	A5	A5	6.10	0.17	14.1	1.04	3.61	3.7	16.7	4.41	3.36	14.8	COMBINED BASIN A1, A2, AND 5 FLOW IN PROPOSED SWALE TO DPA5
	A6	A6	2.76	0.17	12.9	0.47	3.74	1.8	24.1	11.13	2.81	31.3	COMBINED BASIN A1 - A6 FLOW INTO POND A
	A7	A7	8.11	0.17	13.4	1.38	3.69	5.1	16.7	5.79	3.36	19.5	FLOW FROM A7 TO POND A COMBINED BASIN FLOW A1 - A7
	B1	B1	57.78	0.10	25.0	5.77	2.75	15.9					FLOW TO DPB1
	B2	B2	35.77	0.18	22.9	6.29	2.89	18.2	25.0	12.07	2.75	33.2	COMBINED BASIN B1 AND B2 FLOW
	B3	B3	1.10	0.36	13.3	0.39	3.70	1.4	25.0	12.46	2.75	34.3	COMBINED B1 - B3 BASIN FLOW TO POND B
	B4	B4	11.00	0.21	16.4	2.35	3.39	8.0	25.0	14.80	2.75	40.8	FLOW FROM B4 TO POND B COMBINED BASIN FLOW B1 - B4
	B5	B5	10.62	0.17	15.3	1.81	3.49	6.3					OFFSITE BASIN FLOW
	B6	B6	15.96	0.17	18.5	2.72	3.20	8.7					OFFSITE BASIN FLOW
	C1	C1	15.94	0.16	16.3	2.57	3.39	8.7					FLOW TO DPC1
	C2	C2	1.98	0.25	13.1	0.50	3.72	1.9	16.3	3.06	3.39	10.4	COMBINED C1 AND C2 BASIN FLOW TO POND C
	C3	C3	21.39	0.15	15.3	3.24	3.49	11.3	16.3	6.30	3.39	21.4	FLOW FROM CS TO POND C COMBINED FLOWS C1 - C3
	C4	C4	4.31	0.17	11.5	0.73	3.92	2.9					OFFSITE BASIN FLOW
	C5	C5	2.27	0.17	14.4	0.39	3.58	1.4					OFFSITE BASIN FLOW



FLYING HORSE NORTH FILING NO. 4

Calc'd by:

TMM

PROPOSED CONDITIONS

Checked by:

RDL

DESIGN STORM: 5-YEAR

Date:

9/11/2024

			DIRECT RUNOFF						TOTAL RUNOFF				REMARKS
STREET	DESIGN POINT	BASIN ID	AREA (ac)	C ₅	t _c (min)	C ₅ *A (ac)	I (in./hr.)	Q (cfs)	t _c (min)	C ₅ *A (ac)	I (in./hr.)	Q (cfs)	
	F1	F1	12.83	0.17	15.0	2.18	3.52	7.7					FLOW TO DPF1 (TO PROPOSED FUTURE DETENTION)
	F2	F2	13.21	0.17	16.0	2.25	3.42	7.7					FLOW TO DPF2 (TO PROPOSED FUTURE DETENTION)
	G1	G1	2.58	0.17	12.2	0.44	3.83	1.7					FLOW TO DPG1
	G2	G2	4.42	0.08	13.1	0.35	3.73	1.3					COMBINED BASIN G1 AND G2 FLOWS
	H1	H1	5.20	0.17	12.4	0.89	3.81	3.4	13.1	0.79	3.73	3.0	FLOW TO DPH1
	H2	H2	14.46	0.17	13.3	2.46	3.71	9.1	13.3	1.68	3.71	6.2	COMBINE BASIN H1 AND H2 FLOW
	H3	H3	36.80	0.08	19.9	2.94	3.09	9.1	19.9	5.41	3.09	16.8	COMBINED G1, G2, AND H1 - H3 FLOW



FLYING HORSE NORTH FILING NO. 4

Calc'd by:

TMM

PROPOSED CONDITIONS

Check

RDL

DESIGN STORM: 100-YEAR

Date:

9/12/2024

			DIRECT RUNOFF						TOTAL RUNOFF				REMARKS
STREET	DESIGN PONT	BASIN ID	AREA (ac)	C ₁₀₀	t _c (min)	C ₁₀₀ *A (ac)	I (in./hr.)	Q (cfs)	t _c (min)	C ₁₀₀ *A (ac)	I (in./hr.)	Q (cfs)	
	A1	A1	9.57	0.41	16.7	3.92	5.64	22.1					OVERLAND FLOW TO DP A1
	A2	A2	10.79	0.42	13.7	4.50	6.13	27.6					
	A3	A3	72.74	0.37	24.1	26.73	4.72	126.2	16.7	8.42	8.51	71.7	COMBINED BASIN A1 AND A2 FLOW IN PROPOSED SWALE TO DPA2
	A4	A4	18.39	0.42	17.9	7.67	5.47	42.0					FLOW TO DPA3
	A5	A5	6.10	0.42	14.1	2.54	6.06	15.4	24.1	34.40	7.96	274.0	COMBINED BASIN A3 AND A4 FLOW IN EXISTING SWALE TO DPA4
	A6	A6	2.76	0.42	12.9	1.15	6.29	7.2	16.7	10.97	8.51	93.3	COMBINED BASIN A1, A2, AND 5 FLOW IN PROPOSED SWALE TO DPA5
	A7	A7	8.11	0.42	13.4	3.38	6.19	20.9	24.1	35.55	7.96	283.2	COMBINED BASIN A1 - A6 FLOW INTO POND A
	B1	B1	57.78	0.36	25.0	21.08	4.62	97.5					FLOW FROM A7 TO POND A
	B2	B2	35.77	0.42	22.9	15.07	4.85	73.1	16.7	14.35	8.51	122.1	COMBINED BASIN FLOW A1 - A7
	B3	B3	1.10	0.56	13.3	0.61	6.21	3.8					FLOW TO DPB1
	B4	B4	11.00	0.45	16.4	4.94	5.69	28.1	25.0	36.15	7.91	285.8	COMBINED BASIN B1 AND B2 FLOW
	B5	B5	10.62	0.42	15.3	4.43	5.86	25.9					
	B6	B6	15.96	0.42	18.5	6.66	5.38	35.8	25.0	36.76	7.91	290.7	COMBINED B1 - B3 BASIN FLOW TO POND B
	C1	C1	15.94	0.41	16.3	6.54	5.69	37.2					FLOW FROM B4 TO POND B
	C2	C2	1.98	0.48	13.1	0.95	6.25	5.9	25.0	41.70	7.91	329.7	COMBINED BASIN FLOW B1 - B4
	C3	C3	21.39	0.40	15.3	8.62	5.86	50.6					OFFSITE BASIN FLOW
	C4	C4	4.31	0.42	11.5	1.80	6.58	11.8					OFFSITE BASIN FLOW
	C5	C5	2.27	0.42	14.4	0.95	6.01	5.7					OFFSITE BASIN FLOW
									16.3	7.49	8.54	64.0	COMBINED C1 AND C2 BASIN FLOW TO POND C
									16.3	16.11	8.54	137.6	FLOW FROM CS TO POND C
													COMBINED FLOWS C1 - C3
													OFFSITE BASIN FLOW
													OFFSITE BASIN FLOW



FLYING HORSE NORTH FILING NO. 4

Calc'd by:

TMM

PROPOSED CONDITIONS

Check

RDL

DESIGN STORM: 100-YEAR

Date:

9/12/2024

			DIRECT RUNOFF						TOTAL RUNOFF				REMARKS
STREET	DESIGN POINT	BASIN ID	AREA (ac)	C ₁₀₀	t _c (min)	C ₁₀₀ *A (ac)	I (in./hr.)	Q (cfs)	t _c (min)	C ₁₀₀ *A (ac)	I (in./hr.)	Q (cfs)	
													OFF SITE BASIN FLOW
	F1	F1	12.83	0.42	15.0	5.35	5.91	31.6					FLOW TO DPF1 (TO PROPOSED FUTURE DETENTION)
	F2	F2	13.21	0.42	16.0	5.51	5.75	31.7					FLOW TO DPF2 (TO PROPOSED FUTURE DETENTION)
	G1	G1	2.58	0.42	12.2	1.08	6.44	6.9					FLOW TO DPG1
	G2	G2	4.42	0.35	13.1	1.55	6.26	9.7					
									13.1	2.62	8.88	23.3	COMBINED BASIN G1 AND G2 FLOWS
	H1	H1	5.20	0.42	12.4	2.17	6.39	13.9					FLOW TO DPH1
	H2	H2	14.46	0.42	13.3	6.03	6.22	37.5					
									13.3	4.79	8.86	42.4	COMBINE BASIN H1 AND H2 FLOW
	H3	H3	36.80	0.35	19.9	12.88	5.19	66.9					
									19.9	20.30	8.25	167.4	COMBINED G1, G2, AND H1 - H3 FLOW



Flying Horse North Filing No. 4
Final Drainage Report
Project No.: 211030
El Paso County, Colorado

COLORADO URBAN HYDROGRAPH PROCEDURE (CUHP)

CUHP SUBCATCHMENTS - HISTORIC

Columns with this color heading are for required user-input
 Columns with this color heading are for optional override values
 Columns with this color heading are for program-calculated values

Subcatchment Name	EPA SWMM Target Node	Raingage	Area (mi ²)	Length to Centroid (mi)	Length (mi)	Slope (ft/ft)	Percent Imperviousness	Maximum Depression Storage (Watershed inches)		Horton's Infiltration Parameters			DCIA
								Pervious	Impervious	Initial Rate (in/hr)	Decay Coefficient (1/seconds)	Final Rate (in/hr)	Level 0, 1, or 2
A1	A1	100-Year	0.11172	0.24808	0.50417	0.044	2.0	0.4	0.1	4.5	0.0018	0.6	0
A2	A2	100-Year	0.0882	0.28006	0.49237	0.055	2.0	0.4	0.1	4.5	0.0018	0.6	0
B1	B1	100-Year	0.14625	0.17679	0.556	0.039	3.6	0.4	0.1	4.5	0.0018	0.6	0
B2	B2	100-Year	0.07147	0.17404	0.27683	0.046	5.2	0.4	0.1	4.5	0.0018	0.6	0
B3	B3	100-Year	0.01763	0.07669	0.17258	0.062	2.0	0.4	0.1	4.5	0.0018	0.6	0
B4	B4	100-Year	0.01931	0.09155	0.17623	0.056	2.0	0.4	0.1	4.5	0.0018	0.6	0
C1	C1	100-Year	0.01948	0.05134	0.17182	0.048	9.4	0.4	0.1	4.5	0.0018	0.6	0
C2	C2	100-Year	0.03494	0.08962	0.21493	0.044	6.1	0.4	0.1	4.5	0.0018	0.6	0
C3	C3	100-Year	0.00713	0.03548	0.07618	0.064	2.0	0.4	0.1	4.5	0.0018	0.6	0
C4	C4	100-Year	0.00355	0.03177	0.08547	0.072	2.0	0.4	0.1	4.5	0.0018	0.6	0
F1	F1	100-Year	0.07161	0.07509	0.26483	0.035	2.0	0.4	0.1	4.5	0.0018	0.6	0
F2	F2	100-Year	0.01933	0.18144	0.41906	0.035	2.0	0.4	0.1	4.5	0.0018	0.6	0
G1	G1	100-Year	0.01198	0.0589	0.24273	0.056	2.0	0.4	0.1	4.5	0.0018	0.6	0
H1	H1	100-Year	0.08792	0.10799	0.50482	0.047	2.0	0.4	0.1	4.5	0.0018	0.6	0

5-Year Historic Results

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 2.0.1)

Catchment Name/ID	User Comment for Catchment	Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph			
		CT	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f.)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)	Runoff per Unit Area (cfs/acre)
A1		0.157	0.175	32.8	4.71	17.0	3.33	7.9	102	259,548	0.22	57,209	40.0	20	57,208	0.28
A2		0.157	0.158	36.2	4.68	18.8	3.31	7.8	73	204,906	0.22	45,165	41.0	14	45,164	0.25
B1		0.152	0.192	26.6	4.22	13.8	2.99	7.0	165	339,768	0.24	81,189	38.0	33	81,182	0.35
B2		0.148	0.135	25.0	2.89	13.0	2.04	4.8	86	166,039	0.26	42,781	36.0	18	42,775	0.38
B3		0.157	0.076	23.6	1.68	12.3	1.19	2.8	22	40,958	0.22	9,028	35.0	4	9,026	0.36
B4		0.157	0.080	25.5	1.86	13.3	1.31	3.1	23	44,861	0.22	9,888	36.0	4	9,886	0.34
C1		0.135	0.069	19.4	1.34	10.1	0.94	2.2	30	45,256	0.31	13,917	33.0	6	13,920	0.52
C2		0.145	0.096	22.4	1.96	11.6	1.38	3.3	47	81,173	0.27	21,774	35.0	10	21,772	0.43
C3		0.157	0.051	16.4	0.94	8.5	0.66	1.6	13	16,564	0.22	3,650	32.0	2	3,646	0.47
C4		0.157	0.037	21.9	0.92	11.4	0.65	1.5	5	8,247	0.22	1,817	35.0	1	1,816	0.38
F1		0.157	0.144	17.5	2.23	9.1	1.58	3.7	123	166,364	0.22	36,669	34.0	21	36,663	0.46
F2		0.157	0.080	60.0	3.97	31.2	2.81	6.6	10	44,907	0.22	9,898	43.0	2	9,898	0.16
G1		0.157	0.064	29.8	1.77	15.5	1.25	3.0	12	27,832	0.22	6,132	36.0	2	6,131	0.30
H1		0.157	0.157	24.1	3.22	12.5	2.27	5.4	109	204,256	0.22	45,021	37.0	20	45,019	0.36

100-Year Historic Results

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 2.0.1)

Catchment Name/ID	User Comment for Catchment	Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph			
		CT	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)	Runoff per Unit Area (cfs/acre)
A1		0.157	0.175	32.8	4.70	17.0	3.32	7.8	102	259,548	1.33	344,851	46.0	97	344,849	1.36
A2		0.157	0.157	36.2	4.67	18.8	3.30	7.8	73	204,906	1.33	272,251	47.0	71	272,247	1.26
B1		0.151	0.191	26.6	4.20	13.8	2.97	7.0	165	339,768	1.35	457,853	43.0	149	457,810	1.59
B2		0.146	0.134	25.0	2.87	13.0	2.03	4.8	86	166,039	1.37	226,897	41.0	76	226,872	1.66
B3		0.157	0.076	23.6	1.68	12.3	1.19	2.8	22	40,958	1.33	54,419	41.0	19	54,406	1.67
B4		0.157	0.079	25.5	1.85	13.3	1.31	3.1	23	44,861	1.33	59,605	41.0	20	59,594	1.58
C1		0.132	0.068	19.4	1.32	10.1	0.93	2.2	30	45,256	1.42	64,121	39.0	25	64,134	1.98
C2		0.143	0.095	22.4	1.94	11.6	1.37	3.2	47	81,173	1.38	111,795	40.0	40	111,781	1.78
C3		0.157	0.051	16.4	0.94	8.5	0.66	1.6	13	16,564	1.33	22,008	36.0	10	21,986	2.12
C4		0.157	0.037	21.9	0.92	11.4	0.65	1.5	5	8,247	1.33	10,958	40.0	4	10,950	1.74
F1		0.157	0.143	17.5	2.22	9.1	1.57	3.7	123	166,364	1.33	221,042	38.0	95	221,002	2.06
F2		0.157	0.079	60.0	3.96	31.2	2.80	6.6	10	44,907	1.33	59,667	54.0	11	59,665	0.85
G1		0.157	0.064	29.8	1.77	15.5	1.25	2.9	12	27,832	1.33	36,979	42.0	11	36,973	1.41
H1		0.157	0.157	24.1	3.21	12.5	2.27	5.3	109	204,256	1.33	271,387	41.0	94	271,372	1.67

CUHP SUBCATCHMENTS - DEVELOPED

Columns with this color heading are for required user-input
 Columns with this color heading are for optional override values
 Columns with this color heading are for program-calculated values

Subcatchment Name	EPA SWMM Target Node	Raingage	Area (mi ²)	Length to Centroid (mi)	Length (mi)	Slope (ft/ft)	Percent Imperviousness	Maximum Depression Storage (Watershed inches)		Horton's Infiltration Parameters			DCIA
								Pervious	Impervious	Initial Rate (in/hr)	Decay Coefficient (1/seconds)	Final Rate (in/hr)	Level 0, 1, or 2
A1	A1	100-Year	0.01495	0.06629	0.22879	0.040	10.2	0.4	0.05	4.5	0.0018	0.6	0
A2	A2	100-Year	0.01686	0.06174	0.12727	0.026	11.0	0.4	0.05	4.5	0.0018	0.6	0
A3	A3	100-Year	0.11366	0.24242	0.47917	0.040	4.1	0.4	0.05	4.5	0.0018	0.6	0
A4	A4	100-Year	0.02873	0.20436	0.26799	0.022	11.0	0.4	0.05	4.5	0.0018	0.6	0
A5	A5	100-Year	0.00386	0.03409	0.09981	0.114	11.0	0.4	0.05	4.5	0.0018	0.6	0
A6	A6	100-Year	0.00997	0.05587	0.14053	0.074	11.0	0.4	0.05	4.5	0.0018	0.6	0
A7	A7	100-Year	0.0127	0.05492	0.11686	0.077	11.0	0.4	0.05	4.5	0.0018	0.6	0
B1	B1	100-Year	0.15562	0.17803	0.51136	0.068	4.1	0.4	0.05	4.5	0.0018	0.6	0
B2	B2	100-Year	0.05589	0.21155	0.43826	0.068	11.7	0.4	0.05	4.5	0.0018	0.6	0
B3	B3	100-Year	0.00172	0.01705	0.08902	0.116	33.7	0.4	0.05	4.5	0.0018	0.6	0
B4	B4	100-Year	0.01719	0.12121	0.21496	0.037	10.2	0.4	0.05	4.5	0.0018	0.6	0
B5	B5	100-Year	0.01659	0.08051	0.14458	0.052	11.0	0.4	0.05	4.5	0.0018	0.6	0
B6	B6	100-Year	0.02494	0.05130	0.16422	0.038	11.0	0.4	0.05	4.5	0.0018	0.6	0
C1	C1	100-Year	0.02491	0.07630	0.21629	0.043	10.5	0.4	0.05	4.5	0.0018	0.6	0
C2	C2	100-Year	0.00309	0.05303	0.10549	0.060	20.9	0.4	0.05	4.5	0.0018	0.6	0
C3	C3	100-Year	0.03342	0.09570	0.20540	0.050	9.3	0.4	0.05	4.5	0.0018	0.6	0
C4	C4	100-Year	0.00673	0.03561	0.06045	0.063	11.0	0.4	0.05	4.5	0.0018	0.6	0
C5	C5	100-Year	0.00355	0.03788	0.08236	0.067	11.0	0.4	0.05	4.5	0.0018	0.6	0
F1	F1	100-Year	0.02005	0.07509	0.26483	0.020	11.0	0.4	0.05	4.5	0.0018	0.6	0
F2	F2	100-Year	0.02064	0.10766	0.26980	0.030	11.0	0.4	0.05	4.5	0.0018	0.6	0
F3	F3	100-Year	0.026156	0.09124	0.22906	0.036	11.0	0.4	0.05	4.5	0.0018	0.6	0
G1	G1	100-Year	0.00398	0.02309	0.07386	0.074	11.0	0.4	0.05	4.5	0.0018	0.6	0
G2	G2	100-Year	0.00691	0.05845	0.10417	0.069	2.0	0.4	0.05	4.5	0.0018	0.6	0
H1	H1	100-Year	0.00813	0.07519	0.06572	0.012	11.0	0.4	0.05	4.5	0.0018	0.6	0
H2	H2	100-Year	0.02259	0.05209	0.08858	0.031	11.0	0.4	0.05	4.5	0.0018	0.6	0
H3	H3	100-Year	0.0575	0.08230	0.27341	0.031	2.0	0.4	0.05	4.5	0.0018	0.6	0

5-Year Developed Results

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 2.0.1)

Catchment Name/ID	User Comment for Catchment	Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph			
		CT	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f.)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)	Runoff per Unit Area (cfs/acre)
A1		0.132	0.061	29.6	1.68	15.4	1.19	2.8	15	34,732	0.32	11,022	36.0	4	11,019	0.38
A2		0.129	0.063	22.6	1.39	11.8	0.98	2.3	22	39,169	0.33	12,920	35.0	5	12,921	0.48
A3		0.151	0.170	32.0	4.49	16.7	3.17	7.5	106	264,055	0.24	64,659	39.0	22	64,655	0.30
A4		0.129	0.080	47.0	3.18	24.4	2.25	5.3	18	66,746	0.33	22,016	41.0	5	22,015	0.27
A5		0.129	0.032	20.6	0.81	10.7	0.57	1.4	6	8,968	0.33	2,958	33.0	1	2,955	0.51
A6		0.129	0.050	22.3	1.15	11.6	0.81	1.9	13	23,162	0.33	7,640	35.0	3	7,639	0.49
A7		0.129	0.055	18.0	1.06	9.3	0.75	1.8	21	29,505	0.33	9,732	31.0	5	9,726	0.57
B1		0.151	0.196	21.8	3.58	11.3	2.53	6.0	214	361,536	0.25	88,754	36.0	42	88,751	0.42
B2		0.127	0.106	34.1	3.08	17.7	2.18	5.1	49	129,844	0.34	44,014	38.0	13	44,011	0.36
B3		0.099	0.024	14.4	0.56	7.5	0.40	0.9	4	3,996	0.64	2,563	30.0	1	2,548	1.04
B4		0.119	0.060	35.6	1.94	18.5	1.37	3.2	14	39,936	0.40	15,955	37.0	4	15,953	0.38
B5		0.129	0.062	23.3	1.42	12.1	1.00	2.4	21	38,542	0.33	12,713	35.0	5	12,714	0.47
B6		0.129	0.075	17.9	1.33	9.3	0.94	2.2	42	57,941	0.33	19,111	32.0	9	19,115	0.58
C1		0.131	0.076	24.0	1.70	12.5	1.20	2.8	31	57,871	0.32	18,701	35.0	7	18,697	0.46
C2		0.113	0.027	31.6	0.96	16.5	0.68	1.6	3	7,179	0.46	3,318	35.0	1	3,316	0.46
C3		0.135	0.089	22.2	1.81	11.5	1.28	3.0	45	77,641	0.31	23,934	35.0	10	23,930	0.47
C4		0.129	0.042	14.8	0.77	7.7	0.55	1.3	14	15,635	0.33	5,157	31.0	3	5,150	0.66
C5		0.129	0.031	23.3	0.86	12.1	0.61	1.4	5	8,247	0.33	2,720	35.0	1	2,718	0.47
F1		0.129	0.068	34.8	2.11	18.1	1.49	3.5	17	46,580	0.33	15,364	37.0	4	15,362	0.34
F2		0.129	0.069	37.3	2.27	19.4	1.61	3.8	17	47,951	0.33	15,816	37.0	4	15,816	0.32
F3		0.129	0.077	27.5	1.92	14.3	1.36	3.2	29	60,766	0.33	20,043	36.0	7	20,041	0.42
G1		0.129	0.033	16.2	0.71	8.4	0.50	1.2	7	9,246	0.33	3,050	31.0	2	3,045	0.62
G2		0.157	0.050	24.1	1.23	12.5	0.87	2.0	9	16,053	0.22	3,542	35.0	2	3,542	0.35
H1		0.129	0.045	30.2	1.35	15.7	0.96	2.3	8	18,888	0.33	6,230	36.0	2	6,230	0.38
H2		0.129	0.072	14.7	1.11	7.6	0.78	1.9	46	52,481	0.33	17,311	31.0	10	17,301	0.67
H3		0.157	0.130	21.1	2.41	11.0	1.70	4.0	82	133,584	0.22	29,485	35.0	15	29,484	0.40

100-Year Developed Results

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 2.0.1)

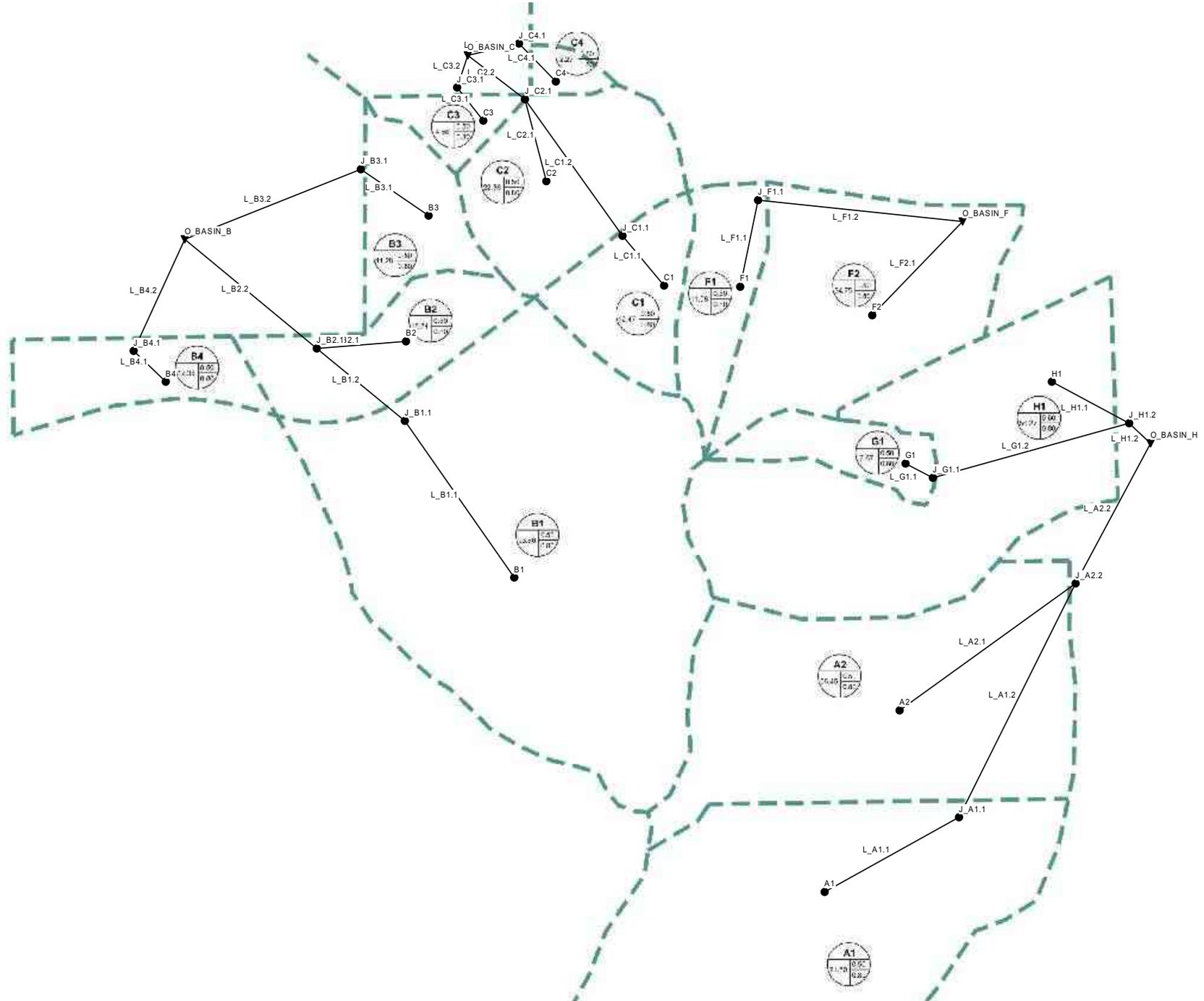
Catchment Name/ID	User Comment for Catchment	Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph			
		CT	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f.)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)	Runoff per Unit Area (cfs/acre)
A1		0.130	0.060	29.5	1.66	15.4	1.17	2.8	15	34,732	1.43	49,514	41.0	14.3	49,504	1.50
A2		0.127	0.062	22.5	1.37	11.7	0.97	2.3	22	39,169	1.44	56,348	40.0	19.6	56,353	1.81
A3		0.150	0.169	32.0	4.46	16.7	3.15	7.4	106	264,055	1.35	357,276	45.0	101.6	357,257	1.40
A4		0.127	0.079	46.8	3.13	24.4	2.21	5.2	18	66,746	1.44	96,019	50.0	20.0	96,014	1.09
A5		0.127	0.032	20.5	0.80	10.7	0.57	1.3	6	8,968	1.44	12,901	40.0	4.7	12,888	1.92
A6		0.127	0.049	22.2	1.13	11.5	0.80	1.9	13	23,162	1.44	33,321	40.0	11.7	33,314	1.83
A7		0.127	0.054	17.9	1.05	9.3	0.74	1.7	21	29,505	1.44	42,445	36.0	17.1	42,413	2.11
B1		0.150	0.194	21.8	3.55	11.3	2.51	5.9	214	361,536	1.35	489,397	41.0	182.0	489,384	1.83
B2		0.125	0.105	34.0	3.04	17.7	2.15	5.1	49	129,844	1.45	188,018	45.0	49.5	188,002	1.38
B3		0.098	0.024	14.1	0.56	7.3	0.40	0.9	4	3,996	1.75	7,002	35.0	3.0	6,962	2.77
B4		0.118	0.060	35.4	1.93	18.4	1.36	3.2	15	39,936	1.51	60,315	45.0	15.1	60,311	1.37
B5		0.127	0.061	23.2	1.39	12.1	0.98	2.3	21	38,542	1.44	55,446	40.0	18.9	55,452	1.78
B6		0.127	0.074	17.8	1.31	9.3	0.93	2.2	42	57,941	1.44	83,352	36.0	33.9	83,372	2.12
C1		0.128	0.075	24.0	1.67	12.5	1.18	2.8	31	57,871	1.43	82,851	40.0	27.7	82,825	1.74
C2		0.111	0.027	31.4	0.95	16.3	0.67	1.6	3	7,179	1.57	11,299	41.0	3.0	11,293	1.52
C3		0.132	0.087	22.1	1.78	11.5	1.26	3.0	45	77,641	1.42	109,982	40.0	39.0	109,959	1.82
C4		0.127	0.041	14.8	0.76	7.7	0.54	1.3	14	15,635	1.44	22,492	35.0	10.3	22,461	2.40
C5		0.127	0.031	23.2	0.85	12.1	0.60	1.4	5	8,247	1.44	11,865	40.0	4.0	11,855	1.77
F1		0.127	0.067	34.6	2.08	18.0	1.47	3.5	17	46,580	1.44	67,009	45.0	17.3	66,999	1.35
F2		0.127	0.068	37.2	2.24	19.4	1.58	3.7	17	47,951	1.44	68,981	46.0	16.9	68,979	1.28
F3		0.127	0.075	27.4	1.89	14.3	1.33	3.1	29	60,766	1.44	87,416	41.0	26.6	87,405	1.59
G1		0.127	0.032	16.1	0.70	8.4	0.49	1.2	7	9,246	1.44	13,302	35.0	5.7	13,278	2.26
G2		0.157	0.050	24.1	1.23	12.5	0.87	2.0	9	16,053	1.33	21,329	40.0	7.2	21,331	1.64
H1		0.127	0.045	30.1	1.33	15.7	0.94	2.2	8	18,888	1.44	27,171	41.0	7.7	27,174	1.48
H2		0.127	0.071	14.7	1.09	7.6	0.77	1.8	46	52,481	1.44	75,498	36.0	35.0	75,456	2.42
H3		0.157	0.130	21.1	2.40	11.0	1.70	4.0	82	133,584	1.33	177,493	40.0	66.9	177,491	1.82



Flying Horse North Filing No. 4
Final Drainage Report
Project No.: 211030
El Paso County, Colorado

STORM WATER MANAGEMENT MODEL (SWMM)

FLYING HORSE NORTH FILING NO. 4 HISTORIC SWMM MODEL





```
[TITLE]
;;Project Title/Notes
Flying Horse North Filing No. 4
Final Drainage Report
```

```
[OPTIONS]
;;Option Value
FLOW_UNITS CFS
INFILTRATION HORTON
FLOW_ROUTING KINWAVE
LINK_OFFSETS DEPTH
MIN_SLOPE 0
ALLOW_PONDING NO
SKIP_STEADY_STATE NO
```

```
START_DATE 01/01/2005
START_TIME 00:00:00
REPORT_START_DATE 01/01/2005
REPORT_START_TIME 00:00:00
END_DATE 01/05/2005
END_TIME 00:00:00
SWEEP_START 01/01
SWEEP_END 12/31
DRY_DAYS 0
REPORT_STEP 00:05:00
WET_STEP 00:05:00
DRY_STEP 01:00:00
ROUTING_STEP 0:01:00
```

```
INERTIAL_DAMPING PARTIAL
NORMAL_FLOW_LIMITED BOTH
FORCE_MAIN_EQUATION H-W
VARIABLE_STEP 0.75
LENGTHENING_STEP 0
MIN_SURFAREA 12.557
MAX_TRIALS 8
HEAD_TOLERANCE 0.005
SYS_FLOW_TOL 5
LAT_FLOW_TOL 5
MINIMUM_STEP 0.5
THREADS 1
```

```
[FILES]
;;Interfacing Files
USE INFLOWS "SWMM_Existing_Interface_100.txt"
```

```
[EVAPORATION]
;;Data Source Parameters
;;-----
CONSTANT 0.0
DRY_ONLY NO
```

```
[JUNCTIONS]
;;Name Elevation MaxDepth InitDepth SurDepth Aponded
;;-----
```

Name	Elevation	MaxDepth	InitDepth	SurDepth	Aponded
A1	7605	0	0	0	0
A2	7597	0	0	0	0
B1	7572	0	0	0	0
B2	7558	0	0	0	0
B3	7558	0	0	0	0
B4	7552	0	0	0	0
C1	7586	0	0	0	0
C2	7562	0	0	0	0
C3	7553	0	0	0	0
C4	7536	0	0	0	0
H1	7550	0	0	0	0
G1	7585	0	0	0	0
F2	7568	0	0	0	0
F1	7582	0	0	0	0
J_B1.1	7536	0	0	0	0
J_A1.1	7565	0	0	0	0
J_G1.1	7555	0	0	0	0
J_C1.1	7570	0	0	0	0
J_A2.2	7525	0	0	0	0

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J_H1.2	7516	0	0	0	0
J_F1.1	7572	0	0	0	0
J_B4.1	7510	0	0	0	0
J_B2.1	7522	0	0	0	0
J_B3.1	7533	0	0	0	0
J_C3.1	7544	0	0	0	0
J_C2.1	7529	0	0	0	0
J_C4.1	7524	0	0	0	0

```
[OUTFALLS]
;;Name      Elevation  Type      Stage Data  Gated  Route To
-----
O_BASIN_B  7510      FREE      NO          NO
O_BASIN_C  7520      FREE      NO          NO
O_BASIN_F  7547      FREE      NO          NO
O_BASIN_H  7515      FREE      NO          NO
```

```
[CONDUITS]
;;Name      From Node  To Node  Length  Roughness  InOffset  OutOffset  InitFlow
MaxFlow
-----
L_A1.1      A1          J_A1.1  400     .013      0         0         0
L_A2.1      A2          J_A2.2  400     .013      0         0         0
L_A1.2      J_A1.1     J_A2.2  1505    .035      0         0         0
L_G1.1      G1          J_G1.1  400     .013      0         0         0
L_H1.1      H1          J_H1.2  400     .013      0         0         0
L_G1.2      J_G1.1     J_H1.2  1031    .035      0         0         0
L_F1.1      F1          J_F1.1  400     .013      0         0         0
L_B1.1      B1          J_B1.1  400     .013      0         0         0
L_B2.1      B2          J_B2.1  400     .013      0         0         0
L_B1.2      J_B1.1     J_B2.1  400     .013      0         0         0
L_B4.1      B4          J_B4.1  400     .013      0         0         0
L_B3.1      B3          J_B3.1  400     .013      0         0         0
L_C3.1      C3          J_C3.1  400     .013      0         0         0
L_C4.1      C4          J_C4.1  400     .013      0         0         0
L_C1.1      C1          J_C1.1  400     .013      0         0         0
L_C1.2      J_C1.1     J_C2.1  400     .013      0         0         0
L_C2.1      C2          J_C2.1  400     .013      0         0         0
L_A2.2      J_A2.2     O_BASIN_H  680    .035      0         0         0
L_H1.2      J_H1.2     O_BASIN_H  400    .013      0         0         0
L_F2.1      F2          O_BASIN_F  400    .013      0         0         0
L_F1.2      J_F1.1     O_BASIN_F  1200   .030      0         0         0
L_B4.2      J_B4.1     O_BASIN_B  400    .013      0         0         0
L_B2.2      J_B2.1     O_BASIN_B  400    .013      0         0         0
L_B3.2      J_B3.1     O_BASIN_B  400    .013      0         0         0
L_C3.2      J_C3.1     O_BASIN_C  400    .013      0         0         0
L_C2.2      J_C2.1     O_BASIN_C  400    .013      0         0         0
L_C4.2      J_C4.1     O_BASIN_C  400    .013      0         0         0
```

```
[XSECTIONS]
;;Link      Shape      Geom1      Geom2      Geom3      Geom4      Barrels  Culvert
-----
L_A1.1      DUMMY      0           0           0           0           1
L_A2.1      DUMMY      0           0           0           0           1
L_A1.2      TRAPEZOIDAL  5           5           4           4           1
L_G1.1      DUMMY      0           0           0           0           1
L_H1.1      DUMMY      0           0           0           0           1
L_G1.2      TRAPEZOIDAL  4           5           4           4           1
L_F1.1      DUMMY      0           0           0           0           1
L_B1.1      DUMMY      0           0           0           0           1
L_B2.1      DUMMY      0           0           0           0           1
L_B1.2      DUMMY      0           0           0           0           1
L_B4.1      DUMMY      0           0           0           0           1
L_B3.1      DUMMY      0           0           0           0           1
L_C3.1      DUMMY      0           0           0           0           1
L_C4.1      DUMMY      0           0           0           0           1
L_C1.1      DUMMY      0           0           0           0           1
L_C1.2      DUMMY      0           0           0           0           1
L_C2.1      DUMMY      0           0           0           0           1
L_A2.2      TRAPEZOIDAL  5           10          4           4           1
L_H1.2      DUMMY      0           0           0           0           1
L_F2.1      DUMMY      0           0           0           0           1
L_F1.2      TRIANGULAR  2           16          0           0           1
```

9/4/2024



```
L_B4.2      DUMMY      0          0          0          0          1
L_B2.2      DUMMY      0          0          0          0          1
L_B3.2      DUMMY      0          0          0          0          1
L_C3.2      DUMMY      0          0          0          0          1
L_C2.2      DUMMY      0          0          0          0          1
L_C4.2      DUMMY      0          0          0          0          1
```

```
[REPORT]
;;Reporting Options
INPUT      NO
CONTROLS   NO
SUBCATCHMENTS ALL
NODES ALL
LINKS ALL
```

```
[TAGS]
```

```
[MAP]
DIMENSIONS -2727.273 0.000 12727.273 10000.000
Units      None
```

```
[COORDINATES]
;;Node      X-Coord      Y-Coord
;;-----
A1           6821.306      2325.315
A2           7424.143      3779.629
B1           4340.564      4852.974
B2           3974.670      6858.617
B3           3649.430      7759.802
B4           1528.598      6587.584
C1           5539.885      7190.633
C2           4327.012      8051.162
C3           4083.620      8522.337
C4           4930.061      8837.157
H1           8083.297      6216.763
G1           6452.759      5965.243
F2           7199.961      6960.255
F1           6142.933      7183.857
J_B1.1       3459.707      6106.501
J_A1.1       7898.053      2920.962
J_G1.1       7691.867      5647.194
J_C1.1       5206.186      7594.502
J_A2.2       8837.854      4803.052
J_H1.2       9262.835      6086.666
J_F1.1       6292.001      7881.767
J_B4.1       1230.461      6845.066
J_B2.1       2599.178      6865.393
J_B3.1       3107.364      8125.696
J_C3.1       3882.630      8787.561
J_C2.1       4421.738      8692.249
J_C4.1       4424.717      9261.142
O_BASIN_B    1697.993      7563.303
O_BASIN_C    3969.007      9043.712
O_BASIN_F    7931.750      7705.595
O_BASIN_H    9436.296      5930.551
```

```
[VERTICES]
;;Link      X-Coord      Y-Coord
;;-----
```



EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.012)

Flying Horse North Filing No. 4
 Final Drainage Report

WARNING 04: minimum elevation drop used for Conduit L_B4.2

 NOTE: The summary statistics displayed in this report are based on results found at every computational time step, not just on results from each reporting time step.

 Analysis Options

 Flow Units CFS
 Process Models:
 Rainfall/Runoff NO
 RDII NO
 Snowmelt NO
 Groundwater NO
 Flow Routing YES
 Ponding Allowed NO
 Water Quality NO
 Flow Routing Method KINWAVE
 Starting Date 01/01/2005 00:00:00
 Ending Date 01/05/2005 00:00:00
 Antecedent Dry Days 0.0
 Report Time Step 00:05:00
 Routing Time Step 60.00 sec

	Volume acre-feet	Volume 10 ⁶ gal
Flow Routing Continuity		
Dry Weather Inflow	0.000	0.000
Wet Weather Inflow	0.000	0.000
Groundwater Inflow	0.000	0.000
RDII Inflow	0.000	0.000
External Inflow	8.818	2.873
External Outflow	8.842	2.881
Flooding Loss	0.000	0.000
Evaporation Loss	0.000	0.000
Exfiltration Loss	0.000	0.000
Initial Stored Volume	0.000	0.000
Final Stored Volume	0.000	0.000
Continuity Error (%)	-0.282	

 Highest Flow Instability Indexes

 All links are stable.

 Routing Time Step Summary

 Minimum Time Step : 60.00 sec
 Average Time Step : 60.00 sec
 Maximum Time Step : 60.00 sec
 Percent in Steady State : 0.00
 Average Iterations per Step : 1.00
 Percent Not Converging : 0.00



 Node Depth Summary

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min	Reported Max Depth Feet
A1	JUNCTION	0.00	0.00	7605.00	0 00:00	0.00
A2	JUNCTION	0.00	0.00	7597.00	0 00:00	0.00
B1	JUNCTION	0.00	0.00	7572.00	0 00:00	0.00
B2	JUNCTION	0.00	0.00	7558.00	0 00:00	0.00
B3	JUNCTION	0.00	0.00	7558.00	0 00:00	0.00
B4	JUNCTION	0.00	0.00	7552.00	0 00:00	0.00
C1	JUNCTION	0.00	0.00	7586.00	0 00:00	0.00
C2	JUNCTION	0.00	0.00	7562.00	0 00:00	0.00
C3	JUNCTION	0.00	0.00	7553.00	0 00:00	0.00
C4	JUNCTION	0.00	0.00	7536.00	0 00:00	0.00
H1	JUNCTION	0.00	0.00	7550.00	0 00:00	0.00
G1	JUNCTION	0.00	0.00	7585.00	0 00:00	0.00
F2	JUNCTION	0.00	0.00	7568.00	0 00:00	0.00
F1	JUNCTION	0.00	0.00	7582.00	0 00:00	0.00
J_B1.1	JUNCTION	0.00	0.00	7536.00	0 00:00	0.00
J_A1.1	JUNCTION	0.01	0.63	7565.63	0 00:41	0.63
J_G1.1	JUNCTION	0.00	0.17	7555.17	0 00:37	0.17
J_C1.1	JUNCTION	0.00	0.00	7570.00	0 00:00	0.00
J_A2.2	JUNCTION	0.01	0.72	7525.72	0 00:44	0.72
J_H1.2	JUNCTION	0.00	0.17	7516.17	0 00:44	0.17
J_F1.1	JUNCTION	0.01	1.07	7573.07	0 00:35	1.07
J_B4.1	JUNCTION	0.00	0.00	7510.00	0 00:00	0.00
J_B2.1	JUNCTION	0.00	0.00	7522.00	0 00:00	0.00
J_B3.1	JUNCTION	0.00	0.00	7533.00	0 00:00	0.00
J_C3.1	JUNCTION	0.00	0.00	7544.00	0 00:00	0.00
J_C2.1	JUNCTION	0.00	0.00	7529.00	0 00:00	0.00
J_C4.1	JUNCTION	0.00	0.00	7524.00	0 00:00	0.00
O_BASIN_B	OUTFALL	0.00	0.00	7510.00	0 00:00	0.00
O_BASIN_C	OUTFALL	0.00	0.00	7520.00	0 00:00	0.00
O_BASIN_F	OUTFALL	0.01	1.06	7548.06	0 00:39	1.05
O_BASIN_H	OUTFALL	0.01	0.72	7515.72	0 00:47	0.72

 Node Inflow Summary

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal	Flow Balance Error Percent
A1	JUNCTION	19.90	19.90	0 00:41	0.428	0.428	0.000
A2	JUNCTION	14.37	14.37	0 00:42	0.338	0.338	0.000
B1	JUNCTION	32.86	32.86	0 00:39	0.607	0.607	0.000
B2	JUNCTION	17.57	17.57	0 00:37	0.32	0.32	0.000
B3	JUNCTION	4.06	4.06	0 00:36	0.0675	0.0675	0.000
B4	JUNCTION	4.18	4.18	0 00:37	0.074	0.074	0.000
C1	JUNCTION	6.43	6.43	0 00:34	0.104	0.104	0.000
C2	JUNCTION	9.54	9.54	0 00:36	0.163	0.163	0.000
C3	JUNCTION	2.16	2.16	0 00:33	0.0273	0.0273	0.000
C4	JUNCTION	0.86	0.86	0 00:36	0.0136	0.0136	0.000
H1	JUNCTION	20.18	20.18	0 00:38	0.337	0.337	0.000
G1	JUNCTION	2.27	2.27	0 00:37	0.0459	0.0459	0.000
F2	JUNCTION	1.97	1.97	0 00:44	0.074	0.074	0.000
F1	JUNCTION	21.05	21.05	0 00:35	0.274	0.274	0.000
J_B1.1	JUNCTION	0.00	32.86	0 00:39	0	0.607	0.000
J_A1.1	JUNCTION	0.00	19.90	0 00:41	0	0.428	0.000
J_G1.1	JUNCTION	0.00	2.27	0 00:37	0	0.0459	0.000
J_C1.1	JUNCTION	0.00	6.43	0 00:34	0	0.104	0.000
J_A2.2	JUNCTION	0.00	33.39	0 00:44	0	0.77	0.000
J_H1.2	JUNCTION	0.00	22.00	0 00:38	0	0.383	0.000
J_F1.1	JUNCTION	0.00	21.05	0 00:35	0	0.274	0.000



J_B4.1	JUNCTION	0.00	4.18	0	00:37	0	0.074	0.000
J_B2.1	JUNCTION	0.00	50.33	0	00:38	0	0.927	0.000
J_B3.1	JUNCTION	0.00	4.06	0	00:36	0	0.0675	0.000
J_C3.1	JUNCTION	0.00	2.16	0	00:33	0	0.0273	0.000
J_C2.1	JUNCTION	0.00	15.94	0	00:36	0	0.267	0.000
J_C4.1	JUNCTION	0.00	0.86	0	00:36	0	0.0136	0.000
O_BASIN_B	OUTFALL	0.00	58.46	0	00:38	0	1.07	0.000
O_BASIN_C	OUTFALL	0.00	18.92	0	00:36	0	0.308	0.000
O_BASIN_F	OUTFALL	0.00	22.28	0	00:39	0	0.35	0.000
O_BASIN_H	OUTFALL	0.00	52.26	0	00:44	0	1.15	0.000

 Node Flooding Summary

No nodes were flooded.

 Outfall Loading Summary

Outfall Node	Flow Freq Pcnt	Avg Flow CFS	Max Flow CFS	Total Volume 10^6 gal
O_BASIN_B	3.40	12.15	58.46	1.069
O_BASIN_C	3.09	3.85	18.92	0.308
O_BASIN_F	4.64	2.92	22.28	0.350
O_BASIN_H	6.77	6.60	52.26	1.155
System	4.47	25.52	145.71	2.881

 Link Flow Summary

Link	Type	Maximum Flow CFS	Time of Max Occurrence days hr:min	Maximum Veloc ft/sec	Max/ Full Flow	Max/ Full Depth
L_A1.1	DUMMY	19.90	0 00:41			
L_A2.1	DUMMY	14.37	0 00:42			
L_A1.2	CONDUIT	19.44	0 00:46	4.24	0.01	0.12
L_G1.1	DUMMY	2.27	0 00:37			
L_H1.1	DUMMY	20.18	0 00:38			
L_G1.2	CONDUIT	2.17	0 00:44	2.36	0.00	0.04
L_F1.1	DUMMY	21.05	0 00:35			
L_B1.1	DUMMY	32.86	0 00:39			
L_B2.1	DUMMY	17.57	0 00:37			
L_B1.2	DUMMY	32.86	0 00:39			
L_B4.1	DUMMY	4.18	0 00:37			
L_B3.1	DUMMY	4.06	0 00:36			
L_C3.1	DUMMY	2.16	0 00:33			
L_C4.1	DUMMY	0.86	0 00:36			
L_C1.1	DUMMY	6.43	0 00:34			
L_C1.2	DUMMY	6.43	0 00:34			
L_C2.1	DUMMY	9.54	0 00:36			
L_A2.2	CONDUIT	33.23	0 00:47	3.61	0.02	0.14
L_H1.2	DUMMY	22.00	0 00:38			
L_F2.1	DUMMY	1.97	0 00:44			
L_F1.2	CONDUIT	20.37	0 00:39	4.69	0.18	0.53
L_B4.2	DUMMY	4.18	0 00:37			
L_B2.2	DUMMY	50.33	0 00:38			
L_B3.2	DUMMY	4.06	0 00:36			
L_C3.2	DUMMY	2.16	0 00:33			
L_C2.2	DUMMY	15.94	0 00:36			
L_C4.2	DUMMY	0.86	0 00:36			



Conduit Surcharge Summary

No conduits were surcharged.

Analysis begun on: Wed Sep 11 10:15:11 2024
Analysis ended on: Wed Sep 11 10:15:11 2024
Total elapsed time: < 1 sec



EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.012)

Flying Horse North Filing No. 4
 Final Drainage Report

WARNING 04: minimum elevation drop used for Conduit L_B4.2

 NOTE: The summary statistics displayed in this report are
 based on results found at every computational time step,
 not just on results from each reporting time step.

 Analysis Options

 Flow Units CFS
 Process Models:
 Rainfall/Runoff NO
 RDII NO
 Snowmelt NO
 Groundwater NO
 Flow Routing YES
 Ponding Allowed NO
 Water Quality NO
 Flow Routing Method KINWAVE
 Starting Date 01/01/2005 00:00:00
 Ending Date 01/05/2005 00:00:00
 Antecedent Dry Days 0.0
 Report Time Step 00:05:00
 Routing Time Step 60.00 sec

	Volume acre-feet	Volume 10^6 gal
Flow Routing Continuity		
Dry Weather Inflow	0.000	0.000
Wet Weather Inflow	0.000	0.000
Groundwater Inflow	0.000	0.000
RDII Inflow	0.000	0.000
External Inflow	50.816	16.559
External Outflow	50.865	16.575
Flooding Loss	0.000	0.000
Evaporation Loss	0.000	0.000
Exfiltration Loss	0.000	0.000
Initial Stored Volume	0.000	0.000
Final Stored Volume	0.000	0.000
Continuity Error (%)	-0.095	

 Highest Flow Instability Indexes

 All links are stable.

 Routing Time Step Summary

 Minimum Time Step : 60.00 sec
 Average Time Step : 60.00 sec
 Maximum Time Step : 60.00 sec
 Percent in Steady State : 0.00
 Average Iterations per Step : 1.00
 Percent Not Converging : 0.00



Node Depth Summary

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min	Reported Max Depth Feet
A1	JUNCTION	0.00	0.00	7605.00	0 00:00	0.00
A2	JUNCTION	0.00	0.00	7597.00	0 00:00	0.00
B1	JUNCTION	0.00	0.00	7572.00	0 00:00	0.00
B2	JUNCTION	0.00	0.00	7558.00	0 00:00	0.00
B3	JUNCTION	0.00	0.00	7558.00	0 00:00	0.00
B4	JUNCTION	0.00	0.00	7552.00	0 00:00	0.00
C1	JUNCTION	0.00	0.00	7586.00	0 00:00	0.00
C2	JUNCTION	0.00	0.00	7562.00	0 00:00	0.00
C3	JUNCTION	0.00	0.00	7553.00	0 00:00	0.00
C4	JUNCTION	0.00	0.00	7536.00	0 00:00	0.00
H1	JUNCTION	0.00	0.00	7550.00	0 00:00	0.00
G1	JUNCTION	0.00	0.00	7585.00	0 00:00	0.00
F2	JUNCTION	0.00	0.00	7568.00	0 00:00	0.00
F1	JUNCTION	0.00	0.00	7582.00	0 00:00	0.00
J_B1.1	JUNCTION	0.00	0.00	7536.00	0 00:00	0.00
J_A1.1	JUNCTION	0.02	1.41	7566.41	0 00:47	1.41
J_G1.1	JUNCTION	0.01	0.41	7555.41	0 00:43	0.41
J_C1.1	JUNCTION	0.00	0.00	7570.00	0 00:00	0.00
J_A2.2	JUNCTION	0.03	1.71	7526.71	0 00:49	1.71
J_H1.2	JUNCTION	0.01	0.41	7516.41	0 00:48	0.41
J_F1.1	JUNCTION	0.02	1.88	7573.88	0 00:39	1.87
J_B4.1	JUNCTION	0.00	0.00	7510.00	0 00:00	0.00
J_B2.1	JUNCTION	0.00	0.00	7522.00	0 00:00	0.00
J_B3.1	JUNCTION	0.00	0.00	7533.00	0 00:00	0.00
J_C3.1	JUNCTION	0.00	0.00	7544.00	0 00:00	0.00
J_C2.1	JUNCTION	0.00	0.00	7529.00	0 00:00	0.00
J_C4.1	JUNCTION	0.00	0.00	7524.00	0 00:00	0.00
O_BASIN_B	OUTFALL	0.00	0.00	7510.00	0 00:00	0.00
O_BASIN_C	OUTFALL	0.00	0.00	7520.00	0 00:00	0.00
O_BASIN_F	OUTFALL	0.02	1.87	7548.87	0 00:42	1.86
O_BASIN_H	OUTFALL	0.03	1.71	7516.71	0 00:51	1.71

Node Inflow Summary

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal	Flow Balance Error Percent
A1	JUNCTION	97.12	97.12	0 00:47	2.58	2.58	0.000
A2	JUNCTION	71.21	71.21	0 00:48	2.04	2.04	0.000
B1	JUNCTION	148.90	148.90	0 00:44	3.42	3.42	0.000
B2	JUNCTION	75.76	75.76	0 00:42	1.7	1.7	0.000
B3	JUNCTION	18.83	18.83	0 00:42	0.407	0.407	0.000
B4	JUNCTION	19.56	19.56	0 00:42	0.446	0.446	0.000
C1	JUNCTION	24.71	24.71	0 00:40	0.48	0.48	0.000
C2	JUNCTION	39.79	39.79	0 00:41	0.836	0.836	0.000
C3	JUNCTION	9.67	9.67	0 00:37	0.164	0.164	0.000
C4	JUNCTION	3.96	3.96	0 00:41	0.0819	0.0819	0.000
H1	JUNCTION	93.99	93.99	0 00:42	2.03	2.03	0.000
G1	JUNCTION	10.83	10.83	0 00:43	0.277	0.277	0.000
F2	JUNCTION	10.52	10.52	0 00:55	0.446	0.446	0.000
F1	JUNCTION	94.56	94.56	0 00:39	1.65	1.65	0.000
J_B1.1	JUNCTION	0.00	148.90	0 00:44	0	3.42	0.000
J_A1.1	JUNCTION	0.00	97.12	0 00:47	0	2.58	0.000
J_G1.1	JUNCTION	0.00	10.83	0 00:43	0	0.277	0.000
J_C1.1	JUNCTION	0.00	24.71	0 00:40	0	0.48	0.000
J_A2.2	JUNCTION	0.00	167.62	0 00:49	0	4.62	0.000
J_H1.2	JUNCTION	0.00	104.43	0 00:43	0	2.31	0.000
J_F1.1	JUNCTION	0.00	94.56	0 00:39	0	1.65	0.000
J_B4.1	JUNCTION	0.00	19.56	0 00:42	0	0.446	0.000



J_B2.1	JUNCTION	0.00	224.49	0	00:43	0	5.12	0.000
J_B3.1	JUNCTION	0.00	18.83	0	00:42	0	0.407	0.000
J_C3.1	JUNCTION	0.00	9.67	0	00:37	0	0.164	0.000
J_C2.1	JUNCTION	0.00	64.49	0	00:41	0	1.32	0.000
J_C4.1	JUNCTION	0.00	3.96	0	00:41	0	0.0819	0.000
O_BASIN_B	OUTFALL	0.00	262.74	0	00:43	0	5.97	0.000
O_BASIN_C	OUTFALL	0.00	78.00	0	00:41	0	1.56	0.000
O_BASIN_F	OUTFALL	0.00	103.21	0	00:43	0	2.1	0.000
O_BASIN_H	OUTFALL	0.00	267.35	0	00:49	0	6.93	0.000

Node Flooding Summary

No nodes were flooded.

Outfall Node	Flow Freq Pcnt	Avg Flow CFS	Max Flow CFS	Total Volume 10^6 gal
O_BASIN_B	3.52	65.57	262.74	5.974
O_BASIN_C	3.23	18.71	78.00	1.562
O_BASIN_F	4.83	16.86	103.21	2.104
O_BASIN_H	7.10	37.77	267.35	6.933

These max flow values are used to set the detention pond release rates.

Detention pond release plus undetained flow must be less than or equal to these values.

System	4.67	138.92	699.63	16.574
--------	------	--------	--------	--------

Link Flow Summary

Link	Type	Maximum Flow CFS	Time of Max Occurrence days hr:min	Maximum Veloc ft/sec	Max/Full Flow	Max/Full Depth
L_A1.1	DUMMY	97.12	0 00:47			
L_A2.1	DUMMY	71.21	0 00:48			
L_A1.2	CONDUIT	96.63	0 00:50	6.49	0.06	0.28
L_G1.1	DUMMY	10.83	0 00:43			
L_H1.1	DUMMY	93.99	0 00:42			
L_G1.2	CONDUIT	10.78	0 00:48	3.94	0.01	0.10
L_F1.1	DUMMY	94.56	0 00:39			
L_B1.1	DUMMY	148.90	0 00:44			
L_B2.1	DUMMY	75.76	0 00:42			
L_B1.2	DUMMY	148.90	0 00:44			
L_B4.1	DUMMY	19.56	0 00:42			
L_B3.1	DUMMY	18.83	0 00:42			
L_C3.1	DUMMY	9.67	0 00:37			
L_C4.1	DUMMY	3.96	0 00:41			
L_C1.1	DUMMY	24.71	0 00:40			
L_C1.2	DUMMY	24.71	0 00:40			
L_C2.1	DUMMY	39.79	0 00:41			
L_A2.2	CONDUIT	167.38	0 00:51	5.81	0.11	0.34
L_H1.2	DUMMY	104.43	0 00:43			
L_F2.1	DUMMY	10.52	0 00:55			
L_F1.2	CONDUIT	93.94	0 00:42	6.76	0.84	0.94
L_B4.2	DUMMY	19.56	0 00:42			
L_B2.2	DUMMY	224.49	0 00:43			
L_B3.2	DUMMY	18.83	0 00:42			
L_C3.2	DUMMY	9.67	0 00:37			
L_C2.2	DUMMY	64.49	0 00:41			
L_C4.2	DUMMY	3.96	0 00:41			

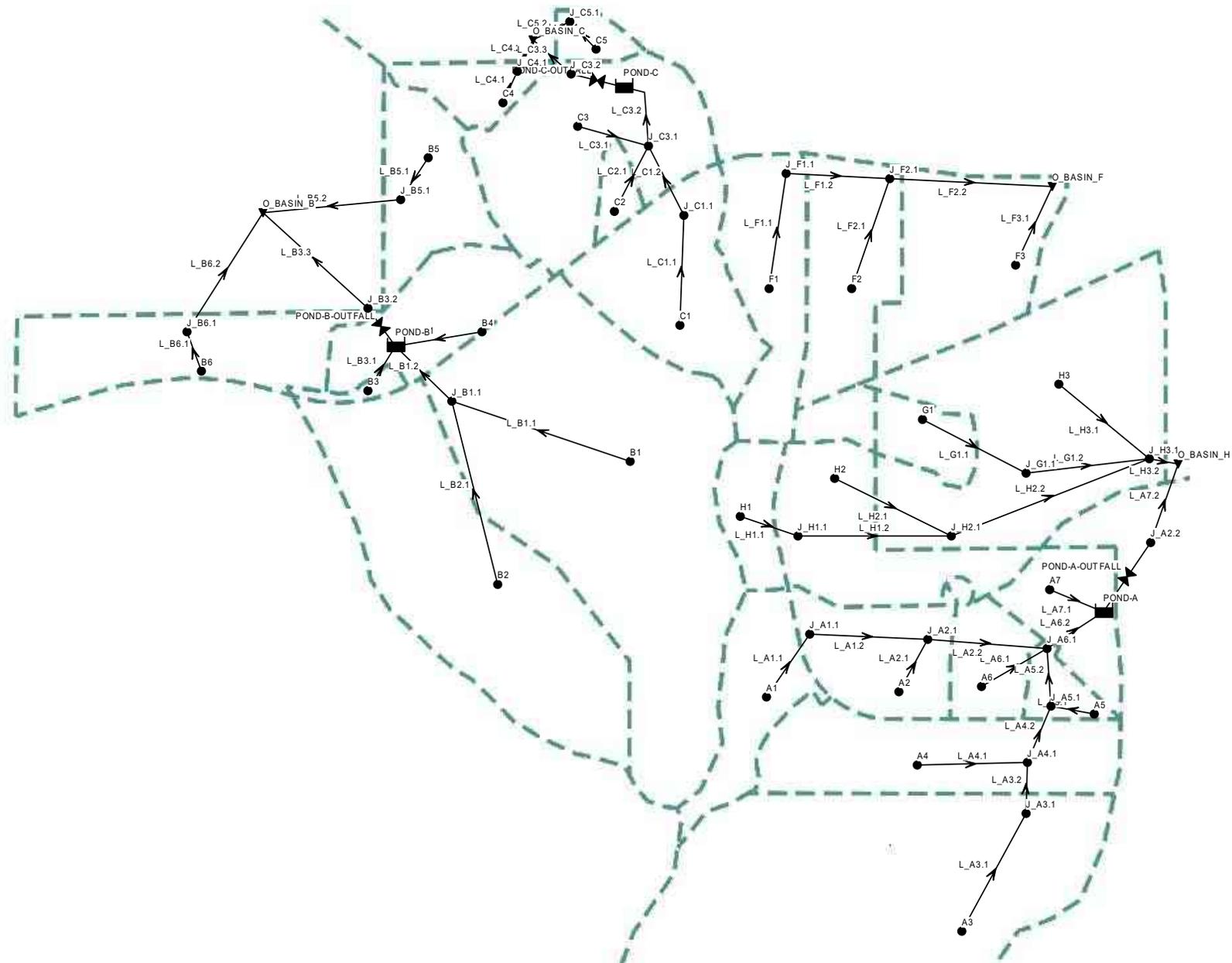


Conduit Surcharge Summary

No conduits were surcharged.

Analysis begun on: Wed Sep 04 10:57:37 2024
Analysis ended on: Wed Sep 04 10:57:37 2024
Total elapsed time: < 1 sec

FLYING HORSE NORTH FILING NO. 4 DEVELOPED SWMM MODEL





```
[TITLE]
;;Project Title/Notes
Flying Horse North Filing No. 4
Final Drainage report
```

```
[OPTIONS]
;;Option Value
FLOW_UNITS CFS
INFILTRATION HORTON
FLOW_ROUTING KINWAVE
LINK_OFFSETS DEPTH
MIN_SLOPE 0
ALLOW_PONDING NO
SKIP_STEADY_STATE NO

START_DATE 01/01/2005
START_TIME 00:00:00
REPORT_START_DATE 01/01/2005
REPORT_START_TIME 00:00:00
END_DATE 01/02/2005
END_TIME 00:00:00
SWEEP_START 01/01
SWEEP_END 12/31
DRY_DAYS 0
REPORT_STEP 00:05:00
WET_STEP 00:05:00
DRY_STEP 01:00:00
ROUTING_STEP 0:02:00
```

```
INERTIAL_DAMPING PARTIAL
NORMAL_FLOW_LIMITED BOTH
FORCE_MAIN_EQUATION H-W
VARIABLE_STEP 0.75
LENGTHENING_STEP 0
MIN_SURFAREA 12.557
MAX_TRIALS 8
HEAD_TOLERANCE 0.005
SYS_FLOW_TOL 5
LAT_FLOW_TOL 5
MINIMUM_STEP 0.5
THREADS 1
```

```
[FILES]
;;Interfacing Files
USE INFLOWS "SWMM_Developed_Interface_100.txt"
```

```
[EVAPORATION]
;;Data Source Parameters
;;-----
CONSTANT 0.0
DRY_ONLY NO
```

```
[JUNCTIONS]
;;Name Elevation MaxDepth InitDepth SurDepth Aponded
;;-----
```

Name	Elevation	MaxDepth	InitDepth	SurDepth	Aponded
A1	7621	0	0	0	0
A2	7590	0	0	0	0
A3	7605	0	0	0	0
A4	7590	0	0	0	0
A5	7550	0	0	0	0
A6	7555	0	0	0	0
A7	7550	0	0	0	0
B1	7572	0	0	0	0
B2	7574	0	0	0	0
B3	7555	0	0	0	0
B4	7558	0	0	0	0
B5	7558	0	0	0	0
B6	7552	0	0	0	0
C1	7586	0	0	0	0
C2	7562	0	0	0	0
C3	7562	0	0	0	0
C4	7553	0	0	0	0
C5	7536	0	0	0	0
F1	7582	0	0	0	0

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F2	7576	0	0	0	0
G1	7585	0	0	0	0
H1	7610	0	0	0	0
H2	7570	0	0	0	0
H3	7550	0	0	0	0
J_A1.1	7600	0	0	0	0
J_A2.1	7566	0	0	0	0
J_A2.2	7525	0	0	0	0
J_A3.1	7562	0	0	0	0
J_A4.1	7548	0	0	0	0
J_A5.1	7538	0	0	0	0
J_A6.1	7536	0	0	0	0
J_B1.1	7536	0	0	0	0
J_C1.1	7570	0	0	0	0
J_C3.1	7533	0	0	0	0
J_G1.1	7555	0	0	0	0
J_H1.1	7594	0	0	0	0
J_H2.1	7560	0	0	0	0
J_H3.1	7514	0	0	0	0
F3	7568	0	0	0	0
J_F1.1	7572	0	0	0	0
J_F2.1	7558	0	0	0	0
J_B3.2	7522	0	0	0	0
J_B5.1	7533	0	0	0	0
J_B6.1	7510	0	0	0	0
J_C4.1	7544	0	0	0	0
J_C3.2	7529	0	0	0	0
J_C5.1	7524	0	0	0	0

[OUTFALLS]

Name	Elevation	Type	Stage Data	Gated	Route To
O_BASIN_B	7510	FREE		NO	
O_BASIN_C	7520	FREE		NO	
O_BASIN_F	7547	FREE		NO	
O_BASIN_H	7515	FREE		NO	

[STORAGE]

Name	Elev.	MaxDepth	InitDepth	Shape	Curve Name/Params	N/A	Fevap	Psi
POND-A	7530	7	0	TABULAR	POND-A_STORAGE	0	0	
POND-B	7528	10	0	TABULAR	POND-B_STORAGE	0	0	
POND-C	7530	10	0	TABULAR	POND-C_STORAGE	0	0	

[CONDUITS]

Name	From Node	To Node	Length	Roughness	InOffset	OutOffset	InitFlow
L_A1.1	A1	J_A1.1	400	.013	0	0	0
L_A2.1	A2	J_A2.1	400	.013	0	0	0
L_A1.2	J_A1.1	J_A2.1	840	.035	0	0	0
L_G1.1	G1	J_G1.1	400	.013	0	0	0
L_H3.1	H3	J_H3.1	400	.013	0	0	0
L_G1.2	J_G1.1	J_H3.1	1031	.035	0	0	0
L_F1.1	F1	J_F1.1	400	.013	0	0	0
L_B1.1	B1	J_B1.1	400	.013	0	0	0
L_B2.1	B2	J_B1.1	400	.013	0	0	0
L_B1.2	J_B1.1	POND-B	400	.013	0	0	0
L_B6.1	B6	J_B6.1	400	.013	0	0	0
L_B5.1	B5	J_B5.1	400	.013	0	0	0
L_C4.1	C4	J_C4.1	400	.013	0	0	0
L_C5.1	C5	J_C5.1	400	.013	0	0	0
L_C1.1	C1	J_C1.1	400	.013	0	0	0
L_C1.2	J_C1.1	J_C3.1	400	.013	0	0	0
L_C2.1	C2	J_C3.1	400	.013	0	0	0
L_A3.1	A3	J_A3.1	400	.013	0	0	0
L_A3.2	J_A3.1	J_A4.1	500	.035	0	0	0
L_A4.2	J_A4.1	J_A5.1	460	.035	0	0	0
L_A4.1	A4	J_A4.1	400	.013	0	0	0
L_A6.1	A6	J_A6.1	400	.013	0	0	0
L_A5.2	J_A5.1	J_A6.1	400	.013	0	0	0



L_A5.1	A5	J_A5.1	400	.013	0	0	0	0
L_A2.2	J_A2.1	J_A6.1	545	.035	0	0	0	0
L_A7.1	A7	POND-A	400	.013	0	0	0	0
L_A6.2	J_A6.1	POND-A	400	.013	0	0	0	0
L_H1.1	H1	J_H1.1	400	.013	0	0	0	0
L_H2.1	H2	J_H2.1	400	.013	0	0	0	0
L_H1.2	J_H1.1	J_H2.1	860	.035	0	0	0	0
L_H2.2	J_H2.1	J_H3.1	400	.013	0	0	0	0
L_A7.2	J_A2.2	O_BASIN_H	680	.035	0	0	0	0
L_H3.2	J_H3.1	O_BASIN_H	400	.013	0	0	0	0
L_B3.1	B3	POND-B	400	.013	0	0	0	0
L_B4.1	B4	POND-B	400	.013	0	0	0	0
L_C3.2	J_C3.1	POND-C	400	.013	0	0	0	0
L_C3.1	C3	J_C3.1	400	.013	0	0	0	0
L_F2.1	F2	J_F2.1	400	.013	0	0	0	0
L_F3.1	F3	O_BASIN_F	400	.013	0	0	0	0
L_F1.2	J_F1.1	J_F2.1	580	.030	0	0	0	0
L_F2.2	J_F2.1	O_BASIN_F	620	.030	0	0	0	0
L_B6.2	J_B6.1	O_BASIN_B	400	.013	0	0	0	0
L_B3.3	J_B3.2	O_BASIN_B	400	.013	0	0	0	0
L_B5.2	J_B5.1	O_BASIN_B	400	.013	0	0	0	0
L_C4.2	J_C4.1	O_BASIN_C	400	.013	0	0	0	0
L_C3.3	J_C3.2	O_BASIN_C	400	.013	0	0	0	0
L_C5.2	J_C5.1	O_BASIN_C	400	.013	0	0	0	0

[OUTLETS]

;;Name	From Node	To Node	Offset	Type	QTable/Qcoeff	Qexpon	Gated

POND-A-OUTFALL	POND-A	J_A2.2	0	TABULAR/DEPTH	POND-A_RELEASE		NO
POND-B-OUTFALL	POND-B	J_B3.2	0	TABULAR/DEPTH	POND-B_RELEASE		NO
POND-C-OUTFALL	POND-C	J_C3.2	0	TABULAR/DEPTH	POND-C_RELEASE		NO

[XSECTIONS]

;;Link	Shape	Geom1	Geom2	Geom3	Geom4	Barrels	Culvert

L_A1.1	DUMMY	0	0	0	0	1	
L_A2.1	DUMMY	0	0	0	0	1	
L_A1.2	TRAPEZOIDAL	4	4	4	4	1	
L_G1.1	DUMMY	0	0	0	0	1	
L_H3.1	DUMMY	0	0	0	0	1	
L_G1.2	TRAPEZOIDAL	4	5	4	4	1	
L_F1.1	DUMMY	0	0	0	0	1	
L_B1.1	DUMMY	0	0	0	0	1	
L_B2.1	DUMMY	0	0	0	0	1	
L_B1.2	DUMMY	0	0	0	0	1	
L_B6.1	DUMMY	0	0	0	0	1	
L_B5.1	DUMMY	0	0	0	0	1	
L_C4.1	DUMMY	0	0	0	0	1	
L_C5.1	DUMMY	0	0	0	0	1	
L_C1.1	DUMMY	0	0	0	0	1	
L_C1.2	DUMMY	0	0	0	0	1	
L_C2.1	DUMMY	0	0	0	0	1	
L_A3.1	DUMMY	0	0	0	0	1	
L_A3.2	TRAPEZOIDAL	5	6	4	4	1	
L_A4.2	TRAPEZOIDAL	2	2	4	4	1	
L_A4.1	DUMMY	0	0	0	0	1	
L_A6.1	DUMMY	0	0	0	0	1	
L_A5.2	DUMMY	0	0	0	0	1	
L_A5.1	DUMMY	0	0	0	0	1	
L_A2.2	TRAPEZOIDAL	2	2	4	4	1	
L_A7.1	DUMMY	0	0	0	0	1	
L_A6.2	DUMMY	0	0	0	0	1	
L_H1.1	DUMMY	0	0	0	0	1	
L_H2.1	DUMMY	0	0	0	0	1	
L_H1.2	TRAPEZOIDAL	5	5	4	4	1	
L_H2.2	TRAPEZOIDAL	4	5	4	4	1	
L_A7.2	TRAPEZOIDAL	5	10	4	4	1	
L_H3.2	DUMMY	0	0	0	0	1	
L_B3.1	DUMMY	0	0	0	0	1	
L_B4.1	DUMMY	0	0	0	0	1	
L_C3.2	DUMMY	0	0	0	0	1	
L_C3.1	DUMMY	0	0	0	0	1	
L_F2.1	DUMMY	0	0	0	0	1	

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L_F3.1	DUMMY	0	0	0	0	1
L_F1.2	TRIANGULAR	2	16	0	0	1
L_F2.2	TRIANGULAR	2	16	0	0	1
L_B6.2	DUMMY	0	0	0	0	1
L_B3.3	DUMMY	0	0	0	0	1
L_B5.2	DUMMY	0	0	0	0	1
L_C4.2	DUMMY	0	0	0	0	1
L_C3.3	DUMMY	0	0	0	0	1
L_C5.2	DUMMY	0	0	0	0	1

```
[CURVES]
;;Name      Type      X-Value  Y-Value
-----
```

POND-A_RELEASE	Rating	0	0
POND-A_RELEASE		0.5	0.04
POND-A_RELEASE		1	0.08
POND-A_RELEASE		1.5	0.12
POND-A_RELEASE		2	0.17
POND-A_RELEASE		2.5	0.21
POND-A_RELEASE		2.72	0.23
POND-A_RELEASE		3	0.31
POND-A_RELEASE		3.18	0.34
POND-A_RELEASE		3.5	16.14
POND-A_RELEASE		4	65.05
POND-A_RELEASE		4.5	132.43
POND-A_RELEASE		4.85	160.22
POND-A_RELEASE		5	162.26
POND-A_RELEASE		5.5	229.95
POND-A_RELEASE		6	352.81
POND-A_RELEASE		6.5	516.42
POND-A_RELEASE		7	716.74
;			
POND-B_RELEASE	Rating	0	0
POND-B_RELEASE		0.5	0.05
POND-B_RELEASE		1	0.11
POND-B_RELEASE		1.5	0.15
POND-B_RELEASE		2	0.23
POND-B_RELEASE		2.28	0.26
POND-B_RELEASE		2.5	0.29
POND-B_RELEASE		2.84	0.33
POND-B_RELEASE		3	6.89
POND-B_RELEASE		3.5	59.48
POND-B_RELEASE		4	139.49
POND-B_RELEASE		4.5	208.28
POND-B_RELEASE		4.98	216.56
POND-B_RELEASE		5	216.9
POND-B_RELEASE		5.5	225.2
POND-B_RELEASE		6	277.32
POND-B_RELEASE		6.5	370.54
POND-B_RELEASE		7	495.34
;			
POND-C_RELEASE	Rating	0	0
POND-C_RELEASE		0.5	0.02
POND-C_RELEASE		1.5	0.06
POND-C_RELEASE		2	0.09
POND-C_RELEASE		2.24	0.1
POND-C_RELEASE		2.5	0.11
POND-C_RELEASE		2.62	0.11
POND-C_RELEASE		3	18.98
POND-C_RELEASE		3.47	64.63
POND-C_RELEASE		3.5	65.06
POND-C_RELEASE		4.5	96.21
POND-C_RELEASE		5	146.69
POND-C_RELEASE		5.5	217.39
POND-C_RELEASE		6	308.17
POND-C_RELEASE		6.5	419.52
POND-C_RELEASE		7	552.1
;			
POND-A_STORAGE	Storage	0	10
POND-A_STORAGE		0.5	376
POND-A_STORAGE		1	2192
POND-A_STORAGE		1.5	7097
POND-A_STORAGE		2	14797
POND-A_STORAGE		2.5	22565



```

POND-A_STORAGE      2.72      25765.12
POND-A_STORAGE      3          29838
POND-A_STORAGE      3.18      32505.96
POND-A_STORAGE      3.5        37249
POND-A_STORAGE      4          43958
POND-A_STORAGE      4.5        49678
POND-A_STORAGE      4.85      52552.9
POND-A_STORAGE      5          53785
POND-A_STORAGE      5.5        56812
POND-A_STORAGE      6          59334
POND-A_STORAGE      6.5        62623
POND-A_STORAGE      7          64854
;
POND-B_STORAGE      Storage  0          10
POND-B_STORAGE      0.5        2138.28
POND-B_STORAGE      1          7169.09
POND-B_STORAGE      1.5        13715.31
POND-B_STORAGE      2          18728.56
POND-B_STORAGE      2.28      21475.96
POND-B_STORAGE      2.5        23634.63
POND-B_STORAGE      2.84      26332.66
POND-B_STORAGE      3          27602.32
POND-B_STORAGE      3.5        30042.07
POND-B_STORAGE      4          32273.85
POND-B_STORAGE      4.5        34626.01
POND-B_STORAGE      4.98      36954.82
POND-B_STORAGE      5          37051.85
POND-B_STORAGE      5.5        39551.39
POND-B_STORAGE      6          42124.62
POND-B_STORAGE      6.5        44775.53
POND-B_STORAGE      7          47666.69
;
POND-C_STORAGE      Storage  0          10
POND-C_STORAGE      0.5        261
POND-C_STORAGE      1.5        5965
POND-C_STORAGE      2          12887
POND-C_STORAGE      2.19      16037.58
POND-C_STORAGE      2.5        21178
POND-C_STORAGE      2.53      21693.94
POND-C_STORAGE      3          29777
POND-C_STORAGE      3.37      35491.28
POND-C_STORAGE      3.5        37499
POND-C_STORAGE      4.5        50444
POND-C_STORAGE      5          55960
POND-C_STORAGE      5.5        55960
POND-C_STORAGE      6          55960
POND-C_STORAGE      6.5        55960
POND-C_STORAGE      7          55960

```

```

[REPORT]
;;Reporting Options
INPUT      NO
CONTROLS   NO
SUBCATCHMENTS ALL
NODES ALL
LINKS ALL

```

[TAGS]

```

[MAP]
DIMENSIONS -2727.273 0.000 12727.273 10000.000
Units      None

```

```

[COORDINATES]
;;Node      X-Coord      Y-Coord
;;-----
A1          5852.080      3834.143
A2          7253.258      3852.399
A3          7842.026      2547.067
A4          7654.898      3400.553
A5          8567.718      3870.655
A6          7691.411      4062.348
A7          8102.180      4564.398
B1          4814.939      5640.594

```

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B2	3809.784	4700.287
B3	3128.872	6182.544
B4	3689.350	6622.589
B5	3680.086	7734.282
B6	1608.409	6446.756
C1	5491.219	6900.512
C2	4958.533	7794.498
C3	4508.350	7693.203
C4	3842.208	8378.137
C5	4926.108	8827.446
F1	6130.442	7178.435
F2	6914.644	7135.956
G1	7043.309	5951.884
H1	5895.032	5135.830
H2	6698.374	5426.070
H3	8081.329	6231.386
J_A1.1	6185.259	4313.373
J_A2.1	7358.232	4349.886
J_A2.2	8781.879	5021.807
J_A3.1	7837.462	2948.708
J_A4.1	8106.744	3514.656
J_A5.1	8298.436	3984.758
J_A6.1	8239.103	4185.578
J_B1.1	3457.748	6099.167
J_C1.1	5315.201	7525.839
J_C3.1	4958.533	8044.629
J_G1.1	7838.601	5550.458
J_H1.1	6091.980	5063.270
J_H2.1	7341.047	5001.076
J_H3.1	8775.757	5660.875
F3	7754.737	7140.178
J_F1.1	6332.068	7815.629
J_F2.1	6999.076	7802.964
J_B3.2	2819.437	6804.229
J_B5.1	3129.490	8044.439
J_B6.1	1425.618	6790.570
J_C4.1	3963.640	8666.499
J_C3.2	4340.348	8769.237
J_C5.1	4454.502	9024.181
O_BASIN_B	2013.301	7541.059
O_BASIN_C	4058.768	8921.442
O_BASIN_F	8033.360	7731.197
O_BASIN_H	8999.559	5612.652
POND-A	8427.940	4487.213
POND-B	3022.335	6516.052
POND-C	4762.717	8491.463

[VERTICES]

;;Link	X-Coord	Y-Coord
;;-----	-----	-----
L_C3.2	4921.476	8456.882



EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.012)

WARNING 04: minimum elevation drop used for Conduit L_B6.2

 NOTE: The summary statistics displayed in this report are based on results found at every computational time step, not just on results from each reporting time step.

 Analysis Options

 Flow Units CFS
 Process Models:
 Rainfall/Runoff NO
 RDII NO
 Snowmelt NO
 Groundwater NO
 Flow Routing YES
 Ponding Allowed NO
 Water Quality NO
 Flow Routing Method KINWAVE
 Starting Date 01/01/2005 00:00:00
 Ending Date 01/02/2005 00:00:00
 Antecedent Dry Days 0.0
 Report Time Step 00:05:00
 Routing Time Step 120.00 sec

	Volume acre-feet	Volume 10 ⁶ gal
Flow Routing Continuity	-----	-----
Dry Weather Inflow	0.000	0.000
Wet Weather Inflow	0.000	0.000
Groundwater Inflow	0.000	0.000
RDII Inflow	0.000	0.000
External Inflow	10.906	3.554
External Outflow	9.874	3.217
Flooding Loss	0.000	0.000
Evaporation Loss	0.000	0.000
Exfiltration Loss	0.000	0.000
Initial Stored Volume	0.000	0.000
Final Stored Volume	1.007	0.328
Continuity Error (%)	0.231	

 Highest Flow Instability Indexes

 All links are stable.

