Preliminary Drainage Report Monument Ridge East

El Paso County, Colorado

and Master Development Drainage Plan

Prepared for:

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> Prepared by: PRC Engineering



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> SP241 April 2024



ENGINEER'S STATEMENT:

The attached drainage plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the El Paso County for drainage reports and said report is in conformity with the master plan of the drainage basin. I accept responsibility for any liability caused by any negligent acts, errors, or omissions on my part in preparing this report.

Signature:

Date:

Raymond Perez, III, PE Registered Professional Engineer State of Colorado

DEVELOPER'S STATEMENT:

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

Name of Owner/Developer: Monument Ridge East, LLC

| Authorized Signature: | Date: | |
|-----------------------|-------|--|
|-----------------------|-------|--|

Title: Owner

Address: 5055 List Drive Colorado Springs, CO 80919

EL PASO COUNTY:

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

Joshua Palmer, P.E. County Engineer / ECM Administrator

Date

Conditions:



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- Basin Runoff Summary
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- Developed Conditions Site



I. INTRODUCTION

A. Purpose

add Preliminary Drainage Report

The purpose of this Master Development Drainage Plan for the Monument Ridge East (hereinafter referred to as the "Project") is to identify major drainageways, detention areas, locations of culverts, open channels and drainage areas contained within and adjacent to the proposed development and quantify and evaluate the impacts of stormwater runoff generated by this project and to provide adequate water quality/detention treatment and flow conveyance.

B. Related Investigations

The Monument Ridge East project is adjacent to the Misty Acres development. The Misty Acres development area has been studied in the past since 2001. There is no known master drainage study on file that encompasses the entire project area (Bald Mountain watershed). Refer to the references listing for Misty Acres development record reports used.

C. Stakeholder Process

To date, there has not been any public outreach or stakeholder engagement for the project. This phase of project development will run concurrently with the Development Plan process.

D. Agency Jurisdictions

This project is located within El Paso County and is subject to the design criteria set forth in the City of Colorado Springs Drainage Criteria Manual, Volumes I and II, dated May 2014 (rev. 2021) (DCM) and the El Paso County Drainage Criteria Manual Volume 1 Updates.

E. General Project Description

This project is in El Paso County, Colorado. Access to the site is from Palmer Divide Road (aka – County line road). It is located in Section 2, Township 14 south, Range 67 west of the 6th Principal Meridian. A vicinity map is provided below in Figure 1.



Figure 1 – Vicinity Map

(Source: Google Earth Imagery 2019)



The Project is a 65-acre single-family development. The project will consist of singlefamily homes and associated site elements typical of residential development (e.g. – roadways, buildings, walkways, parks/open space, detention/water quality ponds etc.) The proposed development area is currently vacant. The site is bounded by the north by existing Palmer-Divide Road to the east by Doewood Drive and Misty Acres Boulevard, to the west by Interstate 25.

F. Data Sources

<u>General</u>

The base mapping (including topography) and structure inventory was provided by Bear Creek Surveying, Inc. (now Colorado ILC Surveying). The field survey was



conducted in the fall of 2022. To date there have been no environmental or geotechnical studies performed for the Project. Soils information is provided in section II.B. Additional topography for areas outside of the topographic survey was obtained from the Colorado Water Conservation Board (CWCB). CWCB topography consists of Digital Elevation Model (DEM) 2ft contours and 5ft contours. The 2' contours were used for off-site basin delineation. The 5ft contours were used in the drawings for the "overall" mapping.

G. Applicable Criteria and Standards

The hydrologic and hydraulic analysis performed in this report utilizes The City of Colorado Springs Drainage Criteria Volumes 1 (revised January 2021) & 2 (revised December 2020), hereinafter referred to as the CSDCM. In addition to the City Criteria Manual, the Urban Storm Drainage Criteria Manual (USDCM), Volumes 1-3, published by the Mile High Flood District (MHFD), latest update, have been used to supplement the Drainage Criteria Manual for water quality capture volume (WQCV). Also, the El Paso County Drainage Criteria Manual volume 1 updates were incorporated. Stormwater runoff was determined using the Rational Method and was calculated for existing and proposed conditions for the 10-yr (minor) and 100-yr (major) recurrences.

II. PROJECT CHARACTERISTICS

A. Drainage Basin Planning Study Compliance

There is no Drainage Basin Planning Study of record that encompasses this project. All developed runoff from the site will be detained and released at predevelopment peak rates, and the water quality capture volume will be treated. Detention and water quality were determined by the MHFD detention spreadsheet UD-Detention v4.04.

B. Land Features

1. Geology

The majority of the site is currently undeveloped and consists of natural vegetative land cover with the exception of existing Misty Acres Boulevard (major arterial roadway) which essentially bisects the property. There were no pronounced geological features discovered during any of the site visits.

2. Vegetation

Ground cover primarily consists of bare ground, sparse vegetation, and trees.



3. Soils

The general topography of the land slopes to the north. According to the Natural Resources Conservation Service (NRCS), the soils in this area can be classified as a Hydrologic Soil Group (HSG) Types B and D. This is used to predict storm water runoff rates. A soils report and map describing the HSG's and other soils properties are provided in Appendix A. For the purposes of this report each basin defined has had runoff coefficients adjusted accordingly using the soils report and map.

4. Environmental

To date there has not been any environmental site evaluations conducted with the exception of wetlands delineation (refer to drainage map for delineation boundaries). There has not been any geotechnical engineering analysis. Endangered species, groundwater determination, etc. will be performed at a later date. Information found within those studies will be included in future Monument Ridge East Final Drainage Report (FDR) documentation.

5. Water Quality

There are no known existing water quality features located on the property.

6. Floodplain

Per the Flood Insurance Rate Map Numbers 08041C0065G and 0804C0276G, El Paso County, Colorado, Revised December 7, 2018, Federal Emergency Management Agency (FEMA) no portion of Monument Ridge East lies within the designated 100year floodplain. A FIRMette of the project area is included in Appendix A.

C. Existing and Proposed Land Uses

Presently, the site is unplatted and consists of undeveloped land. Monument Ridge East is a proposed single-family residential development with associated streets and detention/water quality ponds.

III. HYDROLOGIC ANALYSIS

A. Methodology

1. Method of Analysis

Storm sewer sizing for this project uses the Rational Method as recommended by the DCM for the minor (10 year) and major (100 year) storms for drainage basins less than 100-acres in size.



The Rational Method uses the following equation:

Q=C*I*A

Where:

- Q = Maximum runoff rate in cubic feet per second (cfs)
- C = Runoff coefficient

I = Average rainfall intensity (inches/hour)

A = Area of drainage sub-basin (acres)

2. Runoff Coefficient

Coefficients from Table 6-6 of the EPC DCM Volume 1 update for developed land were utilized in the Rational Method calculations. See Appendix B for more information.

3. Time of Concentration

The time of concentration consists of the initial time of overland flow and the travel time in a hydraulic conveyance feature to a design point or similar location of interest. A minimum time of concentration of 5 minutes is utilized for urban development.

4. Rainfall Intensity

The hypothetical rainfall depths for the 1-hour storm duration were taken from Table 6-2 of the Colorado Springs Drainage Criteria Manual.

B. Basin Hydrology – Existing Conditions

This project is located in the Bald Mountain major drainage basin. It is our understanding there is no Drainage Basin Planning Study (DBPS) on file that encompasses this project. Therefore, this project area is considered unstudied from a master drainage analysis perspective.

Stormwater runoff from the project generally flows to the north, and ultimately discharges into an unnamed drainage way. Eleven (11) basins were delineated for this analysis. Refer to the existing conditions map in Appendix D.

Design Point 1 flows are generated from basin E2. Basin E2 consists of a portion of a single-family home site and undeveloped land. Runoff from this basin travels overland easterly to an existing 36" RCP which outfalls on the east side of Interstate 25 into basin E1. Runoff will then travel easterly via a broad grass lined swale towards Design Point 2.

Please include the basin area and generated flows in the description of each basin. Please include the final outfall location of the flow for each basin.



Design Point 2 flows are generated from basin E1. Basin E1 consists of undeveloped land with a few informal gravel roadways and paths. Runoff from this basin travels overland northeasterly to existing dual 48" RCP's which outfall on the east side of Misty Acres Boulevard into basin E3. Runoff will then travel northeasterly via a broad grass lined swale towards Design Point 3.

Design Point 3 flows are generated from Design Point 2 runoff and basin E3. Basin E3 consists of a portion of a single-family home sites and undeveloped land. Runoff from this basin travels overland northerly to an existing detention pond as part of the Misty Acres Filing No. 1 development. This pond serves as detention for the Misty Acres Filing No. 1 development as well as a portion of the project west of Misty Acres Boulevard. The pond outfalls with a 48" RCP to the north into basin E7. Runoff then travels north via a broad grass lined swale towards Design Point 6.

Specify that this pond was designed/approved under EDARP Filing Number SF01016

Please state whether the pond will remain with upgrades or be removed.

Design Point 4 flows are generated from basin E4. Basin E4 consists of singlefamily home sites. Runoff from this basin travels overland northwesterly to an existing pond facility that does not appear to provide a significant amount of detention as no outlet works are present. Therefore, no peak attenuation or water quality is provided. The pond outfalls to the north into basin E5. Runoff then travels northwesterly via a grass lined swale towards Design Point 5.

Specify that this pond was designed/approved under EDARP Filing Number SF94003

Design Point 5 flows are generated from Design Point 4 runoff and basin E5. Basin E5 consists of single-family home sites. Runoff from this basin travels northwesterly via a grass lined swale to dual 48" CMP's under Doewood Drive to the project's east boundary line. Runoff then travels northwesterly via a broad grass lined swale towards Design Point 6.

Design Point 6 flows are generated from Design Point 3 and Design Point 5 runoff and basin E7. Basin E7 consists of undeveloped land. Runoff from this basin travels overland northerly to an existing wetlands depression area south of and adjacent to the Palmer-Divide Road. During the minor and major storm events, flows overtop the roadway with the single 48" CMP.

Design Point 7 flows are generated from basin E8. Basin E8 consists of undeveloped land and large lot single family development as well as a portion of Interstate 25. Runoff from this basin travels overland easterly to an existing 48" CMP which outfall on the east side of Interstate 25 into basin E10. Runoff will then travel northerly via a broad grass lined swale towards Design Point 8.



Design Point 8 flows are generated from Design Point 7 runoff and basin E9 & E10. Basin E9 consists of Interstate 25 and Monument Hill Road. Runoff from this basin travels via a roadside swale northerly to an existing grated inlet constructed with the Interstate 25 express lane project. Flow is captured in this inlet and combines with runoff from basin E8 and outfalls on the east side of Monument Hill Road into basin E10. Basin E10 consists of Monument Hill Road and undeveloped land. Runoff then travels northeasterly via a broad grass lined swale to Design Point 8. Flow is conveyed under Monument Hill Road via an existing 48" RCP towards Design Point 9. It is noteworthy to mention that at this location it is difficult to determine if there is enough head for all of the flow to enter this culvert. The same holds true at Design Point 9. Additional survey data will be gathered prior to Final Drainage Report analysis.

Design Point 9 flows are generated from basin E11. Basin E11 consists of Interstate 25, an off-ramp and interchange gore areas. Runoff from this basin travels overland northeasterly via a broad grass lined swale to an existing 48" RCP which outfalls on the north side of Palmer Divide Road. It is noteworthy to mention that additional survey data is needed to determine if there is enough head to prevent flows from routing easterly. Regrading the swale to the west may be necessary which will be determined during the construction document preparation phase.

Design Point 10 is shown to represent where runoff from single-family residential home sites east of basins E4, E5 and E6 crosses over the Palmer Divide roadway. Field evidence reveals a roadside swale on the south side of Palmer Divide Road that has very little capacity as it approaches Doewood Drive. Under Doewood Drive, there is an existing 24" RCP that seems to convey flow only from basin E6. Basin E6 consists of single-family residential development. The amount of flow anticipated from the east side of the projects study is assumed to be very large. Due to the current swale geometry and grades at the Doewood intersection, it is assumed the runoff overtops Palmer Divide Road during even minor storm events and is directed to the north. For this reason, no anticipated flow besides that of basin E6 is anticipated to anter into basin E7.

basin E6 is anticipated to enter into basin E7.

C. Basin Hydrology – Developed Conditions

For each basin, notate which WQ PBMP each basin is tributary to and/or which WQ exclusion applies. And/or just provide the WQ Treatment Summary Table I requested on the last page of this report.

Stormwater runoff from the project generally flows to the north, and ultimately discharges into a wetlands depression area south of and adjacent to Palmer Divide Road. Proposed grading of the site will generate twenty-three (23) on-site basins and fourteen (14) off-site basins. Refer to the developed conditions map in Appendix D. All proposed storm piping, inlets and manholes within public right-of-way be publicly owned and maintained. All other proposed storm system elements will be privately owned and maintained. All public storm pipes will be RCP.



Please include a statement when an existing DP is replaced by a new DP for additional clarity

For the purposes of this report, generic descriptions of "pipe" and "inlets" have been referenced instead of using detailed descriptions (e.g. – "pipe 8" or "proposed 8' atgrade inlets"). Refer to the drainage maps, tables and calculations to provide more details as to what the system is composed of. The following basin descriptions are intended to provide general routing guidance only. Additionally, it is noteworthy to mention that at all inlet locations for this project (sump or at-grade), flows are captured in their entirety, i.e. – no flowby. Due to the steep grades of all roadways being proposed, sump inlet locations are not able to be sited in most situations.

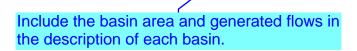
Design Point 11 flows are generated from basin O1. Basin O1 consists of primarily undeveloped land with one home site. Per the Misty Acres drainage reports, this land will be required to detain runoff to historic levels upon development. For this reason, the basin runoff has been accommodated to flow through the project site at a historic rate. Runoff from this basin is routed via a proposed pipe to design point 13 after combining with runoff from basin A1.

Design Point 12 flows are generated from basin O2. Basin O2 consists of Interstate 25 and Monument Hill Road. Runoff from this basin travels east and is captured by a CDOT grated inlet located in the swale adjacent to the roadway. The flow is captured by the inlet and is routed to the east side of Monument Hill Road via a 36" RCP pipe. It is unknown as to why this pipe is so large considering the basin area is so small and is located near the high point of Interstate 25. Flows are then routed overland and enter the street. Flows then proceed via curb and gutter easterly within basin A1 towards Design Point 13.

Design Point 13 flows are generated from basin A1. Basin A1 consists of singlefamily tri-plex home sites. Runoff from this basin travels via curb and gutter to Design Point 13 where they are captured by two proposed inlets. Flows are then conveyed via a pipe system and are routed to Design Point 18.

Design Point 14 flows are generated from basin A2. Basin A2 consists of single family tri-plex home sites. Runoff from this basin travels via curb and gutter to Design Point 14 where they are captured by two proposed inlets. Flows are then conveyed via a pipe system and combine with flows from Design Point 13. They are then routed to Design Point 18.

Design Point 15 flows are generated from basin O3. Basin O3 is the same as basin E2 consisting of a single lot and undeveloped land on the west side of the





interstate. Runoff from this basin travels east via an existing 36" RCP connecting to an existing CDOT grated inlet at Design Point 16.

Design Point 16 flows are generated from basin O4. Basin O4 consist of Interstate 25 and Monument Hill Road. Runoff from this basin travels easterly to a proposed storm pipe located within basin A4 at Design Point 17. Flow is then routed to Design Point 18 via a pipe system.

Design Point 17 flows are generated from basin O4. Runoff from this basin travels easterly after entering a proposed end section to via a proposed storm pipe towards Design Point 18.

Design Point 18 is located where flows from aforementioned Design Points combine and are routed via a proposed storm pipe towards the culvert system which outfalls into pond 1.

Design Point 19 flows are generated from basin A3. Basin A3 consists of singlefamily tri-plex home sites and open space. Runoff from this basin travels to a proposed culvert at Design Point 19 and is routed north via a culvert towards proposed pond 1.

Design Point 20 flows are generated from basin A4. Basin A4 consists of singlefamily duplex and tri-plex home sites. Runoff from this basin travels to a proposed low point where it will be captured by two sump inlets. Flows from this point will be routed to the north to pond 1 after combining with flow from Design Points 18 and 19.

Design Point 21 is located at the outfall of the storm sewer system described above. Design Point 22 flows are generated from Design Point 19, 20 and 21 runoff. Basin A5 consists of pond 1 itself. For the purpose of this report, a detailed pond design was not conducted. This will be provided in future FDR's. As such, the MHFD UD-Detention spreadsheet was used for preliminary sizing. A private full spectrum extended detention basin (EDB) is proposed at this location. The proposed on-site imperviousness contributing to this pond has been calculated to be 45.60%. The ponds' tributary area equals 24.52 acres. The pond facility will provide ~2.1acre-ft of detention volume and ~0.4acre-ft of WQCV. The EDB will have forebays, a maintenance access road, concrete trickle channel, micro pool and an outlet structure retrofitted at the end of one of the existing 48" culverts under Misty Acres Boulevard. The other 48" culvert will be capped on each end and abandoned. The full-spectrum EDB will have a rip rap emergency overflow spillway



that will drain the 100yr peak flows in the event the outlet structure becomes entirely clogged and another 100yr event passes. The spillway will be constructed of soil rip rap. A minimum of 1.0' of freeboard will be provided. The spillway will be situated such that any overflow will be directed to a low point in Misty Acres Boulevard, Design Point 27. Refer to the design calculations in Appendix B for additional pond design information.

Design Point 23 flows are generated from basin B1. Basin B1 consists of singlefamily duplex home sites. Runoff from this basin travels north via curb and gutter to a proposed sump inlet at the end of the street. Flows are then routed via a pipe to Design Point 26.

Design Point 24 flows are generated from basin B2. Basin B2 consists of singlefamily duplex home sites. Runoff from this basin travels north via curb and gutter to a proposed triple type R inlet where flow is captured. Flows are then routed via pipe to Design Point 26.

Design Point 25 flows are generated from basin B3. Basin B3 consists of singlefamily duplex home sites. Runoff from this basin travels north via curb and gutter to a proposed triple type R inlet where flow is captured. Flows are then routed via pipe to Design Point 24 and then north to Design Point 26.

Design Point 26 is located where flows from Design Points 23, 24 and 25 combine and are routed via a proposed storm pipe towards the pipe system in Misty Acres Boulevard which outfalls into pond 2.

Design Point 27 flows are generated from basin B8. Basin B8 consists of open space and portion Misty Acres Boulevard. Runoff from this basin travels to a proposed low point where it will be captured by two sump inlets. Flows from this location will be routed to the north to Design Point 28. In the evnt clogging occurs, flow will overtop the roadway and enter the Misty Acres pond

Design Point 28 flows are generated from a portion of basin B4. Basin B4 consists of open space and the adjacent roadway. Runoff from this basin travels easterly via curb and gutter to an inlet where flow is captured. Flows are then routed in a pipe system towards Design Point 29.



Design Point 29 flows are generated from a portion of basin B4. Runoff from this basin travels easterly via curb and gutter to an inlet where flow is captured. Flows are then routed in a pipe system to proposed pond 2.

Design Point 30 flows are generated from a portion of basin B5. Basin B5 consists of single family duplex home sites and open space. Runoff from this basin travels via curb and gutter to Design Point 30 where they are captured by a proposed inlet. Flows are then conveyed via a pipe system and combine with flows from Design Point 31. They are then routed to Design Point 32 via a storm pipe system.

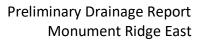
Design Point 31 flows are generated from a portion of basin B5. Runoff from this basin travels via curb and gutter to Design Point 31 where they are captured by a proposed inlet. Flows are then conveyed via a pipe system and combine with flows from Design Point 30. They are then routed to Design Point 32 via a storm pipe system.

Design Point 32 flows are generated from basin B6. Basin B6 consists of single family duplex home sites and open space. Runoff from this basin travels via curb and gutter to Design Point 32 where they are captured by a proposed inlet. Flows are then conveyed via a pipe system after combining with flows from Design Point 31 to Design Point 33.

Design Point 33 flows are generated from basin B7. Basin B6 consists of single family duplex home sites and open space. Runoff from this basin travels via curb and gutter to Design Point 33 where they are captured by a proposed inlet. Flows are then conveyed via a pipe system to proposed pond 2 after combining with flows from Design Point 32.

Design Point 34 flows are generated from Design Point 29 and 33 runoff and basin B9. Basin B9 consists of pond 2 itself along with open space. For the purpose of this report, a detailed pond design was not conducted. This will be provided in future FDR's. As such, the MHFD UD-Detention spreadsheet was used for preliminary sizing. A private full spectrum extended detention basin (EDB) is proposed at this location. The proposed on-site imperviousness contributing to this pond has been calculated to be 57.88%. The ponds' tributary area equals 20.48 acres. The pond facility will provide ~2.1acre-ft of detention volume and ~0.4acre-ft of WQCV. The EDB will have forebays, a maintenance access road, concrete trickle channel, micro pool and an outlet structure. The full-spectrum EDB will have a rip rap emergency overflow spillway that will drain the 100yr peak flows in the event the outlet structure becomes entirely clogged and another 100yr event passes. The spillway will be constructed of soil rip rap. A minimum of 1.0' of freeboard will be provided. The

Preliminary design showing that the
 sizing will work and not require site revisions is needed in this report.





spillway will be situated such that any overflow will be directed on the north side of the pond such that overflow would be directed north to a low point in Misty Acres Boulevard, Design Point 38. Refer to the design calculations in Appendix B for additional pond design information.

Design Point 35 flows are generated from basin C1. Basin C1 consists of single family duplex home sites and the adjacent roadway. Runoff from this basin travels northeasterly via curb and gutter to Design Point 35 where flow is captured by an inlet. Flows are then routed in a pipe system to Design Point 36.

36

Design Point 369 flows are generated from basin C2. Basin C2 consists of single family duplex home sites and the adjacent roadway. Runoff from this basin travels easterly via curb and gutter to an inlet where flow is captured. Flows are then routed in a pipe system to proposed pond 3.

Design Point 37 flows are generated from Design Point 36 runoff and basin C3. Basin C3 consists of pond 3 itself. For the purpose of this report, a detailed pond design was not conducted. This will be provided in future FDR's. As such, the MHFD UD-Detention spreadsheet was used for preliminary sizing. A private full spectrum extended detention basin (EDB) is proposed at this location. The proposed on-site imperviousness contributing to this pond has been calculated to be 63.17%. The ponds' tributary area equals 5.78 acres. The pond facility will provide ~0.6acre-ft of detention volume and ~0.1acre-ft of WQCV. The EDB will have forebays, a maintenance access road, concrete trickle channel, micro pool and an outlet structure. The full-spectrum EDB will have a rip rap emergency overflow spillway that will drain the 100yr peak flows in the event the outlet structure becomes entirely clogged and another 100yr event passes. The spillway will be constructed of soil rip rap. A minimum of 1.0' of freeboard will be provided. The spillway will be situated such that any overflow will be directed to the east to a low point in Misty Acres Boulevard, Design Point 38. Refer to the design calculations in Appendix B for additional pond design information.

Design Point 38 is located where flows from ponds 2 and 3 combine. Flows are then routed northerly via a pipe system towards the Palmer-Divide Roadway. Prior to reaching the intersection, the system directs runoff to the east to Design Point 45.

Design Point 39 flows are generated from basin D1. Basin D1 consists of open space and portion Misty Acres Boulevard. Runoff from this basin travels to a proposed low point where it will be captured by two sump inlets. Flows from this



location will be routed to the east to proposed pond 4 at Design Point 41. In the event clogging occurs, flows will overtop the roadway and enter pond 4.

Design Point 40a flows are generated from a portion of basin D2. Basin D2 consists of single-family home sites. Runoff from this basin travels north via curb and gutter to an inlet where flow is captured. Flows are then routed via pipe to Design Point 40b.

Design Point 40b flows are generated from a portion of basin D2. Runoff from this basin travels north via curb and gutter to an inlet where flow is captured. Flows are then routed via pipe to Design Point 40c.

Design Point 40c flows are generated from a portion of basin D2. Runoff from this basin travels north and then west via curb and gutter to two sump inlets where flow is captured. Flows are then routed via pipe to proposed pond 4 (south) at Design Point 41 after combining with flows from Design Point 40b.

Design Point 41 is composed of the southern basin of the pond 4 facility, basin D5. Flow routed to this location will be routed to the north into the upper portion of the pond via a flat 30" pipe thereby combing the two areas into one facility. The connecting pipe is sized such that there is no backwater effect and captured runoff will flow freely to be detained and treated in the north basin. The reason for this approach is due to the existing wetlands adjacent to the pond and the distance from the Misty Acres Boulevard connection to Palmer Divide Road being so close. To minimize wetlands disturbance, the pond has been located along its western edge. This creates a configuration that necessitates two depression areas which as stated above will be connected by a pipe and will function like a normal water quality and detention facility.

Design Point 42 flows are generated from basin D3. Basin D3 consists of a small portion of Misty Acres Boulevard and adjacent open space This basin has been created to route impervious areas of the roadway to the pond for detention and water quality treatment. Runoff from this basin travels to an inlet where flow will be captured. Flows from this location will be routed to the east to Design Point 43 via a pipe system.

Design Point 43 flows are generated from basin D4. Basin D4 consists of a small portion of Misty Acres Boulevard. Similar to Design Point 42, flows from the roadway are being captured and routed to the pond for detention and water quality treatment.



Design Point 44 flows are generated from Design Points 41 and 43 and basin D5. Basin D5 consists of pond 3 itself. As stated prior, a detailed pond design was not conducted. This will be provided in future FDR's. As such, the MHFD UD-Detention spreadsheet was used for preliminary sizing. A private full spectrum extended detention basin (EDB) is proposed at this location. The proposed on-site imperviousness contributing to this pond has been calculated to be 41.62%. The ponds' tributary area equals 22.15 acres. The pond facility will provide ~1.8acre-ft of detention volume and ~0.4 acre-ft of WQCV. The EDB will have forebays, a maintenance access road, concrete trickle channel, micro pool and an outlet structure. The full-spectrum EDB will have a rip rap emergency overflow spillway that will drain the 100yr peak flows in the event the outlet structure becomes entirely clogged and another 100yr event passes. The spillway will be constructed of soil rip rap. A minimum of 1.0' of freeboard will be provided. The spillway will be situated such that any overflow will be directed to a swale that runs along the south side of Palmer Divide Road, ultimately outfalling into the wetlands depression area. Refer to the design calculations in Appendix B for additional pond design information. Flows released from the pond will be routed to the north into the bypass pipe system at Design Point 45.

Design Point 45 is a junction structure which connects system outflows from ponds 2 and 3 with pond 4. This bypass system outfalls int the wetland depression area.

Design Point 46 flows are generated from basin E. Basin E consists of single family residential home sites as well as pond 5 itself. As stated prior, a detailed pond design was not conducted. This will be provided in future FDR's. As such, the MHFD UD-Detention spreadsheet was used for preliminary sizing. A private full spectrum extended detention basin (EDB) is proposed at this location. The proposed on-site imperviousness contributing to this pond has been calculated to be 48.40%. The ponds' tributary area equals 3.21 acres. The pond facility will provide ~0.3acre-ft of detention volume and ~0.05acre-ft of WQCV. The EDB will have forebays, a maintenance access road, concrete trickle channel, micro pool and an outlet structure. The full-spectrum EDB will have a rip rap emergency overflow spillway that will drain the 100yr peak flows in the event the outlet structure becomes entirely clogged and another 100yr event passes. The spillway will be constructed of soil rip rap. A minimum of 1.0' of freeboard will be provided. The spillway will be situated such that any overflow will be directed north into a vacant parcel, ultimately outfalling into the wetlands depression area. Refer to the design calculations in Appendix B for additional pond design information.

Design Point 47 is where pond 5 will discharge to after being routed through a proposed retaining wall.

Design Point 48 flows are generated from Design Point 2 flows and basin O5 (which is the same as existing conditions basin E3). Flows reaching this location



(Misty Acres Filing No. 1 pond facility) are less than what was determined in the filing no. 1 report. The report planned on an inflow value of Q10=138cfs and a Q100 value of 301cfs with flow attenuation of Q10=58cfs and Q100=130cfs. This report has calculated inflow values of Q10=107cfs and Q100=226cfs which yields outflows of Q10=49cfs and Q100=96cfs. The reason for the difference is that areas planned to route runoff to the pond in the filing no. 1 report are now being routed to the projects' pond 1. The existing pond was not designed to provide water quality and as such cannot be used for the projects water quality requirement. Therefore, these flow will be routed around the development along the east side of basins D and E therefore bypassing the proposed project site. The existing 48" RCP outfall pipe is undersized to capture and convey flows northerly and therefore must be upsized to a 54" RCP.

Design Point 49 flows are generated by basin O6. Basin O6 consists of an area that will be routed to a proposed grated inlet which sits above the proposed existing ponds' outfall extension pipe. This pipe is needed to route flow around the project and into the wetlands depression area as it is now being routed to. Due to the amount of flow planned to be released (Q100max=96cfs) per the Misty Acres report) the pipe system needs to be sized accordingly to the grades which the pipe will flow at. Due to the route the system will take, the anticipated pipe slopes will be approximately 1%. The computed pipe size from Design Point 49 to Design Point 52 is 54".

DP? Would the roadway act as a drainageway?

Design Point 50 flows are generated from basin O7a (same as existing conditions basin E4). Refer to basin E4 for routing information.

Design Point 51 flows are generated from design point 50 and basin O7b (same as existing conditions basin E5). Refer to basin E5 for routing information. Flows reaching this location is conveyed by a channel through the neighboring subdivision. In order to route this flow around the project it must be collected and tied into the proposed bypass system mentioned in the Design Point 48 narrative. To do this, a concrete collection structure is needed at Design Point 52.

Design Point 52 is located where the proposed 66" RCP pipe coming from the existing Misty Acres Filing No. 1 Pond will enter the structure from the south. Flow will be captured in a collection structure and combine with that from Design Point 51. On the north side of the structure, a proposed pipe will route flows to the wetlands area. Due to the amount of flow anticipated from basins O7a and O7b (Q100~248cfs) combined with that expected from the Misty Acres pond (Q100~242cfs) for a total flow of ~470cfs, an 84" pipe is needed. The 84" pipe will route flows into the existing wetlands depression area thereby bypassing all offsite



flows around the project. A detailed design for the collection structure will be provided when the Final Drainage Report is prepared. Due to the amount of flow and the likelihood for scour at the outfall location, an energy dissipation structure will be required. This may be in the form or a riprap tailwater basin or some type of concrete baffle blocks or a combination thereof. A detailed design will be provided when the Final Drainage Report is prepared.

Design Point 53 flows are generated from basin O8 which has is the same basin as E6. See existing conditions narrative Design Point 10.

Design Point 54 flows are generated from the projects five ponds as well as the existing Misty Acres Filing No. 1 Pond and offsite basins O7a, O7b, O8 and O9. Flows reaching this location are approximately on the order of ~431cfs during the 100yr event. The existing conditions flows have been calculated to be ~488cfs during the 100yr event. Therefore, this project releases ~57cfs less during the 100yr event. Also it is noteworthy to mention that off site basins O7a and O7b have ponds located within their development areas. These have not been considered in this report but likely upon final design and analysis they will result in peak flows less than what has been assumed herein.

Design Point 55 is the outfall from the existing 48" CMP and the addition of 2-48" RCP's. The major and minor storm events will be adequately captured and conveyed beneath the roadway with this addition of two culverts.

Please name the roadway here

Design Point 56 flows are generated from basin O10. Basin O10 is the same basin as E8 which consists of undeveloped land and large lot single family development as well as a portion of Interstate 25. Runoff from this basin travels overland easterly to an existing 48" CMP which outfalls on the east side of Interstate 25 into basin O11 (same basin as E9) at Design Point 57.

Design Point 57 consists of an outfall from basins O10 and O11. The proposed site is lower than the proposed outfall and therefore a broad grass lined swale will be constructed to route flows towards Design Point 58.

Design Points 58 and 59. Refer to existing conditions Design Points 8 and 9 for the same routing description. The flow values have changed slightly due to existing conditions basin O10 being minimized by development of this project, but the routing is the same. Regrading the swale to the west may be necessary which will be determined during the construction document preparation phase.



A summary of the basin runoff coefficients, peak flow rates and hydrologic analysis support calculations are provided in Appendix B.

D. Water Quality – 4 Step Process

Four-Step Process

El Paso County requires the MHFD Four Step Process for receiving water protection that focuses on reducing runoff volumes, treating the water quality capture volume (WQCV), stabilizing drainageways, and implementing long-term source controls.

Step 1: <u>Runoff Reduction Practices</u>

Provide a plan highlighting these areas that will be maintained as grass buffers.

This development address Low Impact Development strategies primarily through the utilization of landscape buffers, located in areas adjacent to the building and parking lot areas of the site. Runoff is routed over these grass areas via unconcentrated sheet flow prior to being conveyed to water quality and detention facilities.

Step 2: <u>Implement BMPs - Water Quality Capture Volume with Slow Release</u> On-site flow is directed to five private full-spectrum extended detention basins. These facilities provide Water Quality Capture Volume (WQCV) required for the site by releasing flows over a longer period of time. The proposed facilities meet or exceed the DCM standards for the release rates of full-spectrum detention ponds for water quality capture volumes.

Step 3: Stabilize Drainageways

All the flows generated from impervious portions of this site will be routed to private water quality and detention facilities. These flows will combine with flows from other areas adjacent to the site and discharge into a wetlands depression area at the north end of the project. Only minor channel improvements in basin O12 are being proposed with this development.

Step 4 – Implement Site Specific and Other Source Control BMPs

To adhere to the County's Municipal Separate Storm Sewer System (MS4) requirements, temporary construction BMP's and permanent post construction BMP's will be implemented to reduce the potential of pollutants entering the creek. The implementation of these BMP's will be provided in the Grading, Erosion and Stormwater Quality Control Plan and Stormwater Management Plan for the site. The Stormwater Management Plan also addresses structural and procedural source control BMP's such as materials storage and spill prevention, containment, and control, etc. during construction to protect downstream receiving waters. Refer to the Stormwater Management Plan for this site for additional source control BMP information specific to this site. If deemed necessary, site specific source controls including covering storage/handling areas and spill containment will be used.

Note that per the Soils Report, groundwater was encountered at a depth of 1ft at the nearest test boring (TB-3) to Ponds 2, 3, and 4. Those ponds all have depths greater than 1ft, so please address this in the text here.

Please discussion any WQ exclusions that apply to any portion of the site. 5 exclusions were selected in the PBMP Applicability Form but none have been discussed in this drainage report.

> riprap or soil riprap? Revise to remove

discrepancy.

Statement is unclear, please clarify.

E. Water Quality Improvements

The proposed full-spectrum extended detention basins have been analyzed in this study based on the proposed site conditions as shown on the Developed Conditions Drainage Maps.

Full Spectrum Extended Detention Basing

For the purpose of this report, detailed pond designs were not conducted. This will be provided in future FDR's. As such, the MHFD UD-Detention spreadsheet was used for preliminary sizing. Private full spectrum extended detention basins (EDB) is proposed various portions of the site. The EDB's will have forebays, maintenance access roads, concrete trickle channels, micro pools and outlet structures.

The full-spectrum EDB's will have rip rap emergency overflow spillways that will drain the 100yr peak flows in the event the outlet structure becomes entirely clogged and another 100yr event passes. The spillways will be constructed of soil rip rap. A minimum of 1.0' of freeboard will be provided. The spillway will be situated such that any overflow will be directed away from homes. Refer to the design calculations in Appendix B for additional information.

IV. HYDRAULIC ANALYSIS

Methodology

The following MHFD hydraulic software were used in this report:

- MHFD UD-Culvert v4.00 pipe calculations
- 2022 Civil3d Hydraulics module culvert calculations

All pipes have been sized using "Mannings" equation for open channel flow with a full flow percentage of around 65%. This should account for energy losses found when a final design is provided and the hydraulic grade line calculations are performed. Final design analysis will be conducted during the Final Drainage Report preparation phase.

V. ENVIRONMENTAL EVALUATIONS

A. Wetland and Riparian Areas

A wetland identification process has not been performed however a boundary delineation has been. Future Final Drainage Reports (FDR's) will include this information.

B. Stormwater Quality

Refer to section III E for water quality provided for this project.

Address the condition and capacity of downstream conveyances (including north of County Line Road), effects of the proposed flows from this development, any stabilization that may be required and any maintenance that may be required.

C. Permitting Requirements

A USACE 404 permit is not anticipated for this project since there will be no wetlands disturbance.

VI. ALTERNATIVES EVALUATION

An alternatives evaluation was not conducted for this project since there is no drainage basin planning study for the Bald Mountain watershed.

VII. SELECTED PLAN (IMPLEMENTATION OF THE MASTER PLAN)

A. Plan Hydrology (complete the modeling)

There is no Master Drainage Plan that encompasses this site or more particularly described as being for the Bald Mountain watershed. A DBPS may be needed in the future as more development in the overall basin is experienced.

Per the MHFD modeling of the proposed full-spectrum detention/water quality ponds, detention from this project will either be equal to or reduce the major storm (100yr event) discharge from the site from the pre-development. As the proposed development is not projected to increase runoff from the site, there should not be any additional impact to downstream infrastructure.

B. System Improvements

Impact will be the extended duration of flows with FSD

Proposed improvements to the existing stormwater infrastructure are not planned at this time since no deficiencies have been found. The existing Misty Acres Filing No. 1 pond is now to be considered oversized compared to what was planned due to routing of project flows to proposed ponds located on site.

C. System Priorities/Phasing

No definitive phasing of the development is known at this time. Once development of any portion of the site begins, the owner will be responsible for providing fullspectrum detention and water quality in accordance with this MDDP. Developed runoff cannot be released from the site until full-spectrum water quality and detention has been provided. Subsequent Final Drainage Reports (FDR's) will establish the timing of such improvements.

D. Deficiency Costs

There are no deficient drainage structures associated with the project. All existing pipes will remain.

Please clarify, discussion of -DP 48 states a 48" RCP will need to be replaced with a 54"



E. Reimbursable Costs

Due to the watershed being in an unstudied drainage basin and no public infrastructure is being proposed, no improvements will be reimbursable.

F. Governing Agencies Requirements

A United States Army Corps of Engineers (USACE) 404 permit will not be required for this project. There are no other external governmental agency requirements for this development, however CDOT will be a referral agency thereby reviewing the plans and reports since the project is adjacent to Interstate 25. Final Drainage Reports for each future phase of development will be presented to the Town of Monument and El Paso county with the development of the construction documents.

G. Maintenance Requirements

Regular maintenance of stormwater facilities is essential to ensure long term functionality and effectiveness. The proposed pipes, inlets, manholes, along with the full-spectrum detention and water quality facilities should be inspected regularly, and after significant rainstorms, to verify functionality, document erosion, and remove sediment and debris. Refer to the project's Inspection and Maintenance (IM) Plan for additional information.

The following is a list of recommendations regarding drainage around structures:

- Maintain positive drainage away from all structures at all locations.
- Adhere to guidelines outlined in the geotechnical report (if one has been completed); otherwise refer to the latest International Residential Code (IRC) book.
- Avoid grading low points adjacent to any structures.

The on-site full-spectrum ponds and storm sewer outlined in this report shall be owned and maintained by the metropolitan district or homeowners' association (HOA). The proposed storm sewer facilities located within street right-of-way outlined in this report shall be owned and maintained by the Town of Monument.

H. Implementation Recommendation

Development of the site requires the implementation of full-spectrum detention and water quality procedures that have been detailed in this report. The developed conditions will produce runoff at or below existing conditions. This ensures no additional impacts will result downstream as a result of development of this site.

I. Grading and Erosion Control Plans

Grading and Erosion Control Plans will be submitted separately.



VIII. FEE DEVELOPMENT

Since the Bald Mountain drainage basin has not been studied in a master plan document and there are no regional public improvements, no fees have been developed.

IX. SUMMARY

The Master Development Drainage Plan for Monument Ridge East was prepared using the City of Colorado Springs Drainage Criteria Manuals, MHFD Urban Storm Drainage Criteria Manuals and the El Paso County DCM Volume 1 updates. Stormwater quality is provided by proposed private full spectrum extended detention basin facilities located on-site. Site runoff, storm drain, and associated appurtenances will not adversely affect the downstream and surrounding developments. This report is in general conformance with and all other previously approved reports which included portions of this site.

X. REFERENCES

- 1. Drainage Criteria Manual, Volume I (revised January 2021) and Volume II (revised December 2020), City of Colorado Springs
- 2. Urban Storm Drainage Criteria Manual, Volumes I-III, Mile High Flood District (MHFD).
- 3. El Paso County Drainage Criteria Manual Volume 1 update, El Paso County Municode web site
- 4. El Paso County Engineering Criteria Manual, Drainage Criteria Manual Volume 2, Appendix I.
- 5. Misty Acres Subdivision Filing No. 1, Final Drainage Report, 2002, Kiowa Engineering Corporation
- 6. Misty Acres Ranch, Master Development Drainage Plan, 2001, Kiowa Engineering Corporation
- 7. Interstate 25 Express Lanes: Castle Rock to Monument (The Gap), Hydrology and Hydraulics Report, 2020, CH2M
- 8. Flood Insurance Rate Map Numbers 08041C0065G and 0804C0276G, El Paso County, Colorado, Revised December 7, 2018, Federal Emergency Management Agency (FEMA)
- 9. Web Soil Survey, Natural Resources Conservation Service (NRCS)

XI. APPENDICES

A. Stakeholder Meeting Summary

To date there have been no stakeholder or public meetings conducted for this site. Once meetings have been conducted, this information will be included in subsequent Final Drainage Reports for the project.



B. Hydrology

The following hydrologic calculations are located in appendix B:

- Percent Impervious
- Composite Runoff Coefficients
- Basin Runoff Summary
- Surface Routing Summary

C. Hydraulics – Pipes, Inlets and Ponds

The following hydraulic calculations are located in appendix B:

- Inlets
- Culverts
- Pipes
- Full-spectrum Extended Detention and Water Quality ponds

Hydraulic Grade Lines (HGL) for the minor (10yr) and major (100yr) storm event will be provided for each storm sewer pipe in subsequent FDR's.

D. Drainage Maps

Existing and developed drainage maps are located in appendix C.



Supplemental information related to my comment on PDF pg 22 above regarding groundwater in ponds:

Per CDPHE's "Low Risk Discharge Guidance - Discharges of Uncontaminated Groundwater to Land," discharging groundwater to a pond or other SW conveyance is prohibited unless properly permitted through CDPHE. Please review this guidance and the applicable permits. The guidance and permits can be found on CDPHE's website.

See excerpts from MHFD's DCM Volume 2 and 3 for potential concerns with groundwater in an EDB and the recommended mitigation options (like a clay or geomembrane liner). Please discuss this potential shallow groundwater in the report text. If you decide not to design for mitigation now and shallow groundwater is encountered during or after construction (or at PA/FA), proper mitigation and permitting will need to be implemented at that time.

• **Groundwater**: Shallow groundwater on a site presents challenges for BMPs that rely on infiltration and for BMPs that are intended to be dry between storm events. Shallow groundwater may limit the ability to infiltrate runoff or result in unwanted groundwater storage in areas intended for storage of the WQCV (e.g., porous sub-base of a permeable pavement system or in the bottom of an otherwise dry facility such as an extended detention basin). Conversely, for some types of BMPs such as wetland channels or constructed wetland basins, groundwater can be beneficial by providing saturation of the root zone and/or a source of baseflow. Groundwater quality protection is an issue that should be considered for infiltration-based BMPs. Infiltration BMPs may not be appropriate for land uses that involve storage or use of materials that have the potential to contaminate groundwater underlying a site (i.e., "hot spot" runoff from fueling stations, materials storage areas, etc.). If groundwater or soil contamination exists on a site and it will not be remediated or removed as a part of construction, it may be necessary to avoid infiltration-based BMPs or use a durable liner to prevent infiltration into contaminated areas.

5.12 Linings

Sometimes an impermeable clay or synthetic liner is necessary. Stormwater detention and retention facilities have the potential to raise the groundwater level in the vicinity of the basin. Where there is concern for damage to adjacent structures due to rising ground water, consider lining the basin with an impermeable liner. An impermeable liner may also be warranted for a retention pond where the designer seeks to limit seepage from the permanent pool. Note that if left uncovered, synthetic lining on side slopes creates a serious impediment to egress and a potential drowning hazard. See the Retention Pond Fact Sheet in Volume 3 of the USDCM for guidance and benefits associated with the constructing a safety wetland bench.

Site Selection

EDBs are well suited for watersheds with at least five impervious acres up to approximately one square mile of watershed. Smaller watersheds can result in an orifice size prone to clogging. Larger watersheds and watersheds with baseflows can complicate the design and reduce the level of treatment provided. EDBs are also well suited where flood detention is incorporated into the same basin. The depth of groundwater should be investigated. Groundwater depth should be 2 or more feet below the bottom of the basin in order to keep this area dry and maintainable. Design foundation drains and other groundwater drains to bypass the water quality plate directing these drains to a conveyance element downstream of the EDB. This will reduce baseflows and help preserve storage for the WQCV.

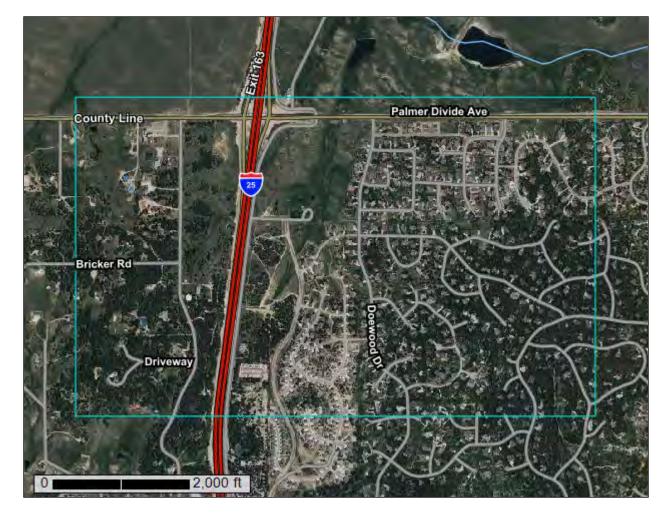


United States Department of Agriculture



Natural Resources Conservation Service A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants Custom Soil Resource Report for Castle Rock Area, Colorado, and El Paso County Area, Colorado

Monument Ridge East



Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/? cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

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Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.



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| 62 | · | | | The orthopho compiled and |

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at scales ranging from 1:20,000 to 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: Castle Rock Area, Colorado Survey Area Data: Version 15, Sep 1, 2022

Soil Survey Area: El Paso County Area, Colorado Survey Area Data: Version 20, Sep 2, 2022

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

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

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

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background

MAP LEGEND

MAP INFORMATION

imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

| Map Unit Symbol | Map Unit Name | Acres in AOI | Percent of AOI |
|-----------------------------|---|--------------|----------------|
| KfF | Kettle-Falcon complex, 9 to 65 percent slopes | 4.0 | 0.5% |
| Lw | Loamy wet alluvial land | 5.3 | 0.6% |
| PpE | Peyton-Pring-Crowfoot sandy loams, 5 to 25 percent slopes | 17.5 | 2.1% |
| PrE2 | Peyton-Pring-Crowfoot complex, 3 to 15 percent slopes, eroded | 38.5 | 4.7% |
| Subtotals for Soil Survey A | rea | 65.2 | 8.0% |
| Totals for Area of Interest | | 813.1 | 100.0% |

| Map Unit Symbol | Map Unit Name | Acres in AOI | Percent of AOI |
|-----------------------------|--|--------------|----------------|
| 1 | Alamosa loam, 1 to 3 percent slopes | 35.2 | 4.3% |
| 41 | Kettle gravelly loamy sand, 8 to 40 percent slopes | 285.9 | 35.2% |
| 42 | Kettle-Rock outcrop complex | 9.1 | 1.1% |
| 69 | Peyton-Pring complex, 8 to 15 percent slopes | 245.8 | 30.2% |
| 92 | Tomah-Crowfoot loamy sands, 3 to 8 percent slopes | 171.9 | 21.1% |
| Subtotals for Soil Survey A | rea | 747.9 | 92.0% |
| Totals for Area of Interest | | 813.1 | 100.0% |

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion

of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Castle Rock Area, Colorado

KfF—Kettle-Falcon complex, 9 to 65 percent slopes

Map Unit Setting

National map unit symbol: jqz2 Elevation: 6,600 to 8,000 feet Mean annual precipitation: 17 to 21 inches Mean annual air temperature: 45 to 47 degrees F Frost-free period: 115 to 125 days Farmland classification: Not prime farmland

Map Unit Composition

Kettle and similar soils: 50 percent *Falcon and similar soils:* 35 percent *Minor components:* 15 percent *Estimates are based on observations, descriptions, and transects of the mapunit.*

Description of Kettle

Setting

Landform: Hills, ridges Landform position (three-dimensional): Side slope, base slope, crest Down-slope shape: Linear Across-slope shape: Linear Parent material: Locally transported sandy alluvium derived from arkose

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material *H1 - 1 to 10 inches:* loamy sand *H2 - 10 to 18 inches:* sand *H3 - 18 to 60 inches:* gravelly loamy coarse sand

Properties and qualities

Slope: 9 to 25 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (2.00 to 20.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 4.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified Land capability classification (nonirrigated): 6e Hydrologic Soil Group: A Ecological site: F048AY925CO - Ponderosa Pine Forest Hydric soil rating: No

Description of Falcon

Setting

Landform: Cliffs Down-slope shape: Linear Across-slope shape: Linear Parent material: Alluvium derived from arkosic sandstone and/or conglomerate

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material

H1 - 1 to 8 inches: sandy loam

H2 - 8 to 15 inches: gravelly sandy loam

H3 - 15 to 18 inches: unweathered bedrock

Properties and qualities

Slope: 25 to 65 percent
Depth to restrictive feature: 4 to 20 inches to lithic bedrock
Drainage class: Well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Very low (about 1.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified Land capability classification (nonirrigated): 7e Hydrologic Soil Group: D Ecological site: F048AY925CO - Ponderosa Pine Forest Hydric soil rating: No

Minor Components

Rock outcrop

Percent of map unit: 7 percent *Hydric soil rating:* No

Pring

Percent of map unit: 7 percent *Hydric soil rating:* No

Aquic haploborolls

Percent of map unit: 1 percent Landform: Swales Hydric soil rating: Yes

Lw—Loamy wet alluvial land

Map Unit Setting

National map unit symbol: jqzd Elevation: 7,000 to 8,000 feet Mean annual precipitation: 17 to 19 inches Mean annual air temperature: 44 to 46 degrees F Frost-free period: 115 to 120 days Farmland classification: Not prime farmland

Map Unit Composition

Loamy wet alluvial land: 85 percent Minor components: 15 percent Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Loamy Wet Alluvial Land

Setting

Landform: Drainageways, swales, flood plains *Down-slope shape:* Linear *Across-slope shape:* Linear

Typical profile

H1 - 0 to 20 inches: sandy loam *H2 - 20 to 60 inches:* stratified sand to clay

Properties and qualities

Slope: 1 to 5 percent
Drainage class: Poorly drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.06 to 6.00 in/hr)
Depth to water table: About 0 to 24 inches
Frequency of flooding: FrequentNone
Calcium carbonate, maximum content: 5 percent
Gypsum, maximum content: 2 percent
Maximum salinity: Very slightly saline to moderately saline (2.0 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum: 2.0
Available water supply, 0 to 60 inches: Moderate (about 6.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified Land capability classification (nonirrigated): 5w Hydrologic Soil Group: D Hydric soil rating: No

Minor Components

Sandy wet alluvial land

Percent of map unit: 14 percent Hydric soil rating: No

Fluvaquentic haplaquolls

Percent of map unit: 1 percent Landform: Sloughs Hydric soil rating: Yes

PpE—Peyton-Pring-Crowfoot sandy loams, 5 to 25 percent slopes

Map Unit Setting

National map unit symbol: jqzn Elevation: 6,500 to 8,000 feet Mean annual precipitation: 15 to 18 inches Mean annual air temperature: 44 to 46 degrees F Frost-free period: 115 to 120 days Farmland classification: Not prime farmland

Map Unit Composition

Peyton and similar soils: 40 percent Pring and similar soils: 25 percent Crowfoot and similar soils: 25 percent Minor components: 10 percent Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Peyton

Setting

Landform: Valley sides, ridges Down-slope shape: Linear Across-slope shape: Linear Parent material: Weathered alluvium derived from arkose

Typical profile

H1 - 0 to 11 inches: sandy loam H2 - 11 to 30 inches: sandy clay loam H3 - 30 to 40 inches: sandy loam H4 - 40 to 60 inches: sandy loam

Properties and qualities

Slope: 5 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches

Frequency of flooding: None *Frequency of ponding:* None *Available water supply, 0 to 60 inches:* Moderate (about 7.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified Land capability classification (nonirrigated): 6e Hydrologic Soil Group: C Ecological site: R048AY222CO - Loamy Park Hydric soil rating: No

Description of Pring

Setting

Landform: Hills Landform position (three-dimensional): Crest, base slope Down-slope shape: Linear Across-slope shape: Linear Parent material: Alluvium derived from arkosic sedimentary rock

Typical profile

H1 - 0 to 12 inches: sandy loam *H2 - 12 to 60 inches:* gravelly sandy loam

Properties and qualities

Slope: 5 to 25 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 6.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified Land capability classification (nonirrigated): 6e Hydrologic Soil Group: A Ecological site: R048AY222CO - Loamy Park Hydric soil rating: No

Description of Crowfoot

Setting

Landform: Valley sides, ridges Down-slope shape: Linear Across-slope shape: Linear Parent material: Residuum weathered from arkosic sedimentary rock

Typical profile

H1 - 0 to 6 inches: sandy loam
H2 - 6 to 19 inches: loamy sand
H3 - 19 to 32 inches: gravelly sandy clay loam
H4 - 32 to 43 inches: gravelly sandy loam
H5 - 43 to 60 inches: coarse sand

Properties and qualities

Slope: 5 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 5.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified Land capability classification (nonirrigated): 6e Hydrologic Soil Group: B Ecological site: R049XY216CO - Sandy Divide Hydric soil rating: No

Minor Components

Brussett

Percent of map unit: 3 percent Hydric soil rating: No

Jarre

Percent of map unit: 3 percent Hydric soil rating: No

Tomah

Percent of map unit: 3 percent Hydric soil rating: No

Aquic haploborolls

Percent of map unit: 1 percent Landform: Swales Hydric soil rating: Yes

PrE2—Peyton-Pring-Crowfoot complex, 3 to 15 percent slopes, eroded

Map Unit Setting

National map unit symbol: jqzp Elevation: 6,500 to 8,000 feet Mean annual precipitation: 15 to 18 inches Mean annual air temperature: 44 to 46 degrees F Frost-free period: 115 to 120 days Farmland classification: Not prime farmland

Map Unit Composition

Peyton, eroded, and similar soils: 40 percent Pring, eroded, and similar soils: 25 percent Crowfoot, eroded, and similar soils: 20 percent Minor components: 15 percent Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Peyton, Eroded

Setting

Landform: Plateaus, mesas Down-slope shape: Linear Across-slope shape: Linear Parent material: Weathered alluvium derived from arkose

Typical profile

H1 - 0 to 11 inches: sandy loam H2 - 11 to 30 inches: sandy clay loam H3 - 30 to 40 inches: sandy loam H4 - 40 to 60 inches: sandy loam

Properties and qualities

Slope: 3 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 7.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified Land capability classification (nonirrigated): 6e Hydrologic Soil Group: C Ecological site: R049XY216CO - Sandy Divide Hydric soil rating: No

Description of Pring, Eroded

Setting

Landform: Plateaus, mesas Down-slope shape: Linear Across-slope shape: Linear Parent material: Alluvium derived from arkosic sedimentary rock

Typical profile

H1 - 0 to 12 inches: gravelly sandy loam *H2 - 12 to 60 inches:* gravelly sandy loam

Properties and qualities

Slope: 3 to 15 percent Depth to restrictive feature: More than 80 inches Drainage class: Well drained Runoff class: Low

Custom Soil Resource Report

Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 6.00 in/hr) Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None

Available water supply, 0 to 60 inches: Low (about 5.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified Land capability classification (nonirrigated): 6e Hydrologic Soil Group: A Ecological site: R048AY222CO - Loamy Park Hydric soil rating: No

Description of Crowfoot, Eroded

Setting

Landform: Plateaus, mesas Down-slope shape: Linear Across-slope shape: Linear Parent material: Residuum weathered from arkosic sedimentary rock

Typical profile

H1 - 0 to 6 inches: sandy loam
H2 - 6 to 19 inches: loamy sand
H3 - 19 to 32 inches: gravelly sandy clay loam
H4 - 32 to 43 inches: gravelly sandy loam
H5 - 43 to 60 inches: coarse sand

Properties and qualities

Slope: 3 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 5.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified Land capability classification (nonirrigated): 6e Hydrologic Soil Group: B Ecological site: R049XY216CO - Sandy Divide Hydric soil rating: No

Minor Components

Kippen

Percent of map unit: 8 percent Hydric soil rating: No

Truckton

Percent of map unit: 7 percent Hydric soil rating: No Custom Soil Resource Report

El Paso County Area, Colorado

1—Alamosa loam, 1 to 3 percent slopes

Map Unit Setting

National map unit symbol: 3670 Elevation: 7,200 to 7,700 feet Farmland classification: Prime farmland if irrigated and reclaimed of excess salts and sodium

Map Unit Composition

Alamosa and similar soils: 85 percent Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Alamosa

Setting

Landform: Fans, flood plains Down-slope shape: Linear Across-slope shape: Linear Parent material: Alluvium

Typical profile

A - 0 to 6 inches: loam Bt - 6 to 14 inches: clay loam Btk - 14 to 33 inches: clay loam Cg1 - 33 to 53 inches: sandy clay loam Cg2 - 53 to 60 inches: sandy loam

Properties and qualities

Slope: 1 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: About 12 to 18 inches
Frequency of flooding: None
Calcium carbonate, maximum content: 5 percent
Maximum salinity: Very slightly saline to strongly saline (2.0 to 16.0 mmhos/cm)
Available water supply, 0 to 60 inches: High (about 10.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified Land capability classification (nonirrigated): 5w Hydrologic Soil Group: D Ecological site: R048AY241CO - Mountain Meadow Hydric soil rating: Yes

Minor Components

Other soils

Percent of map unit: Hydric soil rating: No

41—Kettle gravelly loamy sand, 8 to 40 percent slopes

Map Unit Setting

National map unit symbol: 368h Elevation: 7,000 to 7,700 feet Farmland classification: Not prime farmland

Map Unit Composition

Kettle and similar soils: 85 percent *Estimates are based on observations, descriptions, and transects of the mapunit.*

Description of Kettle

Setting

Landform: Hills Landform position (three-dimensional): Side slope Down-slope shape: Linear Across-slope shape: Linear Parent material: Sandy alluvium derived from arkose

Typical profile

E - 0 to 16 inches: gravelly loamy sand *Bt - 16 to 40 inches:* gravelly sandy loam *C - 40 to 60 inches:* extremely gravelly loamy sand

Properties and qualities

Slope: 8 to 40 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 3.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified Land capability classification (nonirrigated): 7e Hydrologic Soil Group: B Ecological site: F048AY908CO - Mixed Conifer Hydric soil rating: No

Minor Components

Other soils

Percent of map unit: Hydric soil rating: No

Pleasant

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

42—Kettle-Rock outcrop complex

Map Unit Setting

National map unit symbol: 368j Elevation: 6,800 to 7,700 feet Frost-free period: 110 to 130 days Farmland classification: Not prime farmland

Map Unit Composition

Kettle and similar soils: 60 percent *Rock outcrop:* 20 percent *Estimates are based on observations, descriptions, and transects of the mapunit.*

Description of Kettle

Setting

Landform: Hills Landform position (three-dimensional): Side slope Down-slope shape: Linear Across-slope shape: Linear Parent material: Sandy alluvium derived from arkose

Typical profile

E - 0 to 16 inches: gravelly loamy sand *Bt - 16 to 40 inches:* gravelly sandy loam *C - 40 to 60 inches:* extremely gravelly loamy sand

Properties and qualities

Slope: 8 to 40 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 3.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified Land capability classification (nonirrigated): 7e Hydrologic Soil Group: B Ecological site: F048AY908CO - Mixed Conifer Hydric soil rating: No

Description of Rock Outcrop

Typical profile

R - 0 to 60 inches: unweathered bedrock

Properties and qualities

Slope: 8 to 60 percent Depth to restrictive feature: 0 inches to lithic bedrock Available water supply, 0 to 60 inches: Very low (about 0.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified Land capability classification (nonirrigated): 8s Hydrologic Soil Group: D Hydric soil rating: No

Minor Components

Other soils

Percent of map unit: Hydric soil rating: No

69—Peyton-Pring complex, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 369g Elevation: 6,800 to 7,600 feet Farmland classification: Not prime farmland

Map Unit Composition

Peyton and similar soils: 40 percent *Pring and similar soils:* 30 percent *Estimates are based on observations, descriptions, and transects of the mapunit.*

Description of Peyton

Setting

Landform: Hills Landform position (three-dimensional): Side slope Down-slope shape: Linear Across-slope shape: Linear Parent material: Arkosic alluvium derived from sedimentary rock and/or arkosic residuum weathered from sedimentary rock

Typical profile

A - 0 to 12 inches: sandy loam Bt - 12 to 25 inches: sandy clay loam BC - 25 to 35 inches: sandy clay loam C - 35 to 60 inches: sandy loam

Properties and qualities

Slope: 8 to 9 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 7.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified Land capability classification (nonirrigated): 4e Hydrologic Soil Group: B Ecological site: R049XY216CO - Sandy Divide Hydric soil rating: No

Description of Pring

Setting

Landform: Hills Landform position (three-dimensional): Side slope Down-slope shape: Linear Across-slope shape: Linear Parent material: Arkosic alluvium derived from sedimentary rock

Typical profile

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

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 6.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified Land capability classification (nonirrigated): 6e Hydrologic Soil Group: B Ecological site: R048AY222CO - Loamy Park Hydric soil rating: No

Minor Components

Other soils

Percent of map unit: Hydric soil rating: No

Pleasant

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

92—Tomah-Crowfoot loamy sands, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 36b9 Elevation: 7,300 to 7,600 feet Farmland classification: Not prime farmland

Map Unit Composition

Tomah and similar soils: 50 percent *Crowfoot and similar soils:* 30 percent *Estimates are based on observations, descriptions, and transects of the mapunit.*

Description of Tomah

Setting

Landform: Alluvial fans, hills Landform position (three-dimensional): Side slope, crest Down-slope shape: Linear Across-slope shape: Linear Parent material: Alluvium derived from arkose and/or residuum weathered from arkose

Typical profile

A - 0 to 10 inches: loamy sand

E - 10 to 22 inches: coarse sand

- Bt 22 to 48 inches: stratified coarse sand to sandy clay loam
- C 48 to 60 inches: coarse sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified Land capability classification (nonirrigated): 4e Hydrologic Soil Group: B *Ecological site:* R049XY216CO - Sandy Divide *Hydric soil rating:* No

Description of Crowfoot

Setting

Landform: Hills, alluvial fans Landform position (three-dimensional): Side slope, crest Down-slope shape: Linear Across-slope shape: Linear Parent material: Alluvium

Typical profile

A - 0 to 12 inches: loamy sand

E - 12 to 23 inches: sand

Bt - 23 to 36 inches: sandy clay loam

C - 36 to 60 inches: coarse sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified Land capability classification (nonirrigated): 4e Hydrologic Soil Group: B Ecological site: R049XY216CO - Sandy Divide Hydric soil rating: No

Minor Components

Other soils

Percent of map unit: Hydric soil rating: No

Pleasant

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

National Flood Hazard Layer FIRMette



Legend

104°51'58"W 39°7'50"N SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT Without Base Flood Elevation (BFE) Zone A. V. A9 With BFE or Depth Zone AE, AO, AH, VE, AR SPECIAL FLOOD HAZARD AREAS **Regulatory Floodway** 08035C0463F 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average 9/30/2005 depth less than one foot or with drainage Not Printed areas of less than one square mile Zone X Future Conditions 1% Annual Chance Flood Hazard Zone X Area with Reduced Flood Risk due to Levee. See Notes. Zone X OTHER AREAS OF FLOOD HAZARD Area with Flood Risk due to Levee Zone D NO SCREEN Area of Minimal Flood Hazard Zone X Effective LOMRs OTHER AREAS Area of Undetermined Flood Hazard Zone D - - - - Channel, Culvert, or Storm Sewer GENERAL STRUCTURES LIIII Levee, Dike, or Floodwall 20.2 Cross Sections with 1% Annual Chance 17.5 Water Surface Elevation **Coastal Transect** 0804100065G Base Flood Elevation Line (BFE) Limit of Study AREAOFMeff 12/7/2018 DHAZARD Jurisdiction Boundary **Coastal Transect Baseline** OTHER **Profile Baseline** HLPASO COUNTRY T115 R67W S002 FEATURES Hydrographic Feature 080059 **Digital Data Available** No Digital Data Available MAP PANELS Unmapped The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location. This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 1/18/2023 at 3:52 AM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time. 08041C0276G eff. 12/7/2018 This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for 104°51'21"W 39°7'23"N Feet 1:6.000 unmapped and unmodernized areas cannot be used for regulatory purposes. 250 500 1,000 1,500 2.000 n

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

National Flood Hazard Layer FIRMette



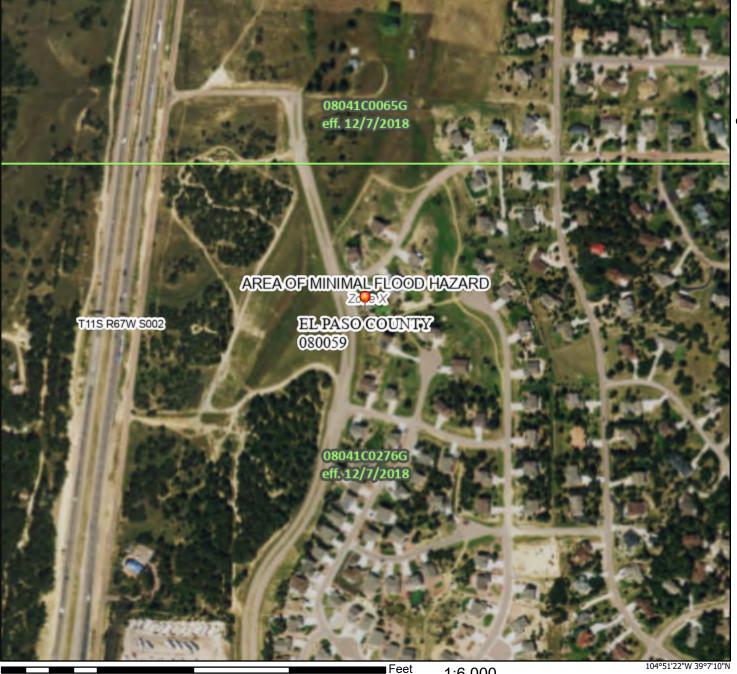
Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT Without Base Flood Elevation (BFE) Zone A. V. A9 With BFE or Depth Zone AE, AO, AH, VE, AR SPECIAL FLOOD HAZARD AREAS **Regulatory Floodway** 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X Future Conditions 1% Annual Chance Flood Hazard Zone X Area with Reduced Flood Risk due to Levee. See Notes. Zone X OTHER AREAS OF FLOOD HAZARD Area with Flood Risk due to Levee Zone D NO SCREEN Area of Minimal Flood Hazard Zone X Effective LOMRs OTHER AREAS Area of Undetermined Flood Hazard Zone D - — – – Channel, Culvert, or Storm Sewer GENERAL STRUCTURES LIIII Levee, Dike, or Floodwall 20.2 Cross Sections with 1% Annual Chance 17.5 Water Surface Elevation **Coastal Transect** Base Flood Elevation Line (BFE) Limit of Study Jurisdiction Boundary **Coastal Transect Baseline** OTHER **Profile Baseline** FEATURES Hydrographic Feature **Digital Data Available** No Digital Data Available MAP PANELS Unmapped The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 1/18/2023 at 3:50 AM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.