 Routing Time Step Summary

 Minimum Time Step : 120.00 sec
 Average Time Step : 120.00 sec
 Maximum Time Step : 120.00 sec
 Percent in Steady State : 0.00
 Average Iterations per Step : 1.00
 Percent Not Converging : 0.00



 Node Depth Summary

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min	Reported Max Depth Feet
A1	JUNCTION	0.00	0.00	7621.00	0 00:00	0.00
A2	JUNCTION	0.00	0.00	7590.00	0 00:00	0.00
A3	JUNCTION	0.00	0.00	7605.00	0 00:00	0.00
A4	JUNCTION	0.00	0.00	7590.00	0 00:00	0.00
A5	JUNCTION	0.00	0.00	7550.00	0 00:00	0.00
A6	JUNCTION	0.00	0.00	7555.00	0 00:00	0.00
A7	JUNCTION	0.00	0.00	7550.00	0 00:00	0.00
B1	JUNCTION	0.00	0.00	7572.00	0 00:00	0.00
B2	JUNCTION	0.00	0.00	7574.00	0 00:00	0.00
B3	JUNCTION	0.00	0.00	7555.00	0 00:00	0.00
B4	JUNCTION	0.00	0.00	7558.00	0 00:00	0.00
B5	JUNCTION	0.00	0.00	7558.00	0 00:00	0.00
B6	JUNCTION	0.00	0.00	7552.00	0 00:00	0.00
C1	JUNCTION	0.00	0.00	7586.00	0 00:00	0.00
C2	JUNCTION	0.00	0.00	7562.00	0 00:00	0.00
C3	JUNCTION	0.00	0.00	7562.00	0 00:00	0.00
C4	JUNCTION	0.00	0.00	7553.00	0 00:00	0.00
C5	JUNCTION	0.00	0.00	7536.00	0 00:00	0.00
F1	JUNCTION	0.00	0.00	7582.00	0 00:00	0.00
F2	JUNCTION	0.00	0.00	7576.00	0 00:00	0.00
G1	JUNCTION	0.00	0.00	7585.00	0 00:00	0.00
H1	JUNCTION	0.00	0.00	7610.00	0 00:00	0.00
H2	JUNCTION	0.00	0.00	7570.00	0 00:00	0.00
H3	JUNCTION	0.00	0.00	7550.00	0 00:00	0.00
J_A1.1	JUNCTION	0.01	0.25	7600.25	0 00:38	0.24
J_A2.1	JUNCTION	0.02	0.48	7566.48	0 00:38	0.47
J_A2.2	JUNCTION	0.07	0.65	7525.65	0 01:04	0.65
J_A3.1	JUNCTION	0.03	0.61	7562.61	0 00:42	0.61
J_A4.1	JUNCTION	0.06	1.01	7549.01	0 00:42	1.01
J_A5.1	JUNCTION	0.06	1.01	7539.01	0 00:44	1.01
J_A6.1	JUNCTION	0.02	0.48	7536.48	0 00:40	0.48
J_B1.1	JUNCTION	0.00	0.00	7536.00	0 00:00	0.00
J_C1.1	JUNCTION	0.00	0.00	7570.00	0 00:00	0.00
J_C3.1	JUNCTION	0.00	0.00	7533.00	0 00:00	0.00
J_G1.1	JUNCTION	0.00	0.14	7555.14	0 00:32	0.13
J_H1.1	JUNCTION	0.01	0.16	7594.16	0 00:38	0.15
J_H2.1	JUNCTION	0.01	0.17	7560.17	0 00:36	0.17
J_H3.1	JUNCTION	0.01	0.17	7514.17	0 00:36	0.17
F3	JUNCTION	0.00	0.00	7568.00	0 00:00	0.00
J_F1.1	JUNCTION	0.04	0.58	7572.58	0 00:38	0.58
J_F2.1	JUNCTION	0.06	0.79	7558.79	0 00:40	0.79
J_B3.2	JUNCTION	0.00	0.00	7522.00	0 00:00	0.00
J_B5.1	JUNCTION	0.00	0.00	7533.00	0 00:00	0.00
J_B6.1	JUNCTION	0.00	0.00	7510.00	0 00:00	0.00
J_C4.1	JUNCTION	0.00	0.00	7544.00	0 00:00	0.00
J_C3.2	JUNCTION	0.00	0.00	7529.00	0 00:00	0.00
J_C5.1	JUNCTION	0.00	0.00	7524.00	0 00:00	0.00
O_BASIN_B	OUTFALL	0.00	0.00	7510.00	0 00:00	0.00
O_BASIN_C	OUTFALL	0.00	0.00	7520.00	0 00:00	0.00
O_BASIN_F	OUTFALL	0.06	0.79	7547.79	0 00:44	0.79
O_BASIN_H	OUTFALL	0.07	0.65	7515.65	0 01:06	0.65
POND-A	STORAGE	2.82	3.62	7533.62	0 01:04	3.62
POND-B	STORAGE	2.52	3.53	7531.53	0 00:52	3.53
POND-C	STORAGE	2.40	2.81	7532.81	0 01:04	2.81



 Node Inflow Summary

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal	Flow Balance Error Percent
A1	JUNCTION	3.65	3.65	0 00:38	0.0824	0.0824	0.000
A2	JUNCTION	5.20	5.20	0 00:36	0.0966	0.0966	0.000
A3	JUNCTION	22.12	22.12	0 00:42	0.484	0.484	0.000
A4	JUNCTION	4.90	4.90	0 00:42	0.165	0.165	0.000
A5	JUNCTION	1.27	1.27	0 00:36	0.0221	0.0221	0.000
A6	JUNCTION	3.10	3.10	0 00:36	0.0571	0.0571	0.000
A7	JUNCTION	4.66	4.66	0 00:34	0.0727	0.0727	0.000
B1	JUNCTION	41.84	41.84	0 00:38	0.664	0.664	0.000
B2	JUNCTION	12.80	12.80	0 00:40	0.329	0.329	0.000
B3	JUNCTION	1.15	1.15	0 00:32	0.0191	0.0191	0.000
B4	JUNCTION	4.22	4.22	0 00:38	0.119	0.119	0.000
B5	JUNCTION	5.00	5.00	0 00:36	0.0951	0.0951	0.000
B6	JUNCTION	9.22	9.22	0 00:34	0.143	0.143	0.000
C1	JUNCTION	7.24	7.24	0 00:38	0.14	0.14	0.000
C2	JUNCTION	0.92	0.92	0 00:38	0.0248	0.0248	0.000
C3	JUNCTION	10.04	10.04	0 00:36	0.179	0.179	0.000
C4	JUNCTION	2.85	2.85	0 00:32	0.0385	0.0385	0.000
C5	JUNCTION	1.06	1.06	0 00:36	0.0203	0.0203	0.000
F1	JUNCTION	4.40	4.40	0 00:38	0.115	0.115	0.000
F2	JUNCTION	4.27	4.27	0 00:40	0.118	0.118	0.000
G1	JUNCTION	1.58	1.58	0 00:32	0.0228	0.0228	0.000
H1	JUNCTION	2.00	2.00	0 00:38	0.0466	0.0466	0.000
H2	JUNCTION	9.63	9.63	0 00:34	0.129	0.129	0.000
H3	JUNCTION	14.61	14.61	0 00:38	0.221	0.221	0.000
J_A1.1	JUNCTION	0.00	3.65	0 00:38	0	0.0824	0.000
J_A2.1	JUNCTION	0.00	8.55	0 00:38	0	0.179	0.000
J_A2.2	JUNCTION	0.00	27.78	0 01:04	0	0.847	0.000
J_A3.1	JUNCTION	0.00	22.12	0 00:42	0	0.484	0.000
J_A4.1	JUNCTION	0.00	26.97	0 00:42	0	0.648	0.000
J_A5.1	JUNCTION	0.00	28.01	0 00:44	0	0.671	0.000
J_A6.1	JUNCTION	0.00	39.08	0 00:42	0	0.907	0.000
J_B1.1	JUNCTION	0.00	54.54	0 00:38	0	0.993	0.000
J_C1.1	JUNCTION	0.00	7.24	0 00:38	0	0.14	0.000
J_C3.1	JUNCTION	0.00	18.18	0 00:36	0	0.344	0.000
J_G1.1	JUNCTION	0.00	1.58	0 00:32	0	0.0228	0.000
J_H1.1	JUNCTION	0.00	2.00	0 00:38	0	0.0466	0.000
J_H2.1	JUNCTION	0.00	10.83	0 00:36	0	0.176	0.000
J_H3.1	JUNCTION	0.00	26.60	0 00:38	0	0.42	0.000
F3	JUNCTION	6.96	6.96	0 00:38	0.15	0.15	0.000
J_F1.1	JUNCTION	0.00	4.40	0 00:38	0	0.115	0.000
J_F2.1	JUNCTION	0.00	8.63	0 00:40	0	0.233	0.000
J_B3.2	JUNCTION	0.00	44.34	0 00:52	0	1.01	0.000
J_B5.1	JUNCTION	0.00	5.00	0 00:36	0	0.0951	0.000
J_B6.1	JUNCTION	0.00	9.22	0 00:34	0	0.143	0.000
J_C4.1	JUNCTION	0.00	2.85	0 00:32	0	0.0385	0.000
J_C3.2	JUNCTION	0.00	9.59	0 01:04	0	0.259	0.000
J_C5.1	JUNCTION	0.00	1.06	0 00:36	0	0.0203	0.000
O_BASIN_B	OUTFALL	0.00	53.58	0 00:50	0	1.25	0.000
O_BASIN_C	OUTFALL	0.00	10.99	0 01:02	0	0.318	0.000
O_BASIN_F	OUTFALL	0.00	15.21	0 00:42	0	0.383	0.000
O_BASIN_H	OUTFALL	0.00	38.01	0 01:04	0	1.27	0.000
POND-A	STORAGE	0.00	43.06	0 00:42	0	0.98	0.391
POND-B	STORAGE	0.00	59.75	0 00:38	0	1.13	0.426
POND-C	STORAGE	0.00	18.18	0 00:36	0	0.344	0.588

 Node Flooding Summary

No nodes were flooded.



 Storage Volume Summary

Storage Unit	Average Volume 1000 ft3	Avg Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 ft3	Max Pcnt Full	Time of Max Occurrence days hr:min	Maximum Outflow CFS
POND-A	27.285	12	0	0	52.312	22	0 01:04	27.78
POND-B	26.141	8	0	0	50.023	16	0 00:52	44.34
POND-C	15.113	4	0	0	23.875	6	0 01:02	9.59

 Outfall Loading Summary

Outfall Node	Flow Freq Pcnt	Avg Flow CFS	Max Flow CFS	Total Volume 10^6 gal
O_BASIN_B	99.44	1.94	53.58	1.249
O_BASIN_C	99.44	0.50	10.99	0.318
O_BASIN_F	18.61	3.19	15.21	0.383
O_BASIN_H	99.31	1.97	38.01	1.266
System	79.20	7.60	104.35	3.217

 Link Flow Summary

Link	Type	Maximum Flow CFS	Time of Max Occurrence days hr:min	Maximum Veloc ft/sec	Max/ Full Flow	Max/ Full Depth
L_A1.1	DUMMY	3.65	0 00:38			
L_A2.1	DUMMY	5.20	0 00:36			
L_A1.2	CONDUIT	3.58	0 00:42	2.98	0.00	0.06
L_G1.1	DUMMY	1.58	0 00:32			
L_H3.1	DUMMY	14.61	0 00:38			
L_G1.2	CONDUIT	1.40	0 00:42	2.09	0.00	0.03
L_F1.1	DUMMY	4.40	0 00:38			
L_B1.1	DUMMY	41.84	0 00:38			
L_B2.1	DUMMY	12.80	0 00:40			
L_B1.2	DUMMY	54.54	0 00:38			
L_B6.1	DUMMY	9.22	0 00:34			
L_B5.1	DUMMY	5.00	0 00:36			
L_C4.1	DUMMY	2.85	0 00:32			
L_C5.1	DUMMY	1.06	0 00:36			
L_C1.1	DUMMY	7.24	0 00:38			
L_C1.2	DUMMY	7.24	0 00:38			
L_C2.1	DUMMY	0.92	0 00:38			
L_A3.1	DUMMY	22.12	0 00:42			
L_A3.2	CONDUIT	22.07	0 00:42	4.29	0.01	0.12
L_A4.2	CONDUIT	26.95	0 00:44	4.42	0.20	0.51
L_A4.1	DUMMY	4.90	0 00:42			
L_A6.1	DUMMY	3.10	0 00:36			
L_A5.2	DUMMY	28.01	0 00:44			
L_A5.1	DUMMY	1.27	0 00:36			
L_A2.2	CONDUIT	8.53	0 00:40	4.61	0.04	0.24
L_A7.1	DUMMY	4.66	0 00:34			
L_A6.2	DUMMY	39.08	0 00:42			
L_H1.1	DUMMY	2.00	0 00:38			
L_H2.1	DUMMY	9.63	0 00:34			
L_H1.2	CONDUIT	1.94	0 00:44	2.28	0.00	0.03
L_H2.2	CONDUIT	10.78	0 00:36	11.08	0.00	0.04
L_A7.2	CONDUIT	27.68	0 01:06	3.40	0.02	0.13
L_H3.2	DUMMY	26.60	0 00:38			
L_B3.1	DUMMY	1.15	0 00:32			
L_B4.1	DUMMY	4.22	0 00:38			



L_C3.2	DUMMY	18.18	0	00:36			
L_C3.1	DUMMY	10.04	0	00:36			
L_F2.1	DUMMY	4.27	0	00:40			
L_F3.1	DUMMY	6.96	0	00:38			
L_F1.2	CONDUIT	4.38	0	00:42	3.31	0.04	0.29
L_F2.2	CONDUIT	8.60	0	00:44	3.50	0.08	0.39
L_B6.2	DUMMY	9.22	0	00:34			
L_B3.3	DUMMY	44.34	0	00:52			
L_B5.2	DUMMY	5.00	0	00:36			
L_C4.2	DUMMY	2.85	0	00:32			
L_C3.3	DUMMY	9.59	0	01:04			
L_C5.2	DUMMY	1.06	0	00:36			
POND-A-OUTFALL	DUMMY	27.78	0	01:04			
POND-B-OUTFALL	DUMMY	44.34	0	00:52			
POND-C-OUTFALL	DUMMY	9.59	0	01:04			

Conduit Surcharge Summary

No conduits were surcharged.

Analysis begun on: Thu Sep 05 13:59:33 2024
Analysis ended on: Thu Sep 05 13:59:33 2024
Total elapsed time: < 1 sec



EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.012)

WARNING 04: minimum elevation drop used for Conduit L_B6.2

 NOTE: The summary statistics displayed in this report are based on results found at every computational time step, not just on results from each reporting time step.

 Analysis Options

 Flow Units CFS
 Process Models:
 Rainfall/Runoff NO
 RDII NO
 Snowmelt NO
 Groundwater NO
 Flow Routing YES
 Ponding Allowed NO
 Water Quality NO
 Flow Routing Method KINWAVE
 Starting Date 01/01/2005 00:00:00
 Ending Date 01/02/2005 00:00:00
 Antecedent Dry Days 0.0
 Report Time Step 00:05:00
 Routing Time Step 120.00 sec

	Volume acre-feet	Volume 10 ⁶ gal
Flow Routing Continuity	-----	-----
Dry Weather Inflow	0.000	0.000
Wet Weather Inflow	0.000	0.000
Groundwater Inflow	0.000	0.000
RDII Inflow	0.000	0.000
External Inflow	52.489	17.104
External Outflow	51.425	16.757
Flooding Loss	0.000	0.000
Evaporation Loss	0.000	0.000
Exfiltration Loss	0.000	0.000
Initial Stored Volume	0.000	0.000
Final Stored Volume	1.018	0.332
Continuity Error (%)	0.089	

 Highest Flow Instability Indexes

 All links are stable.

 Routing Time Step Summary

 Minimum Time Step : 120.00 sec
 Average Time Step : 120.00 sec
 Maximum Time Step : 120.00 sec
 Percent in Steady State : 0.00
 Average Iterations per Step : 1.00
 Percent Not Converging : 0.00



 Node Depth Summary

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min	Reported Max Depth Feet
A1	JUNCTION	0.00	0.00	7621.00	0 00:00	0.00
A2	JUNCTION	0.00	0.00	7590.00	0 00:00	0.00
A3	JUNCTION	0.00	0.00	7605.00	0 00:00	0.00
A4	JUNCTION	0.00	0.00	7590.00	0 00:00	0.00
A5	JUNCTION	0.00	0.00	7550.00	0 00:00	0.00
A6	JUNCTION	0.00	0.00	7555.00	0 00:00	0.00
A7	JUNCTION	0.00	0.00	7550.00	0 00:00	0.00
B1	JUNCTION	0.00	0.00	7572.00	0 00:00	0.00
B2	JUNCTION	0.00	0.00	7574.00	0 00:00	0.00
B3	JUNCTION	0.00	0.00	7555.00	0 00:00	0.00
B4	JUNCTION	0.00	0.00	7558.00	0 00:00	0.00
B5	JUNCTION	0.00	0.00	7558.00	0 00:00	0.00
B6	JUNCTION	0.00	0.00	7552.00	0 00:00	0.00
C1	JUNCTION	0.00	0.00	7586.00	0 00:00	0.00
C2	JUNCTION	0.00	0.00	7562.00	0 00:00	0.00
C3	JUNCTION	0.00	0.00	7562.00	0 00:00	0.00
C4	JUNCTION	0.00	0.00	7553.00	0 00:00	0.00
C5	JUNCTION	0.00	0.00	7536.00	0 00:00	0.00
F1	JUNCTION	0.00	0.00	7582.00	0 00:00	0.00
F2	JUNCTION	0.00	0.00	7576.00	0 00:00	0.00
G1	JUNCTION	0.00	0.00	7585.00	0 00:00	0.00
H1	JUNCTION	0.00	0.00	7610.00	0 00:00	0.00
H2	JUNCTION	0.00	0.00	7570.00	0 00:00	0.00
H3	JUNCTION	0.00	0.00	7550.00	0 00:00	0.00
J_A1.1	JUNCTION	0.03	0.52	7600.52	0 00:44	0.52
J_A2.1	JUNCTION	0.05	0.90	7566.90	0 00:44	0.90
J_A2.2	JUNCTION	0.14	1.68	7526.68	0 01:02	1.68
J_A3.1	JUNCTION	0.08	1.35	7563.35	0 00:48	1.34
J_A4.1	JUNCTION	0.13	1.93	7549.93	0 00:48	1.93
J_A5.1	JUNCTION	0.13	1.93	7539.93	0 00:50	1.93
J_A6.1	JUNCTION	0.05	0.90	7536.90	0 00:46	0.90
J_B1.1	JUNCTION	0.00	0.00	7536.00	0 00:00	0.00
J_C1.1	JUNCTION	0.00	0.00	7570.00	0 00:00	0.00
J_C3.1	JUNCTION	0.00	0.00	7533.00	0 00:00	0.00
J_G1.1	JUNCTION	0.01	0.29	7555.29	0 00:38	0.28
J_H1.1	JUNCTION	0.02	0.34	7594.34	0 00:44	0.34
J_H2.1	JUNCTION	0.02	0.37	7560.37	0 00:40	0.37
J_H3.1	JUNCTION	0.02	0.37	7514.37	0 00:40	0.37
F3	JUNCTION	0.00	0.00	7568.00	0 00:00	0.00
J_F1.1	JUNCTION	0.07	0.96	7572.96	0 00:46	0.96
J_F2.1	JUNCTION	0.10	1.32	7559.32	0 00:48	1.32
J_B3.2	JUNCTION	0.00	0.00	7522.00	0 00:00	0.00
J_B5.1	JUNCTION	0.00	0.00	7533.00	0 00:00	0.00
J_B6.1	JUNCTION	0.00	0.00	7510.00	0 00:00	0.00
J_C4.1	JUNCTION	0.00	0.00	7544.00	0 00:00	0.00
J_C3.2	JUNCTION	0.00	0.00	7529.00	0 00:00	0.00
J_C5.1	JUNCTION	0.00	0.00	7524.00	0 00:00	0.00
O_BASIN_B	OUTFALL	0.00	0.00	7510.00	0 00:00	0.00
O_BASIN_C	OUTFALL	0.00	0.00	7520.00	0 00:00	0.00
O_BASIN_F	OUTFALL	0.10	1.32	7548.32	0 00:50	1.32
O_BASIN_H	OUTFALL	0.14	1.68	7516.68	0 01:04	1.68
POND-A	STORAGE	2.90	4.89	7534.89	0 01:02	4.89
POND-B	STORAGE	2.59	5.22	7533.22	0 00:56	5.21
POND-C	STORAGE	2.44	3.44	7533.44	0 00:54	3.44



 Node Inflow Summary

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal	Flow Balance Error Percent
A1	JUNCTION	14.30	14.30	0 00:44	0.37	0.37	0.000
A2	JUNCTION	19.57	19.57	0 00:42	0.422	0.422	0.000
A3	JUNCTION	101.45	101.45	0 00:48	2.67	2.67	0.000
A4	JUNCTION	20.00	20.00	0 00:52	0.718	0.718	0.000
A5	JUNCTION	4.73	4.73	0 00:42	0.0964	0.0964	0.000
A6	JUNCTION	11.66	11.66	0 00:42	0.249	0.249	0.000
A7	JUNCTION	17.12	17.12	0 00:38	0.317	0.317	0.000
B1	JUNCTION	181.77	181.77	0 00:42	3.66	3.66	0.000
B2	JUNCTION	49.44	49.44	0 00:46	1.41	1.41	0.000
B3	JUNCTION	3.01	3.01	0 00:38	0.0521	0.0521	0.000
B4	JUNCTION	15.04	15.04	0 00:46	0.451	0.451	0.000
B5	JUNCTION	18.88	18.88	0 00:42	0.415	0.415	0.000
B6	JUNCTION	33.86	33.86	0 00:38	0.624	0.624	0.000
C1	JUNCTION	27.69	27.69	0 00:42	0.62	0.62	0.000
C2	JUNCTION	3.00	3.00	0 00:44	0.0845	0.0845	0.000
C3	JUNCTION	39.03	39.03	0 00:42	0.823	0.823	0.000
C4	JUNCTION	10.29	10.29	0 00:38	0.168	0.168	0.000
C5	JUNCTION	4.01	4.01	0 00:42	0.0887	0.0887	0.000
F1	JUNCTION	17.27	17.27	0 00:46	0.501	0.501	0.000
F2	JUNCTION	16.94	16.94	0 00:48	0.516	0.516	0.000
G1	JUNCTION	5.74	5.74	0 00:38	0.0994	0.0994	0.000
H1	JUNCTION	7.68	7.68	0 00:44	0.203	0.203	0.000
H2	JUNCTION	35.02	35.02	0 00:38	0.565	0.565	0.000
H3	JUNCTION	66.87	66.87	0 00:42	1.33	1.33	0.000
J_A1.1	JUNCTION	0.00	14.30	0 00:44	0	0.37	0.000
J_A2.1	JUNCTION	0.00	33.49	0 00:44	0	0.792	0.000
J_A2.2	JUNCTION	0.00	160.82	0 01:02	0	4.71	0.000
J_A3.1	JUNCTION	0.00	101.45	0 00:48	0	2.67	-0.000
J_A4.1	JUNCTION	0.00	121.26	0 00:48	0	3.39	0.000
J_A5.1	JUNCTION	0.00	125.49	0 00:50	0	3.49	0.000
J_A6.1	JUNCTION	0.00	169.54	0 00:48	0	4.53	0.000
J_B1.1	JUNCTION	0.00	230.41	0 00:44	0	5.07	0.000
J_C1.1	JUNCTION	0.00	27.69	0 00:42	0	0.62	0.000
J_C3.1	JUNCTION	0.00	69.70	0 00:42	0	1.53	0.000
J_G1.1	JUNCTION	0.00	5.74	0 00:38	0	0.0994	0.000
J_H1.1	JUNCTION	0.00	7.68	0 00:44	0	0.203	0.000
J_H2.1	JUNCTION	0.00	41.20	0 00:40	0	0.768	0.000
J_H3.1	JUNCTION	0.00	113.43	0 00:42	0	2.2	0.000
F3	JUNCTION	26.57	26.57	0 00:44	0.654	0.654	0.000
J_F1.1	JUNCTION	0.00	17.27	0 00:46	0	0.501	0.000
J_F2.1	JUNCTION	0.00	34.20	0 00:48	0	1.02	0.000
J_B3.2	JUNCTION	0.00	215.66	0 00:56	0	5.45	0.000
J_B5.1	JUNCTION	0.00	18.88	0 00:42	0	0.415	0.000
J_B6.1	JUNCTION	0.00	33.86	0 00:38	0	0.624	0.000
J_C4.1	JUNCTION	0.00	10.29	0 00:38	0	0.168	0.000
J_C3.2	JUNCTION	0.00	61.92	0 00:54	0	1.44	0.000
J_C5.1	JUNCTION	0.00	4.01	0 00:42	0	0.0887	0.000
O_BASIN_B	OUTFALL	0.00	260.91	0 00:48	0	6.49	0.000
O_BASIN_C	OUTFALL	0.00	73.21	0 00:52	0	1.7	0.000
O_BASIN_F	OUTFALL	0.00	60.23	0 00:48	0	1.67	0.000
O_BASIN_H	OUTFALL	0.00	248.45	0 00:54	0	6.9	0.000
POND-A	STORAGE	0.00	185.08	0 00:48	0	4.85	0.166
POND-B	STORAGE	0.00	248.09	0 00:44	0	5.57	0.119
POND-C	STORAGE	0.00	69.70	0 00:42	0	1.53	0.259

 Node Flooding Summary

No nodes were flooded.



 Storage Volume Summary

Storage Unit	Average Volume 1000 ft3	Avg Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 ft3	Max Pcnt Full	Time of Max Occurrence days hr:min	Maximum Outflow CFS
POND-A	30.297	13	0	0	111.834	47	0 01:02	160.82
POND-B	28.109	9	0	0	101.570	32	0 00:56	215.66
POND-C	15.997	4	0	0	43.891	11	0 00:54	61.92

 Outfall Loading Summary

Outfall Node	Flow Freq Pcnt	Avg Flow CFS	Max Flow CFS	Total Volume 10^6 gal
O_BASIN_B	99.44	10.09	260.91	6.486
O_BASIN_C	99.44	2.64	73.21	1.697
O_BASIN_F	19.17	13.49	60.23	1.671
O_BASIN_H	99.31	10.76	248.45	6.903
System	79.34	36.98	639.55	16.756



 Link Flow Summary

Link	Type	Maximum Flow CFS	Time of Max Occurrence days hr:min	Maximum Veloc ft/sec	Max/ Full Flow	Max/ Full Depth
L_A1.1	DUMMY	14.30	0 00:44			
L_A2.1	DUMMY	19.57	0 00:42			
L_A1.2	CONDUIT	14.26	0 00:46	4.51	0.01	0.13
L_G1.1	DUMMY	5.74	0 00:38			
L_H3.1	DUMMY	66.87	0 00:42			
L_G1.2	CONDUIT	5.60	0 00:44	3.27	0.00	0.07
L_F1.1	DUMMY	17.27	0 00:46			
L_B1.1	DUMMY	181.77	0 00:42			
L_B2.1	DUMMY	49.44	0 00:46			
L_B1.2	DUMMY	230.41	0 00:44			
L_B6.1	DUMMY	33.86	0 00:38			
L_B5.1	DUMMY	18.88	0 00:42			
L_C4.1	DUMMY	10.29	0 00:38			
L_C5.1	DUMMY	4.01	0 00:42			
L_C1.1	DUMMY	27.69	0 00:42			
L_C1.2	DUMMY	27.69	0 00:42			
L_C2.1	DUMMY	3.00	0 00:44			
L_A3.1	DUMMY	101.45	0 00:48			
L_A3.2	CONDUIT	101.47	0 00:48	6.61	0.06	0.27
L_A4.2	CONDUIT	121.20	0 00:50	6.46	0.92	0.96
L_A4.1	DUMMY	20.00	0 00:52			
L_A6.1	DUMMY	11.66	0 00:42			
L_A5.2	DUMMY	125.49	0 00:50			
L_A5.1	DUMMY	4.73	0 00:42			
L_A2.2	CONDUIT	33.44	0 00:46	6.59	0.16	0.45
L_A7.1	DUMMY	17.12	0 00:38			
L_A6.2	DUMMY	169.54	0 00:48			
L_H1.1	DUMMY	7.68	0 00:44			
L_H2.1	DUMMY	35.02	0 00:38			
L_H1.2	CONDUIT	7.65	0 00:48	3.59	0.00	0.07
L_H2.2	CONDUIT	41.25	0 00:40	17.31	0.01	0.09
L_A7.2	CONDUIT	160.81	0 01:04	5.75	0.10	0.34
L_H3.2	DUMMY	113.43	0 00:42			
L_B3.1	DUMMY	3.01	0 00:38			
L_B4.1	DUMMY	15.04	0 00:46			
L_C3.2	DUMMY	69.70	0 00:42			
L_C3.1	DUMMY	39.03	0 00:42			
L_F2.1	DUMMY	16.94	0 00:48			
L_F3.1	DUMMY	26.57	0 00:44			
L_F1.2	CONDUIT	17.26	0 00:48	4.65	0.14	0.48
L_F2.2	CONDUIT	34.14	0 00:50	4.91	0.33	0.66
L_B6.2	DUMMY	33.86	0 00:38			
L_B3.3	DUMMY	215.66	0 00:56			
L_B5.2	DUMMY	18.88	0 00:42			
L_C4.2	DUMMY	10.29	0 00:38			
L_C3.3	DUMMY	61.92	0 00:54			
L_C5.2	DUMMY	4.01	0 00:42			
POND-A-OUTFALL	DUMMY	160.82	0 01:02			
POND-B-OUTFALL	DUMMY	215.66	0 00:56			
POND-C-OUTFALL	DUMMY	61.92	0 00:54			

 Conduit Surcharge Summary

No conduits were surcharged.

Analysis begun on: Thu Sep 05 13:58:30 2024
 Analysis ended on: Thu Sep 05 13:58:30 2024
 Total elapsed time: < 1 sec

SWMM hydrographs representing runoff entering ponds, transferred to MHFD-Detention

Table - Node Total Inflow			
		POND-A	
Days	Hours	5-Year	100-Year
0	0:05:00	0	0
0	0:10:00	0.01	0.02
0	0:15:00	0.1	0.11
0	0:20:00	0.3	0.29
0	0:25:00	2.36	1.83
0	0:30:00	11.47	19.59
0	0:35:00	31.46	96.08
0	0:40:00	42.49	161.92
0	0:45:00	42.09	182.46
0	0:50:00	38.34	183.84
0	0:55:00	34.02	175.93
0	1:00:00	30.05	164.79
0	1:05:00	26.4	153.37
0	1:10:00	23.39	142.09
0	1:15:00	20.9	126.74
0	1:20:00	18.58	110.87
0	1:25:00	16.3	96.01
0	1:30:00	14.09	82.24
0	1:35:00	12.12	69.97
0	1:40:00	10.6	60.01
0	1:45:00	9.32	52.05
0	1:50:00	8.13	45.12
0	1:55:00	7.07	39.03
0	2:00:00	6.16	33.71
0	2:05:00	5.36	29.08
0	2:10:00	4.62	24.94
0	2:15:00	3.92	21.21
0	2:20:00	3.25	17.72
0	2:25:00	2.63	14.39
0	2:30:00	2.05	11.28
0	2:35:00	1.57	8.63
0	2:40:00	1.25	6.76
0	2:45:00	1.04	5.46
0	2:50:00	0.88	4.45
0	2:55:00	0.76	3.64
0	3:00:00	0.65	2.98
0	3:05:00	0.55	2.43
0	3:10:00	0.45	1.96
0	3:15:00	0.37	1.57
0	3:20:00	0.29	1.23
0	3:25:00	0.21	0.91
0	3:30:00	0.15	0.63
0	3:35:00	0.11	0.44
0	3:40:00	0.09	0.32
0	3:45:00	0.07	0.23
0	3:50:00	0.06	0.16
0	3:55:00	0.05	0.12
0	4:00:00	0.04	0.08
0	4:05:00	0.03	0.06
0	4:10:00	0.03	0.04
0	4:15:00	0.02	0.03
0	4:20:00	0.02	0.02
0	4:25:00	0.01	0.02

Table - Node Total Inflow			
		POND-B	
Days	Hours	5-Year	100-Year
0	0:05:00	0	0
0	0:10:00	0.02	0.03
0	0:15:00	0.29	0.32
0	0:20:00	0.84	0.81
0	0:25:00	5.28	4.04
0	0:30:00	28.18	47.72
0	0:35:00	55.99	177.86
0	0:40:00	59.11	240.83
0	0:45:00	52.91	247.06
0	0:50:00	45.39	236.61
0	0:55:00	39.31	219.08
0	1:00:00	33.91	200.33
0	1:05:00	28.93	183.22
0	1:10:00	24.45	163.76
0	1:15:00	21.11	137.51
0	1:20:00	18.47	115.66
0	1:25:00	15.99	97.45
0	1:30:00	13.64	81.53
0	1:35:00	11.47	67.41
0	1:40:00	9.51	54.87
0	1:45:00	7.57	43.86
0	1:50:00	5.83	33.94
0	1:55:00	4.79	26.61
0	2:00:00	4.12	21.52
0	2:05:00	3.56	17.61
0	2:10:00	3.01	14.31
0	2:15:00	2.51	11.6
0	2:20:00	2.04	9.28
0	2:25:00	1.6	7.3
0	2:30:00	1.18	5.61
0	2:35:00	0.81	4.07
0	2:40:00	0.55	2.75
0	2:45:00	0.4	1.87
0	2:50:00	0.31	1.28
0	2:55:00	0.24	0.88
0	3:00:00	0.19	0.58
0	3:05:00	0.15	0.37
0	3:10:00	0.12	0.23
0	3:15:00	0.09	0.15
0	3:20:00	0.07	0.11
0	3:25:00	0.05	0.08
0	3:30:00	0.04	0.07
0	3:35:00	0.03	0.05
0	3:40:00	0.02	0.04
0	3:45:00	0.01	0.03
0	3:50:00	0.01	0.02
0	3:55:00	0.00	0.01
0	4:00:00	0.00	0.01
0	4:05:00	0.00	0.00
0	4:10:00	0.00	0.00
0	4:15:00	0.00	0.00
0	4:20:00	0.00	0.00
0	4:25:00	0.00	0.00

Table - Node Total Inflow			
		POND-C	
Days	Hours	5-Year	100-Year
0	0:05:00	0	0
0	0:10:00	0.01	0.02
0	0:15:00	0.16	0.17
0	0:20:00	0.44	0.42
0	0:25:00	3.1	2.4
0	0:30:00	12.19	23.71
0	0:35:00	18.04	57.21
0	0:40:00	17.52	69.03
0	0:45:00	15.52	68.8
0	0:50:00	13.42	65.25
0	0:55:00	11.68	60.06
0	1:00:00	10.12	54.88
0	1:05:00	8.65	50.27
0	1:10:00	7.28	44.01
0	1:15:00	6.21	36.31
0	1:20:00	5.39	30.18
0	1:25:00	4.68	25.27
0	1:30:00	4.04	21.11
0	1:35:00	3.44	17.52
0	1:40:00	2.82	14.24
0	1:45:00	2.17	11.2
0	1:50:00	1.56	8.38
0	1:55:00	1.1	6
0	2:00:00	0.81	4.2
0	2:05:00	0.63	2.99
0	2:10:00	0.49	2.1
0	2:15:00	0.38	1.45
0	2:20:00	0.29	0.96
0	2:25:00	0.22	0.61
0	2:30:00	0.16	0.37
0	2:35:00	0.12	0.25
0	2:40:00	0.09	0.18
0	2:45:00	0.07	0.13
0	2:50:00	0.05	0.1
0	2:55:00	0.04	0.07
0	3:00:00	0.02	0.05
0	3:05:00	0.02	0.04
0	3:10:00	0.01	0.02
0	3:15:00	0.01	0.02
0	3:20:00	0.01	0.01
0	3:25:00	0.00	0.01
0	3:30:00	0.00	0.00
0	3:35:00	0.00	0.00
0	3:40:00	0.00	0.00
0	3:45:00	0.00	0.00
0	3:50:00	0.00	0.00
0	3:55:00	0.00	0.00
0	4:00:00	0.00	0.00
0	4:05:00	0.00	0.00
0	4:10:00	0.00	0.00
0	4:15:00	0.00	0.00
0	4:20:00	0.00	0.00
0	4:25:00	0.00	0.00

SWMM hydrographs representing runoff entering ponds, transferred to MHFD-Detention

Table - Node Total Inflow			
Days	Hours	POND-A	
		5-Year	100-Year
0	4:30:00	0.01	0.02
0	4:35:00	0.01	0.01
0	4:40:00	0.01	0.01
0	4:45:00	0.01	0.01
0	4:50:00	0.00	0.01
0	4:55:00	0.00	0.01
0	5:00:00	0.00	0.00
0	5:05:00	0.00	0.00
0	5:10:00	0.00	0.00
0	5:15:00	0.00	0.00
0	5:20:00	0.00	0.00
0	5:25:00	0.00	0.00
0	5:30:00	0.00	0.00
0	5:35:00	0.00	0.00
0	5:40:00	0.00	0.00
0	5:45:00	0.00	0.00
0	5:50:00	0.00	0.00
0	5:55:00	0.00	0.00
0	6:00:00	0.00	0.00

Table - Node Total Inflow			
Days	Hours	POND-B	
		5-Year	100-Year
0	4:30:00	0.00	0.00
0	4:35:00	0.00	0.00
0	4:40:00	0.00	0.00
0	4:45:00	0.00	0.00
0	4:50:00	0.00	0.00
0	4:55:00	0.00	0.00
0	5:00:00	0.00	0.00
0	5:05:00	0.00	0.00
0	5:10:00	0.00	0.00
0	5:15:00	0.00	0.00
0	5:20:00	0.00	0.00
0	5:25:00	0.00	0.00
0	5:30:00	0.00	0.00
0	5:35:00	0.00	0.00
0	5:40:00	0.00	0.00
0	5:45:00	0.00	0.00
0	5:50:00	0.00	0.00
0	5:55:00	0.00	0.00
0	6:00:00	0.00	0.00

Table - Node Total Inflow			
Days	Hours	POND-C	
		5-Year	100-Year
0	4:30:00	0.00	0.00
0	4:35:00	0.00	0.00
0	4:40:00	0.00	0.00
0	4:45:00	0.00	0.00
0	4:50:00	0.00	0.00
0	4:55:00	0.00	0.00
0	5:00:00	0.00	0.00
0	5:05:00	0.00	0.00
0	5:10:00	0.00	0.00
0	5:15:00	0.00	0.00
0	5:20:00	0.00	0.00
0	5:25:00	0.00	0.00
0	5:30:00	0.00	0.00
0	5:35:00	0.00	0.00
0	5:40:00	0.00	0.00
0	5:45:00	0.00	0.00
0	5:50:00	0.00	0.00
0	5:55:00	0.00	0.00
0	6:00:00	0.00	0.00



Flying Horse North Filing No. 4
Final Drainage Report
Project No.: 211030
El Paso County, Colorado

APPENDIX C

HYDRAULIC CALCULATIONS



Flying Horse North Filing No. 4
Final Drainage Report
Project No.: 211030
El Paso County, Colorado

CULVERT CALCULATIONS

Culvert Report

Culvert 1 (5-Year)

Invert Elev Dn (ft)	= 7579.00
Pipe Length (ft)	= 123.90
Slope (%)	= 0.70
Invert Elev Up (ft)	= 7579.87
Rise (in)	= 18.0
Shape	= Circular
Span (in)	= 18.0
No. Barrels	= 1
n-Value	= 0.012
Culvert Type	= Circular Concrete
Culvert Entrance	= Square edge w/headwall (C)
Coeff. K,M,c,Y,k	= 0.0098, 2, 0.0398, 0.67, 0.5

Embankment

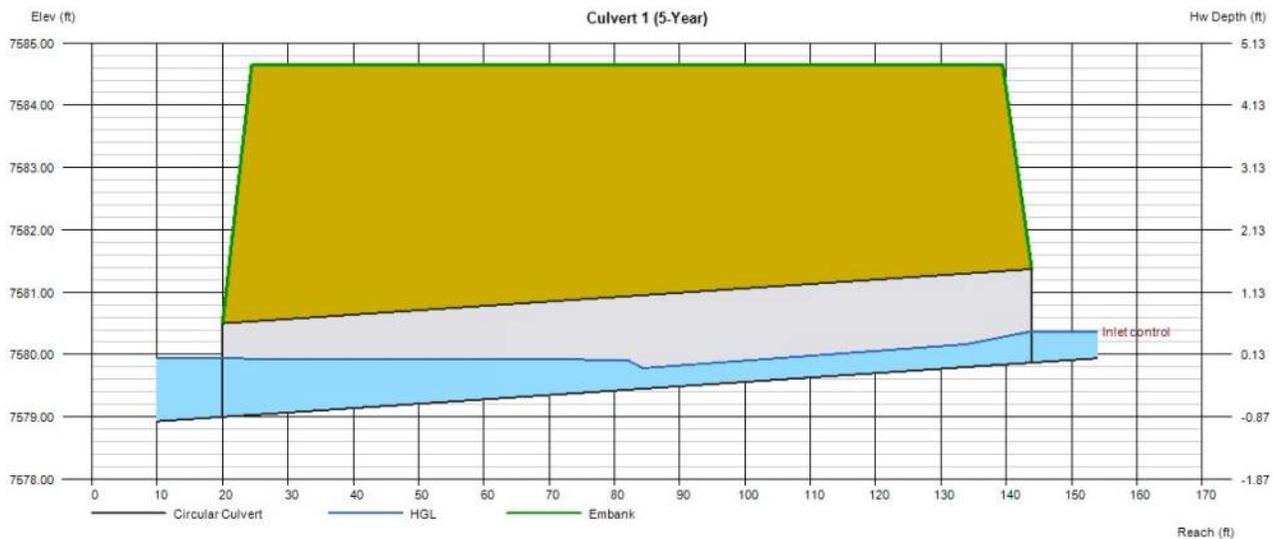
Top Elevation (ft)	= 7584.64
Top Width (ft)	= 115.00
Crest Width (ft)	= 30.00

Calculations

Qmin (cfs)	= 1.00
Qmax (cfs)	= 1.00
Tailwater Elev (ft)	= (dc+D)/2

Highlighted

Qtotal (cfs)	= 1.00
Qpipe (cfs)	= 1.00
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 0.86
Veloc Up (ft/s)	= 2.92
HGL Dn (ft)	= 7579.94
HGL Up (ft)	= 7580.24
Hw Elev (ft)	= 7580.37
Hw/D (ft)	= 0.34
Flow Regime	= Inlet Control



Culvert Report

Culvert 1 (100-Year)

Invert Elev Dn (ft)	= 7579.00
Pipe Length (ft)	= 123.90
Slope (%)	= 0.70
Invert Elev Up (ft)	= 7579.87
Rise (in)	= 18.0
Shape	= Circular
Span (in)	= 18.0
No. Barrels	= 1
n-Value	= 0.012
Culvert Type	= Circular Concrete
Culvert Entrance	= Square edge w/headwall (C)
Coeff. K,M,c,Y,k	= 0.0098, 2, 0.0398, 0.67, 0.5

Embankment

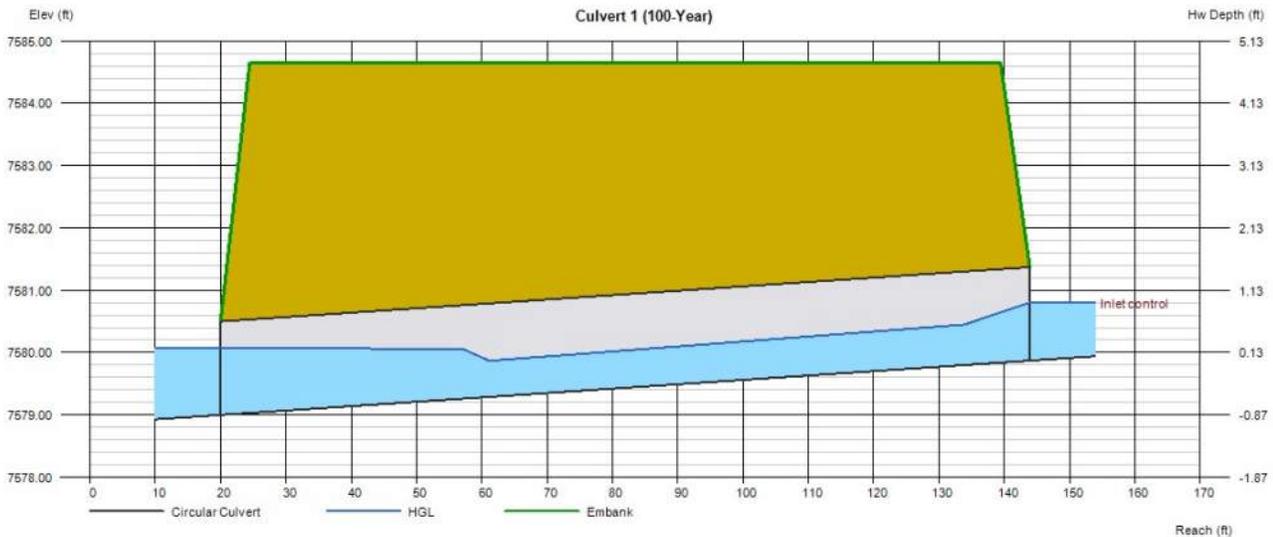
Top Elevation (ft)	= 7584.64
Top Width (ft)	= 115.00
Crest Width (ft)	= 30.00

Calculations

Qmin (cfs)	= 3.00
Qmax (cfs)	= 3.00
Tailwater Elev (ft)	= (dc+D)/2

Highlighted

Qtotal (cfs)	= 3.00
Qpipe (cfs)	= 3.00
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 2.20
Veloc Up (ft/s)	= 4.02
HGL Dn (ft)	= 7580.08
HGL Up (ft)	= 7580.53
Hw Elev (ft)	= 7580.80
Hw/D (ft)	= 0.62
Flow Regime	= Inlet Control



Culvert Report

Culvert 2 - DPA4 (5-Year)

Invert Elev Dn (ft)	= 7545.83
Pipe Length (ft)	= 210.30
Slope (%)	= 1.19
Invert Elev Up (ft)	= 7548.34
Rise (in)	= 60.0
Shape	= Circular
Span (in)	= 60.0
No. Barrels	= 1
n-Value	= 0.012
Culvert Type	= Circular Concrete
Culvert Entrance	= Square edge w/headwall (C)
Coeff. K,M,c,Y,k	= 0.0098, 2, 0.0398, 0.67, 0.5

Embankment

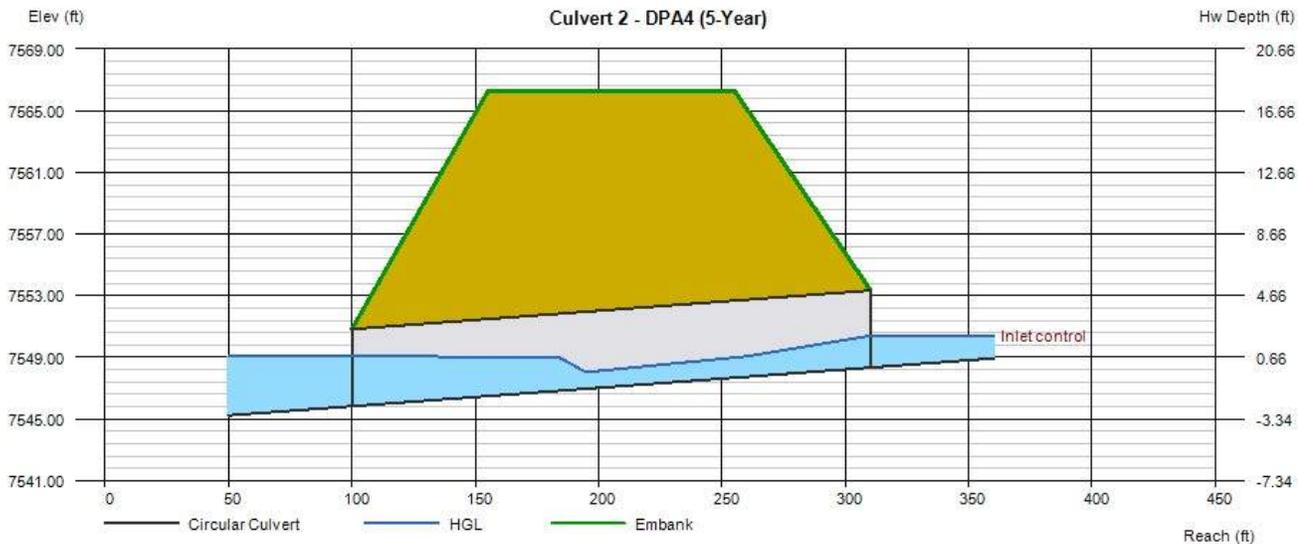
Top Elevation (ft)	= 7566.27
Top Width (ft)	= 100.00
Crest Width (ft)	= 270.00

Calculations

Qmin (cfs)	= 30.00
Qmax (cfs)	= 30.00
Tailwater Elev (ft)	= (dc+D)/2

Highlighted

Qtotal (cfs)	= 30.00
Qpipe (cfs)	= 30.00
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 2.21
Veloc Up (ft/s)	= 5.95
HGL Dn (ft)	= 7549.09
HGL Up (ft)	= 7549.86
Hw Elev (ft)	= 7550.40
Hw/D (ft)	= 0.41
Flow Regime	= Inlet Control



Culvert Report

Culvert 2 - DPA4 (100-Year)

Invert Elev Dn (ft)	= 7545.83
Pipe Length (ft)	= 210.30
Slope (%)	= 1.19
Invert Elev Up (ft)	= 7548.34
Rise (in)	= 60.0
Shape	= Circular
Span (in)	= 60.0
No. Barrels	= 1
n-Value	= 0.012
Culvert Type	= Circular Concrete
Culvert Entrance	= Square edge w/headwall (C)
Coeff. K,M,c,Y,k	= 0.0098, 2, 0.0398, 0.67, 0.5

Embankment

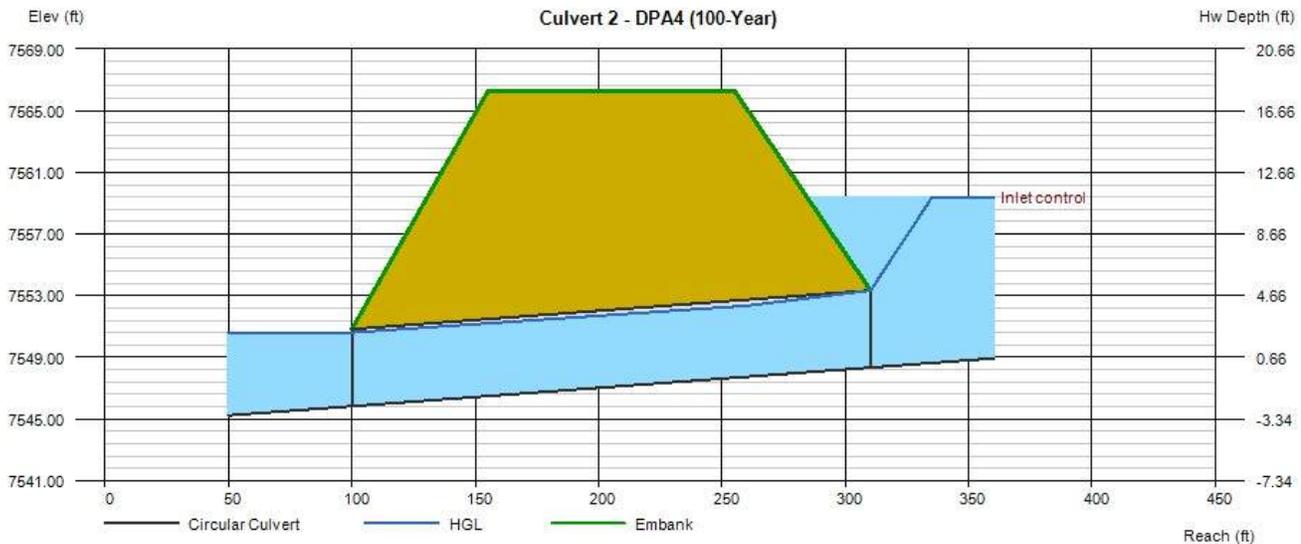
Top Elevation (ft)	= 7566.27
Top Width (ft)	= 100.00
Crest Width (ft)	= 270.00

Calculations

Qmin (cfs)	= 274.00
Qmax (cfs)	= 274.00
Tailwater Elev (ft)	= (dc+D)/2

Highlighted

Qtotal (cfs)	= 274.00
Qpipe (cfs)	= 274.00
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 14.18
Veloc Up (ft/s)	= 14.59
HGL Dn (ft)	= 7550.61
HGL Up (ft)	= 7552.90
Hw Elev (ft)	= 7559.41
Hw/D (ft)	= 2.21
Flow Regime	= Inlet Control



Culvert Report

Culvert 3 (5-Year)

Invert Elev Dn (ft)	= 7598.30
Pipe Length (ft)	= 70.14
Slope (%)	= 0.73
Invert Elev Up (ft)	= 7598.81
Rise (in)	= 18.0
Shape	= Circular
Span (in)	= 18.0
No. Barrels	= 1
n-Value	= 0.012
Culvert Type	= Circular Concrete
Culvert Entrance	= Square edge w/headwall (C)
Coeff. K,M,c,Y,k	= 0.0098, 2, 0.0398, 0.67, 0.5

Embankment

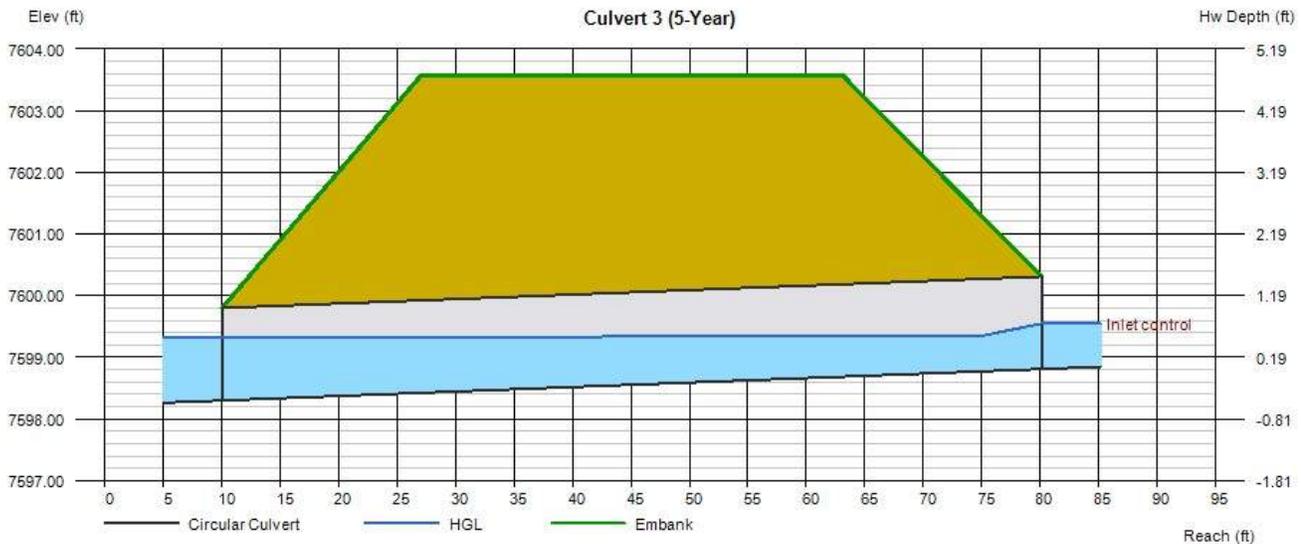
Top Elevation (ft)	= 7603.58
Top Width (ft)	= 36.00
Crest Width (ft)	= 20.00

Calculations

Qmin (cfs)	= 2.00
Qmax (cfs)	= 2.00
Tailwater Elev (ft)	= (dc+D)/2

Highlighted

Qtotal (cfs)	= 2.00
Qpipe (cfs)	= 2.00
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 1.57
Veloc Up (ft/s)	= 3.43
HGL Dn (ft)	= 7599.32
HGL Up (ft)	= 7599.36
Hw Elev (ft)	= 7599.55
Hw/D (ft)	= 0.49
Flow Regime	= Inlet Control



Culvert Report

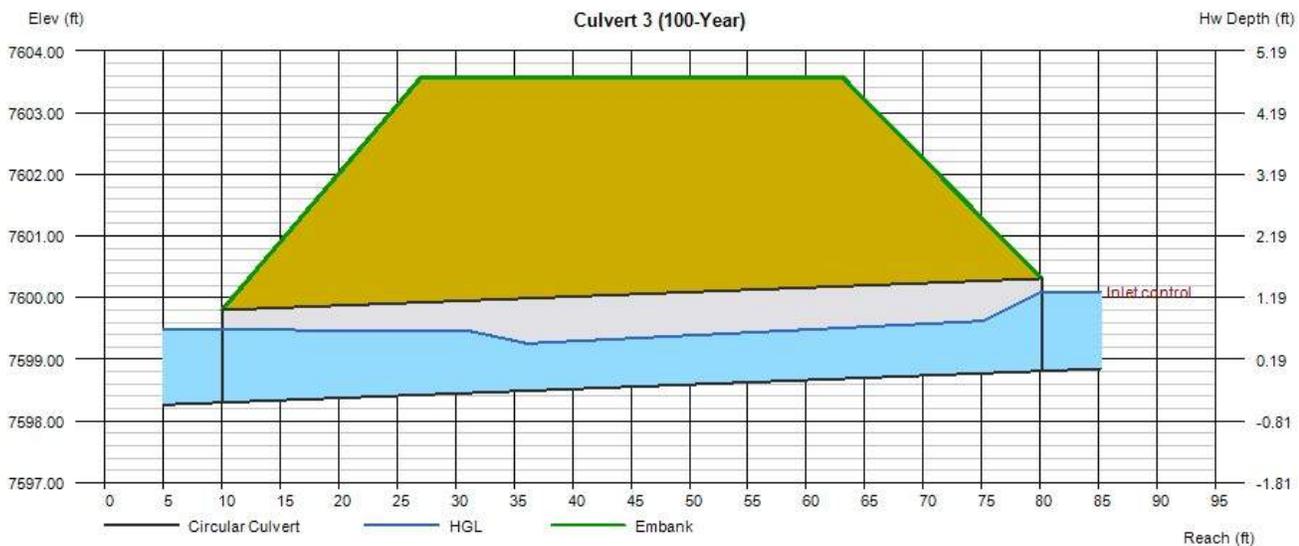
Culvert 3 (100-Year)

Invert Elev Dn (ft)	= 7598.30
Pipe Length (ft)	= 70.14
Slope (%)	= 0.73
Invert Elev Up (ft)	= 7598.81
Rise (in)	= 18.0
Shape	= Circular
Span (in)	= 18.0
No. Barrels	= 1
n-Value	= 0.012
Culvert Type	= Circular Concrete
Culvert Entrance	= Square edge w/headwall (C)
Coeff. K,M,c,Y,k	= 0.0098, 2, 0.0398, 0.67, 0.5

Embankment	
Top Elevation (ft)	= 7603.58
Top Width (ft)	= 36.00
Crest Width (ft)	= 20.00

Calculations	
Qmin (cfs)	= 5.00
Qmax (cfs)	= 5.00
Tailwater Elev (ft)	= (dc+D)/2

Highlighted	
Qtotal (cfs)	= 5.00
Qpipe (cfs)	= 5.00
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 3.35
Veloc Up (ft/s)	= 4.77
HGL Dn (ft)	= 7599.48
HGL Up (ft)	= 7599.67
Hw Elev (ft)	= 7600.10
Hw/D (ft)	= 0.86
Flow Regime	= Inlet Control



Culvert Report

Culvert 4 - DPA1 (5-Year)

Invert Elev Dn (ft)	= 7590.12
Pipe Length (ft)	= 122.21
Slope (%)	= 0.41
Invert Elev Up (ft)	= 7590.62
Rise (in)	= 24.0
Shape	= Circular
Span (in)	= 24.0
No. Barrels	= 1
n-Value	= 0.012
Culvert Type	= Circular Concrete
Culvert Entrance	= Square edge w/headwall (C)
Coeff. K,M,c,Y,k	= 0.0098, 2, 0.0398, 0.67, 0.5

Embankment

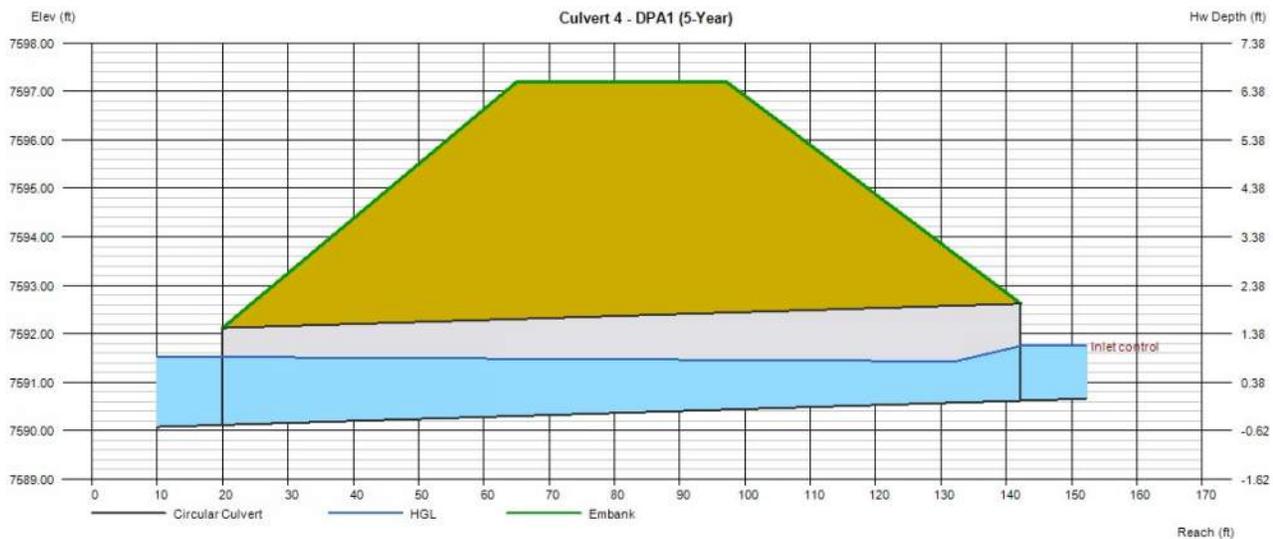
Top Elevation (ft)	= 7597.20
Top Width (ft)	= 32.00
Crest Width (ft)	= 75.00

Calculations

Qmin (cfs)	= 5.20
Qmax (cfs)	= 5.20
Tailwater Elev (ft)	= (dc+D)/2

Highlighted

Qtotal (cfs)	= 5.20
Qpipe (cfs)	= 5.20
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 2.21
Veloc Up (ft/s)	= 4.41
HGL Dn (ft)	= 7591.52
HGL Up (ft)	= 7591.42
Hw Elev (ft)	= 7591.75
Hw/D (ft)	= 0.56
Flow Regime	= Inlet Control



Culvert Report

Culvert 4 - DPA1 (100-Year)

Invert Elev Dn (ft)	= 7590.12
Pipe Length (ft)	= 122.21
Slope (%)	= 0.41
Invert Elev Up (ft)	= 7590.62
Rise (in)	= 24.0
Shape	= Circular
Span (in)	= 24.0
No. Barrels	= 1
n-Value	= 0.012
Culvert Type	= Circular Concrete
Culvert Entrance	= Square edge w/headwall (C)
Coeff. K,M,c,Y,k	= 0.0098, 2, 0.0398, 0.67, 0.5

Embankment

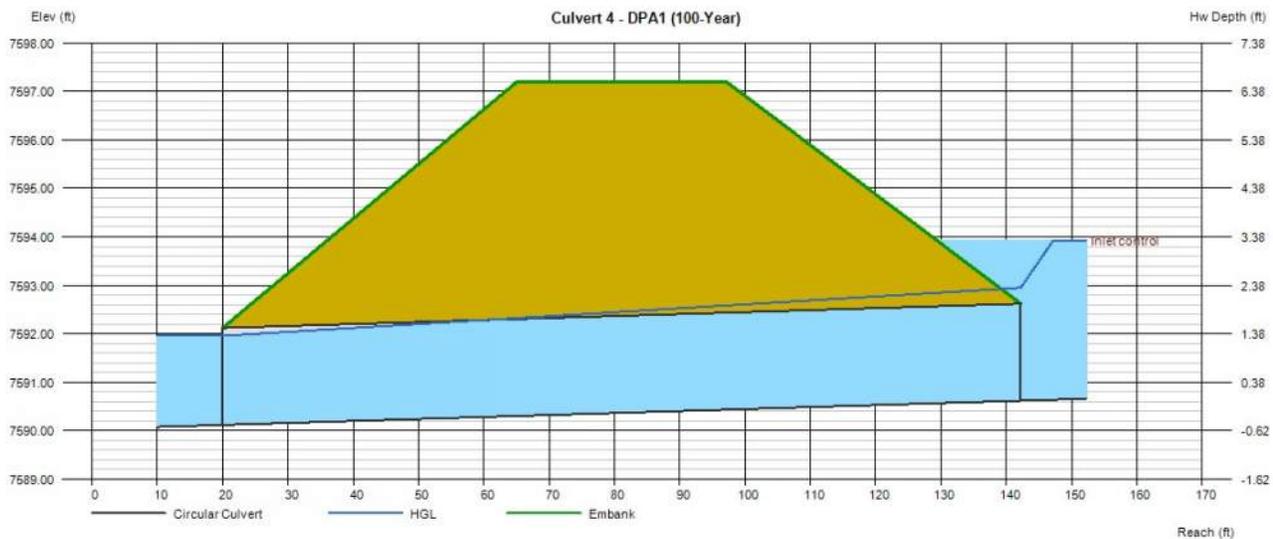
Top Elevation (ft)	= 7597.20
Top Width (ft)	= 32.00
Crest Width (ft)	= 75.00

Calculations

Qmin (cfs)	= 22.10
Qmax (cfs)	= 22.10
Tailwater Elev (ft)	= (dc+D)/2

Highlighted

Qtotal (cfs)	= 22.10
Qpipe (cfs)	= 22.10
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 7.31
Veloc Up (ft/s)	= 7.03
HGL Dn (ft)	= 7591.96
HGL Up (ft)	= 7592.95
Hw Elev (ft)	= 7593.93
Hw/D (ft)	= 1.65
Flow Regime	= Inlet Control



Culvert Report

Culvert 5 - DPH1 (5-Year)

Invert Elev Dn (ft)	= 7588.21
Pipe Length (ft)	= 151.43
Slope (%)	= 1.06
Invert Elev Up (ft)	= 7589.82
Rise (in)	= 18.0
Shape	= Circular
Span (in)	= 18.0
No. Barrels	= 1
n-Value	= 0.012
Culvert Type	= Circular Concrete
Culvert Entrance	= Square edge w/headwall (C)
Coeff. K,M,c,Y,k	= 0.0098, 2, 0.0398, 0.67, 0.5

Embankment

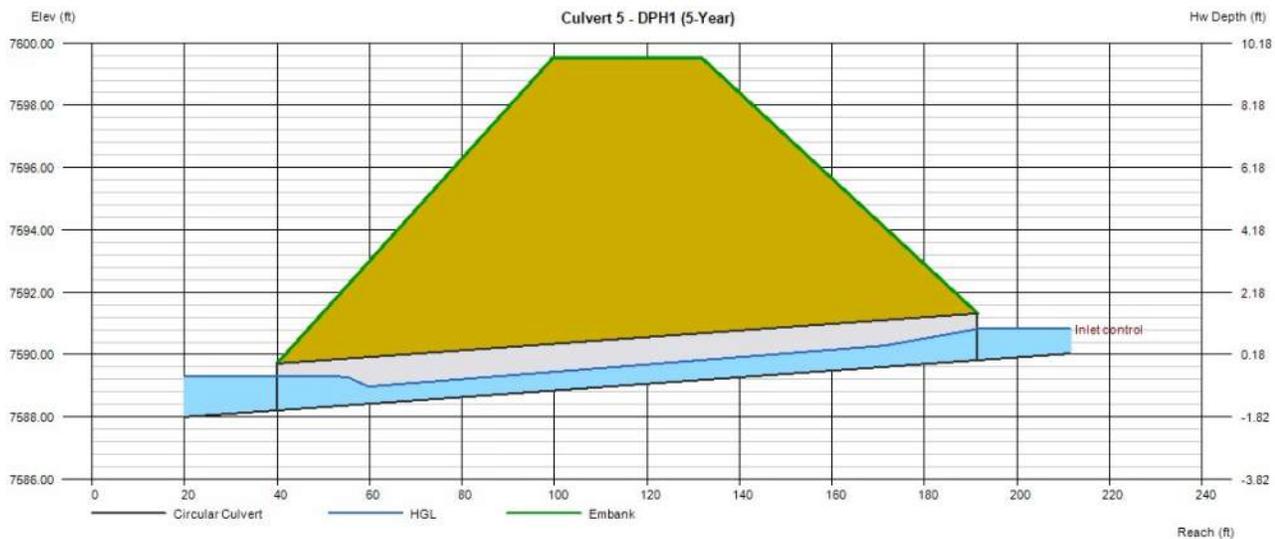
Top Elevation (ft)	= 7599.53
Top Width (ft)	= 32.00
Crest Width (ft)	= 125.00

Calculations

Qmin (cfs)	= 3.40
Qmax (cfs)	= 3.40
Tailwater Elev (ft)	= (dc+D)/2

Highlighted

Qtotal (cfs)	= 3.40
Qpipe (cfs)	= 3.40
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 2.45
Veloc Up (ft/s)	= 4.18
HGL Dn (ft)	= 7589.31
HGL Up (ft)	= 7590.52
Hw Elev (ft)	= 7590.82
Hw/D (ft)	= 0.67
Flow Regime	= Inlet Control



Culvert Report

Culvert 5 - DPH1 (100-Year)

Invert Elev Dn (ft)	=	7588.21
Pipe Length (ft)	=	151.43
Slope (%)	=	1.06
Invert Elev Up (ft)	=	7589.82
Rise (in)	=	18.0
Shape	=	Circular
Span (in)	=	18.0
No. Barrels	=	1
n-Value	=	0.012
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

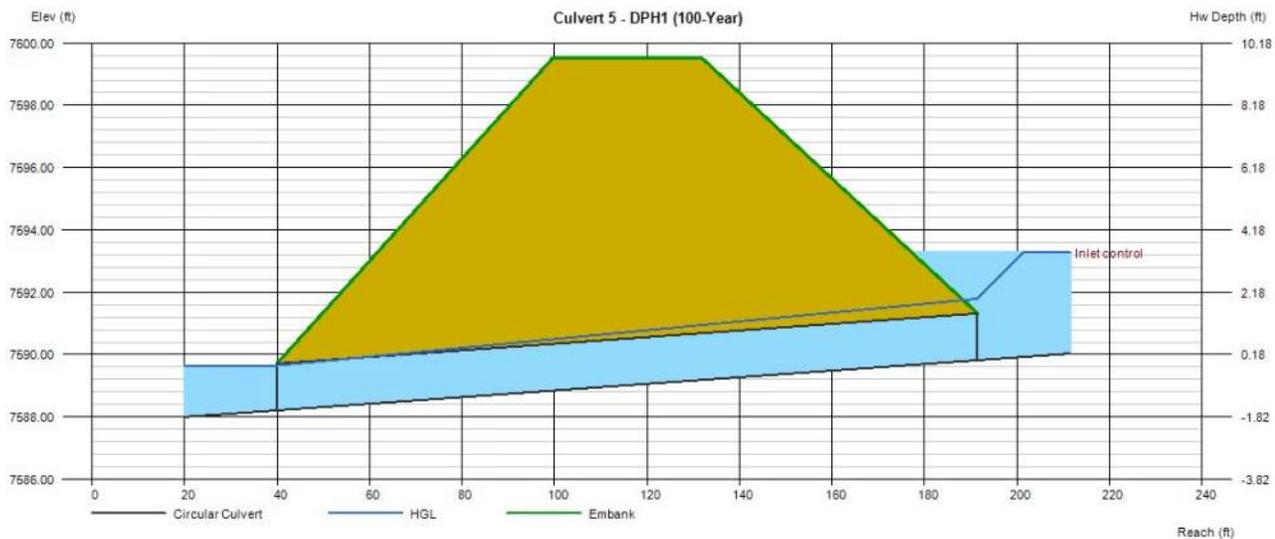
Top Elevation (ft)	=	7599.53
Top Width (ft)	=	32.00
Crest Width (ft)	=	125.00

Calculations

Qmin (cfs)	=	13.90
Qmax (cfs)	=	13.90
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	13.90
Qpipe (cfs)	=	13.90
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	7.98
Veloc Up (ft/s)	=	7.87
HGL Dn (ft)	=	7589.65
HGL Up (ft)	=	7591.79
Hw Elev (ft)	=	7593.28
Hw/D (ft)	=	2.31
Flow Regime	=	Inlet Control



Culvert Report

Culvert 6 (5-Year)

Invert Elev Dn (ft)	=	7594.70
Pipe Length (ft)	=	62.17
Slope (%)	=	2.57
Invert Elev Up (ft)	=	7596.30
Rise (in)	=	18.0
Shape	=	Circular
Span (in)	=	18.0
No. Barrels	=	1
n-Value	=	0.012
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

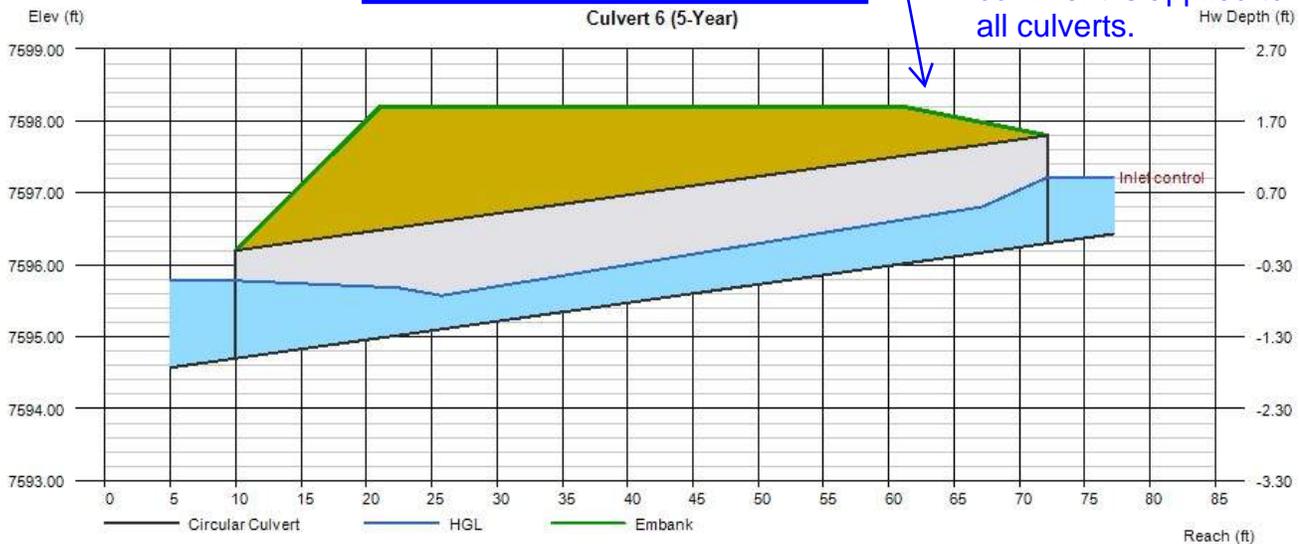
Calculations	
Qmin (cfs)	= 3.00
Qmax (cfs)	= 3.00
Tailwater Elev (ft)	= (dc+D)/2

Highlighted	
Qtotal (cfs)	= 3.00
Qpipe (cfs)	= 3.00
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 2.20
Veloc Up (ft/s)	= 4.02
HGL Dn (ft)	= 7595.78
HGL Up (ft)	= 7596.96
Hw Elev (ft)	= 7597.22
Hw/D (ft)	= 0.61
Flow Regime	= Inlet Control

Embankment	
Top Elevation (ft)	= 7598.20
Top Width (ft)	= 40.00
Crest Width (ft)	= 40.00

HRG Response: The culverts have been updated to have a burial depth of at least 2' under roadways.

The burial depth must be at least 2 feet for all culverts. Please update the CD accordingly. This comment is applied to all culverts.



Culvert Report

Culvert 6 (100-Year)

Invert Elev Dn (ft)	= 7594.70
Pipe Length (ft)	= 62.17
Slope (%)	= 2.57
Invert Elev Up (ft)	= 7596.30
Rise (in)	= 18.0
Shape	= Circular
Span (in)	= 18.0
No. Barrels	= 1
n-Value	= 0.012
Culvert Type	= Circular Concrete
Culvert Entrance	= Square edge w/headwall (C)
Coeff. K,M,c,Y,k	= 0.0098, 2, 0.0398, 0.67, 0.5

Calculations

Qmin (cfs)	= 7.00
Qmax (cfs)	= 7.00
Tailwater Elev (ft)	= (dc+D)/2

Highlighted

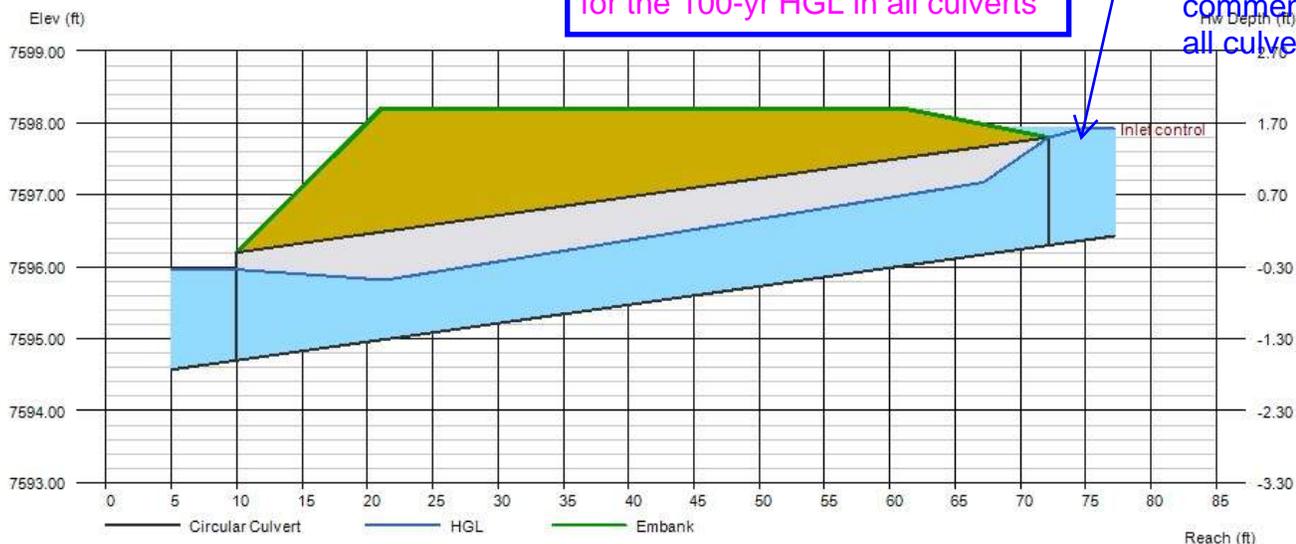
Qtotal (cfs)	= 7.00
Qpipe (cfs)	= 7.00
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 4.41
Veloc Up (ft/s)	= 5.45
HGL Dn (ft)	= 7595.96
HGL Up (ft)	= 7597.32
Hw Elev (ft)	= 7597.92
Hw/D (ft)	= 1.08
Flow Regime	= Inlet Control

Embankment

Top Elevation (ft)	= 7598.20
Top Width (ft)	= 40.00
Crest Width (ft)	= 40.00

HRG Response: The culverts have been updated to have a burial depth of at least 2' under roadways. This change now allows for at least 1' of freeboard for the 100-yr HGL in all culverts

100 yr must be at least 1ft below the ground. This comment is applied to all culverts.