250 n

500

104°51'59"W 39°7'38"N

1,000

1,500

1:6,000

2.000

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



Appendix B Calculations

if this report is an MDDP add this to

MONUMENT RIDGE EAST MASTER DEVELOPMENT DRAINAGE PLAN

the report title

seems high

(Percent Impervious)

| Basin | | | | | | | Area (acres) | | | % Imp |
|-------|----------------------|------------------|------|-------|---------|---------|--------------|---------|-------|-------|
| Basin | Streets/Drives/Walks | Streets - Gravel | Roof | Lawn | Res 1/8 | Res 1/4 | Res 1/3 | Res 1/2 | TOTAL | % imp |
| E1 | | 1.86 | | 30.03 | | | | | 31.89 | 4.67 |
| E2 | | 0.84 | | | | | | 0.52 | 1.36 | 58.97 |
| E3 | 10.77 | | | | | 2.45 | 4.47 | 42.47 | 60.16 | 39.41 |
| E4 | 3.81 | | | | | | 12.98 | 48.78 | 65.57 | 30.35 |
| E5 | 2.18 | | | | | | | 15.29 | 17.47 | 34.36 |
| E6 | 0.55 | | | | | | 0.83 | | 1.38 | 57.90 |
| E7 | 0.81 | | | 34.79 | | | | 5.88 | 41.48 | 5.50 |
| E8 | 1.59 | 2.74 | 0.99 | 55.15 | | | | | 60.47 | 7.73 |
| E9 | 1.72 | | | 1.2 | | | | | 2.92 | 58.90 |
| E10 | 1.42 | 0.4 | | 11.34 | | | | | 13.16 | 13.22 |
| E11 | 1.91 | | | 3.34 | | | | | 5.25 | 36.38 |
| A1 | 2.14 | | 1.55 | 1.06 | | | | | 4.75 | 74.42 |
| A2 | 0.78 | | 0.88 | 0.75 | | | | | 2.41 | 65.23 |
| A3 | 0.04 | | 0.09 | 1.28 | | | | | 1.41 | 8.58 |
| A4 | 2.49 | | 0.82 | 1.34 | | | | | 4.65 | 69.42 |
| A5 | 0.67 | | | 0.5 | | | | | 1.17 | 57.26 |
| B1 | 1.54 | | 1.04 | 1.49 | | | | | 4.07 | 60.84 |
| B2 | 1.12 | | 1.04 | 0.96 | | | | | 3.12 | 65.90 |
| B3 | 0.68 | | 0.73 | 0.47 | | | | | 1.88 | 71.12 |
| B4 | 0.87 | | | 0.37 | | | | | 1.24 | 70.16 |
| B5 | 0.27 | | 0.21 | 0.59 | | | | | 1.07 | 42.90 |
| B6 | 0.82 | | 0.58 | 0.94 | | | | | 2.34 | 57.35 |
| B7 | 0.61 | | 0.26 | 1.42 | | | | | 2.29 | 36.86 |
| B8 | 1.76 | | | 1.61 | | | | | 3.37 | 52.23 |
| B9 | 0.71 | | | 0.39 | | | | | 1.10 | 64.55 |
| C1 | 1.03 | | 0.88 | 1.05 | | 1 | | | 2.96 | 61.55 |

| treets/Drives/Walks treets - Gravel | 100 80 | | | | | | | Pond 5 (Basin E) | 3.21 | 48.40 |
|--|--------------|------|------|--------------|-----------------|----------------|------------------|-------------------|--------------|---------------|
| and Use | % Impervious | | | | Com | posite Develop | oed - Pond 4 (Ba | asins D1 thru D5) | 22.15 | 41.62 |
| | | | | | Com | posite Develop | oed - Pond 3 (Ba | asins C1 thru C3) | 5.78 | 63.17 |
| | | | | | Com | posite Develop | oed - Pond 2 (Ba | asins B1 thru B9) | 20.48 | 57.88 |
| | | | | Co | omposite Devel | oped - Pond 1 | (Basins A1 thru | u A5, O1 thru O4) | 24.52 | 45.60 |
| | | | | Compo | site Existing - | Misty Acres Fi | I No. 1 Pond (Ba | asins E1 thru E3) | 93.41 | 27.83 |
| 013 | 1.91 | | | 3.34 | | | | | 5.25 | 36.38 |
| 012 | 0.74 | | | 3.94 | | | | | 4.68 | 15.81 |
| 011 | 2.08 | | | 0.93 | | | | | 3.01 | 69.10 |
| 010 | 1.59 | 2.74 | 0.99 | 55.15 | | | | | 60.47 | 7.73 |
| 09 | 2.28 | | | 3.62 | | | | | 5.90 | 38.64 |
| 08 | 0.55 | | | | | | 0.83 | | 1.38 | 57.90 |
| 07b | 2.18 | | | | | | 12.00 | 15.29 | 17.47 | 34.36 |
| 07a | 3.81 | | | 0.00 | | | 12.98 | 48.78 | 65.57 | 30.35 |
| 06 | 10.77 | | | 0.63 | | 2.40 | 7.77 | 72.77 | 0.63 | 0.00 |
| 05 | 10.77 | | | 0.23 | | 2.45 | 4.47 | 42.47 | 60.16 | 39.41 |
| 03 | 0.51 | 0.04 | | 0.23 | | | | 0.52 | 0.74 | 68.92 |
| 02 | 0.30 | 0.84 | | 0.15 | | | | 0.52 | 1.36 | 58.97 |
| 01 02 | 0.36 | 0.48 | | 7.04 0.15 | | | | | 7.52 0.51 | 5.11 70.59 |
| E | 0.58 | 0.49 | | 7.04 | 0.63 | | 1.28 | 0.72 | 3.21 | 48.40 |
| D5 | 0.19 | | | 1.39 | 0.00 | | 4.00 | 0.70 | 1.58 | 12.03 |
| D4 | 0.21 | | | 0.13 | | | | | 0.34 | 61.76 |
| D3 | 0.23 | | | 0.41 | | | | | 0.64 | 35.94 |
| D2 | 1.51 | | | 0 | 2.80 | | 6.25 | 1.60 | 12.16 | 46.09 |
| D1 | 2.84 | | 0.16 | 4.43 | | | | | 7.43 | 40.16 |
| C3 | 0.17 | | | 0.28 | | | | | 0.45 | 37.78 |
| C2 | 1.02 | | 0.71 | 0.64 | | | | | 2.37 | 70.00 |

Roof Lawn

90 0

| \sim | \sim | |
|---------------------|--------|-----------------------|
| Res 1/8ac or less | 65 🖌 | |
| Res 1/4ac or less | 40 🗸 | Please see if you can |
| Res 1/3ac or less | 30 | include this |
| Res 1/2ac or less | | information on the |
| Thes fizzac of less | 25 | previous page |
| uuuu | | |

MONUMENT RIDGE EAST MASTER DEVELOPMENT DRAINAGE PLAN

(Composite Runoff Coefficients)

| Basin | Basin Area | Land Use | Sub-B | asin (5yr) | Composite | Sub-B | asin (10yr) | Composite | Sub-Ba | nsin (100yr) | Composite |
|-------|------------|---------------------|-------|--------------|-----------|-----------------|--------------|------------------------|-------------------------|--------------|-----------|
| Basin | (acres) | Land Ose | C 5 | Area (acres) | C₅ | C ₁₀ | Area (acres) | C ₁₀ | C ₁₀₀ | Area (acres) | C 100 |
| E1 | 31.89 | Streets - Gravel | 0.59 | 1.86 | 0.11 | 0.63 | 1.86 | 0.18 | 0.70 | 1.86 | 0.37 |
| | | Lawn | 0.08 | 30.03 | | 0.15 | 30.03 | | 0.35 | 30.03 | |
| E2 | 1.37 | Streets - Gravel | 0.59 | 0.84 | 0.45 | 0.63 | 0.84 | 0.50 | 0.70 | 0.84 | 0.61 |
| E2 | | 1/2 Ac | 0.22 | 0.52 | | 0.30 | 0.52 | | 0.46 | 0.52 | |
| | 60.15 | Streets/Drive/Walks | 0.90 | 10.77 | 0.35 | 0.92 | 10.77 | 0.41 | 0.96 | 10.77 | 0.55 |
| E3 | | 1/4 Ac | 0.30 | 2.45 | | 0.36 | 2.45 | | 0.50 | 2.45 | |
| ⊑3 | | 1/3 Ac | 0.25 | 4.47 | | 0.32 | 4.47 | | 0.47 | 4.47 | |
| | | 1/2 Ac | 0.22 | 42.47 | | 0.30 | 42.47 | | 0.46 | 42.47 | |
| | 65.56 | Streets/Drive/Walks | 0.90 | 3.81 | 0.27 | 0.92 | 3.81 | 0.34 | 0.96 | 3.81 | 0.49 |
| E4 | | 1/3 Ac | 0.25 | 12.98 | | 0.32 | 12.98 | | 0.47 | 12.98 | |
| | | 1/2 Ac | 0.22 | 48.78 | | 0.30 | 48.78 | | 0.46 | 48.78 | |
| E5 | 17.47 | Streets/Drive/Walks | 0.90 | 2.18 | 0.30 | 0.92 | 2.18 | 0.38 | 0.96 | 2.18 | 0.52 |
| ED | | 1/2 Ac | 0.22 | 15.29 | | 0.30 | 15.29 | | 0.46 | 15.29 | |
| E6 | 1.38 | Streets/Drive/Walks | 0.90 | 0.55 | 0.51 | 0.92 | 0.55 | 0.56 | 0.96 | 0.55 | 0.67 |
| EO | | 1/3 Ac | 0.25 | 0.83 | | 0.32 | 0.83 | | 0.47 | 0.83 | |
| | 41.48 | Streets/Drive/Walks | 0.90 | 0.81 | 0.15 | 0.92 | 0.81 | 0.23 | 0.96 | 0.81 | 0.45 |
| E7 | | 1/2 Ac | 0.25 | 5.88 | | 0.33 | 5.88 | | 0.52 | 5.88 | |
| | | Lawn | 0.12 | 34.79 | | 0.20 | 34.79 | | 0.43 | 34.79 | |
| | 60.46 | Streets/Drive/Walks | 0.90 | 1.59 | 0.14 | 0.92 | 1.59 | 0.20 | 0.96 | 1.59 | 0.39 |
| E8 | | Streets - Gravel | 0.59 | 2.74 | | 0.63 | 2.74 | | 0.70 | 2.74 | |
| Eo | | Roof | 0.73 | 0.99 | | 0.75 | 0.99 | | 0.81 | 0.99 | |
| | | Lawn | 0.08 | 55.15 | | 0.15 | 55.15 | | 0.35 | 55.15 | |

| Desta | Basin Area | | Sub-B | asin (5yr) | Composite | Sub-E | asin (10yr) | Composite | Sub-B | asin (100yr) | Composite |
|-------|------------|---------------------|-------|--------------|----------------|-------|--------------|-----------------|--------------|--------------|--------------|
| Basin | (acres) | Land Use | C 5 | Area (acres) | C ₅ | C 10 | Area (acres) | C ₁₀ | C 100 | Area (acres) | C 100 |
| E9 | 2.92 | Streets - Paved | 0.90 | 1.72 | 0.56 | 0.92 | 1.72 | 0.60 | 0.96 | 1.72 | 0.71 |
| E9 | | Lawn | 0.08 | 1.20 | | 0.15 | 1.20 | | 0.35 | 1.20 | |
| | 13.16 | Streets - Paved | 0.90 | 1.42 | 0.22 | 0.92 | 1.42 | 0.29 | 0.96 | 1.42 | 0.50 |
| E10 | | Streets - Gravel | 0.61 | 0.40 | | 0.65 | 0.40 | [| 0.72 | 0.40 | |
| | | Lawn | 0.12 | 11.34 | | 0.20 | 11.34 | | 0.43 | 11.34 | |
| E11 | 5.24 | Streets - Paved | 0.90 | 1.91 | 0.40 | 0.92 | 1.91 | 0.46 | 0.96 | 1.91 | 0.62 |
| | | Lawn | 0.12 | 3.34 | | 0.20 | 3.34 | | 0.43 | 3.34 | |
| | 4.75 | Streets/Drive/Walks | 0.90 | 2.14 | 0.66 | 0.92 | 2.14 | 0.69 | 0.96 | 2.14 | 0.77 |
| A1 | | Roof | 0.73 | 1.55 | | 0.75 | 1.55 | | 0.81 | 1.55 | |
| | | Lawn | 0.08 | 1.06 | | 0.15 | 1.06 | | 0.35 | 1.06 | |
| | 2.41 | Streets/Drive/Walks | 0.90 | 0.78 | 0.58 | 0.92 | 0.78 | 0.62 | 0.96 | 0.78 | 0.72 |
| A2 | | Roof | 0.73 | 0.88 | | 0.75 | 0.88 | [| 0.81 | 0.88 | |
| | | Lawn | 0.08 | 0.75 | | 0.15 | 0.75 | | 0.35 | 0.75 | |
| | 1.41 | Streets/Drive/Walks | 0.90 | 0.04 | 0.14 | 0.92 | 0.04 | 0.21 | 0.96 | 0.04 | 0.40 |
| A3 | | Roof | 0.73 | 0.09 | | 0.75 | 0.09 | [| 0.81 | 0.09 | |
| | | Lawn | 0.08 | 1.28 | | 0.15 | 1.28 | [| 0.35 | 1.28 | |
| | 4.65 | Streets/Drive/Walks | 0.90 | 2.49 | 0.63 | 0.92 | 2.49 | 0.67 | 0.96 | 2.49 | 0.76 |
| A4 | | Roof | 0.73 | 0.82 | | 0.75 | 0.82 | | 0.81 | 0.82 | |
| | | Lawn | 0.08 | 1.34 | | 0.15 | 1.34 | | 0.35 | 1.34 | |
| A5 | 1.17 | Streets/Drive/Walks | 0.90 | 0.67 | 0.55 | 0.92 | 0.67 | 0.59 | 0.96 | 0.67 | 0.70 |
| AJ | | Lawn | 0.08 | 0.50 | | 0.15 | 0.50 | [| 0.35 | 0.50 | |

| Destin | Basin Area | | Sub-B | asin (5yr) | Composite | Sub-B | asin (10yr) | Composite | Sub-Ba | asin (100yr) | Composite |
|--------|------------|---------------------|----------------|--------------|-----------|-------|--------------|------------------------|--------------|--------------|--------------|
| Basin | (acres) | Land Use | C ₅ | Area (acres) | C₅ | C 10 | Area (acres) | C ₁₀ | C 100 | Area (acres) | C 100 |
| | 4.07 | Streets/Drive/Walks | 0.90 | 1.54 | 0.56 | 0.92 | 1.54 | 0.59 | 0.96 | 1.54 | 0.70 |
| B1 | | Roof | 0.73 | 1.04 | | 0.75 | 1.04 | | 0.81 | 1.04 | |
| | | Lawn | 0.08 | 1.49 | | 0.15 | 1.49 | | 0.35 | 1.49 | |
| | 3.12 | Streets/Drive/Walks | 0.90 | 1.12 | 0.59 | 0.92 | 1.12 | 0.63 | 0.96 | 1.12 | 0.72 |
| B2 | | Roof | 0.73 | 1.04 | | 0.75 | 1.04 | | 0.81 | 1.04 | |
| | | Lawn | 0.08 | 0.96 | | 0.15 | 0.96 | | 0.35 | 0.96 | |
| | 1.88 | Streets/Drive/Walks | 0.90 | 0.68 | 0.63 | 0.92 | 0.68 | 0.66 | 0.96 | 0.68 | 0.75 |
| B3 | | Roof | 0.73 | 0.73 | | 0.75 | 0.73 | | 0.81 | 0.73 | |
| | | Lawn | 0.08 | 0.47 | | 0.15 | 0.47 | | 0.35 | 0.47 | |
| B4 | 1.24 | Streets/Drive/Walks | 0.90 | 0.87 | 0.66 | 0.92 | 0.87 | 0.69 | 0.96 | 0.87 | 0.78 |
| D4 | | Lawn | 0.08 | 0.37 | | 0.15 | 0.37 | | 0.35 | 0.37 | |
| | 1.07 | Streets/Drive/Walks | 0.90 | 0.27 | 0.41 | 0.92 | 0.27 | 0.46 | 0.96 | 0.27 | 0.59 |
| B5 | | Roof | 0.73 | 0.21 | | 0.75 | 0.21 | | 0.81 | 0.21 | |
| | | Lawn | 0.08 | 0.59 | | 0.15 | 0.59 | | 0.35 | 0.59 | |
| | 2.34 | Streets/Drive/Walks | 0.90 | 0.82 | 0.53 | 0.92 | 0.82 | 0.57 | 0.96 | 0.82 | 0.68 |
| B6 | | Roof | 0.73 | 0.58 | | 0.75 | 0.58 | | 0.81 | 0.58 | |
| | | Lawn | 0.08 | 0.94 | | 0.15 | 0.94 | | 0.35 | 0.94 | |
| | 2.29 | Streets/Drive/Walks | 0.90 | 0.61 | 0.37 | 0.92 | 0.61 | 0.42 | 0.96 | 0.61 | 0.56 |
| B7 | | Roof | 0.73 | 0.26 | | 0.75 | 0.26 | | 0.81 | 0.26 | |
| | | Lawn | 0.08 | 1.42 | | 0.15 | 1.42 | | 0.35 | 1.42 | |

| Desin | Basin Area | Landling | Sub-B | asin (5yr) | Composite | Sub-B | asin (10yr) | Composite | Sub-Ba | asin (100yr) | Composite |
|-------|------------|---------------------|-------|--------------|-----------|-------|--------------|-------------|--------------|--------------|--------------|
| Basin | (acres) | Land Use | C 5 | Area (acres) | C 5 | C 10 | Area (acres) | C 10 | C 100 | Area (acres) | C 100 |
| B8 | 3.37 | Streets/Drive/Walks | 0.90 | 1.76 | 0.51 | 0.92 | 1.76 | 0.55 | 0.96 | 1.76 | 0.67 |
| Бо | | Lawn | 0.08 | 1.61 | | 0.15 | 1.61 | | 0.35 | 1.61 | |
| В9 | 1.10 | Pond | 0.90 | 0.71 | 0.63 | 0.92 | 0.71 | 0.68 | 0.96 | 0.71 | 0.80 |
| Da | | Lawn | 0.15 | 0.39 | | 0.25 | 0.39 | | 0.50 | 0.39 | |
| | 2.96 | Streets/Drive/Walks | 0.90 | 1.03 | 0.59 | 0.92 | 1.03 | 0.64 | 0.96 | 1.03 | 0.76 |
| C1 | | Roof | 0.75 | 0.88 | | 0.77 | 0.88 | | 0.83 | 0.88 | |
| | | Lawn | 0.15 | 1.05 | | 0.25 | 1.05 | | 0.50 | 1.05 | |
| | 2.37 | Streets/Drive/Walks | 0.90 | 1.02 | 0.65 | 0.92 | 1.02 | 0.69 | 0.96 | 1.02 | 0.80 |
| C2 | | Roof | 0.75 | 0.71 | | 0.77 | 0.71 | | 0.83 | 0.71 | |
| | | Lawn | 0.15 | 0.64 | | 0.25 | 0.64 | | 0.50 | 0.64 | |
| C3 | 0.45 | Pond | 0.90 | 0.17 | 0.39 | 0.92 | 0.17 | 0.44 | 0.96 | 0.17 | 0.58 |
| 03 | | Lawn | 0.08 | 0.28 | | 0.15 | 0.28 | | 0.35 | 0.28 | |
| D1 | 7.45 | Streets/Drive/Walks | 0.90 | 2.84 | 0.43 | 0.92 | 2.84 | 0.49 | 0.96 | 2.84 | 0.64 |
| DI | | Roof | 0.74 | 0.18 | | 0.76 | 0.18 | | 0.82 | 0.18 | |
| | | Lawn | 0.12 | 4.43 | | 0.20 | 4.43 | | 0.43 | 4.43 | |
| | 12.16 | Streets/Drive/Walks | 0.90 | 1.51 | 0.40 | 0.92 | 1.51 | 0.46 | 0.96 | 1.51 | 0.61 |
| D2 | | 1/8 Ac or Less | 0.48 | 2.80 | | 0.52 | 2.80 | | 0.63 | 2.80 | |
| D2 | | 1/3 Ac | 0.28 | 6.25 | | 0.35 | 6.25 | | 0.53 | 6.25 | |
| | | 1/2 Ac | 0.25 | 1.60 | | 0.33 | 1.60 | | 0.52 | 1.60 | |
| D3 | 0.64 | Streets/Drive/Walks | 0.90 | 0.23 | 0.37 | 0.92 | 0.23 | 0.43 | 0.96 | 0.23 | 0.57 |
| D3 | | Lawn | 0.08 | 0.41 | | 0.15 | 0.41 | | 0.35 | 0.41 | |
| D4 | 0.34 | Streets/Drive/Walks | 0.90 | 0.21 | 0.59 | 0.92 | 0.21 | 0.63 | 0.96 | 0.21 | 0.73 |
| U4 | | Lawn | 0.08 | 0.13 | | 0.15 | 0.13 | | 0.35 | 0.13 | |
| D5 | 1.58 | Pond | 0.90 | 0.19 | 0.21 | 0.92 | 0.19 | 0.29 | 0.96 | 0.19 | 0.49 |
| 05 | | Lawn | 0.12 | 1.39 | | 0.20 | 1.39 | | 0.43 | 1.39 | |

| Decim | Basin Area | l and llas | Sub-B | asin (5yr) | Composite | Sub-E | Basin (10yr) | Composite | Sub-Ba | asin (100yr) | Composite |
|-------|------------|---------------------|----------------|--------------|-----------|------------------------|--------------|------------------------|--------------|--------------|--------------|
| Basin | (acres) | Land Use | C ₅ | Area (acres) | C 5 | C ₁₀ | Area (acres) | C ₁₀ | C 100 | Area (acres) | C 100 |
| | 3.21 | Streets/Drive/Walks | 0.90 | 0.58 | 0.42 | 0.92 | 0.58 | 0.48 | 0.96 | 0.58 | 0.63 |
| _ | | 1/8 Ac or Less | 0.48 | 0.63 | | 0.52 | 0.63 | | 0.63 | 0.63 | |
| E | | 1/3 Ac | 0.28 | 1.28 | | 0.35 | 1.28 | | 0.53 | 1.28 | |
| | | 1/2 Ac | 0.25 | 0.72 | | 0.33 | 0.72 | | 0.52 | 0.72 | |
| 01 | 7.52 | Streets - Gravel | 0.59 | 0.48 | 0.11 | 0.63 | 0.48 | 0.18 | 0.70 | 0.48 | 0.37 |
| 01 | | Lawn | 0.08 | 7.04 | | 0.15 | 7.04 | | 0.35 | 7.04 | |
| 00 | 0.51 | Streets/Drive/Walks | 0.90 | 0.36 | 0.66 | 0.92 | 0.36 | 0.69 | 0.96 | 0.36 | 0.78 |
| 02 | | Lawn | 0.08 | 0.15 | | 0.15 | 0.15 | | 0.35 | 0.15 | |
| 00 | 1.37 | Streets - Gravel | 0.59 | 0.84 | 0.45 | 0.63 | 0.84 | 0.50 | 0.70 | 0.84 | 0.61 |
| O3 | | 1/2 Ac | 0.22 | 0.52 | | 0.30 | 0.52 | | 0.46 | 0.52 | |
| 01 | 0.74 | Streets/Drive/Walks | 0.90 | 0.51 | 0.64 | 0.92 | 0.51 | 0.68 | 0.96 | 0.51 | 0.77 |
| O4 | | Lawn | 0.08 | 0.23 | | 0.15 | 0.23 | | 0.35 | 0.23 | |
| | 60.15 | Streets/Drive/Walks | 0.90 | 10.77 | 0.35 | 0.92 | 10.77 | 0.41 | 0.96 | 10.77 | 0.55 |
| O5 | | 1/4 Ac | 0.30 | 2.45 | | 0.36 | 2.45 | | 0.50 | 2.45 | |
| 05 | | 1/3 Ac | 0.25 | 4.47 | | 0.32 | 4.47 | | 0.47 | 4.47 | |
| | | 1/2 Ac | 0.22 | 42.47 | | 0.30 | 42.47 | | 0.46 | 42.47 | |
| O6 | 0.63 | Lawn | 0.15 | 0.63 | 0.15 | 0.25 | 0.63 | 0.25 | 0.50 | 0.63 | 0.50 |
| | 65.56 | Streets/Drive/Walks | 0.90 | 3.81 | 0.27 | 0.92 | 3.81 | 0.34 | 0.96 | 3.81 | 0.49 |
| O7a | | 1/3 Ac | 0.25 | 12.98 | | 0.32 | 12.98 | | 0.47 | 12.98 | |
| | | 1/2 Ac | 0.22 | 48.78 | | 0.30 | 48.78 | | 0.46 | 48.78 | |
| O7b | 18.40 | Streets/Drive/Walks | 0.90 | 2.18 | 0.30 | 0.92 | 2.18 | 0.37 | 0.96 | 2.18 | 0.52 |
| 070 | | 1/2 Ac | 0.22 | 16.22 | | 0.30 | 16.22 | | 0.46 | 16.22 | |
| O8 | 1.38 | Streets/Drive/Walks | 0.90 | 0.55 | 0.51 | 0.92 | 0.55 | 0.56 | 0.96 | 0.55 | 0.67 |
| 08 | | 1/3 Ac | 0.25 | 0.83 | | 0.32 | 0.83 | | 0.47 | 0.83 | |
| 00 | 5.90 | Streets and Pond | 0.90 | 2.28 | 0.42 | 0.92 | 2.28 | 0.48 | 0.96 | 2.28 | 0.63 |
| O9 | | Lawn | 0.12 | 3.62 | | 0.20 | 3.62 | | 0.43 | 3.62 | |

| Destin | Basin Area | Landling | Sub-B | asin (5yr) | Composite | Sub-B | asin (10yr) | Composite | Sub-Ba | nsin (100yr) | Composite |
|--------|------------|---------------------|-------|--------------|----------------|-------|--------------|------------------------|--------------|--------------|-------------------------|
| Basin | (acres) | Land Use | C 5 | Area (acres) | C ₅ | C 10 | Area (acres) | C ₁₀ | C 100 | Area (acres) | C ₁₀₀ |
| | 60.46 | Streets/Drive/Walks | 0.90 | 1.59 | 0.14 | 0.92 | 1.59 | 0.20 | 0.96 | 1.59 | 0.39 |
| O10 | | Streets - Gravel | 0.59 | 2.74 | | 0.63 | 2.74 | | 0.70 | 2.74 | |
| 010 | | Roof | 0.73 | 0.99 | | 0.75 | 0.99 | | 0.81 | 0.99 | |
| | | Lawn | 0.08 | 55.15 | | 0.15 | 55.15 | | 0.35 | 55.15 | |
| 011 | 3.00 | Streets/Drive/Walks | 0.90 | 2.08 | 0.65 | 0.92 | 2.08 | 0.68 | 0.96 | 2.08 | 0.77 |
| 011 | | Lawn | 0.08 | 0.93 | | 0.15 | 0.93 | | 0.35 | 0.93 | |
| 012 | 4.68 | Streets/Drive/Walks | 0.90 | 0.74 | 0.27 | 0.92 | 0.74 | 0.36 | 0.96 | 0.74 | 0.57 |
| 012 | | Lawn | 0.15 | 3.94 | | 0.25 | 3.94 | | 0.50 | 3.94 | |
| 012 | 5.24 | Streets/Drive/Walks | 0.90 | 1.91 | 0.40 | 0.92 | 1.91 | 0.46 | 0.96 | 1.91 | 0.62 |
| 013 | 013 | Lawn | 0.12 | 3.34 | | 0.20 | 3.34 | | 0.43 | 3.34 | |

Notes:

1. Shaded cells indicate composite runoff coefficients with 1/2 HSG B and 1/2 HSG D.

2. All basins split between the two soil groups are 1/2 HSG D or less (i.e. - conservative approach).

MONUMENT RIDGE EAST MASTER DEVELOPMENT DRAINAGE PLAN

(Basin Runoff Calculations)

| | | | | | | Overlar | nd Flow | | | Ch | annel Fl | ow | | Travel Time (T _t) | Inte | nsity | Total | Flows |
|-------|---------------|----------------|------|-------|----------------|---------|---------|-------|--------|---------|----------|-------------------|-------------------------|-------------------------------|---------------|----------------|----------|------------------|
| Basin | Area Total | C ₅ | C 10 | C 100 | C ₅ | Length | Slope | T_c | Length | Slope | Cv | Velocity (fps) | T _t (min) | TOTAL* (min) | ₁₀ | ₁₀₀ | Q 10 | Q ₁₀₀ |
| E1 | (acres) | 0.11 | 0.19 | 0.37 | 0.11 | (ft) | (ft/ft) | (min) | (ft) | (ft/ft) | 1 Г | | | | | (in/hr) 4.9 | (c.f.s.) | (c.f.s.) |
| EI | 31.89 | 0.11 | 0.18 | 0.37 | 0.11 | 300 | 0.076 | 15.9 | 1060 | 0.035 | 15 | 2.8 | 6.3 | 22.2 | 3.4 | 4.9 | 19.4 | 58.2 |
| E2 | 1.37 | 0.45 | 0.50 | 0.61 | 0.45 | 300 | 0.083 | 10.1 | | | | | | 10.1 | 4.8 | 6.9 | 3.3 | 5.7 |
| E3 | 60.15 | 0.35 | 0.41 | 0.55 | 0.35 | 100 | 0.052 | 7.9 | 1370 | 0.065 | 15 | 3.8 | 6.0 | 13.9 | 4.2 | 6.1 | 106.0 | 202.8 |
| E4 | 65.56 | 0.27 | 0.34 | 0.49 | 0.27 | 100 | 0.12 | 6.6 | 1935 | 0.07 | 15 | 4.0 | 8.1 | 14.8 | 4.1 | 6.0 | 92.2 | 191.6 |
| E5 | 17.47 | 0.30 | 0.38 | 0.52 | 0.30 | 100 | 0.102 | 6.7 | 840 | 0.105 | 15 | 4.9 | 2.9 | 9.6 | 4.9 | 7.0 | 32.3 | 64.3 |
| E6 | 1.38 | 0.51 | 0.56 | 0.67 | Л | | | | | | | | | 5.0 | 6.0 | 8.7 | 4.7 | 8.0 |
| E7 | 41.48 | 0.15 | 0.23 | 0.45 | 0.15 | 300 | 0.065 | 16.0 | 1610 | 0.031 | 15 | 2.6 | 10.2 | 26.1 | 3.1 | 4.5 | 30.3 | 84.8 |
| E8 | 60.46 | 0.14 | 0.20 | 0.39 | 0.14 | 300 | 0.077 | 15.4 | 1480 | 0.044 | 15 | 3.1 | 7.8 | 23.2 | 3.3 | 4.8 | 40.8 | 113.2 |
| E9 | 2.92 | 0.56 | 0.60 | 0.71 | Л | | | | | | | | | 5.0 | 6.0 | 8.7 | 10.6 | 18.0 |

| | | | | | | Overlar | nd Flow | | | Ch | annel Fl | ow | | Travel Time (T _t) | Inte | nsity | Total | Flows |
|-------|--------------------------|------|------|-------|----------------|----------------|------------------|-------------------------|----------------|------------------|----------|-------------------|-------------------------|-------------------------------|----------------------------|-----------------------------|-----------------------------|------------------------------|
| Basin | Area Total (acres) | C 5 | C 10 | C 100 | C ₅ | Length (ft) | Slope (ft/ft) | T _c (min) | Length (ft) | Slope (ft/ft) | Cv | Velocity (fps) | T _t (min) | TOTAL* (min) | l ₁₀ (in/hr) | l ₁₀₀ (in/hr) | Q ₁₀ (c.f.s.) | Q ₁₀₀ (c.f.s.) |
| E10 | 13.16 | 0.22 | 0.29 | 0.50 | 0.22 | 230 | 0.078 | 12.2 | 810 | 0.027 | 15 | 2.5 | 5.5 | 17.7 | 3.8 | 5.5 | 14.6 | 35.8 |
| E11 | 5.24 | 0.40 | 0.46 | 0.62 | 0.40 | 100 | 0.04 | 8.0 | 1115 | 0.032 | 15 | 2.7 | 6.9 | 14.9 | 4.1 | 5.9 | 10.0 | 19.4 |
| A1 | 4.75 | 0.66 | 0.69 | 0.77 | | | | | | | | | | 5.0 | 6.0 | 8.7 | 19.8 | 31.9 |
| A2 | 2.41 | 0.58 | 0.62 | 0.72 | | | | | | | | | | 5.0 | 6.0 | 8.7 | 9.0 | 15.0 |
| A3 | 1.41 | 0.14 | 0.21 | 0.40 | 0.14 | 100 | 0.022 | 13.3 | | | | | | 13.3 | 4.3 | 6.2 | 1.3 | 3.5 |
| A4 | 4.65 | 0.63 | 0.67 | 0.76 | | | | | | | | | | 5.0 | 6.0 | 8.7 | 18.7 | 30.6 |
| A5 | 1.17 | 0.55 | 0.59 | 0.70 | | | | | | | | | | 5.0 | 6.0 | 8.7 | 4.2 | 7.1 |
| B1 | 4.07 | 0.56 | 0.59 | 0.70 | | | | | | | | | | 5.0 | 6.0 | 8.7 | 14.6 | 24.7 |
| B2 | 3.12 | 0.59 | 0.63 | 0.72 | | | | | | | | | | 5.0 | 6.0 | 8.7 | 11.8 | 19.6 |
| B3 | 1.88 | 0.63 | 0.66 | 0.75 | | | | | | | | | | 5.0 | 6.0 | 8.7 | 7.5 | 12.2 |
| B4 | 1.24 | 0.66 | 0.69 | 0.78 | | | | | | | | | | 5.0 | 6.0 | 8.7 | 5.2 | 8.4 |

| | | | | | | Overlar | nd Flow | | | Ch | annel Fl | ow | | Travel Time (T _t) | Inte | nsity | Total | Flows |
|-------|--------------------------|------|------|-------|------|----------------|------------------|-------------------------|----------------|------------------|----------|-------------------|-------------------------|-------------------------------|----------------------------|-----------------------------|-----------------------------|------------------------------|
| Basin | Area Total (acres) | C 5 | C 10 | C 100 | C₅ | Length (ft) | Slope (ft/ft) | T _c (min) | Length (ft) | Slope (ft/ft) | Cv | Velocity (fps) | T _t (min) | TOTAL* (min) | l ₁₀ (in/hr) | l ₁₀₀ (in/hr) | Q ₁₀ (c.f.s.) | Q ₁₀₀ (c.f.s.) |
| B5 | 1.07 | 0.41 | 0.46 | 0.59 | 0.41 | 100 | 0.098 | 5.8 | | | | | | 5.8 | 5.8 | 8.3 | 2.8 | 5.3 |
| B6 | 2.34 | 0.53 | 0.57 | 0.68 | 0.53 | 90 | 0.089 | 4.8 | 340 | 0.033 | 20 | 3.6 | 1.6 | 6.3 | 5.6 | 8.1 | 7.5 | 12.8 |
| В7 | 2.29 | 0.37 | 0.42 | 0.56 | 0.37 | 95 | 0.180 | 4.9 | 690 | 0.029 | 20 | 3.4 | 3.4 | 8.3 | 5.1 | 7.4 | 5.0 | 9.6 |
| B8 | 3.37 | 0.51 | 0.55 | 0.67 | 0.51 | 95 | 0.126 | 4.5 | 130 | 0.01 | 20 | 2.0 | 1.1 | 5.6 | 5.8 | 8.4 | 10.9 | 18.9 |
| В9 | 1.10 | 0.63 | 0.68 | 0.80 | | | | | | | | | | 5.0 | 6.0 | 8.7 | 4.5 | 7.6 |
| C1 | 2.96 | 0.59 | 0.64 | 0.76 | | | | | | | | | | 5.0 | 6.0 | 8.7 | 11.4 | 19.5 |
| C2 | 2.37 | 0.65 | 0.69 | 0.80 | | | | | | | | | | 5.0 | 6.0 | 8.7 | 9.9 | 16.4 |
| C3 | 0.45 | 0.39 | 0.44 | 0.58 | | | | | | | | | | 5.0 | 6.0 | 8.7 | 1.2 | 2.3 |
| D1 | 7.45 | 0.43 | 0.49 | 0.64 | 0.43 | 100 | 0.093 | 5.8 | 580 | 0.029 | 20 | 3.4 | 2.8 | 8.6 | 5.1 | 7.3 | 18.5 | 34.9 |

| | | | Overlar | nd Flow | | | Ch | annel Fl | ow | | Travel Time (T_t) | Intensity | | Total Flows | | | | |
|-------|--------------------------|------|---------|---------|------|----------------|------------------|-------------------------|----------------|------------------|-----------------------|-------------------|-------------------------|-----------------|----------------------------|-----------------------------|-----------------------------|------------------------------|
| Basin | Area Total (acres) | C₅ | C 10 | C 100 | C₅ | Length (ft) | Slope (ft/ft) | T _c (min) | Length (ft) | Slope (ft/ft) | Cv | Velocity (fps) | T _t (min) | TOTAL* (min) | l ₁₀ (in/hr) | l ₁₀₀ (in/hr) | Q ₁₀ (c.f.s.) | Q ₁₀₀ (c.f.s.) |
| D2 | 12.16 | 0.40 | 0.46 | 0.61 | 0.40 | 100 | 0.130 | 5.4 | 1050 | 0.0152 | 20 | 2.5 | 7.1 | 12.5 | 4.4 | 6.4 | 24.6 | 46.8 |
| D3 | 0.64 | 0.37 | 0.43 | 0.57 | | | | | | | | | | 5.0 | 6.0 | 8.7 | 1.6 | 3.2 |
| D4 | 0.34 | 0.59 | 0.63 | 0.73 | | | | | | | | | | 5.0 | 6.0 | 8.7 | 1.3 | 2.1 |
| D5 | 1.58 | 0.21 | 0.29 | 0.49 | | | | | | | | | | 5.0 | 6.0 | 8.7 | 2.7 | 6.8 |
| E | 3.21 | 0.42 | 0.48 | 0.63 | | | | | | | | | | 5.0 | 6.0 | 8.7 | 9.3 | 17.4 |
| 01 | 7.52 | 0.11 | 0.18 | 0.37 | 0.11 | 130 | 0.080 | 10.2 | 480 | 0.054 | 10 | 2.3 | 3.4 | 13.7 | 4.3 | 6.1 | 5.8 | 17.2 |
| 02 | 0.51 | 0.66 | 0.69 | 0.78 | | | | | | | | | | 5.0 | 6.0 | 8.7 | 2.1 | 3.5 |
| 03 | 1.37 | 0.45 | 0.50 | 0.61 | 0.45 | 300 | 0.083 | 10.1 | | | | | | 10.1 | 4.8 | 6.9 | 3.3 | 5.7 |
| 04 | 0.74 | 0.64 | 0.68 | 0.77 | | | | | | | | | | 5.0 | 6.0 | 8.7 | 3.0 | 4.9 |
| 05 | 60.15 | 0.35 | 0.41 | 0.55 | 0.35 | 100 | 0.052 | 7.9 | 1370 | 0.065 | 15 | 3.8 | 6.0 | 13.9 | 4.2 | 6.1 | 106.0 | 202.8 |

| | | | | | | Overlan | nd Flow | | Channel Flow | | | | | Travel Time (T _t) | Intensity | | Total Flows | |
|------------|--------------------------|----------------|-----------|---------|------|----------------|------------------|-------------------------|----------------|------------------|----|-------------------|-------------------------|-------------------------------|---------------|-----------------------------|-----------------------------|-------------------|
| Basin | Area Total (acres) | C ₅ | C 10 | C 100 | C 5 | Length (ft) | Slope (ft/ft) | T _c (min) | Length (ft) | Slope (ft/ft) | Cv | Velocity (fps) | T _t (min) | TOTAL* (min) | ₁₀ | l ₁₀₀ (in/hr) | Q ₁₀ (c.f.s.) | Q 100 (c.f.s.) |
| 06 | 0.63 | 0.15 | 0.25 | 0.50 | | ŰIJ | ()ייןי | (11111) | 09 | ()יי)יי | | (jps) | (11111) | | | (<i>m/m)</i> 8.7 | | |
| 06 | 0.63 | 0.15 | 0.25 | 0.50 | | | | | | | | | | 5.0 | 6.0 | 8.7 | 1.0 | 2.7 |
| O7a | 65.56 | 0.27 | 0.34 | 0.49 | 0.27 | 100 | 0.120 | 6.6 | 1935 | 0.070 | 15 | 4.0 | 8.1 | 14.8 | 4.1 | 6.0 | 92.2 | 191.6 |
| O7b | 18.40 | 0.30 | 0.37 | 0.52 | 0.30 | 100 | 0.102 | 6.7 | 840 | 0.105 | 15 | 4.9 | 2.9 | 9.6 | 4.9 | 7.0 | 33.6 | 67.2 |
| 08 | 1.38 | 0.51 | 0.56 | 0.67 | | | | | | | | | | 5.0 | 6.0 | 8.7 | 4.7 | 8.0 |
| 09 | 5.90 | 0.42 | 0.48 | 0.63 | 0.42 | 245 | 0.049 | 11.4 | 330 | 0.036 | 15 | 2.8 | 1.9 | 13.3 | 4.3 | 6.2 | 12.2 | 23.3 |
| 010 | 60.46 | 0.14 | 0.20 | 0.39 | 0.14 | 300 | 0.077 | 15.4 | 1480 | 0.044 | 15 | 3.1 | 7.8 | 23.2 | 3.3 | 4.8 | 40.8 | 113.2 |
| 011 | 3.00 | 0.65 | 0.68 | 0.77 | | | | | | | | | | 5.0 | 6.0 | 8.7 | 12.4 | 20.1 |
| 012 | 4.68 | 0.27 | 0.36 | 0.57 | 0.27 | 180 | 0.044 | 12.4 | 200 | 0.056 | 15 | 3.5 | 0.9 | 13.3 | 4.3 | 6.2 | 7.2 | 16.7 |
| 013 | 5.24 | 0.40 | 0.46 | 0.62 | 0.40 | 100 | 0.040 | 8.0 | 1115 | 0.032 | 15 | 2.7 | 6.9 | 14.9 | 4.1 | 5.9 | 10.0 | 19.4 |
| 5 MINUTE T | IME OF CO | NCENTR | ATION - N | IINIMUM | | | | | | | | | | | | | | l |

MONUMENT RIDGE EAST MASTER DEVELOPMENT DRAINAGE PLAN (Surface Routing Summary)

| | | | | | Intensity | | Fl | ow | | |
|-----------------|---|--------------------------------|---------------------------------|--------------------------|-----------------|------------------|-----------------|------------------|---|--|
| Design Point | Design Point/ Contributing Basins | Equivalent CA ₁₀ | Equivalent CA ₁₀₀ | Routed T _c | I ₁₀ | I ₁₀₀ | Q ₁₀ | Q ₁₀₀ | Comments | |
| 1 | E2 | 0.69 | 0.83 | 10.1 | 4.8 | 6.9 | 3.3 | 5.7 | existing 36" RCP culvert | |
| 2 | DP1,E1 | 6.36 | 12.64 | 22.2 | 3.4 | 4.9 | 21.8 | 62.2 | existing dual 48" RCP culverts | |
| 3 | DP2,E3 | 31.32 | 45.84 | 22.2 | 3.4 | 4.9 | 107.2 | 225.6 | Misty Ac 1 Pond Attenuation of Q10=58cfs, Q100=130cfs (per MDDP), yields Q10out=49.2cfs and Q100=95.6cfs) | |
| 4 | E4 | 22.29 | 32.19 | 14.8 | 4.1 | 5.9 | 92.1 | 191.4 | unk pipe sizes, assume no peak flow attenuation | |
| 5 | DP4,E5 | 28.88 | 41.32 | 18.0 | 3.8 | 5.5 | 109.4 | 225.2 | low point collection structure, size TBD in FDR | |
| 6 | DP3 (attenuated),DP5,E6,E7 | | existing wetla | nd/depression | area | | 214.3 | 488.0 | existing 48" CMP culvert, overtops road | |
| 7 | E8 | 12.20 | 23.54 | 23.2 | 3.3 | 4.8 | 40.8 | 113.3 | existing 48" CMP culvert | |
| 8 | DP7,E9,E10 | 17.79 | 32.14 | 28.7 | 3.0 | 4.3 | 52.9 | 137.4 | existing 48" RCP culvert, overtop elev unk | |
| 9 | DP8,E11 | 20.21 | 35.41 | 28.7 | 3.0 | 4.3 | 60.1 | 151.4 | existing 48" RCP culvert, overtop elev unk | |
| 10 | E6 | 0.77 | 0.92 | 5.0 | 6.0 | 8.7 | 4.7 | 8.0 | existing 24" culvert | |
| 11 | 01 | 1.36 | 2.80 | 13.7 | 4.3 | 6.1 | 5.8 | 17.2 | proposed 18" RCP | |
| 12 | 02 | 0.35 | 0.40 | 5.0 | 6.0 | 8.7 | 2.1 | 3.5 | existing type C inlet | |
| 13 | DP12,A1 | 3.64 | 4.08 | 5.0 | 6.0 | 8.7 | 22.0 | 35.4 | split w/DP14 flows, proposed 4' and 16' D-10-R inlets | |
| 14 | A2 | 1.49 | 1.72 | 5.0 | 6.0 | 8.7 | 9.0 | 15.0 | split w/DP13 flows, proposed 4' and 16' D-10-R inlets | |
| 15 | O3 | 0.69 | 0.83 | 10.1 | 4.8 | 6.9 | 3.3 | 5.7 | existing 36" RCP culvert | |
| 16 | O4 | 0.50 | 0.57 | 5.0 | 6.0 | 8.7 | 3.0 | 4.9 | existing type C inlet | |
| 17 | DP15,DP16 | 1.19 | 1.40 | 10.1 | 4.8 | 6.9 | 5.7 | 9.7 | proposed 18" RCP culvert | |

| 18 | DP13,DP14,DP17 | pipe flow junction, for reference only | | | 42.5 | 77.3 | proposed manhole | | |
|-----|--|--|------------------|------------------|------------|------|------------------|-------|---|
| 19 | A3 | 0.30 | 0.56 | 13.3 | 4.3 | 6.2 | 1.3 | 3.5 | proposed 18" RCP culvert |
| 20 | A4 | 3.11 | 3.52 | 5.0 | 6.0 | 8.7 | 18.7 | 30.6 | proposed 2-12' D-10-R inlets |
| 21 | DP18,DP19,DP20 | storr | n system outfall | location, for re | ference on | у | 62.5 | 111.3 | flow to pond 1, unrouted |
| 22 | DP21,A5 | | extended det | ention basin, p | ond 1 | | 66.7 | 118.4 | total flow to pond 1, not routed |
| 23 | B1 | 2.42 | 2.84 | 5.0 | 6.0 | 8.7 | 14.6 | 24.7 | proposed 16' D-10-R inlet |
| 24 | B2 | 1.95 | 2.25 | 5.0 | 6.0 | 8.7 | 11.8 | 19.6 | split w/DP25 flows, proposed triple type R inlets |
| 25 | B3 | 1.24 | 1.41 | 5.0 | 6.0 | 8.7 | 7.5 | 12.2 | split w/DP24 flows, proposed triple type R inlets |
| 26 | DP23,DP24,DP25 | | pipe flow juncti | on, for referen | ce only | | 33.9 | 56.5 | proposed manhole |
| 27 | B8 | 1.86 | 2.25 | 5.6 | 5.8 | 8.4 | 10.9 | 18.9 | proposed 2-8' D-10-R inlets |
| 28 | B4(60%) | 0.51 | 0.58 | 5.0 | 6.0 | 8.7 | 3.1 | 5.0 | proposed double type 16 inlet |
| 29 | B4(40%) | 0.34 | 0.39 | 5.0 | 6.0 | 8.7 | 2.1 | 3.3 | proposed double type 16 inlet |
| 30 | B5(33%) | 0.16 | 0.21 | 5.8 | 5.8 | 8.3 | 1.0 | 1.8 | proposed single type R inlet |
| 31 | B5(66%) | 0.33 | 0.42 | 5.8 | 5.8 | 8.3 | 1.9 | 3.5 | proposed single type R inlet |
| 32 | B6 | 1.33 | 1.59 | 6.3 | 5.6 | 8.1 | 7.5 | 12.8 | proposed double type R inlet |
| 33 | B7 | 0.97 | 1.29 | 7.9 | 5.2 | 7.5 | 5.1 | 9.7 | proposed double type R inlet |
| 34 | DP23,DP24,DP25,DP27,DP28,DP 29,DP30,DP31,DP32,DP33,B9 | | extended det | ention basin, p | ond 2 | | 69.8 | 119.2 | total flow to pond 2, not routed |
| 35 | C1 | 1.89 | 2.24 | 5.0 | 6.0 | 8.7 | 11.4 | 19.5 | split w/DP36 flows, proposed triple type R inlets |
| 36 | C2 | 1.65 | 1.89 | 5.0 | 6.0 | 8.7 | 9.9 | 16.4 | split w/DP35 flows, proposed triple type R inlets |
| 37 | DP35,DP36,C3 | | extended det | ention basin, p | ond 3 | | 22.5 | 38.1 | total flow to pond 3, not routed |
| 38 | Pond 2 out, Pond 3 out | | pipe flow juncti | on, for referen | ce only | | 12.8 | 34.1 | proposed manhole |
| 39 | D1 | 3.64 | 4.78 | 8.6 | 5.1 | 7.3 | 18.5 | 34.9 | proposed 2-16' D-10-R inlets |
| 40a | D2(25%) | 1.39 | 1.84 | 6.0 | 5.7 | 8.2 | 7.9 | 15.1 | split w/DP40b flows, proposed 12' D-10-R inlet |
| 40b | D2(25%) | 1.39 | 1.84 | 6.0 | 5.7 | 8.2 | 7.9 | 15.1 | split w/DP40a flows, proposed 12' D-10-R inlet |

| n | | | | | | | | | |
|-----|---|--|------------------|------------------|-----------|--|-----------------------------------|-------|--|
| 40c | D2(50%) | 2.78 | 3.68 | 12.5 | 4.4 | 6.4 | 12.3 | 23.4 | proposed 2-12' D-10-R inlets |
| 41 | DP39,DP40a,DP40b,DP40c, D5(50%) | extended detention basin, pond 4 (south) | | | 48.0 | 92.0 | total flow to pond 4 (south side) | | |
| 42 | D3 | 0.27 | 0.36 | 5.0 | 6.0 | 8.7 | 1.6 | 3.2 | proposed 4' D-10-R inlet |
| 43 | D4 | 0.21 | 0.25 | 5.0 | 6.0 | 8.7 | 1.3 | 2.1 | proposed 4' D-10-R inlet |
| 44 | DP42,DP43,D5(50%) | e | xtended detenti | on basin, pond | 4 (north) | | 4.3 | 8.7 | total flow to pond 4 (south side) |
| 45 | DP38, Pond 4 out | | pipe flow juncti | ion, for referen | ce only | | 28.3 | 72.2 | proposed manhole |
| 46 | E | 1.55 | 2.01 | 5.0 | 6.0 | 8.7 | 9.3 | 17.4 | proposed 16' D-10-R inlet |
| 47 | Pond 5 outfall | | extended det | ention basin, p | ond 5 | | 2.1 | 5.5 | total flow release |
| 48 | Pond 1 out,O5 | total flow to existing Misty Acres pond | | 118.9 | 238.3 | Misty Ac 1 Pond Attenuation of Q10=58cfs, Q100=130cfs (per MDDP), yields Q10out=60.9cfs and Q100=108.3cfs) | | | |
| 49 | O6 | 0.16 | 0.32 | 5.0 | 6.0 | 8.7 | 1.0 | 2.7 | proposed type C inlet |
| 50 | O7A | 22.29 | 32.19 | 14.8 | 4.1 | 5.9 | 92.1 | 191.4 | total flow to existing pond, no peak flow attenutation |
| 51 | DP50,07B | 29.16 | 41.74 | 18.0 | 3.8 | 5.5 | 110.5 | 227.6 | existing dual 48" CMP culverts |
| 52 | DP51 | 29.16 | 41.74 | 21.0 | 3.5 | 5.1 | 102.6 | 211.3 | low point collection structure, size TBD in FDR |
| 53 | O8 | 0.77 | 0.92 | 5.0 | 6.0 | 8.7 | 4.7 | 8.0 | ex culvert, size unk |
| 54 | DP45,DP47,DP48 OUT,DP49,DP52,DP53,O9 | | existing wetla | and/depression | area | | 211.7 | 431.3 | total inflow |
| 55 | DP54 Pipe Out | | for reference | ce only, see rep | oort | | 211.7 | 431.3 | existing 48" culvert outfall, add 2-48" RCP's |
| 56 | O10 | 12.20 | 23.54 | 23.2 | 3.3 | 4.8 | 40.8 | 113.3 | existing 48" CMP culvert |
| 57 | DP56,011 | 14.25 | 25.86 | 23.2 | 3.3 | 4.8 | 47.7 | 124.4 | existing type C inlet |
| 58 | DP57,012 | 15.91 | 28.54 | 24.1 | 3.3 | 4.7 | 52.2 | 134.6 | existing 48" RCP culvert |
| 59 | DP58,013 | 18.33 | 31.80 | 24.1 | 3.3 | 4.7 | 60.1 | 150.0 | existing 48" RCP culvert |
| · | | | | | | | | | 1 |

MONUMENT RIDGE EAST MASTER DEVELOPMENT DRAINAGE PLAN (Pipe Summary)

| Dine (D | Flow | v (cfs) | |
|---------|------------------------|-------------------------|----------------|
| Pipe ID | Q ₁₀ | Q ₁₀₀ | Pipe Diam (in) |
| 1 | 5.8 | 17.2 | 30" RCP |
| 2 | 21.3 | 42.4 | 30" RCP |
| 3 | 15.5 | 25.2 | 24" RCP |
| 4 | 36.8 | 67.6 | 36" RCP |
| 5 | 5.7 | 9.7 | 18" RCP |
| 6 | 5.7 | 9.7 | 18" RCP |
| 7 | 42.5 | 77.3 | 42" RCP |
| 8 | 1.3 | 3.5 | 18" RCP |
| 9 | 43.8 | 80.7 | 42" RCP |
| 10 | 9.4 | 15.3 | 24" RCP |
| 11 | 18.7 | 30.6 | 30" RCP |
| 12 | 62.5 | 111.3 | 48" RCP |
| 13 | 14.6 | 24.7 | 24" RCP |
| 14 | 14.6 | 24.7 | 24" RCP |
| 15 | 11.8 | 19.6 | 24" RCP |
| 16 | 7.5 | 12.2 | 24" RCP |
| 17 | 19.3 | 31.8 | 30" RCP |
| 18 | 33.9 | 56.5 | 36" RCP |
| 19 | 5.4 | 9.5 | 24" RCP |
| 20 | 10.9 | 18.9 | 24" RCP |
| 21 | 47.8 | 80.4 | 42" RCP |
| 22 | 49.9 | 83.7 | 42" RCP |
| 23 | 1.0 | 1.8 | 18" RCP |
| 24 | 1.9 | 3.5 | 18" RCP |

| 25 | 2.9 | 5.3 | 18" RCP |
|------------|-------|-------|---------|
| 26 | 7.5 | 12.8 | 24" RCP |
| 23 | 10.3 | 18.1 | 24" RCP |
| 28 | 15.4 | 27.9 | 24" RCP |
| 29 | 10.4 | 28.3 | 24" RCP |
| 30 | 11.4 | 19.5 | 30" RCP |
| 31 | 21.3 | 35.9 | 36" RCP |
| 32 | 2.2 | 5.8 | 18" RCP |
| 33 | 12.8 | 34.1 | 36" RCP |
| 34 | 12.8 | 34.1 | 36" RCP |
| 35 | 9.2 | 17.5 | 24" RCP |
| 36 | 18.5 | 34.9 | 30" RCP |
| 37A | 7.9 | 15.1 | 24" RCP |
| 37A 37B | 15.9 | 30.2 | 30" RCP |
| 37B 37C | 6.2 | 11.7 | 18" RCP |
| | | | |
| 37D | 22.0 | 42.0 | 30" RCP |
| 38 | 28.2 | 53.7 | 36" RCP |
| 39 | 1.6 | 3.2 | 18" RCP |
| 40 | 2.9 | 5.3 | 18" RCP |
| 41 | 15.5 | 38.1 | 36" RCP |
| 42 | 28.3 | 72.2 | 48" RCP |
| 43 | 9.3 | 17.4 | 24" RCP |
| 44 | 2.1 | 5.5 | 18" RCP |
| 45 | 60.9 | 108.3 | 54" RCP |
| 46 | 61.9 | 111.0 | 54" RCP |
| 47 | 61.9 | 111.0 | 54" RCP |
| 48 | 164.5 | 322.3 | 78" RCP |
| 49 | 164.5 | 322.3 | 78" RCP |

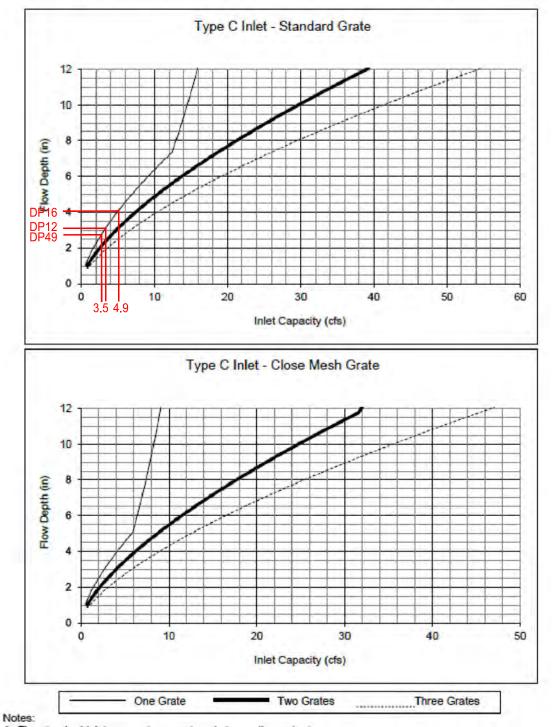


Figure 8-10. Inlet Capacity Chart Sump Conditions, Area (Type C) Inlet

1. The standard inlet parameters must apply to use these charts.

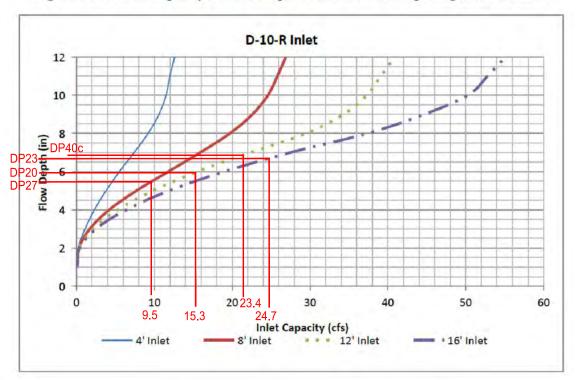


Figure 8-12. Inlet Capacity Chart Sump Conditions, Curb Opening (D-10-R) Inlet

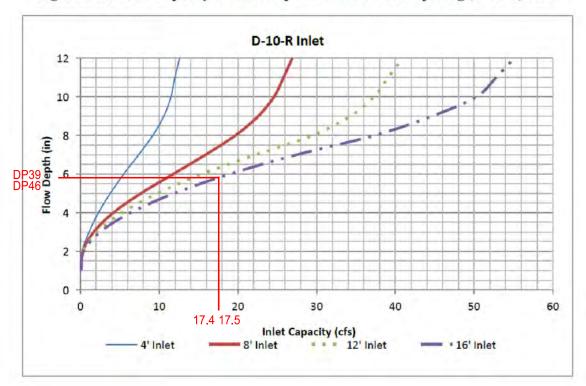


Figure 8-12. Inlet Capacity Chart Sump Conditions, Curb Opening (D-10-R) Inlet

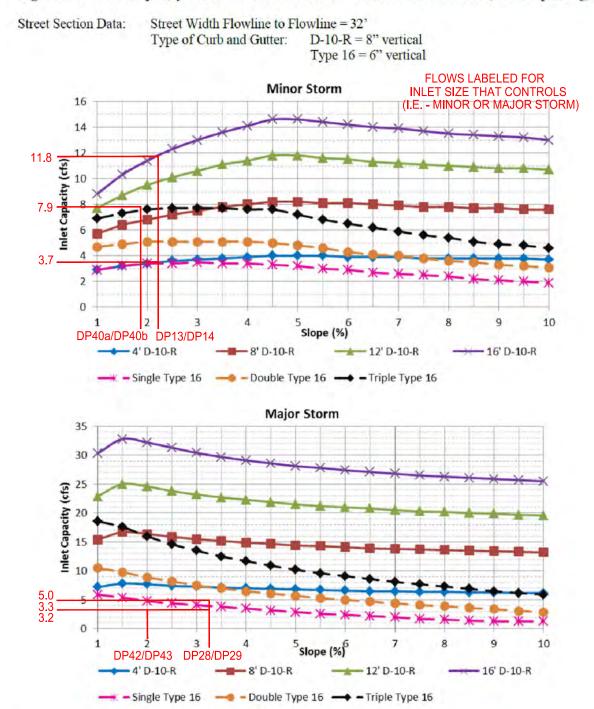


Figure 8-6. Inlet Capacity Chart Continuous Grade Conditions, Collector (without parking)

The standard street section parameters as defined in Chapter 7 must apply to use these charts. For non-standard sections, the inlet capacity shall be calculated using the UDFCD spreadsheets. The maximum spread width is limited by the curb height based on no curb overtopping during a minor storm and flow being contained within the public right-of-way during the major storm. Calculations were done using UD-Inlet 3.00.xls, Mar., 2011 with the default clogging factors.

| May 2014 | City of Colorado Springs | 8-11 |
|----------|------------------------------------|------|
| | Drainage Criteria Manual, Volume 1 | |

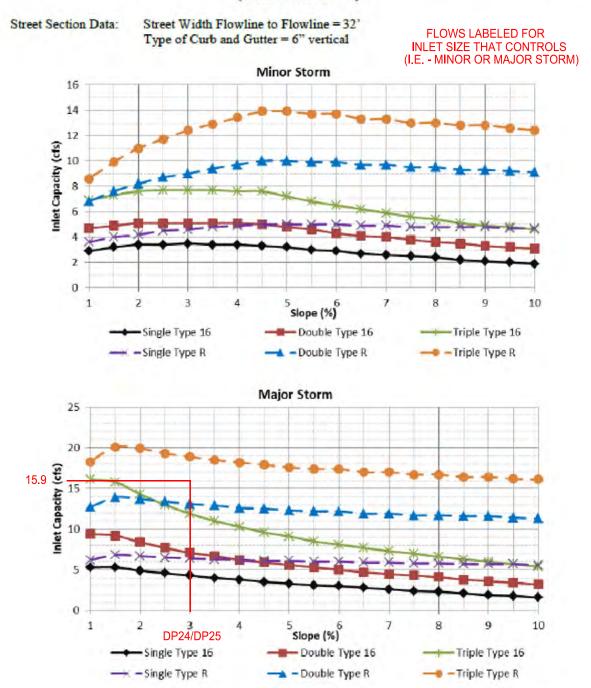


Figure 8-8. Inlet Capacity Chart Continuous Grade Conditions, Minor Residential (Local) (Detached Sidewalk)

The standard street section parameters as defined in Chapter 7 must apply to use these charts. For non-standard sections, the inlet capacity shall be calculated using the UDFCD spreadsheets. The maximum spread width is limited by the curb height based on no curb overtopping during a minor storm and flow being contained within the public right-of-way during the major storm. Calculations were done using UD-Inlet 3.00.xls, Mar., 2011 with the default clogging factors.

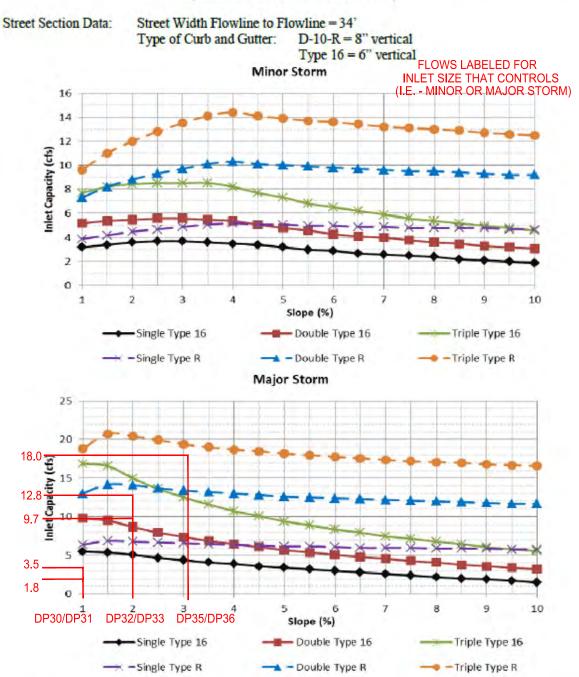


Figure 8-7. Inlet Capacity Chart Continuous Grade Conditions, Residential (Local) (Attached and Detached Sidewalk)

The standard street section parameters as defined in Chapter 7 must apply to use these charts. For non-standard sections, the inlet capacity shall be calculated using the UDFCD spreadsheets. The maximum spread width is limited by the curb height based on no curb overtopping during a minor storm and flow being contained within the public right-of-way during the major storm. Calculations were done using UD-Inlet 3.00.xls, Mar., 2011 with the default clogging factors.

City of Colorado Springs Drainage Criteria Manual, Volume 1

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

DP 1 - 36inch

| Invert Elev Dn (ft) |
|---------------------|
| Pipe Length (ft) |
| Slope (%) |
| Invert Elev Up (ft) |
| Rise (in) |
| Shape |
| Span (in) |
| No. Barrels |
| n-Value |
| Culvert Type |
| Culvert Entrance |
| Coeff. K,M,c,Y,k |
| |

= 7343.00 = 230.00 = 7.39 = 7360.00 = 36.0 = Circular = 36.0 = 1 = 0.013 = Circular Concrete = Square edge w/headwall (C) = 0.0098, 2, 0.0398, 0.67, 0.5

Embankment

Top Elevation (ft) Top Width (ft) Crest Width (ft)

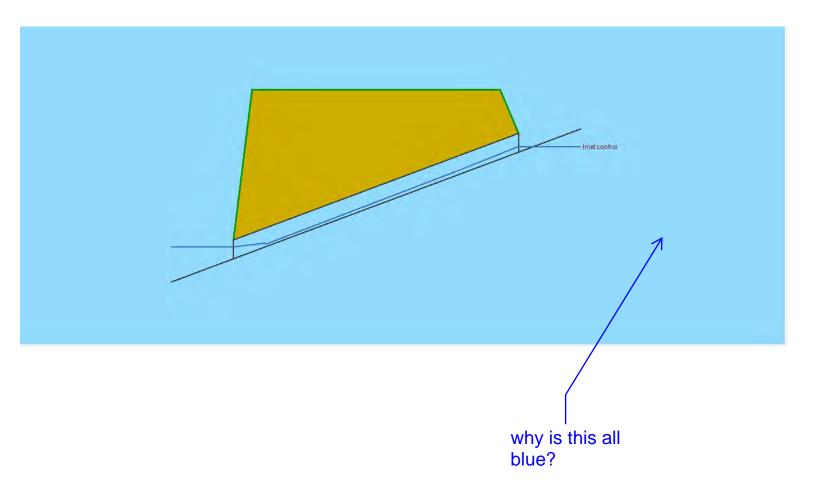
| = | 7370.00 | |
|---|---------|--|
| = | 200.00 | |
| = | 1000.00 | |

Calculations

| Qmin (cfs) | = 5.70 |
|---------------------|------------|
| Qmax (cfs) | = 5.70 |
| Tailwater Elev (ft) | = (dc+D)/2 |

Highlighted

| ingingine a | | |
|-----------------|---|---------------|
| Qtotal (cfs) | = | 5.70 |
| Qpipe (cfs) | = | 5.70 |
| Qovertop (cfs) | = | 0.00 |
| Veloc Dn (ft/s) | = | 1.23 |
| Veloc Up (ft/s) | = | 4.14 |
| HGL Dn (ft) | = | 7344.87 |
| HGL Up (ft) | = | 7360.75 |
| Hw Elev (ft) | = | 7360.91 |
| Hw/D (ft) | = | 0.30 |
| Flow Regime | = | Inlet Control |
| | | |



Wednesday, Jan 18 2023

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

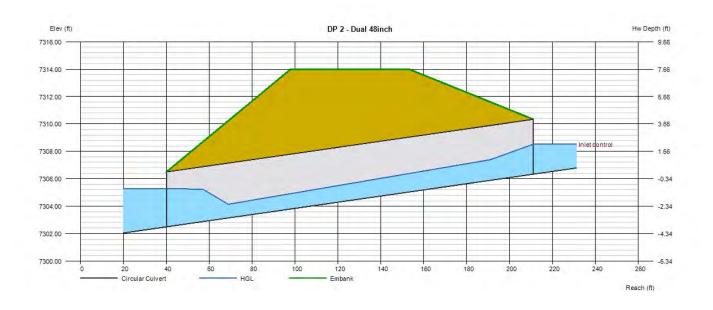
DP 2 - Dual 48inch

| Invert Elev Dn (ft) | = 7302.50 | Calculations | |
|---------------------|--------------------------------|---------------------|------------|
| Pipe Length (ft) | = 171.00 | Qmin (cfs) | = 57.40 |
| Slope (%) | = 2.25 | Qmax (cfs) | = 57.40 |
| Invert Elev Up (ft) | = 7306.34 | Tailwater Élev (ft) | = (dc+D)/2 |
| Rise (in) | = 48.0 | | ζ γ |
| Shape | = Circular | Highlighted | |
| Span (in) | = 48.0 | Qtotal (cfs) | = 57.40 |
| No. Barrels | = 2 | Qpipe (cfs) | = 57.40 |
| n-Value | = 0.013 | Qovertop (cfs) | = 0.00 |
| Culvert Type | = Circular Concrete | Veloc Dn (ft/s) | = 3.06 |
| Culvert Entrance | = Square edge w/headwall (C) | Veloc Up (ft/s) | = 6.18 |
| Coeff. K,M,c,Y,k | = 0.0098, 2, 0.0398, 0.67, 0.5 | HGL Dn (ft) | = 7305.29 |
| | | HGL Up (ft) | = 7307.93 |
| Embankment | | Hw Elev (ft) | = 7308.53 |
| | | | |

Top Elevation (ft) . Top Width (ft) Crest Width (ft)

= 7314.00 = 55.00 = 1000.00

| Qtotal (cfs) | = | 57.40 |
|-----------------|---|---------------|
| Qpipe (cfs) | = | 57.40 |
| Qovertop (cfs) | = | 0.00 |
| Veloc Dn (ft/s) | = | 3.06 |
| Veloc Up (ft/s) | = | 6.18 |
| HGL Dn (ft) | = | 7305.29 |
| HGL Up (ft) | = | 7307.93 |
| Hw Elev (ft) | = | 7308.53 |
| Hw/D (ft) | = | 0.55 |
| Flow Regime | = | Inlet Control |
| | | |



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Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Wednesday, Jan 18 2023

DP 3 - 48inch

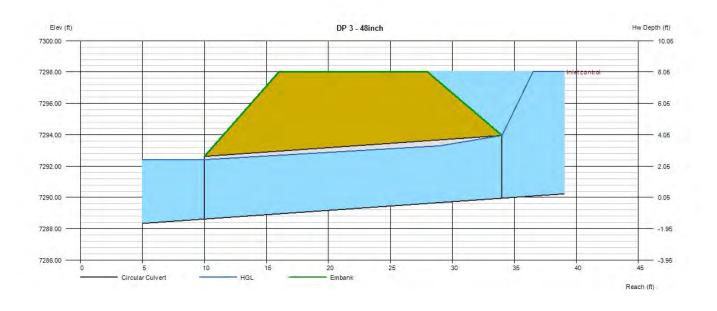
| Invert Elev Dn (ft) | = 7288.62 | Calculations | |
|---------------------|--------------------------------|---------------------|------------|
| Pipe Length (ft) | = 24.00 | Qmin (cfs) | = 150.00 |
| Slope (%) | = 5.54 | Qmax (cfs) | = 208.10 |
| Invert Elev Up (ft) | = 7289.95 | Tailwater Elev (ft) | = (dc+D)/2 |
| Rise (in) | = 48.0 | | |
| Shape | = Circular | Highlighted | |
| Span (in) | = 48.0 | Qtotal (cfs) | = 150.00 |
| No. Barrels | = 1 | Qpipe (cfs) | = 147.71 |
| n-Value | = 0.013 | Qovertop (cfs) | = 2.29 |
| Culvert Type | = Circular Concrete | Veloc Dn (ft/s) | = 12.00 |
| Culvert Entrance | = Square edge w/headwall (C) | Veloc Up (ft/s) | = 12.46 |
| Coeff. K,M,c,Y,k | = 0.0098, 2, 0.0398, 0.67, 0.5 | HGL Dn (ft) | = 7292.41 |
| | | HGL Up (ft) | = 7293.53 |
| Embankment | | Hw Elev (ft) | = 7298.02 |
| Top Elevation (ft) | = 7298.00 | Hw/D (ft) | = 2 02 |

Em

Top Elevation (ft) Top Width (ft) Crest Width (ft)

| = | 7298.00 |
|---|---------|
| = | 12.00 |
| = | 1000.00 |

| Qtotal (cfs) | = | 150.00 |
|-----------------|---|---------------|
| Qpipe (cfs) | = | 147.71 |
| Qovertop (cfs) | = | 2.29 |
| Veloc Dn (ft/s) | = | 12.00 |
| Veloc Up (ft/s) | = | 12.46 |
| HGL Dn (ft) | = | 7292.41 |
| HGL Up (ft) | = | 7293.53 |
| Hw Elev (ft) | = | 7298.02 |
| Hw/D (ft) | = | 2.02 |
| Flow Regime | = | Inlet Control |
| | | |

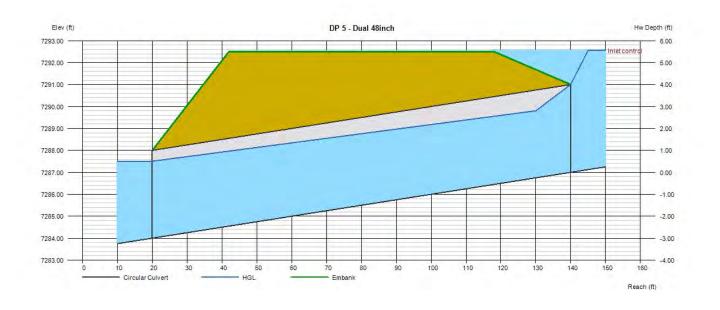


Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Wednesday, Jan 18 2023

DP 5 - Dual 48inch

| Invert Elev Dn (ft) | = 7284.00 | Calculations | |
|---------------------|---------------------------------|---------------------|-----------------|
| Pipe Length (ft) | = 120.00 | Qmin (cfs) | = 225.30 |
| Slope (%) | = 2.50 | Qmax (cfs) | = 225.30 |
| Invert Èlev Up (ft) | = 7287.00 | Tailwater Élev (ft) | = (dc+D)/2 |
| Rise (in) | = 48.0 | | |
| Shape | = Circular | Highlighted | |
| Span (in) | = 48.0 | Qtotal (cfs) | = 225.30 |
| No. Barrels | = 2 | Qpipe (cfs) | = 198.23 |
| n-Value | = 0.023 | Qovertop (cfs) | = 27.07 |
| Culvert Type | = Circular Corrugate Metal Pipe | Veloc Dn (ft/s) | = 8.49 |
| Culvert Entrance | = Projecting | Veloc Up (ft/s) | = 9.76 |
| Coeff. K,M,c,Y,k | = 0.034, 1.5, 0.0553, 0.54, 0.9 | HGL Dn (ft) | = 7287.51 |
| | | HGL Up (ft) | = 7290.01 |
| Embankment | | Hw Elev (ft) | = 7292.55 |
| Top Elevation (ft) | = 7292.50 | Hw/D (ft) | = 1.39 |
| Top Width (ft) | = 76.00 | Flow Regime | = Inlet Control |
| Crest Width (ft) | = 1000.00 | | |



Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Wednesday, Jan 18 2023

DP 6 - 48inch

| Invert Elev Dn (ft) Pipe Length (ft) Slope (%) Invert Elev Up (ft) Rise (in) | = 7251.91 = 71.00 = 5.35 = 7255.71 = 48.0 | Calculations Qmin (cfs) Qmax (cfs) Tailwater Elev (ft) | = 471.00 = 471.00 = (dc+D)/2 |
|--|---|--|------------------------------------|
| Shape | = Circular | Highlighted | |
| Span (in) | = 48.0 | Qtotal (cfs) | = 471.00 |
| No. Barrels | = 1 | Qpipe (cfs) | = 144.22 |
| n-Value | = 0.023 | Qovertop (cfs) | = 326.78 |
| Culvert Type | = Circular Corrugate Metal Pipe | Veloc Dn (ft/s) | = 11.74 |
| Culvert Entrance | = Projecting | Veloc Up (ft/s) | = 12.24 |
| Coeff. K,M,c,Y,k | = 0.034, 1.5, 0.0553, 0.54, 0.9 | HGL Dn (ft) | = 7255.68 |
| | | HGL Up (ft) | = 7259.26 |
| Embankment | | Hw Elev (ft) | = 7265.05 |
| Top Elevation (ft) | = 7264.00 | Hw/D (ft) | = 2.33 |
| Top Width (ft) | = 34.00 | Flow Regime | = Inlet Control |
| Crest Width (ft) | = 100.00 | - | |

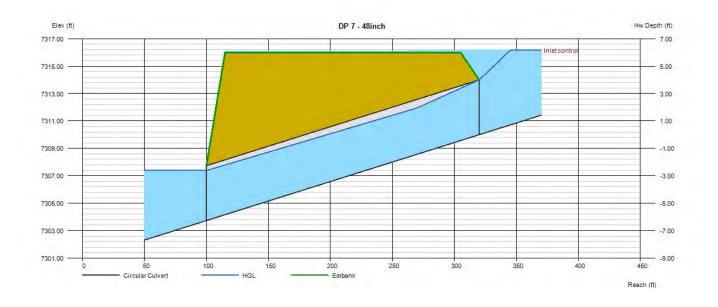
Elev (ft) DP 6 - 48inch Hw Depth (ft) 7266.00 10.29 Inlet control 7.29 7263.00 7260.00 4.29 7257.00 -1.29 7254.00 -1.71 7251.00 -4.71 7248.00 --7.71 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 Circular Culvert - HGL Embank Reach (ft)

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Wednesday, Jan 18 2023

DP 7 - 48inch

| Invert Elev Dn (ft) | = 7303.74 | Calculations | |
|---------------------|---------------------------------|---------------------|-----------------|
| Pipe Length (ft) | = 220.00 | Qmin (cfs) | = 136.70 |
| Slope (%) | = 2.85 | Qmax (cfs) | = 136.70 |
| Invert Elev Up (ft) | = 7310.00 | Tailwater Elev (ft) | = (dc+D)/2 |
| Rise (in) | = 48.0 | | |
| Shape | = Circular | Highlighted | |
| Span (in) | = 48.0 | Qtotal (cfs) | = 136.70 |
| No. Barrels | = 1 | Qpipe (cfs) | = 119.90 |
| n-Value | = 0.023 | Qovertop (cfs) | = 16.80 |
| Culvert Type | = Circular Corrugate Metal Pipe | Veloc Dn (ft/s) | = 9.97 |
| Culvert Entrance | = Headwall | Veloc Up (ft/s) | = 10.83 |
| Coeff. K,M,c,Y,k | = 0.0078, 2, 0.0379, 0.69, 0.5 | HGL Dn (ft) | = 7307.39 |
| | | HGL Up (ft) | = 7313.29 |
| Embankment | | Hw Elev (ft) | = 7316.15 |
| Top Elevation (ft) | = 7316.00 | Hw/D (ft) | = 1.54 |
| Top Width (ft) | = 190.00 | Flow Regime | = Inlet Control |
| Crest Width (ft) | = 100.00 | | |



Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Wednesday, Jan 18 2023

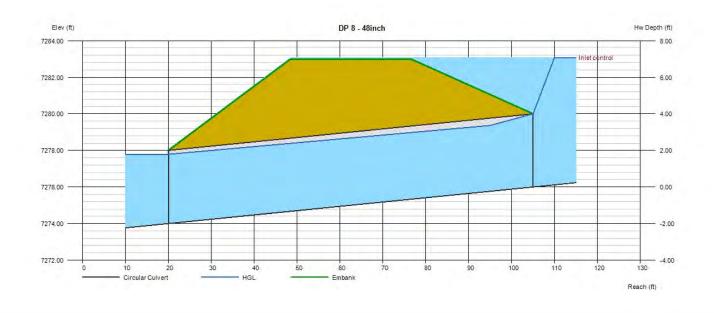
DP 8 - 48inch

| Invert Elev Dn (ft) Pipe Length (ft) Slope (%) Invert Elev Up (ft) Rise (in) | = 7274.00 = 85.00 = 2.35 = 7276.00 = 48.0 | Calculations Qmin (cfs) Qmax (cfs) Tailwater Elev (ft) | = 153.20 = 153.20 = (dc+D)/2 |
|--|---|--|------------------------------------|
| Shape | = Circular | Highlighted | |
| Span (in) | = 48.0 | Qtotal (cfs) | = 153.20 |
| No. Barrels | = 1 | Qpipe (cfs) | = 147.49 |
| n-Value | = 0.013 | Qovertop (cfs) | = 5.71 |
| Culvert Type | = Circular Concrete | Veloc Dn (ft/s) | = 11.98 |
| Culvert Entrance | = Groove end projecting (C) | Veloc Up (ft/s) | = 12.45 |
| Coeff. K,M,c,Y,k | = 0.0045, 2, 0.0317, 0.69, 0.2 | HGL Dn (ft) | = 7277.79 |
| | | HGL Up (ft) | = 7279.57 |
| Embankment | | Hw Elev (ft) | = 7283.08 |
| Top Elevation (ft) | = 7283.00 | Hw/D (ft) | = 1.77 |

Embankment Top Elevation (f Top Width (ft) Crest Width (ft)

| = | 7283.00 |
|---|---------|
| = | 28.00 |
| = | 100.00 |

| 153.20 |
|---------------|
| 147.49 |
| 5.71 |
| 11.98 |
| 12.45 |
| 7277.79 |
| 7279.57 |
| 7283.08 |
| 1.77 |
| Inlet Control |
| |



Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Wednesday, Jan 18 2023

DP 9 - 48inch

| Invert Elev Dn (ft) Pipe Length (ft) Slope (%) Invert Elev Up (ft) Rise (in) | = 7270.00 = 180.00 = 2.22 = 7274.00 = 48.0 | Calculations Qmin (cfs) Qmax (cfs) Tailwater Elev (ft) | = 167.50 = 167.50 = (dc+D)/2 |
|--|--|--|------------------------------------|
| Shape | = Circular | Highlighted | |
| Span (in) | = 48.0 | Qtotal (cfs) | = 167.50 |
| No. Barrels | = 1 | Qpipe (cfs) | = 160.07 |
| n-Value | = 0.013 | Qovertop (cfs) | = 7.43 |
| Culvert Type | Circular Concrete | Veloc Dn (ft/s) | = 12.92 |
| Culvert Entrance | = Square edge w/headwall (C) | Veloc Up (ft/s) | = 13.27 |
| Coeff. K,M,c,Y,k | = 0.0098, 2, 0.0398, 0.67, 0.5 | HGL Dn (ft) | = 7273.83 |
| | | HGL Up (ft) | = 7277.67 |
| Embankment | | Hw Elev (ft) | = 7283.09 |
| Top Elevation (ft) | = 7283.00 | Hw/D (ft) | = 2.27 |

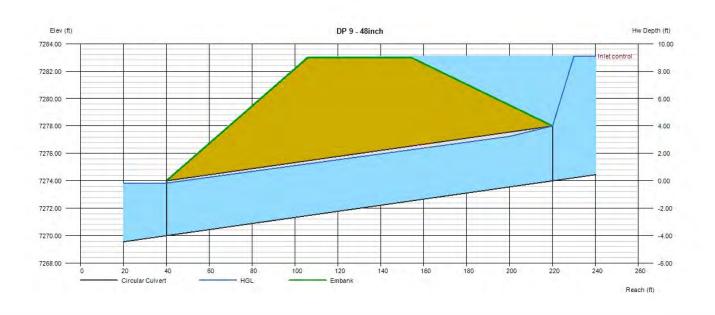
Top Width (ft) Crest Width (ft)

| = | 7283.00 |
|---|---------|
| = | 48.00 |
| _ | 100.00 |

| = | 48.00 |
|---|--------|
| = | 100.00 |

| Qpipe (cis) | = | 160.07 |
|-----------------|---|-----------|
| Qovertop (cfs) | = | 7.43 |
| Veloc Dn (ft/s) | = | 12.92 |
| Veloc Up (ft/s) | = | 13.27 |
| HGL Dn (ft) | = | 7273.83 |
| HGL Up (ft) | = | 7277.67 |
| Hw Elev (ft) | = | 7283.09 |
| Hw/D (ft) | = | 2.27 |
| Flow Regime | = | Inlet Con |
| | | |

= Inlet Control



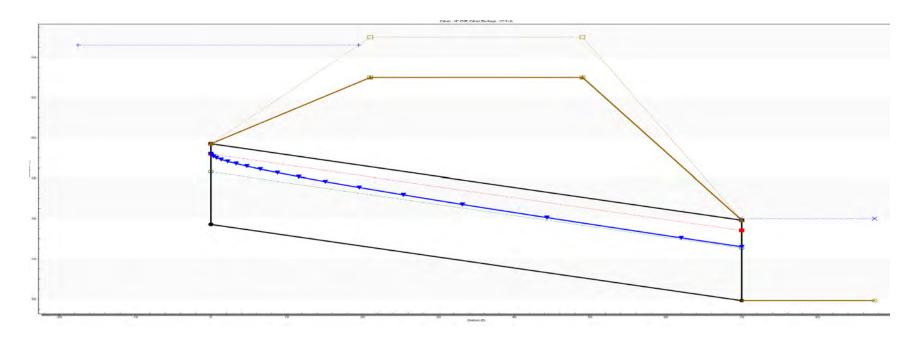
Culvert Crossing: DP6

COUNTY LINE ROAD CROSSING – 48" CMP CULVERT INVERT IN 55.7, TOP OF EMBANKMENT 63.0

OVERTOPS ROAD DURING BOTH MINOR AND MAJOR STORM EVENTS

Customized Table

| Discharg e Names | Total Discharg e (cfs) | Culvert Discharg e (cfs) | Headwate r Elevation (ft) | Inlet Control Depth(ft) | Outlet Control Depth(ft) | Flow Typ e | Norma l Depth (ft) | Critica l Depth (ft) | Outle t Dept h (ft) | Tailwate r Depth (ft) | Outlet Velocit y (ft/s) | Tailwate r Velocity (ft/s) |
|---------------------|------------------------------|--------------------------------|------------------------------------|-----------------------------------|------------------------------------|------------------|--------------------------|-------------------------------|------------------------------|-----------------------------|-------------------------------|-------------------------------------|
| 5 year | 214.3 | 129.73 | 63.86 | 8.15 | 5.37 | 5- S2n | 2.50 | 3.41 | 2.57 | 4.08 | 15.22 | 0.00 |
| 100 year | 488.0 | 136.91 | 64.52 | 8.81 | 5.95 | 5-s- 2n | 2.60 | 3.48 | 2.67 | 4.08 | 15.38 | 0.00 |

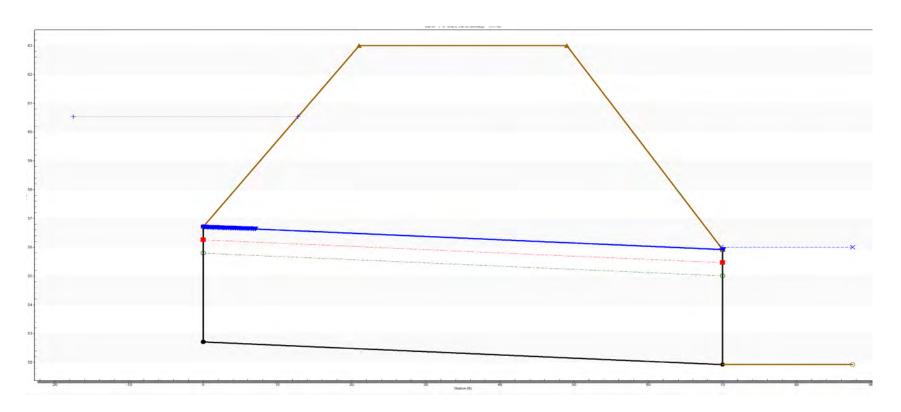


Culvert Crossing: DP54

COUNTY LINE ROAD CROSSING – 48" (3) CULVERTS WITH DEPRESSION AT INLET INVERT IN 55.7, TOP OF EMBANKMENT 63.0

Customized Table

| Discharg e Names | Total Discharg e (cfs) | Culvert Discharg e (cfs) | Headwate r Elevation (ft) | Inlet Control Depth(ft) | Outlet Control Depth(ft) | Flow Typ e | Norma l Depth (ft) | Critica l Depth (ft) | Outle t Depth (ft) | Tailwate r Depth (ft) | Outlet Velocit y (ft/s) | Tailwate r Velocity (ft/s) |
|---------------------|------------------------------|--------------------------------|---------------------------------|-----------------------------------|------------------------------------|------------------|--------------------------|----------------------------|-----------------------------|-----------------------------|-------------------------------|----------------------------------|
| 5 year | 211.70 | 211.70 | 57.34 | 4.63 | 4.25 | 5-S1t | 1.91 | 2.54 | 4.00 | 4.08 | 5.62 | 0.00 |
| 100 year | 431.30 | 431.30 | 60.53 | 7.82 | 7.82 | 5-S1t | 3.08 | 3.54 | 4.00 | 4.08 | 11.44 | 0.00 |



MHFD-Culvert, Version 4.00 (May 2020)

| Flo | T _c H Area D | ↓ ↓¥ | |
|--|----------------------------------|---------|---------------|
| Design Information (Input) | | | |
| Pipe Invert Slope | So = | 0.0080 | ft/ft |
| Pipe Manning's n-value | n = | 0.0130 | |
| Pipe Diameter | D = | 30.00 | inches |
| Design discharge | Q = | 30.60 | cfs |
| Full-Flow Capacity (Calculated) | | | |
| Full-flow area | Af = | 4.91 | sq ft |
| Full-flow wetted perimeter | Pf = | 7.85 | ft |
| Half Central Angle | Theta = | 3.14 | radians |
| Full-flow capacity | Qf = | 36.79 | cfs |
| Calculation of Normal Flow Condition | | | |
| Half Central Angle (0 <theta<3.14)< td=""><td>Theta =</td><td>1.97</td><td>radians</td></theta<3.14)<> | Theta = | 1.97 | radians |
| Flow area | An = | 3.65 | sq ft |
| Top width | Tn = | 2.30 | ft |
| Wetted perimeter | Pn = | 4.94 | ft |
| Flow depth | Yn = | 1.74 | ft |
| Flow velocity | Vn = | 8.38 | fps |
| Discharge | Qn = | 30.60 | cfs |
| Percent of Full Flow | Flow = | 83.2% | of full flow |
| Normal Depth Froude Number | Fr _n = | 1.17 | supercritical |
| Calculation of Critical Flow Condition | | | |
| Half Central Angle (0 <theta-c<3.14)< td=""><td>Theta-c =</td><td>2.10</td><td>radians</td></theta-c<3.14)<> | Theta-c = | 2.10 | radians |
| Critical flow area | Ac = | 3.97 | sq ft |
| Critical top width | Tc = | 2.15 | ft |
| Critical flow depth | Yc = | 1.89 | ft |
| Critical flow velocity | Vc = | 7.71 | fps |
| Critical Depth Froude Number | Fr _c = | 1.00 | |

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| HI HI | Tc O Area D | Ŷ | |
|--|----------------------|--------|---------------|
| Design Information (Input) | | | |
| Pipe Invert Slope | So = | 0.0210 | ft/ft |
| Pipe Manning's n-value | n = | 0.0130 | |
| Pipe Diameter | D = | 30.00 | inches |
| Design discharge | Q = | 42.40 | cfs |
| Full-Flow Capacity (Calculated) | | | |
| Full-flow area | Af = | 4.91 | sq ft |
| Full-flow wetted perimeter | Pf = | 7.85 | ft |
| Half Central Angle | Theta = | 3.14 | radians |
| Full-flow capacity | Qf = | 59.60 | cfs |
| Calculation of Normal Flow Condition Half Central Angle (0 <theta<3.14)< td=""><td>Theta =</td><td>1.82</td><td>radians</td></theta<3.14)<> | Theta = | 1.82 | radians |
| Flow area | An = | 3.22 | sq ft |
| Top width | Tn = | 2.42 | ft |
| Wetted perimeter | Pn = | 4.55 | ft |
| Flow depth | Yn = | 1.56 | ft |
| Flow velocity | Vn = | 13.18 | fps |
| Discharge | Qn = | 42.40 | cfs |
| Percent of Full Flow | Flow = | 71.1% | of full flow |
| Normal Depth Froude Number | Fr _n = | 2.02 | supercritical |
| Calculation of Critical Flow Condition | | | |
| Half Central Angle (0 <theta-c<3.14)< td=""><td>Theta-c =</td><td>2.41</td><td>radians</td></theta-c<3.14)<> | Theta-c = | 2.41 | radians |
| Critical flow area | Ac = | 4.54 | sq ft |
| Critical top width | Tc = | 1.67 | ft |
| Critical flow depth | Yc = | 2.18 | ft |
| Critical flow velocity | Vc = | 9.34 | fps |
| Critical Depth Froude Number | Fr _c = | 1.00 | |

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| PI FI | Tc D Aren D | Ŷ | |
|---|----------------------|--------|------------------|
| Design Information (Input) | <u>.</u> | | |
| Pipe Invert Slope | So = | 0.0300 | ft/ft |
| Pipe Manning's n-value | n = | 0.0130 | |
| Pipe Diameter | D = | 24.00 | inches |
| Design discharge | Q = | 25.20 | cfs |
| Full-Flow Capacity (Calculated) | | | |
| Full-flow area | Af = | 3.14 | sq ft |
| Full-flow wetted perimeter | AI = Pf = | 6.28 | ft |
| Half Central Angle | Theta = | 3.14 | radians |
| Full-flow capacity | Qf = | 39.29 | cfs |
| <u>Calculation of Normal Flow Condition</u> Half Central Angle (0 <theta<3.14) Flow area</theta<3.14) | Theta = | 1.74 | radians sq ft |
| Top width | An = Tn = | 1.90 | ft |
| Wetted perimeter | Pn = | 3.47 | ft |
| Flow depth | Yn = | 1.16 | ft |
| Flow velocity | Vn = | 13.27 | fps |
| Discharge | Qn = | 25.20 | cfs |
| Percent of Full Flow | Flow = | 64.1% | of full flow |
| Normal Depth Froude Number | $Fr_n =$ | 2.38 | supercritical |
| Calculation of Critical Flow Condition | | | _ |
| Half Central Angle (0 <theta-c<3.14)< td=""><td>Theta-c =</td><td>2.44</td><td>radians</td></theta-c<3.14)<> | Theta-c = | 2.44 | radians |
| Critical flow area | Ac = | 2.94 | sq ft |
| Critical top width | Tc = | 1.28 | ft |
| Critical flow depth | Yc = | 1.77 | ft |
| Critical flow velocity | Vc = | 8.58 | fps |
| Critical Depth Froude Number | Fr _c = | 1.00 | |

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| ~ ~ | Tc O low Area | Ŷ | |
|--|------------------------|--------|---------------|
| Design Information (Input) | | | |
| Pipe Invert Slope | So = | 0.0200 | ft/ft |
| Pipe Manning's n-value | n = | 0.0130 | |
| Pipe Diameter | D = | 36.00 | inches |
| Design discharge | Q = | 67.60 | cfs |
| Full-Flow Capacity (Calculated) | | | |
| Full-flow area | Af = | 7.07 | sq ft |
| Full-flow wetted perimeter | Pf = | 9.42 | ft |
| Half Central Angle | Theta = | 3.14 | radians |
| Full-flow capacity | Qf = | 94.58 | cfs |
| Calculation of Normal Flow Condition | | | |
| Half Central Angle (0 <theta<3.14)< td=""><td>Theta =</td><td>1.82</td><td>radians</td></theta<3.14)<> | Theta = | 1.82 | radians |
| Flow area | An = | 4.65 | sq ft |
| Top width | Tn = | 2.90 | ft |
| Wetted perimeter | Pn = | 5.47 | ft |
| Flow depth | Yn = | 1.88 | ft |
| Flow velocity | Vn = | 14.54 | fps |
| Discharge | Qn = | 67.61 | cfs |
| Percent of Full Flow | Flow = | 71.5% | of full flow |
| Normal Depth Froude Number | Fr _n = | 2.03 | supercritical |
| Calculation of Critical Flow Condition | | | |
| Half Central Angle (0 <theta-c<3.14)< td=""><td>Theta-c =</td><td>2.42</td><td>radians</td></theta-c<3.14)<> | Theta-c = | 2.42 | radians |
| Critical flow area | Ac = | 6.56 | sq ft |
| Critical top width | Tc = | 1.99 | ft |
| Critical flow depth | Yc = | 2.62 | ft |
| Critical flow velocity | Vc = | 10.31 | fps |
| Critical Depth Froude Number | Fr _c = | 1.00 | |
| | | | |

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| ← | Tc O Area D | Ŷ | |
|--|----------------------|--------|---------------|
| Design Information (Input) | · | | |
| Pipe Invert Slope | So = | 0.0200 | ft/ft |
| Pipe Manning's n-value | n = | 0.0130 | |
| Pipe Diameter | D = | 18.00 | inches |
| Design discharge | Q = | 9.70 | cfs |
| Full-Flow Capacity (Calculated) | | | |
| Full-flow area | Af = | 1.77 | sq ft |
| Full-flow wetted perimeter | Pf = | 4.71 | ft |
| Half Central Angle | Theta = | 3.14 | radians |
| Full-flow capacity | Qf = | 14.90 | cfs |
| Calculation of Normal Flow Condition | | | |
| Half Central Angle (0 <theta<3.14)< td=""><td>Theta =</td><td>1.75</td><td>radians</td></theta<3.14)<> | Theta = | 1.75 | radians |
| Flow area | An = | 1.08 | sq ft |
| Top width | Tn = | 1.48 | ft |
| Wetted perimeter | Pn = | 2.62 | ft |
| Flow depth | Yn = | 0.88 | ft |
| Flow velocity | Vn = | 8.98 | fps |
| Discharge | Qn = | 9.70 | cfs |
| Percent of Full Flow | Flow = | 65.1% | of full flow |
| Normal Depth Froude Number | Fr _n = | 1.85 | supercritical |
| Calculation of Critical Flow Condition | | | |
| Half Central Angle (0 <theta-c<3.14)< td=""><td>Theta-c =</td><td>2.22</td><td>radians</td></theta-c<3.14)<> | Theta-c = | 2.22 | radians |
| Critical flow area | Ac = | 1.52 | sq ft |
| Critical top width | Tc = | 1.20 | ft |
| Critical flow depth | Yc = | 1.20 | ft |
| Critical flow velocity | Vc = | 6.39 | fps |
| Critical Depth Froude Number | Fr _c = | 1.00 | |

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| PI | Tc Orw angle Area D | ↓ ↓¥ | |
|--|------------------------------|---------|---------------|
| Design Information (Input) | | | |
| Pipe Invert Slope | So = | 0.0170 | ft/ft |
| Pipe Manning's n-value | n = | 0.0130 | |
| Pipe Diameter | D = | 42.00 | inches |
| Design discharge | Q = | 77.30 | cfs |
| Full-Flow Capacity (Calculated) | | | |
| Full-flow area | Af = | 9.62 | sq ft |
| Full-flow wetted perimeter | Pf = | 11.00 | ft |
| Half Central Angle | Theta = | 3.14 | radians |
| Full-flow capacity | Qf = | 131.53 | cfs |
| Calculation of Normal Flow Condition | | | |
| Half Central Angle (0 <theta<3.14)< td=""><td>Theta =</td><td>1.67</td><td>radians</td></theta<3.14)<> | Theta = | 1.67 | radians |
| Flow area | An = | 5.44 | sq ft |
| Top width | Tn = | 3.48 | ft |
| Wetted perimeter | Pn = | 5.86 | ft |
| Flow depth | Yn = | 1.93 | ft |
| Flow velocity | Vn = | 14.22 | fps |
| Discharge | Qn = | 77.30 | cfs |
| Percent of Full Flow | Flow = | 58.8% | of full flow |
| Normal Depth Froude Number | Fr _n = | 2.01 | supercritical |
| Calculation of Critical Flow Condition | | | |
| Half Central Angle (0 <theta-c<3.14)< td=""><td>Theta-c =</td><td>2.18</td><td>radians</td></theta-c<3.14)<> | Theta-c = | 2.18 | radians |
| Critical flow area | Ac = | 8.11 | sq ft |
| Critical top width | Tc = | 2.87 | ft |
| Critical flow depth | Yc = | 2.75 | ft |
| Critical flow velocity | Vc = | 9.53 | fps |
| Critical Depth Froude Number | Fr _c = | 1.00 | |

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| Fie | Tc DW Area D | Ţ¥ | |
|--|-----------------------|--------|---------------|
| Design Information (Input) | | | |
| Pipe Invert Slope | So = | 0.0400 | ft/ft |
| Pipe Manning's n-value | n = | 0.0130 | |
| Pipe Diameter | D = | 18.00 | inches |
| Design discharge | Q = | 3.50 | cfs |
| Full-Flow Capacity (Calculated) | | | |
| Full-flow area | Af = | 1.77 | sq ft |
| Full-flow wetted perimeter | Pf = | 4.71 | ft |
| Half Central Angle | Theta = | 3.14 | radians |
| Full-flow capacity | Qf = | 21.07 | cfs |
| Calculation of Normal Flow Condition | | | |
| Half Central Angle (0 <theta<3.14)< td=""><td>Theta =</td><td>1.11</td><td>radians</td></theta<3.14)<> | Theta = | 1.11 | radians |
| Flow area | An = | 0.40 | sq ft |
| Top width | Tn = | 1.34 | ft |
| Wetted perimeter | Pn = | 1.66 | ft |
| Flow depth | Yn = | 0.41 | ft |
| Flow velocity | Vn = | 8.83 | fps |
| Discharge | Qn = | 3.50 | cfs |
| Percent of Full Flow | Flow = | 16.6% | of full flow |
| Normal Depth Froude Number | Fr _n = | 2.86 | supercritical |
| Calculation of Critical Flow Condition | | | |
| Half Central Angle (0 <theta-c<3.14)< td=""><td>Theta-c =</td><td>1.52</td><td>radians</td></theta-c<3.14)<> | Theta-c = | 1.52 | radians |
| Critical flow area | Ac = | 0.83 | sq ft |
| Critical top width | Tc = | 1.50 | ft |
| Critical flow depth | Yc = | 0.71 | ft |
| Critical flow velocity | Vc = | 4.22 | fps |
| Critical Depth Froude Number | Fr _c = | 1.00 | |

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| | T _c How Area D | ↓ ↓¥ | |
|--|------------------------------------|---------------|---------------|
| Design Information (Input) | | | |
| Pipe Invert Slope | So = | 0.0400 | ft/ft |
| Pipe Manning's n-value | n = | 0.0130 | |
| Pipe Diameter | D = | 42.00 | inches |
| Design discharge | Q = | 80.70 | cfs |
| | | | |
| Full-Flow Capacity (Calculated) | | | |
| Full-flow area | Af = | 9.62 | sq ft |
| Full-flow wetted perimeter | Pf = | 11.00 | ft |
| Half Central Angle | Theta = | 3.14 | radians |
| Full-flow capacity | Qf = | 201.76 | cfs |
| Calculation of Normal Flow Condition | | 4.45 | |
| Half Central Angle (0 <theta<3.14)< td=""><td>Theta =</td><td>1.45</td><td>radians</td></theta<3.14)<> | Theta = | 1.45 | radians |
| Flow area | An = | 4.08 | sq ft |
| Top width | Tn = | 3.47 | ft |
| Wetted perimeter | Pn = | 5.08 | ft |
| Flow depth | Yn = | 1.54 | ft |
| Flow velocity | Vn = | 19.80 | fps |
| Discharge | Qn = | 80.71 | cfs |
| Percent of Full Flow Normal Depth Froude Number | Flow = Fr _n = | 40.0% 3.22 | of full flow |
| Normal Depth Froude Number | 11 _n – | 3.22 | supercritical |
| Calculation of Critical Flow Condition | | | |
| Half Central Angle (0 <theta-c<3.14)< td=""><td>Theta-c =</td><td>2.22</td><td>radians</td></theta-c<3.14)<> | Theta-c = | 2.22 | radians |
| Critical flow area | Ac = | 8.27 | sq ft |
| Critical top width | Tc = | 2.79 | ft |
| Critical flow depth | Yc = | 2.81 | ft |
| Critical flow velocity | Vc = | 9.76 | fps |
| Critical Depth Froude Number | Fr _c = | 1.00 | |

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| File | Tc H Area D | ↓¥ | |
|--|----------------------|--------|---------------|
| Design Information (Input) | | | |
| Pipe Invert Slope | So = | 0.0200 | ft/ft |
| Pipe Manning's n-value | n = | 0.0130 | |
| Pipe Diameter | D = | 24.00 | inches |
| Design discharge | Q = | 15.30 | cfs |
| Full-Flow Capacity (Calculated) | | | |
| Full-flow area | Af = | 3.14 | sq ft |
| Full-flow wetted perimeter | Pf = | 6.28 | ft |
| Half Central Angle | Theta = | 3.14 | radians |
| Full-flow capacity | Qf = | 32.08 | cfs |
| Calculation of Normal Flow Condition | | | |
| Half Central Angle (0 <theta<3.14)< td=""><td>Theta =</td><td>1.54</td><td>radians</td></theta<3.14)<> | Theta = | 1.54 | radians |
| Flow area | An = | 1.52 | sq ft |
| Top width | Tn = | 2.00 | ft |
| Wetted perimeter | Pn = | 3.09 | ft |
| Flow depth | Yn = | 0.97 | ft |
| Flow velocity | Vn = | 10.09 | fps |
| Discharge | Qn = | 15.30 | cfs |
| Percent of Full Flow | Flow = | 47.7% | of full flow |
| Normal Depth Froude Number | Fr _n = | 2.04 | supercritical |
| Calculation of Critical Flow Condition | | | |
| Half Central Angle (0 <theta-c<3.14)< td=""><td>Theta-c =</td><td>1.99</td><td>radians</td></theta-c<3.14)<> | Theta-c = | 1.99 | radians |
| Critical flow area | Ac = | 2.37 | sq ft |
| Critical top width | Tc = | 1.82 | ft |
| Critical flow depth | Yc = | 1.41 | ft |
| Critical flow velocity | Vc = | 6.46 | fps |
| Critical Depth Froude Number | Fr _c = | 1.00 | |

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| Flo | T _c H Area D | ¢ ↓γ | |
|--|----------------------------------|---------|---------------|
| Design Information (Input) | | | |
| Pipe Invert Slope | So = | 0.0200 | ft/ft |
| Pipe Manning's n-value | n = | 0.0130 | |
| Pipe Diameter | D = | 30.00 | inches |
| Design discharge | Q = | 30.60 | cfs |
| | | | |
| Full-Flow Capacity (Calculated) | | | |
| Full-flow area | Af = | 4.91 | sq ft |
| Full-flow wetted perimeter | Pf = | 7.85 | ft |
| Half Central Angle | Theta = | 3.14 | radians |
| Full-flow capacity | Qf = | 58.16 | cfs |
| Calculation of Normal Flow Condition | | | |
| Half Central Angle (0 <theta<3.14)< td=""><td>Theta =</td><td>1.60</td><td>radians</td></theta<3.14)<> | Theta = | 1.60 | radians |
| Flow area | An = | 2.55 | sq ft |
| Top width | Tn = | 2.50 | ft |
| Wetted perimeter | Pn = | 4.00 | ft |
| Flow depth | Yn = | 1.29 | ft |
| Flow velocity | Vn = | 12.00 | fps |
| Discharge | Qn = | 30.60 | cfs |
| Percent of Full Flow | Flow = | 52.6% | of full flow |
| Normal Depth Froude Number | $Fr_n =$ | 2.09 | supercritical |
| Calculation of Critical Flow Condition | | | |
| Half Central Angle (0 <theta-c<3.14)< td=""><td>Theta-c =</td><td>2.10</td><td>radians</td></theta-c<3.14)<> | Theta-c = | 2.10 | radians |
| Critical flow area | Ac = | 3.97 | sq ft |
| Critical top width | Tc = | 2.15 | ft |
| Critical flow depth | Yc = | 1.89 | ft |
| Critical flow velocity | Vc = | 7.71 | fps |
| Critical Depth Froude Number | $Fr_{c} =$ | 1.00 | |

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| Design Information (Input) | | | |
|--|-------------------|--------|---------------|
| Design mornation (mpat) | | | |
| Pipe Invert Slope | So = | 0.0400 | ft/ft |
| Pipe Manning's n-value | n = | 0.0130 | |
| Pipe Diameter | D = | 48.00 | inches |
| Design discharge | Q = | 111.30 | cfs |
| | | | |
| Full-Flow Capacity (Calculated) | | 10.57 | |
| Full-flow area | Af = | 12.57 | sq ft |
| Full-flow wetted perimeter | Pf = | 12.57 | ft |
| Half Central Angle | Theta = | 3.14 | radians |
| Full-flow capacity | Qf = | 288.06 | cfs |
| Calculation of Normal Flow Condition | | | |
| Half Central Angle (0 <theta<3.14)< td=""><td>Theta =</td><td>1.43</td><td>radians</td></theta<3.14)<> | Theta = | 1.43 | radians |
| Flow area | An = | 5.19 | sq ft |
| Top width | Tn = | 3.96 | ft |
| Wetted perimeter | Pn = | 5.73 | ft |
| Flow depth | Yn = | 1.73 | ft |
| Flow velocity | Vn = | 21.45 | fps |
| Discharge | Qn = | 111.31 | cfs |
| Percent of Full Flow | Flow = | 38.6% | of full flow |
| Normal Depth Froude Number | Fr _n = | 3.30 | supercritical |
| Calculation of Critical Flow Condition | | | |
| Half Central Angle (0 <theta-c<3.14)< td=""><td>Theta-c =</td><td>2.21</td><td>radians</td></theta-c<3.14)<> | Theta-c = | 2.21 | radians |
| Critical flow area | Ac = | 10.74 | sq ft |
| Critical top width | Tc = | 3.22 | ft |
| Critical flow depth | Yc = | 3.19 | ft |
| Critical flow velocity | Vc = | 10.36 | fps |
| Critical Depth Froude Number | Fr _c = | 1.00 | ן ו |

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| $\begin{array}{c} \hline T_{C} \\ \hline \\ $ | | | | |
|---|-------------------|--------|---------------|--|
| Design Information (Input) | | | | |
| Pipe Invert Slope | So = | 0.0200 | ft/ft | |
| Pipe Manning's n-value | n = | 0.0130 | | |
| Pipe Diameter | D = | 24.00 | inches | |
| Design discharge | Q = | 24.70 | cfs | |
| | | | | |
| Full-Flow Capacity (Calculated) | . — | | | |
| Full-flow area | Af = | 3.14 | sq ft | |
| Full-flow wetted perimeter | Pf = | 6.28 | ft | |
| Half Central Angle | Theta = | 3.14 | radians | |
| Full-flow capacity | Qf = | 32.08 | cfs | |
| Calculation of Normal Flow Condition | | | | |
| Half Central Angle (0 <theta<3.14)< td=""><td>Theta =</td><td>1.89</td><td>radians</td></theta<3.14)<> | Theta = | 1.89 | radians | |
| Flow area | An = | 2.19 | sq ft | |
| Top width | Tn = | 1.90 | ft | |
| Wetted perimeter | Pn = | 3.79 | ft | |
| Flow depth | Yn = | 1.32 | ft | |
| Flow velocity | Vn = | 11.26 | fps | |
| Discharge | Qn = | 24.70 | cfs | |
| Percent of Full Flow | Flow = | 77.0% | of full flow | |
| Normal Depth Froude Number | Fr _n = | 1.85 | supercritical | |
| Calculation of Critical Flow Condition | | | | |
| Half Central Angle (0 <theta-c<3.14)< td=""><td>Theta-c =</td><td>2.42</td><td>radians</td></theta-c<3.14)<> | Theta-c = | 2.42 | radians | |
| Critical flow area | Ac = | 2.92 | sq ft | |
| Critical top width | Tc = | 1.31 | ft | |
| Critical flow depth | Yc = | 1.75 | ft | |
| Critical flow velocity | Vc = | 8.46 | fps | |
| Critical Depth Froude Number | Fr _c = | 1.00 | | |

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| $\begin{array}{c} \hline T_{c} \\ \hline \\ $ | | | | |
|---|-------------------|--------|---------------|--|
| Design Information (Input) | | | | |
| Pipe Invert Slope | So = | 0.0200 | ft/ft | |
| Pipe Manning's n-value | n = | 0.0130 | | |
| Pipe Diameter | D = | 24.00 | inches | |
| Design discharge | Q = | 19.60 | cfs | |
| | | | | |
| Full-Flow Capacity (Calculated) | | | | |
| Full-flow area | Af = | 3.14 | sq ft | |
| Full-flow wetted perimeter | Pf = | 6.28 | ft | |
| Half Central Angle | Theta = | 3.14 | radians | |
| Full-flow capacity | Qf = | 32.08 | cfs | |
| Calculation of Normal Flow Condition | | | | |
| Half Central Angle (0 <theta<3.14)< td=""><td>Theta =</td><td>1.70</td><td>radians</td></theta<3.14)<> | Theta = | 1.70 | radians | |
| Flow area | An = | 1.83 | sq ft | |
| Top width | Tn = | 1.98 | ft | |
| Wetted perimeter | Pn = | 3.40 | ft | |
| Flow depth | Yn = | 1.13 | | |
| Flow velocity | Vn = | 10.72 | fps | |
| Discharge | Qn = | 19.60 | cfs | |
| Percent of Full Flow | Flow = | 61.1% | of full flow | |
| Normal Depth Froude Number | Fr _n = | 1.97 | supercritical | |
| Calculation of Critical Flow Condition | | | | |
| Half Central Angle (0 <theta-c<3.14)< td=""><td>Theta-c =</td><td>2.20</td><td>radians</td></theta-c<3.14)<> | Theta-c = | 2.20 | radians | |
| Critical flow area | Ac = | 2.68 | sq ft | |
| Critical top width | Tc = | 1.61 | ft | |
| Critical flow depth | Yc = | 1.59 | ft | |
| Critical flow velocity | Vc = | 7.31 | fps | |
| Critical Depth Froude Number | $Fr_{c} =$ | 1.00 | | |

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| $\begin{array}{c} \hline T_{0} \\ \hline \\ $ | | | |
|---|-------------------|--------|---------------|
| Design Information (Input) | | | |
| Pipe Invert Slope | So = | 0.0100 | ft/ft |
| Pipe Manning's n-value | n = | 0.0130 | |
| Pipe Diameter | D = | 24.00 | inches |
| Design discharge | Q = | 12.20 | cfs |
| | | | |
| Full-Flow Capacity (Calculated) | | | |
| Full-flow area | Af = | 3.14 | sq ft |
| Full-flow wetted perimeter | Pf = | 6.28 | ft |
| Half Central Angle | Theta = | 3.14 | radians |
| Full-flow capacity | Qf = | 22.68 | cfs |
| <u>Calculation of Normal Flow Condition</u> Half Central Angle (0 <theta<3.14)< th=""><th>Theta =</th><th>1.62</th><th>radians</th></theta<3.14)<> | Theta = | 1.62 | radians |
| Flow area | An = | 1.66 | sq ft |
| Top width | Tn = | 2.00 | ft |
| Wetted perimeter | Pn = | 3.23 | ft |
| Flow depth | Yn = | 1.04 | ft |
| Flow velocity | Vn = | 7.35 | fps |
| Discharge | Qn = | 12.20 | cfs |
| Percent of Full Flow | Flow = | 53.8% | of full flow |
| Normal Depth Froude Number | Fr _n = | 1.42 | supercritical |
| Calculation of Critical Flow Condition | | | |
| Half Central Angle (0 <theta-c<3.14)< td=""><td>Theta-c =</td><td>1.83</td><td>radians</td></theta-c<3.14)<> | Theta-c = | 1.83 | radians |
| Critical flow area | Ac = | 2.08 | sq ft |
| Critical top width | Tc = | 1.93 | ft |
| Critical flow depth | Yc = | 1.26 | ft |
| Critical flow velocity | Vc = | 5.88 | fps |
| Critical Depth Froude Number | Fr _c = | 1.00 | |

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| Flow angle V Area D | | | |
|---|-----------------------------|---------------|-------------------------------|
| Design Information (Input) | | | |
| Pipe Invert Slope | So = | 0.0110 | ft/ft |
| Pipe Manning's n-value | n = | 0.0130 | |
| Pipe Diameter | D = | 30.00 | inches |
| Design discharge | Q = | 31.80 | cfs |
| | | | |
| Full-Flow Capacity (Calculated) | | | |
| Full-flow area | Af = | 4.91 | sq ft |
| Full-flow wetted perimeter | Pf = | 7.85 | ft |
| Half Central Angle | Theta = | 3.14 | radians |
| Full-flow capacity | Qf = | 43.13 | cfs |
| Colouistion of Normal Flow Condition | | | |
| <u>Calculation of Normal Flow Condition</u> Half Central Angle (0 <theta<3.14)< td=""><td>Theta =</td><td>1.85</td><td>radians</td></theta<3.14)<> | Theta = | 1.85 | radians |
| Flow area | An = | 3.31 | |
| | An = Tn = | | sq ft ft |
| Top width Watted parimeter | | 2.40 | |
| Wetted perimeter Flow depth | Pn = Yn = | 4.63 | ftft |
| | Vn = | 9.61 | |
| Flow velocity | | 31.80 | fps |
| Discharge | Qn = | | Cfs |
| Percent of Full Flow Normal Depth Froude Number | Flow = Fr _n = | 73.7% 1.44 | of full flow supercritical |
| | 11n - | 1.44 | supercifical |
| Calculation of Critical Flow Condition | | | |
| Half Central Angle (0 <theta-c<3.14)< td=""><td>Theta-c =</td><td>2.14</td><td>radians</td></theta-c<3.14)<> | Theta-c = | 2.14 | radians |
| Critical flow area | Ac = | 4.05 | sq ft |
| Critical top width | Tc = | 2.11 | ft |
| Critical flow depth | Yc = | 1.92 | ft |
| | Vc = | 7.86 | fps |
| | Fr _c = | 1.00 | |
| Critical flow velocity Critical Depth Froude Number | Vc = | 7.86 | |

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| $\begin{array}{c} \hline T_{c} \\ \hline \\ $ | | | | |
|---|-------------------|--------|---------------|--|
| Design Information (Input) | | | | |
| Pipe Invert Slope | So = | 0.0250 | ft/ft | |
| Pipe Manning's n-value | n = | 0.0130 | | |
| Pipe Diameter | D = | 36.00 | inches | |
| Design discharge | Q = | 56.50 | cfs | |
| | | | | |
| Full-Flow Capacity (Calculated) | | | | |
| Full-flow area | Af = | 7.07 | sq ft | |
| Full-flow wetted perimeter | Pf = | 9.42 | ft | |
| Half Central Angle | Theta = | 3.14 | radians | |
| Full-flow capacity | Qf = | 105.74 | cfs | |
| Calculation of Normal Flow Condition | | | | |
| Half Central Angle (0 <theta<3.14)< td=""><td>Theta =</td><td>1.61</td><td>radians</td></theta<3.14)<> | Theta = | 1.61 | radians | |
| Flow area | An = | 3.72 | sq ft | |
| Top width | Tn = | 3.00 | ft | |
| Wetted perimeter | Pn = | 4.83 | ft | |
| Flow depth | Yn = | 1.56 | ft | |
| Flow velocity | Vn = | 15.21 | fps | |
| Discharge | Qn = | 56.51 | cfs | |
| Percent of Full Flow | Flow = | 53.4% | of full flow | |
| Normal Depth Froude Number | Fr _n = | 2.41 | supercritical | |
| Calculation of Critical Flow Condition | | | | |
| Half Central Angle (0 <theta-c<3.14)< td=""><td>Theta-c =</td><td>2.24</td><td>radians</td></theta-c<3.14)<> | Theta-c = | 2.24 | radians | |
| Critical flow area | Ac = | 6.15 | sq ft | |
| Critical top width | Tc = | 2.34 | ft | |
| Critical flow depth | Yc = | 2.44 | ft | |
| Critical flow velocity | Vc = | 9.19 | fps | |
| Critical Depth Froude Number | Fr _c = | 1.00 | | |

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| Flor | Tc H Area D | ↓¥ | |
|--|----------------------|--------|---------------|
| Design Information (Input) | | | |
| Pipe Invert Slope | So = | 0.0100 | ft/ft |
| Pipe Manning's n-value | n = | 0.0130 | |
| Pipe Diameter | D = | 24.00 | inches |
| Design discharge | Q = | 9.50 | cfs |
| | | | |
| Full-Flow Capacity (Calculated) | | | |
| Full-flow area | Af = | 3.14 | sq ft |
| Full-flow wetted perimeter | Pf = | 6.28 | ft |
| Half Central Angle | Theta = | 3.14 | radians |
| Full-flow capacity | Qf = | 22.68 | cfs |
| Calculation of Normal Flow Condition | | | |
| Half Central Angle (0 <theta<3.14)< td=""><td>Theta =</td><td>1.47</td><td>radians</td></theta<3.14)<> | Theta = | 1.47 | radians |
| Flow area | An = | 1.38 | sq ft |
| Top width | Tn = | 1.99 | ft |
| Wetted perimeter | Pn = | 2.95 | ft |
| Flow depth | Yn = | 0.90 | |
| Flow velocity | Vn = | 6.90 | fps |
| Discharge | Qn = | 9.50 | cfs |
| Percent of Full Flow | Flow = | 41.9% | of full flow |
| Normal Depth Froude Number | $Fr_n =$ | 1.46 | supercritical |
| Calculation of Critical Flow Condition | | | |
| Half Central Angle (0 <theta-c<3.14)< td=""><td>Theta-c =</td><td>1.67</td><td>radians</td></theta-c<3.14)<> | Theta-c = | 1.67 | radians |
| Critical flow area | Ac = | 1.77 | sq ft |
| Critical top width | Tc = | 1.99 | ft |
| Critical flow depth | Yc = | 1.10 | ft |
| Critical flow velocity | Vc = | 5.36 | fps |
| Critical Depth Froude Number | Fr _c = | 1.00 | |

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| ¢. | To Flow Area D | ↓ ↓ ↓ ↓ Y | |
|---|---------------------------------|-------------------------------|-------------------------------|
| Design Information (Input) | | | |
| Pipe Invert Slope | So = | 0.0140 | ft/ft |
| Pipe Manning's n-value | n = | 0.0130 | |
| Pipe Diameter | D = | 24.00 | inches |
| Design discharge | Q = | 18.90 | cfs |
| Full-Flow Capacity (Calculated) Full-flow area Full-flow wetted perimeter Half Central Angle Full-flow capacity Calculation of Normal Flow Condition | Af = Pf = Theta = Qf = | 3.14 6.28 3.14 26.84 | sq ft ft radians cfs |
| Half Central Angle (0 <theta<3.14)< td=""><td>Theta =</td><td>1.81</td><td>radians</td></theta<3.14)<> | Theta = | 1.81 | radians |
| Flow area | An = | 2.04 | sq ft |
| Top width | Tn = | 1.94 | ft |
| Wetted perimeter | Pn = | 3.62 | ft |
| Flow depth | Yn = | 1.24 | ft |
| Flow velocity | Vn = | 9.26 | fps |
| Discharge | Qn = | 18.90 | cfs |
| Percent of Full Flow | Flow = | 70.4% | of full flow |
| Normal Depth Froude Number | Fr _n = | 1.59 | supercritical |
| Calculation of Critical Flow Condition Half Central Angle (0 <theta-c<3.14)< td=""><td>Theta-c =</td><td>2.17</td><td>radians</td></theta-c<3.14)<> | Theta-c = | 2.17 | radians |
| Critical flow area | Ac = | 2.64 | sq ft |
| Critical top width | Tc = | 1.65 | ft |
| Critical flow depth | Yc = | 1.56 | ft |
| Critical flow velocity Critical Depth Froude Number | Vc = Fr _c = | 7.17 | fps |
| | | 1.00 | |

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| | Tc How Area D | ↓ ↓¥ | |
|--|------------------------|----------------------|---------------|
| Design Information (Input) | | | |
| Pipe Invert Slope | So = | 0.0300 | ft/ft |
| Pipe Manning's n-value | n = | 0.0130 | |
| Pipe Diameter | D = | 42.00 | inches |
| Design discharge | Q = | 80.40 | cfs |
| | | | |
| Full-Flow Capacity (Calculated) | | | |
| Full-flow area | Af = | 9.62 | sq ft |
| Full-flow wetted perimeter | Pf = | 11.00 | ft |
| Half Central Angle | Theta = | 3.14 | radians |
| Full-flow capacity | Qf = | 174.73 | cfs |
| Calculation of Normal Flow Condition | Theta = | 1.52 | radians |
| Half Central Angle (0 <theta<3.14) Flow area</theta<3.14) | An = | 4.52 | |
| | An = Tn = | | sq ft ft |
| Top width | Pn = | 3.50 | ft |
| Wetted perimeter | Yn = | 5.33 1.67 | ft |
| Flow depth | Vn = | - | |
| Flow velocity | On = | 17.78 80.40 | fps cfs |
| Discharge Percent of Full Flow | Flow = | | of full flow |
| Normal Depth Froude Number | FIOW = $Fr_n = $ | <u>46.0%</u> 2.76 | supercritical |
| | · · n – | 2.70 | supercifical |
| Calculation of Critical Flow Condition | | 0.01 | |
| Half Central Angle (0 <theta-c<3.14)< td=""><td>Theta-c =</td><td>2.21</td><td>radians</td></theta-c<3.14)<> | Theta-c = | 2.21 | radians |
| Critical flow area | Ac = | 8.25 | sq ft |
| Critical top width | Tc = | 2.80 | ft |
| Critical flow depth | Yc = | 2.80 | ft |
| Critical flow velocity | Vc = | 9.74 | fps |
| Critical Depth Froude Number | Fr _c = | 1.00 | |