Culvert Report

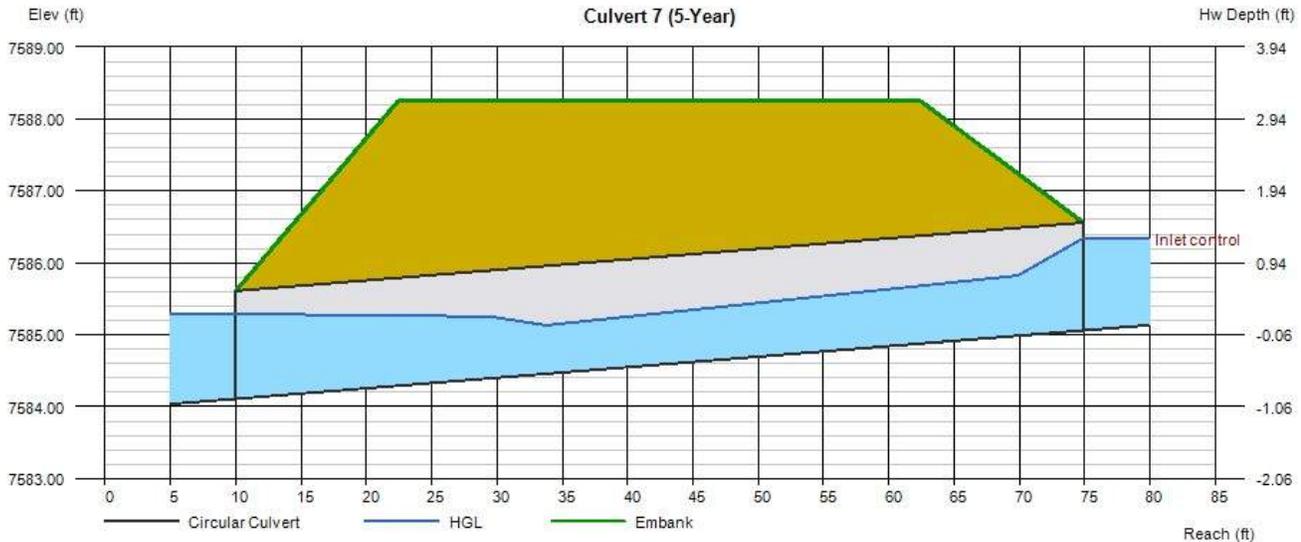
Culvert 7 (5-Year)

Invert Elev Dn (ft)	= 7584.11
Pipe Length (ft)	= 64.88
Slope (%)	= 1.46
Invert Elev Up (ft)	= 7585.06
Rise (in)	= 18.0
Shape	= Circular
Span (in)	= 18.0
No. Barrels	= 1
n-Value	= 0.012
Culvert Type	= Circular Concrete
Culvert Entrance	= Square edge w/headwall (C)
Coeff. K,M,c,Y,k	= 0.0098, 2, 0.0398, 0.67, 0.5

Embankment	
Top Elevation (ft)	= 7588.25
Top Width (ft)	= 40.00
Crest Width (ft)	= 40.00

Calculations	
Qmin (cfs)	= 5.00
Qmax (cfs)	= 5.00
Tailwater Elev (ft)	= (dc+D)/2

Highlighted	
Qtotal (cfs)	= 5.00
Qpipe (cfs)	= 5.00
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 3.35
Veloc Up (ft/s)	= 4.77
HGL Dn (ft)	= 7585.29
HGL Up (ft)	= 7585.92
Hw Elev (ft)	= 7586.34
Hw/D (ft)	= 0.85
Flow Regime	= Inlet Control



Culvert Report

Culvert 7 (100-Year)

Invert Elev Dn (ft)	= 7584.11
Pipe Length (ft)	= 64.88
Slope (%)	= 1.46
Invert Elev Up (ft)	= 7585.06
Rise (in)	= 18.0
Shape	= Circular
Span (in)	= 18.0
No. Barrels	= 1
n-Value	= 0.012
Culvert Type	= Circular Concrete
Culvert Entrance	= Square edge w/headwall (C)
Coeff. K,M,c,Y,k	= 0.0098, 2, 0.0398, 0.67, 0.5

Embankment	
Top Elevation (ft)	= 7588.25
Top Width (ft)	= 40.00
Crest Width (ft)	= 40.00

Calculations	
Qmin (cfs)	= 8.00
Qmax (cfs)	= 8.00
Tailwater Elev (ft)	= (dc+D)/2

Highlighted	
Qtotal (cfs)	= 8.00
Qpipe (cfs)	= 8.00
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 4.92
Veloc Up (ft/s)	= 5.79
HGL Dn (ft)	= 7585.41
HGL Up (ft)	= 7586.16
Hw Elev (ft)	= 7586.87
Hw/D (ft)	= 1.21
Flow Regime	= Inlet Control



Culvert Report

Culvert 8 (5-Year)

Invert Elev Dn (ft)	= 7580.46
Pipe Length (ft)	= 62.79
Slope (%)	= 2.36
Invert Elev Up (ft)	= 7581.94
Rise (in)	= 18.0
Shape	= Circular
Span (in)	= 18.0
No. Barrels	= 1
n-Value	= 0.012
Culvert Type	= Circular Concrete
Culvert Entrance	= Square edge w/headwall (C)
Coeff. K,M,c,Y,k	= 0.0098, 2, 0.0398, 0.67, 0.5

Embankment

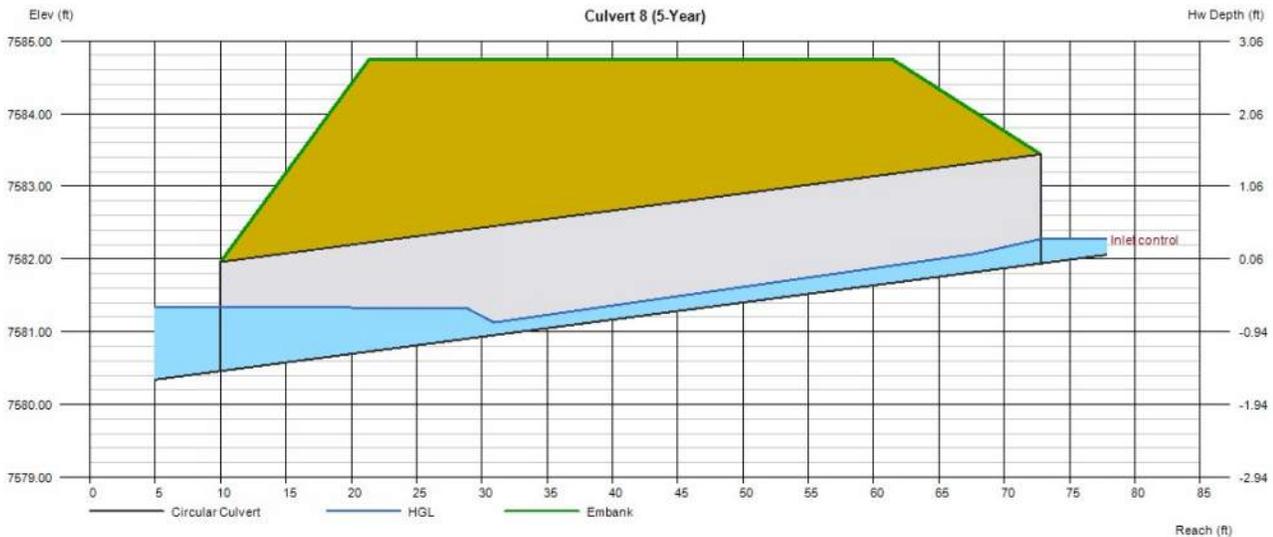
Top Elevation (ft)	= 7584.75
Top Width (ft)	= 40.00
Crest Width (ft)	= 33.00

Calculations

Qmin (cfs)	= 0.50
Qmax (cfs)	= 0.50
Tailwater Elev (ft)	= (dc+D)/2

Highlighted

Qtotal (cfs)	= 0.50
Qpipe (cfs)	= 0.50
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 0.46
Veloc Up (ft/s)	= 2.42
HGL Dn (ft)	= 7581.34
HGL Up (ft)	= 7582.20
Hw Elev (ft)	= 7582.28
Hw/D (ft)	= 0.22
Flow Regime	= Inlet Control



Culvert Report

Culvert 8 (100-Year)

Invert Elev Dn (ft)	= 7580.46
Pipe Length (ft)	= 62.79
Slope (%)	= 2.36
Invert Elev Up (ft)	= 7581.94
Rise (in)	= 18.0
Shape	= Circular
Span (in)	= 18.0
No. Barrels	= 1
n-Value	= 0.012
Culvert Type	= Circular Concrete
Culvert Entrance	= Square edge w/headwall (C)
Coeff. K,M,c,Y,k	= 0.0098, 2, 0.0398, 0.67, 0.5

Embankment

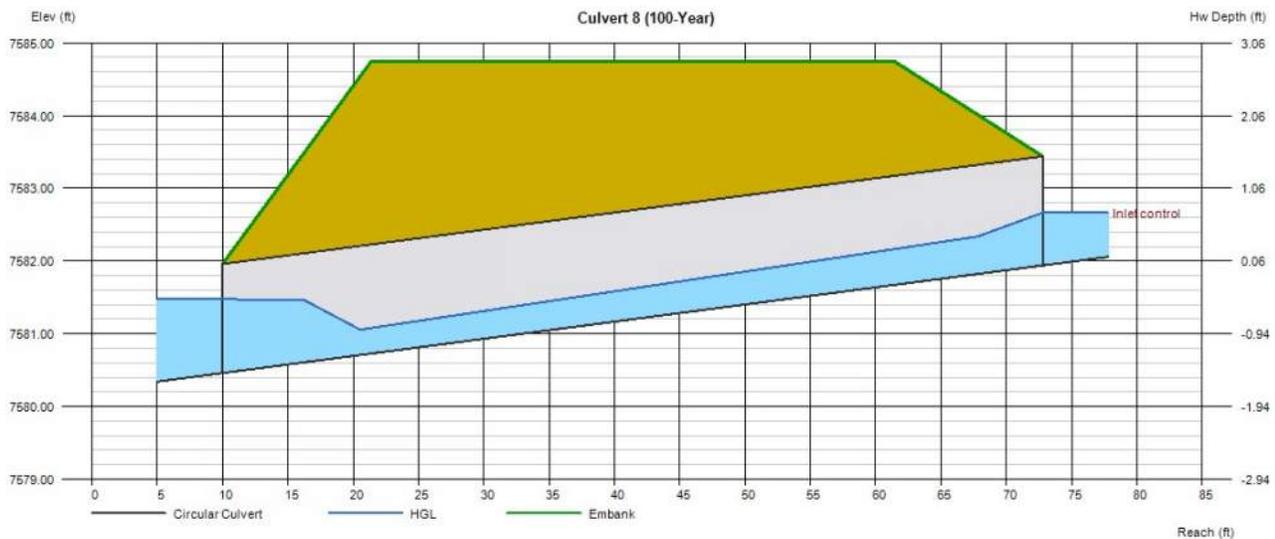
Top Elevation (ft)	= 7584.75
Top Width (ft)	= 40.00
Crest Width (ft)	= 33.00

Calculations

Qmin (cfs)	= 2.00
Qmax (cfs)	= 2.00
Tailwater Elev (ft)	= (dc+D)/2

Highlighted

Qtotal (cfs)	= 2.00
Qpipe (cfs)	= 2.00
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 1.57
Veloc Up (ft/s)	= 3.56
HGL Dn (ft)	= 7581.48
HGL Up (ft)	= 7582.47
Hw Elev (ft)	= 7582.66
Hw/D (ft)	= 0.48
Flow Regime	= Inlet Control



Culvert Report

Culvert 9 (5-Year)

Invert Elev Dn (ft)	= 7580.58
Pipe Length (ft)	= 52.11
Slope (%)	= 1.84
Invert Elev Up (ft)	= 7581.54
Rise (in)	= 18.0
Shape	= Circular
Span (in)	= 18.0
No. Barrels	= 1
n-Value	= 0.012
Culvert Type	= Circular Concrete
Culvert Entrance	= Square edge w/headwall (C)
Coeff. K,M,c,Y,k	= 0.0098, 2, 0.0398, 0.67, 0.5

Embankment

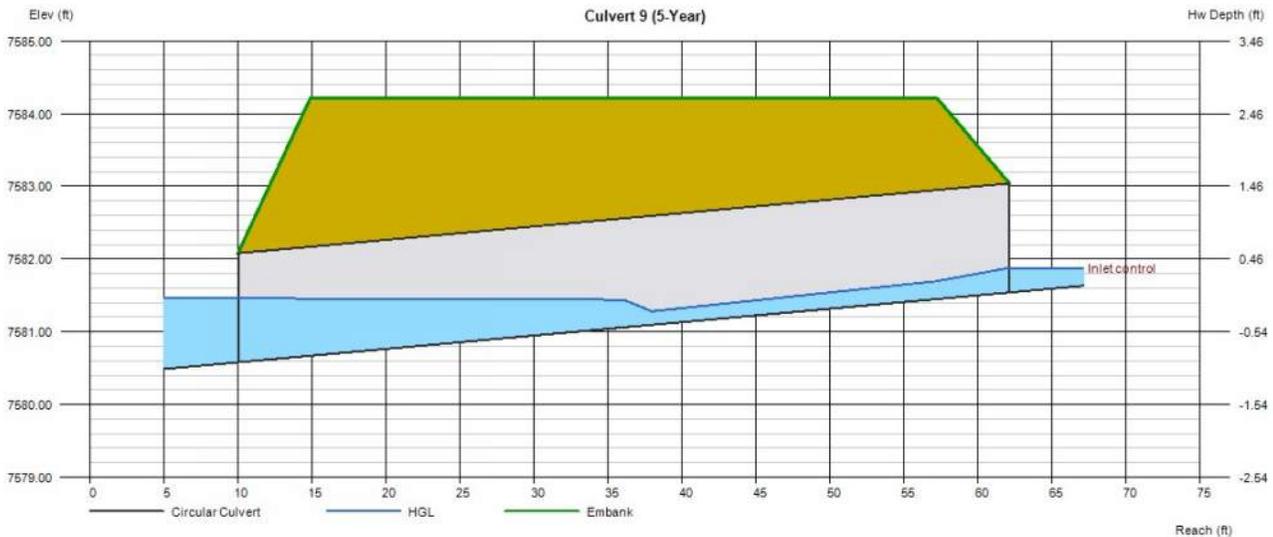
Top Elevation (ft)	= 7584.21
Top Width (ft)	= 42.34
Crest Width (ft)	= 35.00

Calculations

Qmin (cfs)	= 0.50
Qmax (cfs)	= 0.50
Tailwater Elev (ft)	= (dc+D)/2

Highlighted

Qtotal (cfs)	= 0.50
Qpipe (cfs)	= 0.50
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 0.46
Veloc Up (ft/s)	= 2.42
HGL Dn (ft)	= 7581.46
HGL Up (ft)	= 7581.80
Hw Elev (ft)	= 7581.88
Hw/D (ft)	= 0.23
Flow Regime	= Inlet Control



Culvert Report

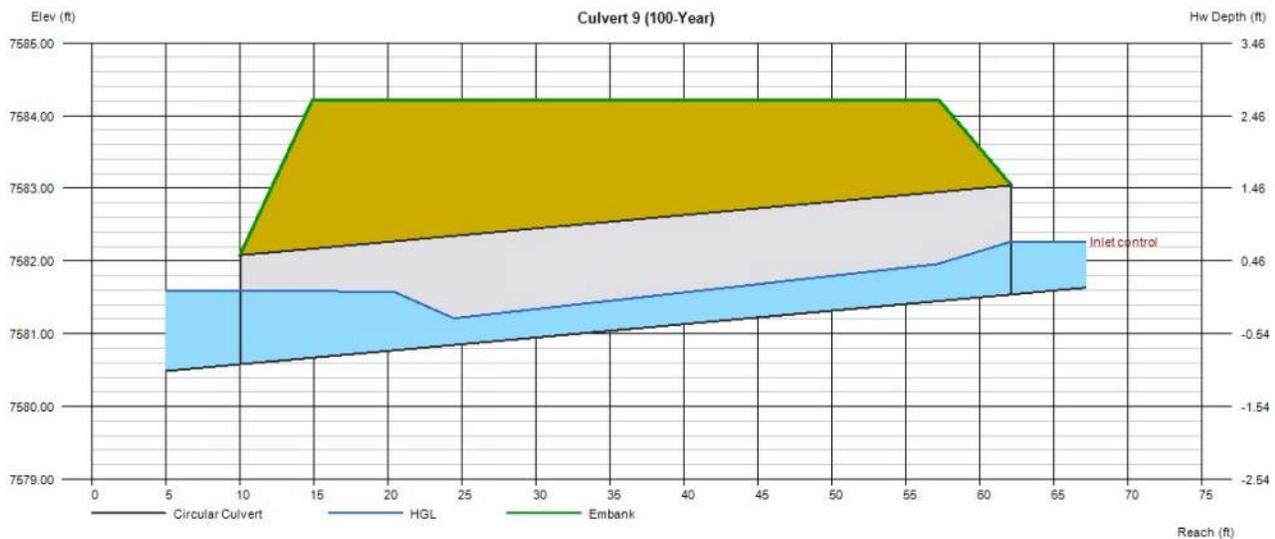
Culvert 9 (100-Year)

Invert Elev Dn (ft)	= 7580.58
Pipe Length (ft)	= 52.11
Slope (%)	= 1.84
Invert Elev Up (ft)	= 7581.54
Rise (in)	= 18.0
Shape	= Circular
Span (in)	= 18.0
No. Barrels	= 1
n-Value	= 0.012
Culvert Type	= Circular Concrete
Culvert Entrance	= Square edge w/headwall (C)
Coeff. K,M,c,Y,k	= 0.0098, 2, 0.0398, 0.67, 0.5

Embankment	
Top Elevation (ft)	= 7584.21
Top Width (ft)	= 42.34
Crest Width (ft)	= 35.00

Calculations	
Qmin (cfs)	= 2.00
Qmax (cfs)	= 2.00
Tailwater Elev (ft)	= (dc+D)/2

Highlighted	
Qtotal (cfs)	= 2.00
Qpipe (cfs)	= 2.00
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 1.57
Veloc Up (ft/s)	= 3.56
HGL Dn (ft)	= 7581.60
HGL Up (ft)	= 7582.07
Hw Elev (ft)	= 7582.27
Hw/D (ft)	= 0.49
Flow Regime	= Inlet Control



Culvert Report

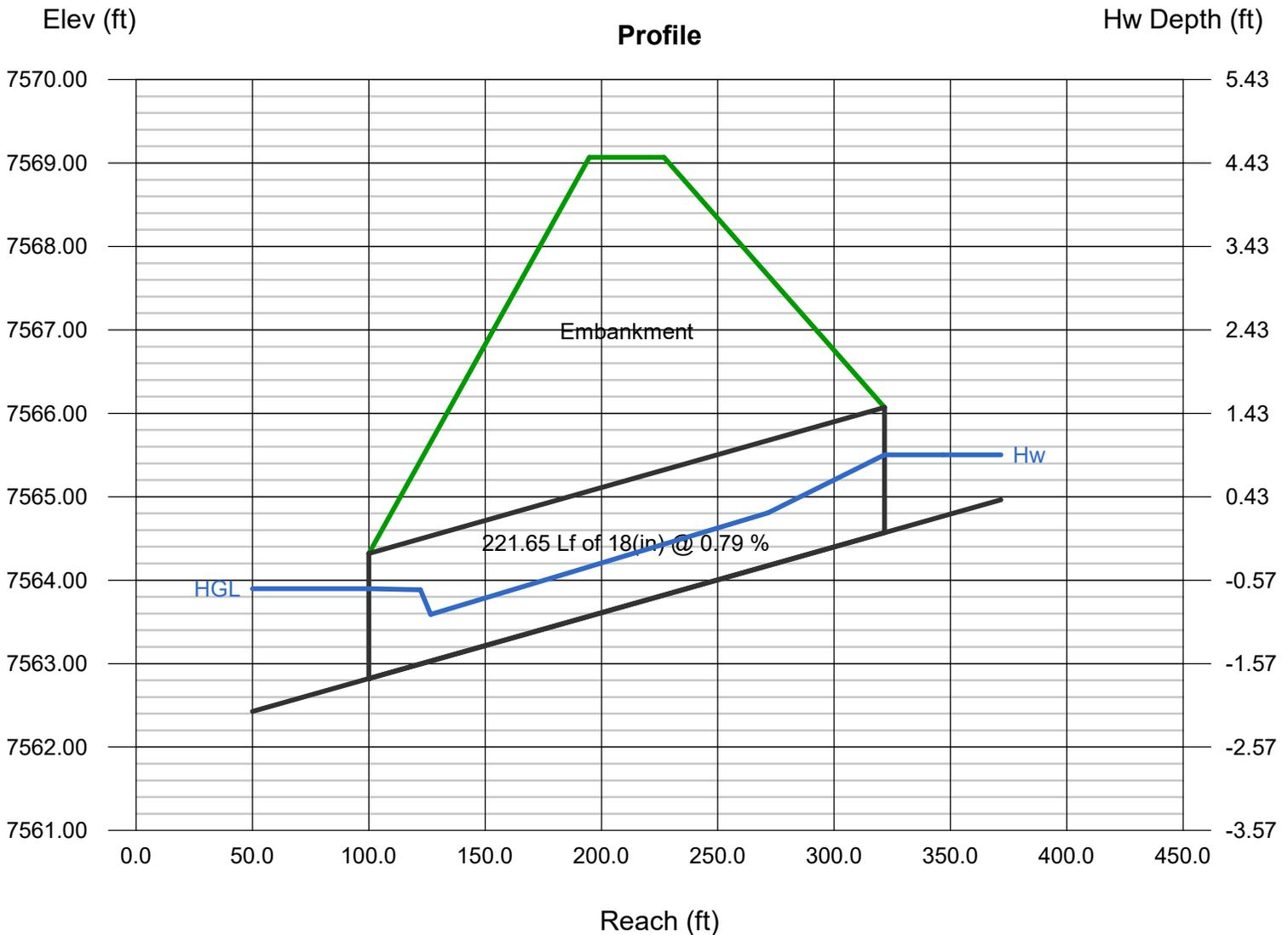
Culvert 10 (5-Year)

Invert Elev Dn (ft)	= 7562.82
Pipe Length (ft)	= 221.65
Slope (%)	= 0.79
Invert Elev Up (ft)	= 7564.57
Rise (in)	= 18.0
Shape	= Circular
Span (in)	= 18.0
No. Barrels	= 1
n-Value	= 0.012
Culvert Type	= Circular Concrete
Culvert Entrance	= Square edge w/headwall (C)
Coeff. K,M,c,Y,k	= 0.0098, 2, 0.0398, 0.67, 0.5

Calculations	
Qmin (cfs)	= 3.00
Qmax (cfs)	= 3.00
Tailwater Elev (ft)	= (dc+D)/2

Highlighted	
Qtot (cfs)	= 3.00
Qpipe (cfs)	= 3.00
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 2.20
Veloc Up (ft/s)	= 4.02
HGL Dn (ft)	= 7563.90
HGL Up (ft)	= 7565.23
Hw Elev (ft)	= 7565.50
Hw/D (ft)	= 0.62
Flow Regime	= Inlet Control

Embankment	
Top Elevation (ft)	= 7569.07
Top Width (ft)	= 32.00
Crest Width (ft)	= 60.00



Culvert Report

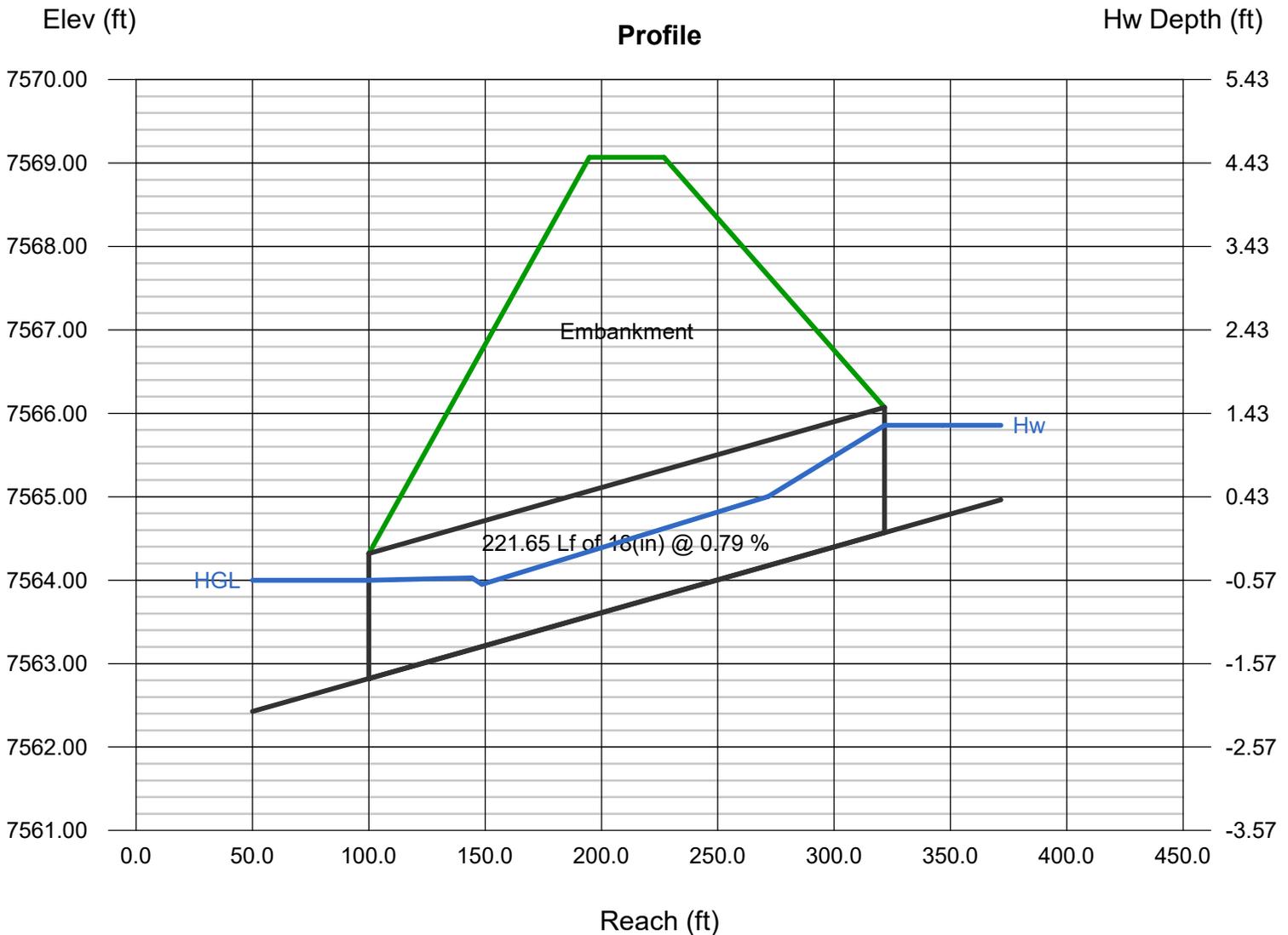
Culvert 10 (100-Year)

Invert Elev Dn (ft)	= 7562.82
Pipe Length (ft)	= 221.65
Slope (%)	= 0.79
Invert Elev Up (ft)	= 7564.57
Rise (in)	= 18.0
Shape	= Circular
Span (in)	= 18.0
No. Barrels	= 1
n-Value	= 0.012
Culvert Type	= Circular Concrete
Culvert Entrance	= Square edge w/headwall (C)
Coeff. K,M,c,Y,k	= 0.0098, 2, 0.0398, 0.67, 0.5

Calculations	
Qmin (cfs)	= 5.00
Qmax (cfs)	= 5.00
Tailwater Elev (ft)	= (dc+D)/2

Highlighted	
Qtotall (cfs)	= 5.00
Qpipe (cfs)	= 5.00
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 3.35
Veloc Up (ft/s)	= 4.77
HGL Dn (ft)	= 7564.00
HGL Up (ft)	= 7565.43
Hw Elev (ft)	= 7565.86
Hw/D (ft)	= 0.86
Flow Regime	= Inlet Control

Embankment	
Top Elevation (ft)	= 7569.07
Top Width (ft)	= 32.00
Crest Width (ft)	= 60.00



Culvert Report

Culvert 11 - DPA2 (5-Year)

Invert Elev Dn (ft)	= 7559.50
Pipe Length (ft)	= 106.87
Slope (%)	= 0.43
Invert Elev Up (ft)	= 7559.96
Rise (in)	= 42.0
Shape	= Circular
Span (in)	= 42.0
No. Barrels	= 1
n-Value	= 0.012
Culvert Type	= Circular Concrete
Culvert Entrance	= Square edge w/headwall (C)
Coeff. K,M,c,Y,k	= 0.0098, 2, 0.0398, 0.67, 0.5

Embankment

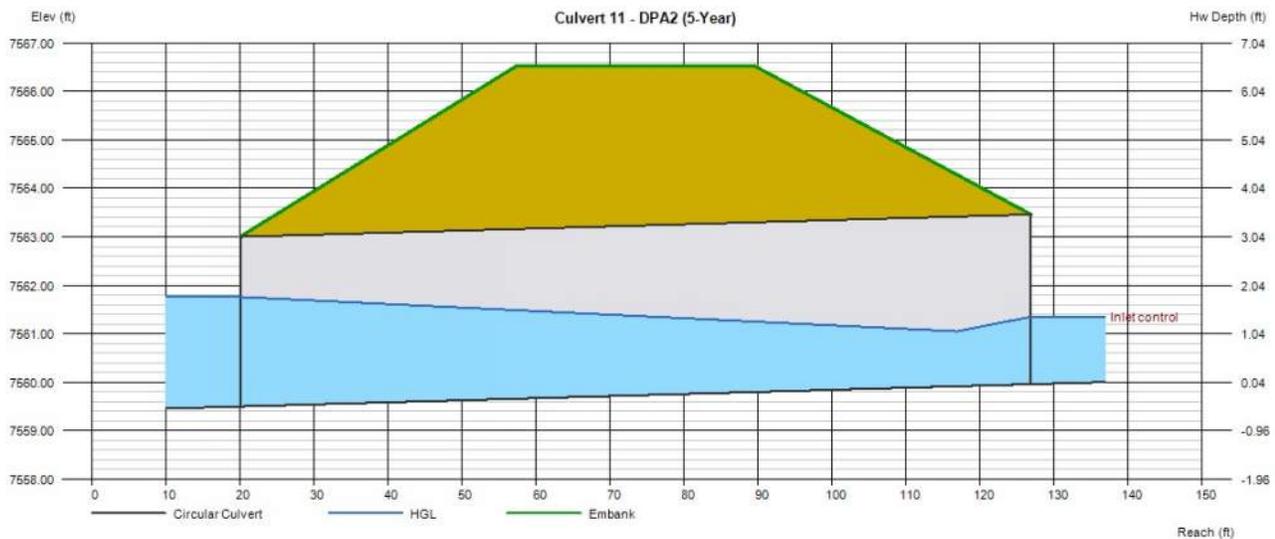
Top Elevation (ft)	= 7566.53
Top Width (ft)	= 32.00
Crest Width (ft)	= 93.00

Calculations

Qmin (cfs)	= 11.30
Qmax (cfs)	= 11.30
Tailwater Elev (ft)	= (dc+D)/2

Highlighted

Qtotal (cfs)	= 11.30
Qpipe (cfs)	= 11.30
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 1.72
Veloc Up (ft/s)	= 4.86
HGL Dn (ft)	= 7561.76
HGL Up (ft)	= 7560.98
Hw Elev (ft)	= 7561.35
Hw/D (ft)	= 0.40
Flow Regime	= Inlet Control



Culvert Report

Culvert 11 - DPA2 (100-Year)

Invert Elev Dn (ft)	= 7559.50
Pipe Length (ft)	= 106.87
Slope (%)	= 0.43
Invert Elev Up (ft)	= 7559.96
Rise (in)	= 42.0
Shape	= Circular
Span (in)	= 42.0
No. Barrels	= 1
n-Value	= 0.012
Culvert Type	= Circular Concrete
Culvert Entrance	= Square edge w/headwall (C)
Coeff. K,M,c,Y,k	= 0.0098, 2, 0.0398, 0.67, 0.5

Embankment

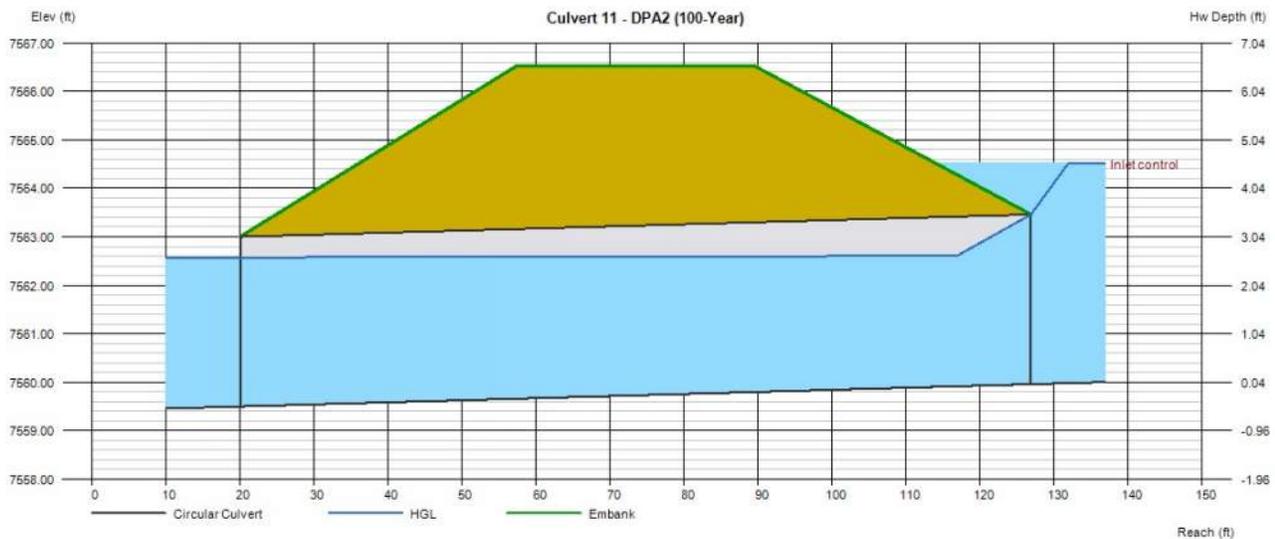
Top Elevation (ft)	= 7566.53
Top Width (ft)	= 32.00
Crest Width (ft)	= 93.00

Calculations

Qmin (cfs)	= 71.70
Qmax (cfs)	= 71.70
Tailwater Elev (ft)	= (dc+D)/2

Highlighted

Qtotal (cfs)	= 71.70
Qpipe (cfs)	= 71.70
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 8.01
Veloc Up (ft/s)	= 9.17
HGL Dn (ft)	= 7562.58
HGL Up (ft)	= 7562.61
Hw Elev (ft)	= 7564.51
Hw/D (ft)	= 1.30
Flow Regime	= Inlet Control



Culvert Report

Culvert 12 - DPA5 (5-Year)

Invert Elev Dn (ft)	=	7540.00
Pipe Length (ft)	=	104.44
Slope (%)	=	1.00
Invert Elev Up (ft)	=	7541.04
Rise (in)	=	48.0
Shape	=	Circular
Span (in)	=	48.0
No. Barrels	=	1
n-Value	=	0.012
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

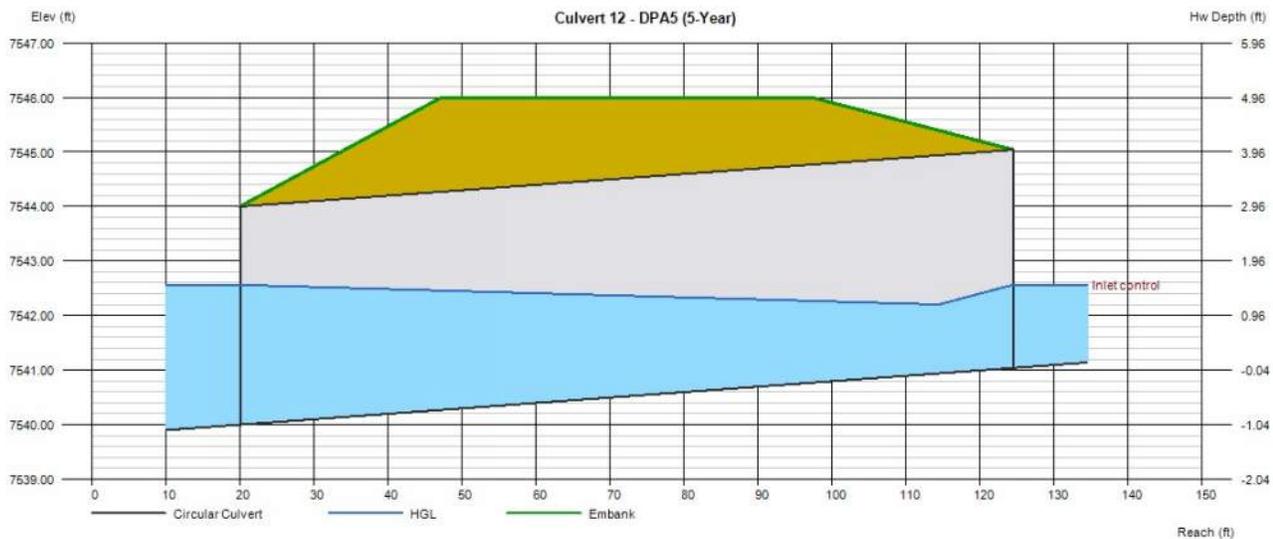
Top Elevation (ft)	=	7546.00
Top Width (ft)	=	50.00
Crest Width (ft)	=	100.00

Calculations

Qmin (cfs)	=	14.80
Qmax (cfs)	=	14.80
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	14.80
Qpipe (cfs)	=	14.80
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	1.74
Veloc Up (ft/s)	=	5.10
HGL Dn (ft)	=	7542.56
HGL Up (ft)	=	7542.17
Hw Elev (ft)	=	7542.56
Hw/D (ft)	=	0.38
Flow Regime	=	Inlet Control



Culvert Report

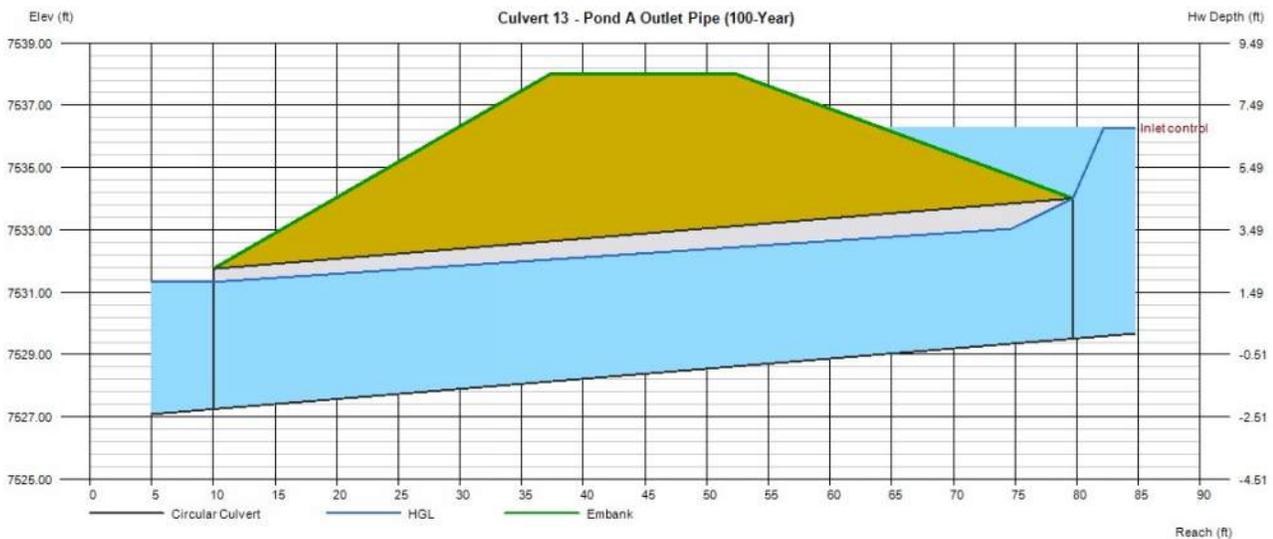
Culvert 13 - Pond A Outlet Pipe (100-Year)

Invert Elev Dn (ft)	= 7527.25
Pipe Length (ft)	= 69.69
Slope (%)	= 3.24
Invert Elev Up (ft)	= 7529.51
Rise (in)	= 54.0
Shape	= Circular
Span (in)	= 54.0
No. Barrels	= 1
n-Value	= 0.012
Culvert Type	= Circular Concrete
Culvert Entrance	= Square edge w/headwall (C)
Coeff. K,M,c,Y,k	= 0.0098, 2, 0.0398, 0.67, 0.5

Embankment	
Top Elevation (ft)	= 7538.00
Top Width (ft)	= 15.00
Crest Width (ft)	= 56.00

Calculations	
Qmin (cfs)	= 156.00
Qmax (cfs)	= 156.00
Tailwater Elev (ft)	= (dc+D)/2

Highlighted	
Qtotal (cfs)	= 156.00
Qpipe (cfs)	= 156.00
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 10.30
Veloc Up (ft/s)	= 11.28
HGL Dn (ft)	= 7531.33
HGL Up (ft)	= 7533.16
Hw Elev (ft)	= 7536.28
Hw/D (ft)	= 1.50
Flow Regime	= Inlet Control



Culvert Report

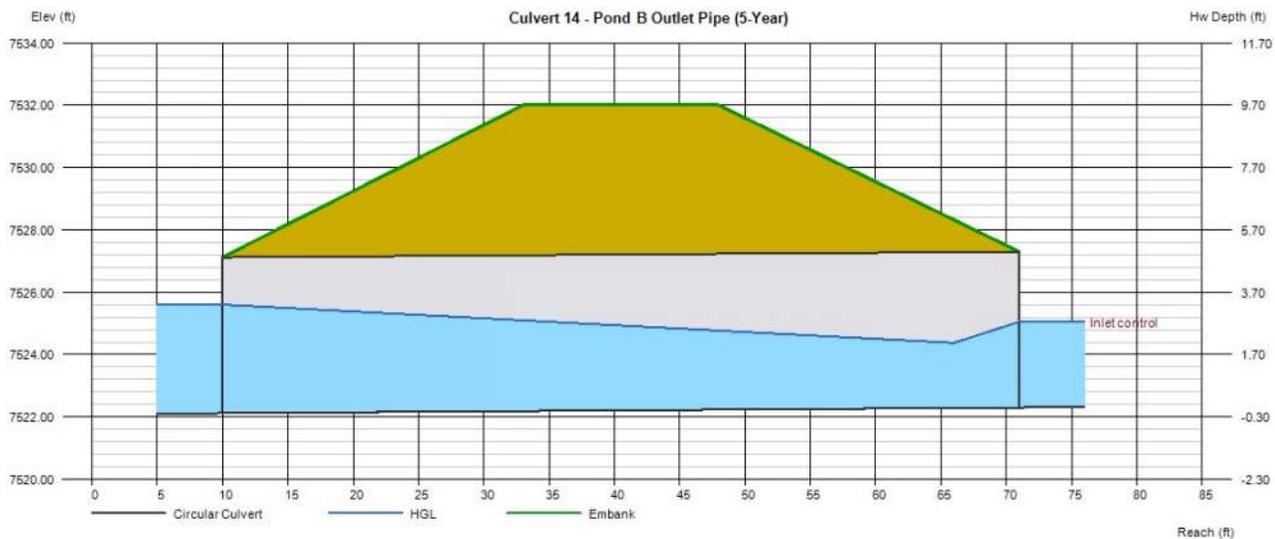
Culvert 14 - Pond B Outlet Pipe (5-Year)

Invert Elev Dn (ft)	= 7522.12
Pipe Length (ft)	= 60.98
Slope (%)	= 0.29
Invert Elev Up (ft)	= 7522.30
Rise (in)	= 60.0
Shape	= Circular
Span (in)	= 60.0
No. Barrels	= 1
n-Value	= 0.012
Culvert Type	= Circular Concrete
Culvert Entrance	= Square edge w/headwall (C)
Coeff. K,M,c,Y,k	= 0.0098, 2, 0.0398, 0.67, 0.5

Embankment	
Top Elevation (ft)	= 7532.00
Top Width (ft)	= 15.00
Crest Width (ft)	= 40.00

Calculations	
Qmin (cfs)	= 49.20
Qmax (cfs)	= 49.20
Tailwater Elev (ft)	= (dc+D)/2

Highlighted	
Qtotal (cfs)	= 49.20
Qpipe (cfs)	= 49.20
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 3.37
Veloc Up (ft/s)	= 6.88
HGL Dn (ft)	= 7525.60
HGL Up (ft)	= 7524.26
Hw Elev (ft)	= 7525.05
Hw/D (ft)	= 0.55
Flow Regime	= Inlet Control



Culvert Report

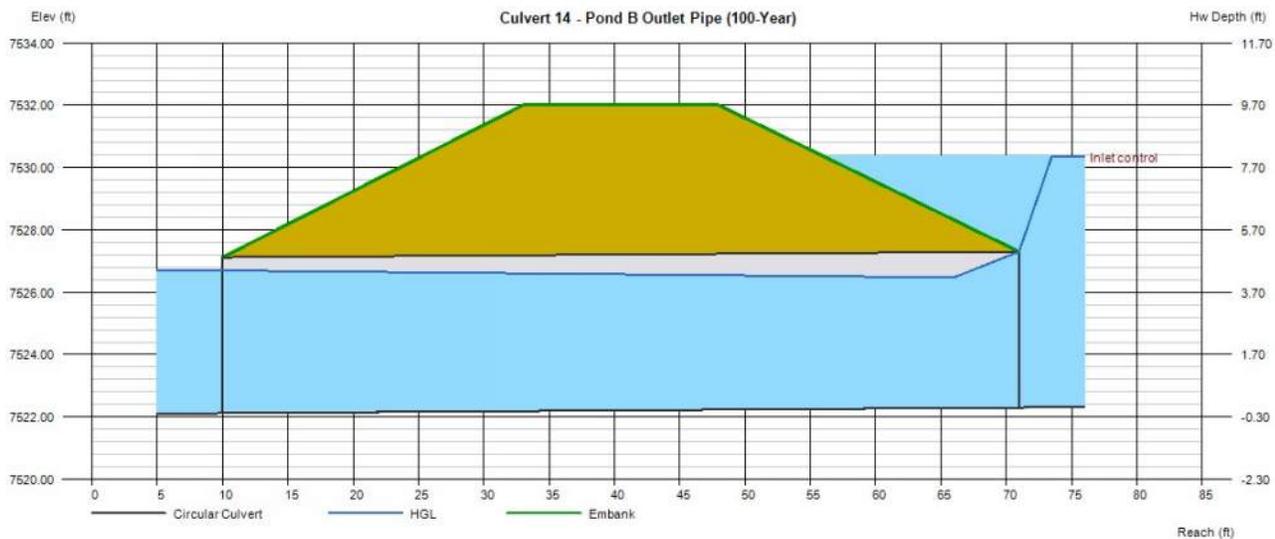
Culvert 14 - Pond B Outlet Pipe (100-Year)

Invert Elev Dn (ft)	= 7522.12
Pipe Length (ft)	= 60.98
Slope (%)	= 0.29
Invert Elev Up (ft)	= 7522.30
Rise (in)	= 60.0
Shape	= Circular
Span (in)	= 60.0
No. Barrels	= 1
n-Value	= 0.012
Culvert Type	= Circular Concrete
Culvert Entrance	= Square edge w/headwall (C)
Coeff. K,M,c,Y,k	= 0.0098, 2, 0.0398, 0.67, 0.5

Embankment	
Top Elevation (ft)	= 7532.00
Top Width (ft)	= 15.00
Crest Width (ft)	= 40.00

Calculations	
Qmin (cfs)	= 213.60
Qmax (cfs)	= 213.60
Tailwater Elev (ft)	= (dc+D)/2

Highlighted	
Qtotal (cfs)	= 213.60
Qpipe (cfs)	= 213.60
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 11.34
Veloc Up (ft/s)	= 12.25
HGL Dn (ft)	= 7526.70
HGL Up (ft)	= 7526.45
Hw Elev (ft)	= 7530.35
Hw/D (ft)	= 1.61
Flow Regime	= Inlet Control



Culvert Report

Culvert 15 - Pond C Outlet Pipe (5-Year)

Invert Elev Dn (ft)	= 7528.00
Pipe Length (ft)	= 57.68
Slope (%)	= 0.50
Invert Elev Up (ft)	= 7528.29
Rise (in)	= 36.0
Shape	= Circular
Span (in)	= 36.0
No. Barrels	= 1
n-Value	= 0.012
Culvert Type	= Circular Concrete
Culvert Entrance	= Square edge w/headwall (C)
Coeff. K,M,c,Y,k	= 0.0098, 2, 0.0398, 0.67, 0.5

Embankment

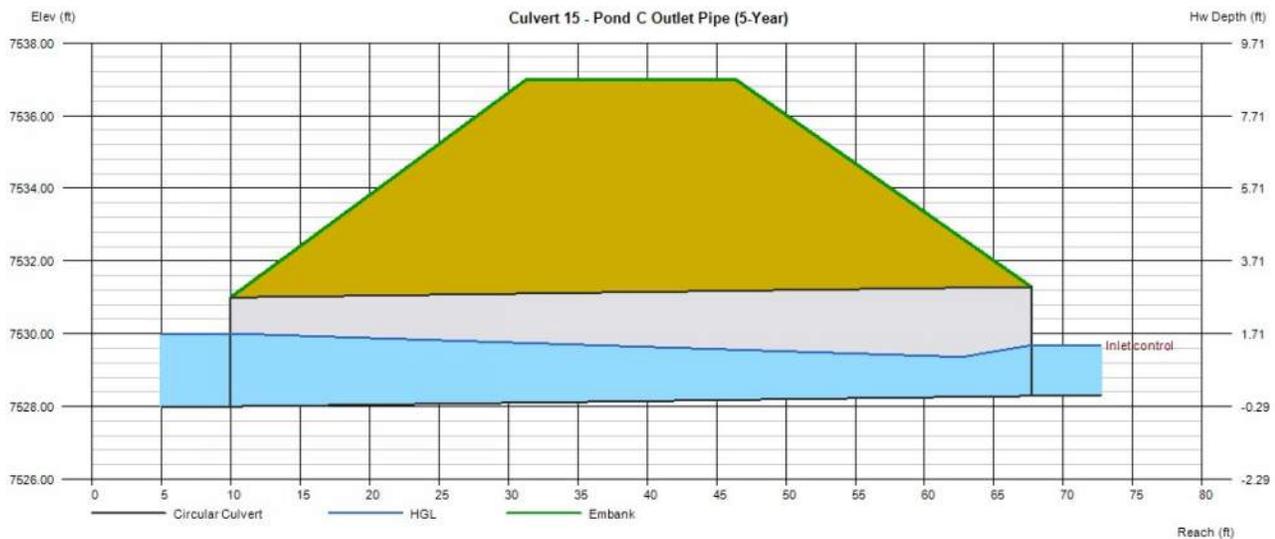
Top Elevation (ft)	= 7537.00
Top Width (ft)	= 15.00
Crest Width (ft)	= 20.00

Calculations

Qmin (cfs)	= 10.20
Qmax (cfs)	= 10.20
Tailwater Elev (ft)	= (dc+D)/2

Highlighted

Qtotal (cfs)	= 10.20
Qpipe (cfs)	= 10.20
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 2.03
Veloc Up (ft/s)	= 4.88
HGL Dn (ft)	= 7530.01
HGL Up (ft)	= 7529.30
Hw Elev (ft)	= 7529.68
Hw/D (ft)	= 0.46
Flow Regime	= Inlet Control



Culvert Report

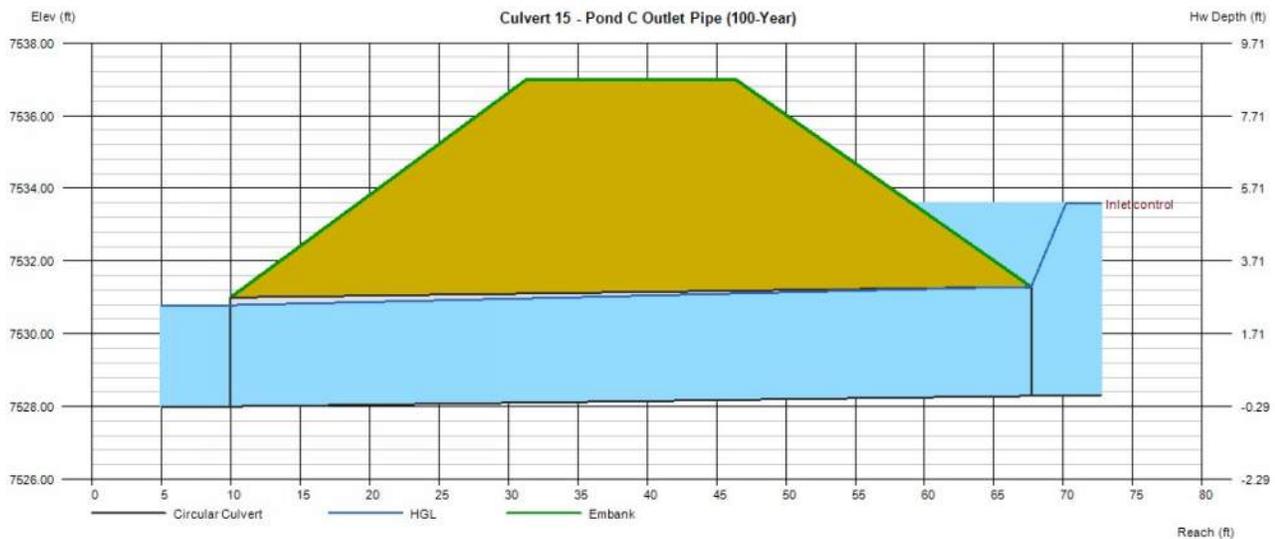
Culvert 15 - Pond C Outlet Pipe (100-Year)

Invert Elev Dn (ft)	= 7528.00
Pipe Length (ft)	= 57.68
Slope (%)	= 0.50
Invert Elev Up (ft)	= 7528.29
Rise (in)	= 36.0
Shape	= Circular
Span (in)	= 36.0
No. Barrels	= 1
n-Value	= 0.012
Culvert Type	= Circular Concrete
Culvert Entrance	= Square edge w/headwall (C)
Coeff. K,M,c,Y,k	= 0.0098, 2, 0.0398, 0.67, 0.5

Embankment	
Top Elevation (ft)	= 7537.00
Top Width (ft)	= 15.00
Crest Width (ft)	= 20.00

Calculations	
Qmin (cfs)	= 64.20
Qmax (cfs)	= 64.20
Tailwater Elev (ft)	= (dc+D)/2

Highlighted	
Qtotal (cfs)	= 64.20
Qpipe (cfs)	= 64.20
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 9.38
Veloc Up (ft/s)	= 9.08
HGL Dn (ft)	= 7530.79
HGL Up (ft)	= 7531.30
Hw Elev (ft)	= 7533.58
Hw/D (ft)	= 1.76
Flow Regime	= Inlet Control





Flying Horse North Filing No. 4
Final Drainage Report
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El Paso County, Colorado

SWALE CALCULATIONS

Worksheet for SECTION A1 - RUBBLE DRIVE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.035
Channel Slope	3.50 %
Left Side Slope	3.000 H:V
Right Side Slope	4.000 H:V
Discharge	42.00 cfs

Results

Normal Depth	1.4 ft
Flow Area	6.9 ft ²
Wetted Perimeter	10.2 ft
Hydraulic Radius	0.7 ft
Top Width	9.81 ft
Critical Depth	1.6 ft
Critical Slope	2.05 %
Velocity	6.10 ft/s
Velocity Head	0.58 ft
Specific Energy	1.98 ft
Froude Number	1.285
Flow Type	Supercritical

GVF Input Data

Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data

Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	1.4 ft
Critical Depth	1.6 ft
Channel Slope	3.50 %
Critical Slope	2.05 %

Worksheet for SECTION A2 - RUBBLE DRIVE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.035
Channel Slope	2.80 %
Left Side Slope	3.000 H:V
Right Side Slope	4.000 H:V
Discharge	31.60 cfs

Results

Normal Depth	1.3 ft
Flow Area	6.0 ft ²
Wetted Perimeter	9.6 ft
Hydraulic Radius	0.6 ft
Top Width	9.20 ft
Critical Depth	1.4 ft
Critical Slope	2.13 %
Velocity	5.23 ft/s
Velocity Head	0.42 ft
Specific Energy	1.74 ft
Froude Number	1.137
Flow Type	Supercritical

GVF Input Data

Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data

Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	1.3 ft
Critical Depth	1.4 ft
Channel Slope	2.80 %
Critical Slope	2.13 %

Worksheet for SECTION B - GIMME WAY

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.035
Channel Slope	2.50 %
Left Side Slope	3.000 H:V
Right Side Slope	4.000 H:V
Discharge	37.90 cfs

Results

Normal Depth	1.4 ft
Flow Area	7.2 ft ²
Wetted Perimeter	10.5 ft
Hydraulic Radius	0.7 ft
Top Width	10.06 ft
Critical Depth	1.5 ft
Critical Slope	2.08 %
Velocity	5.24 ft/s
Velocity Head	0.43 ft
Specific Energy	1.86 ft
Froude Number	1.091
Flow Type	Supercritical

GVF Input Data

Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data

Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	1.4 ft
Critical Depth	1.5 ft
Channel Slope	2.50 %
Critical Slope	2.08 %

Worksheet for SECTION C - STABLEFORD TERRACE

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Roughness Coefficient	0.035
Channel Slope	1.90 %
Left Side Slope	3.000 H:V
Right Side Slope	4.000 H:V
Discharge	22.10 cfs
Results	
Normal Depth	1.2 ft
Flow Area	5.3 ft ²
Wetted Perimeter	9.0 ft
Hydraulic Radius	0.6 ft
Top Width	8.65 ft
Critical Depth	1.2 ft
Critical Slope	2.23 %
Velocity	4.14 ft/s
Velocity Head	0.27 ft
Specific Energy	1.50 ft
Froude Number	0.928
Flow Type	Subcritical
GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	1.2 ft
Critical Depth	1.2 ft
Channel Slope	1.90 %
Critical Slope	2.23 %

Worksheet for SECTION D - BUNKER TRAIL

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.035
Channel Slope	3.10 %
Left Side Slope	3.000 H:V
Right Side Slope	4.000 H:V
Discharge	27.60 cfs

Results

Normal Depth	1.2 ft
Flow Area	5.3 ft ²
Wetted Perimeter	8.9 ft
Hydraulic Radius	0.6 ft
Top Width	8.58 ft
Critical Depth	1.3 ft
Critical Slope	2.17 %
Velocity	5.25 ft/s
Velocity Head	0.43 ft
Specific Energy	1.65 ft
Froude Number	1.183
Flow Type	Supercritical

GVF Input Data

Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data

Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	1.2 ft
Critical Depth	1.3 ft
Channel Slope	3.10 %
Critical Slope	2.17 %

Worksheet for SECTION E - FRINGE PLACE

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.035
Channel Slope	3.10 %
Left Side Slope	4.000 H:V
Right Side Slope	5.000 H:V
Discharge	50.60 cfs

Results

Normal Depth	1.4 ft
Flow Area	8.8 ft ²
Wetted Perimeter	12.9 ft
Hydraulic Radius	0.7 ft
Top Width	12.55 ft
Critical Depth	1.5 ft
Critical Slope	2.02 %
Velocity	5.78 ft/s
Velocity Head	0.52 ft
Specific Energy	1.91 ft
Froude Number	1.220
Flow Type	Supercritical

GVF Input Data

Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data

Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	1.4 ft
Critical Depth	1.5 ft
Channel Slope	3.10 %
Critical Slope	2.02 %



Flying Horse North Filing No. 4
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DRAINAGE CHANNEL SECTION CALCULATIONS

Worksheet for SECTION A-A

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Channel Slope	2.20 %
Discharge	274.00 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	7,565.15
0+49	7,560.92
0+82	7,558.00
0+97	7,556.00
1+19	7,554.00
1+55	7,554.00
1+87	7,560.00
2+20	7,564.00
2+33	7,565.25

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 7,565.15)	(2+33, 7,565.25)	0.035

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.1 ft
Roughness Coefficient	0.035
Elevation	7,555.06 ft
Elevation Range	7,554.0 to 7,565.3 ft
Flow Area	47.3 ft ²
Wetted Perimeter	53.6 ft
Hydraulic Radius	0.9 ft
Top Width	53.49 ft
Normal Depth	1.1 ft
Critical Depth	1.1 ft
Critical Slope	1.84 %
Velocity	5.79 ft/s
Velocity Head	0.52 ft
Specific Energy	1.58 ft
Froude Number	1.086
Flow Type	Supercritical

HRG Response: Reference table for swale lining included in Appendix C (sheet 138 in this report). Turf Rolled Matting is being installed in all roadside ditches. P300 liner is being installed in Section A-A per calculations.

Please state type of channel. Also, please provide erosion protection for this channel if velocity is above the standard velocity per DCM vol.1, chapter 10, table 10-3 and 10-4. This comment is applied to all channels.

GVF Input Data

Worksheet for SECTION A-A

GVF Input Data

Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data

Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	1.1 ft
Critical Depth	1.1 ft
Channel Slope	2.20 %
Critical Slope	1.84 %

Worksheet for SECTION B-B

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	1.90 %
Discharge	71.70 cfs

Section Definitions

Station (ft)		Elevation (ft)
	0+00	7,589.08
	0+35	7,588.00
	0+73	7,585.93
	0+89	7,584.00
	1+08	7,584.00
	1+29	7,585.70
	1+51	7,586.83
	1+72	7,588.27
	1+88	7,589.13

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 7,589.08)	(1+88, 7,589.13)	0.035

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.7 ft
Roughness Coefficient	0.035
Elevation	7,584.70 ft
Elevation Range	7,584.0 to 7,589.1 ft
Flow Area	18.3 ft ²
Wetted Perimeter	33.3 ft
Hydraulic Radius	0.5 ft
Top Width	33.21 ft
Normal Depth	0.7 ft
Critical Depth	0.7 ft
Critical Slope	2.21 %
Velocity	3.92 ft/s
Velocity Head	0.24 ft
Specific Energy	0.94 ft
Froude Number	0.932
Flow Type	Subcritical

GVF Input Data

Worksheet for SECTION B-B

GVF Input Data

Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data

Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.7 ft
Critical Depth	0.7 ft
Channel Slope	1.90 %
Critical Slope	2.21 %

Worksheet for SECTION C-C

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Channel Slope	3.00 %
Discharge	42.40 cfs

Section Definitions

Station (ft)		Elevation (ft)
	0+00	7,585.41
	0+39	7,583.13
	0+85	7,579.41
	1+33	7,576.32
	1+59	7,574.97
	1+95	7,574.19
	2+25	7,575.58
	2+51	7,576.81
	2+65	7,577.24
	3+05	7,580.43
	3+42	7,582.91
	3+78	7,584.13
	3+92	7,585.53

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 7,585.41)	(3+92, 7,585.53)	0.035

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.6 ft
Roughness Coefficient	0.035
Elevation	7,574.80 ft
Elevation Range	7,574.2 to 7,585.5 ft
Flow Area	12.7 ft ²
Wetted Perimeter	41.4 ft
Hydraulic Radius	0.3 ft
Top Width	41.42 ft
Normal Depth	0.6 ft
Critical Depth	0.6 ft
Critical Slope	2.63 %
Velocity	3.34 ft/s
Velocity Head	0.17 ft
Specific Energy	0.79 ft
Froude Number	1.064

Worksheet for SECTION C-C

Results

Flow Type	Supercritical
-----------	---------------

GVF Input Data

Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data

Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.6 ft
Critical Depth	0.6 ft
Channel Slope	3.00 %
Critical Slope	2.63 %

Worksheet for SECTION D-D

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Channel Slope	1.90 %
Discharge	167.40 cfs

Section Definitions

Station (ft)		Elevation (ft)
	0+00	7,540.10
	0+25	7,538.00
	0+72	7,532.16
	0+94	7,530.00
	1+08	7,529.51
	1+77	7,529.95
	1+91	7,532.00
	2+27	7,536.14
	2+37	7,538.00
	2+67	7,540.29

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 7,540.10)	(2+67, 7,540.29)	0.035

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.8 ft
Roughness Coefficient	0.035
Elevation	7,530.26 ft
Elevation Range	7,529.5 to 7,540.3 ft
Flow Area	44.9 ft ²
Wetted Perimeter	88.3 ft
Hydraulic Radius	0.5 ft
Top Width	88.21 ft
Normal Depth	0.8 ft
Critical Depth	0.7 ft
Critical Slope	2.28 %
Velocity	3.73 ft/s
Velocity Head	0.22 ft
Specific Energy	0.97 ft
Froude Number	0.922
Flow Type	Subcritical

Worksheet for SECTION D-D

GVF Input Data

Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data

Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.8 ft
Critical Depth	0.7 ft
Channel Slope	1.90 %
Critical Slope	2.28 %

Worksheet for SECTION E-E

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.035
Channel Slope	9.00 %
Left Side Slope	7.000 H:V
Right Side Slope	6.000 H:V
Discharge	5.00 cfs

Results

Normal Depth	0.4 ft
Flow Area	1.1 ft ²
Wetted Perimeter	5.5 ft
Hydraulic Radius	0.2 ft
Top Width	5.41 ft
Critical Depth	0.5 ft
Critical Slope	2.85 %
Velocity	4.44 ft/s
Velocity Head	0.31 ft
Specific Energy	0.72 ft
Froude Number	1.715
Flow Type	Supercritical

GVF Input Data

Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data

Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.4 ft
Critical Depth	0.5 ft
Channel Slope	9.00 %
Critical Slope	2.85 %

Worksheet for SECTION F-F

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Roughness Coefficient	0.035
Channel Slope	2.20 %
Left Side Slope	7.000 H:V
Right Side Slope	4.000 H:V
Discharge	297.40 cfs
Results	
Normal Depth	2.7 ft
Flow Area	39.4 ft ²
Wetted Perimeter	29.9 ft
Hydraulic Radius	1.3 ft
Top Width	29.43 ft
Critical Depth	2.8 ft
Critical Slope	1.63 %
Velocity	7.56 ft/s
Velocity Head	0.89 ft
Specific Energy	3.56 ft
Froude Number	1.152
Flow Type	Supercritical
GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	2.7 ft
Critical Depth	2.8 ft
Channel Slope	2.20 %
Critical Slope	1.63 %

Worksheet for SECTION G-G

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.035
Channel Slope	8.20 %
Left Side Slope	4.000 H:V
Right Side Slope	4.000 H:V
Discharge	21.00 cfs

Results

Normal Depth	0.9 ft
Flow Area	3.1 ft ²
Wetted Perimeter	7.2 ft
Hydraulic Radius	0.4 ft
Top Width	7.00 ft
Critical Depth	1.1 ft
Critical Slope	2.26 %
Velocity	6.86 ft/s
Velocity Head	0.73 ft
Specific Energy	1.61 ft
Froude Number	1.830
Flow Type	Supercritical

GVF Input Data

Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data

Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.9 ft
Critical Depth	1.1 ft
Channel Slope	8.20 %
Critical Slope	2.26 %

Worksheet for SECTION H-H

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Roughness Coefficient	0.035
Channel Slope	2.00 %
Left Side Slope	4.000 H:V
Right Side Slope	4.000 H:V
Discharge	283.20 cfs
Results	
Normal Depth	3.0 ft
Flow Area	36.6 ft ²
Wetted Perimeter	24.9 ft
Hydraulic Radius	1.5 ft
Top Width	24.18 ft
Critical Depth	3.2 ft
Critical Slope	1.60 %
Velocity	7.75 ft/s
Velocity Head	0.93 ft
Specific Energy	3.96 ft
Froude Number	1.111
Flow Type	Supercritical
GVF Input Data	
Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	3.0 ft
Critical Depth	3.2 ft
Channel Slope	2.00 %
Critical Slope	1.60 %

Worksheet for SECTION I-I

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.035
Channel Slope	6.50 %
Left Side Slope	4.000 H:V
Right Side Slope	5.000 H:V
Discharge	93.30 cfs

Results

Normal Depth	1.5 ft
Flow Area	10.5 ft ²
Wetted Perimeter	14.1 ft
Hydraulic Radius	0.7 ft
Top Width	13.74 ft
Critical Depth	1.9 ft
Critical Slope	1.87 %
Velocity	8.90 ft/s
Velocity Head	1.23 ft
Specific Energy	2.76 ft
Froude Number	1.795
Flow Type	Supercritical

GVF Input Data

Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data

Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	1.5 ft
Critical Depth	1.9 ft
Channel Slope	6.50 %
Critical Slope	1.87 %



Flying Horse North Filing No. 3
Final Drainage Report
Project No.: 211030.20
El Paso County, Colorado

CHANNEL LINING CALCULATIONS

FROUDE NUMBER CALCULATIONS		CALCULATED BY:	TMM	DATE:	9/4/2024	
PROJECT: 211030 FILING NO. 4		CHECKED BY:	RHL			
Froude Number Calculations: 100-YR						
Section	Velocity	Gravitational Constant	Hydraulic depth	Xsectional Area	top Width	Froude #
-	ft/s	ft/s^2	ft	ft^2	ft	N/A
A-A	5.79	32.17	0.88	47.30	53.49	1.09
B-B	3.92	32.17	0.55	18.3	33.21	0.93
C-C	3.33	32.17	0.31	12.6	41.27	1.06
D-D	3.91	32.17	0.55	48.5	88.91	0.93
E-E	4.44	32.17	0.20	1.1	5.41	1.74
F-F	7.56	32.17	1.34	39.4	29.43	1.15
G-G	6.86	32.17	0.44	3.1	7.00	1.82
H-H	7.75	32.17	1.51	36.6	24.18	1.11
I-I	8.90	32.17	0.76	10.5	13.74	1.79
SECTION A1	6.10	32.17	0.76	10.5	13.74	1.23
SECTION A2	5.23	32.17	0.76	10.5	13.74	1.05
SECTION B	5.24	32.17	0.76	10.5	13.74	1.06
SECTION C	4.14	32.17	0.76	10.5	13.74	0.83
SECTION D	5.25	32.17	0.76	10.5	13.74	1.06
SECTION E	5.78	32.17	0.76	10.5	13.74	1.17

SHEAR STRESS & CHANNEL LININGS		CALCULATED BY:	TMM	DATE:	9/4/2024
PROJECT: 211030 FILING NO. 4		CHECKED BY:	RHL		

Shear Stress Calculations: 100-YR				
Section	unit weight of water	Depth of flow	Slope	Shear Stress
-	lb/ft^3	ft	ft/ft	lb/ft^2
A-A	62.43	1.10	0.022	1.51
B-B	62.43	0.70	0.019	0.83
C-C	62.43	0.60	0.030	1.12
D-D	62.43	0.80	0.019	0.95
E-E	62.43	0.40	0.090	2.25
F-F	62.43	2.70	0.022	3.71
G-G	62.43	0.90	0.082	4.61
H-H	62.43	3.00	0.020	3.75
I-I	62.43	1.50	0.065	6.09
SECTION A1	62.43	1.40	0.035	3.06
SECTION A2	62.43	1.30	0.028	2.27
SECTION B	62.43	1.40	0.025	2.19
SECTION C	62.43	1.20	0.019	1.42
SECTION D	62.43	1.20	0.031	2.32
SECTION E	62.43	1.40	0.031	2.71

Channel Lining Determination					
Section	Calculated Values		P300 Max Values		Lining Required
	Shear Stress	Velocity	Shear Stress	Velocity	
A-A	1.51	5.79	3	9	P300
B-B	0.83	3.92	3	9	NONE
C-C	1.12	3.33	3	9	NONE
D-D	0.95	3.91	3	9	NONE
E-E	2.25	4.44	3	9	NONE
F-F	3.71	7.56	3	9	TMAX
G-G	4.61	6.86	3	9	TMAX
H-H	3.75	7.75	3	9	TMAX
I-I	6.09	8.90	3	9	TMAX
SECTION A1	3.06	6.10	3	9	TMAX
SECTION A2	2.27	5.23	3	9	P300
SECTION B	2.19	5.24	3	9	P300
SECTION C	1.42	4.14	3	9	P300
SECTION D	2.32	5.25	3	9	P300
SECTION E	2.71	5.78	3	9	P300



Flying Horse North Filing No. 4
Final Drainage Report
Project No.: 211030
El Paso County, Colorado

RIPRAP SIZING ANALYSIS



FLYING HORSE NORTH FILING NO. 4

Calc'd by:

TMM

211030

Checked by:

RHL

FES 1D RIPRAP

Date:

9/3/2024

Input Parameters	
Flow (Q)	3 cfs
Tailwater depth (Y _t)	0.60 ft
Conduit Diameter (D _c)	18 in
Expansion Factor (per Fig. 9-35)	6.5
Soil Type	Non-Cohesive Soils

Calculated Parameters	
Froude Parameter (Q/D ^{2.5})	1.09
D ₅₀ =	1.35 in
UDFCD Riprap Type =	Type VL
Design D ₅₀ =	6 in
Minimum Mantle Thickness =	12 in
Minimum Length of Apron =	4.5 ft

Calculated D₅₀ for riprap was calculated using Equation 9-16 in the USDCM Vol 2.

$$d_{50} = \frac{0.023Q}{Y_t^{1.2} D_c^{0.3}}$$

Calculated minimum length of apron was calculated using Equations 9-11 and 9-12 in the USDCM Vol. 2

$$L_p = \left(\frac{1}{2 \tan \theta} \right) \left(\frac{A_r}{Y_t} - W \right)$$

Equation 9-11

$$A_r = \frac{Q}{V}$$

Equation 9-12

Where:

L_p = length of protection (ft)

W = width of the conduit (ft, use diameter for circular conduits)

Y_t = tailwater depth (ft)

θ = the expansion angle of the culvert flow

Where:

Q = design discharge (cfs)

V = the allowable non-eroding velocity in the downstream channel (ft/sec)

A_r = required area of flow at allowable velocity (ft²)

Note:

¹ Calculations follow criteria in the USDCM Vol.2 Chapter 9

² Calculations assume a circular culvert

³ This spreadsheet assumes y_t/D_c=0.4 in cases where y_t is unknown or a hydraulic jump is suspected downstream of the outlet.

⁴ Per the USDCM Vol.2 in no case should L_p be less than 3D, nor does L_p need to be greater than 10D whenever the Froude parameter is less than 6.0. whenever the Froude parameter is greater than 6, increase the maximum L_p required by 1/4 D_c for each whole number by which the Froude parameter is greater than 6



FLYING HORSE NORTH FILING NO. 4

Calc'd by:

TMM

211030

Checked by:

RHL

FES 2D RIPRAP

Date:

9/12/2024

Input Parameters	
Flow (Q)	274 cfs
Tailwater depth (Y _t)	2.00 ft
Conduit Diameter (D _c)	60 in
Expansion Factor (per Fig. 9-35)	2.5
Soil Type	Non-Cohesive Soils

Calculated Parameters	
Froude Parameter (Q/D ^{2.5})	4.90
D ₅₀ =	20.31 in
UDFCD Riprap Type =	Type VH
Design D ₅₀ =	24 in
Minimum Mantle Thickness =	48 in
Minimum Length of Apron =	56.0 ft

Calculated D₅₀ for riprap was calculated using Equation 9-16 in the USDCM Vol 2.

$$d_{50} = \frac{0.023Q}{Y_t^{1.2} D_c^{0.3}}$$

Calculated minimum length of apron was calculated using Equations 9-11 and 9-12 in the USDCM Vol. 2

$$L_p = \left(\frac{1}{2 \tan \theta} \right) \left(\frac{A_r}{Y_t} - W \right)$$

Equation 9-11

$$A_r = \frac{Q}{V}$$

Equation 9-12

Where:

L_p = length of protection (ft)

W = width of the conduit (ft, use diameter for circular conduits)

Y_t = tailwater depth (ft)

θ = the expansion angle of the culvert flow

Where:

Q = design discharge (cfs)

V = the allowable non-eroding velocity in the downstream channel (ft/sec)

A_r = required area of flow at allowable velocity (ft²)

Note:

¹ Calculations follow criteria in the USDCM Vol.2 Chapter 9

² Calculations assume a circular culvert

³ This spreadsheet assumes y_t/D_c=0.4 in cases where y_t is unknown or a hydraulic jump is suspected downstream of the outlet.

⁴ Per the USDCM Vol.2 in no case should L_p be less than 3D, nor does L_p need to be greater than 10D whenever the Froude parameter is less than 6.0. whenever the Froude parameter is greater than 6, increase the maximum L_p required by 1/4 D_c for each whole number by which the Froude parameter is greater than 6



FLYING HORSE NORTH FILING NO. 4

Calc'd by:

TMM

211030

Checked by:

RHL

FES 3D RIPRAP

Date:

9/12/2024

Input Parameters	
Flow (Q)	5 cfs
Tailwater depth (Y _t)	0.60 ft
Conduit Diameter (D _c)	18 in
Expansion Factor (per Fig. 9-35)	6.25
Soil Type	Non-Cohesive Soils

Calculated Parameters	
Froude Parameter (Q/D ^{2.5})	1.81
D ₅₀ =	2.26 in
UDFCD Riprap Type =	Type VL
Design D ₅₀ =	6 in
Minimum Mantle Thickness =	12 in
Minimum Length of Apron =	4.5 ft

Calculated D₅₀ for riprap was calculated using Equation 9-16 in the USDCM Vol 2.

$$d_{50} = \frac{0.023Q}{Y_t^{1.2} D_c^{0.3}}$$

Calculated minimum length of apron was calculated using Equations 9-11 and 9-12 in the USDCM Vol. 2

$$L_p = \left(\frac{1}{2 \tan \theta} \right) \left(\frac{A_r}{Y_t} - W \right)$$

Equation 9-11

$$A_r = \frac{Q}{V}$$

Equation 9-12

Where:

L_p = length of protection (ft)

W = width of the conduit (ft, use diameter for circular conduits)

Y_t = tailwater depth (ft)

θ = the expansion angle of the culvert flow

Where:

Q = design discharge (cfs)

V = the allowable non-eroding velocity in the downstream channel (ft/sec)

A_r = required area of flow at allowable velocity (ft²)

Note:

¹ Calculations follow criteria in the USDCM Vol.2 Chapter 9

² Calculations assume a circular culvert

³ This spreadsheet assumes y_t/D_c=0.4 in cases where y_t is unknown or a hydraulic jump is suspected downstream of the outlet.

⁴ Per the USDCM Vol.2 in no case should L_p be less than 3D, nor does L_p need to be greater than 10D whenever the Froude parameter is less than 6.0. whenever the Froude parameter is greater than 6, increase the maximum L_p required by 1/4 D_c for each whole number by which the Froude parameter is greater than 6



FLYING HORSE NORTH FILING NO. 4

Calc'd by:

TMM

211030

Checked by:

RHL

FES 4D RIPRAP

Date:

9/12/2024

Input Parameters	
Flow (Q)	22.1 cfs
Tailwater depth (Y _t)	0.80 ft
Conduit Diameter (D _c)	24 in
Expansion Factor (per Fig. 9-35)	3.75
Soil Type	Non-Cohesive Soils

Calculated Parameters	
Froude Parameter (Q/D ^{2.5})	3.91
D ₅₀ =	6.48 in
UDFCD Riprap Type =	Type L
Design D ₅₀ =	9 in
Minimum Mantle Thickness =	18 in
Minimum Length of Apron =	13.2 ft

Calculated D₅₀ for riprap was calculated using Equation 9-16 in the USDCM Vol 2.

$$d_{50} = \frac{0.023Q}{Y_t^{1.2} D_c^{0.3}}$$

Calculated minimum length of apron was calculated using Equations 9-11 and 9-12 in the USDCM Vol. 2

$$L_p = \left(\frac{1}{2 \tan \theta} \right) \left(\frac{A_r}{Y_t} - W \right)$$

Equation 9-11

$$A_r = \frac{Q}{V}$$

Equation 9-12

Where:

L_p = length of protection (ft)

W = width of the conduit (ft, use diameter for circular conduits)

Y_t = tailwater depth (ft)

θ = the expansion angle of the culvert flow

Where:

Q = design discharge (cfs)

V = the allowable non-eroding velocity in the downstream channel (ft/sec)

A_r = required area of flow at allowable velocity (ft²)

Note:

¹ Calculations follow criteria in the USDCM Vol.2 Chapter 9

² Calculations assume a circular culvert

³ This spreadsheet assumes y_t/D_c=0.4 in cases where y_t is unknown or a hydraulic jump is suspected downstream of the outlet.

⁴ Per the USDCM Vol.2 in no case should L_p be less than 3D, nor does L_p need to be greater than 10D whenever the Froude parameter is less than 6.0. whenever the Froude parameter is greater than 6, increase the maximum L_p required by 1/4 D_c for each whole number by which the Froude parameter is greater than 6



FLYING HORSE NORTH FILING NO. 4

Calc'd by:

TMM

211030

Checked by:

RHL

FES 5D RIPRAP

Date:

9/12/2024

Input Parameters	
Flow (Q)	13.9 cfs
Tailwater depth (Y _t)	0.60 ft
Conduit Diameter (D _c)	18 in
Expansion Factor (per Fig. 9-35)	2.5
Soil Type	Non-Cohesive Soils

Calculated Parameters	
Froude Parameter (Q/D ^{2.5})	5.04
D ₅₀ =	6.27 in
UDFCD Riprap Type =	Type L
Design D ₅₀ =	9 in
Minimum Mantle Thickness =	18 in
Minimum Length of Apron =	7.8 ft

Calculated D₅₀ for riprap was calculated using Equation 9-16 in the USDCM Vol 2.

$$d_{50} = \frac{0.023Q}{Y_t^{1.2} D_c^{0.3}}$$

Calculated minimum length of apron was calculated using Equations 9-11 and 9-12 in the USDCM Vol. 2

$$L_p = \left(\frac{1}{2 \tan \theta} \right) \left(\frac{A_r}{Y_t} - W \right)$$

Equation 9-11

$$A_r = \frac{Q}{V}$$

Equation 9-12

Where:

L_p = length of protection (ft)

W = width of the conduit (ft, use diameter for circular conduits)

Y_t = tailwater depth (ft)

θ = the expansion angle of the culvert flow

Where:

Q = design discharge (cfs)

V = the allowable non-eroding velocity in the downstream channel (ft/sec)

A_r = required area of flow at allowable velocity (ft²)

Note:

¹ Calculations follow criteria in the USDCM Vol.2 Chapter 9

² Calculations assume a circular culvert

³ This spreadsheet assumes y_t/D_c=0.4 in cases where y_t is unknown or a hydraulic jump is suspected downstream of the outlet.

⁴ Per the USDCM Vol.2 in no case should L_p be less than 3D, nor does L_p need to be greater than 10D whenever the Froude parameter is less than 6.0. whenever the Froude parameter is greater than 6, increase the maximum L_p required by 1/4 D_c for each whole number by which the Froude parameter is greater than 6



FLYING HORSE NORTH FILING NO. 4

Calc'd by:

TMM

211030

Checked by:

RHL

FES 6D RIPRAP

Date:

9/12/2024

Input Parameters	
Flow (Q)	7 cfs
Tailwater depth (Y _t)	0.60 ft
Conduit Diameter (D _c)	18 in
Expansion Factor (per Fig. 9-35)	5
Soil Type	Non-Cohesive Soils

Calculated Parameters	
Froude Parameter (Q/D ^{2.5})	2.54
D ₅₀ =	3.16 in
UDFCD Riprap Type =	Type VL
Design D ₅₀ =	6 in
Minimum Mantle Thickness =	12 in
Minimum Length of Apron =	4.5 ft

Calculated D₅₀ for riprap was calculated using Equation 9-16 in the USDCM Vol 2.

$$d_{50} = \frac{0.023Q}{Y_t^{1.2} D_c^{0.3}}$$

Calculated minimum length of apron was calculated using Equations 9-11 and 9-12 in the USDCM Vol. 2

$$L_p = \left(\frac{1}{2 \tan \theta} \right) \left(\frac{A_r}{Y_t} - W \right)$$

Equation 9-11

$$A_r = \frac{Q}{V}$$

Equation 9-12

Where:

L_p = length of protection (ft)

W = width of the conduit (ft, use diameter for circular conduits)

Y_t = tailwater depth (ft)

θ = the expansion angle of the culvert flow

Where:

Q = design discharge (cfs)

V = the allowable non-eroding velocity in the downstream channel (ft/sec)

A_r = required area of flow at allowable velocity (ft²)

Note:

¹ Calculations follow criteria in the USDCM Vol.2 Chapter 9

² Calculations assume a circular culvert

³ This spreadsheet assumes y_t/D_c=0.4 in cases where y_t is unknown or a hydraulic jump is suspected downstream of the outlet.

⁴ Per the USDCM Vol.2 in no case should L_p be less than 3D, nor does L_p need to be greater than 10D whenever the Froude parameter is less than 6.0. whenever the Froude parameter is greater than 6, increase the maximum L_p required by 1/4 D_c for each whole number by which the Froude parameter is greater than 6



FLYING HORSE NORTH FILING NO. 4

Calc'd by:

TMM

211030

Checked by:

RHL

FES 7D RIPRAP

Date:

9/12/2024

Input Parameters	
Flow (Q)	8 cfs
Tailwater depth (Y _t)	0.60 ft
Conduit Diameter (D _c)	18 in
Expansion Factor (per Fig. 9-35)	4.5
Soil Type	Non-Cohesive Soils

Calculated Parameters	
Froude Parameter (Q/D ^{2.5})	2.90
D ₅₀ =	3.61 in
UDFCD Riprap Type =	Type VL
Design D ₅₀ =	6 in
Minimum Mantle Thickness =	12 in
Minimum Length of Apron =	5.25 ft

Calculated D₅₀ for riprap was calculated using Equation 9-16 in the USDCM Vol 2.

$$d_{50} = \frac{0.023Q}{Y_t^{1.2} D_c^{0.3}}$$

Calculated minimum length of apron was calculated using Equations 9-11 and 9-12 in the USDCM Vol. 2

$$L_p = \left(\frac{1}{2 \tan \theta} \right) \left(\frac{A_r}{Y_t} - W \right)$$

Equation 9-11

$$A_r = \frac{Q}{V}$$

Equation 9-12

Where:

L_p = length of protection (ft)

W = width of the conduit (ft, use diameter for circular conduits)

Y_t = tailwater depth (ft)

θ = the expansion angle of the culvert flow

Where:

Q = design discharge (cfs)

V = the allowable non-eroding velocity in the downstream channel (ft/sec)

A_r = required area of flow at allowable velocity (ft²)

Note:

¹ Calculations follow criteria in the USDCM Vol.2 Chapter 9

² Calculations assume a circular culvert

³ This spreadsheet assumes y_t/D_c=0.4 in cases where y_t is unknown or a hydraulic jump is suspected downstream of the outlet.