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| r to | T ₀ H Aren D | ¢ ↓γ | |
|--|----------------------------------|---------|---------------|
| Design Information (Input) | | | |
| Pipe Invert Slope | So = | 0.0300 | ft/ft |
| Pipe Manning's n-value | n = | 0.0130 | |
| Pipe Diameter | D = | 42.00 | inches |
| Design discharge | Q = | 83.70 | cfs |
| | | | |
| Full-Flow Capacity (Calculated) | | | |
| Full-flow area | Af = | 9.62 | sq ft |
| Full-flow wetted perimeter | Pf = | 11.00 | ft |
| Half Central Angle | Theta = | 3.14 | radians |
| Full-flow capacity | Qf = | 174.73 | cfs |
| Calculation of Normal Flow Condition | | | |
| Half Central Angle (0 <theta<3.14)< td=""><td>Theta =</td><td>1.55</td><td>radians</td></theta<3.14)<> | Theta = | 1.55 | radians |
| Flow area | An = | 4.66 | sq ft |
| Top width | Tn = | 3.50 | sq n |
| Wetted perimeter | Pn = | 5.41 | ft |
| Flow depth | Yn = | 1.71 | ft |
| Flow velocity | Vn = | 17.97 | fps |
| Discharge | Qn = | 83.70 | cfs |
| Percent of Full Flow | Flow = | 47.9% | of full flow |
| Normal Depth Froude Number | $Fr_n =$ | 2.74 | supercritical |
| | | 2 | Cuporontiou |
| Calculation of Critical Flow Condition | | | |
| Half Central Angle (0 <theta-c<3.14)< td=""><td>Theta-c =</td><td>2.25</td><td>radians</td></theta-c<3.14)<> | Theta-c = | 2.25 | radians |
| Critical flow area | Ac = | 8.39 | sq ft |
| Critical top width | Tc = | 2.72 | ft |
| Critical flow depth | Yc = | 2.85 | ft |
| Critical flow velocity | Vc = | 9.97 | fps |
| Critical Depth Froude Number | Fr _c = | 1.00 | |

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| PI FI | Tc Orw Aren D | ļ ↓γ , | |
|--|------------------------|----------------------|---------------|
| Design Information (Input) | | | |
| Pipe Invert Slope | So = | 0.0100 | ft/ft |
| Pipe Manning's n-value | n = | 0.0130 | |
| Pipe Diameter | D = | 18.00 | inches |
| Design discharge | Q = | 1.80 | cfs |
| | | | |
| Full-Flow Capacity (Calculated) | | | |
| Full-flow area | Af = | 1.77 | sq ft |
| Full-flow wetted perimeter | Pf = | 4.71 | ft |
| Half Central Angle | Theta = | 3.14 | radians |
| Full-flow capacity | Qf = | 10.53 | cfs |
| Calculation of Normal Flow Condition | | 1 11 | |
| Half Central Angle (0 <theta<3.14)< td=""><td>Theta =</td><td>1.11</td><td>radians</td></theta<3.14)<> | Theta = | 1.11 | radians |
| Flow area | An = | 0.40 | sq ft |
| Top width | Tn = | 1.35 | ft |
| Wetted perimeter | Pn = | 1.67 | ft |
| Flow depth | Yn = Vn = | 0.42 | ft |
| Flow velocity | Vn = On = | 4.45 1.80 | fps cfs |
| Discharge | Flow = | | of full flow |
| Percent of Full Flow Normal Depth Froude Number | FIOW = $Fr_n = $ | <u>17.1%</u> 1.43 | supercritical |
| | • • n = | 1.45 | Supercifical |
| Calculation of Critical Flow Condition | | | |
| Half Central Angle (0 <theta-c<3.14)< td=""><td>Theta-c =</td><td>1.24</td><td>radians</td></theta-c<3.14)<> | Theta-c = | 1.24 | radians |
| Critical flow area | Ac = | 0.52 | sq ft |
| Critical top width | Tc = | 1.42 | ft |
| Critical flow depth | Yc = | 0.50 | ft |
| Critical flow velocity | Vc = | 3.45 | fps |
| Critical Depth Froude Number | $Fr_c =$ | 1.00 | |

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| Design Information (Input)Pipe Invert SlopeSo =0.01Pipe Manning's n-valuen =0.01Pipe DiameterD =Design dischargeQ =3.5Full-Flow Capacity (Calculated)Full-Flow areaAf =Full-flow wetted perimeterPf =Half Central AngleTheta =Full-flow capacityQf =10.5Calculation of Normal Flow ConditionHalf Central Angle (0 <theta<3.14)< td="">Theta =Flow areaAn =Top widthTn =Wetted perimeterPn =2.0Flow depthFlow velocityVn =5.3DischargePercent of Full FlowFlow =Normal Depth Froude NumberFr_n =1.4</theta<3.14)<> | |
|---|-------------------------|
| Pipe Manning's n-value $n = 0.01$ Pipe Diameter $D = 18.0$ Design discharge $Q = 3.5$ Full-Flow Capacity (Calculated) $Full-Flow Capacity (Calculated)$ Full-flow area $Af = 1.7$ Full-flow wetted perimeter $Pf = 4.7$ Half Central AngleTheta = 3.1Full-flow capacity $Qf = 10.3$ Calculation of Normal Flow Condition $An = 0.6$ Flow area $An = 0.6$ Top width $Tn = 1.4$ Wetted perimeter $Pn = 2.0$ Flow depth $Yn = 0.6$ Flow velocity $Vn = 5.3$ Discharge $Qn = 3.5$ Percent of Full FlowFlow = 33.2 | |
| Pipe Diameter $D =$ 18.0Design discharge $Q =$ 3.5 Full-Flow Capacity (Calculated) $Af =$ 1.7 Full-flow area $Af =$ 1.7 Half Central AngleTheta = 3.1 Full-flow capacity $Qf =$ 10.1 Calculation of Normal Flow Condition $Pf =$ 1.3 Flow area $An =$ 0.6 Top widthTn = 1.4 Wetted perimeter $Pn =$ 2.0 Flow depth $Yn =$ 0.6 Flow velocity $Vn =$ 5.3 Discharge $Qn =$ 3.5 Percent of Full FlowFlow = 33.2 | 00 ft/ft |
| Design discharge $Q =$ 3.5 Full-Flow Capacity (Calculated)Full-flow areaAf =Full-flow wetted perimeterPf =Half Central AngleTheta =Full-flow capacityQf =Calculation of Normal Flow ConditionHalf Central Angle (0 <theta<3.14)< td="">Flow areaAn =Top widthTn =Index (Condition flow areaFlow areaAn =Conduct the perimeterPn =Flow depthYn =Flow depthYn =StargeQn =Percent of Full FlowFlow =StargeStargePercent of Full FlowFlow =StargeStargePercent of Full FlowFlow =Starge<td>30</td></theta<3.14)<> | 30 |
| Full-Flow Capacity (Calculated)Full-flow areaAf =Full-flow wetted perimeterPf =Half Central AngleTheta =Start Colspan="2">Start Colspan="2">Start Colspan="2">Theta =Galculation of Normal Flow ConditionHalf Central Angle (0Theta =Half Central Angle (0Theta =Start Colspan="2">IntervalFlow areaAn =Top widthTn =Half Central Angle (0Theta =Start Colspan="2">Start Colspan="2">Theta =Start Colspan="2">Start Colspan="2">Theta =Start Colspan="2">Start Colspan="2">Start Colspan="2">Start Colspan="2">Theta =Start Colspan="2">Start Colspan="2">Sta | 00 inches |
| Full-flow area $Af =$ 1.7 Full-flow wetted perimeter $Pf =$ 4.7 Half Central AngleTheta = 3.1 Full-flow capacity $Qf =$ 10.9 Calculation of Normal Flow Condition $Mn =$ Half Central Angle (0 <theta<3.14)< td="">Theta =Flow area$An =$Top width$Tn =$Wetted perimeter$Pn =$Flow depth$Yn =$Flow velocity$Vn =$Starge$Qn =$Percent of Full Flow$Flow =$</theta<3.14)<> | i0 cfs |
| Full-flow areaAf1.7Full-flow wetted perimeterPf 4.7 Half Central AngleTheta 3.1 Full-flow capacityQf 10.5 Calculation of Normal Flow Condition $Mar = 1.3$ Half Central Angle (0 <theta<3.14)< td="">ThetaFlow areaAnTop widthTnWetted perimeterPnFlow depthYnFlow velocityVnDischargeQnPercent of Full Flow</theta<3.14)<> | |
| Full-flow wetted perimeter $Pf = 4.7$ Half Central AngleTheta = 3.1Full-flow capacity $Qf = 10.1$ Calculation of Normal Flow ConditionHalf Central Angle (0 <theta<3.14)< td="">Half Central Angle (0<theta<3.14)< td="">Flow areaTop widthTn = 1.4Wetted perimeterFlow depthFlow velocityVn = 5.3DischargePercent of Full FlowFlow = 33.2</theta<3.14)<></theta<3.14)<> | 7 |
| Half Central AngleTheta = 3.1 Full-flow capacityQf = 10.9 Calculation of Normal Flow ConditionHalf Central Angle (0 <theta<3.14)< td="">Theta =Flow areaAn =0.6Top widthTn =1.4Wetted perimeterPn =2.0Flow depthYn =0.6Flow velocityVn =5.3DischargeQn =3.5Percent of Full FlowFlow =33.2</theta<3.14)<> | |
| Full-flow capacity $Qf = 10.5$ Calculation of Normal Flow ConditionHalf Central Angle (0 <theta<3.14)< td="">Flow areaTop widthTop widthWetted perimeterFlow depthFlow velocityDischargeQuerter of Full FlowF</theta<3.14)<> | |
| Calculation of Normal Flow ConditionHalf Central Angle (0 <theta<3.14)< td="">Theta =1.3Flow areaAn =0.6Top widthTn =1.4Wetted perimeterPn =2.0Flow depthYn =0.6Flow velocityVn =5.3DischargeQn =3.5Percent of Full FlowFlow =33.2</theta<3.14)<> | |
| Half Central Angle (0 <theta<3.14)< th="">Theta =1.3Flow areaAn =0.6Top widthTn =1.4Wetted perimeterPn =2.0Flow depthYn =0.6Flow velocityVn =5.3DischargeQn =3.5Percent of Full FlowFlow =33.2</theta<3.14)<> | 53 cfs |
| Half Central Angle (0 <theta<3.14)< th="">Theta =1.3Flow areaAn =0.6Top widthTn =1.4Wetted perimeterPn =2.0Flow depthYn =0.6Flow velocityVn =5.3DischargeQn =3.5Percent of Full FlowFlow =33.2</theta<3.14)<> | |
| Flow area $An = 0.6$ Top width $Tn = 1.4$ Wetted perimeter $Pn = 2.0$ Flow depth $Yn = 0.6$ Flow velocity $Vn = 5.3$ Discharge $Qn = 3.5$ Percent of Full FlowFlow = 33.2 | 6 radians |
| Wetted perimeter $Pn = 2.0$ Flow depth $Yn = 0.6$ Flow velocity $Vn = 5.3$ Discharge $Qn = 3.5$ Percent of Full FlowFlow = 33.2 | |
| Wetted perimeter $Pn = 2.0$ Flow depth $Yn = 0.6$ Flow velocity $Vn = 5.3$ Discharge $Qn = 3.5$ Percent of Full FlowFlow = 33.2 | |
| Flow depth $Yn = 0.6$ Flow velocity $Vn = 5.3$ Discharge $Qn = 3.5$ Percent of Full FlowFlow = 33.2 |)4 ft |
| Flow velocity $Vn = 5.3$ Discharge $Qn = 3.5$ Percent of Full FlowFlow = 33.2 | o0 ft |
| Discharge Qn = 3.5 Percent of Full Flow Flow = 33.2 | 6 fps |
| | |
| Normal Depth Froude Number $Fr_{-} = 1.4$ | of full flow |
| | 1 supercritical |
| Calculation of Critical Flow Condition | |
| Half Central Angle (0 <theta-c<3.14) theta-c="1.5</td"><td></td></theta-c<3.14)> | |
| Critical flow area $Ac = 0.8$ | 2 radians |
| Critical top width Tc = 1.5 | |
| Critical flow depth $Yc = 0.7$ | sq ft |
| Critical flow velocity $Vc = 4.2$ | sq ft 0 ft |
| Critical Depth Froude Number $Fr_c = 1.0$ | 3 sq ft 0 ft 1 ft |

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| | Tc OTV ATEN D | ↓ ↓v | |
|--|------------------------|---------|---------------|
| Design Information (Input) | | | |
| Pipe Invert Slope | So = | 0.0100 | ft/ft |
| Pipe Manning's n-value | n = | 0.0130 | |
| Pipe Diameter | D = | 18.00 | inches |
| Design discharge | Q = | 5.30 | cfs |
| Full-Flow Capacity (Calculated) | | | |
| Full-flow area | Af = | 1.77 | sq ft |
| Full-flow wetted perimeter | Pf = | 4.71 | ft |
| Half Central Angle | Theta = | 3.14 | radians |
| Full-flow capacity | Qf = | 10.53 | cfs |
| Calculation of Normal Flow Condition | | | |
| Half Central Angle (0 <theta<3.14)< td=""><td>Theta =</td><td>1.57</td><td>radians</td></theta<3.14)<> | Theta = | 1.57 | radians |
| Flow area | An = | 0.89 | sq ft |
| Top width | Tn = | 1.50 | ft |
| Wetted perimeter | Pn = | 2.36 | ft |
| Flow depth | Yn = | 0.75 | ft |
| Flow velocity | Vn = | 5.97 | fps |
| Discharge | Qn = | 5.30 | cfs |
| Percent of Full Flow | Flow = | 50.3% | of full flow |
| Normal Depth Froude Number | Fr _n = | 1.37 | supercritical |
| Calculation of Critical Flow Condition | | | |
| Half Central Angle (0 <theta-c<3.14)< td=""><td>Theta-c =</td><td>1.75</td><td>radians</td></theta-c<3.14)<> | Theta-c = | 1.75 | radians |
| Critical flow area | Ac = | 1.09 | sq ft |
| Critical top width | Tc = | 1.47 | ft |
| Critical flow depth | Yc = | 0.89 | ft |
| Critical flow velocity | Vc = | 4.87 | fps |
| Critical Depth Froude Number | Fr _c = | 1.00 | |

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| r | Tc low Area | ļ ↓γ | |
|--|-------------------|---------|---------------|
| Design Information (Input) | | | |
| Pipe Invert Slope | So = | 0.0100 | ft/ft |
| Pipe Manning's n-value | n = | 0.0130 | |
| Pipe Diameter | D = | 24.00 | inches |
| Design discharge | Q = | 12.80 | cfs |
| | | | |
| Full-Flow Capacity (Calculated) | | | |
| Full-flow area | Af = | 3.14 | sq ft |
| Full-flow wetted perimeter | Pf = | 6.28 | ft |
| Half Central Angle | Theta = | 3.14 | radians |
| Full-flow capacity | Qf = | 22.68 | cfs |
| Calculation of Normal Flow Condition | | | |
| Half Central Angle (0 <theta<3.14)< td=""><td>Theta =</td><td>1.65</td><td>radians</td></theta<3.14)<> | Theta = | 1.65 | radians |
| Flow area | An = | 1.72 | sq ft |
| Top width | Tn = | 1.99 | ft |
| Wetted perimeter | Pn = | 3.29 | ft |
| Flow depth | Yn = | 1.08 | ft |
| Flow velocity | Vn = | 7.44 | fps |
| Discharge | Qn = | 12.80 | cfs |
| Percent of Full Flow | Flow = | 56.4% | of full flow |
| Normal Depth Froude Number | Fr _n = | 1.41 | supercritical |
| Calculation of Critical Flow Condition | | | |
| Half Central Angle (0 <theta-c<3.14)< td=""><td>Theta-c =</td><td>1.86</td><td>radians</td></theta-c<3.14)<> | Theta-c = | 1.86 | radians |
| Critical flow area | Ac = | 2.14 | sq ft |
| Critical top width | Tc = | 1.92 | ft |
| Critical flow depth | Yc = | 1.29 | ft |
| Critical flow velocity | Vc = | 5.99 | fps |
| Critical Depth Froude Number | Fr _c = | 1.00 | |
| | - | | |

MHFD-Culvert, Version 4.00 (May 2020)

| | T _c Θ angle Area D | Ŷ | |
|--|---|--------|---------------|
| Design Information (Input) | | | |
| Pipe Invert Slope | So = | 0.0200 | ft/ft |
| Pipe Manning's n-value | n = | 0.0130 | |
| Pipe Diameter | D = | 24.00 | inches |
| Design discharge | Q = | 18.10 | cfs |
| Full-Flow Capacity (Calculated) | | | |
| Full-flow area | Af = | 3.14 | sq ft |
| Full-flow wetted perimeter | Pf = | 6.28 | sq n |
| Half Central Angle | Theta = | 3.14 | radians |
| Full-flow capacity | Qf = | 32.08 | cfs |
| Calculation of Normal Flow Condition Half Central Angle (0 <theta<3.14)< td=""><td>Theta =</td><td>1.65</td><td>radians</td></theta<3.14)<> | Theta = | 1.65 | radians |
| Flow area | An = | 1.72 | sq ft |
| Top width | Tn = | 1.99 | ft |
| Wetted perimeter | Pn = | 3.29 | ft |
| Flow depth | Yn = | 1.08 | ft |
| Flow velocity | Vn = | 10.52 | fps |
| Discharge | Qn = | 18.10 | cfs |
| Percent of Full Flow | Flow = | 56.4% | of full flow |
| Normal Depth Froude Number | Fr _n = | 2.00 | supercritical |
| Calculation of Critical Flow Condition | | | |
| Half Central Angle (0 <theta-c<3.14)< td=""><td>Theta-c =</td><td>2.13</td><td>radians</td></theta-c<3.14)<> | Theta-c = | 2.13 | radians |
| Critical flow area | Ac = | 2.58 | sq ft |
| Critical top width | Tc = | 1.69 | ft |
| Critical flow depth | Yc = | 1.53 | ft |
| Critical flow velocity | Vc = | 7.01 | fps |
| Critical Depth Froude Number | Fr _c = | 1.00 | |

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| PI FI | Tc Orw angle Aren D | ↓ ↓¥ | |
|--|---------------------------|---------|---------------|
| Design Information (Input) | | | |
| Pipe Invert Slope | So = | 0.0300 | ft/ft |
| Pipe Manning's n-value | n = | 0.0130 | |
| Pipe Diameter | D = | 24.00 | inches |
| Design discharge | Q = | 27.90 | cfs |
| | | | |
| Full-Flow Capacity (Calculated) | | | |
| Full-flow area | Af = | 3.14 | sq ft |
| Full-flow wetted perimeter | Pf = | 6.28 | ft |
| Half Central Angle | Theta = | 3.14 | radians |
| Full-flow capacity | Qf = | 39.29 | cfs |
| Calculation of Normal Flow Condition | | | |
| Half Central Angle (0 <theta<3.14)< td=""><td>Theta =</td><td>1.82</td><td>radians</td></theta<3.14)<> | Theta = | 1.82 | radians |
| Flow area | An = | 2.06 | sq ft |
| Top width | Tn = | 1.94 | ft |
| Wetted perimeter | Pn = | 3.64 | ft |
| Flow depth | Yn = | 1.24 | ft |
| Flow velocity | Vn = | 13.57 | fps |
| Discharge | Qn = | 27.90 | cfs |
| Percent of Full Flow | Flow = | 71.0% | of full flow |
| Normal Depth Froude Number | Fr _n = | 2.32 | supercritical |
| Calculation of Critical Flow Condition | | | |
| Half Central Angle (0 <theta-c<3.14)< td=""><td>Theta-c =</td><td>2.54</td><td>radians</td></theta-c<3.14)<> | Theta-c = | 2.54 | radians |
| Critical flow area | Ac = | 3.01 | sq ft |
| Critical top width | Tc = | 1.13 | ft |
| Critical flow depth | Yc = | 1.83 | ft |
| Critical flow velocity | Vc = | 9.27 | fps |
| Critical Depth Froude Number | Fr _c = | 1.00 | |
| | | | |

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Project: Monument Ridge East Pipe ID: PIPE 29 POND 2 OUT

| PI E | Tc Orv Area D | ↓¥ | |
|--|------------------------|--------|---------------|
| Design Information (Input) | | | |
| Pipe Invert Slope | So = | 0.0550 | ft/ft |
| Pipe Manning's n-value | n = | 0.0130 | |
| Pipe Diameter | D = | 24.00 | inches |
| Design discharge | Q = | 28.30 | cfs |
| Full-Flow Capacity (Calculated) | | | |
| Full-flow area | Af = | 3.14 | sq ft |
| Full-flow wetted perimeter | Pf = | 6.28 | ft |
| Half Central Angle | Theta = | 3.14 | radians |
| Full-flow capacity | Qf = | 53.20 | cfs |
| Calculation of Normal Flow Condition | | | |
| Half Central Angle (0 <theta<3.14)< td=""><td>Theta =</td><td>1.61</td><td>radians</td></theta<3.14)<> | Theta = | 1.61 | radians |
| Flow area | An = | 1.65 | sq ft |
| Top width | Tn = | 2.00 | ft |
| Wetted perimeter | Pn = | 3.22 | ft |
| Flow depth | Yn = | 1.04 | ft |
| Flow velocity | Vn = | 17.20 | fps |
| Discharge | Qn = | 28.30 | cfs |
| Percent of Full Flow | Flow = | 53.2% | of full flow |
| Normal Depth Froude Number | Fr _n = | 3.34 | supercritical |
| Calculation of Critical Flow Condition | | | |
| Half Central Angle (0 <theta-c<3.14)< td=""><td>Theta-c =</td><td>2.56</td><td>radians</td></theta-c<3.14)<> | Theta-c = | 2.56 | radians |
| Critical flow area | Ac = | 3.02 | sq ft |
| Critical top width | Tc = | 1.10 | ft |
| Critical flow depth | Yc = | 1.83 | ft |
| Critical flow velocity | Vc = | 9.38 | fps |
| Critical Depth Froude Number | Fr _c = | 1.00 | |
| | L | | |

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| Flor | T _c H Area D | ¢ ↓γ | |
|--|----------------------------------|---------|---------------|
| Design Information (Input) | | | |
| Pipe Invert Slope | So = | 0.0080 | ft/ft |
| Pipe Manning's n-value | n = | 0.0130 | |
| Pipe Diameter | D = | 30.00 | inches |
| Design discharge | Q = | 19.50 | cfs |
| | | | |
| Full-Flow Capacity (Calculated) | . — | | |
| Full-flow area | Af = | 4.91 | sq ft |
| Full-flow wetted perimeter | Pf = | 7.85 | ft |
| Half Central Angle | Theta = | 3.14 | radians |
| Full-flow capacity | Qf = | 36.79 | cfs |
| Calculation of Normal Flow Condition | | | |
| Half Central Angle (0 <theta<3.14)< td=""><td>Theta =</td><td>1.61</td><td>radians</td></theta<3.14)<> | Theta = | 1.61 | radians |
| Flow area | An = | 2.56 | sq ft |
| Top width | Tn = | 2.50 | ft |
| Wetted perimeter | Pn = | 4.02 | ft |
| Flow depth | Yn = | 1.29 | ft |
| Flow velocity | Vn = | 7.60 | fps |
| Discharge | Qn = | 19.50 | cfs |
| Percent of Full Flow | Flow = | 53.0% | of full flow |
| Normal Depth Froude Number | $Fr_n =$ | 1.32 | supercritical |
| Calculation of Critical Flow Condition | | | |
| Half Central Angle (0 <theta-c<3.14)< td=""><td>Theta-c =</td><td>1.77</td><td>radians</td></theta-c<3.14)<> | Theta-c = | 1.77 | radians |
| Critical flow area | Ac = | 3.07 | sq ft |
| Critical top width | Tc = | 2.45 | ft |
| Critical flow depth | Yc = | 1.50 | ft |
| Critical flow velocity | Vc = | 6.35 | fps |
| Critical Depth Froude Number | $Fr_c =$ | 1.00 | |

MHFD-Culvert, Version 4.00 (May 2020)

| | Tc OTV Area D | ↓¥ | |
|--|------------------------|--------|--------------|
| Design Information (Input) | | | |
| Pipe Invert Slope | So = | 0.0050 | ft/ft |
| Pipe Manning's n-value | n = | 0.0130 | |
| Pipe Diameter | D = | 36.00 | inches |
| Design discharge | Q = | 35.90 | cfs |
| Full-Flow Capacity (Calculated) | | | |
| Full-flow area | Af = | 7.07 | sq ft |
| Full-flow wetted perimeter | Pf = | 9.42 | ft |
| Half Central Angle | Theta = | 3.14 | radians |
| Full-flow capacity | Qf = | 47.29 | cfs |
| Calculation of Normal Flow Condition | | 17.27 | |
| Half Central Angle (0 <theta<3.14)< td=""><td>Theta =</td><td>1.88</td><td>radians</td></theta<3.14)<> | Theta = | 1.88 | radians |
| Flow area | An = | 4.88 | sq ft |
| Top width | Tn = | 2.86 | ft |
| Wetted perimeter | Pn = | 5.64 | ft |
| Flow depth | Yn = | 1.96 | ft |
| Flow velocity | Vn = | 7.36 | fps |
| Discharge | Qn = | 35.90 | cfs |
| Percent of Full Flow | Flow = | 75.9% | of full flow |
| Normal Depth Froude Number | Fr _n = | 0.99 | subcritical |
| Calculation of Critical Flow Condition | | | |
| Half Central Angle (0 <theta-c<3.14)< td=""><td>Theta-c =</td><td>1.87</td><td>radians</td></theta-c<3.14)<> | Theta-c = | 1.87 | radians |
| Critical flow area | Ac = | 4.86 | sq ft |
| Critical top width | Tc = | 2.86 | ft |
| Critical flow depth | Yc = | 1.95 | ft |
| Critical flow velocity | Vc = | 7.39 | fps |
| Critical Depth Froude Number | Fr _c = | 1.00 | |

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Project: Monument Ridge East Pipe ID: PIPE 32 POND 3 OUT

| Pla | Tc O Area D | Ŷ | |
|--|----------------------|--------|--------------|
| Design Information (Input) | | | |
| Pipe Invert Slope | So = | 0.0050 | ft/ft |
| Pipe Manning's n-value | n = | 0.0130 | |
| Pipe Diameter | D = | 18.00 | inches |
| Design discharge | Q = | 5.80 | cfs |
| Full-Flow Capacity (Calculated) | | | |
| Full-flow area | Af = | 1.77 | sq ft |
| Full-flow wetted perimeter | Pf = | 4.71 | ft |
| Half Central Angle | Theta = | 3.14 | radians |
| Full-flow capacity | Qf = | 7.45 | cfs |
| Calculation of Normal Flow Condition | | | |
| Half Central Angle (0 <theta<3.14)< td=""><td>Theta =</td><td>1.90</td><td>radians</td></theta<3.14)<> | Theta = | 1.90 | radians |
| Flow area | An = | 1.24 | sq ft |
| Top width | Tn = | 1.42 | ft |
| Wetted perimeter | Pn = | 2.86 | ft |
| Flow depth | Yn = | 1.00 | ft |
| Flow velocity | Vn = | 4.66 | fps |
| Discharge | Qn = | 5.80 | cfs |
| Percent of Full Flow | Flow = | 77.9% | of full flow |
| Normal Depth Froude Number | Fr _n = | 0.88 | subcritical |
| Calculation of Critical Flow Condition | | | |
| Half Central Angle (0 <theta-c<3.14)< td=""><td>Theta-c =</td><td>1.81</td><td>radians</td></theta-c<3.14)<> | Theta-c = | 1.81 | radians |
| Critical flow area | Ac = | 1.15 | sq ft |
| Critical top width | Tc = | 1.46 | ft |
| Critical flow depth | Yc = | 0.93 | ft |
| Critical flow velocity | Vc = | 5.04 | fps |
| Critical Depth Froude Number | Fr _c = | 1.00 | |

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| r to | T _c | ¢ ↓γ | |
|--|-------------------|---------|---------------|
| Design Information (Input) | | | |
| Pipe Invert Slope | So = | 0.0080 | ft/ft |
| Pipe Manning's n-value | n = | 0.0130 | |
| Pipe Diameter | D = | 36.00 | inches |
| Design discharge | Q = | 34.10 | cfs |
| | | | |
| Full-Flow Capacity (Calculated) | | | |
| Full-flow area | Af = | 7.07 | sq ft |
| Full-flow wetted perimeter | Pf = | 9.42 | ft |
| Half Central Angle | Theta = | 3.14 | radians |
| Full-flow capacity | Qf = | 59.82 | cfs |
| Calculation of Normal Flow Condition | | | |
| Half Central Angle (0 <theta<3.14)< td=""><td>Theta =</td><td>1.65</td><td>radians</td></theta<3.14)<> | Theta = | 1.65 | radians |
| Flow area | An = | 3.90 | sq ft |
| Top width | Tn = | 2.99 | ft |
| Wetted perimeter | Pn = | 4.96 | ft |
| Flow depth | Yn = | 1.62 | |
| Flow velocity | Vn = | 8.74 | fps |
| Discharge | Qn = | 34.10 | cfs |
| Percent of Full Flow | Flow = | 57.0% | of full flow |
| Normal Depth Froude Number | Fr _n = | 1.35 | supercritical |
| Calculation of Critical Flow Condition | | | |
| Half Central Angle (0 <theta-c<3.14)< td=""><td>Theta-c =</td><td>1.84</td><td>radians</td></theta-c<3.14)<> | Theta-c = | 1.84 | radians |
| Critical flow area | Ac = | 4.71 | sq ft |
| Critical top width | Tc = | 2.89 | ft |
| Critical flow depth | Yc = | 1.90 | ft |
| Critical flow velocity | Vc = | 7.24 | fps |
| Critical Depth Froude Number | $Fr_{c} =$ | 1.00 | |

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| Design Information (Input)Pipe Invert SlopeSo = 0.0090 ft/ftPipe Manning's n-valuen = 0.0130 inchesPipe DiameterD = 36.00 inchesDesign dischargeQ = 34.10 cfsFull-Flow Capacity (Calculated)Fill-flow wated perimeterPf = 9.42 Full-flow wated perimeterPf = 9.42 ftHalf Central AngleTheta = 3.14 radiansFull-flow capacityOf = 63.45 cfsCalculation of Normal Flow ConditionTheta = 1.61 radiansHow areaAn = 3.73 sq ftFlow areaPn = 4.84 ftFlow areaPn = 4.84 ftFlow depthYn = 1.57 ftFlow depthYn = 1.57 ftFlow velocityUn = 9.14 fpsDischargeQn = 34.10 cfsPercent of Full FlowFlow = 53.8% of full flowNormal Depth Froude NumberFr _n = 1.84 radiansCalculation of Critical Flow ConditionTheta-c = 1.84 radiansHalf Central Angle (0 <theta-c<3.14)< td="">Theta-c =1.84radiansCritical flow areaAc =4.71sq ft</theta-c<3.14)<> | Flow angle V Area D | |
|--|---------------------------------------|---|
| Pipe Manning's n-value $n =$ 0.0130 Pipe Diameter $D =$ 36.00 inchesDesign discharge $Q =$ 34.10 cfsFull-Flow Capacity (Calculated) $Pf =$ 9.42 ftFull-flow wetted perimeter $Pf =$ 9.42 ftHalf Central AngleTheta = 3.14 radiansFull-flow capacity $Qf =$ 63.45 cfsCalculation of Normal Flow Condition $An =$ 3.73 sq ftHalf Central Angle (0 <theta<3.14)< td="">Theta =1.61radiansFlow area$An =$$3.73$sq ftTop width$Tn =$$3.00$ftWetted perimeter$Pn =$$4.84$ftFlow depth$Yn =$$1.57$ftFlow velocity$Vn =$$9.14$fpsDischarge$Qn =$$34.10$cfsPercent of Full Flow$Pn =$$1.44$supercriticalCalculation of Critical Flow Condition$Fr_n =$$1.44$supercriticalHalf Central Angle (0<theta-c<3.14)< td="">Theta-c =1.84radiansCritical flow area$Ac =$$4.71$sq ft</theta-c<3.14)<></theta<3.14)<> | | sign Information (Input) |
| Pipe Diameter $D =$ 36.00 inchesDesign discharge $Q =$ 34.10 cfsFull-Flow Capacity (Calculated)Full-flow area $Af =$ 7.07 sq ftFull-flow wetted perimeter $Pf =$ 9.42 ftHalf Central AngleTheta = 3.14 radiansFull-flow capacity $Qf =$ 63.45 cfsCalculation of Normal Flow ConditionHalf Central Angle (0 <theta<3.14)< td="">Theta =1.61Half Central Angle (0<theta<3.14)< td="">Theta =1.61radiansFlow areaAn =$3.73$$sq$ ftTop widthTn =3.00ftWetted perimeterPn =4.84ftFlow depthYn =1.57ftFlow velocityVn =9.14fpsDischargeQn =34.10cfsPercent of Full FlowFlow =53.8%of full flowNormal Depth Froude Number$Fr_n =$$1.44$supercriticalCalculation of Critical Flow ConditionHalf Central Angle (0<theta-c<3.14)< td="">Theta-c =1.84radiansCritical flow areaAc =4.71sq ftaf</theta-c<3.14)<></theta<3.14)<></theta<3.14)<> | So = 0.0090 ft/ft | be Invert Slope |
| Pipe Diameter $D =$ 36.00 inchesDesign discharge $Q =$ 34.10 cfsFull-Flow Capacity (Calculated)Full-flow area $Af =$ 7.07 sq ftFull-flow wetted perimeter $Pf =$ 9.42 ftHalf Central AngleTheta = 3.14 radiansFull-flow capacity $Qf =$ 63.45 cfsCalculation of Normal Flow ConditionHalf Central Angle (0 <theta<3.14)< td="">Theta =1.61Half Central Angle (0<theta<3.14)< td="">Theta =1.61radiansFlow areaAn =$3.73$$sq$ ftTop widthTn =3.00ftWetted perimeterPn =4.84ftFlow depthYn =1.57ftFlow velocityVn =9.14fpsDischargeQn =34.10cfsPercent of Full FlowFlow =53.8%of full flowNormal Depth Froude Number$Fr_n =$$1.44$supercriticalCalculation of Critical Flow ConditionHalf Central Angle (0<theta-c<3.14)< td="">Theta-c =1.84radiansCritical flow areaAc =4.71sq ftaf</theta-c<3.14)<></theta<3.14)<></theta<3.14)<> | n = 0.0130 | |
| Full-Flow Capacity (Calculated)Full-Flow areaAf = 7.07 sq ftFull-flow wetted perimeterPf = 9.42 ftHalf Central AngleTheta = 3.14 radiansFull-flow capacityQf = 63.45 cfsCalculation of Normal Flow ConditionHalf Central Angle (0 <theta<3.14)< td="">Theta =1.61Half Central Angle (0<theta<3.14)< td="">Theta =1.61radiansFlow areaAn =3.73sq ftTop widthTn =3.00ftWetted perimeterPn =4.84ftFlow depthYn =1.57ftFlow velocityUn =9.14fpsDischargeQn =34.10cfsPercent of Full FlowFlow =53.8%of full flowNormal Depth Froude NumberFr_n =1.44supercriticalCalculation of Critical Flow ConditionHalf Central Angle (0<theta-c<< td="">3.14Half Central Angle (0<theta-c<< td="">3.14Theta-c =1.84Critical flow areaAc =4.71sq ft</theta-c<<></theta-c<<></theta<3.14)<></theta<3.14)<> | D = 36.00 inches | |
| Full-flow areaAf = 7.07 sq ftFull-flow wetted perimeterPf = 9.42 ftHalf Central AngleTheta = 3.14 radiansFull-flow capacityQf = 63.45 cfsCalculation of Normal Flow ConditionTheta = 1.61 radiansHalf Central Angle (0 <theta<<math>3.14)Theta =1.61radiansFlow areaAn =3.73sq ftTop widthTn =3.00ftWetted perimeterPn =4.84ftFlow depthYn =1.57ftFlow velocityVn =9.14fpsDischargeQn =34.10cfsPercent of Full FlowFlow =53.8%of full flowNormal Depth Froude NumberFr_n =1.44supercriticalHalf Central Angle (0<theta-c<3.14)< td="">Theta-c =1.84radiansCalculation of Critical Flow ConditionAc =4.71sq ft</theta-c<3.14)<></theta<<math> | Q = 34.10 cfs | sign discharge |
| Full-flow areaAf = 7.07 sq ftFull-flow wetted perimeterPf = 9.42 ftHalf Central AngleTheta = 3.14 radiansFull-flow capacityQf = 63.45 cfsCalculation of Normal Flow ConditionTheta = 1.61 radiansHalf Central Angle (0 <theta<<math>3.14)Theta =1.61radiansFlow areaAn =3.73sq ftTop widthTn =3.00ftWetted perimeterPn =4.84ftFlow depthYn =1.57ftFlow velocityVn =9.14fpsDischargeQn =34.10cfsPercent of Full FlowFlow =53.8%of full flowNormal Depth Froude NumberFr_n =1.44supercriticalHalf Central Angle (0<theta-c<3.14)< td="">Theta-c =1.84radiansCalculation of Critical Flow ConditionAc =4.71sq ft</theta-c<3.14)<></theta<<math> | | |
| Full-flow wetted perimeter $Pf =$ 9.42 ftHalf Central AngleTheta = 3.14 radiansFull-flow capacity $Qf =$ 63.45 cfs Calculation of Normal Flow ConditionHalf Central Angle (0 <theta<3.14)< td="">Theta =1.61radiansFlow areaAn =$3.73$$sq$ ftTop widthTn =3.00ftWetted perimeterPn =4.84ftFlow depthYn =1.57ftFlow velocityVn =9.14fpsDischargeQn =34.10cfsPercent of Full FlowFlow =53.8%of full flowNormal Depth Froude NumberFr_n =1.44supercriticalCalculation of Critical Flow ConditionHalf Central Angle (0<theta-c<3.14)< td="">Theta-c =1.84Half Central Angle (0<theta-c<3.14)< td="">Theta-c =1.84radiansCritical flow areaAc =4.71sq ft</theta-c<3.14)<></theta-c<3.14)<></theta<3.14)<> | · · · · · · · · · · · · · · · · · · · | |
| Half Central AngleTheta = 3.14 radiansFull-flow capacity $Qf = 63.45$ cfsCalculation of Normal Flow ConditionHalf Central Angle (0 <theta<3.14)< td="">Theta =1.61radiansHalf Central Angle (0<theta<3.14)< td="">Theta =1.61radiansFlow areaAn =3.73sq ftTop widthTn =3.00ftWetted perimeterPn =4.84ftFlow depthYn =1.57ftFlow velocityVn =9.14fpsDischargeQn =34.10cfsPercent of Full FlowFlow =53.8%of full flowNormal Depth Froude Number$Fr_n =$$1.44$supercriticalCalculation of Critical Flow ConditionTheta-c =1.84radiansHalf Central Angle (0<theta-c<3.14)< td="">Theta-c =1.84radiansCritical flow areaAc =4.71sq ft</theta-c<3.14)<></theta<3.14)<></theta<3.14)<> | | |
| Full-flow capacity $Qf = 63.45$ cfsCalculation of Normal Flow ConditionHalf Central Angle (0 <theta<3.14)< td="">Theta = 1.61radiansFlow areaAn = 3.73sq ftTop widthTn = 3.00ftWetted perimeterPn = 4.84ftFlow depthYn = 1.57ftFlow velocityVn = 9.14fpsDischargeQn = 34.10cfsPercent of Full FlowFlow = 53.8%of full flowNormal Depth Froude NumberFrn = 1.44supercriticalCalculation of Critical Flow ConditionTheta-c = 1.84radiansHalf Central Angle (0<theta-c<3.14)< td="">Theta-c = 4.71sq ft</theta-c<3.14)<></theta<3.14)<> | Pf = 9.42 ft | - |
| Calculation of Normal Flow ConditionHalf Central Angle (0 <theta<3.14)< td="">Theta =1.61radiansFlow areaAn =3.73sq ftTop widthTn =3.00ftWetted perimeterPn =4.84ftFlow depthYn =1.57ftFlow velocityVn =9.14fpsDischargeQn =34.10cfsPercent of Full FlowFlow =53.8%of full flowNormal Depth Froude NumberFr_n =1.44supercriticalCalculation of Critical Flow ConditionTheta-c =1.84radiansHalf Central Angle (0<theta-c<3.14)< td="">Theta-c =1.84radiansCritical flow areaAc =4.71sq ft</theta-c<3.14)<></theta<3.14)<> | Theta = 3.14 radians | 5 |
| Half Central Angle (0 <theta<3.14)< th="">Theta =1.61radiansFlow areaAn =3.73sq ftTop widthTn =3.00ftWetted perimeterPn =4.84ftFlow depthYn =1.57ftFlow velocityVn =9.14fpsDischargeQn =34.10cfsPercent of Full FlowFlow =53.8%of full flowNormal Depth Froude NumberFr_n =1.44supercriticalCalculation of Critical Flow ConditionTheta-c =1.84radiansHalf Central Angle (0<theta-c<3.14)< td="">Theta-c =1.84radiansCritical flow areaAc =4.71sq ft</theta-c<3.14)<></theta<3.14)<> | Qf = 63.45 cfs | II-flow capacity |
| Flow areaAn = 3.73 sq ftTop widthTn = 3.00 ftWetted perimeterPn = 4.84 ftFlow depthYn = 1.57 ftFlow velocityVn = 9.14 fpsDischargeQn = 34.10 cfsPercent of Full FlowFlow = 53.8% of full flowNormal Depth Froude NumberFr _n = 1.44 supercriticalCalculation of Critical Flow ConditionTheta-c = 1.84 radiansHalf Central Angle (0 <theta-c<3.14)< td="">Theta-c =1.84radiansCritical flow areaAc =4.71sq ft</theta-c<3.14)<> | | |
| Top widthTn = 3.00 ftWetted perimeterPn = 4.84 ftFlow depthYn = 1.57 ftFlow velocityVn = 9.14 fpsDischargeQn = 34.10 cfsPercent of Full FlowFlow = 53.8% of full flowNormal Depth Froude NumberFr _n = 1.44 supercriticalCalculation of Critical Flow ConditionTheta-c = 1.84 radiansHalf Central Angle (0 <theta-c<3.14)< td="">Theta-c =1.84radiansCritical flow areaAc =4.71sq ft</theta-c<3.14)<> | | - |
| Wetted perimeter $Pn =$ 4.84ftFlow depth $Yn =$ 1.57ftFlow velocity $Vn =$ 9.14fpsDischarge $Qn =$ 34.10cfsPercent of Full FlowFlow =53.8%of full flowNormal Depth Froude Number $Fr_n =$ 1.44supercriticalCalculation of Critical Flow ConditionTheta-c =1.84radiansHalf Central Angle (0 <theta-c<3.14)< td="">Theta-c =1.84radiansCritical flow areaAc =4.71sq ft</theta-c<3.14)<> | | |
| Flow depth $Yn =$ 1.57ftFlow velocity $Vn =$ 9.14 fpsDischarge $Qn =$ 34.10 cfsPercent of Full FlowFlow = 53.8% of full flowNormal Depth Froude Number $Fr_n =$ 1.44 supercriticalCalculation of Critical Flow ConditionHalf Central Angle (0 <theta-c<3.14)< td="">Theta-c =1.84Critical flow areaAc =4.71sq ft</theta-c<3.14)<> | | - |
| Flow velocity $Vn =$ 9.14 fpsDischarge $Qn =$ 34.10 cfsPercent of Full Flow $Flow =$ 53.8% of full flowNormal Depth Froude Number $Fr_n =$ 1.44 supercriticalCalculation of Critical Flow ConditionHalf Central Angle (0 <theta-c<3.14)< td="">Theta-c =1.84Critical flow area$Ac =$$4.71$sq ft</theta-c<3.14)<> | | • |
| Discharge $Qn = 34.10$ cfsPercent of Full FlowFlow = 53.8%of full flowNormal Depth Froude Number $Fr_n = 1.44$ supercriticalCalculation of Critical Flow ConditionHalf Central Angle (0 <theta-c<3.14)< td="">Theta-c = 1.84Critical flow areaAc = 4.71sq ft</theta-c<3.14)<> | Yn = <u>1.57</u> ft | |
| Percent of Full FlowFlow = 53.8% of full flowNormal Depth Froude Number $Fr_n =$ 1.44 supercriticalCalculation of Critical Flow ConditionHalf Central Angle (0 <theta-c<3.14)< td="">Theta-c =1.84radiansCritical flow areaAc =4.71sq ft</theta-c<3.14)<> | | ow velocity |
| Normal Depth Froude Number $Fr_n =$ 1.44supercriticalCalculation of Critical Flow ConditionHalf Central Angle (0 <theta-c<3.14)< td="">Theta-c =1.84radiansCritical flow areaAc =4.71sq ft</theta-c<3.14)<> | Qn = 34.10 cfs | 0 |
| Calculation of Critical Flow ConditionHalf Central Angle (0 <theta-c<3.14)< td="">Critical flow areaAc = 4.71Sq ft</theta-c<3.14)<> | | |
| Half Central Angle (0 <theta-c<3.14)< th="">Theta-c =1.84radiansCritical flow areaAc =4.71sq ft</theta-c<3.14)<> | Fr _n = 1.44 supercritical | rmal Depth Froude Number |
| Critical flow area Ac = 4.71 sq ft | | |
| | | If Central Angle (0 <theta-c<3.14)< td=""></theta-c<3.14)<> |
| Critical top width $T_{c} = 2.00$ ff | Ac = | tical flow area |
| | Tc = 2.89 ft | tical top width |
| Critical flow depth Yc = 1.90 ft | Yc = 1.90 ft | tical flow depth |
| Critical flow velocity Vc = 7.24 fps | Vc = 7.24 fps | |
| Critical Depth Froude Number $Fr_c = 1.00$ | $Fr_c = 1.00$ | tical Depth Froude Number |

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| | Tc How Area |) ↓v | |
|--|-------------------|---------|---------------|
| Design Information (Input) | | | |
| Pipe Invert Slope | So = | 0.0200 | ft/ft |
| Pipe Manning's n-value | n = | 0.0130 | |
| Pipe Diameter | D = | 24.00 | inches |
| Design discharge | Q = | 17.50 | cfs |
| | | | |
| Full-Flow Capacity (Calculated) | _ | | |
| Full-flow area | Af = | 3.14 | sq ft |
| Full-flow wetted perimeter | Pf = | 6.28 | ft |
| Half Central Angle | Theta = | 3.14 | radians |
| Full-flow capacity | Qf = | 32.08 | cfs |
| Calculation of Normal Flow Condition | | | |
| Half Central Angle (0 <theta<3.14)< td=""><td>Theta =</td><td>1.62</td><td>radians</td></theta<3.14)<> | Theta = | 1.62 | radians |
| Flow area | An = | 1.68 | sq ft |
| Top width | Tn = | 2.00 | ft |
| Wetted perimeter | Pn = | 3.25 | ft |
| Flow depth | Yn = | 1.05 | ft |
| Flow velocity | Vn = | 10.43 | fps |
| Discharge | Qn = | 17.50 | cfs |
| Percent of Full Flow | Flow = | 54.6% | of full flow |
| Normal Depth Froude Number | Fr _n = | 2.01 | supercritical |
| Calculation of Critical Flow Condition | _ | | _ |
| Half Central Angle (0 <theta-c<3.14)< td=""><td>Theta-c =</td><td>2.10</td><td>radians</td></theta-c<3.14)<> | Theta-c = | 2.10 | radians |
| Critical flow area | Ac = | 2.54 | sq ft |
| Critical top width | Tc = | 1.72 | ft |
| Critical flow depth | Yc = | 1.51 | ft |
| Critical flow velocity | Vc = | 6.89 | fps |
| Critical Depth Froude Number | $Fr_c =$ | 1.00 | |
| | | | |

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| r to | T _c H Area D |) ↓v | |
|--|----------------------------------|---------|---------------|
| Design Information (Input) | | | |
| Pipe Invert Slope | So = | 0.0200 | ft/ft |
| Pipe Manning's n-value | n = | 0.0130 | |
| Pipe Diameter | D = | 30.00 | inches |
| Design discharge | Q = | 34.90 | cfs |
| | | | |
| Full-Flow Capacity (Calculated) | | | _ |
| Full-flow area | Af = | 4.91 | sq ft |
| Full-flow wetted perimeter | Pf = | 7.85 | ft |
| Half Central Angle | Theta = | 3.14 | radians |
| Full-flow capacity | Qf = | 58.16 | cfs |
| Calculation of Normal Flow Condition | . – | | |
| Half Central Angle (0 <theta<3.14)< td=""><td>Theta =</td><td>1.69</td><td>radians</td></theta<3.14)<> | Theta = | 1.69 | radians |
| Flow area | An = | 2.82 | sq ft |
| Top width | Tn = | 2.48 | ft |
| Wetted perimeter | Pn = | 4.22 | ft |
| Flow depth | Yn = | 1.40 | ft |
| Flow velocity | Vn = | 12.39 | fps |
| Discharge | Qn = | 34.90 | cfs |
| Percent of Full Flow | Flow = | 60.0% | of full flow |
| Normal Depth Froude Number | Fr _n = | 2.05 | supercritical |
| Calculation of Critical Flow Condition | | | |
| Half Central Angle (0 <theta-c<3.14)< td=""><td>Theta-c =</td><td>2.22</td><td>radians</td></theta-c<3.14)<> | Theta-c = | 2.22 | radians |
| Critical flow area | Ac = | 4.22 | sq ft |
| Critical top width | Tc = | 1.99 | ft |
| Critical flow depth | Yc = | 2.01 | ft |
| Critical flow velocity | Vc = | 8.27 | fps |
| Critical Depth Froude Number | $Fr_c =$ | 1.00 | |

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| | T _c OTV Area D | ↓¥ | |
|--|------------------------------------|--------|---------------|
| Design Information (Input) | | | |
| Pipe Invert Slope | So = | 0.0170 | ft/ft |
| Pipe Manning's n-value | n = | 0.0130 | |
| Pipe Diameter | D = | 24.00 | inches |
| Design discharge | Q = | 15.10 | cfs |
| Full-Flow Capacity (Calculated) | | | |
| Full-flow area | Af = | 3.14 | sq ft |
| Full-flow wetted perimeter | Pf = | 6.28 | ft |
| Half Central Angle | Theta = | 3.14 | radians |
| Full-flow capacity | Qf = | 29.58 | cfs |
| Calculation of Normal Flow Condition | | | |
| Half Central Angle (0 <theta<3.14)< td=""><td>Theta =</td><td>1.58</td><td>radians</td></theta<3.14)<> | Theta = | 1.58 | radians |
| Flow area | An = | 1.60 | sq ft |
| Top width | Tn = | 2.00 | ft |
| Wetted perimeter | Pn = | 3.17 | ft |
| Flow depth | Yn = | 1.01 | ft |
| Flow velocity | Vn = | 9.46 | fps |
| Discharge | Qn = | 15.10 | cfs |
| Percent of Full Flow | Flow = | 51.1% | of full flow |
| Normal Depth Froude Number | Fr _n = | 1.87 | supercritical |
| Calculation of Critical Flow Condition | | | |
| Half Central Angle (0 <theta-c<3.14)< td=""><td>Theta-c =</td><td>1.98</td><td>radians</td></theta-c<3.14)<> | Theta-c = | 1.98 | radians |
| Critical flow area | Ac = | 2.35 | sq ft |
| Critical top width | Tc = | 1.83 | ft |
| Critical flow depth | Yc = | 1.40 | ft |
| Critical flow velocity | Vc = | 6.43 | fps |
| Critical Depth Froude Number | Fr _c = | 1.00 | |

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| H | T _c Θ angle Area D | ↓γ | |
|--|---|--------|---------------|
| Design Information (Input) | | | |
| Pipe Invert Slope | So = | 0.0170 | ft/ft |
| Pipe Manning's n-value | n = | 0.0130 | |
| Pipe Diameter | D = | 30.00 | inches |
| Design discharge | Q = | 30.20 | cfs |
| | | | |
| Full-Flow Capacity (Calculated) | | | |
| Full-flow area | Af = | 4.91 | sq ft |
| Full-flow wetted perimeter | Pf = | 7.85 | ft |
| Half Central Angle | Theta = | 3.14 | radians |
| Full-flow capacity | Qf = | 53.62 | cfs |
| Calculation of Normal Flow Condition | | | |
| Half Central Angle (0 <theta<3.14)< td=""><td>Theta =</td><td>1.64</td><td>radians</td></theta<3.14)<> | Theta = | 1.64 | radians |
| Flow area | An = | 2.69 | sq ft |
| Top width | Tn = | 2.49 | ft |
| Wetted perimeter | Pn = | 4.11 | ft |
| Flow depth | Yn = | 1.34 | ft |
| Flow velocity | Vn = | 11.25 | fps |
| Discharge | Qn = | 30.20 | cfs |
| Percent of Full Flow | Flow = | 56.3% | of full flow |
| Normal Depth Froude Number | Fr _n = | 1.91 | supercritical |
| Calculation of Critical Flow Condition | | | |
| Half Central Angle (0 <theta-c<3.14)< td=""><td>Theta-c =</td><td>2.09</td><td>radians</td></theta-c<3.14)<> | Theta-c = | 2.09 | radians |
| Critical flow area | Ac = | 3.94 | sq ft |
| Critical top width | Tc = | 2.17 | ft |
| Critical flow depth | Yc = | 1.87 | ft |
| Critical flow velocity | Vc = | 7.66 | fps |
| Critical Depth Froude Number | Fr _c = | 1.00 | |

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| r la | T _c W angle Area D | Ů. Î. | |
|--|--|----------|---------------|
| Design Information (Input) | | | |
| Pipe Invert Slope | So = | 0.0200 | ft/ft |
| Pipe Manning's n-value | n = | 0.0130 | |
| Pipe Diameter | D = | 18.00 | inches |
| Design discharge | Q = | 11.70 | cfs |
| Full-Flow Capacity (Calculated) | | | |
| Full-flow area | Af = | 1.77 | sq ft |
| Full-flow wetted perimeter | Pf = | 4.71 | ft |
| Half Central Angle | Theta = | 3.14 | radians |
| Full-flow capacity | Qf = | 14.90 | cfs |
| Calculation of Normal Flow Condition | | | |
| Half Central Angle (0 <theta<3.14)< td=""><td>Theta =</td><td>1.91</td><td>radians</td></theta<3.14)<> | Theta = | 1.91 | radians |
| Flow area | An = | 1.25 | sq ft |
| Top width | Tn = | 1.41 | ft |
| Wetted perimeter | Pn = | 2.87 | ft |
| Flow depth | Yn = | 1.00 | ft |
| Flow velocity | Vn = | 9.33 | fps |
| Discharge | Qn = | 11.70 | cfs |
| Percent of Full Flow | Flow = | 78.6% | of full flow |
| Normal Depth Froude Number | Fr _n = | 1.75 | supercritical |
| Calculation of Critical Flow Condition | | | |
| Half Central Angle (0 <theta-c<3.14)< td=""><td>Theta-c =</td><td>2.40</td><td>radians</td></theta-c<3.14)<> | Theta-c = | 2.40 | radians |
| Critical flow area | Ac = | 1.63 | sq ft |
| Critical top width | Tc = | 1.02 | ft |
| Critical flow depth | Yc = | 1.30 | ft |
| Critical flow velocity | Vc = | 7.18 | fps |
| Critical Depth Froude Number | Fr _c = | 1.00 | |

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| His | T _c Θ angle Area D | ¢ ↓γ | |
|--|---|---------|---------------|
| Design Information (Input) | | | |
| Pipe Invert Slope | So = | 0.0200 | ft/ft |
| Pipe Manning's n-value | n = | 0.0130 | |
| Pipe Diameter | D = | 30.00 | inches |
| Design discharge | Q = | 42.00 | cfs |
| Full-Flow Capacity (Calculated) | | | |
| Full-flow area | Af = | 4.91 | sq ft |
| Full-flow wetted perimeter | Pf = | 7.85 | ft |
| Half Central Angle | Theta = | 3.14 | radians |
| Full-flow capacity | Qf = | 58.16 | cfs |
| Calculation of Normal Flow Condition | | | |
| Half Central Angle (0 <theta<3.14)< td=""><td>Theta =</td><td>1.83</td><td>radians</td></theta<3.14)<> | Theta = | 1.83 | radians |
| Flow area | An = | 3.25 | sq ft |
| Top width | Tn = | 2.41 | ft |
| Wetted perimeter | Pn = | 4.58 | ft |
| Flow depth | Yn = | 1.57 | ft |
| Flow velocity | Vn = | 12.90 | fps |
| Discharge | Qn = | 42.00 | cfs |
| Percent of Full Flow | Flow = | 72.2% | of full flow |
| Normal Depth Froude Number | Fr _n = | 1.96 | supercritical |
| Calculation of Critical Flow Condition | | | |
| Half Central Angle (0 <theta-c<3.14)< td=""><td>Theta-c =</td><td>2.40</td><td>radians</td></theta-c<3.14)<> | Theta-c = | 2.40 | radians |
| Critical flow area | Ac = | 4.53 | sq ft |
| Critical top width | Tc = | 1.69 | ft |
| Critical flow depth | Yc = | 2.17 | ft |
| Critical flow velocity | Vc = | 9.28 | fps |
| Critical Depth Froude Number | Fr _c = | 1.00 | |

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| Design Information (Input) Pipe Invert Slope Pipe Manning's n-value Pipe Diameter Design discharge <u>Full-Flow Capacity (Calculated)</u> | So = n = D = Q = | 0.0300 0.0130 30.00 53.70 | ft/ft inches |
|--|-----------------------------|------------------------------------|-------------------------------|
| Pipe Manning's n-value Pipe Diameter Design discharge <u>Full-Flow Capacity (Calculated)</u> | n = D = | 0.0130 30.00 | |
| Pipe Diameter Design discharge Full-Flow Capacity (Calculated) | D = | 30.00 | inches |
| Design discharge Full-Flow Capacity (Calculated) | _ | | inches |
| Full-Flow Capacity (Calculated) | Q = | 53.70 | |
| | | | cfs |
| | | | |
| | | | _ |
| Full-flow area | Af = | 4.91 | sq ft |
| Full-flow wetted perimeter | Pf = | 7.85 | ft |
| 5 | Theta = | 3.14 | radians |
| Full-flow capacity | Qf = | 71.24 | cfs |
| Colouistics of Normal Flow Condition | | | |
| <u>Calculation of Normal Flow Condition</u> Half Central Angle (0 <theta<3.14)< td=""><td>Theta =</td><td>1 07</td><td>radians</td></theta<3.14)<> | Theta = | 1 07 | radians |
| Flow area | An = | 1.87 3.37 | |
| | An = Tn = | | sq ft ft |
| Top width Watted parimeter | | 2.39 | |
| Wetted perimeter Flow depth | Pn = Yn = | 4.68 | ft ft |
| | Yn = | - | |
| Flow velocity Discharge | 0n = | 15.94 53.70 | fps cfs |
| 5 | | | |
| Percent of Full Flow Normal Depth Froude Number | Flow = Fr _n = | 75.4% 2.37 | of full flow supercritical |
| | i in — | 2.37 | supercifical |
| Calculation of Critical Flow Condition | | | |
| | neta-c = | 2.63 | radians |
| Critical flow area | Ac = | 4.78 | sq ft |
| Critical top width | Tc = | 1.22 | ft |
| Critical flow depth | Yc = | 2.34 | ft |
| Critical flow velocity | Vc = | 11.24 | fps |
| Critical Depth Froude Number | Fr _c = | 1.00 | 1' |