⁴ Per the USDCM Vol.2 in no case should L_p be less than 3D, nor does L_p need to be greater than 10D whenever the Froude parameter is less than 6.0. whenever the Froude parameter is greater than 6, increase the maximum L_p required by 1/4 D_c for each whole number by which the Froude parameter is greater than 6



FLYING HORSE NORTH FILING NO. 4

Calc'd by:

TMM

211030

Checked by:

RHL

FES 8D RIPRAP

Date:

9/12/2024

Input Parameters	
Flow (Q)	2 cfs
Tailwater depth (Y _t)	0.60 ft
Conduit Diameter (D _c)	18 in
Expansion Factor (per Fig. 9-35)	6.5
Soil Type	Non-Cohesive Soils

Calculated Parameters	
Froude Parameter (Q/D ^{2.5})	0.73
D ₅₀ =	0.90 in
UDFCD Riprap Type =	Type VL
Design D ₅₀ =	6 in
Minimum Mantle Thickness =	12 in
Minimum Length of Apron =	4.5 ft

Calculated D₅₀ for riprap was calculated using Equation 9-16 in the USDCM Vol 2.

$$d_{50} = \frac{0.023Q}{Y_t^{1.2} D_c^{0.3}}$$

Calculated minimum length of apron was calculated using Equations 9-11 and 9-12 in the USDCM Vol. 2

$$L_p = \left(\frac{1}{2 \tan \theta} \right) \left(\frac{A_r}{Y_t} - W \right)$$

Equation 9-11

$$A_r = \frac{Q}{V}$$

Equation 9-12

Where:

L_p = length of protection (ft)

W = width of the conduit (ft, use diameter for circular conduits)

Y_t = tailwater depth (ft)

θ = the expansion angle of the culvert flow

Where:

Q = design discharge (cfs)

V = the allowable non-eroding velocity in the downstream channel (ft/sec)

A_r = required area of flow at allowable velocity (ft²)

Note:

¹ Calculations follow criteria in the USDCM Vol.2 Chapter 9

² Calculations assume a circular culvert

³ This spreadsheet assumes y_t/D_c=0.4 in cases where y_t is unknown or a hydraulic jump is suspected downstream of the outlet.

⁴ Per the USDCM Vol.2 in no case should L_p be less than 3D, nor does L_p need to be greater than 10D whenever the Froude parameter is less than 6.0. whenever the Froude parameter is greater than 6, increase the maximum L_p required by 1/4 D_c for each whole number by which the Froude parameter is greater than 6



FLYING HORSE NORTH FILING NO. 4

Calc'd by:

TMM

211030

Checked by:

RHL

FES 9D RIPRAP

Date:

9/12/2024

Input Parameters	
Flow (Q)	2 cfs
Tailwater depth (Y _t)	0.60 ft
Conduit Diameter (D _c)	18 in
Expansion Factor (per Fig. 9-35)	6.5
Soil Type	Non-Cohesive Soils

Calculated Parameters	
Froude Parameter (Q/D ^{2.5})	0.73
D ₅₀ =	0.90 in
UDFCD Riprap Type =	Type VL
Design D ₅₀ =	6 in
Minimum Mantle Thickness =	12 in
Minimum Length of Apron =	4.5 ft

Calculated D₅₀ for riprap was calculated using Equation 9-16 in the USDCM Vol 2.

$$d_{50} = \frac{0.023Q}{Y_t^{1.2} D_c^{0.3}}$$

Calculated minimum length of apron was calculated using Equations 9-11 and 9-12 in the USDCM Vol. 2

$$L_p = \left(\frac{1}{2 \tan \theta} \right) \left(\frac{A_r}{Y_t} - W \right)$$

Equation 9-11

$$A_r = \frac{Q}{V}$$

Equation 9-12

Where:

L_p = length of protection (ft)

W = width of the conduit (ft, use diameter for circular conduits)

Y_t = tailwater depth (ft)

θ = the expansion angle of the culvert flow

Where:

Q = design discharge (cfs)

V = the allowable non-eroding velocity in the downstream channel (ft/sec)

A_r = required area of flow at allowable velocity (ft²)

Note:

¹ Calculations follow criteria in the USDCM Vol.2 Chapter 9

² Calculations assume a circular culvert

³ This spreadsheet assumes y_t/D_c=0.4 in cases where y_t is unknown or a hydraulic jump is suspected downstream of the outlet.

⁴ Per the USDCM Vol.2 in no case should L_p be less than 3D, nor does L_p need to be greater than 10D whenever the Froude parameter is less than 6.0. whenever the Froude parameter is greater than 6, increase the maximum L_p required by 1/4 D_c for each whole number by which the Froude parameter is greater than 6



FLYING HORSE NORTH FILING NO. 4

Calc'd by:

TMM

211030

Checked by:

RHL

FES 10D RIPRAP

Date:

9/11/2024

Input Parameters	
Flow (Q)	5 cfs
Tailwater depth (Y _t)	0.60 ft
Conduit Diameter (D _c)	18 in
Expansion Factor (per Fig. 9-35)	6.25
Soil Type	Non-Cohesive Soils

Calculated Parameters	
Froude Parameter (Q/D ^{2.5})	1.81
D ₅₀ =	2.26 in
UDFCD Riprap Type =	Type VL
Design D ₅₀ =	6 in
Minimum Mantle Thickness =	12 in
Minimum Length of Apron =	4.5 ft

Calculated D₅₀ for riprap was calculated using Equation 9-16 in the USDCM Vol 2.

$$d_{50} = \frac{0.023Q}{Y_t^{1.2} D_c^{0.3}}$$

Calculated minimum length of apron was calculated using Equations 9-11 and 9-12 in the USDCM Vol. 2

$$L_p = \left(\frac{1}{2 \tan \theta} \right) \left(\frac{A_r}{Y_t} - W \right)$$

Equation 9-11

$$A_r = \frac{Q}{V}$$

Equation 9-12

Where:

L_p = length of protection (ft)

W = width of the conduit (ft, use diameter for circular conduits)

Y_t = tailwater depth (ft)

θ = the expansion angle of the culvert flow

Where:

Q = design discharge (cfs)

V = the allowable non-eroding velocity in the downstream channel (ft/sec)

A_r = required area of flow at allowable velocity (ft²)

Note:

¹ Calculations follow criteria in the USDCM Vol.2 Chapter 9

² Calculations assume a circular culvert

³ This spreadsheet assumes y_t/D_c=0.4 in cases where y_t is unknown or a hydraulic jump is suspected downstream of the outlet.

⁴ Per the USDCM Vol.2 in no case should L_p be less than 3D, nor does L_p need to be greater than 10D whenever the Froude parameter is less than 6.0. whenever the Froude parameter is greater than 6, increase the maximum L_p required by 1/4 D_c for each whole number by which the Froude parameter is greater than 6



FLYING HORSE NORTH FILING NO. 4

Calc'd by:

TMM

211030

Checked by:

RHL

FES 11D RIPRAP

Date:

9/12/2024

Input Parameters	
Flow (Q)	71.7 cfs
Tailwater depth (Y _t)	1.60 ft
Conduit Diameter (D _c)	48 in
Expansion Factor (per Fig. 9-35)	5.5
Soil Type	Non-Cohesive Soils

Calculated Parameters	
Froude Parameter (Q/D ^{2.5})	2.24
D ₅₀ =	7.43 in
UDFCD Riprap Type =	Type L
Design D ₅₀ =	9 in
Minimum Mantle Thickness =	18 in
Minimum Length of Apron =	27.3 ft

Calculated D₅₀ for riprap was calculated using Equation 9-16 in the USDCM Vol 2.

$$d_{50} = \frac{0.023Q}{Y_t^{1.2} D_c^{0.3}}$$

Calculated minimum length of apron was calculated using Equations 9-11 and 9-12 in the USDCM Vol. 2

$$L_p = \left(\frac{1}{2 \tan \theta} \right) \left(\frac{A_r}{Y_t} - W \right)$$

Equation 9-11

$$A_r = \frac{Q}{V}$$

Equation 9-12

Where:

L_p = length of protection (ft)

W = width of the conduit (ft, use diameter for circular conduits)

Y_t = tailwater depth (ft)

θ = the expansion angle of the culvert flow

Where:

Q = design discharge (cfs)

V = the allowable non-eroding velocity in the downstream channel (ft/sec)

A_r = required area of flow at allowable velocity (ft²)

Note:

¹ Calculations follow criteria in the USDCM Vol.2 Chapter 9

² Calculations assume a circular culvert

³ This spreadsheet assumes y_t/D_c=0.4 in cases where y_t is unknown or a hydraulic jump is suspected downstream of the outlet.

⁴ Per the USDCM Vol.2 in no case should L_p be less than 3D, nor does L_p need to be greater than 10D whenever the Froude parameter is less than 6.0. whenever the Froude parameter is greater than 6, increase the maximum L_p required by 1/4 D_c for each whole number by which the Froude parameter is greater than 6



FLYING HORSE NORTH FILING NO. 4

Calc'd by:

TMM

211030

Checked by:

RHL

FES 12D RIPRAP

Date:

9/12/2024

Input Parameters	
Flow (Q)	93.3 cfs
Tailwater depth (Y _t)	1.60 ft
Conduit Diameter (D _c)	48 in
Expansion Factor (per Fig. 9-35)	4.5
Soil Type	Non-Cohesive Soils

Calculated Parameters	
Froude Parameter (Q/D ^{2.5})	2.92
D ₅₀ =	9.67 in
UDFCD Riprap Type =	Type M
Design D ₅₀ =	12 in
Minimum Mantle Thickness =	24 in
Minimum Length of Apron =	34.5 ft

Calculated D₅₀ for riprap was calculated using Equation 9-16 in the USDCM Vol 2.

$$d_{50} = \frac{0.023Q}{Y_t^{1.2} D_c^{0.3}}$$

Calculated minimum length of apron was calculated using Equations 9-11 and 9-12 in the USDCM Vol. 2

$$L_p = \left(\frac{1}{2 \tan \theta} \right) \left(\frac{A_r}{Y_t} - W \right)$$

Equation 9-11

$$A_r = \frac{Q}{V}$$

Equation 9-12

Where:

L_p = length of protection (ft)

W = width of the conduit (ft, use diameter for circular conduits)

Y_t = tailwater depth (ft)

θ = the expansion angle of the culvert flow

Where:

Q = design discharge (cfs)

V = the allowable non-eroding velocity in the downstream channel (ft/sec)

A_r = required area of flow at allowable velocity (ft²)

Note:

¹ Calculations follow criteria in the USDCM Vol.2 Chapter 9

² Calculations assume a circular culvert

³ This spreadsheet assumes y_t/D_c=0.4 in cases where y_t is unknown or a hydraulic jump is suspected downstream of the outlet.

⁴ Per the USDCM Vol.2 in no case should L_p be less than 3D, nor does L_p need to be greater than 10D whenever the Froude parameter is less than 6.0. whenever the Froude parameter is greater than 6, increase the maximum L_p required by 1/4 D_c for each whole number by which the Froude parameter is greater than 6



FLYING HORSE NORTH FILING NO. 4

Calc'd by:

TMM

211030

Checked by:

RHL

FES 13D RIPRAP

Date:

9/12/2024

Input Parameters	
Flow (Q)	156 cfs
Tailwater depth (Y _t)	1.80 ft
Conduit Diameter (D _c)	54 in
Expansion Factor (per Fig. 9-35)	3.5
Soil Type	Non-Cohesive Soils

Calculated Parameters	
Froude Parameter (Q/D ^{2.5})	3.63
D ₅₀ =	13.54 in
UDFCD Riprap Type =	Type H
Design D ₅₀ =	18 in
Minimum Mantle Thickness =	36 in
Minimum Length of Apron =	44.9 ft

Calculated D₅₀ for riprap was calculated using Equation 9-16 in the USDCM Vol 2.

$$d_{50} = \frac{0.023Q}{Y_t^{1.2} D_c^{0.3}}$$

Calculated minimum length of apron was calculated using Equations 9-11 and 9-12 in the USDCM Vol. 2

$$L_p = \left(\frac{1}{2 \tan \theta} \right) \left(\frac{A_r}{Y_t} - W \right)$$

Equation 9-11

$$A_r = \frac{Q}{V}$$

Equation 9-12

Where:

L_p = length of protection (ft)

W = width of the conduit (ft, use diameter for circular conduits)

Y_t = tailwater depth (ft)

θ = the expansion angle of the culvert flow

Where:

Q = design discharge (cfs)

V = the allowable non-eroding velocity in the downstream channel (ft/sec)

A_r = required area of flow at allowable velocity (ft²)

Note:

¹ Calculations follow criteria in the USDCM Vol.2 Chapter 9

² Calculations assume a circular culvert

³ This spreadsheet assumes y_t/D_c=0.4 in cases where y_t is unknown or a hydraulic jump is suspected downstream of the outlet.

⁴ Per the USDCM Vol.2 in no case should L_p be less than 3D, nor does L_p need to be greater than 10D whenever the Froude parameter is less than 6.0. whenever the Froude parameter is greater than 6, increase the maximum L_p required by 1/4 D_c for each whole number by which the Froude parameter is greater than 6



FLYING HORSE NORTH FILING NO. 4

Calc'd by:

TMM

211030

Checked by:

RHL

FES 14D RIPRAP

Date:

9/12/2024

Input Parameters	
Flow (Q)	213.6 cfs
Tailwater depth (Y _t)	2.00 ft
Conduit Diameter (D _c)	60 in
Expansion Factor (per Fig. 9-35)	3.5
Soil Type	Non-Cohesive Soils

Calculated Parameters	
Froude Parameter (Q/D ^{2.5})	3.82
D ₅₀ =	15.83 in
UDFCD Riprap Type =	Type H
Design D ₅₀ =	18 in
Minimum Mantle Thickness =	36 in
Minimum Length of Apron =	57.3 ft

Calculated D₅₀ for riprap was calculated using Equation 9-16 in the USDCM Vol 2.

$$d_{50} = \frac{0.023Q}{Y_t^{1.2} D_c^{0.3}}$$

Calculated minimum length of apron was calculated using Equations 9-11 and 9-12 in the USDCM Vol. 2

$$L_p = \left(\frac{1}{2 \tan \theta} \right) \left(\frac{A_r}{Y_t} - W \right)$$

Equation 9-11

$$A_r = \frac{Q}{V}$$

Equation 9-12

Where:

L_p = length of protection (ft)

W = width of the conduit (ft, use diameter for circular conduits)

Y_t = tailwater depth (ft)

θ = the expansion angle of the culvert flow

Where:

Q = design discharge (cfs)

V = the allowable non-eroding velocity in the downstream channel (ft/sec)

A_r = required area of flow at allowable velocity (ft²)

Note:

¹ Calculations follow criteria in the USDCM Vol.2 Chapter 9

² Calculations assume a circular culvert

³ This spreadsheet assumes y_t/D_c=0.4 in cases where y_t is unknown or a hydraulic jump is suspected downstream of the outlet.

⁴ Per the USDCM Vol.2 in no case should L_p be less than 3D, nor does L_p need to be greater than 10D whenever the Froude parameter is less than 6.0. whenever the Froude parameter is greater than 6, increase the maximum L_p required by 1/4 D_c for each whole number by which the Froude parameter is greater than 6



FLYING HORSE NORTH FILING NO. 4

Calc'd by:

TMM

211030

Checked by:

RHL

FES 15D RIPRAP

Date:

9/12/2024

Input Parameters	
Flow (Q)	64.2 cfs
Tailwater depth (Y _t)	1.20 ft
Conduit Diameter (D _c)	36 in
Expansion Factor (per Fig. 9-35)	3.25
Soil Type	Non-Cohesive Soils

Calculated Parameters	
Froude Parameter (Q/D ^{2.5})	4.12
D ₅₀ =	10.24 in
UDFCD Riprap Type =	Type M
Design D ₅₀ =	12 in
Minimum Mantle Thickness =	24 in
Minimum Length of Apron =	25.0 ft

Calculated D₅₀ for riprap was calculated using Equation 9-16 in the USDCM Vol 2.

$$d_{50} = \frac{0.023Q}{Y_t^{1.2} D_c^{0.3}}$$

Calculated minimum length of apron was calculated using Equations 9-11 and 9-12 in the USDCM Vol. 2

$$L_p = \left(\frac{1}{2 \tan \theta} \right) \left(\frac{A_r}{Y_t} - W \right)$$

Equation 9-11

$$A_r = \frac{Q}{V}$$

Equation 9-12

Where:

L_p = length of protection (ft)

W = width of the conduit (ft, use diameter for circular conduits)

Y_t = tailwater depth (ft)

θ = the expansion angle of the culvert flow

Where:

Q = design discharge (cfs)

V = the allowable non-eroding velocity in the downstream channel (ft/sec)

A_r = required area of flow at allowable velocity (ft²)

Note:

¹ Calculations follow criteria in the USDCM Vol.2 Chapter 9

² Calculations assume a circular culvert

³ This spreadsheet assumes y_t/D_c=0.4 in cases where y_t is unknown or a hydraulic jump is suspected downstream of the outlet.

⁴ Per the USDCM Vol.2 in no case should L_p be less than 3D, nor does L_p need to be greater than 10D whenever the Froude parameter is less than 6.0. whenever the Froude parameter is greater than 6, increase the maximum L_p required by 1/4 D_c for each whole number by which the Froude parameter is greater than 6



Flying Horse North Filing No. 4
Final Drainage Report
Project No.: 211030
El Paso County, Colorado

WEIR SECTION ANALYSIS MAJOR STORM (100-YEAR)

Worksheet for Pond A Rundown

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.040
Channel Slope	10.40 %
Bottom Width	17.81 ft
Discharge	284.00 cfs

Results

Normal Depth	1.3 ft
Flow Area	22.3 ft ²
Wetted Perimeter	20.3 ft
Hydraulic Radius	1.1 ft
Top Width	17.81 ft
Critical Depth	2.0 ft
Critical Slope	2.43 %
Velocity	12.75 ft/s
Velocity Head	2.52 ft
Specific Energy	3.78 ft
Froude Number	2.009
Flow Type	Supercritical

GVF Input Data

Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data

Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	1.3 ft
Critical Depth	2.0 ft
Channel Slope	10.40 %
Critical Slope	2.43 %

Worksheet for Pond B Rundown

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.040
Channel Slope	5.00 %
Bottom Width	16.75 ft
Discharge	297.40 cfs

Results

Normal Depth	1.7 ft
Flow Area	28.4 ft ²
Wetted Perimeter	20.1 ft
Hydraulic Radius	1.4 ft
Top Width	16.75 ft
Critical Depth	2.1 ft
Critical Slope	2.45 %
Velocity	10.46 ft/s
Velocity Head	1.70 ft
Specific Energy	3.40 ft
Froude Number	1.415
Flow Type	Supercritical

GVF Input Data

Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data

Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	1.7 ft
Critical Depth	2.1 ft
Channel Slope	5.00 %
Critical Slope	2.45 %

Worksheet for Pond C Rundown

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.040
Channel Slope	3.00 %
Bottom Width	9.30 ft
Discharge	63.70 cfs

Results

Normal Depth	1.1 ft
Flow Area	10.5 ft ²
Wetted Perimeter	11.6 ft
Hydraulic Radius	0.9 ft
Top Width	9.30 ft
Critical Depth	1.1 ft
Critical Slope	2.99 %
Velocity	6.05 ft/s
Velocity Head	0.57 ft
Specific Energy	1.70 ft
Froude Number	1.001
Flow Type	Supercritical

GVF Input Data

Downstream Depth	0.0 ft
Length	0.0 ft
Number Of Steps	0

GVF Output Data

Upstream Depth	0.0 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	1.1 ft
Critical Depth	1.1 ft
Channel Slope	3.00 %
Critical Slope	2.99 %



Flying Horse North Filing No. 4
Final Drainage Report
Project No.: 211030
El Paso County, Colorado

APPENDIX D

WATER QUALITY AND DETENTION CALCULATIONS

Flying Horse North Filing No. 4 - Detention Modeling Summary

Pond A Developed Parameters			
Catchment Name/ID	Area (sq.mi.)	Area (ac.)	Percent Imperv.
A1	0.017	10.84	10.2
A2	0.017	10.79	11.0
A3	0.111	71.16	4.1
A4	0.029	18.71	11.0
A5	0.004	2.47	11.0
A6	0.010	6.38	11.0
A7	0.013	8.13	11.0
Total		128.48	7.1

Peak Storage Volume		Peak Release
(cu-ft)	(ac-ft)	(cfs)
111,834	2.6	160.8

Pre-Development Flow	
Catchment Name/ID	Peak Flow (cfs)
A1	97.1
A2	71.2
G1	10.8
H1	94.0
Total	273.2
O_BASIN_H	267.4

Post-Development Flow	
Catchment Name/ID	Peak Flow (cfs)
A1	14.3
A2	19.6
A3	101.6
A4	20.0
A5	4.7
A6	11.7
A7	17.1
G1	5.7
G2	7.2
H1	7.7
H2	35.0
H3	66.9
Total	311.6
O_BASIN_H	248.5

Direct summation

Less than or equal to historic at same location

Pond B Developed Parameters			
Catchment Name/ID	Area (sq.mi.)	Area (ac.)	Percent Imperv.
B1	0.090	57.78	4.1
B2	0.056	35.77	11.7
B3	0.002	1.10	33.7
Total		94.65	7.3

Peak Storage Volume		Peak Release
(cu-ft)	(ac-ft)	(cfs)
103,808	2.4	216.7

Pre-Development Flow	
Catchment Name/ID	Peak Flow (cfs)
B1	148.9
B2	75.8
B3	18.8
B4	19.6
Total	263.0
O_BASIN_B	262.7

Post-Development Flow	
Catchment Name/ID	Peak Flow (cfs)
B1	182.0
B2	49.5
B3	3.0
B4	15.1
B5	18.9
B6	33.9
Total	302.3
O_BASIN_B	262.4

Detained

Detained

Detained

Detained

Undetained

Undetained

Direct summation

Less than or equal to historic at same location

Pond C Developed Parameters			
Catchment Name/ID	Area (sq.mi.)	Area (ac.)	Percent Imperv.
C1	0.025	15.94	10.5
C2	0.003	1.98	20.9
C3	0.033	21.39	9.3
Total		39.31	10.4

Peak Storage Volume		Peak Release
(cu-ft)	(ac-ft)	(cfs)

Pre-Development Flow	
Catchment Name/ID	Peak Flow (cfs)
C1	24.7
C2	39.8
C3	9.7
C4	4.0
Total	78.2
O_BASIN_C	78.0

Post-Development Flow	
Catchment Name/ID	Peak Flow (cfs)
C1	27.7
C2	3.0
C3	39.0
C4	10.3
C5	4.0
Total	84.1
O_BASIN_C	73.2

Detained

Detained

Detained

Undetained

Undetained

Direct summation

Less than or equal to historic at same location



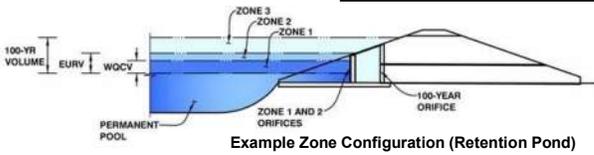
Flying Horse North Filing No. 4
Final Drainage Report
Project No.: 211030
El Paso County, Colorado

POND A

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: FLYING HORSE NORTH FILING NO. 4
Basin ID: POND A



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.72	0.532	Orifice Plate
Zone 2 (EURV)	3.18	0.302	Circular Orifice
Zone 3 (User)	4.90	1.726	Weir&Pipe (Restrict)
Total (all zones)		2.560	

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 Diameter =	N/A	inches

Calculated Parameters for Underdrain

Underdrain Orifice Area =	N/A	ft ²
Underdrain Orifice Centroid =	N/A	feet

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

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	2.72	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	12.70	inches
Orifice Plate: Orifice Area per Row =	1.74	sq. inches (diameter = 1-1/2 inches)

Calculated Parameters for Plate

WQ Orifice Area per Row =	1.208E-02	ft ²
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft ²

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	0.91	1.81					
Orifice Area (sq. inches)	1.74	1.74	1.74					
	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	
Invert of Vertical Orifice =	2.72	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	3.18	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	2.29	N/A	inches

Calculated Parameters for Vertical Orifice

	Zone 2 Circular	Not Selected	
Vertical Orifice Area =	0.03	N/A	ft ²
Vertical Orifice Centroid =	0.10	N/A	feet

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	
Overflow Weir Front Edge Height, Ho =	3.18	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	22.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V
Horiz. Length of Weir Sides =	5.00	N/A	feet
Overflow Grate Type =	Type C Grate	N/A	
Debris Clogging % =	0%	N/A	%

0% clogging to ensure program is using pipe/plate to limit release, see next sheet for results with clogging

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H _u =	3.18	N/A	feet
Overflow Weir Slope Length =	5.00	N/A	feet
Grate Open Area / 100-yr Orifice Area =	5.30	N/A	
Overflow Grate Open Area w/o Debris =	76.56	N/A	ft ²
Overflow Grate Open Area w/ Debris =	76.56	N/A	ft ²

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	2.50	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	54.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	46.00	N/A	inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	14.44	N/A	ft ²
Outlet Orifice Centroid =	2.06	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	2.35	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 Crest Length =	56.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth =	1.01	feet
Stage at Top of Freeboard =	7.01	feet
Basin Area at Top of Freeboard =	1.49	acres
Basin Volume at Top of Freeboard =	5.43	acre-ft

Routed Hydrograph Results

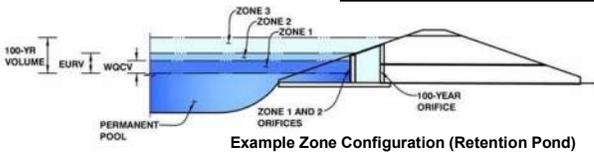
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.14
One-Hour Rainfall Depth (in)	0.532	0.834	1.441	3.437	5.467	9.207	11.701	15.348	21.917
CUHP Runoff Volume (acre-ft)	N/A	N/A	1.441	3.005	5.467	9.207	11.701	14.869	21.917
User Override Inflow Hydrograph Volume (acre-ft)	N/A	N/A	1.441	3.005	5.467	9.207	11.701	14.869	21.917
CUHP Predevelopment Peak Q (cfs)	N/A	N/A	16.2	44.9	67.6	120.7	151.3	192.2	267.2
OPTIONAL Override Predevelopment Peak Q (cfs)	N/A	N/A						160	
Predevelopment Unit Peak Flow, q (cfs/acre)	N/A	N/A	0.13	0.35	0.53	0.94	1.18	1.25	2.08
Peak Inflow Q (cfs)	N/A	N/A	22.2	42.5	74.7	126.0	156.4	183.8	272.6
Peak Outflow Q (cfs)	0.2	0.3	2.7	31.3	66.9	122.2	148.5	156	248.5
Ratio Peak Outflow to Predevelopment Q	N/A	N/A	N/A	0.7	1.0	1.0	1.0	1.0	0.9
Structure Controlling Flow	Vertical Orifice 1	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1	Spillway				
Max Velocity through Grate 1 (fps)	N/A	N/A	0.12	0.4	0.9	1.6	1.9	2.0	2.2
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	49	50	46	39	31	27	22	11
Time to Drain 99% of Inflow Volume (hours)	40	52	54	52	49	45	43	41	35
Maximum Ponding Depth (ft)	2.72	3.18	3.32	3.50	3.71	3.97	4.12	4.61	5.59
Area at Maximum Ponding Depth (acres)	0.59	0.75	0.79	0.85	0.92	1.00	1.04	1.16	1.31
Maximum Volume Stored (acre-ft)	0.53	0.84	0.94	1.09	1.27	1.52	1.69	2.23	3.43
Elevation (ft)	7534.72	7535.18		7535.50				7536.61	
Pond Bottom (ft)	7532.00								

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: FLYING HORSE NORTH FILING NO. 4
Basin ID: POND A



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.72	0.532	Orifice Plate
Zone 2 (EURV)	3.18	0.302	Circular Orifice
Zone 3 (User)	4.90	1.726	Weir&Pipe (Restrict)
Total (all zones)		2.560	

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

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

Calculated Parameters for Underdrain
 Underdrain Orifice Area = ft²
 Underdrain Orifice Centroid = feet

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

Centroid of Lowest Orifice = ft (relative to basin bottom at Stage = 0 ft)
 Depth at top of Zone using Orifice Plate = ft (relative to basin bottom at Stage = 0 ft)
 Orifice Plate: Orifice Vertical Spacing = inches
 Orifice Plate: Orifice Area per Row = sq. inches (diameter = 1-1/2 inches)

Calculated Parameters for Plate
 WQ Orifice Area per Row = ft²
 Elliptical Half-Width = feet
 Elliptical Slot Centroid = feet
 Elliptical Slot Area = ft²

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.91	1.81					
Orifice Area (sq. inches)	1.74	1.74	1.74					

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

User Input: Vertical Orifice (Circular or Rectangular)

Invert of Vertical Orifice = ft (relative to basin bottom at Stage = 0 ft)
 Depth at top of Zone using Vertical Orifice = ft (relative to basin bottom at Stage = 0 ft)
 Vertical Orifice Diameter = inches

Calculated Parameters for Vertical Orifice
 Zone 2 Circular =
 Zone 2 Rectangular =
 Vertical Orifice Area = ft²
 Vertical Orifice Centroid = feet

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
Overflow Weir Front Edge Height, Ho	3.18	N/A
Overflow Weir Front Edge Length	22.00	N/A
Overflow Weir Grate Slope	0.00	N/A
Horiz. Length of Weir Sides	5.00	N/A
Overflow Grate Type	Type C Grate	N/A
Debris Clogging %	50%	N/A

Calculated Parameters for Overflow Weir
 Zone 3 Weir =
 Zone 3 Rectangular =
 Height of Grate Upper Edge, H_g = feet
 Overflow Weir Slope Length = feet
 Grate Open Area / 100-yr Orifice Area = N/A
 Overflow Grate Open Area w/o Debris = ft²
 Overflow Grate Open Area w/ Debris = ft²

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

	Zone 3 Restrictor	Not Selected
Depth to Invert of Outlet Pipe	2.50	N/A
Outlet Pipe Diameter	54.00	N/A
Restrictor Plate Height Above Pipe Invert	46.00	N/A

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate
 Outlet Orifice Area = ft²
 Outlet Orifice Centroid = feet
 Half-Central Angle of Restrictor Plate on Pipe = radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

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

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

Routed Hydrograph Results

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

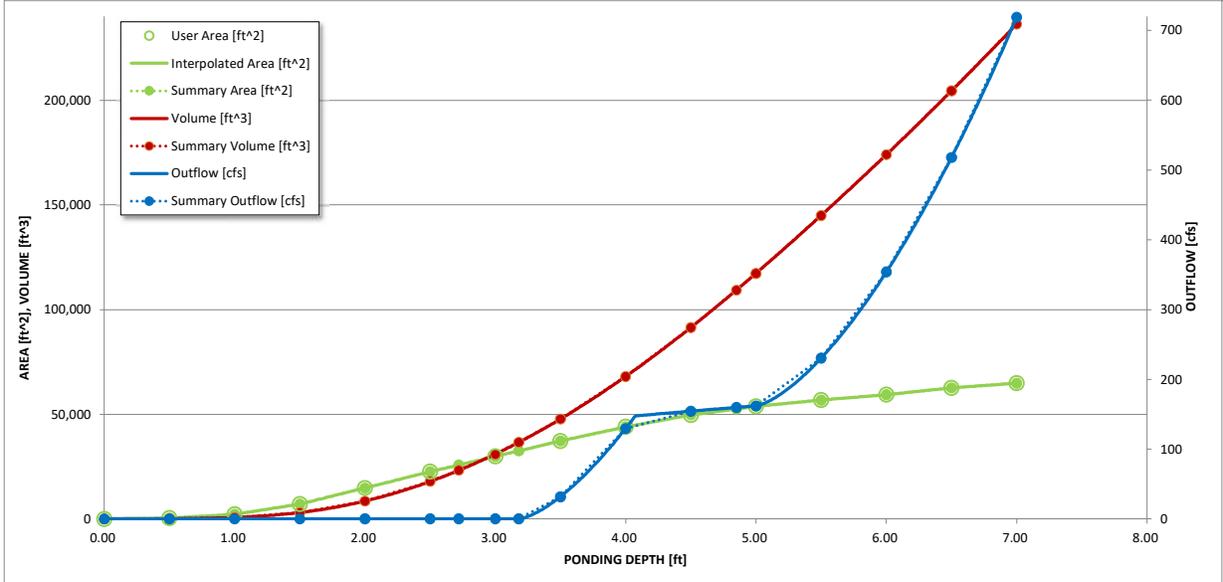
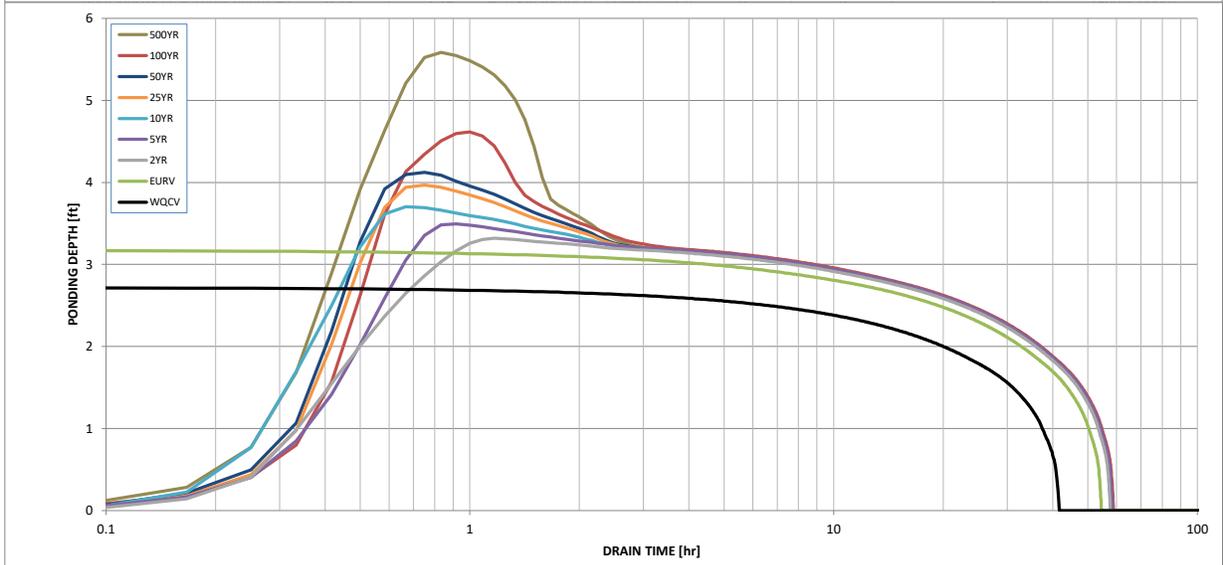
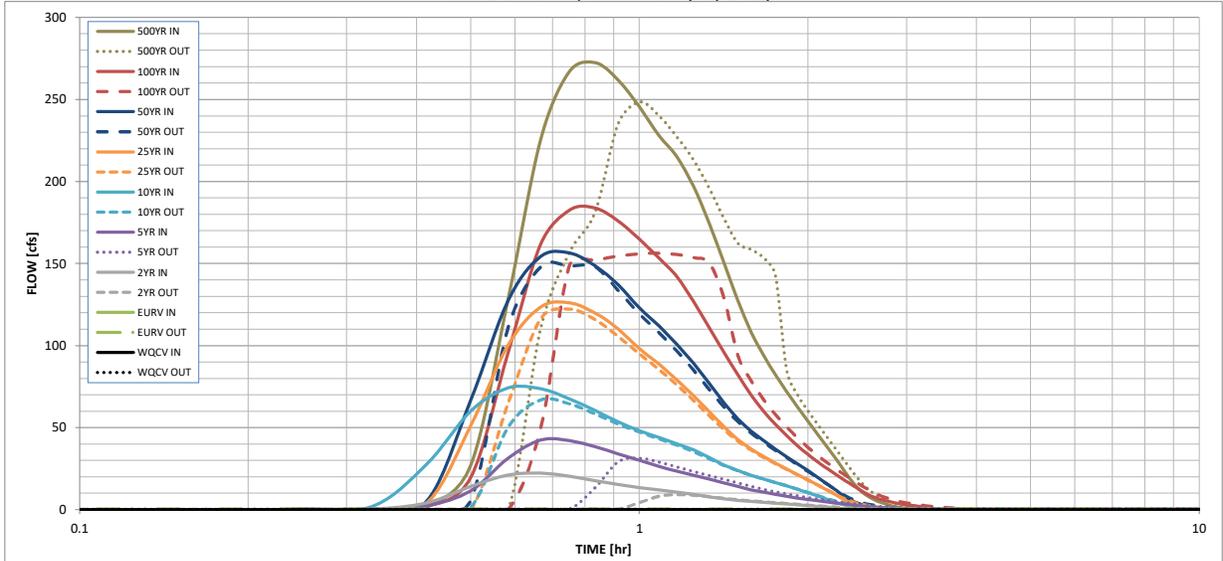
	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.14
One-Hour Rainfall Depth (in)	0.532	0.834	1.441	3.437	5.467	9.207	11.701	15.348	21.917
CUHP Runoff Volume (acre-ft)	N/A	N/A	1.441	3.005	5.467	9.207	11.701	14.869	21.917
User Override Inflow Hydrograph Volume (acre-ft)	N/A	N/A	16.2	44.9	67.6	120.7	151.3	192.2	267.2
CUHP Predevelopment Peak Q (cfs)	N/A	N/A	0.13					160	
OPTIONAL Override Predevelopment Peak Q (cfs)	N/A	N/A	0.13					1.25	2.08
Predevelopment Unit Peak Flow, q (cfs/acre)	N/A	N/A	22.2					183.8	272.6
Peak Inflow Q (cfs)	N/A	N/A	7.7					160	251.7
Peak Outflow Q (cfs)	0.2	0.3	7.7					1.0	0.9
Ratio Peak Outflow to Predevelopment Q	N/A	N/A	N/A					Outlet Plate 1	Spillway
Structure Controlling Flow	Vertical Orifice 1	Overflow Weir 1	Overflow Weir					2.1	2.2
CUHP Predevelopment Peak Q (cfs)	N/A	N/A	0.09					N/A	N/A
Max Velocity through Grate 1 (fps)	N/A	N/A	N/A					22	11
Max Velocity through Grate 2 (fps)	N/A	N/A	N/A					41	35
Time to Drain 97% of Inflow Volume (hours)	38	49	50					4.85	5.60
Time to Drain 99% of Inflow Volume (hours)	40	52	54					1.20	1.32
Maximum Ponding Depth (ft)	2.72	3.18	3.37					2.50	3.46
Area at Maximum Ponding Depth (acres)	0.59	0.75	0.81						
Maximum Volume Stored (acre-ft)	0.53	0.84	0.99						
Elevation (ft)	7534.72	7535.18						7536.85	
Pond Bottom (ft)	7532.00								

HRG Response: The 52-hour drainage time for the EURV follows MHFD criteria in Volume 2, Chapter 12, section 3.4 for Extended Detention Basins. This comment is to be disregarded per email from Daniel Torres sent 10/28/2024

Time to drain 99% of EURV needs to be around 72 hours to prevent downstream erosion. Please revise.

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)



Hydrographs from SWMM modeling input here to be routed through outlet structure

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.

Time Interval	SOURCE	CUHP	CUHP	CUHP	USER	CUHP	CUHP	CUHP	USER	CUHP
	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	0.01	0.00	0.00	0.01	0.02	0.03
	0:15:00	0.00	0.00	0.08	0.10	0.17	0.11	0.15	0.11	0.22
	0:20:00	0.00	0.00	0.35	0.30	1.95	0.36	0.43	0.29	1.85
	0:25:00	0.00	0.00	4.04	2.36	27.62	3.85	5.06	1.83	26.88
	0:30:00	0.00	0.00	14.17	11.47	60.17	51.16	66.72	19.59	128.86
	0:35:00	0.00	0.00	21.13	31.46	74.24	100.43	127.66	96.08	225.74
	0:40:00	0.00	0.00	22.21	42.49	73.61	123.55	154.32	161.92	267.09
	0:45:00	0.00	0.00	20.28	42.09	67.55	126.03	156.43	182.46	272.56
	0:50:00	0.00	0.00	17.61	38.34	60.42	119.92	148.66	183.84	261.90
	0:55:00	0.00	0.00	15.34	34.02	53.43	110.12	137.06	175.93	245.60
	1:00:00	0.00	0.00	13.42	30.05	48.07	98.07	122.87	164.79	228.11
	1:05:00	0.00	0.00	12.05	26.40	43.94	88.75	112.15	153.37	215.24
	1:10:00	0.00	0.00	10.68	23.39	40.13	79.20	100.85	142.09	196.94
	1:15:00	0.00	0.00	9.27	20.90	36.37	69.50	89.18	126.74	174.54
	1:20:00	0.00	0.00	7.85	18.58	31.81	59.80	77.06	110.87	150.60
	1:25:00	0.00	0.00	6.55	16.30	27.25	50.53	65.20	96.01	127.37
	1:30:00	0.00	0.00	5.60	14.09	23.76	42.74	55.29	82.24	108.37
	1:35:00	0.00	0.00	4.98	12.12	21.04	36.98	47.98	69.97	93.96
	1:40:00	0.00	0.00	4.45	10.60	18.66	32.40	42.10	60.01	82.32
	1:45:00	0.00	0.00	3.96	9.32	16.48	28.40	36.94	52.05	71.99
	1:50:00	0.00	0.00	3.47	8.13	14.45	24.78	32.28	45.12	62.66
	1:55:00	0.00	0.00	2.98	7.07	12.42	21.42	27.94	39.03	53.98
	2:00:00	0.00	0.00	2.49	6.16	10.34	18.17	23.77	33.71	45.82
	2:05:00	0.00	0.00	1.99	5.36	8.26	14.99	19.66	29.08	38.00
	2:10:00	0.00	0.00	1.49	4.62	6.24	11.85	15.59	24.94	30.37
	2:15:00	0.00	0.00	1.00	3.92	4.32	8.72	11.57	21.21	22.87
	2:20:00	0.00	0.00	0.57	3.25	2.86	5.68	7.68	17.72	15.88
	2:25:00	0.00	0.00	0.31	2.63	2.05	3.42	4.81	14.39	10.67
	2:30:00	0.00	0.00	0.21	2.05	1.57	2.13	3.16	11.28	7.38
	2:35:00	0.00	0.00	0.16	1.57	1.22	1.36	2.12	8.63	5.10
	2:40:00	0.00	0.00	0.12	1.25	0.94	0.86	1.42	6.76	3.44
	2:45:00	0.00	0.00	0.09	1.04	0.72	0.54	0.94	5.46	2.22
	2:50:00	0.00	0.00	0.07	0.88	0.53	0.34	0.62	4.45	1.35
	2:55:00	0.00	0.00	0.05	0.76	0.38	0.21	0.39	3.64	0.76
	3:00:00	0.00	0.00	0.04	0.65	0.26	0.13	0.26	2.98	0.46
	3:05:00	0.00	0.00	0.03	0.55	0.18	0.10	0.19	2.43	0.33
	3:10:00	0.00	0.00	0.03	0.45	0.12	0.07	0.14	1.96	0.25
	3:15:00	0.00	0.00	0.02	0.37	0.09	0.05	0.10	1.57	0.19
	3:20:00	0.00	0.00	0.01	0.29	0.07	0.04	0.08	1.23	0.15
	3:25:00	0.00	0.00	0.01	0.21	0.05	0.03	0.06	0.91	0.11
	3:30:00	0.00	0.00	0.01	0.15	0.03	0.02	0.04	0.63	0.07
	3:35:00	0.00	0.00	0.00	0.11	0.02	0.01	0.03	0.44	0.05
	3:40:00	0.00	0.00	0.00	0.09	0.01	0.01	0.01	0.32	0.03
	3:45:00	0.00	0.00	0.00	0.07	0.00	0.00	0.01	0.23	0.01
	3:50:00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.16	0.00
	3:55:00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.12	0.00
	4:00:00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.08	0.00
	4:05:00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.06	0.00
	4:10:00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.04	0.00
	4:15:00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.03	0.00
	4:20:00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.02	0.00
	4:25:00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.02	0.00
	4:30:00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.02	0.00
	4:35:00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.00
	4:40:00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.00
	4:45:00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	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

Design Procedure Form: Extended Detention Basin (EDB)

UD-BMP (Version 3.07, March 2018)

Sheet 1 of 3

Designer: RICHARD LYON, PE
Company: HR GREEN
Date: August 15, 2024
Project: FLYING HORSE NORTH - FILING NO. 4
Location: POND A

<p>1. Basin Storage Volume</p> <p>A) Effective Imperviousness of Tributary Area, I_a</p> <p>B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$)</p> <p>C) Contributing Watershed Area</p> <p>D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm</p> <p>E) Design Concept (Select EURV when also designing for flood control)</p> <p>F) Design Volume (WQCV) Based on 40-hour Drain Time ($V_{DESIGN} = (1.0 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12 * Area)$)</p> <p>G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume ($V_{WQCV\ OTHER} = (d_6 * (V_{DESIGN} * 0.43))$)</p> <p>H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired)</p> <p>I) NRCS Hydrologic Soil Groups of Tributary Watershed i) Percentage of Watershed consisting of Type A Soils ii) Percentage of Watershed consisting of Type B Soils iii) Percentage of Watershed consisting of Type C/D Soils</p> <p>J) Excess Urban Runoff Volume (EURV) Design Volume For HSG A: $EURV_A = 1.68 * i^{1.28}$ For HSG B: $EURV_B = 1.36 * i^{1.08}$ For HSG C/D: $EURV_{C/D} = 1.20 * i^{1.08}$</p> <p>K) User Input of Excess Urban Runoff Volume (EURV) Design Volume (Only if a different EURV Design Volume is desired)</p>	<p>$I_a =$ <input type="text" value="7.1"/> %</p> <p>$i =$ <input type="text" value="0.071"/></p> <p>Area = <input type="text" value="128.480"/> ac</p> <p>$d_6 =$ <input type="text" value=""/></p> <div style="border: 1px solid black; padding: 5px; margin: 5px 0;"> <p>Choose One</p> <p><input type="radio"/> Water Quality Capture Volume (WQCV)</p> <p><input checked="" type="radio"/> Excess Urban Runoff Volume (EURV)</p> </div> <p>$V_{DESIGN} =$ <input type="text" value=""/> ac-ft</p> <p>$V_{DESIGN\ OTHER} =$ <input type="text" value=""/> ac-ft</p> <p>$V_{DESIGN\ USER} =$ <input type="text" value="0.532"/> ac-ft</p> <p>HSG A = <input type="text" value="0"/> %</p> <p>HSG B = <input type="text" value="100"/> %</p> <p>HSG C/D = <input type="text" value="0"/> %</p> <p>EURV_{DESIGN} = <input type="text" value=""/> ac-ft</p> <p>EURV_{DESIGN\ USER} = <input type="text" value="0.834"/> ac-ft</p>
<p>2. Basin Shape: Length to Width Ratio (A basin length to width ratio of at least 2:1 will improve TSS reduction.)</p>	<p>L : W = <input type="text" value="2.0"/> : 1</p>
<p>3. Basin Side Slopes</p> <p>A) Basin Maximum Side Slopes (Horizontal distance per unit vertical, 4:1 or flatter preferred)</p>	<p>Z = <input type="text" value="4.00"/> ft / ft</p>
<p>4. Inlet</p> <p>A) Describe means of providing energy dissipation at concentrated inflow locations:</p>	<p>_____</p> <p>_____</p> <p>_____</p>
<p>5. Forebay</p> <p>A) Minimum Forebay Volume ($V_{FMN} =$ <input type="text" value="3%"/> of the WQCV)</p> <p>B) Actual Forebay Volume</p> <p>C) Forebay Depth ($D_F =$ <input type="text" value="18"/> inch maximum)</p> <p>D) Forebay Discharge</p> <p>i) Undetained 100-year Peak Discharge</p> <p>ii) Forebay Discharge Design Flow ($Q_F = 0.02 * Q_{100}$)</p> <p>E) Forebay Discharge Design</p> <p>F) Discharge Pipe Size (minimum 8-inches)</p> <p>G) Rectangular Notch Width</p>	<p>$V_{FMN} =$ <input type="text" value="0.016"/> ac-ft</p> <p>$V_F =$ <input type="text" value="0.018"/> ac-ft</p> <p>$D_F =$ <input type="text" value="18.0"/> in</p> <p>$Q_{100} =$ <input type="text" value="326.90"/> cfs</p> <p>$Q_F =$ <input type="text" value="6.54"/> cfs</p> <div style="border: 1px solid black; padding: 5px; margin: 5px 0;"> <p>Choose One</p> <p><input type="radio"/> Berm With Pipe</p> <p><input checked="" type="radio"/> Wall with Rect. Notch</p> <p><input type="radio"/> Wall with V-Notch Weir</p> </div> <p>Flow too small for berm w/ pipe</p> <p>Calculated $D_p =$ <input type="text" value=""/> in</p> <p>Calculated $W_N =$ <input type="text" value="16.4"/> in</p>

Design Procedure Form: Extended Detention Basin (EDB)

Designer: RICHARD LYON, PE
Company: HR GREEN
Date: August 15, 2024
Project: FLYING HORSE NORTH - FILING NO. 4
Location: POND A

<p>6. Trickle Channel</p> <p>A) Type of Trickle Channel</p> <p>F) Slope of Trickle Channel</p>	<div style="border: 1px solid black; padding: 2px; margin-bottom: 10px;"> Choose One <input checked="" type="radio"/> Concrete <input type="radio"/> Soft Bottom </div> <p>S = <input type="text" value="0.0050"/> ft / ft</p>
<p>7. Micropool and Outlet Structure</p> <p>A) Depth of Micropool (2.5-foot minimum)</p> <p>B) Surface Area of Micropool (10 ft² minimum)</p> <p>C) Outlet Type</p> <p>D) Smallest Dimension of Orifice Opening Based on Hydrograph Routing (Use UD-Detention)</p> <p>E) Total Outlet Area</p>	<p>D_M = <input type="text" value="2.5"/> ft</p> <p>A_M = <input type="text" value="10"/> sq ft</p> <div style="border: 1px solid black; padding: 2px; margin-bottom: 10px;"> Choose One <input checked="" type="radio"/> Orifice Plate <input type="radio"/> Other (Describe): </div> <hr/> <hr/> <hr/> <p>D_{orifice} = <input type="text"/> inches</p> <p>A_{orifice} = <input type="text"/> square inches</p>
<p>8. Initial Surcharge Volume</p> <p>A) Depth of Initial Surcharge Volume (Minimum recommended depth is 4 inches)</p> <p>B) Minimum Initial Surcharge Volume (Minimum volume of 0.3% of the WQCV)</p> <p>C) Initial Surcharge Provided Above Micropool</p>	<p>D_{IS} = <input type="text"/> in</p> <p>V_{IS} = <input type="text" value="70"/> cu ft</p> <p>V_s = <input type="text"/> cu ft</p>
<p>9. Trash Rack</p> <p>A) Water Quality Screen Open Area: $A_t = A_{ot} * 38.5 * (e^{-0.095D})$</p> <p>B) Type of Screen (If specifying an alternative to the materials recommended in the USDCM, indicate "other" and enter the ratio of the total open area to the total screen area for the material specified.)</p> <p style="margin-left: 40px;">Other (Y/N): <input type="text" value="N"/></p> <p>C) Ratio of Total Open Area to Total Area (only for type 'Other')</p> <p>D) Total Water Quality Screen Area (based on screen type)</p> <p>E) Depth of Design Volume (EURV or WQCV) (Based on design concept chosen under 1E)</p> <p>F) Height of Water Quality Screen (H_{TR})</p> <p>G) Width of Water Quality Screen Opening (W_{opening}) (Minimum of 12 inches is recommended)</p>	<p>A_t = <input type="text"/> square inches</p> <hr/> <hr/> <hr/> <p>User Ratio = <input type="text"/></p> <p>A_{total} = <input type="text"/> sq. in.</p> <p>H = <input type="text"/> feet</p> <p>H_{TR} = <input type="text"/> inches</p> <p>W_{opening} = <input type="text"/> inches</p>

HR GREEN FOREBAY SIZING

PROJECT: FLYING HORSE NORTH FILING 4

DATE: 8/19/2024

DESIGNED BY: RDL

CHECKED BY: RDL

POND OR DP: POND A (DP A5)

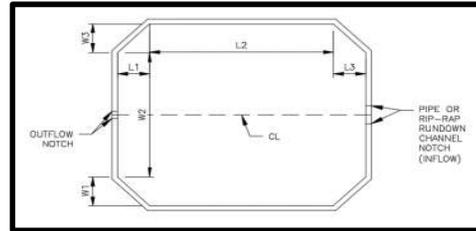
	INNER DIMENSIONS	OUTER DIMENSIONS
LENGTH		
L1	5 FT	5.83 FT
L2	23.750 FT	24.583 FT
L3	5 FT	5.83 FT
INNER L	33.750 FT	OUTER TOTAL L 35.416 FT
WIDTH		
W1	5 FT	5.83 FT
W2	17.8125 FT (75% of L2)	18.65 FT
W3	5 FT	5.83 FT
INNER W	27.813 FT	OUTER TOTAL W 29.479 FT
BAFFLE AREA	(6'x0.83' + 4'x0.83')	8.33 SF

TRIANGLES	50
RECTANGLE	423.0
BAFFLE	8.33
TOTAL SURFACE AREA	464.7 SQ FT

FOREBAY HT. **1.5 FT**

FOREBAY VOLUME	697	CF	SUFFICIENT VOLUME? YES
	25.8	CY	
	0.016	AC-FT	

REQ'D VOL (3% WQCV)	0.016	AC-FT
(per UD-BMP calc)	696	CF
Notch Width per UD-BMI	16.4	in



T-5 Extended Detention Basin (EDB)

Table EDB-4. EDB component criteria

	On-Site EDBs for Watersheds up to 1 Impervious Acre ¹	EDBs with Watersheds between 1 and 2 Impervious Acres	EDBs with Watersheds up to 5 Impervious Acres	EDBs with Watersheds over 5 Impervious Acres	EDBs with Watersheds over 20 Impervious Acres
Forebay Release and Configuration		Release 2% of the undetained 100-year peak discharge by way of a wall/notch configuration	Release 2% of the undetained 100-year peak discharge by way of a wall/notch configuration	Release 2% of the undetained 100-year peak discharge by way of a wall/notch configuration	Release 2% of the undetained 100-year peak discharge by way of a wall/notch or berm/pipe ² configuration
Minimum Forebay Volume	EDBs should not be used for watersheds with less than 1 impervious acre.	1% of the WQCV	2% of the WQCV	3% of the WQCV	3% of the WQCV
Maximum Forebay Depth		12 inches	18 inches	18 inches	30 inches
Trickle Channel Capacity		≥ the maximum possible forebay outlet capacity			
Micropool		Area ≥ 10 ft ²			
Initial Surcharge Volume		Depth ≥ 4 inches	Depth ≥ 4 inches	Depth ≥ 4 in. Volume ≥ 0.3% WQCV	Depth ≥ 4 in. Volume ≥ 0.3% WQCV

¹ EDBs are not recommended for sites with less than 2 impervious acres. Consider a sand filter or rain garden.

² Round up to the first standard pipe size (minimum 8 inches).

Worksheet for Pond A Spillway

Project Description	
Solve For	Headwater Elevation

Input Data	
Discharge	197.60 cfs
Crest Elevation	7,538.00 ft
Tailwater Elevation	7,530.00 ft
Crest Surface Type	Gravel
Crest Breadth	50.00 ft
Crest Length	72.0 ft

Results	
Headwater Elevation	7,538.98 ft
Headwater Height Above Crest	0.98 ft
Tailwater Height Above Crest	-8.00 ft
Weir Coefficient	$2.82 \text{ ft}^{(1/2)}/\text{s}$
Submergence Factor	1.000
Adjusted Weir Coefficient	$2.82 \text{ ft}^{(1/2)}/\text{s}$
Flow Area	70.6 ft ²
Velocity	2.80 ft/s
Wetted Perimeter	74.0 ft
Top Width	72.00 ft

Worksheet for Pond A & B Trickle Channel Capacity

Project Description	
Friction Method	Manning Formula
Solve For	Discharge
Input Data	
Channel Slope	0.005 ft/ft
Normal Depth	6.0 in

Section Definitions

Station (ft)		Elevation (ft)
	0+00	0.58
	0+00	0.08
	0+02	0.00
	0+04	0.08
	0+04	0.58

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 0.58)	(0+04, 0.58)	0.013

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Discharge	7.76 cfs
Roughness Coefficient	0.013
Elevation Range	0.0 to 0.6 ft
Flow Area	1.8 ft ²
Wetted Perimeter	4.8 ft
Hydraulic Radius	4.6 in
Top Width	4.00 ft
Normal Depth	6.0 in
Critical Depth	6.4 in
Critical Slope	0.004 ft/ft
Velocity	4.24 ft/s
Velocity Head	0.28 ft
Specific Energy	0.78 ft
Froude Number	1.103
Flow Type	Supercritical

POND A MAX FOREBAY RELEASE RATE IS 6.54 CFS AND POND B MAX FOREBAY RELEASE RATE IS 3.75 CFS

GVF Input Data

Worksheet for Pond A & B Trickle Channel Capacity

GVF Input Data

Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

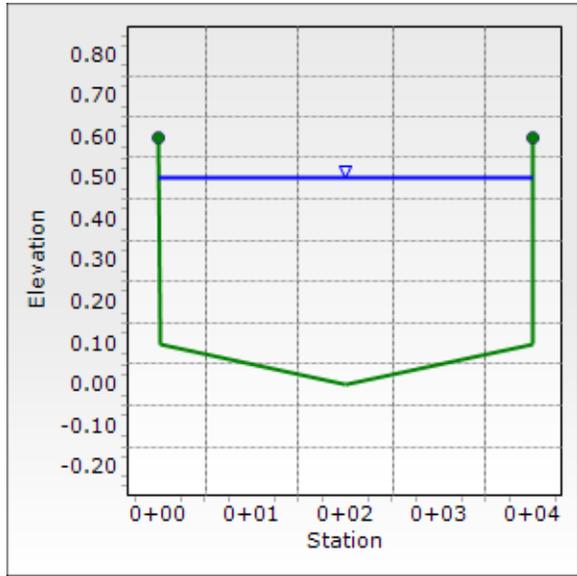
GVF Output Data

Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	6.0 in
Critical Depth	6.4 in
Channel Slope	0.005 ft/ft
Critical Slope	0.004 ft/ft

Cross Section for Pond A & B Trickle Channel Capacity

Project Description	
Friction Method	Manning Formula
Solve For	Discharge

Input Data	
Channel Slope	0.005 ft/ft
Normal Depth	6.0 in
Discharge	7.76 cfs





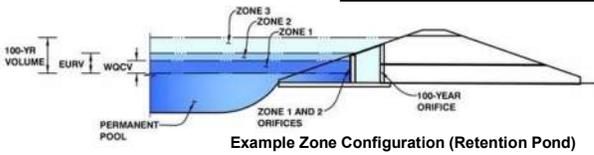
Flying Horse North Filing No. 4
Final Drainage Report
Project No.: 211030
El Paso County, Colorado

POND B

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: FLYING HORSE NORTH FILING NO. 4
Basin ID: POND B



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.28	0.500	Orifice Plate
Zone 2 (EURV)	2.84	0.307	Circular Orifice
Zone 3 (User)	4.92	1.513	Weir&Pipe (Restrict)
Total (all zones)		2.320	

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 Diameter =	N/A	inches

Calculated Parameters for Underdrain

Underdrain Orifice Area =	N/A	ft ²
Underdrain Orifice Centroid =	N/A	feet

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

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	2.28	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	9.20	inches
Orifice Plate: Orifice Area per Row =	2.19	sq. inches (diameter = 1-5/8 inches)

Calculated Parameters for Plate

WQ Orifice Area per Row =	1.521E-02	ft ²
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft ²

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	0.80	1.60					
Orifice Area (sq. inches)	2.19	2.19	2.19					

	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	
Invert of Vertical Orifice =	2.28	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	2.84	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	1.00	N/A	inches

Calculated Parameters for Vertical Orifice

	Zone 2 Circular	Not Selected	
Vertical Orifice Area =	0.01	N/A	ft ²
Vertical Orifice Centroid =	0.04	N/A	feet

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	
Overflow Weir Front Edge Height, H _o =	2.85	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	30.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V
Horiz. Length of Weir Sides =	5.00	N/A	feet
Overflow Grate Type =	Type C Grate	N/A	
Debris Clogging % =	0%	N/A	%

0% clogging to ensure program is using pipe/plate to limit release, see next sheet for results with clogging

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H _u =	2.85	N/A	feet
Overflow Weir Slope Length =	5.00	N/A	feet
Grate Open Area / 100-yr Orifice Area =	5.87	N/A	
Overflow Grate Open Area w/o Debris =	104.40	N/A	ft ²
Overflow Grate Open Area w/ Debris =	104.40	N/A	ft ²

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	3.70	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	60.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	51.00	N/A	inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	17.79	N/A	ft ²
Outlet Orifice Centroid =	2.29	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	2.35	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage =	5.50	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	40.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth =	1.49	feet
Stage at Top of Freeboard =	7.99	feet
Basin Area at Top of Freeboard =	1.09	acres
Basin Volume at Top of Freeboard =	4.33	acre-ft

Routed Hydrograph Results

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

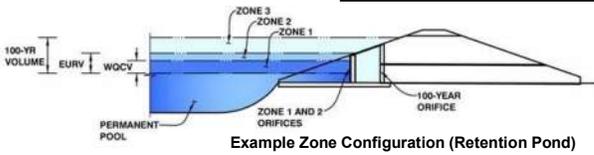
	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.14
One-Hour Rainfall Depth (in)	0.500	0.807	1.270	2.932	4.609	7.657	9.710	12.690	18.086
CUHP Runoff Volume (acre-ft)	N/A	N/A	1.270	3.472	4.609	7.657	9.710	17.082	18.086
User Override Inflow Hydrograph Volume (acre-ft)	N/A	N/A	1.270	3.472	4.609	7.657	9.710	17.082	18.086
CUHP Predevelopment Peak Q (cfs)	N/A	N/A	14.9	41.7	63.1	109.6	138.0	172.8	240.7
OPTIONAL Override Predevelopment Peak Q (cfs)	N/A	N/A	14.9	41.7	63.1	109.6	138.0	172.8	240.7
Predevelopment Unit Peak Flow, q (cfs/acre)	N/A	N/A	0.14	0.39	0.60	1.04	1.31	2.04	2.28
Peak Inflow Q (cfs)	N/A	N/A	21.5	59.1	70.7	116.9	145.8	247.1	248.6
Peak Outflow Q (cfs)	0.3	0.3	8.4	49.2	65.9	116.9	145.8	213.6	213.2
Ratio Peak Outflow to Predevelopment Q	N/A	N/A	N/A	1.2	1.0	1.1	1.1	1.0	0.9
Structure Controlling Flow	Plate	Vertical Orifice 1	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1				
Max Velocity through Grate 1 (fps)	N/A	N/A	0.08	0.5	0.6	1.1	1.4	2.0	2.0
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)	37	48	48	41	38	31	27	16	14
Time to Drain 99% of Inflow Volume (hours)	40	52	53	50	48	44	42	36	35
Maximum Ponding Depth (ft)	2.28	2.84	2.96	3.21	3.29	3.49	3.60	4.81	4.78
Area at Maximum Ponding Depth (acres)	0.49	0.60	0.62	0.66	0.67	0.69	0.70	0.83	0.83
Maximum Volume Stored (acre-ft)	0.50	0.81	0.88	1.04	1.09	1.23	1.30	2.22	2.21
Elevation (ft)	7528.28	7528.84						7530.81	
Pond Bottom (ft)	7526.00								

SWMM volume 103,808

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: FLYING HORSE NORTH FILING NO. 4
Basin ID: POND B



	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.28	0.500	Orifice Plate
Zone 2 (EURV)	2.84	0.307	Circular Orifice
Zone 3 (User)	4.92	1.513	Weir&Pipe (Restrict)
Total (all zones)		2.320	

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 Diameter =	N/A	inches

Calculated Parameters for Underdrain

Underdrain Orifice Area =	N/A	ft ²
Underdrain Orifice Centroid =	N/A	feet

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

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	2.28	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	9.20	inches
Orifice Plate: Orifice Area per Row =	2.19	sq. inches (diameter = 1-5/8 inches)

Calculated Parameters for Plate

WQ Orifice Area per Row =	1.521E-02	ft ²
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft ²

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	0.80	1.60					
Orifice Area (sq. inches)	2.19	2.19	2.19					

	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	
Invert of Vertical Orifice =	2.28	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	2.84	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	1.00	N/A	inches

Calculated Parameters for Vertical Orifice

	Zone 2 Circular	Not Selected	
Vertical Orifice Area =	0.01	N/A	ft ²
Vertical Orifice Centroid =	0.04	N/A	feet

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	
Overflow Weir Front Edge Height, Ho =	2.85	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	30.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V
Horiz. Length of Weir Sides =	5.00	N/A	feet
Overflow Grate Type =	Type C Grate	N/A	
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H _g =	2.85	N/A	feet
Overflow Weir Slope Length =	5.00	N/A	feet
Grate Open Area / 100-yr Orifice Area =	5.87	N/A	
Overflow Grate Open Area w/o Debris =	104.40	N/A	ft ²
Overflow Grate Open Area w/ Debris =	52.20	N/A	ft ²

50% clogging included to review velocity through structure

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	3.70	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	60.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	51.00	N/A	inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	17.79	N/A	ft ²
Outlet Orifice Centroid =	2.29	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	2.35	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage =	5.50	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	40.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth =	1.49	feet
Stage at Top of Freeboard =	7.99	feet
Basin Area at Top of Freeboard =	1.09	acres
Basin Volume at Top of Freeboard =	4.33	acre-ft

Routed Hydrograph Results

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

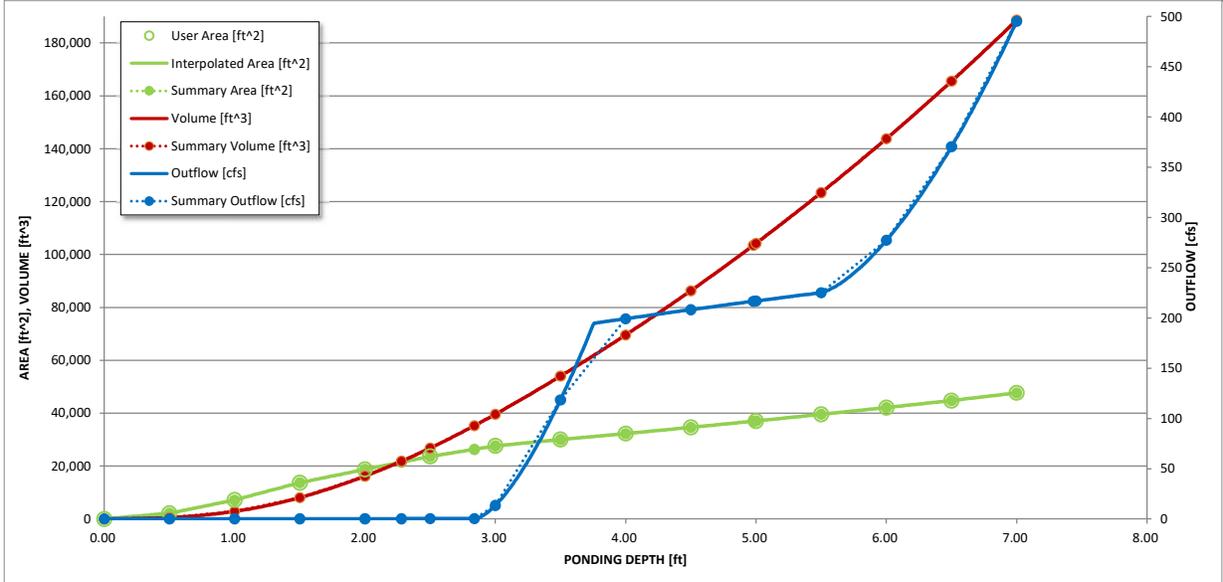
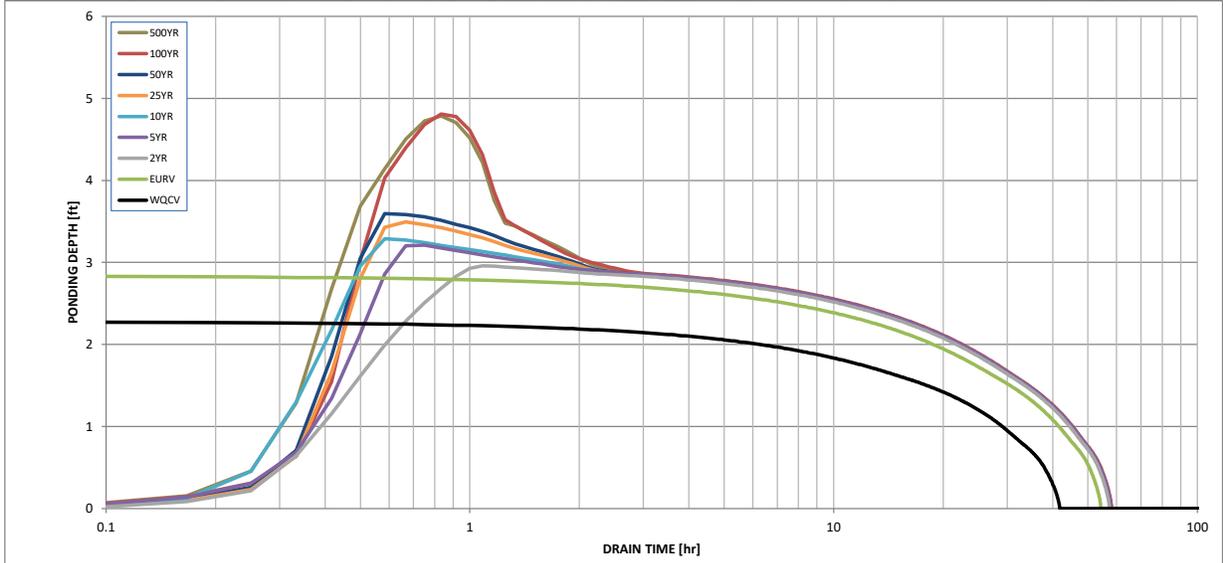
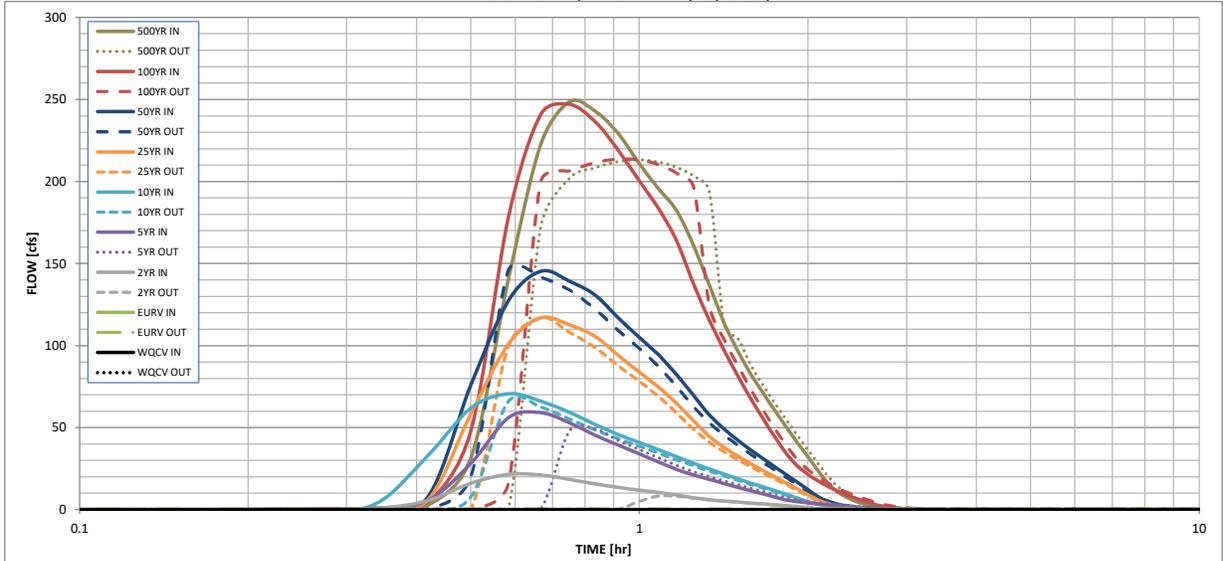
	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.14
One-Hour Rainfall Depth (in)	0.500	0.807	1.270	2.932	4.609	7.657	9.710	12.690	18.086
CUHP Runoff Volume (acre-ft)	N/A	N/A	1.270	3.472	4.609	7.657	9.710	17.082	18.086
User Override Inflow Hydrograph Volume (acre-ft)	N/A	N/A	1.270	3.472	4.609	7.657	9.710	17.082	18.086
CUHP Predevelopment Peak Q (cfs)	N/A	N/A	14.9					172.8	240.7
OPTIONAL Override Predevelopment Peak Q (cfs)	N/A	N/A						216.0	
Predevelopment Unit Peak Flow, q (cfs/acre)	N/A	N/A	0.14					2.04	2.28
Peak Inflow Q (cfs)	N/A	N/A	21.5					247.1	248.6
Peak Outflow Q (cfs)	0.3	0.3	7.2					216.5	217.2
Ratio Peak Outflow to Predevelopment Q	N/A	N/A	N/A					1.0	0.9
Structure Controlling Flow	Plate	Vertical Orifice 1	Overflow Weir 1					Outlet Plate 1	Outlet Plate 1
Max Velocity through Grate 1 (fps)	N/A	N/A	0.06					2.1	2.1
Max Velocity through Grate 2 (fps)	N/A	N/A	N/A					N/A	N/A
Time to Drain 97% of Inflow Volume (hours)	37	48	48					16	14
Time to Drain 99% of Inflow Volume (hours)	40	52	54					36	35
Maximum Ponding Depth (ft)	2.28	2.84	3.00					4.98	5.02
Area at Maximum Ponding Depth (acres)	0.49	0.60	0.63					0.85	0.85
Maximum Volume Stored (acre-ft)	0.50	0.81	0.91					2.37	2.40
Elevation (ft)	7528.28	7528.84						7530.98	
Pond Bottom (ft)	7526.00								

HRG Response: The 52-hour drainage time for the EURV follows MHFD criteria in Volume 2, Chapter 12, section 3.4 for Extended Detention Basins. This comment is to be disregarded per email from Daniel Torres sent 10/28/2024

Time to drain 99% of EURV needs to be around 72 hours to prevent downstream erosion. Please revise.

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)



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.

Time Interval	SOURCE	CUHP	CUHP	CUHP	USER	CUHP	CUHP	CUHP	USER	CUHP
	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	0.02	0.00	0.00	0.01	0.03	0.05
	0:15:00	0.00	0.00	0.13	0.29	0.25	0.17	0.22	0.32	0.32
	0:20:00	0.00	0.00	0.50	0.84	2.56	0.51	0.61	0.81	2.42
	0:25:00	0.00	0.00	5.28	5.28	32.00	5.01	6.58	4.04	31.16
	0:30:00	0.00	0.00	16.15	28.18	61.85	58.31	75.74	47.72	140.12
	0:35:00	0.00	0.00	21.48	55.99	70.65	100.78	127.30	177.86	222.60
	0:40:00	0.00	0.00	21.19	59.11	66.12	116.93	145.33	240.83	248.61
	0:45:00	0.00	0.00	18.41	52.91	59.32	112.63	139.24	247.06	242.92
	0:50:00	0.00	0.00	15.77	45.39	51.88	105.76	130.83	236.61	229.34
	0:55:00	0.00	0.00	13.51	39.31	45.74	94.10	116.93	219.08	210.73
	1:00:00	0.00	0.00	11.89	33.91	40.89	83.71	104.89	200.33	195.31
	1:05:00	0.00	0.00	10.45	28.93	36.47	74.57	94.22	183.22	182.16
	1:10:00	0.00	0.00	8.87	24.45	32.13	64.62	82.26	163.76	160.97
	1:15:00	0.00	0.00	7.27	21.11	28.23	54.18	69.62	137.51	137.05
	1:20:00	0.00	0.00	6.00	18.47	24.80	44.69	57.74	115.66	114.12
	1:25:00	0.00	0.00	5.21	15.99	21.68	37.99	49.23	97.45	96.67
	1:30:00	0.00	0.00	4.56	13.64	18.77	32.53	42.20	81.53	82.47
	1:35:00	0.00	0.00	3.98	11.47	16.17	27.90	36.24	67.41	70.56
	1:40:00	0.00	0.00	3.40	9.51	13.77	23.69	30.82	54.87	59.85
	1:45:00	0.00	0.00	2.83	7.57	11.49	19.86	25.89	43.86	50.04
	1:50:00	0.00	0.00	2.28	5.83	9.29	16.17	21.17	33.94	40.82
	1:55:00	0.00	0.00	1.71	4.79	7.07	12.63	16.64	26.61	32.21
	2:00:00	0.00	0.00	1.15	4.12	4.87	9.19	12.28	21.52	24.12
	2:05:00	0.00	0.00	0.67	3.56	3.31	5.81	7.96	17.61	16.50
	2:10:00	0.00	0.00	0.42	3.01	2.45	3.59	5.15	14.31	11.29
	2:15:00	0.00	0.00	0.30	2.51	1.89	2.28	3.44	11.60	7.89
	2:20:00	0.00	0.00	0.23	2.04	1.47	1.48	2.35	9.28	5.46
	2:25:00	0.00	0.00	0.18	1.60	1.14	0.95	1.58	7.30	3.68
	2:30:00	0.00	0.00	0.13	1.18	0.86	0.62	1.08	5.61	2.39
	2:35:00	0.00	0.00	0.10	0.81	0.63	0.40	0.71	4.07	1.45
	2:40:00	0.00	0.00	0.07	0.55	0.45	0.25	0.46	2.75	0.84
	2:45:00	0.00	0.00	0.06	0.40	0.31	0.17	0.31	1.87	0.55
	2:50:00	0.00	0.00	0.05	0.31	0.21	0.12	0.22	1.28	0.38
	2:55:00	0.00	0.00	0.04	0.24	0.15	0.09	0.17	0.88	0.30
	3:00:00	0.00	0.00	0.03	0.19	0.11	0.06	0.13	0.58	0.24
	3:05:00	0.00	0.00	0.02	0.15	0.08	0.05	0.09	0.37	0.18
	3:10:00	0.00	0.00	0.01	0.12	0.06	0.03	0.07	0.23	0.13
	3:15:00	0.00	0.00	0.01	0.09	0.03	0.02	0.05	0.15	0.09
	3:20:00	0.00	0.00	0.01	0.07	0.02	0.01	0.03	0.11	0.05
	3:25:00	0.00	0.00	0.00	0.05	0.01	0.01	0.02	0.08	0.03
	3:30:00	0.00	0.00	0.00	0.04	0.00	0.00	0.01	0.07	0.01
	3:35:00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.05	0.00
	3:40:00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.04	0.00
	3:45:00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.03	0.00
	3:50:00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.02	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	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	

Design Procedure Form: Extended Detention Basin (EDB)

UD-BMP (Version 3.07, March 2018)

Sheet 1 of 3

Designer: RICHARD LYON, PE
Company: HR GREEN
Date: August 19, 2024
Project: FLYING HORSE NORTH - FILING NO. 4
Location: POND B

<p>1. Basin Storage Volume</p> <p>A) Effective Imperviousness of Tributary Area, I_a</p> <p>B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$)</p> <p>C) Contributing Watershed Area</p> <p>D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm</p> <p>E) Design Concept (Select EURV when also designing for flood control)</p> <p>F) Design Volume (WQCV) Based on 40-hour Drain Time ($V_{DESIGN} = (1.0 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12 * Area)$)</p> <p>G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume ($V_{WQCV\ OTHER} = (d_6 * (V_{DESIGN} * 0.43))$)</p> <p>H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired)</p> <p>I) NRCS Hydrologic Soil Groups of Tributary Watershed i) Percentage of Watershed consisting of Type A Soils ii) Percentage of Watershed consisting of Type B Soils iii) Percentage of Watershed consisting of Type C/D Soils</p> <p>J) Excess Urban Runoff Volume (EURV) Design Volume For HSG A: $EURV_A = 1.68 * i^{1.28}$ For HSG B: $EURV_B = 1.36 * i^{1.08}$ For HSG C/D: $EURV_{C/D} = 1.20 * i^{1.08}$</p> <p>K) User Input of Excess Urban Runoff Volume (EURV) Design Volume (Only if a different EURV Design Volume is desired)</p>	<p>$I_a = 7.5$ %</p> <p>$i = 0.075$</p> <p>Area = 109.200 ac</p> <p>$d_6 =$ in</p> <div style="border: 1px solid black; padding: 5px; margin: 5px 0;"> <p>Choose One</p> <p><input type="radio"/> Water Quality Capture Volume (WQCV)</p> <p><input checked="" type="radio"/> Excess Urban Runoff Volume (EURV)</p> </div> <p>$V_{DESIGN} =$ ac-ft</p> <p>$V_{DESIGN\ OTHER} =$ ac-ft</p> <p>$V_{DESIGN\ USER} = 0.475$ ac-ft</p> <p>HSG A = 0 % HSG B = 100 % HSG C/D = 0 %</p> <p>$EURV_{DESIGN} =$ ac-ft</p> <p>$EURV_{DESIGN\ USER} = 0.752$ ac-ft</p>
<p>2. Basin Shape: Length to Width Ratio (A basin length to width ratio of at least 2:1 will improve TSS reduction.)</p>	<p>L : W = 2.0 : 1</p>
<p>3. Basin Side Slopes</p> <p>A) Basin Maximum Side Slopes (Horizontal distance per unit vertical, 4:1 or flatter preferred)</p>	<p>Z = 4.00 ft / ft</p>
<p>4. Inlet</p> <p>A) Describe means of providing energy dissipation at concentrated inflow locations:</p>	<p>_____</p> <p>_____</p> <p>_____</p>
<p>5. Forebay</p> <p>A) Minimum Forebay Volume ($V_{FMN} = 3\%$ of the WQCV)</p> <p>B) Actual Forebay Volume</p> <p>C) Forebay Depth ($D_F = 18$ inch maximum)</p> <p>D) Forebay Discharge</p> <p>i) Undetained 100-year Peak Discharge</p> <p>ii) Forebay Discharge Design Flow ($Q_F = 0.02 * Q_{100}$)</p> <p>E) Forebay Discharge Design</p> <p>F) Discharge Pipe Size (minimum 8-inches)</p> <p>G) Rectangular Notch Width</p>	<p>$V_{FMN} = 0.014$ ac-ft</p> <p>$V_F = 0.014$ ac-ft</p> <p>$D_F = 18.0$ in</p> <p>$Q_{100} = 187.60$ cfs</p> <p>$Q_F = 3.75$ cfs</p> <div style="border: 1px solid black; padding: 5px; margin: 5px 0;"> <p>Choose One</p> <p><input type="radio"/> Berm With Pipe</p> <p><input checked="" type="radio"/> Wall with Rect. Notch</p> <p><input type="radio"/> Wall with V-Notch Weir</p> </div> <p>Calculated $D_p =$ in</p> <p>Calculated $W_N = 11.0$ in</p> <p style="color: blue; font-size: small;">Flow too small for berm w/ pipe</p>

Design Procedure Form: Extended Detention Basin (EDB)

Designer: RICHARD LYON, PE
Company: HR GREEN
Date: August 19, 2024
Project: FLYING HORSE NORTH - FILING NO. 4
Location: POND B

<p>6. Trickle Channel</p> <p>A) Type of Trickle Channel</p> <p>F) Slope of Trickle Channel</p>	<div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> Choose One <input checked="" type="radio"/> Concrete <input type="radio"/> Soft Bottom </div> <p>S = <input type="text" value="0.0050"/> ft / ft</p>
<p>7. Micropool and Outlet Structure</p> <p>A) Depth of Micropool (2.5-foot minimum)</p> <p>B) Surface Area of Micropool (10 ft² minimum)</p> <p>C) Outlet Type</p> <p>D) Smallest Dimension of Orifice Opening Based on Hydrograph Routing (Use UD-Detention)</p> <p>E) Total Outlet Area</p>	<p>D_M = <input type="text" value="2.5"/> ft</p> <p>A_M = <input type="text" value="10"/> sq ft</p> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> Choose One <input checked="" type="radio"/> Orifice Plate <input type="radio"/> Other (Describe): </div> <hr/> <hr/> <hr/> <p>D_{orifice} = <input type="text"/> inches</p> <p>A_{orifice} = <input type="text"/> square inches</p>
<p>8. Initial Surcharge Volume</p> <p>A) Depth of Initial Surcharge Volume (Minimum recommended depth is 4 inches)</p> <p>B) Minimum Initial Surcharge Volume (Minimum volume of 0.3% of the WQCV)</p> <p>C) Initial Surcharge Provided Above Micropool</p>	<p>D_{IS} = <input type="text"/> in</p> <p>V_{IS} = <input type="text" value="62"/> cu ft</p> <p>V_s = <input type="text"/> cu ft</p>
<p>9. Trash Rack</p> <p>A) Water Quality Screen Open Area: $A_t = A_{ot} * 38.5 * (e^{-0.095D})$</p> <p>B) Type of Screen (If specifying an alternative to the materials recommended in the USDCM, indicate "other" and enter the ratio of the total open are to the total screen are for the material specified.)</p> <p style="margin-left: 40px;">Other (Y/N): <input type="text" value="N"/></p> <p>C) Ratio of Total Open Area to Total Area (only for type 'Other')</p> <p>D) Total Water Quality Screen Area (based on screen type)</p> <p>E) Depth of Design Volume (EURV or WQCV) (Based on design concept chosen under 1E)</p> <p>F) Height of Water Quality Screen (H_{TR})</p> <p>G) Width of Water Quality Screen Opening (W_{opening}) (Minimum of 12 inches is recommended)</p>	<p>A_t = <input type="text"/> square inches</p> <hr/> <hr/> <hr/> <p>User Ratio = <input type="text"/></p> <p>A_{total} = <input type="text"/> sq. in.</p> <p>H = <input type="text"/> feet</p> <p>H_{TR} = <input type="text"/> inches</p> <p>W_{opening} = <input type="text"/> inches</p>

HR GREEN FOREBAY SIZING

PROJECT: FLYING HORSE NORTH FILING 4

DATE: 8/19/2024

DESIGNED BY: RDL

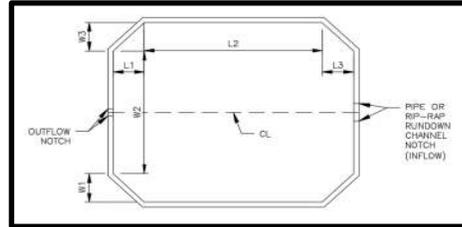
CHECKED BY: RDL

POND OR DP: POND B

	INNER DIMENSIONS	OUTER DIMENSIONS
LENGTH		
L1	5 FT	5.83 FT
L2	22.333 FT	23.166 FT
L3	5 FT	5.83 FT
INNER L	32.333 FT	OUTER TOTAL L 33.999 FT

	INNER DIMENSIONS	OUTER DIMENSIONS
WIDTH		
W1	5 FT	5.83 FT
W2	16.74975 FT (75% of L2)	17.58 FT
W3	5 FT	5.83 FT
INNER W	26.750 FT	OUTER TOTAL W 28.416 FT

BAFFLE (6'x0.83' + 4'x0.83')
AREA 8.33 SF



TRIANGLES	50
RECTANGLE	374.0721668
BAFFLE	8.33
TOTAL SURFACE AREA	415.7421668 SQ FT

FOREBAY HT. **1.5 FT**

FOREBAY VOLUME	623.6132501	CF	SUFFICIENT VOLUME? YES
	23.09678704	CY	
	0.01431619	AC-FT	

REQ'D VOL (3% WQCV)	0.01425	AC-FT
(per UD-BMP calc)	620.73	CF
Notch Width per UD-BMP	11.0	in

T-5 Extended Detention Basin (EDB)

Table EDB-4. EDB component criteria

	On-Site EDBs for Watersheds up to 1 Impervious Acre ¹	EDBs with Watersheds between 1 and 2 Impervious Acres ¹	EDBs with Watersheds up to 5 Impervious Acres	EDBs with Watersheds over 5 Impervious Acres	EDBs with Watersheds over 20 Impervious Acres
Forebay Release and Configuration		Release 2% of the undetained 100-year peak discharge by way of a wall/notch configuration	Release 2% of the undetained 100-year peak discharge by way of a wall/notch configuration	Release 2% of the undetained 100-year peak discharge by way of a wall/notch configuration	Release 2% of the undetained 100-year peak discharge by way of a wall/notch or berm/pipe ² configuration
Minimum Forebay Volume	EDBs should not be used for watersheds with less than 1 impervious acre.				
Maximum Forebay Depth	12 inches	18 inches	18 inches	18 inches	30 inches
Trickle Channel Capacity	≥ the maximum possible forebay outlet capacity				
Micropool	Area ≥ 10 ft ²	Area ≥ 10 ft ²	Area ≥ 10 ft ²	Area ≥ 10 ft ²	Area ≥ 10 ft ²
Initial Surcharge Volume	Depth ≥ 4 inches	Depth ≥ 4 inches	Depth ≥ 4 in. Volume ≥ 0.3% WQCV	Depth ≥ 4 in. Volume ≥ 0.3% WQCV	Depth ≥ 4 in. Volume ≥ 0.3% WQCV

¹ EDBs are not recommended for sites with less than 2 impervious acres. Consider a sand filter or rain garden.