MHFD-Culvert, Version 4.00 (May 2020)

| Design Information (Input)Pipe Invert SlopeSo =Pipe Manning's n-valuen =Pipe DiameterD =Design dischargeQ =3.20cfsFull-Flow Capacity (Calculated)Full-flow wetted perimeterPf =Half Central AngleTheta =Sull-flow capacityQf =Calculation of Normal Flow ConditionHalf Central Angle (0 <theta<3.14)< td="">Flow areaAn =Top widthTn =I.49ftFlow areaPn =2.23ftFlow depthYn =Piecent of Full FlowPn =2.23ftFlow velocityVn =DischargeQn =Aldit Central Angle (0<theta<3.14)< td="">Theta =1.49Flow depthYn =Percent of Full FlowSo =Normal Depth Froude NumberFrn =Calculation of Critical Flow ConditionHalf Central Angle (0<theta-<3.14)< td="">Theta-c =1.48Critical flow depthYn =0.98SubcriticalCritical flow depthYc =0.68Critical flow depthYc =0.68ftCritical flow depthYc =1.00Forther and public to the state of the state</theta-<3.14)<></theta<3.14)<></theta<3.14)<> | | To How angle Area |) ∫γ ⇒ | |
|---|---------------------------------|-------------------------|--------------|-------------|
| Pipe Manning's n-valuen0.0130Pipe DiameterD18.00inchesDesign dischargeQ3.20cfsFull-Flow Capacity (Calculated) $Af = 1.77$ sq ftFull-flow areaAf = 4.71ftFull-flow wetted perimeterPf = 4.71ftHalf Central AngleTheta = 3.14radiansFull-flow capacityQf = 7.45cfsCalculation of Normal Flow Condition $An = 0.79$ sq ftHalf Central Angle (0 <theta<3.14)< td="">Theta = 1.49Flow areaAn = 0.79sq ftTop widthTn = 1.49Wetted perimeterPn = 2.23Flow depthYn = 0.69Flow depthYn = 0.69Flow velocityVn = 4.05DischargeOn = 3.20Percent of Full FlowFlowNormal Depth Froude NumberFr_n = 0.98Calculation of Critical Flow ConditionHalf Central Angle (0<theta-c<3.14)< td="">Theta-c = 1.48Calculation of Critical Flow ConditionHalf Central Angle (0<theta-c<3.14)< td="">Theta-c = 0.78Critical flow areaCritical flow depthCritical flow velocityVc = 0.68Critical flow velocityVc = 4.10Critical flow velocityVc = 4.10Critical flow velocity</theta-c<3.14)<></theta-c<3.14)<></theta<3.14)<> | Design Information (Input) | | | |
| Pipe DiameterD18.00inchesDesign dischargeQ3.20cfsFull-Flow Capacity (Calculated)Full-flow areaAf $=$ 1.77sq ftFull-flow wetted perimeterPf $=$ 4.71ftHalf Central AngleTheta $=$ 3.14 radiansFull-flow capacityQf $=$ 7.45 cfsCalculation of Normal Flow ConditionHalf Central Angle (0Theta $=$ 0.79 sq ftFlow areaAn $=$ 0.79 sq ftftTop widthTn $=$ 1.49 ftftWetted perimeterPn 2.23 ftftFlow areaQn $=$ 3.20 cfsTop widthYn 0.69 ftftWetted perimeterPn 2.23 ftFlow depthYn 0.69 ftFlow velocityVn 43.0% of full flowNormal Depth Froude Number $Fr_n =$ 0.98 subcriticalCalculation of Critical Flow ConditionHalf Central Angle (0Theta-c $=$ 1.48 Half Central Angle (0Theta-c< | Pipe Invert Slope | So = | 0.0050 | ft/ft |
| Pipe DiameterD18.00inchesDesign dischargeQ3.20cfsFull-Flow Capacity (Calculated)Full-flow areaAf $=$ 1.77sq ftFull-flow wetted perimeterPf $=$ 4.71ftHalf Central AngleTheta $=$ 3.14 radiansFull-flow capacityQf $=$ 7.45 cfsCalculation of Normal Flow ConditionHalf Central Angle (0Theta $=$ 0.79 sq ftFlow areaAn $=$ 0.79 sq ftftTop widthTn $=$ 1.49 ftftWetted perimeterPn 2.23 ftftFlow areaQn $=$ 3.20 cfsTop widthYn 0.69 ftftWetted perimeterPn 2.23 ftFlow depthYn 0.69 ftFlow velocityVn 43.0% of full flowNormal Depth Froude Number $Fr_n =$ 0.98 subcriticalCalculation of Critical Flow ConditionHalf Central Angle (0Theta-c $=$ 1.48 Half Central Angle (0Theta-c< | | n = | 0.0130 | |
| Full-Flow Capacity (Calculated)Full-Flow areaAf = 1.77 sq ftFull-flow wetted perimeterPf = 4.71 ftHalf Central AngleTheta = 3.14 radiansFull-flow capacityQf = 7.45 cfsCalculation of Normal Flow ConditionHalf Central Angle (0 <theta<3.14)< td="">Theta =1.49Half Central Angle (0<theta<3.14)< td="">Theta =0.79sq ftFlow areaAn =0.79sq ftTop widthTn =1.49ftWetted perimeterPn =2.23ftFlow depthYn =0.69ftFlow velocityVn =4.05fpsDischargeQn =3.20cfsPercent of Full FlowFlow =43.0%of full flowNormal Depth Froude NumberFr_n =0.98subcriticalCalculation of Critical Flow ConditionHalf Central Angle (0<theta-c<3.14)< td="">Theta-c =Half Central Angle (0<theta-c<3.14)< td="">Theta-c =1.48radiansCritical flow areaAc =0.78sq ftCritical flow depthTc =1.49ftCritical flow depthYc =0.68ftCritical flow velocityVc =4.10fps</theta-c<3.14)<></theta-c<3.14)<></theta<3.14)<></theta<3.14)<> | | D = | 18.00 | inches |
| Full-flow area $Af =$ 1.77 sq ftFull-flow wetted perimeter $Pf =$ 4.71 ftHalf Central AngleTheta = 3.14 radiansFull-flow capacity $Qf =$ 7.45 cfs Calculation of Normal Flow ConditionHalf Central Angle (0 <theta<3.14)< td="">Theta =1.49Half Central Angle (0<theta<3.14)< td="">Theta =1.49radiansFlow area$An =$$0.79$$sq$ ftTop width$Tn =$$1.49$ftWetted perimeter$Pn =$$2.23$ftFlow depth$Yn =$$0.69$ftFlow velocity$Vn =$$4.05$fpsDischarge$Qn =$$3.20$$cfs$Percent of Full FlowFlow =43.0%of full flowNormal Depth Froude Number$Fr_n =$$0.98$subcriticalCalculation of Critical Flow ConditionHalf Central Angle (0<theta-c<3.14)< td="">Theta-c =1.48Critical flow area$Ac =$$0.78$sq ftCritical flow depth$Tc =$$1.49$ftCritical flow depth$Yc =$$0.68$ftCritical flow depth$Yc =$$0.68$ft</theta-c<3.14)<></theta<3.14)<></theta<3.14)<> | Design discharge | Q = | 3.20 | cfs |
| Full-flow area $Af =$ 1.77 sq ftFull-flow wetted perimeter $Pf =$ 4.71 ftHalf Central AngleTheta = 3.14 radiansFull-flow capacity $Qf =$ 7.45 cfs Calculation of Normal Flow ConditionHalf Central Angle (0 <theta<3.14)< td="">Theta =1.49Half Central Angle (0<theta<3.14)< td="">Theta =1.49radiansFlow area$An =$$0.79$$sq$ ftTop width$Tn =$$1.49$ftWetted perimeter$Pn =$$2.23$ftFlow depth$Yn =$$0.69$ftFlow velocity$Vn =$$4.05$fpsDischarge$Qn =$$3.20$$cfs$Percent of Full FlowFlow =43.0%of full flowNormal Depth Froude Number$Fr_n =$$0.98$subcriticalCalculation of Critical Flow ConditionHalf Central Angle (0<theta-c<3.14)< td="">Theta-c =1.48Critical flow area$Ac =$$0.78$sq ftCritical flow depth$Tc =$$1.49$ftCritical flow depth$Yc =$$0.68$ftCritical flow depth$Yc =$$0.68$ft</theta-c<3.14)<></theta<3.14)<></theta<3.14)<> | | | | |
| Full-flow wetted perimeter $Pf =$ 4.71 ftHalf Central AngleTheta = 3.14 radiansFull-flow capacity $Qf =$ 7.45 cfs Calculation of Normal Flow ConditionHalf Central Angle (0 <theta<3.14)< td="">Theta =1.49Half Central Angle (0<theta<3.14)< td="">Theta =1.49radiansFlow areaAn =$0.79$$sq$ ftTop widthTn =1.49ftWetted perimeterPn =2.23ftFlow depthYn =0.69ftFlow velocityVn =4.05fpsDischargeQn =3.20cfsPercent of Full FlowFlow =43.0%of full flowNormal Depth Froude Number$Fr_n =$$0.98$subcriticalHalf Central Angle (0<theta-c<3.14)< td="">Theta-c =1.48radiansCritical flow areaAc =0.78sq ftCritical flow depthTc =1.49ftCritical flow depthYc =0.68ft</theta-c<3.14)<></theta<3.14)<></theta<3.14)<> | Full-Flow Capacity (Calculated) | _ | | |
| Half Central AngleTheta = 3.14 radiansFull-flow capacity $Qf =$ 7.45 cfs Calculation of Normal Flow Condition $Mn =$ 7.45 cfs Half Central Angle (0 <theta<3.14)< td="">Theta =1.49radiansFlow area$An =$$0.79$$sq$ ftTop width$Tn =$$1.49$ftWetted perimeter$Pn =$$2.23$ftFlow depth$Yn =$$0.69$ftFlow velocity$Vn =$$4.05$fpsDischarge$Qn =$$3.20$$cfs$Percent of Full Flow$Rfn =$$0.98$subcriticalNormal Depth Froude Number$Fr_n =$$0.98$subcriticalCalculation of Critical Flow Condition$Ac =$$0.78$$sq$ ftHalf Central Angle (0<theta-c<3.14)< td="">Theta-c =1.48radiansCritical flow area$Ac =$$0.78$$sq$ ftCritical flow depth$Tc =$$1.49$ftCritical flow depth$Yc =$$0.68$ftCritical flow velocity$Vc =$$4.10$$fps$</theta-c<3.14)<></theta<3.14)<> | | Af = | 1.77 | sq ft |
| Full-flow capacity $Qf = 7.45$ cfsCalculation of Normal Flow ConditionHalf Central Angle (0 <theta<3.14)< td="">Theta = 1.49radiansFlow areaAn = 0.79sq ftTop widthTn = 1.49ftWetted perimeterPn = 2.23ftFlow depthYn = 0.69ftFlow velocityVn = 4.05fpsDischargeQn = 3.20cfsPercent of Full FlowFlow = 43.0%of full flowNormal Depth Froude NumberFr_n = 0.98subcriticalCalculation of Critical Flow ConditionTheta-c = 1.48radiansCalculation widthTc = 1.49ftCritical flow areaAc = 0.78sq ftCritical flow depthYc = 0.68ftCritical flow velocityVc = 4.10fps</theta<3.14)<> | Full-flow wetted perimeter | Pf = | 4.71 | ft |
| Calculation of Normal Flow ConditionHalf Central Angle (0 <theta<3.14)< td="">Theta =1.49radiansFlow areaAn =0.79sq ftTop widthTn =1.49ftWetted perimeterPn =2.23ftFlow depthYn =0.69ftFlow velocityVn =4.05fpsDischargeQn =3.20cfsPercent of Full FlowFlow =43.0%of full flowNormal Depth Froude NumberFr_n =0.98subcriticalCalculation of Critical Flow ConditionAc =0.78sq ftCritical flow areaAc =0.78sq ftCritical flow depthTc =1.49ftCritical flow depthYc =0.68ftCritical flow velocityVc =4.10fps</theta<3.14)<> | 5 | Theta = | 3.14 | radians |
| Half Central Angle (0 < Theta < 3.14)Theta =1.49radiansFlow areaAn = 0.79 sq ftTop widthTn = 1.49 ftWetted perimeterPn = 2.23 ftFlow depthYn = 0.69 ftFlow velocityVn = 4.05 fpsDischargeQn = 3.20 cfsPercent of Full FlowFlow = 43.0% of full flowNormal Depth Froude NumberFr _n = 0.98 subcriticalCalculation of Critical Flow ConditionAc = 0.78 sq ftCritical flow areaAc = 0.78 sq ftCritical flow depthYc = 0.68 ftCritical flow depthYc = 0.68 ft | Full-flow capacity | Qf = | 7.45 | cfs |
| Flow areaAn = 0.79 sq ftTop widthTn = 1.49 ftWetted perimeterPn = 2.23 ftFlow depthYn = 0.69 ftFlow velocityVn = 4.05 fpsDischargeQn = 3.20 cfsPercent of Full FlowFlow = 43.0% of full flowNormal Depth Froude NumberFr _n = 0.98 subcriticalCalculation of Critical Flow ConditionHalf Central Angle (0 <theta-c<3.14)< td="">Theta-c =1.48Critical flow areaAc =0.78sq ftCritical flow depthTc =1.49ftCritical flow depthYc =0.68ftCritical flow velocityVc =4.10fps</theta-c<3.14)<> | | _ | | _ |
| Top widthTn =1.49ftWetted perimeterPn =2.23ftFlow depthYn =0.69ftFlow velocityVn =4.05fpsDischargeQn =3.20cfsPercent of Full FlowFlow =43.0%of full flowNormal Depth Froude NumberFr_n =0.98subcriticalCalculation of Critical Flow ConditionHalf Central Angle (0 <theta-c<3.14)< td="">Theta-c =1.48Critical flow areaAc =0.78sq ftCritical flow depthTc =1.49ftCritical flow depthYc =0.68ftCritical flow velocityVc =4.10fps</theta-c<3.14)<> | - | | | |
| Wetted perimeter $Pn =$ 2.23 ftFlow depth $Yn =$ 0.69 ftFlow velocity $Vn =$ 4.05 fpsDischarge $Qn =$ 3.20 cfsPercent of Full FlowFlow = 43.0% of full flowNormal Depth Froude Number $Fr_n =$ 0.98 subcriticalCalculation of Critical Flow ConditionHalf Central Angle (0 <theta-c<3.14)< td="">Theta-c =1.48Critical flow areaAc =0.78sq ftCritical top widthTc =1.49ftCritical flow depthYc =0.68ftCritical flow velocityVc =4.10fps</theta-c<3.14)<> | | | - | |
| Flow depth $Yn =$ 0.69 ftFlow velocity $Vn =$ 4.05 fpsDischarge $Qn =$ 3.20 cfsPercent of Full FlowFlow = 43.0% of full flowNormal Depth Froude Number $Fr_n =$ 0.98 subcriticalCalculation of Critical Flow ConditionHalf Central Angle (0 <theta-c<3.14)< td="">Theta-c =1.48Critical flow areaAc =0.78sq ftCritical top widthTc =1.49ftCritical flow depthYc =0.68ftCritical flow velocityVc =4.10fps</theta-c<3.14)<> | | | | |
| Flow velocity $Vn =$ 4.05 fpsDischarge $Qn =$ 3.20 cfsPercent of Full FlowFlow = 43.0% of full flowNormal Depth Froude Number $Fr_n =$ 0.98 subcriticalCalculation of Critical Flow ConditionHalf Central Angle (0 <theta-c<3.14)< td="">Theta-c =1.48radiansCritical flow areaAc =0.78sq ftCritical top widthTc =1.49ftCritical flow depthYc =0.68ftCritical flow velocityVc =4.10fps</theta-c<3.14)<> | | | - | |
| Discharge $Qn =$ 3.20 cfs Percent of Full FlowFlow = 43.0% of full flowNormal Depth Froude Number $Fr_n =$ 0.98 subcriticalCalculation of Critical Flow ConditionHalf Central Angle (0 <theta-c<3.14)< td="">Theta-c =1.48radiansCritical flow areaAc =0.78sq ftCritical top widthTc =1.49ftCritical flow depthYc =0.68ftCritical flow velocityVc =4.10fps</theta-c<3.14)<> | | | 0.69 | ft |
| Percent of Full FlowFlow = 43.0% of full flowNormal Depth Froude Number $Fr_n =$ 0.98 subcriticalCalculation of Critical Flow Condition $Fr_n =$ 0.98 subcriticalHalf Central Angle (0 <theta-c<3.14)< td="">Theta-c =1.48radiansCritical flow area$Ac =$$0.78$sq ftCritical top width$Tc =$$1.49$ftCritical flow depth$Yc =$$0.68$ftCritical flow velocity$Vc =$$4.10$fps</theta-c<3.14)<> | 5 | Vn = | | |
| Normal Depth Froude Number $Fr_n =$ 0.98subcriticalCalculation of Critical Flow ConditionHalf Central Angle (0 <theta-c<3.14)< td="">Theta-c =1.48radiansCritical flow areaAc =0.78sq ftCritical top widthTc =1.49ftCritical flow depthYc =0.68ftCritical flow velocityVc =4.10fps</theta-c<3.14)<> | 0 | Qn = | 3.20 | |
| Calculation of Critical Flow ConditionHalf Central Angle (0 <theta-c<3.14)< td="">Theta-c =1.48radiansCritical flow areaAc =0.78sq ftCritical top widthTc =1.49ftCritical flow depthYc =0.68ftCritical flow velocityVc =4.10fps</theta-c<3.14)<> | | | | |
| Half Central Angle (0 <theta-c<3.14)< th="">Theta-c =1.48radiansCritical flow areaAc =0.78sq ftCritical top widthTc =1.49ftCritical flow depthYc =0.68ftCritical flow velocityVc =4.10fps</theta-c<3.14)<> | Normal Depth Froude Number | Fr _n = | 0.98 | subcritical |
| Critical flow area $Ac =$ 0.78 sq ftCritical top width $Tc =$ 1.49 ftCritical flow depth $Yc =$ 0.68 ftCritical flow velocity $Vc =$ 4.10 fps | | _ | | _ |
| Critical top width $Tc =$ 1.49ftCritical flow depth $Yc =$ 0.68ftCritical flow velocity $Vc =$ 4.10fps | - | Theta-c = | | |
| Critical flow depthYc = 0.68 ftCritical flow velocityVc = 4.10 fps | | | | |
| Critical flow velocity $Vc = 4.10$ fps | | Tc = | 1.49 | ft |
| | | Yc = | 0.68 | ft |
| IlCritical Depth Froude Number Fr - 1.00 | | | | fps |
| | Critical Depth Froude Number | Fr _c = | 1.00 | |

MHFD-Culvert, Version 4.00 (May 2020)

| Fie | T ₀ Θ angle Area D | ↓¥ | |
|--|---|--------|--------------|
| Design Information (Input) | | | |
| Pipe Invert Slope | So = | 0.0050 | ft/ft |
| Pipe Manning's n-value | n = | 0.0130 | |
| Pipe Diameter | D = | 18.00 | inches |
| Design discharge | Q = | 5.30 | cfs |
| Full-Flow Capacity (Calculated) | | | |
| Full-flow area | Af = | 1.77 | sq ft |
| Full-flow wetted perimeter | Pf = | 4.71 | ft |
| Half Central Angle | Theta = | 3.14 | radians |
| Full-flow capacity | Qf = | 7.45 | cfs |
| Calculation of Normal Flow Condition | | | |
| Half Central Angle (0 <theta<3.14)< td=""><td>Theta =</td><td>1.82</td><td>radians</td></theta<3.14)<> | Theta = | 1.82 | radians |
| Flow area | An = | 1.16 | sq ft |
| Top width | Tn = | 1.45 | ft |
| Wetted perimeter | Pn = | 2.73 | ft |
| Flow depth | Yn = | 0.94 | ft |
| Flow velocity | Vn = | 4.58 | fps |
| Discharge | Qn = | 5.30 | cfs |
| Percent of Full Flow | Flow = | 71.2% | of full flow |
| Normal Depth Froude Number | Fr _n = | 0.90 | subcritical |
| Calculation of Critical Flow Condition | | | |
| Half Central Angle (0 <theta-c<3.14)< td=""><td>Theta-c =</td><td>1.75</td><td>radians</td></theta-c<3.14)<> | Theta-c = | 1.75 | radians |
| Critical flow area | Ac = | 1.09 | sq ft |
| Critical top width | Tc = | 1.47 | ft |
| Critical flow depth | Yc = | 0.89 | ft |
| Critical flow velocity | Vc = | 4.87 | fps |
| Critical Depth Froude Number | Fr _c = | 1.00 | |

MHFD-Culvert, Version 4.00 (May 2020)

Project: Monument Ridge East Pipe ID: PIPE 41 POND 4 OUT

| FI | Tc OTW ATPAN D | Ŷ | |
|--|-------------------------|---------------|---------------|
| Design Information (Input) | | | |
| Pipe Invert Slope | So = | 0.0100 | ft/ft |
| Pipe Manning's n-value | n = | 0.0130 | |
| Pipe Diameter | D = | 36.00 | inches |
| Design discharge | Q = | 38.10 | cfs |
| Full-Flow Capacity (Calculated) | | | |
| Full-flow area | Af = | 7.07 | sq ft |
| Full-flow wetted perimeter | Pf = | 9.42 | ft |
| Half Central Angle | Theta = | 3.14 | radians |
| Full-flow capacity | Qf = | 66.88 | cfs |
| Calculation of Normal Flow Condition | | 1 / 5 | |
| Half Central Angle (0 <theta<3.14)< td=""><td>Theta =</td><td>1.65</td><td>radians</td></theta<3.14)<> | Theta = | 1.65 | radians |
| Flow area | An = | 3.90 | sq ft |
| Top width | In = Pn = | 2.99 | ft |
| Wetted perimeter | Pn = Yn = | 4.96 | ftft |
| Flow depth Flow velocity | Vn = | 1.62 | |
| Discharge | On = | 9.77 38.11 | fps cfs |
| Percent of Full Flow | Flow = | 57.0% | of full flow |
| Normal Depth Froude Number | FIOW = $Fr_n = $ | 1.51 | supercritical |
| Calculation of Critical Flow Condition | | 1.01 | Superentieur |
| Half Central Angle (0 <theta-c<3.14)< td=""><td>Theta-c =</td><td>1.92</td><td>radians</td></theta-c<3.14)<> | Theta-c = | 1.92 | radians |
| Critical flow area | Ac = | 5.03 | sq ft |
| Critical top width | Tc = | 2.82 | ft |
| Critical flow depth | Yc = | 2.01 | ft |
| Critical flow velocity | Vc = | 7.57 | fps |
| Critical Depth Froude Number | Fr _c = | 1.00 | |
| | | | |

MHFD-Culvert, Version 4.00 (May 2020)

| Pic | Tc HW Area D | ↓ ↓¥ | |
|--|-----------------------|---------|---------------|
| Design Information (Input) | | | |
| Pipe Invert Slope | So = | 0.0090 | ft/ft |
| Pipe Manning's n-value | n = | 0.0130 | |
| Pipe Diameter | D = | 48.00 | inches |
| Design discharge | Q = | 72.20 | cfs |
| Full-Flow Capacity (Calculated) | | | |
| Full-flow area | Af = | 12.57 | sq ft |
| Full-flow wetted perimeter | Pf = | 12.57 | ft |
| Half Central Angle | Theta = | 3.14 | radians |
| Full-flow capacity | Qf = | 136.64 | cfs |
| Calculation of Normal Flow Condition | | | |
| Half Central Angle (0 <theta<3.14)< td=""><td>Theta =</td><td>1.60</td><td>radians</td></theta<3.14)<> | Theta = | 1.60 | radians |
| Flow area | An = | 6.55 | sq ft |
| Top width | Tn = | 4.00 | ft |
| Wetted perimeter | Pn = | 6.42 | ft |
| Flow depth | Yn = | 2.07 | ft |
| Flow velocity | Vn = | 11.02 | fps |
| Discharge | Qn = | 72.21 | cfs |
| Percent of Full Flow | Flow = | 52.8% | of full flow |
| Normal Depth Froude Number | Fr _n = | 1.52 | supercritical |
| Calculation of Critical Flow Condition | | | |
| Half Central Angle (0 <theta-c<3.14)< td=""><td>Theta-c =</td><td>1.86</td><td>radians</td></theta-c<3.14)<> | Theta-c = | 1.86 | radians |
| Critical flow area | Ac = | 8.53 | sq ft |
| Critical top width | Tc = | 3.83 | ft |
| Critical flow depth | Yc = | 2.57 | ft |
| Critical flow velocity | Vc = | 8.46 | fps |
| | | | |

MHFD-Culvert, Version 4.00 (May 2020)

| Fie | Tc HW Area D | ļ ↓Υ | |
|--|-----------------------|---------|---------------|
| Design Information (Input) | | | |
| Pipe Invert Slope | So = | 0.0200 | ft/ft |
| Pipe Manning's n-value | n = | 0.0130 | |
| Pipe Diameter | D = | 24.00 | inches |
| Design discharge | Q = | 17.40 | cfs |
| | | | |
| Full-Flow Capacity (Calculated) | | | |
| Full-flow area | Af = | 3.14 | sq ft |
| Full-flow wetted perimeter | Pf = | 6.28 | ft |
| Half Central Angle | Theta = | 3.14 | radians |
| Full-flow capacity | Qf = | 32.08 | cfs |
| Calculation of Normal Flow Condition | | | |
| Half Central Angle (0 <theta<3.14)< td=""><td>Theta =</td><td>1.62</td><td>radians</td></theta<3.14)<> | Theta = | 1.62 | radians |
| Flow area | An = | 1.67 | sq ft |
| Top width | Tn = | 2.00 | ft |
| Wetted perimeter | Pn = | 3.24 | ft |
| Flow depth | Yn = | 1.05 | ft |
| Flow velocity | Vn = | 10.42 | fps |
| Discharge | Qn = | 17.40 | cfs |
| Percent of Full Flow | Flow = | 54.2% | of full flow |
| Normal Depth Froude Number | $Fr_n =$ | 2.01 | supercritical |
| | | | |
| Calculation of Critical Flow Condition | | | |
| Half Central Angle (0 <theta-c<3.14)< td=""><td>Theta-c =</td><td>2.10</td><td>radians</td></theta-c<3.14)<> | Theta-c = | 2.10 | radians |
| Critical flow area | Ac = | 2.53 | sq ft |
| Critical top width | Tc = | 1.73 | ft |
| Critical flow depth | Yc = | 1.50 | ft |
| Critical flow velocity | Vc = | 6.87 | fps |
| Critical Depth Froude Number | Fr _c = | 1.00 | |

MHFD-Culvert, Version 4.00 (May 2020)

| Flor | T _c Θ angle Area D | ∱¥ , | |
|--|--|---------|---------------|
| Design Information (Input) | | | |
| Pipe Invert Slope | So = | 0.0100 | ft/ft |
| Pipe Manning's n-value | n = | 0.0130 | |
| Pipe Diameter | D = | 18.00 | inches |
| Design discharge | Q = | 5.50 | cfs |
| Full-Flow Capacity (Calculated) | | | |
| Full-flow area | Af = | 1.77 | sq ft |
| Full-flow wetted perimeter | Pf = | 4.71 | ft |
| Half Central Angle | Theta = | 3.14 | radians |
| Full-flow capacity | Qf = | 10.53 | cfs |
| Calculation of Normal Flow Condition | | | |
| Half Central Angle (0 <theta<3.14)< td=""><td>Theta =</td><td>1.60</td><td>radians</td></theta<3.14)<> | Theta = | 1.60 | radians |
| Flow area | An = | 0.91 | sq ft |
| Top width | Tn = | 1.50 | ft |
| Wetted perimeter | Pn = | 2.40 | ft |
| Flow depth | Yn = | 0.77 | ft |
| Flow velocity | Vn = | 6.02 | fps |
| Discharge | Qn = | 5.50 | cfs |
| Percent of Full Flow | Flow = | 52.2% | of full flow |
| Normal Depth Froude Number | Fr _n = | 1.36 | supercritical |
| Calculation of Critical Flow Condition | | | |
| Half Central Angle (0 <theta-c<3.14)< td=""><td>Theta-c =</td><td>1.78</td><td>radians</td></theta-c<3.14)<> | Theta-c = | 1.78 | radians |
| Critical flow area | Ac = | 1.11 | sq ft |
| Critical top width | Tc = | 1.47 | ft |
| Critical flow depth | Yc = | 0.90 | ft |
| Critical flow velocity | Vc = | 4.94 | fps |
| | Fr _c = | 1.00 | |

MHFD-Culvert, Version 4.00 (May 2020)

Project: Monument Ridge East Pipe ID: PipeS 45,46 & 47

| Pic | T _c | ↓ ↓¥ | |
|--|-------------------|---------|---------------|
| Design Information (Input) | | | |
| Pipe Invert Slope | So = | 0.0100 | ft/ft |
| Pipe Manning's n-value | n = | 0.0130 | |
| Pipe Diameter | D = | 54.00 | inches |
| Design discharge | Q = | 108.30 | cfs |
| Full-Flow Capacity (Calculated) | | | |
| Full-flow area | Af = | 15.90 | sq ft |
| Full-flow wetted perimeter | Pf = | 14.14 | ft |
| Half Central Angle | Theta = | 3.14 | radians |
| Full-flow capacity | Qf = | 197.18 | cfs |
| Calculation of Normal Flow Condition | | | |
| Half Central Angle (0 <theta<3.14)< td=""><td>Theta =</td><td>1.63</td><td>radians</td></theta<3.14)<> | Theta = | 1.63 | radians |
| Flow area | An = | 8.54 | sq ft |
| Top width | Tn = | 4.49 | ft |
| Wetted perimeter | Pn = | 7.33 | ft |
| Flow depth | Yn = | 2.38 | ft |
| Flow velocity | Vn = | 12.69 | fps |
| Discharge | Qn = | 108.30 | cfs |
| Percent of Full Flow | Flow = | 54.9% | of full flow |
| Normal Depth Froude Number | Fr _n = | 1.62 | supercritical |
| Calculation of Critical Flow Condition | | | |
| Half Central Angle (0 <theta-c<3.14)< td=""><td>Theta-c =</td><td>1.94</td><td>radians</td></theta-c<3.14)<> | Theta-c = | 1.94 | radians |
| Critical flow area | Ac = | 11.52 | sq ft |
| Critical top width | Tc = | 4.20 | ft |
| Critical flow depth | Yc = | 3.06 | ft |
| Critical flow velocity | Vc = | 9.40 | fps |
| Critical Depth Froude Number | Fr _c = | 1.00 | |

MHFD-Culvert, Version 4.00 (May 2020)

Project: Monument Ridge East Pipe ID: PipeS 48 AND 49

| H H | Tc OTV Area D | Ŷ | |
|--|------------------------|--------|---------------|
| Design Information (Input) | | | |
| Pipe Invert Slope | So = | 0.0075 | ft/ft |
| Pipe Manning's n-value | n = | 0.0130 | |
| Pipe Diameter | D = | 78.00 | inches |
| Design discharge | Q = | 322.30 | cfs |
| Full-Flow Capacity (Calculated) | | | |
| Full-flow area | Af = | 33.18 | sq ft |
| Full-flow wetted perimeter | Pf = | 20.42 | sq n |
| Half Central Angle | Theta = | 3.14 | radians |
| Full-flow capacity | Qf = | 455.26 | cfs |
| | | 400.20 | LIS |
| Calculation of Normal Flow Condition | | | |
| Half Central Angle (0 <theta<3.14)< td=""><td>Theta =</td><td>1.82</td><td>radians</td></theta<3.14)<> | Theta = | 1.82 | radians |
| Flow area | An = | 21.66 | sq ft |
| Top width | Tn = | 6.31 | ft |
| Wetted perimeter | Pn = | 11.80 | ft |
| Flow depth | Yn = | 4.04 | ft |
| Flow velocity | Vn = | 14.88 | fps |
| Discharge | Qn = | 322.31 | cfs |
| Percent of Full Flow | Flow = | 70.8% | of full flow |
| Normal Depth Froude Number | Fr _n = | 1.41 | supercritical |
| Calculation of Critical Flow Condition | | | |
| Half Central Angle (0 <theta-c<3.14)< td=""><td>Theta-c =</td><td>2.07</td><td>radians</td></theta-c<3.14)<> | Theta-c = | 2.07 | radians |
| Critical flow area | Ac = | 26.38 | sq ft |
| Critical top width | Tc = | 5.69 | ft |
| Critical flow depth | Yc = | 4.82 | ft |
| Critical flow velocity | Vc = | 12.22 | fps |
| Critical Depth Froude Number | Fr _c = | 1.00 | |
| | L | |] |

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

Project: Monument Ridge East Basin ID: Pond 1 Qmax out = 90% PreDev Q. Q10=12.9cfs, Q100=35.5cfs

ZONE 2 100-YR EURV W 100-YEAR ZONE 1 AND 2 ORFICES Example Zone Configuration (Retention Pond) PERMA

Depth Increment =

Watershed Infor

| tersned information | | |
|---|------------|---------|
| Selected BMP Type = | EDB | |
| Watershed Area = | 24.52 | acres |
| Watershed Length = | 1,320 | ft |
| Watershed Length to Centroid = | 590 | ft |
| Watershed Slope = | 0.036 | ft/ft |
| Watershed Imperviousness = | 45.60% | percent |
| Percentage Hydrologic Soil Group A = | 0.0% | percent |
| Percentage Hydrologic Soil Group B = | 100.0% | percent |
| Percentage Hydrologic Soil Groups C/D = | 0.0% | percent |
| Target WQCV Drain Time = | 40.0 | hours |
| Location for 1-hr Rainfall Depths = | User Input | |
| | | |

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

| the embedded Colorado Urban Hydro | graph Procedu | ure. | Optional Use | r Override |
|--|---------------|-----------|--------------|------------|
| Water Quality Capture Volume (WQCV) = | 0.397 | acre-feet | | acre-fee |
| Excess Urban Runoff Volume (EURV) = | 1.187 | acre-feet | | acre-fee |
| 2-yr Runoff Volume (P1 = 1.19 in.) = | 1.114 | acre-feet | 1.19 | inches |
| 5-yr Runoff Volume (P1 = 1.5 in.) = | 1.619 | acre-feet | 1.50 | inches |
| 10-yr Runoff Volume (P1 = 1.75 in.) = | 2.067 | acre-feet | 1.75 | inches |
| 25-yr Runoff Volume (P1 = 2 in.) = | 2.688 | acre-feet | 2.00 | inches |
| 50-yr Runoff Volume (P1 = 2.25 in.) = | 3.183 | acre-feet | 2.25 | inches |
| 100-yr Runoff Volume (P1 = 2.52 in.) = | 3.817 | acre-feet | 2.52 | inches |
| 500-yr Runoff Volume (P1 = 3.14 in.) = | 5.094 | acre-feet | | inches |
| Approximate 2-yr Detention Volume = | 0.887 | acre-feet | | |
| Approximate 5-yr Detention Volume = | 1.225 | acre-feet | | |
| Approximate 10-yr Detention Volume = | 1.647 | acre-feet | | |
| Approximate 25-yr Detention Volume = | 1.817 | acre-feet | | |
| Approximate 50-yr Detention Volume = | 1.903 | acre-feet | | |
| Approximate 100-yr Detention Volume = | 2.147 | acre-feet | | |

Define Zones and Basin Geometry

| Select Zone 1 Storage Volume (Required) = | | acre-feet |
|---|------|-----------------|
| Select Zone 2 Storage Volume (Optional) = | | acre-feet |
| Select Zone 3 Storage Volume (Optional) = | | acre-feet |
| Total Detention Basin Volume = | | acre-feet |
| Initial Surcharge Volume (ISV) = | user | ft ³ |
| Initial Surcharge Depth (ISD) = | user | ft |
| Total Available Detention Depth (H _{total}) = | user | ft |
| Depth of Trickle Channel $(H_{TC}) =$ | user | ft |
| Slope of Trickle Channel (S_{TC}) = | user | ft/ft |
| Slopes of Main Basin Sides (Smain) = | user | H:V |
| Basin Length-to-Width Ratio $(R_{L/W}) =$ | user | |
| | | |

Initial Surcharge Area (A_{ISV}) = user Surcharge Volume Length (LISV) = user Surcharge Volume Width (WISV) = user Depth of Basin Floor (H_{FLOOR}) = user Length of Basin Floor (LFLOOR) = user Width of Basin Floor (W_{FLOOR}) = user Area of Basin Floor (A_{FLOOR}) user Volume of Basin Floor (V_{FLOOR}) = user Depth of Main Basin (H_{MAIN}) = user Length of Main Basin (L_{MAIN}) user Width of Main Basin (W_{MAIN}) = user Area of Main Basin (A_{MAIN}) = user Volume of Main Basin (V_{MAIN}) = user Calculated Total Basin Volume (V_{total}) = user ft i

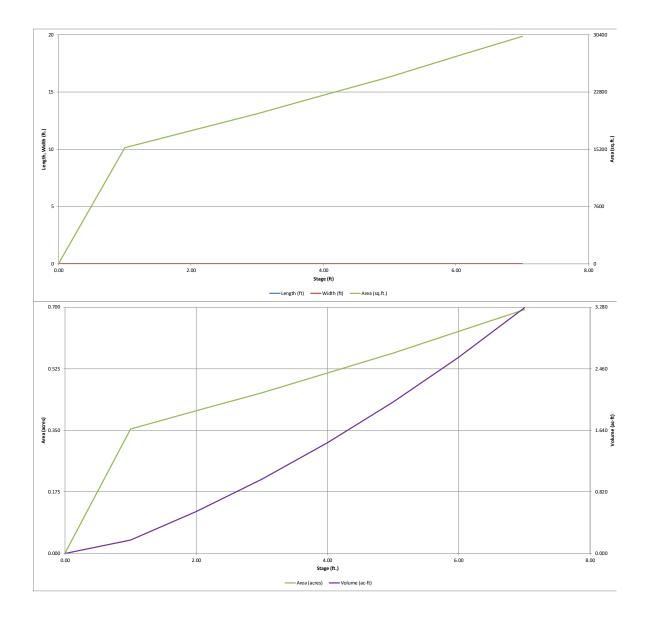
acre-feet

| | Depth Increment = Stage - Storage Description Top of Micropool | Stage (ft) | ft Optional Override Stage (ft) 0.00 | Length (ft) | Width (ft) | Area (ft ²) | Optional Override Area (ft ²) 25 | Area (acre) 0.001 | Volume (ft ³) | Volume (ac-ft) |
|------------------|---|---------------|--|----------------|---------------|----------------------------|---|-------------------------|------------------------------|-------------------|
| | 7308 | | 1.00 | | | | 15,400 | 0.354 | 7,712 | 0.177 |
| | | | | | | | | | | |
| | 7309 | | 2.00 | | | | 17,650 | 0.405 | 24,237 | 0.556 |
| | 7310 | | 3.00 | | | | 19,900 | 0.457 | 43,012 | 0.987 |
| | 7311 7312 | | 4.00 5.00 | | | | 22,350 24,800 | 0.513 | 64,137 87,712 | 1.472 2.014 |
| | 7312 | | 6.00 | | | | 24,800 | 0.631 | 113,862 | 2.614 |
| | 7314 | | 7.00 | | | | 30,200 | 0.693 | 142,712 | 3.276 |
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MHFD-Detention_v4 04 - Pond 1 2024.02.05, Basin

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

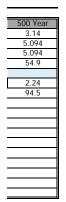
MHFD-Detention, Version 4.04 (February 2021)

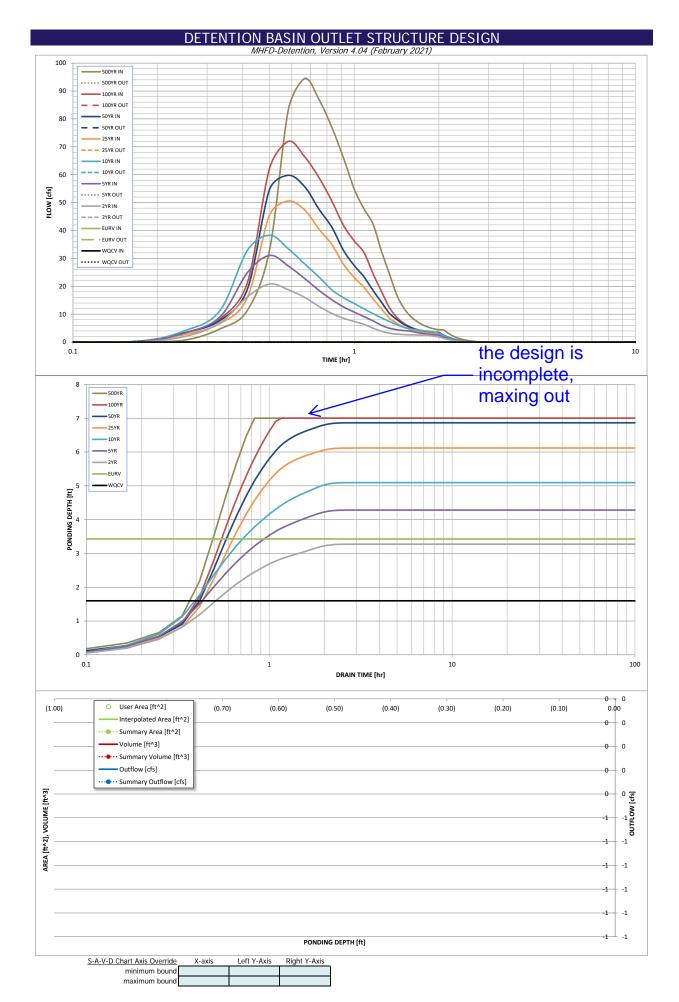


| | | | BASIN OU FD-Detention, Ver. | | | SIGN | | |
|---|-----------------------------------|-------------------------|---------------------------------------|-------------------------|------------------------|--------------------------------|--------------------------|------------------|
| | Monument Ridge Pond 1 Qmax out | East = 90% PreDev Q. | Q10=12.9cfs, Q100 |)=35.5cfs | | | | |
| ZONE 3 ZONE 2 | | | | Estimated | Estimated | | | |
| | | | | Stage (ft) | Volume (ac-ft) | Outlet Type | | |
| | T | | Zone 1 | #N/A | | | | |
| | 100-YEAR ORIFICE | | Zone 2 | | | | | |
| PERMANENT ORIFICES | | | Zone 3 | | | | | |
| POOL Example Zone C | onfiguration (Re | tention Pond) | | Total (all zones) | | | | |
| ser Input: Orifice at Underdrain Outlet (typically | used to drain WO | CV in a Filtration BM | <u>1P)</u> | | L | 1 | Calculated Parame | ters for Underd |
| Underdrain Orifice Invert Depth = | | ft (distance below | the filtration media | surface) | Under | drain Orifice Area = | | ft ² |
| Underdrain Orifice Diameter = | | inches | | | Underdrair | n Orifice Centroid = | | feet |
| eer Innut. Orifice Diete with one or more crifice | o or Elliptical Clat | Main (tunically yourd | to drain WOCV and | (or EUD) (in a codin | entetion DMD) | | Oslaulated Damas | have fam Diata |
| ser Input: Orifice Plate with one or more orifice Invert of Lowest Orifice = | s or Elliptical Slot | | n bottom at Stage = | | | ice Area per Row = | Calculated Parame N/A | ft ² |
| Depth at top of Zone using Orifice Plate = | | | n bottom at Stage = | | | iptical Half-Width = | | feet |
| Orifice Plate: Orifice Vertical Spacing = | | inches | · · · · · · · · · · · · · · · · · · · | | | ical Slot Centroid = | N/A | feet |
| Orifice Plate: Orifice Area per Row = | | inches | | | | Iliptical Slot Area = | N/A | ft ² |
| - | | - | | | | | | |
| | | \wedge | | | | | | |
| ser Input: Stage and Total Area of Each Orifice | | - | | | | | | |
| | Row 1 (optional) | Row 2 (optional) | Row 3 (optional) | Row 4 (optional) | Row 5 (optional) | Row 6 (optional) | Row 7 (optional) | Row 8 (option |
| Stage of Orifice Centroid (ft) | | | | | | | | |
| Orifice Area (sq. inches) | | ⊥ ∖ | | | | | | |
| ٦ | Row 9 (optional) | Row 10 (optional) | Row 11 (optional) | Row 12 (optional) | Row 13 (optional) | Row 14 (optional) | Row 15 (optional) | Row 16 (optic |
| Stage of Orifice Centroid (ft) | Kow 7 (optional) | itom to (optional) | (optional) | | Kow 13 (optional) | now 14 (optional) | Kow 15 (optional) | Now To (optio |
| Orifice Area (sq. inches) | | | | | | | | |
| | | · _ \ | | | | | | |
| er Input: Vertical Orifice (Circular or Rectangul | <u>ar)</u> | | - | | | | Calculated Parame | ters for Vertica |
| | Not Selected | Not Selected | | | | | Not Selected | Not Selecte |
| Invert of Vertical Orifice = | | | | n bottom at Stage = | | rtical Orifice Area = | | |
| Depth at top of Zone using Vertical Orifice = | | | | n bottom at Stage = | = 0 ft) Vertica | I Orifice Centroid = | | |
| Vertical Orifice Diameter = | | | inches | | | | | |
| | | \ \ | | | | | | |
| ser Input: Overflow Weir (Dropbox with Flat or | Sloped Grate and | Outlet Pipe OR Rect | angular/Trapezoida | I Weir (and No Out) | et Pipe) | | Calculated Parame | ters for Overflo |
| | Not Selected | Not Selected |] | · • · · · · · · | | | Not Selected | Not Selecte |
| Overflow Weir Front Edge Height, Ho = | | | ft (relative to basin I | bottom at Stage = 0 f | t) Height of Grat | e Upper Edge, H _t = | | |
| Overflow Weir Front Edge Length = | | | feet | | Overflow V | /eir Slope Length = | | |
| Overflow Weir Grate Slope = | | | H:V | | Grate Open Area / 10 | - | | |
| Horiz. Length of Weir Sides = | | | feet | | Overflow Grate Open | | | |
| Overflow Grate Type = | | | -1.) | | Overflow Grate Ope | n Area w/ Debris = | | |
| Debris Clogging % = | | | % | | | | | |
| ser Input: Outlet Pipe w/ Flow Restriction Plate (| Circular Orifico P | ostrictor Plato, or P | octangular Orifico) | | C | alculated Parameter | rs for Outlet Pipe w/ | Flow Postrictic |
| ser input. Outlet ripe w/ now Restriction riate (| Not Selected | Not Selected | | | <u></u> | | Not Selected | Not Selecte |
| Depth to Invert of Outlet Pipe = | Not Science | Not Sciected | ft (distance below b | asin bottom at Stage | = 0 ft) O | utlet Orifice Area = | Not Scietted | Not Sciect |
| Circular Orifice Diameter = | | | inches | 3 | | t Orifice Centroid = | | |
| · · · · · | | | - \ | Half-Cer | ntral Angle of Restric | tor Plate on Pipe = | N/A | N/A |
| | | | | | | | | |
| ser Input: Emergency Spillway (Rectangular or T | rapezoidal) | | | | | | Calculated Parame | ters for Spillwa |
| Spillway Invert Stage= | | ft (relative to basin | n bottom at \$tage = | 0 ft) | | esign Flow Depth= | | feet |
| Spillway Crest Length = | | feet | \ \ | | 5 | Top of Freeboard = | | feet |
| Spillway End Slopes = | | H:V | \\ | | | Top of Freeboard = | | acres |
| Freeboard above Max Water Surface = | | feet | \ \ | | Basin Volume at | Top of Freeboard = | | acre-ft |
| | | | <u> </u> | | | | | |
| | | rride the default CUI | | | | | | |
| Design Storm Return Period = | WQCV N/A | EURV N/A | 2 Year 1.19 | 5 Year 1.50 | 10 Year | 25 Year 2.00 | 50 Year 2.25 | 100 Year 2.52 |
| One-Hour Rainfall Depth (in) = CUHP Runoff Volume (acre-ft) = | 0.397 | 1.187 | 1.19 | 1.619 | 1.75 2.067 | 2.688 | 3.183 | 3.817 |
| Inflow Hydrograph Volume (acre-ft) = | N/A | N/A | 1.114 | 1.619 | 2.067 | 2.688 | 3.183 | 3.817 |
| CUHP Predevelopment Peak Q (cfs) = OPTIONAL Override Predevelopment Peak Q (cfs) = | N/A N/A | N/A N/A | 3.4 | 9.5 | 14.3 | 25.2 | 31.5 | 39.4 |
| Predevelopment Unit Peak Flow, q (cfs/acre) = | N/A | N/A N/A | 0.14 | 0.39 | 0.58 | 1.03 | 1.29 | 1.61 |
| Peak Inflow Q (cfs) = | N/A | N/A | 20.8 | 31.0 | 38.3 | 50.6 | 59.8 | 71.9 |
| Peak Outflow Q (cfs) = Ratio Peak Outflow to Predevelopment Q = | | | | + $$ | | | | |
| Structure Controlling Flow = | | 1 | | | | | | |
| Max Velocity through Grate 1 (fps) = | | 1 | | | - | | - | |
| Max Velocity through Grate 2 (fps) = Time to Drain 97% of Inflow Volume (hours) = | | | | + $-$ | | | | |
| Time to Drain 97% of Inflow Volume (hours) = | | 1 | | | | | | |
| Maximum Ponding Depth (ft) = | | 1 | | | | | | |
| Area at Maximum Ponding Depth (acres) = Maximum Volume Stored (acre-ft) = | | | | $\backslash \downarrow$ | | | | |
| | | 1 | I | \rightarrow | | | | I |
| | | | | \sim | provide | all prelin | nnary | |
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ICE ft² feet feet feet ft² feet





Outflow Hydrograph Workbook Filename:

Inflow Hydrographs

| Dirk Cliff Cliff <thc< th=""><th></th><th>The user can ov</th><th>verride the calcu</th><th>lated inflow hyd</th><th>lrographs from t</th><th>his workbook wi</th><th>th inflow hydrog</th><th>graphs developed</th><th>d in a separate pr</th><th>ogram.</th><th></th></thc<> | | The user can ov | verride the calcu | lated inflow hyd | lrographs from t | his workbook wi | th inflow hydrog | graphs developed | d in a separate pr | ogram. | |
|--|---------------|-----------------|-------------------|------------------|------------------|-----------------|------------------|------------------|--------------------|----------------|----------------|
| 5.00 min 0.00 | | SOURCE | CUHP | CUHP | CUHP | CUHP | CUHP | CUHP | CUHP | CUHP | CUHP |
| 0.07000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.15000 0.000 <td< th=""><th>Time Interval</th><th>TIME</th><th>WQCV [cfs]</th><th>EURV [cfs]</th><th>2 Year [cfs]</th><th>5 Year [cfs]</th><th>10 Year [cfs]</th><th>25 Year [cfs]</th><th>50 Year [cfs]</th><th>100 Year [cfs]</th><th>500 Year [cfs]</th></td<> | Time Interval | TIME | WQCV [cfs] | EURV [cfs] | 2 Year [cfs] | 5 Year [cfs] | 10 Year [cfs] | 25 Year [cfs] | 50 Year [cfs] | 100 Year [cfs] | 500 Year [cfs] |
| 0.07000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.15000 0.000 <td< th=""><th>5.00 min</th><th>0:00:00</th><th>0.00</th><th>0.00</th><th>0.00</th><th>0.00</th><th>0.00</th><th>0.00</th><th>0.00</th><th>0.00</th><th>0.00</th></td<> | 5.00 min | 0:00:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 0.100 0.00 0.00 0.00 0.00 0.02 0.02 0.210 0.00 0.00 0.00 0.00 0.00 0.01 | | 0:05:00 | | | | | | | | | 0.00 |
| 0.15.00 0.00 2.01 3.28 4.07 2.24 3.29 3.34 0.25.00 0.00 0.00 10.11 21.62 15.36 11.85 21.20 0.35.00 0.00 0.00 10.17 10.95 35.42 50.55 59.74 71.91 0.45.00 0.00 0.00 110.17 27.74 33.42 50.55 59.74 71.95 0.45.00 0.00 0.00 110.11 27.74 33.42 30.44 47.40 59.84 69.74 0.50.00 0.00 0.00 110.11 27.74 13.81 27.83 41.74 11.94 14.94 14.14 <t< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>0.74</td></t<> | | | | | | | | | | | 0.74 |
| 0.200 0.00 6.91 0.44 11.29 6.97 7.74 8.83 0.300 0.00 0.00 22.79 11.06 38.22 45.84 54.49 62.23 0.300 0.00 0.00 116.10 22.76 33.42 65.84 54.49 62.23 0.4400 0.00 0.00 112.77 18.12 23.84 64.44 7.40 55.89 0.5500 0.00 0.00 12.27 15.85 15.85 12.23 15.66 14.70 15.94 0.5500 0.00 0.00 2.55 12.58 15.86 11.11 13.85 24.21 1.0000 0.00 0.00 2.20 10.71 11.81 2.31 13.85 24.21 1.1000 0.00 0.00 2.20 4.07 7.97 8.42 13.44 12.42 1.200 0.00 0.20 2.07 7.33 8.21 6.56 2.21 1.55 1.30 4.41 | | | | | | | | | | | 4.72 |
| 0.28.00 0.00 0.00 10.18 21.24 13.86 18.85 21.20 0.33.00 0.00 0.00 18.75 27.26 33.42 50.55 19.77 77.95 0.4500 0.00 0.00 110.71 18.51 22.28 40.44 47.20 55.56 64.71 0.4500 0.00 0.00 10.24 18.51 22.28 40.44 47.80 55.64 64.71 0.5500 0.00 0.00 10.24 18.56 27.81 32.82 41.79 110.000 0.00 0.20 6.21 0.11 11.91 14.30 11.83 115.00 0.00 0.20 4.27 7.37 8.62 10.34 12.12 11.500 0.00 0.00 2.87 4.46 6.20 6.75 8.11 8.11 13.500 0.00 0.20 2.87 3.41 4.43 3.81 4.52 5.42 14.500 0.000 0.20 | | | | | | | | | | | 11.34 |
| 0.3000 0.000 0.007 10.75 27.84 33.42 48.44 94.497 47.25 0.4000 0.00 10.01 12.77 13.81 27.36 0.42 17.95 0.4500 0.00 0.00 10.27 13.81 22.32 0.44 0.40 93.97 0.5500 0.00 0.00 10.24 15.16 18.71 34.98 0.111 19.99 0.5500 0.00 0.00 15.9 12.36 15.66 12.31 12.35 12.32 14.70 13.94 12.35 < | | | | | | | | | | | 32.90 |
| 0.3500 0.00 10.75 17.26 23.42 95.55 19.77 17.95 0.4500 0.00 0.00 12.77 18.11 22.28 40.46 47.20 55.66 66.41 0.5500 0.00 0.00 10.27 18.11 12.28 40.46 47.40 55.49 0.5500 0.00 0.00 4.59 12.39 13.58 27.81 12.22 17 53.56 22.21 1.0500 0.00 0.00 4.39 41.11 19.43 23.56 22.13 1.1600 0.00 0.00 4.39 7.42 0.17 13.90 14.50 14.30 14.30 14.30 14.30 14.30 14.30 14.30 14.30 14.30 14.30 14.30 14.30 14.30 14.30 14.30 14.31 14.30 14.30 14.31 14.41 14.40 14.41 14.40 14.41 14.40 14.41 14.40 14.31 14.41 14.41 14.41 <td></td> <td>83.38</td> | | | | | | | | | | | 83.38 |
| 0.4500 0.00 10.20 1124 115.16 117.1 34.98 41.11 50.49 0.5500 0.00 0.00 7.39 10.76 11.31 22.17 27.43 32.82 41.79 1.6500 0.00 0.00 7.39 10.76 11.31 22.17 27.45 36.28 12.10 1.1500 0.00 0.00 4.99 7.60 10.17 15.50 16.0 16.10 1.1500 0.00 0.00 3.87 4.63 8.73 11.33 16.31 14.30 16.16 1.2500 0.00 0.00 2.87 4.45 6.20 4.75 5.27 5.42 1.3500 0.00 0.00 2.62 3.19 4.12 2.33 4.37 1.4600 0.00 0.00 2.47 2.44 3.91 3.22 3.27 3.42 1.4600 0.00 0.00 2.47 2.44 3.91 3.22 3.27 3.42 | | | 0.00 | 0.00 | 18.75 | 27.26 | 33.42 | 50.55 | 59.79 | 71.95 | 94.48 |
| 0:50:00 00:00 < | | 0:40:00 | 0.00 | 0.00 | 16.01 | 22.76 | 28.02 | 47.32 | 55.66 | 66.41 | 86.91 |
| 0 55 00 0 00 | | 0:45:00 | 0.00 | 0.00 | 12.77 | 18.51 | 23.28 | 40.46 | 47.60 | 58.89 | 76.94 |
| $\begin{array}{c c c c c c c c c c c c c c c c c c c $ | | 0:50:00 | 0.00 | 0.00 | 10.24 | 15.16 | 18.71 | 34.98 | 41.11 | 50.49 | 65.91 |
| 10500 0.00 0.00 4.94 9.12 11.91 19.63 22.10 11500 0.00 0.00 2.87 6.03 8.72 11.93 14.30 18.18 1.2000 0.00 0.00 2.87 6.03 8.72 11.93 14.30 18.18 1.2500 0.00 0.00 2.37 4.45 6.20 6.75 8.14 4.91 1.3500 0.00 0.00 2.42 5.31 6.33 6.37 6.76 1.4500 0.00 0.00 2.42 3.91 4.79 4.45 5.27 5.32 6.32 7.44 1.450 1.450 0.00 0.00 2.42 3.91 1.32 3.33 3.45 1.52 1.44 1.49 1.450 1.50 0.00 0.00 1.34 1.77 2.26 2.17 2.42 2.55 2.1000 0.00 0.00 1.34 1.52 1.53 1.44 1.49 1.53 1.17 1.10 | | 0:55:00 | 0.00 | 0.00 | 8.56 | 12.58 | 15.86 | 27.83 | 32.82 | 41.79 | 54.86 |
| 110:00 0.00 0.00 3.67 7.22 10.17 115.30 116.30 1120:00 0.00 0.00 3.67 6.33 8.77 11.39 14.30 112.42 1120:00 0.00 0.00 2.70 4.45 6.20 6.75 8.11 8.41 13:00 0.00 0.00 2.76 4.12 5.37 5.33 6.37 6.76 14:00 0.00 0.00 2.55 3.44 4.39 3.85 4.52 4.49 14:500 0.00 0.00 2.51 3.99 4.11 3.48 4.66 3.88 15:500 0.00 0.00 2.12 2.45 3.62 3.04 3.87 3.31 3.45 2.15:00 0.00 0.00 1.34 1.75 2.26 2.12 2.42 2.25 2.10:00 0.00 0.00 0.44 0.74 0.73 0.77 0.75 2.50:00 0.00 0.00 | | | | | | | | | | | 47.73 |
| 115:00 0.00 0.00 327 6.03 6.73 11.93 14.30 18.18 125:00 0.00 0.00 320 4.97 7.39 8.62 10.34 124 1.25:00 0.00 0.00 270 4.12 5.37 5.33 6.37 6.76 1.55:00 0.00 0.00 255 3.44 4.99 3.85 4.52 4.49 1.45:00 0.00 0.00 2.55 3.44 4.99 3.85 4.52 4.49 1.45:00 0.00 0.00 2.47 2.84 3.91 3.22 3.33 3.45 1.5:00 0.00 0.00 1.86 2.44 3.20 2.97 3.40 3.14 2.05:00 0.00 0.00 1.86 2.44 3.20 2.97 3.40 3.14 2.05:00 0.00 0.00 0.48 0.55 0.74 0.70 0.79 0.75 2.5:00 0.00 0 | | | | | | | | | | | 42.31 |
| 1.2000 0.00 0.00 2.80 4.45 6.23 6.31 1.242 1.25.00 0.00 0.00 2.80 4.45 6.20 6.35 8.11 8.91 1.35.00 0.00 0.00 2.70 4.12 5.31 6.37 6.76 1.4000 0.00 0.00 2.55 3.91 4.79 4.45 5.27 5.42 1.4000 0.00 0.00 2.51 3.99 4.11 3.48 4.66 3.88 1.95000 0.00 0.00 2.47 2.84 3.91 3.22 3.31 2.0600 0.00 0.00 1.86 2.44 3.00 2.57 3.40 3.41 2.0600 0.00 0.00 0.44 1.52 2.62 2.12 2.42 2.52 2.1000 0.00 0.00 0.44 0.31 0.31 1.17 1.10 2.3000 0.00 0.00 0.00 0.00 0.00 0. | | | | | | | | | | | 32.58 |
| $\begin{array}{c c c c c c c c c c c c c c c c c c c $ | | | | | | | | | | | 24.49 |
| $\begin{array}{c c c c c c c c c c c c c c c c c c c $ | | | | | | | | | | | 16.91 12.23 |
| $\begin{array}{c c c c c c c c c c c c c c c c c c c $ | | | | | | | | | | | 9.32 |
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| 14500 0.00 2.51 3.99 4.11 3.46 4.06 3.88 150.00 0.00 0.00 2.47 2.84 3.91 3.22 3.13 3.45 1:55:00 0.00 0.00 1.86 2.44 3.00 3.52 3.21 2:00:00 0.00 0.00 1.86 2.44 3.20 2.97 3.40 3.14 2:05:00 0.00 0.00 0.94 1.72 2.85 1.48 1.69 1.88 2:15:00 0.00 0.00 0.84 1.09 1.03 1.17 1.10 2:25:00 0.00 0.00 0.28 0.36 0.44 0.46 0.52 0.49 2:30:00 0.00 0.00 0.10 0.14 0.18 0.18 0.33 0.33 2:35:00 0.00 0.00 0.00 0.02 0.02 0.02 0.03 0.03 2:45:00 0.00 0.00 0.00 0.00 <td< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>6.21</td></td<> | | | | | | | | | | | 6.21 |
| $\begin{array}{c c c c c c c c c c c c c c c c c c c $ | | | | | | | | | | | 5.36 |
| 2:00:00 0.00 1.86 2.44 3.20 2.97 3.40 3.14 2:05:00 0.00 0.00 1.34 1.75 2.26 2.12 2.42 2.25 2:10:00 0.00 0.00 0.45 0.34 1.09 1.33 1.17 1.16 2:15:00 0.00 0.00 0.44 0.55 0.74 0.70 0.77 0.75 2:25:00 0.00 0.00 0.18 0.24 0.31 0.31 0.31 0.33 0.33 2:35:00 0.00 0.00 0.11 0.14 0.18 0.21 0.19 2:46:00 0.00 | | | | | | | | | | | 4.77 |
| $\begin{array}{c c c c c c c c c c c c c c c c c c c $ | | 1:55:00 | 0.00 | 0.00 | 2.12 | 2.65 | 3.62 | 3.06 | 3.52 | 3.21 | 4.43 |
| $\begin{array}{c c c c c c c c c c c c c c c c c c c $ | | 2:00:00 | 0.00 | 0.00 | 1.86 | 2.44 | 3.20 | 2.97 | 3.40 | 3.14 | 4.32 |
| $\begin{array}{c c c c c c c c c c c c c c c c c c c $ | | | 0.00 | 0.00 | 1.34 | 1.75 | 2.26 | 2.12 | 2.42 | 2.25 | 3.07 |
| 2:20:00 0.00 0.00 0.28 0.36 0.46 0.52 0.47 2:35:00 0.00 0.00 0.18 0.24 0.31 0.31 0.33 0.33 2:35:00 0.00 0.00 0.11 0.14 0.18 0.24 0.31 0.31 0.33 0.33 2:35:00 0.00 0.00 0.04 0.07 0.08 0.09 0.10 0.09 2:45:00 0.00 0.00 0.02 0.02 0.03 0.03 0.03 0.03 2:55:00 0.00 | | | | | | | | | | | 2.16 |
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| 5:35:00 0:00 | | | | | | | | | | | 0.00 |

MHFD-Detention, Version 4.04 (February 2021)

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

| Stage - Storage Description | Stage [ft] | Area [ft ²] | Area [acres] | Volume [ft ³] | Volume [ac-ft] | Total Outflow [cfs] | |
|--------------------------------|---------------|----------------------------|-----------------|------------------------------|-------------------|---------------------------|---|
| | | | | | | | For best results, include the |
| | | | | | | | stages of all grade slope changes (e.g. ISV and Floor) |
| | | | | | | | from the S-A-V table on |
| | | | | | | | Sheet 'Basin'. |
| | | | | | | | Also include the inverts of all |
| | | | | | | | outlets (e.g. vertical orifice, |
| | | | | | | | overflow grate, and spillway, where applicable). |
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MHFD-Detention, Version 4.04 (February 2021)

Project: Monument Ridge East Basin ID: Pond 2 Qmax out = 90% PreDev Q. Q10=10.6cfs, Q100=28.3cfs

ZONE 2 100-YR EURV WO 100-YEAR ZONE 1 AND 2 ORFICES Example Zone Configuration (Retention Pond) PERM

Depth Increment =

acre-feet acre-feet

ft

acre-feet

Watershed Information

| Itersned Information | | |
|---|------------|---------|
| Selected BMP Type = | EDB | |
| Watershed Area = | 20.48 | acres |
| Watershed Length = | 1,370 | ft |
| Watershed Length to Centroid = | 660 | ft |
| Watershed Slope = | 0.049 | ft/ft |
| Watershed Imperviousness = | 57.88% | percent |
| Percentage Hydrologic Soil Group A = | 0.0% | percent |
| Percentage Hydrologic Soil Group B = | 82.0% | percent |
| Percentage Hydrologic Soil Groups C/D = | 18.0% | 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.

| the embedded Colorado Urban Hydro | graph Procedu | ure. | Optional Use | r Override |
|--|---------------|-----------|--------------|------------|
| Water Quality Capture Volume (WQCV) = | 0.391 | acre-feet | | acre-fee |
| Excess Urban Runoff Volume (EURV) = | 1.256 | acre-feet | | acre-fee |
| 2-yr Runoff Volume (P1 = 1.19 in.) = | 1.170 | acre-feet | 1.19 | inches |
| 5-yr Runoff Volume (P1 = 1.5 in.) = | 1.625 | acre-feet | 1.50 | inches |
| 10-yr Runoff Volume (P1 = 1.75 in.) = | 2.024 | acre-feet | 1.75 | inches |
| 25-yr Runoff Volume (P1 = 2 in.) = | 2.517 | acre-feet | 2.00 | inches |
| 50-yr Runoff Volume (P1 = 2.25 in.) = | 2.938 | acre-feet | 2.25 | inches |
| 100-yr Runoff Volume (P1 = 2.52 in.) = | 3.456 | acre-feet | 2.52 | inches |
| 500-yr Runoff Volume (P1 = 3.14 in.) = | 4.533 | acre-feet | | inches |
| Approximate 2-yr Detention Volume = | 0.987 | acre-feet | | |
| Approximate 5-yr Detention Volume = | 1.353 | acre-feet | | |
| Approximate 10-yr Detention Volume = | 1.713 | acre-feet | | |
| Approximate 25-yr Detention Volume = | 1.853 | acre-feet | | |
| Approximate 50-yr Detention Volume = | 1.929 | acre-feet | | |
| Approximate 100-yr Detention Volume = | 2.120 | acre-feet | | |

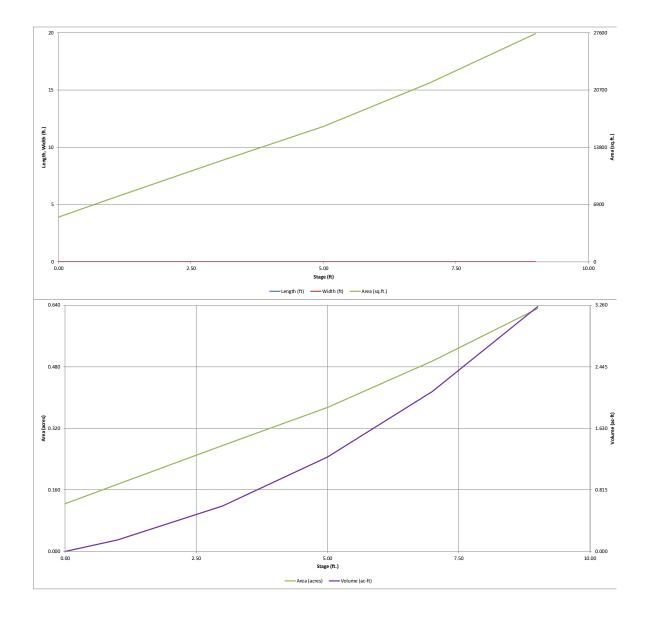
Define Zones and Basin Geometry

| Select Zone 1 Storage Volume (Required) = | | acre-feet |
|---|------|-----------------|
| Select Zone 2 Storage Volume (Optional) = | | acre-feet |
| Select Zone 3 Storage Volume (Optional) = | | acre-feet |
| Total Detention Basin Volume = | | acre-feet |
| Initial Surcharge Volume (ISV) = | user | ft ³ |
| Initial Surcharge Depth (ISD) = | user | ft |
| Total Available Detention Depth (H _{total}) = | user | ft |
| Depth of Trickle Channel $(H_{TC}) =$ | user | ft |
| Slope of Trickle Channel (S_{TC}) = | user | ft/ft |
| Slopes of Main Basin Sides (Smain) = | user | H:V |
| Basin Length-to-Width Ratio ($R_{L/W}$) = | user | |
| | | |

user user Surcharge Volume Width (WISV) = user Depth of Basin Floor (H_{FLOOR}) = user Length of Basin Floor (LFLOOR) = user Width of Basin Floor (W_{FLOOR}) = user Area of Basin Floor (A_{FLOOR}) user Volume of Basin Floor (V_{FLOOR}) = user Depth of Main Basin (H_{MAIN}) = user Length of Main Basin (L_{MAIN}) user Width of Main Basin (W_{MAIN}) = user Area of Main Basin (A_{MAIN}) = user Volume of Main Basin (V_{MAIN}) = user Calculated Total Basin Volume (V_{total}) = user

| | | Depth Increment = | | ft | | | | | | | |
|---|------------------|-------------------|-------|----------------------|--------|-------|--------------------|-------------------------|--------|--------------------|---------|
| | | Stage - Storage | Stage | Optional Override | Length | Width | Area | Optional Override | Area | Volume | Volume |
| | | Description | (ft) | Stage (ft) | (ft) | (ft) | (ft ²) | Area (ft ²) | (acre) | (ft ³) | (ac-ft) |
| | | Top of Micropool | | 0.00 | | | | 5,400 | 0.124 | | |
| | | 7278 | | 1.00 | | | | 7,600 | 0.174 | 6,500 | 0.149 |
| | | 7280 | | 3.00 | | | | 12,000 | 0.275 | 26,100 | 0.599 |
| | | 7282 | | 5.00 | | | | 16,300 | 0.374 | 54,400 | 1.249 |
| | | 7284 | | 7.00 | | | | 21,550 | 0.495 | 92,250 | 2.118 |
| | | 7286 | | 9.00 | | | | 27,500 | 0.631 | 141,300 | 3.244 |
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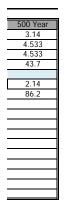
MHFD-Detention, Version 4.04 (February 2021)

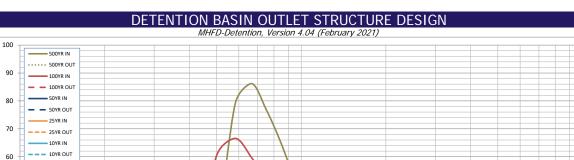


| | D | | BASIN OU FD-Detention, Ver | | | SIGN | | |
|---|-----------------------------------|-------------------------------|-------------------------------|-----------------------|------------------------|--|--------------------------|------------------|
| | Monument Ridge Pond 2 Qmax out | East = 90% PreDev Q. | Q10=10.6cfs, Q100 |)=28.3cfs | | | | |
| ZONE 3 | | | | Estimated | Estimated | | | |
| | | | | Stage (ft) | Volume (ac-ft) | Outlet Type | | |
| | | | Zone 1 | #N/A | | | | |
| | 100-YEAR ORIFICE | | Zone 2 | | | | | |
| PERMANENT ORIFICES | | | Zone 3 | | | | | |
| POOL Example Zone C | onfiguration (Re | etention Pond) | | Total (all zones) |) | | | |
| ser Input: Orifice at Underdrain Outlet (typically | used to drain WC | CV in a Filtration BM | <u>1P)</u> | | L | 1 | Calculated Parame | ters for Underd |
| Underdrain Orifice Invert Depth = | | ft (distance below | the filtration media | surface) | Under | drain Orifice Area = | | ft ² |
| Underdrain Orifice Diameter = | | inches | | | Underdrair | n Orifice Centroid = | | feet |
| eer Innut. Orifies Diets with one or more erifies | o as Elliptical Clat | Mais (typically your | to drain WOCV and | (or EUD)/ in a codin | contation DMD) | | Oslavdata d Damana | have for Dista |
| ser Input: Orifice Plate with one or more orifice Invert of Lowest Orifice = | s or Elliptical Slot | | n bottom at Stage = | | | ice Area per Row = | Calculated Parame N/A | ft ² |
| Depth at top of Zone using Orifice Plate = | | | n bottom at Stage = | | | iptical Half-Width = | | feet |
| Orifice Plate: Orifice Vertical Spacing = | | inches | | | | ical Slot Centroid = | N/A | feet |
| Orifice Plate: Orifice Area per Row = | | inches | | | | Iliptical Slot Area = | N/A | ft ² |
| | | <u> </u> | | | | | | |
| | | \wedge | | | | | | |
| ser Input: Stage and Total Area of Each Orifice | | | | | | | | |
| | Row 1 (optional) | Row 2 (optional) | Row 3 (optional) | Row 4 (optional) | Row 5 (optional) | Row 6 (optional) | Row 7 (optional) | Row 8 (option |
| Stage of Orifice Centroid (ft) | | + \ | | | | | | |
| Orifice Area (sq. inches) | | | | | | | | |
|] | Row 9 (optional) | Row 10 (optional) | Row 11 (optional) | Row 12 (optional) | Row 13 (optional) | Row 14 (optional) | Row 15 (optional) | Row 16 (optio |
| Stage of Orifice Centroid (ft) | Roll 7 (optional) | (optional) | Kow II (optional) | now iz (optional) | now to (optional) | non in (optional) | now to (optional) | |
| Orifice Area (sq. inches) | | | | | | | | |
| | | | | | | • | | |
| er Input: Vertical Orifice (Circular or Rectangu | | | 7 | | | | Calculated Parame | |
| | Not Selected | Not Selected | _ | | | | Not Selected | Not Selecte |
| Invert of Vertical Orifice = | | + | | h bottom at Stage = | | rtical Orifice Area = | - | |
| Depth at top of Zone using Vertical Orifice = Vertical Orifice Diameter = | | + | inches | n bottom at Stage = | = 0 ft) Vertica | I Orifice Centroid = | | |
| | | | Inches | | | | | |
| | | \ \ | | | | | | |
| ser Input: Overflow Weir (Dropbox with Flat or | Sloped Grate and | Outlet Pipe OR Rect | angular/Trapezoida | I Weir (and No Outl | et Pipe) | | Calculated Parame | ters for Overflo |
| | Not Selected | Not Selected | | | | | Not Selected | Not Selecte |
| Overflow Weir Front Edge Height, Ho = | | | ft (relative to basin | bottom at Stage = 0 f | t) Height of Grat | e Upper Edge, $H_t =$ | | |
| Overflow Weir Front Edge Length = | | ' | feet | | | Veir Slope Length = | | |
| Overflow Weir Grate Slope = | | | H:V | | Grate Open Area / 10 | - | | |
| Horiz. Length of Weir Sides = | | | feet | | Overflow Grate Open | | | |
| Overflow Grate Type = Debris Clogging % = | | | % | | Overflow Grate Ope | in Area w/ Debris = | | |
| | | | 1,0 | | | | | |
| ser Input: Outlet Pipe w/ Flow Restriction Plate | Circular Orifice, R | Restrictor Plate, or Re | ectangular Orifice) | | <u>Ca</u> | alculated Parameter | rs for Outlet Pipe w/ | Flow Restriction |
| | Not Selected | Not Selected | | | | | Not Selected | Not Selecte |
| Depth to Invert of Outlet Pipe = | | | ft (distance below b | asin bottom at Stage | = 0 ft) O | utlet Orifice Area = | | |
| Circular Orifice Diameter = | | | inches | | | t Orifice Centroid = | | |
| | | | 1 | Half-Cer | ntral Angle of Restric | ctor Plate on Pipe = | N/A | N/A |
| | | | 1 | | | | | |
| ser Input: Emergency Spillway (Rectangular or 1 | rapezoidal) | ft (malation to be all | | 0.61) | C III 5 | | Calculated Parame | |
| Spillway Invert Stage= Spillway Crest Length = | | ft (relative to basin feet | n bottom at Stage = | · u I() | | esign Flow Depth= Top of Freeboard = | | feet feet |
| Spillway Erest Length = Spillway End Slopes = | | H:V | \ | | • | Top of Freeboard = Top of Freeboard = | | acres |
| Freeboard above Max Water Surface = | | feet | \ \ | | | Top of Freeboard = | | acre-ft |
| | | | \ \ | | | | L | |
| outed Hydrograph Results | The user cap ave | rrida tha dafault CU | UD bydrographs and | I rupoff volumos by | optoring now value | a in the Inflow Llude | rographs table (Coli | mpc W through |
| Design Storm Return Period = | WQCV | rride the default CUI EURV | 2 Year | 5 Year | 10 Year | 25 Year | 50 Year | 100 Year |
| One-Hour Rainfall Depth (in) = | N/A | N/A | 1.19 | 1.50 | 1.75 | 2.00 | 2.25 | 2.52 |
| CUHP Runoff Volume (acre-ft) = | 0.391 N/A | 1.256 N/A | 1.170 1.170 | 1.625 1.625 | 2.024 2.024 | 2.517 2.517 | 2.938 2.938 | 3.456 3.456 |
| Inflow Hydrograph Volume (acre-ft) = CUHP Predevelopment Peak Q (cfs) = | N/A N/A | N/A N/A | 3.1 | 7.8 | 2.024 11.8 | 20.2 | 2.938 | 3.450 31.4 |
| OPTIONAL Override Predevelopment Peak Q (cfs) = | N/A | N/A | | | | | | |
| Predevelopment Unit Peak Flow, q (cfs/acre) = Peak Inflow Q (cfs) = | N/A N/A | N/A N/A | 0.15 22.5 | 0.38 | 0.58 37.9 | 0.99 47.9 | 1.23 55.8 | 1.53 66.6 |
| Peak Millow Q (cfs) = Peak Outflow Q (cfs) = | IN A | 11/74 | 22.3 | 51.4 | 51.7 | 77.7 | 55.0 | 00.0 |
| Ratio Peak Outflow to Predevelopment Q = | | | | | | | | |
| Structure Controlling Flow = Max Velocity through Grate 1 (fps) = | | | | + | | | | |
| Max Velocity through Grate 2 (fps) = | | | | | <u> </u> | <u> </u> | <u> </u> | |
| Time to Drain 97% of Inflow Volume (hours) = | | | - '\ | | | | | |
| Time to Drain 99% of Inflow Volume (hours) = Maximum Ponding Depth (ft) = | | 4 | \vdash | | | | | |
| Area at Maximum Ponding Depth (acres) = | | | | ~ 1 | | 1 | | |
| Maximum Volume Stored (acre-ft) = | | | | | | | | |
| | | | | \sim | provide | all prelir | ninary | |
| | | | | | | | , | |
| | | | | × | design of | Jata | | |

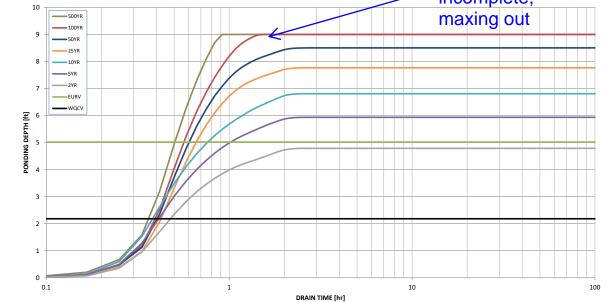


ice ft² feet ² freet feet ft² ft² ft² fteet radians





⁰ 0.1 11 the design is incomplete,



0 1 0 (1.00) User Area [ft^2] 0.00 (0.70) (0.60) (0.50) (0.40) (0.30) (0.20) (0.10) Interpolated Area [ft^2] 0 0 ···• Summary Area [ft^2] Volume [ft^3] 0 0 ···• Summary Volume [ft^3] Outflow [cfs] 0 0 ···• Summary Outflow [cfs] OUTFLOW [cfs] AREA [ft^2], VOLUME [ft^3] 0 -1 -1 -1 -1 -1 -1 1 -1 -1 -1 PONDING DEPTH [ft] S-A-V-D

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

5YR IN

••••• 5YR OUT

EURV OUT
 WQCV IN

····· WQCV OUT

2YR IN 2YR OUT EURV IN

FLOW [cfs]

50

40

30

20

10

10

Outflow Hydrograph Workbook Filename:

Inflow Hydrographs

| | The user can ov | verride the calcu | lated inflow hyd | rographs from t | his workbook wi | th inflow hydrog | raphs develope | d in a separate pr | ogram. | |
|---------------|--------------------|-------------------|------------------|-----------------|-----------------|------------------|----------------|--------------------|----------------|----------------|
| | SOURCE | CUHP | CUHP | CUHP | CUHP | CUHP | CUHP | CUHP | CUHP | CUHP |
| Time Interval | TIME | WQCV [cfs] | EURV [cfs] | 2 Year [cfs] | 5 Year [cfs] | 10 Year [cfs] | 25 Year [cfs] | 50 Year [cfs] | 100 Year [cfs] | 500 Year [cfs] |
| 5.00 min | 0:00:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 0:05:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 0:10:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.29 | 0.03 | 0.93 |
| | 0:15:00 | 0.00 | 0.00 | 2.55 | 4.16 | 5.15 | 3.46 | 4.27 | 4.21 | 5.90 |
| | 0:20:00 | 0.00 | 0.00 | 8.66 | 11.25 | 13.61 | 8.27 | 9.57 | 10.32 | 13.63 |
| | 0:25:00 | 0.00 | 0.00 | 18.81 | 27.26 | 34.70 | 18.44 | 21.63 | 23.98 | 34.77 |
| | 0:30:00 | 0.00 | 0.00 | 22.53 | 31.45 | 37.87 | 45.54 | 53.66 | 60.34 | 79.26 |
| | 0:35:00 | 0.00 | 0.00 | 19.52 | 26.60 | 31.85 | 47.89 | 55.84 | 66.55 | 86.21 |
| | 0:40:00 | 0.00 | 0.00 | 16.36 | 21.86 | 26.26 | 43.45 | 50.46 | 59.59 | 77.03 |
| | 0:45:00 | 0.00 | 0.00 | 12.77 | 17.48 | 21.36 | 36.39 | 42.25 | 51.79 | 66.75 |
| | 0:50:00 | 0.00 | 0.00 | 10.23 | 14.49 | 17.38 | 30.74 | 35.65 | 43.34 | 55.91 |
| | 0:55:00 | 0.00 | 0.00 | 8.53 | 11.98 | 14.68 | 24.59 | 28.60 | 35.97 | 46.52 |
| | 1:00:00 1:05:00 | 0.00 | 0.00 | 7.11 | 9.89 | 12.40 | 20.17 | 23.53 | 30.83 | 39.94 |
| | 1:10:00 | 0.00 | 0.00 | 5.90 4.49 | 8.12 6.74 | 10.41 8.90 | 16.75 12.67 | 19.58 14.89 | 26.68 19.46 | 34.57 25.41 |
| | 1:15:00 | 0.00 | 0.00 | 3.68 | 5.77 | 8.32 | 9.67 | 11.46 | 14.14 | 18.80 |
| | 1:20:00 | 0.00 | 0.00 | 3.30 | 5.09 | 7.38 | 7.57 | 8.96 | 10.15 | 13.54 |
| | 1:25:00 | 0.00 | 0.00 | 3.08 | 4.67 | 6.25 | 6.27 | 7.41 | 7.61 | 10.16 |
| | 1:30:00 | 0.00 | 0.00 | 2.97 | 4.38 | 5.48 | 5.17 | 6.06 | 6.06 | 8.09 |
| | 1:35:00 | 0.00 | 0.00 | 2.89 | 4.20 | 4.96 | 4.43 | 5.14 | 5.02 | 6.70 |
| | 1:40:00 | 0.00 | 0.00 | 2.83 | 3.69 | 4.59 | 3.98 | 4.58 | 4.35 | 5.78 |
| | 1:45:00 | 0.00 | 0.00 | 2.79 | 3.32 | 4.34 | 3.66 | 4.19 | 3.89 | 5.17 |
| | 1:50:00 | 0.00 | 0.00 | 2.77 | 3.06 | 4.16 | 3.47 | 3.94 | 3.63 | 4.82 |
| | 1:55:00 | 0.00 | 0.00 | 2.34 | 2.89 | 3.89 | 3.36 | 3.81 | 3.55 | 4.70 |
| | 2:00:00 | 0.00 | 0.00 | 2.03 | 2.68 | 3.46 | 3.30 | 3.73 | 3.52 | 4.65 |
| | 2:05:00 | 0.00 | 0.00 | 1.40 | 1.83 | 2.36 | 2.26 | 2.55 | 2.43 | 3.20 |
| | 2:10:00 | 0.00 | 0.00 | 0.93 | 1.22 | 1.59 | 1.52 | 1.71 | 1.64 | 2.16 |
| | 2:15:00 2:20:00 | 0.00 | 0.00 | 0.62 | 0.80 | 1.05 | 1.02 | 1.15 | 1.10 | 1.44 |
| | 2:25:00 | 0.00 | 0.00 | 0.39 | 0.50 | 0.67 | 0.65 | 0.73 | 0.70 | 0.92 |
| | 2:30:00 | 0.00 | 0.00 | 0.12 | 0.19 | 0.24 | 0.24 | 0.27 | 0.26 | 0.34 |
| | 2:35:00 | 0.00 | 0.00 | 0.05 | 0.09 | 0.24 | 0.12 | 0.13 | 0.13 | 0.16 |
| | 2:40:00 | 0.00 | 0.00 | 0.02 | 0.03 | 0.03 | 0.04 | 0.04 | 0.04 | 0.05 |
| | 2:45:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 2:50:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 2:55:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
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| | 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 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 |
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| | 4:05:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
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| | 4:15:00 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 4:40:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
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| | 4:55:00 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 |
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| | 5:15:00 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 5:40:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
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| | 5:50:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
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MHFD-Detention, Version 4.04 (February 2021)

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

| Stage - Storage Description | Stage [ft] | Area [ft ²] | Area [acres] | Volume [ft ³] | Volume [ac-ft] | Total Outflow [cfs] | |
|--------------------------------|---------------|----------------------------|-----------------|------------------------------|-------------------|---------------------------|---|
| | - | | | | | | For best results, include the |
| | | | | | | | stages of all grade slope changes (e.g. ISV and Floor) |
| | | | | | | | from the S-A-V table on |
| | | | | | | | Sheet 'Basin'. |
| | | | | | | | Also include the inverts of all |
| | | | | | | | outlets (e.g. vertical orifice, |
| | | | | | | | overflow grate, and spillway, where applicable). |
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MHFD-Detention, Version 4.04 (February 2021)

Depth Increment =

acre-feet acre-feet acre-feet

acre-feet

ft ³

n/n H:V

ft

acre-feet

ZONE 2 100-YR EURV W 100-YEAR ZONE 1 AND 2 ORFICES Example Zone Configuration (Retention Pond) PERMA

Watershed Infor

| tersned information | | |
|---|------------|---------|
| Selected BMP Type = | EDB | |
| Watershed Area = | 5.78 | acres |
| Watershed Length = | 1,080 | ft |
| Watershed Length to Centroid = | 490 | ft |
| Watershed Slope = | 0.027 | ft/ft |
| Watershed Imperviousness = | 63.17% | percent |
| Percentage Hydrologic Soil Group A = | 0.0% | percent |
| Percentage Hydrologic Soil Group B = | 53.0% | percent |
| Percentage Hydrologic Soil Groups C/D = | 47.0% | 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.

| the embedded Colorado Urban Hydro | graph Procedu | ure. | Optional Use | r Override |
|--|---------------|-----------|--------------|------------|
| Water Quality Capture Volume (WQCV) = | 0.119 | acre-feet | | acre-fee |
| Excess Urban Runoff Volume (EURV) = | 0.376 | acre-feet | | acre-fee |
| 2-yr Runoff Volume (P1 = 1.19 in.) = | 0.369 | acre-feet | 1.19 | inches |
| 5-yr Runoff Volume (P1 = 1.5 in.) = | 0.506 | acre-feet | 1.50 | inches |
| 10-yr Runoff Volume (P1 = 1.75 in.) = | 0.624 | acre-feet | 1.75 | inches |
| 25-yr Runoff Volume (P1 = 2 in.) = | 0.761 | acre-feet | 2.00 | inches |
| 50-yr Runoff Volume (P1 = 2.25 in.) = | 0.884 | acre-feet | 2.25 | inches |
| 100-yr Runoff Volume (P1 = 2.52 in.) = | 1.030 | acre-feet | 2.52 | inches |
| 500-yr Runoff Volume (P1 = 3.14 in.) = | 1.342 | acre-feet | | inches |
| Approximate 2-yr Detention Volume = | 0.311 | acre-feet | | |
| Approximate 5-yr Detention Volume = | 0.429 | acre-feet | | |
| Approximate 10-yr Detention Volume = | 0.521 | acre-feet | | |
| Approximate 25-yr Detention Volume = | 0.559 | acre-feet | | |
| Approximate 50-yr Detention Volume = | 0.579 | acre-feet | | |
| Approximate 100-yr Detention Volume = | 0.632 | acre-feet | | |

Define Zones and Basin Geometry

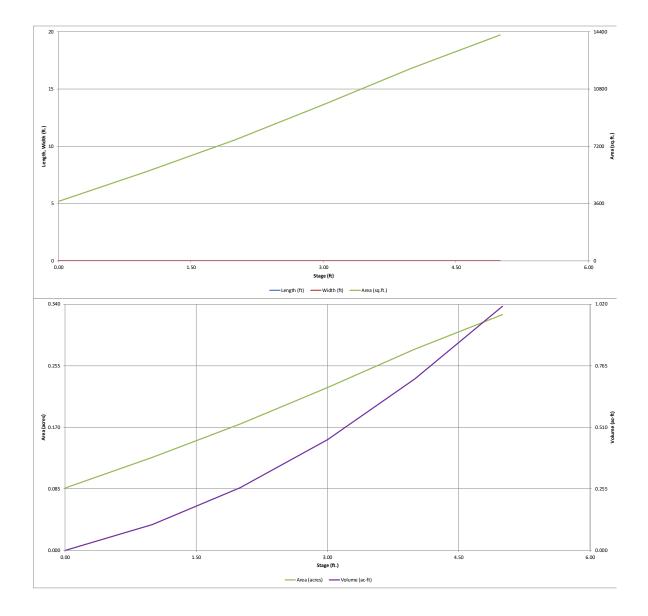
| Select Zone 1 Storage Volume (Required) = | |
|---|------|
| Select Zone 2 Storage Volume (Optional) = | |
| Select Zone 3 Storage Volume (Optional) = | |
| Total Detention Basin Volume = | |
| Initial Surcharge Volume (ISV) = | user |
| Initial Surcharge Depth (ISD) = | user |
| Total Available Detention Depth (H _{total}) = | user |
| Depth of Trickle Channel $(H_{TC}) =$ | user |
| Slope of Trickle Channel (S_{TC}) = | user |
| Slopes of Main Basin Sides (Smain) = | user |
| Basin Length-to-Width Ratio (R _{L/W}) = | user |
| | |

Initial Surcharge Area $(A_{ISV}) =$ user Surcharge Volume Length (L_{ISV}) = user Surcharge Volume Width (WISV) = user Depth of Basin Floor (H_{FLOOR}) = user Length of Basin Floor (LFLOOR) = user Width of Basin Floor (W_{FLOOR}) = user Area of Basin Floor (A_{FLOOR}) user Volume of Basin Floor (V_{FLOOR}) = user Depth of Main Basin (H_{MAIN}) = user Length of Main Basin (L_{MAIN}) user Width of Main Basin (W_{MAIN}) = user Area of Main Basin (A_{MAIN}) = user Volume of Main Basin (V_{MAIN}) = user Calculated Total Basin Volume (V_{total}) = user

| | 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 | | | | 3,750 | 0.086 | (11) | (ac-it) |
| | 7272 | | 1.00 | | | | 5,600 | 0.129 | 4,675 | 0.107 |
| | 7273 | | 2.00 3.00 | | | | 7,600 9,800 | 0.174 | 11,275 19,975 | 0.259 0.459 |
| | 7275 | | 4.00 | | | | 12,100 | 0.223 | 30,925 | 0.710 |
| | 7276 | | 5.00 | | | | 14,200 | 0.326 | 44,075 | 1.012 |
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MHFD-Detention_v4 04 - Pond 3 2024.02.05, Basin

MHFD-Detention, Version 4.04 (February 2021)

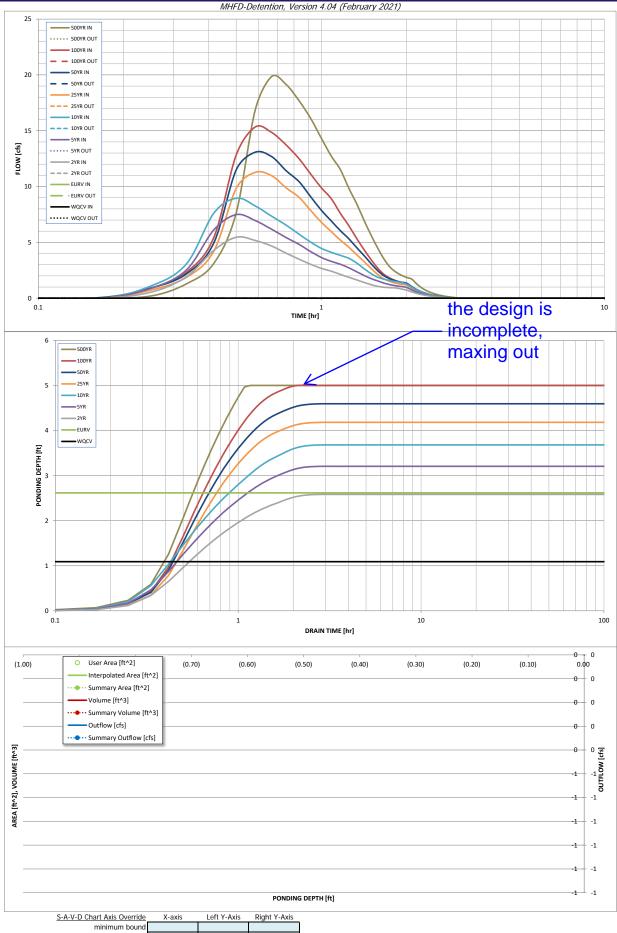


| Invert of Vertical Orifice = ft (relative to basin bottom at Stage = 0 ft) Vertical Orifice Area = Depth at top of Zone using Vertical Orifice Diameter = ft (relative to basin bottom at Stage = 0 ft) Vertical Orifice Centroid = Vertical Orifice Diameter = inches inches ser Input: Overflow Weir (Dropbox with Flat or Sloped Grate and Outlet Pipe OR Rectangular/Trapezoidal Weir (and No Outlet Pipe) Calculated Parameters for Overflow | | | | BASIN OU FD-Detention, Ver | | | SIGN | | |
|--|--|----------------------|-----------------------|-------------------------------|---------------------------------------|------------------------|--------------------------------|-----------------------|------------------|
| <form></form> | | | | Q10=2.2cfs, Q100= | =5.8cfs | | | | |
| Sign 0 | ZONE 3 | | - | | Estimated | Estimated | | | |
| <form></form> | | | | | Stage (ft) | Volume (ac-ft) | Outlet Type | | |
| | VOLUME EURY WOCY | | | Zone 1 | #N/A | | | | |
| Image Total of the second | | 100-YEAR | | Zone 2 | | | | | |
| trad UPC and U | PERMANENT ORIFICES | | | Zone 3 | | | | | |
| Uberdania Office here Indexa band here Uberdania Office here Indexa band here Selficier Indexa band here | POOL Example Zone C | onfiguration (Re | tention Pond) | | Total (all zones) |) | | | |
| Lindernia Girlo, Linuxda - | ser Input: Orifice at Underdrain Outlet (typically | used to drain WQ | CV in a Filtration BM | <u>1P)</u> | | L | 1 | Calculated Parame | ters for Underd |
| er inpul. Office Paile silli oue or noe enflete al Eliptica Sid. Veri Etystal yaed to data WOO' and/or CRN's ha sedimatidion DMT Inter of Usaed Office - Define Verice Paile. Office - Define Verice Paile Verice Paile Paile. Office - Define Verice Paile Paile. Office Paile Paile Paile Paile. Office Paile Paile Paile Paile Paile Paile. Office Paile Paile Paile Paile. Office Paile Paile Paile. Office Paile Paile Paile Paile. Office Paile Paile Paile Paile. Office Paile Pail | Underdrain Orifice Invert Depth = | | ft (distance below | the filtration media | surface) | Under | drain Orifice Area = | | ft ² |
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| Invert of Lowoff Chine Leng and Total Action of the Control of Stage = 0 (f) Stage of Office Chine Has provided in the Stage = 0 (f) Stage of Office Chine Has provided in the Stage = 0 (f) Stage of Office Chine Has provided in the Stage = 0 (f) Stage of Office Chine Has provided in the Stage of Office Chine Has provided in | eer Innut. Orifice Dista with one or more crifice | o or Elliptical Clat | Mair (turically used | to drain WOCV and | (or EUD) (in a codin | entetion DMD) | | Oslaulated Damas | have fam Diata |
| Despite at the of Zene using Giffer Nettice Spaces Image of the first Nettice Spaces Net A rest First Netter Net A rest Space Net A rest Space </td <td>· · ·</td> <td>s or Elliptical Slot</td> <td></td> <td></td> <td></td> <td></td> <td>ice Area per Pow -</td> <td>r</td> <td></td> | · · · | s or Elliptical Slot | | | | | ice Area per Pow - | r | |
| Drifter Heit: Write Virtual Specing Num Num <td></td> <td></td> <td></td> <td>-</td> <td></td> <td></td> <td></td> <td></td> <td></td> | | | | - | | | | | |
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| Stage of Drite Central (P) Prov 2 (optional) Prov 3 (optional) Prov 5 (optional) Prov 6 (optional) Prov 7 (optional) Prov 1 (optional) </td <td></td> <td></td> <td>-</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> | | | - | | | | | | |
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| Stage of Office Central (10) Image: Vertical Office Central (1 | ser Input: Stage and Total Area of Each Orifice | | - | | | | | | |
| Orice Area (q) inched Image of Dates Contraid (P) Operation of the Area (q) inched of the area (q) The Area (q) <ththe (q)<="" area="" th=""> The Area (q) <</ththe> | | Row 1 (optional) | Row 2 (optional) | Row 3 (optional) | Row 4 (optional) | Row 5 (optional) | Row 6 (optional) | Row 7 (optional) | Row 8 (option |
| Stop of Oritics Area (or light) Rev 11 (optional Rev 11 (optional <threv (optional<="" 11="" th=""> Rev 11 (optional <threv (optional<="" 11="" th=""> <threv 1<="" td=""><td>-</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></threv></threv></threv> | - | | | | | | | | |
| Stage of Orice Avery (in pre- Orice Avery (in pre- Depth at top of Zone using Vertical Orifice - Depth at top of Zone using Vertical Orifice - Depth at top of Zone using Vertical Orifice - Vertical Orifice Dameter - Into Selection In (relative to basis bottom at Stage - 0.11) Vertical Orifice Centrals - Depth at top of Zone using Vertical Orifice - Depth at top of Zone using Vertical Orifice Office Centrals - Vertical Orifice Dameter - Catalated Parameters for Vertical Into Selection Inches ext input: Overflow Weir Docesson with Bat or Source Orate and Outer Ego: DR Ortenaus Orifice Centrals - Vertical Orifice Dameter - Not Selection Inches Not Selection Inches Overflow Weir Docesson with Bat or Source Orate and Outer Ego: DR Ortenaus Orifice Centrals - Vertical Orifice Dameter - Not Selection Inches Not Selection Inches Not Selection Inches Overflow Weir Docesson with Front Ego: Ego: Orifice Cata Not Selection Inches Inches Not Selection Inches Inches Not Selection Inches Not Selection Not Selection Inches Not Selection Not Not Selection Inches Not Selection Not Not Selection Inches Not Selection Not Not Not Not Selection Inches Not Selection Not Not Not Selection Inches Not Selection Not Not Not Selection Inches Not Selection Not | Orifice Area (sq. inches) | | <u> </u> | | | | | | |
| Step of Office Central (10) Calculated Parameters for Vertical Office (Enclaror Restanguar) Calculated Parameters for Vertical Office (Enclaror Restanguar) Calculated Parameters for Vertical Office (Enclaror Restanguar) Depth at top of Zone using Vertical Office Domentor Vertical Offic | ſ | Pow 9 (optional) | Row 10 (optional) | Pow 11 (ontional) | Pow 12 (optional) | Pow 13 (optional) | Pow 14 (optional) | Pow 15 (optional) | Pow 16 (optic |
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| optimizer Vertical Orifice (Circular or Rectangular) Calculated Parameters for Vertical Drifice Area Depth at top of Zone using Vertical Orifice Dameter Not Selected Tri (relative to basin bottom at Stage - 0 ft) Vertical Orifice Centrol - Depth at top of Zone using Vertical Orifice Dameter Not Selected Not Selected Not Selected Depth at top of Zone using Vertical Orifice Dameter Not Selected Not Selected Not Selected Vertical Orifice Dameter Not Selected Not Selected Not Selected Not Selected Overflow Weit (Dropkex with Tait or Stoped Grale and Outlet Pipe OR Vertical Vertical Drofice Centrol - Not Selected | - | | | | | | | | |
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| Depth at top of Zone using Vertical Orifice Diameter = In (relative to basin bottom at Slage = 0.1) Vertical Orifice Centroid = wer input: Overflow Weir Front Edge Height, Ho Inches Not Selected Not Selected Overflow Weir Front Edge Height, Ho Inches Not Selected Not Selected Not Selected Overflow Weir Front Edge Height, Ho Inches Not Selected Not Selected Not Selected Overflow Weir Front Edge Height, Ho Inches Inches Not Selected Not Selected Overflow Weir Front Edge Height, Ho Inches Inches Inches Inches Overflow Weir Front Edge Length Inches Inches <t< td=""><td></td><td>Not Selected</td><td>Not Selected</td><td></td><td></td><td></td><td></td><td>Not Selected</td><td>Not Selecte</td></t<> | | Not Selected | Not Selected | | | | | Not Selected | Not Selecte |
| Vertical Orifice Diameter = Inches ser. Input. Overflow Weir Chropbox with Elat or Steped Gate and Outlet Pipe. OR Restangular. Trapezoidal Weir, (and No. Outlet Pipe.). Calculated Parameters for Outlet Ope. Overflow Weir Front Edge Height, Ho Inches Total Statesteel Inches Overflow Weir Front Edge Height, Ho Inches Inches Inches Overflow Weir Front Edge Height, Ho Inches Overflow Weir Grate Stope Inches Overflow Weir Grate Stope Inches Inches Inches Overflow Grate Type - Inches Overflow Read Vice Open Area Inches Overflow Grate Type - Inches Inches Overflow Read Open Area Inches Overflow Grate Type - Inches Inches Overflow Read Open Area Inches Overflow Grate Type - Inches Inches Overflow Read Open Area Inches Open To Untel Pipe - Inches Inches Inches Inches Inches Open To Untel Pipe - Inches Inches Inches Inches Inches Inches Inches Inches Inches I | | | | | - | | | | |
| ser. Input. Overflow Weir (Dropbox with Flat or Sloped Grate and Outlet Pipe OR Rectangular/Trapezoidal Weir (and No Outlet Pipe) Calculated Parameters for Overflow Overflow Weir Front Edge Height, No = Not Selected Not Selected Not Selected Not Selected Overflow Weir Front Edge Height, No = Not Selected Not Selected Not Selected Not Selected Overflow Weir Front Edge Height, No = Not Selected Not Selected Not Selected Not Selected Overflow Weir Front Edge Height, No = Not Selected Not Selected Not Selected Not Selected Overflow Weir Front Edge Height, No = Not Selected Not Selected Not Selected Not Selected Overflow Weir Front Edge Height, No = Not Selected Not Selected Not Selected Not Selected Overflow Grate Open Area w/ Debris = Debris Clogging % = Not Selected Not Selected Not Selected Not Selected Not Selected Not Selected Beith to Invert of Outlet Pipe w/ Flow Restrictor Plate or Debris Clogging % = Not Selected Not Selected Not Selected Not Selected Not Selected Not Selected </td <td></td> <td></td> <td></td> <td></td> <td>n bottom at Stage =</td> <td>= 0 ft) Vertica</td> <td>I Orifice Centroid =</td> <td></td> <td></td> | | | | | n bottom at Stage = | = 0 ft) Vertica | I Orifice Centroid = | | |
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| Overflow Weir Front Edge Height, Ho Int Selected Not Selected Not Selected Not Selected Not Selected Overflow Weir Front Edge Length Interview Great Open Area / 100-yr Orfice Area Interview Interv | ser Input: Overflow Weir (Dropbox with Flat or | Sloped Grate and | Outlet Pipe OR Rect | angular/Trapezoida | I Weir (and No Out) | et Pipe) | | Calculated Parame | ters for Overflo |
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| Overflow Weir Grate Stope = | Overflow Weir Front Edge Height, Ho = | | | ft (relative to basin | bottom at Stage = 0 f | t) Height of Grat | e Upper Edge, H _t = | | |
| Horiz, Length of Weir Sides Image: Control of Grate Type - Debris Control of Grate Type - Debris Control of Grate Type - Debris Control of Control of Grate Type - Debris Control of Control of Grate Type - Debris Control of Contro | Overflow Weir Front Edge Length = | | | feet | | Overflow V | /eir Slope Length = | | |
| Overflow Grate Type | Overflow Weir Grate Slope = | | | H:V | G | Grate Open Area / 10 | 00-yr Orifice Area = | | |
| Debris Clogging % = 78 ser Input: Outlet Pipe w/ Flow Restriction Plate (Circular Onfice. Restrictor Plate. or Rectangular Onfice) Calculated Parameters for Outlet Pipe w/ Flow Restriction Depth to Invert of Outlet Pipe Circular Onfice. Diservice below hasin bottom at Stage = 0 ft) Outlet Onfice Central = Circular Onfice. Dismeter = Inches Outlet Onfice Central = Splilway (Rectangular or Trapezoidal) Calculated Parameters for Splike Splikway (Restangular or Trapezoidal) Calculated Parameters for Splike Splikway (Restangular or Trapezoidal) Calculated Parameters for Splike Splikway (Restangular or Trapezoidal) Splikway (Restangular or Trapezoidal) Splikway (Restangular or Trapezoidal) Feet Splikway (Restangular or Trapezoidal) Calculated Parameters for Splike Splikway (Restangular or Trapezoidal) Feet Splikway (Restangular or Trapezoidal) Calculated Parameters for Splike One for Ranfal Depth (n) Feet Splikway (Restangular or Trapezoidal) The user can override the default CIHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W theoremaths and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W theoremaths and runoff volume (are t)) Outer Hydrograph New (thydrograph Volume (are t)) N/A N/A <td>5</td> <td></td> <td></td> <td>feet</td> <td></td> <td></td> <td></td> <td></td> <td></td> | 5 | | | feet | | | | | |
| Calculated Parameters for Outlet Pipe w/ Flow Restriction Pilate (Circular Orifice. Restrictor Pilate, or Rectandular Orifice) Calculated Parameters for Outlet Pipe w/ Flow Restriction Depth to Invert of Outlet Pipe - Circular Orifice Diameter = Not Selected ft disknose below basin bottom at Stage = 0 ft) Outlet Orifice Area = Outlet Orifice Centroid = Image: Calculated Parameters for Spillway ser Input: Emergency Spillway (Rectangular or Trapezoidal) Spillway (Invert Stage = Spillway Crest Length = Spillway Crest Length = Spillway Crest Length = Freeboard above Max Water Surface = If (relative to basin bottom at stage = 0 ft) Spillway Design Flow Depth = feet Image: Calculated Parameters for Spillway Outled Hydrograph Results If (relative to basin bottom at stage = 0 ft) Spillway Design Flow Depth = feet Image: Trapezoidal) Image: Columns W Itrapezoidal Image: Columns W Itrapezoidal Outled Hydrograph Results Image: Columns W Itrapezoidal Image: Columns W Itrapezoidal Image: N/A | | | | | | Overflow Grate Ope | n Area w/ Debris = | | |
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| ser Input: Emergency Spillway (Rectangular or Trapezoidal) Calculated Parameters for Spillway Spillway Invert Stage = Spillway Crest Length = Spillway End Slopes = Freeboard above Max Water Surface = feet Spillway End Slopes = H:V feet Spillway End Slopes = Freeboard above Max Water Surface = feet Basin Area at Top of Freeboard = Basin Volume at Top of Freeboard = Basin Volume at Top of Freeboard = Culted Hydrograph Results feet acres The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W throug One-Hour Rainfall Depti (n) = CultP Runoff Volume (acre-t) = CultP Runoff Volume (acre-t) = CultP Runoff Volume (acre-t) = CultP Runoff Volume (acre-t) = N/A N/A N/A 0.506 0.624 0.761 0.884 1.030 OPTIONAL Override Predevelopment Peak O (cfs) = Predevelopment Unit Peak Flow, q (cfs/acre) = MXA N/A N/A 0.12 0.29 0.42 0.711 0.87 1.11 Predevelopment Deak O (cfs) = Max Velocity through Grate 1 (ps) = Max Velocity through Grate 1 (ps) = Maximum Ponding Depth (cre) = Maximum Ponding Depth (cre) = Maximum Volume Stored (acre-t) = Maximanum Volume Stored (acre-t) = Maximum Volume Stored (ac | | | | inches | | Outle | t Orifice Centroid = | | |
| Spillway Invert Stage ft (relative to basin bottom at stage = 0 ft) Spillway Design Flow Depth= feet Spillway Crest Length = feet Stage at Top of Freeboard = feet Spillway End Slopes = feet Basin Area at Top of Freeboard = acres Spillway End Slopes = feet Basin Volume at Top of Freeboard = acres Outled 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 Ore Hour Rainfall Depth (med care-ft) = N/A N/A N/A 1/9 1.50 1.75 2.00 2.25 2.52 2.52 2.52 2.52 2.52 2.51 0.119 0.376 0.369 0.506 0.624 0.761 0.884 1.030 Inflow Hydrograph Volume (acre-ft) = N/A N/A N/A 0.7 1.7 2.4 4.1 5.1 6.4 OPTIONAL Overide Predevelopment Peak Q (cfs) = N/A N/A 0.71 7.7 2.4 4.1 5.1 6.4 OPTIONAL Overide Predevelopment Peak Q (cfs) = N/A N/A 0.72 5.5 7.5 9.0 11.3 13.1 15.3 </td <td></td> <td></td> <td>•</td> <td>- \</td> <td>Half-Cer</td> <td>ntral Angle of Restric</td> <td>tor Plate on Pipe =</td> <td>N/A</td> <td>N/A</td> | | | • | - \ | Half-Cer | ntral Angle of Restric | tor Plate on Pipe = | N/A | N/A |
| Spillway Invert Stage ft (relative to basin bottom at stage = 0 ft) Spillway Design Flow Depth= feet Spillway Crest Length = feet Stage at Top of Freeboard = feet Spillway End Slopes = feet Basin Area at Top of Freeboard = acres Spillway End Slopes = feet Basin Volume at Top of Freeboard = acres Outled 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 Ore Hour Rainfall Depth (med care-ft) = N/A N/A N/A 1/9 1.50 1.75 2.00 2.25 2.52 2.52 2.52 2.52 2.52 2.51 0.119 0.376 0.369 0.506 0.624 0.761 0.884 1.030 Inflow Hydrograph Volume (acre-ft) = N/A N/A N/A 0.7 1.7 2.4 4.1 5.1 6.4 OPTIONAL Overide Predevelopment Peak Q (cfs) = N/A N/A 0.71 7.7 2.4 4.1 5.1 6.4 OPTIONAL Overide Predevelopment Peak Q (cfs) = N/A N/A 0.72 5.5 7.5 9.0 11.3 13.1 15.3 </td <td></td> <td></td> <td></td> <td>1</td> <td></td> <td></td> <td></td> <td></td> <td></td> | | | | 1 | | | | | |
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| Spillway End Slopes | . , , , | | | n bottom at Stage = | = 0 ft) | | • · | | |
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| Outed Hydrograph Results The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W throug One-Hour Rainfall Depth (in) = WOCV EURV 2 Year 5 Year 10 Year 25 Year 50 Year 100 Year One-Hour Rainfall Depth (in) N/A N/A 1.19 1.50 1.75 2.00 2.25 2.52 2.55 | | | | \ \ | | | | | |
| Design Storm Return Period WQCV EURV 2 Year 5 Year 10 Year 25 Year 50 Year 100 Year One-Hour Rainfall Depth (in) N/A N/A 1.19 1.50 1.75 2.00 2.25 2.52 CUHP Runoff Volume (acre-ft) 0.119 0.376 0.369 0.506 0.624 0.761 0.884 1.030 CUHP Predevelopment Peak Q (cfs) N/A N/A 0.7 1.7 2.4 4.1 5.1 6.4 OPTIONAL Override Predevelopment Peak Q (cfs) N/A N/A 0.7 1.7 2.4 4.1 5.1 6.4 OPTIONAL Override Predevelopment Peak Q (cfs) N/A N/A 0.7 1.7 2.4 4.1 5.1 6.4 Predevelopment Unit Peak Flow q (cfs/acre) N/A N/A 0.12 0.29 0.42 0.71 0.87 1.11 Peak Outflow Q (cfs) N/A N/A N/A 5.5 7.5 9.0 11.3 13.1 15.3 Ratio Peak Outflow to Predevelopment Q </td <td>Freeboard above max water surface =</td> <td></td> <td>leet</td> <td>\ \</td> <td></td> <td>basin volume at</td> <td>Top of Freeboard =</td> <td></td> <td>acre-n</td> | Freeboard above max water surface = | | leet | \ \ | | basin volume at | Top of Freeboard = | | acre-n |
| Design Storm Return Period WQCV EURV 2 Year 5 Year 10 Year 25 Year 50 Year 100 Year One-Hour Rainfall Depth (in) N/A N/A 1.19 1.50 1.75 2.00 2.25 2.52 CUHP Runoff Volume (acre-ft) 0.119 0.376 0.369 0.506 0.624 0.761 0.884 1.030 CUHP Predevelopment Peak Q (cfs) N/A N/A 0.7 1.7 2.4 4.1 5.1 6.4 OPTIONAL Override Predevelopment Peak Q (cfs) N/A N/A 0.7 1.7 2.4 4.1 5.1 6.4 OPTIONAL Override Predevelopment Peak Q (cfs) N/A N/A 0.7 1.7 2.4 4.1 5.1 6.4 Predevelopment Unit Peak Flow q (cfs/acre) N/A N/A 0.12 0.29 0.42 0.71 0.87 1.11 Peak Outflow Q (cfs) N/A N/A N/A 5.5 7.5 9.0 11.3 13.1 15.3 Ratio Peak Outflow to Predevelopment Q </td <td></td> <td></td> <td></td> <td><u> </u></td> <td></td> <td></td> <td></td> <td></td> <td></td> | | | | <u> </u> | | | | | |
| One-Hour Rainfall Depth (in) N/A N/A 1.19 1.50 1.75 2.00 2.25 2.52 0.119 0.376 0.369 0.506 0.624 0.761 0.884 1.030 0HP Redevelopment Peak Q (cfs) N/A N/A 0.7 1.7 2.4 4.1 5.1 6.4 OPTIONAL Override Predevelopment Peak Q (cfs) N/A N/A 0.7 1.7 2.4 4.1 5.1 6.4 OPTIONAL Override Predevelopment Peak Q (cfs) N/A N/A 0.7 1.7 2.4 4.1 5.1 6.4 OPTIONAL Override Predevelopment Deak Q (cfs) N/A N/A 0.7 1.7 2.4 4.1 5.1 6.4 Predevelopment Unit Peak Flow, q (cfs/acre) N/A N/A 0.12 0.29 0.42 0.71 0.87 1.11 Peak Inflow Q (cfs) N/A N/A N/A 5.5 7.5 9.0 11.3 13.1 15.3 Ratio Peak Outflow Q forat 1 (fps) | | | | | | | | | |
| CUHP Runoff Volume (acre-ft) 0.119 0.376 0.369 0.506 0.624 0.761 0.884 1.030 Inflow Hydrograph Volume (acre-ft) N/A N/A 0.369 0.506 0.624 0.761 0.884 1.030 CUHP Predevelopment Peak Q (cfs) N/A N/A 0.7 1.7 2.4 4.1 5.1 6.4 OPTIONAL Override Predevelopment Peak Q (cfs) N/A N/A 0.7 1.7 2.4 4.1 5.1 6.4 OPTIONAL Override Predevelopment Peak Q (cfs) N/A N/A 0.7 1.7 2.4 4.1 5.1 6.4 OPTIONAL Override Predevelopment Peak Q (cfs) N/A N/A 0.12 0.29 0.42 0.71 0.87 1.11 Peak Outflow Q (cfs) N/A N/A 5.5 7.5 9.0 11.3 13.1 15.3 Ratio Peak Outflow to Predevelopment Q | | | 4 | | | | | | |
| CUHP Predevelopment Peak Q (cfs) N/A N/A 0.7 1.7 2.4 4.1 5.1 6.4 OPTIONAL Override Predevelopment Peak Q (cfs) N/A N/A N/A N/A 0.7 1.7 2.4 4.1 5.1 6.4 Predevelopment Unit Peak Flow, q (cfs/acre) N/A N/A N/A 0.12 0.29 0.42 0.71 0.87 1.11 Peak Inflow Q (cfs) N/A N/A 5.5 7.5 9.0 11.3 13.1 15.3 Ratio Peak Outflow to Predevelopment Q Structure Controlling Flow Max Velocity through Grate 1 (fps) | CUHP Runoff Volume (acre-ft) = | 0.119 | 0.376 | 0.369 | 0.506 | 0.624 | 0.761 | 0.884 | 1.030 |
| OPTIONAL Override Predevelopment Peak Q (cfs) = N/A N/A N/A 0.12 0.29 0.42 0.71 0.87 1.11 Peak Inflow Q (cfs) = N/A N/A 0.12 0.29 0.42 0.71 0.87 1.11 Peak Outflow Q (cfs) = N/A N/A 5.5 7.5 9.0 11.3 13.1 15.3 Ratio Peak Outflow to Predevelopment Q = | | | | | | | | | |
| Predevelopment Unit Peak Flow, q (cfs/acre) = N/A N/A 0.12 0.29 0.42 0.71 0.87 1.11 Peak Inflow 0 (cfs) = N/A N/A 5.5 7.5 9.0 11.3 13.1 15.3 Ratio Peak Outflow 0 predevelopment 0 = | | | | 0.7 | 1.7 | 2.4 | 4.1 | J.1 | 0.4 |
| Peak Outflow Q (cfs) = | Predevelopment Unit Peak Flow, q (cfs/acre) = | N/A | N/A | | | | | | |
| Ratio Peak Outflow to Predevelopment Q = | | N/A | N/A | 5.5 | 7.5 | 9.0 | 11.3 | 13.1 | 15.3 |
| Structure Controlling Flow = | | | | | + | | | | |
| Max Velocity through Grate 2 (fps) = | Structure Controlling Flow = | | | | | | | | |
| Time to Drain 97% of Inflow Volume (hours) = | | | | | + $+$ $+$ $+$ $+$ $+$ $+$ $+$ $+$ $+$ | | | | |
| Maximum Ponding Depth (ft) = | | | 1 | | \ | 1 | 1 | 1 | |
| Area at Maximum Ponding Depth (acres) = | | | | | | | | | |
| Maximum Volume Stored (acre-ft) = provide all preliminary | | | | | | | | | |
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Outflow Hydrograph Workbook Filename:

Inflow Hydrographs

| | JRCE | CUHP | CUHP | CUHP | CUHP | CUHP | CLILID | | OLULID | |
|-------------------|--------------|------------|------------|--------------|--------------|---------------|---------------|---------------|----------------|----------------|
| Time Interval TII | | | 00111 | COIII | COHP | CUHP | CUHP | CUHP | CUHP | CUHP |
| | ME | 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 | 0:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 0:05 | 5:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 0:10 | 0:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.06 | 0.01 | 0.20 |
| 0:15 | 5:00 | 0.00 | 0.00 | 0.54 | 0.88 | 1.09 | 0.73 | 0.91 | 0.89 | 1.28 |
| 0:20 | 0:00 | 0.00 | 0.00 | 1.92 | 2.52 | 3.06 | 1.87 | 2.17 | 2.33 | 3.11 |
| 0:25 | 5:00 | 0.00 | 0.00 | 4.28 | 6.11 | 7.60 | 4.20 | 4.94 | 5.42 | 7.64 |
| 0:30 | 0:00 | 0.00 | 0.00 | 5.46 | 7.48 | 8.95 | 9.83 | 11.49 | 12.82 | 16.83 |
| | 5:00 | 0.00 | 0.00 | 5.17 | 6.96 | 8.27 | 11.27 | 13.07 | 15.33 | 19.84 |
| | 0:00 | 0.00 | 0.00 | 4.67 | 6.18 | 7.35 | 10.97 | 12.69 | 14.85 | 19.15 |
| | 5:00 | 0.00 | 0.00 | 4.04 | 5.44 | 6.55 | 9.89 | 11.43 | 13.73 | 17.70 |
| | 0:00 | 0.00 | 0.00 | 3.50 | 4.82 | 5.74 | 9.04 | 10.44 | 12.50 | 16.10 |
| | 5:00 0:00 | 0.00 | 0.00 | 3.03 | 4.17 | 5.02 | 7.86 | 9.09 | 11.12 | 14.32 |
| | 5:00 | 0.00 | 0.00 | 2.67 2.42 | 3.64 3.30 | 4.46 | 6.80 5.97 | 7.87 6.92 | 9.88 8.92 | 12.74 11.52 |
| | 0:00 | 0.00 | 0.00 | 2.42 | 3.04 | 3.83 | 5.20 | 6.05 | 7.60 | 9.85 |
| | 5:00 | 0.00 | 0.00 | 1.87 | 2.72 | 3.57 | 4.56 | 5.32 | 6.49 | 8.44 |
| | 0:00 | 0.00 | 0.00 | 1.63 | 2.36 | 3.14 | 3.89 | 4.52 | 5.34 | 6.94 |
| | 5:00 | 0.00 | 0.00 | 1.41 | 2.03 | 2.63 | 3.27 | 3.80 | 4.33 | 5.62 |
| | 0:00 | 0.00 | 0.00 | 1.21 | 1.75 | 2.19 | 2.65 | 3.08 | 3.44 | 4.46 |
| 1:35 | 5:00 | 0.00 | 0.00 | 1.06 | 1.54 | 1.88 | 2.12 | 2.45 | 2.68 | 3.48 |
| 1:40 | 0:00 | 0.00 | 0.00 | 0.98 | 1.34 | 1.69 | 1.72 | 1.99 | 2.12 | 2.77 |
| | 5:00 | 0.00 | 0.00 | 0.94 | 1.21 | 1.57 | 1.49 | 1.72 | 1.78 | 2.34 |
| | 0:00 | 0.00 | 0.00 | 0.92 | 1.11 | 1.49 | 1.34 | 1.55 | 1.56 | 2.06 |
| | 5:00 | 0.00 | 0.00 | 0.82 | 1.04 | 1.39 | 1.24 | 1.43 | 1.41 | 1.86 |
| | 0:00 | 0.00 | 0.00 | 0.73 | 0.96 | 1.27 | 1.17 | 1.34 | 1.30 | 1.71 |
| | 5:00 | 0.00 | 0.00 | 0.57 | 0.75 | 0.99 | 0.91 | 1.04 | 0.99 | 1.30 |
| | 0:00 5:00 | 0.00 | 0.00 | 0.43 | 0.57 | 0.75 | 0.68 | 0.79 0.59 | 0.73 | 0.96 |
| | 0:00 | 0.00 | 0.00 | 0.33 | 0.43 | 0.56 | 0.32 | 0.59 | 0.54 | 0.72 |
| | 5:00 | 0.00 | 0.00 | 0.23 | 0.33 | 0.42 | 0.39 | 0.43 | 0.41 | 0.40 |
| | 0:00 | 0.00 | 0.00 | 0.14 | 0.18 | 0.23 | 0.21 | 0.24 | 0.23 | 0.30 |
| | 5:00 | 0.00 | 0.00 | 0.10 | 0.13 | 0.17 | 0.16 | 0.18 | 0.17 | 0.22 |
| 2:40 | 0:00 | 0.00 | 0.00 | 0.07 | 0.09 | 0.12 | 0.12 | 0.13 | 0.12 | 0.16 |
| 2:45 | 5:00 | 0.00 | 0.00 | 0.05 | 0.06 | 0.08 | 0.08 | 0.09 | 0.09 | 0.11 |
| 2:50 | 0:00 | 0.00 | 0.00 | 0.03 | 0.04 | 0.05 | 0.05 | 0.06 | 0.06 | 0.07 |
| 2:55 | 5:00 | 0.00 | 0.00 | 0.02 | 0.02 | 0.03 | 0.03 | 0.03 | 0.03 | 0.04 |
| | 0:00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 | 0.02 | 0.01 | 0.02 |
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| 4:25 | 5:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 0:00 5:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
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| 4:45 | 5:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
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| 5:05 | 5:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
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| | 0:00 5:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 0:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

MHFD-Detention, Version 4.04 (February 2021)

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

| Stage - Storage Description | Stage [ft] | Area [ft ²] | Area [acres] | Volume [ft ³] | Volume [ac-ft] | Total Outflow [cfs] | |
|--------------------------------|---------------|----------------------------|-----------------|------------------------------|-------------------|---------------------------|---|
| | | | | | | | For best results, include the |
| | | | | | | | stages of all grade slope changes (e.g. ISV and Floor) |
| | | | | | | | from the S-A-V table on |
| | | | | | | | Sheet 'Basin'. |
| | | | | | | | Also include the inverts of all |
| | | | | | | | outlets (e.g. vertical orifice, |
| | | | | | | | overflow grate, and spillway, where applicable). |
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MHFD-Detention, Version 4.04 (February 2021)

Project: Monument Ridge East Basin ID: Pond 4 Qmax out = 90% PreDev Q. Q10=15.5cfs, Q100=38.1cfs

ZONE 3

Depth Increment = 100-YEAR ZONE 1 AND 2 ORFICES Example Zone Configuration (Retention Pond)

> ptional User Overrid acre-fe

acre-feet acre-feet

h.

acre-feet

Watershed Infor

PERMA

| tersned information | | |
|---|------------|---------|
| Selected BMP Type = | EDB | |
| Watershed Area = | 22.15 | acres |
| Watershed Length = | 1,005 | ft |
| Watershed Length to Centroid = | 490 | ft |
| Watershed Slope = | 0.045 | ft/ft |
| Watershed Imperviousness = | 41.62% | percent |
| Percentage Hydrologic Soil Group A = | 0.0% | percent |
| Percentage Hydrologic Soil Group B = | 56.0% | percent |
| Percentage Hydrologic Soil Groups C/D = | 44.0% | percent |
| Target WQCV Drain Time = | 40.0 | hours |
| Location for 1-hr Rainfall Depths = | User Input | |
| | | |

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

| · · · · · · · · · · · · · · · · · · · | | | Optional User | Overno |
|--|-------|-----------|---------------|----------|
| Water Quality Capture Volume (WQCV) = | 0.340 | acre-feet | | acre-fee |
| Excess Urban Runoff Volume (EURV) = | 0.922 | acre-feet | | acre-fee |
| 2-yr Runoff Volume (P1 = 1.19 in.) = | 0.954 | acre-feet | 1.19 | inches |
| 5-yr Runoff Volume (P1 = 1.5 in.) = | 1.412 | acre-feet | 1.50 | inches |
| 10-yr Runoff Volume (P1 = 1.75 in.) = | 1.828 | acre-feet | 1.75 | inches |
| 25-yr Runoff Volume (P1 = 2 in.) = | 2.364 | acre-feet | 2.00 | inches |
| 50-yr Runoff Volume (P1 = 2.25 in.) = | 2.809 | acre-feet | 2.25 | inches |
| 100-yr Runoff Volume (P1 = 2.52 in.) = | 3.376 | acre-feet | 2.52 | inches |
| 500-yr Runoff Volume (P1 = 3.14 in.) = | 4.524 | acre-feet | | inches |
| Approximate 2-yr Detention Volume = | 0.733 | acre-feet | | |
| Approximate 5-yr Detention Volume = | 1.072 | acre-feet | | |
| Approximate 10-yr Detention Volume = | 1.351 | acre-feet | | |
| Approximate 25-yr Detention Volume = | 1.494 | acre-feet | | |
| Approximate 50-yr Detention Volume = | 1.561 | acre-feet | | |
| Approximate 100-yr Detention Volume = | 1.799 | acre-feet | | |
| | | | | |

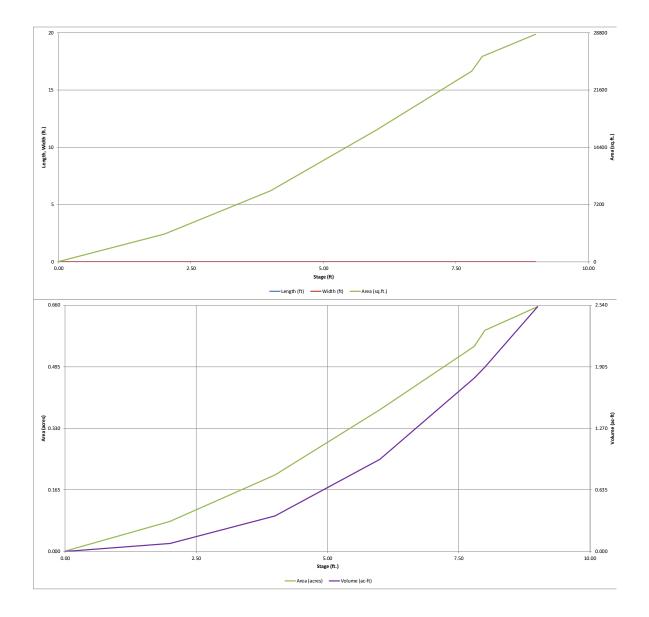
Define Zones and Basin Geometry

| Select Zone 1 Storage Volume (Required) = | | acre-feet |
|---|------|-----------------|
| Select Zone 2 Storage Volume (Optional) = | | acre-feet |
| Select Zone 3 Storage Volume (Optional) = | | acre-feet |
| Total Detention Basin Volume = | | acre-feet |
| Initial Surcharge Volume (ISV) = | user | ft ³ |
| Initial Surcharge Depth (ISD) = | user | ft |
| Total Available Detention Depth (H _{total}) = | user | ft |
| Depth of Trickle Channel $(H_{TC}) =$ | user | ft |
| Slope of Trickle Channel (S _{TC}) = | user | ft/ft |
| Slopes of Main Basin Sides (Smain) = | user | H:V |
| Basin Length-to-Width Ratio $(R_{L/W}) =$ | user | |
| | | |

user user Surcharge Volume Width (WISV) = user Depth of Basin Floor (H_{FLOOR}) = user Length of Basin Floor (LFLOOR) = user Width of Basin Floor (W_{FLOOR}) = user Area of Basin Floor (A_{FLOOR}) user Volume of Basin Floor (V_{FLOOR}) = user Depth of Main Basin (H_{MAIN}) = user Length of Main Basin (L_{MAIN}) user Width of Main Basin (W_{MAIN}) = user Area of Main Basin (A_{MAIN}) = user Volume of Main Basin (V_{MAIN}) = user Calculated Total Basin Volume (V_{total}) = user

| | Depth increment = | | n | | | | | | | |
|-----------|-------------------|-------|----------------------|--------|-------|--------|-------------------------|----------|---------|----------|
| | Stage - Storage | Stage | Optional Override | Length | Width | Area | Optional Override | Area | Volume | Volume |
| | Description | (ft) | Stage (ft) | (ft) | (ft) | (ft 2) | Area (ft ²) | (acre) | (ft 3) | (ac-ft) |
| | Top of Micropool | | 0.00 | | | | 50 | 0.001 | | |
| | 7262 | | 2.00 | | | | 3,500 | 0.080 | 3,550 | 0.081 |
| | 7264 | | 4.00 | | | | 8,900 | 0.204 | 15,950 | 0.366 |
| | 7266 | | 6.00 | | | | 16,550 | 0.380 | 41,400 | 0.950 |
| | 7267.8 | | 7.80 | | | | 23,950 | 0.550 | 77,850 | 1.787 |
| | 7268 | | 8.00 | | | | 25,800 | 0.592 | 82,825 | 1.901 |
| | 7269 | | 9.00 | | | | 28,600 | 0.657 | 110,025 | 2.526 |
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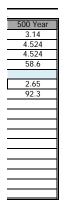
MHFD-Detention, Version 4.04 (February 2021)