² Round up to the first standard pipe size (minimum 8 inches).

Worksheet for Pond B Spillway

Project Description	
Solve For	Headwater Elevation

Input Data	
Discharge	187.60 cfs
Crest Elevation	7,534.00 ft
Tailwater Elevation	7,522.00 ft
Crest Surface Type	Gravel
Crest Breadth	75.00 ft
Crest Length	68.0 ft

Results	
Headwater Elevation	7,534.98 ft
Headwater Height Above Crest	0.98 ft
Tailwater Height Above Crest	-12.00 ft
Weir Coefficient	2.82 ft ^(1/2) /s
Submergence Factor	1.000
Adjusted Weir Coefficient	2.82 ft ^(1/2) /s
Flow Area	66.9 ft ²
Velocity	2.80 ft/s
Wetted Perimeter	70.0 ft
Top Width	68.00 ft



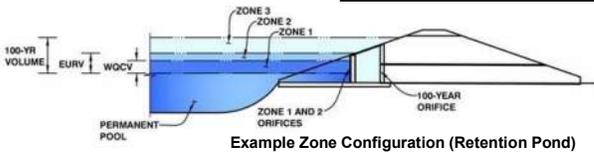
Flying Horse North Filing No. 4
Final Drainage Report
Project No.: 211030
El Paso County, Colorado

POND C

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: FLYING HORSE NORTH FILING NO. 4
Basin ID: POND C



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.24	0.227	Orifice Plate
Zone 2 (EURV)	2.62	0.159	Orifice Plate
Zone 3 (User)	3.60	0.615	Weir&Pipe (Restrict)
Total (all zones)		1.000	

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 Diameter =	N/A	inches

Calculated Parameters for Underdrain

Underdrain Orifice Area =	N/A	ft ²
Underdrain Orifice Centroid =	N/A	feet

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

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	2.62	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	10.20	inches
Orifice Plate: Orifice Area per Row =	0.88	sq. inches (diameter = 1-1/16 inches)

Calculated Parameters for Plate

WQ Orifice Area per Row =	6.111E-03	ft ²
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft ²

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	0.87	1.75					
Orifice Area (sq. inches)	0.88	0.88	0.88					

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

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected	
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	N/A	N/A	inches

Calculated Parameters for Vertical Orifice

	Not Selected	Not Selected	
Vertical Orifice Area =	N/A	N/A	ft ²
Vertical Orifice Centroid =	N/A	N/A	feet

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	
Overflow Weir Front Edge Height, H _o =	2.63	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	8.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V
Horiz. Length of Weir Sides =	5.00	N/A	feet
Overflow Grate Type =	Type C Grate	N/A	
Debris Clogging % =	0%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H _g =	2.63	N/A	feet
Overflow Weir Slope Length =	5.00	N/A	feet
Grate Open Area / 100-yr Orifice Area =	3.97	N/A	
Overflow Grate Open Area w/o Debris =	27.84	N/A	ft ²
Overflow Grate Open Area w/ Debris =	27.84	N/A	ft ²

0% clogging to ensure program is using pipe/plate to limit release, see next sheet for results with clogging

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	1.70	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	36.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	35.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	7.01	N/A	ft ²
Outlet Orifice Centroid =	1.49	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	2.81	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage =	4.00	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	20.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth =	0.99	feet
Stage at Top of Freeboard =	5.99	feet
Basin Area at Top of Freeboard =	1.04	acres
Basin Volume at Top of Freeboard =	3.16	acre-ft

Routed Hydrograph Results

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

	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.14
One-Hour Rainfall Depth (in)	0.227	0.385	0.534	1.166	1.796	2.914	3.678	4.777	6.781
CUHP Runoff Volume (acre-ft)	N/A	N/A	0.534	1.053	1.796	2.914	3.678	4.683	6.781
User Override Inflow Hydrograph Volume (acre-ft)	N/A	N/A	6.8	18.3	27.1	47.3	59.0	74.0	102.5
CUHP Predevelopment Peak Q (cfs)	N/A	N/A	0.17	0.47	0.69	1.20	1.50	1.63	2.61
OPTIONAL Override Predevelopment Peak Q (cfs)	N/A	N/A	10.6	18.0	32.7	51.7	63.0	69.0	107.2
Predevelopment Unit Peak Flow, q (cfs/acre)	N/A	N/A	0.17	0.47	0.69	1.20	1.50	1.63	2.61
Peak Inflow Q (cfs)	N/A	N/A	10.6	18.0	32.7	51.7	63.0	69.0	107.2
Peak Outflow Q (cfs)	0.1	0.1	2.7	10.2	22.8	44.0	55.3	64.2	82.8
Ratio Peak Outflow to Predevelopment Q	N/A	N/A	N/A	0.6	0.8	0.9	0.9	1.0	0.8
Structure Controlling Flow	Plate	Plate	Overflow Weir 1	Outlet Plate 1	Spillway				
Max Velocity through Grate 1 (fps)	N/A	N/A	0.08	0.4	0.8	1.6	2.0	2.3	2.6
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	54	57	53	48	42	38	34	25
Time to Drain 99% of Inflow Volume (hours)	40	57	60	59	56	54	52	50	46
Maximum Ponding Depth (ft)	2.24	2.62	2.72	2.87	3.05	3.28	3.39	3.47	4.31
Area at Maximum Ponding Depth (acres)	0.36	0.48	0.51	0.56	0.61	0.67	0.70	0.72	0.85
Maximum Volume Stored (acre-ft)	0.23	0.39	0.43	0.52	0.62	0.77	0.84	0.90	1.58
Elevation (ft)	7535.24	7535.62						7536.47	
Pond Bottom (ft)	7533.00								

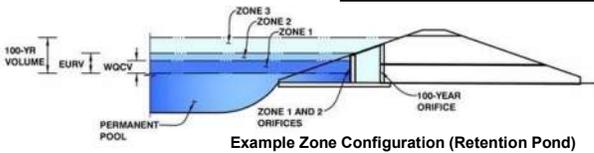
SWMM volume	43,891	1.01
SWMM release		61.9

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: FLYING HORSE NORTH FILING NO. 4

Basin ID: POND C



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.24	0.227	Orifice Plate
Zone 2 (EURV)	2.62	0.159	Orifice Plate
Zone 3 (User)	3.60	0.615	Weir&Pipe (Restrict)
Total (all zones)		1.000	

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 Diameter =	N/A	inches

Calculated Parameters for Underdrain

Underdrain Orifice Area =	N/A	ft ²
Underdrain Orifice Centroid =	N/A	feet

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

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	2.62	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	10.20	inches
Orifice Plate: Orifice Area per Row =	0.88	sq. inches (diameter = 1-1/16 inches)

Calculated Parameters for Plate

WQ Orifice Area per Row =	6.111E-03	ft ²
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft ²

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	0.87	1.75					
Orifice Area (sq. inches)	0.88	0.88	0.88					

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

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected	
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	N/A	N/A	inches

Calculated Parameters for Vertical Orifice

	Not Selected	Not Selected	
Vertical Orifice Area =	N/A	N/A	ft ²
Vertical Orifice Centroid =	N/A	N/A	feet

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	
Overflow Weir Front Edge Height, Ho =	2.63	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	8.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V
Horiz. Length of Weir Sides =	5.00	N/A	feet
Overflow Grate Type =	Type C Grate	N/A	
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H _g =	2.63	N/A	feet
Overflow Weir Slope Length =	5.00	N/A	feet
Grate Open Area / 100-yr Orifice Area =	3.97	N/A	
Overflow Grate Open Area w/o Debris =	27.84	N/A	ft ²
Overflow Grate Open Area w/ Debris =	13.92	N/A	ft ²

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	1.70	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	36.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	35.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	7.01	N/A	ft ²
Outlet Orifice Centroid =	1.49	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	2.81	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage =	4.00	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	20.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth =	0.99	feet
Stage at Top of Freeboard =	5.99	feet
Basin Area at Top of Freeboard =	1.04	acres
Basin Volume at Top of Freeboard =	3.16	acre-ft

Routed Hydrograph Results

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

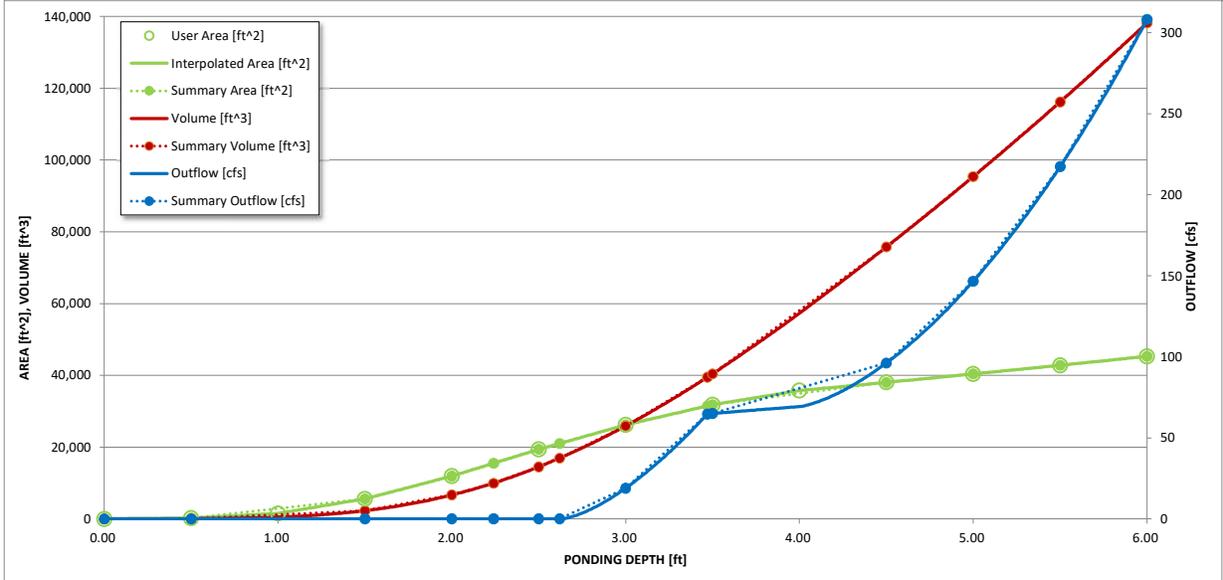
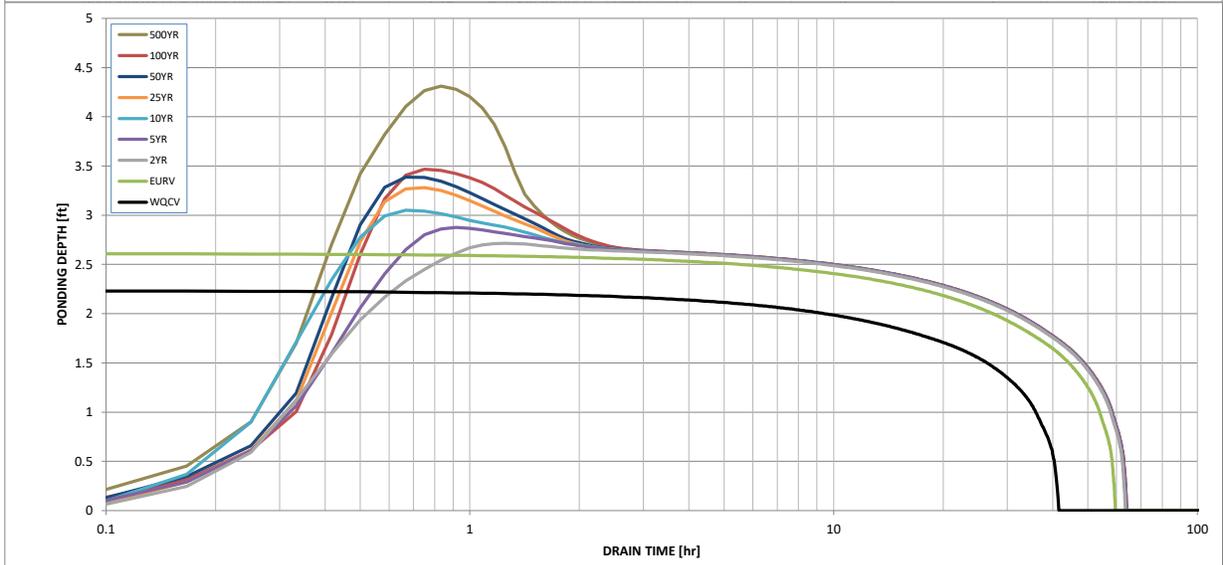
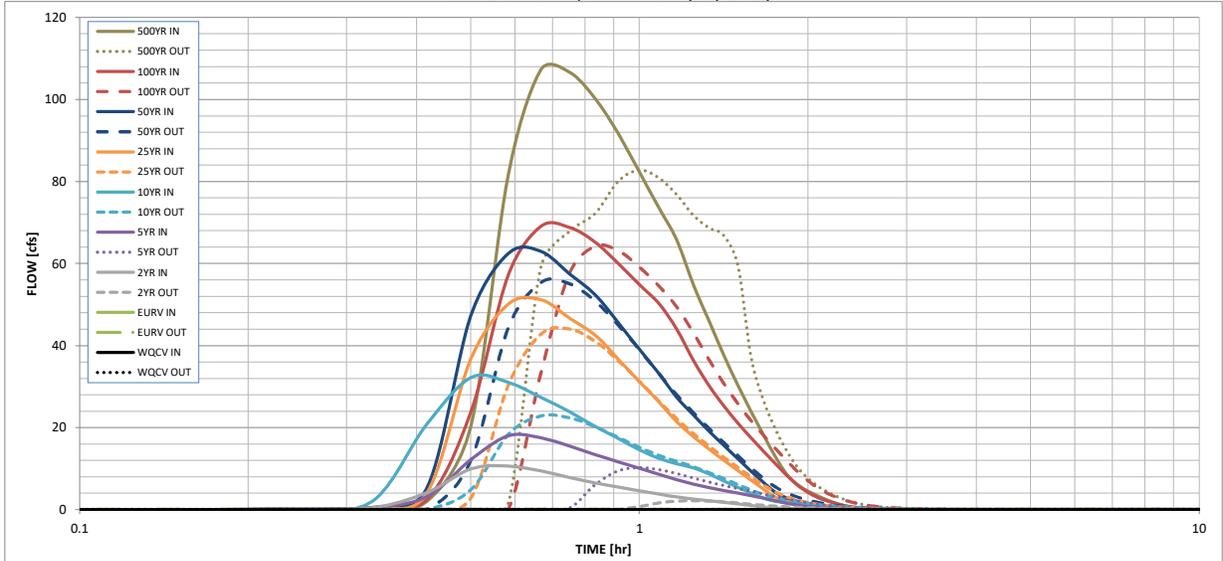
	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.14
One-Hour Rainfall Depth (in)	0.227	0.385	0.534	1.166	1.796	2.914	3.678	4.777	6.781
CUHP Runoff Volume (acre-ft)	0.227	0.385	0.534	1.166	1.796	2.914	3.678	4.777	6.781
User Override Inflow Hydrograph Volume (acre-ft)	N/A	N/A	0.534	1.053	1.796	2.914	3.678	4.683	6.781
CUHP Predevelopment Peak Q (cfs)	N/A	N/A	6.8	18.3	27.1	47.3	59.0	74.0	102.5
OPTIONAL Override Predevelopment Peak Q (cfs)	N/A	N/A						64.0	
Predevelopment Unit Peak Flow, q (cfs/acre)	N/A	N/A						1.50	2.61
Peak Inflow Q (cfs)	N/A	N/A						63.0	107.2
Peak Outflow Q (cfs)	N/A	N/A						48.6	86.5
Ratio Peak Outflow to Predevelopment Q	N/A	N/A						0.8	0.8
Structure Controlling Flow	Plate	Plate						flow Weir 1	Overflow Weir 1
Max Velocity through Grate 1 (fps)	N/A	N/A						1.7	2.1
Max Velocity through Grate 2 (fps)	N/A	N/A						N/A	N/A
Time to Drain 97% of Inflow Volume (hours)	38	54						39	34
Time to Drain 99% of Inflow Volume (hours)	40	57						53	51
Maximum Ponding Depth (ft)	2.24	2.62						3.73	3.86
Area at Maximum Ponding Depth (acres)	0.36	0.48						0.77	0.80
Maximum Volume Stored (acre-ft)	0.23	0.39						1.10	1.20
Elevation (ft)	7535.24	7535.62							7536.86
Pond Bottom (ft)	7533.00								

HRG Response: The 52-hour drainage time for the EURV follows MHFD criteria in Volume 2, Chapter 12, section 3.4 for Extended Detention Basins. This comment is to be disregarded per email from Daniel Torres sent 10/28/2024

Time to drain 99% of EURV needs to be around 72 hours to prevent downstream erosion. Please revise.

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)



Hydrographs from SWMM modeling input here to be routed through outlet structure

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.

Time Interval	SOURCE	CUHP	CUHP	CUHP	USER	CUHP	CUHP	CUHP	USER	CUHP
	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	0.01	0.00	0.00	0.01	0.02	0.05
	0:15:00	0.00	0.00	0.13	0.16	0.26	0.17	0.21	0.17	0.30
	0:20:00	0.00	0.00	0.46	0.44	2.03	0.45	0.52	0.42	1.91
	0:25:00	0.00	0.00	4.10	3.10	20.74	3.87	5.06	2.40	20.17
	0:30:00	0.00	0.00	9.96	12.19	32.18	36.67	47.27	23.71	81.63
	0:35:00	0.00	0.00	10.60	18.04	31.02	50.08	62.48	57.21	107.23
	0:40:00	0.00	0.00	9.44	17.52	27.38	51.18	63.00	69.03	106.70
	0:45:00	0.00	0.00	7.85	15.52	23.86	46.69	57.48	68.80	100.27
	0:50:00	0.00	0.00	6.54	13.42	20.36	42.59	52.46	65.25	91.74
	0:55:00	0.00	0.00	5.52	11.68	17.36	36.72	45.58	60.06	82.30
	1:00:00	0.00	0.00	4.58	10.12	14.59	31.23	39.08	54.88	73.61
	1:05:00	0.00	0.00	3.78	8.65	12.50	26.32	33.22	50.27	65.75
	1:10:00	0.00	0.00	3.09	7.28	11.19	21.43	27.38	44.01	54.71
	1:15:00	0.00	0.00	2.59	6.21	10.19	17.79	23.04	36.31	45.89
	1:20:00	0.00	0.00	2.16	5.39	8.66	14.73	19.11	30.18	37.59
	1:25:00	0.00	0.00	1.76	4.68	7.00	12.06	15.64	25.27	30.34
	1:30:00	0.00	0.00	1.38	4.04	5.46	9.55	12.42	21.11	24.01
	1:35:00	0.00	0.00	1.00	3.44	4.03	7.20	9.42	17.52	18.18
	1:40:00	0.00	0.00	0.65	2.82	2.77	4.98	6.59	14.24	12.87
	1:45:00	0.00	0.00	0.41	2.17	2.05	3.04	4.16	11.20	8.63
	1:50:00	0.00	0.00	0.32	1.56	1.68	1.99	2.85	8.38	6.12
	1:55:00	0.00	0.00	0.27	1.10	1.38	1.36	2.05	6.00	4.50
	2:00:00	0.00	0.00	0.23	0.81	1.11	0.97	1.55	4.20	3.35
	2:05:00	0.00	0.00	0.18	0.63	0.86	0.65	1.08	2.99	2.30
	2:10:00	0.00	0.00	0.13	0.49	0.64	0.44	0.75	2.10	1.50
	2:15:00	0.00	0.00	0.10	0.38	0.46	0.29	0.51	1.45	0.93
	2:20:00	0.00	0.00	0.07	0.29	0.33	0.19	0.34	0.96	0.58
	2:25:00	0.00	0.00	0.06	0.22	0.22	0.14	0.24	0.61	0.41
	2:30:00	0.00	0.00	0.04	0.16	0.15	0.10	0.17	0.37	0.29
	2:35:00	0.00	0.00	0.03	0.12	0.11	0.07	0.12	0.25	0.22
	2:40:00	0.00	0.00	0.02	0.09	0.08	0.05	0.09	0.18	0.16
	2:45:00	0.00	0.00	0.02	0.07	0.06	0.04	0.07	0.13	0.12
	2:50:00	0.00	0.00	0.01	0.05	0.04	0.03	0.05	0.10	0.09
	2:55:00	0.00	0.00	0.01	0.04	0.02	0.02	0.03	0.07	0.06
	3:00:00	0.00	0.00	0.00	0.02	0.01	0.01	0.02	0.05	0.03
	3:05:00	0.00	0.00	0.00	0.02	0.00	0.00	0.01	0.04	0.02
	3:10:00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.02	0.01
	3:15:00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.02	0.00
	3:20:00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	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

Design Procedure Form: Extended Detention Basin (EDB)

UD-BMP (Version 3.07, March 2018)

Sheet 1 of 3

Designer: RICHARD LYON, PE
Company: HR GREEN
Date: August 19, 2024
Project: FLYING HORSE NORTH - FILING NO. 4
Location: POND C

<p>1. Basin Storage Volume</p> <p>A) Effective Imperviousness of Tributary Area, I_a</p> <p>B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$)</p> <p>C) Contributing Watershed Area</p> <p>D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm</p> <p>E) Design Concept (Select EURV when also designing for flood control)</p> <p>F) Design Volume (WQCV) Based on 40-hour Drain Time ($V_{DESIGN} = (1.0 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12 * Area)$)</p> <p>G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume ($V_{WQCV\ OTHER} = (d_6 * (V_{DESIGN} / 0.43))$)</p> <p>H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired)</p> <p>I) NRCS Hydrologic Soil Groups of Tributary Watershed i) Percentage of Watershed consisting of Type A Soils ii) Percentage of Watershed consisting of Type B Soils iii) Percentage of Watershed consisting of Type C/D Soils</p> <p>J) Excess Urban Runoff Volume (EURV) Design Volume For HSG A: $EURV_A = 1.68 * i^{1.28}$ For HSG B: $EURV_B = 1.36 * i^{1.08}$ For HSG C/D: $EURV_{C/D} = 1.20 * i^{1.08}$</p> <p>K) User Input of Excess Urban Runoff Volume (EURV) Design Volume (Only if a different EURV Design Volume is desired)</p>	<p>$I_a = 10.4$ %</p> <p>$i = 0.104$</p> <p>Area = 39.300 ac</p> <p>$d_6 =$ in</p> <div style="border: 1px solid black; padding: 5px; margin: 5px 0;"> Choose One <input type="radio"/> Water Quality Capture Volume (WQCV) <input checked="" type="radio"/> Excess Urban Runoff Volume (EURV) </div> <p>$V_{DESIGN} =$ ac-ft</p> <p>$V_{DESIGN\ OTHER} =$ ac-ft</p> <p>$V_{DESIGN\ USER} = 0.227$ ac-ft</p> <p>HSG A = 0 % HSG B = 100 % HSG C/D = 0 %</p> <p>$EURV_{DESIGN} =$ ac-ft</p> <p>$EURV_{DESIGN\ USER} = 0.385$ ac-ft</p>
<p>2. Basin Shape: Length to Width Ratio (A basin length to width ratio of at least 2:1 will improve TSS reduction.)</p>	<p>L : W = 2.0 : 1</p>
<p>3. Basin Side Slopes</p> <p>A) Basin Maximum Side Slopes (Horizontal distance per unit vertical, 4:1 or flatter preferred)</p>	<p>Z = 4.00 ft / ft</p>
<p>4. Inlet</p> <p>A) Describe means of providing energy dissipation at concentrated inflow locations:</p>	<p>_____</p> <p>_____</p> <p>_____</p>
<p>5. Forebay</p> <p>A) Minimum Forebay Volume ($V_{FMN} = 2\%$ of the WQCV)</p> <p>B) Actual Forebay Volume</p> <p>C) Forebay Depth ($D_F = 18$ inch maximum)</p> <p>D) Forebay Discharge</p> <p>i) Undetained 100-year Peak Discharge</p> <p>ii) Forebay Discharge Design Flow ($Q_F = 0.02 * Q_{100}$)</p> <p>E) Forebay Discharge Design</p> <p>F) Discharge Pipe Size (minimum 8-inches)</p> <p>G) Rectangular Notch Width</p>	<p>$V_{FMN} = 0.005$ ac-ft</p> <p>$V_F = 0.005$ ac-ft</p> <p>$D_F = 18.0$ in</p> <p>$Q_{100} = 78.00$ cfs</p> <p>$Q_F = 1.56$ cfs</p> <div style="border: 1px solid black; padding: 5px; margin: 5px 0;"> Choose One <input type="radio"/> Berm With Pipe <input checked="" type="radio"/> Wall with Rect. Notch <input type="radio"/> Wall with V-Notch Weir </div> <p>Calculated $D_p =$ in</p> <p>Calculated $W_N = 6.7$ in</p> <p style="color: blue; font-size: small;">Flow too small for berm w/ pipe</p>

Design Procedure Form: Extended Detention Basin (EDB)

Designer: RICHARD LYON, PE
Company: HR GREEN
Date: August 19, 2024
Project: FLYING HORSE NORTH - FILING NO. 4
Location: POND C

<p>6. Trickle Channel</p> <p>A) Type of Trickle Channel</p> <p>F) Slope of Trickle Channel</p>	<div style="border: 1px solid black; padding: 2px; margin-bottom: 5px;"> Choose One <input checked="" type="radio"/> Concrete <input type="radio"/> Soft Bottom </div> <p>S = <input style="width: 50px;" type="text" value="0.0050"/> ft / ft</p>
<p>7. Micropool and Outlet Structure</p> <p>A) Depth of Micropool (2.5-foot minimum)</p> <p>B) Surface Area of Micropool (10 ft² minimum)</p> <p>C) Outlet Type</p> <p>D) Smallest Dimension of Orifice Opening Based on Hydrograph Routing (Use UD-Detention)</p> <p>E) Total Outlet Area</p>	<p>D_M = <input style="width: 50px;" type="text" value="2.5"/> ft</p> <p>A_M = <input style="width: 50px;" type="text" value="10"/> sq ft</p> <div style="border: 1px solid black; padding: 2px; margin-bottom: 5px;"> Choose One <input checked="" type="radio"/> Orifice Plate <input type="radio"/> Other (Describe): </div> <hr/> <hr/> <hr/> <p>D_{orifice} = <input style="width: 50px;" type="text"/> inches</p> <p>A_{orifice} = <input style="width: 50px;" type="text"/> square inches</p>
<p>8. Initial Surcharge Volume</p> <p>A) Depth of Initial Surcharge Volume (Minimum recommended depth is 4 inches)</p> <p>B) Minimum Initial Surcharge Volume (Minimum volume of 0.3% of the WQCV)</p> <p>C) Initial Surcharge Provided Above Micropool</p>	<p>D_{IS} = <input style="width: 50px;" type="text"/> in</p> <p>V_{IS} = <input style="width: 50px;" type="text"/> cu ft</p> <p>V_s = <input style="width: 50px;" type="text"/> cu ft</p>
<p>9. Trash Rack</p> <p>A) Water Quality Screen Open Area: $A_t = A_{ot} * 38.5 * (e^{-0.095D})$</p> <p>B) Type of Screen (If specifying an alternative to the materials recommended in the USDCM, indicate "other" and enter the ratio of the total open area to the total screen area for the material specified.)</p> <p style="margin-left: 40px;">Other (Y/N): <input style="width: 50px;" type="text" value="N"/></p> <p>C) Ratio of Total Open Area to Total Area (only for type 'Other')</p> <p>D) Total Water Quality Screen Area (based on screen type)</p> <p>E) Depth of Design Volume (EURV or WQCV) (Based on design concept chosen under 1E)</p> <p>F) Height of Water Quality Screen (H_{TR})</p> <p>G) Width of Water Quality Screen Opening (W_{opening}) (Minimum of 12 inches is recommended)</p>	<p>A_t = <input style="width: 50px;" type="text"/> square inches</p> <hr/> <hr/> <hr/> <p>User Ratio = <input style="width: 50px;" type="text"/></p> <p>A_{total} = <input style="width: 50px;" type="text"/> sq. in.</p> <p>H = <input style="width: 50px;" type="text"/> feet</p> <p>H_{TR} = <input style="width: 50px;" type="text"/> inches</p> <p>W_{opening} = <input style="width: 50px;" type="text"/> inches</p>

HR GREEN FOREBAY SIZING

PROJECT: FLYING HORSE NORTH FILING 4

DATE: 8/19/2024

DESIGNED BY: RDL

CHECKED BY: RDL

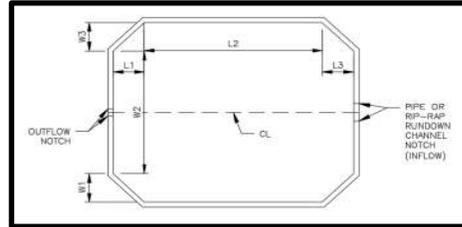
POND OR DP: POND C

	INNER DIMENSIONS	OUTER DIMENSIONS
LENGTH		
L1	5 FT	5.83 FT
L2	12.167 FT	13.000 FT
L3	5 FT	5.83 FT
INNER L	22.167 FT	OUTER TOTAL L 23.833 FT

	INNER DIMENSIONS	OUTER DIMENSIONS
WIDTH		
W1	5 FT	5.83 FT
W2	9.12525 FT (75% of L2)	9.96 FT
W3	5 FT	5.83 FT
INNER W	19.125 FT	OUTER TOTAL W 20.791 FT

BAFFLE (6'x0.83' + 4'x0.83')
AREA 8.33 SF

TRIANGLES 50
 RECTANGLE 111.0269168
 BAFFLE 8.33
TOTAL SURFACE AREA 152.6969168 SQ FT



FOREBAY HT. **1.5 FT**

FOREBAY VOLUME **229 CF**
8.483 CY
0.005 AC-FT

SUFFICIENT VOLUME?	YES
--------------------	-----

REQ'D VOL (2% WQCV) 0.005 AC-FT
 (per UD-BMP calc) 198 CF
 Notch Width per UD-BMP 6.7 in

T-5 Extended Detention Basin (EDB)

Table EDB-4. EDB component criteria

	On-Site EDBs for Watersheds up to 1 Impervious Acre ¹	EDBs with Watersheds between 1 and 2 Impervious Acres ¹	EDBs with Watersheds up to 5 Impervious Acres	EDBs with Watersheds over 5 Impervious Acres	EDBs with Watersheds over 20 Impervious Acres
Forebay Release and Configuration		Release 2% of the undetained 100-year peak discharge by way of a wall/notch configuration	Release 2% of the undetained 100-year peak discharge by way of a wall/notch configuration	Release 2% of the undetained 100-year peak discharge by way of a wall/notch configuration	Release 2% of the undetained 100-year peak discharge by way of a wall/notch or berm/pipe ² configuration
Minimum Forebay Volume	EDBs should not be used for watersheds with less than 1 impervious acre.				
Maximum Forebay Depth	12 inches	18 inches	18 inches	18 inches	30 inches
Trickle Channel Capacity	≥ the maximum possible forebay outlet capacity				
Micropool	Area ≥ 10 ft ²	Area ≥ 10 ft ²	Area ≥ 10 ft ²	Area ≥ 10 ft ²	Area ≥ 10 ft ²
Initial Surcharge Volume	Depth ≥ 4 inches	Depth ≥ 4 inches	Depth ≥ 4 in. Volume ≥ 0.3% WQCV	Depth ≥ 4 in. Volume ≥ 0.3% WQCV	Depth ≥ 4 in. Volume ≥ 0.3% WQCV

¹ EDBs are not recommended for sites with less than 2 impervious acres. Consider a sand filter or rain garden.

² Round up to the first standard pipe size (minimum 8 inches).

Worksheet for Pond C Spillway

Project Description	
Solve For	Headwater Elevation
Input Data	
Discharge	78.00 cfs
Crest Elevation	7,537.00 ft
Tailwater Elevation	7,528.00 ft
Crest Surface Type	Gravel
Crest Breadth	40.00 ft
Crest Length	30.0 ft
Results	
Headwater Elevation	7,537.95 ft
Headwater Height Above Crest	0.95 ft
Tailwater Height Above Crest	-9.00 ft
Weir Coefficient	2.82 ft ^(1/2) /s
Submergence Factor	1.000
Adjusted Weir Coefficient	2.82 ft ^(1/2) /s
Flow Area	28.4 ft ²
Velocity	2.74 ft/s
Wetted Perimeter	31.9 ft
Top Width	30.00 ft

Worksheet for Pond C Trickle Channel

Project Description	
Friction Method	Manning Formula
Solve For	Discharge
Input Data	
Channel Slope	0.005 ft/ft
Normal Depth	6.0 in

Section Definitions

Station (ft)	Elevation (ft)
0+00	0.58
0+00	0.08
0+01	0.00
0+02	0.08
0+02	0.58

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 0.58)	(0+02, 0.58)	0.013

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Discharge	3.49 cfs
Roughness Coefficient	0.013
Elevation Range	0.0 to 0.6 ft
Flow Area	0.9 ft ²
Wetted Perimeter	2.8 ft
Hydraulic Radius	3.9 in
Top Width	2.01 ft
Normal Depth	6.0 in
Critical Depth	6.0 in
Critical Slope	0.005 ft/ft
Velocity	3.81 ft/s
Velocity Head	0.23 ft
Specific Energy	0.73 ft
Froude Number	0.994
Flow Type	Subcritical

GVF Input Data

Worksheet for Pond C Trickle Channel

GVF Input Data

Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

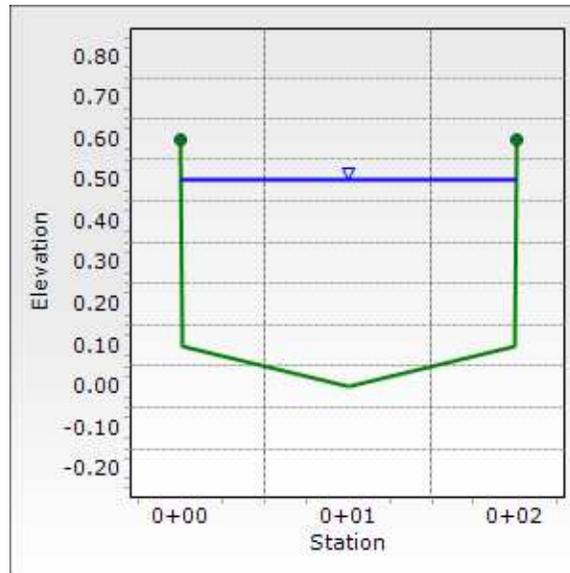
GVF Output Data

Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	6.0 in
Critical Depth	6.0 in
Channel Slope	0.005 ft/ft
Critical Slope	0.005 ft/ft

Cross Section for Pond C Trickle Channel

Project Description	
Friction Method	Manning Formula
Solve For	Discharge

Input Data	
Channel Slope	0.005 ft/ft
Normal Depth	6.0 in
Discharge	3.49 cfs





Flying Horse North Filing No. 4
Final Drainage Report
Project No.: 211030
El Paso County, Colorado

APPENDIX E

REFERENCE MATERIALS



INNOVATIVE DESIGN. **CLASSIC RESULTS.**

**PRELIMINARY DRAINAGE REPORT
FOR
FLYING HORSE NORTH PRELIMINARY PLAN
AND
FINAL DRAINAGE REPORT
FOR
FLYING HORSE NORTH FILING NO. 1**

**NOVEMBER 2017
Revised June 2018**

Prepared for:
PRI #2 LLC
6385 CORPORATE DRIVE SUITE 200
COLORADO SPRINGS CO 80919
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Prepared by:
**CLASSIC CONSULTING ENGINEERS &
SURVEYORS**
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Job no. 1096.11
PCD File No. SP-17-012 and SF-18-001



and B-B channel calculations) These facilities not only meet all current drainage criteria but also remain consistent with the intent of the DBPS. It is also noted that these facilities release well under the pre-development flows as established by the DBPS. Thus, the downstream corridor within the existing Reach 13 on the adjacent property will not be significantly affected with the installation of these full-spectrum facilities. Portions of the Cathedral Pines Development to the south contributes developed flows to this property. These flows will be accommodated in the various on-site facility designs. A smaller on-site basin at the southeast corner of section 36 releases historic flows onto the Cathedral Pines and the Edmonds Subdivision. An on-site detention/storm water quality facility is planned in this corridor to help mitigate development.

East Cherry Creek Drainage Basin

The Palmer Divide traverses the eastern half of section 36 which defines the major basin line between the Black Squirrel Creek and the East Cherry Creek Basins. The vegetation also changes drastically in this area. The majority of the East Cherry Creek Basin contains very little trees and more grazing prairie land and meadows. This area defines the edge of Black Forest. In general, historic flow patterns in this basin travel in a northeasterly direction towards Hodgen Road. The MDDP designates several major design points along the north boundary. Again, multiple detention/storm water quality facilities are planned for these corridors and to be constructed along with future land development. This report has analyzed the downstream corridors along the north property line for the pre-development condition (per MDDP hydrology) and post-development condition (per UD-detention designed release). No significant erosion currently exists in these channels and we have been consistently maintaining proper BMPs along this property boundary. This effort will continue through final construction and revegetation of the permanent detention/SWQ facilities. (See Appendix for Sections D-D and E-E channel calculations). Portions of the Palmer Divide Subdivision and multiple large unplatted properties the south contribute developed flows to this property. These flows will be accommodated in the various on-site facility designs.

PROPOSED DRAINAGE CONDITIONS

The proposed land development within the Flying Horse North Filing No. 1 and future development within the remaining portions of the Preliminary Plan will be 2.5-5 acre large lot residential with associated paved streets and roadside ditches. The 18-hole private Golf Course with a club house site, driving range and



maintenance facility is also planned as a part of Filing No. 1. Based on the current El Paso County ECM Section I.7.1.B. and given the size of the lots within this entire development area, stormwater quality is not required to be provided. However, detention/EURV will still be provided in specific locations on-site to limit the on-site development flow release to remain consistent with pre-development conditions within the major drainage corridors. These proposed facilities will aide in limiting any detrimental effects on downstream corridors. At specific areas where the Filing No. 1 development creates concentrated flows into future development areas, temporary sediment basins will be constructed to minimize sediment transfer downstream and off-site. The Filing No. 1 Final Drainage Report portion of this report will define the permanent facilities providing an Excess Urban Runoff Volume (EURV) in the lower portion of the facility storage volume with an outlet control device. Frequent and infrequent inflows are released at rates approximating undeveloped conditions. This concept provides some mitigation of increased runoff volume by releasing a portion of the increased runoff at a low rate over an extended period of time, up to 72 hours. This means that frequent storms, smaller than the 2 year event, will be reduced to very low flows near or below the sediment carrying threshold value for downstream drainage ways. Also, by incorporating an outlet structure that limits the 100-year runoff to the undeveloped condition rate, the discharge hydrograph for storms between the 2 year and the 100 year event will approximate the hydrograph for the undeveloped conditions and will help effectively mitigate the effects of this development. Again, prior to any land development beyond the Filing No. 1 Final Plat area, additional final drainage reports, final plats and construction plans will be required detailing this criteria.

Given the rural nature of this development, roadside ditches are planned along all roadways. Concrete curb and gutter will only be used at the round-about locations and along the jurisdictional dam embankment as required by the State. The typical roadside ditch will be designed as a V-ditch with a depth of 24 inches. The natural terrain within much of this development creates some steeper slopes on many of the roadways. These slopes range from 1% to 10%. An analysis of the roadside ditches was performed in order to determine the necessary ditch lining required to maintain allowable velocity and shear stress.

The following three basic ditch improvements are recommended throughout the development:

(See Appendix for reference)

1. Revegetation with native seeding (Grass lined only)
Slope 2% or less and minimal flow



2. Erosion Control Blanket (North American Green SC150 or equiv.) with native seeding
Slope 5% or less and max. flow range of 7-43 cfs.
3. Turf Reinforcement Mat (North American Green P300 or equiv.) with natives seeding
Slope 10% or less and max. flow of 70 cfs.

The specific ditch lining locations will be shown on the street improvements plans

The following hydrology descriptions will start at the western edge of the Flying Horse North property and move east into the East Cherry Creek Basin, describing the development within the Filing No. 1 area first.

FLYING HORSE NORTH FILING NO. 1

Black Squirrel Creek Drainage Basin

As mentioned previously, Flying Horse North is located in the upper region of the Black Squirrel Creek Drainage Basin. Per the approved DBPS for Black Squirrel Creek, the reaches in this area were proposed to remain as natural as possible. There were no recommendations for detention facilities within the area that is Flying Horse North, but due to current drainage criteria, detention/EURV facilities will be proposed with this development.

High Forest Ranch Detention Pond 26 outfalls onto the property at the very northwest corner of the site. These existing flows will continue to enter the site and travel within the natural channel towards the existing 48" CMP culvert crossing at Hwy. 83. Drainage easements across the proposed lots in this area will be provided on the final plat. The existing stock pond within lots 2 and 3 will be removed with grading of the road in this area. Tract B is platted in order to provide a detention/EURV facility for the lots and public road in this area. This facility will be constructed with Filing No. 1 with ownership and maintenance by the Flying Horse North HOA.

Design Point 1 ($Q_2 = 2$ cfs $Q_5 = 3$ cfs, $Q_{100} = 11$ cfs) represents the existing off-site and on-site developed flows from Basins OS-1A and BS-2B. The combined flow from these basins travel to a low point just east of Stagecoach Road where a proposed 24" RCP culvert will be installed to convey these flows under the road. (See Appendix for culvert design)



Design Point 26 ($Q_2 = 3$ cfs $Q_5 = 16$ cfs, $Q_{100} = 102$ cfs) represents the full build-out developed flows from Basins CC-8 and CC-10. Basin CC-8 represents future residential lots and CC-10 mostly future passive park area. These flows will continue to sheet flow towards the low-point where a 48" RCP culvert is sized to handle the fully developed flows at this location. (See Appendix for culvert design) After crossing Stagecoach Road, these flows will continue to flow directly into the existing stock pond just north of the roadway. This facility will provided sediment control for the small developed roadway area. Upon future development and plating of the lots planned within these basins, this stock pond will be formally designed into a detention facility.

Basin CC-15 ($Q_2 = 1$ cfs $Q_5 = 4$ cfs, $Q_{100} = 20$ cfs) represents the full build-out developed flows from the future residential lots tributary to this basin. These flows will continue to sheet flow towards the low-point where a 30" RCP culvert is sized to handle the fully developed flows at this location. (See Appendix for culvert design) A downstream sediment basin will be installed to provide sediment control for the small developed roadway area.

Basin CC-16 ($Q_2 = 1$ cfs $Q_5 = 5$ cfs, $Q_{100} = 24$ cfs) represents the full build-out developed flows from the future residential lots tributary to this basin. These flows will continue to sheet flow towards the low-point at the southwest corner of Old Stagecoach Road and Rubble Drive where a 24" RCP culvert is sized to handle the fully developed flows at this location. (See Appendix for culvert design) A downstream sediment basin will be installed to provide sediment control for the small developed roadway area.

Design Point 30 ($Q_2 = 0.7$ cfs $Q_5 = 2$ cfs, $Q_{100} = 10$ cfs) represents the full build-out developed flows from Basin CC-18. This Basin represents future residential lots. The flows will continue to sheet flow towards the low-point where a 24" RCP culvert is sized to handle the fully developed flows at this location. (See Appendix for culvert design) A downstream sediment basin will be installed to provide sediment control for the small developed roadway area.

Design Point 31 ($Q_2 = 0.9$ cfs $Q_5 = 3$ cfs, $Q_{100} = 15$ cfs) represents the full build-out developed flows from Basin CC-19 and the upstream release from DP-30. This Basin represents future residential 5 ac. lots. The flows will continue to sheet flow within a proposed drainage easement towards the existing low-point where an existing 24" CMP culvert will adequately handle the fully developed flows at this location.



Basin BS-26 ($Q_2 = 0.04$ cfs $Q_5 = 0.4$ cfs, $Q_{100} = 3$ cfs) represents sheet flow from the extreme rear portion of a future residential lot. This area of the lot will likely not be built upon, therefore not significantly changing the drainage conditions from the pre-development condition. The pre-development flow from the historic basin area equals $Q_2 = 0.04$ cfs $Q_5 = 0.4$ cfs, $Q_{100} = 3$ cfs. Also, given the lot size, no water quality is required.

Basins BS-31 ($Q_2 = 0.3$ cfs $Q_5 = 2$ cfs, $Q_{100} = 12$ cfs), BS-32 ($Q_2 = 0.3$ cfs $Q_5 = 2$ cfs, $Q_{100} = 9$ cfs) and BS-33 ($Q_2 = 0.8$ cfs $Q_5 = 3$ cfs, $Q_{100} = 15$ cfs) represent smaller basins that will continue to sheet flow off-site to the south. These basins represent some golf course development and multiple future residential lots. Given the lot size, no water quality is required. However, permanent sediment basins will be installed downstream of the golf course development to provide sediment control. Developed flows released from these basins will not be significantly different than the pre-development flows.

East Cherry Creek Drainage Basin

The following basins are not tributary to the Filing No. 1 platting area but are within the East Chery Creek Drainage Basin and planned for future residential lot development.

Design Point 28 ($Q_2 = 5$ cfs $Q_5 = 20$ cfs, $Q_{100} = 110$ cfs) represents the full build-out developed flows from Basins OS-13 and CC-13A. Basin CC-13A represents future residential lots and OS-13 platted, 5-ac. zoned residential property. These flows will continue to sheet flow towards the low-point where a future culvert will be installed to handle the fully developed flows at this location. The flows are then conveyed in the natural channel towards Design Point 29.

Design Point 29 ($Q_2 = 6$ cfs $Q_5 = 27$ cfs, $Q_{100} = 155$ cfs) represents the full build-out developed flows from Basins CC-13B, CC-13C and release from DP-28. These basins represent future residential lots. At this location, a future detention facility will be installed to meet EURV requirements and release pre-development flow quantities. This future facility will be constructed in a tract with ownership and maintenance by the Flying Horse North HOA.



Basin CC-13D ($Q_2 = 2$ cfs $Q_5 = 6$ cfs, $Q_{100} = 29$ cfs) represents future residential lots that will continue to sheet flow off-site. Given the lot size, no water quality is required. However, a permanent sediment basin will be installed just prior to release off-site to provide sediment control. Developed flows released from this basin will not be significantly different than the pre-development flows.

Basin CC-14 ($Q_2 = 0.4$ cfs $Q_5 = 2$ cfs, $Q_{100} = 8$ cfs) represents sheet flow from the rear portion of two future residential lots. The majority of this area is not anticipated to be developed, therefore not significantly changing the drainage conditions from the pre-development condition. Also, given the lot size, no water quality is required.

Design Point 27 ($Q_2 = 4$ cfs $Q_5 = 17$ cfs, $Q_{100} = 81$ cfs) represents the full build-out developed flows from the previously described basin CC-15 and CC-20. These basins represent future residential lots. At this location, a future detention facility will be installed to meet EURV requirements and release pre-development flow quantities. This future facility will be constructed in a tract with ownership and maintenance by the Flying Horse North HOA.

Basins CC-21 ($Q_2 = 0.1$ cfs $Q_5 = 1$ cfs, $Q_{100} = 9$ cfs) and CC-22 ($Q_2 = 1$ cfs $Q_5 = 5$ cfs, $Q_{100} = 21$ cfs) represent future residential 5 ac. lots and park area that will continue to sheet flow off-site. Given the lot size, no water quality is required. However, a permanent sediment basin will be installed just prior to release off-site to provide sediment control. Developed flows released from this basin will not be significantly different than the pre-development flows.

Basins CC-23 ($Q_2 = 0.4$ cfs $Q_5 = 1$ cfs, $Q_{100} = 8$ cfs) and CC-24 ($Q_2 = 3$ cfs $Q_5 = 13$ cfs, $Q_{100} = 62$ cfs) represent future 5 ac. residential lots that will continue to sheet flow off-site. Given the lot size, no water quality is required. Given that the proposed lots are planned for 5 ac. residential, the developed flows released from this basin will not be significantly different than the pre-development flows. However, multiple permanent sediment basins may be installed just prior to release off-site to provide sediment control. This basin also contains a portion of the adjacent Franktown/Parker Reservoir emergency spillway crossing two proposed lots. This existing facility, which doesn't appear to be within any existing easement, will be further analyzed with a final drainage report for this area. Appropriate drainage easements may be provided at time of final plating.



Basin CC-25 ($Q_2 = 0.3$ cfs $Q_5 = 1$ cfs, $Q_{100} = 6$ cfs) represents a small portion of two future residential 5 ac. lots that will continue to sheet flow off-site. Given that the proposed lots are planned for 5 ac. residential, the developed flows released from this basin will not be significantly different than the pre-development flows.

Design Point 34 ($Q_2 = 6$ cfs $Q_5 = 24$ cfs, $Q_{100} = 168$ cfs) represents the full build-out developed flows from Basins CC-26, CC-27, CC-28, release from CC-16 and release from DP-32. These basins represent future residential lots and park area. At this location, a future detention facility will be installed and likely replace the existing stock pond to meet EURV requirements and release pre-development flow quantities. The downstream existing culvert under Hodgen Road will be further analyzed with future final drainage reports. This future facility will be constructed in a tract with ownership and maintenance by the Flying Horse North HOA.

FACILITY MAINTENANCE

All proposed drainage structures within the platted County ROW will be owned and maintained by El Paso County. All proposed drainage structures within easements or tracts will be owned and maintained by the Flying Horse North HOA of Golf Course owner.

DRAINAGE CRITERIA

Hydrologic calculations were performed using the City of Colorado Springs/El Paso County Drainage Criteria Manual, revised in November 1991 and October 1994 with County adopted Chapter 6 and Section 3.2.1 of Chapter 13 of the City of Colorado Springs/El Paso County Drainage Criteria Manual as revised in May 2014. Detention storage and storm sewer conveyance to Black Squirrel Creek Drainage Basin was established with the Black Squirrel DBPS, previously referenced. The IDF curves from Figure 6-5 of the City of Colorado Springs/El Paso County DCM was used to estimate storm water runoff anticipated from design storms for the 2 year, 5 year and 100 year recurrence interval. (See Appendix)

The City of Colorado Springs/El Paso County DCM requires the Four Step Process for receiving water protection that focuses on reducing runoff volumes, treating the water quality capture volume (WQCV),



stabilizing drainage ways, and implementing long-term source controls. The Four Step Process pertains to management of smaller, frequently occurring storm events, as opposed to larger storms for which drainage and flood control infrastructure are sized. Implementation of these four steps helps to achieve storm water permit requirements. This site adheres to this **Four Step Process** as follows:

1. **Employ Runoff Reduction Practices:** Development of project site is proposed large lot single family residential (2.5 ac. min.) with homes and associated landscaping along with a private golf course. Proposed impervious areas (roof tops, patios) will sheet flow across landscaped ground, through open space areas and across the golf course to slow runoff and increase time of concentration prior to being conveyed to the proposed public streets. This will minimize directly connected impervious areas within the project site.
2. **Stabilize Drainageways:** This site will utilize roadside ditches with culvert crossings throughout the site and channel stabilization and grade control structures installed within some of the historic natural channels. These facilities will then direct the on-site development flows to the multiple detention/SWQ ponds mentioned above, designed to release at or below historic rates into Black Squirrel and East Cherry Creek. Based upon the proposed reduction in released flows compared to the pre-developed flows, no impact to downstream drainageways is anticipated.
3. **Provide Water Quality Capture Volume (WQCV):** Runoff from this development will be treated through capture and slow release of the WQCV in multiple permanent Extended Detention Basins designed per current El Paso County drainage criteria.
4. **Consider need for Industrial and Commercial BMPs:** No industrial or commercial uses are proposed within this development. However, a site specific storm water quality and erosion control plan and narrative was previously approved for this development in October 2016 (PUD-16-002). Details such as site specific source control construction BMP's as well as permanent BMP's were detailed in this plan and narrative to protect receiving waters. Much of these BMP's are currently constructed and being maintained as the majority of the development has been graded and erosion control methods employed.



ALL LAND ASSUMED 2 ACRE RESIDENTIAL LOTS, UNDEVELOPED WOODS OR
GOOD CONDITION OPEN SPACE (LAWNS, PARKS GOLF COURSES, CEMETARIES ETC.)

C_N VALUES - DEVELOPED CONDITIONS

BASIN (label)	BASIN AREA (Ac)	GOLF COURSE / WOODS (B)		2 AC. RESIDENTIAL (B)		COMPOSITE C _N
		CN	AREA (Ac.)	CN	AREA (Ac.)	
OS-1A	4.4	61	4.4	65	0.0	61.0
OS-1B	5.6	61	5.6	65	0.0	61.0
EX-DP-3 (Pre-Dev.)	36.0	60	36.0	65	0.0	60.0
OS-2	2.9	61	2.9	65	0.0	61.0
OS-3	10.2	61	0.0	65	10.2	65.0
OS-4	32.9	61	0.0	65	32.9	65.0
OS-5	29.7	61	0.0	65	29.7	65.0
OS-6	9.2	61	0.0	65	9.2	65.0
OS-7	5.0	61	0.0	65	5.0	65.0
OS-8	14.2	61	0.0	65	14.2	65.0
OS-9	9.8	60	9.8	65	0.0	60.0
OS-10	4.1	61	0.0	65	4.1	65.0
OS-11	28.0	61	0.0	65	28.0	65.0
OS-12	68.1	61	40.0	65	28.1	62.7
OS-13	36.9	61	18.0	65	18.9	63.0
OS-14	26.4	61	20.0	65	6.4	62.0
OS-15	70.8	61	20.0	65	50.8	63.9
OS-16	4.5	61	0.0	65	4.5	65.0
OS-17	15.8	61	0.0	65	15.8	65.0
OS-18	13.0	61	0.0	65	13.0	65.0

ALL LAND ASSUMED 2 ACRE RESIDENTIAL LOTS, UNDEVELOPED WOODS OR
GOOD CONDITION OPEN SPACE (LAWNS, PARKS GOLF COURSES, CEMETARIES ETC.)

C_N VALUES - DEVELOPED CONDITIONS

BASIN (label)	BASIN AREA (Ac)	GOLF COURSE / WOODS (B)		2 AC. RESIDENTIAL (B)		COMPOSITE C _N
		CN	AREA (Ac.)	CN	AREA (Ac.)	
CC-1A	9.8	61	0.0	65	9.8	65.0
CC-1B	12.6	61	0.5	65	12.1	64.8
CC-2A	11.0	61	0.0	65	11.0	65.0
CC-2B	20.8	61	0.0	65	20.8	65.0
CC-2C	6.4	61	0.0	65	6.4	65.0
CC-3	52.5	61	25.0	65	27.5	63.1
CC-4A	108.7	61	65.0	65	43.7	62.6
CC-4B	8.1	85	4.5	65	3.6	76.1
CC-4C (Pre-Dev.)	7.4	61	7.4	65	0.0	61.0
CC-5	22.4	61	0.0	65	22.4	65.0
CC-6	27.8	61	0.0	65	27.8	65.0
CC-7	18.4	61	0.0	65	18.4	65.0
CC-8	7.7	61	0.0	65	7.7	65.0
CC-9	5.6	61	0.0	65	5.6	65.0
CC-10	85.6	61	51.0	65	34.6	62.6
CC-11	18.6	61	9.0	65	9.6	63.1
CC-12	12.2	61	0.0	65	12.2	65.0
CC-13A	19.3	61	0.0	65	19.3	65.0
CC-13B	25.5	61	0.0	65	25.5	65.0
CC-13C	9.9	61	0.0	65	9.9	65.0
CC-13D	18.8	61	0.0	65	18.8	65.0
CC-14	4.6	61	0.0	65	4.6	65.0
CC-15	12.8	61	0.0	65	12.8	65.0
CC-16	16.3	61	0.0	65	16.3	65.0
CC-17	25.0	61	0.0	65	25.0	65.0
CC-18	6.2	65	5.8	89	0.4	66.5
CC-19	3.7	61	0.0	65	3.7	65.0
CC-20	39.3	61	0.0	65	39.3	65.0
CC-21	6.2	61	6.2	65	0.0	61.0
CC-22	13.8	61	0.0	65	13.8	65.0
CC-23	5.7	61	0.4	65	5.3	64.7
CC-24	39.6	61	0.0	65	39.6	65.0
CC-25	3.5	61	0.0	65	3.5	65.0
CC-26	16.7	61	0.0	65	16.7	65.0
CC-27	18.9	61	3.0	65	15.9	64.4
CC-28	154.8	61	23.0	65	131.8	64.4

TIME OF CONCENTRATION - DEVELOPED

BASIN	COMPOSITE Cn	C(5)	Length (ft)	OVERLAND Height (ft)	Tc (min)	STREET / CHANNEL FLOW (DCM Vol. 1 Fig. 6-25)				Tc TOTAL (min)	Tc LAG (0.6tc) (min)	Tc LAG (0.6tc) (hr)
						Length (ft)	Slope (%)	Velocity (fps)	Tc (min)			
OS-1A	61.0	0.08	300	20	17.1	150	4.0%	1.0	2.5	19.6	11.7	0.20
OS-1B	61.0	0.08	300	20	17.1	300	8.0%	1.4	3.6	20.6	12.4	0.21
EX-DP-3 (Pre-Dev.)	60.0	0.08	300	20	17.1	900	5.0%	1.9	7.9	25.0	15.0	0.25
OS-2	61.0	0.08	300	20	17.1	300	6.0%	2.0	2.5	19.6	11.7	0.20
OS-3	65.0	0.08	300	22	16.5	275	6.2%	2.0	2.3	18.8	11.3	0.19
OS-4	65.0	0.08	300	18	17.7	420	4.3%	1.3	5.4	23.0	13.8	0.23
OS-5	65.0	0.08	300	12	20.2	1200	2.5%	1.1	19.0	39.2	23.5	0.39
OS-6	65.0	0.08	300	17	18.0	300	5.5%	1.9	2.6	20.6	12.4	0.21
OS-7	65.0	0.08	300	20	17.1	180	6.5%	2.1	1.4	18.5	11.1	0.18
OS-8	65.0	0.08	300	14	19.2	260	5.5%	0.6	7.5	26.7	16.0	0.27
OS-9	60.0	0.08	300	12	20.2	500	3.5%	0.5	16.7	36.9	22.1	0.37
OS-10	65.0	0.08	300	19	17.3					17.3	10.4	0.17
OS-11	65.0	0.08	300	14	19.2	600	6.5%	0.7	15.4	34.6	20.7	0.35
OS-12	62.7	0.08	300	10	21.4	1400	2.5%	1.5	15.6	37.0	22.2	0.37
OS-13	63.0	0.08	300	10	21.4	1000	3.0%	1.5	11.1	32.6	19.5	0.33
OS-14	62.0	0.08	300	8	23.1	1000	5.0%	2.1	7.9	31.0	18.6	0.31
OS-15	63.9	0.08	300	16	18.4	2200	4.0%	1.9	19.3	37.7	22.6	0.38
OS-16	65.0	0.08	300	7	24.1					24.1	14.5	0.24
OS-17	65.0	0.08	300	20	17.1	350	6.0%	2.5	2.3	19.4	11.6	0.19
OS-18	65.0	0.08	300	18	17.7	300	6.0%	2.5	2.0	19.7	11.8	0.20
BS-1A	65.0	0.08	300	19	17.3					17.3	10.4	0.17
BS-1B	65.0	0.08	300	18	17.7	200	2.5%	1.2	2.8	20.4	12.3	0.20
BS-2	89.0	0.08	300	16	18.4	630	7.0%	0.7	16.2	34.5	20.7	0.35
BS-2A	89.0	0.08	30	1.5	5.9	700	6.5%	1.7	6.9	12.8	7.7	0.13
BS-2B	89.0	0.08	30	1.5	5.9	800	6.5%	2.2	6.1	12.0	7.2	0.12
BS-3	65.0	0.08	300	18	17.7	300	5.3%	2.2	2.3	19.9	12.0	0.20
BS-4	67.0	0.08	300	22	16.5	960	7.0%	2.4	6.7	23.2	13.9	0.23
BS-5	65.0	0.08	300	20	17.1	150	7.0%	2.4	1.0	18.1	10.9	0.18
BS-6	89.0	0.08	10	0.2	4.6	700	7.0%	2.4	4.9	9.5	5.7	0.09

TIME OF CONCENTRATION - DEVELOPED

BASIN	COMPOSITE Cn	C(5)	Length (ft)	OVERLAND Height (ft)	Tc (min)	STREET / CHANNEL FLOW (DCM Vol. 1 Fig. 6-25)				Tc TOTAL (min)	Tc LAG (0.6tc) (min)	Tc LAG (0.6tc) (hr)
						Length (ft)	Slope (%)	Velocity (fps)	Tc (min)			
CC-1A	65.0	0.08	300	16	18.4	500	5.0%	1.7	4.9	23.3	14.0	0.23
CC-1B	64.8	0.08	300	14	19.2	700	4.0%	2.0	5.8	25.0	15.0	0.25
CC-2A	65.0	0.08	300	14	19.2	250	3.0%	1.5	2.8	22.0	13.2	0.22
CC-2B	65.0	0.08	300	14	19.2	280	3.0%	1.5	3.1	22.3	13.4	0.22
CC-2C	65.0	0.08	300	18	17.7					17.7	10.6	0.18
CC-3	63.1	0.08	300	18	17.7	2300	3.0%	1.5	25.6	43.2	25.9	0.43
CC-4A	62.6	0.08	300	14	19.2	2700	2.0%	1.8	25.0	44.2	26.5	0.44
CC-4B	76.1	0.08	300	12	20.2	600	3.0%	1.6	6.3	26.4	15.9	0.26
CC-4C (Pre-Dev.)	61.0	0.08	40	0.8	9.3	350	3.0%	1.5	3.9	13.2	7.9	0.13
CC-5	65.0	0.08	300	18	17.7	1000	4.0%	2.0	8.3	26.0	15.6	0.26
CC-6	65.0	0.08	300	14	19.2	550	2.5%	1.6	5.7	24.9	14.9	0.25
CC-7	65.0	0.08	300	16	18.4	1000	3.0%	1.6	10.4	28.8	17.3	0.29
CC-8	65.0	0.08	300	10	21.4	250	2.0%	1.2	3.5	24.9	14.9	0.25
CC-9	65.0	0.08	300	18	17.7	100	2.0%	1.2	1.4	19.0	11.4	0.19
CC-10	62.6	0.08	300	22	16.5	2400	3.0%	1.8	22.2	38.7	23.2	0.39
CC-11	63.1	0.08	300	18	17.7	450	5.0%	2.1	3.6	21.2	12.7	0.21
CC-12	65.0	0.08	300	11	20.8	650	4.0%	2.0	5.4	26.2	15.7	0.26
CC-13A	65.0	0.08	300	14	19.2	1400	4.0%	2.0	11.7	30.9	18.5	0.31
CC-13B	65.0	0.08	300	18	17.7	1300	3.0%	1.6	13.5	31.2	18.7	0.31
CC-13C	65.0	0.08	300	14	19.2	350	4.0%	2.0	2.9	22.1	13.3	0.22
CC-13D	65.0	0.08	300	20	17.1	900	4.0%	2.0	7.5	24.6	14.7	0.25
CC-14	65.0	0.08	300	10	21.4					21.4	12.9	0.21
CC-15	65.0	0.08	300	14	19.2	550	3.0%	1.8	5.1	24.3	14.6	0.24
CC-16	65.0	0.08	300	10	21.4	650	2.5%	1.3	8.3	29.8	17.9	0.30
CC-17	65.0	0.08	300	9	22.2	950	2.0%	1.2	13.2	35.4	21.2	0.35
CC-18	66.5	0.08	300	7	24.1	400	2.0%	1.2	5.6	29.7	17.8	0.30
CC-19	65.0	0.08	300	8	23.1	100	2.0%	1.0	1.7	24.7	14.8	0.25
CC-20	65.0	0.08	300	9	22.2	350	6.0%	2.2	2.7	24.8	14.9	0.25
CC-21	61.0	0.08	300	18	17.7	200	3.0%	1.8	1.9	19.5	11.7	0.20
CC-22	65.0	0.08	300	14	19.2	700	4.0%	2.0	5.8	25.0	15.0	0.25
CC-23	64.7	0.08	300	10	21.4	850	2.0%	1.2	11.8	33.2	19.9	0.33
CC-24	65.0	0.08	300	20	17.1	900	4.0%	1.9	7.9	25.0	15.0	0.25
CC-25	65.0	0.08	300	16	18.4	500	3.0%	1.8	4.6	23.0	13.8	0.23
CC-26	65.0	0.08	300	14	19.2	900	5.0%	2.1	7.1	26.3	15.8	0.26
CC-27	64.4	0.08	300	14	19.2	1300	3.0%	1.8	12.0	31.2	18.7	0.31
CC-28	64.4	0.08	300	14	19.2	4700	3.0%	1.8	43.5	62.7	37.6	0.63

BASIN SUMMARY - DEVELOPED CONDITIONS

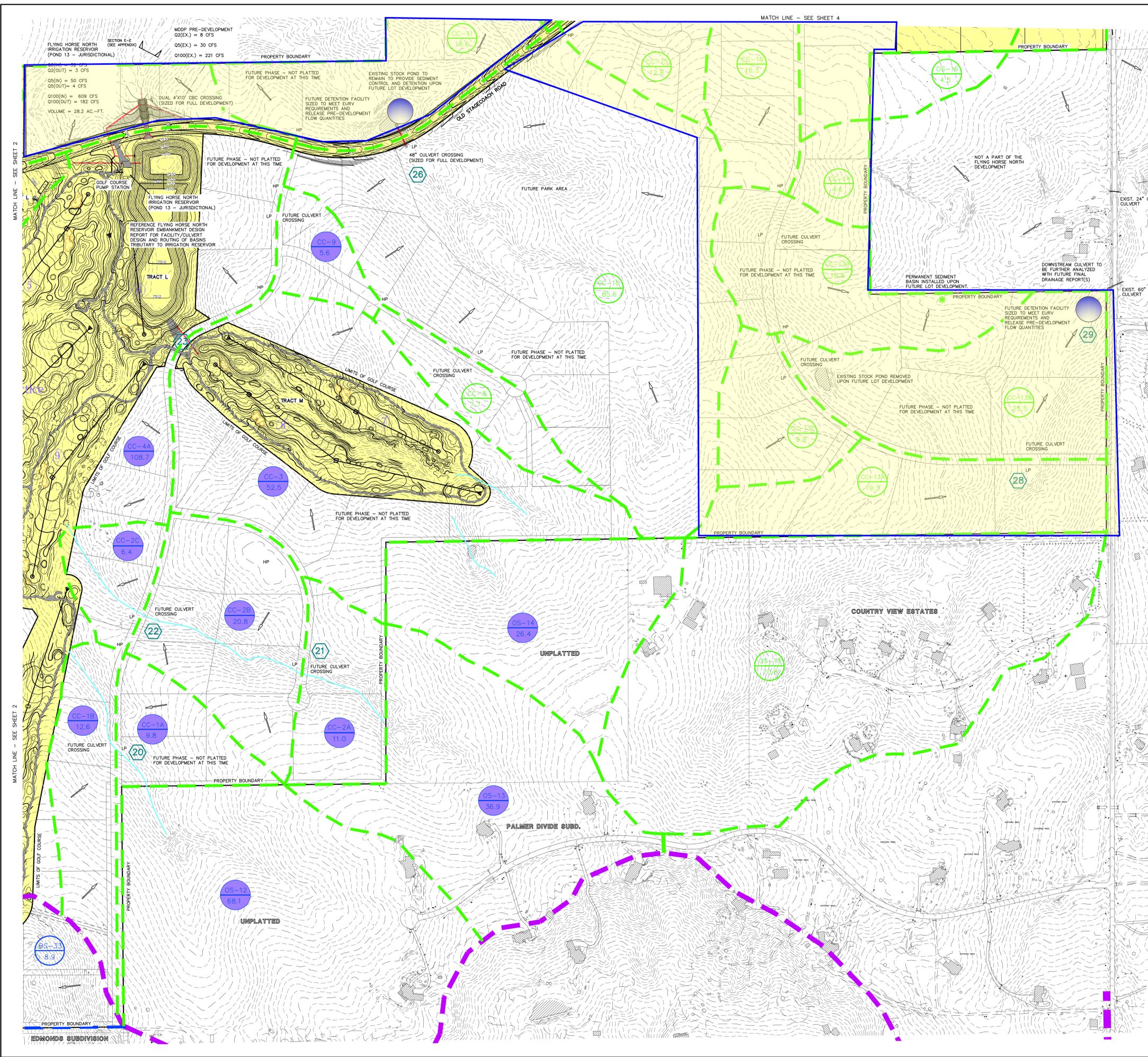
BASIN (label)	AREA (acres)	COMPOSITE CN	TOTAL LAG TIME (hours)	Q 2 Yr. (cfs)	Q 5 Yr. (cfs)	Q 100 Yr. (cfs)
OS-1A	4.40	61.0	0.20	0.4	1.6	7.7
OS-1B	5.60	61.0	0.21	0.5	1.9	9.4
EX-DP-3 (Pre-Dev.)	36.00	60.0	0.25	0.5	4.8	41.3
OS-2	2.90	61.0	0.20	0.1	0.6	4.0
OS-3	10.20	65.0	0.19	1.0	3.8	17.9
OS-4	32.90	65.0	0.23	2.8	11.2	53.6
OS-5	29.70	65.0	0.39	1.9	7.1	37.0
OS-6	9.20	65.0	0.21	0.9	3.2	15.5
OS-7	5.00	65.0	0.18	0.5	2.0	9.0
OS-8	14.20	65.0	0.27	2.1	6.2	24.7
OS-9	9.80	60.0	0.37	0.1	1.0	9.1
OS-10	4.10	65.0	0.17	0.7	2.1	8.2
OS-11	28.00	65.0	0.35	2.4	8.2	38.7
OS-12	68.10	62.7	0.37	2.2	11.9	75.8
OS-13	36.90	63.0	0.33	1.4	7.4	45.0
OS-14	26.40	62.0	0.31	0.7	4.6	31.0
OS-15	70.80	63.9	0.38	3.3	14.8	84.2
OS-16	4.50	65.0	0.24	0.4	1.5	7.2
OS-17	15.80	65.0	0.19	1.6	5.9	27.7
OS-18	13.00	65.0	0.20	1.3	4.7	22.6

BASIN SUMMARY - DEVELOPED CONDITIONS

BASIN (label)	AREA (acres)	COMPOSITE CN	TOTAL LAG TIME (hours)	Q 2 Yr. (cfs)	Q 5 Yr. (cfs)	Q 100 Yr. (cfs)
CC-1A	9.80	65.0	0.23	0.8	3.3	16.0
CC-1B	12.60	64.8	0.25	1.0	4.0	19.4
CC-2A	11.00	65.0	0.22	1.0	3.8	18.3
CC-2B	20.80	65.0	0.22	1.9	7.1	34.6
CC-2C	6.40	65.0	0.18	0.7	2.5	11.5
CC-3	52.50	63.1	0.43	1.8	8.8	54.5
CC-4A	108.70	62.6	0.44	15.4	39.0	156.0
CC-4B	8.10	76.1	0.26	4.0	7.3	20.6
CC-4C (Pre-Dev.)	7.40	61.0	0.13	0.2	1.8	11.2
CC-5	22.40	65.0	0.26	1.8	7.1	34.3
CC-6	27.80	65.0	0.25	2.3	9.1	43.2
CC-7	18.40	65.0	0.29	1.4	5.4	27.0
CC-8	7.70	65.0	0.25	0.6	2.5	12.0
CC-9	5.60	65.0	0.19	0.6	2.1	9.8
CC-10	85.60	62.6	0.39	2.6	14.1	91.9
CC-11	18.60	63.1	0.21	0.9	5.0	28.1
CC-12	12.20	65.0	0.26	1.0	3.9	18.7
CC-13A	19.30	65.0	0.31	1.4	5.4	27.3
CC-13B	25.50	65.0	0.31	1.8	7.2	36.1
CC-13C	9.90	65.0	0.22	0.9	3.4	16.5
CC-13D	18.80	65.0	0.25	1.5	6.2	29.2
CC-14	4.60	65.0	0.21	0.4	1.6	7.8
CC-15	12.80	65.0	0.24	1.1	4.3	20.4
CC-16	16.30	65.0	0.30	1.2	4.6	23.6
CC-17	25.00	65.0	0.35	1.7	6.5	32.8
CC-18	6.20	66.5	0.30	0.7	2.2	9.7
CC-19	3.70	65.0	0.25	0.3	1.2	5.8
CC-20	39.30	65.0	0.25	3.2	12.9	61.0
CC-21	6.20	61.0	0.20	0.1	1.2	8.5
CC-22	13.80	65.0	0.25	1.1	4.5	21.4
CC-23	5.70	64.7	0.33	0.4	1.5	7.7
CC-24	39.60	65.0	0.25	3.3	13.0	61.5
CC-25	3.50	65.0	0.23	0.3	1.2	5.7
CC-26	16.70	65.0	0.26	1.4	5.3	25.6
CC-27	18.90	64.4	0.31	1.2	4.9	25.8
CC-28	154.80	64.4	0.63	6.5	24.7	136.3

DESIGN POINTS SURFACE ROUTING SUMMARY - DEVELOPED CONDITIONS

Design Point (label)	Contributing Basins	Q 2 Yr. Q (cfs)	Q 5 Yr. Q (cfs)	Q 100 Yr. Q (cfs)
DP-18 DEV	BS-28, BS-29, BS-30, OS-18	5.0	21.6	115
DP-19 DEV	BS-27, OS-17, Release from DP-18	3.8	16.8	126
DP-20 DEV	CC-1A, OS-12	3.2	14.3	88
DP-21 DEV	CC-2A, OS-13	2.1	10.5	62
DP-22 DEV	CC-2B, Release from DP-21	3.7	16.6	92
DP-23 DEV	CC-3, OS-14	2.5	13.0	84
DP-24 DEV	CC-4C (Pre-Dev.), CC-5	1.9	8.4	45
TOTAL INFLOW TO POND 12 (UD Detention hydrograph)	CC-4C, CC-5, CC-6	6	9	85
DP-25 DEV	Release from FHN Pond 12	0.2	0.3	45
DP-26 DEV	CC-8, CC-10	3.0	15.9	102
DP-27 DEV	CC-15, CC-20	4.3	17.2	81
DP-28 DEV	CC-13A, OS-15	4.6	19.8	110
DP-29 DEV	CC-13B, CC-13C, Release from DP-28	5.8	26.6	155
DP-30 DEV	CC-18	0.7	2.2	10
DP-31 DEV	CC-19, Release from DP-30	0.9	3.2	15
DP-32 DEV	CC-17, OS-16	2.0	7.8	40
DP-33 DEV	CC-23, CC-24	3.6	14.4	69
DP-34 DEV	CC-26, CC-27, CC-28 and Release from CC-16 & DP-32	6.0	23.5	168



BASIN SUMMARY - DEVELOPED CONDITIONS

BASIN (label)	AREA (acres)	COMPOSITE CN	TOTAL LAG TIME (hours)	Q 2 Yr. (cfs)	Q 5 Yr. (cfs)	Q 100 Yr. (cfs)
OS-8	14.20	65.0	0.27	2.1	6.2	24.7
OS-9	9.80	60.0	0.37	0.1	1.0	9.1
OS-10	4.10	65.0	0.17	0.7	2.1	8.2
OS-11	28.00	65.0	0.35	2.4	8.2	38.7
OS-12	68.10	62.7	0.37	2.2	11.9	75.8
OS-13	36.90	63.0	0.33	1.4	7.4	45.0
OS-14	26.40	62.0	0.31	0.7	4.6	31.0
OS-15	70.80	63.9	0.38	3.3	14.8	84.2
OS-16	4.50	65.0	0.24	0.4	1.5	7.2
OS-17	15.80	65.0	0.19	1.6	5.9	27.7
OS-18	13.00	65.0	0.20	1.3	4.7	22.6
CC-1A	9.80	65.0	0.23	0.8	3.3	16.0
CC-1B	12.60	64.8	0.25	1.0	4.0	19.4
CC-2A	11.00	65.0	0.22	1.0	3.8	18.3
CC-2B	20.80	65.0	0.22	1.9	7.1	34.6
CC-2C	6.40	65.0	0.18	0.7	2.5	11.5
CC-3	52.50	63.1	0.43	1.8	8.8	54.5
CC-4A	108.70	62.6	0.44	15.4	39.0	156.0
CC-4B	8.10	76.1	0.26	4.0	7.3	20.6
CC-4C (Pre-Dev.)	7.40	61.0	0.13	0.2	1.8	11.2
CC-5	22.40	65.0	0.26	1.8	7.1	34.3
CC-6	27.80	65.0	0.25	2.3	9.1	43.2
CC-7	18.40	65.0	0.29	1.4	5.4	27.0
CC-8	7.70	65.0	0.25	0.4	1.5	7.2
CC-9	5.00	65.0	0.19	0.5	2.1	9.8
CC-10	85.60	62.6	0.39	2.6	14.1	91.9
CC-11	18.60	63.1	0.21	0.9	5.0	28.1
CC-12	12.20	65.0	0.26	1.0	3.9	19.7
CC-13A	19.30	65.0	0.31	1.4	5.4	27.3
CC-13B	25.50	65.0	0.31	1.8	7.2	36.1
CC-13C	9.90	65.0	0.22	0.9	3.4	16.5
CC-13D	18.80	65.0	0.25	1.5	6.2	29.2
CC-14	4.60	65.0	0.21	0.4	1.6	7.8
CC-15	12.80	65.0	0.24	1.1	4.3	20.4
CC-16	16.30	65.0	0.30	1.2	4.6	23.6
CC-17	25.00	65.0	0.35	1.7	6.5	32.8
CC-18	6.20	66.5	0.30	0.7	2.2	9.7
CC-19	3.70	65.0	0.25	0.3	1.2	5.8
CC-20	39.30	65.0	0.25	3.2	12.9	61.0
CC-21	6.20	61.0	0.20	0.1	1.2	8.5
CC-22	13.80	65.0	0.25	1.1	4.5	21.4
CC-23	5.70	64.7	0.33	0.4	1.5	7.7
CC-24	39.60	65.0	0.25	3.3	13.0	61.5
CC-25	3.50	65.0	0.23	0.3	1.2	5.7
CC-26	19.70	65.0	0.26	1.4	5.3	26.6
CC-27	18.90	64.4	0.31	1.2	4.9	25.8
CC-28	154.80	64.4	0.63	6.5	24.7	136.3