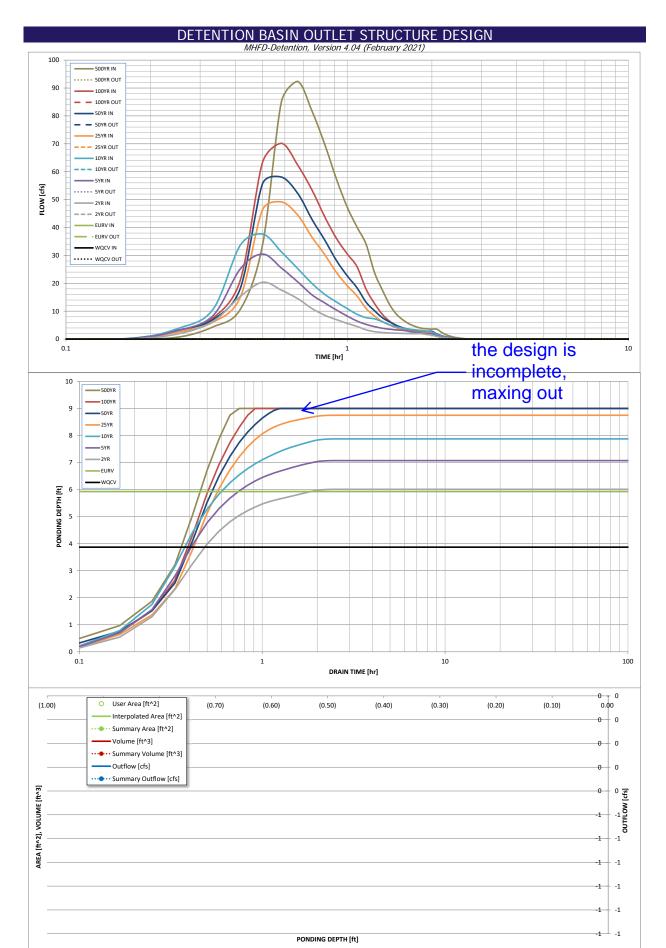


| | DE | | BASIN OU D-Detention, Ver. | LEI SIRU | CIURE DES | SIGN | | |
|--|------------------------|-----------------------|-------------------------------|-----------------------|---------------------------------------|-----------------------|----------------------|-------------------|
| | Monument Ridge I | East | | - | y 2021) | | | |
| Basin ID: | Pond 4 Qmax out | = 90% PreDev Q. | Q10=15.5cfs, Q100 | | | | | |
| ZONE 2 ZONE 2 ZONE 1 | \sim | | | Estimated | Estimated | | | |
| | | | | Stage (ft) | Volume (ac-ft) | Outlet Type | 1 | |
| VOLUME EURY WOCV | | | Zone 1 | #N/A | | | | |
| ZONE 1 AND 2 | -100-YEAR ORIFICE | | Zone 2 | | | | | |
| PERMANENT ORIFICES | onfiguration (Ret | ention Pond) | Zone 3 | | | | | |
| | | | | Total (all zones) | | | | |
| ser Input: Orifice at Underdrain Outlet (typically | used to drain WQ0 | 1 | | | | | Calculated Parame | |
| Underdrain Orifice Invert Depth = | | | the filtration media | surface) | | drain Orifice Area = | | ft ² |
| Underdrain Orifice Diameter = | | inches | | | Underdrain | Orifice Centroid = | | feet |
| ser Input: Orifice Plate with one or more orifice | s or Elliptical Slot V | Veir (typically used | to drain WQCV and | or EURV in a sedin | nentation BMP) | | Calculated Parame | ters for Plate |
| Invert of Lowest Orifice = | ••••• | | bottom at Stage = | | | ice Area per Row = | N/A | ft ² |
| Depth at top of Zone using Orifice Plate = | | ft (relative to basir | bottom at Stage = | 0 ft) | Elli | ptical Half-Width = | N/A | feet |
| Orifice Plate: Orifice Vertical Spacing = | | inches | | | Ellipt | ical Slot Centroid = | N/A | feet |
| Orifice Plate: Orifice Area per Row = | | inches | | | E | Iliptical Slot Area = | N/A | ft ² |
| | | | | | | | | |
| oor Innut. Store and Total Area of Each Orifica | | an lawaat ta hisha | | | | | | |
| ser Input: Stage and Total Area of Each Orifice | Row 1 (optional) | Row 2 (optional) | Row 3 (optional) | Row 4 (optional) | Row 5 (optional) | Row 6 (optional) | Row 7 (optional) | Row 8 (option |
| Stage of Orifice Centroid (ft) | Row I (optional) | Now 2 (optional) | Now 5 (optional) | Kow 4 (optional) | Row 5 (optional) | Row o (optional) | Row 7 (optional) | |
| Orifice Area (sq. inches) | | | | | | | | |
| | | | | | | | | |
| | Row 9 (optional) | Row 10 (optional) | Row 11 (optional) | Row 12 (optional) | Row 13 (optional) | Row 14 (optional) | Row 15 (optional) | Row 16 (option |
| Stage of Orifice Centroid (ft) | | | | | | | | |
| Orifice Area (sq. inches) | | | | | | | | |
| | | | | | | | | |
| er Input: Vertical Orifice (Circular or Rectangu | | _ | 1 | | | | Calculated Parame | |
| | Not Selected | Not Selected | | | a (i) | | Not Selected | Not Selecte |
| Invert of Vertical Orifice = | | | | bottom at Stage = | , | tical Orifice Area = | | |
| Depth at top of Zone using Vertical Orifice = Vertical Orifice Diameter = | | | inches | bottom at Stage = | υπ) vertica | I Orifice Centroid = | | |
| | | | inclics | | | | | |
| | | \ \ | | | | | | |
| ser Input: Overflow Weir (Dropbox with Flat or | Sloped Grate and (| Dutlet Pipe OR Rect | angular/Trapezoida | Weir (and No Outl | et Pipe) | | Calculated Parame | ters for Overflow |
| | Not Selected | Not Selected | | | | | Not Selected | Not Selected |
| Overflow Weir Front Edge Height, Ho = | | | ft (relative to basin b | oottom at Stage = 0 f | t) Height of Grate | e Upper Edge, $H_t =$ | | |
| Overflow Weir Front Edge Length = | | | feet | | | /eir Slope Length = | | |
| Overflow Weir Grate Slope = | | | H:V | | irate Open Area / 10 | | | |
| Horiz. Length of Weir Sides = | | | feet | | Verflow Grate Open | | | |
| Overflow Grate Type = Debris Clogging % = | | | oz | | Overflow Grate Ope | n Area w/ Debris = | | |
| | | | 1,0 | | | | | |
| ser Input: Outlet Pipe w/ Flow Restriction Plate | (Circular Orifice, Re | strictor Plate, or Re | ectangular Orifice) | | Ca | alculated Parameter | s for Outlet Pipe w/ | Flow Restrictio |
| | Not Selected | Not Selected | | | | | Not Selected | Not Selecte |
| Depth to Invert of Outlet Pipe = | | | ft (distance below ba | asin bottom at Stage | = 0 ft) O | utlet Orifice Area = | | |
| Circular Orifice Diameter = | | | inches | | Outle | t Orifice Centroid = | | |
| | | | | Half-Cer | ntral Angle of Restric | tor Plate on Pipe = | N/A | N/A |
| | | | 1 | | | | | |
| ser Input: Emergency Spillway (Rectangular or 1 | rapezoidal) | 1 | | | | | Calculated Parame | ters for Spillway |
| Spillway Invert Stage= | | | i bottom at Stage = | 0 ft) | | esign Flow Depth= | | feet |
| Spillway Crest Length = | | feet | 1 | | 5 | Top of Freeboard = | | feet |
| Spillway End Slopes = | | H:V | \ | | | Fop of Freeboard = | | acres |
| Freeboard above Max Water Surface = | | feet | \ \ | | Basin volume at | Top of Freeboard = | | acre-ft |
| | | | | | | | | |
| outed Hydrograph Results | | | | | entering new values | | | |
| Design Storm Return Period = One-Hour Rainfall Depth (in) = | WQCV N/A | EURV N/A | 2 Year 1.19 | 5 Year 1.50 | 10 Year 1.75 | 25 Year 2.00 | 50 Year 2.25 | 100 Year 2.52 |
| CUHP Runoff Volume (acre-ft) = | 0.340 | 0.922 | 0.954 | 1.412 | 1.828 | 2.364 | 2.809 | 3.376 |
| Inflow Hydrograph Volume (acre-ft) = $CHUD Production Production Production (acre-ft) = CHUD Production (acre-ft)$ | N/A | N/A | 0.954 | 1.412 | 1.828 | 2.364 | 2.809 | 3.376 |
| CUHP Predevelopment Peak Q (cfs) = OPTIONAL Override Predevelopment Peak Q (cfs) = | N/A N/A | N/A N/A | 5.2 | 11.7 | 17.2 | 27.6 | 34.1 | 42.3 |
| Predevelopment Unit Peak Flow, q (cfs/acre) = | N/A | N/A | 0.23 | 0.53 | 0.78 | 1.25 | 1.54 | 1.91 |
| Peak Inflow Q (cfs) = $Poak Qutflow Q (cfs) =$ | N/A | N/A | 20.3 | 30.5 | 37.6 | 49.1 | 58.1 | 70.2 |
| Peak Outflow Q (cfs) = Ratio Peak Outflow to Predevelopment Q = | | | | | | | | <u> </u> |
| Structure Controlling Flow = | | | | | | | | |
| Max Velocity through Grate 1 (fps) = Max Velocity through Grate 2 (fps) = | | | | \vdash | | | | |
| Time to Drain 97% of Inflow Volume (hours) = | | 1 | <u>−− P2</u> | | 1 | | | |
| Time to Drain 99% of Inflow Volume (hours) = | | | | | | | | |
| Maximum Ponding Depth (ft) = Area at Maximum Ponding Depth (acres) = | | | ` | | | | | |
| Maximum Volume Stored (acre-ft) = | | <u> </u> | <u> </u> | | <u> </u> | <u> </u> | <u> </u> | |
| - | | | | | provide | all prolin | ninary | |
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ice ft² feet ² freet feet ft² ft² ft² fteet radians





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

DETENTION BASIN OUTLET STRUCTURE DESIGN Outflow Hydrograph Workbook Filename:

Inflow Hydrographs

| | The user can ov | verride the calcu | lated inflow hyd | lrographs from t | his workbook wi | th inflow hydrog | raphs developed | d in a separate pr | ogram. | |
|---------------|--------------------|-------------------|------------------|------------------|-----------------|------------------|-----------------|--------------------|----------------|----------------|
| | SOURCE | CUHP | CUHP | CUHP | CUHP | CUHP | CUHP | CUHP | CUHP | CUHP |
| Time Interval | TIME | WQCV [cfs] | EURV [cfs] | 2 Year [cfs] | 5 Year [cfs] | 10 Year [cfs] | 25 Year [cfs] | 50 Year [cfs] | 100 Year [cfs] | 500 Year [cfs] |
| 5.00 min | 0:00:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 0:05:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 0:10:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.21 | 0.02 | 0.69 |
| | 0:15:00 | 0.00 | 0.00 | 1.87 | 3.07 | 3.80 | 2.56 | 3.15 | 3.12 | 4.36 |
| | 0:20:00 | 0.00 | 0.00 | 6.31 | 8.42 | 10.67 | 6.05 | 7.01 | 7.57 | 10.66 |
| | 0:25:00 | 0.00 | 0.00 | 15.29 20.34 | 25.16 30.46 | 33.65 37.64 | 15.00 46.35 | 18.13 55.67 | 21.05 63.33 | 33.70 85.02 |
| | 0:30:00 0:35:00 | 0.00 | 0.00 | 17.55 | 25.47 | 31.27 | 40.35 | 58.08 | 70.18 | 92.33 |
| | 0:40:00 | 0.00 | 0.00 | 14.49 | 20.52 | 25.28 | 44.45 | 52.24 | 62.37 | 81.70 |
| | 0:45:00 | 0.00 | 0.00 | 10.94 | 15.83 | 19.92 | 36.51 | 42.88 | 53.39 | 69.62 |
| | 0:50:00 | 0.00 | 0.00 | 8.52 | 12.93 | 15.98 | 30.16 | 35.40 | 43.70 | 57.22 |
| | 0:55:00 | 0.00 | 0.00 | 6.95 | 10.39 | 13.26 | 23.80 | 28.08 | 36.02 | 47.30 |
| | 1:00:00 | 0.00 | 0.00 | 5.63 | 8.26 | 10.92 | 19.14 | 22.69 | 30.56 | 40.14 |
| | 1:05:00 1:10:00 | 0.00 | 0.00 | 4.54 3.34 | 6.47 5.28 | 8.89 7.69 | 15.47 11.01 | 18.40 13.24 | 25.95 17.92 | 34.06 23.91 |
| | 1:15:00 | 0.00 | 0.00 | 2.68 | 4.48 | 7.26 | 8.29 | 10.17 | 12.80 | 17.59 |
| | 1:20:00 | 0.00 | 0.00 | 2.36 | 3.89 | 6.23 | 6.26 | 7.66 | 8.85 | 12.24 |
| | 1:25:00 | 0.00 | 0.00 | 2.19 | 3.52 | 5.10 | 5.03 | 6.13 | 6.34 | 8.81 |
| | 1:30:00 | 0.00 | 0.00 | 2.10 | 3.29 | 4.36 | 3.98 | 4.83 | 4.87 | 6.77 |
| | 1:35:00 | 0.00 | 0.00 | 2.03 | 3.14 | 3.84 | 3.30 | 3.99 | 3.86 | 5.38 |
| | 1:40:00 | 0.00 | 0.00 | 1.98 | 2.70 | 3.51 | 2.88 | 3.48 | 3.22 | 4.49 |
| | 1:45:00 1:50:00 | 0.00 | 0.00 | 1.95 1.94 | 2.39 2.18 | 3.28 3.12 | 2.60 2.44 | 3.12 2.93 | 2.81 2.64 | 3.91 3.66 |
| | 1:55:00 | 0.00 | 0.00 | 1.94 | 2.18 | 2.86 | 2.44 | 2.93 | 2.64 | 3.66 |
| | 2:00:00 | 0.00 | 0.00 | 1.41 | 1.88 | 2.50 | 2.30 | 2.76 | 2.56 | 3.54 |
| | 2:05:00 | 0.00 | 0.00 | 0.95 | 1.25 | 1.67 | 1.54 | 1.84 | 1.72 | 2.37 |
| | 2:10:00 | 0.00 | 0.00 | 0.62 | 0.82 | 1.10 | 1.02 | 1.21 | 1.13 | 1.56 |
| | 2:15:00 | 0.00 | 0.00 | 0.40 | 0.52 | 0.71 | 0.66 | 0.78 | 0.73 | 1.01 |
| | 2:20:00 | 0.00 | 0.00 | 0.24 | 0.32 | 0.43 | 0.41 | 0.48 | 0.45 | 0.62 |
| | 2:25:00 2:30:00 | 0.00 | 0.00 | 0.14 | 0.20 | 0.28 | 0.26 | 0.30 | 0.28 | 0.39 |
| | 2:35:00 | 0.00 | 0.00 | 0.03 | 0.05 | 0.05 | 0.06 | 0.07 | 0.06 | 0.08 |
| | 2:40:00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.02 |
| | 2:45:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 2:50:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
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| | 3:00:00 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 |
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| | 4:45:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
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| | 5:10:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 5:15:00 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 |
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| | 5:35:00 | 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 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 |

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

| Stage - Storage Description | Stage [ft] | Area [ft ²] | Area [acres] | Volume [ft ³] | Volume [ac-ft] | Total Outflow [cfs] | |
|--------------------------------|---------------|----------------------------|-----------------|------------------------------|-------------------|---------------------------|--|
| | | | | | | | For best results, include the |
| | | | | | | | stages of all grade slope changes (e.g. ISV and Floor) |
| | | | | | | | from the S-A-V table on |
| | | | | | | | Sheet 'Basin'. |
| | | | | | | | Also include the inverts of all |
| | | | | | | | outlets (e.g. vertical orifice, overflow grate, and spillway, |
| | | | | | | | where applicable). |
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MHFD-Detention, Version 4.04 (February 2021)

Project: Monument Ridge East Basin ID: Pond 5 Qmax out = 90% PreDev Q. Q10=2.1cfs, Q100=5.5cfs

ZONE 3 ZONE 2 ZONE 2 ZONE 1 100-YEAR ORIFICE ZONE 1 AND 2 ORFICES Example Zone Configuration (Retention Pond)

PERMANENT

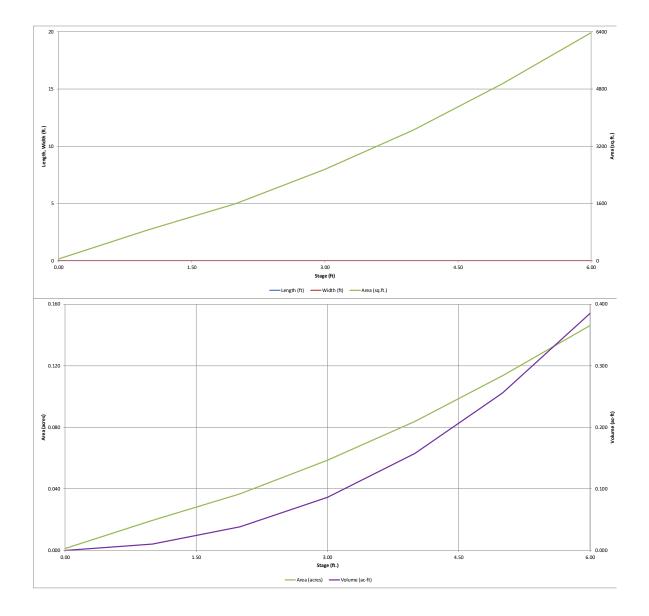
Depth Increment =

| POOL Example Zone | Configuratio | on (Retent | ion Pond) | |
|--|--------------|------------------------|--------------|---------|
| Watershed Information | | | | |
| Selected BMP Type = | EDB | | Note: L / W | / Ratio |
| Watershed Area = | 3.21 | acres | L / W Ratio | = 0.83 |
| Watershed Length = | 340 | ft | | |
| Watershed Length to Centroid = | 160 | ft | | |
| Watershed Slope = | 0.028 | ft/ft | | |
| Watershed Imperviousness = | 48.40% | 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 = | | | | |
| After providing required inputs above inc | | | | |
| depths, click 'Run CUHP' to generate run the embedded Colorado Urban Hydro | | | Optional Use | |
| Water Quality Capture Volume (WQCV) = | 0.054 | acre-feet | Optional Use | acre-fe |
| Excess Urban Runoff Volume (EURV) = | 0.166 | acre-feet | | acre-fe |
| 2-yr Runoff Volume (P1 = 1.19 in.) = | 0.146 | acre-feet | 1.19 | inches |
| 5-yr Runoff Volume (P1 = 1.5 in.) = | 0.210 | acre-feet | 1.50 | inches |
| 10-yr Runoff Volume (P1 = 1.75 in.) = | 0.266 | acre-feet | 1.75 | inches |
| 25-yr Runoff Volume (P1 = 2 in.) = | 0.343 | acre-feet | 2.00 | inches |
| 50-yr Runoff Volume (P1 = 2.25 in.) = | 0.404 | acre-feet | 2.25 | inches |
| 100-yr Runoff Volume (P1 = 2.52 in.) = | 0.483 | acre-feet | 2.52 | inches |
| 500-yr Runoff Volume (P1 = 3.14 in.) = | 0.641 | acre-feet | | inches |
| Approximate 2-yr Detention Volume = | 0.125 | acre-feet | | - |
| Approximate 5-yr Detention Volume = | 0.171 | acre-feet | | |
| Approximate 10-yr Detention Volume = | 0.228 | acre-feet | | |
| Approximate 25-yr Detention Volume = | 0.250 | acre-feet | | |
| Approximate 50-yr Detention Volume = | 0.262 | acre-feet | | |
| Approximate 100-yr Detention Volume = | 0.293 | acre-feet | | |
| | | | | |
| Define Zones and Basin Geometry | | 1 | | |
| Select Zone 1 Storage Volume (Required) = | | acre-feet acre-feet | | |
| Select Zone 2 Storage Volume (Optional) = Select Zone 3 Storage Volume (Optional) = | | acre-feet | | |
| Total Detention Basin Volume = | | acre-feet | | |
| Initial Surcharge Volume (ISV) = | user | ft 3 | | |
| Initial Surcharge Depth (ISD) = | user | ft | | |
| Total Available Detention Depth (H _{total}) = | user | ft | | |
| Depth of Trickle Channel (H _{TC}) = | user | ft | | |
| Slope of Trickle Channel (STC) = | user | ft/ft | | |
| Slopes of Main Basin Sides (Smain) = | user | H:V | | |
| Basin Length-to-Width Ratio (R _{L/W}) = | user | 1 | | |
| | | _ | | |
| Initial Surcharge Area (A _{ISV}) = | user | ft ² | | |
| Surcharge Volume Length (L_{ISV}) = | user | ft | | |
| | | | | |

| Initial Surcharge Area (A _{ISV}) = | user | ft ² |
|---|------|-----------------|
| Surcharge Volume Length $(L_{ISV}) =$ | user | ft |
| Surcharge Volume Width (W_{ISV}) = | user | ft |
| Depth of Basin Floor (H_{FLOOR}) = | user | ft |
| Length of Basin Floor $(L_{FLOOR}) =$ | user | ft |
| Width of Basin Floor (W _{FLOOR}) = | user | ft |
| Area of Basin Floor (A _{FLOOR}) = | user | ft ² |
| Volume of Basin Floor (V_{FLOOR}) = | user | ft ³ |
| Depth of Main Basin (H _{MAIN}) = | user | ft |
| Length of Main Basin $(L_{MAIN}) =$ | user | ft |
| Width of Main Basin (W _{MAIN}) = | user | ft |
| Area of Main Basin (A _{MAIN}) = | user | ft ² |
| Volume of Main Basin (V _{MAIN}) = | user | ft ³ |
| Calculated Total Basin Volume (V_{total}) = | user | acre-feet |
| | | |

| | Depth Increment = Stage - Storage Description Top of Micropool | Stage (ft) | ft Optional Override Stage (ft) 0.00 | Length (ft) | Width (ft) | Area (ft ²) | Optional Override Area (ft ²) 50 | Area (acre) 0.001 | Volume (ft ³) | Volume (ac-ft) |
|---------------|---|---------------|--|----------------|---------------|----------------------------|---|-------------------------|------------------------------|-------------------|
| io < 1 | 7271 | - | 1.00 | | | | 850 | 0.001 | 450 | 0.010 |
| .83 | 7272 | | 2.00 | | | | 1,600 | 0.037 | 1,675 | 0.038 |
| | 7273 | | 3.00 4.00 | | | | 2,550 3,650 | 0.059 | 3,750 6,850 | 0.086 |
| | 7275 | | 5.00 | | | | 4,940 | 0.113 | 11,145 | 0.256 |
| | 7276 | | 6.00 | | | | 6,370 | 0.146 | 16,800 | 0.386 |
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MHFD-Detention, Version 4.04 (February 2021)

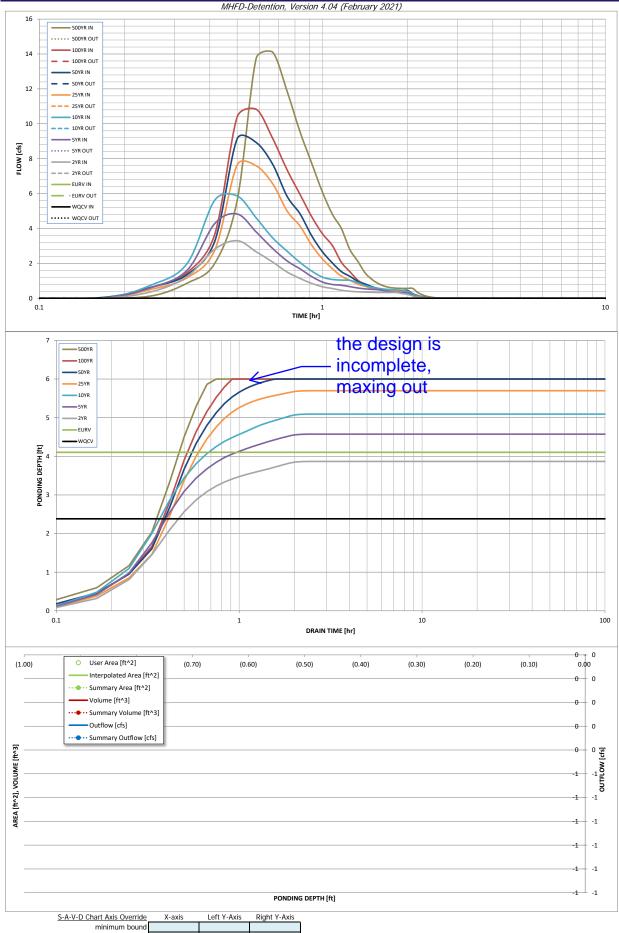


| Next: Mean et Rige Edit | | D | ETENTION | BASIN OU FD-Detention, Ver. | | | SIGN | | |
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| Elimited | | | | Q10=2.1cfs, Q100= | =5.5cfs | | | | |
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| in up and the product of the product | | onfiguration (Re | tention Pond) | Zone 3 | | | | | |
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| A liquid. Office Pails with an or on the office of an office A liquid and a liquid of liquid of a | | | | the filtration media | surface) | | | | |
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| Stage of Ortice Certroll (R) Nov 2 (optional) Nov 2 (optional) Nov 5 (optional) Nov 5 (optional) Nov 7 | er Input: Stage and Total Area of Each Orifice | Row (numbered f | rom lowest to highe | st) | | | | | |
| Stage of Othics Control 01 Ontice Area (cq. inches) Box 0 (cgalana) Box 11 (cgalana) Box 12 (cgalana)< | | | - | | Row 4 (optional) | Row 5 (optional) | Row 6 (optional) | Row 7 (optional) | Row 8 (opt |
| Ontice Area (q., notec) Image: a function Current of (partered) | Stage of Orifice Centroid (ft) | | | | | | | (| |
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| Invert of Vertical Orifice Image of Line Ima | | | Not Selected | 1 | | | | | |
| Depth at top of Zone using vertical Orifice Dameter = In checks Overflow Weir Front Edge Height, Ho Not Selected Not Selected Not Selected Not Selected Not Selected Overflow Weir Front Edge Height, Ho Not Selected Not Selec | Invert of Vertical Orifice = | | | ft (relative to basir | h bottom at Stage = | 0 ft) Ve | rtical Orifice Area = | | |
| Vertical Orifice Diameter = Inches er Input: Overflow Weir (Dropbox with Flat or Sloped Grate and Outlet Pipe OR Rectangular/Trapezoidal Weir (and No Outlet Pipe). Calculated Parameters for Overflow Weir Stope Length = Overflow Weir Font Edge Height, Ho = Not Selected Tre (values to basin bottom at Stage = 0 ft) Height of Grate Upper Edge, H, = Not Selected Not Not Selected | | | | | - | | | | |
| er Input: Overflow Weir (Dropbox with Flat or Sloped Grate and Outlet Pipe OR Rectangular/Trapezoidal Weir (and No Outlet Pipe). Overflow Weir Front Edge Height. Ho Inot Selected Not Select | | | | | | , | | | |
| Overflow Weir Front Edge Height, Ho Int Selected Not Selected Not Selected Not Selected Not Selected Overflow Weir Front Edge Height, Ho Intel Cellster to basin bottom at Stage = 0 ft) Height of Grate Upper Area / 100-yr Grite Area = Intel Cellster Stage = | | | - | | | | | | |
| Overflow Weir Grate Stope H:V Grate Open Area // 100-yr Orifice Area = Horiz. Length of Weir States Het Overflow Grate Open Area w/ Debris = Debris Clogging % = Debris Clogging % = Debris Clogging % = Impat: Outlet Pipe w/ Flow Restriction Plate. Clircular Orifice. Restrictor Plate. or Rectangular Orifice) Calculated Parameters for Outlet Pipe w/ Flow Restrict Depth to Invert of Outlet Pipe Not Selected Not Selected Not Selected Circular Orifice Diameter Inches Outlet Orifice Area = Not Selected Spillway Invert of Outlet Pipe Inches Outlet Orifice Area = Not Selected Spillway Invert of Outlet Pipe If (relative to basin bottom at stage = 0 ft) Spillway Design Flow Depth= Inches Spillway Crest Length Feet Basin Vioune at Top of Freeboard = Inches Inches Spillway Crest Length Feet Basin Vioune at Top of Freeboard = Inches Inches Uted Hydrograph Nexulis The user can override the default CUHP hydrographs of runoff volume at top of Freeboard = Inches Inches Inches Outlet Noting Care Lingth N/A N/A 1.16 0.146 0.210 0.266 0.343 0.404 <td< th=""><th></th><th></th><th></th><th></th><th>pottom at Stage = 0 f</th><th></th><th></th><th>-</th><th></th></td<> | | | | | pottom at Stage = 0 f | | | - | |
| Horiz. Length of Weir Sides = Overflow Grate Type = Debris Cloging % = Debris Cloging % = Debris Cloging % = Overflow Grate Open Area w/Debris = Debris Cloging % = Overflow Grate Open Area w/Debris = Debris Cloging % = Overflow Grate Open Area w/Debris = Debris Cloging % = Overflow Grate Open Area w/Debris = Debris Cloging % = Overflow Crate Open Area w/Debris = Overflow Grate Open Area Area Area Overflow Grate Open Area Area A | | | | - | 0 | | | | |
| Overflow Grate Type | | | | 1 | | • | | | |
| Debris Clogging % = % er Input: Outlet Pipe w/ Flow Restriction Plate (Circular Orifice. Restrictor Plate, or Rectangular Orifice) Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate (Circular Orifice. Restrictor Plate, or Rectangular Orifice) Depth to Invert of Outlet Pipe w/ Flow Restriction Plate (Circular Orifice. Diameter = Not Selected Not Na NA er Input: Emergency Spillway (Rectangular or Trapezoidal) Calculated Parameters for Spillway Design Flow Depths Feet | Ū | | | iper | | | | | |
| er Input: Outlet Pipe w/ Flow Restrictor Plate (Circular Orifice. Restrictor Plate, or Rectanular Orifice) Calculated Parameters for Outlet Pipe w/ Flow Restrictor Plate or Outlet Orifice Area = 0 ft) N/A N/A N/A splitway Invert Stage = 0 ft) Splitway Invert Stage = 0 ft) ft (relative to basin bottom at tage = 0 ft) Splitway Design Flow Depth = 1 feet feet feet feet feet acres area feet acres area feet acres area feet acres 1 feet 100 Vec N/A N/A N/A 0.404 0.433 0.404 0.433 UPH Round Vulke (acres for 0.054 0.0166 0.0146 0.0170 0.0266 0.0343 0.404 0.433 0.404 0.433 0.404 0.433 0.404 0.433 0.404 0.433 0.404 0.433 0.404 0.433 0.404 0.433 0.404 0.433 0.404 0.433 0.404 0.433 0.404 0.433 0.404 0.433 | | | | % | | overnow orace ope | | | |
| Depth to Invert of Outlet Pipe = Circular Orifice Diameter = Not Selected Not Selected Not Selected Not Selected Not Selected Not Selected Circular Orifice Diameter = Inches Outlet Orifice Array and Selected Not Selected Not Selected Not Selected Spillway Invert Stage = Spillway Crest Length = Spillway End Stopes = Trapezoidal) Spillway Crest Length = Spillway End Stopes = Calculated Parameters for Spillway Best Not Selected Feet Treeboard above Max Water Surface = H: V Basin Area at Top of Freeboard = acres Design Storm Return Period One-Hour Rainfail Depth (In) N/A N/A N/A N/A OutHe Orifice Array = The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W throw One-Hour Rainfail Depth (In) N/A N/A 1/D Year 2/Year 1/D Year 2/Year 1/D Year 2/Year 1/D Year 1/ | Dobilo ologgilig /o | | | 1,0 | | | | | |
| Depth to Invert of Outlet Pipe = Circular Orifice Diameter = Not Selected Not Selected Not Selected Not Selected Not Selected Not Selected Circular Orifice Diameter = Inches Outlet Orifice Array and Selected Not Selected Not Selected Not Selected Spillway Invert Stage = Spillway Crest Length = Spillway End Stopes = Trapezoidal) Spillway Crest Length = Spillway End Stopes = Calculated Parameters for Spillway Best Not Selected Feet Treeboard above Max Water Surface = H: V Basin Area at Top of Freeboard = acres Design Storm Return Period One-Hour Rainfail Depth (In) N/A N/A N/A N/A OutHe Orifice Array = The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W throw One-Hour Rainfail Depth (In) N/A N/A 1/D Year 2/Year 1/D Year 2/Year 1/D Year 2/Year 1/D Year 1/ | er Input: Outlet Pipe w/ Flow Restriction Plate | Circular Orifice. R | estrictor Plate, or Re | ectangular Orifice) | | Ca | alculated Parameter | rs for Outlet Pipe w/ | Flow Restric |
| Depth to Invert of Outlet Pipe = Inches Outlet Orifice Area = Inches Outlet Orifice Centroid = Inches Cricular Orifice Diameter = Inches Outlet Orifice Centroid = Inches Inches Outlet Orifice Centroid = Inches File Spillway (Rectangular or Trapezoidal) Inches Spillway Cest Length = Inches Inches <td>• • • •</td> <td></td> <td></td> <td>1</td> <td></td> <td></td> <td></td> <td></td> <td></td> | • • • • | | | 1 | | | | | |
| Circular Orifice Diameter = inches Outlet Orifice Centrold = Inches N/A N/A Half-Central Angle of Restrictor Plate on Pipe = N/A N/A N/A Spillway Invert Stage = ft (relative to basin bottom at stage = 0 ft) Spillway Design Flow Depth = feet Spillway End Stopes = H:V Basin Area at Top of Freeboard = feet feet Spillway End Stopes = H:V Basin Area at Top of Freeboard = acres Spillway End Stopes = H:V Basin Area at Top of Freeboard = acres Vited Hydrograph Results The user can override the default CUPP hydrographs and runoff volumes by entering new values in the Inflow Hydrograph stable (Columns W throo CUHP Runoff Volume (acre-ft) 0.054 0.166 0.146 0.210 0.266 0.343 0.404 0.483 Oriflox Under Predevelopment Peak Q (cfs) N/A N/A 0.146 0.210 0.266 0.343 0.404 0.483 Oriflox Under Predevelopment Peak Q (cfs) N/A N/A 0.146 0.210 0.266 0.343 0.404 0.483 Predevelopment Peak Q (cfs) N/A N/A 0.146 0.210 0.266< | Depth to Invert of Outlet Pipe = | | | ft (distance below b | asin bottom at Stage | = 0 ft) O | utlet Orifice Area = | | |
| er Input: Emergency Spillway (Rectangular or Trapezoidal) Calculated Parameters for Spillway Invert Stageft (relative to basin bottom at stage = 0 ft) Spillway Design Flow Depthfeet Spillway Crest Length = feet Stage at Top of Freeboard = feet Spillway Invert Stage = H:V Basin Area at Top of Freeboard = acres Spillway End Slopes = H:V Basin Area at Top of Freeboard = acres Freeboard above Max Water Surface = feet Basin Volume at Top of Freeboard = acres Uted Hydrograph Results The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W througe CuHP Runoff Volume (acreft) = N/A N/A N/A 0.054 0.166 0.210 0.266 0.343 0.404 0.483 CUHP Runoff Volume (acreft) = N/A N/A N/A 0.175 2.30 3.9 4.8 6.1 OPTIONAL Override Predevelopment Peak 0 (cfs) = N/A N/A 0.17 0.47 0.72 1.21 1.50 1.89 Predevelopment Peak 0 (cfs) = N/A N/A 0.14 0.43 0.404 0.483 Max Velocity through Grate 1 (tps) = N/A | | | | · · · · | 5 | | | | |
| Spillway Invert Stage ft (relative to basin bottom at stage = 0 ft) Spillway Design Flow Depth= feet Spillway Crest Length = feet Stage at Top of Freeboard = feet Spillway Crest Length = feet Basin Area at Top of Freeboard = acres Freeboard above Max Water Surface = feet Basin Volume at Top of Freeboard = acres Uted Hydrograph Results The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W throutone Columns V throutone Columns Pace (Cis) = N/A N/A N/A N/A 0.166 0.146 0.210 0.266 0.343 0.404 0.483 One-Hour Rainfail Depth (in) = N/A N/A 0.146 0.210 0.266 0.343 0.404 0.483 OUHP Predevelopment Peak 0 (cis) = N/A N/A 0.17 0.47 0.72 1.21 1.50 1.89 Preak Inflow Q (cis) = N/A N/A 0.17 0.47 0.72 1.21 1.50 1.89 Ratio Peak Inflow Q (cis) = N/A N/A 0.47 0.72 1.21 1.50 | , | | | - \ | Half-Cer | tral Angle of Restric | ctor Plate on Pipe = | N/A | N/A |
| Spillway Invert Stage ft (relative to basin bottom at stage = 0 ft) Spillway Design Flow Depth= feet Spillway Crest Length = feet Stage at Top of Freeboard = feet Spillway End Slopes = feet Basin Area at Top of Freeboard = acres Freeboard above Max Water Surface = feet Basin Volume at Top of Freeboard = acres Uted Hydrograph Results The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W throut On Ventor Structure Columns V throut On Ventor Structure Columns V throut On Ventor Structure Columns Head O(cfs) = N/A N/A 1.19 1.50 1.75 2.00 2.25 2.52 ODF4 OLHP Predevelopment Peak O(cfs) = N/A N/A 0.146 0.210 0.266 0.343 0.404 0.483 OPTIONAL Overfide Predevelopment Peak O(cfs) = N/A N/A 0.6 1.5 2.3 3.9 4.8 6.1 Predevelopment Unit Peak Flow, q (cfs/acre) = N/A N/A 0.17 0.47 0.72 1.21 1.50 1.89 Max Velocity through Grate 1 (tps) = N/A N/A 0.47 0.72 1.21 1.50 1.89< | | | | 1 | | Ū | | | |
| Spillway Crest Length = feet Stage at Top of Freeboard = feet Spillway End Slopes = H:V Basin Area at Top of Freeboard = acres Basin Volume at Top of Freeboard = Design Storm Return Period The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W throug One-Hour Rainfall Depth (in) The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W throug CUHP Rendet Volume (acre-ft) N/A N/A 1.19 1.50 1.75 2.00 2.25 2.52 CUHP Predevelopment Pack Q (cfs) N/A N/A 0.166 0.146 0.210 0.266 0.343 0.404 0.483 OPTIONAL Override Predevelopment Pack Q (cfs) N/A N/A 0.6 1.5 2.3 3.9 4.8 6.1 Predevelopment Pack Q (cfs) N/A N/A 0.17 0.47 0.72 1.21 1.50 1.89 Peak Lotitow Q (cfs) N/A N/A 0.17 0.47 0.72 1.21 1.50 1.89 Max Velocity through Grate 1 (ps) N/A N/A N/A | er Input: Emergency Spillway (Rectangular or 1 | rapezoidal) | | 1 | | | | Calculated Parame | ters for Spilly |
| Spillway End Slopes = H:V Basin Area at Top of Freeboard = acres Freeboard above Max Water Surface = feet Basin Volume at Top of Freeboard = acres Uted Hydrograph Results The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W throut) One-Hour Rainfall Depth (in) = N/A N/A N/A N/A 0.054 0.066 0.146 0.210 0.266 0.343 0.404 0.483 CHP Predevelopment Peak Q (cfs) = N/A N/A N/A 0.6 1.5 2.3 3.9 4.8 6.1 Predevelopment Peak Q (cfs) = N/A N/A N/A 0.17 0.47 0.72 1.21 1.50 1.89 Predevelopment Peak Q (cfs) = N/A N/A 0.17 0.47 0.72 1.21 1.50 1.89 Ratio Peak Outflow Q (cfs) = N/A N/A 0.17 0.47 0.72 1.21 1.50 1.89 Max Velocity through Grate 1 (fps) N/A N/A 0.40 0.483 0.404 0.483 Inflow Dyf (cfrine Controlling Flow = N/A <td< td=""><td>Spillway Invert Stage=</td><td></td><td>ft (relative to basir</td><td>n bottom at Stage =</td><td>0 ft)</td><td>Spillway D</td><td>Design Flow Depth=</td><td>:</td><td>feet</td></td<> | Spillway Invert Stage= | | ft (relative to basir | n bottom at Stage = | 0 ft) | Spillway D | Design Flow Depth= | : | feet |
| Freeboard above Max Water Surface feet Basin Volume at Top of Freeboard = acre-ft uted Hydrograph Results The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W throw One-Hour Rainfall Depth (in CUHP Runoff Volume (acre-ft) = N/A N/A 1.19 1.50 1.75 2.00 2.25 2.52 2.52 UHP Runoff Volume (acre-ft) = N/A N/A 0.166 0.146 0.210 0.266 0.343 0.404 0.483 OPTIONAL Override Predevelopment Peak Q (fs) = N/A N/A 0.64 1.5 2.3 3.9 4.8 6.1 Predevelopment Unit Peak Flow, q (fs/acre) = N/A N/A N/A 0.17 0.47 0.72 1.21 1.50 1.89 Peak Unflow Q (fs) = N/A N/A 0.17 0.47 0.72 1.21 1.50 1.89 Ratio Peak outflow Q (fs) = N/A N/A 0.17 0.47 0.72 1.21 1.50 1.89 Max Velocity through Grate 1 (ps) = N/A N/A N/A <t< td=""><td>Spillway Crest Length =</td><td></td><td>feet</td><td>\ \</td><td></td><td>Stage at</td><td>Top of Freeboard =</td><td></td><td>feet</td></t<> | Spillway Crest Length = | | feet | \ \ | | Stage at | Top of Freeboard = | | feet |
| Ite user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W throut One-Hour Rainfall Depth (in) = Null | Spillway End Slopes = | | H:V | \ \ | | Basin Area at | Top of Freeboard = | | acres |
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| Design Storm Return Period WOCV EURV 2 Year 5 Year 10 Year 25 Year 50 Year 100 Year One-Hour Rainfall Depth (in) N/A N/A N/A 1.19 1.50 1.75 2.00 2.25 2.52 2.52 OUHP Runoff Volume (acre-ft) 0.054 0.166 0.146 0.210 0.266 0.343 0.404 0.483 CUHP Predevelopment Peak Q (cfs) N/A N/A 0.146 0.210 0.266 0.343 0.404 0.483 OPTIONAL Override Predevelopment Peak Q (cfs) N/A N/A 0.6 1.5 2.3 3.9 4.8 6.1 Predevelopment Unit Peak Flow, q (cfs/acre) N/A N/A 0.17 0.47 0.72 1.21 1.50 1.89 Peak Inflow Q (cfs) N/A N/A 3.3 4.8 5.9 7.6 9.1 100.8 Ratio Peak Outflow to Predevelopment Q Structure Controlling Flow Structure Controlling Flow Structure Controlling Flow Structure Controlling Flow Structure Controlling Flo | | | | \ \ | | | | | |
| Design Storm Return Period WQCV EURV 2 Year 5 Year 10 Year 25 Year 50 Year 100 Year One-Hour Rainfall Depth (in) N/A N/A N/A 1.19 1.50 1.75 2.00 2.25 2.52 2.52 CHP Runoff Volume (acre-ft) 0.054 0.166 0.146 0.210 0.266 0.343 0.404 0.483 CUHP Predevelopment Peak Q (cfs) N/A N/A 0.146 0.210 0.266 0.343 0.404 0.483 OPTIONAL Override Predevelopment Peak Q (cfs) N/A N/A 0.6 1.5 2.3 3.9 4.8 6.1 OPTIONAL Override Predevelopment Peak Q (cfs) N/A N/A 0.17 0.47 0.72 1.21 1.50 1.89 Predevelopment Unit Peak Flow, q (cfs/acre) N/A N/A 3.3 4.8 5.9 7.6 9.1 100.8 Predevelopment Q Structure Controlling Flow N/A N/A 3.3 4.8 5.9 0.6 10.8 | uted Hydrograph Results | The user can ever | rido tho dofault CUI | JP bydrographs apo | l rupoff volumos hv | optoring now value | s in the Inflow Hydr | rographs table (Colu | imps W/ throu |
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| Inflow Hydrograph Volume (acre-ft) N/A N/A 0.146 0.210 0.266 0.343 0.404 0.483 CUHP Predevelopment Peak Q (cfs) N/A N/A 0.6 1.5 2.3 3.9 4.8 6.1 Predevelopment Unit Peak Flow, q (cfs/acre) N/A N/A N/A 0.47 0.72 1.21 1.50 1.89 Peak Inflow Q (cfs) N/A N/A 0.17 0.47 0.72 1.21 1.50 1.89 Peak Outflow Q (cfs) N/A N/A 3.3 4.8 5.9 7.6 9.1 10.8 Structure Controlling Flow | One-Hour Rainfall Depth (in) = | N/A | N/A | 1.19 | 1.50 | 1.75 | 2.00 | 2.25 | 2.52 |
| CUHP Predevelopment Peak Q (cfs) = N/A N/A 0.6 1.5 2.3 3.9 4.8 6.1 DPTIONAL Override Predevelopment Peak Q (cfs) = N/A N/A N/A 0.6 1.5 2.3 3.9 4.8 6.1 Predevelopment Peak Flow, q (cfs/acre) = N/A N/A 0.17 0.47 0.72 1.21 1.50 1.89 Peak Inflow Q (cfs) = Peak Inflow Q (cfs) = N/A N/A 0.17 0.47 0.72 1.21 1.50 1.89 Peak Inflow Q (cfs) = Peak Inflow Q (cfs) = N/A N/A 0.17 0.47 0.72 1.21 1.50 1.89 Ratio Peak Outflow Q (cfs) = N/A N/A 0.17 0.47 0.72 1.21 1.50 1.89 Structure Controlling Flow = Structure Controlling Flow = Structure Controlling Flow = | . , | | | | | | | | |
| N/A N/A N/A OPTIONAL Override Predevelopment Peak Q (cfs) = N/A N/A O.17 O.47 O.72 1.21 1.50 1.89 Predevelopment Unit Peak Flow, q (cfs) = N/A N/A O.17 O.47 O.72 1.21 1.50 1.89 Peak Inflow Q (cfs) = N/A N/A 3.3 4.8 5.9 7.6 9.1 10.8 Peak Outflow to Predevelopment Q = </td <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> | | | | | | | | | |
| Predevelopment Unit Peak Flow, q (cfs/acre) = N/A N/A 0.17 0.47 0.72 1.21 1.50 1.89 Peak Inflow Q (cfs) = N/A N/A 3.3 4.8 5.9 7.6 9.1 10.8 Peak Outflow Q (cfs) = Peak Outflow Q (cfs) = 10.8 10.8 | | | | 0.0 | 1.0 | 2.3 | 3.7 | 4.0 | 0.1 |
| Peak Outflow Q (cfs) = | Predevelopment Unit Peak Flow, q (cfs/acre) = | N/A | N/A | | | | | | |
| Ratio Peak Outflow to Predevelopment Q = | | N/A | N/A | 3.3 | 4.8 | 5.9 | 7.6 | 9.1 | 10.8 |
| Structure Controlling Flow = | | | | 1 | \ | | | | <u> </u> |
| Max Velocity through Grate 1 (fps) = | | | 1 | | | | | 1 | |
| Time to Drain 97% of Inflow Volume (hours) = | Max Velocity through Grate 1 (fps) = | | <u> </u> | | | | | | |
| Time to Drain 99% of Inflow Volume (hours) = | | | | N N | | | | | |
| Maximum Ponding Depth (ft) = | | | | · · · · | | | | | <u> </u> |
| Area at Maximum Ponding Depth (acres) = | | | 4 | | | 1 | | | |
| | Area at Maximum Ponding Depth (acres) = | | <u> </u> | | | <u> </u> | <u> </u> | | |
| \sum provide all preliminary | Maximum Volume Stored (acre-ft) = | | | | | | | | |
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Outflow Hydrograph Workbook Filename:

Inflow Hydrographs

| | The user can ov | verride the calcu | lated inflow hyd | lrographs from t | his workbook wi | th inflow hydrog | raphs develope | d in a separate pr | ogram. | |
|---------------|--------------------|-------------------|------------------|------------------|-----------------|------------------|----------------|--------------------|----------------|----------------|
| | SOURCE | CUHP | CUHP | CUHP | CUHP | CUHP | CUHP | CUHP | CUHP | CUHP |
| Time Interval | TIME | WQCV [cfs] | EURV [cfs] | 2 Year [cfs] | 5 Year [cfs] | 10 Year [cfs] | 25 Year [cfs] | 50 Year [cfs] | 100 Year [cfs] | 500 Year [cfs] |
| 5.00 min | 0:00:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 0.00 1111 | 0:05:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 0:10:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.04 | 0.00 | 0.14 |
| | 0:15:00 | 0.00 | 0.00 | 0.38 | 0.62 | 0.00 | 0.52 | 0.64 | 0.63 | 0.87 |
| | 0:20:00 | 0.00 | 0.00 | 1.26 | 1.62 | 2.01 | 1.19 | 1.37 | 1.48 | 1.99 |
| | 0:25:00 | 0.00 | 0.00 | 2.81 | 4.28 | 5.62 | 2.75 | 3.26 | 3.66 | 5.61 |
| | 0:30:00 | 0.00 | 0.00 | 3.30 | 4.83 | 5.86 | 7.64 | 9.14 | 10.39 | 13.74 |
| | 0:35:00 | 0.00 | 0.00 | 2.67 | 3.80 | 4.61 | 7.59 | 8.93 | 10.84 | 14.11 |
| | 0:40:00 | 0.00 | 0.00 | 2.08 | 2.86 | 3.47 | 6.58 | 7.69 | 9.18 | 11.88 |
| | 0:45:00 | 0.00 | 0.00 | 1.50 | 2.14 | 2.70 | 5.01 | 5.85 | 7.36 | 9.55 |
| | 0:50:00 | 0.00 | 0.00 | 1.14 | 1.69 | 2.05 | 4.14 | 4.84 | 5.96 | 7.74 |
| | 0:55:00 | 0.00 | 0.00 | 0.85 | 1.24 | 1.56 | 3.05 | 3.58 | 4.68 | 6.09 |
| | 1:00:00 | 0.00 | 0.00 | 0.66 | 0.93 | 1.21 | 2.26 | 2.67 | 3.70 | 4.83 |
| | 1:05:00 | 0.00 | 0.00 | 0.56 | 0.79 | 1.08 | 1.70 | 2.03 | 3.03 | 4.00 |
| | 1:10:00 | 0.00 | 0.00 | 0.46 | 0.74 | 1.04 | 1.27 | 1.53 | 2.06 | 2.79 |
| | 1:15:00 | 0.00 | 0.00 | 0.40 | 0.67 | 1.03 | 1.03 | 1.26 | 1.53 | 2.12 |
| | 1:20:00 | 0.00 | 0.00 | 0.37 | 0.59 | 0.89 | 0.81 | 0.97 | 1.04 | 1.44 |
| | 1:25:00 | 0.00 | 0.00 | 0.35 | 0.54 | 0.73 | 0.68 | 0.82 | 0.77 | 1.07 |
| | 1:30:00 | 0.00 | 0.00 | 0.34 | 0.51 | 0.62 | 0.55 | 0.65 | 0.60 | 0.82 |
| | 1:35:00 | 0.00 | 0.00 | 0.33 | 0.49 | 0.56 | 0.48 | 0.56 | 0.49 | 0.68 |
| | 1:40:00 | 0.00 | 0.00 | 0.33 | 0.42 | 0.52 | 0.43 | 0.50 | 0.44 | 0.60 |
| | 1:45:00 1:50:00 | 0.00 | 0.00 | 0.33 | 0.37 | 0.49 | 0.41 | 0.47 | 0.42 | 0.58 0.57 |
| | 1:55:00 | 0.00 | 0.00 | 0.33 | 0.34 | 0.48 | 0.39 | 0.45 | 0.42 | 0.57 |
| | 2:00:00 | 0.00 | 0.00 | 0.27 | 0.33 | 0.45 | 0.39 | 0.44 | 0.42 | 0.57 |
| | 2:05:00 | 0.00 | 0.00 | 0.23 | 0.18 | 0.40 | 0.23 | 0.27 | 0.42 | 0.34 |
| | 2:10:00 | 0.00 | 0.00 | 0.08 | 0.11 | 0.14 | 0.14 | 0.16 | 0.15 | 0.21 |
| | 2:15:00 | 0.00 | 0.00 | 0.04 | 0.06 | 0.08 | 0.08 | 0.09 | 0.09 | 0.12 |
| | 2:20:00 | 0.00 | 0.00 | 0.02 | 0.03 | 0.04 | 0.05 | 0.05 | 0.05 | 0.07 |
| | 2:25:00 | 0.00 | 0.00 | 0.01 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.03 |
| | 2:30:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| | 2:35:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 2:40:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 2:45:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 2:50:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
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| | 3:00:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 3:05:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 3:10:00 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 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 |
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| | 4:30:00 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 4:55:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 4:55:00 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 5:15:00 | 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 |
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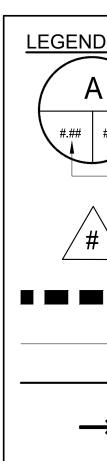
MHFD-Detention, Version 4.04 (February 2021)

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

| Stage - Storage Description | Stage [ft] | Area [ft ²] | Area [acres] | Volume [ft ³] | Volume [ac-ft] | Total Outflow [cfs] | |
|--------------------------------|---------------|----------------------------|-----------------|------------------------------|-------------------|---------------------------|--|
| | | | | | | | For best results, include the |
| | | | | | | | stages of all grade slope changes (e.g. ISV and Floor) |
| | | | | | | | from the S-A-V table on |
| | | | | | | | Sheet 'Basin'. |
| | | | | | | | Also include the inverts of all |
| | | | | | | | outlets (e.g. vertical orifice, overflow grate, and spillway, |
| | | | | | | | where applicable). |
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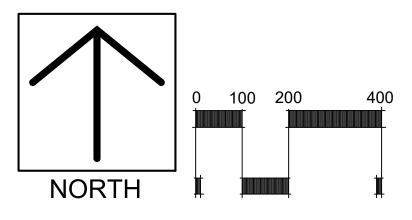


Provide tables of sub-basins, design points, conveyances, etc. Provide all required checklist items.

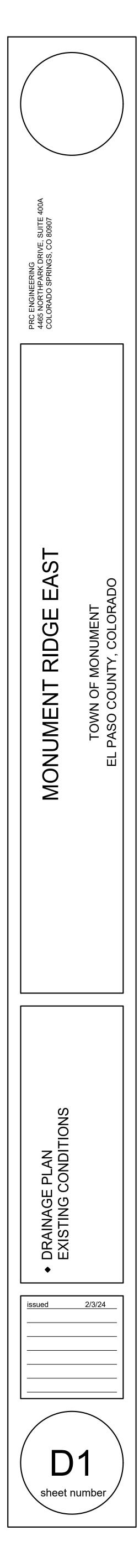


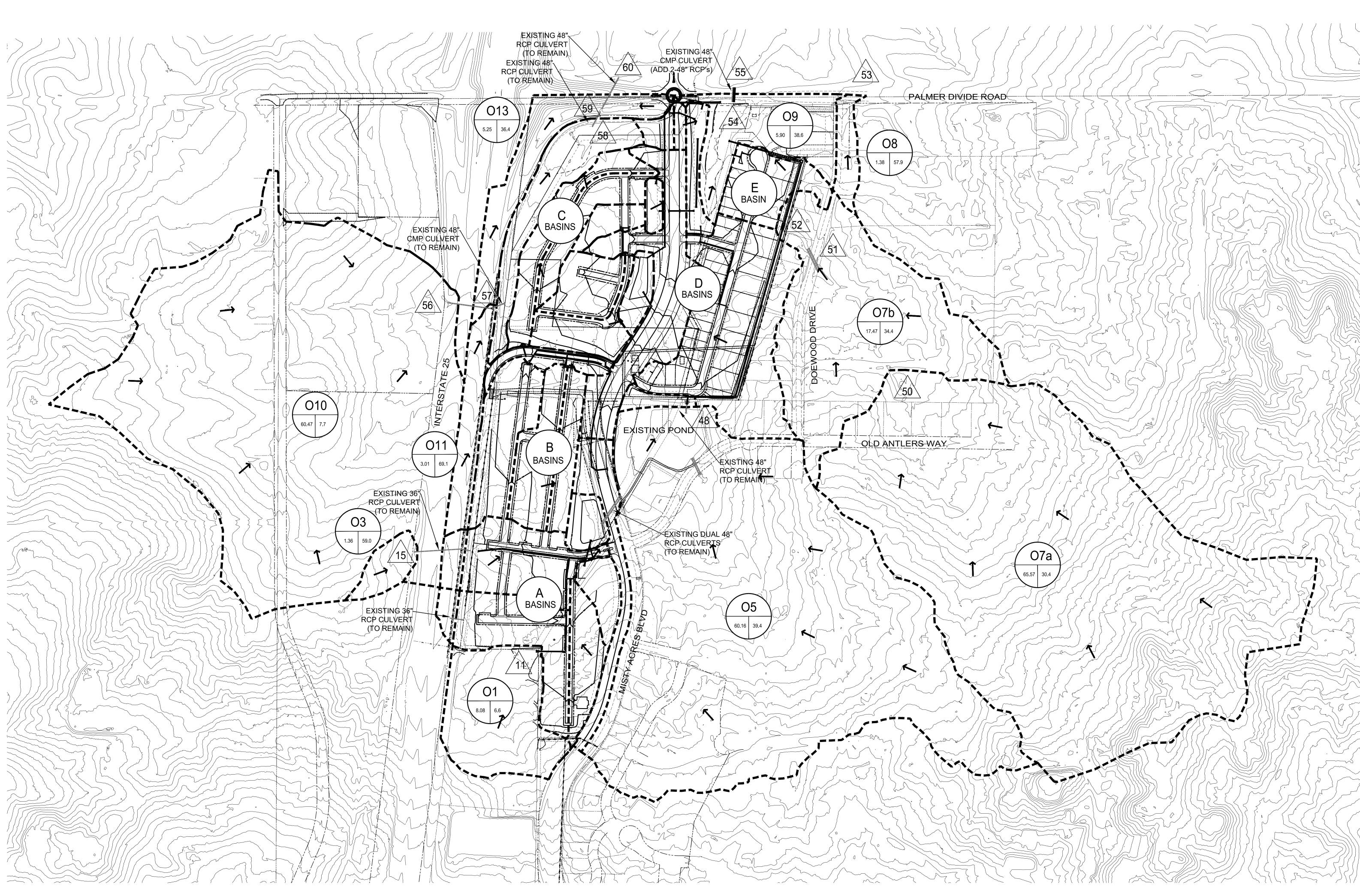
| <u> </u> | BASIN ID |
|----------|-------------------------|
| ##.# | % IMPERVIOUS |
| | BASIN AREA (ACRES) |
| | DESIGN POINT |
| | DRAINAGE BASIN BOUNDARY |
| | EXISTING CONTOUR |
| | PROPOSED CONTOUR |
| → | SURFACE FLOW DIRECTION |
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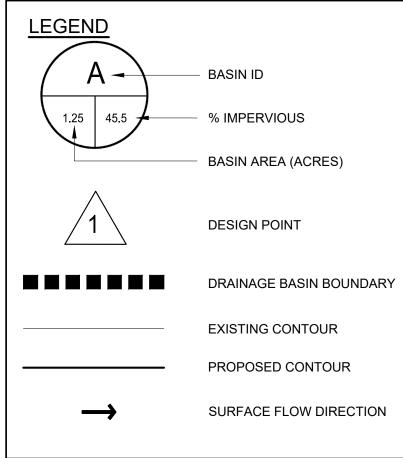
- <u>GENERAL NOTES</u>
 1. EXISTING TOPOGRAPHY PROVIDED BY THE COLORADO WATER CONSERVATION BOARD (CWCB).
 2. ALL CONTOURS REFLECT EXISTING CONDITIONS.
 3. CONTOURS SHOWN ON THIS MAP REFLECT A 5' CONTOUR INTERVAL.
 4. AERIAL IMAGERY FROM GOOGLE EARTH DATED 2019

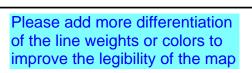




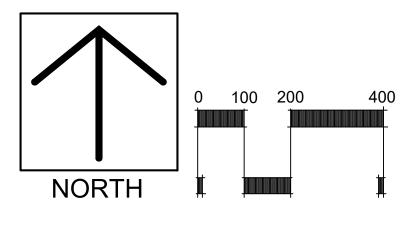


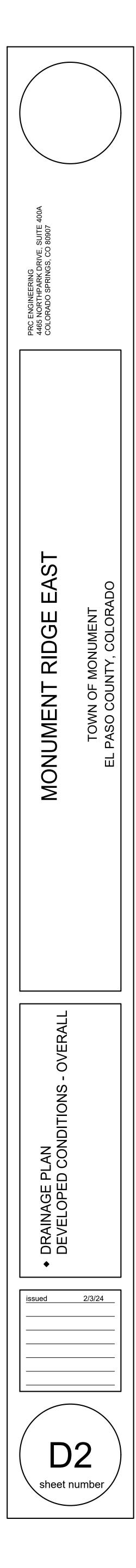


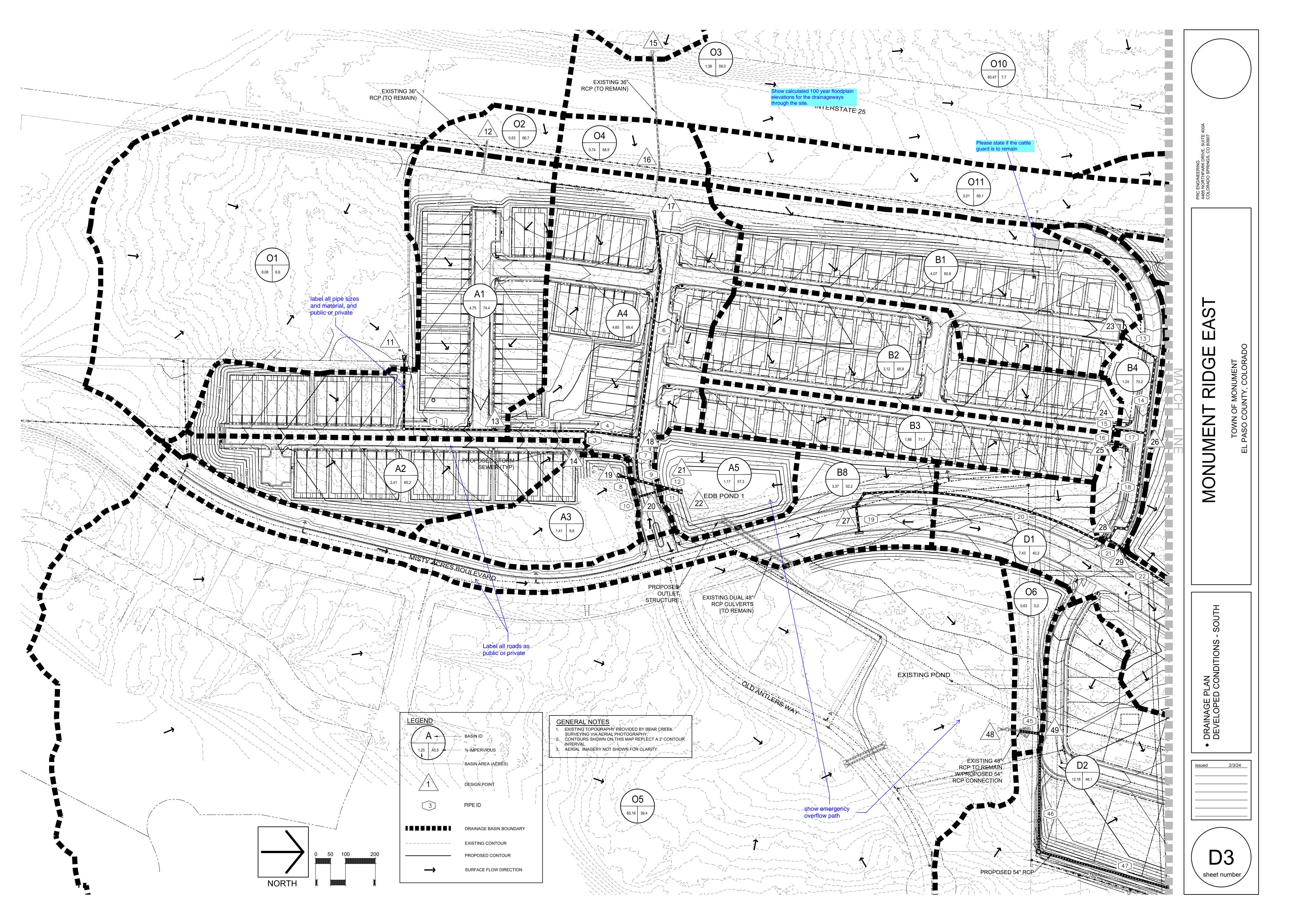


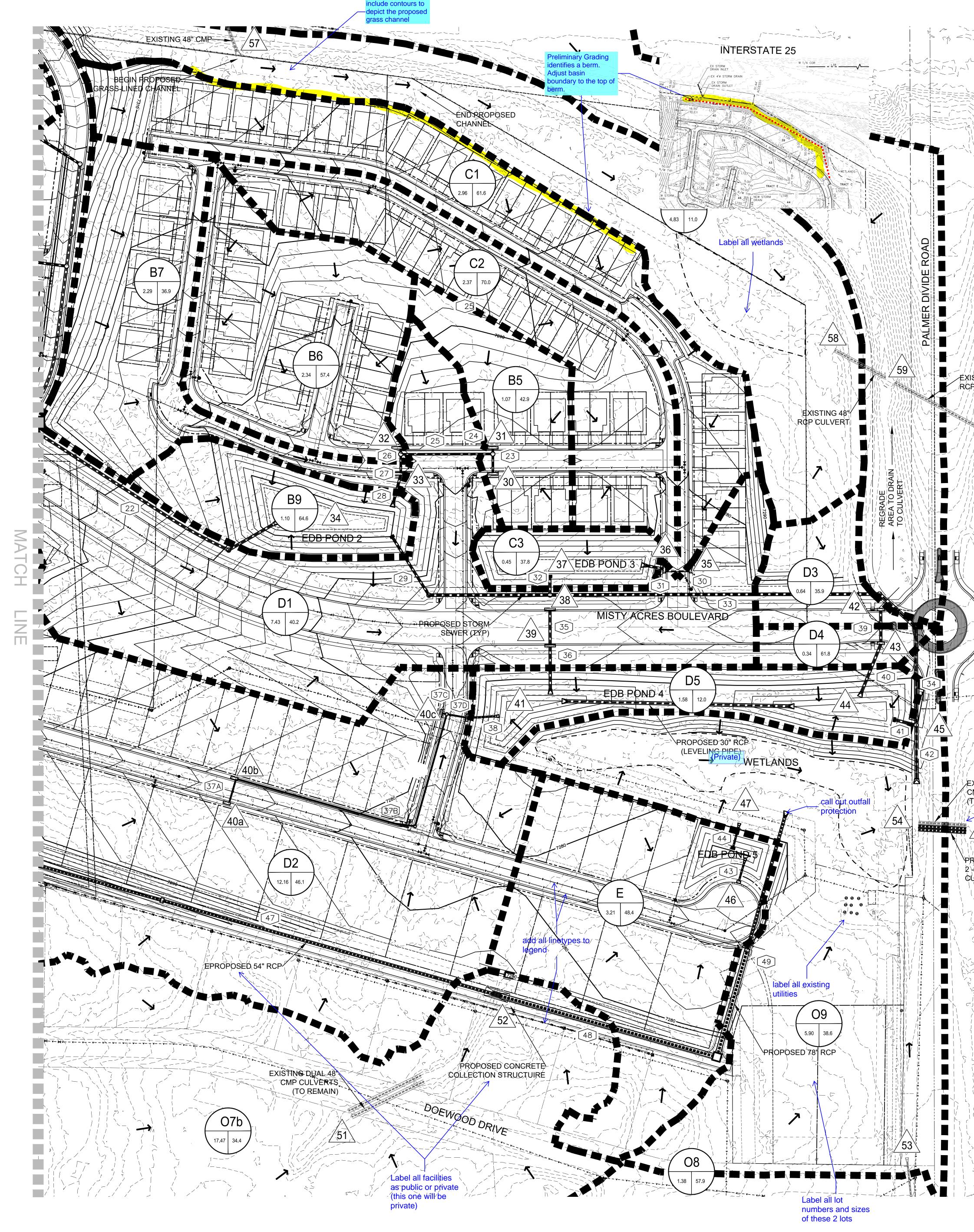


- <u>GENERAL NOTES</u>
 1. EXISTING TOPOGRAPHY PROVIDED BY THE COLORADO WATER CONSERVATION BOARD (CWCB).
 2. ALL CONTOURS REFLECT EXISTING CONDITIONS.
 3. CONTOURS SHOWN ON THIS MAP REFLECT A 5' CONTOUR INTERVAL
- INTERVAL.
- AERIAL IMAGERY NOT SHOWN FOR CLARIFICATION.
 ALL BASINS FOR THE SITE HAVE BEEN SHOWN HEREIN, HOWEVER THE SUB-BASINS HAVE BEEN GENERALLY LABELED TO CORRESPOND WITH THE MAJOR BASIN (E.G. -BAINS A1 THRU A7 ARE LABELED AS "A" ON THE MAP.