DESIGN POINTS SURFACE ROUTING SUMMARY - DEVELOPED CONDITIONS

Design Point (label)	Contributing Basins	Q 2 Yr. Q (cfs)	Q 5 Yr. Q (cfs)	Q 100 Yr. Q (cfs)
DP-20 DEV	CC-1A, OS-12	3.2	14.3	88
DP-21 DEV	CC-2A, OS-13	2.1	10.5	62
DP-22 DEV	CC-2B, Release from DP-21	3.7	16.6	92
DP-23 DEV	CC-3, OS-14	2.5	13.0	84
DP-24 DEV	CC-4C (Pre-Dev.), CC-5	1.9	8.4	45
TOTAL INFLOW TO POND 12 (UD Detention hydrograph)	CC-4C, CC-5, CC-6	6	9	85
DP-25 DEV	Release from FHN Pond 12	0.2	0.3	45
DP-26 DEV	CC-8, CC-10	3.0	15.9	102
DP-27 DEV	CC-15, CC-20	4.3	17.2	81
DP-28 DEV	CC-13A, OS-15	4.6	19.8	110
DP-29 DEV	CC-13B, CC-13C, Release from DP-28	5.8	26.6	155
DP-30 DEV	CC-18	0.7	2.2	10
DP-31 DEV	CC-19, Release from DP-30	0.9	3.2	15
DP-32 DEV	CC-17, OS-16	2.0	7.8	40
DP-33 DEV	CC-23, CC-24	3.6	14.4	69
DP-34 DEV	CC-26, CC-27, CC-28 and Release from CC-16 & DP-32	6.0	23.5	168

LEGEND

DESCRIPTION	SYMBOL
EXISTING GROUND CONTOUR	6910
PROPOSED FINISHED CONTOUR	6910
BASIN BOUNDARY EAST CHERRY CREEK	---
MAJOR BASIN BOUNDARY	---
DESIGN POINT	3
BASIN IDENTIFIER	BB 10.0
EXISTING DIRECTION OF FLOW	→
PROPOSED DIRECTION OF FLOW	→
STORM SEWER	---
FILING NO. 1 PLAT AREA	---

SCALE: 1" = 200'

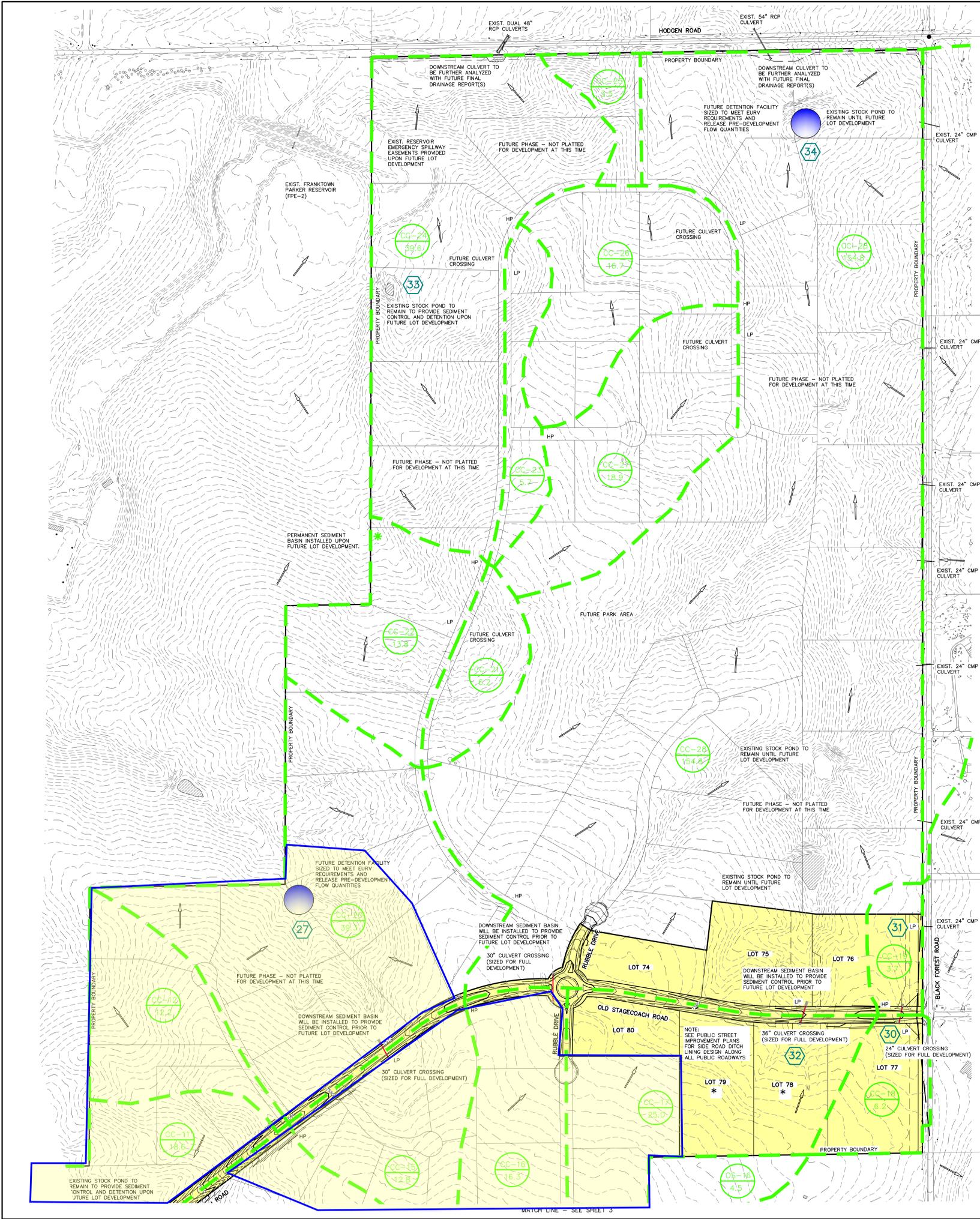
CLASSIC CONSULTING ENGINEERS & SURVEYORS

FLYING HORSE NORTH
PRELIMINARY/FINAL DRAINAGE REPORT
FILING NO. 1 AND
PRELIMINARY PLAN DRAINAGE MAP

DESIGNED BY	MAW	SCALE	DATE	10-25-17
DRAWN BY	MAW	(H) 1" = 200'	SHEET	3 OF 4
CHECKED BY	(V) 1" = N/A	JOB NO.	1096.11	

619 N. Cascade Avenue, Suite 200 Colorado Springs, Colorado 80903 (719)785-0790 (719)785-0789 (Fax)

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BASIN SUMMARY - DEVELOPED CONDITIONS

BASIN (label)	AREA (acres)	COMPOSITE CN	TOTAL LAG TIME (hours)	Q 2 Yr. (cfs)	Q 5 Yr. (cfs)	Q 100 Yr. (cfs)
OS-16	4.50	65.0	0.24	0.4	1.5	7.2
OS-17	15.80	65.0	0.19	1.6	5.9	27.7
OS-18	13.00	65.0	0.20	1.3	4.7	22.6
CC-11	18.60	63.1	0.21	0.9	5.0	28.1
CC-12	12.20	65.0	0.26	1.0	3.9	18.7
CC-13A	19.30	65.0	0.31	1.4	5.4	27.3
CC-13B	25.50	65.0	0.31	1.8	7.2	36.1
CC-13C	9.90	65.0	0.22	0.9	3.4	16.5
CC-13D	18.80	65.0	0.25	1.5	6.2	29.2
CC-14	4.60	65.0	0.21	0.4	1.6	7.8
CC-15	12.80	65.0	0.24	1.1	4.3	20.4
CC-16	16.30	65.0	0.30	1.2	4.6	23.6
CC-17	25.00	65.0	0.35	1.7	6.5	32.8
CC-18	6.20	66.5	0.30	0.7	2.2	9.7
CC-19	3.70	65.0	0.25	0.3	1.2	5.8
CC-20	39.30	65.0	0.25	3.2	12.9	61.0
CC-21	6.20	61.0	0.20	0.1	1.2	8.5
CC-22	13.80	65.0	0.25	1.1	4.5	21.4
CC-23	5.70	64.7	0.33	0.4	1.5	7.7
CC-24	39.60	65.0	0.25	3.3	13.0	61.5
CC-25	3.50	65.0	0.23	0.3	1.2	5.7
CC-26	16.70	65.0	0.26	1.4	5.3	25.6
CC-27	18.90	64.4	0.31	1.2	4.9	25.8
CC-28	154.80	64.4	0.63	6.5	24.7	136.3

DESIGN POINTS SURFACE ROUTING SUMMARY - DEVELOPED CONDITIONS

Design Point (label)	Contributing Basins	Q 2 Yr. Q (cfs)	Q 5 Yr. Q (cfs)	Q 100 Yr. Q (cfs)
DP-27 DEV	CC-15, CC-20	4.3	17.2	81
DP-28 DEV	CC-13A, OS-15	4.6	19.8	110
DP-29 DEV	CC-13B, CC-13C, Release from DP-28	5.8	26.6	155
DP-30 DEV	CC-18	0.7	2.2	10
DP-31 DEV	CC-19, Release from DP-30	0.9	3.2	15
DP-32 DEV	CC-17, OS-16	2.0	7.8	40
DP-33 DEV	CC-23, CC-24	3.6	14.4	69
DP-34 DEV	CC-26, CC-27, CC-28 and Release from CC-16 & DP-32	6.0	23.5	168

LEGEND

DESCRIPTION	SYMBOL
EXISTING GROUND CONTOUR	6910
PROPOSED FINISHED CONTOUR	6910
BASIN BOUNDARY EAST CHERRY CREEK	---
MAJOR BASIN BOUNDARY	---
BASIN BOUNDARY BLACK SQUIRREL	---
DESIGN POINT	3
LOTS WITH NON-STANDARD CULVERT SIZE	*
BASIN IDENTIFIER	BB 10.0
EXISTING DIRECTION OF FLOW	→
PROPOSED DIRECTION OF FLOW	→
STORM SEWER	---
FILING NO. 1 PLAT AREA	---

SCALE: 1" = 200'

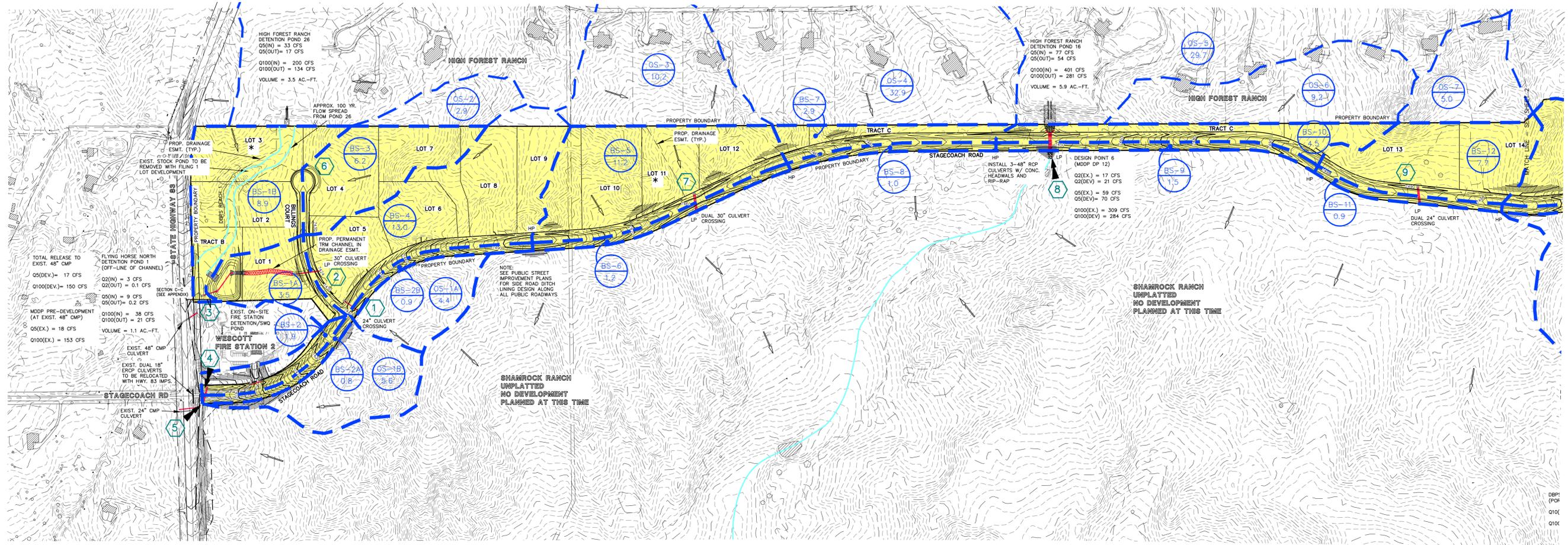
CLASSIC CONSULTING ENGINEERS & SURVEYORS

FLYING HORSE NORTH
PRELIMINARY/FINAL DRAINAGE REPORT
FILING NO. 1 AND
PRELIMINARY PLAN DRAINAGE MAP

DESIGNED BY: MAW SCALE: DATE: 10-17-17
DRAWN BY: MAW (H) 1" = 200' SHEET 4 OF 4
CHECKED BY: (V) 1" = N/A JOB NO. 1096.11

619 N. Cascade Avenue, Suite 200 (719) 785-0790
Colorado Springs, Colorado 80903 (719) 785-0799 (Fax)

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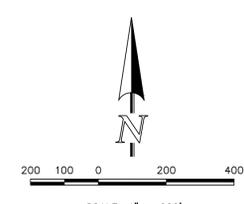
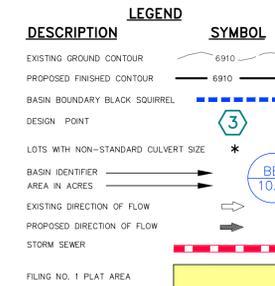


BASIN SUMMARY - DEVELOPED CONDITIONS

BASIN (label)	AREA (acres)	COMPOSITE CN	TOTAL LAG TIME (hours)	Q 2 Yr. (cfs)	Q 5 Yr. (cfs)	Q 100 Yr. (cfs)
OS-1A	4.40	61.0	0.20	0.4	1.6	7.7
OS-1B	5.60	61.0	0.21	0.5	1.9	9.4
EX-DP-3 (Pre-Dev)	36.00	60.0	0.25	0.5	4.8	41.3
OS-2	2.90	61.0	0.20	0.1	0.6	4.0
OS-3	10.20	65.0	0.19	1.0	3.8	17.9
OS-4	32.90	65.0	0.23	2.8	11.2	53.6
OS-5	29.70	65.0	0.39	1.9	7.1	37.0
OS-6	9.20	65.0	0.21	0.9	3.2	15.5
OS-7	5.00	65.0	0.18	0.5	2.0	9.0
BS-1A	3.50	65.0	0.17	0.4	1.4	6.3
BS-1B	8.90	65.0	0.20	0.4	2.4	13.8
BS-2	1.90	89.0	0.35	2.9	4.2	8.4
BS-2A	0.80	89.0	0.13	1.2	1.8	3.5
BS-2B	0.90	89.0	0.12	1.4	2.0	4.0
BS-3	6.20	65.0	0.20	0.6	2.3	10.8
BS-4	13.00	67.0	0.23	1.9	5.5	23.6
BS-5	11.20	65.0	0.18	1.1	4.4	20.1
BS-6	1.20	89.0	0.09	1.9	2.8	5.4
BS-7	2.90	65.0	0.13	4.4	6.4	12.8
BS-8	1.00	89.0	0.12	1.6	2.2	4.5
BS-9	1.50	89.0	0.13	2.3	3.3	6.6
BS-10	4.50	65.0	0.24	6.0	8.7	17.5
BS-11	0.90	89.0	0.08	1.5	2.1	4.1
BS-12	7.70	65.0	0.19	0.8	3.0	13.8

DESIGN POINTS SURFACE ROUTING SUMMARY - DEVELOPED CONDITIONS

Design Point (label)	Contributing Basins	Q 2 Yr. Q (cfs)	Q 5 Yr. Q (cfs)	Q 100 Yr. Q (cfs)
DP-1 DEV	OS-1A, BS-2B	1.6	3.4	11
DP-2 DEV	DP-1, BS-4	3.2	8.8	35
TOTAL INFLOW TO POND 1 (UD Detention hydrograph)	DP-1, DP-2, BS-1A	4	7	38
DP-3 DEV (Pond Pack routing)	OS-2, BS-3, BS-1B, Release from FHN Pond 1	1	6	39
DP-4 DEV	BS-2	2.9	4.2	8
DP-5 DEV	OS-1B, BS-2A	1.5	3.5	13
DP-6 DEV	OS-2, BS-3	0.6	2.8	15
DP-7 DEV	OS-3, BS-5	2.1	8.2	38
DP-8 DEV	OS-4, OS-5, OS-6, BS-7, BS-10, Release from Exist. HFR Pond 16	20.9	70.4	284
DP-9 DEV	OS-7, BS-12	1.3	5.0	23

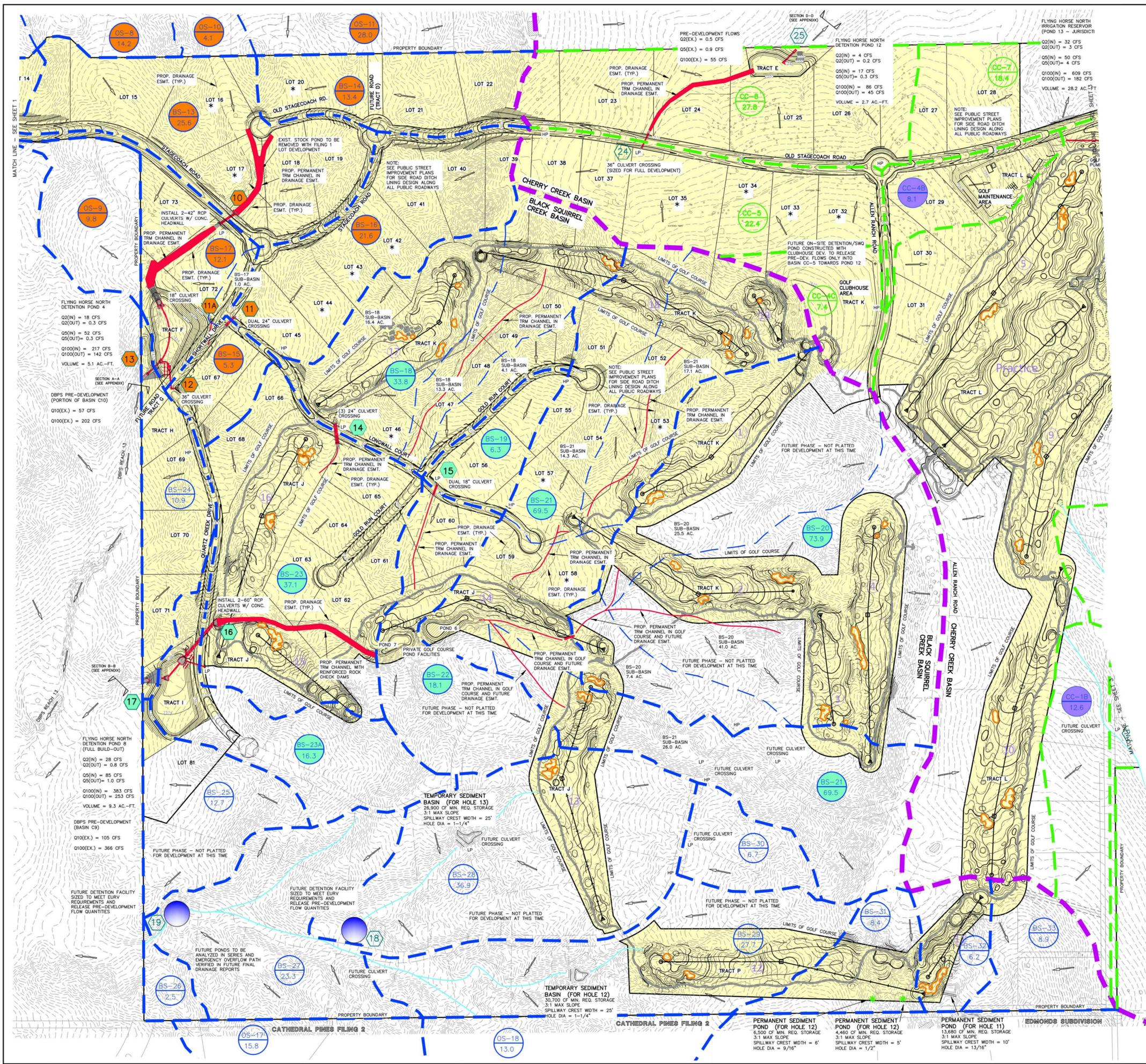


FLYING HORSE NORTH
PRELIMINARY/FINAL DRAINAGE REPORT
FILING NO. 1 DRAINAGE MAP

DESIGNED BY	MAW	SCALE	DATE	10-20-17
DRAWN BY	MAW	(H) 1" = 200'	SHEET	1 OF 4
CHECKED BY	(V) 1" = N/A	JOB NO.	1096.11	

619 N. Cascade Avenue, Suite 200
Colorado Springs, Colorado 80903
(719) 785-0790
(719) 785-0799 (Fax)

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BASIN SUMMARY - DEVELOPED CONDITIONS

BASIN (sqft)	AREA (ac)	COMPOSITE CN	TOTAL LAG TIME	Q 2 Yr. (cfs)	Q 5 Yr. (cfs)	Q 100 Yr. (cfs)
OS-8	14.20	65.0	0.27	1.0	6.2	24.7
OS-9	9.80	60.0	0.37	0.1	1.0	9.1
OS-10	4.10	65.0	0.17	0.7	2.1	8.2
OS-11	28.00	65.0	0.35	2.4	8.2	38.7
OS-12	28.10	62.7	0.37	2.1	11.9	78.8
OS-13	36.90	63.0	0.33	1.4	7.4	45.0
OS-14	26.40	62.0	0.31	0.7	4.6	31.0
OS-15	70.80	65.0	0.36	3.3	14.8	84.2
OS-16	4.50	65.0	0.24	0.4	1.5	7.2
OS-17	15.80	63.0	0.19	1.6	5.9	27.7
OS-18	13.00	65.0	0.20	1.3	4.7	22.6
BS-13	25.60	65.0	0.23	3.7	10.2	40.7
BS-14	13.40	65.0	0.23	2.8	8.8	26.5
BS-15	5.30	65.0	0.18	1.6	3.7	12.2
BS-16	21.80	65.0	0.34	4.6	11.8	44.1
BS-17	12.10	65.0	0.21	3.1	7.7	28.7
BS-18	33.80	63.6	0.41	3.5	12.4	56.0
BS-19	6.30	65.0	0.18	2.1	4.6	15.0
BS-20	73.90	63.4	0.31	7.4	24.6	112.4
BS-21	69.50	64.3	0.35	7.8	23.9	103.0
BS-22	18.10	64.4	0.22	3.7	9.6	36.5
BS-23	37.10	63.3	0.33	4.5	13.6	58.2
BS-24	16.30	64.4	0.29	5.5	12.0	38.3
BS-25	10.50	63.0	0.17	0.6	2.3	11.6
EX-24 (Pre-Dev)	13.20	60.0	0.17	0.2	2.2	17.8
BS-26	12.70	63.0	0.23	0.4	2.7	17.3
BS-27	2.50	80.0	0.18	0.0	0.4	3.4
BS-28	23.30	65.0	0.22	2.1	6.9	38.8
BS-29	36.90	64.4	0.32	2.2	9.3	49.4
BS-30	27.70	64.0	0.33	1.4	6.5	36.9
BS-31	6.70	65.0	0.20	0.7	2.4	11.7
BS-32	8.40	62.5	0.23	0.3	1.9	11.8
BS-33	6.20	62.6	0.20	0.3	1.6	9.4
BS-33	8.90	64.7	0.19	0.8	3.2	15.3
CC-1A	9.80	65.0	0.23	0.8	3.3	16.0
CC-1B	12.60	64.8	0.25	1.0	4.0	19.4
CC-2A	11.00	65.0	0.22	1.0	3.8	18.3
CC-2B	20.80	65.0	0.22	1.9	7.1	34.6
CC-3C	6.40	65.0	0.18	0.7	2.5	11.5
CC-3	52.50	63.1	0.43	1.8	8.8	54.5
CC-4A	108.70	62.6	0.44	15.4	39.0	156.0
CC-4B	8.10	76.1	0.26	4.0	7.3	20.6
CC-4C (Pre-Dev)	7.40	61.0	0.13	0.2	1.8	11.2
CC-5	22.40	65.0	0.26	1.8	7.1	34.3
CC-6	27.80	65.0	0.25	2.3	9.1	43.2
CC-7	18.40	65.0	0.29	1.4	5.4	27.0

DESIGN POINTS SURFACE ROUTING SUMMARY - DEVELOPED CONDITIONS

Design Point (label)	Contributing Basins	Q 2 Yr. (cfs)	Q 5 Yr. (cfs)	Q 100 Yr. (cfs)
DP-10 DEV	OS-8, OS-10, OS-11, BS-13, BS-14	10.7	32.0	143
DP-11 DEV	BS-16	4.6	11.8	36
DP-12 DEV	DP-11, 1.0 Ac. Portion of BS-17 and BS-15	4.2	11.8	46
TOTAL INFLOW TO POND 4 (UD Detention hydrograph)	DP-10, DP-12, BS-17, OS-9	10	16	217
DP-13 DEV	Release from FHN Pond 4	0.3	0.3	142
DP-14 DEV	BS-18	3.5	12.4	56
DP-15 DEV	BS-19	2.1	4.6	15
DP-16 DEV	DP-14, DP-15, BS-20, BS-21, BS-22, BS-23	25.0	78.0	362
TOTAL INFLOW TO FHN POND 8 (Full Build-out) (UD Detention hydrograph)	DP-10, DP-12, BS-17, OS-9	24	37	390
DP-17 DEV (Full Build-out)	Release from FHN Pond 8	0.8	1.0	253
TOTAL INFLOW TO FHN POND 8 (Filing 1 Only) (UD Detention hydrograph)	DP-10, DP-12, BS-17, OS-9	9	14	301
DP-17 DEV (Filing 1 Only)	Release from FHN Pond 8	0.4	0.5	219
DP-18 DEV	BS-28, BS-29, BS-30, OS-18	5.0	21.6	115
DP-19 DEV	BS-27, OS-17, Release from DP-18	3.8	16.8	126
DP-20 DEV	CC-1A, OS-12	3.2	14.3	88
DP-21 DEV	CC-2A, OS-13	2.1	10.5	62
DP-22 DEV	CC-2B, Release from DP-21	3.7	16.6	92
DP-23 DEV	CC-3, OS-14	2.5	13.0	84
DP-24 DEV	CC-4C (Pre-Dev), CC-5	1.9	8.4	45
TOTAL INFLOW TO POND 12 (UD Detention hydrograph)	CC-4C, CC-5, CC-6	6	9	85
DP-25 DEV	Release from FHN Pond 12	0.2	0.3	45

LEGEND

DESCRIPTION

- EXISTING GROUND CONTOUR: 6910
- PROPOSED FINISHED CONTOUR: 6910
- BASIN BOUNDARY EAST CHERRY CREEK: ---
- MAJOR BASIN BOUNDARY: - - - -
- BASIN BOUNDARY BLACK SQUIRREL: - - - -
- DESIGN POINT: (3)
- LOTS WITH NON-STANDARD CULVERT SIZE: *
- BASIN IDENTIFIER AREA IN ACRES: BB 10.0
- EXISTING DIRECTION OF FLOW: →
- PROPOSED DIRECTION OF FLOW: →
- STORM SEWER: ---
- FILING NO. 1 PLAT AREA: [Yellow Box]

SCALE: 1" = 200'

CLASSIC CONSULTING ENGINEERS & SURVEYORS

FLYING HORSE NORTH PRELIMINARY/FINAL DRAINAGE REPORT
FILING NO. 1 DRAINAGE MAP

DESIGNED BY	MAW	SCALE	DATE	10-25-17
DRAWN BY	MAW	(H) 1" = 200'	SHEET	2 OF 4
CHECKED BY	(V)	N/A	JOB NO.	1096.11

619 N. Cascade Avenue, Suite 200 (719)785-0790
Colorado Springs, Colorado 80903 (719)785-0799 (Fax)

BASIN SUMMARY - DEVELOPED CONDITIONS

BASIN (label)	AREA (acres)	COMPOSITE CN	TOTAL LAG TIME (hours)	Q 2 Yr. (cfs)	Q 5 Yr. (cfs)	Q 100 Yr. (cfs)
OS-16	4.50	65.0	0.24	0.4	1.5	7.2
OS-17	15.80	65.0	0.19	1.6	5.9	27.7
OS-18	13.00	65.0	0.20	1.3	4.7	22.6
CC-11	18.60	63.1	0.21	0.9	5.0	28.1
CC-12	12.20	65.0	0.26	1.0	3.9	18.7
CC-13A	19.30	65.0	0.31	1.4	5.4	27.3
CC-13B	25.50	65.0	0.31	1.8	7.2	36.1
CC-13C	9.90	65.0	0.22	0.9	3.4	16.5
CC-13D	18.80	65.0	0.25	1.5	6.2	29.2
CC-14	4.60	65.0	0.21	0.4	1.6	7.8
CC-15	12.80	65.0	0.24	1.1	4.3	20.4
CC-16	16.30	65.0	0.30	1.2	4.6	23.6
CC-17	25.00	65.0	0.35	1.7	6.5	32.8
CC-18	6.20	66.5	0.30	0.7	2.2	9.7
CC-19	3.70	65.0	0.25	0.3	1.2	5.8
CC-20	39.30	65.0	0.25	3.2	12.9	61.0
CC-21	6.20	61.0	0.20	0.1	1.2	8.5
CC-22	13.80	65.0	0.25	1.1	4.5	21.4
CC-23	5.70	64.7	0.33	0.4	1.5	7.7
CC-24	39.60	65.0	0.25	3.3	13.0	61.5
CC-25	3.50	65.0	0.23	0.3	1.2	5.7
CC-26	16.70	65.0	0.26	1.4	5.3	25.6
CC-27	18.90	64.4	0.31	1.2	4.9	25.8
CC-28	154.80	64.4	0.63	6.5	24.7	136.3

DESIGN POINTS SURFACE ROUTING SUMMARY - DEVELOPED CONDITIONS

Design Point (label)	Contributing Basins	Q 2 Yr. Q (cfs)	Q 5 Yr. Q (cfs)	Q 100 Yr. Q (cfs)
DP-27 DEV	CC-15, CC-20	4.3	17.2	81
DP-28 DEV	CC-13A, OS-15	4.6	19.8	110
DP-29 DEV	CC-13B, CC-13C, Release from DP-28	5.8	26.6	155
DP-30 DEV	CC-18	0.7	2.2	10
DP-31 DEV	CC-19, Release from DP-30	0.9	3.2	15
DP-32 DEV	CC-17, OS-16	2.0	7.8	40
DP-33 DEV	CC-23, CC-24	3.6	14.4	69
DP-34 DEV	CC-26, CC-27, CC-28 and Release from CC-16 & DP-32	6.0	23.5	168

LEGEND

DESCRIPTION	SYMBOL
EXISTING GROUND CONTOUR	6910
PROPOSED FINISHED CONTOUR	6910
BASIN BOUNDARY EAST CHERRY CREEK	---
MAJOR BASIN BOUNDARY	---
BASIN BOUNDARY BLACK SQUIRREL	---
DESIGN POINT	3
LOTS WITH NON-STANDARD CULVERT SIZE	*
BASIN IDENTIFIER	BB 10.0
AREA IN ACRES	→
EXISTING DIRECTION OF FLOW	→
PROPOSED DIRECTION OF FLOW	→
STORM SEWER	---
FLYING HORSE NORTH PLAT AREA	---

SCALE: 1" = 200'

CLASSIC CONSULTING ENGINEERS & SURVEYORS

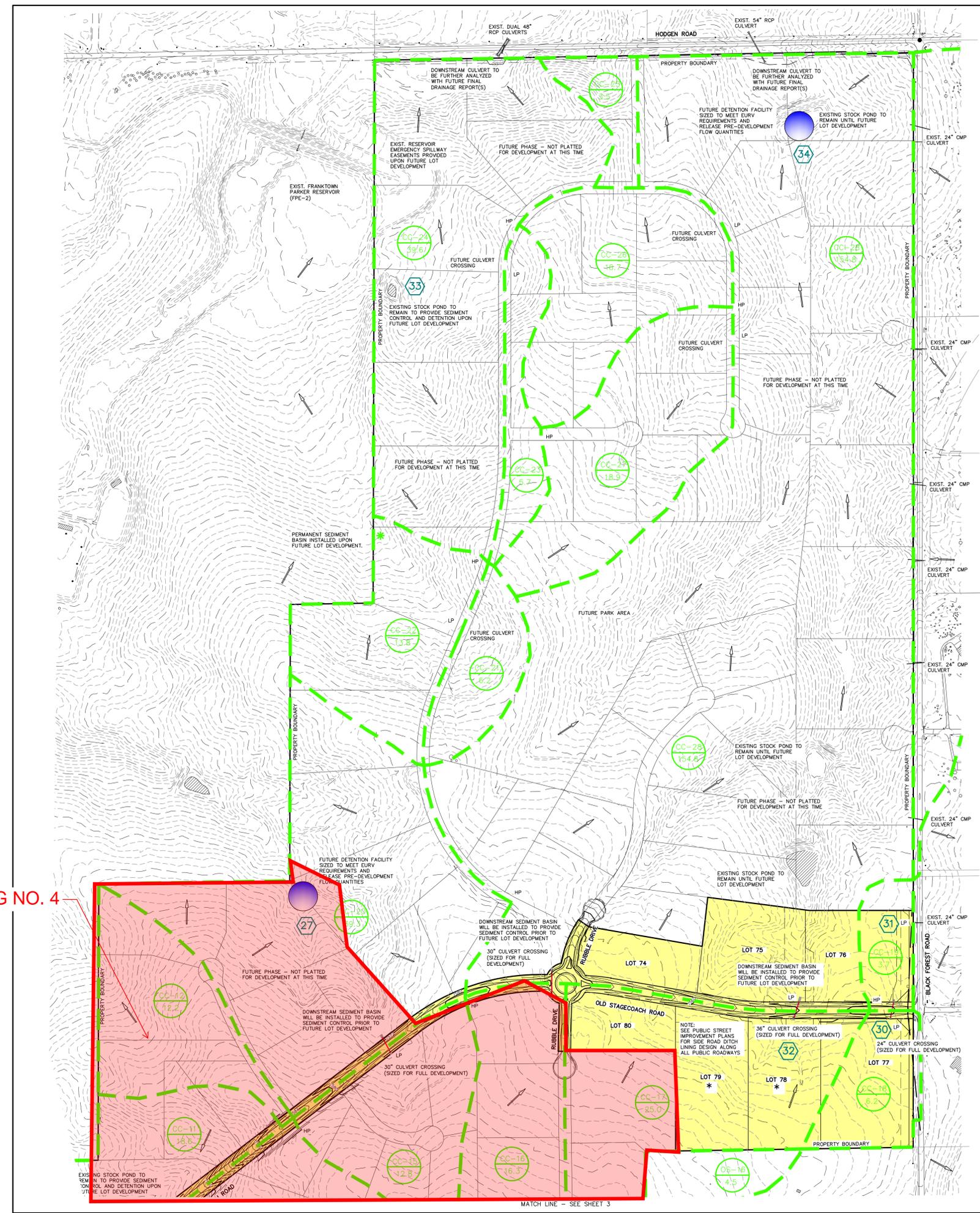
FLYING HORSE NORTH
PRELIMINARY/FINAL DRAINAGE REPORT
PRELIMINARY PLAN DRAINAGE MAP

DESIGNED BY	MAW	SCALE	DATE	10-17-17
DRAWN BY	MAW	(H) 1" = 200'	SHEET	4 OF 4
CHECKED BY	(V)	N/A	JOB NO.	1096.11

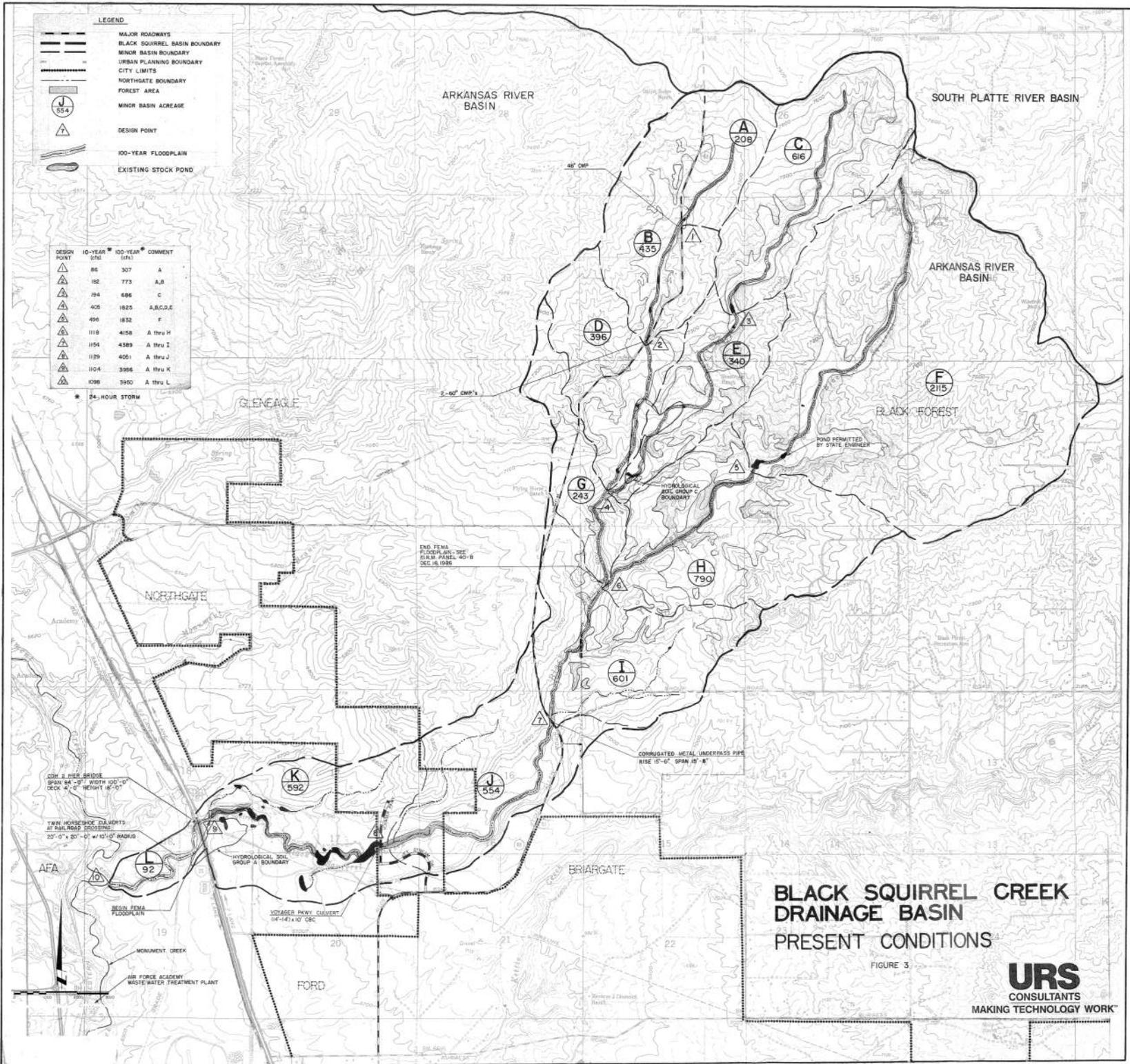
619 N. Cascade Avenue, Suite 200
Colorado Springs, Colorado 80903
(719)785-0790
(719)785-0799 (Fax)

FILING NO. 4

K:\026114\REPORTS\DRG\10101717\DRG_20141019_81142019_81142019.dwg, 11



MATCH LINE - SEE SHEET 3



LEGEND

- MAJOR ROADWAYS
- BLACK SQUIRREL BASIN BOUNDARY
- MINOR BASIN BOUNDARY
- URBAN PLANNING BOUNDARY
- CITY LIMITS
- NORTHGATE BOUNDARY
- FOREST AREA
- MINOR BASIN ACREAGE
- DESIGN POINT
- 100-YEAR FLOODPLAIN
- EXISTING STOCK POND

DESIGN POINT	10-YEAR (FE)	100-YEAR (FE)	COMMENT
	86	307	A
	182	773	A,B
	194	686	C
	405	1825	A,B,C,D,E
	490	1832	F
	1119	4158	A thru H
	1154	4383	A thru I
	1199	4051	A thru J
	1104	3956	A thru K
	1288	3950	A thru L

* 24-HOUR STORM

**BLACK SQUIRREL CREEK
DRAINAGE BASIN
PRESENT CONDITIONS**

FIGURE 3

URS
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Flying Horse North Master Development Drainage Plan

March 09, 2022

Revised: July 28, 2022

Revised: September 9th, 2022

HR Green Project No: 211030.01

Prepared For:

Mr. Drew Balsick

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Prepared By:

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720-602-4956

PCD File No. SKP223

g. Applicable Criteria and Standards

Per the DBPS and El Paso County Criteria Manual, flows from the proposed site will be limited to historic flows to maintain the stability of the existing channels within the drainage basins. The master plan follows the Drainage Criteria Manual for El Paso County which refers to the City of Colorado Springs Drainage Criteria Manuals as amended.

II. Project Characteristics

a. Location in Drainage Basin, Offsite Flows, Size

Flying Horse North is located within both the Black Squirrel Drainage Basin and East Cherry Creek Basin. Predominantly, the existing Filing No.1 and part of the proposed Filing No. 2 is located within the Black Squirrel Drainage Basin. This drainage basin encompasses 10.9 square miles of mostly forested area and generally slopes from east to west and outfalls into Monument Creek. Black Squirrel is a sub-basin of the Arkansas River. The remaining filings and part of Filing No. 2 is located within the East Cherry Creek Basin. There is not a current planning study of the drainage basin, but generally it slopes from southwest to northeast. The basin eventually flows into the South Platte River.

As the site generally lies at the top of each of the respective basins, minimal offsite flows are conveyed onto the site. The Black Squirrel Creek Drainage basin has no offsite flow come onto the site sans those flows generated as part of Filing 1 of Flying Horse North. The development which is within the Black Squirrel Creek Drainage Basin is unchanged from the FDR shown in Filing 1.

For the East Cherry Creek basin, 4 drainage basins are conveyed onto the site on the southwestern portion of the basin. These basins are labeled A, C, F and Q. The respective contributing flows from these basins is shown in the table below:

Basin Name	Acreage	5 Year Flow (cfs)	100 Year Flow (cfs)
A	18.99	20.84	43.83
C	36.39	33.36	71.27
F	25.25	24.27	51.63
Q	72.29	64.68	137.80

These four basins are generally conveyed through the development via natural drainage ways. The proposed ponds discussed later within this report have been sized to pass through the offsite flows.

b. Compliance with DBPS

This MDDP is in general conformance with the guidelines outlined in the Black Squirrel DBPS and current drainage flows of the East Cherry Creek Basin. Flying Horse North will construct multiple full spectrum detention facilities to limit the effects of development and mimic natural flow patterns.

Existing downstream infrastructure is currently limited to the historic drainage channels and minimal downstream improvements exist. As such, the site follows the DBPS and restricts offsite flow rates to not exceed historic flow rates. The sites ultimate outfalls will generally be along the same historic tributaries. Although outfall rates will be at or below historic, the cumulative volume of runoff will increase and therefore downstream facilities may see an increase in the duration of flows. This may provide a net benefit to the downstream facilities by providing more water to assist with the sustenance of vegetation however it should be noted that increased volume may expedite potential erosion or channel movement.



c. Site Characteristics

Per the NRCS web soil survey, the site is made up entirely of Type B soils. The ridge line between the Arkansas River and South Platte River Basins creates different soil environments for each. The portion of site that is within the Black Squirrel Drainage Basin, which includes Flying Horse Norse Filing No. 2 and No. 3, are predominately Elbeth sandy loam. The remaining filings are within the East Cherry Creek Basin which consists of Peyton sandy loam and Peyton-Pring complex. See Appendix A for the NRCS soil map.

Current ground cover varies between the two basins as well. Filings No. 2 and 3 are predominantly covered by Ponderosa Pine trees as a part of Black Forest and pasture. The remaining filings are short-to mid-grass prairie grasslands and former farmland which consists of non-native weeds and grasses. This portion of the site has very few, if any, trees and a minimal number of shrubs are found on the site.

d. Major Drainage Ways and Structures

No major drainage ways exist within the development; however, small tertiary tributaries are within the site currently and function to convey flows to unnamed tributaries of the East Cherry Creek and Black Squirrel Creek. Additionally, as part of the Flying Horse North Filing 1 development, a large irrigation pond was built for water storage and flood control. This drains to the north and to the aforementioned unnamed tributary.

Existing minor drainage channels within the site are planned to be maintained to the maximum extent possible within parkways and greenways with the development. These will continue to be used for conveyance of storm drainage flows.

The Franktown Parker Dam (080130) is located near the northwest corner of site. The dam is designated as a jurisdictional dam and has a low hazard class. It is located along East Cherry Creek. See Appendix A for characteristics and location of dam.

e. Existing and proposed land uses

The existing site is open rangeland on the eastern portion of the site and the western site is single family homes on large (~2.5 acre) home site within a heavily forested area. As part of Filing 1, a road was constructed along with facilities to support a golf course. Structures, outside of the homes are scattered throughout the overall development which will either be removed as part of the project or were built as part of Filing 1. The proposed development will consist of estate, low and medium lots, along with a future hotel site and multiple green spaces and small parks. The current land plan assumes approximately 897 dwelling units will be constructed on the site, not including an approximate 225 provided the proposed hotel.

Land Use	MAX DU/AC
Estate Lots (2.5 Acres)	0.32
Estate Lots (5 Acres)	0.2
Low	1.9
Medium	3.0

III. Hydrologic Analysis

a. Major Basins and subbasins

Major Basin Description

- Previous basin study: Black Squirrel Drainage Basin Planning Study
- Per FEMA FIRM 08041C0305G and 08041C0315G (eff. 12/7/2018), Flying Horse North has the East Cherry Creek run through the northwest portion of the site. Currently, FEMA shows a LOMR effective April 4th, 2019 Base Flood Elevations and Zone A. Per the El Paso County Land Development Code Chapter 8 Section 8.4.2.B.1.e.i, the base flood elevations for Zone A will be determined once the platted lots are solidified and are confirmed within 300-ft of the current floodplain designation. Certification of the flood elevations will be via the FEMA CLOMR/LOMR process or Floodplain Certification Letter.
- There is a large irrigation pond that accounts for water storage and water control on the east side of the site.

The site has been divided into several major drainage basins per where each basin is tributary to a full spectrum detention pond facility. These basins and associated sub basins are described in more detail in the next section of this report.

Existing Subbasin Description

The site's flows are split by the major ridgeline of the Arkansas River Basin and South Platte Basin. Within the South Platte Basin, flow is generally carried northeast throughout the site. On the other side of the ridgeline, the Arkansas River Basin flows in a southwest direction. Subbasin IDs with single letters are part of the South Platte Basin and Subbasin IDs with double letters are part of the Arkansas River Basin.

- Subbasin A is located off site and on the southeast corner. The basin drains towards the northwest and towards Subbasin B1. The basin is 18.99 acres, with a composite impervious value of 2.00% and runoff rates for the 5 and 100 year of 20.84 cfs and 43.83 cfs respectively.
- Subbasin B is located north of Subbasin A. The basin drains towards the northwest into a natural drainageway that flows directly to an existing irrigation pond. The basin is 59.74 acres, with a composite impervious value of 2.00% and runoff rates for the 5 and 100 year of 103.48 cfs and 221.28 cfs respectively.
- Subbasin C is located off site and on the southeast corner. The basin drains towards the northwest and towards Subbasin B2. The basin is 36.39 acres, with a composite impervious value of 2.00% and runoff rates for the 5 and 100 year of 33.36 cfs and 71.27 cfs respectively.
- Subbasin D is located north of Subbasin B. The basin drains towards the northwest and towards the existing irrigation pond. The basin is 38.84 acres, with a composite impervious value of 2.00% and runoff rates for the 5 and 100 year of 31.56 cfs and 67.84 cfs respectively.
- Subbasin E is in a central location of the site and includes the existing irrigation pond. The basin drains towards the north and towards existing irrigation pond. The basin is 106.53 acres, with a composite impervious value of 2.00% and runoff rates for the 5 and 100 year of 223.69 cfs and 483.10 cfs respectively.

- Subbasin F is located off site and on the southeast corner. The basin drains towards the northwest and towards Subbasin G. The basin is 25.25 acres, with a composite impervious value of 2.00% and runoff rates for the 5 and 100 year of 24.27 cfs and 51.63 cfs respectively.
- Subbasin G is directly north of Subbasin D and east of Subbasin E. The basin drains towards the northwest and towards Subbasin E with the irrigation pond. The basins consist of the existing golf course. The basin is 52.19 acres, with a composite impervious value of 2.00% and runoff rates for the 5 and 100 year of 79.17 cfs and 166.51 cfs respectively.
- Subbasin H is located directly downstream of Subbasin E and on the north side of Stagecoach Rd. The basin drains towards the north through a natural drainageway. There are existing lots on the west side of the basin. The basin is 20.63 acres, with a composite impervious value of 2.00% and runoff rates for the 5 and 100 year of 18.59 cfs and 39.78 cfs respectively.
- Subbasin I is located west of Subbasin E and northeast of the major ridgeline between basins. The basin drains towards the northwest and towards an existing culvert. There are existing lots on the west side of the basin. The basin is 31.93 acres, with a composite impervious value of 2.00% and runoff rates for the 5 and 100 year of 34.58 cfs and 72.63 cfs respectively.
- Subbasin J is located downstream of Subbasin I. The basin drains towards the northeast to an unnamed tributary of the East Cherry Creek. The basin is 28.47 acres, with a composite impervious value of 2.00% and runoff rates for the 5 and 100 year of 56.31 cfs and 120.46 cfs respectively.
- Subbasin K is located south of proposed section of Stagecoach Rd. The basin drains towards the northwest and into an existing 48" culvert. The basin is 93.15 acres, with a composite impervious value of 2.00% and runoff rates for the 5 and 100 year of 92.05 cfs and 195.43 cfs respectively.
- Subbasin L is downstream of Subbasin K and is located on the north side of the proposed section of Stagecoach Rd. The basin drains towards the northwest to a natural drainageway of East Cherry Creek. The basin is 16.39 acres, with a composite impervious value of 2.00% and runoff rates for the 5 and 100 year of 107.58 cfs and 228.73 cfs respectively.
- Subbasin M is located on the east side of the site and between Subbasin N and V1. The basin drains towards the northwest and into an existing 30" culvert. The basin is 13.85 acres, with a composite impervious value of 2.00% and runoff rates for the 5 and 100 year of 11.48 cfs and 24.61 cfs respectively.
- Subbasin N is located south of Subbasin O and north of proposed Stagecoach Rd. The basin drains towards the northwest to a nearby unnamed tributary and eventually East Cherry Creek. The basin is 49.00 acres, with a composite impervious value of 2.00% and runoff rates for the 5 and 100 year of 64.68 cfs and 143.11 cfs respectively.
- Subbasin O is located south of Subbasin P. The basin drains towards the northwest and towards the north. The basin is 24.76 acres, with a composite impervious value of 2.00% and runoff rates for the 5 and 100 year of 22.69 cfs and 48.54 cfs respectively.
- Subbasin P is in the northeast corner of the site and downstream of Subbasin O. The basin drains towards the northeast to an unnamed tributary of East Cherry Creek. The basin is 43.80 acres, with a composite impervious value of 2.00% and runoff rates for the 5 and 100 year of 38.52 cfs and 82.17 cfs respectively.

- Subbasin Q is located off site and on the southeast corner. The basin drains towards the northeast and towards Subbasin R. The basin is 72.29 acres, with a composite impervious value of 2.00% and runoff rates for the 5 and 100 year of 64.68 cfs and 137.80 cfs respectively.
- Subbasin R is located on the east side of site adjacent to Black Forest Rd. The basin drains towards the northeast. The basin is 54.98 acres, with a composite impervious value of 2.00% and runoff rates for the 5 and 100 year of 108.65 cfs and 232.13 cfs respectively.
- Subbasin S is located north of Subbasin Q. The basin drains towards the southeast and overland towards Subbasin R. The basin is 24.36 acres, with a composite impervious value of 2.00% and runoff rates for the 5 and 100 year of 25.99 cfs and 54.65 cfs respectively.
- Subbasin T is located off site and on the southeast corner. The basin drains towards the southeast and towards Black Forest Rd. The basin is 5.24 acres, with a composite impervious value of 2.00% and runoff rates for the 5 and 100 year of 4.04 cfs and 8.68 cfs respectively.
- Subbasin U is located east of subbasin V and is composed of existing 2.5 acre lots. The basin drains offsite towards the southeast and follows historic drainage patterns. The basin is 5.86 acres, with a composite impervious value of 10.00% and runoff rates for the 5 and 100 year of 4.15 cfs and 8.95 cfs respectively.
- Subbasin V is located on the east side of the site in between Subbasin M and U. The basin drains towards the north and towards Subbasin X via culvert. The basin is 38.57 acres, with a composite impervious value of 2.00% and runoff rates for the 5 and 100 year of 29.63 cfs and 63.92 cfs respectively.
- Subbasin W is located north of Subbasin U on the site. The basin drains offsite through an existing 24" CMP culvert. The basin is 3.96 acres, with a composite impervious value of 2.00% and runoff rates for the 5 and 100 year of 3.45 cfs and 7.33 cfs respectively.
- Subbasin X is located on the northeastern corner of the site. The basin drains north towards an unnamed tributary of East Cherry Creek. The basin is 190.88 acres, with a composite impervious value of 2.00% and runoff rates for the 5 and 100 year of 167.76 cfs and 361.56 cfs respectively.
- Subbasins AA and CC are located on the west side of the site along the major ridgeline. Both basins were developed in Filing No. 1 and are included in the analysis to provide a better understanding for the flows draining towards Black Squirrel Creek. The basins drain towards the southwest. The basins are 33.8 acres and 37.15 acres, with a composite impervious value of 10% and 10% and runoff rates for the 5 and 100 year of 38.76 cfs and 80.22 cfs and 6.53 cfs and 13.57 cfs respectively.
- Subbasin BB is located downstream of Subbasin AA. The basin drains towards the southwest and towards Subbasin GG. A section of the area of the basin was developed in Filing No. 1 and consists of 2.5-acre lots. The basin is 37.15 acres, with a composite impervious value of 10.00% and runoff rates for the 5 and 100 year of 40.62 cfs and 84.15 cfs respectively.
- Subbasin DD is located west and downstream of Subbasin EE. The basin drains towards the west. A portion developed in Filing No. 1 consists of the Flying Horse North Golf Course and 2.5-acre lots. The basin is 70.07 acres, with a composite impervious value of 10.00% and runoff rates for the 5 and 100 year of 58.42 cfs and 123.69 cfs respectively.

Proposed Subbasin Description

- Subbasin A is located off site and on the southeast corner. The basin drains towards the northwest and towards Subbasin B1. The basin is 18.99 acres, with a composite impervious value of 2.00% and runoff rates for the 5 and 100 year of 20.84 cfs and 43.83 cfs respectively.
- Subbasin B1 is located north of Subbasin A. The basin drains towards the northwest and towards proposed Detention Pond 11. Current planning documents call for low density dwelling units. The basin is 59.74 acres, with a composite impervious value of 29.83% and runoff rates for the 5 and 100 year of 66.93 cfs and 133.69 cfs respectively.
- Subbasin B2 is located northeast of Subbasin B1. The basin drains towards the northwest and towards the proposed Detention Pond 11. Current planning documents call for low density dwelling units. The basin is 19.99 acres, with a composite impervious value of 24.55% and runoff rates for the 5 and 100 year of 17.99 cfs and 37.14 cfs respectively.
- Subbasin C is located off site and on the southeast corner. The basin drains towards the northwest and towards Subbasin B2. The basin is 36.39 acres, with a composite impervious value of 2.00% and runoff rates for the 5 and 100 year of 35.31 cfs and 75.28 cfs respectively.
- Subbasin D is located north of north of Subbasins B1 and B2. The basin drains towards the northwest and towards Detention Pond 15. Current planning documents call for low density dwelling units. The basin is 40.87 acres, with a composite impervious value of 37.20% and runoff rates for the 5 and 100 year of 61.12 cfs and 117.38 cfs respectively.
- Subbasin E is in a central location of the site and includes the existing irrigation pond. The basin drains towards the north and towards existing irrigation pond. Current planning documents call for two small parking lots. The basin is 106.53 acres, with a composite impervious value of 14.35% and runoff rates for the 5 and 100 year of 74.68 cfs and 157.91 cfs respectively.
- Subbasin F is located off site and on the southeast corner. The basin drains towards the northwest and towards Subbasin G. The basin is 25.25 acres, with a composite impervious value of 2.00% and runoff rates for the 5 and 100 year of 24.27 cfs and 51.63 cfs respectively.
- Subbasin G is directly north of Subbasin D and east of Subbasin E. The basin drains towards the northwest and towards Subbasin E. Current planning documents call for a small amount of low density dwelling units, where most of the basin consist of the existing golf course. The basin is 31.45 acres, with a composite impervious value of 12.48% and runoff rates for the 5 and 100 year of 27.18 cfs and 57.12 cfs respectively.
- Subbasin H is located located directly downstream of Subbasin E and on the north side of Stagecoach Rd. The basin drains towards the north and towards Detention Pond 10. Current planning documents call for medium density dwelling units. There are existing lots on the west side of the basin. The basin is 21.96 acres, with a composite impervious value of 10.00% and runoff rates for the 5 and 100 year of 17.86 cfs and 37.8 cfs respectively.
- Subbasin I is located west of Subbasin E and northeast of the major ridgeline between basins. The basin drains towards the northwest and towards proposed Detention Pond 16. There are existing lots on the west side of the basin. Current planning documents call for a commercial golf club. The basin is 28.99 acres, with a composite impervious value of 34.66% and runoff rates for the 5 and 100 year of 40.37 cfs and 78.06 cfs respectively

- Subbasin J is located downstream of Subbasin I. The basin drains towards the northeast to an unnamed tributary of the East Cherry Creek. Current planning documents do not call for any changes to this basin. The basin is 28.07 acres, with a composite impervious value of 10% and runoff rates for the 5 and 100 year of 24.25 cfs and 51.19 cfs respectively.
- Subbasin K is located south of proposed section of Stagecoach Rd. The basin drains towards the northwest and towards proposed Detention Pond 7. Current planning documents call for high, medium, and low density dwelling units and a few pocket parks. The basin is 114.73 acres, with a composite impervious value of 38.08% and runoff rates for the 5 and 100 year of 200.94 cfs and 382.3 cfs respectively
- Subbasin L is downstream of Subbasin K and is located on the north side of the proposed section of Stagecoach Rd. The basin drains towards the northwest into proposed Detention Pond 8. Current planning documents call for medium density dwelling units. The basin is 15.89 acres, with a composite impervious value of 24.82% and runoff rates for the 5 and 100 year of 15.97 cfs and 32.4 cfs respectively. The pond will discharge at predevelopment rates into an unnamed tributary of the East Cherry Creek via the ponds outlet structure.
- Subbasin M is located on the east side of the site and between Subbasin N and V1. The basin drains towards the northwest and towards proposed Detention Pond 6. Detention Pond 6 outlets into a culvert under proposed Stagecoach Rd. and eventually to Subbasin N. Current planning documents call for medium density dwelling units, potential fitness center, and a park. The basin is 26.83 acres, with a composite impervious value of 33.19% and runoff rates for the 5 and 100 year of 46.54 cfs and 89.08 cfs respectively.
- Subbasin N is located south of Subbasin O and North of proposed Stagecoach Rd. The basin drains towards the northwest towards proposed Detention Pond 5. Detention Pond 5 outlets to a nearby unnamed tributary and eventually East Cherry Creek. Current planning documents call for medium density dwelling units along with a pocket park. The basin is 41.57 acres, with a composite impervious value of 29.60% and runoff rates for the 5 and 100 year of 73.48 cfs and 141.24 cfs respectively.
- Subbasin O is located south of Subbasin P. The basin drains towards the northwest and towards Detention Pond 3. Current planning documents call for medium density dwelling units. The basin is 52.52 acres, with a composite impervious value of 30.10% and runoff rates for the 5 and 100 year of 63.86 cfs and 127.4 cfs respectively. The pond will discharge at predevelopment rates and into Pond 1 via a swale.
- Subbasin P is in the northeast corner of the site and downstream of Subbasin O. The basin drains towards the northeast to proposed Detention Pond 1. Current planning documents call for low density dwelling units. The basin is 43.71 acres, with a composite impervious value of 20.71% and runoff rates for the 5 and 100 year of 40 cfs and 82.83 cfs respectively. The pond will discharge at predevelopment rates into an unnamed tributary of the East Cherry Creek via the ponds outlet structure.
- Subbasin Q is located off site and on the southeast corner. The basin drains towards the northeast and towards Subbasin R. The basin is 72.29 acres, with a composite impervious value of 2.00% and runoff rates for the 5 and 100 year of 64.68 cfs and 137.8 cfs respectively.

- Subbasin R is located on the east side of site adjacent to Black Forest Rd. The basin drains towards the northeast and towards Detention Pond 9. Current planning documents call for low density and 1-acre lots. The basin is 76.38 acres, with a composite impervious value of 21.81% and runoff rates for the 5 and 100 year of 56.59 cfs and 116.06 cfs respectively. The pond will discharge at predevelopment rates into an unnamed tributary of the East Cherry Creek via the ponds outlet structure.
- Subbasin S is located north of Subbasin Q. The basin drains towards the southeast and overland towards Subbasin R. Current planning documents call for low density dwelling units. The basin is 21.67 acres, with a composite impervious value of 40.88% and runoff rates for the 5 and 100 year of 30.83 cfs and 58.96 cfs respectively.
- Subbasin T is located off site and on the southeast corner. The basin drains towards the southeast and towards Black Forest Rd. The basin is 5.24 acres, with a composite impervious value of 2.00% and runoff rates for the 5 and 100 year of 4.04 cfs and 8.68 cfs respectively.
- Subbasin U is located east of subbasin V2 and is composed of existing 2.5 acre lots. The basin drains offsite towards the southeast and follows historic drainage patterns. The basin is 5.86 acres, with a composite impervious value of 2% and runoff rates for the 5 and 100 year of 4.96 cfs and 10.51 cfs respectively.
- Subbasin V1 is located on the east side of the site in between Subbasin M and V2. The basin drains towards the north and towards Subbasin X3 via culvert. Current planning documents call for low density dwelling units. The basin is 11.57 acres, with a composite impervious value of 38.62% and runoff rates for the 5 and 100 year of 13.99 cfs and 27.67 cfs respectively.
- Subbasin V2 is located south of subbasin X3 and proposed Stagecoach Rd. The basin drains towards the north and towards subbasin X3. The flows are directed through a culvert and eventually to Detention Pond 4. There are no proposed dwelling unit for the area, as there are existing 2.5 acre lots that cover the basin. The basin is 15.34 acres, with a composite impervious value of 15.00% and runoff rates for the 5 and 100 year of 16.15 cfs and 33.25 cfs respectively.
- Subbasin W is located on the north side of subbasin U. The basin drains offsite to the southeast. The basin is 3.76 acres, with a composite impervious value of 10.00% and runoff rates for the 5 and 100 year of 3.58 cfs and 7.46 cfs respectively.
- Subbasin X1 is located on the northeastern corner of the site. The basin drains north towards proposed Detention Pond 2. Current planning documents call for low density dwelling units, potential fire station and a pocket park. The basin is 76.38 acres, with a composite impervious value of 29.50% and runoff rates for the 5 and 100 year of 80.91 cfs and 163.27 cfs respectively. The pond will discharge at predevelopment rates into an unnamed tributary of the East Cherry Creek via the ponds outlet structure.
- Subbasin X2 is located south of Subbasin X1 The basin drains towards the northeast towards proposed Detention Pond 4. Current planning documents call for low density dwelling units along with a pocket park. The basin is 36.33 acres, with a composite impervious value of 33.33% and runoff rates for the 5 and 100 year of 41.46 cfs and 82.46 cfs respectively.
- Subbasin X3 is located south of Subbasin X2. The basin drains towards the north and towards Detention Pond 4. Current planning documents call for low density dwelling units and a pocket

The above-mentioned basins are large planning area basins and as drainage reports are developed for the individual developed parcels additional drainage reports and calculations will be required. It is expected that storm drainage infrastructure consisting of inlets, storm sewer and open drainage channels will be constructed as the property develops.

- Although mentioned above, offsite basins include basins A, C, F, and Q. Flow contributing to the site from these basins will be routed through the proposed detention ponds. Flow rates are shown below.

Offsite Flow Summary					
Basin Description	Ultimate Design Point	Basin Area (ac)	Receiving Detention Pond	5 Year Peak Runoff (cfs)	100 Year Peak Runoff (cfs)
A	A	18.99	Pond 11	20.84	43.83
C	C	36.39	Pond 11	33.36	71.27
F	F	25.25	Irr. Pond	24.27	51.63
Q	Q	72.29	Pond 9	64.68	137.80

b. Methodology

Design rainfall was determined utilizing Table 6-2 from the City of Colorado Springs Drainage Criteria Manual to determine the 5-year and 100-year rainfall values for the 1-hour events. The 1-hour rainfall depths are 1.5 and 2.52 in/hr respectively.

Composite percent impervious calculations were completed for each subbasin based on the density of lots and can be found in Appendix B. The El Paso County Drainage Criteria Manual Table 5-1 was used for reference when correlating land use to percent impervious values and located in Appendix F. Impervious values for 5-Acre Lots, 2.5-Acre Lots, Medium Density, Low Density, and Commercial Lots had impervious values of 10%, 15%, 45%, 55% and 75% respectively. The rainfall and percent impervious values were then used as inputs into the Colorado Urban Hydrograph Procedure (CUHP) spreadsheets to determine runoff values for both pre-development and post-development site.

CUHP is an evolution of the Snyder unit hydrograph and is calibrated for use along the Colorado Front Range. 1 Hour rainfall amounts are input into the program to produce a storm hydrograph that is then used to calculate a storm hydrograph for each basin depending on the subbasins properties including slope, length, shape, impervious area, pervious depression storage area, and various infiltration rates. Tabular hydrographs are then computed and can be used in EPA SWMM. The CUHP results are included within Appendix B.

EPA SWMM was used to determine flow routing via the kinematic wave method. Subbasins were routed to their respective design points and detention ponds for both the developed and predeveloped condition to determine peak runoff amounts for the 5-year and 100-year storm events. Information from these models along with information and calculations performed in the Mile High Flood District BMP spreadsheets was used to determine pond sizing calculations and release rates.

c. Basin Hydrology

A summary of the flows for both the predeveloped and developed cases for each basin, subbasin and Pond are found on next page along with the full computation found in Appendix B.

Existing SWMM Basin Summary				
Basin Description	Basin Area (ac)	% Impervious	5 Year Peak Runoff (cfs)	100 Year Peak Runoff (cfs)
A	18.99	2.00	20.84	43.83
B	59.74	2.00	103.48	221.48
C	34.87	2.00	33.36	71.27
D	38.84	2.00	31.56	67.84
E	127.86	2.00	223.69	483.10
F	25.25	2.00	24.27	51.63
G	52.19	2.00	79.17	166.51
H	20.63	2.00	18.59	39.78
I	31.93	2.00	34.58	72.63
J	28.47	2.00	56.31	120.46
K	93.14	2.00	92.05	195.43
L	16.39	2.00	107.58	228.73
M	13.87	2.00	11.48	24.61
N	49.00	2.00	68.16	143.11
O	24.76	2.00	22.69	48.54
P	43.80	2.00	38.52	82.17
Q	72.29	2.00	64.68	137.80
R	54.98	2.00	108.65	232.13
S	24.36	2.00	25.99	48.54
T	5.24	2.00	4.04	8.68
U	5.48	2.00	4.15	8.95
V	38.47	2.00	29.63	63.92
W	3.76	2.00	3.45	7.33
X	190.88	2.00	167.76	361.56
AA	33.49	10.00	38.76	80.22
BB	37.15	10.00	40.62	84.15
CC	6.33	10.00	6.53	13.57
DD	70.06	10.00	58.42	123.69
EE	69.47	10.00	81.16	167.45
FF	17.62	2.00	162.77	340.42
GG	16.35	2.00	14.93	31.99
HH	12.61	2.00	13.01	27.42
II	97.53	2.00	81.77	175.59
JJ	8.72	2.00	9.74	20.50
KK	8.12	2.00	7.51	15.99
LL	6.10	2.00	6.88	14.48



Proposed SWMM Basin and Pond Summary						
Basin Description	Basin Area (ac)	% Impervious	5 Year Peak Runoff (cfs)	100 Year Peak Runoff (cfs)	5 Year Pond Volume (ac-ft)	100 Year Pond Volume (ac-ft)
P	43.71	20.71%	40.00	82.83		
Pond 1					1.03	1.97
X1	76.38	29.50%	80.91	163.27		
Pond 2					6.56	8.80
O	52.52	30.10%	63.86	127.40		
Pond 3					3.79	6.37
X2	36.33	33.33%	41.46	82.46		
X3	61.99	13.53%	47.59	100.73		
V2	15.34	15.00%	16.15	33.25		
V1	11.57	38.62%	13.99	27.67		
Pond 4					7.21	7.35
N	41.57	29.60%	73.48	141.24		
Pond 5					1.86	2.55
M	26.83	33.19%	46.54	89.09		
Pond 6					0.84	0.94
K	114.73	38.03%	200.94	382.30		
Pond 7					8.38	12.59
L	15.89	24.82%	15.97	32.40		
Pond 8					1.05	1.09
S	21.67	40.88%	30.83	58.96		
R	56.16	21.81%	56.59	116.06		
Q	72.29	2.00%	64.68	137.80		
Pond 9					6.28	10.31
H	21.96	10.00%	17.86	37.80		
Pond 10					0.66	0.94
B2	19.99	24.55%	17.99	37.14		
B1	59.74	29.83%	66.93	133.69		
A	18.99	2.00%	20.84	43.83		
C	36.39	2.00%	35.31	75.28		
Pond 11					1.94	3.23
J	28.07	10.00%	24.25	51.19		
Existing Pond 12						
EE2	16.36	75.00%	35.71	63.62		
EE3	6.67	55.00%	10.38	19.93		
Pond 13					1.33	1.61
II3	23.97	10.0%	28.32	58.65		
II2	23.13	10.0%	28.04	116.62		
II1	50.43	10.0%	34.94	74.39		
Pond 14					1.06	3.99
D	40.87	37.20%	61.12	117.38		
Pond 15					1.94	3.23
E	106.53	14.35%	74.68	157.91		



I	26.99	34.66%	40.37	78.06		
Pond 16					1.40	1.79
JJ	8.9	20.70%	11.49	22.8		
KK	8.4	12.09%	8.14	16.95		
LL	6.2	10.00%	7.36	15.07		
Pond 17					1.09	1.23
G	31.45	12.48%	37.69	107.75		
Irrigation Pond						
JJ	8.90	20.70%	11.06	28.04		
LL	6.2	12.09%	5.85	15.68		
KK	8.4	10.00%	5.9	16.72		
Natural Drainage Way						
DD	69.5	10.0%	42.26	120.76		
EE1	50.87	10.0%	42.6	154.16		
Existing Flying Horse North Detention Pond 6						
CC	6.33	10.0%	4.74	13.39		
FF	18.1	10.0%	100.02	325.29		
Existing Flying Horse North Detention Pond 7						
GG	16.35	10.0%	11.25	32.04		
AA	33.8	10.0%	28.57	80.08		
BB	37.15	10.0%	29.52	83.01		
Existing Flying Horse North Detention Pond 8						
HH	12.7	10.0%	9.86	27.77		
Natural Drainage Way						
T	5.24	2.00%	2.92	8.56		
U	5.86	10.0%	3.63	10.37		
W	3.76	10.0%	2.6	7.36		
Natural Drainage Way						

IV. Hydraulic Analysis

a. Major Drainageways

There are no major drainage ways exist within the development; however, small tertiary tributaries are within the site currently and function to convey flows to unnamed tributaries of the East Cherry Creek and Black Squirrel Creek.

V. Environmental Evaluations

a. Significant Existing or Potential Wetland and Riparian Areas Impacts

As part of this work, the developer has engaged Bristlecone Ecology, LLC to perform environmental studies of the site that will be submitted with the planning documents. Major information in the report concerning wetlands concludes that there is a wetland associated with Black Squirrel Creek. Black Squirrel Creek is known to be a jurisdictional stream.

At this time, there are no improvements proposed for Black Squirrel Creek. The minimal impact to the stream will keep the natural habitat intact and the natural function of the Creek as it is to maintain the wetland habitat.

b. Stormwater Quality Considerations and Proposed Practices

As part of the development, full spectrum detention facilities will be installed to provide water quality for the development. The facilities will be designed using El Paso County criteria and provide stormwater quality by slowing the release of stormwater captured by the ponds and allowing solids to settle out. Additionally, when possible, the existing natural drainage ways will be used to convey stormwater to more closely mimic the natural hydrologic and hydraulic cycle. Some of the drainage ways will be used to convey water to the ponds and others will receive water from the ponds and in both scenarios will provide additional water quality benefits.

On site practices for the homes, schools, churches, and other buildings should use means such that impervious areas drain across pervious area to allow for infiltration during the minor events. This would include discharge of the gutters onto landscape areas vs. directly connecting to storm sewer and as discussed above as well using natural ditches and swales where it is logical and makes sense to convey stormwater in lieu of storm sewer piping.

c. Permitting Requirements

When work infringes upon the wetlands or floodplain a 404 Permit will be required. If the work within the waterways is minimal, it will likely be covered under a nationwide 404 permit; it is however possible that an individual permits will be required.

The Colorado Department of Public Health and Environment will require permits for any disturbance that exceed 1 acre of land. Should groundwater be encountered, a dewatering permit will also be required.

El Paso County will require an Erosion and Stormwater Quality Control Permit and any other construction permits required to complete the construction of the site.

Should development occur which effects the floodplain, FEMA will require a permit for work within the floodplain prior to the commencement of any construction or development within any special flood hazard area (SFHA). If the infrastructure is to be installed within the channel the designer shall route the design through the proper FEMA channels whether that be with a no rise certification or via the CLOMR/LOMR process should a more major improvement within the floodplain be proposed. At this time the project does not propose any direct development within the floodplain however storm infrastructure will discharge into the existing FEMA channel.

d. 4-Step Process

In accordance with the Engineering Criteria Manual I.7.2.A and DCM V2, this site has implemented the four-step process to minimize adverse impacts of urbanization. The four-step process includes reducing runoff volumes, stabilizing drainageways, treating the water quality capture volume, and considering the need for Industrial Commercial BMPs.

Step 1 – Reducing Runoff Volumes: The development of the project site includes a variety of land uses including open and vegetated areas interspersed to help disconnect impervious areas and reduce runoff volumes.

- Pond 2 is located to the east of Pond 1 and discharges into another unnamed tributary of East Cherry Creek. The pond is planned to store a maximum of 8.8 ac-ft during the 100-year event and have a peak outflow of 74.6 cfs which is slightly below the predevelopment peak outflow of 81.0 cfs. The 5-year storage volume is 6.56 ac-ft with a peak outflow of 27.8 cfs.
- Pond 3 is located on the eastern portion of the site and south of Pond 1. The pond discharges into an unnamed tributary of East Cherry Creek. The pond is planned to store a maximum of 6.37 ac-ft during the 100-year event and have a peak outflow of 46.1 cfs which is slightly below the predevelopment peak outflow of 48.5 cfs. The 5-year storage volume is 3.79 ac-ft with a peak outflow of 22.7 cfs.
- Pond 4 is located near the eastern portion of the site adjacent to Black Forest Rd. The pond discharges into a natural drainage way, which outlets into an unnamed tributary of East Cherry Creek. The pond is planned to store a maximum of 7.35 ac-ft during the 100-year event and have a peak outflow of 198.8 cfs which is slightly below the predevelopment peak flow rate of 231.6 cfs. The 5-year storage volume is 7.12 ac-ft with a peak outflow of 70.6 cfs.
- Pond 5 is located in the northwest portion of the site. The pond discharges natural drainageway, which outlets into an unnamed tributary of East Cherry Creek. The pond is planned to store a maximum of 2.5 ac-ft during the 100-year event and have a peak outflow of 103.1 cfs which is greater than the predevelopment peak outflow of 116.9 cfs. The 5-year storage volume is 1.86 ac-ft with a peak outflow of 39.4 cfs.
- Pond 6 is located near the northwest corner of the site and upstream of Pond 5. The pond discharges into a natural drainageway which outlets into an unnamed tributary of East Cherry Creek. The pond is planned to store a maximum of 2.93 ac-ft during the 100-year event and have a peak outflow of 48.2 cfs which is greater than the predevelopment peak outflow of 47.5 cfs. The 5-year storage volume is 1.77 ac-ft with a peak outflow of 12.2 cfs.
- Pond 7 is located in the central portion of site. The pond discharges into a natural drainageway that eventually outlets to an unnamed tributary of East Cherry Creek. The pond is planned to store a maximum of 12.59 ac-ft during the 100-year event and have a peak outflow of 172.2 cfs which is slightly lower than the predevelopment peak outflow of 191.6 cfs. The 5-year storage volume is 8.38 ac-ft with a peak outflow of 65.4 cfs.
- Pond 8 is located near the central portion of the site and downstream of Pond 7. The pond discharges into an unnamed tributary of East Cherry Creek. The pond is planned to store a maximum of 0.94 ac-ft during the 100-year event and have a peak outflow of 28.9 cfs which lower than the predevelopment peak outflow of 32.7. The 5-year storage volume is 0.84 ac-ft with a peak outflow of 11.4 cfs.
- Pond 9 is located near the southeast corner of the site just and adjacent to Black Forest Road. The pond discharges into a natural drainageway and flows under Black Forest Rd. via culvert. The natural drainageway is southeast of the existing property and eventually drains northeast to East Cherry Creek. The pond is planned to store a maximum of 10.31 ac-ft during the 100-year

- event and have a peak outflow of 220.7 cfs which is lower than the predevelopment peak outflow of 282.3 cfs. The 5-year storage volume is 6.28 ac-ft with a peak outflow of 94.8 cfs.
- Pond 10 is located on the north central portion of the site and north of Stagecoach Road. The pond discharges into an unnamed tributary of East Cherry Creek. The pond is planned to store a maximum of 0.94 ac-ft during the 100-year event and have a peak outflow of 33.9 cfs which is lower than the predevelopment peak outflow of 39.2 cfs. The 5-year storage volume is 0.68 ac-ft with a peak outflow of 13.6 cfs.
 - Pond 11 is located near the central portion of the site. The pond discharges into a natural drainageway which eventually discharges into the Irrigation Pond. The pond is planned to store a maximum of 6.83 ac-ft during the 100-year event and have a peak outflow of 230.0 cfs which is above than the predevelopment peak outflow of 221.3 cfs. The 5-year storage volume is 3.66 ac-ft with a peak outflow of 98.4 cfs.
 - Existing Pond 12 is designed in the Classic Homes Filing No. 1 FDR and located near the northwest corner of the site and north of Stagecoach Road. The pond discharges into an unnamed tributary of East Cherry Creek. The pond is planned to have a peak outflow of 45.0 cfs.
 - Pond 13 is located central portion of the site and just west of the major ridgeline between the two basins. The pond discharges into a natural drainageway to an existing pond of Filing No. 1, which ultimately outlets to Black Squirrel Creek. The pond is planned to store a maximum of 1.8 ac-ft during the 100-year event and have a peak outflow of 54.2 cfs which lower than the predevelopment peak outflow of 55.0. The 5-year storage volume is 1.3 ac-ft with a peak outflow of 17.2 cfs.
 - Pond 14 is located near the southwest corner of the site just east of the Black Squirrel Creek. The pond discharges into a natural drainageway of Black Squirrel Creek. The pond is planned to store a maximum of 3.99 ac-ft during the 100-year event and have a peak outflow of 152.3 cfs which is slightly lower than the predevelopment peak outflow of 173.0 cfs. The 5-year storage volume is 1.06 ac-ft with a peak outflow of 59.0 cfs.
 - Pond 15 is near the central portion of the site. The pond discharges into a natural drainageway which eventually discharges into the existing Irrigation Pond. The pond is planned to store a maximum of 3.23 ac-ft during the 100- year event and have a peak outflow of 68.4 cfs which is slightly above the predevelopment peak of 67.8 cfs. The 5-year storage volume is 1.94 ac-ft with a peak outflow of 30.9 cfs.
 - Pond 16 is near the central portion of the site. The pond discharges into a culvert and goes under Stagecoach Road, which eventually discharges into an existing drainageway of East Cherry Creek. The pond is planned to store a maximum of 5.40 ac-ft during the 100-year event and have a peak outflow of 63.8 cfs which is slightly below the predevelopment peak of 71.2 cfs. The 5 year storage volume is 4.66 ac-ft with a peak outflow of 24.3 cfs.



- Pond 17 is near near the central portion of the site. The pond discharges into a natural drainageway which eventually discharges into an existing drainageway of Black Squirrel Creek. The pond is planned to store a maximum of 1.23 ac-ft during the 100 year event and have a peak outflow of 49.6 cfs which is slightly below the predevelopment peak of 49.9 cfs. The 5 year storage volume is 1.09 ac-ft with a peak outflow of 16.8 cfs..
- The existing Irrigation Pond is in the central portion of site and just south of existing Stagecoach Road. The pond discharges towards an unnamed tributary of East Cherry Creek. The irrigation pond was design and subsequently built as part of the Filing 1 project. Storage Volumes for the pond assumed different upstream development conditions and therefore the pond will receive a higher volume of water during the storm events however the rate into the pond will be reduced. The irrigation pond will store 35.92 ac-ft during the 100-year event with a peak outflow of 274.73 cfs and the 5 year storage volume is 19.67 ac-ft with a peak outflow of 114.0 cfs.

The site plans propose the construction of 2 culverts in the southwest corner of site that navigates flow under roads to proposed Detention Pond 14. Analyses were completed by flow master and calculations can be found in Appendix E.