Provide all checklist items

Design Point/ Contributing Basins

Design Point

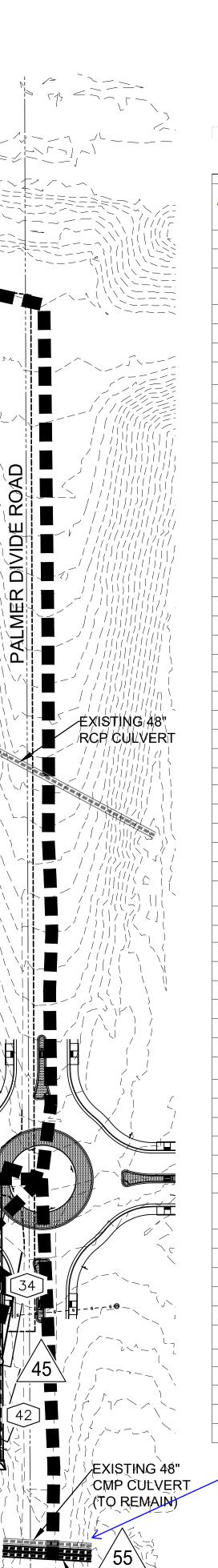
MONUMENT RIDGE EAST MASTER DEVELOPMENT DRAINAGE PLAN (Surface Routing Summary)

3.3 5.7 existing 36" RCP culvert

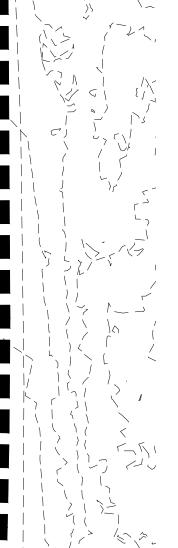
Comments

Flow

Q 10 Q 100







| 1 | E2 | 3.3 | 5.7 | existing 36" RCP culvert | | 1 | | 5.8 | 17.2 | | 30" |
|-----|--|-------------------|----------|--|----------------------|---|---|---------------------------------------|--|--------------------------------------|---------------|
| 2 | DP1,E1 | 21.8 | 62.2 | existing dual 48" RCP culverts | | 2 | | 21.3 | 42.4 | | 30" |
| 2 | DD2 52 | 407.0 | 225.6 | Misty Ac 1 Pond Attenuation of Q10=58cfs, | | 3 | | 15.5 | 25.2 | | 24" |
| 3 | DP2,E3 | 107.2 | 225.6 | Q100=130cfs (per MDDP), yields Q10out=49.2cfs and Q100=95.6cfs) | | 4 | | 36.8 5.7 | 67.6 9.7 | | 36" 18" |
| 4 | E4 | 92.1 | 191.4 | unk pipe sizes, assume no peak flow attenuation | | 6 | | 5.7 | 9.7 | | 18" |
| 5 | DP4,E5 | 109.4 | 225.2 | low point collection structure, size TBD in FDR | | 7 | | 12.5 | 77.3 | | 42" |
| 6 | DP3 (attenuated),DP5,E6,E7 | 214.3 | 488.0 | existing 48" CMP culvert, overtops road | | 8 | | 1.3 | 3.5 | | 18" |
| 7 | E8 | 40.8 | 113.3 | existing 48" CMP culvert | | 9 10 | | 13.8 9.4 | 80.7 15.3 | | 42" 24" |
| 8 | DP7,E9,E10 | 52.9 | 137.4 | existing 48" RCP culvert, overtop elev unk | | 10 | | 18.7 | 30.6 | | 30" |
| 9 | DP8,E11 | 60.1 | 151.4 | existing 48" RCP culvert, overtop elev unk | | 12 | (| 62.5 | 111.3 | | 48" |
| 10 | E6 | 4.7 | 8.0 | existing 24" culvert | | 13 | | 14.6 | 24.7 | | 24" |
| 11 | 01 | 5.8 | 17.2 | proposed 18" RCP | | 14 | | 14.6 | 24.7 | | 24" |
| 12 | 02 | 2.1 | 3.5 | existing type C inlet | | 15 16 | | 11.8 7.5 | 19.6 12.2 | | 24" 24" |
| 13 | DP12,A1 | 22.0 | 35.4 | split w/DP14 flows, proposed 4' and 16' D-10-R inlets | | 10 | | 1.5 | 31.8 | | 30" |
| 14 | A2 | 9.0 | 15.0 | split w/DP13 flows, proposed 4' and 16' D-10-R inlets | | 18 | | 33.9 | 56.5 | | 36" |
| 15 | 03 | 3.3 | 5.7 | existing 36" RCP culvert | | 19 | | 5.4 | 9.5 | | 24" |
| 16 | 04 | 3.0 | 4.9 | existing type C inlet | | 20 | 1 | 10.9 | 18.9 | | 24" |
| 17 | DP15,DP16 | 5.7 | 9.7 | proposed 18" RCP culvert | | 21 | | 17.8 | 80.4 | | 42" |
| 18 | DP13,DP14,DP17 | 42.5 | 77.3 | proposed manhole | | 22 23 | | 19.9 1.0 | 83.7 1.8 | | 42" 18" |
| 19 | A3 | 1.3 | 3.5 | proposed 18" RCP culvert | | 23 | | 1.9 | 3.5 | | 18" |
| 20 | A4 | 18.7 | 30.6 | proposed 2-12' D-10-R inlets | | 25 | | 2.9 | 5.3 | | 18" |
| 21 | DP18,DP19,DP20 | 62.5 | 111.3 | flow to pond 1, unrouted | | 26 | | 7.5 | 12.8 | | 24" |
| 22 | DP21,A5 | 66.7 | 118.4 | total flow to pond 1, not routed | | 27 | | 10.3 | 18.1 | | 24" |
| 23 | B1 | 14.6 | 24.7 | proposed 16' D-10-R inlet | | 28 | | 15.4 | 27.9 | | 24" |
| 24 | B2 | 11.8 | 19.6 | split w/DP25 flows, proposed triple type R inlets | | 29 30 | | 10.6 11.4 | 28.3 19.5 | | 24" 30" |
| 25 | B3 | 7.5 | 12.2 | split w/DP24 flows, proposed triple type R inlets | | 31 | | 21.3 | 35.9 | | 36" |
| 26 | DP23,DP24,DP25 | 33.9 | 56.5 | proposed manhole | | 32 | | 2.2 | 5.8 | | 18" |
| 27 | B8 | 10.9 | 18.9 | proposed 2-8' D-10-R inlets | | 33 | | 12.8 | 34.1 | | 36" |
| 28 | B4(60%) | 3.1 | 5.0 | proposed double type 16 inlet | | 34 | | 12.8 | 34.1 | | 36" |
| 29 | B4(40%) | 2.1 | 3.3 | proposed double type 16 inlet | | 35 | | 9.2 | 17.5 | | 24" |
| 30 | B5(33%) | 1.0 | 1.8 | proposed single type R inlet | | 36 37A | | 18.5 7.9 | 34.9 15.1 | | 30" 24" |
| 31 | B5(66%) | 1.9 | 3.5 | proposed single type R inlet | | 37B | | 15.9 | 30.2 | | 30" |
| 32 | B6 | 7.5 | 12.8 | proposed double type R inlet | | 37C | | 6.2 | 11.7 | | 18" |
| 33 | B7 | 5.1 | 9.7 | proposed double type R inlet | | 37D | | 22.0 | 42.0 | | 30" |
| 34 | DP23,DP24,DP25,DP27,DP28,DP 29,DP30,DP31,DP32,DP33,B9 | 69.8 | 119.2 | total flow to pond 2, not routed | | 38 | | 28.2 | 53.7 | | 36" |
| 35 | C1 | <mark>11.4</mark> | 19.5 | split w/DP36 flows, proposed triple type R inlets | | 39 | | 1.6 | 3.2 | | 18" |
| 36 | C2 | 9.9 | 16.4 | split w/DP35 flows, proposed triple type R inlets | | 40 41 | | 2.9 15.5 | 5.3 38.1 | | 18" 36" |
| 37 | DP35,DP36,C3 | 22.5 | 38.1 | total flow to pond 3, not routed | | 42 | | 28.3 | 72.2 | | 48" |
| 38 | Pond 2 out, Pond 3 out | 12.8 | 34.1 | proposed manhole | | 43 | | 9.3 | 17.4 | | 24" |
| 39 | D1 | 18.5 | 34.9 | proposed 2-16' D-10-R inlets | | 44 | | 2.1 | 5.5 | | 18" |
| 40a | D2(25%) | 7.9 | 15.1 | split w/DP40b flows, proposed 12' D-10-R inlet | | 45 | | 60.9 | 108.3 | | 54" I |
| 40b | D2(25%) | 7.9 | 15.1 | split w/DP40a flows, proposed 12' D-10-R inlet | | 46 47 | | 61.9 61.9 | 111.0 111.0 | | 54" 54" |
| 40c | D2(50%) | 12.3 | 23.4 | proposed 2-12' D-10-R inlets | | 47 | | 64.5 | 322.3 | | 78" |
| 41 | DP39,DP40a,DP40b,DP40c, D5(50%) | 48.0 | 92.0 | total flow to pond 4 (south side) | | 49 | | 64.5 | 322.3 | | 78" |
| 42 | D3 | 1.6 | 3.2 | proposed 4' D-10-R inlet | | | | I | | I | |
| 43 | D4 | 1.3 | 2.1 | proposed 4' D-10-R inlet | | | | | | | |
| 44 | DP42,DP43,D5(50%) | 4.3 | 8.7 | total flow to pond 4 (south side) | | | | | | | |
| 45 | DP38, Pond 4 out | 28.3 | 72.2 | proposed manhole | | | | | | | |
| 46 | E | 9.3 | 17.4 | proposed 16' D-10-R inlet | | | | | | | |
| 47 | Pond 5 outfall | 2.1 | 5.5 | total flow release | | | | | | | |
| 48 | Pond 1 out,O5 | 118.9 | 238.3 | Misty Ac 1 Pond Attenuation of Q10=58cfs, Q100=130cfs (per MDDP), yields Q10out=60.9cfs and | | | | | | | |
| | | | | Q100=108.3cfs) | | | | | | | |
| 49 | O6 | 1.0 | 2.7 | proposed type C inlet | | | | | | | |
| 50 | 07A | 92.1 | 191.4 | total flow to existing pond, no peak flow attenutation | | | | | | | |
| 51 | DP50,07B | 110.5 | 227.6 | existing dual 48" CMP culverts | | | | | | | |
| 52 | DP51 | 102.6 | 211.3 | low point collection structure, size TBD in FDR | | | | | | | |
| 53 | 08 | 4.7 | 8.0 | ex culvert, size unk | | | | | | | |
| 54 | DP45,DP47,DP48 OUT,DP49,DP52,DP53,O9 | 211.7 | 431.3 | total inflow | | | | | | | |
| 55 | DP54 Pipe Out | 211.7 | 431.3 | existing 48" culvert outfall | | | | | | | |
| 56 | 010 | 40.8 | 113.3 | existing 48" CMP culvert | | | | | | | |
| 57 | DP56,011 | 47.7 | 124.4 | existing type C inlet | | | | | | | |
| 58 | DP57,012 | 52.2 | 134.6 | existing 48" RCP culvert | | | | | | | |
| 59 | DP58,013 | 60.1 | 150.0 | existing 48" RCP culvert | | | | | | | |
| | | | . | | | | | | ا م م م ا | | |
| | Address the d | owns | lrean | easements that will be need | | or cons | liuction | and ad | luitional | conveya | ance |
| | e need to know how mu | | | | | | | | | | |
| | sturbance (not just the in treated and if there are | | | | | | | | | | |
| | treated areas. So pleas | | | | | 1 | Water Qu | uality Treatmer | nt Summary Tak | ble | |
| | odify an existing drainag at shows areas tributary | | | | Total Area | Total Proposed | Area Trib to | Disturbed Area Treated via | Disturbed Area Excluded from | | Applicable V |
| rec | duction, etc.) and those | disturb | ed are | as that are not treated | (ac) | Disturbed Area | Pond A (ac) | Runoff Reduction | WQ per ECM App I.7.1.C.1 | WQ per ECM App I.7.1.B.# | (App I.7.1.B. |
| | a PBMP, with the appli 1ac of development cal | | | on labeled (ex: 20% up | 4.50 | (ac) 4.50 | 4.50 | (ac) | (ac) | (ac) | |
| 1.7 | .1.C.1 and exclusions li | isted in | ECM / | App I.7.1.B.#). An | 4.50 1.25 6.00 | 4.50 1.25 4.00 | 4.50 | 1.25 | | 4.00 | ECM App I.7 |
| | companying summary f | | | nap would also be very | 2.50 | 2.50 | 1.00 | | 0.50 | 1.00 | ECM App I.7 |
| ne | lpful (example provided | as a s | creens | F | 3.00 8.25 | 40.05 | 3.00 | 1.05 | 0.50 | 6.00 | |
| | | | | Comments | 25.50 | 12.25 [For each row, the sum of the | 8.50 [Values in this column can be | 1.25 [See RR calc spreadsheet.] | 0.50 [Total must be <20% of site and | 5.00 | |
| Λ. | maintenance agreem | ent wil | | | | values in Columns 4-7 | more than Column 3 if over- | | <1ac.] | | |
| | required for private f | | | | | must be greater than or equal to the value in | treating non- disturbed areas of the same land- | | | | |
| are | e being discharged in | EPC | | | | the value in Column 3 above.] | of the same land- use.] | | | | |
| | OW. It appears that flo | | | | | | | | | | |
| | e private roadways ar scharged at DP 54 | e peiné | y | | | Total Proposed Disturbed Area (ac) | | ed Treated Area (ac) | Excluded | l Disturbed Area l from WQ ac) | Minimum Ar |
| GIU | | | | | | 12.25 | 9 | .75 | | .50 | (|
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| | LEGEND | | | | | | IOTES | | | | |
| | $\langle \rangle$ | | | | FXIS | | POGRAPI | HY PROVI | | AR CREE | < |

- BASIN ID

% IMPERVIOUS

DESIGN POINT

PIPE ID

BASIN AREA (ACRES)

DRAINAGE BASIN BOUNDARY

SURFACE FLOW DIRECTION

EXISTING CONTOUR

PROPOSED CONTOUR

A -

x.xx | xx.x 🖌

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(#)

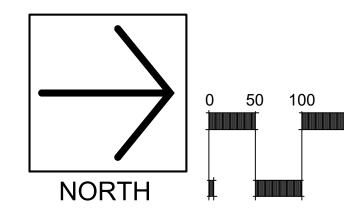
 \rightarrow

| | | | Water Qu | ality Treatmen | t Summary Tab | le | |
|----------|--------------------|--|--|--|--|--|--|
| Basin ID | Total Area (ac) | Total Proposed Disturbed Area (ac) | Area Trib to Pond A (ac) | Disturbed Area Treated via Runoff Reduction (ac) | Disturbed Area Excluded from WQ per ECM App I.7.1.C.1 (ac) | Disturbed Area Excluded from WQ per ECM App I.7.1.B.# (ac) | Applicable WQ Exclu (App I.7.1.B.#) |
| A | 4.50 | 4.50 | 4.50 | | | | |
| В | 1.25 | 1.25 | | 1.25 | | | |
| С | 6.00 | 4.00 | | | | 4.00 | ECM App I.7.1.B.5 |
| D | 2.50 | 2.50 | 1.00 | | 0.50 | 1.00 | ECM App I.7.1.B.7 |
| E | 3.00 | | 3.00 | | | | |
| F | 8.25 | | | | | | |
| Total | 25.50 | 12.25 | 8.50 | 1.25 | 0.50 | 5.00 | |
| Comments | | [For each row, the sum of the values in Columns 4-7 must be greater than or equal to the value in Column 3 above.] | [Values in this column can be more than Column 3 if over- treating non- disturbed areas of the same land- use.] | [See RR calc spreadsheet.] | [Total must be <20% of site and <1ac.] | | |
| | | Total Proposed Disturbed Area (ac) | | ed Treated Area ac) | Excluded | Disturbed Area from WQ c) | Minimum Area to be Tr (ac) |
| | | 12.25 | 9 | .75 | 5. | 50 | 6.75 |

GENERAL NOTES

. EXISTING TOPOGRAPHY PROVIDED BY BEAR CREEK SURVEYING VIA AERIAL PHOTOGRAPHY. CONTOURS SHOWN ON THIS MAP REFLECT A 2' CONTOUR

- INTERVAL. 3. AERIAL IMAGERY NOT SHOWN FOR CLARITY.



| add a column for |
|------------------|
| public/private |

30" RCP

30" RCP

24" RCP

36" RCP

18" RCP

18" RCP

42" RCP

18" RCP

42" RCP

24" RCP

48" RCP

24" RCP

24" RCP

24" RCP

24" RCP

30" RCP

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24" RCP

24" RCP

30" RCP

24" RCP

54" RCP

54" RCP

MONUMENT RIDGE EAST MASTER DEVELOPMENT DRAINAGE PLAN (Pipe Summary)

Q 100

17.2

Flow (cfs)

Q 10

5.8

Pipe ID

1

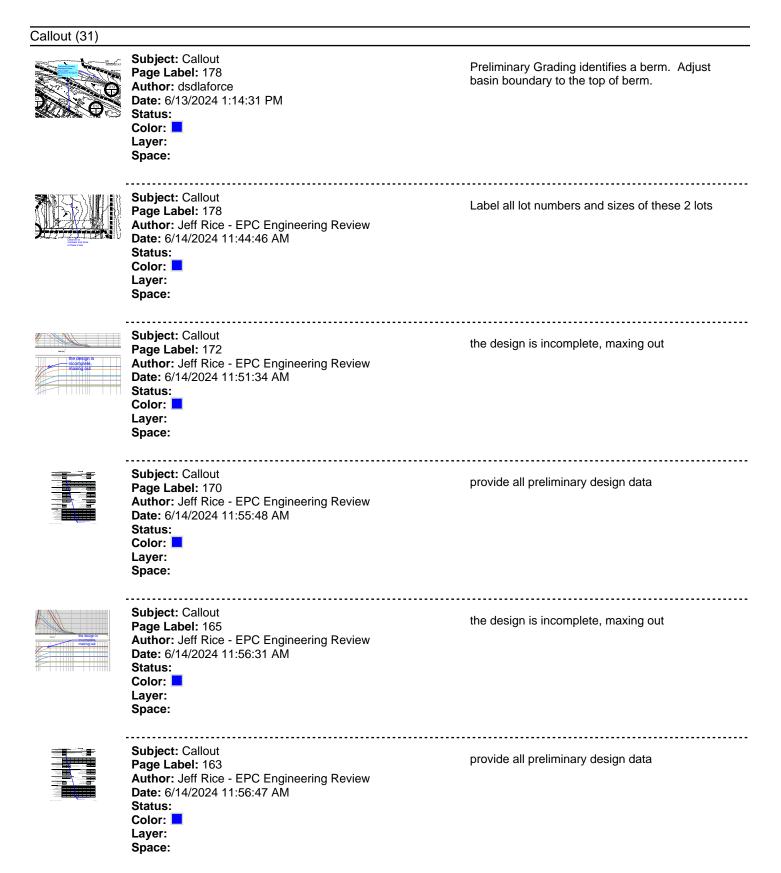




200



V1_Drainage Report - Preliminary.pdf Markup Summary



| | Subject: Callout Page Label: 156 Author: Jeff Rice - EPC Engineering Review Date: 6/14/2024 11:57:13 AM Status: Color: Layer: Space: | provide all preliminary design data |
|--|--|--------------------------------------|
| Pic claspin la Michael Carlos Michael Carlos | Subject: Callout Page Label: 158 Author: Jeff Rice - EPC Engineering Review Date: 6/14/2024 11:57:31 AM Status: Color: Layer: Space: | the design is incomplete, maxing out |
| Part Report | Subject: Callout Page Label: 151 Author: Jeff Rice - EPC Engineering Review Date: 6/14/2024 11:57:52 AM Status: Color: Layer: Space: | the design is incomplete, maxing out |
| | Subject: Callout Page Label: 149 Author: Jeff Rice - EPC Engineering Review Date: 6/14/2024 11:58:07 AM Status: Color: Layer: Space: | provide all preliminary design data |
| | Subject: Callout Page Label: 142 Author: Jeff Rice - EPC Engineering Review Date: 6/14/2024 11:58:28 AM Status: Color: Layer: Space: | provide all preliminary design data |
| E Rog E margaret margaret t | Subject: Callout Page Label: 144 Author: Jeff Rice - EPC Engineering Review Date: 6/14/2024 11:58:41 AM Status: Color: Layer: Space: | the design is incomplete, maxing out |

| why the all | Subject: Callout Page Label: 83 Author: Jeff Rice - EPC Engineering Review Date: 6/14/2024 12:01:22 PM Status: Color: Layer: Space: | why is this all blue? |
|--|---|---|
| If this report is an MDDP add this to MANGETAN The report life with Analyses merits Analyses and Analyses and Analyses and Analyses and Analyses and Analyses | Subject: Callout Page Label: 58 Author: Jeff Rice - EPC Engineering Review Date: 6/14/2024 12:02:39 PM Status: Color: Layer: Space: | if this report is an MDDP add this to the report title |
| Port and Master Development Drainage Plan | Subject: Callout Page Label: 1 Author: Jeff Rice - EPC Engineering Review Date: 6/14/2024 12:03:13 PM Status: Color: Layer: Space: | and Master Development Drainage Plan |
| which have been able to the | Subject: Callout Page Label: 15 Author: Jeff Rice - EPC Engineering Review Date: 6/14/2024 12:08:50 PM Status: Color: Layer: Space: | Preliminary design showing that the sizing will work and not require site revisions is needed in this report. |
| <section-header><section-header><section-header><section-header><section-header><text></text></section-header></section-header></section-header></section-header></section-header> | Subject: Callout Page Label: 21 Author: Jeff Rice - EPC Engineering Review Date: 6/14/2024 12:13:56 PM Status: Color: Layer: Space: | Provide a plan highlighting these areas that will be maintained as grass buffers. |
| 0 | Subject: Callout Page Label: 178 Author: Jeff Rice - EPC Engineering Review Date: 6/14/2024 1:14:19 PM Status: Color: Layer: Space: | Label all facilities as public or private (this one will be private) |

| | Subject: Callout Page Label: 177 Author: Jeff Rice - EPC Engineering Review Date: 6/14/2024 1:15:18 PM Status: Color: Layer: Space: | Label all roads as public or private |
|---|---|--|
| | Subject: Callout Page Label: 177 Author: Jeff Rice - EPC Engineering Review Date: 6/14/2024 1:16:36 PM Status: Color: Layer: Space: | show emergency overflow path |
| | Subject: Callout Page Label: 177 Author: Jeff Rice - EPC Engineering Review Date: 6/14/2024 1:17:41 PM Status: Color: Layer: Space: | label all pipe sizes and material, and public or private |
| ad a column for publications numerical columns with the second second second second second second second second second second second second second second second second second se | Subject: Callout Page Label: 178 Author: Jeff Rice - EPC Engineering Review Date: 6/14/2024 1:18:40 PM Status: Color: Layer: Space: | add a column for public/private |
| | Subject: Callout Page Label: 178 Author: Jeff Rice - EPC Engineering Review Date: 6/14/2024 1:19:20 PM Status: Color: Layer: Space: | Label all wetlands |
| | Subject: Callout Page Label: 178 Author: Jeff Rice - EPC Engineering Review Date: 6/14/2024 1:19:59 PM Status: Color: Color: Color: Space: | label all existing utilities |

| | Subject: Callout Page Label: 178 Author: Jeff Rice - EPC Engineering Review Date: 6/14/2024 1:20:40 PM Status: Color: Layer: Space: | add all linetypes to legend |
|---|---|--|
| | Subject: Callout Page Label: 178 Author: Jeff Rice - EPC Engineering Review Date: 6/14/2024 1:22:27 PM Status: Color: Layer: Space: | call out outfall protection |
| D PLAN (IMPLEMENTATION OF THE MASI long) (complete the modeling) auto brains of the incompasses this at being for the Babl Morham waterheid. A Die tore development in the overall basin is expe modeling of the proposed full development on from the proposed full end be used to or discarge from the site from the pre-develop endevelopment by the exception of the pre-development interference to be set on the pre-development interference to be a set of the pre-development interference to be a set on the pre-dev | Subject: Callout Page Label: 23 Author: Jeff Rice - EPC Engineering Review Date: 6/14/2024 1:27:45 PM Status: Color: Layer: Space: | (complete the modeling) |
| Control of the second sec | Subject: Callout Page Label: 23 Author: Jeff Rice - EPC Engineering Review Date: 6/14/2024 1:27:23 PM Status: Color: Layer: Space: | Address the condition and capacity of downstream conveyances (including north of County Line Road), effects of the proposed flows from this development, any stabilization that may be required and any maintenance that may be required. |
| <text><text><text><text><text></text></text></text></text></text> | Subject: Callout Page Label: 23 Author: Jeff Rice - EPC Engineering Review Date: 6/14/2024 1:30:09 PM Status: Color: Layer: Space: | Impact will be the extended duration of flows with FSD |
| | Subject: Callout Page Label: 178 Author: Jeff Rice - EPC Engineering Review Date: 6/14/2024 2:01:45 PM Status: Color: Layer: Space: | Address the downstream easements that will be needed for construction and additional conveyance |

Subject: Callout seems high Page Label: 58 Author: Jeff Rice - EPC Engineering Review Date: 6/14/2024 3:01:05 PM Status: Color: Layer: Space: Engineer (25) Subject: Engineer Joshua Palmer, P.E. Page Label: 2 Author: Bret County Engineer / ECM Date: 6/6/2024 11:59:19 AM Conditions: Status: Color: Layer: Space: Subject: Engineer Master Development Drainage Plan Page Label: 5 Author: Bret Date: 6/6/2024 12:00:28 PM Status: Color: Layer: Space: Subject: Engineer add Preliminary Drainage Report Page Label: 5 Author: Bret Date: 6/17/2024 11:27:25 AM Status: Color: 📘 Layer: Space: Subject: Engineer Please include the basin area and generated flows Page Label: 9 in the description of each basin. Author: Bret Please include the final outfall location of the flow Date: 6/13/2024 11:30:42 AM for each basin. Status: Color: Layer: Space: Subject: Engineer Please state whether the pipes run under Misty Page Label: 10 Acres Boulevard Author: Bret Date: 6/6/2024 2:36:11 PM Status: Color: Layer: Space:

| The devices in the statistic generation used in the devices of the statistic generation of the parallel to the statistic generation of the sta | Subject: Engineer Page Label: 10 Author: Bret Date: 6/6/2024 2:38:25 PM Status: Color: Layer: Space: | Please state whether the pond will remain with upgrades or be removed. |
|---|---|--|
| int <mark>369</mark> flo lex home | Subject: Engineer Page Label: 16 Author: Bret Date: 6/6/2024 3:22:11 PM Status: Color: Layer: Space: | 369 |
| ire then routed in 369 flows are ge | Subject: Engineer Page Label: 16 Author: Bret Date: 6/6/2024 3:22:20 PM Status: Color: Layer: Space: | 36 |
| all locatio rm <mark>or</mark> a ri n thereof | Subject: Engineer Page Label: 20 Author: Bret Date: 6/6/2024 3:29:21 PM Status: Color: Layer: Space: | or |
| Il location, an energy m or a riprap tailwater thereof. A detailed c nared. of | | of |
| Agrinert areas. These have not been considered in the output of the second se | Subject: Engineer Page Label: 20 Author: Bret Date: 6/6/2024 3:33:09 PM Status: Color: Layer: Space: | Please name the roadway here |

| | Subject: Engineer Page Label: 175 Author: Bret Date: 6/6/2024 3:42:54 PM Status: Color: Layer: Space: | Please change the color or make a change to make the DP easier to identify |
|---|--|---|
| SURFACE FLC Please add more differentiation into the line weights or color to propose the legislity of the map. | Subject: Engineer Page Label: 176 Author: Bret Date: 6/6/2024 3:52:29 PM Status: Color: Layer: Space: | Please add more differentiation of the line weights or colors to improve the legibility of the map |
| | Subject: Engineer Page Label: 178 Author: Bret Date: 6/6/2024 4:14:22 PM Status: Color: Layer: Space: | include contours to depict the proposed grass channel |
| An address of the strength | Subject: Engineer Page Label: 23 Author: Bret Date: 6/7/2024 10:03:59 AM Status: Color: Layer: Space: | All existing pipes will remain |
| Here some provinses, aussessener visue surger response the toring of such reprovements. In Order Control (1997) and the surger source and the surger for the surger source and the surger source and the surger Order source and the surger source and the surger Def strates and the surger source and the surger of the surger source and the surger source and the surger of the surger source and the surger source and the surger of the surger source and the surger source and the surger of the surger source and | Subject: Engineer Page Label: 23 Author: Bret Date: 6/13/2024 11:33:37 AM Status: Color: Layer: Space: | Please clarify, discussion of DP 48 states a 48" RCP will need to be replaced with a 54" |
| | Subject: Engineer Page Label: 60 Author: Bret Date: 6/7/2024 10:18:33 AM Status: Color: Layer: Space: | Please see if you can include this information on the previous page |

| | Subject: Engineer Page Label: 177 Author: Bret Date: 6/7/2024 2:11:57 PM Status: Color: Layer: Space: | Please state if the cattle guard is to remain |
|--|--|---|
| <mark>SP241</mark> Anril 2024 | Subject: Engineer Page Label: 1 Author: Bret Date: 6/10/2024 10:40:55 AM Status: Color: Layer: Space: | SP241 |
| A Sector of the | Subject: Engineer Page Label: 12 Author: Bret Date: 6/13/2024 11:32:20 AM Status: Color: Layer: Space: | Please include a statement when an existing DP is replaced by a new DP for additional clarity |
| A maintenance agreement will be required for private flows that are being discharged in EPC models and the EPC Models and the State of the State Mischarged at DP 54 LEGEND | Subject: Engineer Page Label: 178 Author: Bret Date: 6/12/2024 11:30:56 AM Status: Color: Layer: Space: | A maintenance agreement will be required for private flows that are being discharged in EPC ROW. It appears that flows from the private roadways are being discharged at DP 54 |
| | Subject: Engineer Page Label: 67 Author: Bret Date: 6/13/2024 11:46:43 AM Status: Color: Layer: Space: | Please include calculations for all basins |
| A series of a part part of the second of the | Subject: Engineer Page Label: 12 Author: Jeff Rice - EPC Engineering Review Date: 6/14/2024 12:07:05 PM Status: Color: Layer: Space: | Include the basin area and generated flows in the description of each basin. |



Subject: Engineer Page Label: 177 Author: Bret Date: 6/17/2024 11:07:40 AM Status: Color: Layer: Space:

Show calculated 100 year floodplain elevations for the drainageways through the site.

stands depression area as its nove being our planned to be elevated (2100mav965) pp 1 system needs to be sized accordingly to the te other novate her system will take, the anticip 1%. The computed pipe size from Design PD What is the combine path form Design PD What is the overflow path for the DPP Vioub the readway size is a 0 flows are generated from design point 50 an 1 flows are generated from design point 50 an Subject: Engineer Page Label: 19 Author: Bret Date: 6/17/2024 11:11:31 AM Status: Color: Layer: Space:

File Attachment (1)



Subject: File Attachment Page Label: 178 Author: Glenn Reese - EPC Stormwater Date: 6/10/2024 9:21:21 AM Status: Color: Layer: Space:

Highlight (3)



Subject: Highlight Page Label: 178 Author: dsdlaforce Date: 6/13/2024 1:14:07 PM Status: Color: Layer: Space:



Subject: Highlight Page Label: 178 Author: dsdlaforce Date: 6/13/2024 1:14:15 PM Status: Color: Layer: Space:

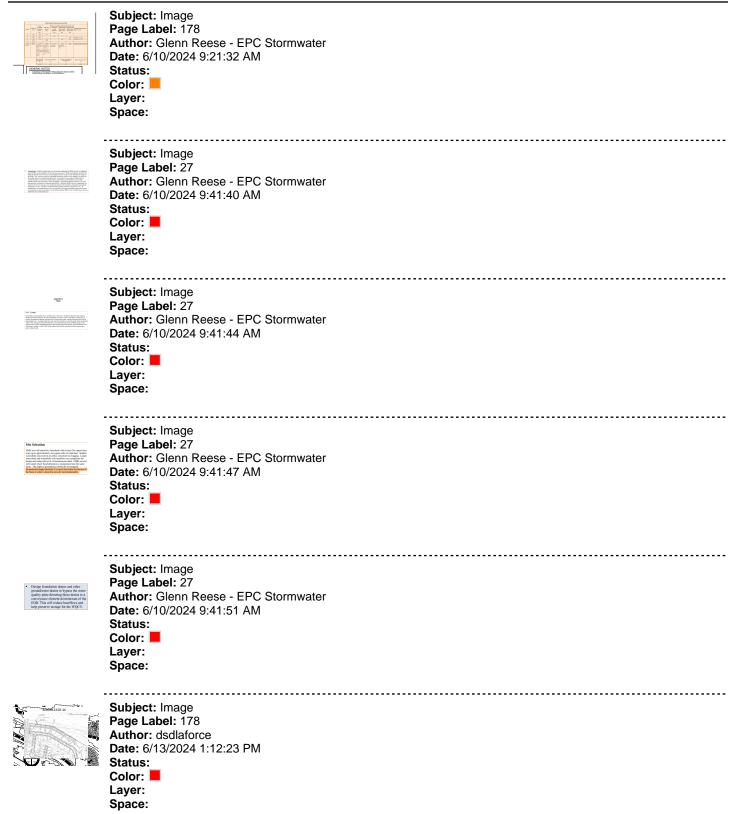


Subject: Highlight Page Label: 7 Author: Jeff Rice - EPC Engineering Review Date: 6/14/2024 12:04:32 PM Status: Color: Layer: Space:

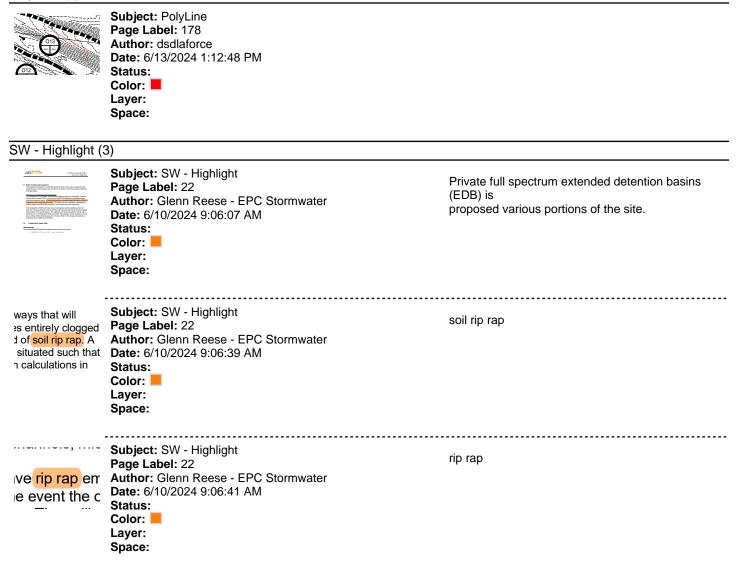
pre-development

What is the overflow path for this DP? Would the roadway act as a drainageway?

Image (6)



PolyLine (1)



SW - Textbox (4)



Subject: SW - Textbox Page Label: 178 Author: Glenn Reese - EPC Stormwater Date: 6/10/2024 9:21:18 AM Status: Color: ■ Layer: Space:

We need to know how much of the proposed area of disturbance (not just the impervious surfaces) is treated vs untreated and if there are any exclusions that apply to the untreated areas. So please create a basic overview map (or modify an existing drainage map) with color shading/hatching that shows areas tributary to each PBMP (pond, runoff reduction, etc.) and those disturbed areas that are not treated by a PBMP, with the applicable exclusion labeled (ex: 20% up to 1ac of development can be excluded per ECM App I.7.1.C.1 and exclusions listed in ECM App I.7.1.B.#). An accompanying summary table on this map would also be very helpful (example provided as a screenshot and in excel form):

| neare use most network memory network towards stacking Developed Towards (Towards Towards Towa |
|---|
| In reason, no amorphism fow persons that on basis E7. For each basis, notice which WO MAMP each basis in thorasy to and/or which WO exclusion applies. And/or just posside the WO Treatment Summary Inditiona |
| penerally flows to the north, and ultimately ion area south of and adjacent to Palmer Divide |
| i will generate twenty-three (23) on-site basins ifer to the developed conditions map in |
| sing, inlets and manholes within public right-of- sed. All other proposed storm system elements sed. All public storm pipes will be RCP. |

Subject: SW - Textbox Page Label: 11 Author: Glenn Reese - EPC Stormwater Date: 6/10/2024 9:23:30 AM Status: Color: ■ Layer: Space:

Author: Glenn Reese - EPC Stormwater

Subject: SW - Textbox

Date: 6/10/2024 9:41:37 AM

Page Label: 27

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For each basin, notate which WQ PBMP each basin is tributary to and/or which WQ exclusion applies. And/or just provide the WQ Treatment Summary Table I requested on the last page of this report.

Per CDPHE's "Low Risk Discharge Guidance -Discharges of Uncontaminated Groundwater to Land," discharging groundwater to a pond or other SW conveyance is prohibited unless properly permitted through CDPHE. Please review this guidance and the applicable permits. The guidance and permits can be found on CDPHE's website.

See excerpts from MHFD's DCM Volume 2 and 3 for potential concerns with groundwater in an EDB and the recommended mitigation options (like a clay or geomembrane liner). Please discuss this potential shallow groundwater in the report text. If you decide not to design for mitigation now and shallow groundwater is encountered during or after construction (or at PA/FA), proper mitigation and permitting will need to be implemented at that time.

Supplemental information related to my comment on PDF pg 22 above regarding groundwater in ponds:

Supplemental information related to my comment of PDF pg 22 above regarding groundwater in ponds Subject: SW - Textbox Page Label: 27 Author: Glenn Reese - EPC Stormwater Date: 6/10/2024 9:41:29 AM Status: Color: ■ Layer: Space:

SW - Textbox with Arrow (6)



Subject: SW - Textbox with Arrow Page Label: 22 Author: Glenn Reese - EPC Stormwater Date: 6/10/2024 9:06:18 AM Status: Color: ■ Layer: Space:

Statement is unclear, please clarify.

A marchy metry cub-sensitive production and the sensitive production of the sensitive productine production of the sensitive production of the sensitive prod

Subject: SW - Textbox with Arrow Page Label: 22 Author: Glenn Reese - EPC Stormwater Date: 6/10/2024 9:06:57 AM Status: Color: ■ Layer: Space:

riprap or soil riprap? Revise to remove discrepancy.

| C A second secon | Subject: SW - Textbox with Arrow Page Label: 22 Author: Glenn Reese - EPC Stormwater Date: 6/10/2024 9:38:29 AM Status: Color: ■ Layer: Space: | Please discussion any WQ exclusions that apply to any portion of the site. 5 exclusions were selected in the PBMP Applicability Form but none have been discussed in this drainage report. |
|--|---|--|
| | Subject: SW - Textbox with Arrow Page Label: 10 Author: Glenn Reese - EPC Stormwater Date: 6/10/2024 9:14:37 AM Status: Color: ■ Layer: Space: | Specify that this pond was designed/approved under EDARP Filing Number SF94003 |
| <text><text><text><text><text><text></text></text></text></text></text></text> | Subject: SW - Textbox with Arrow Page Label: 10 Author: Glenn Reese - EPC Stormwater Date: 6/10/2024 9:15:02 AM Status: Color: Layer: Space: | Specify that this pond was designed/approved under EDARP Filing Number SF01016 |
| • Construction of the second secon | Subject: SW - Textbox with Arrow Page Label: 22 Author: Glenn Reese - EPC Stormwater Date: 6/10/2024 9:40:06 AM Status: Color: Layer: Space: | Note that per the Soils Report, groundwater was encountered at a depth of 1ft at the nearest test boring (TB-3) to Ponds 2, 3, and 4. Those ponds all have depths greater than 1ft, so please address this in the text here. |
| Text Box (3) | | |
| Provide all checklist items | Subject: Text Box Page Label: 178 Author: Jeff Rice - EPC Engineering Review Date: 6/14/2024 11:42:45 AM Status: Color: Layer: Space: | Provide all checklist items |
| International Control of Control | Subject: Text Box Page Label: 175 Author: Jeff Rice - EPC Engineering Review Date: 6/14/2024 11:48:14 AM Status: Color: Layer: Space: | Provide tables of sub-basins, design points, conveyances, etc. Provide all required checklist items. |



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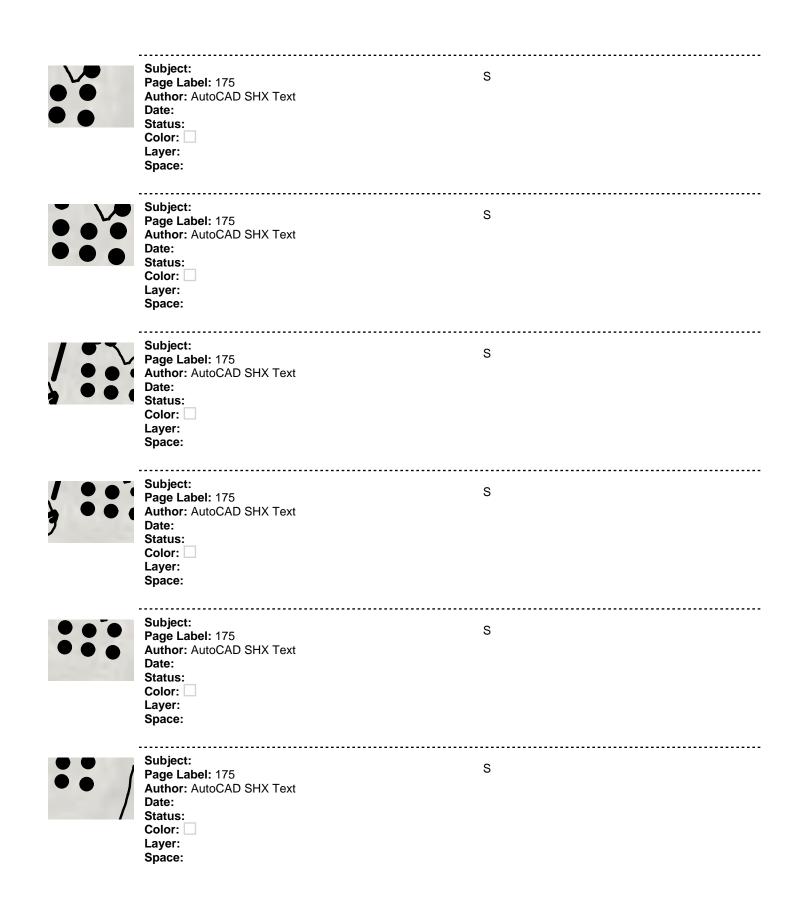


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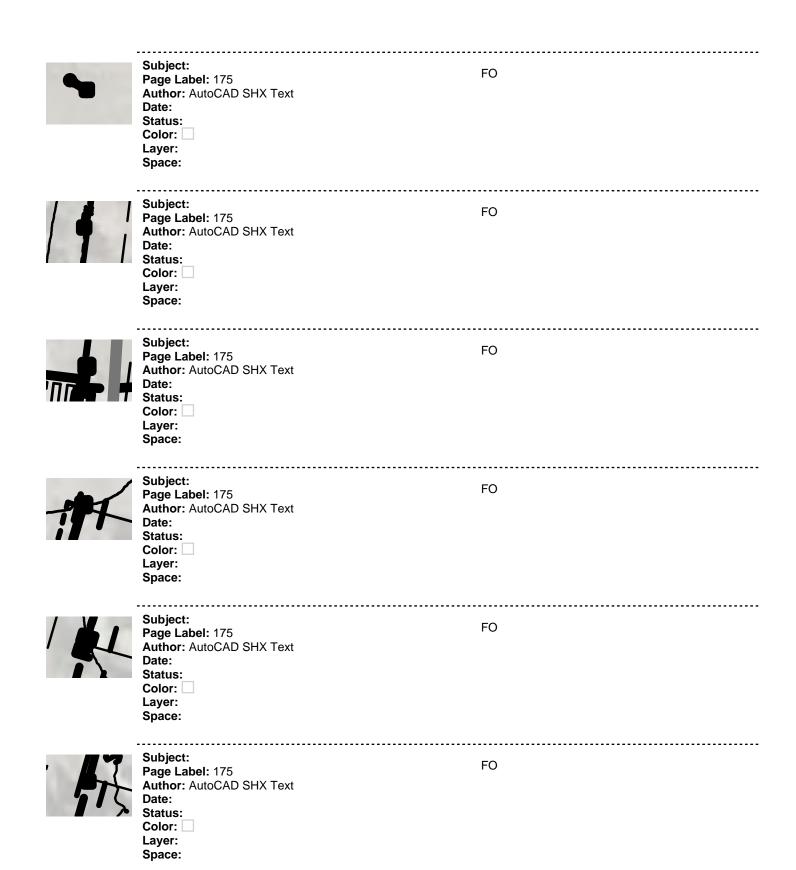
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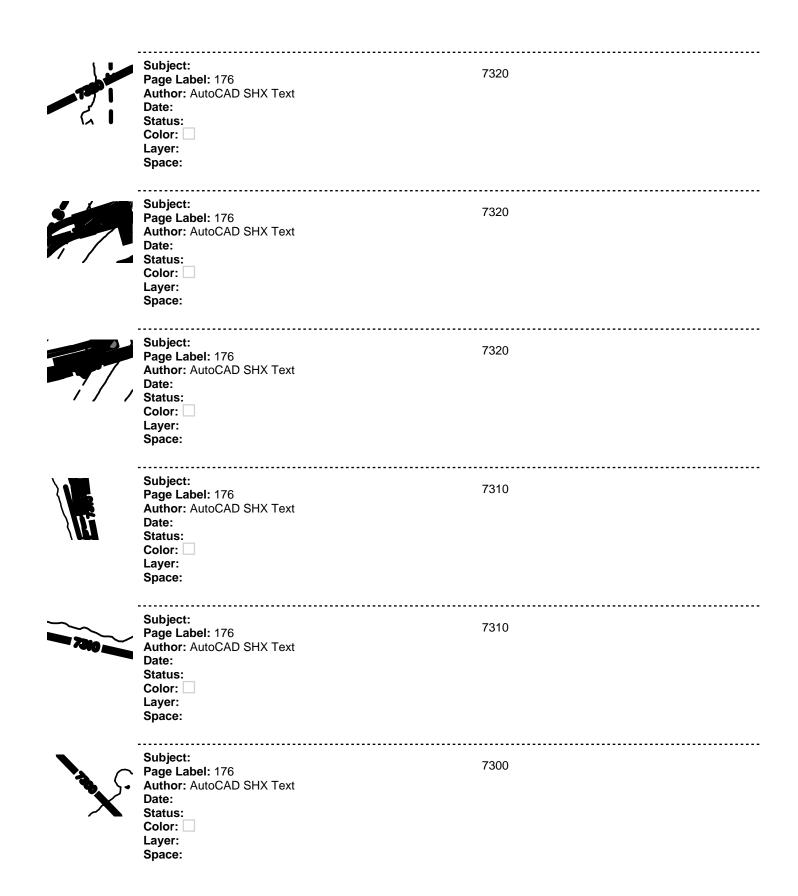
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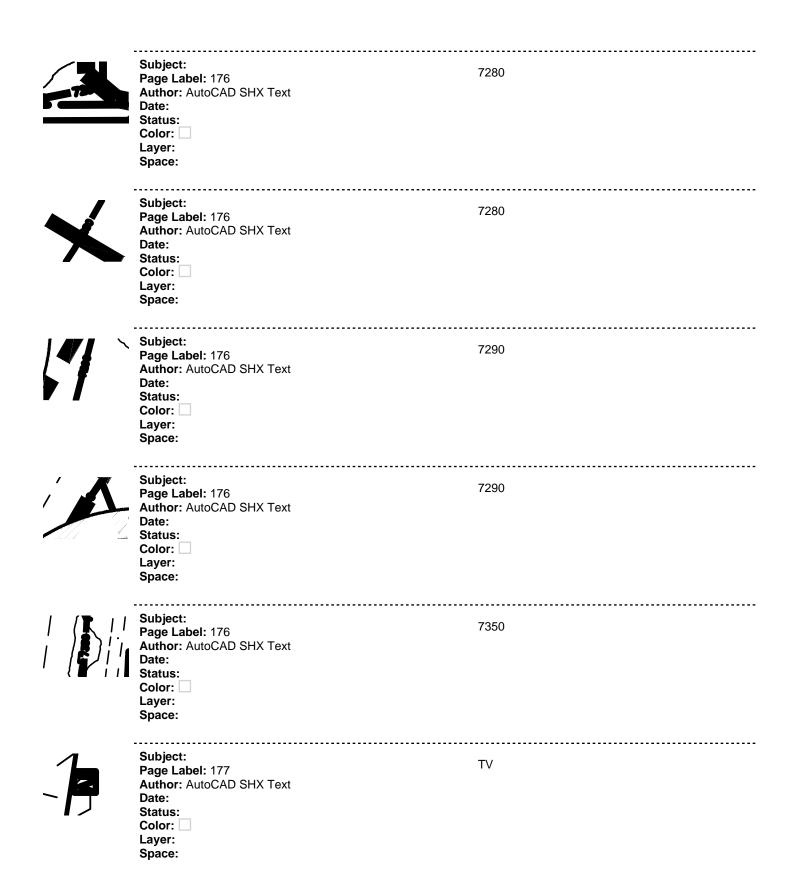
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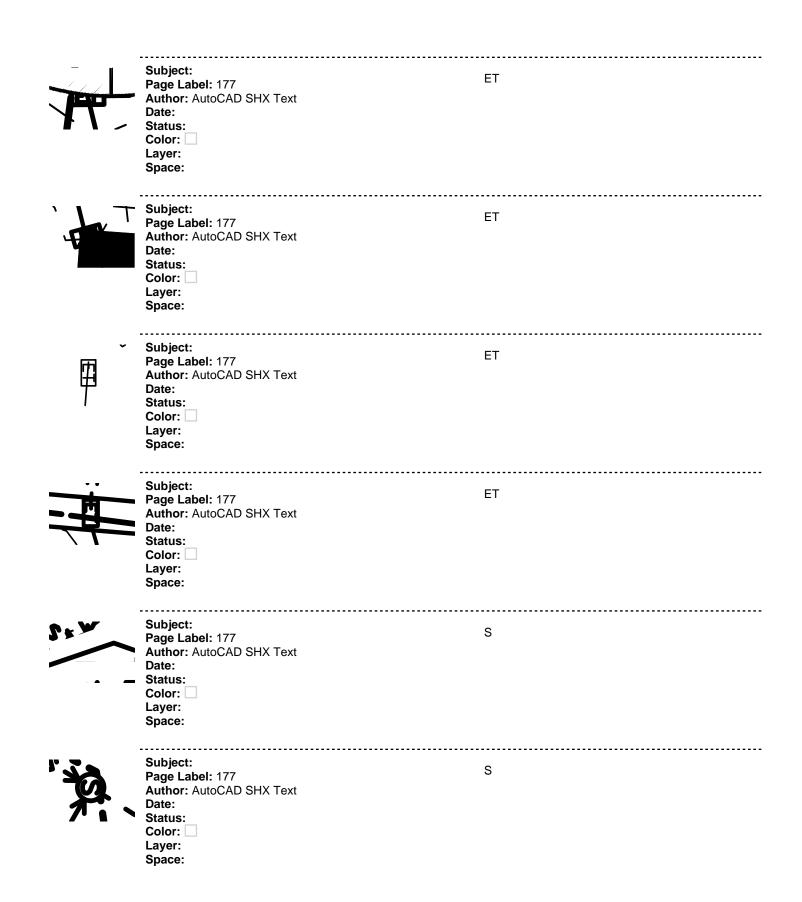
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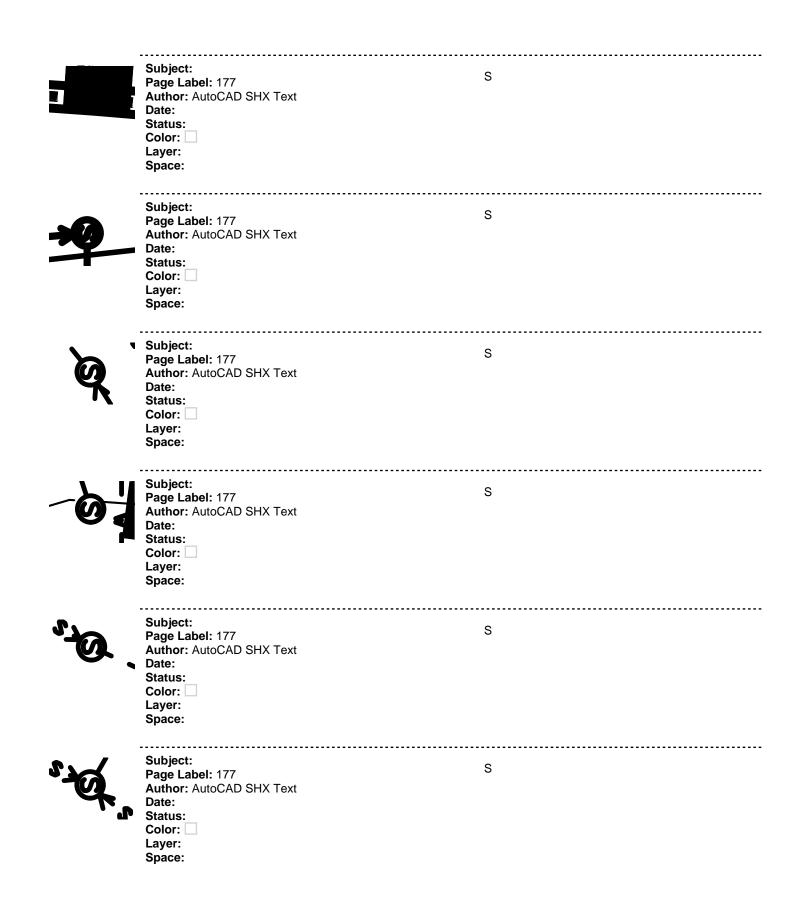


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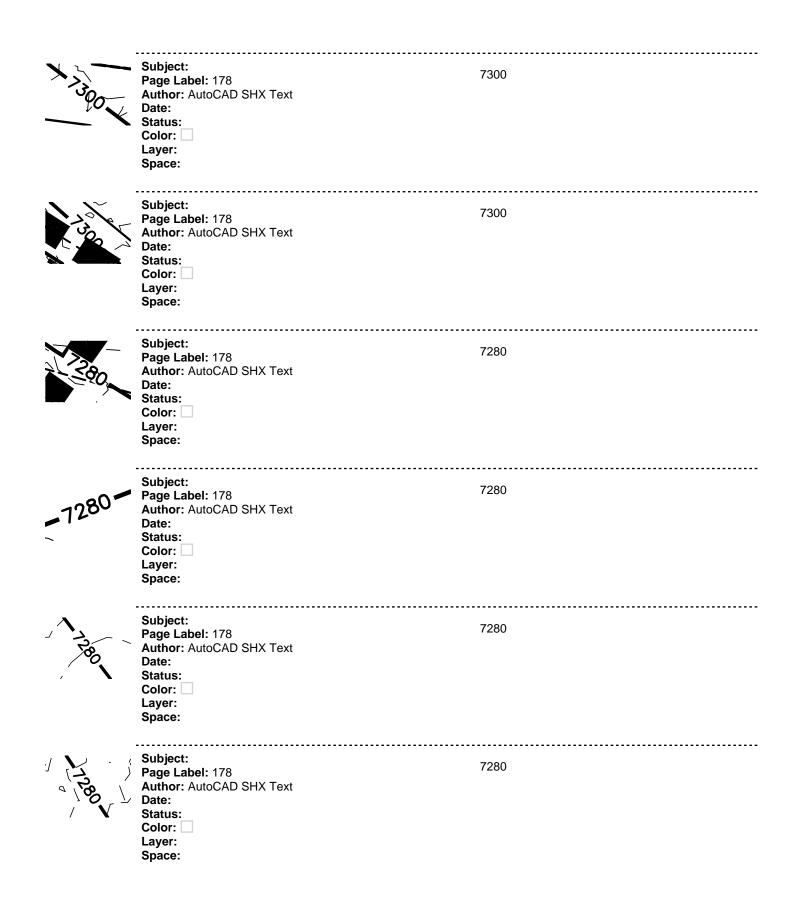


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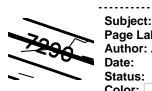




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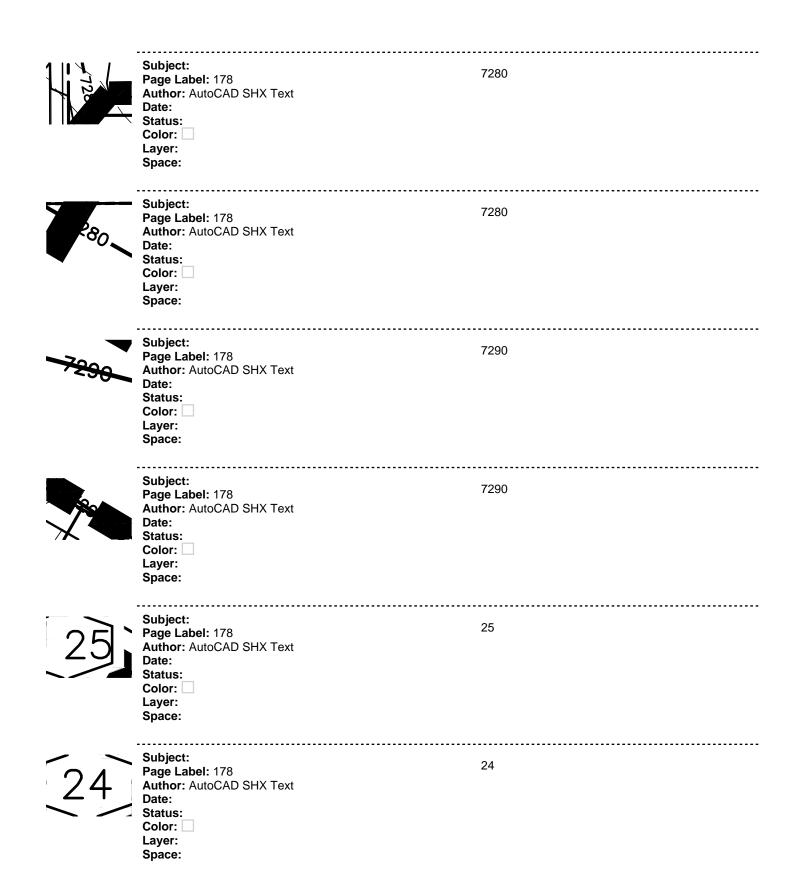
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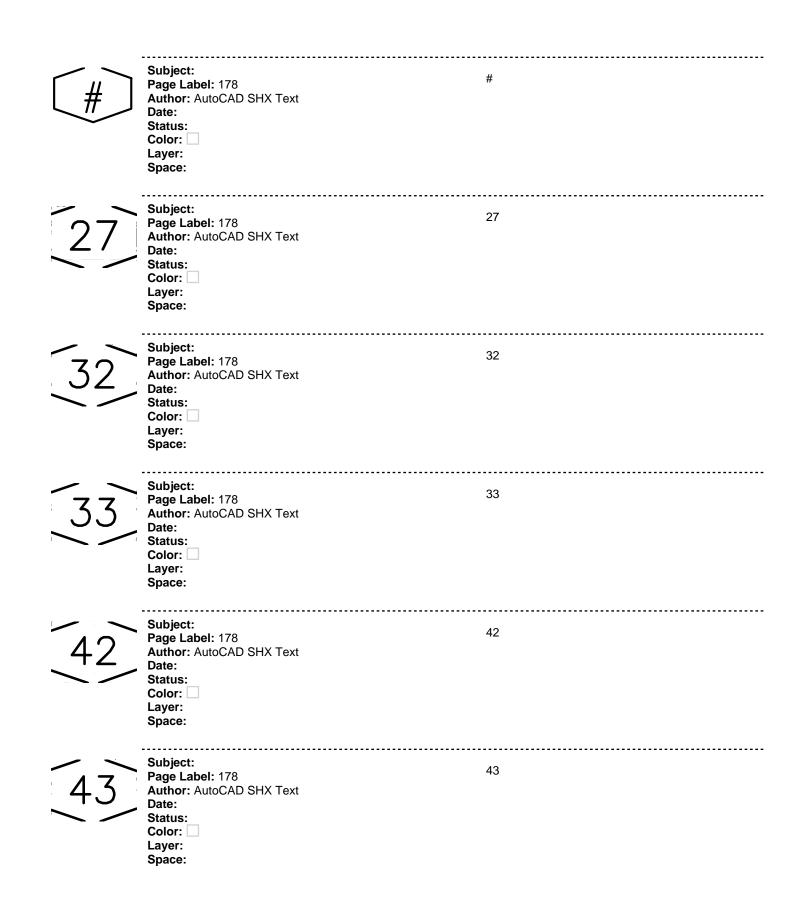
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| 23 | Subject: Page Label: 178 Author: AutoCAD SHX Text Date: Status: Color: Layer: Space: | 23 |
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| <text><text><text><text></text></text></text></text> | Subject: Page Label: 15 Author: Jeff Rice - EPC Engineering Review Date: 6/14/2024 12:08:05 PM Status: Color: Layer: Space: | For the purpose of this report, a detailed pond design was not conducted. |

| <pre>/ structures. er outlined in this report shall be ric or homeowners' association ated within street right-of-way tained by the Town of Monument tation of full-spectrum detention and ad in this report. The developed</pre> | Subject: Page Label: 24 Author: Jeff Rice - EPC Engineering Review Date: 6/14/2024 1:28:41 PM Status: Color: Layer: Space: | by the Town of Monument. |
|---|---|--|
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| 4.07 58.97 30 / 1 | Subject: Page Label: 58 Author: Jeff Rice - EPC Engineering Review Date: 6/14/2024 2:54:29 PM Status: Color: Layer: Space: | 58.97 |