- Culvert 1 carries flow from Subbasin II3 to Subbasin II2 in the southwest corner of site. Each of the basins consist of the Flying Horse Golf Course and 2.5-acre estate lots. The culvert is 36” RCP at a 1% slope and designed for the 100-year event. The culvert will have a peak outflow of 58.65 cfs, where the pipe is 72% full.
- Culvert 2 carries flow from Subbasin II2 to Subbasin II1 in the southwest corner of site. Each of the basins consist of the Flying Horse Golf Course and 2.5-acre estate lots. The culvert is 42” RCP at a 2% slope and designed for the 100-year event. The culvert will have a peak outflow of 116.62 cfs, where the pipe is 68% full.

The culverts sizes should be refined in the PDR and FDR. Energy dissipation calcs can also be performed later within the design.

Overall runoff from the site will by and large match or be less than predevelopment peak flows sans those for outfall 5 which is slightly greater than predevelopment flows. The volume of water will increase however as the drainage channels are designs, continuous simulation models will be done to see the effects of prolonged runoff rates. Predevelopment and post development flows for the 5-year and 100-year events are summarized in the following table for the 5 site outfalls.

OUTFALL	Predevelopment		Postdevelopment*	
	5 year	100 year	5 year	100 year
1	320.31	725.59	183.76	705.93
2	145.46	311.00	80.36	242.18
3	167.76	361.56	70.06	271.49
4	346.26	733.92	230.07	646.46
5	24.12	50.88	16.85	45.91

*Values to be refined with Preliminary and Final Drainage Reports for each filing

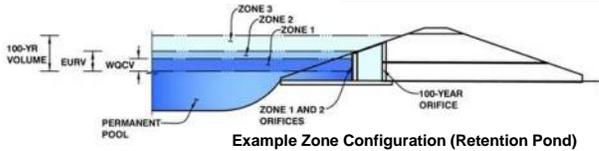
Basin Description	Park/Open Space	5 Acre	2.5 Acre	Low Density	Med Density	Commercial	Total Impervious	Total Acreage	Composite Percent Impervious	Predominant Soil Group	5 Year C Factor	100 Year C Factor
Impervious Percentage	10%	10%	15%	45%	55%	75%						
P	15.55	14.78	0.00	13.38	0.00	0.00	9.05	43.71	20.71%	B	0.15	0.41
						Pond 1		43.71	20.71%			
X1	38.32	3.30	0.00	25.66	0.00	9.10	22.53	76.38	29.50%	B	0.24	0.47
						Pond 2		76.38	29.50%			
O	13.17	0.00	10.72	28.63	0.00	0.00	15.81	52.52	30.10%	B	0.19	0.44
						Pond 3		52.52	30.10%			
X2	12.11	0.00	0.00	24.22	0.00	0.00	12.11	36.33	33.33%	B	0.19	0.44
X3	38.88	16.85	0.00	6.26	0.00	0.00	8.39	61.99	13.53%	B	0.13	0.40
V2	0.00	0.00	15.34	0.00	0.00	0.00	2.30	15.34	15.00%	B		
V1	2.11	0.00	0.00	9.46	0.00	0.00	4.47	11.57	38.62%	B	0.20	0.45
						Pond 4		125.23	20.85%			
N	10.44	11.52	0.00	6.77	12.84	0.00	12.30	41.57	29.60%	B	0.19	0.46
						Pond 5		41.57	29.60%			
M	14.55	0.00	0.00	1.24	6.94	4.10	8.91	26.83	33.19%	B	0.28	0.52
						Pond 6		26.83	33.19%			
K	26.45	2.93	0.00	61.89	23.46	0.00	43.69	114.73	38.08%	B	0.21	0.47
						Pond 7		114.73	38.08%			
L	6.93	5.54	0.00	0.00	2.72	0.00	2.74	15.19	18.06%	B	0.15	0.42
						Pond 8		15.19	18.06%			
S	2.31	0.24	0.00	19.12	0	0.00	8.86	21.67	40.88%	B	0.21	0.45
R	26.63	16.11	0.00	21.77	0.00	0.00	14.07	64.51	21.81%	B	0.15	0.41
						Pond 9		86.18	21.81%			
H	17.65	4.31	0.00	0.00	0.00	0.00	2.20	21.96	10.00%	B	0.12	0.39
						Pond 10		21.96	10.00%			
B2	7.20	4.48	0.00	8.31	0.00	0.00	4.91	19.99	24.55%	B	0.16	0.42
B1	12.86	13.03	0.00	33.85	0.00	0.00	17.82	59.74	29.83%	B	0.18	0.43
						Pond 11		79.73	28.51%			
J	28.07	0.00	0.00	0.00	0.00	0.00	2.81	28.07	10.00%	B	0.12	0.39
						Existing Pond 12						
I	17.99	0.00	0.00	0.00	0.00	11.00	10.05	28.99	34.66%	B	0.38	0.58
						Pond 16		57.06	22.53%			
EE2	0.00	0.00	0.00	0.00	0.00	16.36	12.27	16.36	75.00%	B	0.81	0.88
EE3	0.00	0.00	0.00	0.00	6.67	0.00	3.67	6.67	55.00%	B	0.30	0.58
						Pond 13		23.03	69.21%			
II2	0.00	23.13	0.00	0.00	0.00	0.00	2.31	23.13	10.00%	B	0.12	0.39
II3	0.00	23.97	0.00	0.00	0.00	0.00	2.40	23.97	10.00%	B	0.12	0.39
II1	15.77	34.66	0.00	0.00	0.00	0.00	5.04	50.43	10.00%	B	0.12	0.39
						Pond 14		97.53	10.00%			
D	4.41	4.70	0.00	31.76	0.00	0.00	15.20	40.87	37.20%	B	0.20	0.44
						Pond 15		40.87	37.20%			
E	99.63	8.80	0.00	1.72	0.00	6.90	16.79	117.05	14.35%	B	0.16	0.42
G	25.81	3.41	0.00	2.23	0.00	0.00	3.93	31.45	12.48%	B	0.13	0.39
						Irrigation Pond		148.50	13.95%			
JJ	1.86	4.32	0.00	2.72	0.00	0.00	1.84	8.90	20.70%	B	0.15	0.41
LL	4.39	1.44	0.00	0.37	0.00	0.00	0.75	6.20	12.09%	B	0.13	0.39
						Pond 17		15.10	17.16%			
KK	5.98	2.42	0.00	0.00	0.00	0.00	8.40	8.40	10.00%	B	0.12	0.39
AA	0.00	33.88	0.00	0.00	0.00	0.00	3.39	33.88	10.00%	B	0.12	0.39
BB	0.00	37.15	0.00	0.00	0.00	0.00	3.72	37.15	10.00%	B	0.12	0.39
CC	0.00	6.33	0.00	0.00	0.00	0.00	6.33	6.33	10.00%	B	0.12	0.39
DD	0.00	69.5	0.00	0.00	0.00	0.00	6.95	69.50	10.00%	B	0.12	0.39
FF	0.00	18.1	0.00	0.00	0.00	0.00	1.81	18.10	10.00%	B	0.12	0.39
GG	0.00	16.35	0.00	0.00	0.00	0.00	1.64	16.35	10.00%	B	0.12	0.39
HH	0.00	12.7	0.00	0.00	0.00	0.00	1.27	12.70	10.00%	B	0.12	0.39

*2% imperviousness for all, and runoff coefficients are .09 and .36 for 5 and 100 yr respectively

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Project: Flying Horse North
Basin ID: Pond 5



	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.36	0.520	Orifice Plate
Zone 2 (EURV)	3.72	0.741	Circular Orifice
Zone 3 (100-year)	5.96	1.477	Weir&Pipe (Restrict)
Total (all zones)		2.738	

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 Diameter =	N/A	inches

Calculated Parameters for Underdrain		
Underdrain Orifice Area =	N/A	ft ²
Underdrain Orifice Centroid =	N/A	feet

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	2.36	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	9.40	inches
Orifice Plate: Orifice Area per Row =	1.77	sq. inches (diameter = 1-1/2 inches)

Calculated Parameters for Plate		
WQ Orifice Area per Row =	1.229E-02	ft ²
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft ²

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	1.57					
Orifice Area (sq. inches)	1.77	1.77	1.77					

	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	
Invert of Vertical Orifice =	2.38	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	3.59	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	24.00	N/A	inches

Calculated Parameters for Vertical Orifice		
Zone 2 Circular	Not Selected	
Vertical Orifice Area =	3.14	N/A
Vertical Orifice Centroid =	1.00	N/A

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	
Overflow Weir Front Edge Height, Ho =	4.00	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	6.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V
Horiz. Length of Weir Sides =	6.00	N/A	feet
Overflow Grate Type =	Type C Grate	N/A	
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir		
Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H _u =	4.00	N/A
Overflow Weir Slope Length =	6.00	N/A
Grate Open Area / 100-yr Orifice Area =	2.41	N/A
Overflow Grate Open Area w/o Debris =	25.06	N/A
Overflow Grate Open Area w/ Debris =	12.53	N/A

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	1.00	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	48.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	37.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate		
Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	10.39	N/A
Outlet Orifice Centroid =	1.70	N/A
Half-Central Angle of Restrictor Plate on Pipe =	2.14	N/A

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage =	7.00	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	60.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway		
Spillway Design Flow Depth =	0.80	feet
Stage at Top of Freeboard =	8.80	feet
Basin Area at Top of Freeboard =	0.94	acres
Basin Volume at Top of Freeboard =	5.10	acre-ft

Routed Hydrograph Results

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

	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.14
One-Hour Rainfall Depth (in) =	0.520	1.261	1.226	1.996	2.708	3.784	4.596	5.681	7.783
CUHP Runoff Volume (acre-ft) =	0.520	1.261	1.226	4.578	2.708	3.784	4.596	8.724	7.783
User Override Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	1.226	4.578	2.708	3.784	4.596	8.724	7.783
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	9.0	25.3	37.9	62.0	78.4	99.1	137.2
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A		40.1				116.9	
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.22	0.96	0.91	1.49	1.89	2.81	3.30
Peak Inflow Q (cfs) =	N/A	N/A	28.6	69.6	61.5	85.5	103.2	135.8	169.5
Peak Outflow Q (cfs) =	0.2	7.1	3.2	39.4	19.6	45.9	62.2	103.1	114.7
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.0	0.5	0.7	0.8	0.9	0.8
Structure Controlling Flow =	Plate	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Outlet Plate 1				
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.9	0.2	1.1	1.7	3.2	3.6
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	45	46	37	42	39	37	28	29
Time to Drain 99% of Inflow Volume (hours) =	40	48	49	46	48	47	46	42	43
Maximum Ponding Depth (ft) =	2.36	3.72	3.19	4.68	4.27	4.80	5.06	5.70	5.95
Area at Maximum Ponding Depth (acres) =	0.51	0.59	0.55	0.65	0.62	0.65	0.67	0.71	0.73
Maximum Volume Stored (acre-ft) =	0.522	1.265	0.957	1.858	1.598	1.929	2.108	2.551	2.732

HRG Response: These ponds were modeled with the Master Drainage Report and are included in this report as references.

Please indicate how this will be addressed. Typical where occurs.

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename: ...[SWM]Outflow hydrographs\Pond6 OutflowHydrograph.xlsx

Inflow Hydrographs

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

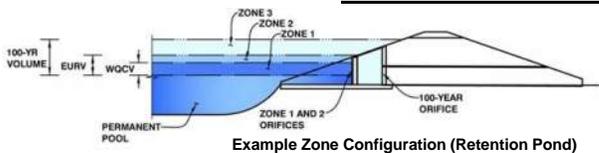
Time Interval	SOURCE	CUHP	CUHP	CUHP	USER	CUHP	CUHP	CUHP	USER	CUHP
	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.27	0.00	0.00	0.22	0.40	0.70
	0:15:00	0.00	0.00	1.84	7.09	3.80	2.57	3.17	6.01	4.42
	0:20:00	0.00	0.00	6.21	38.48	13.58	6.05	7.03	33.89	13.57
	0:25:00	0.00	0.00	20.49	67.67	52.13	20.37	24.85	93.63	52.58
	0:30:00	0.00	0.00	28.59	69.63	61.49	78.91	97.73	133.95	154.89
	0:35:00	0.00	0.00	24.76	62.10	50.77	85.48	103.19	135.78	169.46
	0:40:00	0.00	0.00	20.16	54.00	40.35	77.39	92.60	124.29	148.88
	0:45:00	0.00	0.00	14.94	46.63	31.22	62.69	74.92	110.29	125.63
	0:50:00	0.00	0.00	11.44	40.64	24.29	51.40	61.39	95.61	102.47
	0:55:00	0.00	0.00	9.23	36.18	19.62	39.56	47.65	83.59	83.62
	1:00:00	0.00	0.00	7.39	32.69	15.61	30.99	37.59	75.22	69.81
	1:05:00	0.00	0.00	5.81	29.50	12.14	24.16	29.44	65.17	58.06
	1:10:00	0.00	0.00	4.00	26.06	10.35	16.01	19.65	53.50	38.75
	1:15:00	0.00	0.00	3.01	22.56	9.76	11.60	14.65	42.49	27.91
	1:20:00	0.00	0.00	2.54	20.01	8.24	8.40	10.62	32.94	18.76
	1:25:00	0.00	0.00	2.28	18.54	6.59	6.53	8.22	26.39	12.92
	1:30:00	0.00	0.00	2.14	17.63	5.51	4.92	6.21	22.26	9.46
	1:35:00	0.00	0.00	2.04	16.51	4.77	3.94	4.98	19.57	7.13
	1:40:00	0.00	0.00	1.96	14.95	4.30	3.32	4.19	17.72	5.64
	1:45:00	0.00	0.00	1.92	13.73	3.97	2.92	3.68	16.45	4.78
	1:50:00	0.00	0.00	1.90	12.82	3.73	2.73	3.44	15.55	4.51
	1:55:00	0.00	0.00	1.59	12.02	3.37	2.61	3.29	14.99	4.39
	2:00:00	0.00	0.00	1.38	1.90	2.81	2.56	3.23	13.30	4.39
	2:05:00	0.00	0.00	0.92	1.25	1.86	1.68	2.12	9.94	2.89
	2:10:00	0.00	0.00	0.60	0.80	1.20	1.10	1.38	7.23	1.87
	2:15:00	0.00	0.00	0.39	0.49	0.76	0.70	0.88	5.23	1.18
	2:20:00	0.00	0.00	0.24	0.30	0.46	0.43	0.53	3.73	0.71
	2:25:00	0.00	0.00	0.14	0.19	0.27	0.26	0.32	2.62	0.42
	2:30:00	0.00	0.00	0.07	0.10	0.13	0.14	0.16	1.85	0.21
	2:35:00	0.00	0.00	0.03	0.04	0.04	0.05	0.06	1.26	0.07
	2:40:00	0.00	0.00	0.01	0.01	0.01	0.01	0.00	0.81	0.00
	2:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.49	0.00
	2:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.00
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.00
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	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 4.04 (February 2021)

Project: Flying Horse North Master Drainage Plan

Basin ID: Pond 6



	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.35	0.360	Orifice Plate
Zone 2 (EURV)	3.87	0.561	Circular Orifice
Zone 3 (100-year)	5.98	0.978	Weir&Pipe (Restrict)
Total (all zones)		1.899	

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 Diameter =	N/A	inches

Calculated Parameters for Underdrain

Underdrain Orifice Area =	N/A	ft ²
Underdrain Orifice Centroid =	N/A	feet

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	2.35	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	9.40	inches
Orifice Plate: Orifice Area per Row =	1.27	sq. inches (diameter = 1-1/4 inches)

Calculated Parameters for Plate

WQ Orifice Area per Row =	8.819E-03	ft ²
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft ²

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	0.78	1.57					
Orifice Area (sq. inches)	1.27	1.27	1.27					

	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	
Invert of Vertical Orifice =	2.35	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	3.87	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	12.00	N/A	inches

Calculated Parameters for Vertical Orifice

	Zone 2 Circular	Not Selected	
Vertical Orifice Area =	0.79	N/A	ft ²
Vertical Orifice Centroid =	0.50	N/A	feet

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	
Overflow Weir Front Edge Height, Ho =	4.20	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	1.50	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V
Horiz. Length of Weir Sides =	1.50	N/A	feet
Overflow Grate Type =	Type C Grate	N/A	
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H _u =	4.20	N/A	feet
Overflow Weir Slope Length =	1.50	N/A	feet
Grate Open Area / 100-yr Orifice Area =	0.39	N/A	
Overflow Grate Open Area w/o Debris =	1.57	N/A	ft ²
Overflow Grate Open Area w/ Debris =	0.78	N/A	ft ²

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	1.00	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	30.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	23.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	4.04	N/A	ft ²
Outlet Orifice Centroid =	1.05	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	2.13	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage =	7.30	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	29.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth =	0.93	feet
Stage at Top of Freeboard =	9.23	feet
Basin Area at Top of Freeboard =	0.72	acres
Basin Volume at Top of Freeboard =	3.91	acre-ft

Routed Hydrograph Results

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

	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.14
One-Hour Rainfall Depth (in) =	0.360	0.921	0.903	1.424	1.899	2.602	3.143	3.855	5.243
CUHP Runoff Volume (acre-ft) =	0.360	0.921	0.903	1.424	1.899	2.602	3.143	3.855	5.243
User Override Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.903	3.107	1.899	2.602	3.143	5.635	5.243
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	4.3	11.6	17.2	30.3	37.9	47.5	65.9
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.16	0.43	0.64	1.13	1.41	1.77	2.46
Peak Inflow Q (cfs) =	N/A	N/A	16.5	44.8	34.4	47.7	57.5	86.7	93.4
Peak Outflow Q (cfs) =	0.2	4.0	2.5	12.2	8.0	12.1	13.9	48.2	49.0
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.0	0.5	0.4	0.4	1.0	0.7
Structure Controlling Flow =	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Spillway	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	3.5	1.7	3.4	4.2	5.4	5.4
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	44	46	38	43	40	38	30	31
Time to Drain 99% of Inflow Volume (hours) =	40	48	49	47	48	48	47	44	44
Maximum Ponding Depth (ft) =	2.35	3.87	3.27	5.74	4.66	5.68	6.36	7.79	7.79
Area at Maximum Ponding Depth (acres) =	0.33	0.41	0.38	0.51	0.45	0.50	0.54	0.63	0.63
Maximum Volume Stored (acre-ft) =	0.362	0.924	0.685	1.776	1.261	1.745	2.101	2.930	2.936

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename: ...[SWM]Outflow hydrographs\Pond6 OutflowHydrograph.xlsx

Inflow Hydrographs

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

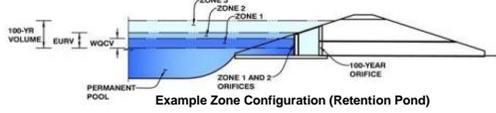
Time Interval	SOURCE	CUHP	CUHP	CUHP	USER	CUHP	CUHP	CUHP	USER	CUHP
	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.09	0.00
	0:10:00	0.00	0.00	0.00	1.28	0.00	0.00	0.13	1.42	0.41
	0:15:00	0.00	0.00	1.10	9.19	2.27	1.53	1.91	7.77	2.68
	0:20:00	0.00	0.00	3.88	32.51	7.65	3.83	4.46	29.44	7.72
	0:25:00	0.00	0.00	11.46	44.81	27.18	11.35	13.73	68.64	27.37
	0:30:00	0.00	0.00	16.45	43.32	34.42	40.25	49.45	86.70	78.42
	0:35:00	0.00	0.00	15.52	38.43	31.05	47.72	57.47	84.90	93.38
	0:40:00	0.00	0.00	13.51	33.50	26.49	46.00	54.93	77.48	88.14
	0:45:00	0.00	0.00	11.12	29.15	22.63	40.10	47.88	68.88	79.41
	0:50:00	0.00	0.00	9.18	25.51	18.68	35.67	42.56	59.79	70.00
	0:55:00	0.00	0.00	7.60	22.86	15.52	29.20	34.93	52.73	59.52
	1:00:00	0.00	0.00	6.52	20.78	13.55	24.05	28.95	47.77	51.66
	1:05:00	0.00	0.00	5.79	18.84	12.11	20.68	25.05	40.76	46.51
	1:10:00	0.00	0.00	4.81	16.55	10.75	16.99	20.66	33.68	37.61
	1:15:00	0.00	0.00	3.90	14.19	9.44	13.77	16.83	26.52	29.85
	1:20:00	0.00	0.00	3.08	12.64	7.58	10.57	12.86	20.51	21.91
	1:25:00	0.00	0.00	2.40	11.79	5.80	7.81	9.45	16.51	15.33
	1:30:00	0.00	0.00	2.00	11.26	4.76	5.55	6.78	14.04	10.88
	1:35:00	0.00	0.00	1.82	10.33	4.13	4.22	5.21	12.41	8.22
	1:40:00	0.00	0.00	1.74	9.38	3.70	3.41	4.23	11.29	6.50
	1:45:00	0.00	0.00	1.68	8.67	3.39	2.88	3.58	10.51	5.31
	1:50:00	0.00	0.00	1.64	8.14	3.18	2.53	3.16	9.96	4.49
	1:55:00	0.00	0.00	1.43	7.59	2.90	2.31	2.88	9.61	3.90
	2:00:00	0.00	0.00	1.25	6.09	2.51	2.16	2.68	7.83	3.53
	2:05:00	0.00	0.00	0.94	4.45	1.84	1.59	1.97	5.73	2.57
	2:10:00	0.00	0.00	0.69	3.20	1.32	1.15	1.42	4.16	1.84
	2:15:00	0.00	0.00	0.51	2.27	0.94	0.82	1.02	3.00	1.33
	2:20:00	0.00	0.00	0.37	1.57	0.68	0.59	0.73	2.12	0.96
	2:25:00	0.00	0.00	0.26	1.08	0.48	0.41	0.51	1.48	0.67
	2:30:00	0.00	0.00	0.18	0.73	0.33	0.29	0.36	1.02	0.47
	2:35:00	0.00	0.00	0.12	0.48	0.22	0.20	0.25	0.66	0.32
	2:40:00	0.00	0.00	0.08	0.28	0.14	0.13	0.16	0.39	0.20
	2:45:00	0.00	0.00	0.04	0.15	0.07	0.07	0.09	0.20	0.11
	2:50:00	0.00	0.00	0.02	0.07	0.03	0.03	0.04	0.09	0.04
	2:55:00	0.00	0.00	0.01	0.02	0.01	0.01	0.01	0.03	0.01
	3:00:00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01	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 STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

Project: **Flying Horse North Master Drainage Plan**

Basin ID: **Pond 7**



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB
Watershed Area =	114.73 acres
Watershed Length =	1,683 ft
Watershed Length to Centroid =	1,362 ft
Watershed Slope =	0.040 ft/ft
Watershed Imperviousness =	38.80% 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

Note: L / W Ratio < 1
L / W Ratio = 0.57

Water Quality Capture Volume (WQCV) =	1.689 acre-feet
Excess Urban Runoff Volume (EURV) =	4.663 acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	4.575 acre-feet
5-yr Runoff Volume (P1 = 1.5 in.) =	6.891 acre-feet
10-yr Runoff Volume (P1 = 1.75 in.) =	8.978 acre-feet
25-yr Runoff Volume (P1 = 2 in.) =	11.989 acre-feet
50-yr Runoff Volume (P1 = 2.25 in.) =	14.328 acre-feet
100-yr Runoff Volume (P1 = 2.52 in.) =	17.379 acre-feet
500-yr Runoff Volume (P1 = 3.14 in.) =	23.422 acre-feet
Approximate 2-yr Detention Volume =	3.427 acre-feet
Approximate 5-yr Detention Volume =	4.799 acre-feet
Approximate 10-yr Detention Volume =	6.641 acre-feet
Approximate 25-yr Detention Volume =	7.450 acre-feet
Approximate 50-yr Detention Volume =	7.822 acre-feet
Approximate 100-yr Detention Volume =	8.992 acre-feet

acre-feet	
inches	1.19
inches	1.50
inches	1.75
inches	2.00
inches	2.25
inches	2.52
inches	

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	1.689 acre-feet
Zone 2 Volume (EURV - Zone 1) =	2.974 acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	4.329 acre-feet
Total Detention Basin Volume =	8.992 acre-feet
Initial Surcharge Volume (ISV) =	221 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}) =	0.004 ft/ft
Slopes of Main Basin Sides (S _{main}) =	4 H:V
Basin Length-to-Width Ratio (R _{LW}) =	2
Initial Surcharge Area (A _{ISV}) =	669 ft ²
Surcharge Volume Length (L _{ISV}) =	25.9 ft
Surcharge Volume Width (W _{ISV}) =	25.9 ft
Depth of Basin Floor (H _{FLOOR}) =	1.48 ft
Length of Basin Floor (L _{FLOOR}) =	401.8 ft
Width of Basin Floor (W _{FLOOR}) =	210.9 ft
Area of Basin Floor (A _{FLOOR}) =	84,720 ft ²
Volume of Basin Floor (V _{FLOOR}) =	45,839 ft ³
Depth of Main Basin (H _{MAIN}) =	3.69 ft
Length of Main Basin (L _{MAIN}) =	431.3 ft
Width of Main Basin (W _{MAIN}) =	240.4 ft
Area of Main Basin (A _{MAIN}) =	103,677 ft ²
Volume of Main Basin (V _{MAIN}) =	347,004 ft ³
Calculated Total Basin Volume (V _{total}) =	9.031 acre-feet

Depth Increment = 0.10 ft

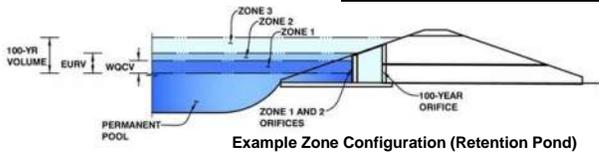
Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft ²)	Optional Override Area (ft ²)	Area (acre)	Volume (ft ³)	Volume (ac-ft)
Top of Micropool	0.00		25.9	25.9	669		0.015		
ISV	0.33		25.9	25.9	669		0.015	221	0.005
	0.40		25.9	25.9	669		0.015	268	0.006
	0.50		25.9	25.9	669		0.015	334	0.008
	0.60		25.9	25.9	669		0.015	401	0.009
	0.70		25.9	25.9	669		0.015	468	0.011
	0.80		25.9	25.9	669		0.015	535	0.012
	0.90		43.6	34.6	1,510		0.035	630	0.014
	1.00		69.0	47.1	3,253		0.075	862	0.020
	1.10		94.4	59.6	5,630		0.129	1,301	0.030
	1.20		119.8	72.1	8,642		0.198	2,010	0.046
	1.30		145.2	84.6	12,289		0.282	3,051	0.070
	1.40		170.6	97.1	16,571		0.380	4,489	0.103
	1.50		196.0	109.6	21,488		0.493	6,386	0.147
	1.60		221.4	122.1	27,040		0.621	8,807	0.202
	1.70		246.8	134.6	33,228		0.763	11,815	0.271
	1.80		272.2	147.1	40,050		0.919	15,474	0.355
	1.90		297.6	159.6	47,507		1.091	19,847	0.456
	2.00		323.0	172.1	55,599		1.276	24,997	0.574
	2.10		348.4	184.6	64,326		1.477	30,988	0.711
	2.20		373.8	197.1	73,688		1.692	37,883	0.870
	2.30		399.2	209.6	83,685		1.921	45,746	1.050
Floor	2.31		401.8	210.9	84,720		1.945	46,588	1.070
	2.40		402.5	211.6	85,162		1.955	54,233	1.245
	2.50		403.3	212.4	85,654		1.966	62,774	1.441
	2.60		404.1	213.2	86,147		1.978	71,364	1.638
Zone 1 (WQCV)	2.63		404.3	213.4	86,295		1.981	73,950	1.698
	2.70		404.9	214.0	86,641		1.989	80,003	1.837
	2.80		405.7	214.8	87,137		2.000	88,692	2.036
	2.90		406.5	215.6	87,634		2.012	97,431	2.237
	3.00		407.3	216.4	88,132		2.023	106,219	2.438
	3.10		408.1	217.2	88,632		2.035	115,057	2.641
	3.20		408.9	218.0	89,133		2.046	123,945	2.845
	3.30		409.7	218.8	89,635		2.058	132,884	3.051
	3.40		410.5	219.6	90,138		2.069	141,872	3.257
	3.50		411.3	220.4	90,643		2.081	150,911	3.464
	3.60		412.1	221.2	91,149		2.092	160,001	3.673
	3.70		412.9	222.0	91,656		2.104	169,141	3.883
	3.80		413.7	222.8	92,165		2.116	178,332	4.094
	3.90		414.5	223.6	92,675		2.128	187,574	4.306
	4.00		415.3	224.4	93,186		2.139	196,867	4.519
Zone 2 (EURV)	4.07		415.9	224.9	93,544		2.147	203,403	4.669
	4.10		416.1	225.2	93,698		2.151	206,211	4.734
	4.20		416.9	226.0	94,212		2.163	215,607	4.950
	4.30		417.7	226.8	94,727		2.175	225,054	5.167
	4.40		418.5	227.6	95,243		2.186	234,552	5.385
	4.50		419.3	228.4	95,760		2.198	244,103	5.604
	4.60		420.1	229.2	96,279		2.210	253,705	5.824
	4.70		420.9	230.0	96,799		2.222	263,358	6.046
	4.80		421.7	230.8	97,321		2.234	273,064	6.269
	4.90		422.5	231.6	97,843		2.246	282,823	6.493
	5.00		423.3	232.4	98,367		2.258	292,633	6.718
	5.10		424.1	233.2	98,892		2.270	302,496	6.944
	5.20		424.9	234.0	99,419		2.282	312,412	7.172
	5.30		425.7	234.8	99,947		2.294	322,380	7.401
	5.40		426.5	235.6	100,476		2.307	332,401	7.631
	5.50		427.3	236.4	101,006		2.319	342,475	7.862
	5.60		428.1	237.2	101,538		2.331	352,602	8.095
	5.70		428.9	238.0	102,070		2.343	362,783	8.328
	5.80		429.7	238.8	102,605		2.355	373,016	8.563
	5.90		430.5	239.6	103,140		2.368	383,304	8.799
Zone 3 (100-year)	5.99		431.2	240.3	103,623		2.379	392,608	9.013
	6.00		431.3	240.4	103,677		2.380	393,644	9.037
	6.10		432.1	241.2	104,215		2.392	404,039	9.275
	6.20		432.9	242.0	104,754		2.405	414,487	9.515
	6.30		433.7	242.8	105,294		2.417	424,990	9.756
	6.40		434.5	243.6	105,836		2.430	435,546	9.999
	6.50		435.3	244.4	106,379		2.442	446,157	10.242
	6.60		436.1	245.2	106,924		2.455	456,822	10.487
	6.70		436.9	246.0	107,469		2.467	467,542	10.733
	6.80		437.7	246.8	108,016		2.480	478,316	10.981
	6.90		438.5	247.6	108,565		2.492	489,145	11.229
	7.00		439.3	248.4	109,114		2.505	500,029	11.479
	7.10		440.1	249.2	109,665		2.518	510,968	11.730
	7.20		440.9	250.0	110,217		2.530	521,962	11.983
	7.30		441.7	250.8	110,770		2.543	533,012	12.236
	7.40		442.5	251.6	111,325		2.556	544,116	12.491
	7.50		443.3	252.4	111,881		2.568	555,277	12.747
	7.60		444.1	253.2	112,438		2.581	566,493	13.005
	7.70		444.9	254.0	112,997		2.594	577,764	13.264
	7.80		445.7	254.8	113,556		2.607	589,092	13.524
	7.90		446.5	255.6	114,117		2.620	600,476	13.785
	8.00		447.3	256.4	114,680		2.633	611,915	14.048
	8.10		448.1	257.2	115,243		2.646	623,411	14.312
	8.20		448.9	258.0	115,808		2.659	634,964	14.577
	8.30		449.7	258.8	116,374		2.672	646,573	14.843
	8.40		450.5	259.6	116,942		2.685	658,239	15.111
	8.50		451.3	260.4	117,510		2.698	669,962	15.380
	8.60		452.1	261.2	118,080		2.711	681,741	15.651
	8.70		452.9	262.0	118,652		2.724	693,578	15.922
	8.80		453.7	262.8	119,224		2.737	705,471	16.195
	8.90		454.5	263.6	119,798		2.750	717,422	16.47

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD- Detention, Version 4.04 (February 2021)

Project: Flying Horse North Master Drainage Plan

Basin ID: Pond 7



	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.63	1.689	Orifice Plate
Zone 2 (EURV)	4.07	2.974	Weir&Pipe (Circular)
Zone 3 (100-year)	5.99	4.329	Weir&Pipe (Restrict)
Total (all zones)		8.992	

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 Diameter =	N/A	inches

Calculated Parameters for Underdrain	
Underdrain Orifice Area =	N/A ft ²
Underdrain Orifice Centroid =	N/A feet

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	2.65	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	10.60	inches
Orifice Plate: Orifice Area per Row =	5.17	sq. inches (use rectangular openings)

Calculated Parameters for Plate	
WQ Orifice Area per Row =	3.590E-02 ft ²
Elliptical Half-Width =	N/A feet
Elliptical Slot Centroid =	N/A feet
Elliptical Slot Area =	N/A ft ²

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	0.88	1.77					
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)

	Not Selected	Not Selected	
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	N/A	N/A	inches

Calculated Parameters for Vertical Orifice	
Vertical Orifice Area =	N/A ft ²
Vertical Orifice Centroid =	N/A feet

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

	Zone 2 Weir	Zone 3 Weir	
Overflow Weir Front Edge Height, Ho =	4.50	4.70	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	6.00	10.00	feet
Overflow Weir Grate Slope =	0.00	4.00	H:V
Horiz. Length of Weir Sides =	6.00	12.00	feet
Overflow Grate Type =	Type C Grate	Type C Grate	
Debris Clogging % =	50%	50%	%

Calculated Parameters for Overflow Weir	
Height of Grate Upper Edge, H _u =	4.50 feet
Overflow Weir Slope Length =	6.00 feet
Grate Open Area / 100-yr Orifice Area =	3.54
Overflow Grate Open Area w/o Debris =	25.06 ft ²
Overflow Grate Open Area w/ Debris =	12.53 ft ²

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

	Zone 2 Circular	Zone 3 Restrictor	
Depth to Invert of Outlet Pipe =	2.50	2.70	ft (distance below basin bottom at Stage = 0 ft)
Circular Orifice Diameter or Pipe Diameter =	36.00	72.00	inches
Restrictor Plate Height Above Pipe Invert =		60.00	inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate	
Outlet Orifice Area =	7.07 ft ²
Outlet Orifice Centroid =	1.50 feet
Half-Central Angle of Restrictor Plate on Pipe =	N/A radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage =	7.80	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	119.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway	
Spillway Design Flow Depth =	0.98 feet
Stage at Top of Freeboard =	9.78 feet
Basin Area at Top of Freeboard =	2.87 acres
Basin Volume at Top of Freeboard =	18.94 acre-ft

Routed Hydrograph Results

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

	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.14
One-Hour Rainfall Depth (in) =	1.689	4.663	4.575	6.891	8.978	11.989	14.328	17.379	23.422
CUHP Runoff Volume (acre-ft) =	N/A	N/A	4.575	13.698	8.978	11.989	14.328	24.727	23.422
User Override Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	19.1	53.5	79.8	138.4	173.6	217.5	301.7
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.17	0.57	0.70	1.21	1.51	1.67	2.63
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A	91.6	192.8	181.1	244.9	292.5	370.7	466.9
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.9	65.4	25.4	69.6	98.6	172.2	186.6
Peak Inflow Q (cfs) =	N/A	N/A	0.9	1.0	0.3	0.5	0.6	0.9	0.6
Peak Outflow Q (cfs) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Ratio Peak Outflow to Predevelopment Q =	Plate	Plate	Plate	Overflow Weir 2					
Structure Controlling Flow =	N/A	N/A	N/A	2.1	0.8	2.2	3.0	3.9	4.0
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.1	0.0	0.1	0.2	0.9	1.0
Max Velocity through Grate 2 (fps) =	38	80	80	90	94	91	89	82	83
Time to Drain 97% of Inflow Volume (hours) =	40	84	83	99	100	99	98	95	95
Time to Drain 99% of Inflow Volume (hours) =	2.63	4.07	3.95	5.73	5.17	5.77	6.13	7.45	7.70
Maximum Ponding Depth (ft) =	1.98	2.15	2.13	2.35	2.28	2.35	2.39	2.56	2.59
Area at Maximum Ponding Depth (acres) =	1.698	4.669	4.413	8.375	7.081	8.493	9.323	12.594	13.264
Maximum Volume Stored (acre-ft) =									

HRG Response: These ponds were modeled with the Master Drainage Report and are included in this report as references.

fix so that drain times are met

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename: ...[SWM]Outflow hydrographs\Pond6 OutflowHydrograph.xlsx

Inflow Hydrographs

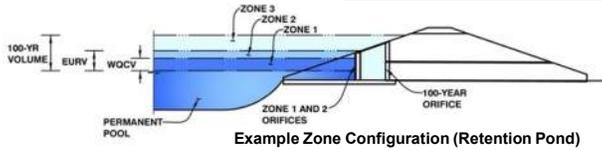
The user can override the calculated inflow hydrographs from this workbook with inflow hydrographs developed in a separate program.

Time Interval	SOURCE	CUHP	CUHP	CUHP	USER	CUHP	CUHP	CUHP	USER	CUHP
	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	0.35	0.00	0.00	0.00	1.15	0.00
	0:10:00	0.00	0.00	0.00	8.35	0.00	0.00	0.87	8.80	2.79
	0:15:00	0.00	0.00	7.53	41.96	15.37	10.35	12.91	36.23	18.14
	0:20:00	0.00	0.00	26.66	135.18	45.76	26.13	30.39	122.53	46.04
	0:25:00	0.00	0.00	66.84	192.81	145.94	65.52	78.49	282.20	146.25
	0:30:00	0.00	0.00	91.59	189.89	181.09	208.88	253.77	370.69	396.24
	0:35:00	0.00	0.00	83.49	168.08	156.84	244.93	292.46	368.77	466.90
	0:40:00	0.00	0.00	69.51	147.36	128.13	226.22	267.84	337.06	424.31
	0:45:00	0.00	0.00	54.32	129.31	103.79	190.55	225.54	301.99	368.42
	0:50:00	0.00	0.00	42.53	112.57	82.17	160.69	189.97	264.23	309.75
	0:55:00	0.00	0.00	34.81	100.65	68.10	126.75	150.57	231.91	255.54
	1:00:00	0.00	0.00	29.24	91.99	57.54	102.55	122.63	210.05	218.61
	1:05:00	0.00	0.00	24.37	84.30	48.10	84.65	101.75	182.04	189.95
	1:10:00	0.00	0.00	18.53	75.10	39.94	63.92	77.12	152.54	140.96
	1:15:00	0.00	0.00	14.20	64.91	35.46	46.28	56.24	122.62	100.15
	1:20:00	0.00	0.00	11.95	56.89	30.57	33.94	41.44	96.04	69.57
	1:25:00	0.00	0.00	10.84	52.28	25.28	26.43	32.25	76.32	49.57
	1:30:00	0.00	0.00	10.26	49.65	21.53	20.77	25.24	63.82	37.19
	1:35:00	0.00	0.00	9.94	45.63	19.01	16.94	20.45	55.99	29.25
	1:40:00	0.00	0.00	9.68	41.44	17.27	14.62	17.52	50.64	23.93
	1:45:00	0.00	0.00	9.50	38.27	16.09	13.10	15.56	46.97	20.37
	1:50:00	0.00	0.00	9.40	35.96	15.24	12.09	14.28	44.36	18.18
	1:55:00	0.00	0.00	8.11	33.53	13.98	11.56	13.59	42.55	17.39
	2:00:00	0.00	0.00	7.01	27.14	12.28	11.24	13.17	34.89	17.03
	2:05:00	0.00	0.00	5.02	19.98	8.67	8.06	9.43	25.68	12.26
	2:10:00	0.00	0.00	3.38	14.45	5.83	5.40	6.30	18.63	8.24
	2:15:00	0.00	0.00	2.27	10.39	3.91	3.64	4.25	13.59	5.54
	2:20:00	0.00	0.00	1.48	7.28	2.54	2.37	2.76	9.71	3.59
	2:25:00	0.00	0.00	0.92	5.00	1.60	1.52	1.76	6.81	2.28
	2:30:00	0.00	0.00	0.53	3.43	0.95	0.94	1.09	4.77	1.39
	2:35:00	0.00	0.00	0.26	2.28	0.48	0.50	0.57	3.20	0.72
	2:40:00	0.00	0.00	0.10	1.39	0.18	0.20	0.22	1.96	0.26
	2:45:00	0.00	0.00	0.02	0.74	0.03	0.03	0.03	1.04	0.02
	2:50:00	0.00	0.00	0.00	0.32	0.00	0.00	0.00	0.45	0.00
	2:55:00	0.00	0.00	0.00	0.11	0.00	0.00	0.00	0.15	0.00
	3:00:00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.03	0.00
	3:05:00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01	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 4.04 (February 2021)

Project: Flying Horse North MDDP
Basin ID: Pond 8



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.39	0.178	Orifice Plate
Zone 2 (EURV)	3.67	0.221	Circular Orifice
Zone 3 (100-year)	5.97	0.543	Weir&Pipe (Restrict)
Total (all zones)		0.942	

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

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

Calculated Parameters for Underdrain
 Underdrain Orifice Area = ft²
 Underdrain Orifice Centroid = feet

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

Invert of Lowest Orifice = ft (relative to basin bottom at Stage = 0 ft)
 Depth at top of Zone using Orifice Plate = ft (relative to basin bottom at Stage = 0 ft)
 Orifice Plate: Orifice Vertical Spacing = inches
 Orifice Plate: Orifice Area per Row = sq. inches (diameter = 7/8 inch)

Calculated Parameters for Plate
 WQ Orifice Area per Row = ft²
 Elliptical Half-Width = feet
 Elliptical Slot Centroid = feet
 Elliptical Slot Area = ft²

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.80	1.59					
Orifice Area (sq. inches)	0.65	0.65	0.65					

	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	
Invert of Vertical Orifice =	2.39	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	3.67	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	2.88	N/A	inches

Calculated Parameters for Vertical Orif

	Zone 2 Circular	Not Selected
Vertical Orifice Area =	0.05	N/A
Vertical Orifice Centroid =	0.12	N/A

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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	5.00	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	4.00	N/A	feet
Overflow Weir Gate Slope =	0.00	N/A	H:V
Horiz. Length of Weir Sides =	5.00	N/A	feet
Overflow Gate Type =	Type C Gate	N/A	
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected
Height of Gate Upper Edge, H _t =	5.00	N/A
Overflow Weir Slope Length =	5.00	N/A
Gate Open Area / 100-yr Orifice Area =	5.22	N/A
Overflow Gate Open Area w/o Debris =	13.92	N/A
Overflow Gate Open Area w/ Debris =	6.96	N/A

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	1.00	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	24.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	19.00	N/A	inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected
Outlet Orifice Area =	2.67	N/A
Outlet Orifice Centroid =	0.87	N/A
Half-Central Angle of Restrictor Plate on Pipe =	2.19	N/A

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage =	6.30	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	11.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth =	0.85 feet
Stage at Top of Freeboard =	8.15 feet
Basin Area at Top of Freeboard =	0.38 acres
Basin Volume at Top of Freeboard =	1.66 acre-ft

Routed Hydrograph Results

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

	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
Design Storm Return Period =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52
One-Hour Rainfall Depth (in) =	N/A	N/A	0.416	0.713	0.991	1.426	1.746	2.181
CUHP Runoff Volume (acre-ft) =	0.178	0.399	0.416	1.850	0.991	1.426	1.746	3.383
User Override Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.416	1.850	0.991	1.426	1.746	3.383
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	1.6	4.6	6.9	12.4	15.5	19.9
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A	1.6	11.1	6.9	12.4	15.5	32.7
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.10	0.70	0.44	0.78	0.98	2.06
Peak Inflow Q (cfs) =	N/A	N/A	4.8	15.9	10.8	16.6	20.1	32.3
Peak Outflow Q (cfs) =	0.1	0.3	0.3	11.4	3.5	9.4	13.5	28.9
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.0	0.5	0.8	0.9	0.9
Structure Controlling Flow =	Plate	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1				
Max Velocity through Gate 1 (fps) =	N/A	N/A	N/A	0.8	0.2	0.6	0.9	2.1
Max Velocity through Gate 2 (fps) =	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	49	51	48	55	51	49	38
Time to Drain 99% of Inflow Volume (hours) =	40	52	54	59	62	60	59	54
Maximum Ponding Depth (ft) =	2.39	3.67	3.51	5.52	5.22	5.46	5.58	5.99
Area at Maximum Ponding Depth (acres) =	0.15	0.19	0.19	0.26	0.25	0.26	0.27	0.28
Maximum Volume Stored (acre-ft) =	0.179	0.399	0.369	0.821	0.741	0.802	0.837	0.946

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.

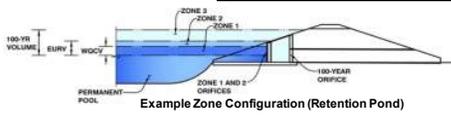
Time Interval	SOURCE	CUHP	CUHP	CUHP	USER	CUHP	CUHP	CUHP	USER	CUHP
	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.06	0.00
	0:10:00	0.00	0.00	0.00	0.34	0.00	0.00	0.02	0.34	0.07
	0:15:00	0.00	0.00	0.18	2.78	0.37	0.25	0.31	2.31	0.44
	0:20:00	0.00	0.00	0.66	10.46	1.64	0.65	0.80	9.50	1.64
	0:25:00	0.00	0.00	2.63	14.81	7.18	2.58	3.15	22.52	7.13
	0:30:00	0.00	0.00	4.43	15.89	10.39	11.21	13.94	29.84	22.90
	0:35:00	0.00	0.00	4.81	15.66	10.85	15.07	18.39	32.21	30.64
	0:40:00	0.00	0.00	4.71	15.11	10.40	16.58	20.07	32.32	32.92
	0:45:00	0.00	0.00	4.31	14.56	9.75	16.12	19.49	31.57	32.76
	0:50:00	0.00	0.00	3.95	13.85	8.98	15.64	18.90	30.25	31.70
	0:55:00	0.00	0.00	3.62	13.31	8.27	14.42	17.48	28.95	30.01
	1:00:00	0.00	0.00	3.35	12.85	7.71	13.24	16.11	27.97	28.37
	1:05:00	0.00	0.00	3.13	12.39	7.26	12.28	15.01	26.11	27.13
	1:10:00	0.00	0.00	2.85	11.75	6.83	11.17	13.71	24.14	24.72
	1:15:00	0.00	0.00	2.57	10.98	6.41	10.13	12.46	21.80	22.36
	1:20:00	0.00	0.00	2.30	10.25	5.80	9.02	11.10	19.55	19.70
	1:25:00	0.00	0.00	2.04	9.75	5.13	7.96	9.80	17.56	17.19
	1:30:00	0.00	0.00	1.82	9.39	4.59	6.91	8.50	16.06	14.90
	1:35:00	0.00	0.00	1.66	8.88	4.19	6.09	7.51	14.87	13.13
	1:40:00	0.00	0.00	1.55	8.36	3.86	5.46	6.74	13.83	11.76
	1:45:00	0.00	0.00	1.45	7.87	3.57	4.94	6.10	12.89	10.57
	1:50:00	0.00	0.00	1.35	7.42	3.30	4.47	5.53	12.01	9.51
	1:55:00	0.00	0.00	1.22	6.93	3.01	4.05	5.01	11.18	8.53
	2:00:00	0.00	0.00	1.10	6.06	2.68	3.65	4.51	9.79	7.61
	2:05:00	0.00	0.00	0.95	5.17	2.31	3.17	3.91	8.39	6.58
	2:10:00	0.00	0.00	0.81	4.34	1.94	2.70	3.34	7.04	5.61
	2:15:00	0.00	0.00	0.67	3.57	1.60	2.25	2.78	5.79	4.67
	2:20:00	0.00	0.00	0.53	2.90	1.28	1.82	2.25	4.63	3.76
	2:25:00	0.00	0.00	0.41	2.39	0.98	1.40	1.73	3.63	2.89
	2:30:00	0.00	0.00	0.30	2.01	0.74	1.01	1.25	2.90	2.09
	2:35:00	0.00	0.00	0.22	1.68	0.59	0.70	0.88	2.34	1.50
	2:40:00	0.00	0.00	0.18	1.40	0.48	0.51	0.65	1.89	1.11
	2:45:00	0.00	0.00	0.15	1.16	0.39	0.38	0.49	1.51	0.82
	2:50:00	0.00	0.00	0.12	0.96	0.32	0.29	0.37	1.21	0.60
	2:55:00	0.00	0.00	0.10	0.78	0.26	0.22	0.29	0.97	0.44
	3:00:00	0.00	0.00	0.08	0.64	0.21	0.17	0.22	0.78	0.32
	3:05:00	0.00	0.00	0.07	0.52	0.16	0.13	0.17	0.64	0.23
	3:10:00	0.00	0.00	0.05	0.42	0.13	0.10	0.13	0.52	0.17
	3:15:00	0.00	0.00	0.04	0.32	0.10	0.08	0.10	0.42	0.14
	3:20:00	0.00	0.00	0.03	0.25	0.08	0.06	0.08	0.32	0.11
	3:25:00	0.00	0.00	0.03	0.18	0.06	0.05	0.06	0.24	0.09
	3:30:00	0.00	0.00	0.02	0.13	0.04	0.04	0.05	0.18	0.06
	3:35:00	0.00	0.00	0.01	0.08	0.03	0.03	0.04	0.12	0.05
	3:40:00	0.00	0.00	0.01	0.05	0.02	0.02	0.02	0.07	0.03
	3:45:00	0.00	0.00	0.01	0.03	0.01	0.01	0.02	0.04	0.02
	3:50:00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	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 STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

Project: **Flying Horse North MDDP**

Basin ID: **Pond 8**



Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	15.89	acres
Watershed Length =	1,507	ft
Watershed Length to Centroid =	741	ft
Watershed Slope =	0.040	ft/ft
Watershed Imperviousness =	24.82%	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 WQC 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 CH2P" to generate runoff hydrographs using the embedded Colorado Urban Hydrograph Procedure.

Water Quality Capture Volume (WQCV) =	0.178	acre-feet
Excess Urban Runoff Volume (EURV) =	0.399	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.416	acre-feet
5-yr Runoff Volume (P1 = 1.5 in.) =	0.713	acre-feet
10-yr Runoff Volume (P1 = 1.75 in.) =	0.991	acre-feet
25-yr Runoff Volume (P1 = 2 in.) =	1.426	acre-feet
50-yr Runoff Volume (P1 = 2.25 in.) =	1.746	acre-feet
100-yr Runoff Volume (P1 = 2.52 in.) =	2.181	acre-feet
500-yr Runoff Volume (P1 = 3.14 in.) =	3.010	acre-feet
Approximate 2-yr Detention Volume =	0.280	acre-feet
Approximate 5-yr Detention Volume =	0.407	acre-feet
Approximate 10-yr Detention Volume =	0.620	acre-feet
Approximate 25-yr Detention Volume =	0.740	acre-feet
Approximate 50-yr Detention Volume =	0.781	acre-feet
Approximate 100-yr Detention Volume =	0.942	acre-feet

Optional User Overrides

		acre-feet
		acre-feet
	1.19	inches
	1.50	inches
	1.75	inches
	2.00	inches
	2.25	inches
	2.52	inches
		inches

Define Zones and Basin Geometry

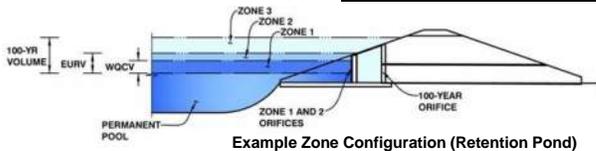
Zone 1 Volume (WQCV) =	0.178	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.221	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.543	acre-feet
Total Detention Basin Volume =	0.942	acre-feet
Initial Surcharge Volume (ISV) =	23	ft ³
Initial Surcharge Depth (ISD) =	0.33	ft
Total Available Detention Depth (H _{total}) =	6.00	ft
Depth of Trickle Channel (H _{tc}) =	0.50	ft
Slope of Trickle Channel (S _{tc}) =	0.004	ft/ft
Slopes of Main Basin Sides (S _{main}) =	4	H:V
Basin Length-to-Width Ratio (R _{L/W}) =	2	
Initial Surcharge Area (A _{ISV}) =	70	ft ²
Surcharge Volume Length (L _{ISV}) =	8.4	ft
Surcharge Volume Width (W _{ISV}) =	8.4	ft
Depth of Basin Floor (H _{FLOOR}) =	0.35	ft
Length of Basin Floor (L _{FLOOR}) =	97.3	ft
Width of Basin Floor (W _{FLOOR}) =	52.1	ft
Area of Basin Floor (A _{FLOOR}) =	5,073	ft ²
Volume of Basin Floor (V _{FLOOR}) =	670	ft ³
Depth of Main Basin (H _{MAIN}) =	4.82	ft
Length of Main Basin (L _{MAIN}) =	135.8	ft
Width of Main Basin (W _{MAIN}) =	90.7	ft
Area of Main Basin (A _{MAIN}) =	12,321	ft ²
Volume of Main Basin (V _{MAIN}) =	40,648	ft ³
Calculated Total Basin Volume (V _{total}) =	0.950	acre-feet

Depth Increment =	0.10	ft		ft		ft		ft		ft		ft		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		8.4	8.4	70		0.002								
ISV	0.33		8.4	8.4	70		0.002	23	0.001						
	0.40		8.4	8.4	70		0.002	28	0.001						
	0.50		8.4	8.4	70		0.002	35	0.001						
	0.60		8.4	8.4	70		0.002	42	0.001						
	0.70		8.4	8.4	70		0.002	49	0.001						
	0.80		8.4	8.4	70		0.002	56	0.001						
	0.90		26.2	17.1	449		0.010	75	0.002						
	1.00		51.6	29.6	1,528		0.035	168	0.004						
	1.10		77.0	42.1	3,243		0.074	402	0.009						
	1.18		97.3	52.1	5,073		0.116	732	0.017						
Floor	1.20		97.4	52.3	5,096		0.117	833	0.019						
	1.30		98.2	53.1	5,217		0.120	1,349	0.031						
	1.40		99.0	53.9	5,339		0.123	1,877	0.043						
	1.50		99.8	54.7	5,462		0.125	2,417	0.055						
	1.60		100.6	55.5	5,586		0.128	2,969	0.068						
	1.70		101.4	56.3	5,711		0.131	3,534	0.081						
	1.80		102.2	57.1	5,838		0.134	4,111	0.094						
	1.90		103.0	57.9	5,966		0.137	4,702	0.108						
	2.00		103.8	58.7	6,096		0.140	5,305	0.122						
	2.10		104.6	59.5	6,226		0.143	5,921	0.136						
Zone 1 (WQCV)	2.20		105.4	60.3	6,358		0.146	6,550	0.150						
	2.30		106.2	61.1	6,492		0.149	7,192	0.165						
	2.39		107.0	61.8	6,613		0.152	7,782	0.179						
	2.40		107.0	61.9	6,626		0.152	7,848	0.180						
	2.50		107.8	62.7	6,762		0.155	8,518	0.196						
	2.60		108.6	63.5	6,899		0.158	9,201	0.211						
	2.70		109.4	64.3	7,037		0.162	9,898	0.227						
	2.80		110.2	65.1	7,177		0.165	10,608	0.244						
	2.90		111.0	65.9	7,318		0.168	11,333	0.260						
	3.00		111.8	66.7	7,460		0.171	12,072	0.277						
Zone 2 (EURV)	3.10		112.6	67.5	7,604		0.175	12,825	0.294						
	3.20		113.4	68.3	7,748		0.178	13,593	0.312						
	3.30		114.2	69.1	7,894		0.181	14,375	0.330						
	3.40		115.0	69.9	8,042		0.185	15,172	0.348						
	3.50		115.8	70.7	8,190		0.188	15,983	0.367						
	3.60		116.6	71.5	8,340		0.191	16,810	0.386						
	3.67		117.2	72.1	8,446		0.194	17,397	0.399						
	3.70		117.4	72.3	8,491		0.195	17,651	0.405						
	3.80		118.2	73.1	8,644		0.198	18,508	0.425						
	3.90		119.0	73.9	8,798		0.202	19,380	0.445						
Zone 3 (100-year)	4.00		119.8	74.7	8,953		0.206	20,268	0.465						
	4.10		120.6	75.5	9,109		0.209	21,171	0.486						
	4.20		121.4	76.3	9,266		0.213	22,089	0.507						
	4.30		122.2	77.1	9,425		0.216	23,024	0.529						
	4.40		123.0	77.9	9,585		0.220	23,975	0.550						
	4.50		123.8	78.7	9,747		0.224	24,941	0.573						
	4.60		124.6	79.5	9,909		0.227	25,924	0.595						
	4.70		125.4	80.3	10,073		0.231	26,923	0.618						
	4.80		126.2	81.1	10,239		0.235	27,939	0.641						
	4.90		127.0	81.9	10,405		0.239	28,971	0.665						
Zone 3 (100-year)	5.00		127.8	82.7	10,573		0.243	30,020	0.689						
	5.10		128.6	83.5	10,742		0.247	31,085	0.714						
	5.20		129.4	84.3	10,912		0.251	32,168	0.738						
	5.30		130.2	85.1	11,084		0.254	33,268	0.764						
	5.40		131.0	85.9	11,257		0.258	34,385	0.789						
	5.50		131.8	86.7	11,431		0.262	35,519	0.815						
	5.60		132.6	87.5	11,607		0.266	36,671	0.842						
	5.70		133.4	88.3	11,783		0.271	37,841	0.869						
	5.80		134.2	89.1	11,961		0.275	39,028	0.896						
	5.90		135.0	89.9	12,141		0.279	40,233	0.924						
Zone 3 (100-year)	5.97		135.6	90.5	12,267		0.282	41,087	0.943						
	6.00		135.8	90.7	12,321		0.283	41,456	0.952						
	6.10		136.6	91.5	12,503		0.287	42,697	0.980						
	6.20		137.4	92.3	12,686		0.291	43,957	1.009						
	6.30		138.2	93.1	12,871		0.295	45,235	1.038						
	6.40		139.0	93.9	13,057		0.300	46,531	1.068						
	6.50		139.8	94.7	13,244		0.304	47,846	1.098						
	6.60		140.6	95.5	13,432		0.308	49,180	1.129						
	6.70		141.4	96.3	13,621		0.313	50,532	1.160						
	6.80		142.2	97.1	13,812		0.317	51,904	1.192						
Zone 3 (100-year)	6.90		143.0	97.9	14,004		0.321								

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD- Detention, Version 4.04 (February 2021)

Project: Flying Horse North MDDP
Basin ID: Pond 9



	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.01	0.883	Orifice Plate
Zone 2 (5-year)	2.76	1.030	Weir&Pipe (Restrict)
Zone 3 (100-year)	4.64	2.829	Weir&Pipe (Restrict)
Total (all zones)		4.742	

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 Diameter =	N/A	inches

Calculated Parameters for Underdrain	
Underdrain Orifice Area =	N/A ft ²
Underdrain Orifice Centroid =	N/A feet

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	2.36	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	9.40	inches
Orifice Plate: Orifice Area per Row =	3.45	sq. inches (use rectangular openings)

Calculated Parameters for Plate	
WQ Orifice Area per Row =	2.396E-02 ft ²
Elliptical Half-Width =	N/A feet
Elliptical Slot Centroid =	N/A feet
Elliptical Slot Area =	N/A ft ²

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	1.57					
Orifice Area (sq. inches)	3.45	3.45	3.45					

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

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected	
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	N/A	N/A	inches

Calculated Parameters for Vertical Orifice	
Vertical Orifice Area =	N/A ft ²
Vertical Orifice Centroid =	N/A feet

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

	Zone 2 Weir	Zone 3 Weir	
Overflow Weir Front Edge Height, Ho =	3.10	4.10	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	4.00	8.00	feet
Overflow Weir Grate Slope =	0.00	4.00	H:V
Horiz. Length of Weir Sides =	6.00	12.00	feet
Overflow Grate Type =	Type C Grate	Type C Grate	
Debris Clogging % =	50%	50%	%

Calculated Parameters for Overflow Weir	
Height of Grate Upper Edge, H _u =	3.10 feet
Overflow Weir Slope Length =	6.00 feet
Grate Open Area / 100-yr Orifice Area =	1.82
Overflow Grate Open Area w/o Debris =	16.70 ft ²
Overflow Grate Open Area w/ Debris =	8.35 ft ²

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

	Zone 2 Restrictor	Zone 3 Restrictor	
Depth to Invert of Outlet Pipe =	2.30	2.60	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	42.00	66.00	inches
Restrictor Plate Height Above Pipe Invert =	38.00	64.00	inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate	
Outlet Orifice Area =	9.16 ft ²
Outlet Orifice Centroid =	1.67 feet
Half-Central Angle of Restrictor Plate on Pipe =	2.51 radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage =	7.80	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	113.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway	
Spillway Design Flow Depth =	0.98 feet
Stage at Top of Freeboard =	9.78 feet
Basin Area at Top of Freeboard =	2.19 acres
Basin Volume at Top of Freeboard =	14.42 acre-ft

Routed Hydrograph Results

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

	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.14
One-Hour Rainfall Depth (in) =	0.883	1.880	2.026	3.599	5.087	7.473	9.201	11.580	16.065
CUHP Runoff Volume (acre-ft) =	0.883	1.880	2.026	3.599	5.087	7.473	9.201	11.580	16.065
User Override Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	2.026	17.291	5.087	7.473	9.201	31.926	16.065
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	11.0	30.3	46.1	81.0	101.4	129.3	179.9
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A	11.0	95.0				282.3	
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.13	1.10	0.53	0.94	1.18	3.28	2.09
Peak Inflow Q (cfs) =	N/A	N/A	28.4	148.4	67.1	103.1	125.4	309.0	207.1
Peak Outflow Q (cfs) =	0.4	0.5	0.5	94.8	21.0	46.0	61.0	220.7	118.9
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.0	0.5	0.6	0.6	0.8	0.7
Structure Controlling Flow =	Plate	Plate	Plate	Overflow Weir 2	Overflow Weir 1	Overflow Weir 2	Overflow Weir 2	Overflow Weir 2	Overflow Weir 2
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	4.5	1.2	2.7	3.4	6.1	4.9
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	0.3	N/A	0.0	0.1	1.7	0.5
Time to Drain 97% of Inflow Volume (hours) =	38	65	69	61	78	74	71	46	62
Time to Drain 99% of Inflow Volume (hours) =	40	68	72	78	84	83	82	70	78
Maximum Ponding Depth (ft) =	2.01	2.74	2.77	5.58	3.84	4.37	4.71	7.79	6.13
Area at Maximum Ponding Depth (acres) =	1.33	1.41	1.41	1.70	1.51	1.57	1.61	1.94	1.75
Maximum Volume Stored (acre-ft) =	0.889	1.890	1.932	6.278	3.484	4.300	4.856	10.314	7.229

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename: ...[SWM]Outflow hydrographs\Pond6 OutflowHydrograph.xlsx

Inflow Hydrographs

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

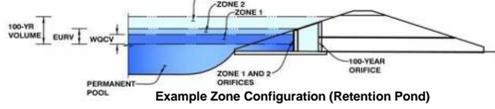
Time Interval	SOURCE	CUHP	CUHP	CUHP	USER	CUHP	CUHP	CUHP	USER	CUHP
	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.19	0.00	0.00	0.00	0.48	0.00
	0:10:00	0.00	0.00	0.00	2.62	0.00	0.00	0.09	2.67	0.28
	0:15:00	0.00	0.00	0.76	19.04	1.55	1.04	1.33	15.51	1.92
	0:20:00	0.00	0.00	2.95	79.68	8.04	2.99	3.82	71.52	8.06
	0:25:00	0.00	0.00	13.17	128.64	38.75	12.89	15.88	184.41	38.44
	0:30:00	0.00	0.00	24.71	146.60	62.28	61.82	77.38	267.93	131.08
	0:35:00	0.00	0.00	28.36	148.36	67.13	92.57	113.75	302.41	190.37
	0:40:00	0.00	0.00	27.34	143.02	62.88	103.09	125.40	309.03	207.06
	0:45:00	0.00	0.00	24.41	137.31	57.36	98.90	119.90	302.18	202.23
	0:50:00	0.00	0.00	21.63	130.82	51.33	93.57	113.46	289.65	191.70
	0:55:00	0.00	0.00	19.31	124.44	46.31	84.26	102.47	276.21	177.33
	1:00:00	0.00	0.00	17.53	119.29	42.27	75.99	92.91	264.30	165.28
	1:05:00	0.00	0.00	15.91	115.25	38.56	68.79	84.53	247.33	155.08
	1:10:00	0.00	0.00	13.92	110.41	34.92	60.71	74.92	229.27	137.88
	1:15:00	0.00	0.00	11.89	104.32	31.47	52.43	65.01	209.03	119.21
	1:20:00	0.00	0.00	10.24	97.99	28.23	44.33	55.03	188.58	100.29
	1:25:00	0.00	0.00	9.11	92.36	25.24	38.41	47.78	169.75	85.97
	1:30:00	0.00	0.00	8.22	87.52	22.52	33.51	41.71	153.19	74.48
	1:35:00	0.00	0.00	7.43	82.28	20.08	29.37	36.58	139.26	64.85
	1:40:00	0.00	0.00	6.68	77.25	17.85	25.63	31.93	128.04	56.24
	1:45:00	0.00	0.00	5.94	72.85	15.74	22.26	27.74	118.85	48.37
	1:50:00	0.00	0.00	5.22	68.94	13.70	19.04	23.75	111.03	40.97
	1:55:00	0.00	0.00	4.38	64.94	11.58	15.95	19.92	104.07	34.02
	2:00:00	0.00	0.00	3.55	58.11	9.29	13.00	16.27	93.16	27.58
	2:05:00	0.00	0.00	2.64	50.37	6.91	9.71	12.19	80.96	20.65
	2:10:00	0.00	0.00	1.92	43.04	5.27	6.60	8.35	69.34	14.54
	2:15:00	0.00	0.00	1.47	36.34	4.21	4.68	6.04	58.65	10.55
	2:20:00	0.00	0.00	1.17	30.41	3.40	3.43	4.48	48.94	7.79
	2:25:00	0.00	0.00	0.94	25.39	2.74	2.56	3.37	40.27	5.71
	2:30:00	0.00	0.00	0.75	21.07	2.19	1.91	2.52	32.86	4.14
	2:35:00	0.00	0.00	0.60	17.30	1.72	1.45	1.92	26.42	2.94
	2:40:00	0.00	0.00	0.47	14.29	1.33	1.08	1.43	20.94	2.04
	2:45:00	0.00	0.00	0.37	11.86	1.02	0.80	1.06	16.66	1.43
	2:50:00	0.00	0.00	0.30	9.83	0.77	0.62	0.81	13.31	1.09
	2:55:00	0.00	0.00	0.24	8.11	0.59	0.48	0.63	10.64	0.85
	3:00:00	0.00	0.00	0.19	6.68	0.45	0.37	0.49	8.52	0.68
	3:05:00	0.00	0.00	0.14	5.47	0.34	0.29	0.37	6.87	0.53
	3:10:00	0.00	0.00	0.11	4.47	0.25	0.21	0.28	5.54	0.39
	3:15:00	0.00	0.00	0.07	3.61	0.17	0.15	0.20	4.47	0.28
	3:20:00	0.00	0.00	0.05	2.87	0.11	0.10	0.13	3.60	0.18
	3:25:00	0.00	0.00	0.03	2.23	0.06	0.06	0.08	2.85	0.11
	3:30:00	0.00	0.00	0.01	1.69	0.03	0.03	0.04	2.21	0.05
	3:35:00	0.00	0.00	0.00	1.25	0.01	0.01	0.01	1.67	0.02
	3:40:00	0.00	0.00	0.00	0.88	0.00	0.00	0.00	1.20	0.00
	3:45:00	0.00	0.00	0.00	0.58	0.00	0.00	0.00	0.82	0.00
	3:50:00	0.00	0.00	0.00	0.36	0.00	0.00	0.00	0.52	0.00
	3:55:00	0.00	0.00	0.00	0.21	0.00	0.00	0.00	0.29	0.00
	4:00:00	0.00	0.00	0.00	0.11	0.00	0.00	0.00	0.16	0.00
	4:05:00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.06	0.00
	4:10:00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01	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 STAGE-STORAGE TABLE BUILDER

MHFD-*Detention*, Version 4.04 (February 2021)

Project: **Flying Horse North Master Drainage Plan**

Basin ID: **Pond 10**



Watershed Information

Selected BMP Type =	EDB
Watershed Area =	21.96 acres
Watershed Length =	1,715 ft
Watershed Length to Centroid =	1,346 ft
Watershed Slope =	0.056 ft/ft
Watershed Imperviousness =	10.00% 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.

Water Quality Capture Volume (WQCV) =	0.123 acre-feet	0.123 acre-feet
Excess Urban Runoff Volume (EURV) =	0.206 acre-feet	0.206 acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.293 acre-feet	1.19 inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.647 acre-feet	1.50 inches
10-yr Runoff Volume (P1 = 1.75 in.) =	1.000 acre-feet	1.75 inches
25-yr Runoff Volume (P1 = 2 in.) =	1.630 acre-feet	2.00 inches
50-yr Runoff Volume (P1 = 2.25 in.) =	2.059 acre-feet	2.25 inches
100-yr Runoff Volume (P1 = 2.52 in.) =	2.677 acre-feet	2.52 inches
500-yr Runoff Volume (P1 = 3.14 in.) =	3.804 acre-feet	3.14 inches
Approximate 2-yr Detention Volume =	0.132 acre-feet	
Approximate 5-yr Detention Volume =	0.207 acre-feet	
Approximate 10-yr Detention Volume =	0.429 acre-feet	
Approximate 25-yr Detention Volume =	0.599 acre-feet	
Approximate 50-yr Detention Volume =	0.627 acre-feet	
Approximate 100-yr Detention Volume =	0.810 acre-feet	

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.123 acre-feet
Zone 2 Volume (5-year - Zone 1) =	0.084 acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.603 acre-feet
Total Detention Basin Volume =	0.810 acre-feet
Initial Surcharge Volume (ISV) =	16 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}) =	0.004 ft/ft
Slopes of Main Basin Sides (S _{main}) =	4 H:V
Basin Length-to-Width Ratio (R _{LW}) =	2
Initial Surcharge Area (A _{ISV}) =	49 ft ²
Surcharge Volume Length (L _{ISV}) =	7.0 ft
Surcharge Volume Width (W _{ISV}) =	7.0 ft
Depth of Basin Floor (H _{FLOOR}) =	0.37 ft
Length of Basin Floor (L _{FLOOR}) =	100.9 ft
Width of Basin Floor (W _{FLOOR}) =	53.2 ft
Area of Basin Floor (A _{FLOOR}) =	5,372 ft ²
Volume of Basin Floor (V _{FLOOR}) =	732 ft ³
Depth of Main Basin (H _{MAIN}) =	4.80 ft
Length of Main Basin (L _{MAIN}) =	139.3 ft
Width of Main Basin (W _{MAIN}) =	91.6 ft
Area of Main Basin (A _{MAIN}) =	12,767 ft ²
Volume of Main Basin (V _{MAIN}) =	42,274 ft ³
Calculated Total Basin Volume (V _{total}) =	0.988 acre-feet

Depth Increment = **0.10** ft

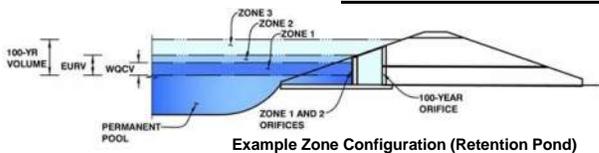
Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft ²)	Optional Override Area (ft ²)	Area (acre)	Volume (ft ³)	Volume (ac-ft)
Top of Micropool	0.00		7.0	7.0	49		0.001		
ISV	0.33		7.0	7.0	49		0.001	16	0.000
	0.40		7.0	7.0	49		0.001	19	0.000
	0.50		7.0	7.0	49		0.001	24	0.001
	0.60		7.0	7.0	49		0.001	29	0.001
	0.70		7.0	7.0	49		0.001	34	0.001
	0.80		7.0	7.0	49		0.001	39	0.001
	0.90		24.7	15.7	389		0.009	54	0.001
	1.00		50.1	28.2	1,415		0.032	139	0.003
	1.10		75.5	40.7	3,076		0.071	358	0.008
Floor	1.20		100.9	53.2	5,372		0.123	775	0.018
	1.30		101.7	54.0	5,496		0.126	1,319	0.030
	1.40		102.5	54.8	5,622		0.129	1,874	0.043
	1.50		103.3	55.6	5,748		0.132	2,443	0.056
	1.60		104.1	56.4	5,876		0.135	3,024	0.069
	1.70		104.9	57.2	6,005		0.138	3,618	0.083
	1.80		105.7	58.0	6,135		0.141	4,225	0.097
	1.90		106.5	58.8	6,267		0.144	4,845	0.111
	2.00		107.3	59.6	6,400		0.147	5,479	0.126
	2.10		108.1	60.4	6,534		0.150	6,125	0.141
	2.20		108.9	61.2	6,670		0.153	6,785	0.156
	2.30		109.7	62.0	6,806		0.156	7,459	0.171
Zone 1 (WQCV)	2.32		109.9	62.2	6,834		0.157	7,596	0.174
	2.40		110.5	62.8	6,945		0.159	8,147	0.187
	2.50		111.3	63.6	7,084		0.163	8,848	0.203
	2.60		112.1	64.4	7,224		0.166	9,564	0.220
	2.70		112.9	65.2	7,366		0.169	10,293	0.236
	2.80		113.7	66.0	7,510		0.172	11,037	0.253
Zone 2 (5-year)	2.90		114.5	66.8	7,654		0.176	11,795	0.271
	3.00		115.3	67.6	7,800		0.179	12,568	0.289
	3.10		116.1	68.4	7,947		0.182	13,355	0.307
	3.20		116.9	69.2	8,095		0.186	14,157	0.325
	3.30		117.7	70.0	8,245		0.189	14,974	0.344
	3.40		118.5	70.8	8,395		0.193	15,806	0.363
	3.50		119.3	71.6	8,548		0.196	16,653	0.382
	3.60		120.1	72.4	8,701		0.200	17,516	0.402
	3.70		120.9	73.2	8,856		0.203	18,393	0.422
	3.80		121.7	74.0	9,012		0.207	19,287	0.443
	3.90		122.5	74.8	9,169		0.210	20,196	0.464
	4.00		123.3	75.6	9,327		0.214	21,121	0.485
	4.10		124.1	76.4	9,487		0.218	22,061	0.506
	4.20		124.9	77.2	9,648		0.221	23,018	0.528
	4.30		125.7	78.0	9,811		0.225	23,991	0.551
	4.40		126.5	78.8	9,974		0.229	24,980	0.573
	4.50		127.3	79.6	10,139		0.233	25,986	0.597
	4.60		128.1	80.4	10,306		0.237	27,008	0.620
	4.70		128.9	81.2	10,473		0.240	28,047	0.644
	4.80		129.7	82.0	10,642		0.244	29,103	0.668
	4.90		130.5	82.8	10,812		0.248	30,176	0.693
	5.00		131.3	83.6	10,983		0.252	31,265	0.718
	5.10		132.1	84.4	11,156		0.256	32,372	0.743
	5.20		132.9	85.2	11,330		0.260	33,497	0.769
	5.30		133.7	86.0	11,505		0.264	34,638	0.795
	5.40		134.5	86.8	11,681		0.268	35,798	0.822
	5.50		135.3	87.6	11,859		0.272	36,975	0.849
	5.60		136.1	88.4	12,038		0.276	38,169	0.876
	5.70		136.9	89.2	12,218		0.280	39,382	0.904
	5.80		137.7	90.0	12,400		0.285	40,613	0.932
	5.90		138.5	90.8	12,583		0.289	41,862	0.961
Zone 3 (100-year)	5.98		139.2	91.5	12,730		0.292	42,875	0.984
	6.00		139.3	91.6	12,767		0.293	43,130	0.990
	6.10		140.1	92.4	12,952		0.297	44,416	1.020
	6.20		140.9	93.2	13,139		0.302	45,720	1.050
	6.30		141.7	94.0	13,327		0.306	47,043	1.080
	6.40		142.5	94.8	13,516		0.310	48,386	1.111
	6.50		143.3	95.6	13,707		0.315	49,747	1.142
	6.60		144.1	96.4	13,899		0.319	51,127	1.174
	6.70		144.9	97.2	14,092		0.324	52,527	1.206
	6.80		145.7	98.0	14,286		0.328	53,945	1.238
	6.90		146.5	98.8	14,482		0.332	55,384	1.271
	7.00		147.3	99.6	14,679		0.337	56,842	1.305
	7.10		148.1	100.4	14,877		0.342	58,320	1.339
	7.20		148.9	101.2	15,076		0.346	59,817	1.373
	7.30		149.7	102.0	15,277		0.351	61,335	1.408
	7.40		150.5	102.8	15,479		0.355	62,873	1.443
	7.50		151.3	103.6	15,683		0.360	64,431	1.479
	7.60		152.1	104.4	15,887		0.365	66,009	1.515
	7.70		152.9	105.2	16,093		0.369	67,608	1.552
	7.80		153.7	106.0	16,300		0.374	69,228	1.589
	7.90		154.5	106.8	16,509		0.379	70,868	1.627
	8.00		155.3	107.6	16,718		0.384	72,530	1.665
	8.10		156.1	108.4	16,929		0.389	74,212	1.704
	8.20		156.9	109.2	17,142		0.394	75,916	1.743
	8.30		157.7	110.0	17,355		0.398	77,640	1.782
	8.40		158.5	110.8	17,570		0.403	79,387	1.822
	8.50		159.3	111.6	17,786		0.408	81,154	1.863
	8.60		160.1	112.4	18,004		0.413	82,944	1.904
	8.70		160.9	113.2	18,222		0.418	84,755	1.946
	8.80		161.7	114.0	18,442		0.423	86,588	1.988
	8.90		162.5	114.8	18,664		0.428	88,444	2.030
	9.00		163.3	115.6	18,886		0.434	90,321	2.073
	9.10		164.1	116.4	19,110		0.439	92,221	2.117
	9.20		164.9	117.2	19,335		0.444	94,143	2.161
	9.30		165.7	118.0	19,561		0.449	96,088	2.206
	9.40		166.5	118.8	19,789		0.454	98,056	2.251
	9.50		167.3	119.6	20,018		0.460	100,046	2.297

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD- Detention, Version 4.04 (February 2021)

Project: Flying Horse North Master Drainage Plan

Basin ID: Pond 10



	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.98	0.123	Orifice Plate
Zone 2 (5-year)	2.53	0.084	Circular Orifice
Zone 3 (100-year)	5.36	0.603	Weir&Pipe (Restrict)
Total (all zones)		0.810	

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 Diameter =	N/A	inches

Calculated Parameters for Underdrain	
Underdrain Orifice Area =	N/A ft ²
Underdrain Orifice Centroid =	N/A feet

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	1.98	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	8.80	inches
Orifice Plate: Orifice Area per Row =	0.45	sq. inches (diameter = 3/4 inch)

Calculated Parameters for Plate	
WQ Orifice Area per Row =	3.125E-03 ft ²
Elliptical Half-Width =	N/A feet
Elliptical Slot Centroid =	N/A feet
Elliptical Slot Area =	N/A ft ²

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	0.66	1.32					
Orifice Area (sq. inches)	0.45	0.45	0.45					
	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	
Invert of Vertical Orifice =	1.98	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	2.53	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	18.00	N/A	inches

Calculated Parameters for Vertical Orifice	
Zone 2 Circular	Not Selected
Vertical Orifice Area =	1.77 ft ²
Vertical Orifice Centroid =	0.75 feet

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	
Overflow Weir Front Edge Height, Ho =	4.70	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	3.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V
Horiz. Length of Weir Sides =	3.00	N/A	feet
Overflow Grate Type =	Type C Grate	N/A	
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir	
Zone 3 Weir	Not Selected
Height of Grate Upper Edge, H _u =	4.70 feet
Overflow Weir Slope Length =	3.00 feet
Grate Open Area / 100-yr Orifice Area =	1.55
Overflow Grate Open Area w/o Debris =	6.26 ft ²
Overflow Grate Open Area w/ Debris =	3.13 ft ²

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	1.00	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	36.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	20.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate	
Zone 3 Restrictor	Not Selected
Outlet Orifice Area =	4.03 ft ²
Outlet Orifice Centroid =	0.95 feet
Half-Central Angle of Restrictor Plate on Pipe =	1.68 radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage =	6.70	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	26.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway	
Spillway Design Flow Depth =	0.94 feet
Stage at Top of Freeboard =	8.64 feet
Basin Area at Top of Freeboard =	0.42 acres
Basin Volume at Top of Freeboard =	1.92 acre-ft

Routed Hydrograph Results

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

	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.14
One-Hour Rainfall Depth (in) =	0.123	0.206	0.293	0.647	1.000	1.630	2.059	2.677	3.804
CUHP Runoff Volume (acre-ft) =	N/A	N/A	0.293	2.509	1.000	1.630	2.059	4.656	3.804
User Override Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	2.0	5.7	8.7	15.6	19.6	25.0	35.0
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.09	0.60	0.40	0.71	0.89	1.79	1.60
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A	3.3	17.8	10.1	17.0	21.0	37.7	36.7
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	1.0	13.6	6.5	10.7	13.6	33.9	31.4
Peak Inflow Q (cfs) =	N/A	N/A	1.0	1.0	0.8	0.7	0.7	0.9	0.9
Peak Outflow Q (cfs) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Structure Controlling Flow =	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.2	N/A	N/A	0.2	3.0	2.7
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	43	44	21	35	29	25	6	11
Time to Drain 99% of Inflow Volume (hours) =	40	45	47	38	44	41	40	30	33
Maximum Ponding Depth (ft) =	1.99	2.52	2.46	4.85	3.37	4.28	4.85	5.83	5.71
Area at Maximum Ponding Depth (acres) =	0.15	0.16	0.16	0.25	0.19	0.22	0.25	0.29	0.28
Maximum Volume Stored (acre-ft) =	0.124	0.206	0.195	0.680	0.357	0.544	0.680	0.938	0.904

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename: ...[SWM]Outflow hydrographs\Pond6 OutflowHydrograph.xlsx

Inflow Hydrographs

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

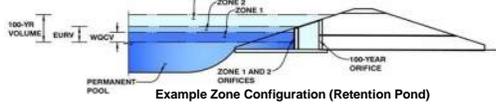
Time Interval	SOURCE	CUHP	CUHP	CUHP	USER	CUHP	CUHP	CUHP	USER	CUHP
	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
	0:10:00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.05	0.01
	0:15:00	0.00	0.00	0.03	1.83	0.06	0.04	0.05	1.39	0.07
	0:20:00	0.00	0.00	0.11	9.48	0.47	0.11	0.13	8.51	0.45
	0:25:00	0.00	0.00	0.97	14.91	5.06	0.92	1.21	22.24	4.95
	0:30:00	0.00	0.00	2.57	17.12	8.84	9.02	11.66	31.63	20.83
	0:35:00	0.00	0.00	3.18	17.81	9.99	14.05	17.64	36.02	30.90
	0:40:00	0.00	0.00	3.29	17.64	10.09	16.51	20.48	37.66	35.22
	0:45:00	0.00	0.00	3.11	17.35	9.65	17.00	21.04	37.68	36.71
	0:50:00	0.00	0.00	2.84	16.96	8.96	16.79	20.76	36.95	36.31
	0:55:00	0.00	0.00	2.61	16.50	8.35	15.81	19.62	36.11	35.07
	1:00:00	0.00	0.00	2.41	16.04	7.79	14.79	18.46	35.23	33.85
	1:05:00	0.00	0.00	2.22	15.74	7.25	13.82	17.33	33.48	32.63
	1:10:00	0.00	0.00	2.01	15.37	6.84	12.57	15.85	31.77	30.15
	1:15:00	0.00	0.00	1.85	14.87	6.52	11.51	14.62	29.79	27.86
	1:20:00	0.00	0.00	1.70	14.33	6.07	10.54	13.40	27.78	25.45
	1:25:00	0.00	0.00	1.55	13.77	5.55	9.62	12.24	25.86	23.11
	1:30:00	0.00	0.00	1.41	13.20	5.03	8.72	11.10	23.99	20.91
	1:35:00	0.00	0.00	1.26	12.43	4.51	7.84	9.99	22.18	18.81
	1:40:00	0.00	0.00	1.12	11.70	4.01	6.98	8.91	20.48	16.77
	1:45:00	0.00	0.00	0.99	11.14	3.55	6.14	7.85	19.08	14.83
	1:50:00	0.00	0.00	0.88	10.69	3.23	5.39	6.92	17.99	13.15
	1:55:00	0.00	0.00	0.81	10.23	2.98	4.85	6.25	17.09	11.89
	2:00:00	0.00	0.00	0.75	9.42	2.74	4.42	5.71	15.71	10.84
	2:05:00	0.00	0.00	0.69	8.54	2.50	4.03	5.21	14.26	9.85
	2:10:00	0.00	0.00	0.63	7.69	2.27	3.68	4.74	12.87	8.95
	2:15:00	0.00	0.00	0.57	6.90	2.05	3.35	4.31	11.57	8.10
	2:20:00	0.00	0.00	0.52	6.17	1.84	3.03	3.90	10.38	7.31
	2:25:00	0.00	0.00	0.46	5.49	1.64	2.73	3.51	9.28	6.57
	2:30:00	0.00	0.00	0.41	4.85	1.44	2.44	3.13	8.23	5.87
	2:35:00	0.00	0.00	0.35	4.25	1.25	2.15	2.76	7.22	5.19
	2:40:00	0.00	0.00	0.30	3.68	1.07	1.86	2.39	6.26	4.51
	2:45:00	0.00	0.00	0.25	3.14	0.89	1.58	2.03	5.32	3.84
	2:50:00	0.00	0.00	0.20	2.62	0.72	1.29	1.67	4.39	3.17
	2:55:00	0.00	0.00	0.15	2.14	0.54	1.01	1.31	3.51	2.50
	3:00:00	0.00	0.00	0.10	1.79	0.37	0.73	0.95	2.76	1.84
	3:05:00	0.00	0.00	0.06	1.52	0.25	0.45	0.61	2.21	1.24
	3:10:00	0.00	0.00	0.04	1.29	0.19	0.28	0.40	1.80	0.85
	3:15:00	0.00	0.00	0.03	1.10	0.15	0.18	0.27	1.47	0.60
	3:20:00	0.00	0.00	0.02	0.94	0.12	0.12	0.19	1.22	0.42
	3:25:00	0.00	0.00	0.02	0.79	0.10	0.08	0.13	1.00	0.28
	3:30:00	0.00	0.00	0.01	0.66	0.07	0.05	0.09	0.81	0.19
	3:35:00	0.00	0.00	0.01	0.54	0.06	0.04	0.06	0.66	0.12
	3:40:00	0.00	0.00	0.01	0.44	0.04	0.02	0.04	0.54	0.07
	3:45:00	0.00	0.00	0.01	0.35	0.03	0.02	0.03	0.44	0.05
	3:50:00	0.00	0.00	0.01	0.27	0.02	0.01	0.02	0.35	0.04
	3:55:00	0.00	0.00	0.00	0.21	0.02	0.01	0.02	0.27	0.03
	4:00:00	0.00	0.00	0.00	0.15	0.01	0.01	0.01	0.21	0.02
	4:05:00	0.00	0.00	0.00	0.11	0.01	0.00	0.01	0.15	0.02
	4:10:00	0.00	0.00	0.00	0.07	0.01	0.00	0.01	0.10	0.01
	4:15:00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.06	0.01
	4:20:00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.03	0.01
	4:25:00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01	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 STAGE-STORAGE TABLE BUILDER

MHFD-*Detention*, Version 4.04 (February 2021)

Project: **Flying Horse North Master Drainage Plan**

Basin ID: **Pond 11**



Watershed Information

Selected BMP Type =	EDB
Watershed Area =	79.73 acres
Watershed Length =	2,715 ft
Watershed Length to Centroid =	1,530 ft
Watershed Slope =	0.037 ft/ft
Watershed Imperviousness =	28.50% 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.

Water Quality Capture Volume (WQCV) =	0.975 acre-feet
Excess Urban Runoff Volume (EURV) =	2.322 acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	2.370 acre-feet
5-yr Runoff Volume (P1 = 1.5 in.) =	3.903 acre-feet
10-yr Runoff Volume (P1 = 1.75 in.) =	5.321 acre-feet
25-yr Runoff Volume (P1 = 2 in.) =	7.486 acre-feet
50-yr Runoff Volume (P1 = 2.25 in.) =	9.112 acre-feet
100-yr Runoff Volume (P1 = 2.52 in.) =	11.293 acre-feet
500-yr Runoff Volume (P1 = 3.39 in.) =	17.208 acre-feet
Approximate 2-yr Detention Volume =	1.653 acre-feet
Approximate 5-yr Detention Volume =	2.375 acre-feet
Approximate 10-yr Detention Volume =	3.504 acre-feet
Approximate 25-yr Detention Volume =	4.095 acre-feet
Approximate 50-yr Detention Volume =	4.317 acre-feet
Approximate 100-yr Detention Volume =	5.132 acre-feet

Optional User Overrides

	acre-feet
	acre-feet
	inches

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.975 acre-feet
Zone 2 Volume (5-year - Zone 1) =	1.400 acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	2.757 acre-feet
Total Detention Basin Volume =	5.132 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}) =	0.004 ft/ft
Slopes of Main Basin Sides (S _{main}) =	4 H:V
Basin Length-to-Width Ratio (R _{LW}) =	2
Initial Surcharge Area (A _{ISV}) =	386 ft ²
Surcharge Volume Length (L _{ISV}) =	19.6 ft
Surcharge Volume Width (W _{ISV}) =	19.6 ft
Depth of Basin Floor (H _{FLOOR}) =	0.99 ft
Length of Basin Floor (L _{FLOOR}) =	271.1 ft
Width of Basin Floor (W _{FLOOR}) =	143.4 ft
Area of Basin Floor (A _{FLOOR}) =	38,876 ft ²
Volume of Basin Floor (V _{FLOOR}) =	14,235 ft ³
Depth of Main Basin (H _{MAIN}) =	4.18 ft
Length of Main Basin (L _{MAIN}) =	304.5 ft
Width of Main Basin (W _{MAIN}) =	176.8 ft
Area of Main Basin (A _{MAIN}) =	53,855 ft ²
Volume of Main Basin (V _{MAIN}) =	192,959 ft ³
Calculated Total Basin Volume (V _{total}) =	4.764 acre-feet

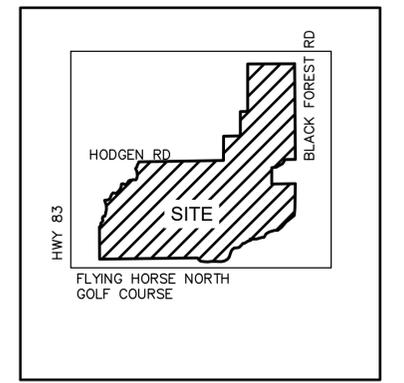
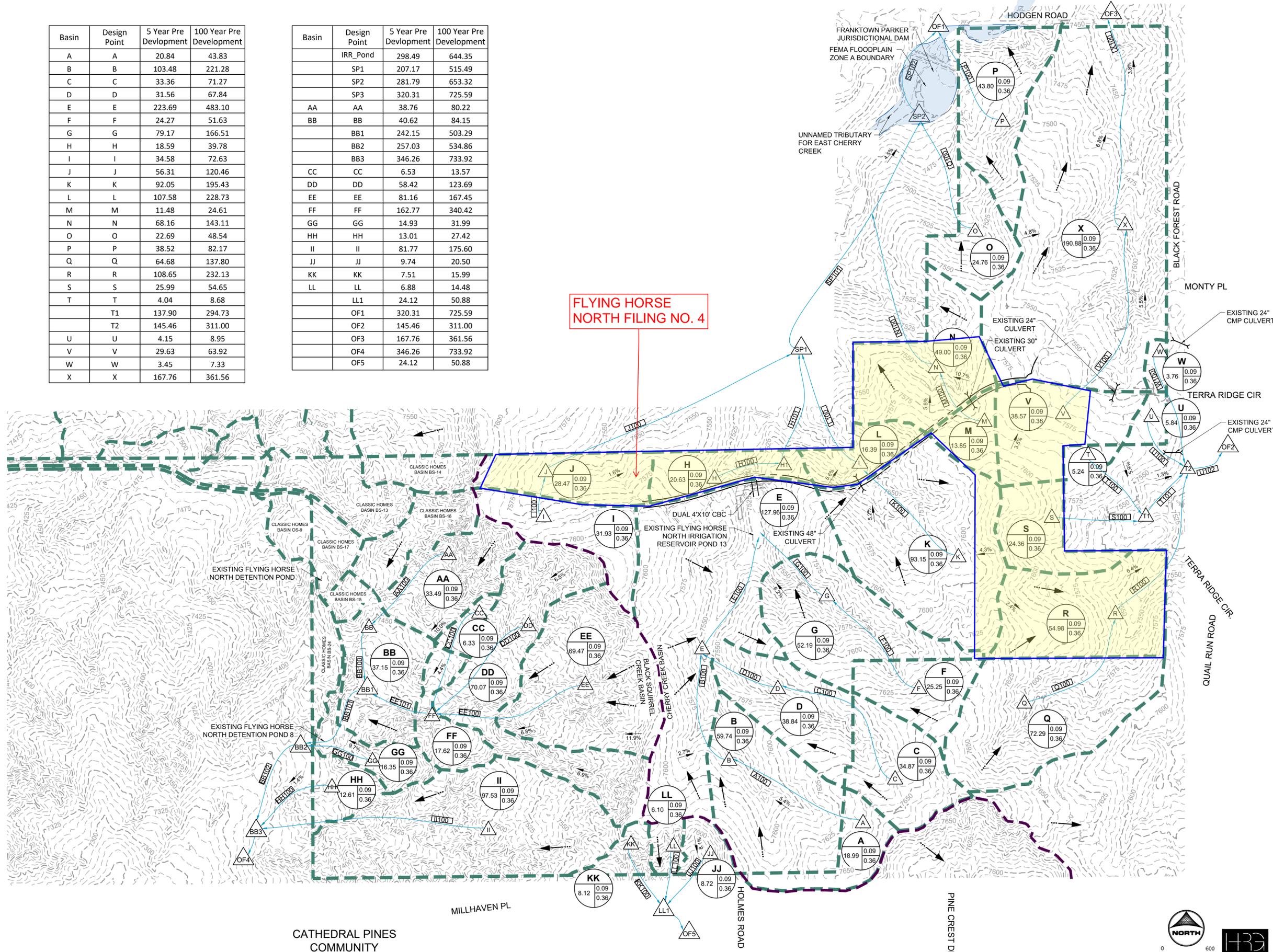
Depth Increment = **0.10** ft

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		19.6	19.6	386		0.009		
ISV	0.33		19.6	19.6	386		0.009	127	0.003
	0.40		19.6	19.6	386		0.009	154	0.004
	0.50		19.6	19.6	386		0.009	193	0.004
	0.60		19.6	19.6	386		0.009	232	0.005
	0.70		19.6	19.6	386		0.009	270	0.006
	0.80		19.6	19.6	386		0.009	309	0.007
	0.90		37.4	28.4	1,063		0.024	369	0.008
	1.00		62.8	40.9	2,569		0.059	546	0.013
	1.10		88.2	53.4	4,711		0.108	904	0.021
	1.20		113.6	65.9	7,488		0.172	1,509	0.035
	1.30		139.0	78.4	10,899		0.250	2,423	0.056
	1.40		164.4	90.9	14,946		0.343	3,710	0.085
	1.50		189.8	103.4	19,628		0.451	5,433	0.125
	1.60		215.2	115.9	24,944		0.573	7,657	0.176
	1.70		240.6	128.4	30,896		0.709	10,443	0.240
	1.80		266.0	140.9	37,482		0.860	13,857	0.318
Floor	1.82		271.1	143.4	38,876		0.892	14,621	0.336
	1.90		271.7	144.0	39,142		0.899	17,741	0.407
	2.00		272.5	144.8	39,475		0.906	21,672	0.498
	2.10		273.3	145.6	39,809		0.914	25,636	0.589
	2.20		274.1	146.4	40,145		0.922	29,634	0.680
	2.30		274.9	147.2	40,482		0.929	33,665	0.773
	2.40		275.7	148.0	40,821		0.937	37,730	0.866
Zone 1 (WQCV)	2.45		276.1	148.4	40,990		0.941	39,776	0.913
	2.50		276.5	148.8	41,160		0.945	41,830	0.960
	2.60		277.3	149.6	41,501		0.953	45,963	1.055
	2.70		278.1	150.4	41,844		0.961	50,130	1.151
	2.80		278.9	151.2	42,187		0.968	54,331	1.247
	2.90		279.7	152.0	42,532		0.976	58,567	1.345
	3.00		280.5	152.8	42,878		0.984	62,838	1.443
	3.10		281.3	153.6	43,225		0.992	67,143	1.541
	3.20		282.1	154.4	43,574		1.000	71,483	1.641
Zone 2 (5-year)	3.23		282.4	154.7	43,679		1.003	72,792	1.671
	3.30		282.9	155.2	43,924		1.008	75,858	1.741
	3.40		283.7	156.0	44,275		1.016	80,268	1.843
	3.50		284.5	156.8	44,627		1.025	84,713	1.945
	3.60		285.3	157.6	44,981		1.033	89,193	2.048
	3.70		286.1	158.4	45,336		1.041	93,709	2.151
	3.80		286.9	159.2	45,693		1.049	98,260	2.256
	3.90		287.7	160.0	46,050		1.057	102,848	2.361
	4.00		288.5	160.8	46,409		1.065	107,471	2.467
	4.10		289.3	161.6	46,769		1.074	112,129	2.574
	4.20		290.1	162.4	47,131		1.082	116,824	2.682
	4.30		290.9	163.2	47,493		1.090	121,556	2.791
	4.40		291.7	164.0	47,857		1.099	126,322	2.900
	4.50		292.5	164.8	48,223		1.107	131,127	3.010
	4.60		293.3	165.6	48,589		1.115	135,968	3.121
	4.70		294.1	166.4	48,957		1.124	140,845	3.233
	4.80		294.9	167.2	49,326		1.132	145,759	3.346
	4.90		295.7	168.0	49,696		1.141	150,710	3.460
	5.00		296.5	168.8	50,068		1.149	155,698	3.574
	5.10		297.3	169.6	50,441		1.158	160,724	3.690
	5.20		298.1	170.4	50,815		1.167	165,787	3.806
	5.30		298.9	171.2	51,191		1.175	170,887	3.923
	5.40		299.7	172.0	51,568		1.184	176,025	4.041
	5.50		300.5	172.8	51,946		1.193	181,201	4.160
	5.60		301.3	173.6	52,325		1.201	186,414	4.279
	5.70		302.1	174.4	52,706		1.210	191,666	4.400
	5.80		302.9	175.2	53,087		1.219	196,955	4.521
	5.90		303.7	176.0	53,471		1.228	202,283	4.644
Zone 3 (100-year)	5.98		304.4	176.7	53,778		1.235	206,573	4.742
	6.00		304.5	176.8	53,855		1.236	207,649	4.767
	6.10		305.3	177.6	54,241		1.245	213,054	4.891
	6.20		306.1	178.4	54,628		1.254	218,498	5.016
	6.30		306.9	179.2	55,016		1.263	223,980	5.142
	6.40		307.7	180.0	55,406		1.272	229,501	5.269
	6.50		308.5	180.8	55,797		1.281	235,061	5.396
	6.60		309.3	181.6	56,189		1.290	240,660	5.525
	6.70		310.1	182.4	56,582		1.299	246,299	5.654
	6.80		310.9	183.2	56,977		1.308	251,977	5.785
	6.90		311.7	184.0	57,373		1.317	257,694	5.916
	7.00		312.5	184.8	57,770		1.326	263,451	6.048
	7.10		313.3	185.6	58,169		1.335	269,248	6.181
	7.20		314.1	186.4	58,569		1.345	275,085	6.315
	7.30		314.9	187.2	58,970		1.354	280,962	6.450
	7.40		315.7	188.0	59,372		1.363	286,879	6.586
	7.50		316.5	188.8	59,776		1.372	292,837	6.723
	7.60		317.3	189.6	60,181		1.382	298,834	6.860
	7.70		318.1	190.4	60,587		1.391	304,873	6.999
	7.80		318.9	191.2	60,994		1.400	310,952	7.138
	7.90		319.7	192.0	61,403		1.410	317,072	7.279
	8.00		320.5	192.8	61,813		1.419	323,232	7.420
	8.10		321.3	193.6	62,225		1.428	329,434	7.563
	8.20		322.1	194.4	62,637		1.438	335,677	7.706
	8.30		322.9	195.2	63,051		1.447	341,962	7.850
	8.40		323.7	196.0	63,466		1.457	348,288	7.996
	8.50		324.5	196.8	63,883		1.467	354,655	8.142
	8.60		325.3	197.6	64,301		1.476	361,064	8.289
	8.70		326.1	198.4	64,720		1.486	367,515	8.437
	8.80		326.9	199.2	65,140		1.495	374,008	8.586
	8.90		327.7	200.0	65,561		1.505	380,543	8.736
	9.00		328.5						

Basin	Design Point	5 Year Pre Development	100 Year Pre Development
A	A	20.84	43.83
B	B	103.48	221.28
C	C	33.36	71.27
D	D	31.56	67.84
E	E	223.69	483.10
F	F	24.27	51.63
G	G	79.17	166.51
H	H	18.59	39.78
I	I	34.58	72.63
J	J	56.31	120.46
K	K	92.05	195.43
L	L	107.58	228.73
M	M	11.48	24.61
N	N	68.16	143.11
O	O	22.69	48.54
P	P	38.52	82.17
Q	Q	64.68	137.80
R	R	108.65	232.13
S	S	25.99	54.65
T	T	4.04	8.68
T1	T1	137.90	294.73
T2	T2	145.46	311.00
U	U	4.15	8.95
V	V	29.63	63.92
W	W	3.45	7.33
X	X	167.76	361.56

Basin	Design Point	5 Year Pre Development	100 Year Pre Development
	IRR_Pond	298.49	644.35
	SP1	207.17	515.49
	SP2	281.79	653.32
	SP3	320.31	725.59
AA	AA	38.76	80.22
BB	BB	40.62	84.15
	BB1	242.15	503.29
	BB2	257.03	534.86
	BB3	346.26	733.92
CC	CC	6.53	13.57
DD	DD	58.42	123.69
EE	EE	81.16	167.45
FF	FF	162.77	340.42
GG	GG	14.93	31.99
HH	HH	13.01	27.42
II	II	81.77	175.60
JJ	JJ	9.74	20.50
KK	KK	7.51	15.99
LL	LL	6.88	14.48
	LL1	24.12	50.88
	OF1	320.31	725.59
	OF2	145.46	311.00
	OF3	167.76	361.56
	OF4	346.26	733.92
	OF5	24.12	50.88

FLYING HORSE NORTH FILING NO. 4



LEGEND:

- PROPOSED MAJOR CONTOUR: Solid purple line
- PROPOSED MINOR CONTOUR: Dashed purple line
- EXISTING MAJOR CONTOUR: Solid blue line
- EXISTING MINOR CONTOUR: Dashed blue line
- EXISTING CULVERT: Blue line with 'C' symbol
- PROPOSED DRAINAGE CHANNEL: Blue line with 'D' symbol
- PROPOSED ROAD: Double line
- PROPERTY LINE: Dashed green line
- DIRECTIONAL FLOW ARROW: Arrow with 'D' symbol
- EMERGENCY OVERFLOW ARROW: Arrow with 'E' symbol
- EXISTING 100-YR FLOODWAY: Dashed purple line
- EXISTING 100-YR FLOODPLAIN: Dashed blue line
- PROPOSED 100-YR FLOODPLAIN: Dashed purple line
- WATERSHED BOUNDARY: Dashed green line
- MAJOR BASIN LINE: Dashed green line
- 100YR ZONE A FLOODPLAIN: Shaded area
- PROPOSED DETENTION LOCATION: Circle with 'A' symbol
- POTENTIAL WATER QUALITY LOCATION: Circle with 'WQ' symbol
- SWMM CONVEYANCE ELEMENT: Square with 'S' symbol
- PROPOSED PEAK FLOW RATE (CFS): Circle with '850' symbol
- DESIGN POINT: Triangle with 'D' symbol
- PROPOSED BASIN LABEL: Circle with 'XX' symbol
- BASIN DESIGNATION: Circle with 'XX' symbol
- AREA (AC.): Circle with 'XX' symbol
- C5: Circle with 'XX' symbol
- C100: Circle with 'XX' symbol

NOTES:

CATHEDRAL PINES COMMUNITY

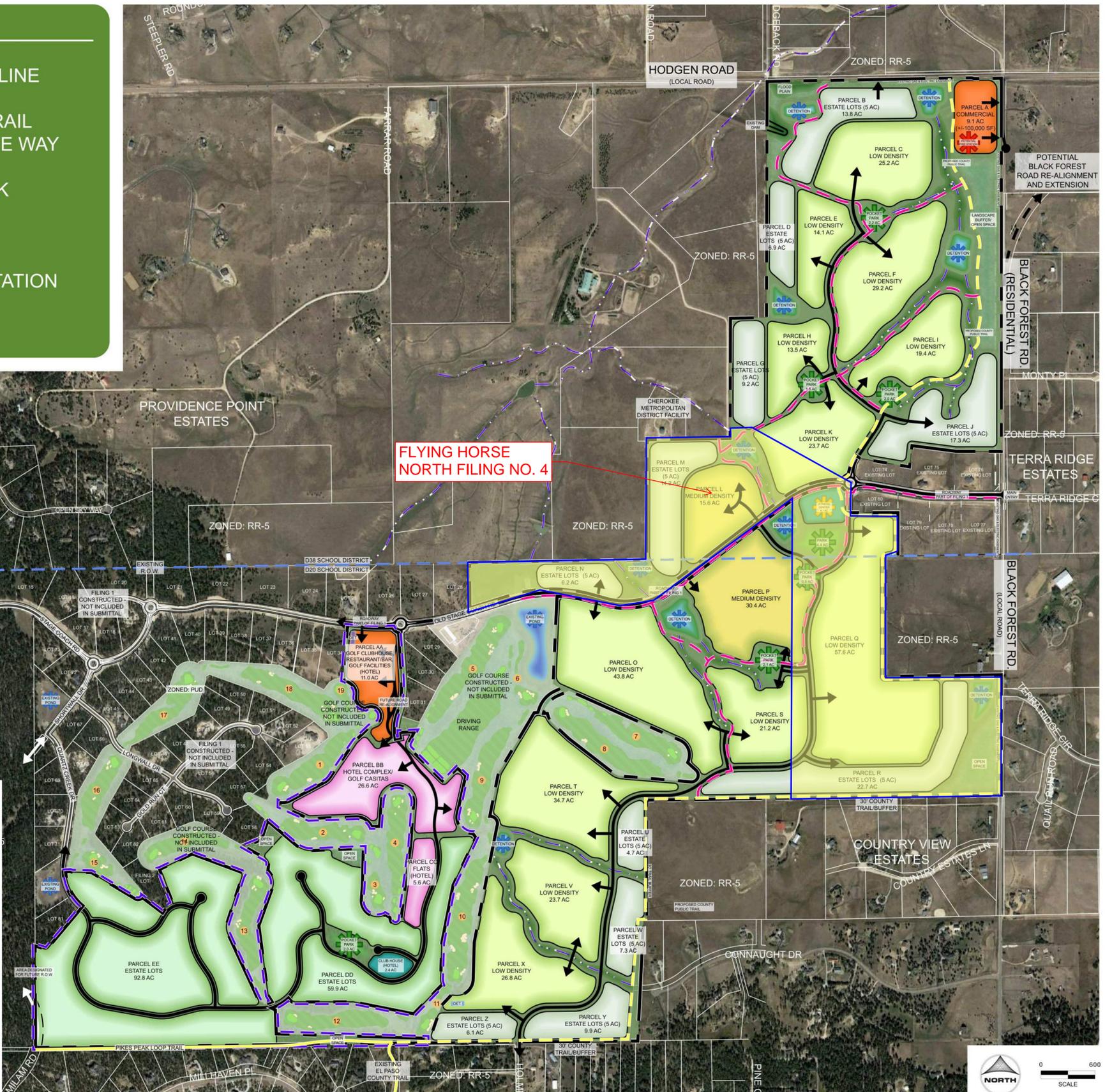
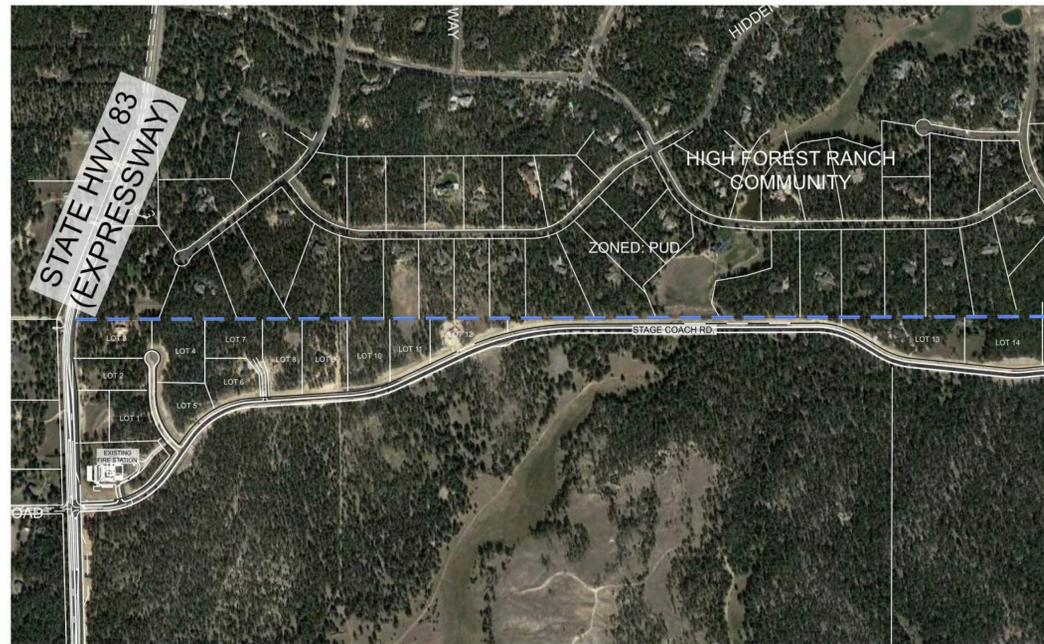
Job No.: 211030.01
 Prepared By: CLB
 Date: 02/21/2022

EXISTING EX1

FLYING HORSE NORTH SKETCH PLAN

LEGEND

- ESTATE LOTS (5 AC)
- ESTATE LOTS (2.5 AC)
- LOW DENSITY
- MEDIUM DENSITY
- COMMERCIAL
- GOLF CLUB, FITNESS CENTER, RESTAURANT/BAR (HOTEL)
- HOTEL COMPLEX
- CLUBHOUSE
- ROADWAY
- DETENTION
- SITE BOUNDARY
- HOTEL PARCELS
- SCHOOL DISTRICT LINE
- FHN TRAIL
- PUBLIC COUNTY TRAIL
- EXISTING DRAINAGE WAY
- PARK/POCKET PARK
- FITNESS CENTER
- POTENTIAL FIRE STATION
- DETENTION



LAND USE SUMMARY				
LAND USE CATEGORY	ACREAGE	ACREAGE PERCENTAGE	DU/AC	UNITS
GROSS RESIDENTIAL ACREAGE (+/-)				
ESTATE LOTS (5 ACRES)	118.3 AC.	13.0%	0.225	27
ESTATE LOTS (2.5 ACRES)	152.7 AC.	16.7%	0.32	49
LOW DENSITY RESIDENTIAL	332.9 AC.	36.5%	1.9	632
MEDIUM DENSITY RESIDENTIAL	46.0 AC.	5.0%	3.0	138
ESTIMATED OPEN SPACE	203.9 AC.	22.3%		
GROSS RESIDENTIAL SUB-TOTAL	853.8 AC.			846
HOTEL/COMMERCIAL ACREAGE (+/-)				
HOTEL ROOMS/CASITAS/FLATS	32.2 AC.	3.5%		275
GOLF CLUB, RESTAURANT/BAR, GOLF AMENITIES (HOTEL)	11.0 AC.	1.2%		
ESTATE CLUBHOUSE (HOTEL)	2.4 AC.	0.3%		
COMMERCIAL	9.1 AC.	1.0%		
FITNESS CENTER	4.1 AC.	0.4%		
TOTAL	912.6 AC	100.0%		

NOTE - OPEN SPACE INCLUDES: PARKS, POCKET PARKS, DETENTION, DRAINAGE CORRIDORS, GENERAL OPEN SPACE, EASEMENTS AND LANDSCAPE BUFFERS.

HR GREEN Xrefs: EX:Topo; EX:Alts; xg:1-ARCH; D:01; EX:Parcels

DRAWN BY: JAG JOB DATE: 05/21/2023
 APPROVED: PLS JOB NUMBER: 211030
 CAD DATE: 07/01/2022
 CAD FILE: J:\2021\211030\CAD\Drawings\C\Sketch-Plan\BUBBLE-PLAN

NO.	DATE	BY	REVISION DESCRIPTION



FLYING HORSE NORTH DEVELOPMENT, LLC.
 EL PASO COUNTY, COLORADO

FLYING HORSE NORTH SKETCH PLAN
 SKETCH PLAN DRAWING

SHEET SP.2 2

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**Federal Highway
Administration**

Hydraulic Engineering Circular No. 15, Third Edition

Design of Roadside Channels with Flexible Linings



National Highway Institute

Table 2.1. Typical Roughness Coefficients for Selected Linings

Lining Category	Lining Type	Manning's n ¹		
		Maximum	Typical	Minimum
Rigid	Concrete	0.015	0.013	0.011
	Grouted Riprap	0.040	0.030	0.028
	Stone Masonry	0.042	0.032	0.030
	Soil Cement	0.025	0.022	0.020
	Asphalt	0.018	0.016	0.016
Unlined	Bare Soil ²	0.025	0.020	0.016
	Rock Cut (smooth, uniform)	0.045	0.035	0.025
RECP	Open-weave textile	0.028	0.025	0.022
	Erosion control blankets	0.045	0.035	0.028
	Turf reinforcement mat	0.036	0.030	0.024

¹Based on data from Kouwen, et al. (1980), Cox, et al. (1970), McWhorter, et al. (1968) and Thibodeaux (1968).

²Minimum value accounts for grain roughness. Typical and maximum values incorporate varying degrees of form roughness.

Table 2.2. Typical Roughness Coefficients for Riprap, Cobble, and Gravel Linings

Lining Category	Lining Type	Manning's n for Selected Flow Depths ¹		
		0.15 m (0.5 ft)	0.50 m (1.6 ft)	1.0 m (3.3 ft)
Gravel Mulch	D ₅₀ = 25 mm (1 in.)	0.040	0.033	0.031
	D ₅₀ = 50 mm (2 in.)	0.056	0.042	0.038
Cobbles	D ₅₀ = 0.10 m (0.33 ft)	-- ²	0.055	0.047
Rock Riprap	D ₅₀ = 0.15 m (0.5 ft)	-- ²	0.069	0.056
	D ₅₀ = 0.30 m (1.0 ft)	-- ²	-- ²	0.080

¹Based on Equation 6.1 (Blodgett and McConaughy, 1985). Manning's n estimated assuming a trapezoidal channel with 1:3 side slopes and 0.6 m (2 ft) bottom width.

²Shallow relative depth (average depth to D₅₀ ratio less than 1.5) requires use of Equation 6.2 (Bathurst, et al., 1981) and is slope-dependent. See Section 6.1.

2.2 SHEAR STRESS

2.2.1 Equilibrium Concepts

Most highway drainage channels cannot tolerate bank instability and possible lateral migration. Stable channel design concepts focus on evaluating and defining a channel configuration that will perform within acceptable limits of stability. Methods for evaluation and definition of a stable configuration depend on whether the channel boundaries can be viewed as:

- essentially rigid (static)
- movable (dynamic).

In the first case, stability is achieved when the material forming the channel boundary effectively resists the erosive forces of the flow. Under such conditions the channel bed and banks are in

protected. Therefore permissible shear stress is not significantly affected by the erodibility of the underlying soil. However, if the lining moves, the underlying soil will be exposed to the erosive force of the flow.

Table 2.3 provides typical examples of permissible shear stress for selected lining types. Representative values for different soil types are based on the methods found in Chapter 4 while those for gravel mulch and riprap are based on methods found in Chapter 7. Vegetative and RECP lining performance relates to how well they protect the underlying soil from shear stresses so these linings do not have permissible shear stresses independent of soil types. Chapters 4 (vegetation) and 5 (RECPs) describe the methods for analyzing these linings. Permissible shear stress for gabion mattresses depends on rock size and mattress thickness as is described in Section 7.2.

Table 2.3. Typical Permissible Shear Stresses for Bare Soil and Stone Linings

Lining Category	Lining Type	Permissible Shear Stress	
		N/m ²	lb/ft ²
Bare Soil ¹ Cohesive (PI = 10)	Clayey sands	1.8-4.5	0.037-0.095
	Inorganic silts	1.1-4.0	0.027-0.11
	Silty sands	1.1-3.4	0.024-0.072
Bare Soil ¹ Cohesive (PI ≥ 20)	Clayey sands	4.5	0.094
	Inorganic silts	4.0	0.083
	Silty sands	3.5	0.072
	Inorganic clays	6.6	0.14
Bare Soil ² Non-cohesive (PI < 10)	Finer than coarse sand D ₇₅ < 1.3 mm (0.05 in)	1.0	0.02
	Fine gravel D ₇₅ = 7.5 mm (0.3 in)	5.6	0.12
	Gravel D ₇₅ = 15 mm (0.6 in)	11	0.24
Gravel Mulch ³	Coarse gravel D ₅₀ = 25 mm (1 in)	19	0.4
	Very coarse gravel D ₅₀ = 50 mm (2 in)	38	0.8
Rock Riprap ³	D ₅₀ = 0.15 m (0.5 ft)	113	2.4
	D ₅₀ = 0.30 m (1.0 ft)	227	4.8

¹Based on Equation 4.6 assuming a soil void ratio of 0.5 (USDA, 1987).

²Based on Equation 4.5 derived from USDA (1987)

³Based on Equation 6.7 with Shield's parameter equal to 0.047.

2.3 DESIGN PARAMETERS

2.3.1 Design Discharge Frequency

Design flow rates for permanent roadside and median drainage channel linings usually have a 5 or 10-year return period. A lower return period flow is allowable if a transitional lining is to be used, typically the mean annual storm (approximately a 2-year return period, i.e., 50 percent probability of occurrence in a year). Transitional channel linings are often used during the establishment of vegetation. The probability of damage during this relatively short time is low,

TABLE 10-1

COMPOSITE ROUGHNESS COEFFICIENTS FOR UNLINED OPEN CHANNELS
(Reference: Chow, Ven Te, 1959; Open-Channel Hydraulics)

$$n = (n_0 + n_1 + n_2 + n_3 + n_4)m \quad (10-2)$$

	<u>Channel Conditions</u>	<u>Value</u>
Material Type n_0	Earth	0.020
	Fine Gravel	0.024
	Coarse Gravel	0.028
Degree of Irregularity n_1	Smooth	0.000
	Minor	0.005
	Moderate	0.010
	Severe	0.020
Variation of Channel Cross Section n_2	Gradual	0.000
	Alternating	
	Occasionally	0.005
	Alternating Frequently	0.010 - 0.015
Relative Effect of Obstructions n_3	Negligible	0.000
	Minor	0.010 - 0.015
	Appreciable	0.020 - 0.030
	Severe	0.040 - 0.060
Vegetation n_4	Low	0.005 - 0.010
	Medium	0.010 - 0.025
	High	0.025 - 0.050
	Very High	0.050 - 0.100
Degree of Meandering m	Minor	1.000 - 1.200
	Appreciable	1.200 - 1.500
	Severe	1.500

- significant uncertainty regarding the design discharge
- consequences of failure are high

The basic procedure for flexible lining design consists of the following steps and is summarized in Figure 3.1. (An alternative process for determining an allowable discharge given slope and shape is presented in Section 3.6.)

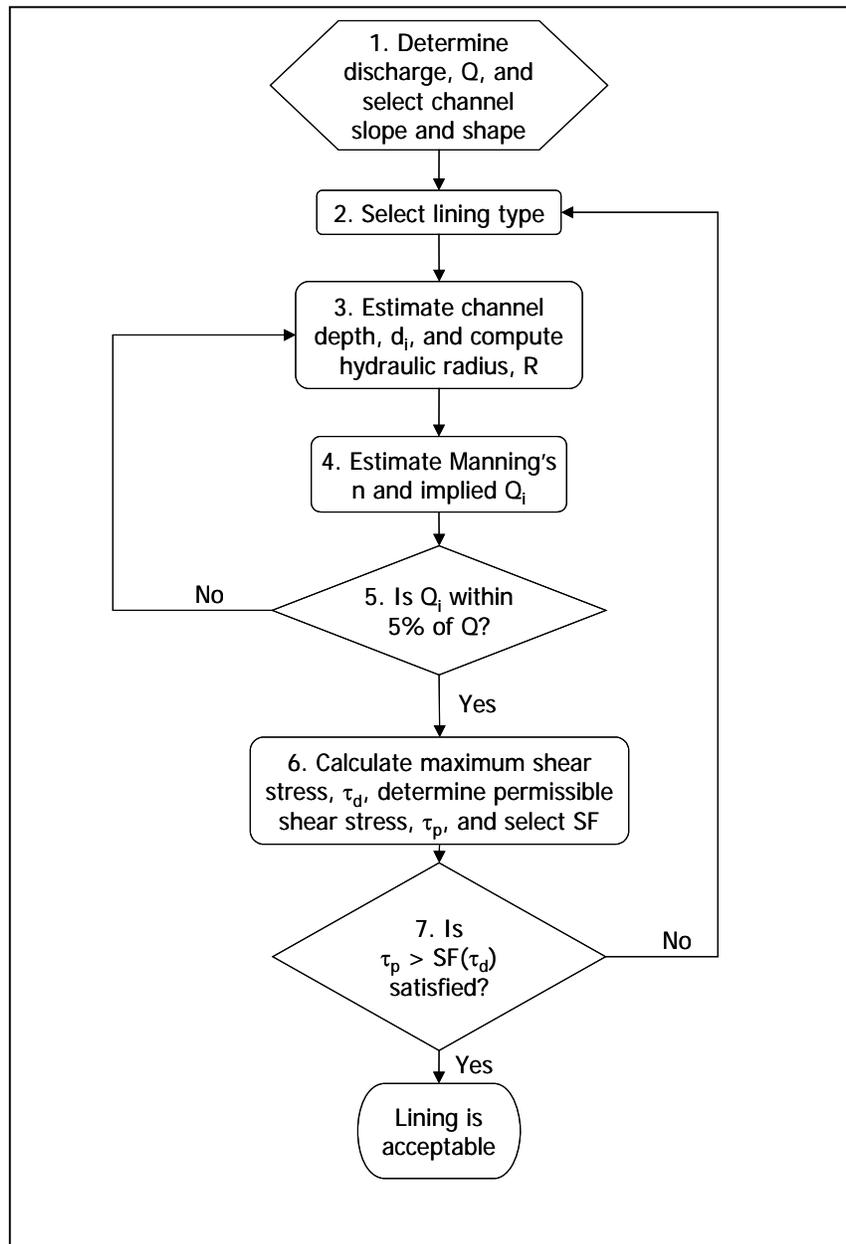
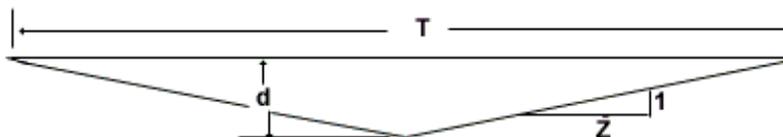


Figure 3.1. Flexible Channel Lining Design Flow Chart

APPENDIX B: CHANNEL GEOMETRY EQUATIONS

V- SHAPE

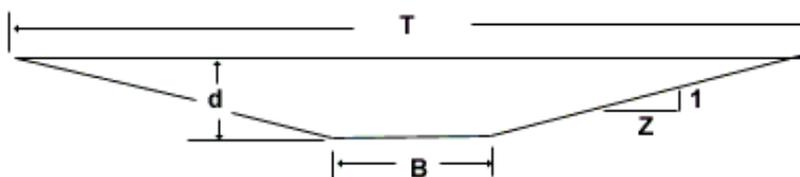


$$A = Zd^2$$

$$p = 2d\sqrt{Z^2 + 1}$$

$$T = 2dZ$$

TRAPEZOIDAL

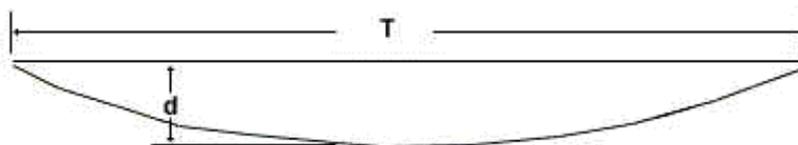


$$A = Bd + Zd^2$$

$$P = B + 2d\sqrt{z^2 + 1}$$

$$T = B + 2dZ$$

PARABOLIC

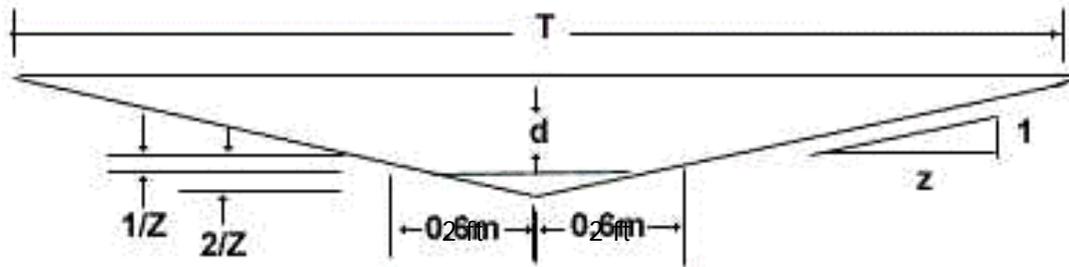


$$A = \frac{2}{3} Td$$

$$P = \frac{1}{2} \sqrt{16d^2 + T^2} + \left(\frac{T^2}{8d} \right) \ln_e \left(\frac{4d + \sqrt{16d^2 + T^2}}{T} \right)$$

$$T = 1.5 \frac{A}{d}$$

V-SHAPE WITH ROUNDED BOTTOM



2 CASES

No. 1

If $d \leq 1/Z$, then:

$$A = \frac{8}{3}d\sqrt{dZ}$$

$$P = 2Z \ln_e \left(\sqrt{\frac{d}{Z}} + \sqrt{1 + \frac{d}{Z}} \right) + 2\sqrt{d^2 + dZ}$$

$$T = 4\sqrt{dZ}$$

No. 2

If $d > 1/Z$, then:

$$A = \frac{8}{3}d + 4\left(d - \frac{1}{Z}\right) + Z\left(d - \frac{1}{Z}\right)^2$$

$$P = 2Z \ln_e \left(\frac{1 + \sqrt{Z^2 + 1}}{Z} \right) + 2\frac{\sqrt{Z^2 + 1}}{Z} + 2\left(d - \frac{1}{Z}\right)\sqrt{1 + Z^2}$$

$$T = 4 + 2Z\left(d - \frac{1}{Z}\right)$$

Note: The equations for V-shape with rounded bottom only apply in customary units for a channel with a 4 ft wide rounded bottom.

ROADSIDE DITCH CALCUALTIONS

Limits of specific Ditch Lining relative to max. slope

	Erosion Control Blanket (ECB)	Turf Reinforcement Mat (TRM)	Revegetation - Grass lined
	(North American Green - SC150)	(North American Green - P300)	(Native Seed Mix)
Given:	(Temporary - 24 months)	(Permanent)	
Max. Design Flow (cfs)	7.4	70.0	4.3
Permissible Shear (lbs/ft. ²)	2.0	8.0	2.0
Permissible Velocity (ft./sec.)	8.0	16.0	3.0
Safety Factor	1	1	1
Max. Ditch Slope	5%	10%	2%
Ditch Section (24 in. depth)	V-Ditch	V-Ditch	V-Ditch
Flow Area (ft. ²)	1.69	6.25	1.44
Wetted Perimeter (ft.)	5.37	10.33	4.96
Hydraulic Radius	0.31	0.61	0.29
Mannings n	0.035	0.030	0.030
Depth of Flow (max.)	0.65	1.25	0.60
Calculations:			
Shear Stress (lbs/ft. ²)	2.0	7.8	0.7
Velocity (ft./sec.)	4.4	11.2	3.0
Allowed Flow (cfs)	7.4	70.2	4.4

ROADSIDE DITCH CALCUALTIONS

Limits of specific Ditch Lining relative to max. flow

	Erosion Control Blanket (ECB)		Turf Reinforcement Mat (TRM)	
	(North American Green - SC150)		(North American Green - P300)	
Given:	(Temporary - 24 months)		(Permanent)	
Max. Design Flow (cfs)	43.8		70.0	4.3
Permissible Shear (lbs/ft. ²)	2.0		8.0	2.0
Permissible Velocity (ft./sec.)	8.0		16.0	3.0
Safety Factor	1		1	1
Max. Ditch Slope	2%		10%	2%
Ditch Section (24 in. depth)	V-Ditch		V-Ditch	V-Ditch
Flow Area (ft. ²)	9.00		6.25	1.44
Wetted Perimeter (ft.)	12.39		10.33	4.96
Hydraulic Radius	0.73		0.61	0.29
Mannings n	0.035		0.030	0.030
Depth of Flow (max.)	1.50		1.25	0.60
Calculations:				
Shear Stress (lbs/ft. ²)	1.9		7.8	0.7
Velocity (ft./sec.)	4.9		11.2	3.0
Allowed Flow (cfs)	43.8		70.2	4.4



ROLLMAX™
ROLLED EROSION CONTROL

ROLLED EROSION CONTROL

SYSTEMS BROCHURE



**NORTH
AMERICAN
GREEN®**

Temporary RollMax™ Solutions



Erosion control has never been so simple yet effective. North American Green RollMax™ temporary Erosion Control Blankets (ECBs) provide immediate erosion protection and vegetation establishment assistance, then degrade once the vegetation's root and stem systems are mature enough to stabilize the soil.

Our high-quality temporary solutions are available in varying functional longevities and materials:

- ▶ Short-term photodegradable blankets with a functional longevity of 45 days up to 12 months
- ▶ Extended-term and long-term photodegradable blankets for protection up to 36 months
- ▶ Short-term biodegradable blankets for protection up to 12 months
- ▶ Extended-term and long-term biodegradable products for protection and mulching from 18 to 24 months

ERONET™ EROSION CONTROL BLANKETS

North American Green EroNet™ ECBs incorporate photodegradable nettings, which means they are broken down by the ultraviolet rays in sunlight. These temporary products can be used in a variety of scenarios, including moderate to steep slopes, medium-to high-flow channels, shorelines and other areas needing protection until permanent vegetation establishment.

EroNet™ C125® Long-Term Photodegradable Double-Net Coconut Blanket

The C125® ECB is made of 100% coconut fiber stitched between heavyweight UV-stabilized polypropylene nets. It offers excellent durability, erosion control and longevity for severe slopes, steep embankments, high-flow channels and other areas where vegetation may take up to 36 months to grow in.



The EroNet temporary ECBs are designed to provide immediate erosion protection and vegetation establishment assistance, and then degrade after the vegetation is mature enough to permanently stabilize the underlying soil. Both short-term and extended-term ECBs are available.



EroNet™ SC150® Extended-Term Photodegradable Double-Net Straw/Coconut Blanket

With a layer of 70% straw and 30% coconut fiber stitched between a heavyweight UV-stabilized polypropylene top net and a lightweight photodegradable polypropylene bottom net, the SC150® ECB has increased durability, erosion control capabilities and longevity. It is suitable for steeper slopes, medium-flow channels and other areas where it may take vegetation up to 24 months to grow in.

EroNet™ S150® Short-Term Photodegradable Double-Net Straw Blanket

The S150 ECB is made with a 100% straw fiber matrix stitched between lightweight photodegradable polypropylene top and bottom nets. The S150 ECB's double-net construction has greater structural integrity than single net blankets for use on steeper slopes and in channels with moderate water flow. It provides erosion protection and mulching for up to 12 months.

EroNet™ DS150™ Ultra Short-Term Photodegradable Double-Net Straw Blanket

The DS150™ ECB is suitable for high maintenance areas where close mowing will occur soon after installation. Special additives in the thread and top and bottom net ensure it degrades in adequate sunlight within 60 days.

EroNet™ S75® Short-Term Photodegradable Single-Net Straw Blanket

The S75® ECB protects and mulches moderate slopes and low-flow channels in low maintenance areas for up to 12 months. It is constructed of 100% straw fiber stitched with degradable thread to a lightweight photodegradable polypropylene top net.

EroNet™ DS75™ Ultra Short-Term Photodegradable Single-Net Straw Blanket

Designed for high maintenance areas where close mowing will occur soon after installation, the DS75™ ECB degrades within 45 days because of special additives in the thread and top net that facilitate rapid breakdown in adequate sunlight.



Every site has its own unique characteristics and challenges. EroNet Erosion Control Blankets are available in varying longevities to suit a variety of scenarios and conditions.



With our Erosion Control Materials Design Software (ECMDS), you can select either short-term, extended-term or long-term EroNet blankets based on your specific design needs.

Permanent RollMax™ Solutions



Back in the day, rock riprap, articulated concrete blocks and poured concrete were the only way to deal with erosion in high-flow channels, on shorelines and other areas where water and/or wind exceed the shear limits of unreinforced vegetation.

Not anymore. North American Green permanent Turf Reinforcement Mats (TRMs) use 100% synthetic components or a composite of synthetic and natural materials for long-term erosion protection and vegetation establishment. Whether compared to rock riprap or concrete, the RollMax™ Systems' permanent TRMs offer a number of significant advantages:

- ▶ Prevent loss of precious topsoil to wind and water erosion
- ▶ Permanently reinforce vegetation root and stem structures
- ▶ Provide excellent conditions for quick, healthy vegetation growth
- ▶ Stabilize slopes from erosion to keep roadways safe and clean
- ▶ Protect water quality in lakes, rivers and streams
- ▶ Protect dormant seeding during winter months
- ▶ Easily conform to landscape features
- ▶ Lightweight for easy handling and transportation



The TRMs easily conform to various landscape features to prevent the loss of precious topsoil.

VMAX® COMPOSITE TURF REINFORCEMENT MATS

VMax® C-TRMs combine three-dimensional matting with fiber matrix material for permanent erosion control on severe slopes, spillways, stream banks, shorelines and in high- to extreme-flow channels. These extensively tested products provide maximum performance through all three phases of reinforced vegetative lining development: unvegetated, establishment, and maturity. Incorporating the best performance features of temporary and permanent North American Green erosion control products, VMax C-TRMs deliver these tangible benefits:

- ▶ Surface-applied for the highest level of immediate soil protection
- ▶ Less than one third of the installed cost of rock or concrete
- ▶ No heavy equipment needed to install
- ▶ More attractive and effective "Green" alternative than rock riprap or concrete

VMax® High-Performance TRMs (HPTRMs)

VMax® HPTRMs utilize patent-pending woven 3-D structures that are soil-filled for use in areas experiencing high stress and strain. The VMax HPTRMs are designed to provide appropriate thickness and open area for effective erosion and vegetation reinforcement against high flow induced shear forces. Our HPTRMs are excellent for increased bearing capacity of vegetated soils subjected to heavy loads from maintenance equipment and other vehicular traffic.



The RollMax TRMs are installed in a one-step operation directly over the prepared seedbed saving time and money and ensuring the highest level of erosion control and vegetation reinforcement.



VMax® TMax™ Permanent HPTRM

The TMax HPTRM woven polypropylene technology is designed to provide appropriate thickness and open area for effective erosion and vegetation reinforcement against high flow induced shear forces up to 15 pfs (kN/m²), and with the highest tensile strength on the market up to 5,000 lbs/ft (73 kN/m). TMax may be used as an alternative to hard armor system in extreme erosion control applications.

VMax® P550® Permanent TRM

P550® TRM has a polypropylene fiber matrix augmenting the permanent netting structure with permanent mulching and erosion control performance. Unvegetated, the P550 TRM reduces soil loss to less than 0.5 in. (12.7 mm) under shear stress up to 4.0 lbs/ft² (191 Pa). The ultra-strong structure drives the vegetated shear resistance up to 14 lbs/ft² (672 Pa). The P550 TRM may be used as an alternative for poured concrete or articulated concrete blocks in extreme erosion control projects.

VMax® C350® Permanent TRM

A 100% coconut fiber matrix supplements the C350's permanent three-dimensional netting structure with initial mulching and erosion control performance for up to 36 months. Unvegetated, the C350® TRM reduces soil loss to less than 0.5 in. (12.7 mm) under shear stress up to 3.2 lbs/ft² (153 Pa) and boosts permanent vegetation performance up to 12 lbs/ft² (576 Pa). This environmentally friendly alternative to 30 in. (76 cm) or larger rock riprap is ideal for severe erosion control projects.



To boost performance of the VMax turf reinforcement mats in critical applications, combine with our ShoreMax® flexible transition mat to create a system that can dramatically elevate the permissible shear stress and velocity protection beyond many hard armor solutions.

VMax® SC250® Permanent TRM

The SC250® permanent TRM has a 70% straw/30% coconut fiber matrix to enhance initial mulching and erosion control performance for up to 24 months. Unvegetated, SC250 TRMs reduce soil loss to less than 0.5 in. (12.7 mm) under shear stress up to 3.0 lbs/ft²; and increases permanent vegetation performance up to 10 lbs/ft² (480 Pa) for a green alternative to rock riprap.

ERONET™ PERMANENT EROSION CONTROL BLANKETS

The EroNet™ Permanent ECB provides immediate erosion protection and vegetation establishment assistance until vegetation roots and stems mature.

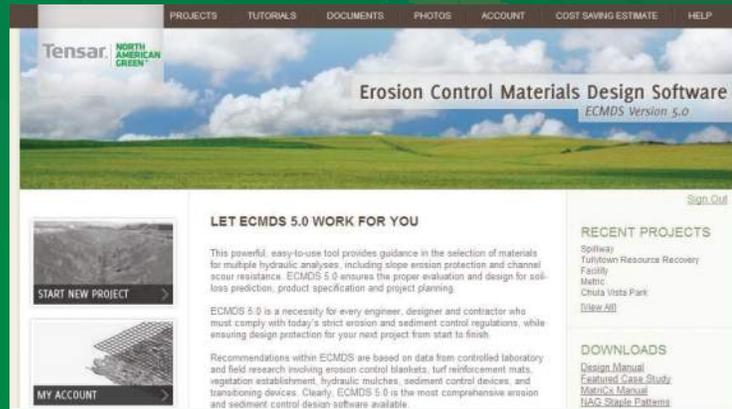
EroNet™ P300® Permanent Erosion Control Blankets

The P300® permanent erosion control blanket consists of UV-stabilized polypropylene fiber stitched between heavy-weight UV-stabilized polypropylene top and bottom nets. These mats reduce soil loss and protect vegetation from being washed away or uprooted, even under high stress. Unvegetated, they reduce soil loss to less than 0.5 in. (12.7 mm) under shear stress up to 3.0 lbs/ft² (144 Pa), and protect vegetation from being washed away or uprooted when exposed to shear stresses up to 8 lbs/ft² (383 Pa).



VMax Mats are perfect for pipe outlets, channel bottoms, shoreline transition zones, and other areas subjected to highly turbulent water flows.

Design and Installation Tools



SHIFT, CONTROL, ENTER

Professional guidance on RECP selection, design and project planning is at your fingertips with Tensar's proprietary Erosion Control Materials Design Software (ECMDS®). This web-based program incorporates design methodologies from the Federal Highway Administration and United States Department of Agriculture to analyze your specific site conditions, and make quantified recommendations based on data from controlled laboratory and field research. ECMDS is a must-have if you face tough erosion and sediment control regulations. Best of all, it's free of charge, compliments of North American Green. To learn more and access the software directly, go to www.ECMDS.com.

INSTRUCTIONS INCLUDED

Proper anchoring patterns and rates must be used to achieve optimal results in RECP installation. View our installation guides for stapling patterns. Site specific staple pattern recommendations based on soil type and severity of application may be acquired through our ECMDS.



HOLD ON TIGHT

When under the pressure of severe conditions, even the best erosion control products can't function to their full potential without proper installation and anchoring. North American Green supplies a wide variety of fastener options for nearly every application and soil type.

For use in cohesive soils, wire staples are a cost-effective means to fasten RECPs. Available in 6 in., 8 in., 10 in. and 12 in. lengths, our U-shaped staples can reach to various depths to ensure adequate pull-out resistance. For installation using our handy Pin Pounder installation tool, 6 in. V-top staples or 6 in. circle top pins are available.

Our biodegradable BioStakes® are available in 4 in. and 6 in. lengths and provide an environmentally friendly alternative to metal staples. For an even more durable, deeper reaching yet all-natural anchoring option, our wood EcoStakes® are available in 6 in., 12 in., 18 in. and 24 in. lengths.

For severe applications needing the ultimate, long-lasting hold, try our 12 and 18 in. rebar staples, our 12 in. plastic ShoreMax® stakes, or our complete line of percussion earth anchors. The Tensar earth anchors reach deep into the soil strata to offer enhanced anchoring in the worst conditions. Our variety of earth anchors are designed for durability and holding power under extreme hydraulic stresses and adverse soil conditions (*Table 1*).

For more information on the RollMax Systems or other systems within the North American Green Erosion Control Solutions, call **800-772-2040** or visit nagreen.com.

Earth Anchor Options

				EA 400		EA 680			
		Tendon Type (1/2 in. x 36 in.)	Assembly Description	Fast Install	Economic Anchor	Stainless	Galvanized	Stainless	Galvanized
End Piece Options with a PVC Face Plate	Copper Stop Sleeve with Stainless Steel Washer	Manually crimped to the stainless steel cable to secure the face plate.			X	X		X	
	Grip End Piece with Stainless Steel Washer	Three-dimensional, self-securing metal end piece that does not require manual crimping for tendon tensioning.	X	X	X	X	X	X	X
	Wedge Grip Piece	Self-securing end piece that installs flush to the face plate. Does not require manual crimping for tendon tensioning.	X		X	X	X	X	X
	Aluminum Stop Sleeve with Stainless Steel Washer	Manually crimped to the galvanized cable to secure the face plate.					X		X

TABLE 1

The complete line of RollMax™ products offers a variety of options for both short-term and permanent erosion control needs. Reference the RollMax Products Chart below to find the right solution for your next project.



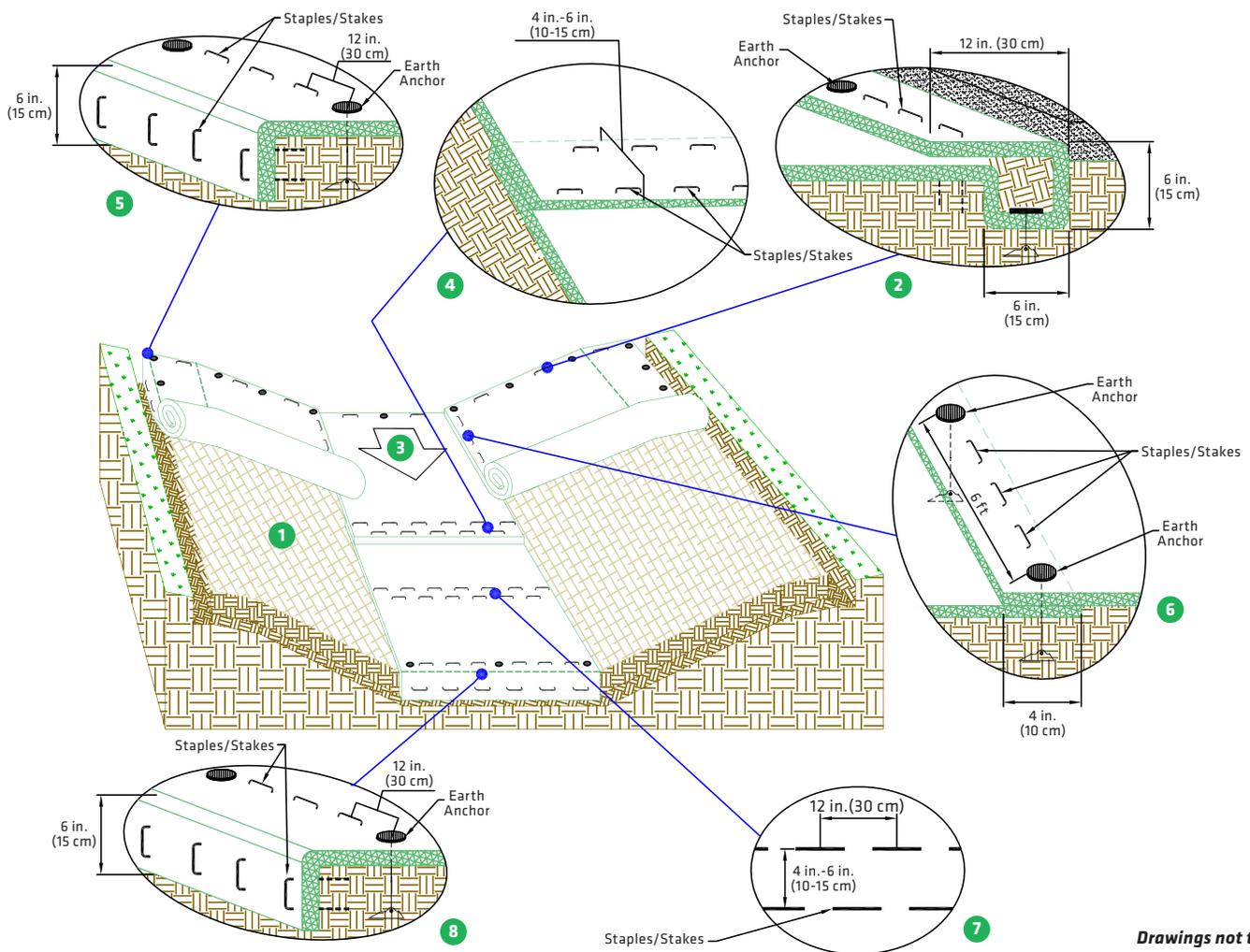
RollMax Product Selection Chart

TEMPORARY					
	Product Description	Longevity	Applications	Design Permissible Shear Stress lbs/ft ² (Pa)	Design Permissible Velocity ft/s (m/s)
ERONET					
 DS75	1.5 lb., accelerated photodegradable, polypropylene top net, 100% straw fiber matrix	45 days	Low Flow Channels 4:1 - 3:1 Slopes	Unvegetated 1.55 (74)	Unvegetated 5.0 (1.52)
 DS150	1.5 lb., photodegradable, polypropylene top & bottom net, 100% straw fiber matrix	60 days	Moderate Flow Channels 3:1 - 2:1 Slopes	Unvegetated 1.75 (84)	Unvegetated 6.0 (1.83)
 S75	1.5 lb., photodegradable, polypropylene top net, 100% straw fiber matrix	12 months	Low Flow Channels 4:1 - 3:1 Slopes	Unvegetated 1.55 (74)	Unvegetated 5.0 (1.52)
 S150	1.5 lb., photodegradable, polypropylene top & bottom net, 100% straw fiber matrix	12 months	Moderate Flow Channels 3:1 - 2:1 Slopes	Unvegetated 1.75 (84)	Unvegetated 6.0 (1.83)
 SC150	2.9 lb., UV-stable polypropylene top net, 70% straw/30% coconut fiber matrix, 1.5 lb., photodegradable polypropylene bottom net	24 months	Medium Flow Channels 2:1 - 1:1 Slopes	Unvegetated 2.0 (96)	Unvegetated 8.0 (2.44)
 C125	2.9 lb., UV stable polypropylene top & bottom nets, 100% coconut fiber matrix	36 months	High Flow Channels 1:1 and Greater Slopes	Unvegetated 2.25 (108)	Unvegetated 10.0 (3.05)
BIONET					
 S75BN	9.3 lb., leno woven biodegradable jute top net, 100% straw fiber matrix	12 months	Low Flow Channels 4:1 - 3:1 Slopes	Unvegetated 1.60 (76)	Unvegetated 5.0 (1.52)
 S150BN	9.3 lb., leno woven biodegradable jute top net, 100% straw fiber matrix, 7.7 lb., woven biodegradable jute bottom net	12 months	Moderate Flow Channels 3:1 - 2:1 Slopes	Unvegetated 1.85 (88)	Unvegetated 6.0 (1.83)
 SC150BN	9.3 lb., leno woven biodegradable jute top net, 70% straw/30% coconut fiber matrix, 7.7 lb., woven biodegradable jute bottom net	18 months	Medium Flow Channels 2:1 - 1:1 Slopes	Unvegetated 2.10 (100)	Unvegetated 8.0 (2.44)



TEMPORARY					
Product Description	Longevity	Applications	Design Permissible Shear Stress lbs/ft ² (Pa)	Design Permissible Velocity ft/s (m/s)	
BIONET CONT'D					
 C125BN	9.3 lb., leno woven biodegradable jute top net, 100% coconut fiber matrix, 7.7 lb., woven biodegradable jute bottom net	24 mo.	High Flow Channels 1:1 and Greater Slopes	Unvegetated 2.35 (112)	Unvegetated 10.0 (3.05)
 C700BN	143 lb., (700 g) woven biodegradable coir top net, 100% coconut fiber matrix, 7.7 lb., woven biodegradable jute bottom net	36 mo.	High Flow Channels 1:1 and Greater Slopes	Unvegetated 2.35 (112)	Unvegetated 10.0 (3.05)
PERMANENT					
ERONET					
 P300	5.0 lb., UV-stable polypropylene top net, 100% polypropylene fiber matrix, 3.0 lb., UV-stable polypropylene bottom net	Permanent	High Flow Channels 1:1 Slopes	Unvegetated 3.0 (144) Vegetated 8.0 (383)	Unvegetated 9.0 (2.7) Vegetated 16.0 (4.9)
VMAX					
 SC250	5.0 lb., UV-stable polypropylene top & bottom nets, 24.0 lb., UV-stable polypropylene corrugated center net, 70% straw/30% coconut fiber matrix	Permanent	High Flow Channels 1:1 and Greater Slopes	Unvegetated 3.0 (144) Vegetated 10.0 (480)	Unvegetated 9.5 (2.9) Vegetated 15.0 (4.6)
 C350	8.0 lb., UV-stable polypropylene top & bottom nets, 24.0 lb., UV-stable polypropylene corrugated center net, 100% coconut fiber matrix	Permanent	High Flow Channels 1:1 and Greater Slopes	Unvegetated 3.2 (153) Vegetated 12.0 (576)	Unvegetated 10.5 (3.2) Vegetated 20.0 (6.0)
 P550	24.0 lb., UV-stable polypropylene top & bottom nets, 24.0 lb., UV-stable polypropylene corrugated center net, 100% polypropylene fiber matrix	Permanent	Extreme High Flow Channels 1:1 and Greater Slopes	Unvegetated 4.0 (191) Vegetated 14.0 (672)	Unvegetated 12.5 (3.8) Vegetated 25.0 (7.6)
 TMax	100% UV-stable polypropylene monofilament yarns, woven into a 3-D structure	Permanent	Extreme High Flow Channels 1:1 and Greater Slopes	Vegetated 15.0 (718)	Vegetated 25.0 (7.6)
 W3000	100% UV-stable polypropylene monofilament yarns, woven into a 3-D structure	Permanent	Extreme High Flow Channels 1:1 and Greater Slopes	Vegetated 16.0 (766)	Vegetated 25.0 (7.6)

Channel Installation Detail

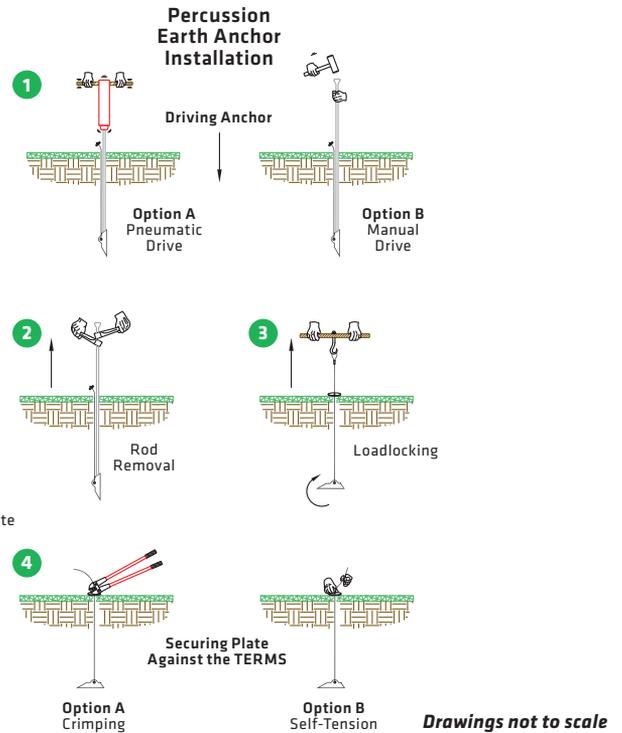
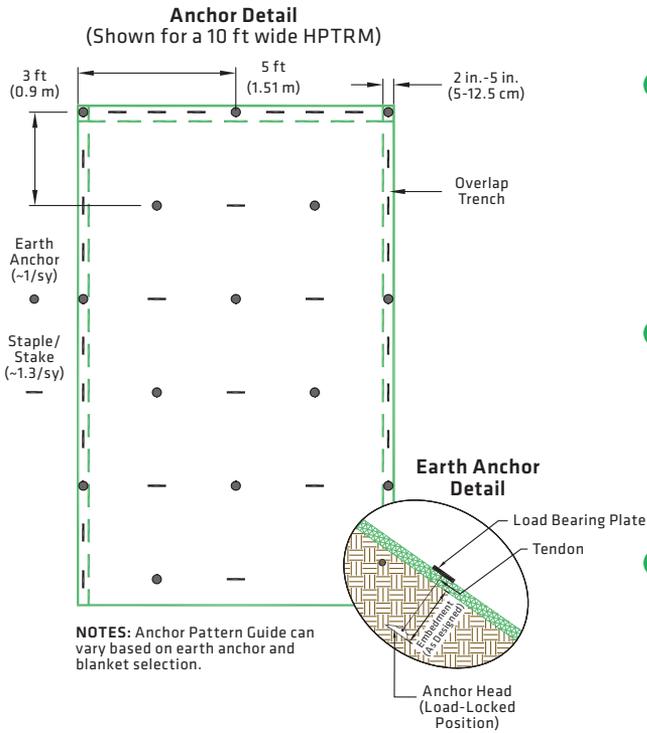


Drawings not to scale

GENERAL INSTALLATION

1. Prepare soil before installing the HPTRM, including any necessary application of soil amendments such as lime or fertilizer. See seeding and vegetating section for details regarding preseeding, overseeding or use with sod.
2. Begin at the top of the channel by anchoring the HPTRM in a 6 in. (15 cm) deep x 6 in. (15 cm) wide trench with approximately 12 in. (30 cm) of HPTRM extended beyond the upslope portion of the trench. Anchor the HPTRM with a row of anchors/staples/stakes spaced approximately 12 in. (30 cm) apart in the bottom of the trench. Backfill and compact the trench after stapling. Compact soil and fold remaining 12 in. (30 cm) portion of HPTRM back over compacted soil. Secure HPTRM over soil with a row of anchors/staples/stakes spaced approximately 12 in. (30 cm) across the width of the HPTRM.
3. Roll center HPTRM in direction of water flow in bottom of channel. HPTRMs will unroll with appropriate side against the soil surface. All HPTRMs must be securely fastened to soil surface by placing anchors/staples/stakes in appropriate locations as shown in the anchoring detail.
4. Place consecutive HPTRMs end over end (shingle style) with a 4 in. x 6 in. (10 cm-15 cm) overlap. Use a double row of staples/stakes staggered 12 in. (30 cm) apart and 12 in. (30 cm) on center to secure HPTRMs.
5. Full length edge of HPTRMs at top of side slopes must be anchored with a row of staples/stakes approximately 12 in. (30 cm) apart in a 6 in. (15 cm) deep x 6 in. (15 cm) wide trench. Backfill and compact the trench after stapling.
6. Adjacent HPTRMs must be overlapped approximately 4 in. (10 cm) and fastened.
7. In high flow channel applications, a staple/stake check slot is recommended at 30 ft to 40 ft (9 m-12 m) intervals. Use a double row of staples/stakes staggered 4 in. (10 cm) apart and 12 in. (30 cm) on center over entire width of the channel.
8. The terminal end of the HPTRMs must be anchored with a row of staples/stakes approximately 12 in. (30 cm) apart in a 6 in. (15 cm) deep x 6 in. (15 cm) wide trench. Backfill and compact the trench after stapling.

Anchoring Detail



ANCHORING DETAIL

The performance of ground anchoring devices is highly dependent on numerous site/project specific variables. It is the sole responsibility of the project engineer and/or contractor to select the appropriate anchor type and length. Anchoring shall be selected to hold the mat in intimate contact with the soil subgrade and resist pullout in accordance with the project's design intent.

1. Staples and/or stakes should be at least 6 in. (15 cm) in length and with sufficient ground penetration to resist pullout. Longer staples and/or stakes may be needed in looser soils.
2. The percussion earth anchor assembly consists of an anchor head, a tendon, a faceplate, and an end-piece device. See North American Green® Earth Anchor specification for detailed information on assembly components and associated pull-out strength.

PERCUSSION EARTH ANCHOR INSTALLATION

1. Insert the drive rod into the assembly's anchor head then use either a sledge hammer or vibratory hammer to drive the anchor to their desired depth.
2. After the desired anchor depth is achieved, retract the drive rod.
3. Lock the anchor assembly by swiftly pulling the cable upwards until the anchor head rotates as signaled by sudden resistance to pulling. A hooked setting tool may be used to aid in this step.

NOTE: Larger anchors may require more force to set the anchor. This can be achieved through using simple mechanical equipment for greater leverage, such as a fulcrum, manual or hydraulic jack, winch, or post puller.

4. Secure the faceplate to the High-performance Turf Reinforcement Mat (HPTRM) surface by locking the end-piece. If using a copper or aluminum stop, crimp the ferrule to

secure. If using a self-tensioning end-piece (grip or wedge grip) set by simply tightening the end-piece against the faceplate. If desired, cut the remaining cable assembly, above end-piece, to desired length.

SEEDING AND VEGETATING

When using a Composite Turf Reinforcement Mat (C-TRM) with fiber components:

1. Pre-seed prepared soils prior to the installation of the C-TRM. Install matting as directed. C-TRM does not require soil infill or a top dressing of seed. Overseeding may be done as a secondary form of seeding.
2. Sod may be installed in place of seeding on top of the C-TRM. Additional staking of sod is recommended in high-flow conditions. Sodded areas should be irrigated until rooting through the mat and into subgrade occurs.

When using a woven HPTRM:

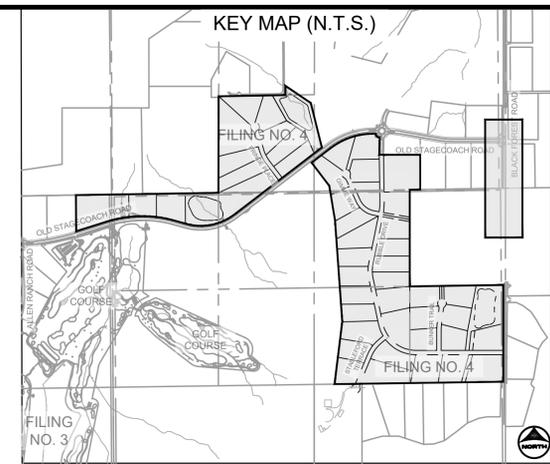
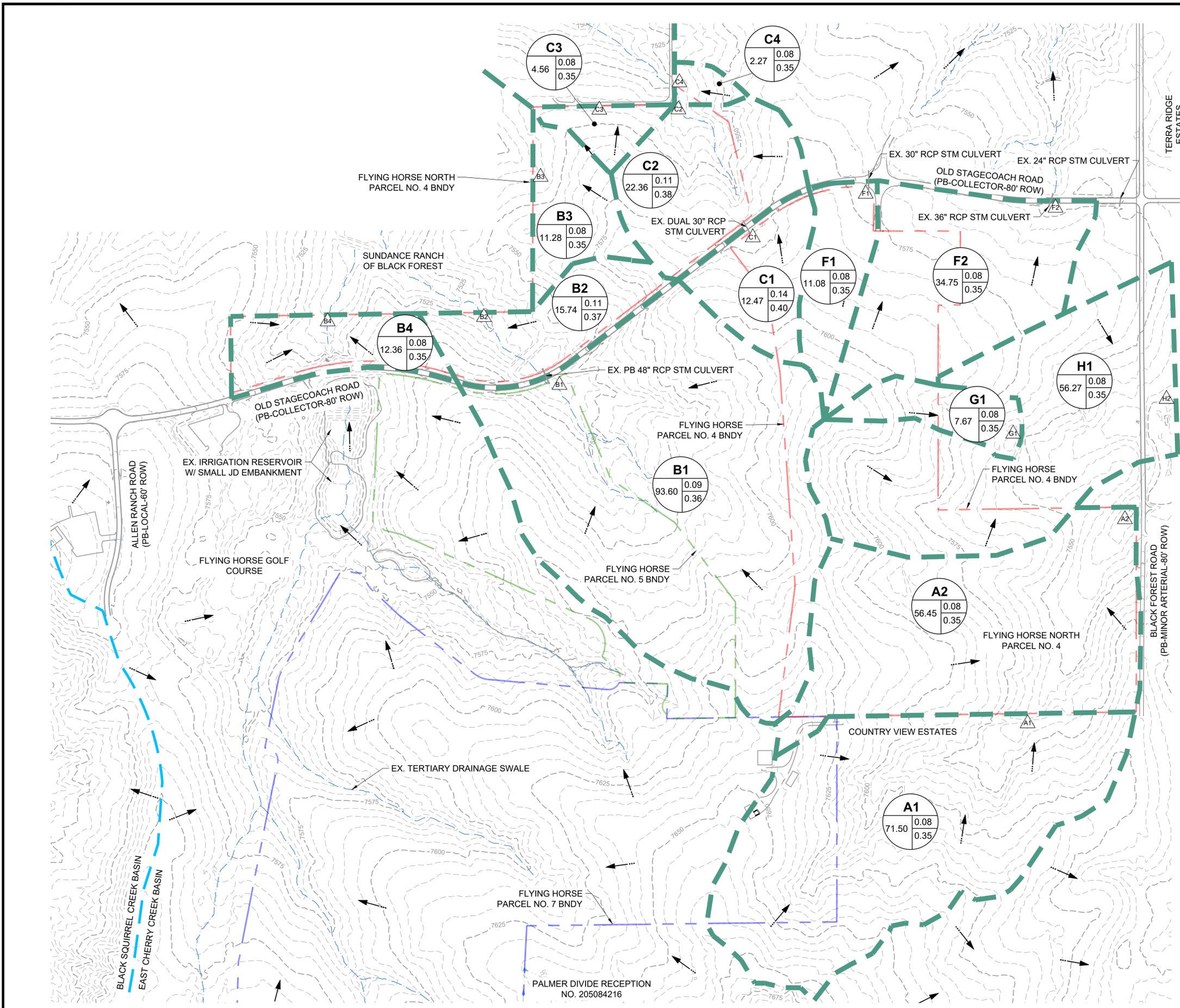
1. Install the HPTRM as directed prior to seed and soil filling.
2. Place seed into the installed HPTRM. After seeding, spread a layer of fine soil into the mat. Using the flat side of a rake, broom or other tool, completely fill the voids. Smooth soil-fill in order to just expose the top of the HPTRM matrix. Do not place excessive soil above the mat.
3. Additional seed, hydraulic mulching or the use of a temporary Erosion Control Blanket (ECB) can be applied over the soil-filled mat for increased protection.
4. Sod may be installed in place of seeding. Install HPTRM, and soil-fill as outlined above. Place sod directly onto the soil-filled HPTRM. Additional staking of sod is recommended in high-flow conditions. Sodded areas should be irrigated until rooting through the mat and into subgrade occurs.
5. Consult with a manufacturer's technical representative for installation assistance if unique conditions apply.



Flying Horse North Filing No. 4
Final Drainage Report
Project No.: 211030
El Paso County, Colorado

APPENDIX F

DRAINAGE MAPS



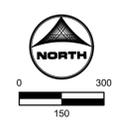
LEGEND:

- PROPOSED MAJOR CONTOUR --- 5250
- PROPOSED MINOR CONTOUR --- 5250
- EXISTING MAJOR CONTOUR --- 5250
- EXISTING MINOR CONTOUR --- 5250
- PROPOSED STORM SEWER ---
- EXISTING STORM SEWER ---
- EXISTING DRAINAGE SWALE ---
- PROPOSED DRAINAGE SWALE ---
- EXISTING TERTIARY DRAINAGE WAY ---
- PARCEL BOUNDARY ---
- FLOW DIRECTION ---
- DRAINAGE BASIN ---
- DESIGN POINT X
- BASIN LABEL X

A1	BASIN DESIGNATION	
	1.00	0.40
A1	0.60	0.35
	MINOR 5-YR RUNOFF COEF. MAJOR 100-YR RUNOFF COEF.	

Please include a summary table of sub-basins and design points with areas, Q5 and A100.

HRG Response: Summary tables added.



DRAWN BY: TMM	JOB DATE: 9/16/2024	BAR IS ONE INCH ON OFFICIAL DRAWINGS.
APPROVED: RHL	JOB NUMBER: 210742.24	0" = 1"
CAD DATE: 9/5/2024		IF NOT ONE INCH, ADJUST SCALE ACCORDINGLY.
CAD FILE: J:\2021\211030\CAD\Drawings\C\Drainage\FDR Filing 4\FHN_FH4_EX		

NO.	DATE	BY	REVISION DESCRIPTION

HR GREEN - COLORADO SPRINGS
1975 RESEARCH PARKWAY SUITE 160
COLORADO SPRINGS, CO 80920
PHONE: 719.300.4140
FAX: 713.965.0044

**FLYING HORSE NORTH FILING 4
PRI #2, LLC.
EL PASO COUNTY, CO**

FINAL DRAINAGE REPORT
EXISTING CONDITIONS DRAINAGE MAP

SHEET
DR1
1

